Influence of Garmsil and High Temperature on Cotton Productivity

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Abstract. For the first time in the Republic, a special device was developed to create an artificial harmsel with different wind speeds (2; 4; 6; 8; 10 m/sec) and high temperatures (+48-50°C). A method was developed for determining resistance to garmsel and high temperature in breeding material and samples of the cotton gene pool. The research results obtained under artificial garmsel conditions were confirmed under natural garmsel conditions, on the basis of which it became possible to determine the resistance of cotton varieties to these conditions before planting and propagation in regions exposed to garmsel. The resistance of more than 30 varieties of cotton grown on large areas of Uzbekistan was studied, varieties resistant to this stress factor were isolated from them, which are recommended for genetic breeding and the creation of new varieties and lines of cotton that are resistant to garmsel and high temperatures, as well as for sowing. in areas subject to the action of harmcel.
Key words: cotton, harmsel, endurance, water balance, transpiration, productivity, productivity, phenology, cotton physiology, artificial harmsel, natural harmsel, special device.

1 Introduction

On a global scale, 19-25% of cultivated crops are lost as a result of various natural disasters. Garmsel is also one of the most dangerous abiotic factors that adversely affect the development of crop plants. According to statistical data, as a result of the negative impact of garmsel, the yield of wheat is reduced by 7.0-8.0 c/ha, rice - by 3.0-5.0 c/ha, cotton - by 9.0-11.0 c/ha. ha. The negative effect of the garmsel is especially noticeable in North Africa and the countries of the Middle East, in some countries of South and East Asia, Australia, as well as in the steppe and desert zones of South and North America.

Currently, in the leading research centers of the world, in particular, in the Department of Atmospheric Science, Colorado State University, U.S. Department of Agriculture, Kansas state University, Soil scientist USDA-ARS, Institute of Geography of the Russian Academy of Sciences, USDA-ARS, Wind Erosion and Water Conservation Research Unit, Department of Atmospheric Sciences, University of Illinois, is conducting extensive research to mitigate the negative impact of garmsel on crops through agrotechnical measures, the creation of

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modern innovative technologies and their introduction into production, as well as the creation of new crop varieties that are resistant to adverse environmental factors and increase their productivity [1-3].

Studies on the effect of Garmsel on crop plants were carried out by D.W. Armbrast et al. on cereals and leguminous crops (wheat, barley, mung bean), also information on the negative effect of garmsel at a speed of 4-15 m/s on plants is given in the works of Finell (Calendula); Martin, Clements (sunflower); Whitehead (wheat); Whitehead, Luti (sugar sorghum); Wadsworth (barley, peas, rapeseed [4-5]. However, D.V. Armbrast et al. in order to study the negative effect of garmsel on the intensity of photosynthesis, in the phase of budding and flowering for 1, 3, 7, 14 days under artificial conditions, garmsel was affected, where the leaves of plants were covered with dust in the amount of 10.8 $mg.m^{-2}$–51.1 $mg.m^{-2}$. As a result, it was found that the temperature in plant tissues increased by 2-4 °C, and the respiration coefficient decreased from 21.42 mg CO2 h^{-1} to 9.14 mg CO2 h^{-1}. The word Garmsel means a hot stream of air and represents a hot and dry wind blowing in Central Asia [6]. Garmsel is formed by blowing hot dry air in the Kyzylkum and Karakum deserts, the speed of which reaches 15-20 m/s. Due to the lack of moisture in the soil and air, the plant dries up or dries out completely [7-8].

Garmsel is also found in other tropical and subtropical regions, in the countries of the Mediterranean, called Sirokko [9], Samum - in Algeria, Khamsin - in Egypt or Dry wind - in the United States of America and causes serious damage to crops [10-11].

Another local wind, known as the Santa Ana winds, occurs in southern California at 15–25 m/s, very high temperatures (+45–55°C) and a 35–40% drop in relative humidity not only affect crops, but also require special control, since they cause large forest fires.

Strong winds (above 15 m/s) are observed on the plains of Uzbekistan. The maximum wind speed is 40-45 m/s. A period of strong winds of 30 days is observed in the Tomdinsky region, 85 days - in the Kolkuduk region, where its speed reaches 45 m/s. In the area of Yangiyer and Bekabad, the wind speed from the Ferghana Valley reaches 40 m/s.

In Surkhandarya and Kashkadarya regions, 19% of the annual garmsel wind falls in June, 45-46% in July and 26% in August.

Extremely hot summer days (+45-50°C) in Surkhandarya region last 5-48 days, maximum 19-85 days.

