FOREST PROTECTION AND LANDSCAPING

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ECONOMIC FEASIBILITY OF CHEMICAL AND BIOLOGICAL METHODS TO PROTECT THE PINE FROM DIPLODIA TIP BLIGHT

Diplodia tip blight is found overall the young pine plantations of Belarus. The prevalence of the disease can reach 40%. One of the most effective protective measure of pine trees is treatment with biological and chemical preparations. Calculations of economic substantiation of modern pesticides applying for plant protection against Diplodia tip blight are given in the article. Investigations showed that applying of fungicide Menara, SC can reduce costs from the disease in the greatest level.

Introduction. Increasing demands in forest products move forward a task of the productivity increase and tree plantations resistance to unfavorable factors of the external environment, diseases and insects. Effectiveness of the intentional protective action complicates by the fact that forest protective measures are often carried out as preventive measures positive effect of which is difficult to calculate.

In non-linked pine planting and newly planted planting epiphytotics of a new disease for the Republic named diplodia tip blight has been observed since 2009 [1]. As a rule, this is a disease of young (to 15–20 years) pine planting resulting to the drying off of the current year sprouts and retardation of growing processes of a tree. Under the low rate of the affection of the trees at the age of 6–10 years by diplodia tip blight decrease of their linear growth by 4.3% is observed, under the mild rate – by 15.5%, under the heavy rate – by 20.4%. By diameter growth index decreases by 2.0, 15.7 and 19.5% correspondently. The heavy rate of affection of a pine tree by diplodia tip blight and (or) disease development on one and the same tree during several years leads to multitopping or death of a tree.

In integrated system of measures on the protection from diplodia tip blight chemical and biological protective measures have an important role which is only to be applied in cases of epiphytotics occurring under the heavy rate of affection of forest planting by diseases. Chemical and biological protective measures are to be carried out only with the help of highly efficient agents registered in state register of plant-protecting agents [2], and practicability of such measures is to be proven, that is the aim of this work. Practicability of forest protective measures is determined by three basic components: ecological, economic and social effects. In general, they aim to prevent destroying of forest ecosystems from hazardous organisms' affection, rise in profitability of forest growing by means of quality and quantity increase of harvested timber, increase of recreational, water protective, soil protective and many other useful features of forest.

Main part. In this work calculation of economics of protective measures is given. Economic effect is determined as excess of cost estimate of the results of forest protective measures over the cost rate on their fulfillment. Spending reduction on all types of resources (per unit area) through prevented damage from the development of hazardous organisms is regarded as an effect [3].

The most complicated at determination of economic effect of forest protective measures is calculation of real or possible damage from the influence of pests and diseases on forest plants.

In accordance with common methods for damage calculation, sampling areas on damaged and undamaged areas are taken into consideration. Calculation and further comparison of harvesting timber production volume in natural (m^3) or money (rub.) terms is carried out. Effect from forest protective measures is determined by multiplication of the prevented damage volume in terms of natural units (m^3/ha) on tariff price of 1 m^3 of the timber and on the area where forest protective measures were carried out (ha). For calculation of the coefficient of total or absolute economic effectiveness of forest protective measures (K_{fp}) the following formula is recommended [3]:

$$K_{fp} = \frac{D - E_{fp} - E_{test} + P}{E_{fp} + E \cdot K}, \qquad (1)$$

where K_{fp} – coefficient of economic effectiveness of forest protective measures; D – the size of possible damage (losses), rub./ha; E_{fp} – expenses on forest protective measures, rub./ha; E_{test} – expenses on forest pathological testing, researching and experiments, rub./ha; P – cost of marketable products received during the fulfillment of measures, rub./ha; E – norm coefficient of investment

performance (0.15); K – investment expenditure on equipment purchase, rub./ha.

