Cotton breeding and seed production

5410400 - Plant breeding and seed production of agricultural crops

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The manual **"Cotton breeding and seed production"** is targeted to conduct practical and laboratory classes for bachelor students of agricultural educational establishments.

It also can be used by masters, research assistants and teachers.

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Annotation

This manual has been designed for the students being educated on the direction of 5410400 - Plant breeding and seed production of agricultural crops at the higher education establishments.

A teaching manual has been prepared on the basis of a working program (2019-2020) on the subject of cotton breeding and seed production, department of Plant breeding and seed production of agricultural crops, TSAU. Taking into account expecting changes in the working program relatively to the sizes of themes the supplementary trainings have also been added.

The teaching manual focusing on the conducting of practical and laboratory trainings on the subject of cotton breeding and seed production includes the following questions: significance of selected themes, the aim of the trainings, necessary aids for performing trainings, conducting order of trainings, analysis and analysis outcomes, the questions and tasks for every theme of training.

The themes in the manual embrace the most of the knowledge to be studied on the subject of cotton breeding and seed production. They are necessary for young specialists, scientists, researcher-breeders, seed producers and farm managers.

Annotasiya

Ushbu qo’llanma qishloq ho’jaligi oliy o’quv yurtlari 5410400 – Qishloq ho’jaligi ekinlari seleksiyasi va urug’chiligi yo’nalishi bo’yicha ta’lim olayotgan talabalar uchun mo’ljallangan.

O’quv qo’llanma ToshDAU, Qishloq ho’jaligi ekinlari seleksiyasi va urug’chiligi kafedrasida G’o’za seleksiyasi va urug’chiligi fani darslari uchun tuzilgan 2019-2020 o’quv yili ishchi dasturi asosida tayyorlangan. Ishchi dasturda kutiladigan ta’lum o’zgarishlarni e’tiborga olgan holda mavzular hajmiga nisbatan qo’shimcha mashg’ulotlar bilan ham ta’minlangan.

Qo’llanma G’o’za seleksiyasi va urug’chiligi fani amaliy va laboratoriya darslarida tanlangan mavzuning ahamiyati, mashg’ulotning maqsadi, mashg’ulotni o’tkazish uchun kerak bo’ladigan o’quv qurollari, laboratoriya asbob-uskunalari va mashg’ulotning o’tkazilish tartiblari, tahlil natijalari, har bir mavzu uchun savollar va topshiriqlar bilan ham ta’minlangan.

Qo’llanmadagi mavzular G’o’za seleksiyasi va urug’chiligida o’rganilishi kerak bo’lgan bilimlarning ko’pchiligini o’ziga jamlab olgan bo’lib, sohaning bakalavr talabalari, magistrlari, seleksioner-tadqiqotchilari, urug’ etishtiruvchi va ishlab chiqaruvchi hamda fermerlari uchun kerakli adabiyot hisoblanadi.

Аннотация

Настоящее пособие предусмотрено для студентов, обучающихся по направлению 5410400 – Селекция и семеноводство сельскохозяйственных культур в сельскохозяйственных высших учебных заведениях.

Учебное пособие подготовлено на основе рабочей программы за 2019-2020 учебный год по предмету Селекция и семеноводство хлопчатника, составленной на кафедре Селекция и семеноводство сельскохозяйственных

культур ТашГАУ. С учетом ожидаемых изменений в рабочей программе, относительно объема занятий также добавлены дополнительные темы.

Учебное пособие предназначено для проведения практических и лабораторных занятий по предмету Селекция и семеноводство хлопчатника и охватывает нижеследующие вопросы: значение выбранных тем, цель занятий, необходимое учебное оборудование для проведения занятий и порядок проведения занятий, результаты анализов, вопросы и задания по каждой теме.

Темы в пособии охватывают большинство знаний, нужных для изучения Селекции и семеноводства хлопчатника, а пособие является необходимой литературой для студентов, магистров, селекционеров-исследователей, семеноводов, производителей посевных семян, а также фермеров.

Contents.

Mundarija.

Содержание

1-practical training. **Types of nurseries and familiarization with the work performed in them.**

Purpose of the lesson. This study is devoted to the getting acquaintance with the types of nurseries are being widely used by the breeders on the selection plots now. The various nurseries are to be employed by the breeders to implement the whole process of selection in the evolving of novel variety. And the sequence of works are fulfilling in the nurseries.

The kinds of nurseries are:

-initial parental form breeding nursery;
-seed nursery of the first generation;
-seed nursery of the second generation;
-seed nursery of the third generation;
-breeding nursery.

These nurseries names (Figure 1) may vary depending on the departments of the Scientific Research Establishments or the goals of the directions of selection but the sequences of selection works in them generally will be kept as the example shown below.

The whole process of selection work, starting from the plot of the initial parental forms up to the time of transfer of the new variety to the state strain testing lasts for seven eight years.

Initial parental form breeding nursery is sown by the best local, selection and foreign varieties, collection species which take part in hybridization. Moreover, supplementary investigations of new materials are conducted in the same breeding nursery.

Seed nursery of the first generation is sown by the hybrid seeds obtained during last year crossing. Standard seed stock is sown after every 10-15 rows for comparing with hybrid combinations. In such cases, when it is required to observe the character of sign inheritance in relation with the initial parental varieties, only the maternal or both varieties are sown. In the course of vegetation period the seed nursery is checked a few times and records concerning behavior of some hybrid combinations in respect with the standard stock, the initial parental forms and other crossing combinations should be made in the field-journal. Hybrid combinations which are noted for their low productivity, late ripening, poor development, presence of negative signs and properties discarded and their yield is not picked.

Those of the hybrid combinations and families which proved to be good are harvested and analyzes in laboratories as regards the length and output of fiber; moreover, if the record on bolls had been kept, then their size should be taken into account. Since the major process of splitting and determination of positive or negative signs takes place in the second generation, it is not necessary to conduct strict discarding in the first generation in order to have more species in the second one.

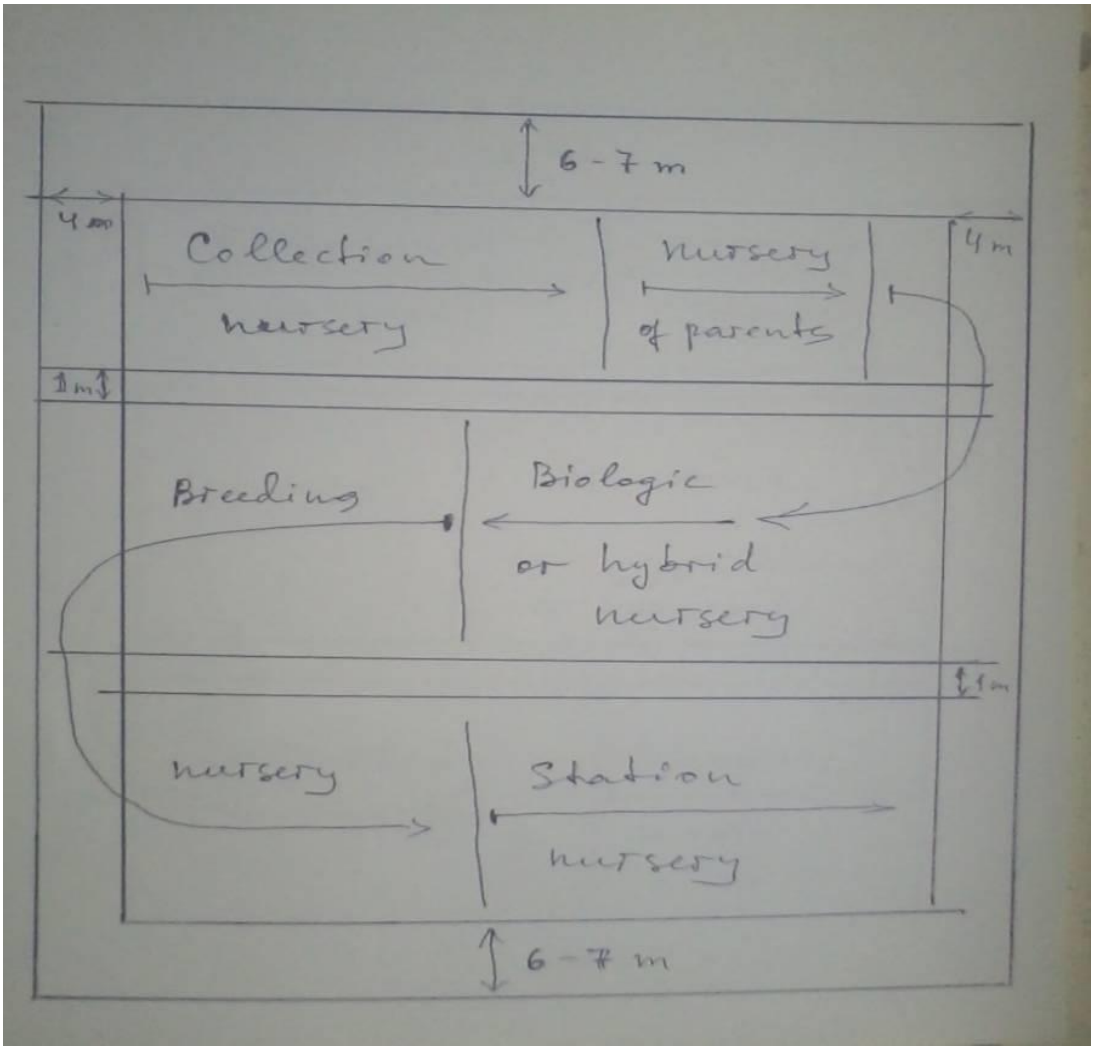


Figure 1. ***A simple draft view of particular selection plot which were used varieties of the first type fiber department of selection of Uz.SRICGSP during 1985-1993.***

Seed nursery of the second generation is sown on the usual background. Hybrid combinations or families are sown in 1-2-3 rows with 30-50 seed holes each one with single-standing plant in the hole depending on the seeds. Standard variety is sown after every 9 rows (1-11-21, etc.). In the course of the vegetative period regular field inspections for determining best combinations, families and separate plants are to be carried out. A very strict discarding operation is conducted in the said

nursery. Only those materials are selected which combine the best complex signs and properties and by their productivity surpass the standard variety (photo 1).

Seeds of selected plants are subjected to additional analyses in laboratories and only the best kinds are taken for sowing.

Seed nursery of the third generation is devoted to individual plants selected for this purpose in the seed nursery of the second generation. The standard variety is sown for proper you. For checking the material on wilt-resistance, half of selection is sown on the wilt background.

Since the material control of morphological and economical signs is usually started in the third generation, inspections of ripening of the best families are conducted in this nursery; moreover, test species are taken for determining the size of bolls, fiber length and the fiber output percentage. The yield is taken into consideration too (photo 2). Test specie includes 50 bolls taken from the first places of 2-5 fruiting branches. The size of bolls is determining by dividing the weight of the test boll on the number of picked bolls. The length of fiber is determined by 10 measured pappuses taken from the central part of the lobule, and the output – ratio between fibers and cleaned raw-cotton. After laboratory analysis the best families may be handed over for thorough strain testing. The individual selections are sown in the seed nursery of the first year on a usual and wilt backgrounds, whereas the row picking – on strain testing.

Photo 1. ***Cotton breeder Mukhammadjan Sukurov (third on clockwise) and his colleagues inspect selected plants (August 19, 2005).***

Breeding nurseries are sown similar to the composition of plot of the third generation. The following kinds of works are conducted in them: study, finishing operations and reproduction of the best hybrid combinations of groups and families. This includes individual selections, family selections and test species of the best seeds. The breeding nurseries are laid parallel on highly –fertile and wilt background. Selection materials which have insufficient wilt resistance are discarded and removed from further tests. Work with the hybrid materials is conducted in breeding nurseries until the new variety is handed over for the State strain testing.

At the same time the seeds of this new variety are transferred to the preliminary reproduction first on institute fields or originator stations and then for preliminary reproduction on the fields of stock enterprises.

The tasks coming from the contents of above described nurseries for enriching the students knowledge:

1.Draft your own selection plot and dispose in it all nurseries needed to fulfill selection process in solving one of the selection problems.

2.Do an attempt on describing the differences of valuable signs and properties by inspecting different presented bushes which may occur in your selection nurseries.

Photo 2. ***Yield of cotton.***

2-laboratory training. **Selection of land and soil treatment prior to seed planting.**

The purpose of the lesson. The laboratory training covers the significance of **existing rules** on the selecting of areal plots, orders of agro-practices to be done before seed planting, selection of sowing schemes, division of selected plots into essential nurseries, and orders on marking them and registering rows to plant seeds of selected accessions with specially prepared wooden stakes.

Any variety of cotton plant is the result of many years of scientific research carried out by breeders in the experimental field plots comprising all kinds of nurseries. That is why observance of all technical rules in the implementing of experiments is extremely important in the obtaining of accurate data, fit and trustworthy for objective evaluation of the selected strains or varieties.

Students must understand that the soil of the areal plot used to implement the breeding process must be adequately selected in order to fulfill all agro-technical practices and, ultimately, to meet the general requirements for soil, plot area, and feeding to seed germination and further plant development.

Selection area. The value of a field experiment depends on the observation of definite methodic requirements. The more significant ones are:

-uniformity of the experiment;

-history of the field;

-land relief.

The uniformity of the experiment states that the selected area in the future should correspond to those conditions where the results of the experiment (the new varieties in our example) are going to be used.

The history of the field can help greatly in the choosing of the proper area according to the soil texture. Which field was used for only one crop over the last three years of its history? That field is considered scientifically the best area for the experiment.

Land relief is the decisive factor in the attainment of good quality in the watering of plants in the course of vegetation, which is closely connected to the qualities of following some practices. It was accepted that the land relief on the slope of the soil’s surface has to be 1–1.5m per 100m.

The distance from the nearest boarder of the selected area to many stored homes should be at least 50-100m, and the distance from the forest should be at least 25-30m, and the distance from roads should be at least 10-20m.The preferences are given an exception because of their influence on the accuracy of the evaluation process on the dignity of bred plants.

Agro-technical practices before seed planting. The preparation of a good seed bed is very important, and this can be done by plowing, spike-tooth harrowing, and dragging of a heavy log or metal pole. The soil preparation carried out by many farmers includes plowing to 30-40 cm deep and to 60-70 cm deep with a heavy plow or a sub-soiler every 3–4 years. The soil is afterwards harrowed by spike-tooth, slightly pressed and levelled by a log or metal pole.

The land marked specially for the experiments on cotton plant breeding or seed reproduction is being ploughed deeply (35-40 cm) one to two times and harrowed two to three times to obtain fine tilth. Make the soil well pulverized and level the field evenly for uniform irrigation and drainage of excess rainwater. Removing all the residues of plants and trash from the previous crop and getting the soil ready to open up ridges and furrows of 5 m long at a distance of 60 or 90 cm should be done. The soil surface should be free of clods of 5 cm in diameter or larger, which cause uneven drilling by a precise drill at its function (photo 3).

And then planting is planned on flat soil or in furrows. Furrow preparation by the planter has an advantage in heavy soils. Because it hastens the drying of the soil in rainfall regions in winter, it also increases soil temperatures earlier, so planting is possible at the earlier dates.

Photo 3. ***Inspection of the prepared soil before seed planting by the young scientist D.Yakhshibayev (a student of the group 3-76 in 2015).***

Seed planting schemes. It is supposed that, the seeding rate of acid delinted and fuzzy seeds ranges from 40 to 60 kilograms depending on sowing schemes. Sowing schemes are recommended by breeders and noted that the varieties respond well to agro-practices. In general, the sowing scheme is differentiated by two types of seed plantings: 90x20x4; 90x10x3; 90x5x4; and 60x10x5; 60x7x2; 60x5x1. In these schemes were included both distances between rows (90 and 60 cm) and distances between seed nests (20cm) depending on plant bushes' branch sub-types. The length of the rows in the selection plot, measured independently on different nurseries, is 5 meters. Likely, one of those schemes is preferable to use in every selection plot, taking into account the selection plants' branching habits. Hence, the most responsible concern is the number of seeds placed in each hole, which ranges from 1 to 5 depending on the distance between seed nests. In this order of sowing, it is needed to put at least about 300 prepared seeds into selection hand sacks (photo 4).

Photo 4. ***Seed sacks with hand-selected seeds.***

Wide spacing of seed nests rarely reduces yields and is the most practical way of obtaining earliness. Wide spacing does not advance initial flowering appreciably, but merely provides more plants to produce a proportionally larger number of early bolls and restricts later branching and flowering.

Disconnection of the selected area from structural parts. Laying out the breeding nurseries (figure 2.) in the plot is another methodically responsible arrangement in the designing of the best experimental plot to solve all kinds of breeding processes.

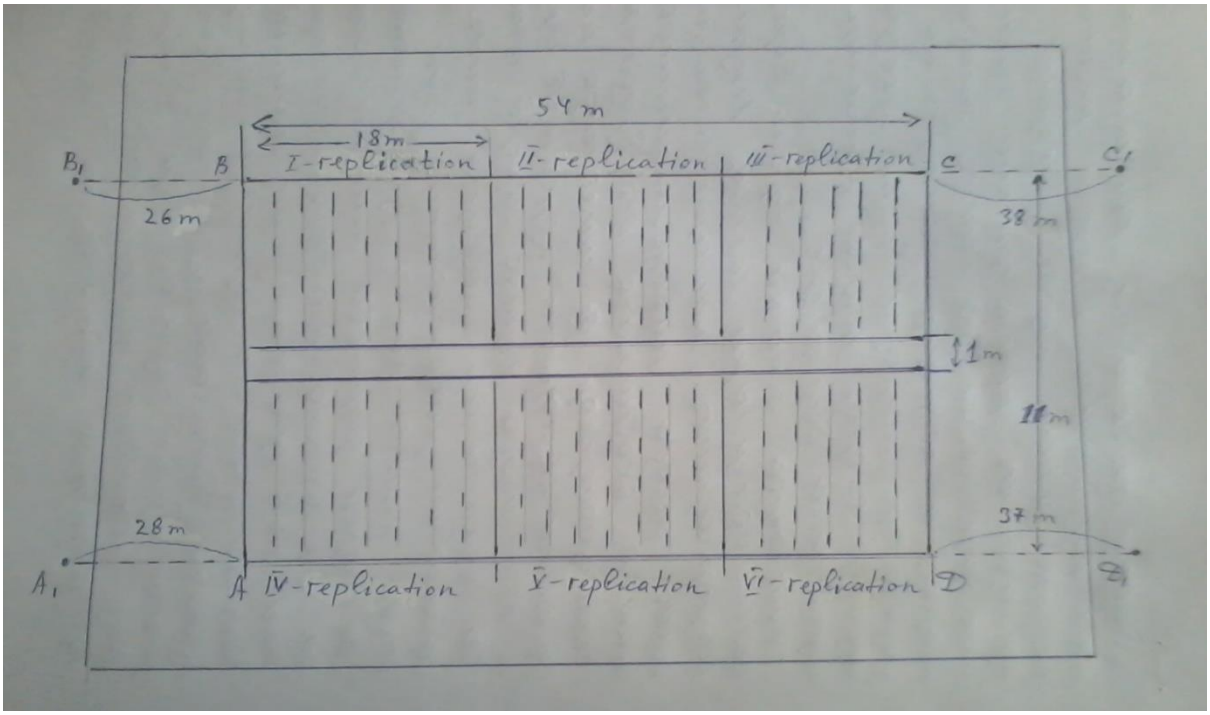


Figure 2. ***The scheme of proposed experiment on study of bred accessions.***

Through detailed statistical processing methods, which are annually required, more elderly generations of bred plants with their families should be studied in several replications and compared with standard varieties (or check variety accordance with foreign literature) in order to prove their state on some valuable characteristics. Here, one of the simple draw-on plans for a cotton plant's field experiment to be placed in the selected plot was presented.

The problems of transferring the elements of the experiment shown in the draft to their actual locations along the plot will necessitate the use of the following auxiliary instruments: a gauge of 20 or better of 100 meters, a hand hammer, a long clothes line of more than 100 meters, two pieces of 1–2.5 meter long stakes, and a number of small, traditionally wooden stakes of 25–30 cm long.

Marking the registered nurseries and rows. Placing the families or strains in several rows, each one with a standard variety and not facing the problem of confusion with one another, is a very difficult thing to do day by day when the plants grow to definite heights and sizes. Their methods of placing on the rows of each replication in accordance with the methodology rules take place in accordance with one of the schemes shown below (figure 3.). To avoid them becoming confused with one another, the above-mentioned wooden stakes of 25-30 cm were used.

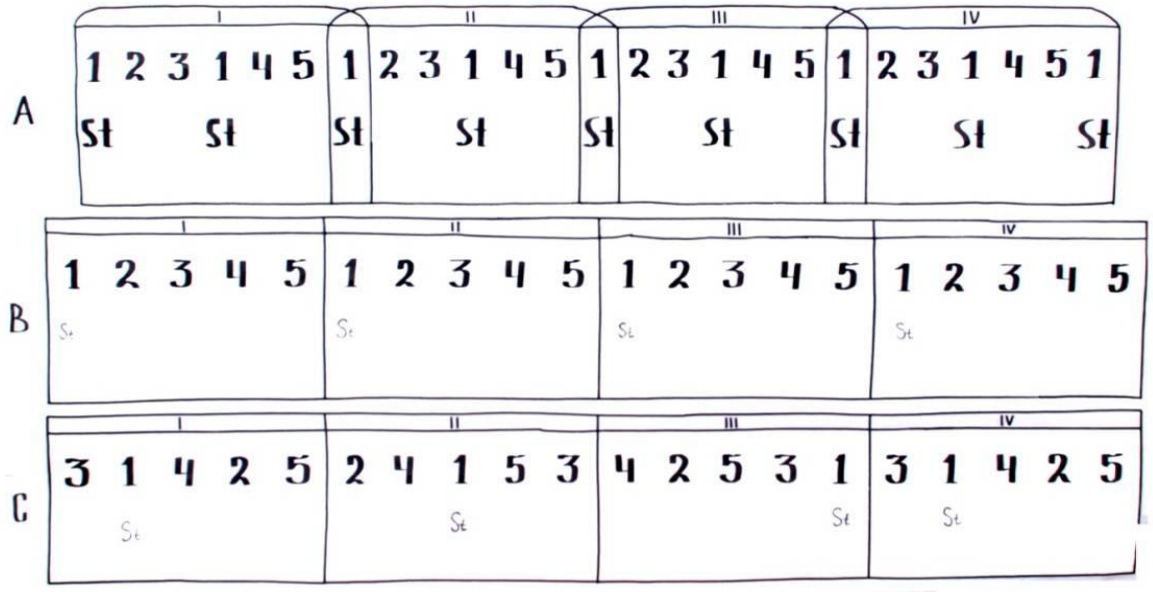


Figure 3. ***Methods (A, B, C) to place experimentally selected accessions.***

In advance of using them, they were marked with the numbers by the simple black pencil in correspondence with row locations in the plot (fig. 3). There will be a space for each bred accession marked by these in each row.

Stakes, driven in by the hand hammer until the length of 20 cm is seen above the soil. This work has to be done just after the division of the plot into nurseries and rows under the breeder's supervision. And these wooden stakes with their numbers help to show every breeding accession's row where it is to be sown at the time of planting. These stakes will serve as a landmark for the breeder to easily find the required row with the specific accession.

Questions and tasks concerning this training:

1. Look through the above given teaching text again and make notes about the importance of rules meant to promote the efficiency of experiments in the breeding process.

2. Do you see any differences in the placing of selected accessions in the above illustrated scheme? If so, please provide some specific confirmations of your understanding.

3-practical training. **Planting methods and their differences in the breeding nurseries.**

The aim of the training. To study the methods of seed planting, general operations to be done in the seed planting preparation in breeding cotton nurseries and investigation of their differences is the aim of the following practical training.

Necessary sources for the students. Lecture notes and practical copy books of the students for the subject of cotton breeding and its seed production. Placates depicting schemes of nurseries' disposition and seed planting process in the cotton breeding nurseries and facilities to be used for seed planting. Stationary.

Generally, two widely accepted planting methods: hand and precise drill are used in seed planting of the nurseries in breeding plots at the Scientific Research Institutes designed for cotton breeding. They have some qualitative differences from each other depending on the seed preparation, seed materials' origin, amount and nursery kinds. They are as follows:

1.Seeds are packaged in different lists and garlands, planting bags. Hand planting seeds taken from collection depository and progenies of first crossings have the special lists designated to plant by hand in the collection (or parental) nursery, biologic nursery F_1, in the green house chambers and prevocational (or artificially infected by diseases) backgrounds. And their seed bags are generally smaller than seed bags designed to plant by the precise drills.

2. Seeds selected from collection and hybrids belong to remote accessions or their progenies often require a special day light (short day or contrary) than our native. Therefore, they will be sown by hand in an adjusting nurseries' conditions.

3. Amount of selected seeds from collection accessions, hybrids, families and lines considerably differ: from units up to several hundred and even kilograms the latest allow to plant by seed drills in the biologic, breeding nurseries, station testing nurseries and external protective zones (figure 4).

4. Biological (F_2-F_4), breeding nurseries have sufficiently enlarged amount of selected seeds which admit to sow by efficient mechanical drills.

5. Hand seed planting is more reliable and precise in the laying of definite number of seeds into handmade ridges or holes (seed nests) in mapped distance and depth however it consumes hard work, more labour and time. After hand planting of breeding seeds no need to do hand thinning of seedlings.

6. Planting of selected seeds by the help of a special precise drill (photo 5) is extraordinarily efficient. It makes possible to plant the whole breeding plot (figure 4) for 2, 3 hour that is very important to fulfill the seed planting in time under capricious conditions of early spring. But, hand thinning of seedlings is necessary.

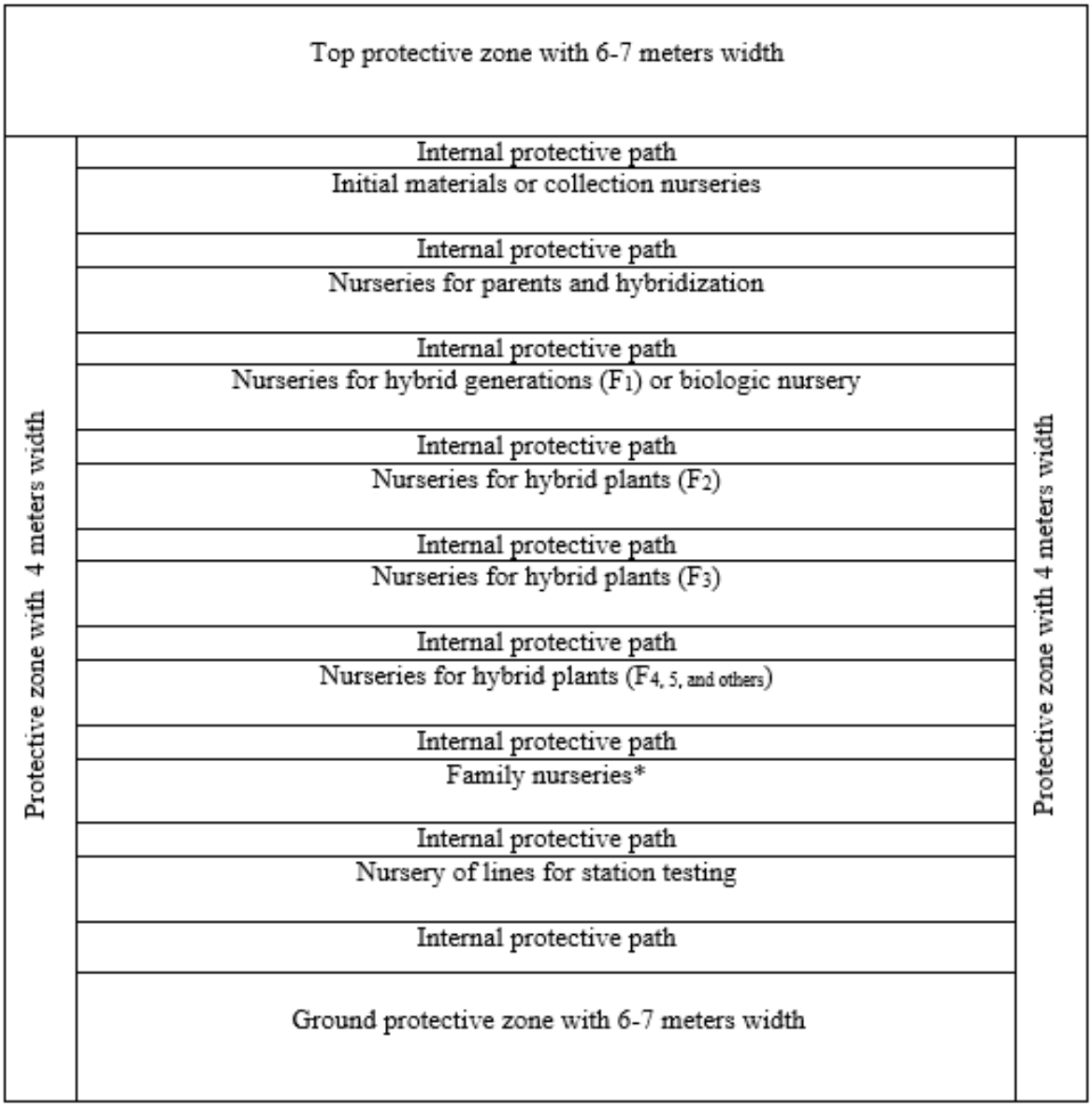


Figure 4. ***Disposition of breeding nurseries in the breeding plot.***

The general works of hand and mechanical seed sowing consisting of seed preparation, registering in corresponding lists, placing the seeds in planting bags, composing the seed bag in the garland chains, grouping with corresponding tags with numbers, chemical treatment against root rot pathogens, soaking of seeds, transporting to the breeding plot and distribution of seed bags along the top protective zone (figure 4) are implemented similarly and jointly.

Seed preparation. Prior to make above mentioned plot's plan in the real view, the lab assistants of the department should prepare seeding bags on the base of selected seeds from former breeding materials in the result of visual and lab discards. This work is usually done in the winter months according to the list of future seed planting (appendix 1) to place selected seeds in them. Seeding bags are preferably new, sewn from simple fabric material in the sewing shop by the size of 15 x 18 cm and have circled strings (appendix 2). They are numbered with a special chemical pencil for preventing it from fading during the soaking. This wise, the seeding bags have grown numbers according to the planting numbers of seeding list and all selected seeds are placed in them. They are grouped by 100 each one into chains (garlands) though twisting their strings with each other. Then every five garlands (each one has 100 seed bags) gathered together and placed into jute sacks with the size of about 50 x 90 cm.

Photo 5. ***Four row planting drill mounting to cultivator tractors in spring.***

These garland sacks tagged with wooden tag numbered with growing numbers written by chemical pencils. Besides, garland sacks, there should be one additional sack with seeds of standard variety to sow in the protective zone surrounded the nurseries in the plot. The most parts of the experimental plot except some first hybrid seeds are sown by mechanical drill. In one of sunny days in the beginning of spring, all staff of department come together in the area equipped with disinfection baths and water reservoir with running water to redistribute seeding bags for operational order of the seeding drill. The lab assistants bring the garland sacks with seed sack of standard variety out of depository and put aside in the area. The seed drill presents itself as a special one (look at the manual for practical trainings) and considerably differs from farmers' seeding drills. Here, the square area about 20 to 40 meters in size will be represented as a real breeding plot, but only in decreased size. And all seeding bags are taken out of their garland sacks and started to put one by one on the land under the control of a senior scientist with seeding list. The order of putting the seed bags should coincide with the drill's movement, which has four row seeding apparatus and moves across nurseries of experimental plot. According, to this order of work, all seeding bags are redistributed on the ground. In this order, all seeding bags will have their new place on the land similarly as the nursery rows where the seeds of each seed bag would be sown by that mechanical drill. If a part of nursery for initial materials purposefully was intended to sow by hand, here will be placed empty bags with the numbers of rows only. After completion of the redistribution, the senior scientist and others with the help of seed planting list randomly check the correctness of redistribution of seed bags in both order of drill's movement and seed bags on their own rows in the nurseries of the experimental plot. Eventually, the redistribution order of the seed bags should ensure correctness with space scheme made in the experimental register also. This will attain by the repeated checking through comparing of seed bag order with nurseries disposition in the space scheme (figure 4). And after that, all seed bags are sewn with a breeding awl using of firm thread in consistency of drill's movement. And now each garland sack (smaller than the sack for seed bag garlands) has to contain four chains of seed bags sewn in parallel to the direction of four seeding apparatus of the drill across the nurseries of the experimental plot

up or down. The seed sacks according to their numbers are divided into two groups to provide the drill's uninterrupted functioning. One group of sacks for drill's movement to up, the second – for drill's movement to down, across the nurseries. No need to forget that the sacks with empty seed bags in their garlands have one duplicate sack with the seed bags, their seeds have to be seeded by hand after massive seeding with a drill. The tag of this sack bears record "Hand seeding" and the order number following major seed sacks' numbers.

Chemical treatment of selected seeds. Usually, seeding takes place in the mid of spring, when the soil has yet not get enough warm and the part of sown seeds is injured as the result of disease caused by soil microorganisms. In order to prevent the loosing of selected bred seeds, breeders use treatment of seed materials one day before the general seeding. For this intention, a bath was installed near the water reservoir for soaking of seeds. The bath is filled with water up to 70% of its volume. Then, formalin of 40% is poured in this water in the ratio of 20 parts of available water. The solution is mixed with a long stick until the solution gets its constant specific color. Immersing of seed sacks in the solution is started with the immersing of four first sacks at the same time. The quality of treatment depends on the completeness of sinking the sacks under solution and soaking of all seeds in the seed bags. These sacks should be kept under solution for 30 minutes. After that, the first four sacks pulled out of the solution and marked with numbers. About three meters long strong strings are tied to the neck of sacks at the base of fence while other groups of assistants got started to fill the bath with solution until it reached initial volume level, and they sink the second four sacks according to their numbers. This order of work will continue until the last four seed sacks have been tied to the fence of water reservoir (chemical treatment) with solution. The sacks will let to stay in this state until sunset and all sacks dropped into running water in the reservoir for the night carefully without tangling their strings to each other. One of the assistants will come early before sunrise and pull out all the sacks from the reservoir one by one and put them in their former place in order to drain exceeded water. After two or three hours they will be ready to general seeding in the experimental plot

Sowing. The seed drill used to seed of bred seeds in the experimental plot has a special modification than all serial seeding drills in the production (look at the photo presented in the manual of practical trainings). It has sits for lab assistants and a wooden long box mounted above seeding apparatus to put seed sacks at the time of seeding (look at the manual for practical training).

All seed sacks at the beginning of the working day, after drained exceeded water for about two hours, they are ready for seeding in the experimental plot. They are loaded on a special floorboard near the seeding apparatus of the drill and transported to the top side of the plot. And according to sacks' numbers, they are unloaded and distributed against every nursery rows above the top boarder of the protective zone (figure 4). Only the seed sack of seeds to protective zones is left on the side of the drill's floorboard, because the seeds of this sack are sown regularly when the drill comes to every protective zone, moving ahead and back. The order and accuracy of sowing the bred seed to their intended rows depend upon the attention of the senior scientist who takes the full responsibility. Under his supervision and checking the drill stands with landed apparatus above the top protective zone and first four rows of the nurseries. The assistants take their places above the seeding apparatus. The first two seed sacks with the numbers of 1 and 2 on their tags are loaded on the long wood box. The box of drill has the little four boxes against every sitting assistant for a hand knife or blade to cut the thread of her garlands. One of the assistants sitting on the beginning side untied the sack for a protecting zone and the first sack with seed garlands. All four assistants take seeds with the help of empty seed bags from untied protective seed sack and put them on the bottom of the wood box against themselves. As well as the four garlands from the first seed sack are distributed to the assistants accordingly to their numbers: 1, 2, 3 and 4. Every garland consists of an amount of seed bags, equal to the nurseries number across the different breeding nurseries from top to the foot of plot before of ground protective zone. At the command of senior scientist the drill begins to move ahead, the assistants either begin to seed the seeds picked out for protective zone. At the command of other scientist who going side by side with drill shows the signal to the drill operator to stop the drill when the seeding apparatus of drill gets the first internal protective path. The

assistants replace seeds to the first garland's seeds. When all the assistants ready to seed, the drill starts to move ahead until the next internal protective path and stops again. The senior scientist armed with register of experiment and seeding list continues his control over proper working of a drill operator, assistants and junior scientist. This kind of interrupting work followed, eventually the drill gets its stop out of the ground protective zone. And it turns back with raised drill apparatus together with assistants. The second movement of the drill begins with the seeding of seeds for the ground protective zone until the first internal protective path (look at the figure 4). Another junior scientist ready to restore the damaged pigs after passing a drill over them. If the pig broken, he immediately replaces with a new one and as well as rewrites its former number. Time by time, in different parts of the plot, the senior scientist examines the correctness of the sowing. He stops the drill and checks the numbers of seed bags with the numbers for the respective rows in the seed list and the nurseries along the resister of experiment. At the end of the general sowing of all nurseries, the drill without stopping moves through two side protective zones. They have 4 rows each one, and it needs only one movement of drill up or down. The assistants will sow only the seeds remained for protective zone. The three scientists together and attentively inspect the accuracy of seed sowing and safety of all pigs along the protective zones, internal paths and across the breeding nurseries just after completion of all seeding works.

The part of nurseries for initial materials had left for hand sowing is used for special experiments. Usually, one of the junior scientists of the department runs here his or department's special experiment. All scientific staff and assistants come together with seed sack had left to hand seeding along internal protective path. Assistants bring hoes to hand seed, pegs hand hammer. The responsible scientist over this nursery after hand seeding has approved list of seeding. He conducts a little instruction about the order of seeding rows, the numbers of seed bags in the seed sack, the number of the seed nests per row and the number of seeds per seed nests. The scientists and assistants have mostly multiyear experiences and do not face to any difficulties in the implementation of the hand seeding. The work starts with assistants who make nests of the said number along the rows. Others continue seeding by putting the definite seed units in the

opened soil nests from seed bags are in their hands. And the third group of people have already became busy with closing the seed nests with soil and are going to mark the rows with wood pegs. While the pegs are numbered by the responsible scientist on the base of his seeding list. After the end of these work, he will check the accuracy of the seeding and remarking the seeded rows. This proper order of hand sowing enables easily and authentically conduct observation, specially focused on some studies like soil disease resistance of seeds and their field germination capabilities.

The next day, scientists of the department inspect the soil above the sown seeds and its humidity over the experimental plot. If the moisture of soil inadequate for seeds to grow normally, the first irrigation is carried out.

Questions for students to enhance their acquired knowledge:

1. How many planting methods of cotton seeds' planting in the breeding plots are used?
2. What kind of advantages and disadvantages has hand seed planting method?
3. What kind of advantages and disadvantages has mechanical seed planting method?
4. Why, some breeding seed materials need hand planting?
5. What are the works of composing the seed lists, garland grouping, seed treatment and seed soaking?
6. Does mechanical seed planting effect on density of sprouted seedlings?

4-practical training. **Planting, monitoring and recording in the breeding plantations**

Purpose of the lesson. The students will be introduced with the methods of sowing the seeds of cotton plant, preparing selected seeds to seeding, treatment of seeds, sowing, phonologic monitoring, seed germination and recordings need to be carried out in the breeding plots (figure 5).

One of the two existing planting methods of seed sowing: hand and precision drill.

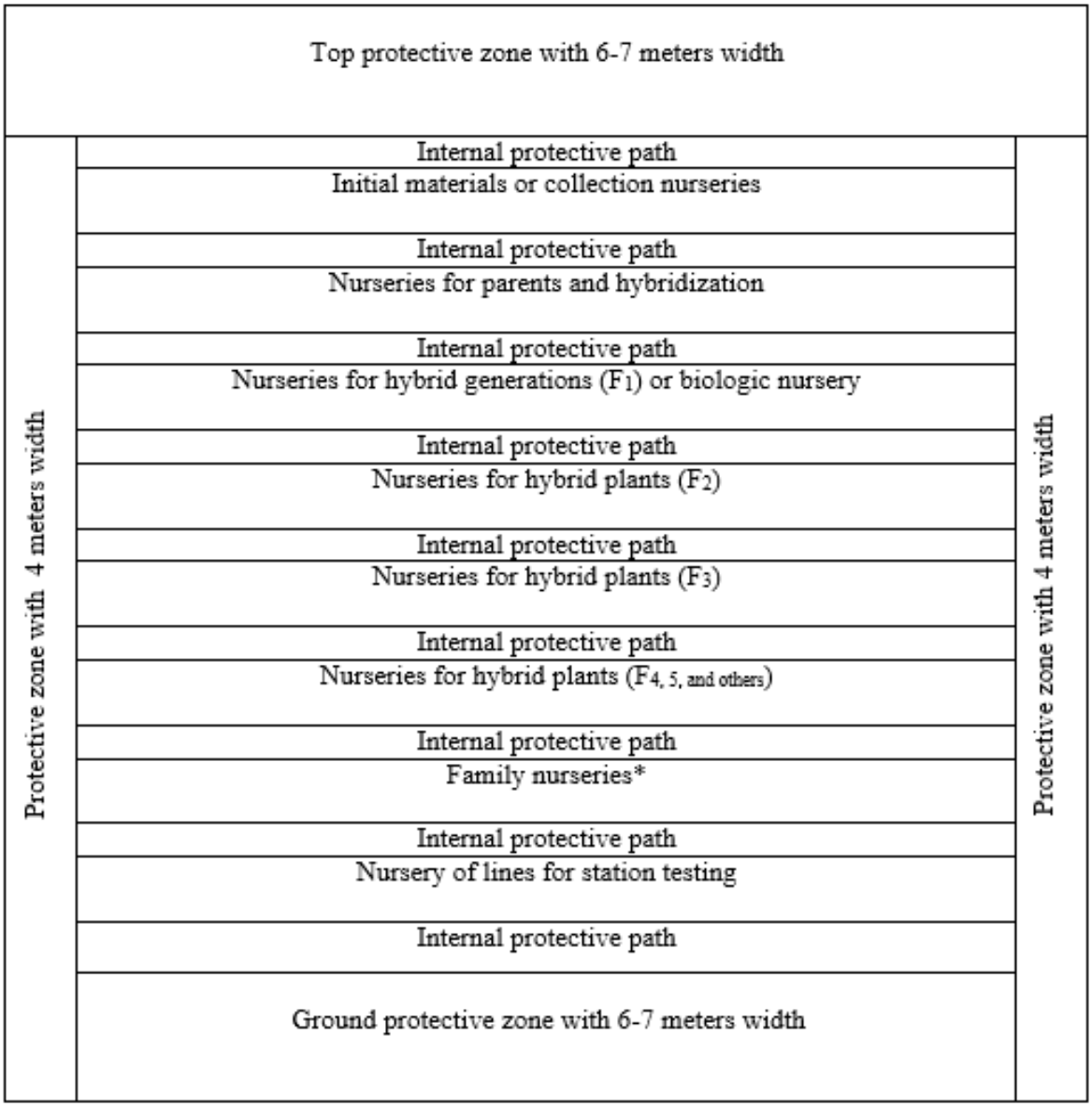


Figure 5. ***Exemplary location plan of the breeding plot of department for releasing of fine staple cotton varieties headed by the breeder Yu.P. Khutornoy – State Prize Laureate at the former SRI of Cotton Breeding and Seed Production named after G.S. Zhaytsev.***

Preparing selected seeds for seeding. Before realize above mentioned plan in the real plot of department, the lab assistants of the department need to prepare seeding bags on the base of selected seeds from former breeding materials in the result of visual and lab discards. This work usually is carried out in the winter season according to the list of future seed planting (appendix 1) placing selected seeds in them. Seeding bags are preferably should be new, sewn from simple fabric material in the sewing shop with the size of 15 x 18 cms and has circled strings (appendix 2). They will be numbered (marked) with a special chemical pencil in order to avoid colour fading during soaking. So, the seeding bags have growing numbers according to the planting numbers of seeding list and all selected seeds are placed in them. They are grouped by 100 each one into chains (garlands) though twisting their strings each other.

Then every five garlands (each one has 100 seed bags) gathered together and placed into jute sacks with the size of about 50 x 90 cms. These garland sacks tagged with wooden tag numbered with growing numbers written by that chemical pencils. Beside, garland sacks there should be one additional sack with seeds of standard variety to sow in the protective zone surrounded the nurseries in the plot. The most part of the experimental plot except some first hybrid seeds sown by mechanical drill. In one of sunny days in the beginning of spring all staff of the department come together in the square equipped with disinfection baths and water reservoir with running water to redistribute seeding bags for operational order of the seeding drill. The lab assistants bring the garland sacks with seed sack of standard variety out of depository and put aside of the plot.

The seed drill presents itself as special one (look at the manual for practical trainings) and considerably differs from farmers' seeding drills. Here, the sowing area about 20 to 40 meters in size will be represented as real breeding plot but only in decreased size. And all seeding bags will be take out of their garland sacks and starts to put one by one on the land under the control of a senior scientist with seeding list. The order of putting the seed bags should coincide with the drill's movement which has four row seeding apparatus and moves across nurseries of experimental plot. According to this order of work all seeding bags will be distributed on the ground. In this order, all seeding bags will have their new place on

the land similarly as the nursery rows where the seeds of each seed bags would be sown by that mechanical drill. If a part of nursery for initial materials purposefully was intended to sow by hand here will be placed empty bags with the numbers of rows only.

After completion of the redistribution, the senior scientist and others by the help of seed planting list randomly check the correctness of redistribution of seed bags in both order of drill's movement and seed bags on their own rows in the nurseries of the experimental plot. Eventually the redistribution order of the seed bags should ensure correctness with space scheme made in the experimental register also. This will attained by the repeated checking through comparing of seed bag order with nurseries disposition in the space scheme (figure 5). And after that all seed bags are sewn each other with breeding awl using of firm thread in consistency of drill's movement. And now each garland sack (smaller than sack for seed bag garlands) has to contain four chains of seed bags sewn in parallel to the direction of four seeding apparatus of the drill across the nurseries of the experimental plot up or down. The seed sacks according their numbers are divided into two groups to provide drill's uninterrupted functioning. One group of sacks for drill's movement to up, the second – for drill's movement to down across the nurseries. It should not be neglected that the sacks with empty seed bags in their garlands have one duplicate sack with the seed bags, which have to be seeded by hand after massive seeding with drill. The tag of this sack bears will be marked "Hand seeding" and the order number following major seed sacks' numbers.

Chemical treatment of selected seeds. Usually seeding takes place in the mid of spring, when the soil has yet not get enough warm and the part of sown seeds is injured in the result of disease causing by soil microorganisms. In order to prevent the loosing of selected bred seeds breeders use treatment of seed materials one day before the general seeding. For this intention, a bath will be installed near the water reservoir for soaking of seeds. The bath is filled with water up to 70% of its volume. Then, formalin of 40% is poured in this water in the ratio of 20 parts of available water. The solution is mixed with long stick until the solution gets its constant specific color. Immersing of seed sacks in the solution is started with the immersing of four first sacks at the same time. The quality

of treatment depends on the completeness of sinking the sacks under the solution and soaking of all seeds in the seed bags.

