International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

The Study of the Resistance of Garden Strawberry Varieties Belonged to Various Ecological Groups to Unfavorable Air Temperatures in the Condition of Uzbekistan

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Abstract: ***The article highlights the data on the heat and cold resistance of garden strawberry (Fragaria Duch.) varieties Uzbekistanskaya (Uzbekistan), Preya (Russia), Voskhod (Russia) and Bauntiful (the USA) belonged to different ecological groups, as well as the resistance to the highest temperatures + 40ºC, + 45ºC, + 50ºC, + 55ºC degrees and the level of heat damage, the resistance to the low temperatures -15ºC, -20ºC, -25ºC, -30ºC degrees and the level of cold damage too.***

Keywords: garden strawberry, varieties, temperatures, heat resistance, cold resistance, damaging level of leaves and flower buds

1. Introduction

Global climatic change is one of the main issues of the 21st century. Various unfavorable conditions adversely affect the plants during their growth. Experts say that over the past 100 years, the average temperature in the Earth has risen dramatically. In 2015-2018, the hottest climate on our planet was observed. According to the World Meteorological Organization's report declared in January of 2018, the highest temperatures were recorded in 2015, 2016 and 2017 too. When the general indices were compared, it was found that the Earth's average temperature increased by 1.2 degrees over the next four years [8].

The adverse influence of high temperatures on plants are different. First of all, the accumulation of toxic substances as a result of disfunction of metabolic processes in plants and clotting of protoplasm proteins under the high temperature cause to the death of cells. The climate of Uzbekistan is sharply continental with very hot continuous summer. As a result of a sharp rise in air temperature and a decrease in air humidity the sensitivity of many farm crops to high temperatures increases, and the resistance of generative and vegetative organs to heat decreases [1, 2, 6, 7].

The duration of high temperatures (55-65ºC) may cause to the heat shock in plants and thermoinactivation occurs in enzymes. It also affects physiological processes in the plant such as photosynthesis, transpiration, and respiration [2, 3, 4, 5].

Plants are often affected by high temperatures during the formation of their generative organs.

It is should be noted that the possibility of high temperatures in summer and low air humidity are high throughout the country and constitutes on average 85%.

Besides, a great deal of information is provided in the literature on cold resistance of fruit crops, where the strongest resistance of plant to low temperatures, that is, the formation of archespore cells of microsporogenesis corresponds to the end of December and the first ten days of January.

During this period, the physiological process of the plant, that is, the lowest degree of water balance was noted, but these indicators were observed to be various among the varieties, as well as the unsustainability of resistance and variation of duration of winter hibernation in the plant varieties were determined [5, 7].

2. Methods of Research

The experiments were carried out at the Scientific Research Institute of Horticulture, Viticulture and Winemaking named after Makhmud Mirzayev.

The garden strawberry was planted in the area of 0.30 ha in 70×25 cm planting scheme in 2016 and 2018, and physiological processes were analyzed in Uzbekistanskaya (st) (Uzbekistan), Preya (Russia), Voskhod (Russia) and Bauntiful (the USA) varieties.

The investigations on heat resistance of garden strawberry varieties were conducted according to the methods of F.F. Matskov (1976), in which under the artificial hot temperature 40°C, 45°C, 50°C, 55°C, 60°C degrees the damaging level of leaves were studied [4].

The frost tolerance (low temperatures) of flowers buds of garden strawberry varieties was determined according to the method developed by M.A. Solovyev (1988) [5].

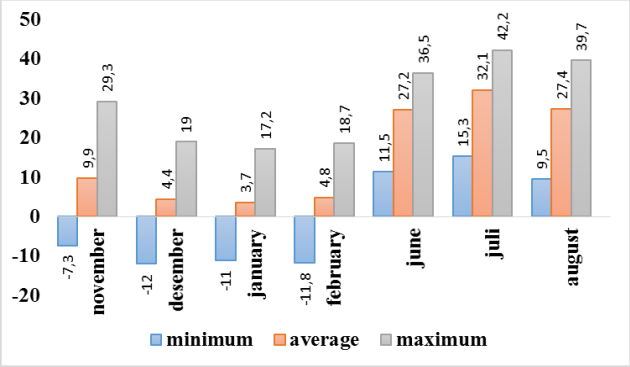
At the same time, for the determination of cold resistance of flower-buds and one year old shoots of garden strawberry varieties they were stored in a special refrigerator at a low temperature of -10, -15, -20, -25 and -30 ° C for 6 hours.

Flower-buds damaged by frost were estimated by percentage.

The experiments were carried out during 2017-2019 and the tables were analyzed on the basis of average three years results.

3. Results and discussion

The experiments were conducted mostly in winter and summer months, because of the possibility of the lowest temperature in winter months and the maximal rise in temperature in summer months. In November the minimal temperature made -7,3ºC degree, an average air temperature was +9,9ºC degree and maximal temperature made +29,3ºC degree. In December month minimal temperature was -12ºC degree and average air temperature made +4,4ºC degree while maximal air temperature was +19ºC degree. In January minimal temperature constituted -11ºC degree and average air temperatures did +3,7ºC degree, maximal temperature was +17,2ºC degree. In February minimal air temperature made -11,8ºC gedree, average air temperature was +4,8ºC degree and maximal temperature was +18,7ºC degree. In summer in June month minimal temperature made +11,5ºC degree, average air temperature made +27,2ºC degree while maximal temperature was +36,5ºC degree. In July minimal air temperature was +15,3ºC degree, average air temperature constituted +32,1ºC degree and maximal one made +42.2ºC degree, while in August minimal temperature was +9.5ºC degree, average temperature was +27,4ºC degree and maximal air temperature constituted +39,7ºC degree (Picture 1).



