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Resistance of Olive Varieties to Spring Frosts and Winter Frosts in Laboratory and Field Conditions

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Abstract: the article presents the results of the research conducted to study the resistance of olive varieties to spring frosts and winter frosts in laboratory and field conditions.

Keywords: olive varieties, laboratory, field, spring frosts, winter frosts.

Introduction

Olive is a rather large evergreen plant, sometimes the height of the tree is 22 m or more, but in the conditions of the subtropical regions of the country, its height is usually 5 m [1, 2, 3].

The main distinguishing biological feature of the olive is the intensity of the formation of branches, the high awakening of the bud with the formation of vegetative reproduction. The formation of branches in the olive plant is due to lateral and terminal shoots. In branches of all orders, usually the last growing bud continues to produce a branch, in lateral branches, in the higher order. The main propagating mass is provided by branches of orders III and V.

The optimum temperature for olive growth is 18–24 °C. Very slow growth of olive continues at a temperature of +8-10 °C, and at a stable temperature below 8 °C, it stops developing completely [4].

According to V.P.Alekseev [5], the optimum for the growth of branches apparently lies in the range of 22–28 °C, the slowdown of the growth of branches is observed only at temperatures above +40 °C. There have been no cases of damage to olives caused by burns or excessive heat, even in the hottest deserts where the maximum temperature is above +50 °C.

According to V.A. Sholokhova [6], the most optimal temperature for olive growth is +16–24 °C. Shoots grow more intensively in May-June at a temperature of 25 °C, and when the temperature is below 8 °C, the growth slows down and then stops altogether.

Materials and Methods

The researches were carried out at the Bandikhon experimental farm belonging to the Research Institute of Horticulture, Viticulture and Winery named after Academician M.M.Mirzaev and at the experimental field of the horticultural farm "Sunbul Sultan Moviya" of the Oltinsoy district of the Surkhondarya region.

In order to determine the cold tolerance of olive plant branches after spring frosts in laboratory conditions, branches were prepared from mother bushes in different periods (deep dormancy period - January, coming out of dormancy period - the third ten days of February). For this purpose, branches of olive varieties are cut into 15 cm length, tied in bundles of 10 pieces and placed in a freezer chamber (Votsch VT 4004, Germany) to determine their resistance to cold and kept for 24 hours.

Then the branches were kept at room temperature for 6-8 hours, and the state of tissue damage was determined. The experiment was carried out in the following scheme: 1. keeping the branches in a refrigerated
chamber at a temperature of -8 °C; 2. store the branches in a refrigerating chamber at a temperature of -10 °C; 3. store the branches in a refrigerating chamber at a temperature of -12 °C; 4. store the branches in a refrigerating chamber at a temperature of -14 °C; 5. store the branches in a refrigerating chamber at a temperature of -16 °C; 6. store the branches in a refrigerating chamber at a temperature of -18 °C.

In olive groves, damage to olive tree branches from frost was determined by points: 0-point - branches are not damaged; 1-point - up to 10% of branches are affected by frost; 2-point - 11-25% of branches are affected by frost; 3-point - 26-50% of branches are affected by frost; 4-point - 51-75% of the branch is affected by frost; 5-point - more than 75% of branches are affected by frost.

In order to determine the winter resistance of olive varieties in field conditions, the condition of generative shoots was determined by varieties. The degree of damage to generative buds of 20 trees is checked. Damage to generative buds by varieties is evaluated by percentage and points: 0- no damage; 1-point - up to 10% of generative buds are damaged; 2-point - 11-25% of generative buds are damaged; 3-point - 26-50% of generative buds are damaged; 4-point - 51-75% of generative buds are damaged; 5-point - more than 75% of generative buds are damaged.

The phenological observations, biometric calculations and laboratory theoretical and practical analyzes carried out during the research were based on Kh.Ch.Buryev and others' "Methodology of calculations and phenological observations during experiments with fruit and berry-fruit plants" [8], mathematical-statistical processing of experimental data B It was conducted according to the method recommended by A. Dospekhov [7].