These sacks will be kept under solution for 30 minutes. After that the first four sacks will be pulled out of the solution and put them with numbers top beside the fence of water reservoir. About three meters long strong strings are tied to the neck of sacks and base of fence while other groups of assistants got started to fill the bath with solution until the initial volume level and sink the second batch four sacks according their numbers. These works will continue until the last batch of four seed sacks have been fixed to the fence of water reservoir after soaking (chemical treatment) with solution. The sacks will let to stay in this state until sunset and all sacks dropped into running water in the reservoir for night carefully without tangled their strings each other. One of the assistants will come early before sunrise and pull out all sacks from reservoir one by one and put their former places for their exceeded water flow down. After two or three hours they will be ready to general seeding in the soil of experimental plot

Sowing. Seed drill using to seed of bred seeds in the experimental plot has a special modification than all serial seeding drills in the production (look at the photo presented in the manual of practical trainings). It has seats for lab assistants and wooden long box mounted above seeding apparatus to put seed sacks at the time of seeding (look at the manual for practical trainings).

All seed sacks in the beginning of the working day after drained down of exceeded water. After about two hours are ready to seeding in the experimental plot. They are loaded on a special floorboard near seeding apparatus of the drill and transported to the top side of the plot. And according to sacks' numbers they are unloaded and distributed against every nursery row above the top boarder of the protective zone (figure 5).

Only the seed sack of seeds to protective zones will be left on the side of the drill's floorboard, because the seeds of this sack are sown regularly when the drill comes to every protective zone, moving ahead and back. The order and accuracy of sowing the bred seed to their intended rows depend upon the attention of the senior scientist who bears the full responsibility. Under his control and checking the drill stands with landed apparatus above the top protective zone and first four rows of the

nurseries. The assistants take their places above the seeding apparatus. The first two seed sacks with the numbers of 1 and 2 on their tags are loaded on the long wood box. The box of drill has the little four boxes against every sitting assistant for a hand knife or blade to cut the thread of garlands. One of the assistants sitting on the beginning side untied the sack for a protecting zone and the first sack with seed garlands. All four assistants take seeds by the help of empty seed bags from untied protective seed sack and put on the bottom of wood box against themselves. As well as the four garlands from the first seed sack are distributed to the assistants according to their numbers: 1, 2, 3 and 4.

Every garland consists of an amount of seed bags, equal to the nurseries number across the different breeding nurseries from top to the foot of plot before of ground protective zone. Under the command of senior scientist, the drill begins to move ahead, the assistants either begin to seed the seeds picked out for protective zone. Under the command of other scientist who walking side by side with drill shows the signal to the drill operator to stop the drill when the seeding apparatus of drill gets the first internal protective path. The assistants replace seeds to the first garland's seeds. when all the assistants ready to seed the drill starts to move ahead until the next internal protective path and stops again. The senior scientist armed with register of experiment and seeding list continues his control over proper working of a drill operator, assistants and junior scientist. Such kind of interrupting work followed eventually the drill gets its stop out of ground protective zone. And it turns back with raised drill apparatus together with assistants. The second movement of the drill begins with the seeding of seeds for ground protective zone until the first internal protective path (look at the figure 5).

Another junior scientist ready to restore the damaged pegs after passing drill over them. If the pig broken he immediately replaces with new one and as well as rewrites its former number. Time by time, in different parts of plot the senior scientist examines the correctness of the sowing. He stops the drill and checks the numbers of seed bags with the numbers for the respective rows in the seed list and the nursery along the resister of experiment. At the end of the general sowing of all nurseries the drill without stopping moves through two side protective zones. They have 4 rows and each one and needs only one movement of drill up or down.

The assistants will sow only the seeds remained for protective zone. The three scientists together and attentively inspect the accuracy of seed sowing and safety of all pegs along the protective zones, internal paths and across the breeding nurseries just after completion of all seeding works.

The part of nursery for initial materials had left for hand sowing is used for special experiments. Usually, one of the junior scientists of the department runs here his or department's special experiment. All scientific staffs and assistants come together with seed sack which left to hand seeding, along internal protective path to the destination. Assistants will bring hoes for hand seeding, pegs and hand hammer. The scientist in charge of this nursery after hand seeding has approved list of seeding. He conducts a brief instruction about the order of seeding rows, the numbers of seed bags in the seed sack, the number of the seed nests per row and the number of seeds per seed nests. The most of the scientists and assistants have many years of experience and do not face to any difficulties in the implementation of the hand seeding. The work starts with assistants who make nests along the rows. Others continue seeding by putting the definite seed units in the opened soil nests from seed bags which are in their hands. And the third group of people have already became busy with closing the seed nests with soil and are going to mark the rows with wood pegs. While the pegs are numbered by the responsible scientist on the base of his seeding list. After the end of these work he will check the accuracy of the seeding and remarking the seeded rows. This proper order of hand sowing enables easily and authentically conduct observation, specially focused on some of the studies like soil disease resistance of seeds and their field germination capabilities.

The next day, scientists of the department inspect the soil above the seeded seeds and its humidity over the experimental plot. If the moisture of soil inadequate for seeds to grow normally the first irrigation is to be organized.

Phenological observations, measurements and statistical treatment of data. Phenological observation and measurements are the most vital and responsible works in the cotton breeding process. It means to study all breeding forms and their progenies throughout the nurseries of the experimental plot, select the best plant and reproduce its seeds due to economically important traits and properties the breeder would like to see

at the end of the breeding process. The successful selection relates with the breeder's intellectual ability in the regard of inheritance law of plant traits. Most of the economic traits of cotton plant is characterized by their polygene heredity. Traits like productivity and fiber quality belong to the polygene controlling traits.

Breeder can see frequently non-stop variation within experimental plants during reproduction on the above mentioned traits. This presents a certain difficulties to the breeder in the selection of a plant with constantly hereditary trait. Consequently, the breeder in the laying out of the experimental plants in the nurseries and monitoring them should observe some of principles underlined in the sciences of genetics and statistics. They claim that the traits are handed down from parents to offspring on the G. Mendel's principles of segregation as dominant or recessive. Genes (alleles) of chromosomes responsible in the controlling of the trait come in pairs and are inherited as distinct units, one randomly from each parent. Here, by keeping in mind the statistical principles either, the breeder tries to make as much as possible numbers of experiments plants in order to increase the chance to catch desirable individual plants with valuable trait combinations.

Multiplication of seeds after the first study and lab analysis results either increasing the number of experimental plant genotypes bearing complex of valuable hereditary traits. But here additionally, no need to forget about the segregation on the dominant and recessive traits not only under the influences of genetics but the natural factors which unfortunately act against breeders' expectation. Emerge different morphological shapes of plants which hide discovering of the progeny of those selected plants in the previous year. Meanwhile, the number of experimental plants along of the hybrid combinations gets up to several hundred plants (population) since the second (F_2) and it progresses in the elder generations. Scientific staffs of the department have to secure optimal and constant agro-technical condition for all nurseries under which the desirable family plants and lines of plants have to be evolved and mentored from the generation of first selected plants. It is possible by caring after plants in time to provide optimum background for experimentally selected and hybrid plants' development. It is necessary to remember the valuable information presented by well-known cotton genetic scientist N.G. Simongulyan

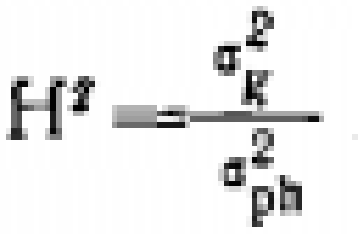
(1987) about genetic substantiation of traits which give the indexes of heredity.

According to morphological (phenotypic) variation of the trait in the population presents the result of genetic heterogeneous of population and variation caused by effect of environmental condition (paratypic). That is why, phenotypic dispersion of the trait may be pronounced by following conception:

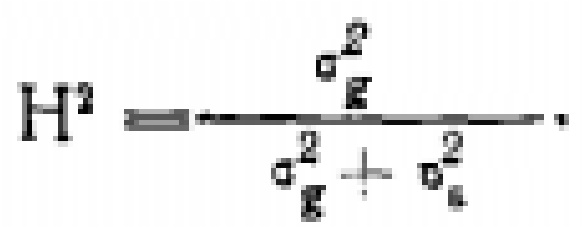
$$\sigma^2_{ph} = \sigma^2_{g} + \sigma^2_{e}$$

Where, σ^2_{ph} – phenotypic dispersion; σ^2_{g} – genotypic dispersion and σ^2_{e} – dispersion caused by environmental effect.

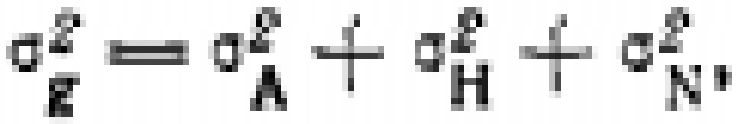
Attitude of genotypic dispersion to general phenotypic is called an inheritance of trait in the **broad sense** and pronounces via symbol.



or



Genetic dispersion of population makes of three components – additive dispersion, its effect will not lose in the progeny, and dispersion, substantiated by the effects of dominancy and interaction of allele genes:



Where: σ^2_{A} – additive variance; σ^2_{H} – dominant variance; σ^2_{N} – variance caused by non-allele interaction of genes.

These effects are loosed at the splitting time. Attitude of additive variance to general phenotypic variance pronounces the hereditary in the **close sense**:

$$h^2 = \frac{\sigma^2_A}{\sigma^2_A + \sigma^2_H + \sigma^2_N + \sigma^2_\varepsilon}.$$

The more paratypic variation of the trait caused by the effect of environment conditions (σ^2_E), the lower the indexes of inheritance, and contrary, the traits, the less altering under the influence of cultivation conditions, have the values of inheritance equal to one.

Heredity depends also upon genetic substantiality of the trait. The genetically complicated trait, the more number genes it is controlled, the lower indexes of inheritance. This theoretic knowledge is vital for the breeders in understanding of essentiality in the hereditary reforming of cotton plants. The breeders should observe such commonly accepted theories on the inheritance of cotton traits and their alterations in the cotton plants. They are necessary approaches in the breeding process to increase the efficiency of selection despite of existing difficulties, growing from generation to generation of selected plants. Additionally, some of new initial parental forms of cotton are included in the initial material lists annually and is started to study in the collection (initial materials) nursery and some of them subjected to the hand crossings, newly in the nursery of hybridization.

Hybridization is usually carried out in the different directions of crossing combinations depending on the program accepted by the decisions of scientists and on the general or specific combining abilities of included parental genotypes. To overcome existing difficulties, scientific staffs of the department do maximum effort to keep optimal developing condition for plants and control effective breeding process comprehensively without losing desirable plant genotypes. Optimal condition of cultivation excludes the environmental effect on the phenotypic reforming of new hybrid plants and enables to see the inheritance of traits by the anticipated genes. Phenological observation (monitoring) means exploring and selection the best plants in the progenies (in the F_3 and following generations) of plant populations. Since the starting of plant developing phases begins exploring the plants by the breeders along the nurseries. A special notices with respective records on

the all remarked plants are made in the last column of planting list remained for this purpose (see appendix 5).

For example, two plants within plants of one parental form population in their nursery have considerable distinguishes on their outstripping for over 4 days at the time of blooming than others. If they are not remarked in time they will lose at the time of coming to massive ripening. Their value is concluded that, the accumulation of fruit components and crop per individual plant depends in particular, on the control of two genes: early starting of flowering and ripening. In the result, these two plants possible to accumulate even more crop than any plants which have shown earliness only at the time of massive maturity of bolls. In similar cases in the course of exploring, researcher oblige to do respective records with number in the last column of the planting list for notices and to attach tags on those plants with that number. For this intention, the special numbered tags with their strings foreseen to carry in the planting list at the times of phonologic monitoring and recording. Moreover, life circle and development phases of cotton plant compel breeders to carry out a range of phonological observations, measurements and accountings.

Traditionally, the life cycle of cotton plant is divided into five developing phases: germination, forming of the first true leaves, budding (or squaring), flowering and maturation. They present some of important periods of the whole vegetation life of cotton plant from cotton seed sown in the soil to ginning of raw cotton where gets new cotton seed (appendix 3). At least, the following kinds of phonological observations and accountings are to be conducted in cotton breeding process:

-seed germination;

-forming of the first true leaf;

-bud (square) forming;

-height of plants;

-number of vegetative and fruiting branches;

-blooming;

-maturation and their rate;

- accounting of bacterial blight and wilt.

-phonologic analyze of hybrids, bacterial blight, wilt and productivity.

Depending upon the breeding program some of them would be no need or added to others with modified changes. For example, records on the field seed germination or rate of boll maturation which are proceeded up to 50% or 100% of the quantity of sown seeds, seed nests or in regard of tagged plants' numbers. The second and following observations are conducted along the growing plants on the rows. Similarly, as the MFE a certain plant quantity (10, 20 to 30 individuals) picked out, preferably in the center of each row and tagged with order numbers. The data recording and measuring are carried out according to small sampling (non-grouped data) or large sampling (40 and more plants) on the grouped data. This order of picking out the experimental plants is continued up to four times (as the replications) along the identical plants on origin from other rows disposed in other parts of the nursery. They encompass respectively three or four replications as they were described by the MFE. To do these and other observations, measurements and accountings in the nurseries related closely with accepted program for every nurseries.

Seed germination in the field conditions is one of the important farm valuable traits of any studied cotton plants. It becomes even more important when the new initial cotton samples or newly developed cotton families are studied in the course of breeding process. In a week after seeding begins the first observation on the account of seeds' germination. In order to subject the collected data from this observation to statistical treatments accounting rows should have at least three replications. Field notebook (take a look at the manual for practical trainings or appendix 4) is needed to make records from observation. It is prepared by one of the junior scientists prior to the starting of first seedling emerging. This notebook has a title: Accounting of the field germination on the samples taken from Pakistan (for example). The blank table in it has columns with records: the date of seeding, the names of sown samples, the numbers of rows, the numbers of nests in the each row and quantity of seeds laid in each nest. Accounting is done by the assistants after getting necessary tips from responsible scientist. According to the program of study it may be conducted in regard of all numbers of nests (first mode) or numbers of seeded seeds per nest (second mode).

For example, in the first accounting the numbers of nests per row is observed and in every third day remarks the number of nests with emerged

seedlings. The numbers of nests with emerged seedlings are increased day by day. Every row in the replications has 20 nests. Accounting is continued until 50 or 100% of nests have sprouted seedlings. The day, when the remark of the numbers of nests in the row gets its 50 (10 units of nests) or 100% (all nests), the last written number is circled and stops the further accounting on this row. The similar completing of accounts follow in regard of other rows in the replications. Some of rows are left at the different levels until 20. After completion or circling the numbers in all observing rows, the collected data in the notebook are carried by responsible scientist to the first blank page of this note book. Carrying across of the date of studied sample is done by pencil in order: one after the other, as shown in the methods by B.A. Dospekhov. Let assume, the scientist carried across the data (in units) of the first experimental sample or standard variety in following orders: On the four replications of the variety S-6037 (standard): 16; 13; 20 and 17.

Sample 1 (from Pakistan): 13; 15; 10; 16 and other observed cotton samples followed as those order.

Questions for improving mastered knowledge:

1.What kind of seeding methods are used in the cotton plant breeding plantations (plots and nurseries)?

2.For what reason is used the hand sowing?

3.In what purpose exist hand and drill sowing?

4.What do you know about the phonological monitoring and their list?

5.Do the sowing methods affect the quality of breeding materials?

5-practical training. **Morphological and phonological monitoring in the cotton varieties**

Purpose of the lesson. The class covers the studying on conception of morphological and phonological characteristics of selected plants. Setting the terms and dates on morphological inspections, measuring and recording of plants' height, setting up the infection extent caused by the agents of diseases and evaluation of plant density in the experimental nurseries are also stressed.

The more elder generations of selected parental plants and their hybrid combinations in the result of individual selections and discards tend to some definite morphological characteristics in the families and onwards true to heredity. Breeding process focused on the forward evolving of new competitive strains from these best formed families is gradually complicated by the growing number of plants in the consequences of seed reproduction, in particular, on morphological characteristics. It is genetic principle that morphological construction of signs and properties of cotton plant have actual correlations with genes responsible of valuable characteristics and impart closely to the following generations. Morphological or phenologic inspections are carrying out in time have made it possible to manage the accumulation and consolidation of desirable genotypes in the structure of novel strains to meet the most requirements in the evaluation of them.

The data collected in the result of phonological inspections and records are made in the field note-books and subjected to statistical analysis for summarizing for proper conclusions.

Morphological characteristics involve in:

-the shapes of bush which distinguished by: zero type, limited and unlimited types and explained with the character of place of setting fruits (see attentively to the differences between plants in regard to boll attached places on every plant was presented on the last pages of the text of second practical class).

Zero type, where the setting of fruit components takes place straightly on the main stem;

Limited type, where the setting of fruit components takes place from the basis of leaves settled on the short fruiting branches which in their turn were established from the base of first leaf grown on the end of the first node of fruit branch.

Unlimited type is characterized by the elongation of the distance between internodes which are ranged from 5 to 10-15, 20-25 centimeters and even more an average and marking in the first, second and third sub-types respectively (photo 6).

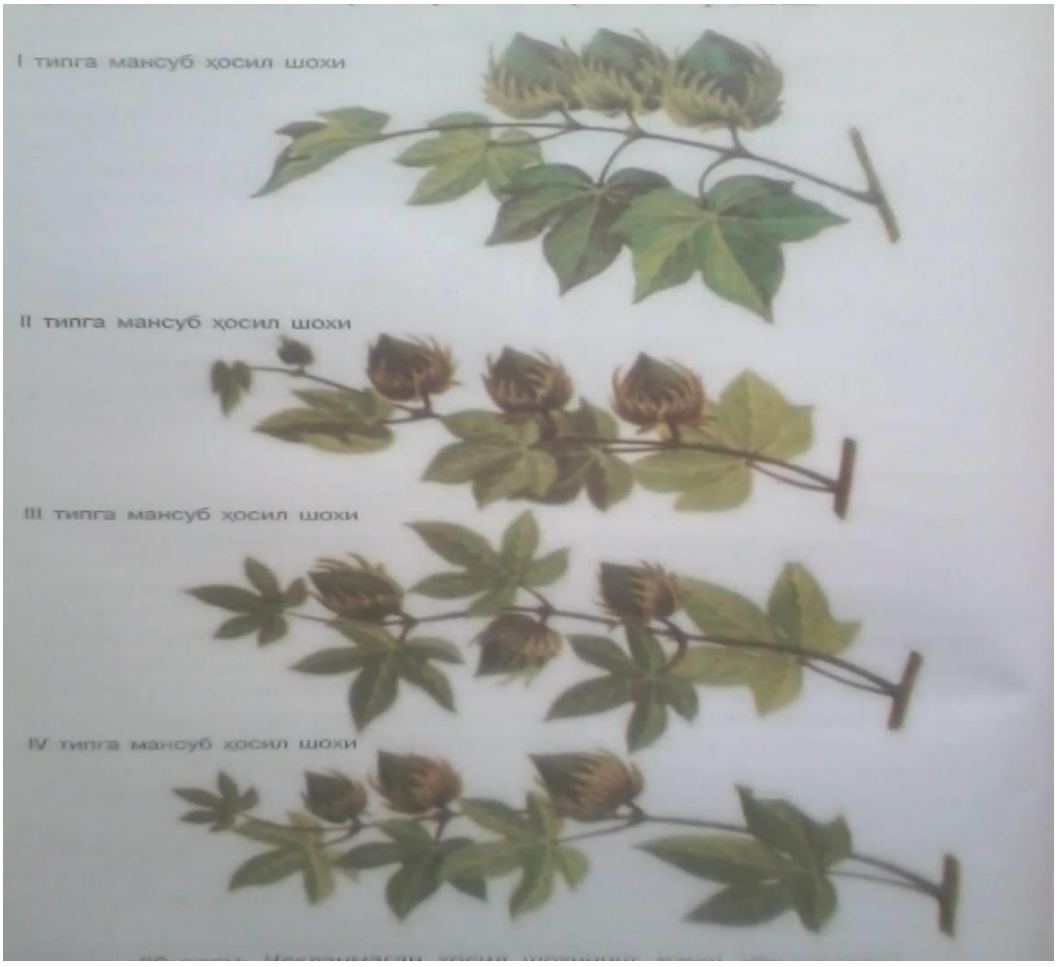


Photo 6. ***The outlooks of sub-type fruiting branches***

Outlook of main stem: tall, middle-tall, dwarf, naked stem or covered with pubescence (or with downy).

Commonly, in standpoint of cotton plant's suitability to mechanical cultivation it is classified as tall, where the plants' height is above by1.2 m. These kind of plants usually have less interests in the process of selection. The height of 0.8-1.1m is guest the good one at the selection process and other one which is shorter than 0.8m. This kind of plants do not suit to our cultivation technology and they may have only a breeding interest as the initial accession with some remarkable characteristics.

-kinds of branches: vegetative and generative.

Vegetative branches according to heredity of the cotton plant take start their growing primarily from the true axilary bud on the bases of the first leaves. The amount of vegetative branches accounting for 1-3and

more mostly promotes the period of vegetation. In general, early ripening varieties have only one or two vegetative branches. If the cotton bush has 3 or more of them it undoubtedly predicts its late ripening.

Generative branches are arising from an extra axilary bud and have fruits on every node. They end with fruiting bud at the top of every branch and provide earliness of the whole bush.

-character of leaf shapes: the leaves have different kinds and even the commercially cultivating varieties vary at the certain shapes, colors and size (photo 7).

Here, on the photo of 7 showed two shapes of leaves: serrate and lobed leaf.

They have some definite implications in the breeding process and successfully employed by the scientists. Responsible genes for their heredity in the plant population may have correlation with farm valuable signs. In this point of view their availability is inspected and data relevant to them made in field note-book.

Photo 7. ***Two shapes of cotton plant leaves.***

-character of blooming and ripening: short and long periods.

Short period of blooming takes place successively from the blossom situated on the first node of the first fruiting branch, for example of the below stated figure 6 to the direction of the other side of the bush, that is the blossom situated on the first node of the first fruiting branch (on the dates of 24-26.06) in 2 days. This behavior in the blooming known as the hereditary principle which continues again from the second blossom (30.06) of branch on the right side of bush to the horizon direction of second blossom situated on the second place of the first branch on the left side of bush in two days again (2.07) and so on. In the structure of the bush this movement acquires the shape of triangle consistently enlarging in 2 days along up and aside.

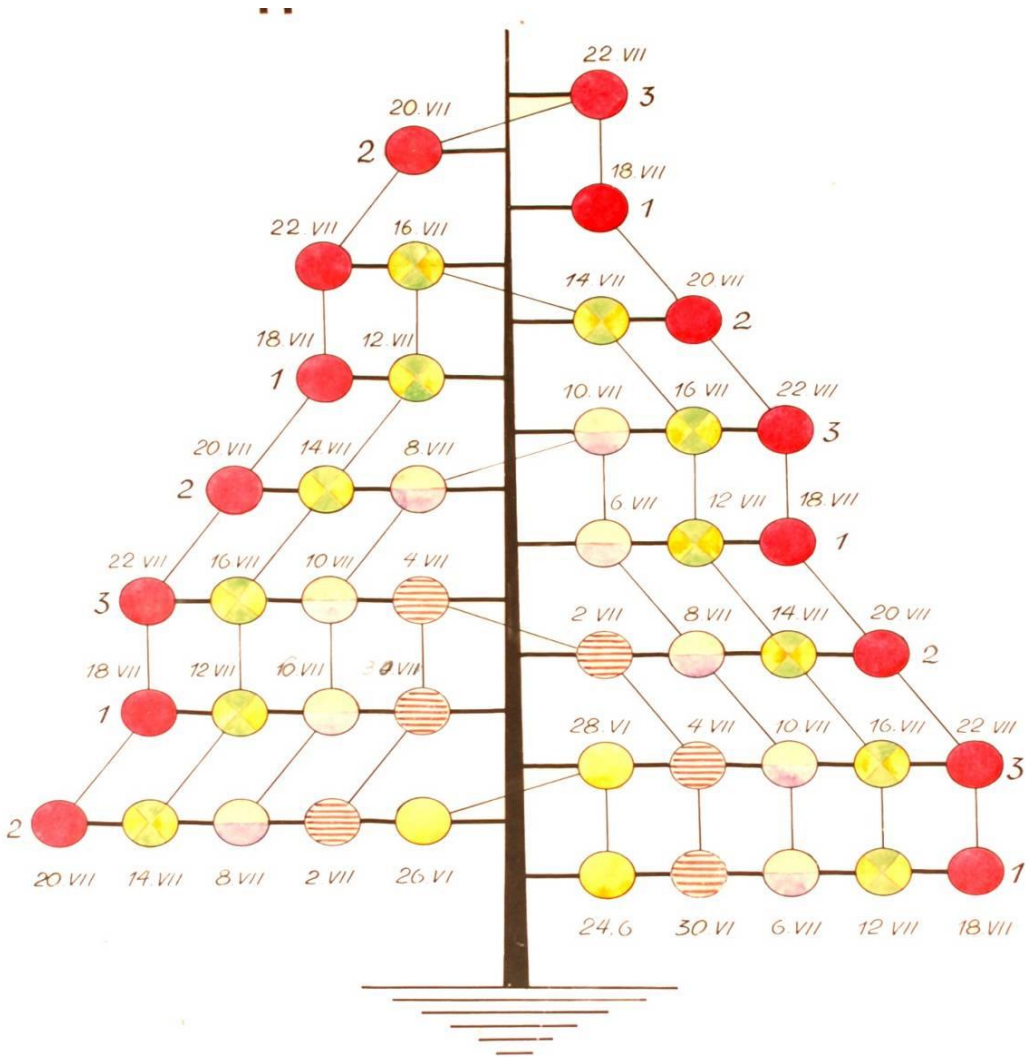


Figure 6. ***Short and long periods of blooming.***

Long period of blooming concerning to the blooming, successively going on vertical direction from lower blossom to the straightly above situated blossom in 4 days on average. On the example of that first

blossom bloomed on the July 24 and blossom settled above it, which blooms in 4 days that is July 28 and so on. The same phenomenon exists in the ripening principle of bolls in autumn but some slightly variations can be occur by the stress effects, on the example of weather, diseases and insects.

And also not less importance have others conceptions of phonological characteristics as:

-setting of bolls;

-character of bolls' dehiscing (or cracking, opening);

-seed kinds: naked or downy.

All above mentioned inspected and recorded in time phonological characteristics of bred cotton plant and their analyzed data with statistical methods enabled the breeder to report authentic conclusion on the potentials of newly developing cotton strains.

For example, the below presenting draft 9 shows that nearly 85 percent of the bolls are set during the first three weeks of blooming. Only 15.2 percent are set in the last four weeks (figure 7).

It is very important to protect the selected cotton from insect damages and diseases agents during this critical period of early blooming. If early leaves are protected, the cotton plant can fruit normally and mature on schedule.

Experimental plots of cotton should be scouted attentively and carefully to determine the dates of morphological inspections, plant characteristics, measuring of plant height, registering of disease agents occur, plant density, entire crop and even the plant damaging and infection rates.

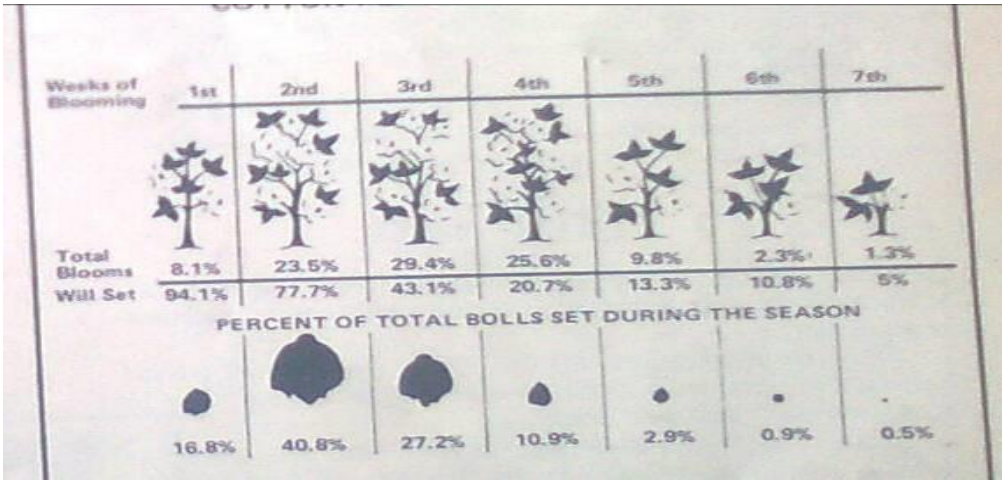


Figure 7. ***The way of cotton plant fruiting.***

The task to students for enhancing their personal understanding about the principles, in particular, on blooming, ripening and setting of bolls during the season:

1.On the base of studied text invent the imaginary family of selected plants which has remarkable potential in the accumulating of profitable crop and give an explanation about those, what hereditary signs and properties had made it possible to achieve such kind of output!

6-practical training. **Studying branching and its types in the cotton varieties**

The aim of the training. To get familiarize with the types of branches forming on the cotton plant is the task of this training.

The needed sources for students. Lecture and practical notebooks, placates depicting the cotton branches and also cotton bush herbariums, pencils, erasers, rulers.

The developing branches on a cotton plant can be schematically classified as either vegetative branches or fruiting branches (figure 7). Scientifically they explained as monopodia and sympodia. Thus wise, cotton plant varieties grown in the fields of farmers have two types of branches: monopodial and sympodial. Some genotype diversities may have both monopodial and sympodial branches, while others may have only sympodial branches arose directly from main stem which is called as zero type. Zero type of cotton varieties belong to fine staple cotton varieties (photo 8). Branches on the main stem are located in a spiral order, angled along the main stem (photo 9).

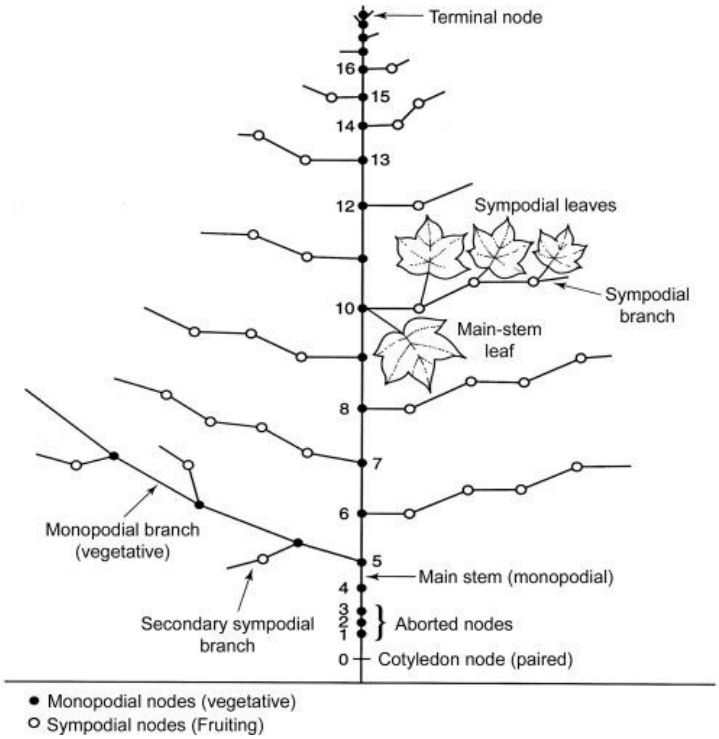


Figure 7. ***Schematic structure of cotton plant.*** *Photo 8.* ***Zero type of branching****.*

Vegetative branches on the cotton plant bush, like the main stem, are referred to as monopodia (meaning “single foot”, named by the scientist

Glen L. and others, 2007.) since they have only one meristem. It is commonly known that vegetative branches have only one meristem, they grow straight and erect, resembling the main stem (photo 9).

The main stem begins from cotyledon node. This node characterizes with two parallel nodes on the both side of the main stem. They hereditarily have 3 nodes without branches and they are called aborted nodes. Vegetative branches can also produce fruiting branches in the second order (or secondary sympodial branches).

In general, monopodial branches are larger and longer than sympodial branches. The distance between the last monopodial branch and the first sympodial branch is only one internodal length. The branches that do not bear fruit directly are the monopodial branches. Monopodial branches are also called vegetative branches and are always formed at the base of the cotton plant.

Due to the enlarged size monopodial branches give the plant a bushy look and usually cause for slow rate of boll formation compared to a sympodial-type plant. In the result of this performance plant has less fruiting organs but leaves and woods. Plant spacing also has a great influence on the number of monopodial branches. Closer spacing of plant bushes per area reduces the appearance of monopodial branches.

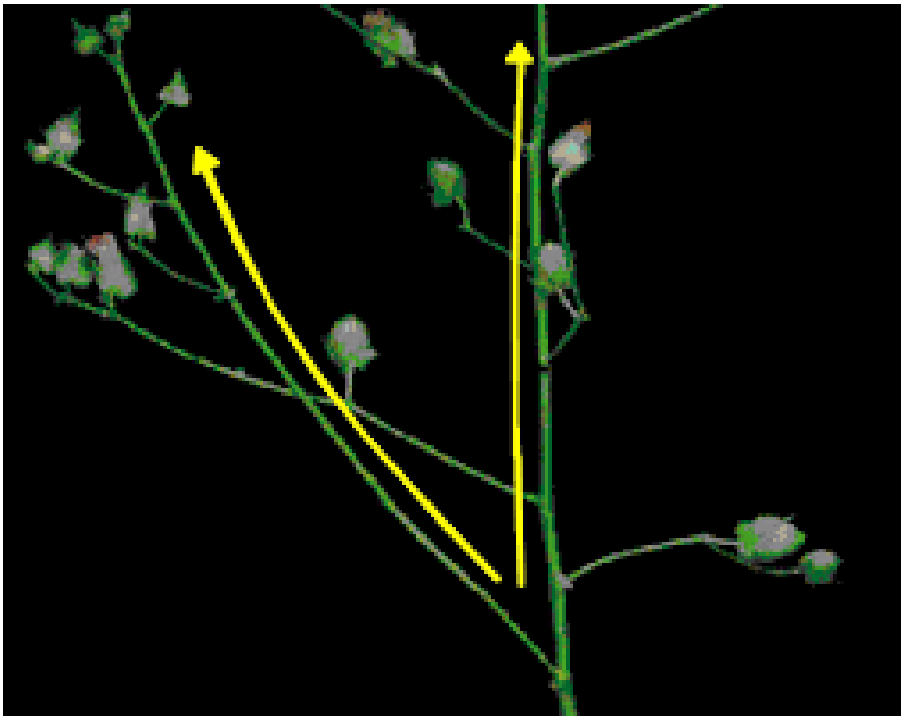


Photo 9. ***A cotton plant with straight growth performance of the main stem and the vegetative branch.***

Sympodial branches bear buds, flowers and bolls directly, for this reason they are called fruiting branches. The secondary branches on monopodial branches are also sympodial and bear the same fruit elements directly. Once a sympodial branch has formed on the main stem of the cotton plant, one or two branches are formed on every subsequent node until the plant is physiologically exhausted and growth stopped in the autumn.

After a sympodial branch has form at the main stem node, the plant is no longer able to produce monopodial branches above that node. Term of this changing depends on the vegetative period of grown varieties. The node on which the first sympodial branch will appear is a varietal trait, but it is also affected by agronomic practices and treatments. Most sympodial branches are primary branches and located in the base part just above the one or two monopodial branches of the main stem, but they may have secondary or tertiary branches and commonly depending on the earliness of the varieties.

In the result of plant breeding, cultivated varieties have a higher number of genetic inheritable sympodial branches than monopodial branches. Zero type branching plants, mostly in the G.barbadense species varieties with only sympodial branches enter into the fruiting phase of growth earlier than plants of the varieties of G.hirsutum L, G.arboreum L. and G.herbaceum L. which have monopodial branches.

Branches on which fruiting buds arise are called fruiting branches, or sympodia (meaning “multiple feet”), because each fruiting branch contains multiple meristems. Fruiting branches have a “zig-zag” growth habit, as opposed to the straight growth habit of the vegetative branches (photo 10).

According to scientists` observations, the initial growth of a sympodial branch is terminated once a fruiting bud (square) forms. The fruiting branch of cotton, however, initiates a new growing point, called an axillary meristem. The axillary meristem is located at the base of a leaf that subtends the newly formed fruiting bud but zero type of branching. The “zig-zag” growing habit is a consequence of the stop-and-go growth of the fruiting branch in the most of growing cotton species. The first fruiting branch will generally arise at mainstem node 5 or 6 on the plants of middle-early ripening varieties of Uzbekistan. Arise of the first fruiting

branches at the 7th and above nodes or axillary meristems is characteristic of considerably late ripening varieties or hybrids.

Photo 10. ***A fruiting branch with removed leaves shows its zig-zag growing habit.***

A cotton plant of grown varieties will mainly produce fruiting branches, but several common environmental factors like low population density, insect and disease pressure and over-fertilization can cause forming of vegetative branches. In the consequences of these factors, vegetative branches are produced after fruiting branches, and develop at nodes directly below on node at which the first fruiting branch was developed. For instance, if the first fruiting branch is initiated at main-stem node 5, one vegetative branch may develop at 4^{th} main-stem node. As above mentioned, the cotyledons are oriented opposite each other on the stem, but the true leaves and branches of the cotton plant occur in a 3/8 alternate phyllotaxy, meaning the distance from one leaf to the next is 3/8 of a complete turn around the stem (Figure 8a).

Branches on the main stem also show 3/8 alternate arrangement, since they grow adjacent to the leaves. Nodes are numbered in the same order the leaves are numbered where the cotyledon node is considered as zero node (Figure 8b). New fruiting branches of growing cotton varieties are generally believed to develop approximately every 3 days, although recent studies show that this developmental rate varies depend on the cotton genotypes.

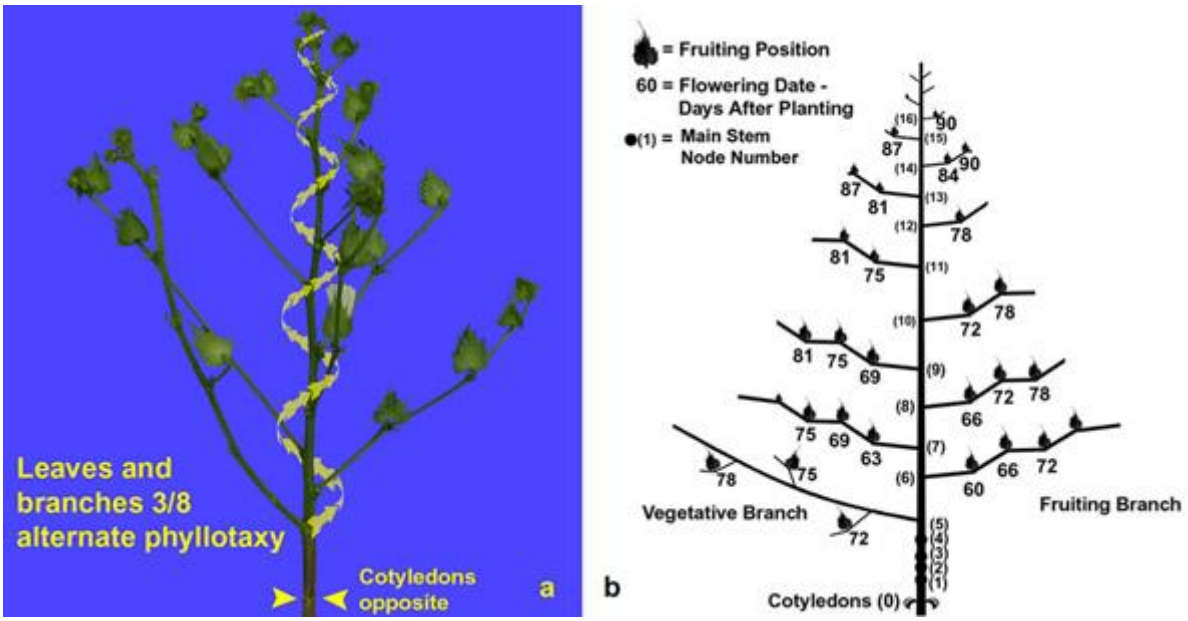


Figure 8. ***(a) A defoliated cotton plant shows the alternate phyllotaxy of branches. Each branch turns around the stem from the branch below it. The branches form from the axils of main stem leaves. (b) A diagram of the general timing of flower emergence from buds on the fruiting branches by fruiting position.***

According to the reports of Uzbek breeder G.S. Zhaytsev (1928), who scientifically coined the principles of flowering order of cotton plant, the squares are produced at new positions on a fruiting branch approximately every 6 days. The age of fruiting structures on a cotton plant can be mapped according to the time sequences of different cotton species (figure 8b). Thus, every branch forms up to terminal node in three days and the next squares arose in six days an average.

Questions to improve acquired knowledge:

1.How branching types of cotton plant are schematically classified?

2.What types of cotton plant branching do you know?

3.Do cotton branches have specific names?

4.Do environmental factors effect on the formation of cotton branches?

5.What structural elements made up of sympodial branches?

6.What structural elements made up of monopodial branches?

7.On which part of a main stem does the branch form?

8.What is the “zig-zag” growth habit means in the most of growing cotton species?

9. Is it possible to predict the sequences of days to form cotton bolls on the branches of cotton plant?

7-practical training. **The architecture of flowers belongs to the cotton varieties of G.hirsutum and G.barbadense**

The aim of the training. Study of the flowers of cotton plant species, the main parts of the cotton flower (photo 11), and differences in the size and colors are the aim of this training.

Educational sources: Copy books of lecture and practical lessons; placates depicting cotton flowers and flower herbariums prepared from different cotton species. Alive cotton flowers from cotton fields or collection growing in the green houses of the scientific research institutes, internet sources, literature on the cotton plant's biology and morphology, pencil, ruler, and eraser.

Cotton flowers have different sizes (5–9 cm), and all components are located in five circles around the base. They contain both male and female structures which are scientifically called pentamerous (parts arranged in fives). They have both floral and extra-floral nectaries (figure 9). The style is 2–5 cm long and terminates in the 0.5-1 cm-long stigma. The ovary contains 5–10 ovules in each of 3–5 sections, or locules. The stamina sheath, which encloses most of the style, bears numerous stamens 0.5–1 cm long, each terminating in an anther that normally produces an abundance of viable self-fertile pollen. According to some literature their number makes up approximately 20,000 pollen grains per flower (Ter-Avanesian,1978).

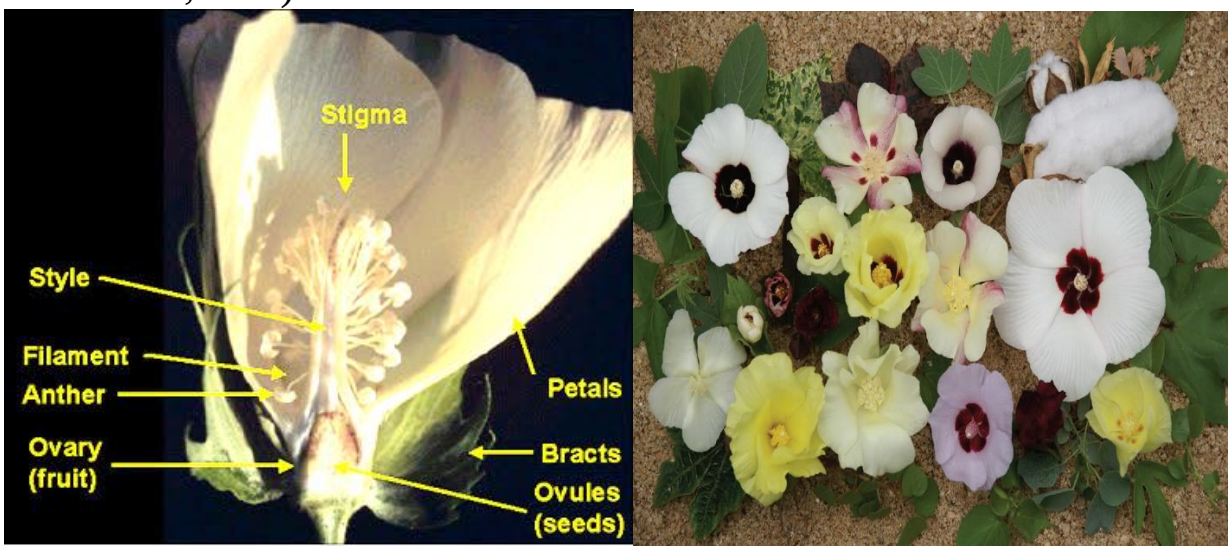


Photo 11. ***Structure of cotton flower and flowers of cotton diversities.***

The flowers of *G. hirsutum* and *G. barbadense* differ in appearance and in their presentation as a pollinator, attracting various insects and flies *G. hirsutum* flowers are cream in colour, with cream pollen and secrete a

low volume of nectar, whereas *G. barbadense* flowers are yellow, with a maroon nectar guide, orange pollen and produce more nectar with a lower sugar concentration than *G. hirsutum*. Furthermore, the *G. barbadense* stigma extends well above the anthers, unlike *G. hirsutum anthers*, and this may affect the likelihood of cross-pollination occurs. Until today, it has not been determined whether or not these differences make *G. barbadense* flowers more attractive to native natural insect pollinators than *G. hirsutum*. Herein, we can study the comparatively different flower morphologies between *G. hirsutum and G. barbadense*, which are outlined in the table 1.

Table 1. **Comparative differences of flower morphologies (by Fryxell 1984).**

Flower parts	**G. hirsutum**	**G. barbadense**
Flowers	flowers are usually in sympodial inflorescences, the *pedicels* 20–40 mm long, surmounted by three involucellar nectaries	solitary or in sympodial inflorescences, the *pedicels* are 10–40 mm long, gland-dotted, usually glabrate, and surmounted by three involucellar nectaries
Bracts	The bracts of the involucel are inserted above each nectary, foliaceous (enclosing the bud), ovate, three to 19-laciniate	The bracts of the involucel three, inserted above the nectaries, are ovate, up to 60 mm long, 45 mm broad, and seven to 19-laciniate.
Calyx	truncate or five-toothed, 5–6 mm long (excluding teeth)	6–10 mm long, undulate or truncate, prominently gland-dotted, ciliate on margin, otherwise glabrous, a trio of nectaries often present at juncture of calyx and involucel, alternate with the bracts
Petals	up to 50 mm long, cream-colored or pale yellow, with or without a dark spot at base; androecium included	Up to 80 mm long, usually yellow with a dark-red spot at the base, minutely gland-dotted; staminal column ca. 25 mm long, pallid, glabrous, gland-dotted, the filaments 2–4 mm long.
Style	single with decurrent stigmatic lobes, more or less enclosed by androecium or somewhat exceeding	exceeding the androecium, gland-dotted

	androedium	
Capsule	three to five-celled, glabrous, smooth, broadly ovoid or subglobose	three-celled, glabrous, prominently pitted, usually narrowly elongated (35–60 mm long) and beaked
Seeds	several per locule, lanate, the seed fibres are white, tan, or red-brown	several per cell, free or fused together, lanate, the fibres usually white

The maturity of the reproductive organs of cotton is reached approximately four to five weeks after planting, with the formation of floral buds (‘squares’). The floral buds first appear as small pyramidal structures which are composed of three large green bracts which completely enclose the developing young flower. Usually, approximately 25 days elapse between the initial appearance of a square and the anthesis (flower opening). Development of the bud from pinhead square (a) to flower (e) involves both a size increase and petal development. In this photo, two bracts have been removed from each square in order to show the candle and bloom fully (photo 12).

