

RESEARCH ARTICLE

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STUDY OF DROUGHT RESISTANCE OF RASPBERRY VARIETIES

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Abstract

This article presents the results of the study of drought resistance of raspberry varieties. In this, drought resistance was evaluated by studying the water deficit, amount of water and water loss abilities of leaf tissues before and after irrigation in June, July, and August. In the leaves of raspberry varieties, water deficit and water loss capacity were higher at 1 pm in July, while leaf amount of water was the lowest at 1 pm in July.

Keywords Raspberry varieties, water deficit, amount of water, water loss abilities, drought, leaf, tissues, temperature.

INTRODUCTION

Drought resistance of plants is the ability to withstand long periods of water deprivation [1, 4]. The progress of the most important physiological and biochemical processes depends on the water supply of plants. As a result of water deficit, the metabolism is disrupted, which affects the growth, development and productivity of plants [6].

Drought is one of the adverse environmental factors in raspberry cultivation. Heat, dry air and lack of moisture in the soil during the growing season negatively affect the growth and development of raspberries, like other plants [2, 5].

As a result of changes in weather and climatic conditions in Uzbekistan, water deficits are often observed in the summer season, the stages of growth and development of plants are difficult.

Based on this problem, it is important to study and select varieties suitable for the climatic conditions of our republic, which are highly resistant to abiotic factors, especially drought and to improve their cultivation technologies. Therefore, research on the effects of drought on raspberry cultivation is very actual.

MATERIALS AND METHODS

Gonchareva's method of studying drought resistance of raspberry varieties [3] and for this, 20 leaves of each variety were taken from annual branches at 6 am in the morning and at 1 pm in the afternoon and at 6 pm in the evening and the water deficit and amount of water were determined. To determine the dry mass of the leaves, the leaves were placed in paper bags and completely dried in

drying cabinets at a temperature of 105°C. Leaf water deficit (%) was determined using the following formula:

$$CT = ((TC \times 100)) / MC$$

Here: CT – water deficit; TC – the amount of saturated water, the difference in weight between the leaves before saturation and after saturation; MC – available water, the difference between the dry weight of leaves and the weight of leaves after water saturation.

The amount of water (%) in the leaves of raspberry was determined by the following formula:

$$CM = ((B1 - B2)) / B1 \times 100$$

Here: CM – amount of water, %; B1 – initial weight of leaves or branches, g; B2 – dry weight of leaves or branches, g.

The water loss ability of the leaf tissues of raspberry cultivars was studied in leaves taken from annual branches at 8 am in the state of dehydration for 2, 4 and 6 hours. The ability of leaves to lose water was determined by the following formula:

$$X = (b \times 100) / A$$

Here: X – water retention ability of leaves, %; A – the amount of water in the leaves at the beginning of the experiment, g; b – the amount of water lost by the leaves during 2 hours of wilting, g.

RESULTS AND DISCUSSION

Air temperature, relative humidity and soil moisture were determined before and after irrigation in the experimental field where the raspberry plantation was located during the research years (Table 1).

Table 1
Air temperature, relative air humidity and soil moisture in the experimental field where the raspberry plantation is located

Factors	June			July			August		
	6 am	1 pm	6 pm	6 am	1 pm	6 pm	6 am	1 pm	6 pm
Before irrigation									
Temperature, °C	23,5	35,4	31,8	25,2	40,2	33,4	20,2	34,6	31,2
Relative humidity, %	68,2	60,4	62,7	63,4	55,0	57,6	79,5	67,2	70,4
Soil moisture, %	17,5			15,8			17,2		
After irrigation									
Temperature, °C	24,3	38,8	36,2	26,7	39,4	35,4	18,7	32,4	29,5
Relative humidity, %	72,5	64,3	61,6	62,4	57,5	59,1	79,2	65,2	76,4
Soil moisture, %	21,2			19,6			22,5		

In the study of drought resistance of raspberry varieties, the water deficit, amount of water and water loss ability of the leaves were determined.

