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INFLUENCE OF PLANT DENSITY ON PRODUCTIVINESS AND CORRELATION BETWEEN PRODUCTIVITY ELEMENTS

Abstract

The article is devoted to the introduction of the "Studying of the effect of external conditions and components of agro-technical cultivation components on falling degree of vegetative organs of cotton plant" which was started in 2011, where the plant density is also described. The experiment was carried out in the plots with 100m length, 4-rowed fields by 4 repeats and 12 options. The size of each of the rows was 240 m^2, total experimental plot equaled 240 x 12 x 4=11520m^2.

By that purpose observation over plant densities had been conducted in the experiments which were based on introduction of microelements at two periods, on background of fertilizers N_{100} P_{100} K_{50}, two plant densities and three deeply varying irrigation regimes. The factors affecting on decline at 6020x1; 60x20x2 plant density, dependence between plant density and mass of a ball, plant density and productiveness are determined.

Keywords: *plant density, water-nutrition, irrigation regime, hard, optimal, high regime of irrigation, nutrition area, fruit organs, falling, correlation*

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Bitki sıxlığının məhsuldarlığa və məhsuldarlıq elementləri arasındakı korrelyasiyaya təsiri

Xülasə

Məqalədə "Pambıq bitkisinin bar orqanlarının tökülmə dərəcəsinə xarici şərait amillərinin və aqrotexniki becərmə komponentlərinin təsirinin öyrənilməsi" mövzusunun icrasına 2011-ci ildə başlanmış və həmin tədqiqatın araşdırma obyektlərindən biri olan bitki sıxlığından bəhs olunur. Təcrübə uzunluğu 100 m olan, 4 cərgəli ləklərdə, 4 təkrarda, 12 variantda yerləşdirilmişdir. Hər ləkin ölçüsü 240 m^2 olmaqla, cəmi təcrübə 240x12x4=11520 m^2 sahədə yerləşdirilmişdir.

Bu məqsədlə, bir-birindən kəskin fərqlənən üç müxtəlif suvarma rejimində, iki bitki sıxlığında, N_{100} P_{100} K_{50} gübrələri fonunda mikroelementlərin iki müddətdə tətbiqinə əsaslanan təcrübədə bitki sıxlığı üzərində müşahidələr aparılmışdır. 60x20-1; 60x20-2 bitki yerləşməsində tökülməyə təsir edən amillər hər tərəfli araşdırılmış, bitki sıxlığı ilə bir qozanın kütləsi arasında, bitki sıxlığı ilə tökülən ümumu bar orqanları arasında, bitki sıxlığı ilə məhsuldarlıq arasında olan qarşılıqlı asılılıqlara aydınlıq gətirilmişdir.

Açar sözlər: *Bitki sıxlığı, su-qida, suvarma rejimi, sərt, optimal, yüksək suvarma rejimləri, qida sahəsi, bar orqanları, tökülmə, korrelyasiya.*

Introduction

Cotton plant is economically universal technical crop which is one of the main fields in the agricultral economics of our country. Its signifficance is due its indispensable fiber. Cotton fiber is the main raw- material for knitting industry. It is used in preparing of different textile, thread and cloth, as well as various technical production.

There is no field of national economy where cotton isn't used - in motor-car and plane production, chemical industry, cattle breeding, medicine, food industry etc. That's why production of that plant have to be increased on intensive plant-growing principles.

It is known that icrease of row cotton production in direction of dynamic development is possible not only by introduction of new varieties with high biological potencial plastic to various extremal conditions, but also by taking into account the specific agtotechnical signs of cultivated crops and agro-climatic conditions of production years and correct binding of matters of cultivation technology.

The components of cultivation technology irrigation and correct feeding of plants during vegetative period are important factors regulated by human mind.

There are a lot of reasons of getting low production on cotton fields. One of them is falling of vegetative organs. Decline of vegetative organs (buds, flowers, balls) are happened in connection with violation of

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physiological and agrotechnical measures (50-60% and more). Degree of falling of fruit organs also depends on external condition and hereditary trait factors. Lack and abundance of humidity in the soil, disbalanced fertilizer, strong winds, overheat, injures by diseases and pests, etc. Increase the defolation. Besides that the length of day also has a signifficant effect. The factors caused to falling of fruit organs lead to decrease of productivity.

MATERIALS AND METHODS. For increase of productivity - the main factor in icrease of economical effectifiness of cotton growing, the actual task is minimizing of the falling of fruit organs which is thought to be a global problem. By this purpose a scientific research work had been started by us in 2011. The research work was carried out at deeply varying 3 different irrigation regimes (hard, optimal, high), by using fertilizer norms N_{100} P_{100} K_{50} on background of microelements.

The research work was carried out by generally accepted Aslanov H.A.,Valiyeva M.A. methodics (Aslanov, Valiyeva, 2013). The reasearch work was placed on 4- rowed plots with 100m of length, 12 options, size of each plot was $240m^2$, total experimental area formed $240x12x4=11520m^2$. One of the objects of research is plant density.