Picture 1: Air temperature in experimental field, (average in 2017-2019), ºC

Garden strawberry is a perennial herbaceous plant and requires more water. In Uzbekistan, the temperature is high in summer and autumn, therefore the leaves of garden strawberry plant are sometimes damaged by burning under the influence of heat.

In June, when the heat resistance was identified, 5.7% of the leaf of Uzbekistanskaya control variety was found to be damaged, while the highest leaf damage of 11.7% was noted in Voskhod variety. When the temperature raised to + 45°C degree, the leaves of control Uzbekistanskaya variety were damaged by 6.7%, while the highest leaf loss was 12.8% in Voskhod. At the temperature + 50°C degree the leaves of control Uzbekistanskaya variety were damaged by 22.2% and the highest leaf damage was 44% noted in Bauntiful variety.

The investigations conducted in July and August months have howed that at 40°C, 45°C degrees hot temperatures the leaves of all varieties were damaged up to 13,9% (Uzbekistanskaya), at 50°C degree in July up to 43,2% (Uzbekistanskaya), while in August it was up to 49,7% (Bauntiful). The lowest damaged leaves were observed in Preya variety constituting 15,9% damage in July month and 30,6% in August.

At 55°C degree hot temperature damaging level of all varieties extended over 50%.

At 60°C degree hot temperature in June, July and August months 100% damage were observed in all varieties.

It was noted that the more temperature increased, the more damage level raised in all varieties (Table 1).

Table 1: Damaging level of leaves of garden strawberry varieties by the heat in different high temperatures, %

Varieties	Temperature				
	+40°C	+45°C	+50°C	+55°C	+60°C
June					
Uzbekistanskaya (st)	5,7	6,0	22,2	87,9	100,0
Preya	9,0	11,7	39,8	67,2	100,0
Voskhod	11,7	12,8	41,0	88,1	100,0
Bauntiful	10,9	12,3	44,0	84,8	100,0
July					
Uzbekistanskaya (st)	9,3	13,9	43,2	85,0	100,0
Preya	3,3	4,9	15,9	85,8	100,0
Voskhod	6,7	9,0	41,6	85,7	100,0
Bauntiful	4,8	8,7	35,8	96,4	100,0
August					
Uzbekistanskaya (st)	1,6	4,2	37,8	86,3	100,0
Preya	1,8	4,9	30,6	93,7	100,0
Voskhod	1,7	5,6	34,9	97,1	100,0
Bauntiful	1,4	6,6	49,7	98,1	100,0

The study of cold resistance (low temperature) of flower-buds of garden strawberry varieties was carried out in winter, according to the results of investigation the highest damage in November at -30ºC degree made 95,8% in Uzbekistanskaya (st) variety while in Voskhod variety it constituted less, 82,1%.

When the resistance of buds to low temperature was detected in December month the highest damage was 51,6% at 30ºC degree low temperature in Uzbekistanskaya (st) variety, while in Voskhod it was less, 82,1%.

In January month the highest damage of flower-buds was observed in Uzbekistanskaya (st) variety at -30ºC cold temperature and constituted 61,1%, while in Bauntiful variety the lowest damage was less, 52%.

In February the damage of flower-buds occurred in the beginning of vegetation period and that's why its level was higher than in other months, the highest damage at -30ºC cold temperature was 100% in Uzbekistanskaya (st) variety, the lowest damage was found to be less, 91,5% in Voskhod

variety.

It was known in the results of experiments that due to higher temperature in November and February months than in December and January, and not having hibernation time, the level of damage in these months was higher. It is obvious that garden strawberry plant has less damage because of its full hibernation period in December and January months (Table 2).

Table 2: Damaging of flower-buds of garden strawberry varieties by cold at low temperatures, %

Varieties	Temperature			
	-15°C	-20°C	-25°C	-30°C
November				
Uzbekistanskaya (st)	14,8	37,8	61,8	95,8
Bauntiful	15,0	31,6	50,4	83,3
Preya	17,7	33,3	61,2	89,1
Voskhod	14,4	24,8	49,0	82,6
December				
Uzbekistanskaya (st)	1,3	15,7	25,3	51,6
Bauntiful	1,8	10,7	14,0	45,7
Preya	1,0	14,1	19,6	47,2
Voskhod	3,0	10,5	18,7	40,9
January				
Uzbekistanskaya (st)	8,0	22,3	37,5	61,1
Bauntiful	4,9	16,9	24,0	52,0
Preya	8,7	19,0	29,3	52,7
Voskhod	6,0	16,2	26,5	56,9
February				
Uzbekistanskaya (st)	25,3	56,5	82,1	100,0
Bauntiful	27,3	51,2	71,7	95,0
Preya	24,5	51,8	80,4	97,6
Voskhod	21,0	46,7	73,2	91,5

4. Conclusions

In all varieties of garden strawberry it was observed that the more the temperature increased, the more damage occurred on their leaves. Additionally, when the plant's cold resistance feature was studied, it was also noted that the more temperature decreased, the more flower-buds got damaged by the cold.

The tolerance level of garden strawberry varieties to high temperature was between 45-50°C degrees, particularly, Preya (Russia) variety was found to be more resistant to heat compared to other varieties.

The tolerance level of garden strawberry flower-buds to low temperature was around -15 and -20°C degrees, there is a possibility of survival of flower-buds in spring after damaging at these low temperatures. Among the varieties the flower-buds of Voskhod (Russia) and Bauntiful (the USA) varieties differentiated with their tolerance to low temperature.

In future these varieties are to be used as a primary source in breeding to create resistant varieties to high temperatures. Furthermore, it is recommended to extend the growing area of these varieties and to use them as a necessary food source in hot and cold climatic conditions of our planet.

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