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V. V. Nosnikov¹, A. V. Yurenya¹, A. P. Mayseenok²¹ Belarusian State Technological University² Dvinskaya forest experimental station of Belarus National Academy of Sciences

HERBICIDES APPLICATION EXPERIMENT DURING CHEMICAL TREATMENT IN FOREST PLANTATIONS

Oppression of forest plantation on cutting areas is observed first of all at the expense of a intensive growth of undesirable wood and shrub vegetation.

Chemical care in forest plantation can be carried out before their planting, prior to the beginning of vegetation period, during vegetation period. The more safer in relation to treated forest cultures is machining before their planting. In this case it is better to use soil herbicides with the long term of action, such as Terrsan in a dose of 100–200 g/hectares, the Grader in a dose of 1 l/hectare. Machining Glifos in a dose of 4–8 l/hectares also is effective, however the best effect render tank mixtures of these herbicides. Optimum time of machining is the middle of summer till the cultural operations moment and on tilled soil (to drills, strips) till the end of October. We carried out treatment of plantation of a *Lárix decídua*, *Betula pendula*, *Píceá ábies*, *Tília cordáta*.

Machining prior to the beginning of vegetation period is a little effective, as in negligible extent acts on wood and shrub plants. In vegetation period it is possible to use direct machining of strips abutting to rows by hand sprayers with screen with herbicides of Terrsan, the Grader, Glifos and them tank mixtures. In the end of vegetation period the most effective is machining of crops of a spruce by tank mixture of herbicide of Terrsan in a dose of 100 g/hectares and Glifos in a dose of 4 l/hectares in September. At augmentation of a dose of Terrsan to 200 g/hectares or Glifos to 6–8 l/hectares increases risk of damage of plantation of spruce crops.

Key words: herbicides, coniferous breeds, deciduous breeds, forest plantation, processing terms and dose, efficiency.

Introduction. One of the main problems of reforestation is the care timeliness of wood cultures when there is a competitive reduction of unwanted woody, shrubby and herbaceous vegetation effects. Traditional control methods with these plants are their mechanical destruction using forest cultivators or moto-bunchy cutting machines and chemical treatment, based on herbicides and arboricides using. Mechanical destruction of plants by mowing refers to one of the most labour-intensive and expensive operation, so in some cases there is an untimely care resulting to inhibition of growth and even death of forest plants. In addition, there is an intense re-growth of cut unwanted tree and shrub vegetation, forcing to repeat the action time and again. Chemical care is much cheaper. When it is, a complete destruction of treated unwanted plants is registered, so there is no resumption of young growth. However, unlike the mechanical method, the chemical method has a serious impact on the environment of the treated area, which greatly limits its use.

Main part. In contrast of forest nurseries, where weeds are mainly represented by herbaceous plants, forest woody and bushy species greatly inhibit young forest plantations growth. The role of the herbaceous vegetation is less, but it is also essential, especially in the lands that came out of agricultural use, provided mostly by long fallow lands. Consequently, herbicides, used for chemical care of forest cultures, should have equally effective influence on both herbaceous, and woody and bushy vegetation.

Herbicides treatment of forest growing area or forest plantations can be continuous and partial.

Using continuous treatment, the destruction or the deceleration of unwanted vegetation growth takes place on the total area, and growing plants do not feel any weeds competition. However, this method has a strong negative impact on biological diversity of vegetation in the area.

More harmless environmentally and less expensive is a partial treatment, when herbicides are applied only in certain bandwidth along the row of plantations. The bandwidth depends on the age of forest plantations and the type of habitats.

In the early years of growing, it may be sufficient to introduce herbicides within the bandwidth of cultivated soil. For example, when cutting grooves herbicide may be introduced at the bottom and on beds, without occupying the untreated ground. It may well be enough to protect the seedlings or saplings, but under favorable conditions, unwanted vegetation between the rows can quickly outgrow planted plants and choke them. In this case, it is necessary to increase the treated bandwidth. In our studies, we used only the band treatment as less environmentally hazardous.

Herbicide treatment can be carried out till the moment of forming the forest plantations, before and during their growing season.

