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FUNGICIDE SCREENING FOR THE ENGLISH OAK PROTECTION FROM THE POWDERY MILDEW

The estimation results of biological efficiency of modern fungicides in protection of English oak forest plantations from powdery mildew at single, double and triple spraying are given in this article. Experiments carried out in the field conditions showed that falcone has higher protective effect at the oak protection from fungus *Microsphaera alphitoides* Griff. et Maubl, both in single and in double treatment, falcone and folikur at the triple treatment. The tested fungicides showed not only absence of negative effect on the oak growth, but also stimulated its growth by reducing the affected area.

Introduction. A special place among the domestic forest-formers is occupied by the English oak (*Quercus robur* L.) which is one of the most valuable tree species naturally growing in the republic. It is an edifier plant of not only oak phytocenosis, but also of all broad-leaved forests.

Now they occupy 3.5% of areas covered with forests (about 274 thousand hectares), they mainly grow on rich sod-podzol and sod-calcareous loam and sandy loam soils of various humidity, forming plantings of the II and III quality classes.

For the last 20–25 years the condition of oak plantings has sharply worsened [1]. As principal causes of weakening and degradation of oak forests such factors as periodically repeating droughts and frosty winters, groundwater level changes, mass reproduction of leaf-eating insects and diseases, change of seed plantings for shrubwood, etc. are pointed out. As a result of influence of these and other factors the oak forests presence in the structure of forests of Belarus constantly decreases. Therefore the problem of oak forests reforestation at the given stage has all-important meaning.

A special place in weakening and oak drying is occupied by fungous diseases. Evolving on the growing trees, agents of diseases reduce productivity of oak timber stands, worsen quality of wood trunks, many useful functions of oak plantings are thus lost. In arboreta oak diseases can reduce considerably the yield of standard planting material and even cause a mass death of seedlings and saplings.

The most harmful and widespread disease is the powdery mildew of leaves caused by ascigerous fungus *Microsphaera alphitoides* Griff. et Maubl. The given disease spreads over the entire geographic range of *Quercus* L. type in the European part of the former USSR, and consequently, over the entire territory of Belarus [2].

The powdery mildew agent of disease is capable to affect oak trees of all ages; the affection is dangerous at any age as mycelium growing on leaves and browses leads to reduction of assimilation activity of laminae, to violation of processes of transpiration and water exchange, to reduction of growth processes of a plant.

Success in the English oak protection from the powdery mildew can be obtained only under condition of an integrated approach. Its essence consists in complex and rational application of the most effective forestry, chemical, biological and other forest protection methods with to reduce the dimensions of the fungus affection.

The most active oak protection against the given disease, as a rule, is carried out in arboreta and consists in prophylactic sprayings by fungicides the application efficiency of which is high enough [3, 4]. According to the State register of plants protection means (pesticides) and fertilizers permitted to application on the territory of the Republic of Belarus [5], it is possible to use such fungicides as alto super, SK (with consumption of 0.5 l/ha, one time usage) and baileton, WP (2.4 kg/ha, there are no instructions on frequency rate in the register) for protection of the English oak from the powdery mildew. Thus, the assortment of the used substances includes only two names and that does not permit to conduct qualitative rotation of chemical protection means, preventing emergence of the pathogen resistance.

Main part. The work purpose consisted in selection of effective fungicides, with various reactants, to suppress development of the powdery mildew in the English oak trees. Experiments were carried out on forest oak trees of Negorelsky experiment-and-training forestry enterprise. Randomized scheme of experimental plots location was chosen for experiments by us. Treatment was done by modern fungicides 1 time, 2 times and 3 times with interval of 12 days, in concentration of 0.1%: amistar extra, SK (azoxystrobin, 200 g/l, + ciprokonazol, 80 g/l), falcone, SK (tebukonazol, 167 g/l, + triadimenole, 43 g/l, + spiroxamine, 250 g/l), folikur, SK (tebukonazol, 250 g/l), prozaro (protriokonazol, 125 g/l, + tebukonazol, 125 g/l).

The substance alto super, SK (propikonazol, 250 g/l, + ciprokonazol, 80 g/l) in concentration of 0,1% was used as a standard permitted to application on the English oak. Plants in the reference variant were not treated. Plants spraying was done with the help of back-pack sprayer JactoHD-300.

Protective action of fungicides was estimated at the end of the vegetation period (in September), on control and experimental variants by detailed inspection of oak plants. Five-mark scale was used to determine development of the oak powdery mildew [6]:

- 0 – sound tree;
- 1 – up to 25% of leaves are affected;
- 2 – from 26% to 50% of leaves are affected;
- 3 – from 51% to 75% of leaves are affected;
- 4 – more than 76% of leaves are affected.