Plant density is the main factor affecting on growth, development and productivity of cotton plant. Plants grow intensively on rare plantations. But as the quantity of plants on plantations are not large, the total production of a unit field is less. If the number of plants on the field are high their height will be short in connection with their requirement for defined feeding matters.The number of balls on a bush will decrease, but production from a unit area will be high. A lot of fruit organs are collected on the each of the bushes (Aslanov, Valiyeva, 2014: 520). **RESULTS AND DISCUSSIONS**. Although the theme of plant density, placement of plants on the field had been the main research object for lots of researchers for a long period of time this task is still hadn't found its solvation. This is connected with the difficulties faced during studing of that problem.

Placement of plants in the field is a very dinamic factor. While an optimal density in one field gives positive result, in other it may be otherwise in the other options. In the same plant density (same number of plants in 1 hectare) in dependence with sown seed variety, degree of soil fertility, introducted mineral fertilizer norms, irrigation regime, quality of agrotechnical measurements and other reasons it has different influence. That's why there is a necessity of conduction of research on plant density on scientific basis.

Practice on the plant density is widealy spread in our country. So, creation of condition for effective using from solar radiation for plant density is one of the most important factors of managing the photosynthetisis prosess. Before the determination of the main rules and their practical introduction the task had been studied for a very long time. Such researches being one of the stages of scientific history had given valuable results, some of them are still of great signifficance. New achievements on this sphere of science will create opportunities for strengthenning and improvement of practice on plant density.

Different plant density – the distance between the plants in the row may be achieved by regulating the number of plants in the nest, also by narrowing or widening the distance between the roads, keeping the definite number of plants in the row or in the nest. Let's have a look to the works of scientists worked despite the methods of placement.

The first research works on studying of plant density took place in the first half of XIX century. In 1881 E.Volni at the end of results of experiments which were conducted over the plant density defined that the productivity of great number of types of agricultural crops depend on fertility degree of soils. The author had defined that the higher soil fertility and wider feeding area, the higher the productivity. High yield on relatively less productive soils may be achieved by increasing of plant density.

The next researches had shown that during definition of plant densities the characters of cultivated crop and introduced agrotechnics have to be taken into account. A great signifficance to plant density had given also by D.N.Pryanishnikov. Generalization and studying of materials, also the results of his own practices gave an opportunity to D.N.Pryanisnikov to give a great importance to feeding area of agricultural crops. Altogether he noticed that fertility of soil, biological signs of soil, mineral feeding, water support and other factors have to be taken into account.

Plant density have been of great inportance all over the cotton-growing history. The signifficance of that problem is still actual. M.V.Mahammadjanov's and others'research works conducted on this direction over the determination of plant densities, as well as noticed in the S.Kh.Yuldashov's monography devoted to the solvation of laying problems of cotton plant (Mukhamedzhanov, Suleymanov, Dusmukhamedov, Zakirov, 1972; Yuldashev, 2012: 29-31; Yuldashov, 1964).

The factors of studying of plant placement on a plant density are also of great signifficance.

At the result of research works conducted over the plant density in the Agricultural Institute of UZ.SSR it had been defined that production of raw-cotton at the same plant density depends on the number of plants in the nest. The productivity was higher for 6-7sen/ha at 112 thous. plants compared with the option with more number of plants. On the fields with the short distance of underground water the optimal plant density per hectare was 80-90

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thous., on gray soils- 120, and on the soils weakly supplied by nutrition matters – 130-140 thous (Ergashev, Rustamov, Abdullaev, Kobilov, 2016: 153-154).

Each of the plant density has to be suited with the length of the main stem defined by experimental way, by irrigations, by fertilizers and other agrotechnical measurements. The length of the plant for the variety 108F at 110-120 thous. plants must be 14-23cms at budding stage, 42-48 cms at flowering stage, and 80-85 cms from flowering till castration. At such height the plants receive enough light, balls formation and openning of balls occur in time.

The fine-fibre variety 108F with had been studied at plant densities from 61 thous. to 132 tous. under conditions of Tajikistan. Increase of cotton had been observed at plant density 71-61 thous. So, the plant density for the variety 108F is recommended to be increased from 100-120 thous. to 135 thous (Yuldashev, 2011: 192-193; Tsikov, 2016: 15-17).

The researches on placement of cotton plant had been carried out by collaborators of Institute for Experimental Biology of Plants of Uz.SSR. Only one plant in the nest creates conditions for stability of plant to laying due to which increase of yield is obtained. The best result was received at 114,2 plants. By increase of plant density to 171 thous. the worse results were obtained in connection with the dense. In one of the author’s experiments at the same plant density (111plants per ha) the quantity of balls, raw-cotton product and its quality increased in the option with a single plant in a nest compared with more plants in the nest. Besides that, defoliation (fall of leaves) also fastens. That is the result of preparation which makes better the working regime of collecting machines (Khlebutina, 1972; 14).

Better growth, development and increase of productivity in such placement is explained by increase of matters exchange due to the better light support (Hamidov, Suvanov, 2018: 153-159; Starov, 1952).

In the study conducted at the Dagestan zone experimental station, the yield increase was 2-3 s / ha higher in the variant with a plant density of 90-100 thousand per hectare compared to the plant density of 50-60 thousand per hectare. However, the author associates different plant densities with moisture supply. Thus, if increase in precipitation is recorded in the second half of the growing season, it is recommended to reduce the number of plants per hectare to 50-60 thousand (Starov, 1940).