The water deficit of raspberry leaf tissue was determined in three periods before irrigation, i.e. in June, July, August, when the water demand of the plant is high, from annual branches at 6 am in the morning and at 1 pm in the afternoon and at 6 pm in the evening by taking 20 leaves of each variety using special formulas.

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Table 2
Water deficit in the leaves of raspberry varieties before irrigation
(2019-2021), %

Varieties	June			July			August		
	6 am	1 pm	6 pm	6 am	1 pm	6 pm	6 am	1 pm	6 pm
Barnaulskaya	15,4	27,8	21,6	19,5	28,9	22,4	16,6	27,7	21,4
Vislukha	14,4	24,3	20,7	16,6	27,2	20,7	13,6	25,4	18,5
Sugana	14,7	26,2	20,2	20,2	28,5	21,5	16,2	28,2	20,2
Isobilnaya	16,8	28,7	21,5	24,4	31,3	24,3	17,4	30,5	25,2
Laszka	17,8	29,5	22,8	22,7	31,8	25,5	18,2	29,2	26,7
Malboro	16,0	27,4	22,1	20,5	30,2	23,6	15,5	28,8	20,6
Polka	18,6	30,6	23,5	26,2	33,5	26,8	19,6	31,7	25,5
Progress	14,1	25,5	19,8	17,4	27,8	20,2	15,5	26,6	19,4

At 6 am in June, the lowest water deficit in raspberry varieties before irrigation was 14,1% in Progress variety and the highest was 18,6% in Polka variety. By 1 pm, when the air temperature rose to the highest level, the water deficit in all varieties increased, the highest water deficit was 30,6% in Polka variety, while the lowest water deficit was 24,3% in Vislukha variety. At 6 pm in the evening, the highest water deficit was 23,5% in the Polka variety, while the lowest water deficit was 19,8% in the Progress variety.

The highest water deficit in leaves was observed in July compared to other months due to the increase in air temperature. At 6 am in the morning, the lowest water deficit among varieties was 16,6% in Vislukha, and the highest water deficit was 26,2% in Polka. At 1 pm in the afternoon, when the air temperature rose to the highest level, the water deficit in all varieties increased, the highest water deficit was 33,5% in the Polka variety, while the lowest water deficit was 27,2% in the Vislukha

variety

In August, the highest water deficit in varieties was observed at 1 pm, when the air temperature rose to the highest level, as in other months. Among raspberry varieties, the lowest water deficit before irrigation was 25,4% in Vislukha variety, 26,6% in Progress variety, while the highest water deficit among studied varieties was Polka variety 31,7%, Izobilnaya variety 30,5%, Laszka made up 29,2%. In August, the lowest water deficit among raspberry cultivars before irrigation was observed at 6 am, as in other months.

When water deficit of raspberry leaf tissue was studied after irrigation of the experimental field, the highest water deficit was observed at 1 pm, similar to the pre-irrigation experiments. In June, the highest water deficit at 1 pm was 27,7% in Laszka variety, while the lowest water deficit among varieties was 23,2% in Progress variety and 23,6% in Vislukha variety (Table 3).

Table 3
Water deficit in the leaves of raspberry varieties after irrigation
(2019-2021), %

Varieties	June			July			August		
	6 am	1 pm	6 pm	6 am	1 pm	6 pm	6 am	1 pm	6 pm
Barnaulskaya	14,2	25,9	22,5	17,6	26,8	21,1	12,5	23,2	19,2
Vislukha	12,8	23,6	19,5	15,1	25,4	20,3	11,4	21,5	16,9
Sugana	13,5	24,8	19,2	18,7	26,6	21,4	14,8	26,3	18,2

Isobilnaya	15,3	27,4	22,6	22,4	28,7	23,6	14,5	26,4	20,7
Laszka	16,8	27,7	23,5	21,5	30,4	23,9	17,4	29,2	22,3
Malboro	14,5	25,2	20,7	19,7	27,6	21,8	13,2	25,4	18,1
Polka	15,7	27,4	21,2	22,8	32,2	22,6	16,3	28,7	24,5
Progress	13,2	23,2	17,6	15,8	24,6	21,3	12,6	22,1	17,5

In July, the highest water deficit among varieties was 32,2% in Polka variety at 1 pm, while the lowest water deficit was 24,6% in Progress variety.