Especially due to abnormal weather conditions in 2015, 2016 and 2018, under the influence of heat, there was a massive loss of fruit elements on the 2nd, 3rd and 4th tiers of cotton plants cultivated over large areas in the hot regions of the country [12-13].

The aim of the study is to determine cotton cultivars tolerant to garmsel by studying the influence of this stress factor on quantitative and qualitative traits, morphophysiological indicators of cotton cultivars and lines and recommend them for genetic and breeding studies to create new cotton cultivars and lines tolerant to garmsel and reproduction in zones subjected to the action of the harmsel.

2 Materials and methods

Place and conditions for conducting experiments, source material and methodology for conducting experiments under conditions of an artificial harmsel (different speed and high temperature), created using a special device created in the Phytotron and in natural conditions of the Termez Research and Experimental Station of the Research Institute of Breeding, Seed Production and Agrotechnology cotton cultivation.

The starting material for the research was cotton varieties: zoned Bukhara-6, Bukhara-102, Bukhara-8, Ibrat, Omad, S-6541, Namangan-34, Sultan, Namangan-77; new zoned Andijan-37, Beshkahramon, Kupaisin, S-6775, Istiklol-14, S-2510V, S-8286, Kelajak; Pakhtakor-1, Navruz, Besharik-96, Buston, UzPITI-102, S-8284, Barkhayot, S-9082, Zharkurgan, S-8290, Charos, UzFA-703, Umid, which are in state variety testing; new Paytug, Termez-256 and lines L-425, L-588, L-7276.

The influence of artificial garmsel on economically valuable and some physiological indicators of cotton varieties and lines in various variants was studied. In order to confirm the obtained results, the varieties and lines were sown in the Termez Research and Experimental Station of the NIISSAVH, and the influence of the natural garmsel on the economically valuable traits of these varieties was studied.

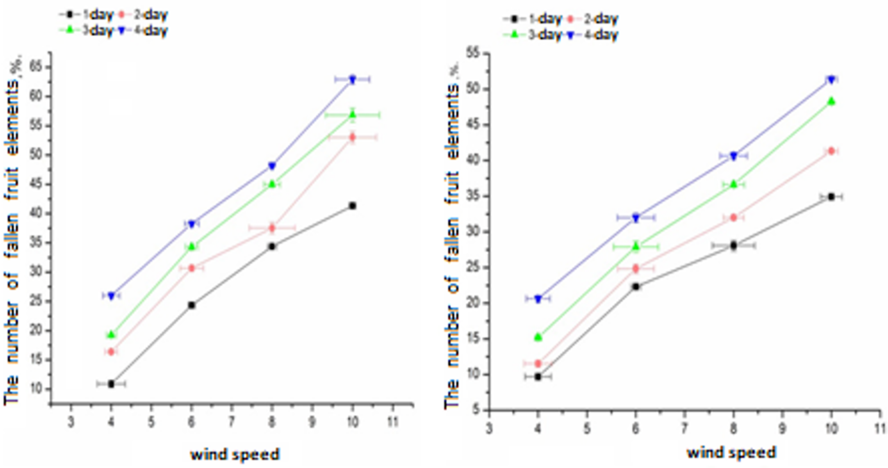
The studies were carried out according to the "Methods of conducting field experiments" [14], as well as using classical and modern methods of physiology and biochemistry, determining the resistance of cotton varieties when exposed to different speeds of artificial garmsel at high temperatures and different exposure times, as well as with using modern methods of phenological observation and statistical analysis (Fig. 1).

Fig. 1. Device for artificial harmsel and type of experience.

3 Results and discussion

Based on the study of the influence of the garmsel on the quantitative and qualitative indicators of cotton varieties and lines, the results obtained on the influence of the garmsel on such important traits as early maturity, the height of the main stem, the number of fruit branches, the number of fruit elements, the productivity and yield of varieties and lines of cotton in artificial and natural conditions are analyzed.

In experiments with the impact of artificial garmsel in 11 varieties (Bukhara-102, Bukhara-8, Andijan-37, S-2510 V, Kelajak, UzPITI-102, S-8284, Barkhayot, Charos, UzFA-703) and 1 line (L -588) out of 35, bolls fall off on the 3rd tier of plants. A decrease in the total number of fruit elements from 1.4 to 4.2 pieces was determined in comparison with field conditions (Fig. 2).



Bukhara-102 Jarkurgan

Fig. 2. Falling off of cotton fruit elements under the influence of an artificial garmsel, %.