The first method is the most effective and safe in terms of using herbicides to control undesirable vegetation. In this case, it is reasonable to use either soil

herbicides, or tank herbicides mixes with glyphosate preparations, permitting to reduce the impact of unwanted competitive plants to a minimum.

To appreciate herbicides treatment effect on the areas of forest plantations before their foundation, test areas in Novogrudok forestry of SFI "Novogrudok Forestry" were founded, where at the end of October in 2014 a cutting area of the hornbeam forest has been treated. Sod-podzolic sabulous on sandy loam connected soil underlying by light clay loam moraine at a depth of 1 m. The grooves have been previously made on the area. The height of undesirable woody and bushy vegetation between the grooves, at the time of herbicide treatment ranged from 0.67 to 1.43 m, the projective cover was 100%. The grooves space of 0.5 m aside from them were subjected by Terrsan herbicide treatment at a dose of 100 g/ha. In spring of 2015, the annual age seedlings of European larch with closed root system as well as of the annual age birch and of four years old spruce seedlings with open root system have been planted on the area.

The account, held in autumn of 2015 at the area resulted in a strong inhibition of unwanted vegetation. The projected cover of grasses on the treated areas, adjacent to the grooves was reduced to 27%, while the latter remained virtually clean. There were isolated sedges samples with signs of phytotoxicity and Veronica drug. Woody and bushy vegetation was better preserved because the treatment was carried out rather late. The total loss of aspen and willow plants was observed in 63%, but other plants have been largely weakened, have reduced shoots and leaves, and by the end of the growing season could not form a large green mass.

None of planted species was observed to be damaged by the herbicides. Last year self-seeding Norway maple was damaged where it was a significant amount of herbicide. Recent years, especially last year self-seeding oak was heavily damaged by the herbicide. The plants last year shoots died, although the plants remain alive. However, on the treated areas this year oak and maple resumption successfully began, indicating the possibility of such treatment when oak or maple seeding in the composition of forest plantations.

Also, the treatment by Terrsan herbicide of the plot from former agricultural use in Ivie forestry of SFI "Ivie Forestry" was carried out at a dose of 100 g/ha. Soil is humus-gley sabulous on loose sandy loam, changed by sands. Also at the time of treatment the grooves were cut. The height of the ground cover did not exceed 10 cm, but the vegetation was under a thick layer of dried grass, the presence of which suggests that in the growing season the height of herbaceous vegetation was 0.5 m. In spring of 2015, on this plot lime and spruce European plants were created.

By the end of the growing season, the bottom of the grooves and beds were almost clean of weeds. Only a few plants of turkey grass, Veronica drug, couch grass and garden violet were remained. At the same time, on the beds of untreated areas grass vegetation has already been highly developed. The projected cover was 100%. The height of the herbaceous canopy was 32–45 cm.

Herbicides treatments effects on lime are not revealed. Spruce plants have a lighter color, but it is not clear, if it is caused by the action of the herbicide, or the cause is physiological processes, because the spruce plants are intensely insulated, while the untreated plants are shaded by grassland.

Another method of herbicide introduction is a treatment before vegetation starting of created or already established forest plantations. This treatment of 3 years aged Norway spruce plantations in Putchinsky forestry SFI "Minsk Forestry" was carried out by Terrsan herbicide at a dose of 50 and 100 g/ha. As, at the time of treatment herbaceous vegetation was mainly represented by very young overwintering and perennial weeds and unwanted trees and bushes have just started to break up buds, the effectiveness of the herbicide was not high. At the end of vegetation projective cover on the treated plot at a dose of 50 g/ha was the same as on the untreated plot. At a dose of 100 g/ha vegetation damage was significant. However, the effect of the herbicide was evident and on some spruces plants, becoming apparent in shortening of apical shoot and in its discoloration.