The effect of different nutrition norms on plant density 95.2 and 114.2 thousand of medium-late and early-maturing cotton varieties (108 F and C 3210) are studied. Irrespective of the food background, the opening rate had fastened at 81.6 thousand plants was accelerated for both varieties, which is explained by the early of the flowering phase and the best weather and light conditions.

Soil fertility varies significantly depending on the norms of fertilizers, biological characteristics of the cultivated plant, water supply and other factors.

Numerous studies have shown that the optimal plant density per hectare is 80-150 thousand. Satisfactory yields can be obtained by reducing the density in various areas with good water supply. In areas with low fertility, plants should be planted close to get high yields.

Yields of compact shrubs, especially those with zero type of branching, were higher than of varieties with well-developed vegetative organs.

However, it should be noted that most plant density studies are based on phenological observations of cotton plants and yield indicators.

From the above mentioned, it can be concluded that the density was determined by experimenting with certain soil types, taking into account the specific conditions for this or that plant, including the cotton plant. This work will be more effective if we study the internal metabolic processes that take place in the plant organism in parallel at certain plant density (Kholmatov, 1951).

Plant density is very important, but not the only factor in increasing productivity. The proposed plant density cannot solve the problem of increasing the productivity of the cotton plant without taking into account other conditions (water-nutrient regime, agrotechnics, varietal characteristics, etc.). Increased plant productivity can be achieved in a complex way at optimal density along with other growing conditions.

The main criterion for the placement of cotton plants is the lighting conditions in the fields. When determining plant density, the degree of photosynthesis, one of the main physiological functions of plants, must be taken into account.

If the plants thrive when compacted, enriching the nutrient medium and in other conditions, then measures should be taken to improve the lighting by appropriate placement in the sows to increase productivity.

When you keep more than 3 plants in the nest, the absorbing activity of the root system is destroyed. Thus, the roots are concentrated in one place that is not recorded when they are located alone. Plant density in subsoil of clover has been studied. For medium-sized cotton varieties, it is recommended to keep 70-90 thousand plants per hectare for the first and second years, and 90-100 thousand plants per hectare for the third year. The number of plants per hectare is recommended to be at least 130 thousand for the fine-fibre 5904 variety. Later, when the

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density was increased to 186 thousand the plant was severely infected by macrosporiosis and the technological qualities of the fiber deteriorated (Prokofyev, Igamberdiyeva, 1971).

Employees of the agro-technological department of the former AzETPI (Azerbaijan Scientific Research Institute for Cotton - Growing) conducted research to determine the agro-techniques of the new variety, including plant density. Thus, the plant density of Akala-Verit cotton variety imported from Israel in 1994 was studied in Central Eperimental Basis and plant densities of Ganja-2 and Ganja-8, Ganja-78, Ganja-110, Ganja-103, Ganja-80 varieties were determined in 1997. In addition, in 2014, research works were conducted on the topic of intensive sowing (Hasanov, Mammadov, 2015: 56-58; Hasanov, Marlamova, 2014: 40-44).

It is clear from the literature that the quality and quantity of the product is closely related to the number of plants placed in a single sowing area.

Distance between raws. Before the revolution, small farms engaged in individual farming used manual labor and premium agricultural techniques. At that time, all work was done by hand, and irrigation was carried out by pond irrigation. As a result, the field was overgrown with weeds and dried quickly. Irrigation water was not used efficiently. All of this required a great deal of labor, but little product was got.

Rowing, especially wide-rowing, was a significant step forward in cotton production. However, the extent to which the distance between rows was considered optimal has not yet been resolved.

Square nest sowing and two-way cultivation of crops have played a role in increasing cotton production as a developing method at a certain stage. Later, the rise of farming culture, the providence of landowners with modern agricultural machinery, replaced the square nest crops and cultivation technology in two directions, and was replaced by row spacing of 60 cms.

Thus, from an economic point of view, the effectiveness of row crops has been proven by many researchers for different cotton growing zones.

Wide-row sowing creates conditions for the movement of a wide range of equipment, increases its productivity, allows the construction of deeper irrigation ditches, improves the quality of irrigation by increasing the daily norms of irrigators, prevents crop failure during cultivation, accelerates harvesting by machine. According to numerous studies, row crops are superior to row crops in terms of total yield. In the same product, they are more effective than the narrow-rowed (Valiyeva, Kazimov, 2007: 86-88).

In recent years, experiments with narrow-row growing has begun in the United States. Usually the applied 90 and 100 cms row spacing is reduced to 20; 30; 50 or even 8 cms. Generally accepted plant density 40-150 thousand is increased to 250-750 thousand per hectare. In this case, different sowing methods are tested: scattered sowing by plane, row sowing with grain sowing maschine, two four-row sowing, etc. These experiments prove that intensive sowing reduces costs. To date, the optimal width of the row spacing to ensure maximum raw cotton yield has not been determined yet.

The change in the width of the rows is due to the change in technical and economic capabilities. When analyzing changes in cotton practice, it should be noted that it is not necessary to dwell on any distance between rows. Cultivation conditions (water, food, soil, machinery, etc.) vary. Cotton cultivation changes in natural climates, and the conditions of the soil in which cotton is grown are also different. In addition, cotton varieties have different biological properties and react differently to them. So their potential will be expressed differently. Therefore, changing the row spacing of the cotton crop to increase productivity should be of paramount importance (Valiyeva, 2016: 132-135).

