

Resistance of *Hibiscus x moscheutos* L. to biostressors in the south of Russia

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Abstract. 16 varieties and 2 hybrid forms of *Hibiscus x moscheutos* L. have been studied for adaptability to biostressors. It was found that in the conditions of the south of Russia, root rot is most often found from pathogens (*Fusarium equiseti* (Corda) Sacc., *Phytophthora* sp.) on hibiscus plants. An assessment of the field resistance of hibiscus varieties to root rot and phytophagans was carried out. It was revealed that the maximum harmfulness to *Hibiscus x moscheutos* L. was noted in pests: *Helicoverpa armigera* L., *Padagrica fuscicornis* L., and *Altica oleracea* L. Helicoverpa zea caterpillars primarily damage varieties with red and bright pink flowers: *Cranberry Crush*, *Heartthrob*, etc. (2-3 points). Varieties with white, white-pink petals: *Old Yella*, *Peppermint Shnaps*, etc. were damaged by helicoverpa zea to a weak degree (0-1 point). The main harmfulness of ground psylla is noted in June, the maximum damage score was recorded in varieties with a thin leaf blade: *Heartthrob*, *Robert Fleming*, hybrid D-200 (4 points), varieties with dense leaf texture were slightly damaged: *Peppermint Shnaps*, *Fantasia* (1 point). The obtained data on the degree of impact of biostressors on hibiscus plants allows to develop an effective protection system for growing hibiscus.

1 Introduction

Modern landscape construction offers a wide range of design solutions in the landscaping of populated areas. Currently, such a popular gardening technique as the creation of gardens of prolonged flowering is gaining popularity. As a rule, these are multicomponent agrocenoses, including a variety of beautifully flowering tree species, perennial and annual flower crops. In this case, the plants are planted in such a way that a "flowering conveyor" is observed in the created phytocomposition for the longest possible period with a high decorative effect. The main criteria for the use of decorative species in gardens of prolonged flowering are adaptability, increased adaptability to stressors of various origins in combination with high decorativeness. Hybrid hardy hibiscus (*Hibiscus x moscheutos* L.) is a thick rhizomatous

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highly ornamental perennial, which in many respects corresponds to the concept of "Gardens of long flowering". Modern varieties of *Hibiscus x moscheutos* L. differ in the variety of bush habitus – the height of the plants is from 0.3 m to 2.2 m, the bush diameter in 5 summer plants can reach 2 m. The size, shape, and color of the leaves varies greatly. The leaf blade is often painted in various shades of green, grayish-bluish, brown-burgundy shades, which gives the plantings a special appeal, even when the plants are not blooming. The color of the flowers can be white, white-pink, bright pink, crimson, red, dark burgundy with numerous shades and differ in the gradient in the distribution of color in the petals. In 2010, under the guidance of the famous breeder Dariusz P. Malinowski the first variety of *Blue Angel* with a blue color of flowers was obtained, which makes it possible to significantly expand the possibilities of this valuable decorative crop in landscape design [1-3]. The flower size of hybrid hardy hibiscus is one of the largest among flower perennials and varies from 12-15 cm to 30-32 cm in diameter. The valuable quality of hibiscus is a long flowering period, in some varieties up to 3.5 months or more, which begins from the third decade of June and lasts until the end of October. The inclusion of hybrid hardy hibiscus in phytocompositions allows to create spectacular landscape objects. The phytosanitary condition of landscape construction facilities is of the utmost importance, especially in agricultural regions, where various branches of crop production are actively developing. In comparison with other industries, the assortment and volumes of introduced plants are most widely represented in decorative gardening. Together with the imported planting material, new invasive phytophagans and pathogens enter, which, as a result of stepwise adaptation, can spread in the agroecosystems of this region. On the other hand, pests already known in the area often introduce new introduced plant species into their food supply [4-5]. In connection with the above, the **purpose of these studies** is determined – to assess the stability of *Hibiscus x moscheutos* L. to the effects of biostressors during introduction in the conditions of the south of Russia, to identify potentially harmful objects in hibiscus cultivation.

2 Materials and methods

The study included 16 promising varieties and 2 hybrid forms of hardy hibiscus (*Hibiscus x moscheutos* L.) from the collection of the FSBSI North Caucasus Federal Research Center for Horticulture, Viticulture, Winemaking (city of Krasnodar): *Cranberry Crush*, *Fantasia*, *Fireball*, *Jazzberry Jam*, *Peppermint Shnaps*, *Heartthrob*, *Summer Storm*, *Tie Dye*, *Berrylicious*, *Berry Awesome*, *Little Prince*, *Pink Swirl*, D-200, CX-17. Hibiscus plants are grown without drip irrigation, in the spacings – grassing-down of naturally growing grasses, in a row - mulching with larch bark with a layer of 8-10 cm. Planting scheme: between plants 1.5 m, between rows 1.8 m.

