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PHOTOPERIODISM OF SWEET CHERRY DURING CULTIVATION IN A GREENHOUSE

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ABSTRACT

Photoperiodism of sweet cherry during growing in a winter period in a greenhouse and under artificial light is researched. Stated, that development phases of trees are connected both with an air temperature regime and hours of daylight. A positive influence of the artificial lighting on a tree growth in hydroponics condition is shown. A timetable of a phenological tree development for the cultivation in winter time has been developed. A possibility for production of sweet cherries in the greenhouse of IV light zone is demonstrated.

KEY WORDS

Sweet cherry, artificial light, hydroponics, phenological development, fruit-growing.

Growing of horticulture crops in the greenhouse is a new direction in the gardening [1,4]. Technologies of wild strawberry, raspberry and blackberry production in the greenhouses are known and widely used. However, due to growth features and a size of the tree plants the production of sweet cherries is not commonly used in greenhouse complexes currently. There is information about successful growing of Southern crops of trees in the greenhouses. This experience opens perspectives for a development of a sweet cherry production technology in a temperate climate in winter time [2, 3, 6].

Modern technologies, applied in hydroponics, and design features of the recently appeared constructions for the greenhouse open an opportunity to grow wood plants in the greenhouse. In the last decade new cultivars of sweet cherry, which are featured with a quick entry into a fruiting phase, a low height and good dessert fruit appeared [7]. This research is directed to a development of an innovative sweet cherry fruit production technology under artificial light as a perspective direction in the production.

The aim of the research was an identifying photoperiodic reactions of sweet cherry during growing in various conditions under natural and artificial light.

MATERIALS AND METHODS OF RESEARCH

Three cultivars of sweet cherry (Valeriy Chkalov, Krupnoplodnaya and SweetHeart) were the objects of study. The trial was conducted in the experimental greenhouse of Volgograd State Agricultural University, in the individual entrepreneur A. Konovalov's vegetation installation with artificial light and in the sweet cherry open ground planting.

Methods of the research were based on the study of phenological phases of sweet cherry trees development at a young age, features of the growth processes under different light conditions, analysis of sweet cherry photoperiodic reactions in different planting conditions. The experiment scheme included the following variants:

1. Growing in a heatable glass "Agrisogaz" design greenhouse under natural sunlight without additional light in fall-winter period; during cultivation period the temperature was maintained at 16-22 °C;
2. Growing in the vegetation installation under artificial light using sodium discharge lamps 600 watt with a dynamically increasing daylight duration from 12 to 16 hours; the temperature was maintained at 16-22 °C;
3. Sweet cherry growing in open ground under natural light; an average air temperature in spring period was 12-18 °C, and 24-27 °C – in summer.

A dynamic of shoot growth was defined through direct measurements every 5 days in active growth period. Phenological observations were held according to a common in fruitgrowing method with marking phases of swelling of buds, a green cone, opening of buds, a leaf emergence, full flushing, an end of shoot growth, buds set, leaf yellowing and a defoliation. Photoperiodic reactions were considered on a relative change in the growth activity in different light conditions [5]. The perspective evaluation of sweet cherry growing under artificial light had been made in a sum of points and was ranged afterwards according to the following scale:

III – a cultivar which relatively to other varieties reacts long to a change of light conditions, emerges slowly from the rest state, growth processes are weak.

II – a cultivar responds to the change of the light condition, but grows slowly with increasing of the daylight hours;

I – a cultivar quickly emerges from the rest state with increasing of the daylight hours, grows actively regardless of the season.

RESULTS AND DISCUSSION

The study found that the sweet cherry trees sensitively reacted to the growing conditions both in open ground and in the greenhouse. One of the characterizing growth indicators was the length of growth. The cultivar suitability to growing in a low space is estimated on a crown size which depends on the growth length. The less the growth of shoots and the more their branching – the more perspective the cultivar is for the growing under artificial light. This way the cultivars Sweetheart and Krupnoplodnaya have some advantages. They had the growth 26% less than the cultivar Valeriy Chkalov. Data on parameters for growth and shoots development of tested sweet cherry cultivars is given in the table 1. The cultivar Sweetheart showed stability in the shoot growth processes in open ground in the natural climate and light conditions. Other cultivars revealed an increase in the intensity of the growth under artificial light and a decrease within 10-20% in the greenhouse.