Distance between plants. By adjusting the distance between plants in a row, different plants can be obtained from areas with the same width of rows.

Due to the application of row sowing in cotton, many researchers started to study the distance between plants s 18; 35; 53; 54; 71 cms, etc., when the distance between the rows was 89 cms wide, by keeping one, two, three plants in the nest. When one keeps a plant in the nest, the number of shoots and the area of the leaf surface increase by increase of the distance between plants. In subsequent experiments, they learned to increase the distance between plants to 106 cm and to keep one or two plants in the nest. The least yield was taken from a bush with 18 cm of vegetation. High raw cotton yield was obtained from the single area. The number of cones increased in sparse crops, and their maturation depended on weather conditions. Yield growth from one branch was obtained when the inter-plant distance was raised to 106 cm. At that time, in the American practice, the inter-plant distance of cotton was 30-45 cm, depending on soil fertility (Zhurbitskiy, 1968: 260).

Experinent was conducted by keeping slot distance 15; 30; 45 cm row spacing 50; 70 and 100 cm, one or two plants in the nest. It was found that by increase of the distance between plants in the rows and their number in the nest, the growth of the plant weakens. If the rate of opening of balls is delayed by only 1-2 days due to the reduction of the row spacing, then the yield per plant decreases significantly as the number of plants in the nest increases, with a difference of 4-6 days as the distance between plants increases.

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According to research and the widespread use of mechanization, the main method of plant placement in cotton growing is row sowing. It has been in force since 1954-1955. In this case, when placing 2-3 plants in the nests, 20-40 cm, the distance between the rows was 60 and 65, 70 cm. At the same time, the distance between plants was taken to be 10-20 cm, keeping one plant in the nests. Recently, the most widely used row spacing on farms is 60, 76, 90 cm. Such plantings are carried out in accordance with the newly tested seeding units with a row spacing of 76,90 cm.

It is also noted that it is preferable to keep a single plant in the nest with the distance between rows 90 cm, the distance between plants 10-13 cm.

From the above mentioned, it can be concluded that the best result for high yields is obtained when there are 80-100 thousand plants per hectare, keeping one plant in the nest in coniferous (80, 90 cm) crops.

It is also clear from the presented indicators that the distance between plants in the row is 10-20 cm and more, which creates conditions for increasing productivity.

Depending on the feasibility, natural economic conditions, the level of mechanization and the chemicalization of cotton, the characteristics of the variety, the width of the rows, the density of plants and the distance between plants always change. However, the density of plants in the current crop rotation will not always remain the same.

The creation of new varieties, which are superior to the previous ones in terms of biological characteristics, the further development of technical capabilities and agricultural techniques, poses new challenges for researchers in the placement of plants in the fields. The application of high-yielding, low- growing varieties will ensure that cultivation is carried out in a very dense sequence.

After getting acquainted with the works of the above-mentioned authors, we aimed to study our research in two plant schemes.

The first scheme is 60x20-1, the water of the theoretical slots is 83000, the second scheme is 60x20-2, the number of theoretical slots is 166000. Both plant densities were studied in three different irrigation regimes.

In the study conducted in 2011, in the first variant (hard irrigation mode), the height of the main stem was 74 cm, the average number of sympodial branches was 13.2, and the total number of fruit ogans was 29.0. At different stages of plant development 6.9 of shoots, 6.6 of buds; 6.2 of flowers were shed. The total number of spilled fruit organs was 19.8. By the end of the growing season, the number of mature balls was 9.2 (Table 1).

The second option of the study is the optimal irrigation regime. In this variant, the height of the main stem was 100.0 cm, the number of sympodial branches was 15.0, the total number of fruit organs was 35.2. During the shoot period 7.0, during budding 7.2, during flowering 5.9, a total of 20.2 general fruit organs were shed.

The number of matured balls was 15. The falling was 57.4%, which is 10.9% less than in the first option.

In this variant, the weight of one ball was 5.9 g, the productivity per hectare was 35.7 s / ha.

The third option is a high irrigation regime. In this variant, the height of the main stem is 104.0 cm, the number of sympodial branches is 16.0, the total number of fruit organs is 35.4. 7.4 of them were shed during the budding period, 7.8 during budding and 7.2 during flowering, totally it farmed 22.1. The number of mature balls was 13.3. The falling was 62.4%, which is 5.9% less than the first option and 5.0% more than the second option. In this variant, the weight of one ball was 5.7 g, the yield per hectare was 31.4 quintals. Productivity is 5.9 s / ha more than the first option and 4.3 s / ha more than the second option.

The next three variants 4,5,6, which are the same in terms of plant density, are the also same as the previous three variants in terms of irrigation regimes. It differs from the previous three options in the method of application of the microelement. These options differ from the previous options with slight reductions. Thus, in the fourth variant, the height of the main stem is 71.0 cm, the number of sympodial branches is 13.0. The total number of fruit organs is 28.5. From that 6.3 were shed in the budding period: 6.9 in bloom, 6,2 in flowering: in general it formed 19.4 units. At the end of the growing season, the number of mature balls was 9.1, the defolation was 68.1%, the weight of one ball was 5.1 g, and the yield per hectare was 24.2 s / ha. As can be seen, there was no significant difference between the options due to the application of the microelement.