Results and Discussion

In many regions of our republic, in some years, the air temperature can drop below -20°C. At such negative temperatures, there is a possibility of frostbite on the branches and buds of the olive plant. The risk of frostbite can increase especially when there is no snow in the winter. Based on this, in our research, we aimed to determine the level of frost tolerance of branches and growth buds of introduced varieties of olive during winter dormancy.

In our research, we analyzed the branches taken from the mother plants during deep dormancy in laboratory conditions at air temperatures ranging from negative -10 °C to -18 °C. Observations have shown that when the selected olive varieties were stored at a temperature of -10 °C to -12 °C, damage, that is, cold shock (100 % or 0 points), was not observed at all. When the temperature of the refrigerating chamber was reduced to -14°C, damage was observed in the branches. In this case, the lowest resistance was recorded in the variety Krymskaya 172 (control) (82% or 2 points), the highest resistance was Nikitskaya II (88% or 1.7 points). Nikitskaya type I (85% or 1.3 points) took an intermediate place (Table 1, Figure 1).

It was noted that the degree of cold damage of olive branches during deep dormancy increased when the chamber temperature was lowered to -16 °C. In this case, Krymskaya 172 variety has an average resistance level of 38% or 4 points, Nikitskaya I variety has an average resistance level of 39% or 4 points, and Nikitskaya II variety has an average of 42; 4. When we raise the negative temperature to -18 °C, the highest level of frost resistance among varieties was observed in the variety Nikitskaya II (23% or 5 points).

Table 1 Spring frost tolerance of olive varieties in laboratory conditions (March), 2020-2022

Varieties	Years	Durability (%) of olive branches at different negative temperatures, degree of damage (points)									
		-10°C		-12°C		-14°C		-16°C		-18°C	
		%	points	%	points	%	points	%	points	%	points
Krymskaya 172 (con)	2020	100	0	100	0	80	2	40	4	20	5
	2021	100	0	100	0	85	2	38	4	17	5

	2022	100	0	100	0	82	2	36	4	16	5
	Average	100	0	100	0	82	2	38	4	18	5
Nikitskaya I	2020	100	0	100	0	83	1	42	4	22	5
	2021	100	0	100	0	89	1	39	4	19	5
	2022	100	0	100	0	82	2	37	4	19	5
	Average	100	0	100	0	85	1,3	39	4	20	5
Nikitskaya II	2020	100	0	100	0	88	2	44	4	25	5
	2021	100	0	100	0	90	1	42	4	22	5
	2022	100	0	100	0	86	2	40	4	21	5
	Average	100	0	100	0	88	1,7	42	4	23	5

The lowest cold tolerance was recorded in the control variant (18% or 5 points). Nikitskaya I variety took an intermediate place. It can be concluded that lowering the temperature further can lead to the complete death of the branches.

Thus, in the state of deep dormancy, olive varieties are practically not damaged by frost below -15 °C, which clearly shows that they can be fully grown in open fields in the conditions of Surkhandarya region.

It should be noted separately that, in addition to the period of winter deep dormancy, in the cultivation of olives in regional conditions, their resistance to cold during the exit from deep dormancy is also important. After all, in the conditions of the region, warm days are often repeated in the last month of winter, and this causes the olive bushes to come out of the deep rest period. Repeated cold days after warm days can have a harmful effect on them. Therefore, in our experiments, we determined the degree of frost resistance of olive varieties in field conditions during the deep dormancy period (December, January) and during the exit from the dormancy period (the last ten days of February).

During the years of research, it was not observed that the air temperature was in a negative state during the phases of olive tree cultivation, flowering, and fruit ripening. Only, it was found that it was around + 15 ... + 18 °C during spring frosts in March.

Since the olive plant is a perennial plant, external conditions affect them continuously throughout the year, not only during the growing season.

The climate of Uzbekistan is sharply continental, the annual temperature amplitude variation is more than 85°C. The weather in the winter months is changeable, and sudden changes from hot to cold are common. At this time, the absolute minimum air temperature in Surkhandarya region is around -20-25°C.