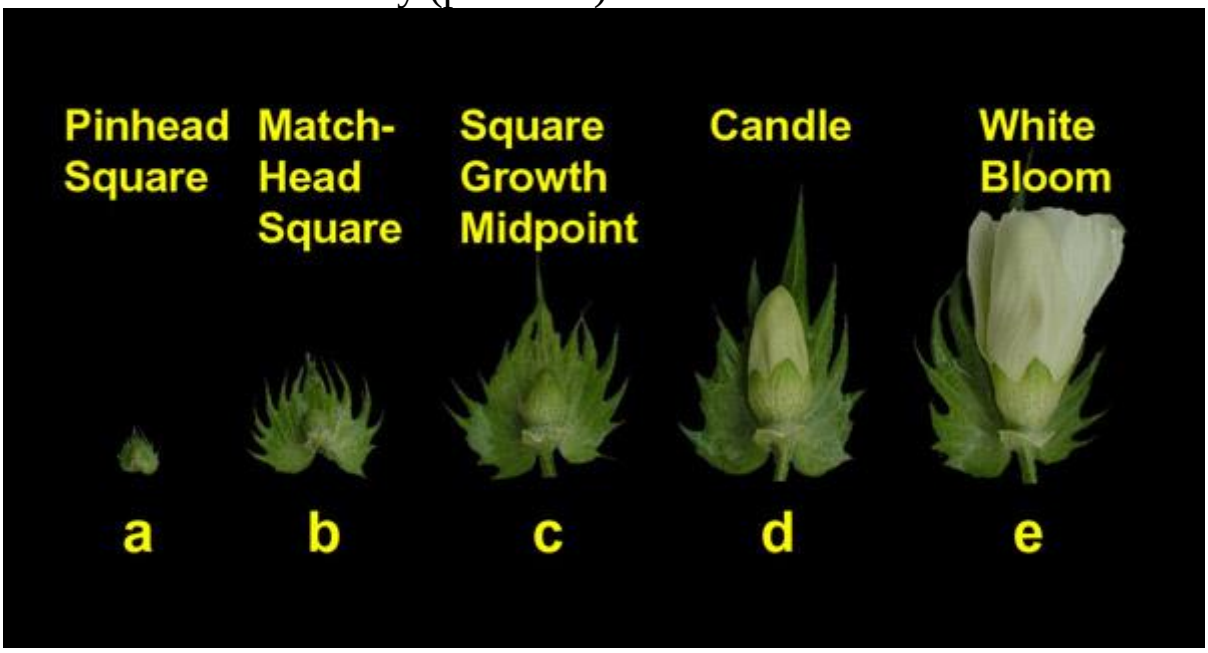


Photo 12. ***Development of cotton flower.***

Cotton inflorescence (or flowering): The 2- to 4-inch-long (1inch=2.54 cm) by 2-inch-broad cotton blossom is subtended by three green leafy bracts, each an inch or more across, and a green calyx that fits snugly around the base of the ovary (2,5 cm in diameter). The five-petal corolla of upland cotton is cream colored when it opens in the morning

shortly after sunup, but turns pink in the afternoon and closes toward nightfall never to reopen (photo 13). On the second day, the color of the petals is a watermelon red. The typical corolla of Pima cotton is yellow, with a maroon throat or petal spot, and the color changes little with age. The corolla and stamina columns usually fall on the second day.

The staminal column surrounds the 1- to 2-inch-long style leading from the ovary and terminating in the l/4 to l/2-inch-long stigma (photo 14). The ovary contains 5 to 10 ovules in each of three to five sections, carpers, or locules. The stamina sheath, enclosing most of the style, bears numerous stamens l/4 to 1/2 inch long, each terminating in an anther that normally produces an abundance of viable self-fertile pollen, 45,000 grains per flower. The grains are large, 81 to 143 microns, and coated with a viscid material that causes them to adhere to each other; therefore, cotton pollen is not transported by wind. Each section of the oval, 1-inch boll that develops from the ovary may produce a "lock," a distinct group of lint-entangled seeds. These locks are exposed in the open three- to five-sectioned "burr."

The number of flowers on a cotton plant is determined by numerous factors, including the available plant food, water supply, variety, and density of the plant population. Usually, about half of the flowers produce mature bolls. Flowering reaches its peak at about four flowers per plant per day. Between 225 and 400 bolls are usually required to produce a pound (1 pound=453.592 gram) of fruit.

A  B 

Photo 13, 14. ***Cotton flowers of G.hirsutum (A) and G.barbadense (B).***

Where: Cotton flowers showing general corolla shape and proximity of anthers to stigma. *A. G.hirsutum cotton flower with a flored, cream-colored corolla and stigma protruding only slightly above the anthers: B. G. barbadense has a yellowish corolla with a turbulent shape and a dark "petal sport" near the base. Stigma extends well above the anthers.*

Cotton flowers have floral nectaries. Nectar is normally produced in five different areas of the cotton plant, although the reason why the nectar is secreted is not clear.

The different areas of nectar secretion are (1) floral, (2) inner or circumbracteal, (3) outer or subbracteal, (4) foliar or leaf, and (5) unipapillate (microscopic) areas on the flower peduncles and young leaf petioles (figure 9).

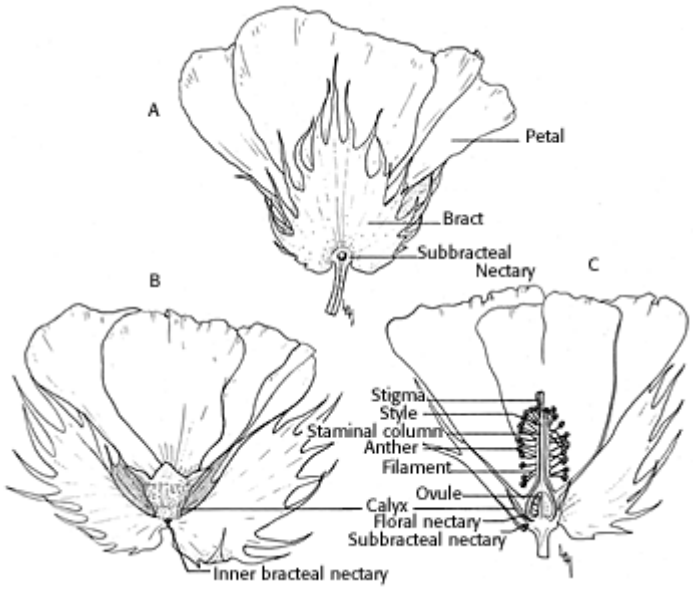


Figure 9. ***Parts of G.hirsutum flower where the nectaries located.*** *A, side view, showing one of the 3 subbracteal nectaries; B, bracts slightly spread to show one of the 3 inner bracteal nectaries; C, longitudinal section.*

Table 1. **Comparative differences of flower phenotypes.**

Flower parts	**G. hirsutum**	**Variety:**	**Variety:**	**Variety:**
Flowers				
Bracts				
Calyx				
Petals				

Table 2. **Comparative differences of flower phenotypes.**

Flower parts	**G. barbadense**	**Variety:**	**Variety:**	**Variety:**
Flowers				
Bracts				
Calyx				
Petals				

Questions and tasks to improve knowledge:

1. How many types of cotton are there in cultivation?
2. How long does it take for a cotton plant to flower?
3. How many parts does a cotton flower have and what are they?
4. Does the environment have an effect on the flowering period?
5. What are the floral nectaries of cotton flowers and their areas on the cotton flowers?
6. Can you describe what trait of cotton flowers in general is a distinguishing mark to point out fine staple cotton (G.barbadense L.) or middle staple cotton (G.hirsutum L.) ?
7. Make your best effort to describe the available flower varieties using the table, rulers, pencils, and erasers.

8-practical training. **Orders of hybridization in cotton plant breeding**

Purpose of the lesson. In the course of this class the students should master their knowledge by some items on crossing breeding as: purpose of artificial crossing, component parts of the flower and its order: choosing the time of emasculation of maternal plants' flowers, preparation of cotton plant blossoms to pollination, emasculation, isolation of emasculated flowers with paper cups, collecting of pollen**,** pollination of the flowers and their isolation by the paper bags, registration of pollinated flowers in the hybridization register and dates of pollination.

Cotton growing is a highly profitable branch of agriculture and yields the great income for peasants. The introduction of the new varieties into production radically cuts down expenses and consequently reduces production cost of agricultural crops.

The aim of the crossing is to combine valuable signs and properties of the initial parental forms in the hybrid plants through artificial pollination (crossing) in the course of hybridization process as well as to evolve essential farm valuable characteristics on the base of genetic recombination in the successive generations and to consolidate needed signs and properties under the influence of the certain soil-climatic and agro-practices of cultivation.

The order of works involved in the process of crossing is mainly focused on the primarily choosing of desirable parental plants which will promote the success of breeder's outcome.

In the capacity of parental forms it is preferable to select high-productive varieties distinguished by place of origin, distant genetic relationship and, of course, with the least of number of negative signs. In the first place, wilt-resistance is considered as the most important factor. Selection of the maternal plants is also of a great importance. During the inter-variety crossing preference is given the plants of local high productive varieties as the quality of maternal plants.

Components of cotton flower. Flower is that part of the plant which is concerned with the sexual reproductive process of angiosperms. The formation of the flower is preliminary to the production of fruit, its seeds. At first arises, the flower bud on the plant when reproductive growth begins is called a "square". The flower bud is enclosed by three bracts (photo 15). Squares grow for about three weeks before a flower appears. Cream or yellow flowers open during early morning hours. During this time, the male and female flower parts expand rapidly (photo

17). For the 3-5 days, flower petals turn from yellow to pink (on the second day) and at last to dark red and dry up to drop off and then develop a cotton boll (photo 16).

The structure of cotton plant flowers made up of some important components which responsible not only for sexual but in diverse functions as attractive in regard to natural insect pollinators and the defender against the effect caused by the outdoor stresses.

The flower may appear on alternate sides of the fruiting branch. There are three relatively large leaves like bracts at the base of the flower, above which is a true calyx consisting of five unequally lobed sepals. The corolla consists of five petals, which range in color from white to yellow or rose in different types. The stem column bears 10 more or less double rows of stamens, while the pistil is made up of from 3 to 5 carpels. The fruit is an enlarged ovary that develops into a three to five locule capsule or boll (photo 16).

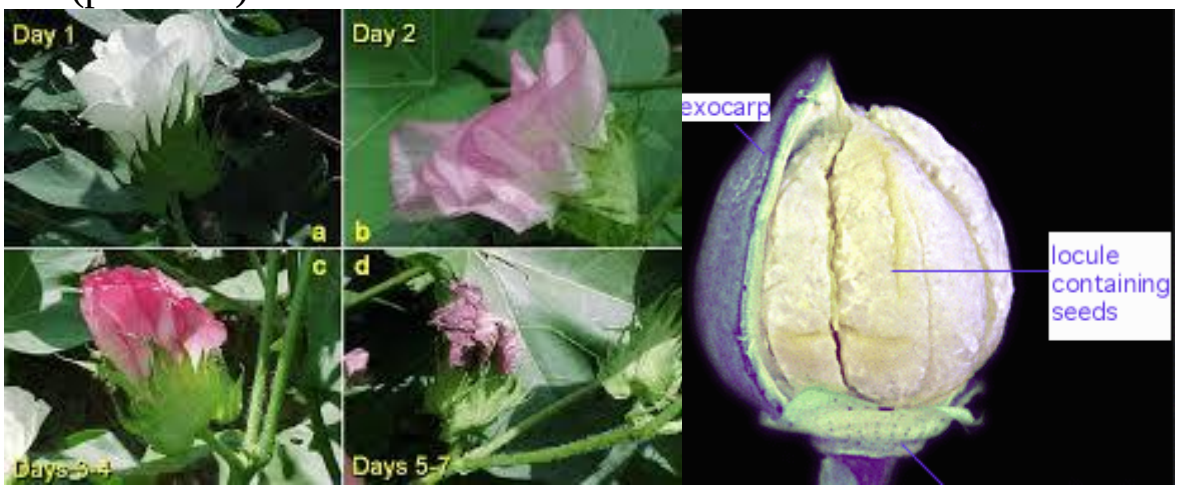


Photo 15, 16. ***Life span of cotton flowers.***

Emasculation. During crossing with emasculation of maternal blossoms or flowers, emasculation is executed in the evening – a day before the blossom opens or even still better in the morning on the day when the blossom opens up. At this, the corolla with stamina leg is removed (photo 18), whereas, the emasculated blossom, in order to avoid penetration of undesirable pollen, is covered up by a paper cup (photo 19).

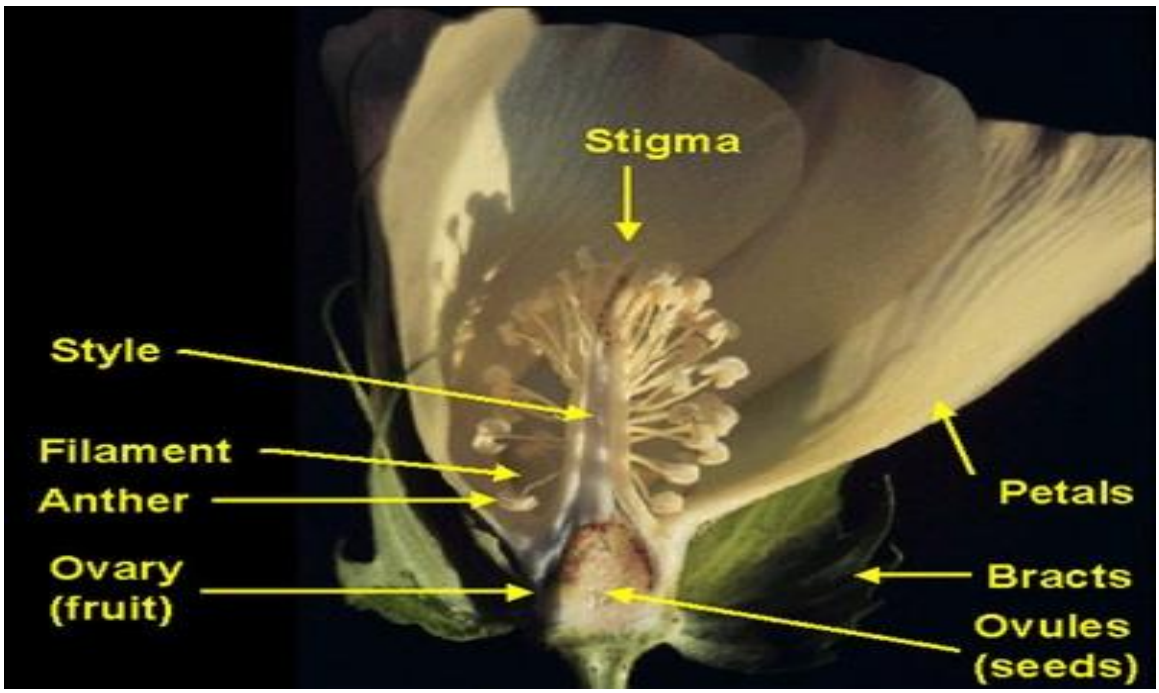


Photo 17. ***Structural components of cotton flower.***

Emasculation is one of the most responsible operations which is performed under direct supervision of the breeder and daily registered on the pages of copy-book which is being specially prepared annually for this purpose. The assistants of the breeder are experienced specialists and have passed through the breeder's advanced instructions relevant to the quality of the crossing to be done.


Photo 18, 19. ***General view of emasculated and isolated cotton flowers.***

Here, the most important thing is to account the numbers of emasculated flowers per hybridization combinations and register in the copy book on the hybridization. This would give an information about the daily numbers of emasculated flowers and the necessity to prepare the definite number of isolation paper bags to be covered on the emasculated

flowers in the next day. They have advance to be marked by names of combination and the date of pollination. This information help breeders to get 150-200 pollinated flowers at optimal period of vegetation, which defines efficiency of planned hybridization.

Collecting of pollen. Collecting of pollen is done just before pollination, from 10 to 11 a.m. Collecting of pollen out of maternal plants is another responsible task for lab assistants. At first, according to the list of hybridization and the number of row or rows where the needed maternal plants grow is found by the assistant who is going to collect them. After that, the assistant selects a healthy, typical plant bush with newly opened flowers. When the cotton flower opens, its stigma and anthers are seen clearly. The amount of paternal flowers to be collected pollen depends on the number of emasculated flowers. It is equivalent that one paternal flower is needed to pollinate an average of 5 emasculated maternal plants. So, 3 normally opened flowers are necessary to get their pollen if 15 maternal flowers have been emasculated the day before. Collecting of pollen is executed by shaking selected flowers turned down above the tea cups or combine with the help of soft brush in the tins, tea cups, packets (doesn't matter glass or metal cups). Often, assistance take flowers from the paternal plant and use straight touching and rubbing their pollen on the stigma of emasculated maternal flower (photo 21).

Isolation. Isolation paper bags are prepared in advance, taking into account the number of emasculated flowers per hybridization combinations. And the paper bags should bear the number of crossing combination, maternal and paternal variety and date of emasculation (photo 22). After pollination the flowers are isolated through bagging by these paper bags which defend the penetration of insects with off pollen.

Figures 20. ***Collecting of pollens****.*

Photo 21. ***Straight pollination.***

During crossing without emasculation, it commonly is recommended to conduct pollination early in the morning before the sigma is pollinated by the pollen of its own blossom. A tag showing the number of crossing 5 for example, crossing combinations and date of pollination should be tied up to the scape of the pollinated blossom (photo 23).

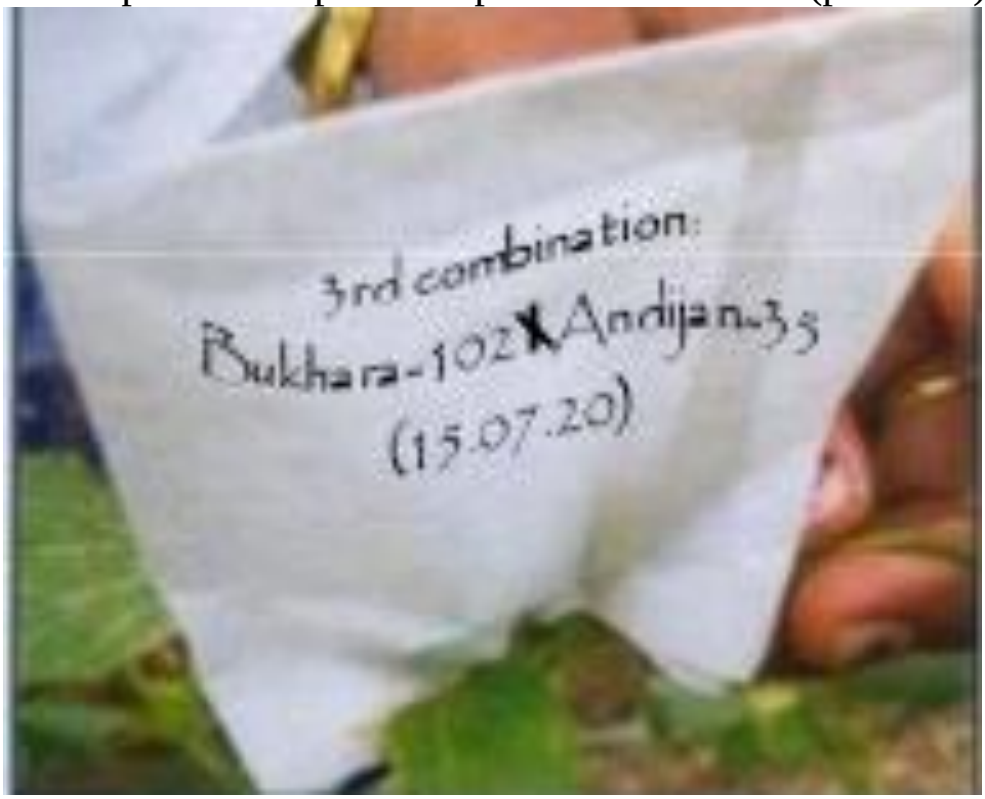


Photo 22. ***Isolation of hand pollinated cotton flower.***

All these operations are conducted daily according to the direct managing of the breeder and timely registered into the list (or register of hybridization) of crossing by the regularly checking of the correspondence each other the numbers of every day registration in the list and the numbers of packages covered up the pollinated flowers.

Beside of this the senior executor of the assistants ought to report the breeder about the course on the daily crossings and receive some advises to be correction.

Generally proved that at the departments of the SRI of selection or even at the private researches of the breeders in order to achieve the maximum outcome are to be conducted several crossings in diverse combinations between various parental accessions.

Dates of crossing. Crossings are executed on the first-second places of the second-eight fruiting woods, this corresponds from 1-5 up to 25-30 of July. Bolls from crossings made in August usually fail to grow ripe.

In autumn with the help of the records made in the crossing register, the ripe bolls together with the isolation bags and tags are taken in and cleaned, fiber is separated, seeds are inspected and made ready for sowing in the next year.

Photo 23. ***Tagging of self pollinated flowers or branch on that all flowers were self pollinated.***

The tasks and questions for self training:

1. Imagine that you are performing the crossing of the flowers between two plants and list the things necessary to do it successfully.
2. Explain the primary activities of the breeder in regard to the selection of parental accessions and their possible contribution towards the development of novel varieties.
3. What kind of works does involve hand pollination made by breeders?
4. What kind of works does involve self-pollination made by breeders?
5. Do you know the importance of artificial hybridization in the plant breeding?
6. What is emasculation in the process of pollination?
7. Can you describe the significance of the isolation?
8. How can the breeders distinguish their self pollinated bolls in autumn?

9-practical training. **Orders of approbation and its documentation.**

Aim of the lesson. Approbation. Conducting orders of approbation. Inspections carrying out in the seed plantations. Selection of samples. Laboratory procedures on the analysis of samples. Documentation of approbation results.

Seed, being the basic and vital input for cotton production and plays its decisive role in cotton productivity and quality has been greatly emphasized in the recent years. In the consequences of the releasing the high yielding varieties and hybrids, the concept of quality seed usage has assumed greater importance. The high quality, seeds have made it possible to ensure the true traits of a definite variety and meet all requirements of standards on seed certification.

So, the good seeds are scientifically and practically essential for taking in bumper and quality crop. Furthermore, economical value of approbation has been specially emphasized in the second clause of the law on **"Seed production"** - "Conducting of approbation is the investigation carrying out for the purpose of identifying the plant purity (photo 24) on genetic (variety) features, resistance to diseases and pests and general state of the planting seed stocks".

Photo 24. ***A model appearance of seed plantation prepared to approbation***

Approbation of seed-cotton plantations.

1. Annually, it is conducted in the fields of seed producing plantations in the purpose of ensuring the cotton plantations in the year to come with the best seeds on planting qualities.

Kinds of fields to be approbated;

a) elite plantations, the first, second, and the third reproduction of varieties introduced into regional distribution, in volumes of demanded for ensuring the fulfillment of plan on storing up the planting seed from the best reproductions, predominantly of the first class on germination and conditioned on all other quality indexes.

On the basis of preliminary plans on introduction of varieties into regional distribution is worked out and confirmed the plan of approbation on every region, with pointing out of areas under cotton on varieties and reproductions and the time of conducting and transferring of this plan through all regional governance of agriculture and also up to cotton seed laboratories, ginneries and via cotton farmers until storing places.

2. **Approbation-agronomist is thought to be responsible in carrying out the following works in each of seed producing farms:**

a) verify the availability of documents on received and used seed for planting, re-seeding and under sowing and compare to registered documents: variety, reproductions and sort grade with approbation plan;

b) in the case of divergences in approbation plans with available documents on planted or under sowed varieties, reproductions or sort grade, to inform immediately of senior approbation-agronomist about these divergences and to guide his instructions for further actions;

c) distinguish the typical cotton plants on overall development and state for determination of variety purity on the plantations of the second and next reproductions in every farm. On the second reproduction, the samples for determination of variety grade are laid on every 10-20 hectares of cotton plantations.

Chopping of cotton plant's top in the plots, distinguished for determination of sort grade of plantation, does not conduct.

Variety purity of plants on elite plantations is conducted by employers of elite farm in the field through clearing process on all not discarded seed nurseries. Beside of that, after clearing out of seed multiplication nurseries and the first reproduction, their variety purity is defined by special commission from representatives of cotton seed laboratories, ginneries, district production governance of agriculture with

participation of elite farm's head and farm's agronomist, specialists of agricultural ministry and scientific research establishments on cotton plant breeding.

Commission visually observes elite plantations (seed multiplication) on all not discarded families. Sort grade on the seed multiplication is identified selectively by the way of observation of plants not less than of 5 – 10 % of families or, at necessity, on the consideration of commission in large amount, or even, on all non – discarded families.

Plantation of the first reproduction observes by this commission through its diagonal, in two directions on all fields and plots have separated for approbation. Sort grade on these plantations is identified selectively by setting out of samples not more in each 20 hectares of the plantation (photo 24).

Summary of the commission is registered by the corresponding statements and which serve as the base for payment to the farms on their seeds handed over to the provisionary basis.

Field register of the approbation.

Agronomist should have a field register. All data relevant to sizes of area, agro-technical states and state of plants subjected to damage caused by outdoor stresses likely to drought, diseases or pest origin made regularly in this field register. They will need for substantiation of any question on the quality of preparing seeds filling up the statements on approbation (form1).

3. Sort grade identification.

Sort grade identification of plantations is carried out on the plots by agronomist- approbation on the plots separately, distinguished in advance for this purpose in each farm for every variety and reproductions.

Two rows having normal developed plants from more typical part in every distinguished field, displaced apart each other at least 20 m, are selected.

On every row agronomist– approbation is observing of 100 normal developed plants and identified, to what variety belong to every plant of these plant bushes. Plants subjected to illness and crotches are excepted from calculation and will not subject to analysis.

The Agronomist-approbatory for the identifying of sort grade, composition of the mixes and sterilized (infertile) plants is guided by the following major morphological traits:

A) Size and shape of leaf;

B) Pubescence of main stalk;

C) Type of woods and shape of bush;

D) Size and shape of bolls.

E) For the fine staple cotton varieties, besides above represented traits` presence of internal spots in the base of flower and the color of corolla should be noticed.

After the identifying of the number of typical plants for variety under the approbation and the mixes from other varieties, sterile plants and also is identified on every row (sample) in individually the sort grade percentage, that it is the percent of typical plants for variety subjected to approbation to total number of observed plants on the row. The arithmetic means from two replications – rows will characterize the percentage of sort grade on this field.

In the consequences of the approbation will draw up statements: on seed plantations in the farm at two copies; general variety plantations- in three; plots of hybridization at the self-pollination strains; plots of simple hybrid reproduction, seed plantations of scientific research establishments; education and experimental, in elite seed and seed enterprises- in four copies.

On registered sort, plantations will draw up the registered statement in two (or three) copies: one to farm, the second for RAPO (District Agro-industry government), the third to the ginnery (form 2). To all other sort plantations recognized as the unfit to seed proposes, are drawn up statement of rejection.

Form1.

Field journal of approbation conductors

District department of agriculture and water resources

_____

Farm, farmer _____

Cotton variety_____

Generation _____

Area _____

Whereas, harvested by hand _____ ha

The following were determined in the result of approbation:

1.Variety grade _____ %

2.Intirely crop anticipated_____ ton

3.Productivity _____ c\ha

4.wilt infected plants _____ %

5.Gommoz infected plants _____ %

compound of yield _____ %

Identity of infected plants						Identity of variety grade					Identity of infected plants						Identity of variety grade				
		In this, disease infected		On ten plants				Here is					In this, disease infected		On two plants				Here is		
№ of samples	Plant amount	With wilt	With gommoz	Totally, number of boll	Here is disease aff.	№ of samples	Plants in specie	Strangers	Sterials	Variety grade, %	Species, %	Plants in specie	With wilt	With gommoz	Totally, n of boll	Disease effected	№ of spacie	Plants in spacie	Strangers	Sterials	Variety grade, %
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

Form2.

An exemplary appearance of statement on identification of seed plantations' sort grade

Statement № ____ identification of sort grade

Prior to blooming _____ 20 ___ y.

Farm _____

_____

Plantation _____ Variety

_____

Agronomist _____

_____

with the person who is responsible to seed production_____

and representative _____ from “Center of sort control”

Seed plantations have been inspected and the following have been identified:

1. The area of plantation _____ ha
2. Place of area: farm _____ , plot №____ __
3. Previous crop _____

____

4. The main and supplementary dressing method, kinds and rate

_____

_____

_ ___

5. Time of planting and method

_____

6. Distance between row_____ and between nests_____
7. Damage caused by weeds: strongly, weekly, mean (by leaving which one)

Occurrences of quarantine weeds

_____ _

8. Loosing state of plants (% than planted) _____

_____

9. Agro-practices

_____ ____

10. Damages caused by diseases and pests (kinds)_____

11. Amount of watering (and method kind)

_____

12. Development stage at the inspection_____

13. State of seed plantation: excellent, good, tolerable, bad (by leaving which one)

_____

Signature of responsible person and seal:

Answer the questions:

1. What is approbation?
2. What can you say about the responsibilities of approbatory-agronomist?
3. Does the quality of prepared seed effect on the state of harvested crop?
4. Who takes part in the staff of commission?
5. What traits of cotton plant are subjected to the defining of sort grades in the seed plantations?
6. What does mean the sort grade?

10-practical training. **Orders of individual selection in the cotton plants**

The importance of individual selecting. Orders of its execution and dates. Its attention needed sides in the period of individual selecting. Analyses of individual samples at the laboratory.

Purpose of the lesson. Students should understand and imagine that the created strains or still hybrid progenies are being studied in the conditions of selection nurseries display complete characteristics of morphological and economical signs, as well as, agro - biological features and on the other hand this process genetically refers to the splitting of numerous surprisingly coupled plants with genes out of parental accessions.

Importance of individual selection. The work of individual selection facilitates of propagation of single plant's progeny separately along several generations and evaluation (photo 25). Due to this ensures the evaluation of some individuals' capacities on imparting their heredity qualities to their posterities. Owing to individual selections, it is easy to split the population of selections into new unique ones with desirable complexes of farm valuable characteristics as early ripening canopy, enlarged numbers and sizes of bolls, fine qualities of fiber and output than parental plants.

Photo 25. ***Cotton breeder and geneticist M. Pulatov (1990) demonstrates the desirable plant shape is to be selected as individual selection.***

Orders of its execution and dates. Individual selection is conducted by the breeder at the maturing phase of plant's development when every plant has six or seven opened bolls. If a chose done a little later, when all bolls on the plants have opened the breeder unfortunately will not be able to determine the earliness. In other case when a chose has been done earlier when the plants have only two or three opened bolls contrarily to the first chance the breeder not able to define the plant's maturity intensity .

The individual selections are fixed at the typical plants with high complexes of farm-valuable characteristics. As were noticed above, to fix the individual selections is ought to, when 5-6 bolls on the canopy have been ripen; to fix the individual selections on the later term at the massive boll ripening on the bushes is not ought, because the character of earliness of the canopy may be slip out of the breeder's attention.

The breeder by fixing plants along plant rows in every nursery for individual selection is marked with breaking their top parts or twisting a bit of cotton wools. One of the lab assistants following the breeder and carrying a bundle of small hand sacks hangs sacks successively one by one on marked plants.

Picking of the raw cottons from the selected individual plants is done by another of the instructed lab assistants on the first-second bolls of the second-eight fruiting woods and put it into individual sack hanged prior on the selected plant. For this, the picker finds of every individual sack hanged on a maternal plant by its string along the row. Writing the numbers of hanging sacks in the list of special register on individual selections is performed as traditionally by the young scientist. The dates of harvesting correspond from 1-5 up to 25-30 of September per requirement.

Then the next lab assistant following the young scientist bounded the sacks of individual selections each other by means of their strings up to one hundred each and attentively made a group separately. Onwards each group as a garland of sacks is labeled bearing their ordinal numbers and their correct is examined regularly by the young scientist in the sphere of each nursery on the base of register for taking in of individual selections. Moreover, picking of raw cotton should be done only out of normally opened bolls. The groups of separated garlands in the limit of every nursery are placed into big sacks for them. Obviously these big sacks also bearing their proper labels with the name of nursery and the numbers of garland groups and now ready to be transported to granary for keeping on dry shelves.

Laboratory analysis. In winter, 6 shares of fibers with seeds in them are singled out from raw cotton packed into those individual sacks with the

help of fingers and are getting ready to send for analysis of their lengths. For this, the raw cotton from every sack is separated into six parts. And from the center of these shares is punctured out again the new fiber with seeds. Then all these fiber selections are placed individually into special sheet of page (photo 26) and they are remarked with the numbers of field row and their sacks numbers. While this work is done the number of the specie (strain or variety) and its data are written into other special register, then together with the above taken fibers' register will be transferred to the laboratory of technology.

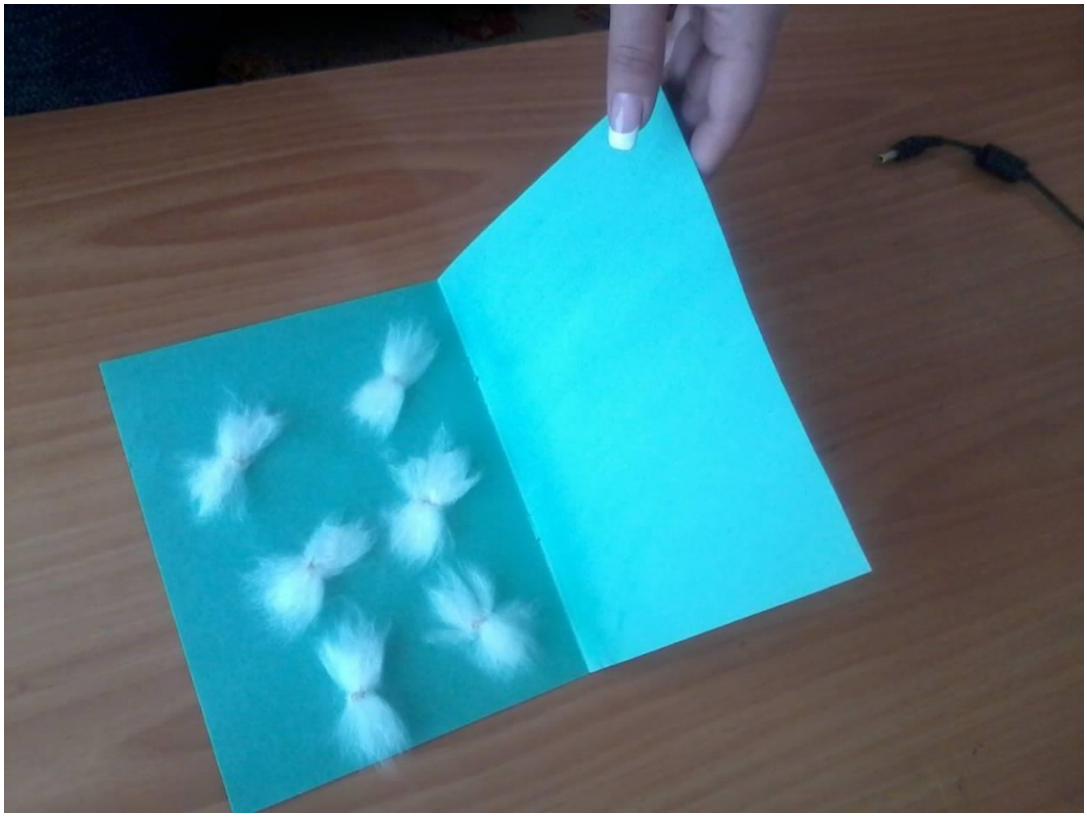


Photo 26. ***Fiber probes to analysis their lengths***

All the species in the conditions of contemporary cotton laboratory will be subjected to comprehensive analysis strictly according of internationally accepted methods and procedures to identify of fibers' textile standard parameters. The analysis began with weighing the species in the accuracy of 0.1 g by the technical scales and their fibers are cleaned from the seeds. The length of fiber measured and seeds are weighed singly. According to the weighs of fiber and seeds are identified the share of fiber and so on.

Some of individual selections after the results of that laboratory which had lower fiber characteristics not adequate to meet breeder‘s

expectation will be discarded and their seeds in the individual selection sacks excluded out of further planting and studying.

On the basis of best laboratory data and largeness of boll (in grams), fiber output (ratio of fiber weight to raw cotton weight in percentage) and fiber's length (in mms) which have been defined on test species above are designed new year experiment in order to achieve the heredity progression in improving of attained characteristics likely to below happened examples from the history of cotton selection (photo 27, 28, 29).

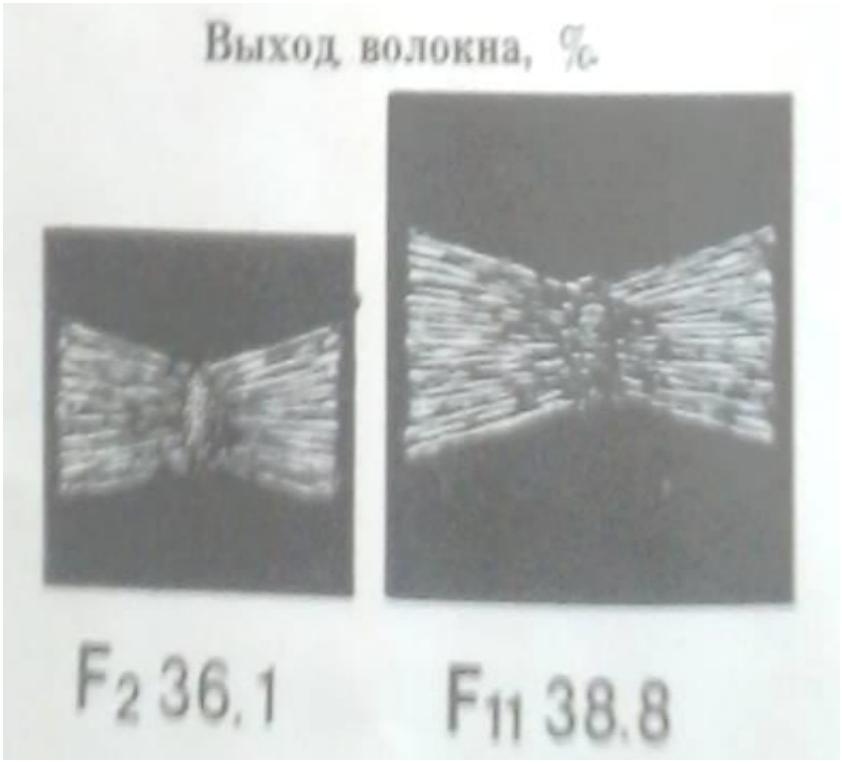


Photo 27, 28, 29. ***Achievements of individual selection in the improving of boll largeness, length of fiber and fiber output in the history of breeding process.***

Supplementary the species of cotton fibers separated from bolls had set on the second and up to fifth fruit branches in the quantity of 10 or 100 bolls belong to the representatives of elderly generations along their breeding nurseries are claimed to complete textile analysis likely as:

length of fiber;
metric number;
fiber strength;
rupture length;
fiber maturity and others.

The tasks for self training:

1.By the using of related literature to the qualities of fiber enrich above presented teaching material with the descriptions of fiber's length, metric number, fiber strength, rupture length, and fiber maturity.

2. Find out and demonstrate in the view of table the requirements of textile industry to the parameters of above listed indexes of cotton fiber.

11-practical training. **Orders of mass selection**

The aim of the training is to get acquainted with the method of mass selection in cotton breeding and the genetic principles important in the conducting of this selection method in the breeding nurseries, evaluation process of selected breeding materials and achievements.

Necessary sources: Lecture and practical notebooks, placates depicting of breeding nurseries, cotton plant terrariums, placates about fruiting elements of cotton plant, schemes of mass selection in cotton breeding and other crops breeding processes, stationary.

Generally, in the mass selection, seeds are **collected** from (usually a few hundred to a thousand) desirable appearing plants in the populations, and the next generation is sown from their mixed seeds. This procedure, sometimes referred to as phenotypic selection, is based on how each plant looks (figure 10 and photo 30).

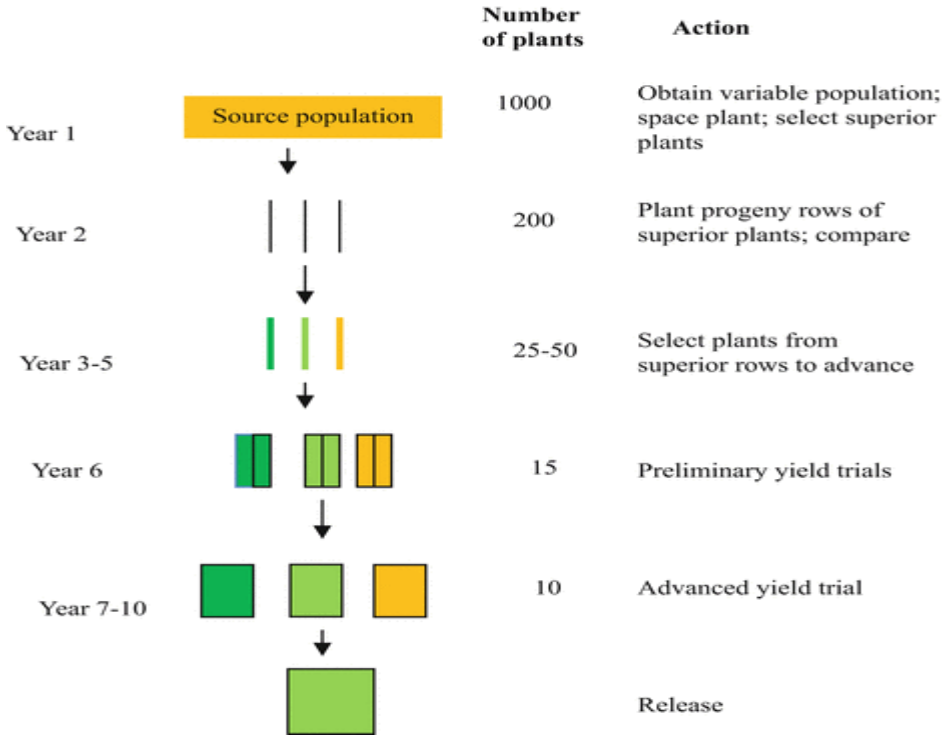


Figure 10. ***Schematic view of a simple mass selection in the plant breeding process.***

Mass selection in cotton plant breeding. Numerous cotton plants of similar phenotype are selected, and their seeds are mixed together to constitute a new strain or even a variety called mass selection. Some populations obtained from the selected initial cotton varieties of the

collection nursery and elite plants of F_4-F_6 in the breeding nursery must be more uniform than the original populations. 27 May 2007.

Beside of uniformity, the breeder pays attention to performance of plant structure. In particular, the state of precocity of the plants, accumulation of fruiting elements, health and structure of branches. At the time of maturation, these uniform plants with desirable phenotype characteristics in above-mentioned nurseries are picked out by the breeder in the groups as mass selection and raw cotton is harvested together into mass selection bags (photo 30 and 31). These mass selection bags are numbered prior and registered in the list of mass selection. After selection of these elite plants (separation of a group of elite plants by breaking down the plant top or marking with raw cotton the top of selected plants in the plant row and even the whole plant raw with uniform plants) harvest will begin separately into mass selection bags according to the number of bags, plants and rows. Mass selection bags with raw cotton are put into another bigger jute sac with correspondingly numbered tags (photo 31) and transported to the breeding depositories. These harvested breeding materials will be stored until the time when they are shipped to the laboratory for analysis in the winter. Laboratory analysis contains weight of raw cotton in the sample, weight of seeds, weight of 1000 seeds, fiber length, fiber out and textile characteristics.

Photo 30 and 31. ***View of elite plant bush and mass selection bags and jute sac.***

Genetically, cotton plant is characterized as the outcross plant and the individual selection is deemed the most acceptable method in cotton plant breeding. However, in the history of cotton growing in Uzbekistan, many cotton varieties have been developed by the help of this method. For example, the first native cotton varieties were: Navrotskiy (photo 32), Triumf Navrotskiy, 182 (Djura), 508 (Batir) and 169 (Dekhkan) were released by the method of mass selection in 1914-1915.

Navrotskiy was developed by the breeder Ya, L. Navrotskiy from the population of American variety Russels at the cotton breeding station "Pakhtalik-kul" nearest to Namanghan city which was set up in 1913.

According to the data of C.C. Kanash (1928), the variety of Navrotskiy has superiority on the productivity than plant mixes of Tashkent and Ferghana by 20-25%, has more fiber output (4.9-5.1%), more weight of raw cotton per boll (1.2-1.5 g), but was later maturing comparing to them by 3-4 days.

Triumf Navrotskiy also was evolved by the breeder Ya, L. Navrotskiy from an imported variety population Triumf.

169 and 182 were developed at the Golodnestepskoy station, by the breeder G.S. Zhaytsev. These varieties have been developed by the mass selection of elite, early ripening plants within local "Plant mixes" population and progeny plants of mixed seeds possessed remarkable precocity. These varieties were 10 days early ripening than variety Navrotskiy and mainly cultivated in northern regions.

The varieties of Navrotskiy, 182 and 169 had very short fiber length: 26-28 mms and not met the requirements of textile industry.

Reproduction of these varieties took place very slowly and could not spread to enlarged areas due to the absence of adequate seed production works there.

The Turkestan cotton breeding station located 10 km from Tashkent has been organized by G.S. Zhaytsev in 1922 in the light of fulfillment of the decree on restoration of plants growing in Turkestan and Azerbaijan signed by V.I. Lenin (1920). The decree has been the landmark for further development of our cotton breeding at the first period of its development. In one paragraph of that decree was specially remarked intention as "Restore formerly existed, organize new experimental fields and breeding stations".

The station played a great role in the coordination of regional breeding stations and considerably improved cotton breeding and seed

production works across the newly established Uzbek Soviet Socialist Republic in 1924.

In 1929, the Turkestan breeding station was renamed to Central breeding station and joined to the system of the newly formed All Union Scientific Research Institute of Cotton Growing (SousNIKHI).

In 1921-1931, the first strain changing took place all over the former cotton growing republics of the former Soviet Union. The varieties of Navrotskiy, 169 and 182 were the major varieties which fully replaced the old low productive and short fiber plant mixes in the territories of Uzbekistan

In the 1930s, the mean length of varieties has reached to 27.5 mm in combination of lower quality of fiber (19-21 rupture length). It developed a problem by the side of industrial consumers was the creation and introduction of varieties with long and high quality fiber into production.

For the short period of cotton breeding activities, the breeders evolved new varieties with long fiber: 8517 (Kolkhoznik), 36M2 and 2034. All of these varieties were developed by the method of mass selection from American variety populations.