In August, the highest water deficit at 1 pm was 29,2% in Laszka variety, while the lowest water deficit was 21,5% in Vislukha variety and 22,1% in Progress variety. Taking into account that varieties with a high water deficit in the leaf tissues are prone to drought, Polka, Izobilnaya, and Laszka varieties were assessed as drought resistance.

In the assessment of drought resistance of raspberry varieties, amount of water in leaves was also determined during the growing season in June, July, August before irrigation and after irrigation at 6 am in the morning and at 1 pm in the afternoon and at 6 pm in the evening. The amount of water of all varieties was lower in July than in other months. In all months, leaf amount of water was highest at

6 am and lowest at 1 pm, and it was observed that leaf amount of water increased again by 6 pm.

Before irrigation of the experimental field, in the hottest time of the day in June, i.e. at 1 pm, the amount of water of the Polka variety was 57,4%, and the Laszka variety was 58,5%. The amount of water in the leaves was 63,2% in the Vislukha variety, 62,6% in the Progress variety, and 61,8% in the Sugana variety compared to other varieties.

In July, a decrease in the amount of water in the leaves was observed in all varieties. When the amount of water in the leaves was studied at 1 pm compared to other varieties, the water content was low in Polka variety 55,8%, Laszka variety 56,9% and Izobilnaya variety 58,2%. The amount of water in the leaves was 62,6% in the Malboro variety, 62,4% in the Progress variety, and 61,5% in the Vislukha variety and showed a higher result compared to other varieties (Table 4).

Table 4

The amount of water in the leaves of raspberry varieties before irrigation (2019-2021), %

Varieties	June			July			August		
	6 am	1 pm	6 pm	6 am	1 pm	6 pm	6 am	1 pm	6 pm
Barnaulskaya	64,8	60,5	62,2	63,4	58,7	61,7	64,2	60,2	61,2
Vislukha	65,7	63,2	64,3	64,8	61,5	62,4	65,0	62,5	63,5
Sugana	65,0	61,8	63,8	63,2	60,5	61,8	64,1	61,7	63,2
Isobilnaya	64,1	59,7	62,4	62,3	58,2	60,4	63,3	59,6	61,4
Laszka	63,5	58,5	60,6	61,6	56,9	58,1	62,5	59,2	60,7
Malboro	65,3	61,5	63,5	65,5	62,6	63,6	64,7	62,4	62,8
Polka	62,4	57,4	58,5	62,2	55,8	59,3	60,8	57,5	58,2
Progress	66,8	62,6	64,7	65,7	62,4	63,5	65,2	63,4	64,6

In August, amount of water in leaves at 1 pm was the lowest among varieties compared to other varieties: 57,5% in Polka variety, 59,2% in Lyashka variety and 59,6% in Izobilnaya variety. The amount of water in the leaves was 63,4% in the

Progress variety and 62,5% in the Vislukha variety, which showed the highest result among the studied varieties.

When the amount of water of raspberry leaves was studied after irrigation, the lowest water content in

the leaves was observed in all months at the hottest time of the day, i.e. at 1 pm. At 1 pm in June, the lowest leaf water content was 60,6% in Polka variety and 61,6% in Izobilnaya variety, while the highest amount of water among the varieties was 65,1% in Progress variety (Table 5).