Under field conditions, the indicators of the "mass of raw cotton in one box" in the studied varieties and lines were in the range of 3.8-6.2 g. The highest average indicator (6.2 g) of this trait was possessed by the Bukhara-8 variety by tiers amounted to 5.3, respectively; 6.6; 6.8 g. Indicators close to this result (5.3; 5.5 g) were noted in varieties Barkhayot and Bukhara-6 and line L-7276 (Fig. 4). Under the influence of artificial garmsel, the weight of raw cotton per box was 3.7-6.5 g, in this case, the Bukhara-8 variety also retained its high indicator. Under the conditions of artificial garmsel, varieties Navruz and S-9082 had low indicators (3.9 g) for this trait, where there were decreases in indicators by 04-1.6 g, compared with the indicators of the trait in the field.

The average indicators of “plant productivity” ranged from 29.0 to 48.9 g. The highest indicator (48.9 g) was possessed by the Termez-256 variety. Close to high results (48.4 g) were varieties Pakhtakor-1 and Zharkurgan, in which 20.8-20.0 were accumulated on the 1st, 2nd and 3rd tiers, respectively; 14.5-15.4 and 13.1-13.0 g of yield. Variety S-8290 had the lowest result, with indicators of 1, 2 and 3 tiers - 17.2; 5.9 and 5.9 g, respectively. Positive results were also noted in varieties Besharik-96, Sultan, Namangan-34, Itiklol-14 and Ibrat, in which the indicators were 44.8; 44.3; 44.1; and 43.6 g, respectively. Under the influence of artificial garmsel, varieties and lines showed yield losses from 1.4 to 19.7 g. UzPITI-102 and Bukhara-102 varieties accumulated 10.2-12.5 g less yield compared to field conditions.

As of September 1, the indicators of the total number of fruit elements in varieties ranged from 25.1 to 49.4 pieces, the number of fallen fruit elements was in the range from 8.7 to 23.1 pieces (29-60%), and the number of surviving from - 14, 0 to 26.5 pieces. The highest rate was noted in variety S-9082 (49.4 pieces), the fall of fruit elements in this variety was 46% (22.9 pieces), and the remaining ones amounted to 54% (26.3 pieces).

The analysis of the obtained data shows that the productivity of varieties and lines of cotton in the control variant (+25-300C) was noted in the range from 24.6 to 45.8 g and high values of this trait were obtained in the line "L-02" (45.8 g) and varieties "Istiklol-14" (45.4 g) (Fig. 3).

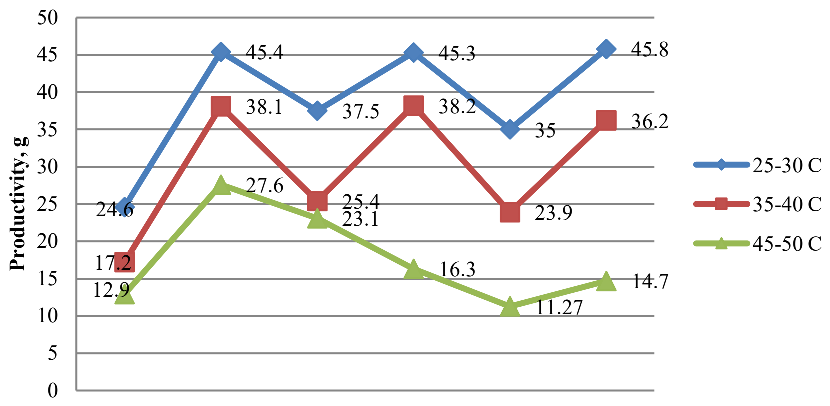


Fig. 3. Productivity indicators of varieties and lines at different temperature conditions, g

With an increase in air temperature, productivity indicators decrease, at a temperature of +40-45^{O}C, the productivity of one plant was in the range from 17.0 to 38.2 g, and at an air temperature of +45-52^{O}C, productivity indicators ranged from 11.9 to 27.6 g. At high temperatures (+40-50^{O}C), positive indicators were obtained in the varieties "Bukhara-102" (38.2 g) and "Istiklol-14" (38.1 g). The data of the main morphophysiological properties indicate the resistance to high air temperatures of these varieties.

4 Conclusion

It is recommended to serially determine the resistance to garmsel of newly created varieties of cotton under the conditions of an artificial garmsel created using a special device.

It was revealed that in the control variant of the experiment (air temperature +25-30ºC) the mass of raw cotton of one box is from 3.6 to 8.9 g, and when exposed to high air temperature (+45-50ºC) - from 1, 7 to 4.6 grams. It was determined that for this trait, compared with the control variant, the indicator decreases in the Surkhan-14 variety by 1.8 g, and in the L-02 line by 2.0 g.

Varieties Sultan, Istiklol-14, Bukhara-102, S-8290, Zharkurgan and lines L-422, L-588, L-7276 are recommended as starting material for selection and genetic studies when creating cotton varieties resistant to Garmsel.

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