The employees of Dvina experimental base of the Forest Institute of NAS of Belarus have also done a spring treatment of spruces plantations by herbicide Terrsan and Tornado in Glubokoe experimental forestry. The soil is sod-podzolic-lightly podzolic loamy on the light clay loam, changed by sandy loam, underlying moraine at a depth of 1 m. The first year aged spruces plantations having been taken care by the chemical herbicide Tornado 500 (3 l/ha) projective cover of soil by herbaceous species are not exceeded 20%, and their weight has decreased by 3 times. Only a limited number of raspberries, blackberries, brake fern, blueberries was preserved.

A higher efficiency is achieved in a variant of three years aged spruces plantations with Tornado 500 at 5 l/ha. Only raspberries, blackberries and blueberries save the depressed state.

Herbicide Terrsan application shows a higher efficiency. Thus, in variants with Terrsan at a dose of 150 g/ha, a soil projective cover decreased by 90% in comparison with the control variant and a top phytomass decreased by 10 times. In a variant with Terrsan at a dose of 200 g/ha a herbicide biological effect on grassy vegetation is even higher. The soil projected cover of undesirable vegetation

decreased here by 95% and a top phytomass compared with the control (without care) decreased by 22 times. Practically the growing season of all plantations come from the direct negative impact of herbaceous vegetation.

However, the terms of the herbicide treatment before the start of the growing season is limited. Under favorable weather conditions, vegetation may begin early, but it increases injury risk of forest plantations by herbicide.

In most cases, during the active growing season, the continuous application of herbicides will result to the destruction of forest plantations, but the way of their introduction can be directed treatment with using handy sprayers with protective screens. In this way, only the edges of grooves and the adjacent bands are treated by herbicides, a direct spraying of forest plantations is excluded.

Directional treatment by Grader herbicide at a dose of 1 l/ha and a tank mix of Terrsan herbicides (100 g/ha) and Glifos (4 l/ha) was carried out by us in the forestry Smolevichy a month after the creation of Norway spruce and English oak plantations. The soil in the area is sod-podzolic medium-podzolic sandy loam on connected sandy loam, underlying moraine at a depth of more than 1 m. At the end of the growing season, the treated bands of 1.5 m wide were practically free of undesirable woody, shrubby and herbaceous vegetation. Forest plantations damage wasn't observed. The main disadvantage of this method is the high labor intensity, but it is still lower than with bushy moto-cutting care, and the efficiency is higher as the effect of treatment can be seen and for the next season.

To evaluate the use of herbicides at the end of the vegetation period experiments on forestry areas of Putchinsky SFI "Minsk Forestry" in Norway spruce plantations aged of four were founded. Terrsan herbicides at a dose of 100 and 200 g/ha and Glifos at doses of 4, 6 and 8 l/ha, as well as their tank mixes were used for the experiment in late September.

In general, we can evaluate the effectiveness of treatment in early autumn as high. At the end of the next growing season on the treated by Glifosom at a dose of 4 l/ha area only a few herbs were presented. They were all at the bottom, i. d. significantly lower than spruce. Glague, sally-bloom, wood pea, coltsfoot, sedges are met. Shoots of broadleaved species, appearing profusely after bushy moto-cutting care are almost completely lost. The remaining plants are strongly suppressed. They are completely missing the current increase. Leaves are very deformed. On the area, isolated aspen and birch of seed origin began to appear. Solitary raspberries are also met. Herbicide treatment removed raspberries and herbaceous vegeta-

tion under the canopy of remained wings of softwood trees.

No phytotoxicity signs of spruces plants were found. All plants gave an intense increase in height. At the same time undesirable vegetation projective cover on the control reached 100%. The height of the canopy ranged from 1.6–1.8 m.

Tank mixtures application of herbicide Glifos at a dose of 4 l/ha and Terrsan at a dose of 100 g/ha appeared to be more effective.

On the area treated by tank mixture of Terrsana and Glifos, there is almost completely absent not only the growth of softwood species, but also plants of the seed origin. Herbaceous vegetation is represented by curtains, confined to the places, where the amount of herbicide have not been enough introduced.

Also, the object of 2014 in spruce, English oak, birch forest plantations were found in Novogrudok forestry of SFI "Novogrudok Forestry". The soils in the area of sod-podzolic lightly podzolic temporarily wet in abundance loamy on loose sandy loam underlying by moraine at a depth of 1 m. The treatment was carried out in late September by tank mixture of Glifos herbicide at a dose of 4 l/ha and Terrsan at a dose of 100 g/ha.