Analysis of constituents of calculation formula of absolute economic effectiveness coefficient showed that in our case it isn't possible to calculate this index as it is difficult to calculate the reserve of timber of forest plantation for 2–3 years of growing. Besides, at this age it is impossible to transfer volume of timber from natural to cost equivalent as in non-linked forest plants is almost impossible to harvest marketable timber. That is during the calculation of economic damage from diplodia tip blight affection only decrease rate of plants growth and real per cent of their death can be estimated that in practice it can be shown by survival index. Research was carried out in Central forest area of Negorelskoe experimental forestry in 2012. At the base of calculation of practicability of forest protective measures in this work different rate of affection and death of forest plantation on experimental and test areas (Table 1).

Table 1

Survival of forest plantation in the locations of diplodia tip blight on experimental and test areas

Experiment variation	Biological effectiveness of agents, %	Disease development, %	Survival of plantation, %
Menara, SC, 0.1%	98.2	0.05	95.6
Phytopro-tectin, L 5%	89.7	0.65	89.0
Control	–	5.65	72.1

In protection from diplodia tip blight on experimental areas agents with high biological effectiveness were taken and optimal concentrations of working fluids were selected. These were: Menara, SC (0.1%); Phytoprotectin, L (5%). Protection is carried out by means of double spraying of plants in accordance with current rate of agent application for 1 ha [4, 5]. On tested areas plants were not processed.

For calculation of expenses on planned forest protective measures regulatory technological maps (RTM) have been developed with industry standards of output and job prices on works in forestry [6] on forming of 1 ha of forest plantations of Pinus sylvestris of experimental and control areas of pine plants for the period of two years. Expenses on fuel necessary for motorized sprayer work are included in the cost of materials. Rate of fuel application on the processing of 1 ha of forest plantation – 6.5 l. RTM on forming of forest plantation, its maintenance and plants processing by agents in experimental areas differs

in volumes of some works. It is connected with different acclimation rate of forest plants in all areas at the moment of stock-taking and, as consequence, different volumes of their supplement. In the course of undertaken calculations it was established that tariff fund of wages for workers in the area with application of agents Menara, SC and Phytoprotectin, L constitutes 1,042.5 thousand rub. and in the control – 1,273.9 thousand rub. in prices as on 01.01.2012.

On the basis of documents of RTM on forming and growing of forest plants for the all three areas calculation of necessary expenses for two years of growing is made (Table 2).

Table 2

Comparative calculation of expenses on forming and growing (two years) of 1 ha of forest plants of Pinus sylvestris, thousand rub.

Heads of expenditure	Experience variations		
	Menara, SC	Phytopro-tectin, L	Control
Main W – tariff fund W – bonuses and other payment	2,293.5 1,042.5 1,251.0	2,293.5 1,042.5 1,251.0	2,802.6 1,273.9 1,528.7
extra W	275.2	275.2	336.3
W. payments	873.4	873.4	1,067.2
Expenses on maintenance and use of cars and machines	1,546.9	1,546.9	1,557.8
Cost of basic materials – seedlings – fungicides – fuel A-92	1,635.4 1,149.1 473.0 13.3	2,966.9 1,149.1 1,804.5 13.3	2,284.3 2,284.3 – –
Total direct expenses	6,624.4	7,955.9	8,048.2
Household expenses	993.7	1,193.4	1,207.2
Total expenses	7,618.1	9,149.3	9,255.4

Note. W – wages.

Expenses on maintenance and usage of cars are included into calculation: soil processing with milling cutter FC-045 on MTZ-1221 tractor, carriage (UAZ-3303) and planting of seeds with the help of tree planting machine MLU-1 by means of MTZ-82, agrotechnical processing with moto-bushcutter «Stihl».

Based on the comparative calculation of expenses it is possible to make a conclusion that on cultivation and growing of 1 ha of forest plantation of Pinus sylvestris within 2 years the biggest expenses (9,255.4 thousand rubles) are observed in the control variation of the experience. It can be explained by a number of expenses on supplement of forest plants in connection with the destruction of a part of the plants from diplodia tip blight

(workers' wages, expenses on maintaining of mechanisms, seedlings cost).