For this reason, the probability of damage to olive crops from low temperatures is very high in the winter months, and damage to the above-ground part and branches of olive trees occurs in the winter months.

Meteorological data show that severe frosts occur periodically every 15-20 years, and in these conditions, the probability of complete death of olive crops is very high. Olive varieties go into a dormant period to avoid unfavorable conditions during the winter months. This biological characteristic has been formed for thousands of years. Their resistance to low temperatures is the highest during the dormant period, and their cold resistance is much lower before and after the dormant period.

In most cases, the rest period of olive crops lasts until the middle of January. For this reason, the frosts that occur in late autumn and the second half of the winter season are very dangerous and can lead to the complete death of olive trees.

The resistance of olive varieties to low temperatures is their biological characteristics.

Table 2 Cold resistance of olive shoots during the deep rest period (in December, January, February) under field conditions, 2020-2022.

Varieties	Years	Number of trees	0-point		1 point		2 point		3 point		4 point		5 point	
			r	%	r	%	r	%	r	%	r	%	r	%
Krymskaya 172 (con)	2020	20	19	95	-	-	-	-	-	-	-	-	-	-
	2021	20	19	95	-	-	-	-	-	-	-	-	-	-
	2022	20	-	-	18	90	-	-	-	-	-	-	-	-
	Average	20	19	95	-	-	-	-	-	-	-	-	-	-
Nikitskaya I	2020	20	20	100	-	-	-	-	-	-	-	-	-	-
	2021	20	19	95	-	-	-	-	-	-	-	-	-	-
	2022	20	19	95	-	-	-	-	-	-	-	-	-	-
	Average	20	19	97	-	-	-	-	-	-	-	-	-	-
Nikitskaya II	2020	20	20	100	-	-	-	-	-	-	-	-	-	-
	2021	20	20	100	-	-	-	-	-	-	-	-	-	-
	2022	20	19	95	-	-	-	-	-	-	-	-	-	-
	Average	20	20	98	-	-	-	-	-	-	-	-	-	-

In order to create winter-resistant varieties, it is necessary to study this issue under specific conditions and take into account the factors that affect it, such as the age of the trees, condition, olive agrotechnics, olive tree yield, location of the olive orchard, grafting, soil conditions, growth strength of the varieties, etc. In the conditions of Surkhandarya region, the low temperatures of the air in the winter months mainly damage the generative organs of olive crops. Damage to the first, second order and main skeletal branches of vegetative organs is very rare.

In our control option Krymskaya 172, 19 out of 20 trees in 2020, i.e. 95%, are frost-resistant, which is equal to 0 points. Almost no difference was observed in the 2021 studies. In 2022, 18 out of 20 trees, or 90%, were frost-resistant and scored 0.

It was observed that the Nikitskaya I variety had 100% cold tolerance in 2020, which was clear from the analysis and was equal to 0 points. In 2021, 19 out of 20 trees were frost-resistant, and only 1 tree was damaged. In 2022, this situation was repeated. On average, the Nikitskaya I variety was 95% frost-resistant and proved to be equal to 0 points.

In 2020-2022, the air temperature was warm, and Nikitskaya II variety (98%) did not have a significant difference compared to other varieties. The selected varieties were all found to be cold tolerant during the research years.

Conclusion

When the selected olive varieties were stored in laboratory conditions at a temperature of -10 °C to -12 °C, damage, that is, cold shock (100 % or 0 points), was not observed at all. When the temperature of the refrigerating chamber was reduced to -14°C, damage was observed in the branches. In this case, the lowest resistance was recorded in the variety Krymskaya 172 (naz) (82% or 2 points), the highest resistance was Nikitskaya II (88% or 1.7 points).

It was noted that the degree of cold damage of olive branches during deep dormancy increased when the chamber temperature was lowered to -16 °C. In this case, Krymskaya 172 variety has an average resistance level of 38% or 4 points, Nikitskaya II variety has 42; 4. The highest level of frost resistance among varieties when the negative temperature was raised to -18 °C was observed in the variety Nikitskaya II (23% or 5 points).

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