Generally accepted methods of variety study of ornamental crops were used in the work [6-7]. The gathering of phytophagans was carried out during a route survey of hibiscus plantings, followed by the study of samples in laboratory conditions [8-10]. The degree of damage to plants was determined considering generally accepted methodological provisions [11-13].

3 Results and Discussion

According to the results of the conducted studies for the period 2017-2020, it was found that in the south of Russia varieties *Hibiscus x moscheutos* L. show varying degrees of resistance to biostressors. As noted earlier, among the pathogens found on hibiscus plants, the most common pathogens of root rot are *Fusarium equiseti* (Corda) Sacc., *Phytophthora* sp., anthracnose – *Colletotrichum hibisci* Poll, alternaria – *Alternaria* sp., which form a pathogenic complex [14-16].

It was found that during the observation period, the spread of root rot differed by varieties and amounted to 10-15% of varieties *Fireball*, *Kopper King*, *Old Yella*, *Royal Gems*, hybrid D-200; 50% for varieties *Tie Dye*, *Heartthrob*, *Strawberry Swirl*, *Robert Fleming*; 80% for the varieties *Little Prince*, *Pink Swirl*, *Berrylicious*. There were no signs of root rot damage in the varieties: *Fantasia*, *Cranberry Crush*, *Peppermint Shnaps*, *Jazzberry Jam*, *Summer Storm*, hybrid CX-17, *Berry*.

It has been established that one of the important factors in the spread of root rot is the presence of wound surfaces in combination with high humidity. It was noted that more often root rot damage was observed on plants whose shoots fell apart or broke out at the level of the root crown. The data obtained indicate that to reduce the risk of hibiscus infection with root rot, it is necessary to treat the root system of plants with fungicides during the division of bushes, during the collapse of bushes after wind load or heavy rains.

Not only pathogens can have a negative impact on the manifestation of decorative qualities of plants, but numerous phytophagans. The study of the species composition of phytophagans in the conditions of agroecosystems, where collections of introduced and native plants are artificially collected, is of great interest to identify the regularity of the formation of trophic connections of insect pests with possible forage plants. In addition, in this case, the task of identifying potentially dangerous pests in connection with the introduction of new plant species is actualized.

According to the results of the monitoring of the phytosanitary condition of collection plantings of *Hibiscus x moscheutos* L. it has been established that over the past 5 years, the greatest harm to hibiscus plants has been caused by the helicoverpa zea *Hilicoverpa armigera* (family of noctuid moths Noctuidae), ordinary ground psylla *Padagraca fuscicornis* L. (family of leaf beetles Chrysomelidae subfamily of flea beetles Alticinae), and *Haltica palustris Altica oleracea* (family of leaf beetles subfamily of Galerucinae).

Hibiscus x moscheutos L. is a popular ornamental crop, which is represented by numerous varieties. Currently, the areas of this perennial plantings are increasing in the south of Russia. 7-8 years ago, damage to hybrid hardy hibiscus plants with helicoverpa zea was isolated, but the harmfulness of *H. armigera* on hibiscus has increased over the past 3-5 years. According to the results of observations, it was found that the mass appearance of the helicoverpa zea coincides with "mass flowering" phase of hybrid hibiscus, which usually occurs in most varieties from the second half of July. The features of damage to vegetative and generative parts of hibiscus plants have been established.

First, caterpillars damage varieties with red and bright pink flowers. At the same time, the caterpillars penetrate into the colored buds that have not yet opened and at the first stage eat pollen sacs, and then damage the petals of the perianth. If there are seed balls on the plant, some of the caterpillars gnaw through the passages in the balls and eat the seeds that have formed. Damage to the young tops of herbaceous shoots and leaves occurs last (Figure 1).



Fig. 1. Damage to generative parts of *Hibiscus x moscheutos* L. plants by caterpillars *Helicoverpa armigera*, August 2021.

The maximum degree of damage by helicoverpa zea is noted on varieties *Cranberry Crush*, *Heartthrob*, *Robert Fleming*, *Jazzberry Jam*, hybrid CX-17 (2-3 points). Varieties with white, white-pink petals: *Old Yella*, *Peppermint Shnaps*, *Summer Storm* was damaged by the helicoverpa zea less often and to a lesser extent (0-1 point).

Since mid-June, during the active growth of vegetative mass, in the "beginning of budding" phase on hibiscus plants, characteristic numerous damages to the leaves and the apical part of the forming buds were noted. At the same time, the leaf blades were skeletonized, the plant tissue between the veins was eaten, numerous through rounded holes were formed. Numerous passages and holes were formed at the growth points of the growing buds.