Photo 32. ***Navrotskiy cotton variety***

Variety 8517 was released (1928) in Turkestan breeding station of Souz NIKhI by S.S.Kanash from sample Acala 0278 (photo 33). This variety has complexity good traits as fiber length of 31-32 mm, high fiber output (37-38%) and high yield.

Variety 36M2 was selected from other collection samples of Acala 036 (1929) by P.V. Mogilnikov in the Fergana station which had been organized in the years of 1924-1926 as a branch of Turkestan cotton breeding station. The breeding process of the variety took place in the wilt backgrounds. Owing to this factor in the process of selection, the developed variety has distinguished by its high resistance to wilt and other traits as fiber length and productivity have also been significantly improved.

The variety of 2034 was selected from population of America variety Express Vebbera by G.S. Zhaytseva and Ya.D. Nagibin.

The second strain changing took place in the years of 1934-1937. The extension of cotton varieties with positive complex of high productivity, fiber length of 31-33 mm and higher fiber output were the major directions of this strain changing.

Photo 33. ***Cotton variety 8517***

The historic feature of this period was its rapid multiplication of the seeds of new varieties owing to arrangement of severely mapped out system of seed production. This system involved a five-year scheme of renewing the seeds, broadened net of elite-seed production farms into the kinds of collective farms and state farms, setting up republican seed stations and seed laboratories at the cotton clearing plants. The variety of 8517 has got the most distribution in the strain changing. It has the fiber with a length of 30-32 mm and fiber output of 37-38%. Total area planted to this variety consisted of 736 thousand hectares. The variety of 2034 has else more fiber length (33-34 mm) with very high quality of fiber which reached 28-29 km of rupture length. The second strain changing has facilitated the increasing of productivity by 15-19% across the republic, mean fiber length by 27 to 30.5 mm, fiber output by 28.4 to 33%. Sharply enhanced the grade of variety (up to 87%) and planting seed quality.

Unfortunately, the main commercialized varieties of cotton in the second strain changing were not resistant to wilt disease caused by Verticillium dahlia. This disease has started rapidly spread through main cotton planting regions and at the end of 1940s, decreased the productivity up to 10-20%. The spread of this disease is explained by the absence of proper crop rotation, which is monoculture with cotton plant and either the lower resistance of varieties to disease spreading pathogens. This has resulted in the accumulation of wilt infection in the soil. The resolution of the state about “The measurements for further rising of cotton growing in Uzbekistan” dated by 1939 has committed to carry out the next, fourth (1941-1946) strain changing to 1944 on the introduction of high productive and resistant to wilt varieties into production.

The new challenges in the cotton growing required to use more complicated breeding methods like crossing of different cotton forms in order for the new cotton varieties to have genetically strong resistance to aggressive races of diseases.

The direct mass selection method or mass selection from progenies of individual selections within initial cotton populations has been successfully used by our breeders and were created many historically valuable cotton varieties. Some of them are: S-3210 (registered in 1947); 9018 (in 1957); S-3506 (in 1966); S-4811 (in 1968); Kizil-Ravot (in 1976); Tashkent-6 (in 1981); An—Bayaut-2 (in 1983); Akdariya-4 (in

1984); Dustlik (in 1996); S-9076 (in 2001); Ok-Oltin-10 (in 2002); Khorezm-150 (in 2009) and others.

Questions and tasks to enrich the knowledge of students concerning in the use of mass selection method in cotton breeding:

1. What is the method of mass selection?
2. Can you explain the basic of procedure in the mass selection of plants?
3. Do you able to list the order of mass selection works?
4. Did mass selection method any contribution to the development of cotton growing in Uzbekistan?
5. Prepare a proper report about mass selection method used by the foreign cotton breeders.
6. Analyze the methods used after 2010 for breeding of cotton varieties and determine which of varieties were created by the method of mass selection.

12-laboratory training. **Used methods of polyploidy in cotton**

The purpose of this laboratory training. The goal of this training is to study the concept of "ploidy" and polyploidy, the origin and phenomenon of polyploidy in the cotton genus, and the methods for using polyploidy in cotton breeding.

Necessary sources to conduct the training. Lecture and laboratory note books, literature on the taxonomy of cotton, cotton plant herbariums belonging to different species of cotton plant, stationery.

The term **"ploidy"** expresses the number of sets of chromosomes in a cell of an organism and is marked by an "X". For example, tetraploid organisms have four sets of chromosomes in their cells (figure 11).

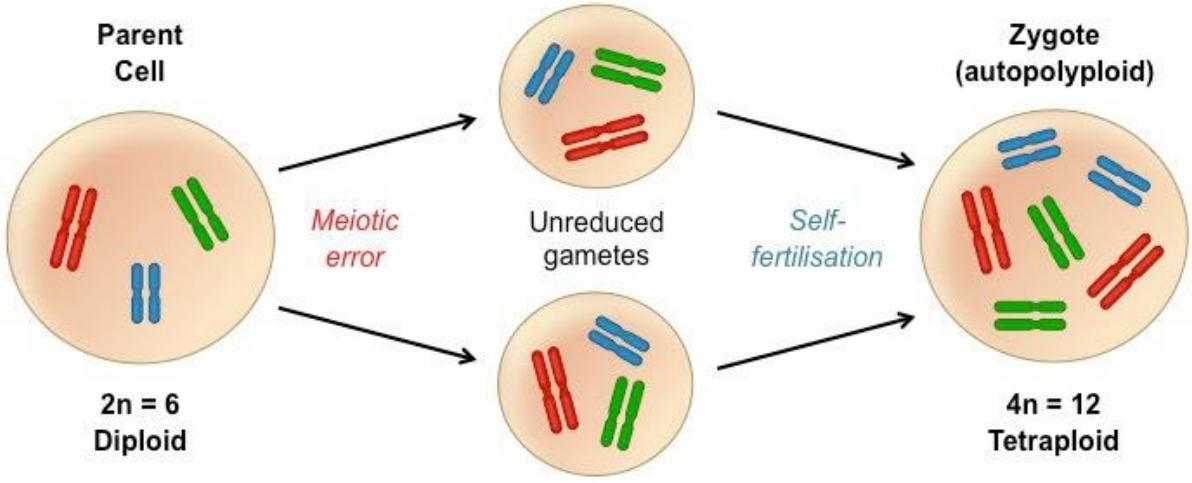


Figure 11. ***Polyploidization results in offspring with two sets of chromosomes***

Polyploidy is a condition in which the cells of an organism have more than two paired (homologous) sets of chromosomes, which is common in plants. Two general types of polyploids have long been recognized: those involving the multiplication of one chromosome set and those resulting from the merger of structurally different chromosome sets. Kihara and Ono (1926) used the terms ***autopolyploidy*** (auto = "same") and ***allopolyploidy*** (allo = "different"), respectively, to distinguish between these two types.

Amphidiploid: synonymous with allopolyploids.

On the basis of many cotton geneticists, F. Wendel and Richard Clark Crone (2003) summarized the phenomenon of polyploidy in the cotton genus. According to their description, the cotton genus gradually diversified and spread. It underwent extensive chromosomal evolution. Chromosomal morphology has remained similar among closely related

species, and this is reflected in the ability of related species to form hybrids of high F_1 fertility. While, crosses among more distant relatives are often difficult and tend to meiotic abnormalities, It is well known that at present, eight genome groups (A-G and K) are recognized. Cytogenetic investigations conducted at the turn of the 20th century revealed that in addition to species, a haploid complement of 13 chromosomes exists along with the other haploid number of 26. Some other geneticists comment that the formation of 13 bivalents in a hybrid between wild and cultivated American species "supports the hypothesis that the species having 26 pairs are allotetraploids," and later suggested that the ancestral diploid donors involved "wild American species,"... and Asian species."

This conclusion was also attained by other scientists based on the analysis of chromosome sizes and pairing behavior in different interspecific hybrids. Widely known from the former textbooks on the genetics and breeding of cotton that historically important confirmation of the allopolyploid nature of the American tetraploid cotton species emerged from the work of Beasley, Harland and L.G. Arutyunovoy who synthesized experimental allotetraploids and amphidiploids from A-genome (Asiatic) and D-genome (American) diploids and demonstrated that these could form fertile hybrids with natural American tetraploids. These classic cytogenetic studies demonstrated that the American tetraploid species are true allopolyploids (or amphidiploids) and that they contain two resident genomes, an A genome from Africa or Asia, and D-genome similar to those found in the American diploids.

The hybridization between different chromosomal species, such as American tetraploids with Asian and American diploids, has generated the most interest. Tetraploid species occupy a leading place in the cultivation of cotton, and enriching the gene fond on the account of precious genes derived from diploid species presents a great interest and attracts the attention of many researchers. But the crossing between different chromosomal species is difficult. The difficulties of hybridization are evidenced by the following examples: Only one cotton boll with two seeds has been formed in the crossing combination of G. barbadense x G. arboreum (S.S. Kanash) out of 337 pollinated flowers. 10496 crossings between 52 and 26 chromosomal species have been implemented for a period of two years and taken 59 seeds, or 0.4%. S.S. Kanash noted that fertility at the crossings between different chromosomal species does not

exceed 2.5%. The same data was presented by Beasley, Harland, and other foreign researchers.

What is the reason for the difficulties in crossings?

It proposes that the pollen of species belonging to other genomes, landing on the stigma, predominantly grows, reaching the ovary and ovule (figure 12). L.G. Arutyunova noted that the hybrids between G.hirsutum x G.herbaceum and G.hirsutum x G.arboreum die predominantly in the embryonic stage, when the ovule attains its 12–18 cell age. That is why hybrid ovaries fall in the first 5–10 days after pollination. In the contrary combinations, where 26-chromosomal cotton was the maternal form, the ovules developed for 20–25 days and then died. For example, according to the data of L.G. Arutyunova, the pollen tubes of diploid cotton actively grow in the stigmas of tetraploidi forms, growing through tube tissue and attaining maturity 24 hours after pollination.

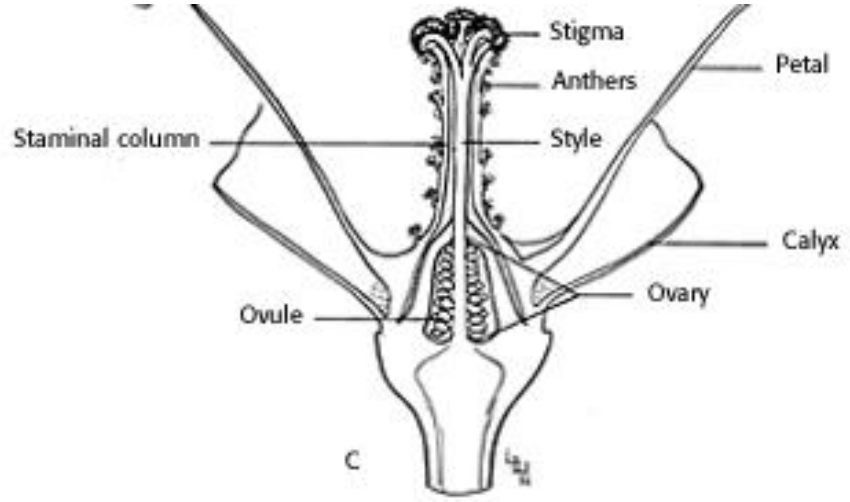


Figure 12. ***Longitudinal section of a cotton flower***

Beasley also remarks that the pollen of Asian cotton grows well in the stigma of American tetraploids. It was identified that 70–80% of ovaries contained fertilized ovules at the crossings of G. hirsutum x G. arboreum. So, the pollen of species that belong to different genomes has relatively easy growth in the stigmas and takes place during normal pollination. But in the next fertilization, egg cells die. Furthermore, withering away may be in different stages – from first cell division till the blooming stage.

Treatment with colchicine is the basis for the increase in fertility of interspecies hybrids, which facilitates the doubling of chromosome

number. Colchicine inhibits the establishment of spindle fibres, as a result of which the doubled chromosomes do not split and remain in one cell.

Plants with 2n = 78 appear in the amphidiploids taken from colchicine treatment. Amphidiploidy is not constant and splitting begins in the F_2 with the formation of plants, containing them in diploid 65, 58, and 52 sets or other chromosome numbers. Moreover, if amphidiploid hybrids are distinguished with high uniformity and as their products of segregation with different numbers of chromosomes, they will be very dissimilar in phenotypic and economic traits. In rare cases, amphidiploids may retain constancy for several years. For example, the amphidiploid G.hirsutum x G.sturtii with 2n = 78 for five years has maintained a mediate constant type, then has become segregating.

The offspring of the hybrids, taken from the pollination of parental forms, and the offspring of amphidiploids are split into exemplarily similar. At the end of summarizing, the number of chromosomes in the amphidiploid decreases from generation to generation and establishes forms with the number of chromosomes of multi-chromosome parent species (figure 13).

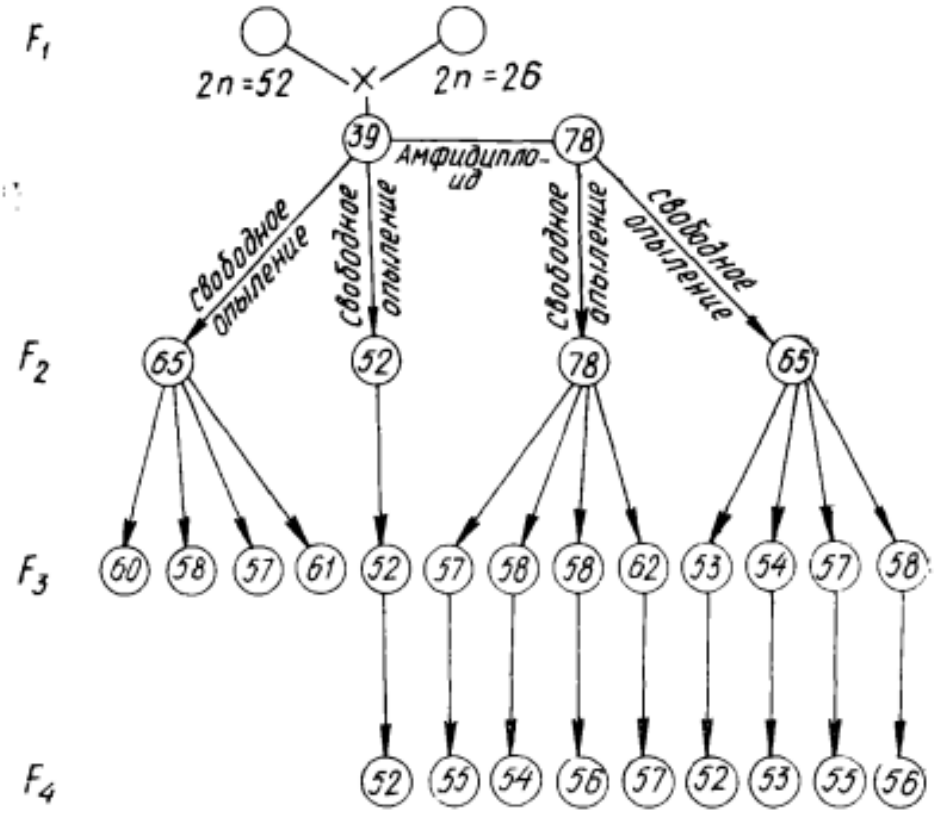


Figure 13. ***Splitting on the number of chromosomes in the generations of amphidiploid***

Amphidiploids, taken from crossings of species, belong to different genomes and there is considerable splitting in the third and consequent generations. On the level with good fruit bearing plants, can be seen entirely sterile and semi-sterile forms; on the level with powerful, high-growing plants, dwarf, sharply different is the precocity and other economic and phenotypic traits. Moreover, it is necessary to remark that the behavior of hybrids does not always correspond to the number of chromosomes and mode of the meiosis process. In the experiment of L.G. Arutyunova, hybrids with a chromosome number of 52 and normal meiosis (G.hirsutum x G.herbaceum) x G.harknessii did poor crossings with normal tetraploids and were semi-sterile.

Amphidiploid G. herbaceum x G. arboreum with 52 chromosomes is freely crossed with tetraploid species, but the offspring becomes sterile.

So, amphidiploids, taken with the help of colchicine, are phenotypically uniform, fertile plants, but they do not remain constant and inevitably split in the progeny.

Cotton breeders, in spite of the above mentioned difficulties occurring in the amphidiploid hybrids, are widely being used in the creation of new cotton varieties to resolve some of the problems standing before cotton growing. Cotton variety S-4507 (registered in 1956) was developed by L.G. Arutyunova from the amphidiploid G. hirsutum x G. herbaceum. The same examples may be continued with later created cotton varieties such as: S-9082 (registered in 2002), Sultan (registered in 2004), Jarkurgan (registered in 2007), S-7277 (registered in 2009), S-9085 (registered in 2010), which were selected from the amphidiploids of G.hirsutum x (G.turberii x G.raimondii) and others.

Questions and tasks to consolidate acquired knowledge concerning this lesson:

1.What is the ploidy of cotton?

2.Are cotton plants allopolyploids?

3.What does polyploidy do to plants?

4.What is polyploidy and examples of its use in the creation of new cotton varieties?

5.Describe in detail the breeding process of cotton varieties: S-9082 and Sultan.

6.Describe in detail the breeding process of cotton varieties: Jarkurgan, S-7277, S-9085.

13-practical training. **Studying a variety of grades of cotton plant varieties.**

The aim of the training. The goal of this training is for students to master all of the definitions of plant varieties and specific traits of cotton variety traits characterizing its variety grade (or variety uniformity) in the field of cotton breeding and seed production, as well as to acquire the professional capability to use variety traits in the distinguishing of cotton varieties planted in breeding nurseries, seed producing farms, and industrial farms.

Necessary teaching aids. The students' lecture and practical note books, internet sources, wall placates depicting cotton hybrids and various cotton varieties, herbariums of cotton varieties, pencils, rulers, and erasers.

According to the encyclopedic dictionary, "**variety"** of plants refers to the set (like a group) of cultivated plants of one species artificially created by man and characterized by:

- definite hereditary features; and
- hereditarily fixed productivity; and
- structural and phenotypic traits.

In the acting obligations of the UPOV (the International Union established in Paris in 1961 for the Protection of New Varieties of Plants with headquarters in Geneva), the varieties of cultivating plants have been underlined by the following criteria: a new variety must be **distinct** (D), that is, easily distinguishable through certain characteristics from any other known variety (protected or otherwise). The other two criteria, **uniformity** (U) and **stability** (S), mean that individual plants of the new variety must show no more variation in the relevant characteristics than one would naturally expect to see, and that future generations of the variety, through various propagation means, must continue to show the relevant distinguishing characteristics.

So, it makes no difference whether the cotton plant variety is old or new, because other cultivating plant varieties must have distinct phenotypic and constructive characteristics in order to distinguish among many varieties. As above mentioned, it should be distinct, that is, distinguishable characteristics on the outlook that help to point out a definite cotton variety. And to be uniform in the constructive components like leaf color, shape, size, and branching types, so on, in its population. The major variety traits of the cotton plant are:

1. The size and shape of the leaf.
2.Pubescence of main stalk.
3.The type of branches and the shape of the bush.
4. The size and shape of the bolls.

For the fine staple cotton varieties, besides the above-represented traits, they also take into account the presence of internal spots in the base of the flower and the color of the corolla. Most G.hirsutum varieties have corollas that are cream-colored or pale yellow, up to 50 mm long without dark spot, while the flowers of G.barbadense have enlarged flowers (up to 80 mm long) with yellow color and dark red sport at the base (photo 34, 35). Herein, the color of flowers on the second day of age is deemed the correct day to compare with the flower' outlook on cotton species.

Photo 34, 35. Out look ***of the cotton flowers of G.hirsutum L. and G.barbadense L.***

1.Size and shape of the leaf. A well developed cotton leaf has an average size of 12–15 cm in length and width. G. barbadense cotton varieties are bigger in size than G.hirsutum and other cultivated cotton species. Generally, the true leaves have 3–5 lobes. The cuts between the lobes may be deep or reach up to half the cut. Usually, leaves with deep cuts provide more aeration in the crop bush and are called "okra type" or even "super okra" depending on the size of the cut to the base of the leaf (photo ..). Scientifically revealed that okra and super okra leaves, owing to deeper cuts, may have a higher perimeter but a lower leaf area index compared with broad leaves (in the varieties of G.hirsutum). Except for some of the collection, introduced cotton forms that have okra type leaves and red color (photo 36, 37), the majority of the growing varieties in Uzbekistan have green colored leaves with five lobs. Some of the varieties are

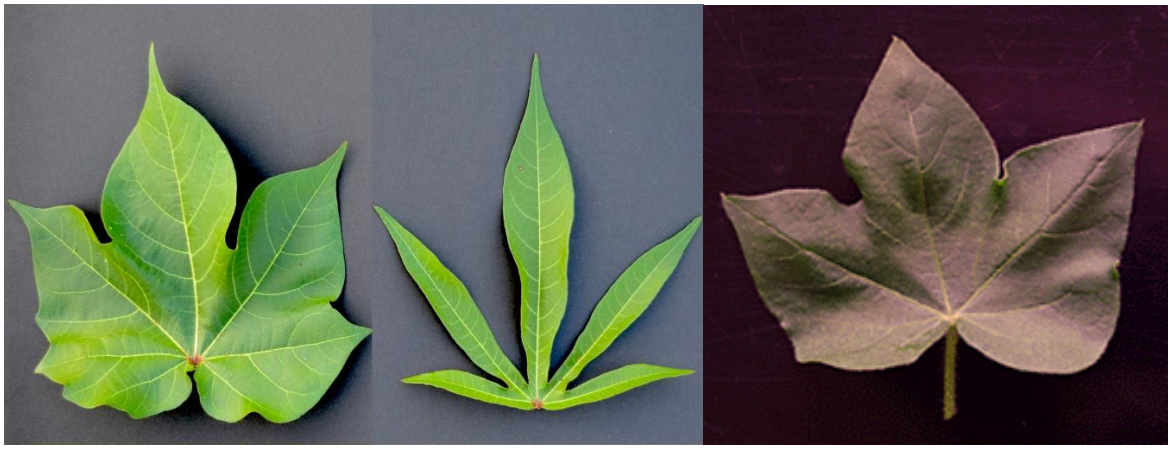


Photo 36, 37. ***The diversity of cotton leaves belongs to different cotton species.***

They are especially noted for their leaves with hairs on the down side. Due to the availability of these hairs, the host plant is resistant to the cotton pests. These leaves, together with stem hairs, have rare genetic heredity. And breeders prefer to strengthen this hereditary trait in the genotypes of new cotton varieties, hybrids, and lines.

According to the analysis of leaf shapes underlined by their breeders, the majority of registered home G.hirsutum cotton varieties have middle lobbed leaves (photo 38): Andijan-35, Omad, S-4727, Beshqakhramon, Dustlic, Kupaysin, Andijan-36, Khorazm-150, Gulbakhor, Chimbay-5018, S-8284, S-6524 (photo .., Bukhara-6, Bukhara-8, Khorezm-127, Mekhnat, Parloq-1, Parloq-2, S-6541, Namangan-34, Navbakhor, 8286, S-6550, Namangan-102 and from G.barbadense varieties: Termiz-31, Surkhan-9 (photo 39).

Photo 37, 38. ***Leaf shape variations of cotton varieties S-6524 and S-8286.***

Sultan has a lobbed structure of medium size; Jarkurgan has 3–5 lobbed leaves of medium size; and by the way, G.barbadense variety Surkhan-14 has the same shape of leaves.

Middle-sized leaves with hair cover are characteristic of the G.hirsutum varieties of Namangan-77 (middle cover), Bukhara-102 and AN-Bayaut-2.

2. Pubescence of the main stalk or hairiness of the main stem (photo 39). From a genetic point of view, stem hairs are explained as stem trichomes, which are mostly single cells that arise from stem epidermal cells. They are of central importance to the

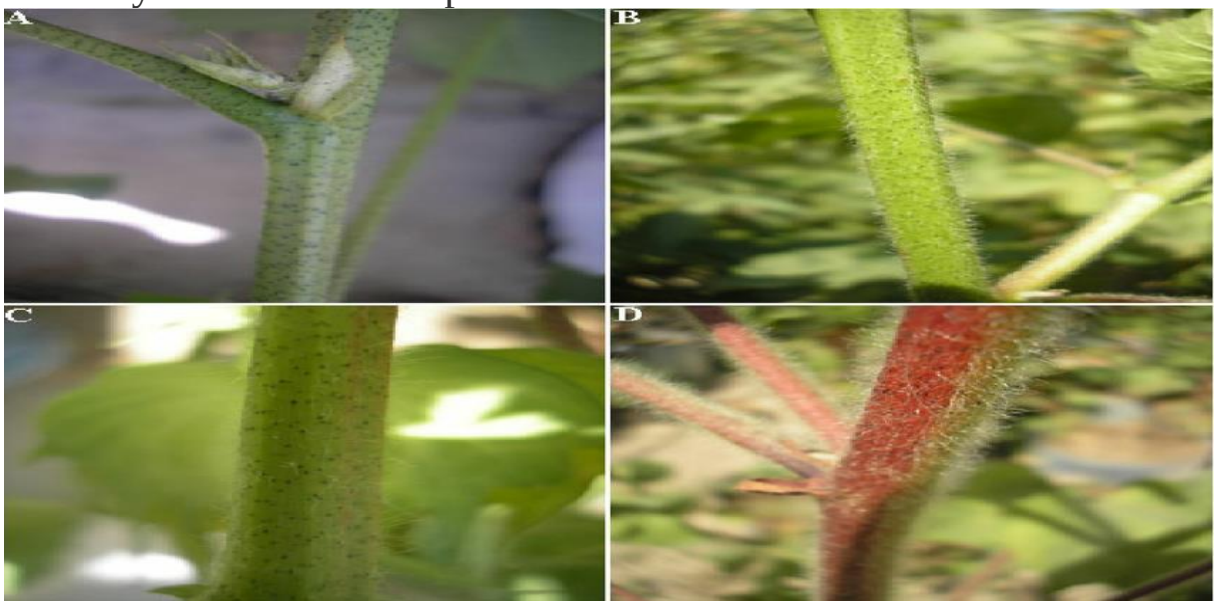


Photo 39. ***Main stem of the cotton plant and its pubescence variations.***

*The genus Gossypium (cotton) plays an important role in pest resistance and other traits.*Trichomes are found on the stems of many *Gossypium* species and are even reflected in the species name of the most widely cultivated species, *Gossypium hirsutum* (whose name is derived from the Latin word *hirsutus*, meaning "hairy"). Stem trichomes exhibit striking phenotypic differences between different species and even among cotton varieties within the same species. The pubescence of stems differs depending on the varieties and is made up of strong or weak pubescence. Usually, the top parts of cotton plants (photo 39, c.) have a higher density of hair than the lower parts (photo 39, a). The varieties of cotton plants with strong and weak pubescence belong to the species of G.hirsutum and deserve to be distinguished from certain growing cotton varieties. This trait is considered a constant hereditary trait of the varieties. The varieties of G.barbadense have weak stem pubescence or are hairless.

3.Type of branches and shape of the bush. Branches develop from an axillary bud located at a node in a location immediately above where the leaf petiole joins the main stem (photo 40). Two types of branches are produced: vegetative (monopodial) and fruiting (sympodial or reproductive). They vary from each other considerably.

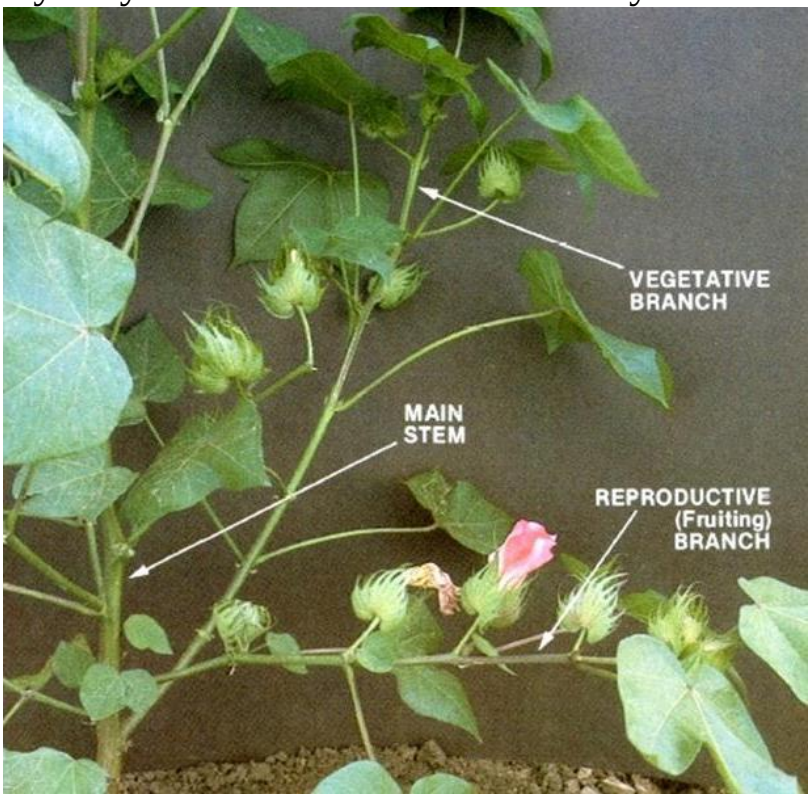


Photo 40. ***Types of cotton plant branches.***

Vegetative branches are structurally similar to the main stem. They normally arise from the main stem near the ground and grow in an upright position. The number of vegetative branches produced depends primarily on environmental conditions and plant spacing. The number of monopodies on the main stem of cotton plants is made up of 1–4 units.

Fruiting branches develop from buds on the main stem or from vegetative branches and are defined by the presence of floral buds (squares), flowers and fruit (cotton bolls and later a cotton bur with puffed raw cotton). Once fruiting has begun, fruiting branches tend to be produced at each successive main-stem node. The first fruiting branch of the varieties of G.hirsutum is normally produced at the fourth (in the early maturing varieties) or seventh node above the location of the cotyledons on the main stem. In the cotton varieties of G.barbadense, they begin to arise from the ground on the 3rd node on the main stem. The number of fruiting branches per main stem of a plant depends on the growing

condition and varies from around 15 to 20. The types of branching in the cotton varieties are also another striking variety phenotypic trait.

Besides these two branches, there are also bred cotton varieties distinguished by their fruiting branch structures. They are zero (without branches), limited and unlimited types of branching. On the zero type branching (photo 41), cotton plant bush has a very compact construction. This type of branching commonly occurs in the varieties of G.barbedense. The cotton bolls are produced straightly from the main stem buds. Cotton varieties and the new cotton lines with zero type branching are widely recognized owing to their superior precocity and accumulation a bumper number of fruiting components per a plant bush in a short period of time. At this, no need enlarged area to grow and development for every bush. Consequently, the cotton varieties of this type of branching admits farmers to increase the number of plants per hectare of their areas to get more benefits.

Photo 41. ***State Prize Laureate Uriy Petrovich Khutornoy (on the left) and his apprentice, Madaris Ismailovich Iksanov, discussing the fruit setting manner of zero type branching plants within the cotton population (in 1976).***

Cotton plant varieties with limited branching type (photo 42) are characterized by their mediated in the sizes and shape on the every cotton bush than plant bushes with zero and unlimited types of branching. Herein, setting of fruiting components takes place from the end of the first node of fruiting branches. The number of fruiting components accounts for 2-4, mostly depending on the condition of growing.

Cotton bushes with an unlimited type of branching are characterized by an extremely spread bush outlook (photo 43). Many scientific and practical predictions exist about the late maturity nature of cotton varieties with such kinds of branching types. But we must not ignore that the productivity traits of cotton plant varieties often have a positive correlation with their late maturity traits. Unlimited cotton branches have four subtypes:

-branches belong to the I subtype;
-branches belong to the II subtype;
-branches belong to the III subtype and
-branches belong to the IV subtype.

Photo 42, 43. ***Cotton bushes with limited and unlimited types of branching.***

They differ from each other mainly in their internode lengths between fruit components on the fruiting branches (photo). The first subtype usually has 2–5 cm of length between two cotton bolls. The second subtype has 5-10 cm, the third subtype has 10-15 cm, and the

fourth subtype has 15-20 cm. These parameters concerning the subtype shapes of the branching are very important to recognize correctly in every cotton plant variety in the process of cotton breeding and seed reproduction.

4.Size and shape of bolls. The cotton boll reaches its maximal size in 20–25 days after the cotton flower has been fertilized (figure 14). Then, seeds and fiber (future locules) mature for 40-45 days. The bolls of cotton varieties that belong to the cotton species of H.hirsutum are the most enlarged in the sizes in which the number of locules reaches up to 4-5 locules. The weight of bolls, or more precisely the weight of raw cotton (locules containing seeds) out of one boll (or bur) is the equivalent of 5-8 g. in the varieties of G.hirsutum. The raw cotton weight out of bolls in varieties of G.barbadense is about 2-3 g.

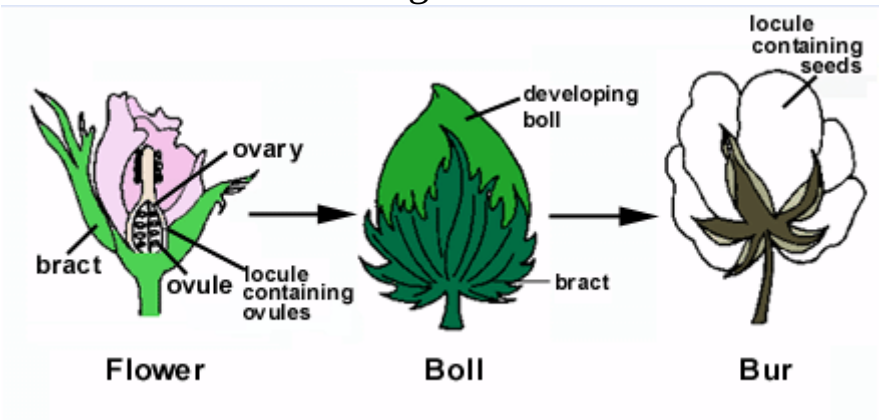


Figure 14. ***Formation, shape and splitting open of cotton boll.***

The shapes of cotton bolls are differentiated, especially in various varieties. Because, the trait of cotton boll has a genetic nature in the varieties and is transferred from generation to generation. According to the literature, cotton bolls of different varieties are characterized by their shape and color, as: oval, elongated egg, striking nose shape on the top of the boll or like the fine pointed stars, soft surface, wrinkled surface with dark spots, and colors that differ from green to dark green (photo 44).

Photo 44. ***Cotton bolls of G.hirsutum L. and G.barbadense L. varieties.***

Questions and tasks to improve mastered knowledge:

1.What is the variety conception of agricultural crops?

2.How can the variety be characterized?

3.What kinds of variety characteristics have been accepted as the basis for describing plant varieties by the international union for protection of new plant varieties?

4. Can you enumerate the variety of traits of cotton varieties?

5.Does flower aid in determining the differences between G.hirsutum and G.barbadense varieties? If so, how?

6.Describe the diversity of cotton plant varieties and prepare a proper report.

7.Look through it one more time and rehearse properly about the development and shape of cotton bolls.

14-laboratory training. **Evaluation and study of pest impacts on the plants in the breeding and seed producing nurseries.**

The aim of this training is to study major cotton pests and evaluate their impacts on the experimental plants in the breeding nurseries and seed production plots.

Sources of stationery: Lecture and laboratory copy books, literature about cotton pests, recommendations on the forecast of sucking and rodent pests in cotton plantations, their harmfulness, biology of reproduction and their threshold level.

The major pests of cotton plants are: common (cotton) spider mite, tobacco thrips, aphids, whiteflies and boll worms. The last one can cause up to 40–50% crop losses in severe incidents (photo 45).

Photo 45. ***Various cotton plant pests are causing negative impacts on cotton development.***

The occurrence of cotton pests has always been an important factor affecting the total cotton development and quality of products. And the resistance of cotton breeding materials to the above-mentioned pests is the main problem standing constantly before cotton breeders and seed producers in our republic. Study of pests, assessment of their influences and selection of resistant initial cotton accessions are essential in any breeding program.

Common (cotton) spider mite. It is a severe and stable pest on cotton plants and has spread in the cotton-growing regions. The summer reproductions take place for 8-12 days. A female specimen lives for 30–40 days, laying out 100–160 eggs on the middle staple cotton varieties. Regeneration of this pest for a year consists of 10-15 new generations.

Settling of cotton mites takes place on the lower side of leaves (usually in the bottoms along the veins) and bracts, forming colonies of up to 100 specimens. The mite winds the leaf with a thin spider's web of grey color, intending to completely suck out cell content along with chlorophyll grains (photo 45, O).

Cotton crop loss depends on the amount of mite and the duration of its settlement on the plants. A mite does not cause a loss of yield at the settlement for 10 days with an amount of up to 163 mites (biologic threshold of harmfulness) per 100 leaves of infected plants. Harmfulness is inevitable if their number grows over 200 and up to 575 per 100 leaves, or if 40 to 80 specimens per 100 leaves occur on every plant in the field.

Photo 46. ***View of thrips at their different ages.***

Tobacco thrips. The development duration of trips is 12–20 days, depending on temperature. The eggs of thrips develop for five days, the larva of pests for four to ten days, and the pest nymph for two to five days. The life span of the female specimen lasts for 20–30 days. During this period, it lays out up to 100 eggs. The elderly specimen overwinters under clouds of soil, plant residues, and rotting leaves. The thrips come out of their overwintering at the end of March or beginning of April and settle on

the weeds and alfalfa. Since the germination of the cotton plant, they go over it. On the cotton plant, they live until fall (photo 46).

Aphids. The aphids are settled on the very juicy parts of the cotton plant—the top part of the woods and the younger leaves. Nymphs and adults extract nutrients from the plant and disturb the balance of growth hormones (photo 45, B). As a result, the plant's growth is retarded, giving rise to deformed leaves or, if the infestation occurs early enough in the season, the death of young plants. Retarded growth of flower buds and flowers and defoliation reduce yield. The loss of yield is about 20%. At the time of boll splitting, they spoil the fiber with their extracts.

The economical threshold is equal to 50 specimens per 100 leaves or the occurrence of aphids on 50% of the plants in the row.

Whiteflies (photo 45, K). They appear in the cotton fields in the first decade of May, emigrating from green houses. And the imago of whiteflies settled on the first true leaves of the cotton plant and began to suck leaf juice and retard the photosynthetic activity of the plant.

Boll worms (photo 45, C). The duration of development is 40–60 days depending on the temperature; three to five days for caterpillars, and 15–20 days for cocoons. For the year, it produces three or four generations. For a year, it lays 500 to 1800 eggs, 20–30 per day. Only the first generations of caterpillars` damage cotton plants. They nibble roots or stems at the root neck. Sometimes they eat the entire surface seedling part. In the years of bumpy growth, they thinning the seedlings and are able to cause a complete loss of plantation. They are particularly dangerous in plantations where precise seed planting is performed.

As stated in many of the literature about the resistance of cotton plants to pests, plants, depending on their phenotypic and physiologic features, differently persist against the attacks of pests. In particular, taking this phenomenon into account, breeders must have knowledge about pests' biology and effects, and be able to visually evaluate the resistance of experimental plants to them. It is very important at the time of sample, individual, and mass selections. That is why it is necessary to pick out raw cotton only from perfectly healthy plants, which provides the development of plants more resistant or tolerant to pests.

Questions and tasks to consolidate acquired knowledge:

1.Do cotton pests have an effect on the slowing down of the development of breeding materials?

2. What is the threshold of pests?

3.Can you list of sucking and rodent pests of cotton plants?

4.Find out the threshold levels of tobacco thrips, aphids, whiteflies and boll worms.

5.Identify the names and harmfulness of pests: A, E, F, G, H, I, J, L, M and N depicted in the photo.

15-laboratory training. **Study of laboratory documents and documentation of them**

The aim of the training. The students must get familiar with laboratory documents used in collecting the results of their laboratory analysis on cotton breeding and seed production. The first and often applied laboratory documents are the journal of experiments, sowing list, forms for registration and observations of plants, forms for fiber, and seed quality analysis.

Needed supplies. Lecture and laboratory note books, exemplary copies of journals of experiments, blank sowing lists, blank forms for registration and observation of plants, crop harvest lists, forms for fiber, seed quality analysis, rulers, pencils and erasers are needed to conduct this training.

Many documents like journals of experiment (1), sowing lists (2), field copy books designated to conduct registration and observation (phenotypic) of plants (3), field lists or crop harvest lists (4), forms of fiber and seed quality lists (5) are deemed laboratory documents by cotton breeders and their seed producers. In general, they had worked out during a long historical period of cotton plant breeding and its seed production by subjecting them to different modifications in order to achieve the maximum convenience in their understanding, consequences of describing, and precision in conclusion and presentation.

1. The journal of experiments is a basic document that describes the experimental plan for the annual research at every plant breeding department of plant breeding Scientific Research Institutes (SRIs) or their local experimental stations. It comprises the title of the plant breeding project, the decision of the scientific research council of the institute on approving the working program of this project and its implementation at this department. This document has a hard cover page to make it convenient to keep it on the table of the senior breeder. It must have the schematic views of the main breeding plot with its nurseries (figure 15) and the special nurseries for assessment of the resistance or tolerance of families and lines to biotic and abiotic stresses. The size of this scheme for the breeding process depends on the volume of breeding work that should be done for the crop year. Then, a schematic view of the plots is created by the senior breeder who bears the responsibility of conducting approved scientific research for the purposes of plant breeding and reproduction of selected breeding materials. This scheme has to

consist of all the areal elements of the breeding process that are located according to the approved project and working program. The result of that will be the annual breeding research of the department. The senior breeder, together with colleagues and lab assistants, considers this breeding scheme and may accept some of the corrections recommended by the scientific staff into the scheme. The final breeding process scheme drawn in the lab journal serves as the starting point for all breeding work for the department. On the basis of this breeding scheme, the scientists require or choose areal plots from the fields of the SRI. Besides the main breeding scheme there will be schematic outlines of other special schemes on the defining of the results of resistance or tolerance to some of the stresses. These should be carried out in special backgrounds or under the conditions of green houses. Every scheme drawn in the journal of experimentation has a title, as well as the main responsible scientist and assistants who will carry it out. the needed area for every scheme of breeding process is easy because of the accepted sizes of seeding lots (rows) for every nursery.

Top protective zone with 6-7 meters width		
Protective zone with 4 meters width	Internal protective path	Protective zone with 4 meters width
	Initial materials or collection nurseries	
	Internal protective path	
	Nurseries for parents and hybridization	
	Internal protective path	
	Nurseries for hybrid generations (F_1) or biologic nursery	
	Internal protective path	
	Nurseries for hybrid plants (F_2)	
	Internal protective path	
	Nurseries for hybrid plants (F_3)	
	Internal protective path	
	Nurseries for hybrid plants ($F_{4, 5, \text{and others}}$)	
	Internal protective path	
	Family nurseries*	

	Internal protective path	
	Nursery of lines for station testing	
	Internal protective path	
	Ground protective zone with 6-7 meters width	

Figure 15. ***Schematic view of the annual plot of a plant breeding department.***

For example, experimental lots in the scheme have a 5m length of rows with 0.9 or 0.6m apart (inter row distance) which together makes 4.5 or 3.0m^2. On the basis of the total number of breeding materials plus the area of protective zones (the width of the internal protective zone is equivalent to 1 m), the responsible breeder can summarize the total area necessary for the department. The phonologic records and observations are also mentioned in this document.

2. Sowing list: it is prepared in the laboratory annually (form 3) or using a special form with a definite number that is reprinted annually by the publishing house of the SRIs and stored for many years in the department or SRI archives, along with the annual reports and journal of experiment. The list has columns for: the number of sample bags for individual selections, the number of rows in the previous year, the number of rows in this year and tags on the plants and the numbers on them. The sowing list of the year has a close connection with all sowing lists of the past years, chronologically to understand and trace the origin of every formed hybrid, family, line, and variety of the department (form 3).

Form 3. **Filled image of seed sowing list.**

N of individual sample bags.	N of rows in the previous year	Date of planting	N of rows in this year.	Tags on the plants and the numbers on them.
1	3	14.04.20	1	
2	5	-\\-	2	
3		-\\-	3	
4		-\\-	4	1 and 2: plants

				of early flowering.
5	6	-\\-	5	
6	7	-\\-	6	
7		-\\-	7	
8		-\\-	8	
9		-\\-	9	3, 4, 5: plants of enlarged bolls.
10		-\\-	10	
11	8	-\\-	11	
12		-\\-	12	
13	9	-\\-	13	
14		-\\-	14	
15		-\\-	15	6: plant with closed flowers
16		-\\-	16	
17	10	-\\-	17	
18		-\\-	18	
19		-\\-	19	
20		-\\-	29	
21		-\\-	21	
22	11	-\\-	22	8, 9: plants of compact architecture with hair covered woods.
23		-\\-	23	
24		-\\-	24	
25	12	-\\-	25	
26		-\\-	26	
27	13	-\\-	27	
28	14	-\\-	28	
29		-\\-	29	
30	15	-\\-	30	
31	16	-\\-	31	
32		-\\-	32	
33		-\\-	33	
34		-\\-	34	

35	17	-\\-	35	
36		-\\-	36	10: plant with serrated leaf and downed stems and fruit elements.
37		-\\-	37	
38	28	-\\-	38	

This is easy. The breeder can find an answer to the earliness of those two plants (with tags 1 and 2) by surprising him in the row under the number 4 (form 3). The plants grown in this row were the progenies of those plants that had grown in the previous year's row of 5. Three raw cotton individual samples were taken from that row. They are bags with numbers 2, 3 and 4. So, the breeder opens field copy books on the phonologic observation and the individual sample selection list for the past years and gets the answer to why these two plants have early flowering, which is the major reason for shortening the vegetation period. Its identification is very important in terms of breeding outcome, because two factors may cause this precocity in plants: the first is genetic recombination of genes or mutation, and the second is environmental, that is, terminal phenotypic variation tends to mislead the breeder. If this earliness is connected with parental earliness or the result of the consequent selections, the breeder must take into his consideration for future reproduction the seeds of these plants and selections. This order of study will be continued for the plants: 3, 4, 5, 6, 7, 8, 9 and 10 discovered in the successive rows of different breeding nurseries. Some of the fixed plants with some desirable and genetically substantiated traits will be pretending plants for selection and reproduction of their seeds in the next few years.

3. Field copy books. Several field copy books are necessary to conduct the registration and observation of phenotypic developments of plants in the breeding process. The least number of them is 5 depending on the main 5 stages of cotton development: field seed germination, level of the first fruiting wood, forming of the budding, flowering and maturation. Additionally, some other inspections, like resistance or tolerance to biotic and abiotic stresses, require to prepare their specific field and laboratory copy books.

Observation and registration of field germination of seeds are common in almost all cotton breeding processes in the release of cotton varieties. All researchers, prior to the study of cotton growing problems in their experiments, are eager to get their own information about the field germinating qualities of the seeds of chosen varieties. Registration of field germination is done up to 50 or 100% of germinated seedlings out of seed nest numbers or the number of planted seeds into all nests. If the registrations of seed germination, flowering and maturation are not one of the main registrations in the research, the researcher can unite these three registrations into one field copy book (photo 46) and do registration up to 50% of nests numbers will have seedlings. In other cases, every one of them requires preparation of individual field copy book (form 4) and at the time of reporting the results of each require individual description. In this case, registration can be more complicated by registering all seed numbers planted to all seed nests and continued until their 50 or even 100% germination.