Disease development is determined according to the formula:

$$R = \frac{\sum(a \cdot b) \cdot 100\%}{N \cdot K},$$

where *R* – disease development of, %; $\sum(a \cdot b)$ – sum of products of the sick plants number (*a*) on the corresponding to them affection mark (*b*); *N* – total number of the studied plants; *K* – the highest scale mark.

Biological efficacy of fungicides and biological substances were determined according to the Ebbot formula [7]:

$$BE = \frac{K - O}{K} \cdot 100\%,$$

where *BE* – biological efficiency, %; *K* – disease development in control, %; *O* – disease development in experiment, %.

Registration carried out at the end of vegetation period showed that all tested substances have high oak protection efficiency against the powdery mildew. As a result of experiments carried out by us it was found out (Table 1) that falcone has higher protective effect at 1 time treatment, lower rates were observed at application of folikur, their biological efficiency in comparison with control was 82.9 and 63.3% accordingly.

The second treatment led to better results. So, the greatest efficiency was obtained using falcone (94.3%), rates are lower at application of alto super (84.2%). Triple oak treatment by modern fungicides permitted to receive higher results in experiments with falcone and folikur, the biological efficiency of which accounted for 98.5 and 98.0% accordingly, and that is more than the variant with the standard (96.2%). Also the researches conducted by us showed that the third treatment during the vegetation season is complete eradication of the powdery mildew.

However according to visual examinations the current summer was characterized by a considerable quantity of precipitation and that, most likely, led to fast enough reduction of fungicides concentration in oaklets, as a result was affection of some plants in the area of the youngest leaves at the end of vegetation season. Probably, in some years two protective treatments by system fungicides will be quite enough for young plants protection against the powdery mildew.

Table 1

Biological efficiency of fungicides application for the English oak protection from the powdery mildew depending on treatment frequency rate

Variant	Concentration (w/w), %	Powdery mildew development depending on treatment frequency rate, %			Powdery mildew biological efficiency depending on treatment frequency rate, %		
		1	2	3	1	2	3
Control (without treatment)	–	66.3			–		
Alto super – standard	0.1	21.0	10.5	2.5	68.3	84.2	96.2
Amistar extra	0.1	22.5	6.8	1.8	66.1	89.7	97.3
Falcone	0.1	11.3	3.8	1.0	82.9	94.3	98.5
Folikur	0.1	24.3	7.0	1.3	63.3	89.4	98.0
Prozaro	0.1	22.5	6.3	1.8	66.1	90.5	97.3

Table 2

Fungicides influence on the oak growth

Variant	Size of the last growth depending on treatment frequency rate, cm			Size of the last growth depending on treatment frequency rate, % to control		
	1	2	3	1	2	3
Alto super – standard	25.9	25.9	27.4	214.0	214.0	226.4
Amistar extra	32.5	35.9	40.0	268.6	296.7	330.5
Falcone	24.8	25.2	27.4	204.9	208.3	226.4
Folikur	25.3	28.0	28.1	209.1	231.4	232.2
Prozaro	27.9	29.0	29.9	230.6	239.7	247.1
Control	12.1			100		

Visual observations of oak plants conditions will permit to set correctly the date and quantity of treatments in the vegetation season. Attentive examination of plants at the end of May –beginning of June will permit to find first development symptoms of the powdery mildew on leaves –it will be exactly the time to make a decision about the necessity and expediency of treatments carrying out.

The conducted researches also showed that all tested fungicides showed not only absence of negative effect on the oak growth, but also stimulated its growth by reducing the affected area.

As it is clear from the data of table 2, the greatest oak growth is observed after one-time, two-time and three-time treatments by the substance amistar extra. The size of the last growth exceeds control 2.7–3.3 times as a result of application of the given fungicide. Falcone and alto super had also positive influence on the oak growth.

Conclusion. 1. Many modern system fungicides have high biological efficiency in protection of the English oak plants from the powdery mildew. Falcone and folikur substances have a high protective effect in oak protection against *Microspora alphitoides* Griff. et Maubl. fungus.

2. The tested fungicides show not only absence of negative effect on the oak growth, but also stimulate its growth by reducing the affected area.

3. Oak treatment by fungicides should be begun with appearance of the first disease symptoms and be continued during the conidia sowing period with interval of 12–14 days while calculating the epiphytotic disease developments. Usage of fungicides is inexpedient in years of depressive and moderate development.

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