A formation of shoots is a resultative trait. It was assessed on a 5-point scale. The cultivar Sweetheart differed in the best indication of a duraminization, a growth, a leaf axils set and a formation of bark. This cultivar quickly started and finished vegetation both in open ground and in the greenhouse which indicates its ecological flexibility.

Table 1 – An influence of cultivation conditions on the growth and shoot development of sweet cherry

Kind of experiment	Cultivar Valeriy Chkalov		Cultivar Krupnoplodnaya		Cultivar Sweetheart	
	length of growth, sm	formation of shoots, point	length of growth, sm	formation of shoots, point	length of growth, sm	formation of shoots, point
Greenhouse	29-30	4,5	22-23	4,2	20-22	4,7
Under artificial light	31-42	4,3	24-26	4,5	20-24	4,8
Open ground	28-36	5,0	21-26	5,0	18-22	5,0

Table 2 – Terms of passing phenological phases in different growing conditions

Variant of experience	Duration of phenologic phass, days								
	swelling of buds	green cone	greening	opening	active growth	buds setting	vegetation	yellowing	defoliation
Cultivar Valeriy Chkalov									
Greenhouse	9	3	7	10	28	14	28	10	5
Under artificial light	7	3	5	9	35	15	32	10	5
Open ground	12	5	7	13	39	17	47	8	4
Cultivar Krupnoplodnaya									
Greenhouse	10	4	7	10	26	14	27	9	5
Under artificial light	8	3	5	8	33	14	35	9	5
Open ground	12	5	8	12	34	16	51	8	5
Cultivar Sweetheart									
Greenhouse	8	3	6	8	30	14	30	9	4
Under artificial light	6	2	4	7	42	14	33	9	4
Open ground	9	5	7	11	40	17	53	9	4

An indication of the sweet cherry shoot formation directly depends on the seasonal development. The study of cycles of passing the phenological phases in the experimental

planting leads us to believe that all the cultivars pass a full ontogenesis cycle in the artificial climate condition. However, the vegetation period of the sweet cherry trees reduces under artificial light (for Valeriy Chkalov cultivar – 121 days, Krupnoplodnaya – 120 days, Sweetheart – 121 day) which is 31-34 days less comparing to open ground.

Beginning phases of development – from the swelling of buds till the active growth – are influenced by the artificial light most of all the phenological phases. The terms of these phenological phases virtually two times reduce. Exactly this regularity allows us to conclude that the artificial light is one of the most priority directions in the sweet cherry growing.

The perspective evaluation of sweet cherry on a complex of parameters let us range the cultivars and select the most suitable for the growing under artificial light. In accordance with the sum of points the cultivar Sweetheart is the most interesting. It differs in dynamical development, stress resistance and moderate growth activity.

Table 3 – Perspective evaluation of sweet cherry for growing under artificial light

Parameter	Cultivars		
	Valeriy Chkalov	Krupnoplodnaya	Sweetheart
Growth activity, point	4,8	4,5	3,9
Buds setting, point	3,6	4,8	4,9
Photoperiodic reaction an artificial light, point	4,3	4,6	4,7
Stress resistance, point	3,2	3,3	4,8
Sum of points	15,9	17,2	18,3
Rank of suitability for growing under artificial light	III	II	I

The cultivar Valeriy Chkalov doesn't suit for the growing under artificial light as it has a pronounced photoperiodic reaction, sets the leaf axils and handles stress poorly. The two of the cultivars – Sweetheart and Krupnoplodnaya – may be recommended for the growing in the greenhouse.

CONCLUSION

Thus, our research confirms the possibility of growing the sweet cherry trees both in the greenhouse and under artificial light for the fruit production from fall to spring. The sweet cherry plants are sensitive to the artificial light condition, and their phenological phases respond to a control as a result of a growing condition modelling. This way the cultivars with the moderate growth activity, the stress resistance and the positive photoperiodic reaction to the artificial light (for instance, Sweetheart) are most adaptive.

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