Field copy books for registration of field germination, flowering and maturation have the same blank tables with columns for the number of rows, names of breeding materials with notification, number of seed nests, number of seeds in every nest, and total number of seedlings or plants in the row. The duration of the register depends on the sprouting vigor of seedlings to reach up to 50 or 100% germination. The nesting season begins with the appearance of about 2-5 seedlings (photo 47) within nests. And every new register of sprouted seedling numbers is continued every third day, consequently, until there are appearing seedlings out of the number of seed nests equivalent to 50% (or 100%) of the total number of seed nests in every row. It is clearly seen in the photo 47 that row 11 has 25 seed nests. The register has been continued until the seedling 12 appears, which is made up of 50% of all the seed nests, and the registering stopped by circling the number 12. In row 14, there were 27 nests and the registering continued until the number 13, which was equal to 50% of the total number of nests, and so on. In this order, registers of germination of seeds on the breeding materials (varieties) in a newly planned experiment (form 5).

Form 4. **Registration of field germination of seeds planted on April 14th, 2021.**

№ of rows	Varieties*	Number of seed nests	Total number of seeds	Days of registration					Total	An average
				24.05	27.05	30.05	02.06	05.06		
I-replication										
1	1	25	5							
2	2	-\-	-\-							
3	3	-\-	-\-							
4	4 (st)	-\-	-\-							
5	5	-\-	-\-							
6	6	-\-	-\-							
7	7	-\-	-\-							
8	8	-\-	-\-							
II-replication										
III-replication										
IV-replication										

*1-Parloq-1; 2-Namangan-102; 3-Sultan; 4-S-6524 (standard variety); 5-Bukhara-8; 6-Namangan-77; 7-Omad; 8-Bukhara-102.

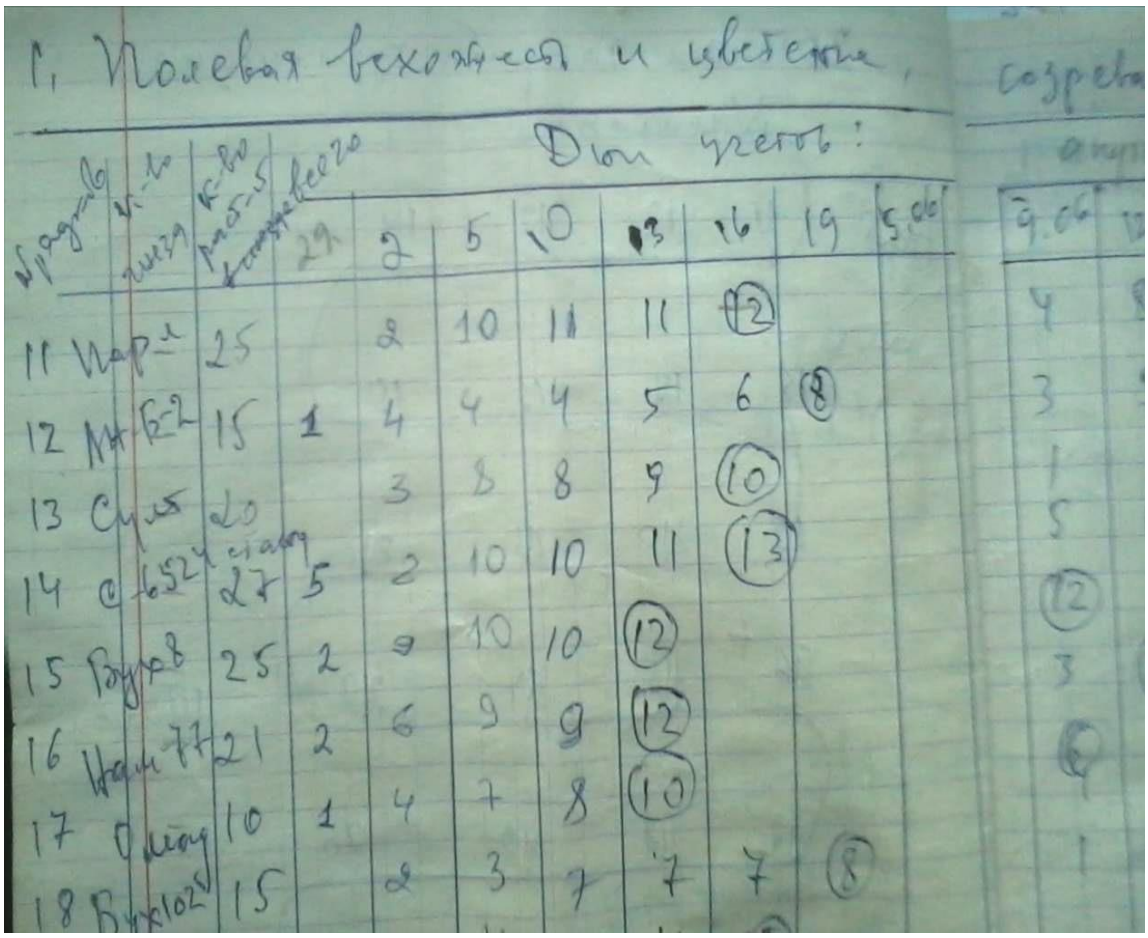


Photo 47. ***One page of a field copy book used to register the field germination, flowering and maturation of cotton varieties by the researcher M. Ashurov (2017).***

In order to collect suitable data on the field germination for statistical treatments, the registering is conducted in several replications. In general, data from three replications are subjected to existing statistical treatments in order to define the genuine difference in germination of some studied varieties versus standard varieties. The fourth one deserves to be the reserve for replacing one of the replications in the case of its unfitness.

The germination quality of variety seeds can be defined by the number of seed nests and the number of seeds planted in each nest. The choice of one of them depends on the study problem in the experiment. Beginning from flowering the register can be conducted on the basis of 10 separated typical plants with their tags without changing their tags.

Forms for defining the level of the first fruiting wood, flowering, maturation, individual selections (form 6), family selections (form 7), fiber output and lengths, and forms for registering experimental plants in special backgrounds are the next laboratory documents. Without their application, any cotton breeding and seed production processes cannot be successfully

implemented. Their state and timely orders predict the result of these processes (tables 2, 3).

Table 2. **Exemplary field lists for individual selection.**

№ of rows	Name of breeding nursery	№ of individual selection bags	№ of bolls, units	Weight of raw cotton, g.	Weight of seeds, g.	Weight of fiber, g.	Fiber output, %.	Other distinguishing characteristics

Table 3. **Samples (probes) and mass (family) selections and their characteristics.**

№ of rows	Name of breeding nursery	№ of sample bags	№ of bolls, units	Weight of raw cotton, g.	Weight of seeds, g.	Weight of fiber, g.	Fiber output, %.	№ of mass selection bags	Other distinguishing characteristics

The tasks to complete the study of the laboratory documents are:

1. To draw a blank form on the register at the level of the first fruiting woods of the abovementioned experiment under the direct supervision of the lab instructor.

2. Under the direct supervision of the lab instructor, to draw a blank form on the register of the 50% flowering of varieties for the abovementioned experiment.

3. To draw a blank form on the register of the 100% maturation of varieties for the abovementioned experiment under the direct supervision of the lab instructor.

4.Fill in the blanks on the individual (form 6) and family selections (form 7, in the field list) for the nurseries of the breeding and seed reproduction experiments under the direct supervision of the lab instructor (prompt can be taken from the training about individual and mass selections).

5. To create a blank form for the registers that will be conducted in the special backgrounds under the direct supervision of the lab instructor.

6. To draw a blank form for the determination of the fiber output and fiber length of experimental plants under the direct supervision of the lab instructor.

16-laboratory training. **Seed structure in cotton varieties**

The aim of the training. Study of components of cotton seeds and their importance, outlook, internal structure of cotton seeds, seed coat shape and structure, seed shape, size, weight in different cotton varieties and bred cotton diversities is the aim of this training.

Needed supplies: Notes of lectures and laboratory practices, dry and soaked cotton seeds from different varieties of cotton plants, forceps and tweezers, scalpels, automatic seed counters, and stationery are needed to conduct the training.

Cotton seeds are the seeds of the cotton plant. Cotton seeds are ovoid, 3.5–10 mm long (photo 48). They are densely covered with white or rusty, long and woolly hairs, called lint, which is the main product used to make cotton textiles, and shorter hairs (linters). Commercially available cotton seeds are usually a by-product of the production of cotton fiber by a cotton gin, which separates the lint from the seeds.

Photo 48. ***General view of cotton seeds.***

Consequently, seed production is dominated by factors determining the production of cotton fiber, and the seed represents about 15-20% of the value of the cotton crop. Depending on the species and variety, cotton lint has different colours (white, brown, or red), and may be long and thin (*Gossypium* hirsutum, 90% of world production), longer and finer (*Gossypium barbadense*, also called Egyptian cotton), or shorter and thicker (*Gossypium herbaceum* and *Gossypium arboretum*).

Once ginned, the cotton seed remains covered with linters and is called **whole cottonseed** or **fuzzy cotton seed**. The amount of linters left on the seeds varies from 4 to 8%, except for seeds of Gossypium

barbadense varieties, such as the American Pima cotton, which are naturally devoid of linters. Linters are a valuable fiber used for paper, cellulose acetate, viscose, explosives, plastic or photographic film. Fuzzy cotton seeds are subjected to a mechanical delinting process that yields linters and naked seeds called "**delinted cotton seed", "black",** or "**slick cotton seed"**. Cotton seeds intended for sowing generally undergo chemical (sulphuric acid) treatment in order to remove linters, but these delinted seeds (sometimes called **acid cotton seed**) should not be used as feed as they may contain chemical residues and can have an unpalatable flavor (photo 49).

Fuzzy or delinted cotton seeds may be either fed to livestock or submitted to oil extraction, yielding oil, cottonseed meal and hulls. Cotton seeds contain about 20% of valuable cooking oil. A typical cottonseed crushing operation separates the seed into oil (16%), hulls (26%), meal (45.5%) and linters (8.5%).

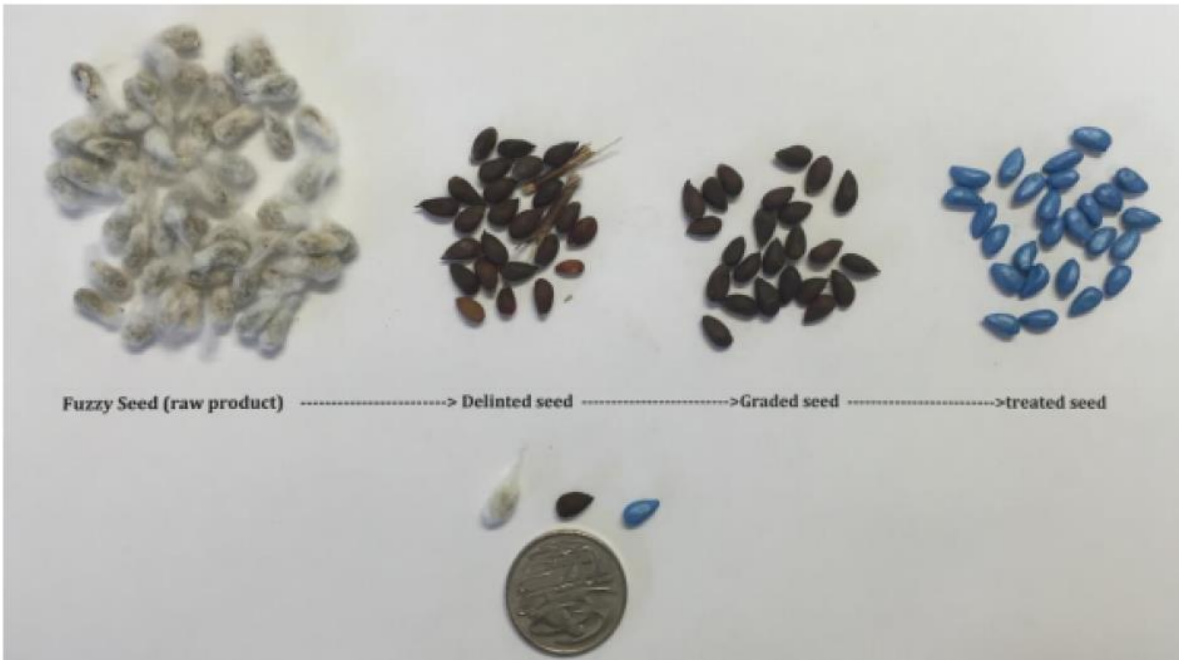


Photo 49. ***View of natural, fuzzy cotton seeds and view after preparing to plant them.***

In terms of anatomy, seeds are made up of three components: **embryo, endosperm (sometimes perisperm), and seed-coat**. Both endosperm and embryo are the products of double fertilization, whereas the seed-coat develops from the maternal, ovular tissues (figure 16). The seed habit is a significant advancement in evolution of higher plants.

The mature seeds are **brown and weigh** about a tenth of a gram. By weight, they are 60% cotyledon, 32% coat, and 8% embryonic root and

shoot. These are 20% protein, 20% oil and 3.5% starch. Fibers grow from the seed coat to form a boll of cotton lint.

The endosperm of the seeds is the nutrient rich storage tissue that will feed the seed when it germinates. Endosperm is common in monocots and remains in the seed as a food reserve. This food is absorbed through epidermal cells as food for the embryo. Endosperm is not common in dicots. In dicots, the endosperm's energy is transferred to the cotyledons (seed leaves) as the seed forms (matures).

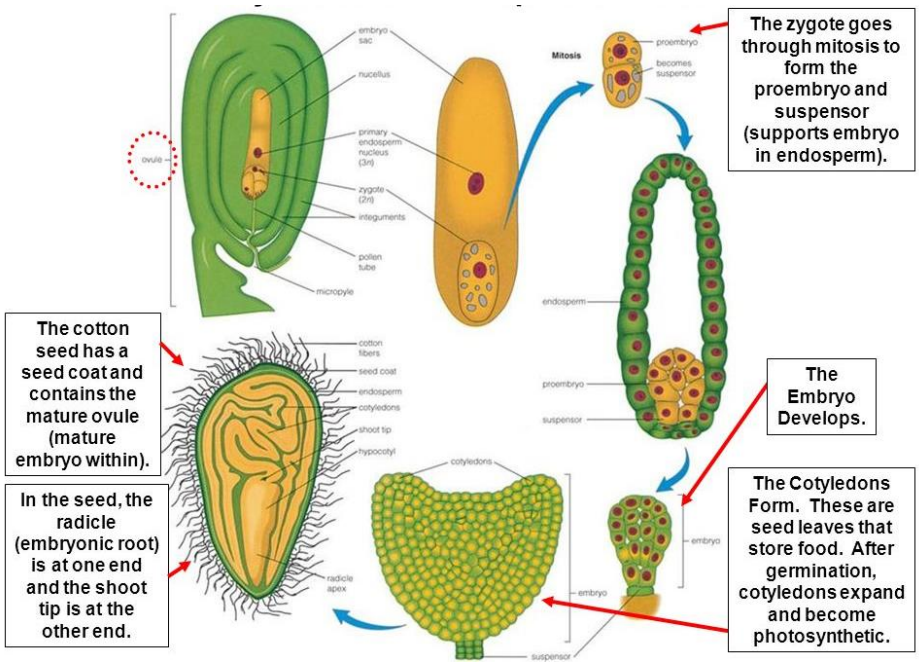


Figure 16. ***Cotton plant endosperm, embryo, and seed coat performance.***

Cotyledon – seed leaf; there are two in the **embryo**/seedling of dicotyledonous plants (dicots). They generally store food and can expand and become photosynthetic; in monocotyledonous plants (monocots), only one cotyledon is present, generally a digestive organ. Dicots have 2 seed leaves emerge from the embryo.

Cotton seed-coat. Microscope observation showed that the cotton seed coat has a five-layer structure (photo 50): **epidermal layer, outer pigment layer, colorless layer, palisade layer, and inner pigment layer.**

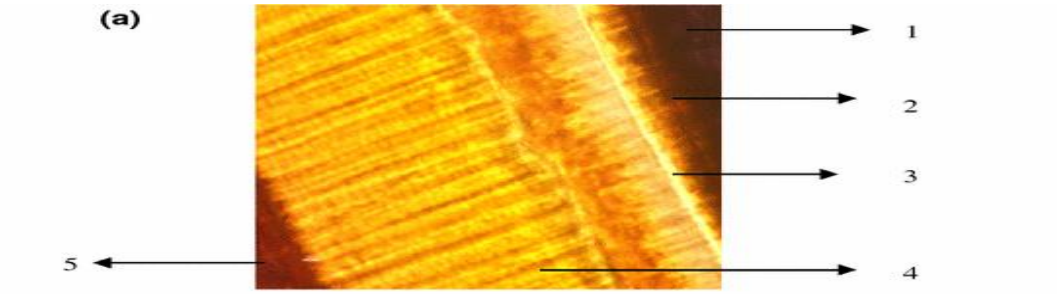


Photo 50. ***Photo of seed-coat taken by the help of experimental microscope.***

A fully developed and matured seed has a pear-like or incorrect pear form with different length and width correlations (photo 51).

It is made up of an embryo and two outer skins covering it – an internal thin film and an external heavy, woody film, which is called a coat. On the external skin of the coat, there are fibers. In one cotton species, they are longer than in other species, they are as short as pubescence or lint. Usually, after ginning, the seeds exhibit their true outlook as fuzzy, fuzzless, lintless. Lintless seeds belong to the wild variety, which has no fibers on the seed coat and sprays seeds just after the mature cotton boll starts to split open.

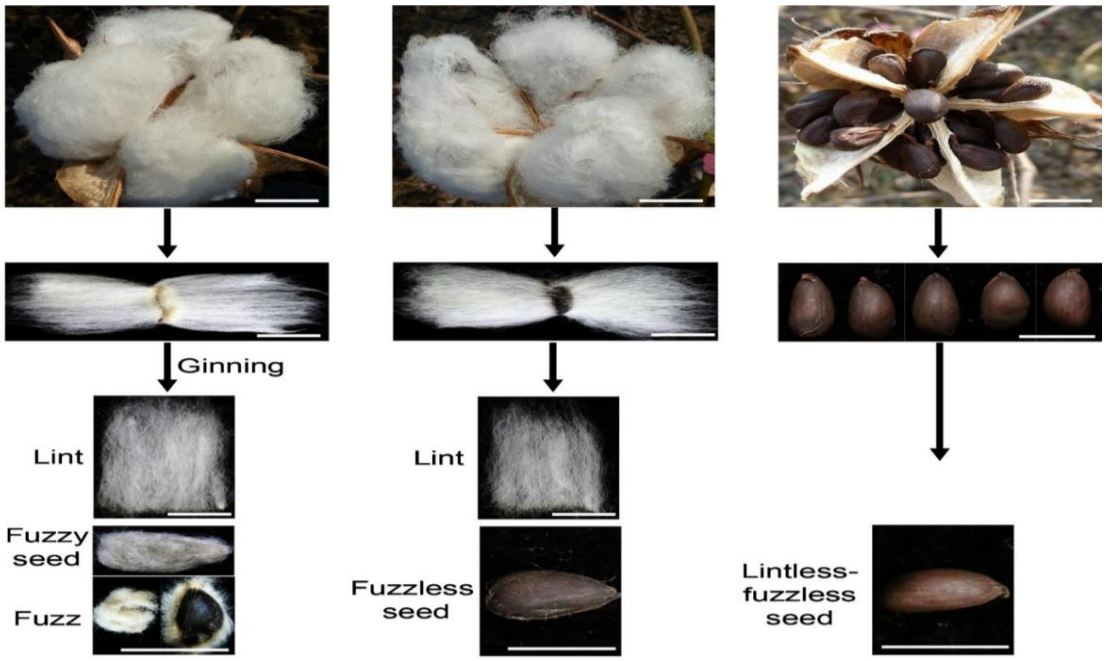


Photo 51. ***Cotton seed-coats with different fiber contents.***

If one cleans the cotton seeds out of fibers and lint, one will usually find that one side of the seed is usually more convex than the other. Along the flat side, from micropylar end to chalazal end passes - so called "seam" which presents itself as the major vascular fork of the seed. At the chalazal

this vascular fork gives branching resulting in a thick net of vascular, directed to the micropylar end where they are completed (figure 16).

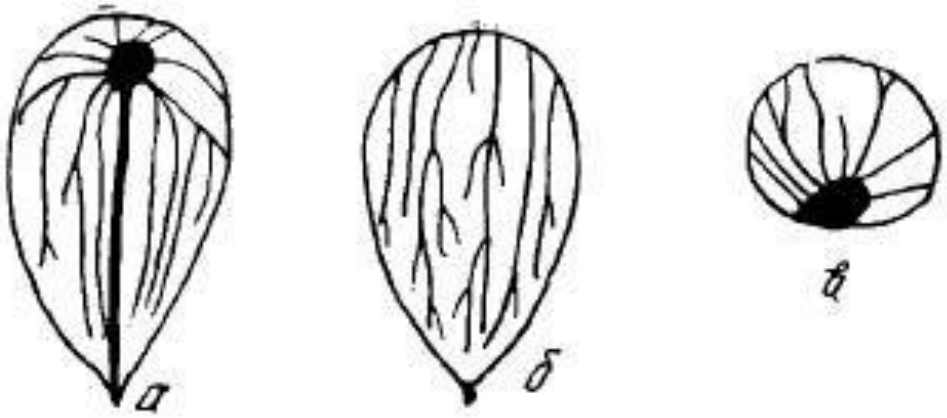


Figure 16. ***Feeding vascular system of cotton seed coat.***

Where: a-on the side of the main fork, entering through the micropylar and giving on the chalazal the initiation to the branching; б-with opposite, usually more convex, side; в-with the side of the chalazal.

The size of varies greatly depending on the species and variety features, as well as the condition of growth (most notably the condition of nourishment). The shape of seeds may be prolonged, more or less circular. For example, the seeds of the varieties of G.hirsutum and G.barbadense are enlarged and longer than those of G.herbaceum and G.arboreum. The seed size is varied along the length from 5 to 14 mm and in the diameter at the widest point (at the chalazal) from 3 to up to 6–8 mm.

The weight of the seed is very important and depends on the size, largeness, and plumpness of the embryo. Seed weights vary according to species features, species, variety, and growing conditions, and range from 50 to 200 mg and more.In the growing varieties of G.hirsutum, it is equal to 90-160 mg., and in the varieties of G.barbadense, it is equal to 120-150 mg. In the practice of cotton growing, the seed weight is commonly expressed as the weight of 1000 units.

Questions and tasks to improve acquired knowledge:

1. What is the seed of cotton?
2. What is the structure of a seed?
3. Does fiber develop from all cotton seeds?
3.What drives the variation between seed structures?

4.Take the seeds from different species and varieties and compare them with each other on the size and weight of 1000 seeds with the help of laboratory instruments.

5.Describe the pubescence of the seeds taken from different variety diversities.

6.Analyze seed interior parts by the disclosing of soaked cotton seeds with scalpel cutting and compare them with the seed coat and embryo pointed out in the figure 16.

7.Prepare a proper report about the seed structure of cotton diversities in the written form as course work.

17-laboratory training. **Orders for the picking out of samples in the breeding and seed stock fields**

The aim of the training. To familiarize students with the orders, kinds and picking out of raw cotton samples and their designation, individual and mass selections in the breeding nurseries and preliminary seed stock plots are made.

Necessary teaching aids. The students must have lecture and laboratory copy books, internet access, literature about cotton breeding and seed production, instruction on the production of seed stocks from elite and other generations of the newly developed cotton varieties and stationery.

Raw cotton samples, individual selections and mass selection (photo 52, 53) are essential parts of the breeding process in cotton breeding. Individual sample selections are conducted first in the younger hybrid generations, while raw cotton samples and mass selections in the older hybrid plant populations are studied.

Photo 52, 53. ***Raw cotton samples, individual and mass selections, with their special bags are being used during harvest time.***

Individual sample selections in cotton breeding present themselves as raw cottons picked out of the best plants individually. Meanwhile, raw cotton samples and mass selections present the raw cotton harvested together out of plants in one row or more, remarked as the uniform family at the time of field observations. The senior breeder bears the responsibility for the quality of these selections.

Remarking of individual sample selections in the breeding nurseries and even in the populations of collection accessions studied in the collection nursery of the breeding plot is carried out on the basis of the

sowing list and field copy books (look through the text of training: laboratory documents). Usually, selections of samples and individual harvests begin in the second generation of hybrids (F_2). At the time of individual selection, the breeders take into account the productivity of plants, the number and size of bolls, the number of boll lobules, the number of seeds in each lobule, earliness, length and strength of fiber (visually defined), maturity and fiber output, plant architecture, suitability of crop to machine harvest (plant structure), rate of foliage, the height of the first fruiting branch, the character of stickiness of fiber to boll glumes and the pappus each other. The plants fixed to individual selection should be perfectly healthy, the plants neighboring to next combination and the plants developed in the sparse rows do not fit to individual selections (photo 54). The last fixing of plants for individual selections is fulfilled at the time of full plant formation, with about 70% (or 6-8 bolls) splitting open. Some of the previously remarked plants may be rejected and their tags removed while the remaining plants are registered into a field list (form 6) with their row number and their tag numbers.

Photo 54. ***Cotton researcher and breeder M. Ashurov fixes the fitness of previously tagged plants in the breeding nursery to individual selections (2018).***

Form 6. **Samples of individual selections and their characteristics (2021).**

№ of rows	Name of breeding nursery	№ of individual selection bags	№ of bolls, units	Weight of raw cotton, g.	Weight of seeds, g.	Weight of fiber, g.	Fiber output, %.	Other distinguishing characteristics
4 9 15	Collection	1 2 3	5 6 5					

65 101 140	-\\- F_2 hybrids -\\-	4 5 6 7	8 6 7 8					

If the selections are made at a late stage, when the majority of the bolls on all of the plants have opened, the breeder will be unable to reveal early ripening plants. In contrast, when selections are made too early, at two to three open bolls, the breeder is unable to account for the maturation rate of the plants. The tops of selected plants, in addition to their tags, are broken or raw cottons are wound around the plant tops. The breeder remarks the number of selections on every row in his field list (form 6). Assistants before the beginning of the harvest under the control of the breeder hang the bags on the remarked plants. The bags prior to that are numbered consequently. At the transfer from nursery to nursery, their numbers are continued and do not begin with the first number again. So, all the bags of individual selections for one year have different growing numbers. At the same time, the number of the rows and the numbers of the bags laid out in the rows are registered in the new field list (form 6).

The harvest of raw cotton from plants is then completed, with raw cotton only being extracted from fully mature bolls. Often, individual harvests are accompanied by the counting of the number of harvested bolls. These individual selections may fulfill the role of samples (probes) simultaneously. That is why form 5 has a column for the number of bolls. Bags with individual harvests are gathered in the internal protecting path and bound together to make up to 100. Then she makes the garlands with 100 bags each. They are put in large tagged sacks and transported into dry storehouses. In the winter, in the laboratory, six seed fibers (papus) are taken from each individual selection before weighing their raw cotton to define the length of fiber.

Mass samples (or row harvests) are selected from older generations of hybrids or biologic nurseries. Some hybrid plants in one or several rows have good phenotypic uniformity, which they distinguish together with their earliness and productivity. They present plants of one new family and attract the breeder’s attention during the vegetation and phonologic observations and will be remarked for mass selection. Mass selection is followed by 25 or 50 ball sample (probe) selections (form 7).

Form 7. **Samples and mass selections and their characteristics (2021).**

№ of rows	Name of breeding nursery	№ of sample bags	№ of bolls, units	Weight of raw cotton, g.	Weight of seeds, g.	Weight of fiber, g.	Fiber output, %.	№ of mass selection bags	Other distinguishing characteristics
15 65 101 140 181	Collection -\\- F_5 hybrids -\\-	525 526 527 528 529 530 531	25 -\\- -\\ -\\- -\\- -\\- -\\-					1 2 3 4 5 6 7	

The number of bolls in samples will increase depending on the types of bred materials. For example, in a station line trial and preliminary seed reproduction plots of 100; a competition variety trial of 200. They are combined in special numbered sample bags with corresponding numbers in the field list on the harvest and transferred to the laboratory for analysis.

The special wooden (or plastic with numbers) boxes with an intended number of cells (25, 50, 100 and 200) or hand bags with lock counter wicket, not letting the above needed number of bolls inside, have been constructed by the scientists and producers (photo 55, 56).

Raw cotton of the samples picked out of the first place, second, and third simpodial branches. Raw cotton samples are exposed to lab analysis to identify the average size of boll, output, and length of fiber (on the basis of 6, 12 and 22 papus). Here, the size of bolls is defined by dividing the weight of raw cotton by the number of bolls. Fiber output is determined in percentage through the weight ratio of fiber separated from seeds to the general weight of raw cotton. The fiber of some families presents their superior level in regard to complex farm traits when transferred to the technological laboratories equipped with HVI facilities to identify such fiber indexes as rupture length, fiber numbers, and maturity.


Photo 55, 56. ***Plastic box with numbered cells and waist sample selecting bag.***

Selection of samples prior to mass selection is conducted by the same experienced assistants using one of the above mentioned instruments and placed into specially prepared and laid out bags. The row numbers of the nurseries are registered in the list of harvests (form 7).

Questions and tasks to improve knowledge of cotton samples:

1. What is the sample size for individual and mass selections?

2.Does sample selection differ from individual and mass selections?

3.Can you list the order of sample selection processes?

4.What kinds of cotton traits are identified as a result of sample selections?

5.Try to select samples from cotton varieties grown in your fields.

6.Try to define boll size and fiber output on the basis of your samples and from recieved data into forms of 5 and 6.

18- laboratory training. **Orders of average seed sample selecting from seed stocks**

The purpose of the lab training. The students are acquainted with such concepts as seed planting quality, conditioned seeds, seed batches, control units, point sampling, average sample and the order of average seed sampling out of cotton seed stocks.

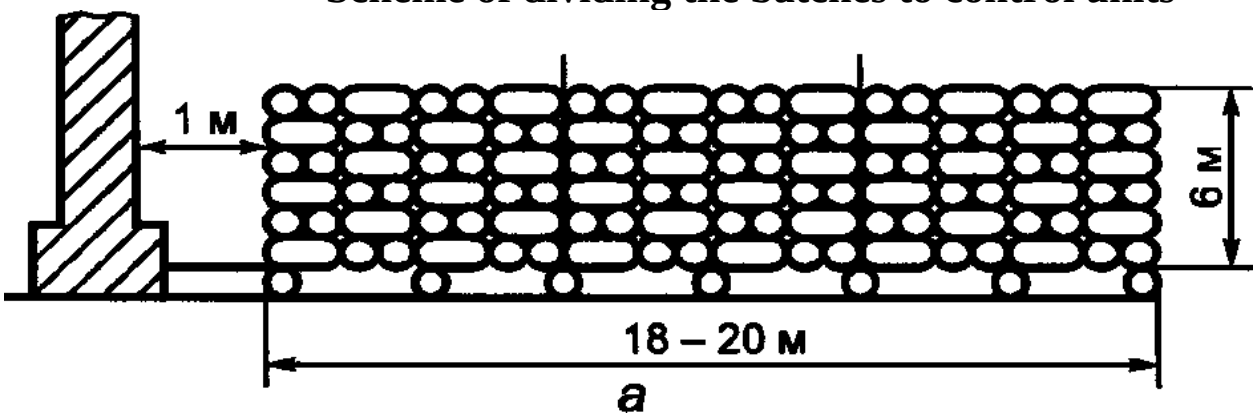
The necessary articles to be employed at the time of studying the average seed sampling in the lab are: lab copy-books, manual on practical lessons on the subject of "Selection and seed production of cotton plant.", extracts from the state standards: on the orders of storing and average seed sampling of farm crops (12036-85), table of the sizes of control units for sampling of agricultural crops, models of the gauges, technical scales, paper and fabric seed packages, seed lab dishes, rulers, erasers, pencils.

The full complex of cotton seed planting qualities is identified on the basis of the average seed sample. The orders of work accepted by the corresponding seed standards are:

1.The method of point sampling from cotton seed. The point samples are taken evenly from the wells which are dug out of the walls of the wells along the depth per piled control unit of seed.

The next point sampling is done from 20 cm out of wall surface. If the seeds have natural free flow, the sampling is done by the means of gauges (figure 17).

Scheme of dividing the batches to control units



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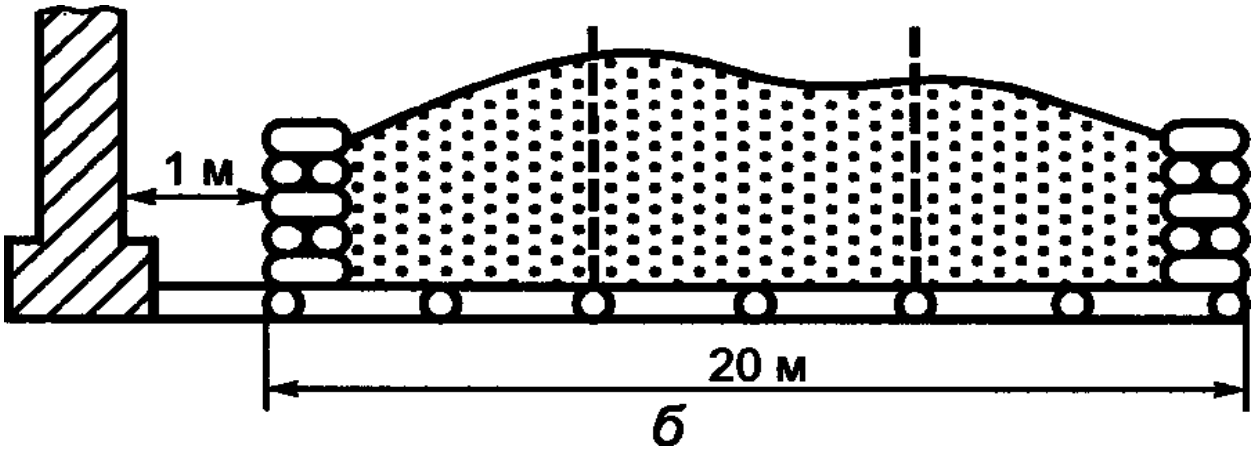


Figure 17. ***a — seeds in the sacks; b — seeds in the pile.***

The point sampling from seeds, packed in sacks, is implemented: from every sack when available, up to 10 sacks; from every fifth when available 11-100 sacks in a batch and from every tenth of sacks when available more than 100 sacks in a batch.

The total weight of point samples is calculated in such a way that the weight, composed of only point samples, would not be less than 5 kg.

For the cotton seed, taking a united sample depends on the seed piles being treated with chemicals or non-treated seeds, as shown below (table 5).

Table 5. **The size of control unites to take an average sample from cotton seed pile.**

Reproduction	Weight of control unit (ton)	
	Treated with chemical	Non-treated
Elite	5	10
R_1	10	20
R_2	20	40
R_3	50	100

2.This united sample of raw cotton or cotton seed is granted by the certificate, presented below. Certification №___
on cotton planting seed (which is valid for two months) _____« », 20_____.
Given (to) _____,
On seed stock batch № ___ with a mass ____ ton,
taken from the cleaning of seed stock batches of raw cotton batch № ___,
Provisioned in _____ in 20 ____,
intended for dispatch to _____
(and pointed out all the lab analyze results below)

3.Compositing of united samples. The control samples taken from batches (control units) are combined into one united sample after setting up their typicality. If the weight of the united sample is not enough, supplementary control samples will be taken from different parts of the batch.

4. Choosing the average samples. The three average samples are picked out from the same sample:

the first for defining the purity, germination, vitality, typicality and weight of 1000 seeds;

the second is for defining the moisture and barn (or granary) pests' settlement;

the third is for defining the infection of seeds with diseases in the humid chamber and in the nutritious mediums.

5.The average sample is picked out from a united sample by the method of "Quartovaniya" (figure 18). For this procedure, the seeds of the united sample are poured on the table, thoroughly mixed with two rulers, and made into a quadrat shape with a depth of up to 1,5 cm for small seeds and up to 5,0 cm for enlarged seeds. After that, the quadrat is divided into four triangles. Two triangles on opposite sides are combined together for the purpose of composing the first sample. And the two left triangles are also combined together to pick out the second and third samples as above.

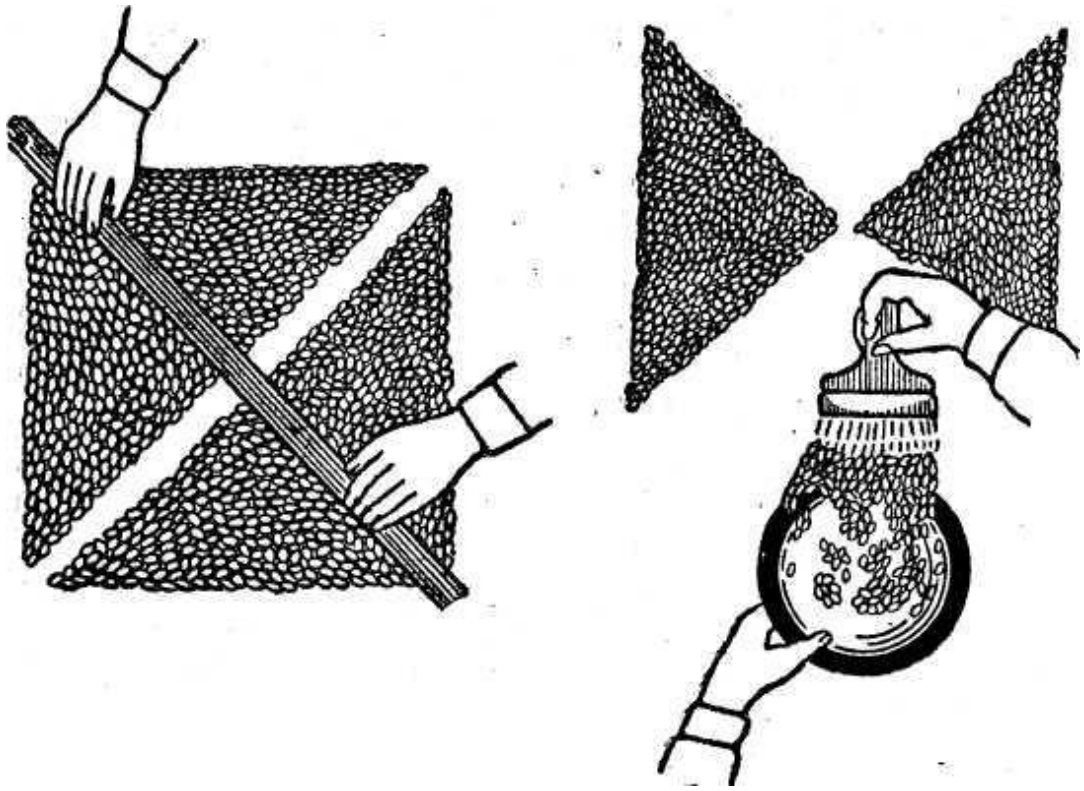


Figure 18. ***The method of "Quartovaniya"***

The seeds for composing the first sample are divided again into four triangles and two opposite seed triangles are removed. Such a division is continued until the necessary quantity of seeds is taken. For this purpose, the second and third samples are also picked out in the same way from the left seeds, after the first division of the united sample is made.

Planting quality of seeds: this is the sum of a seed's properties, as determined by its suitability for planting.

Purity, germination, germination energy, growing vigor, vitality, moisture, weight of 1000 seeds, infection by diseases and pests are involved in the main planting quality of seeds. Every planting quality is fixed by the GOST. The seeds meeting the requirements of the GOST on the planting quality are called "**conditioned"** seeds, and according to them, planting can be done; **unconditioned seeds** are not permitted for planting.

The seed batch is a definite number of uniform seeds (of one crop, variety, reproduction, category, variety purity, year of crop, similar origin, numbered and conformed by corresponding documents).

The control unit consists of one average sample of a particular amount or its parts, which is taken to determine the quality of seeds in a separate batch.

An average sample is analyzed in the lab to inspect the correspondence of seed quality to the requirements of standard documents, which are selected from the seed batch.

Methods of sampling have been approved by the GOST (Standard on the sampling of farm crops 12036-85).

The questions and tasks to consolidate the gained knowledge:

1. What is the seed batch and control unit?
2. What significance have seed batch and control unite in the selection of the average sample?
3. Why are the sizes of control units changed in the reproductions?
4. Does seed certification affect the marketability of seeds?
5. How is the quality of stored seeds judged?
6. Describe the rules and the order of an average sampling.
7. Practice taking an average sample from cotton seed piles (heaps) at your practical education visits to cotton seed storage warehouses.

19-laboratory training. **Defining the seed fiber residue and weight of 1000 seeds in cotton varieties**

The purpose of this training is to study the admitted indexes of fiber residue on the cotton seeds and the importance of the weight of 1000 cotton seeds. The methodic order of identifying the fiber residue and the weight of 1000 seeds is the purpose of this training.

Needed **supplies.** Different cotton seeds, technical scales of the 1st class with the type of T-1, device to define the residual fibrousness of cotton seed, model POS or OV-Yu, lab drying closet, exhaust-hood, electric lab seed drying ovens, clay pods of 500 cm^3, hydrochloric acid, tweezers, analyzing glasses, unbleached bags, plastic dishes, laboratory copy books, stationery are needed to conduct this training.

According to the state standard for variety and planting qualities (table 6), residual fibers on the surface of seeds must be less than 0.4–0.9 percent, depending on the seed category. Usually, the increase of residual fibers or pubescence on the surface of planted cotton seeds causes a lowering of precision drills' operation efficiency at the time of seed planting.

Table 6. State standard on cotton seed Uz.SS. 663:2006

Planting seed varieties and qualities

Seed category	Variety purity %, not less	Germination %, not least	Moisture %, not more	Dockage (mass portion of mineral and organic sweepings)			Downy for delinted seed %, not more	Mechanical damage of seeds in %, not more			Residual fiber of seeds in %, not more		
				For fuzzy	For seed least downy	For delinted		For fuzzy	For seed least downy	For delinted	For fuzzy	For seed least downy	For delinted
OS ES	100	95	9.0	0.5	0.5	0.2	0.5	5.0	8.0	6.0	0.9	2.5	0.4
R-1	99	90	9.0	0.6	-'-	0.3	0.4	6.0	-'-	7.0	0.8	-'-	0.4
R-2	98	90	9.0	0.7	-'-	0.3	0.4	7.0	-'-	8.0	0.8	-'-	0.4
R-3	96	87	10.0	0.7	-'-	0.3	0.4	7.0	-'-	8.0	0.8	-'-	0.4

The weight of 1000 cotton seeds has ranged from 100 (Namangan-77) up to 145 grams (Parloq-2) as a result of the analysis of 30 modern cotton varieties. From the point of view of cotton breeding and its seed production, it has both positive and negative importance. Positive importance based on its oil content, which depends on the weight of the seed, and negative importance related to fiber output. Fiber output of cotton varieties has a negative correlation with the weight of 1000 seeds (photo 57, 58, 59).

Photo 57, 58, 59. ***Naked seeds and fiber attached to the seed, cotton fiber, fuzzy seeds.***

The determination of fiber residue and weight of 1000 seeds of planting seed is carried out in the laboratory on the basis of **average probes (seed samples)** by the method of Standard 21820.3-76. According to this method, 1 kg of average seed probe is picked out from a **united sample** of seeds through "Quartovaniya". This mass of seed is enough to define residual fibrousness (1), residual pubescence (2) and the weight of 1000 seeds (3).

1. Defining the residual fibrousness of seeds is done by taking off the fiber residue from cotton seeds by hand or with the help of devices like POS or OVYu.

At the application of the probe, the working chamber of the device is adjusted by the plastic spacer: three spacers are put in the working chamber for the seed with residual fibrousness of 0.5 % and less, which has passed double lintering, for the rest of the seeds, two spacers.

Removing fiber residue by hand is done by the forefinger, not letting go of the pubescence.

The seeds are put in the working chamber of device to removing the fiber residue by the mechanical way. Gradually rotate the hand of the device of POS, making by the right hand of 150 turns on the counter; frequency of rotation – one turn per 1.5-2 seconds.

Simultaneously, the external slender-shaped wall of the working chamber is turned slowly by hand against the hand to improve the mixing of seeds.

At the device OV-Yu is set exposition to work for 3 minute. The cotton fibers span on the spindle are take off by the tweezers. Removed fiber by hand or by device is calculated up to precise of hundred shares of gram.

The percentage of fiber residue in seeds is calculated by multiplying the weight of individual fiber by 10.arithmetic index of the two definitions is accepted as the result of the analysis. The result is calculated up to the decimal share of the percentage. The analysis is repeated if the divergence index between the results of the two definitions exceeds 0.2 percent. If the divergence between the results of the repeated analysis exceeds 0.2%, the residual fibrousness of the seeds is calculated as the mean arithmetic value of the four probes of the analyzed results (table 7).

The definition of residual fibrousness is repeated, if the fibrousness of two probes of seeds diverges from the mean to the size that is more than pointed out in the table.

A record of the analysis result and calculation of the analysis result are done on the seed batch.

Table 7. **Data on the laboratory analysis on the definition of residual fibrousness and residual pubescence of cotton seeds.**

Mean of residual fibrousness of two seed probes, %.	Admissible divergence between two probes, %.
	0.2
Mean of residual pubescence of two seed probes, %.	Admissible divergence between two probes, %.
	0.05

2. Defining the residual pubescence of delinted seeds In GOST 3118, hydrochloric acid is poured into two clay pods and, in 15-20 minutes, it pours off. Fill a pod with seeds after 5 minutes of the acid pouring off, covered with glass, and put into a drying closet heated up to 120–130 oC, equipped with an exhaust-hood.

After the pods have dried, the seeds are poured over the previously weighed glasses. The glasses with the seeds are weighed up to hundreds of grams. Fill in unbleached bags with separated lint of seeds destroyed under the effect of acid vapor by gentle rubbing for 2-3 minutes. Then the seeds

are poured out on the black page. The smallest particles of husks and pubescence are separated from the seeds and weighed with delinted (cleaned out of pubescence) seeds together with husks on the prior used glass up to hundreds of shares of gram.

Treatment of the results. Calculated the weight of delinted seeds after being exposed to acid vapor, defining the weight of pubescence.

The following formula was used to calculate residual pubescence (O) as a percentage:

$$O = \frac{m_1 \cdot 1{,}06}{m_2} \cdot 100,$$

Where: m_1 - weight of pubescence, in gram; m_2 - weight of seed probe, in gram; 1.06 – amendment on the moisture.

The mean arithmetic value of the two definitions is accepted as the result. The result is calculated to be up to hundreds of shares of the percentage. The analysis is repeated if the divergence of the results of the two defining exceeds 0.05 %. If it again exceeds the divergence, the arithmetic mean of four probes is accepted as a result. The table is used to record the results.

3.Methodic instruction about the definition of the weight of 1000 cotton seeds is given in the "Interstate standard GOST 21820.076 Seeds of raw cotton and cotton seed. Methods of sampling". Herein, singled out two probes (samples) with 100 seeds each from an average sample to define the weight of 1000 cotton seeds and absolute weight.