Option 5 of the study is the optimal irrigation regime. In this variant, the height of the main stem was 98.0 cm, the number of sympodial branches was 15.0, the number of total fruit organs was 35.6. At different stages of development, 6.4 shoots, 7.6 buds and 6.7 flowers were shed. The total number of fallen fruit organs was 20.6, the number of matred balls was 15.0. Falling formed 57.9%, weight of one ball was 5.8 g, productivity per hectare was 34.8 s / ha. This option is 5.9 more in comparison with the fourth option in terms of the number of balls, 10.2% less in terms of shedding percentage, 0.7 g more in terms of weight per ball, and 10.6 s / ha higher in terms of productivity. According to the method of application of the microelement, very small differences were obtained.

In the sixth variant of the study, the height of the main stem was 102.0 cm, the number of sympodial branches was 15.0, the total number of fruit organs was 35.2.

From that 7.4 was fallen in the budding period; 7.8 during blossom; 6.8 units were shed during flowering. During the growing season, the total shedding was

22.0 units. By the end of the growing season, the number of remaining balls was 13.2. Decline was 62.5%, weight of one ball was 5.7 g, yield per hectare was 30.6 s / ha. According to the irrigation regime, this variant is 4.1 more in terms of matured balls than the fourth variant, and 1.8 less than the fifth variant. The percentage of falling is 5.6% less than the fourth option and 4.6% more than the fifth option. According to the weight of one ball 0.6 g more than the fourth variant, 0.1 g less than the fifth option. According to the productivity per hectare, it is 6.4 s / ha higher than the fourth option and 4.2 s / ha less than the fifth option.

According to the method of application of the microelement, although there is a slight advantage in favor of the third option when comparing the third option with the sixth option, no sharp differences were obtained between these options.

Significant differences between the height of the main stem, the number of sympodial branches, the total vegetative organs, their decline, maturation, and finally the yield per hectare were recorded only in the irrigation regime in the six variants according to the plant placement scheme (60x20-1). Insignificant differences were obtained according to the method of application of the microelement. According to the irrigation regime, the high decline percentage in the first variant is due to the violation of physiological processes in the main stem due to lack of water.

In the third variant, due to the application of a high irrigation regime, the growth of vegetative organs in the bush increased, and the development of generative organs slowed down, resulting in the decay fruit organs in the lower tier.

As the second option has an optimal irrigation regime, it was superior to both the first and third options in all respects.

Variants 7, 8, 9, 10, 11, 12 of the study differed from the first 6 variants only in terms of layout. That is, 60x20-2 layout scheme was applied to the mentioned options. Thus, in the seventh variant, the number of theoretical slots was 166,600, and the actual 165,502. There were kept 2 plants in one nest. In this variant, the height of the main stem was 68.0 cm, the sympodial branches were 13.0, the total fruit organs were 30.2. At various stages of development, 6.5 shoots, 7.0 buds and 8.1 flowers were shed. The total discharge was

21.4 units, which is 1.2 and 2.0 units more than both the first and 4th options in the same irrigation regime. The number of mature balls was 8.8, which is 0.4 less than the first variant and 0.3 less than the 4th variant.

The decline was 70.9%. This is 2.6 and 2.8% more than the first and fourth variants of the same irrigation regime, respectively. The weight of one ball was 5.0 grams, which is 0.3-0.2 grams less than the first and fourth options, respectively. The productivity per hectare is 22.1 s / ha, which is 2.4 s / ha less than the first option and 2.1 s / ha less than the fourth option. As can be seen, in the case of two plants in one nest, the productivity was much lower when there were twice as many plants per hectare as in the previous variants. It is true that the total number of fruit organs is 1.2 and 1.7 more than both the first and fourth options, respectively. There are 0.4 and 0.3 units more in this variant compared to the first and fourth variants, respectively. At the end of the growing season, the number of ripening balls was 8.8, which is 0.4 less than the first option and 0.3 less than the fourth option. The decline was 70.9%, which is 2.6% more than the first option and 2.8% more than the fourth option. The weight of one ball was 5.0 g. This is 0.3-0.1 g less than the first and fourth options.

Why is this option lagging behind in all respects compared to the layout scheme? According to the literature, due to the narrowing of the suction pipes carrying water and nutrients from the root to the stem, the plants were not provided with normal water and nutrients in time, which had a negative impact on all productivity indicators.

In the eighth variant, the height of the main body was 98.0 cm, the number of sympodial branches was 15.0, and the total number of fruit organs was 37.4. 6.9 units were shed during the budding period, 7.3 units during budding and 8.2 units during flowering. The total number of fallen fruit organs was 22.4, which is 1.0 more than in the seventh option. Compared to the second and fifth options, there are 2.2 and 2.4 more, respectively. The number of maturing balls was 15.0, which is 6.2 more than in the seventh variant and the same in comparison with the second and fifth variants. The decline was 59.9%. This is 11.0% less than the seventh option for the same plant density for the irrigation regime, and corresponding to the second and fifth options for 2.5 and 2.0%. The weight of raw cotton of one ball was 5.6 g. It weighed 0.6 g more than the seventh variant in terms of irrigation regime, and 0.3 and 0.2 grams less in terms of plant density compared to the second and fifth variants, respectively.