The effectiveness of herbicides effects on vegetation is high, as by September 2015, projective cover had not exceeded 5%. It was not required to carry out extra care on the area.

Single samples of sedge, field sow thistle were saved. Raspberry almost all died. The remained samples are very deformed and completely stopped in growth.

However, the drooping birch plantations completely died. Oak was badly damaged too. Most of the plants have died.

Increased dosage both of Glifos as far as 6–8 l/ha and Terrsan to 200 g/ha dramatically increases the injury risk of spruce, which has brown needles damage on the whole plant or on the top, as well as the shortening of the needles on the shoots of the current year. The total number of damaged plants in rows ranged from 10 to 80%.

Treatment by tank mixture of Glifos herbicides (4 l/ha) and Terrsan (100 g/ha) of 4 years aged spruce plantations in Minsk forestry has shown that a reduction of the competitive effects of unwanted vegetation on spruce increases the current growth, which is in the area chemically treated was 39% more compared with intensively developed by undesirable vegetation area.

In the fall of 2014, they also treated spruce forest plantations, formed by saplings 2+2 in spring of this year. By the end of the first year on the area aspen and birch are massively developed, almost completely suppressed forest plantations. Increased growth of plants on treated plots ranged from 29 to

44% compared with the control, and the safety was higher by 33%.

It should be noted that the use of handy motorized sprayer does not provide uniformity of treatment, so high doses of herbicides result to damage and death of a plant part, which get more of the preparation. Using the tractor sprayers may treat uniformly the area, and it may be to permit using higher doses providing the effect for several seasons. However, in forestry there are no specialized tractor sprayers.

Conclusion. Herbicide treatment before foundation of forest plantations can effectively deal with unwanted vegetation in the first growing season. Particularly efficiency of this treatment is high on the rich soils and soils of former agricultural use.

The most effective treatment is a fall one preceding planting of forest plantations. In this case, a tank-mix of Terrsan herbicide (100 g/ha) and any Glyphosate preparation at a dose of 4 l/ha, e. g. Glifos or Glifos only at a dose of 6–8 l/ha.

Using of Terrsan herbicide at a dose of 150 and 200 g/ha and the Tornado 500 in the spring before the growing season of plants has a high effectiveness, but at the early beginning of the spruce growing season may cause its damage.

Early fall treatment by tank mixture of Glifos herbicides (4 l/ha) and Terrsan (100 g/ha) has a high efficiency, which allows to suppress weed vegetation during the next growing season. Early fall glyphosate treatment at a dose of 4 l/ha has a less effect. Increasing the dose of glyphosate to 6–8 l/ha and Terrsan to 200 g/ha increases the risk of phytotoxicity.

Thus, the optimal scheme of herbicides application is the treatment before planting forest plants, followed by the fall treatment of spruce by tank mixture of Terrsan and Glifos herbicide at doses of 100 g/ha and 4 l/ha, respectively. In the forest hardwood plantations during the growing season a directional treatment of bands along the rows of plants can be used handy sprayers having protective shields of tank mixture of these herbicides.

Information about the authors

Nosnikov Vadim Valer'evich – PhD (Agriculture), Assistant Professor, Head of the Department of Forest Plantations and Soil Science. Belarusian State Technological University (13a, Sverdlova str., 220006, Minsk, Republic of Belarus). E-mail: nosnikov@belstu.by

Yurenja Andrey Vladimirovich – PhD (Agriculture), Senior Lecture, the Department of Forest Plantations and Soil Science. Belarusian State Technological University (13a, Sverdlova str., 220006, Minsk, Republic of Belarus). E-mail: urenja@belstu.by

Mayseenok Anatoliy Petrovich – PhD (Agriculture), Senior Researcher. Dvinskaya forest experimental station of Belarus National Academy of Sciences (88, Yubileynaya str., 211797, Podsvil'ye, Glubokoe district, Vitebsk region, Republic of Belarus). E-mail: dvinsk_elb@tut.by

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