The defining of the weight of 1000 seeds is conducted through the weighing of those two seed probes with 100 seeds each, and multiplying the mean index of those two indexes to 10.

The absolute weight of seeds – this is the weight of seeds without pubescence (linted) and dried for one hour at 130 oC, calculated on the two seed probes with 100 seeds each and multiplying the average weight to 10. Absolute weight of seeds is the most precise index of seed size, because defining it excludes pubescence and moisture, which effects the weight change (Rakhimov Kh.R., Rudenko L.S., 1976).

The questions and tasks to help you consolidate your knowledge

1. What is the seed batch and control unit?
2. Why is the analysis of residual fibrousness repeated?

3. Does seed residue affect the marketability and planting quality of seeds?

4. How is the quality of seeds judged?

5. Does the moisture of seeds affect the precision of defining the weight of 1000 seeds?

5.Fill in the table .. with your data taken in your analysis on the definition of residual fibrousness and weight of 1000 seeds.

7.Practice taking of seed probes from cotton seed piles and united samples at your practical education visits to cotton seed storage warehouses.

20-laboratory training. **Determination of seed stock moisture**

The aim of the training is to study the determination of cottonseed moisture in laboratory conditions.

Necessary teaching aids and appliances. Lecture and laboratory copy books, different seeds of cotton varieties, lab drying cupboard, technical scales of the first class (T-1), metal cups, graduated cylinder, tweezers, test tube holder, sulfuric acid, fume hood, desiccator, sand watch, stationery.

The State standard GOST 21820.2-76 is widely used to determine the moist content of cotton seeds in the conditions of seed certification laboratories (photo 60). This standard comprises a description of the method for the determination of moisture.

Photo 60. ***Seed control laboratory and its equipment.***

Hygroscopic moisture in the cottonseeds refers to the seed moisture.

Order of analysis work

1.Two samples (probes) weighing 10 g. each from a previously prepared average seed sample are taken for analysis. They are weighed to a precision of up to 0.01 g. and placed in previously weighed and numbered metal cups with lids.

2. The open cups together with seeds and lids, are placed into a previously heated up to 130 ^{o}C drying cupboard, where the seeds are dried at a constant temperature (130 ^{o}C+2) for 60 minutes.

3.After drying, the cups were taken out of the cupboard with the help of a test tube holder and covered by their lids, and then transferred to

cooling for 20-25 minutes in the desiccator, into which was poured sulfuric acid up to a depth of 2 cm. It is renewed periodically.

4.The cooled cups with lids and seeds are weighed with preciseness not more 0.01 g.

5.The calculation of moisture (W) in percentage is done on the base of this formula:

$$W = \frac{m - m_1}{m_2} \times 100.$$

where: m – weight of cup with sample until drying, g.; m1 – weight of cup with sample after drying, g.; m2 – weight sample before drying, g.

For example, the weight of the empty cup was 15.82 g., weight of the cup with seeds until drying was 25.82 g., and the weight of the cup with seeds after drying was 24.94 g. Loss of weight after drying: 25.82 – 24.94 = 0.88 g. The weight of the seed sample is 10 g.

Seed moisture in the sample will be equal to 0.88 x 8.8 = 8.8 %.

The mean arithmetic value of two samples, calculated up to a tenth of a percent is accepted as the result of tests.

6. It should be verified that the divergence between the results of two samples is not more than 0.5%. In the case of divergence that is more than 0.5%, the analysis will be repeated. If the result of a repeated test is more again, the mean arithmetic of four samples is accepted as the last result.

7.The result of all calculations is registered on the laboratory card (form 8).

Form 8. **The results of analysis on cottonseed moisture designated to the planting, in the laboratory card.**

Moisture ……____ Date of analyze …….

Type of analysis	Number of samples	Number of cups	Weight of cups, g.			Weight loss, g.	Moisture, %	
			empty	With the seeds			On the sample	An average
				Till drying	After drying			
Main	1							
	2							
Repeated	1							
	2							

The mean arithmetic results of analysis on the control units of seeds are calculated as the result on batch. Calculation is done in the preciseness up to tenth of a percent.

The tasks to consolidate mastered practice on the determination of planting cottonseed moisture:

1. Repeat the cottonseed moisture analysis on cottonseeds from other cotton varieties.

2. Analyze the seeds of the control unit out of one seed batch to determine the seed moisture of that seed batch under the straight guidance of the lab instructor.

21-laboratory training. **Defining the seed germination and sprouting energy in the lab condition**

The purpose of the lesson. This class material is designed to provide students with the field and laboratory analysis to determine the planting qualities of any stock seeds of cotton intended to be planted. In its turn, the quality of planting seed is described by its sprouting energy and germination.

The fitness of stock seeds bearing essential certificates for planting purposes is defined by their planting qualities, which are determined by field observation results (table 8) and lab analysis on the standard requirements (photo 62).

Table 8. **Number of planted seeds and their field germination (Data of M. Ashurov and others, 2019).**

Sample areas	Number of planted seeds, units.	Date of planting	Records on the seedling formation and losings							
			10.04	13.04	16.04	19.04	22.04	Number of seedlings in regard of planted	06.05	Number of seedlings in regard of planted
1	24	04.04	4	6	10	14	19	79.2	16*	66.7
2	27	-\\-	6	10	16	22	27	100	23	85.2
3	7	-\\-	-	2	3	5	6	85.7	5	71.4
4	17	-\\-	1	3	8	12	15	88.2	11	65.0
5	17	-\\-	-	2	7	11	15	88.2	13	76.5
6	9	-\\-	-	1	3	7	9	100	8	88.9
7	16	-\\-	2	5	9	13	16	100	15	93.8
8	14	-\\-	-	3	6	8	10	71.4	10	71.4
9	13	-\\-	-	1	4	5	7	53.8	7	53.8
10	23	-\\-	3	6	10	15	18	78.3	19	82.6
	m=16.7						m=14.2	m=75.7	m=12.7	m=75.3
Number of maintained healthy plants in regard to the number of planted seeds.							85.0		76.0	

*-restored data.

Sprouting energy is characterized by the seeds' outbreak of sprouting at a definite time.

Germination is characterized by the presence of some normally germinated seeds with regard to all the seeds to be subjected to determination of their germination.

The planting quality of seeds is defined on the basis of submitting meddle seed trials (samples) from local seed enterprises to state seed inspections. The middle trials are being taken from prepared, that is, cleaned, graded, dried, numbered and properly labeled in copy seed batches.

A seed batch refers to the seeds of numbered and registered similar seeds of a certain crop, variety, reproduction, variety category and their origin, produced in the same year and in a certain bulk of seeds.

The picking out of the middle trial is the most responsible action and it has to be taken by the experienced and instructed agronomist and staff of the provisional basis, guided by the obligatory rules of GOST. The representative from the enterprise of the seed's producer and the person, who is responsible for the seed's storage have to take part at the moment of taking the trial.

Prior to the start of trial taking, it has to pay attention to seeds' color, smell, moisture, cleanness, and uniformity. Here, it will also be examined whether the documents concerning the seeds are available. Any operational changes with this seed batch are prevented during the period of time from the taking of the trial to the completion of the inspection. The middle trial picked out has to characterize the complete properties of the seed batch. But to achieve such authenticity is difficult, when the size of the batch is enlarged. As a result, when taking the middle trial from the enlarged seed batches, they are traditionally divided into smaller parts called "control units."

The control unit refers to the restricted part with a certain size of the seed batch that is permitted to take one middle trial according to GOST to determine the seed batch's or its one part's quality. The following special instruments (photo 61) are used to collect the middle trial from the seed batch or its control unit:

For determining the seed germination in the lab, four sub-trails of 100 seeds each were used.

Calculation of the number of sub-trial seeds in the treated seeds for determination of their germination is permitted directly in the containers from sacks with seeds selected in the lab.

The determination of seeds' germination **in the conditions of the laboratory** is conducted in accordance with the methods listed in the below presented GOST (photo 62).

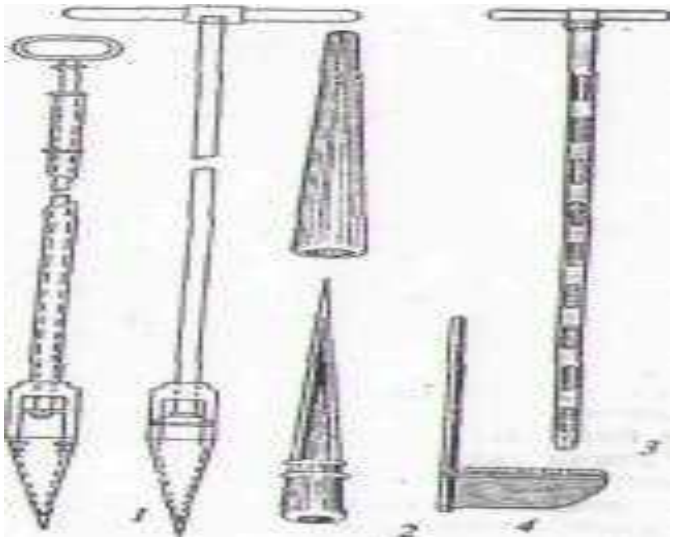


Photo 61. ***The diversities of instruments for taking of seed trials.***

Where: 1-cone gauge of railway carriage; 2-sack gauge; 3-cylinder gauge; 4-special scoop.

According to this guide, the determination of germination is carried out in the sand or filter paper**.**

Requirements for the sand. The sand is screened through sieves with a diameter of 1.0 mm and 0.5 mm. The remaining sand on the second sieve is washed, but it has not yet entered the clean water.

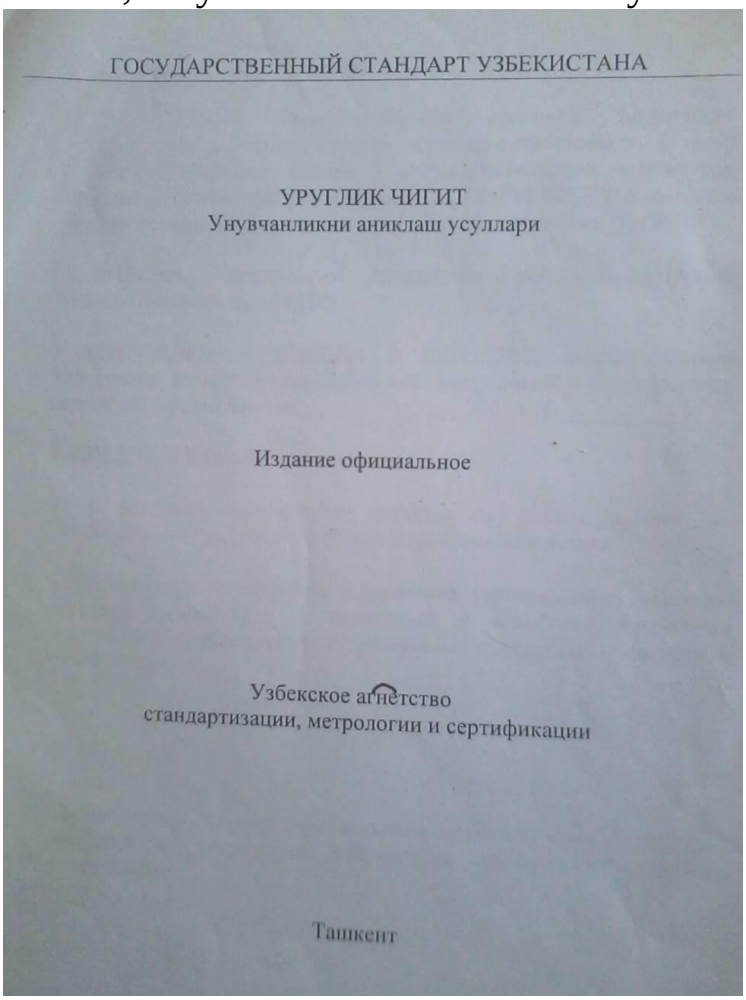
Washed sand is dried and fired until it has not carbonized the paper inserted into it and the sand is screened through a sieve with a diameter of 0.5 mm.

The sand is soaked with boiled water at room temperature up to 50% of its water capacity, prior to the planting of delinted and inconsiderable fluffy seeds and up to 60% of fluffy seeds.

Conducting an analysis. Seed germination takes place in special thermostats. Selected refrigerators are disinfected to avoid the appearance of mould fungi at least once every 10 days through rubbing of shelves and internal surfaces with soaked fabric in ethyl alcohol at 95º. After treating the thermostat, it is closed for 2 hours, then aired until the alcohol smell is fully removed.

Metal and plastic bathes, partitions, glass, porcelain glasses, pincers, and other facilities are being used for the germination of seeds washed in hot boiled water with washing means, rinsing with the 1% potassium

manganate solution, then with water. Just before the use of the abovementioned facilities, they are disinfected with ethyl alcohol 95º.


ГОСУДАРСТВЕННЫЙ СТАНДАРТ УЗБЕКИСТАНА

УРУГЛИК ЧИГИТ
Унувчанликни аниклаш усуллари

Издание официальное

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Ташкент

Photo 62. ***The GOST on the methods of determination of planting seed's germination***

According to this guide, the determination of germination is carried out in the sand or filter paper**.**

Germinate seeds in the sand. Soaked sand in advance is spread in the bath with a layer of 2 cm, leveling and setting a partition in the middle of the bath.

The seeds are laid out by micropyle downwards in the sand with the pincer so they do not come into contact with each other.

Put a paper label on the half of each bath between partition and sand with the lab number of the working analysis of the trial written in simple pencil, the numeral number of the trial (first, second, third, fourth), and the date of the start of the analysis.

Seed baths filled with sand are weighted to bring them to equal weight for all seed bathes without adding or taking off the sand.

Bathes with the seed laid out on thermostat shelves at a distance of not less than 2 cm from each other and from the thermostat's wall (photo 63).

Sub trials, singled out from one another's working trials, are placed on different shelves and in different places in the refrigerator.

Every 24 hours, the bathes are rotated in the refrigerator so that during the germination period, each bath was on a different shelf of the refrigerator. At the time of changing the bath’s place, it is turned on its other side to the refrigerator door.

Photo 63. ***Common thermostat for analyze of seed germination***

At the rearrangement of the seed baths, the sand is watered with boiled water at 25º+-1C. Watering the bath is done by placing the bath on one pan of a scale, and on the other pan is put the constant thing with the same weight as the bath’s primary weight with sand and seeds at the time of planting and watering up to the well-balanced weights.

The seeds of cotton are grown in the thermostat refrigerator in the dark at a temperature of 25º+-1C. At the time of seed germination, the temperature is controlled by the thermometers that are inserted in the sands of the bathes, standing in the middle of the first, third, and fifth shelves.

The tray filled with boiled water, which is filled daily, is placed on the bottom of the refrigerator to keep the proper moisture of air in the thermostat.

Register of germination. The germinating seeds are registered twice: the first time in four days, after setting the seed bathes in the refrigerator, and the second time, in twelve days.

At the first register, counting and removing only normally grown and obviously rotted seeds, and at the second register, solely accounting of normally grown seeds, swollen, hard, rotted, puny and abnormal seeds (photo 64).

Normal sprouts have the capacity to develop into perfect plants when grown in good soil and under favorable conditions of moisture, temperature, and light. In accordance with the following categories, the normal sprout is referred to:

a) Not injured sprouts: the sprouts, which have a well developed state of all essential structures, whole, proportional and healthy.

b) The sprouts with inconsiderable defects: the seeds with inconsiderable defects on individual important structures. In good condition, they grow normally and even, as did the seeds which were not injured in this analysis.

c) The sprouts with second infection are those sprouts that correspond to the above mentioned categories of a and b, but are infected by fungus or bacteria not from parental seeds.

d) In good soil and under favorable moisture, temperature, and light conditions, abnormal seeds have no chance of fully developing as valuable plants.

The following sprouts are thought to be abnormal:

a) Injured seeds: the sprouts on which they are missing have severely or irreparably injured one of the structures, making proportional development impossible.

b) Deformed or not proportional sprouts: weekly developed sprouts, with physiological infringements or sprouts with deformations, with non-proportional structures.

c) Rotted seeds: sprouts with significantly sick or rotted structure as a result of the first infection (from parental seeds), making normal development impossible.

d) Rotted seeds: sprouts with significantly sick or rotted structure as a result of the first infection (from parental seeds), making normal development impossible.

Rotted seeds: sprouts with significantly sick or rotted structure as a result of the first infection (from parental seeds), making normal development impossible.

Not grown seeds: at the end of analysis belongs to following categories:

a) Hard seeds: the seeds, remained hard at the end of the analysis, that is why they had not absorbed the water.

b) Fresh seeds: the seeds, are not hard or grown, but at the end of analysis they remained clean, firmed and obviously alive.

c) Dead seeds: the seeds, which are not hard and fresh at the end of the analysis but had not given any signs of growth.

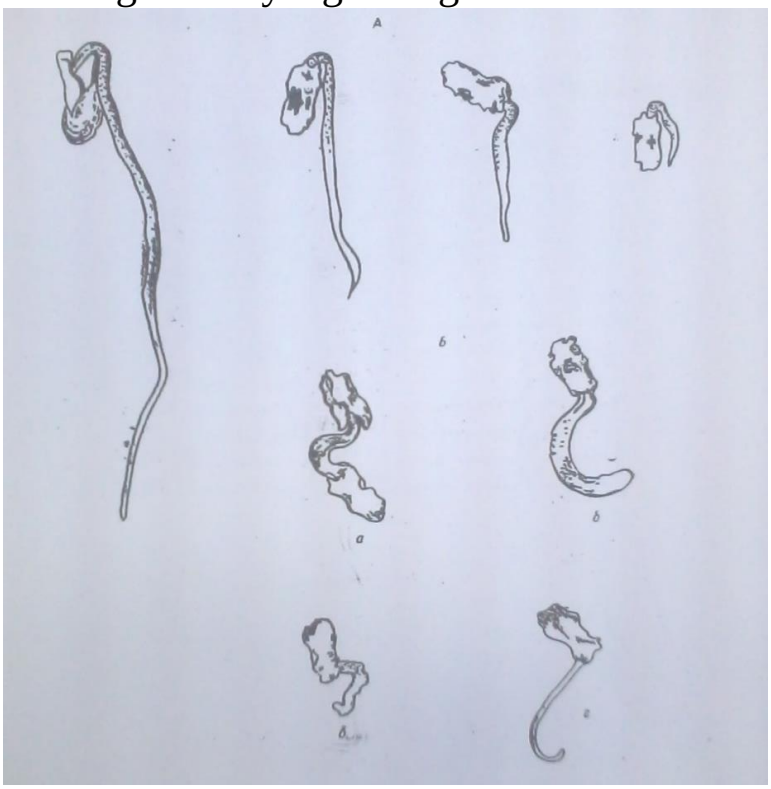


Photo 64. ***Differentiation of the growing of seeds.***
Where: a-normally grown seeds; b-abnormally grown seeds; c-seeds grown through seed cover, and different difected ones.

At the time of the first and second registers, attention to the visually occurring mold fungi on the surfaces of the sands will be paid at the time of all four trials in accordance with table No1.

Table No1.

Injurement extant of seeds	The seeds covered with mould fungi, in %.
Weekly	Up to 5
Mean	Up to 25
Strong	More than 25

Result calculation. Seed germination is calculated in percentages. The results of all the calculations made on the card of laboratory analysis are displayed in the form displayed in the enclosure of B.

All notifications have noted an abrupt change in the temperature of the sand, the availability and extent of fungi development in the seed bathes and others at the period of seed germination are written on this card.

Seed germination is calculated as the mean arithmetic of the quantity of normally germinated seeds in the four trials and is announced in percent.

The maximum admitted divergence between the results of four replications on 100 seeds at one analysis on germination (level of significance at 2.5%) is revealed in the enclosure of D.

Uz. GOST :200
Enclosure B (obligatorily)

Defining of germination

Started:_____ Completed_____ Thermostat №_____ Temperature_____ Couch _____						Started:_____ Completed_____ Refrigerator №_____ Temperature_____ Couch_____							
Germinated a day ———	Date	Trials				Average	Germinated a day ———	Date	Trials				Average
		1	2	3	4				1	2	3	4	
Altogether													
Hardy													
Totally With hardy													
In that quantity													
Swollen													
Rotted													
a) at the accounting of sprouting													

energy												
at the acco unting of germina tion												
Abnormal germina ted												
Totally:												

Germination at the first registration _____
Germination at the second registration _____
Fungi: strongly, mean, week.

Germination at the first registration _____
Germination at the second registration _____
Fungi: strongly, mean, week.

Lab assistant _____ (full name)

Uz GOST : 200
Enclosure D (guide)

Admitted

Divergence for analyses on germination, conducted in two different analysis trials at one or different laboratories on 400 seeds.

/level of significance 5/

Percent an average		Admission
50	50	
1	2	3
99	2	2
97 to 98	3 to 4	3
94 to 96	5 to 7	4
91 to 93	8 to 10	5
87 to 90	11 to 14	6
82 to 86	15 to 19	7
76 to 81	20 to 25	8
70 to 75	26 to 31	9
60 to 69	32 to 41	10
51 to 59	42 to 50	11

In the case of seed germination from 4 sub-trials at the average arithmetic significance on the value of more than admitted divergence, the germination is calculated on the results of the three remaining sub-trials. The divergence was higher than admitted, and the germination was below the norms, set by the standard. The germination was an average arithmetic of two defining, which is on eight sub-trials.

The results of analyses on batches are calculated as the arithmetic mean of the analyses' results of control seed units.

Calculations are carried out up to the integer level.

In the enclosure of D, it is stated that divergences for analyses on germination, undertaking control examining, arbitrage trials, and repeated analyses of cotton seed are permitted.

The task for the group of students in order to gain practical experience:

1. Execute laboratory analysis of specific cotton seeds at no cost to define planting quality from their middle trial using the above-mentioned method.

22-laboratory training. **Defining seed impurities and mechanical damage**

The aim of this training is to study the work orders to determine seed impurities and mechanical damage, laboratory tools and standard instructions to guide the process of analysis.

Necessary items. Lecture and laboratory copy books, literature about planting seed qualities, non-standard syllabus (GOST 21820.3-76) about the methods for determining impurities and mechanical damage of cotton seed, scales like the old VLTK-500 or scales on the first class types of T-1 and T1-1, laboratory glass to analyze seeds, magnifying glass, tweezers, sulfuric acid with density of 1.84g\cm3, rubber gloves, plastic sticks of acid resistant, lab funnel (Byunkher), clay cups, oil cloth, acid resistant apron, porcelain glasses, paper filters and stationery.

Harvested cotton has things causing raw cotton (photo 65) and delinted seed impurities. Seed impurity is determined by the methods of GOST 21820.3-76.

Photo 65. ***Raw cotton impurities causing cotton seed impurities.***

According to this standard, two samples (probes) of cotton seed weighing 50 grams each are used to determine **seed impurity**.

The order of the analyzed works is listed as follows:

1.The seeds are poured on the lab glass and singled out of admixtures by the tweezers, which are: puny seeds with damaged coat, nucleus of seeds or their parts, coat, parts of the seed size less than 2\3 of seeds, seeds of weeds and seeds of other domesticated crops, their parts, alive and dead insects, their larva and parts, soil clouds, stones, sand, dust, free fiber, lint and other things (photo 66). Separated admixture is weighed to the preciseness of hundreds of lots per gram.

2. Enlarged admixture (soil clouds, stones, parts of stems, pods of raw cotton) discovered prior to the singling out of seed samples that could not be evenly spread along the length of the seed samples are picked out individually and weighed up to the preciseness of hundreds of lots to the gram.

Photo 66. ***View of delinted cotton seeds.***

3.At the discovery of weed seeds, they are accounted for in units per 1 kilogram of cotton seeds. With the discovery of quarantine weeds, they are accounting for the species.

4.Data treatment of the impurity of seeds in the percentage is calculated by multiplying the weight of admixture in the seed sample by

two. The mean arithmetic value of two definitions, calculated up to ten shares of a percentage, is accepted as the result of the analysis.

5.At the discovering of enlarged admixtures in the average sample, their contents are calculated in the percentage and the taken result is added to result of seed impurity of two samples. For example, separated pods and soil clouds with a weight of 1.62 g. from an average sample of 1000 g, which makes up 0.16%. Summing up of 0.16% with the analysis result of impurity of two samples, for example, 0.32 will be taken as 0.48%. After circling of seed impurity – 0.5%.

6.Determination of seed impurity is repeated if the impurity indexes of two samples diverge from the average to a value that is greater than that shown in the table 9.

Table 9. **Accepted data for use in the determination of seed impurity.**

Average impurity of two seed samples, in %.	Admissible divergence between two samples, in %.
0-0.5	0.2
0.6-1.0	0.4
1.1-2.0	0.6
2.1-3.0	0.8
3.1-4.0	1.0
4.1-5.0	1.2
5.1-6.0	1.4
6.1-7.0	1.6
7.1-8.0	1.8

If divergence between result of two definitions at the repeated analysis again becomes over admissible, the mean arithmetic value of all four samples is calculated as the seed impurity.

Determination of mechanical damage to seeds.

Two samples of 50 g each are used to determine mechanical damage of seeds or 100 g. each of raw cotton (in the lobules at the analysis of hand-picked raw cotton and in the pappus-machine harvest).

Sequence of analysis:

1. As the first step in determining seed impurity, admixtures are removed from samples.

2.*Preparation of fuzzy seeds to analyze*. The seeds are placed in porcelain glass, then poured 20-30 cm3 of sulfuric acid with a density of 1.84 g\cm3 and periodically mixed with acid resistant sticks until full burning of pubescence (about 10 minutes). Then it was washed in the funnel with pure water and let slightly dry on the filter paper.

3.*Preparation of delinted and treated seeds for analysis*. The seed sample is placed in the porcelain glass, 100 ml of water is poured in and for 10 minutes it is mixed 2-3 times, then it is washed with water, slightly rubbed in the water imbibing bag and poured out onto filter paper to remove excess water.

4. *Preparation of raw cotton for analysis*. The raw cotton is placed in glass cup, 60 ml sulfuric acid is poured and periodically mixed with acid resistant stick until fully burning of fiber and pubescence on the seeds. Then is washed with water, slightly dried on the filter paper and singling out 500 seeds from every sample.

5. Analyzing. The wet seeds are examined thoroughly, removed and the seeds are counted that have mechanical damage and those without. Mechanically damaged seeds are: seeds with coat (hull) damage, through which the kernel (nucleus) is seen; seeds with cracked skin, which is notable by slight pressing with finger on seed or clearly seen under magnifying glass; crushed seeds with obvious damage to coat; parts of seeds with the two\three sizes of seeds.

6.Calculation of results. Mechanical damage of seeds (M) is calculated as a percentage by using the formula:

$$M = \frac{b \times 100}{a + b}$$

where: a – amount of seeds without mechanical damages, in units;

b – amount of seeds with mechanical damages, in units.

The mean arithmetic value of two definitions counted up to a tenth of a percent is accepted as the result of the analysis.

The analysis is repeated if the divergence between the results of definitions differs from the average to a value that is more than shown in the table 10.

If the divergence between results in repeated analysis, again is higher than admissible, the mean arithmetic value of four samples is accepted as the mechanical damage of seeds.

Table 10. **Accepted data on the average mechanical damage and admissible divergences.**

Average mechanical damages of two seed samples, in %.	Admissible divergence between two samples, in %.	Average mechanical damages of two seed samples, in %.	Admissible divergence between two samples, in %.
0-0.5	0.2	6.1-7.0	1.6
0.6-1.0	0.4	7.1-8.0	1.8
1.1-2.0	0.6	8.1-9.0	2.0
2.1-3.0	0.8	9.1-10.0	2.2
3.1-4.0	1.0	10.1-15.0	3.0
4.1-5.0	1.2	15.1-20.0	3.8
5.1-6.0	1.4	20.1-25.0	4.6

Questions and tasks to consolidate acquired knowledge:

1.On the basis of what state standard are the seed impurity and mechanical damage of seeds determined?

2. Can you list the order of analysis works for pointing out the index of seed impurity?

3. How is the index of mechanical damage of cotton seeds determined?

4.Point out all the necessary lab subjects to determine seed impurity and mechanical damage of cotton seeds.

5. Try to analyze seeds to determine the seed impurity under the direct control of the lab instructor and prompts from your friends.

23-laboratory training. **Define seed stock maturity in cotton varieties**

The aim of the training. The students will get acquainted with grades of mature cotton, maturation of cotton seeds depending on the development of cotton boll, dormancy and after harvest maturation, time of formation and variety properties for seed maturation.

Needed supplies. Textbooks on the subject of seed science, lecture and laboratory note books, seeds picked out of different cotton bolls on the cotton plant bush, stationery.

The cotton seeds attain technical maturity at the time of raw cotton harvest, but they are not yet physiologically mature. After harvest, maturation is characteristic of many agricultural crops.

The time between harvest and planting, which is autumn when the seeds have matured and spring when they are planted for the cotton seeds is defined by the 6-7 months period. In the term of annual storage, that is, when the seeds are used for planting after 6-7 months of storage, the sprouting energy, in most cases, doesn't attain its maximum at the time of planting. As per the rule (Rakhimov Kh.R., Rudenko L.S., 1976., and others), the cotton seeds attain their maximum value for 8–9 months.

In our cotton growing practices, with the planting of seeds which have not yet passed through harvest maturation (photo 67, 68, and 69), virtually all the seedlings develop not even (not vigorous), prolonged, slowly, and often with high mortality, which leads to different development and thickness in spite of the pre-plant (pre-seeding) seed grading on the industrial scales and conditioned seed qualities.

Photo 67. ***Seedlings of the variety Sultan.***

Photo 68. ***Seedlings of the variety Bukhara-102.***

Photo 69. ***Seedlings of the variety Namangan-77.***

This situation has been proved by our experiments, implemented in the spring of 2020 in the fields of the Republican Center on the Seed Certification of Agricultural Crops. Planting of soaked cotton seeds is done on April 4th by common 4-row planters. The distance between rows is 0.6 m.

The state of seedling development on May 5th of a wide-growing variety of Sultan was an average of 74.3 units per 1.6 m (in the three replications) of row probe with 3 dried. In the varieties of Bukhara-102 and Namangan-77, they accounted for correspondingly: 55\12,7 and 100\8.7 (photo 68, 69). The elite seeds of these three cotton varieties were prepared, planted and grown similarly but their results (74.3; 55 and 100) vary considerably. Here, we can explain these differences on the basis of the explanation in regard to cotton seed maturity given by N.G. Simongulyan and others (1987). They have presented the results of numerous scientists who studied the planting quality of cotton seeds and came to the conclusion that there is an eternal quality differentiation in cotton seeds depending on many biological and agro-practice factors. She also listed some important seed production measurements to improve the maturity of seeds and enhance planting quality.

Because at the beginning of the boll splitting open, the seeds attain the state called morphologic maturity, but they do not have the energy to grow and germinate. Full maturity of seeds occurs when the seeds possess a high grade of vitality and, normally, germination comes for a prolonged time after harvest maturity, which is called a period of seed dormancy. Duration of dormancy depends on the variety properties and the conditions under seeds develop and matured on the maternal plants as well as on the condition of storage of seed stock after harvesting. It may last from several days to one to two years. In this period, physiologic-biochemical processes take place in the seeds, and as a result, the seeds acquire full maturity and readiness for germination. So, sprouting energy and germination of planted seeds are the major indicators of seed maturity.

In the result of our experiments (tables 11, 12, 13), germination and formation of seedlings of elite seeds in the field, in spite of the high

germination indexes (not less than 95 % for 12 days) in laboratory conditions (look through .. training material), show a more prolonged duration of germination lasting for a month or more (from April 4th to May 7th).

In the example of the variety Sultan, the first seedlings (1-2 units) appear on April 25 after 21 days (planted on April 4th). On April 25, the number of seedlings made on the varieties Bukhara-102 and Namangan-77 was correspondingly 1–3 and 2-37 units. Here, we can see the higher maturity of seeds of the variety Namangan-77 substantiated by the variety feature.

The length of every seed row probe (1.6 m) was selected depending on the distance between seed rows and the point of view that the length of the probe is made up of 1 part of the row length per hectare. This method would simplify the calculation of taken data to the example of a hectare.

Table 11. **Number of seedlings with two cotyledons of the variety Sultan on May 7, 2020.**

Number of rows in where taken the probes of 1.6 m.	Dates of inspection and recording							After hand thin-ning.	In the prolonged probes of 16.6 m.
	25.04	27.04	29.04	1.05	3.05	5.05	7.05	18.05	23.05
34-44	1	32	66/1	81	86/1	85/2	85/4	17	113
-\\-	2	32	53	66	66	64/3	68/4	11	81
-\\-	0	32	63	69	70	69	71/1	14	98

/*-dried seedlings.

Table 12. **Number of seedlings with two cotyledons of the variety Bukhara-102 on May 7, 2020.**

Number of rows in which the probes of 1.6 m are taken	Dates of inspection and recording							After hand thin-ning.	In the prolonged probes of 16.6 m.
	25.04	27.04	29.04	1.05	3.05	5.05	7.05	18.05	23.05
19-23	3	28	48	57/1	53/5	48/11	44/11	8	79

-\\-	2	34	60	60/7	58/8	54/15	49/15	14	90
-\\-	1	21	71	79/1	77/5	78/8	73/9	8	75

/*-dried seedlings.

Table 13. **Number of seedlings with two cotyledons of the variety Namangan-77 on May 7, 2020.**

Number of rows in which the probes of 1.6 m are taken	Dates of inspection and recording							After hand thin-ning.	In the prolonged probes of 16.6 m.
	25.04	27.04	29.04	1.05	3.05	5.05	7.05	18.05	23.05
10-11	20	45	59	69	74/6	63/14	63/17	8	96
-\\-	2	15	23	28	26/2	25/1	22/1	-	50
-\\-	37	138	179	197	190/1	205/4	215/8	10	80

/-dried seedlings.*

Progress in the number of grown seedlings during the inspected days (from 25.04 to 7.05) greatly differentiated not only between probes of one variety but between varieties. In fact, the Namangan variety is the relatively early ripening variety, but the numbers on the seedlings vary greatly between its probes. Similarity can be seen only in the progress of the number of seedlings day by day, but again, there is differentiation in the growing numbers between probes depending on the seed maturity. There can be no doubt about the differences in seed growth caused by the effects of planting procedure, soil condition, and temperature. The reason is their natural effects have no selective character in regard to the studied probes. So, the non-uniformity of seed maturity predominantly has a great role in the differences in development and the formation of healthy seedlings in a short time of growing. Consequently, the differentiation in seed quality has further adverse impacts on the results of hand thinning and taking uniform and healthy plant stands per hectare (tables 11, 12 and 13).

Questions and laboratory tasks to consolidate self-cognition concerning cotton seed maturity:

1. Where does the formation of seed maturity take place?
2. How long of a time does it take for cotton seed to mature?
3. What is seed dormancy?

4. Does seed dormancy impact seedling formation?

5.What drives the drying of some cotton seedlings during the period of field observations?

6.Analyze the duration of seedling formation per 3 probes of variety Sultan (table 11) and report differences jointly with seed maturity and variety feature.

7. Analyse the duration of seedling formation for each of the three probes of the variety Bukhara-102 (table 12) and report differences with seed maturity and variety feature.

8. Analyse the duration of seedling formation for each of the three probes of the variety Namangan-77 (table 13) and report differences with seed maturity and variety feature.

24-laboratory training. **Defining the seed stock's burning rate.**

The aim of the training. The students get acquainted with the seed stock's burning rate, methods of identifying the burning rate of seeds, seed cards in lab form for seed quality analysis results, and requirements of the standards in regard to these seed characteristics, factors causing deterioration of the seed quality, and the consequences of burning.

Needed **supplies.** Lecture and laboratory copy books, international standard on the methods of defining the burning (GOST 21820.3-76) in cotton seeds, seeds of different cotton varieties conserved for a long time, seed weighing scales, magnifying glasses, scalpels to cut seeds (photo 70), analyzing glasses and microscope, stationery.

Photo 70. ***Cotton seed sections for analysis of the burning indexes.***

For every batch of cotton ginned, approximately 70% of the seed must be handled from beneath the gin stands and placed either in a temporary or long-term storage facility. For long-term storage, aeration is necessary to reduce seed temperature and moisture and minimize mold growth, insect activity within the seed and even the rise of seed burning rate.

The burning of cotton seeds is characterized by the number of seeds which have a tendency to darken the seed nucleus in percentage to the quantity taken for analysis. In the seed batches according to the corresponding standards, burnt seeds will not be admitted. Their availability in the seed batches demonstrates that they were stored or provisioned in conditions of adverse or exceeded moisture. Such kinds of seeds cause an abrupt decrease in seed germination and plant productivity.

According to the above mentioned standard (GOST 21820.3-76), two probes out of a mean sample with 100 seeds each are used to define the seed burning. These seeds are cut lengthwise with the help of a scalpel.

The half section of the seeds is inspected for the color of the seed nucleus and divided into healthy and burnt, calculating the number of burnt seeds. The seeds that have a dark brown color, yellow and dark brown nectars, a light brown, dark brown, waxy nucleus without nectars are referred to as burnt seeds. Because of the uneven color of the nucleus, its color is defined by the dominating color. The healthy seed nucleus has a white color with yellow-greenish spots (photo 71). The hollow seeds are not included in the number of burnt seeds.

Photo 71. ***Sectional view of a cottonseed nucleus with a magnifying glass.***

The number of burnt seeds in the probes consists of seed burning in percentage.

The analysis is repeated if the divergence between the results of the two definitions differs from the average by a value that exceeds the value shown in the table 14.

Table 14. **Indexes of seed burning and admissible divergences.**

% of the average burning of two seed probes	% of allowable divergence between two probes
0-2	1
3-5	2
6-10	4
11-20	6
21 and more	10

If the divergence between results at repeated analysis is higher than admissible, the seed burning is calculated out of the mean arithmetic value of analysis results from all four probes.

The result of the analysis on the batch is calculated as the mean arithmetic value of the analyzed results of control unite seeds. The result is calculated up to the whole number.

The result of seed burning is included in the form of records of cotton seed results on the contamination, mechanical damage, residual fibrous, and residual pubescence in the card of laboratory analysis of cotton seeds:

Contamination,

date of analyze _____.

A type of analysis	Number of probe.	Weight of withdrawal, g.	Contamination, %.
Main	1		
	2		
Repeated	1		
	2		

Seeds of weeds, one per 1 kg.

Quarantine weeds (species name, total number of probes, unite).

Mechanical damage of seeds

Date of analyze _____

A type of analysis	Probe number	Number of seeds in the probe, unite	Mechanical damage, %.

Totally	Including of mechanical damaged	In the probe	Mean
Main	1		
	2		
Repeated	1		
	2		

Residual fibrous of seeds

Date of analyze _____

A type of analysis	Probe number	Weight of fiber, separated from seed, g.	Residual fibrous, %.
In the probe	Mean		
Main	1		
	2		
Repeated	1		
	2		

Residual pubescence of seeds

Date of analyze _____

A type of analysis	Number of probe	Weight, after burning of seeds, g.	Weight of seeds and husk, g.	Weight of fuzz, g.	Residual pubescence, %.
In the probe	Mean				
Main	1				
	2				
Repeated	1				
	2				

Burning index

Date of analyze _____

A type of analysis	Number of probe	Seed number in the probe	In the probe, unite	Burning index, %.

	Healthy	Hollow	Burnt	Mean
Main	1			
	2			
Repeated	1			
	2			

Questions and tasks to enrich the understanding of cotton seed burning, its significance in cotton breeding, and its seed production:

1. What is seed burning and why is it important for cotton seed quality?
2. Does seed burning have an effect on the quality of cotton seed?
3. Why is seed burning not admitted in the seed batches?
4. Describe the order of the seed burning procedure in the laboratory.
5. Fill in the table of contamination with the data taken in the laboratory training to determine seed contamination.
6. Fill in the table of mechanical damage of seeds with the data taken in the laboratory training to determine seed mechanical damage.
7. Fill in the table of residual fibrous of seeds with the data taken in the laboratory training to determine the residual fibrous of seeds.
8. Fill in the table of residual pubescence of seeds with the data taken in the laboratory training to determining of residual pubescence of seeds.

25-laboratory training. **An investigation into the seed calibration quality of seed stock on cotton varieties**

The aim of this training. The students will get acquainted with the order of reprocessing raw cotton at the cotton seed ginning plants (photo 72), technique, GOST requirements for planting cotton seeds of cotton varieties, machines for seed calibration, sorting, and chemical treatment procedures to provide high quality planting seeds.

Needed **teaching items.** Lecture and laboratory note books, internet access, manual on the conducting of laboratory training, standards for cotton seed quality, literature on cotton seed calibration and sorting techniques, stationery.

Photo 72. ***Modern cotton seed separators (gins) at the cotton seed ginning plants.***

It is well known that on account of 60 kilograms of fuzzy and 40 kilograms of delinted, high quality cotton seeds per hectare are provisioned annually in our republic. Traditionally, reprocessing of raw cotton designated for the provision of planting seed involves separation of seeds from fiber with the help of saws and roller fiber separators (gins).

The first mechanical gin in history was created by American inventor Eli Whitney in 1793 and patented in 1794.

Modern gins are divided into two groups: saw and roller gins. Saw gins (seed separators) are used for raw cotton of medium-staple cotton varieties, while roller gins are used for fine-staple cotton varieties. And, after that, the residual fiber and particularly the fuzz on the seeds are separated by means of two-delinting on the linters (fuzz separators).

Planting seed must meet GOST requirements. The seeds with seed quality meeting the GOST (5895-75 Cotton seed. Varietal and sowing characteristics.) are called "conditioned seeds." Planting seeds, depending on the germination, are divided into three classes:

Class:	1	2	3
Germination:	95	90	85

Order of planting and seed preparation. The operation of preparing seed for planting is divided into two cycles: the first is the work done at seed ginning plants, and the second is the work done on cotton growing farms. Description of the work to prepare seeds to plant at the seed ginning plants is given below:

1.Ginning (seed separation). Just before starting reprocessing of seed cotton to plant seed provision, all accommodations in the building of the seed ginning plant, technological equipment, ways to handle seed cotton and seeds are thoroughly inspected and cleaned from technical (goods) raw cotton, seeds, and waste. The seeds produced during the first 10 minutes of seed cotton reprocessing in a cotton gin plant are combined and handled to the technical (goods).

If the seed cotton is reprocessed after reprocessing of the other seed batch of the same variety but with better planting qualities and better reproduction, the produced seeds for the first 10 minutes of work of the cotton gin plant are combined with the batch of the previously produced seeds. At the reprocessing of seed cotton, it is exposed to the working organs of gin and linters. To avoid the seeds being damaged, the reprocessing of the seed cotton is underway by a softer technological regime than the technical raw cotton, with decreased production capabilities of the saw gin, not more than 560 kg of fiber per machine for one hour. Delinting of seed cotton is conducted two times, in the saw linters with a total take off of 5.5% of fuzz. The first time is 2.5% and the second time is 3.0%. The technological regime for reprocessing of fine staple seed cotton in the roller gins is set for every variety individually.

2.Control. At the time of working, technological equipment is inspected regularly in every work shift by controlling the indexes of seed

pubescence and damage according to the corresponding GOST requirements.

Fuzzy seeds or delinted (naked) seeds (photo 73, 74) are produced as a result of the ginning and delinting of seed cotton. Almost all middle-stapled cotton varieties give fuzzy seeds, and fine-stapled cotton varieties are naked (photo 74).

3. Sorting. The preparation of fuzz seeds at cotton ginning plants entails seed sorting with the aid of ESKhB-4 and treatment with chemical preparations to disinfect against pests and diseases, as well as prevent root rotting and damage caused by harmful microorganisms in the soil. The part of the fuzzy seeds that is specially delinted (free from pubescence) to give them friability in mechanical or chemical ways, or wrapped up in the special preparations-coated (photo 75).

Photo 73, 74, 75. ***Different outlook of cotton seeds at the time of seed preparation.***

4.Mechanical delinting is implemented by some machines. SOM-4 is deemed one of the most perfect. It almost fully removes pubescence from seeds. But it has a disadvantage in that it does considerable damage to the seeds.

5. Chemical delinting. Exposing seeds to strong sulfuric acid is a well-worked out method that can fully melt the pubescence. Exposing seeds to the mixed vapors of acids is a chemical way of destroying pubescence, particularly. This way of delinting takes place with less seed damage.

6.Seed coating. **The seed** coating in the fuzz seeds is conducted by the special machines. It involves wrapping up the mixes of different fungicides with adhering substances. This method attracts great interest because of the friability that lets the seeds save the natural coat longer and the seeds will not be damaged. Simultaneously, the seeds are treated with fungicides to prevent them from developing diseases and rotting in the soil. The establishment of a fungicide layer on the seeds is the result of the

coating being firmly kept on the seeds, and after planting, they melt from the soil moisture. But seed coating could not get a wide spread because of the difficulties and impossibilities of seeding by the precise seed drills.

7.Preparation of delinted (naked) seeds. They are friable, and they lend themselves easily to sorting based on size and weight, calibration, and planting a specific number of seeds into seed next.

8. Sorting and calibration of delinted seeds by the grid machines (photo 76) **with corresponding sizes of holes.** Small, light, and defective seeds are separated during the seed sorting process. Seeds are divided into enlarged, middle, and small fractions. The middle fraction of seeds with a size of not less than 94% uniformity is used to plant by the precise seed drill.

The seed is put through a salt solution of a certain concentration to sort the seeds by weight. The majority of the seeds (drowned) are chosen for planting. But this machine also did not get widely spread because of the amount of labor consumed and expenditure. For the latter, a special machine like the KCM (calibration-sorting machine) was constructed to conduct this process.

Photo 76. ***One of the modern calibration-sorting machines for cotton seeds.***

Many engineers (Mamajonov V.D. and others, 2018) propose new and more efficient modifications to calibrate and sort cotton seed (as DKCM). They allow for increased seed planting quality by removing waste (fraction using technical demand), immature, and damaged seeds. In particular, the weight of 1000 seeds of planting fraction in the DKCM increases by 4–14 g in comparison with SOM-4. The germination of seeds is enhanced by 4–9%, which is the result of the early appearing seedlings by 0.5–1.3 days compared to the control. All these indexes are able to effect the rise in productivity by 0.2-0.4 tons per hectare.

9.Seed disinfection. Disinfection is carried out by the dry or half-moisture methods. In the first method, the fuzzy seeds are disinfected usually using the preparation of TXFM and then disinfection is completed by using the machine of SP-3M. The average consumption of preparation is 7 kg/ton. The preparation of Fentiuram is used in the half moisture method. It has a complex fungicide bacterial effect, suppressing bacterial and fungus-inducing diseases. Besides, it effects soil infection-causing agents like Verticilium and Fuzarium wilts of cotton plants.

Questions to consolidate acquired knowledge about cotton seed preparation and planting:

1.By whom was the historic cotton ginning machine invented and when?

2.What does it mean to calibrate and sort cotton seeds?

3. Can you list the order of work for the provision of planting cotton seed?

4.Do you know the GOST requirements for planting seed quality?

5.How is ginned raw cotton of middle and fine staple cotton varieties?

6.Is there a need to control raw cotton reprocessing?

7.What is the difference between sorting and delinting?