Productivity per hectare was 32.6 s / ha. According to this irrigation regime, it has an advantage of 10.5 s / ha compared to the seventh option, and 3.1 and 2.2 s / ha less than the second and fifth options, respectively, in terms of plant density. In the ninth variant, the height of the main stem was 102.0 cm, the number of sympodial branches was 15.0, and the total number of fruit organs was 37.8. During the formation of shoots 7.4, during budding 8.0, during flowering 9.0, a total of 24.4 fruit organs were shed. By the end of the growing season, 13.4 matured balls remained. According to the irrigation regime, it is 4.6 units more than in the seventh option and 1.6 units less than in the eighth

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option. The decline was 64.6%. According to the irrigation regime, it is 6.3% less than in the seventh option and 4.7% more than in the eighth option. The weight of one ball was 5.5 grams. According to the irrigation regime, it is 0.5 grams more than in the seventh option and 0.1 grams less than in the eighth option. Compared to the third and sixth options, the plant density was 0.2 grams less, respectively. As for the productivity per hectare, it was 28.4 s / ha in this variant. This is 6.3 s / ha more than in the seventh option and 4.2 s / ha less than in the eighth option.

In the tenth variant, the height of the main stem was 68.0 cm, the number of sympodial branches was 13.0, the number of total fruit organs was 30.0. At various stages of development, 21.2 of them are shed for various reasons. At the end of the growing season, the number of remaining balls was 8.8. This means a 70.7% decline. The falling is 0.2% less than the seventh option for the irrigation regime, and 2.4 and 2.6% less for the plant density than the first and fourth options, respectively. The weight of a ball is 4.9 grams. This is 0.1 grams less than the seventh option for the irrigation regime, and 0.4-0.2 less compared to the first and fourth options for plant density. Productivity per hectare is 21.6 s / ha. According to this irrigation regime, it is 0.5 s / ha less than in the seventh option, and 2.9 s / ha and 2.6 s / ha less, respectively, compared to the first and fourth options in terms of plant density (Tsikov, 2016: 15-17).

In the eleventh variant of the study, the height of the main stem was 96.0 cm, sympodial branches were 15.0, total fruit organs were 37.0. During the whole vegetation period 7.4 units during budding, 7.9 units during flowering, 22.0 total fruit organs were shed during the growing season. This is 0.4 less than in the eighth option and 1.8-1.4 more in comparison with the second and fifth options. The number of balls left at the end of the growing season is 15.0. This was the same compared to the second and fifth options. The decline was 59.5%. This is 0.4% less than the eighth option, and 2.1 and 1.6% more than the second and fifth options, respectively. The weight of one ball was 5.6 grams, which was the same compared to the eighth option, 0.3 and 0.2 grams less compared to the second and fifth options, respectively. The productivity per hectare was 32.2 s / ha. This was 0.4 s / ha less than the eighth option and 3.5 and 2.6 s / ha less than the second and fifth options, respectively.

In the twelfth variant of the study, the height of the main stem was 100.0 cms, the number of sympodial branches was 15.0, and the total number of fruit organs was 37.3. 24.0 of them were shed at different stages of vegetation development. This is 0.4 units less than the ninth option, and 1.9 and 2.0 units more than the third and sixth options, respectively. The number of mature balls was 13.3. This is 0.1 less than the ninth variant, the same as the third variant, and 0.1 more than the sixth variant. The decline was 64.3%, which is 1/9 and 1.8 more, respectively, compared to the third and sixth options. The weight of raw cotton in one variant was 5.4 g, which is 0.1 grams less than in the ninth variant and 0.3 grams less in the third and sixth variants, respectively. Productivity per hectare is 28.1 s / ha. This is 0.3 s / ha less than the ninth option, and 3.3 and 2.5 s / ha less than the third and sixth options, respectively. The same patterns were obtained in the following years of the study.

Production indicators and fallen fruit organs

№	Options	Plant density things.	The height of thmain stem, cms	Monopodial branches, things	Sympodial branches, things	General fruit organs, thin gs	General fruit organs				Matured balls,things	Fallen fruitorgans, %	Weight of a ballg	Productivity ofhectare, c/ha
							Buds, things	Blossoms, things	Flowers, things	Total, things				
1	Hard i.r.	82751	74,0	1	13,2	29,0	6,9	6,6	6,2	19,8	9,2	68,3	5,3	24,5
2	Optimal i.r.	82668	100,0	2	15,0	35,2	7,0	7,2	5,9	20,2	15,0	57,4	5,9	35,7
3	High i.r.	82634	104,0	2	16,0	35,4	7,4	7,8	7,2	22,1	13,3	62,4	5,7	31,4
4	Hard i.r.	82834	71,0	1	13,0	28,5	6,3	6,9	6,2	19,4	9,1	68,1	5,1	24,2
5	Optimal s.r.	82668	98,0	2	15,0	35,6	6,4	7,6	6,7	20,6	15,0	57,9	5,8	34,8
6	High i.r.	82502	102,0	2	15,0	35,1	7,4	7,8	6,8	22,0	13,2	62,5	5,7	30,6
7	Hard i.r.	165502	68,0	1	13,0	30,2	6,5	7,0	8,1	21,4	8,8	70,9	5,0	22,1
8	Optimal	165668	98,0	2	15,0	37,4	6,9	7,3	8,2	22,4	15,0	59,9	5,6	32,6
9	High i.r.	165502	102,0	2	15,0	37,8	7,4	8,0	9,0	24,4	13,4	64,6	5,5	28,4
10	Hard i.r.	165502	68,0	1	13,0	300	6,5	7,2	7,0	21,2	8,8	70,7	4,9	21,6
11	Optimal s.r.	165665	96,0	2	15,0	37,0	6,7	7,4	7,9	22,0	15,0	59,5	5,6	32,2
12	High i.r.	165668	100,0	2	15,0	37,3	7,5	7,5	9,0	24,0	13,3	64,3	5,4	28,1