Table 5
The amount of water in the leaves of raspberry varieties after irrigation (2019-2021), %

Varieties	June			July			August		
	6 am	1 pm	6 pm	6 am	1 pm	6 pm	6 am	1 pm	6 pm
Barnaulskaya	70,5	62,7	65,6	66,4	61,2	63,5	67,0	63,5	64,7
Vislukha	73,6	64,5	67,9	70,3	63,2	64,6	71,4	63,7	66,0
Sugana	69,8	63,2	68,0	65,8	61,1	65,5	67,2	62,5	67,3
Isobilnaya	71,3	61,6	66,5	64,7	60,3	63,2	68,6	61,4	63,1
Laszka	68,6	62,4	63,5	63,9	58,4	62,4	66,5	60,2	62,7
Malboro	70,4	63,7	67,5	67,4	62,3	64,6	68,5	64,0	65,6
Polka	67,5	60,6	62,7	63,5	59,7	61,2	65,4	60,8	63,5
Progress	74,2	65,1	69,4	69,8	63,7	64,2	72,5	65,7	66,4

In July at 1 pm, the lowest amount of water in leaves was 58,4% in Laszka variety and 59,7% in Polka variety, while the highest amount of water among varieties was 63,7% in Progress variety and 63,2% in Vislukha variety.

At 1 pm in August, the lowest leaf amount of water was 60,2% in Laszka and 60,8% in Polka, while the highest amount of water among varieties was 65,7% in Progress.

The higher the amount of water in the leaf tissues of the plants, the more drought resistant those varieties are. Among the varieties studied above, Progress, Vislukha showed drought resistance compared to other varieties with higher water retention in leaves. Polka, Lyashka, and Izobilnaya varieties stood out among the studied varieties due

to the low amount of water in the leaf tissue.

The ability of leaves of raspberry varieties to lose water was studied in summer (June, July, August), when the air temperature is high. The leaves of raspberry varieties were studied by leaving them without water for 2, 4 and 6 hours.

In raspberry varieties, the ability of leaves to lose water increased every 2 hours. The amount of leaf water loss was higher in July than in other months. In this case, the highest amount of water loss of leaves, i.e. when the leaves were left without water for 6 hours, the varieties with lower water loss compared to other varieties were Vislukha 26,5%, Progress 28,3% and Sugana 28,9 Polka variety 34,2%, Izobilnaya variety 32,4%, Lyashka variety 31,7% water loss was higher than other varieties (Table 6).

Table 6
Water loss ability of leaves of raspberry cultivars (2019-2021), %

Varieties	June			July			August		
	Time								
	2	4	6	2	4	6	2	4	6
Barnaulskaya	9,2	16,5	23,8	14,2	22,6	30,5	14,2	18,5	27,2
Vislukha	7,5	14,9	20,8	12,7	19,5	26,5	8,6	16,7	22,9
Sugana	8,6	17,4	24,2	13,8	24,2	28,9	14,5	21,6	26,4

Isobilnaya	12,4	20,3	28,2	18,1	27,5	32,4	15,7	24,2	27,4
Laszka	10,3	19,8	26,7	16,9	24,3	31,7	13,2	22,5	28,7
Malboro	9,7	16,8	24,1	15,2	23,2	29,2	13,1	17,4	26,8
Polka	11,6	22,7	29,4	18,6	26,8	34,2	16,2	24,9	31,6
Progress	7,8	15,1	21,5	13,4	20,2	28,3	9,8	18,7	23,1

According to the results of the study, Vislukha and Progress varieties have more water retention in their leaves than other varieties. Polka, Izobilnaya, and Lyashka varieties have higher water loss than other varieties.

CONCLUSION

During the study, the drought resistance of raspberry varieties was evaluated by studying the water deficit, amount of water and water loss abilities of the leaf tissues. In this case, the varieties Progress, Vislukha were distinguished by their resistance to drought compared to other varieties, while the varieties Polka, Laszka, Izobilnaya were distinguished by their lack of resistance to drought among the varieties.

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