8.Please describe the advantages of calibrated and chemically disinfected seeds.

26-practical training. **The amount of required seeds and accounting up of the planting area in seed producing farms**

In the designing and fulfillment the field experiments on breeding of cotton plant and its seed production in seed producing farms often needed essential knowledge and skills on items of accounting of seed amount and area to be required. They involve the works on calculations of sowing rates, accounting up the areas for individually selected, foundation and elite seeds are to be planted. Conditioned and insurance seed funds.

Purpose of the lesson. At this lesson, the students will have acquaintances with the calculation of planting rate, area to be needed and with some of ideas referring to conditioned and insurance fund seeds, foundation and elite seeds.

In the nurseries of breeding plots and preliminary seed reproduction enterprises mainly planted only ginned fuzzy seeds. The ginned seeds (and delinted) are planted in all other special and commercial seed industry fields (photos 77, 78)

Photo 77. ***Appearance of ginned fuzzy seed.***

Photo 78. ***Appearance of ginned (delinted) seeds.***

Not only breeder but any researcher who's research program relevant to dealing with questions of cotton breeding or its seed production. Faces on diversities of planting methods in the breeding plot. This diversity is connected with different parts of breeding plot. They are: protecting line enclosed of major nurseries, breeding test of families, enlarged strain test, competitive test and so on. Each of them requires a proper planting rate. Its correctness promotes the accuracy of the designing of particular field experiment (take a look at figure 15 of the scheme of breeding plot).

Protecting the line nurseries, according to the planting principles requires one of the mechanical sowings in agricultural industry which ranges from 40 to 60 kgs per hectare.

In the sphere of breeding selection: the initial parental form breeding nursery is foreseen 30-50 seed holes on a single stand. In the seed nursery of the first generation 4-6 seeds are sown into each nest, 1-2 rows with 20-25 seed holes. Seed nursery of the second generation 1-2-3 rows with 30 to 50 seed holes each one a single stand; enlarged strain testing represents two-row, 75-100 seed holes plots; competitive test includes the size of plots is minimum 100 m^2 with one of the mechanical planting schemes.

All above listed methods are fulfilled through accounting up of proper planting rates in each occurrence.

Calculation of planting rate. Usually, the protecting line is planted by the using of the seed of one standard variety. The planting rate here will be chosen in accordance with the recommended schemes are being given to the new varieties on their cultivation: 90x10x1; 90x10x3; 90x15x2; 90x8x1; 60x15x1; 60x30x2; 60x60x4; 60x50x3 and others depending on

environmental conditions, special schemes accepted and variety's features on forming of branches sub-types in particular.

Every number of the scheme means one of the items is being used in the planting practices:

-the first number is a distance between rows, in cm;

-the second number is a distance between seed nests (seed holes), in cm;

-the third number is the number of healthy seedlings to be remained after loosening, in pieces.

Determination of seed planting rates.

Example1. The planting scheme of 90x10x3 has been accepted.

Tasks:

1)how many long strap meters has every hectare according to this scheme of planting?

2)how many seeds would be seeded in the whole area of 1 hectare

3) how many kgs of cotton seed are necessary to take (rate of planting) in order to fulfill this scheme of planting?

Orders of resolving:

1)To define the total elongation of rows in every hectare of area.

The area of 1 hectare is equal to 10 000 m^2, hence the index of area is to divide to the index of distance between rows, that is 10 000 m^2 : 0.9m (or 90 cm) = 11 111m. There are 11 111 meters.

2)If 30 seeds are planted for every meter, it gets for hectare: 30 x 11 111m = 333 330 pairs of seed;

3)If the weight of 1000 pairs of seeds are equal to 120 gr.

Hence, it is desirable to use the universal simple proportion:

If the 1000 seeds weight – 120 g

333 330 seeds – X g: 120 x 333 330 : 1000 = 39.9 or 40.0

So, in all probability we will have to **39.9 kg.**

Conclusion: at the accepted planting scheme of 90x10x3 it is needed to take a definite seed amount for the area of protecting line on the accounting of 39.9 or 40.0 kg of planting seeds per hectare.

The exception here would be the actual quality of seeds which expresses in different percent. If the above used seeds in their batches have 95% of germination obviously we will have to take a little more than those 333 330 seeds vital to develop normal plants.

How many seeds are actually needed to take normal grown plants?

To compensate this scarcity is better again to use that proportion:

333 330 – 100%

X - 5% = 16 667. So, this seeds are to be added as the compensation to 333 330 and gets 349 997 seeds.

Calculation of area to be needed. In majority of cases the breeder has puzzled in the defining of: how many rows should be left for seeds of varieties in the initial parental nursery?

From the above presented data we know that the planting in the initial parent nursery was foreseen of 30-50 holes for per row with single stand in the seed hole.

In such situation we need to know how seeds weights are possible in grams or kilograms and the weight of 1000 seeds in each variety. And on the base of amount of holes for per row and amount of stand per hole we can easily to define the rows or area to be needed to every variety.

For example, we found that one of the varieties was available 1.32 kg of seeds with 97% of germination and 117.4 g of 1000 seeds.

Practically, single stand of plants in each hole will be achieved after loosening by removing of other supplementary plants from this hole. Generally, at least three seeds are laid into each hole. Commentary needless that in the field conditions it is never possible to take single stand through planting only one seed into every hole. So, we should understand that single stand is a result of sowing whenever before at least three or five seeds in every hole.

Exemplary ways of resolving:

1.On description of every variety known its weight of 1000 seeds. For this example it was as above 117.4 g.

2.On every row with 50 holes was foreseen is laying 5seeds in every hole (by keeping into attention of its 97% germination), so for every row of 5 m long necessities 250 seeds.

3.Now we should find out how many seeds are there in 1.32 kg?

If 117.4 g – 1000 seeds

1032 g – x seeds On this proportion: 1 032 g x 1 000 : 117.4 g = 8 790.5 seeds we have in available seed stock of 1 kg 32 g.

4.Every row with the area of 0.9 m x 5 m = 4.5m^2 will demand 250 seeds to be planted in it.

5. If 250 seeds – 4.5 m^2

8 790.5 seeds – X m^2

In accordance with this proportion: 8 790.5 seeds x 4.5 m^2 : 250 seeds = 158.2 m^2 . So, it is needed to single out 158.2 m^2 of area for the first variety with the seeds of weight 1.32 kg. Or on other hand, with the stand point of rows: 158.2 m^2 : 4.5 m^2 = 35.2 = 35 rows.

Summary: 158.2 m^2 (or 35 rows) of area is needed to dispose of the variety with the seed stocks of 1.32 kg in the initial parental nursery.

Conditioned and insurance fund seeds.

Conditioned seeds mean the seeds which meet all requirements of standard on seed

The environmental stresses have threatening effects on the maintaining of seedlings in the fields of any agricultural crops. To avoid of these effects or replant injured fields are under taken the establishment of **insurance and conversional seed funds.**

Foundation seed. The word of foundation or super elite is a Latin word which means prior than elite. Super elite seeds must have the superior productivity, variety and planting qualities. Super elite seeds are the yield of reproduction nursery is being organized in the elite production process

Elite seed means the initial seed of one certain variety, produced through special method of breeding and seed production and meets all requirements on its variety and planting qualities**.**

The word of elite in French is the better, sorted. Elite is reproduced progeny from the best selected plants typical to the variety. Foundation or super elite seeds are produced before than production of elite seeds.

The tasks to outdoor trainings on calculating of seeds' amounts are planting and area for them:

1. Find the quantity of needed seeds to the seed nursery of the first generation in which intended to plant 4-6 seeds into each hole, with 1-2 rows having 20-25 seed nests.

2. Find the quantity of needed seeds to the nursery of the second generation which should have 3 rows with 50 seed holes each double stand?

3. Find the area of one strain in the nursery of enlarged strain testing where foreseen two-rows with 100 seed holes each one. The accepted scheme of planting is 90x10x1.

4. Find the area for strain in the competitive test plot with the planting of four replications from where was asked to send 6 kg of seed. What area is necessary in the case of planting scheme 90x15x2?

27-laboratory training. **Preparation of seed stock for precision drills**

The aim of the training is The aim of this training is familiarize students with the preparation work of bred seed stocks for mechanical seeders (photo 79) or hand seeding, the function principles of seeders, the requirements of seed drills for seed stocks and the work tools to be used at the time of seeding of seed stocks.

Necessary sources to conduct this training. Lecture and laboratory copy books, internet access to get information about functioning models of cotton seed precision drills, requirements of seed drills for seeds, schemes of cotton seed planting, standards for the indexes of cotton seed stock, and working tool sets kept in the laboratory for use in the laying out of experiments.

Photo 79. ***One of the precision of cotton seed drills is being used on the seed stock producing farms.***

Cotton seeds are prepared and seeded every year in the experimental nurseries at the SRIs (Scientific Research Institutes) and their local branches or stations to continue the breeding process, in the special backgrounds to test bred cotton lines in the conditions of biotic and abiotic stresses, in the preliminary seed reproduction plots to present new cotton varieties for state trials (photo 79), in the elite farms to reproduce high quality seeds of cotton varieties and their progenies for distribution throughout the regions to harvest the raw cotton of high quality for the textile and other reprocessing industries.

Special breeding seeders (photo 5) are used in the breeding nurseries at the cotton breeding SRIs and precise seed drills are commonly accepted

seeders for seed planting in the preliminary seed reproducing and elite seed producing farms.

To prepare selected seeds to sow in the breeding plots. According to the scheme of breeding plots in the journal of experiment and dispositions of breeding nurseries in it, the lab assistants of the breeding departments get to prepare seeding bags on the basis of selected seeds from former breeding materials as a result of visual and lab discards. Selecting seeds for individual or family selections is based on the fiber output or outlook differences of the seeds. They are thoroughly cleaned, sorted individually, and weighed. The fiber output is calculated on the basis of raw cotton, fiber and seed weights. The seeds of selected materials revealed fewer indexes on the fiber output and form differences than parental or standard varieties and were not admitted to plant again and study in the breeding process. This lab analysis is usually done in the winter months according to the list of future seed plantings (appendix 1) to place selected seeds in seed bags. Seeding bags are preferably new, sewn from various suitable fabrics in the sewing shop to the size of 15 x 18 cm or larger, with their own circled strings and tags (photo 79, 80, 81).

Photo 79, 80, 81. ***Diversity of seed bags used to prepare seed stocks.***

They are numbered with a special chemical pencil in order to not wash off their color at the time of seed soaking. So, the seeding bags have growing numbers according to the planting numbers on the seeding list and all the selected seeds are placed in them. They are grouped by 100 each into chains (garlands) by twisting their strings together. Then, every five garlands (each with 100 seed bags) are gathered together (photo 80) and placed in 50 x 90 cm jute sacks (photo 81).These garland sacks are tagged with wooden tags numbered with growing numbers written by those chemical pencils. Besides the garland sacks, there should be one additional sack with seeds of standard variety to sow in the protective zone surrounding the breeding nurseries in a plot. Most parts of the experimental plot, except for some first hybrid seeds, are sown by

mechanical drill. On one of the sunny days at the beginning of spring, all the staff of the department come together in the square equipped with disinfection baths and water reservoirs with running water to redistribute seeding bags for operational order of the seeding drill. The lab assistants bring the garland sacks with seed sacks of the standard variety out of the depository and put them aside on the square.

The breeding seed drill presents itself as a special one (take a look at the photo 5) and considerably differs from seed producing and farmers' seeding drills. Here, the space square about 20 to 40 meters in size on asphalt will be represented as a real breeding plot of about 150 m to 300 m to conduct the distribution of selected last year's seeds according to the scheme of breeding plot. So, all the seed bags are brought and the seed bag garlands are taken out of their sacks and started to be put one by one on the land under the control of a senior scientist with a seeding list. The order of putting the seed bags in lines should coincide with the scheme of rows in the nurseries and the drill's movement, which has four row seeding apparatus simultaneously moving across the nursery belts of the experimental plot. Accordingly, this order of work redistributed all seeding bags on the ground. In this order, all seeding bags will have their new place on the land, similarly to the nursery rows where the seeds of each seed bag will be sown by that mechanical drill. Along with the movement of the four-row drill, the bags will be garlanded newly, and the four garlands will get their new numbers and aim to place together one sowing bag with its tag, which will indicate the drill's planting from up or down across the plot. If a part of the nursery for initial materials is purposefully intended to be sowed by hand (hybrids with a few seeds, for example), the empty seed bags are placed with their numbers of rows which will be left without seed sowing. With the help of the seed planting list, the senior scientist and other scientists randomly inspect the correctness of the redistribution of seed bags in both the order of the drill's movement and seed bags on their own rows in the nurseries of the experimental plot. Eventually, the redistribution order of the seed bags should ensure correctness with regard to the space scheme made in the experimental journal as well. This will be attained by the repeated checking through comparing of seed bag orders with nurseries' dispositions in the space scheme.

And after that, all seed bags are sewn together with breeding awl using a firm thread in the consistency of the drill's movement. And now each garland sack (smaller than sacks for seed bag garlands) has to contain

four chains of seed bags sewn in parallel to the direction of the four seeding apparatuses of the drill across the nurseries of the experimental plot, up or down. The seed sacks, according to their numbers, are divided into two groups to provide the drill with uninterrupted functioning. The first group of sacks is for drill's movement up, the second is for drill's movement down across the nurseries. No need to forget that the sacks with empty seed bags in their garlands have one duplicate sack with the seed bags. They are kept separately and their seeds have to be seeded by hand after massive seeding with a drill. The tag of this sack bears the record "Hand seeding" and the order numbers follow the major seed sacks' numbers. Then, all seed stock bags are ready for seed disinfection and soaking with water.

Chemical treatment of selected seeds. Typically, seeding occurs in the middle of spring, when the soil has yet to warm sufficiently and a portion of the sown seeds has rotted as a result of soil humidity, cold, and disease-causing microorganisms. In order to prevent the loss of selected bred seeds, breeders use treatment of seed materials one day before general seeding. For this intention, a bath near that square was installed and provided with an enlarged water reservoir for the soaking of seeds just after disinfection (or chemical treatment). The bath is filled with water up to 70% of its volume. Then, formalin at 40% is poured into this water in a ratio of 20 parts of available water. The solution is mixed with long wood sticks until the solution gets its constant, specific greenish color. The immersing of seed sacks in the solution is started with the immersing of four first sacks at the same time. The quality of treatment depends on the completeness of sinking the sacks under solution and the soaking of all seeds in the seed bags. For this, sacks will be kept under solution for 30 minutes. After that, the first four sacks were pulled out of the solution and put with their numbers on top beside the fence of the water reservoir. About three meters long, strong strings are tied to the necks of sacks and the base of the fence while other groups of assistants start to fill the bath with solution until the initial volume level and sink the second four sacks according to their numbers. This work will continue until the last four seed sacks have been tied to the fence of the water reservoir after soaking (chemical treatment) with solution. The sacks will be allowed to stay in this state until sunset, when all sacks will be dropped into running water in the reservoir for the night carefully without tangling their strings with each other. One of the assistants will come early before sunrise and pull out all

the sacks from the reservoir one by one and put them in their former places for their exceeded water flow.

After two or three hours, they will be ready to be transported to the experimental plot and start the general seeding in the breeding nurseries according to the seed planting list.

With the exception of preliminary seed reproduction, all seed stocks of bred materials are planted with the help of commonly accepted drills for precise seeding (photo 79). They are built by our machine building plants and are deemed to meet almost all the requirements of seed producers and farmers. The seeding apparatus can plant delinted, treated, and fuzzy seeds in rows 60 to 90 cm apart. Additionally, their seeding apparatus has the facilities to adjust the number of seeds per every seed nest, but to their great regret, there is still thinning of seedlings in the cotton fields (analyze the data on the number of planted seeds by these kinds of planters per 1 meter of row samples presented in the table 8). These drills for precise seeding may adjust the depth of seed planting depending on the soil moisture level and types of soil. Simultaneously, they did work to make ditches, lay out seeds into these ditches, fill them up with soil, and spray pesticides around seed nests. And these drills may do the first soil loosening around the seed nest soils with feeding and make ridges for irrigation.

The seed drills require certified seed stocks to function at their high level of efficiency and to ensure more precise sowing of cotton seeds because they have passed through testing with a certain planting quality of seeds. Certified seed stocks must have seed quality indexes according to the state standard and presented in the table 21 of this manual.

Depending on the germination rate, planting cotton seeds is divided into **3 classes (**GOST (5895-75 Cotton seed. Varietal and sowing characteristics.):

Classes:	1	2	3
Germination:	95	90	85

In general, the germination of seeds depends on their maturity and formation. The seeds harvested from mature plants, harvested out of split open balls until frost, have a germination rate of over 85%. So, seed producers working at the preliminary seed producing farms must follow seed preparation procedures to improve their seed stock prior to general planting and disinfect. Moreover, the variety quality of seed stocks must have a high variety quality (grade of seed). The grade of seeds is determined by the number of seeds possessing all genetic traits and

properties, relevant to the given variety. It is given in a percentage. The higher the variety grade, the more uniform the seedlings and plants will be, which results in getting a higher and more uniform yield.

On the basis of **variety purity**, the seed stocks of elite, F_1, F_2 and F_3 must be correspondingly: 100, 99, 98 and 96 (table 21).

Soaking of seed stock is widely used on an industrial scale to ensure getting enough cotton seedlings in a short period of time. This will be necessary if the soil has lost its natural moisture in our spring months of April and May. The seed stock in a heap state is sunk into the water tank. Soaking is continued for about 2 hours, but the water uptake by the seeds takes place differently. Soaked seeds cause lowered efficiency of mechanical seeders. Across the republican cotton plantations, an average of 40 to 60 kilograms of delinted and fuzzy seeds (in dried seed weights) are traditionally used to plant.

Seed stock preparation and planting technology and techniques to plant this seed stock are not yet perfected in our republic. More than half of the seed stock being used to plant is lost at the time of germination and seedling thinning. This current situation in SRIs and industrial spheres has significant negative consequences from both a scientific and practical standpoint.

Tasks to improve your own knowledge of cotton seed stock preparation work for cotton sowing:

1.Master order of existing seed preparation works for seed planting in the breeding nurseries.

2.Learn again the standard requirements for planting seed stocks.

3. Experimentation under the guidance of your scientific supervisor to study the existing situation at the time of seed stock preparation, planting, and getting healthy cotton plants.

4. Create your own scientific practical conclusions based on the results of your own experiment and compare them to the data in the literature.

28-laboratory training. **Evaluation of fiber quality indexes in different varieties of cotton plants**

The aim of the training. The students will get acquainted with contemporary laboratory equipment (photo 82) to test cotton fibers, cotton fiber types, quality indexes of cotton fibers and fiber grades on appearance, report fiber qualities of different cotton varieties and fiber acceptance rules.

Photo 82. ***A general view of the uHVI 1000 cotton fiber testing instrument.***

Necessary teaching sources to conduct training. Notes of lectures and laboratory practices, a manual on the practical and laboratory training, cotton fiber samples of different cotton varieties, and stationery.

Cotton fiber. Cotton is currently the leading plant fiber crop worldwide and is grown commercially in the temperate and tropical regions of more than 50 countries. It is estimated that cotton is cultivated on approximately 2.4% of the world's arable land. Mostly, cotton varieties from four species of cotton are grown worldwide.

1. The length of hirsutum, or upland cotton fibers, ranges from 28 to 36 mms or more and has a medium coarseness.

2. Barbadense or Sea Island cottons, as well as American Egyptian cottons, have extra long, fine fibers that can be 37-41 mm long or longer in some cases. The lint is readily detached from the seed.

The Asiatic cottons are classified as G. arboretum and G. herbaseum. Their fibers are coarse and short, their length being mostly between 25 and 28 mm.

To date, almost all cotton fiber producing countries have up to date cotton fiber analyzing laboratories like our Uzbek Center for Certification of Cotton Fiber "Sifat" under the Cabinet of Ministers of the Republic of Uzbekistan. It renders its service to all applicants to identify the quality of their cotton fiber. The center has a laboratory equipped with modifications of USTER® instrument-based cotton classing that is able to test 70 grams of fiber sample and produce test results that are the most accurate and repeatable in the world (photo 82). Testing can be completed in seconds, by only one operator. And the USTER® HVI 1000 quickly generates full reports on fourteen important quality characteristics, including the fiber's length, strength, fineness, color, and moisture content. The result is consistent and objective fiber quality data, allowing breeders and spinners to make smarter and simpler pricing and purchasing decisions. In today’s demanding market environment, that’s the way to keep breeders and spinners profitable and their customers satisfied.

According to the state standard on cotton fiber (Uz.DST 604:2001), cotton fiber is divided into nine (9) types: 1a, 1b, 1, 2, 3, 4, 5, 6, 7 by length indices in accordance with the norms, which are given in the table 15.

Table 15. **Types of cotton fiber**

Type	UHML*		Staple**		(Str) for sorts 1 and 2 cN/tex (df/tex)
	mm	inch	Inch***	code	
1a	33.7-34.3	1.33-1.35	1.11/32	43	29.4-34.3 (30.0-35.0)
1b	32.9-33.6	1.30-1.32	1.5/16	42	
1	32.2-32.8	1.27-1.29	1.9/32	41	
2	31.4-32.1	1.24-1.26	1.1/4	40	
3	30.7-31.3	1.21-1.23	1.7/32	39	
	29.9-30.6	1.18-1.20	1.3/16	38	
4	28.9-29.8	1.14-1.17	1.5/32	37	23.0-27.8 (24.5-28.4)
	28.1-28.8	1.11-1.13	1.1/8	36	
5	27.4-28.0	1.08-1.10	1.3/32	35	
	26.6-27.3	1.05-1.07	1.1/16	34	
6	25.8-26.5	1.02-1.04	1.1/32	33	
7	25.1-25.7	0.90-1.01	1	32	

*Where: *-dependence on the HVI method; **-dependence on the classer method; and ***-dependence on the special methods.*

UHML: upper half mean length, the average length of the longest fibers, which constitute half of the tested sample by weight and expressed in mm or inches. This term is also known as "upper half of mean length" in the correct translation.

Staple- staple length 32-nds, is a fiber length that a classer defines visually by a staple of parallel fibers laid out by him or her manually (photo ..). It is expressed in 1/32 inch (for example, 1 1/32) or by a code equal to the number of intervals in 1/32, in the example given, code 33.

The inch (in) is a unit of measurement equal to 2.5 cm.

If there is divergence while specifying different quality characteristics, the priority is given to the Upper Half Mean Length (UHML), expressed in mm.

Types 1a, 1b, 1, 2, and 3 are referred to as G. barbadense (Long Staple Fiber), while types 4, 5, 6, and 7 are referred to as G. hirsutum (Middle Staple Fiber).

Depending on appearance, color, and presence of spots, cotton fiber of each type is sub-divided into five grades: The first (1), the second (2), the third (3), the fourth (4), and the fifth (5) in compliance with the requirements of table 16 and standards of cotton appearance (boxes), approved by the established procedure.

We know, that cotton is harvested as "seed cotton," which is then "ginned" to separate the seed and lint. The long "lint" fibers are further processed by spinning to produce yarn that is knitted or woven into fabrics.

The ginned G. hirsutum seed is covered in short, fuzzy fibers, known as "linters". These must be removed before the seed can be used for planting or crushed for oil. The linters are produced as first-cut or second-cut linters. The first-cut linters have a longer fiber length and are used in the production of mattresses, furniture upholstery, and mops. The second-cut linters have a much shorter fiber length and are a major source of cellulose for both chemical and food uses.

Table 16. **Fiber grades on appearance**

Industrial Grade	Fiber color and appearance by fiber types	
	1a, 1b, 1, 2, 3	4-7
I	White, or white with natural creamy shade or creamy according to breeding variety or region of cotton cultivation. Lustrous, silky and dense by appearance.	White, or white with natural creamy shade
II	From mat-white to creamy or yellow of uneven coloration with yellow spots. Lustre, silkiness and density are lower that in case of the sort I	From mat-white to creamy with light yellow spots
III	From mat-white to creamy or yellow of uneven coloration with yellow spots. Greyish shade, almost lusterless.	From dull-white to creamy with yellowish spots with mat-greyish shade
IV	Yellow or light yellow of uneven coloration with grey shade and brown spots. Lustre less.	From dull white and cream-colored to yellow-creamy with grey shade and brown spots.
V	From brown to yellow with spots. Grey.	Dull-white or dull-creamy to bright yellow with brown spots. Grey.

Note. *Cotton fiber with color shades different from the requirements of table 3 and standards of appearance (boxes) is supplied in co-ordination with the consumer.*

The dignity of cotton varieties in regard to their fiber quality is reported usually as the table 17 and 18. Here, breeders exhibit the main

fiber qualities that are understandable to any expert to evaluate given cotton varieties' dignity.

Table 17. **Deltapine select ™ cotton varieties and the fiber quality characteristics.**

Deltapine select ™ products	Fiber quality characteristics				
	Lint %	Staple	Micronaire	Strength	Lint unif.
DP 1646 B2XF	41.7	39.0	4.5	29.9	83.0
DP 1820 B3XF	43.0	39.3	4.6	32.7	83.3
DP 1845 B3XF	40.3	39.5	3.80	30.06	81.5

Table 18. **Uzbek cotton varieties and their fiber quality characteristics.**

Cotton varieties	Fiber quality characteristics				
	Lint %	Staple	Micronaire	Strength	Lint unif.
Sultan	34-35	37	4.5-4.6	26.4	-
Bukhara-102	37.0	36	4.3-4.4	26.5	-
Parloq-1	33.3	41	4.1-4.3	36	-
Parloq-2	32.4	42	3.9-4.2	36	-

*Where: **Micronaire (Mic)** – the characteristic of cotton fiber fineness and maturity, which is defined by the air-flow method. (A micronaire reading below 3.0 is considered very fine, and 5.0 and above is considered coarse; 3.5 to 4.9 is the most desirable range for upland cotton varieties).*

Besides these indexes, other below listed indexes are also defined to provide a detailed characterization of fiber quality:

Mean Length (ML) – the average length of all fibers in the sample.

The Uniformity Index (Unf) is the ratio of fiber mean length to upper half mean length expressed in percentage.

Short Fiber Index (SFI) – a percentage of short fibers in a sample with a length of less than 0.5 inch (12.2 mm).

Reflectance (Rd) is the percentage of light reflected by the surface of the tested sample.

Yellowness (+b) – the amount of yellow color in the tested sample.

Trash Code (T) – a non-fiber contamination characteristic defined by multiplying the area of admixtures by ten. For example, if the portion of admixture area is 0.4%, the trash code is 4.

Trash Area: the ratio of the accumulated areas of all the trash particles measured instrumentally on the HVI machine by scanning of a sample surface to the area of the viewing window expressed in percentage.

Trash Count (Cnt) – the number of individual trash particles in a sample of 0.01 inch (0.25 mm) or greater in diameter.

Strength (Str) – the strength of cotton fiber expressed in the graduation of HVI

Elongation (Elg): the cotton fiber elongation to the moment of its breakage on the dynamometer of the HVI system, expressed in percentage.

Cotton fiber is supplied and accepted in lots. A lot is the quantity of bales of the same type, variety, and industrial grade that are accompanied by one document certifying their quality.

The maximum lot size is no more than a railroad car.

The standard moisture regain for the calculation of conditioned weight is 8.5 %. The minimal moisture gain is – 5 %.

A formula is used to calculate conditioned weight (Mc) in kilograms.

$$M_c = M_A \frac{100 + W_S}{100 + W_A}$$

Where: M_A –actual weight of the cotton fiber lot which is submitted for acceptance, kg.

W_S – standardized moisture regain, equal to 8.5 %.

W_A – actual moisture regain in cotton fiber lot, %.

Calculation is up to the first decimal sign and is rounded off to whole units.

The following information should be included in the accompanying document:

-name and location of a ginnery;

-quantity of bales in a lot;

-numbers of bales;

-gross weight of every bale;

-gross and net weight of a lot;

-conditioned weight of a lot;

-variety and industrial sorts, type and class of cotton fiber;

-test results according to the tests used in complying with the table of classification methods;

-date of fiber production.

Questions to consolidate acquired knowledge:

1. What is the cotton quality and its importance?
2. What kind of laboratory equipment is equipped at the center for "Sifat"?
3. How is the cotton fiber accepted or supplied?

29-laboratory training. **Seed storage and control of variety purity**

The aim of the training. The major aim of this training is to get the students familiar with cotton plant seed storage and control variety purity of seeds.

Necessary teaching aids to conduct the training: some standards designated for storage of the cotton seeds, a lecture note-book, cotton seeds (naked and with fiber), placates depicting warehouses for storage of cotton seeds and bags to store seeds, pencils and erasers.

According to the internet sources, cotton seed (photo 83, 84) is characterized as a seed approximately 3/8-inch-long and 3/16 inch wide. It is covered by a soft, fibrous white substance. Sometimes the seed will appear dark and fiberless (no cotton adhering to the seed).

Photo 83, 84. ***Cotton seeds and their various appearances***

A ginning machine is used to separate the cotton fibers from the seed. Cotton gin was invented by Eli Whithey in 1793.

In the past, the separation of cotton fibers from the seeds was done by hand (manually). It was very hard and time-consuming work. The invention of the cotton gin has considerably reduced the time and extraordinarily enhanced the efficiency of cottonseed ginning.

There are two types of ginning machines for our cotton ginning plants.

1.Saw gin machine (for middle fiber cotton varieties, G.hirsutum L.).

2.Roller ginning machine (for fine staple cotton varieties, G.barbadense L.).

Cottonseeds are surrounded by fibers which grow from the surface of the seed. This lint is removed in one of the ginneries and used to make cotton thread and fabric.

The seeds are about 15% of the value of the crop, which makes up 70% of the raw cotton weight and are pressed to make oil and used as animal feed. About 5% of the seeds are used for sowing the next crop.

Storage of cotton seeds is implemented by the guidance of GOST 5947-68 (reissued, June 2010). According to this GOST cottonseeds are packaged in fabric or paper bags (photo 85, 86) or in piles (unloaded) insuring perfectly safe (at 10º C; 14% of humidity) and ensuring from mixing with industrial varieties.

Photo 85, 86. ***Storage of cotton seeds in paper bags and unloaded.***

Seeds accepted to the storage should have certificate about the seed quality presented below:

Certification
№___
on cotton planting seed (which is valid for two months) _____« », 20_____.
Name of the cotton variety _____,
Given (to) _____,
On seed stock batch № ___ with a weight of____ ton,
taken from the cleaning of seed stock batches of raw cotton batch № ___,
Provisioned in _____ in 20 ____,
intended for dispatch to _____,
Industrial grade of the seeds _____,
Moisture (to absolute dried and real weight) _____,
Purity (impurity or spoilage) _____,
Full hairiness of the seeds _____,
Multiple delinting _____,

The seed batch- is a defined amount of uniform seeds (of one crop, variety, reproduction, category, variety purity, year of crop, similar origin, numbered and conformed by corresponding documents).

After two months of storage, the cotton seeds will be analyzed again to determine their quality.

GOST 21820.0-76 spreads to seed stock raw cotton and cotton seed intended for planting and identifies the methods to select samples for determination (control) of planting seed qualities. Depending on their

batch weight, the sampling is carried out from batches or their parts. The weight of the control unit, identified for seed stock, raw cotton and cotton seed, is presented in the table 19.

Control unit: one average sample of a particular amount or its parts is taken to determine the quality of seeds in a separate batch.

Table 19. **Weight of control unit for seed stock raw cotton and cotton seeds.**

Reproductions	Weight of control units (ton)		
	Seed stock raw cotton batches	Seeds at ginning and storage times	
		Non-disinfected	Disinfected
Elite	15	5	10
F_1	30	10	20
F_2	60	20	40
F_3 and successive reproductions	150	50	100

Storage of cotton seeds on farms prior to sowing. The planting seeds are delivered to farmers from state provisional points in correspondence with the variety allocation plan, on the basis of the conformed norm of sowing, the identified plan of area and modes of planting.

At the time of release, provisional point gives a certificate to the recipient, pointing out the characteristics of planting and variety quality of seeds and their origin (elite farm).

The planted seeds are transported in the fabric or paper bags in every batch, distinguished from each other by quality and variety indexes, in individual transport. Until sowing, the seeds are conserved in the dried, well-aired premises, which have previously been cleaned properly and disinfected.

Boards and reed stacks are laid under seed bags to prevent moisture penetration into them from the floor. The width of every stack must be equal to the length of two bags, and the distance between neighboring stacks must be at least 1 m. That lets free air flow and makes it possible for the controlling person to check the state of seeds. On the brightest days, all windows and doors are opened to air the premises.

The naked seeds require great attention because of their high environmental moisture absorbing characteristics and rapid spoilage. The state of seeds is subjected to systematic observation at the time of storage. In the event of moisture penetration, soaked seeds must be immediately

dried by spreading them out on the dried area to a depth of 10 cm and regularly mixing as necessary.

Control of seeds at the time of storage is more important, especially for those intended for seed purposes. First attention in the maintaining the good quality of stored seeds must be paid to the moisture of seeds, that is the seeds are properly dried and cleaned. Because poor quality seed loses its viability even when stored under ideal storage conditions. Furthermore, high moisture heating (photo 87), which encourages the growth of seeds, burns fungi and increases insect activity. Hence, seeds must be stored at a dry 14% content (MC-moisture content). As a rule of thumb, for seed MC between 5% and 14%, each 1% reduction in MC approximately doubles seed storage life.

A special control should be observed above the functioning order of storage facilities. A good storage facility maintains good quality seeds with high viability and vigor. Sample seeds for moisture content are taken every month to monitor the seed condition in storage. Sanitation and cleanliness in the storeroom must be maintained. Keep the storage room free from insects and spilled seeds on the floor.

Photo 87. Modern ***cottonseed storage complex with air and heat-adjusting facilities.***

Store old and new seed stocks separately. As much as possible, do not mix the new stocks with the old ones to prevent pest infestation. Maintain the ideal temperature and relative humidity inside the storeroom.

According to advanced seed storage technologies, the following factors of the environment have to be under control:

1. An increase in temperature and humidity can cause seed deterioration and promote the proliferation of seed borne pathogens and stored seed insect pests.

2. As a rule of thumb, each 5C decrease in storage temperature between 0C and 50C approximately doubles seed storage life. When storing seeds under ambient conditions, the storage room should be provided with adequate ventilation.

3. Use paleta (pallets) or tarimas to keep the piles at a distance from the floor to avoid moisture condensation. Pile the bags following the Japanese Piling System, where the bags are piled, leaving the center space vacant to facilitate better aeration. This also allows access for re-sampling and quality inspection.

The definition of purity (or impurity) of seeds is carried out in two ways:

1. Definition of contents of mineral and organic impurities;
2. Definition of the contents of empty, beaten, burnt and moved seeds.

A weighed portion of seeds weighing 500 g is sifted through a sieve with an outlet of 3 x 3 mm above the oil paper.

Sweepings and dust are collected in a dish, and seeds are placed on a clean sheet of paper with pincers to separate the remaining mineral and organic impurities. Next, all mineral and organic impurities are weighed. At this, the smallest fuzz picked out from the sifting of seeds adds to the weight of the seeds.

The content of mineral and organic impurities in the percentage (K_o) is defined by the following formula:

$$K_0 = \frac{m_0 \cdot 100}{500},$$

Where: mo –weight of mineral and organic impurities in g;

500 – initial weight portion in g.

After defining the contents of mineral and organic impurities from the sieved weight portion, two portions of 100 units of seeds each are sieved without selection. Each portion is weighed and analyzed individually.

At the beginning, pick out beaten and damaged seeds, which have less than half the nucleus of safe nucleus seeds and their parts. Then unbroken seeds are cut in half (across) and overlooked. The seeds are selected into one out of five groups depending on the study analysis.

The first is that the color of the seed nucleus is specific to this variety (table 20);

The second-touched seeds, the color of the nucleus is darker than expected for this variety;

The third – hollow seeds;

The fourth – burnt seeds with black color of nucleus;

Table 20. **Requirements for the color of the seed nucleus of cotton seeds.**

Grade of cotton seed	Corresponding grades of raw cotton	Color of cross-section of the nucleus
I	I	Light-creamy with greenish and other spots depending on the cotton varieties
II	II	Creamy with spots depending on the cotton varieties
III	III	From grey-creamy up to yellowish with spots
IV	IV	From yellow up to light-brown

The fifth – beaten and damaged seeds, which have less than half the nucleus, the safe nucleus, and their parts.

The seeds of the second group are weighed with the seeds of the fifth group, which together consists of oil mixes. (Beaten and damaged seeds have less than half the nucleus of healthy seeds, and their parts are involved in oil mixes).

The percentages of the contents of oil mixes (b) are calculated based on the following formula:

$$b = \frac{m_м \cdot (100 - K_0)}{M_c},$$

Where: m_o – weight of oil mixed in g,

M_c – initial weight of 100 units of seeds in g,

Ko – percentage content of mineral and organic mixes.

The seeds of the third group are weighed together with the seeds of the forth group.

Taken weight (K_c) in percentage is calculated by using the formula:

$$K_c = \frac{m_c \cdot (100 - K_0)}{M_c},$$

Where: m_c – denotes total weight of hollow (third group) and burnt (fourth group) seeds in g,

M_c – weight of 100 unit seeds in g,

K_o – percentage content of mineral and organic mixes.

The mean arithmetic index on two weight portions is accepted for the general content of oil mixes or hollow and burnt seeds if the difference between the two definitions will be not more then:

for I grade 0,5%,

for II-III grades 1,0%,

for IV grade 2,0%.

In the case of exceeding this difference, repeated analysis is conducted. If the difference does not exceed the established norm of admittance, the result of repeated definition is accepted as the completion result.

Otherwise, the mean arithmetic index of oil mixes or hollow and burnt seeds in four weight portions is accepted for a completion result.

The percentage content of impurities (a) is defined by the formula:

$$a = K_o + K_c,$$

where: K_o – percent content of mineral and organic mixes,

K_c – percent content of hollow and burnt seeds.

Content of total impurity (C) in percentage is defined by the formula:

$$C = a + \frac{b}{2},$$

Where: a – percent content of impurities,

b – percent content of oil mixes.

Final result of impurity is rounded off up to 0,1%.

The questions and tasks to firm acquired knowledge on control of seed storage and variety purity (or impurity):

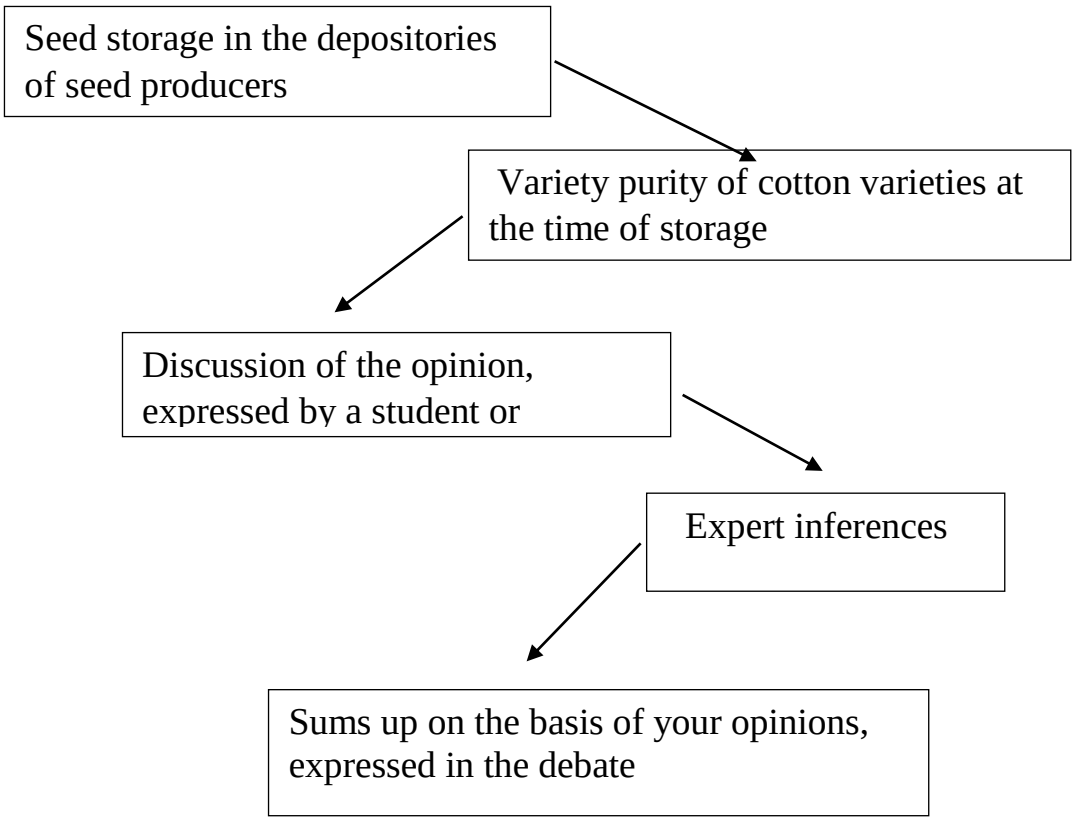
1. What is the ginning of cotton seed?
2. What standard has been worked out to control cotton seed storage?
3. Can you explain the meanings of seed batch and control unit?
4. Do you remember what kinds of gauges were exploited?

5.Does the color of seed nucleus have relation with the purity of seeds?

6.Review the methodical order of sampling from stored cotton seed.

7.Review the ways of defining cotton seed purity (or impurity) by using cotton seeds available in the laboratory.

8. On the base of pedagogical method "Debate" organize question and answer, share your friends with studied material.



30-laboratory training. **Measuring the fiber length of cultivating cotton varieties**

The fiber length of cultivating cotton varieties is valued as one of the textile's important traits. That is why, breeders have to pay great attention to the formation and inheritance of fiber length in their plant populations, hybrids, families, lines and new varieties. Annually, probes of pappus (photo 88) taken from individual selections of boll probe samples and family harvests are exposed to measure the length of fibers. Commonly, probes of pappus taken from individual selections (6 pappus in the probe package) are measured in laboratory conditions by the assistants of breeding departments.

Photo 88. ***Probes of pappus and their packages to measure the fiber length of individual selections***

The aim of this laboratory training is to get acquainted with the methodic order of cotton fiber length measurement in the conditions of an academic laboratory.

Needed supplies. Laboratory copy book, stationery, velvet board to measure cotton fiber length (photo 89), raw cotton of individual selections from different cultivating cotton varieties, tooth brushes, glass rulers with millimeter indexes, blank tables on the fiber length list (form 5).

Learning the order of fiber length measured by the students is effective when every student in pairs works together after the instructor’s explanation of how to work together. Measuring of fiber length is implemented in the following order:

1.Every pair of students will be provided with the individual raw selection of one of the cultivating cotton varieties, a velvet board, tooth brush, glass ruler, blank tables on the fiber length list, exemplary fiber packages with pappus to measure their length and other stationeries.

2. The students untie the fiber packages (photo 88) with ten paper lists with 6 pappus between each list and distribute them to every pair of students to know how the pappus were prepared and spread out on the list.

3.Students prepare a paper with two lists as pointed out in the photo with 4 pappus and write their cotton variety and name and surname on the title page.

4.Start by picking out 6 pappus out of the middle part of cotton locules (or lobules) randomly chosen from different places of the individual raw cotton sample.

5. Using your fingers, brush the pappus fiber and divide it into two directions from the concave part of the seed.

6. At the teacher's prompting, fasten the pappus under the holder of the velvet board and rub with a tooth brush as shown in the appendix 6.

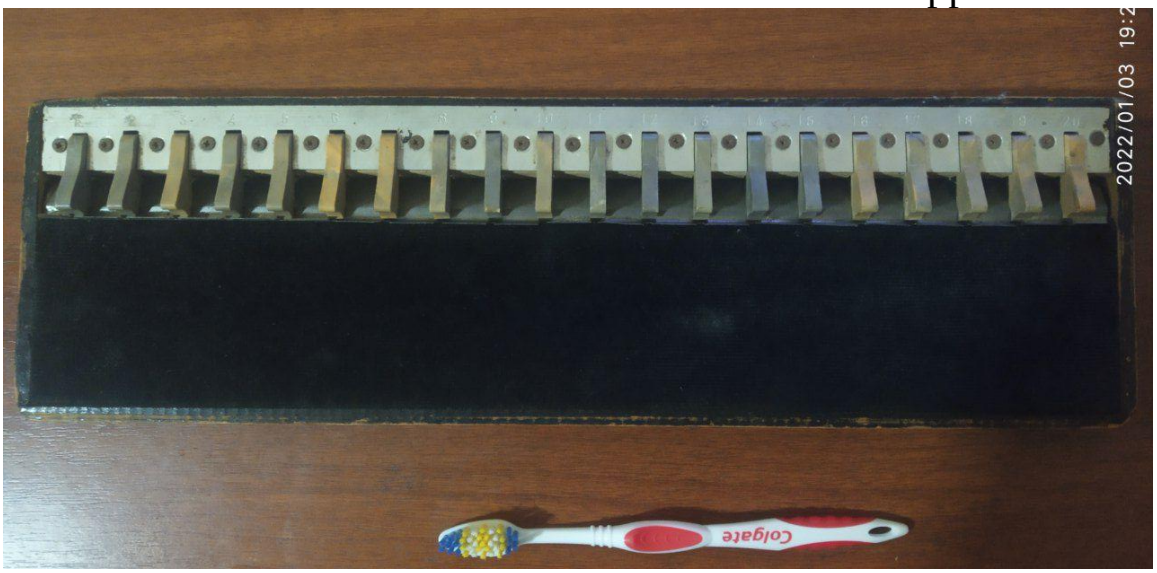


Photo 89. ***One of the velvet boards used to measure cotton fiber length***

7.Put the glass ruler from the seed holder on the rubbed fiber and take a look at the end of the last 2-3 fibers to see what index of the ruler they have reached. The same measurement is repeated with the other direction of fibers. The indexes of the last 2-3 fibers on the glass rulers are being accepted as the result of fiber length.

8.Above explained, preparing and measuring (6^{th} and 7^{th} work) of the fibers will be continued (as the second replication) with the remaining 5 pappus.

9.Name your blank table (by replace the form name with records of your title list).

10.Start registering the taken data in the blank tables on the fiber length list. Depending on the species of cotton variety, the basic fiber length will be chosen as follows:

a) 30 mm for the middle staple cotton variety;

b) to fibers with lengths of up to 40 mm and fine staple cotton varieties with lengths of up to 35 mm;

c) to fibers longer than 40 mm in length, as well as fine staple cotton varieties longer than 40 mm in length.

11.Length of basic is accepted as the zero value and all measured results will be accounted for and remarked under + or – values in the corresponding columns (by the prompt of the teacher if it is needed).

12.Full points (or dots) are used to remark the values of measuring in the corresponding cells of table as following: one- **.**, two- **:**, three- **:.**, four- **::**, five- **:::**, six- **:.:**, seven- **:::.**, eight- **:::.**, nein- **:::.**, and ten- **:::.**

13. So, 5 out of 6 pappus are measured and calculated. At this point, numbers in every cell are multiplied to create divergences out of the basic and taken result, which doesn't mean it is + or – individually added. Values of small divergences are minus those of big divergences, and the result is divided by the number of measured pappus. Then, the new result depends on its sign is added or minus the basic fiber length.