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Table 2

Dependence between plant density and the mass of a ball

№	**Options**	**Pair of signs**		**Fluctuations**		**Fluctuation squares**		**Multiplicand of fluctuation**
		Plant density X	General fallen fruit organs, Things Y	X-X̄	y-ȳ	(x-x̄)²	(y-ȳ)²	(x-x̄)(y-ȳ)
1	Hard i.r.	82,7	20,6	41,34	0,808333	1709,13	0,653	33,418
2	Optimal i.r	82,8	20,1	41,24	1,308333	1700,88	1,712	53,958
3	High i.r.	82,8	20,9	41,24	0,508333	1700,88	0,258	20,965
4	Hard i.r.	82,5	19,6	41,54	1,808333	1725,71	3,270	75,121
5	Optimal i.r	82,7	20,1	41,34	1,308333	1709,13	1,712	54,089
6	High i.r..	82,8	21	41,24	0,408333	1700,88	0,167	16,840
7	Hard i.r.	165,4	21,4	-41,36	0,008333	1710,51	0,000	-0,345
8	Optimal i.r	165,5	22	-41,46	-0,59167	1718,79	0,350	24,530
9	High i.r.	165,3	24,2	-41,26	-2,79167	1702,25	7,793	115,180
10	Hard i.r.	165,3	21,5	-41,26	-0,09167	1702,25	0,008	3,782
11	Optimal i.r	165,4	21,8	-41,36	-0,39167	1710,51	0,153	16,199
12	High i.r.	165,3	23,7	-41,26	-2,29167	1702,25	5,252	94,550
	Total	**1489**	**256,9**	**0,0**	**0,0**	**20493,2**	**21,3**	**508,3**
		124,0	**21,40833333**					

№	**Options**	**Pair of signs**		**Fluctuations**		**Fluctuation squares**		**Multiplicand of fluctuation**
		Plant density X	General fallen fruit organs, things	X-X̄	y-ȳ	(x-x̄)²	(y-ȳ)²	(x-x̄) (y-ȳ)
1	Hard i.r.	82,8	5,4	41,23	0,1	1699,50	0,010	4,122
2	Optimal s.r	82,8	5,9	41,23	-0,4	1699,50	0,160	-16,490
3	High i.r.	82,7	5,8	41,33	-0,3	1707,76	0,090	-12,398
4	Hard i.r.	82,5	5,4	41,53	0,1	1724,33	0,010	4,152
5	Optimal s.r	82,7	5,8	41,33	-0,3	1707,76	0,090	-12,398
6	High i.r.	82,6	5,8	41,43	-0,3	1716,03	0,090	-12,428
7	Hard i.r.	165,3	5	-41,28	0,5	1703,63	0,250	-20,638
8	Optimal s.r	165,4	5,6	-41,38	-0,1	1711,89	0,010	4,137
9	High i.r.	165,5	5,4	-41,48	0,1	1720,18	0,010	-4,147
10	Hard i.r.	165,2	5	-41,18	0,5	1695,38	0,250	-20,588
11	Optimal s.r	165,3	5,6	-41,28	-0,1	1703,63	0,010	4,127
12	High i.r.	165,5	5,3	-41,48	0,2	1720,18	0,040	-8,295
	Total	**1488**	**66**	**0,0**	**0,0**	**20509,7**	**1,0**	**-90,8**
		124,0	**5,5**					

$$r = \frac{\sum (x - x^-)(y - y^-)}{\sqrt{\sum (x - x^-)^2 (y - y^-)^2}} = \frac{-90,8}{\sqrt{20509,7 \cdot 1,0}} = \frac{-90,8}{143} = -0,63$$

$$m_r = \frac{1 - r^2}{\sqrt{n}} = \frac{1 - (-0,63)^2}{\sqrt{12}} = \frac{1 - 0,40}{3,5} = \frac{0,60}{3,5} = 0,2$$

r =-0,63 ± 0,2

Table 3

Correlatiom between plant density and general fallen fruit organs

$$r = \frac{\sum (x - x^-)(y - y^-)}{\sqrt{\sum (x - x^-)^2 (y - y^-)^2}} = \frac{508,3}{\sqrt{20493,2 \cdot 21,3}} = \frac{508,3}{143,2 \cdot 4,6} = \frac{508,3}{659} = 0,77 \; r =$$

$$\frac{1 - r^2}{\sqrt{n}} = \frac{1 - (0,77)^2}{\sqrt{12}} = \frac{1 - 0,59}{35} = \frac{0,41}{35} = 0,1$$

r = 0,77 ± 0,1

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Correlation between plant density and productivity