Based on the results of route surveys, conducted collections, study of entomological samples the types of phytophagans and the degree of their harmfulness were determined. It has been established that the characteristic damage to the vegetative mass of hybrid hardy hibiscus plants is caused by two types of psylla: ordinary ground psylla *Padagraca fuscicornis* L. and the *Haltica palustris Altica oleracea* L. (Figure 2-3).



Fig. 2. Imago of an ordinary ground psylla *Padagraca fuscicornis* L. (Coleoptera, Chrysomelidae, collected on *Hibiscus x moscheutos* L. plants, June 2021.



Fig. 3. Imago of the *Haltica palustris Altica oleracea* (Coleoptera, Chrysomelidae) collected on *Hibiscus x moscheutos* L. plants, October 2021.

Chrysomelidae leaf beetles are one of the largest families of herbivorous beetles both in the world and in regional faunas. Many family species are associated with cultivated plants and are economically significant pests [17]. A characteristic feature of leaf beetles is a narrow food specialization, so each harmful species, as a rule, includes a certain range of plants in its food base.

Ordinary ground psylla *Padagrlica fuscicornis* L. is distributed in South and Central Europe, it is noted in Denmark, Southern Poland, and Southern England, it is often found in the Crimea, the Caucasus, Western Asia, North Africa [18]. It is known that the period of harmfulness in adult beetles is observed from May to August. As a result of the observations, it was found that the maximum harm on hibiscus plants *P. fuscicornis* L. is noted in June on young growing leaves of apical shoots, buds, corolla petals. Damage to plants reaches up to 70-90% (3-4 points). At the same time, the decorative effect of plants is sharply reduced, the drying of young skeletonized leaves is observed, flowers of poor quality are formed from damaged buds. The analysis of the conducted studies showed that the maximum damage score (4 points) is observed on varieties characterized by a thinner leaf blade: *Heartthrob*, *Robert Fleming*, D-200. Varieties with dense leaf texture covered with waxy cuticle were damaged to a lesser extent: *Peppermint Shnaps*, *Fantasia*, hybrid CX-17 (damage score 1). With the onset of the dry hot period (from the end of July), as the leaves age, the activity and harmfulness of *P. fuscicornis* L was declining. In addition to the ordinary ground psylla, the *Haltica palustris Altica oleracea* L. also causes damage. Phytophagan is found on hibiscus plants from June to November, sometimes later. Adults of *A. oleracea* more often damage larger formed leaves, skeletonizing the surface, forming numerous irregularly rounded holes.

4 Conclusions

In the south of Russia, plants of hybrid hardy hibiscus *Hibiscus x moscheutos* L. are influenced by stress factors of biotic origin. The degree of harmfulness of pathogens and pests varies depending on the variety. There is an increase in the harmfulness of root rot pathogens *Fusarium equiseti* (Corda) Sacc., *Phytophthora* sp. It was found that the varieties: *Fantasia*, *Cranberry Crush*, *Peppermint Shnaps*, *Jazzberry Jam*, *Summer Storm*, *Berry Awesome*, hybrid CX-17 were not affected by root rot; the varieties - *Little Prince*, *Pink Swirl*, *Berrylicious* reached 80 percent or more.

Based on the results of phytosanitary situation monitoring in hybrid herbaceous plantings of hibiscus the most harmful phytophagans were revealed: *helicoverpa zea* *Helicoverpa armigera* L., ground psylla *Padagrlica fuscicornis* L., *Haltica palustris Altica oleracea* L. The

maximum degree of damage to *H. armigera* L. is observed on varieties with red and bright pink flower petals: *Cranberry Crush*, *Heartthrob*, *Robert Fleming*, *Jazzberry Jam*, hybrid CX-17 (2-3 points); varieties with white, white-pink petals: *Old Yella*, *Peppermint Shnaps*, *Summer Storm* are damaged by the helicoverpa zea to a weak degree (0-1 point).

According to the results of the conducted studies, the expansion of the number of forage plants in *Haltica palustris* *Altica oleracea* L. was revealed, i.e., the hybrid hardy hibiscus *Hibiscus x moscheutos* L. should be included in the feed base of this species. The maximum degree of damage by helicoverpa zea is noted on varieties with a thinner leaf blade: *Heartthrob*, *Robert Fleming*, hybrid D-200 (4 points); varieties with dense leaves covered with a waxy cuticle are slightly damaged: *Peppermint Shnaps*, *Fantasia*, hybrid CX-17 (1 point). The data obtained on the degree of adaptability of *Hibiscus x moscheutos* L. biostressors allow to develop an effective system of agrotechnical and chemical measures for the cultivation of hibiscus in the south of Russia.

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