14.Above done measuring is repeated again with six newly taken pappus samples and registering the results in the table as the second sample, because fiber length measuring should be done in two replications.

15.Check the value of divergence between two replications (probes). It should not be more than 1 mm. If it becomes more, the third measuring will be done, and their average value will be accepted as the final result.

Questions and tasks to firm up acquired knowledge:

1. Does fiber length formation impact the textile qualities of cotton varieties?

2.What was not correctly completed with the pappus in the prepared package (photo ..) to measure the fiber length of individual selection?

3.List the laboratory instruments necessary to measure the length of fiber samples.

4. Can you list and describe the order and principles of measuring work and fill in the blank table with the results of fiber lengths?

5.Under the prompt of the teacher and on the basis of the lecture copy book, measure the length of fiber samples of 12 pappus (appendix 6).

Form 5. **Table on the measuring of fiber length in the selection samples by the help of velvet board.**

№ of fiber probes		-5	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	Sum of divergence from mean length, (+, -).	Difference of divergences	Number of measures	Fiber length on the probes, mm.	Average length on the probes, mm.
1																						
2																						
1																						
2																						

6. Under the prompt of the teacher and on the basis of the lecture copy book, measure the length of fiber samples of 22 pappus (appendix).

7.Describe the construction and use of the velvet board for measuring fiber length.

8. What kind of breeding materials are needed to prepare 12 and 22 pappus probes?

9. Describe the method of getting pappus from raw cotton samples to measure fiber length.

31-laboratory training. **Registration of documents of new variety to submit to State variety trail.**

The aim of this training is to study variety testing, the object of the state variety trial, the dignity of newly developed varieties, and the kinds of documents that must be presented by the breeders, together with a request for seed stock of a new cotton variety to be studied in the plots of the state variety trial.

Necessary training stationeries. Lecture and laboratory copy books, literature about breeding and seed production of cotton plants, and special forms of state variety trials to be filled in by the applicants.

The State trial on new plant varieties is conducted in the variety testing plots of the Center for the Variety Trial of Agricultural Crops at the Ministry of Agriculture of the Republic of Uzbekistan (photo 90, 91).

Photo 90, 91. View ***of one of the regional cotton variety testing plots of the Center on the variety trial of agricultural crops.***

The object of the state trial is the complete and comprehensive assessment of new varieties, created by the plant breeding establishments, singling out the best varieties on the complex of traits for introduction into production and defining the districts of their cultivation. Besides this, the Center fulfills the functions of defining the perspectives of the new varieties and including them in the State Register.

The Center for the Variety Trials of Agricultural Crops has a vast net of variety testing stations and plots (a total of 59) are disposed in various

zones of the cotton growing regions of the republic. They are: 1-Karakalpakistan, 2-Andijan, 3-Bukhara, 4-Jizzakh, 5-Kashkadariya, 6-Navoiy, 7-Namangan, 8-Samarkand, 9-Surkhandariya, 10-Sirdariya, 11-Tashkent, 12-Ferghana and 13-Khorezm.

Including the new varieties into state variety testing is implemented in a definite order. Only the varieties that revealed stable superiority over standard varieties on productivity and other economically valuable traits, as well as those that were sufficiently uniform for three-year competition variety testing in the plant breeding establishment, were submitted to the state variety trial.

Every variety remarked for submission in the state variety trial should have **a special card** that should include the following information: number or name of variety, botanic species, author and co-authors, origin of variety, years of testing. Fully characterized morphologic variety traits which distinguish from other varieties. Three-year data of competitive variety testing of the new variety and standard on all important economic-valuable traits: the first crop of raw cotton, until frost and total, crop of fiber, fiber output, its length, rupture length, fiber maturity, precocity, resistance to diseases and absolute weight of seed. The spinning properties of fiber are given separately.

Furthermore, the dignity of the new variety is considered by the scientific council of the plant breeding establishment, which will accept the decision about nominating the new variety and transfer it to the state variety trial. As a result of a positive decision, the author and co-authors of the new variety must execute the **next documents** to submit them to the state variety trial:

1.Letter to the name of the chairman of the Center.

2. Statement to the accepting in the variety test.

3.Resume about the variety.

4.Description of the variety.

5.Photo of the variety – 4 units.

6. Confirmation from a company to a legal entity or individual is necessary if the variety has a foreign origin.

Center on the testing of varieties of agricultural crops

100144, Great silk road street – 374. M. Ulugbek district. Tashkent city.

Application of recommendation to plant selection achievements

Form-90.

Request number _____ **Date of registration** **_____**

(Day/month/year)

1(a) Applicant(s)_____
(Legal person and address)
_____
_____
1(b) Citizenship (only individual)

2(a) Address and name of person, responsible to exchange information request_____

_____
_____
Contact number _____ Fax_____

2(b) Address and name of achievement originator _____

_____

Contact number _____ Fax_____

3(a) Genus,
_____
(Name in Uzbek and Russian)
3(b) Genus and
_____
(Name in Latin)

4(a) Proposed name _____

4(b) Breeding number _____

5 Co-authors (if the authors are not applicants) (Their given name and surname, fully)

_____

_____

_____

According my (our) information there is no other authors.

6.Previous requests	Registered		Number of statement	Rate	Under what name	I (we) i
	In the country	Date				our data statement
Recommendation to planting						with this achievem

7.Recommended regions by the originator to test the breeding achievement.

Sides of using	Numbers of regions (not need is deleted)											
	1	2	3	4	5	6	7	8	9	10	11	

Documents adhering to the request:

{} - Breeding achievement questionnaire – in 2 copies.

{} - Description of breeding achievement.

.

{} - Document ensuring the right to give statement (for legal successors and intermedia

{} - Photo complex

{} - Protocol of scientific council

I (we), ask to include the breeding achievement into State register of agricult recommended to planting.

I (we) approve that my (our) information available which are necessary to consideration and included in this statement and enclosure are completing and correct.

I (we) confirm that the accessions were taken properly and present representative sam breeding achievement.

I (we) undertake to provide required amount of seeds free of charge to the addresses by the plan of the State Commission to conduct tests on the economic usefulness.

Signature of applicant (s)

Place of the seal (s)

Authors-breeder is obliged to provide recommendations on the variety of agro-practices. He is obliged to provide state variety plots with the seeds of the new variety in an account of 20–25 kg per plot and send the seeds to the address of the variety plots.

Questions and tasks to consolidate acquired knowledge:

1. Where are the new developed cotton varieties tested before they are grown in the regions?
2. How are the regions of future introduction of the new variety identified?
3. What kinds of documents does the request comprise?
4. Compose the resume and description of one of the cotton varieties under the guidance of the teacher.
5. If the breeder has recommended testing his variety in four plots in different regions, how much seed must he provide for those plots?
6. Look through the text again and point out when the newly developed cotton variety is ready to present at the state variety trial.
7. Complete study of documents must be adhered to the letter of statement.
8. When the new variety would be included in the state register of agricultural crops, pointing out the numbers of regions?

32-practical training. **Requirements are presented for elite seeds and producing methods**.

The purpose of the lesson. This lesson is intended to increase the students' knowledge of the techniques of seed reproduction of the newly introduced cotton varieties and about the conceptions of elite seeds and their requirements on them, as well as the methods of inter variety crossing and without inter variety crossing.

Elite seeds are offspring of the seeds that have developed at the elite farms through selection and reproduction of the seeds of the best families grown in the seed nursery.

The basic requirements for the elite seeds and successive seed reproductions are depicted on the pages of the state standard (table 21), which is adduced below.

Table 21. State standard on cotton seed Uz.SS. 663:2006

Variety and planting quality indexes of seeds

Seed category	Variety purity %, not less	Germination %, not least	Moisture %, not more	Dockage (mass portion of mineral and organic sweepings)			Downy for delinted seed %, not more	Mechanical damage %, not more			Residual faberness %, not more		
				For fuzzy	For seed least downy	For delinted		For fuzzy	For seed least downy	For delinted	For fuzzy	For seed least downy	For delinted
OS ES	100	95	9.0	0.5	0.5	0.2	0.5	5.0	8.0	6.0	0.9	2.5	0.4
R-1	99	90	9.0	0.6	-‘-	0.3	0.4	6.0	-‘-	7.0	0.8	-‘-	0.4
R-2	98	90	9.0	0.7	-‘-	0.3	0.4	7.0	-‘-	8.0	0.8	-‘-	0.4
R-3	96	87	10.0	0.7	-‘-	0.3	0.4	7.0	-‘-	8.0	0.8	-‘-	0.4

The main object of seed reproduction is the production of the high variety of seeds of the commercially grown cotton varieties and the persistent enhancement of their planting qualities.

The seeds of high quality to meet the above listed requirements are obtained due to the cultivation of plants on a high agro-technical

background, by continuously directed selection of the best plants and application of inter-variety crossing by the breeder or originator of the definite variety. For this aim, **the seed nursery** is laid in the elite seed production farms, in which are studied and brought to light the best families for further reproduction (multiplication), and the plot of **seed reproduction** to get the elite – seeds (photo 92). The third plot - inter variety crossing (IVC) is laid in the farms, where, on understanding with the breeder, the originator of the variety, the inter variety crossing is carried out.

Photo 92. ***Outlook of seed reproducing plot.***

The techniques for the methods of elite seed production consist of:

1. The seed nursery is laid by individual selections of seeds (not less than 150) provided by the author of the variety together with a full description of the morphological and farm characteristics and the peculiarities of its agro- technique.

2. Harvesting is executed on the next successions: the first - discarded; the second –samples on 100 bolls; the third –individual selections; and the fourth –family raw cotton.

3. The seeds from individual selections service for planting in the next year's **seed nursery.**

4. The progeny of the not rejected (or not discarded) families are planted in the **seed reproduction nursery**.

Annually, on the plantations of elite and nearby seed producing farms, the seeds of the first, second, and third reproductions (R 1, R2, and R3) are planted with approval while adhering to appropriate agro-practices. As a result of approbation, the best fields are separated out for provision (preparation) of seed raw-cotton.

A scientifically substantiated and practically recognized seed production system has been elaborated and is successfully functioning throughout our republic. The system of seed production involves two agricultural measurements, which comprise the **strain changing and strain renovation** (figure 19) of agricultural crops grown in the republic. The efficiency of implementation of the strain renovation on the varieties primarily depends on the strictly observed instructions on elite seed production and its reproductions.

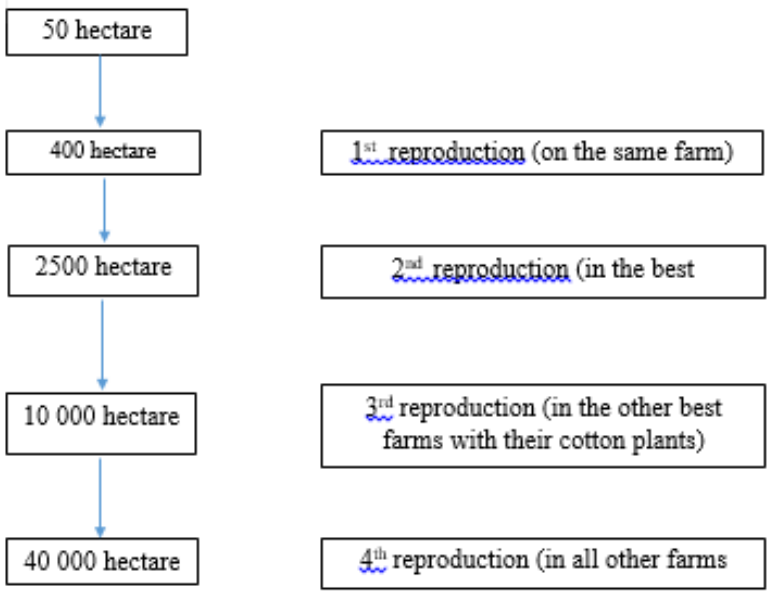


Figure 19. **Cotton variety renovation scheme on the example of one elite seed production farm.**

This scheme of variety renovation shows the amount of high quality sowing seeds in their reproductions to ensure mapped out areas of the production districts that service a certain elite farm. The number of cotton elite farms in our republic is made up of 72 (in 2004). They are organized throughout the cotton-growing zones of the republic, and their network across the cotton producing regions is approved by the government.

The seeds of only one commercialized cotton variety are produced on every elite farm. Planting the seeds of other varieties and conducting variety testing are not admitted in the territory under one elite farm. Historically, the amount of seeds to be produced was defined as enough to plan variety renovation on a five-year scheme, as shown in figure 19, to 40–50 thousand hectares.

According to the "Methodic manual on the production of the highest progeny seeds of cotton varieties included in the state register in the elite farms" published by the ministry of agriculture (2021), the elite seed and its reproductions are provisioned in an adequate amount to renovate the cotton variety in every zone on the basis of that five-year scheme. Production of sowing seeds and their multiplication in the scheme involves:

First year – production of elite (selected) seeds in specially designated elite seed producing farms.

Second year – production of the 1st reproduction seeds.

Third year – production of the second generation of reproduction seeds.

Fourth year – production of the 3rd reproduction seeds.

Fifth year – is planted for technic raw cotton in the 4th reproduction farms.

Consistently, much work is being done in the republic on radically improving cotton seed production, the specialization and concentration of sowing seed production, reforming seed production into industrial production bases, and innovational sowing seed production clusters (photo 93). From this perspective, elite seed producing farms are being strengthened and seed producing plantations are being expanded in them.

Photo 93. ***Sphere of activity of the agricultural cluster functioning in our republic.***

Internet sources about the conception of the term "cluster" in agriculture give the following definition: "Cluster farming **creates real profit by merging several smallholder farms** into satellites attached to a nucleus farm (hub farm) or to a solid entrepreneurial group (cluster), which is capable of sharing both the benefits and the burden."

One of the first objectives of agricultural clusters is to produce and realize sowing seeds of agricultural crops that correspond with the seed quality requirements of state and international standards.

In general, historically worked out methods to produce elite seeds and other reproductions (F1, F2 and others) involving work on the production of these seeds are retained as the best, regionally adopted method for our cotton producing conditions in the newly accepted innovative seed producing technologies.

Production of the first reproduction (F1) seed stocks.

The R1 plantation is located on the farm where the elite seed producing farm is located.

Plantation R1 is a plantation where elite seeds are planted.

The seeds are planted fully in separate individual areas without mixing with other seeds of reproductions or varieties in order to save the variety uniformity of the first reproduction.

Prior to the boll splitting open or the beginning of opening, the first reproduction areas are cleaned from off plants in accordance with the typical variety.

Seed stock raw cotton is harvested **twice** by hand:

The first time, when one single boll is split open on the 4^{th} and 5^{th} fruit branches of the cotton plant, and the second – the first opened boll is on the 7^{th} and 8^{th} fruiting branch.

Seed stock raw cotton is harvested only from normally developed, healthy, and fully opened bolls.

Seed stock before being handled to the provisional point, raw cotton is dried in the sun for one or two days by spreading it out on a specially prepared area. This method considerably improves the quality of seed stock.

Dried raw cotton is packaged into special hemp-made sacks. A special tag with records on the origin of raw cotton, name of variety, reproduction, and time of harvest is attached to the sack. A copy of this tag is placed in the sack. The seed stock of raw cotton is submitted to the provisional point with a registered list.

This list has a diagonal red line which separates seed stock raw cotton from technic raw cotton.

The grade purity of the first reproduction must not be lower than 99% (table 21). On the planting quality, its seeds must meet GOST requirements and the germination is to be no lower than 2 classes.

The seeds picked out from branches located below are formed in the good condition of nature or in the intensive photosynthesis activity of the maternal plant.

These kinds of seeds are more heavy, better matured and have high growing speed and germination potential.

Taking into account this state, the selection of seeds to plant is checked on the basis of biologic and date terms of raw cotton.

According to the instruction, the seed for seed stock is not taken from branches above the 7-8 fruiting branches.

Seed stocks of the first, second, and reproductions (R1, R2, and R3) are planted in the areas of farms located around elite farms by strictly observing appropriate agro-practices and approbation.

The best fields to harvest their raw cotton for the provision of seed stock are isolated on the basis of approbation.

Second (F2) and third reproduction (F3) seed production

The area of the second reproduction is placed on the nearest better farms, with one deserving cotton seed clearing plant. If the first and elite seeds are reproduced on one farm, the second and, in some cases, third reproductions are also placed on the same farm. The main area (third reproduction) in which the seeds of the third reproduction are to be planted is isolated from the best farms in the zone of other cotton seed clearing plants.

Table 22. **Seed quality indexes depending on the place of bolls on branches (in the example of the variety of 108-F).**

№ of fruiting branch	Bolls on the branches							
	First				Second			
	Weight of 1000 seeds, g.	Growing speed, %.	Germination, %	Maturity, %.	Weight of 1000 seeds, g.	Growing speed, %.	Germination, %	Maturity, %.
1	134.5	94	97	91\21	133.7	90	100	64\44
2	130.5	90	100	97\35	124.0	95	96	86\29
3	127.5	90	98	96/38	118.5	90	95	67\25
4	126.0	90	96	91\34	113.5	94	86	68\23
5	120.0	88	97	85\25				
6	119.0	85	88	83/32				
7	113.0	85	88	73\30				
8	114.0	81	88	74\44				
9	110.0	81	85	65\46				
10	106.0	68	72	59\37				

Seed production measures in the areas for cultivation of second and third reproduction are:

1) to consume the seed stock fund with great care that is planting of seeds not exceeding the fixed norm;

2) approval with careful consideration;

3) to comply with the instructions for harvesting seed stock, raw cotton separately, and

4) to fulfill all obligations on the composed agreement by farm. Seed producing agronomist is responsible for fulfilling all measurements of the farm.

All documents concerning the seed stock are composed under his responsibility. He inspects the precision of seed expenditure of the seeds for planting.

To do approbation of fields designated for seed stock provision under the supervision of the district approbation-agronomist,

He had to organize the harvesting of seed stock and raw cotton separately and fulfill all obligations accepted by his farm.

Commonly, only one variety and one reproduction are planted on one farm. If, two reproductions are mapped out to be planted on the farm, here they are planted alone in the remote departments of this farm. The special attention is paid on the harvesting of seed stock raw cotton alone, storage and drying and also transfer to provisional point.

A great deal of attention at the time of production of top reproduction seeds will be focused on the saving of seed quality, which is expressed by its germination. As we all know, germination is the percentage of normally grown seeds that germinate in a specific laboratory condition.

According to a corresponding standard, germination of the seeds is divided into 3 classes in the percentage:

1 – at least 95;

2 – at least 90;

3 – at least 85.

The tasks for the students in the group to extend their knowledge of elite seed production and strain renovation are:

1. Redraw the blanked scheme without records and numbers of the above presented scheme on cotton strain renovation and fill it in with corresponding terms by prior translation of all records into Uzbek and Russian.
2. A recount of all kinds of analyses conducted in the laboratory on the basis of harvested samples (100 bolls) from the selected families.
3. Redraw photo 93 in the scheme view without records on the given cluster and fill it in with corresponding terms by translating all records into English.

Glossary of some key terms.

Name of terms	In English	In Uzbek	In Russian
Approbation –	Research, conducting in the field with the purpose of determination the genetic purity rate (grade) of plants, resistance to diseases, pests and the general state of seeds, designated to the planting.	O'simliklarning genetik (nav) jihatdan kanchalik toza ekanligini, kasalliklarga, zararkunandalarga chidamligi va ekishga mo'ljallangan urug'likning umumiy holatini aniqlash maqsadida dalada o'tkaziladigan tadqiqot.	Исследование, проводимое на поле с целью определения генетической (сортовой) чистоты растений, устойчивости к болезням, вредителям и общего состояния семян, предназначенных для заготовки посевных семян.
Biological impurity of the variety –	Natural pollination of the variety with other variety or crop taking place in the result of accidental mutations.	Navning boshqa nav `ki ekin bilan tabiiy changlanishi va kichik mutatsiyalar natijasida kechadigan ifloslanish.	Загрязнение, происходящее в результате естественных скрещиваний одного сорта с другим сортом или культурой и случайных мутаций.
Bred variety –	The variety, developed at the scientific research enterprises on the base of scientific selection methods.	Ilniy-tadqiqot muassalarida seleksiyaning ilmiy usullari asosida yaratilgan nav.	Сорт, созданный в научно - исследовательских учреждениях на основе научных методов селекции.
CMS –	Cytoplasmic male sterility (infertility), that is pollen grains inability to impregnation.	Sitoplasmatik erkak sterilligi (pushtsizligi), yani chang donachalarining naslsiz (puch) bepusht bo'lishi.	Цитоплазматическая мужская стерильность (неспособность к оплодотворению), то есть, пыльцевые зерна неспособные к оплодотворению (щуплые).

Coefficient of propagation –	Ratio of conditioned seed stock yield to the amount of planted seed stock.	Konditsiyali urug'lik hosilining ekilgan urug'lik miqdoriga nisbati.	Соотношение урожая кондиционных семян к количеству посеянных семян.
Dominancy –	The privilege of one over other on allele traits in the heterosis organism.	Geterozigota organizmda allel belgilardan birining ikkinchisidan ustun turishi.	Преимущество одного над другим по аллельным признакам в гетерозисном организме.
Elite –	Seed stock, produced from propagation of the best plants, belonging to the variety, which inherited all characteristics to the next generation.	Navga hos eng yahshi o'simliklarning tanlab, ko'paytirib olgan urug'ligi bo'lib, navning barcha irsiy belgi va husissiyatlarini keyingi bo'ginlarga o'tkazadi.	Семена, полученные путем отбора и размножения от наиболее типичных для сорта растений, которые передают все наследственные признаки и свойства сорта следующему потомству.
Emasculation –	Nipping off (removing) grain pollens from flowers of maternal plant.	Ona sifatida olingan o'simlikning gulidagi changdonlarni terib olish (yulib tashlash).	Удаление пыльников из цветков материнских растений.
Family –	Progeny of one cross pollinating plant, taken via propagating.	Chettan changlanuvchi bitta o'simlikni ko'paytirib olingan avlodi.	Потомство одного перекрестно опыляемого растения, полученного путем размножения.
Heredity –	Transferring of trait and properties of the organism from generation to generation.	Organismdagi belgi va hususiyatlarning nasldan naslga o'tishi.	Передача признаков и свойств организма от потомства к потомству.
Heterosis –	Becoming vigorious, viability and productivity of the first	Birinchi bo'g'in (F_1) duragayining ota va ona	Мощность, жизнеспособность и

	hybrid generation (F_1) comparing with parental organisms.	organismlarga nisbatan kuchli, hayotchan va mahsuldor bo'lishi.	продуктивность первого поколения гибридов (F_1) по сравнению с родительскими организмами.
Hybrid –	A new generation, distinguishing with hereditary traits and properties taken by crossing of two and more organisms.	Irsiy belgi va hususiyatlari bilan farq qiladigan ikki va undan ortiq organismlarni chatishtirib olingan yangi bo'g'in.	Поколение, полученное путем скрещивания двух и более организмов, отличающихся по наследственным признакам и характеристикам.
Hybrid population –	Totality of organisms differing from each other on hereditary sign, taken in the result of crossing.	Chatishtirish natijasida olingan irsiy jihatdan bir-biridan farqlanuvchi organismlar to'plami.	Совокупность организмов, полученных путем скрещивания, отличающихся друг от друга по наследственному признаку.
Hybridization of remote forms –	Hybridization of plants different in their species and genus.	Turlari yoki turkumlari boshqa boshqa bo'lgan o'simliklarni duragaylash.	Гибридизация растений от разных видов и родов.
Industry based seed breeding –	Specialization, seed stock material concentration in a specialized production, meeting the requirements of the State standards on variety, seed stock and crop quality, and also seed breeding organization on the base of all technological processes of	Nav, urug'lik va hosil sifatlari bo'yicha davlat standarti va tehnik talablarga javob beradigan urug'lik materiallar mahsus ihtisoslashgan ho'jaliklarda ishlab chiqarishni ihtisoslashtirish, kosentratsiyalash, barcha tehnologik jarayonlarni	Специализация, концентрация производства семенных материалов в особо специализированных хозяйствах, отвечающих техническим и государственным стандартам по сортовым, посевным и урожайным качествам, а

	mechanization and automation, using the least labour expenditure.	mehanizatsiyalashtirish hamda avtomatlashtirish asosida eng kam mehnatni sarflab urug'chilikni tashkil etish.	также организация семеноводства на основе механизации и автоматизации всех технологических процессов, используя наименьшие затраты труда.
Insurance seed fund –	Seed reserve (stock), established at the state depositories or directly in the farms to use at the time of natural disasters. Its amount is different, depending on the various sections of seed stock system. For example, Insurance fund in the primary seed sections makes 100 % in ratio to seed stock necessity, depositing amounts are consisted for super elite - 50 %, elite and 1 reproduction – 25-30 %.	Tabiiy ofatlar vaqtida foydalanish uchun to'g'ridan-to'g'ri ho'jaliklarda yoki davlat jamg'armalarida yaratilgan urug'lik zahirasi. Uning miqdori urug'lik tizimining turli zvenolarida har hil bo'lib, masalan, birinchi urug'lik zvenolarida ehtiyot fondi urug'likka bo'lgan ehtiyojga nisbatan 100% miqdorda, superelita uchun 50%, elita va 1 reproduksiya uchun 25-30% miqdorda jamg'ariladi.	Запас посевных семян, созданный из непосредственно хозяйственных или государственных закромов, для их использования во время природных катастроф. Его объём различается в зависимости от звеньев в системе семеноводства. Например, объём набора страхового фонда в звеньях первичного семеноводства составляет 100% от их нужд в посевных семенах, для супер элиты 50%, для элиты и 1 репродукции 25-30%.
Intensive type variety –	The variety, possessing by high photosynthesis capacity, possibility in effective using of	Fotosintetik qobiliyati yuqori bo'lib, tashqi muhit omillaridan (tuproq, suv, ug'it va	Сорт с высокой фотосинтетической способностью, отзывчивый к

	environmental factors (soil, water, fertilizer and light) and also resistant to lodging, diseases, pests and adverse external stresses and give capability to bumper crop with quality products.	yorug'likdan) unumli foydalana oladigan, hamda yuqori agrotehnika sharoitida yotib qolishga, kasallik, zararkunanda va boshqa noqulay tasirlarga chidab, mol hosil va sifatli mahsulot beradigan nav.	условиям внешних факторов (почва, вода, удобрения и свет), устойчив к полеганию, болезням, вредителям и другим стрессам и способный дать большой урожая и качественную продукцию.
Introduction –	Bringing of the species and varieties of plants from other territories.	O'simliklarning tur va navlarini boshqa joylardan keltirish.	Привоз видов и сортов растений из других территорий.
Mechanical contamination of the variety –	Seed stock's mixing (pollution) with other variety or crop at harvest, renewing, purification, transportation processes.	Hosilni yig'ish, yangilash, tozalash, tashish kabi jarjayonlarda urug'likning boshqa vav yoki ekin urug'iga aralashib ketishi (ifloslanishi).	Загрязнение посевных семян семенами других сортов или культур во время сбора урожая, обновление, очищение и транспортировки.
Modification variability –	Not hereditary (phenotype) variability.	Irsiy bo'lmagan (fenotipik) o'zgaruvchanlik.	Ненаследственная (фенотипическая) изменчивость.
Mutational variability –	It arises by the external influences and does not transmit from generation to the generation.	U tashqi sharoit tasirida uzaga kelib, bo'g'indan-bo'g'inga berilmaydi.	Она возникает под влиянием внешней условии, но не передается по наследству.
Mutation –	A sudden (by spasmodic way) hereditary altering of traits and properties in the organism.	Organismdagi belgi va hususiyatlarning tasodifiy (sakrash yoli bilan) irsiy o'zgarishi.	Случайная (неожиданная), наследственная изменчивость признаков и свойств организма.

Phenotype –	Sum of external and internal traits (properties), formed together in the organism in the result of interactions of organism's genotype and environmental conditions.	Organism genotypi bilan tashqi sharoitning o'zaro tasiri natijasida organismda shakllanadigan tashqi va ichki belgilar (husisiyatlar) yig'indisi.	Совокупность внешних и внутренних признаков (свойств), сформировавшихся в результате взаимодействия генотипа организма и условий окружающей среды.
Population –	A group of plants, spreading in a certain areal (territory), belonging to one species, freely mats within species, but differs in regard of heredity.	Muayyan arealda (territoriyada) tarqalgan, bir turga mansub bo'lgan, o'zaro erkinchatishadigan, lekin bir-biridan irsiy jihatdan farq qiladigan o'simliklar to'plami.	Группа растений, распространённых в определенном ареале (территории), относящихся к одному виду, свободно скрещивающиеся между собой, но наследственно отличающиеся друг от друга.
Polyploids –	Hereditary variation depending on multiply increasing the haploid chromosome sum of organism.	Organism gaploid hromosomalar yig'indisining karrali ortishi bilan bog'lik bo'lgan irsiy o'zgaruvchanlik.	Наследственная изменчивость, связанная с кратным увеличением гаплоидных наборов хромосом организма.
Reproduction –	It means copy taking, that is a consecutive seed obtaining by propagation of elite seeds, taking of 1-reproduction through planting of elite seed stocks, and from it to produce the 2-reproduction, from this to produce the 3-the last	Nusha ko'chirish degan manoni bildirib, elita urug'larni ko'paytirib olingan urug'lik, yani elita urug'lik ekilib 1-reproduksiya urug'lik, undan esa 2-reproduksiya, undan 3 va so'nggi reproduksiya urug'liklar olinadi.	Означает снятие копии, т.е. последовательное получение семян, посевная от размножения элиты, 1-репродукция от посевов элиты, далее 2-репродукция, 3-и последняя репродукции.

	reproductions.		
Seed control –	A system of measures, directed to inspect seed sowing suitability at the time of producing, storage and releasing from warehouses.	Urug'ni etishtirish, saqlash va amborlardan chiqarish vaqtlarida urug'likning ekinboplik husisiyatlarini tekshirishga qaratilgan tadbirlar tizimi.	Система мероприятий, направленных на проверку посевных свойств семян во время выращивания, хранения и выноса их из хранилищ.
Seed production –	It is the special branch of agricultural production, the main aim of which is to mass multiplication of zoned and registered into state register seeds of growing varieties in peasant, farmer and community farms through maintain their variety purity, biologic and farm properties.	Qishloq ho'jalik ishlab chiqarishining mahsus tarmog'I bo'lib, uning asosiy maqsadi dehqon, fermer va jamoa ho'jaliklarini rayonlashtirilgan, Davlat reestiriga kiritilib ekilayotgan navlarning urug'ini nav tozaligi, biologic va ho'jalik hususiyatlarini saqlab ommaviy ravishda ko'paytirish.	Являясь специальной отраслью производства сельского хозяйства, её основной цель является сохранение сортовой чистоты, биологических хозяйственных свойств и массовое размножение сортов семян, районированных в дехканские и фермерские хозяйства, включенных в государственный реестр.
Seed production scheme –	A complex of inter linked nurseries and seed stock plantations, designed to renew (reproduction of seed stock) of the variety via purposeful order of selection and propagation.	Muayyan tartibda tanlash va ko'paytirish bilan navni yangilab turishga (urug'likni qayta etishtirib turishga) qaratilgan o'zaro bog'langan pitomniklar va urug'lik ekinzorlarining majmui.	Комплекс связанных между собой питомников и семенных посевов, направленных на сорто - обновление с определенным порядком отбора и размножения (перепроизводство посевных

			семян).
Seed production system –	A complex of inter linked production nets, providing all crop plantations with excellent quality seeds of one or several crops. according to the state plan.	Davlat planiga muaffiq barcha ekin maydonlarining bir yoki bir qancha ekinlarning a'lo sifatli urug'lari bilan ta'minlab turadigan, bir biri bilan o'zaro bog'langan ishlab chiqarish tarmoqlarning majmui.	Комплекс производственных отраслей, связанных между собой и обеспечивающих все посевные площади высококачественными семенами одной или нескольких культур, соответственно с государственным планом.
Strain –	Progeny of one, self-pollinating plant.	O'zidan changlanuvchi bitta o'simlikning avlodi.	Потомство одного самоопыляющегося растения.
Strain changing –	Changing of one elder variety of the crop, grown in the industry, by the new more productive and fine quality product variety.	Biror ekinning ishlab chiqarishda ekib kelinayotgan eski navini serhosil va mahsulotning sifati yahshiroq bo'lgan yangi navi bilan almashtirish.	Замена старого сорта одной из культур, высеваемого в производстве, новым сортом с лучшими по урожайности и качеству продукции характеристиками.
Super elite –	Seed stock of superior productivity, grade and planting attributes. It is produced from the nursery of family multiplication, established at the process of elite seed production.	Mahsuldorligi, nav va ekinboplik hususiyatlari eng yuqori bo'lgan urug'lik. U elita urug'lari etishtirish jaroyonida tashkil etiladigan oilalarni ko'paytirish pitomnigidan olinadi.	Посевные семена с наивысшими продуктивными, сортными и посевными свойствами. Она получается путем размножения семей, созданных в процессе производства семян элиты.
The plant	The creation of the new	Dehqonchilic sohasida yangi	Наука о методике улучшения

breeding –	varieties (hybrids) in the farming branch and the science about the methods of improving the varieties under production.	navlar (duragaylar) yaratish va ekilib kelinayotgan navlarni yahshilash usullari to'g'risidagi fan.	высеваемых сортов и создания новых сортов (гибридов) в отрасли земледелия.
Triticale –	56 and 42 chromosomal wheat - rye amphidiploids.	56 va 42 hromosomali bug'doy-javdar amfidiploidlari.	Амфидиплоиды пшеницы и ржи, состоящие из 56 и 42 хромосомов.
Variation –	Quality and quantity altering of traits.	Belgining sifat va miqdor jihatidan o'zgarishi.	Качественные или количественные изменения признаков.
Variability –	Difference of organism progeny from own ancestors on some of characteristics and properties.	Organizm avlodining o'z ajdodlaridan qandaydir belgi yoki hususiyatlar bilan farq qilishi.	Отличие потомства организма от своих предков по каким-нибудь признакам и свойствам.
Variety –	A group of plants, created by the method of selection, which have a certain hereditary, morphologic, farm, biologic trait and attributes	Seleksiya usullari bilan yaratilgan, aniq irsiy morphologic, biologic, ho'jalik belgi va hususiyatlarga ega bo'lgan o'simliklar guruhi.	Группа растений, созданная методом селекции, обладающая определенной наследственностью, морфологией, хозяйственно биологическими признаками и свойствами.
Variety control –	A system of measures, directed to the full provision of all cropping fields by high quality seed stock, on the base of state standard requirements,	Dala aprobasiyasi yordamida amalga oshiriladigan barcha ekin maydonlarini davlat standarti talablari asosida yuqori sifatli urug'lik bilan	Система мероприятий, направленных на полное обеспечение всех посевных площадей культурами с высококачественными

	realizing with the help of approbation.	to’la ta’minlashga qaratilgan tadbirlar tizimi.	семенами, на основе государственных стандартов, осуществляемых путем апробации.
Variety renewing –	Rotation of high planting quality seeds of the same variety after diminishing its crop, seed planting qualities and biological attributes in the result of growing in the industry.	Bir nav ishlab chiqarishda ekilib, uning hosili, urug’likni ekish sifatlari va biologik hususiyatlari pasayganidan so’ng shu navning urug’lik sifati yuqori bo’lgan urug’ bilan almashtirib ekish.	Замена семян сорта, высеваемых в производстве, после того как у них понизилась урожайность, посевное качество и биологические свойства, семенами этого же сорта, обладающих высокими семенными качествами.
Variety trials –	Conducting of preliminary (small), competitive (enlarged), ecologic industrial, dynamic and state trials in the process of new variety creation.	Yangi nav yaratish jarayonida shu navni dastlabki (kichik), konkurs (kata), ecologic ishlab chiqarish, dinamik va davlat nav sinashlaridan o’tkazish.	Проведение предварительных (станционный), конкурсных (расширенный), производственно-экологических, динамических и государственных сортоиспытаний в процессе создания нового сорта.

Appendixes

Appendix 1.

Filled image of seed planting list.

Date of planting	N of row	N of seed bags	N of individual selections	Date of planting	N of row	N of seed bags	N of individual selections
14.04.20	1	1	2	14.04.20	39	39	
-\\-	2	2		-\\-	40	40	
-\\-	3	3	5	-\\-	41	41	46
-\\-	4	4		-\\-	42	42	
-\\-	5	5		-\\-	43	43	
-\\-	6	6	8	-\\-	44	44	47
-\\-	7	7		-\\-	45	45	
-\\-	8	8	10	-\\-	46	46	
-\\-	9	9		-\\-	47	47	
-\\-	10	10		-\\-	48	48	48
-\\-	11	11	14	-\\-	49	49	
-\\-	12	12		-\\-	50	50	49
-\\-	13	13	18	-\\-	51	51	
-\\-	14	14		-\\-	52	52	
-\\-	15	15		-\\-	53	53	50
-\\-	16	16		-\\-	54	54	
-\\-	17	17	21	-\\-	55	55	
-\\-	18	18		-\\-	56	56	
-\\-	19	19	22	-\\-	57	57	51
-\\-	29	29		-\\-	58	58	
-\\-	21	21		-\\-	59	59	
-\\-	22	22	25	-\\-	60	60	52
-\\-	23	23		-\\-	61	61	
-\\-	24	24		-\\-	62	62	
-\\-	25	25	30	-\\-	63	63	53
-\\-	26	26		-\\-	64	64	
-\\-	27	27		-\\-	65	65	54
-\\-	28	28	33	-\\-	66	66	
-\\-	29	29		-\\-	67	67	
-\\-	30	30	35	-\\-	68	68	55
-\\-	31	31		-\\-	69	69	

-\\-	32	32		-\\-	70	70	56
-\\-	33	33	39	-\\-	71	71	
-\\-	34	34		-\\-	72	72	57
-\\-	35	35	43	-\\-	73	73	
-\\-	36	36		-\\-	74	74	
-\\-	37	37		-\\-	75	75	58
-\\-	38	38	45	-\\-	76	76	

Appendix 2.

Diversity of special breeding bags and tags to use in the cotton breeding process.

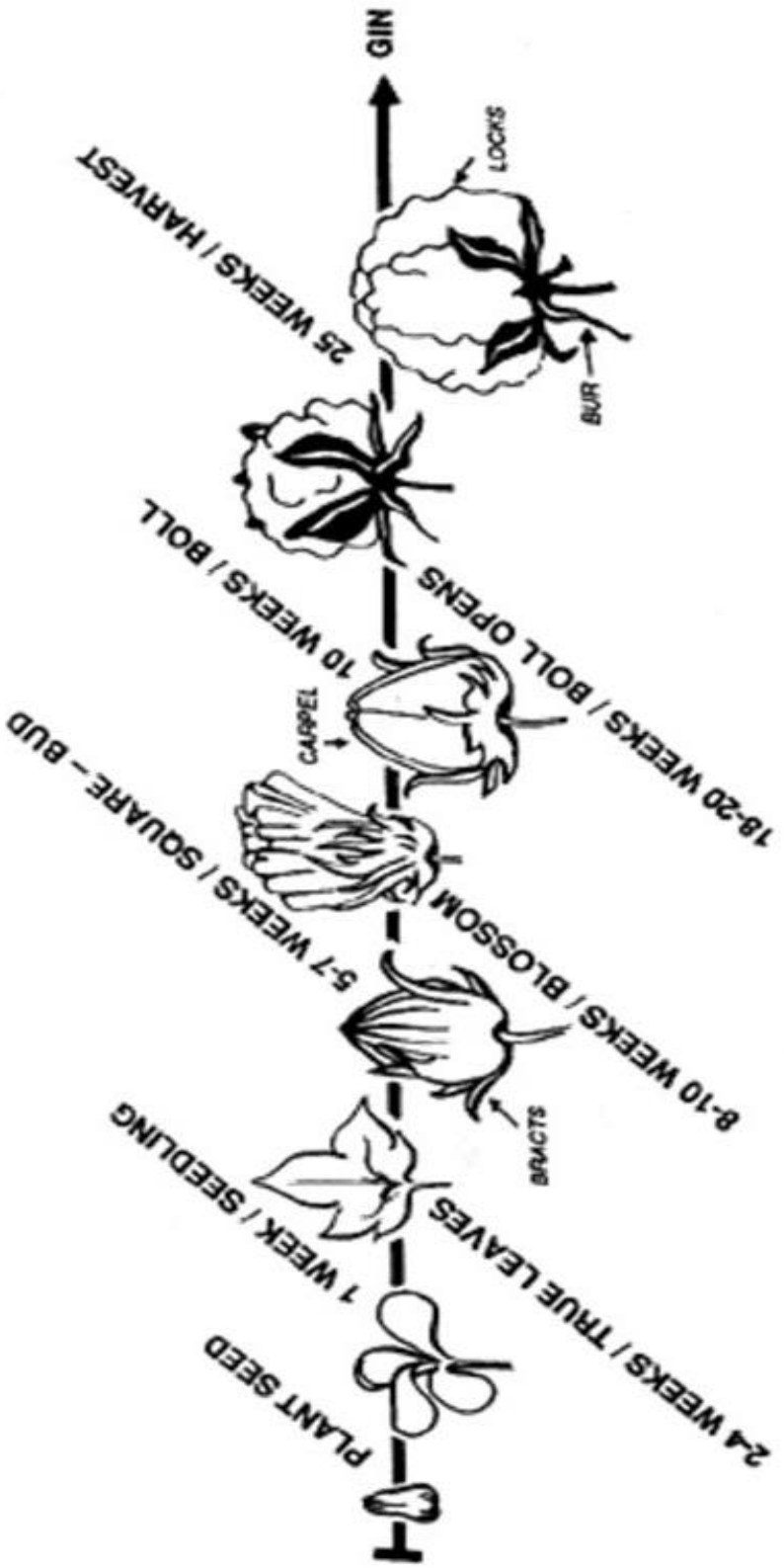






Appendix 3.

The growth cycle of cotton plant.



The growth cycle of the various cotton species vary in length, but the sequence of fruit production remain the same. Weather, insects and moisture can adversely affect optimum conditions for plant growth and it is the farmer's responsibility to adjust to these conditions to optimize yield.

Appendix 4.

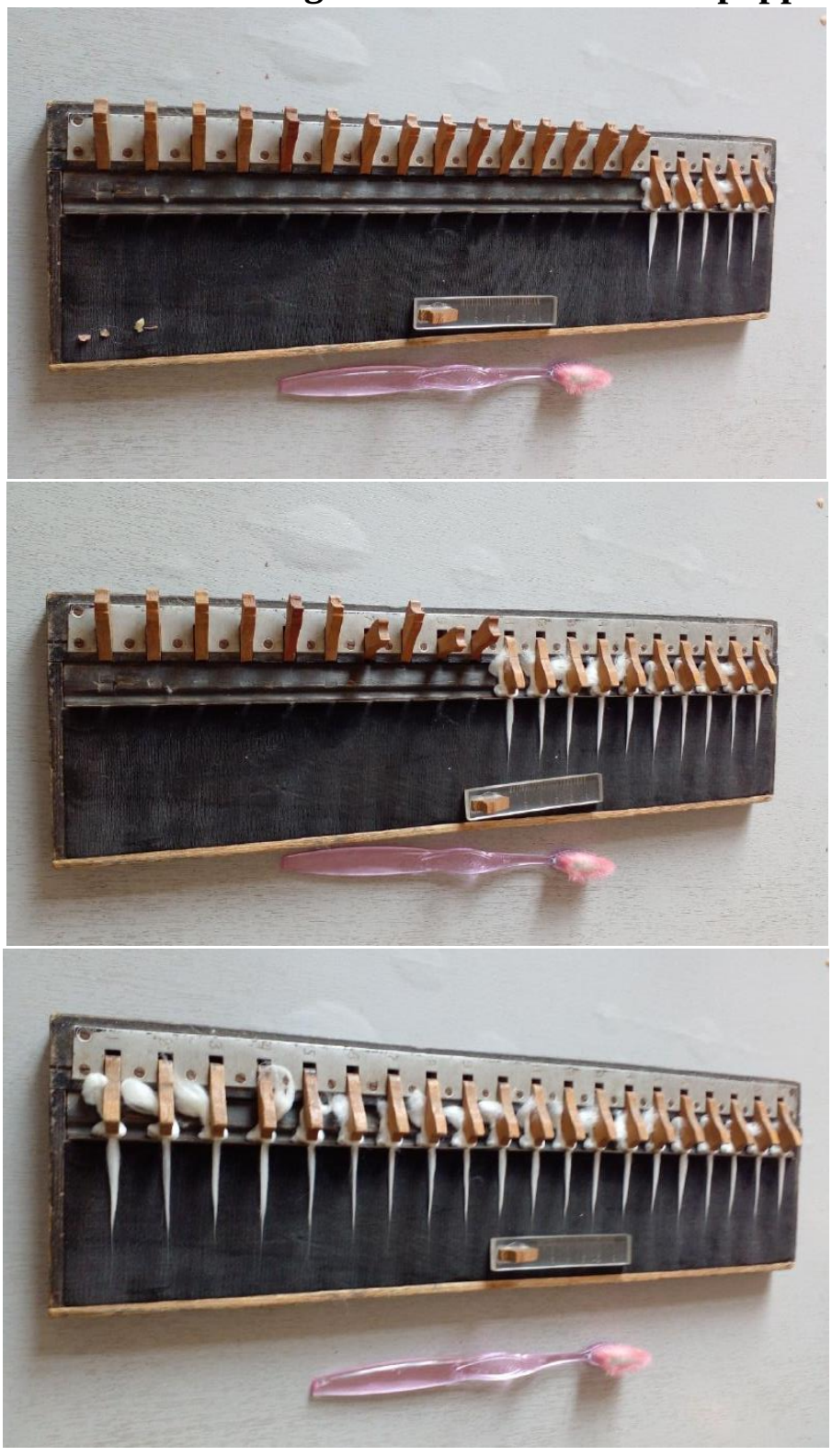
Filled image of field note book.

Date of planting	N of row	N of sample bags for individual selections	N of row in the previous year	N of tags and notices
14.04.20	1	2	3	
-\\-	2			
-\\-	3	5	5	
-\\-	4			1 and 2: plants of early flowering.
-\\-	5			
-\\-	6	8	5	
-\\-	7			
-\\-	8	10	7	
-\\-	9			3, 4, 5: plants of enlarged bolls.
-\\-	10			
-\\-	11	14	9	
-\\-	12			
-\\-	13	18	9	
-\\-	14			
-\\-	15			6: plant with closed flowers
-\\-	16			
-\\-	17	21	10	
-\\-	18			
-\\-	19	22	10	
-\\-	29			
-\\-	21			
-\\-	22	25	11	8, 9: plants of compact architecture with hair covered woods.
-\\-	23			
-\\-	24			
-\\-	25	30	11	
-\\-	26			

-\\-	27			
-\\-	28	33	14	
-\\-	29			
-\\-	30	35	15	
-\\-	31		16	
-\\-	32			
-\\-	33	39	16	
-\\-	34			
-\\-	35	43	19	
-\\-	36			10: plant with serrated leaf.
-\\-	37			
-\\-	38	45	20	

Appendix 5.

Velvet board for measuring of different number of pappus probes.



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