Cultivation and growing of forest plantation within 2 years with preventive protection of plants with fungicide Menara, SC (according to the first variation of the experiment) will cost forestry 7,618.1 thousand rubles/ha. This variant is the most economically profitable, but its main drawback is impossibility of usage of the chemical agent in forest areas near human settlements, garden associations, in recreational, water protection areas and in some other areas.

While using biopesticide Phytoprotectin, L growing of forest plantation within 2 years will cost forestry 9,149.3 thousand rubles/ha, but its main priority against fungicide Menara, SC is the possibility of its application in any areas including woodland park areas as the agent is ecologically save.

Calculation of comparative economic efficiency of the application of fungicide Menara, SC and biopesticide Phytoprotectin, L was carried out by their pair comparison with the control variation. Comparative economic efficiency was expressed by the amount of economic effect (E), the following formula was used for its calculation: [7]:

$$E = (C_1 - C_2) \cdot B, \qquad (2)$$

where E – economic effect, in thousands of rubles/ha; C_1 – cost price of measures on the supplement of forest plants in the control variant (per 1 ha), thousand rubles.; C_2 – cost price of protective measures per 1 ha with application of the agent, thousand rubles.; B – area, in this case – 1 ha.

In accordance with our calculation economic effect from the application of fungicide Menard, CE constitutes:

$$E_1 = (9,255.4 - 7,618.1) \cdot 1 = 1,637.3 \text{ thous.}$$
$$\text{rub./ha.}$$

Economic effect from the application of biopesticide Phytoprotectin, L constitutes:

$$E_2 = (9,255.4 - 9,149.3) \cdot 1 = 106,1 \text{ thous. rub./ha.}$$

Thus, the most economic reasonable is the application of fungicide Menara, SC which allows cutting expenses on growing of forest plants of Pinus sylvestris (at epiphytotic level of development of diplodia dry rot) during 2 years by 18%. Application of biopesticide Phytoprotectin, L can be reasonable first of all in forests of high ecological importance (cutting of expenses by 1.1%).

To additional results of forest protective measures we can place silvicultural effect, improvement of sanitary conditions of plants, decrease of probability of contamination of nearby forest areas by fungus spores as a result of decrease of pathogens due to the processing with agents.

On a national scale, the approximate calculation of economic effect is based on real volumes of yearly planting of forest plantation of Pinus sylvestris – from 13 to 25 thousand ha. In 2010 plants of Pinus sylvestris were cultivated on area of 15.7 thousand ha. According to our data, annually at the age of 2 years about 3.7% of area is contaminated (in 2010 it constituted about 580 ha), where money on supplement of forest plants will be spent.

Thus, without application of agents (control) expenses will be:

580 ha · 9,255.4 thous. rub. = 5,368.1 mln. rub.

With application of fungicide Menara, SC

580 ha · 7,618.1 thous. rub. = 4,418.5 mln. rub.

With application of biopesticide Phytoprotectin, L

580 ha · 9,149.3 thous. rub. = 5,306.6 mln. rub.

Thus, with application of different agents only for forest plantations of 2 years old annual economy of funds within the Republic will be 61.5–949.6 mln. rub. at the average level of diplodia tip blight development.

Conclusion. In the course of revealing of economic effectiveness of forest protective measures it is necessary to take into consideration preventive character of a number of works aimed at getting effect in the future. However, during the examination of the protective measures of a pine at an early age from diplodia dry rot the vivid connection of the effect from applied material and manpower resources and the results expressed in the decrease of percentage of diseases and decrease of expenses on plants supplement in connection with their damage and even partial destruction.

Provided calculations on justification of economic reasonability of forest protective measures and choice of effective agent show that the largest economic effect can be obtained in case of applying of systemic fungicide Menara, SC.

Reasonability of application of the offered agent is proven by economic effectiveness which is only in the 2 year old forest plantations can constitute 950 mln. rub. in prices as for 01.01.2012.

In areas where pesticides of chemical origin is not allowed to apply due to tightened inspection to ecological safety and environmental protection, to protect the plants from diplodia dry rot the application of biopesticide Phytoprotectin, L is reasonable.

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