№	Options	Pair of signs		Fluctuations		Fluctuation squares		Multiplicand of fluctuation
		Plant density X	Productivity Y	X-X¯	y-y¯	(x-x¯)²	(y-y¯)²	(x-x¯)(y-y¯)
1	Hard i.r.	82,8	25,8	41,20	4,075	1697,44	16,606	167,890
2	Optimal i.r	82,8	36,7	41,20	-6,825	1697,44	46,581	-281,190
3	High i.r.	82,6	32,3	41,40	-2,425	1713,96	5,881	-100,395
4	Hard i.r.	82,4	25,5	41,60	4,375	1730,56	19,141	182,000
5	Optimal i.r	82,6	36,6	41,40	-6,725	1713,96	45,226	-278,415
6	High i.r.	82,5	32	41,50	-2,125	1722,25	4,516	-88,187
7	Hard i.r.	165,3	22,3	-41,30	7,575	1705,69	57,381	-312,848
8	Optimal i.r	165,5	33,4	-41,50	-3,525	1722,25	12,426	146,288
9	High i.r.	165,4	29,6	-41,40	0,275	1713,96	0,076	-11,385
10	Hard i.r.	165,3	22	-41,30	7,875	1705,69	62,016	-325,238
11	Optimal i.r	165,4	33	-41,40	-3,125	1713,96	9,766	129,375
12	High i.r.	165,4	29,3	-41,40	0,575	1713,96	0,331	-23,805
	Total	**1488**	**358,5**	**0,0**	**0,0**	**20551,1**	**279,9**	**-795,9**
		124,0	**29,875**					

$$r = \frac{\sum (x-x^{-})(y-y^{-})}{\sqrt{\sum (x-x^{-})^2 (y-y^{-})^2}} = \frac{-787}{\sqrt{20542,8.279,7}} = \frac{-787}{2397} = -0,33$$

$$\frac{1-r^2}{\sqrt{n}} = \frac{1-(-0,33)^2}{\sqrt{12}} = \frac{0,89}{3,5} = 0,25 \qquad r = -0,33 \pm 0,2$$

Results

The materials in the table were followed by three different irrigation regimes and two different application methods of the microelement, which differed sharply from each other against the background of two different plant densities.

Keeping a single plant in the nest has the advantage over many other plants.

1. In the 60x 20-1 plant scheme, the plant's root system is developing normally. The roots move freely down and to the sides.
2. When two plants are kept in the same nest (60x20-2), the roots rotate around each other, worsening their performance by squeezing the suction pipes. The flow of water and nutrients to the stem and surroundings of the plant deteriorates.
3. When you keep one plant in the nest, the total number of fruit organs is more than the number of plants. When you keep two plants in the nest, the total number of fruit organs is slightly more than the total number of plants, but less than one plant.

The falling percentage is higher when the second plant is retained. When the falling is high, the number of balls matured at the end of the growing season also decreases.

4. Insolation goes normally when you keep a plant in the nest. When you keep two plants in the nest, the sun rays do not completely cover the plant. Therefore, the insolation is not complete. This results in the decay of common fruit organs in the lower tiers.

It can be concluded from the literature that the width of the rows, the placement of plants in the field and the distance between plants have always changed depending on the technical and economic capabilities of farms, soil and climatic conditions, the level of mechanization and chemicalization applied in cotton growing. However, the plant density determined in the row crops currently used in production, the placement of plants in the rows can never remain unchanged. The new varieties presented to the regionalization by the selection department of the Scientific Research Institute for Plant Protection and Technical Crops have an advantage over their predecessors, their biological characteristics, technical capabilities and agro-techniques are expanding day by day, and researchers are constantly researching the placement of plants in the field. It will also require work on the technology of transition of high-yielding low-yielding varieties to narrow, dense plantings.

As all agricultural crops, there is a hereditary relationship between the quantitative characteristics of cotton.

The interdependence of the components that determine the productivity of cotton plants, their variability in relation to various external factors and backgrounds of cultivation were studied. The author clarified the relationship between the sections of the ball and the weight of the slice and the relationship between the total number of fruit organs and the number of growing balls.

It is known that there is a negative correlation between several quantitative and economically valuable features of the cotton plant. Therefore, breeders and seed-growers should not ignore the undesirable consequences of inverse correlation of one trait when selecting the other one.

The correlation can vary from +1 to -1. If the change of one society causes the other to change in the same direction, it is called a positive correlation, if it causes the weakening of one sign, it is called a negative correlation. To further clarify the relationship between the symptoms, it is necessary to determine the correlation coefficient.

The correlation coefficient of the two signs is called the correlation coefficient and is denoted by the letter "r". Mathematical calculations show that a correlation coefficient between r = 0-33 is weak between the signs, r = 0.33-0.66 is moderate between the signs, and r = 0.66 to 1 is a strong correlation, when r = 1 indicates a complete correlation.

Z.I Jurbitsky's mathematical statistical method was used in the study to clarify any relationship between plant density and total fruit organs, plant density and mass of a ball, plant density and productivity. Thus, it has been mathematically proven that there is a moderately positive correlation between plant density and total fruit organs shed (Table 2), a moderately negative correlation between plant density and the mass of a ball (Table 3), and a weakly inverse correlation between plant density and productivity (Table 4). The results are approximate, as mathematical analysis is performed on a small number of samples. Numerous samples need to be researched for clarification.

In different years of research, the correlation between the two pairs of traits was completely proven mathematically and was consistent with the obtained productivity.

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