УДК 630*232

A. I. Rusalenko, D. Sc. (Biology), professor (BSTU)

TECHNOLOGY AND COSTS OF CREATION OF FOREST CULTURES OF PINE IN ACCORDANCE WITH HABITAT CONDITIONS

For the characteristic of conditions of growth are accepted a class of bonitet and group of stands. The technology of creation of forest cultures is resulted: processing of soil by loosening of strips by a mill, manual landing of annual seedlings under Kolesov´s sword, addition for the second and third year by the annual seedlings and cares of forest by cutting of vegetation by motor-units (in the conditions of II class of bonitet – 1, I – 2, Ia and Ib – 3 cares). Are not planned cares of forest in the conditions of III–V classes of bonitet. Industrial expenses for creation of forest cultures of 1 hectares fluctuate from 1151.3 (III class of bonitet) to 3906.0 thousand roubles (Ia class of bonitet). Cost of taxes at the age of the principal cuttings changes from 10,296 (V class of bonitet) to 71,912 thousand roubles (Ib class of bonitet). After discounting it has appeared that in the conditions of V class of bonitet expenses for creation of forest cultures exceed the resulted estimation of volume of wood on 298.9 thousand roubles. On other classes of bonitet economic benefit makes from 453.0 to 2601.8 thousand roubles. It is noticed that at the decision of a question on creation of forest cultures it is necessary to consider huge ecological and social value of forests.

Introduction. The territory of Belarus belongs to a zone of intensive agriculture and developed industry. Historically more fertile soils were used for agricultural needs. Therefore currently the woods grow mainly on low-fertile sandy and peat-bog soils. For creation of artificial plantings sandy soils are used generally.

While developing the technology of cultivation of forest plantings, including the technology of creation of forest cultures and improvement thinning, the primary target is formation of highly productive forest stands corresponding to the habit conditions.

The productivity and species composition of our forests in future in large degree depend on progress of forest restoration and forest cultivation by means of creation of forest cultures. According to the forest management Republican unitary enterprise "Belgosles" [1], plantings of artificial origin make only 18.3% of the total area of the state forest resource of our republic. Meanwhile, as it is known [2], plantings of an artificial origin exceed natural plantings' efficiency. This advantage in many respects depends on the selection of species composition of forest cultures in accordance with habitat conditions, and also is determined by efficiency of distribution of trees on the area and the increased density at the age of the final felling.

The creation of forest cultures is rather expensive, but as it is carried out once, and formed forest stands depend on its efficiency, this stage of forest growing needs to be given close attention. As it is mentioned in the Strategic Plan [3], while making decisions concerning the composition of plantings and mix of breeds, first of all there should be considered growth conditions, and then questions of wood usage and ecology. Besides, this document provides improvement of technologies of forest growing. In our opinion, quite essential questions

of reforestation are the cost of works and economic benefits of forest growing.

Main part. There isn't enough available knowledge about the soil to determine precisely a forest stands bonitet by the type of the soil. On the current stage of forestry science development it's expedient to implement a widespread phytocoenotic method to characterize habitat.

As it was noticed by P. S. Pogrebnyak [4], the most perfect and exact analyses of soils and climate aren't able to replace the characteristic of fertility which is established by parameters of the plant itself.

That is why for the characteristic of soil conditions, it's normal to use forest stands bonitet, which, as we know, is an integrated indicator of soil fertility and is determined according to M. M. Orlov's bonitet table [5]. As the same bonitet class can be in forest stands both of the first and the second class of the woods, besides a bonitet class, a group of plantings [6] is specified. This methodological approach allows to deprive of subjectivity the definition of habitat conditions.

In the present article we regard production of forest cultures in the conditions of bonitet class V–Ib, i.e. restoration of forest stands of the first class of the woods relating to the 1-6th groups of plantings. Costs of production of forest cultures depend on habitat conditions and technology of forest cultures creation. The following technology of creation of forest cultures is provided.

Strip cultivation using a miller to loosen the soil is implemented, because when being planted in furrows, plants bend their root system mainly to inter-furrow space [7] is applied. Such development of root system subsequently reduces stability of plants against a windfall.

Seedlings are delivered to the silvicultural area by car and temporarily heeled in. Planting of seedlings is

carried out manually using Kolesov sword; the use of planting machines is impossible because of stubs. 1-year old pine seedlings with height of aerial part 5 cm are used for planting. When using 2-year seedlings which have a developed root system, it is difficult to exclude an essential disadvantage of manual planting using Kolesov sword – a bend of roots.

For the same reasons 1-year old seedlings are used also for reinforcement planting. Reinforcement planting is provided at the 2nd and 3rd years after creation in the number of 20% of planting spots. This action needs to be paid close attention as low-quality reinforcement planting leads to forest stands of low density and falling efficiency.

It is determined by researches [8] that taking care of forest cultures by soil loosening is inexpedient, because roots get damaged and growth of plants decreases. Therefore it is planned to take care of plantations by cutting grassland vegetation using motor-units and cultivation of soft-wooded broadleaved species. In the conditions of the 1-3rd groups of plantings the specified treatment isn't planned in connection with a poor development of grassy and wood vegetation [9].

In the conditions of the 4th group (the bonitet class II) it's provided to carry out treatment only one time , in the conditions of the 5th group (the bonitet class I) – two times, and in the conditions of the 6th group (bonitet classes Ia and Ib) – three times.

Density and place of planting of forest cultures depend on habitat conditions [9], and while calculation of expenses for creation of forest cultures they were accepted by the following: The bonitet class V – 2.5×1 m (4000 pcs./ha); IV – 2.7×1 m (3700 pcs./ha); III – 2.8×1 m (3570 pcs./ha); II – 2.9×1 m (3450 pcs./ha); I – 3.2×1 m (3130 pcs./ha); Ia – 3.4×1 m (2940 pcs/ha) and Ib – 3.6×1 m (2780 pcs./ha).

For calculation of expenses for creation of forest cultures the current tariff rates and norms were used. The tariff salary fund decreases in proportion to quantity of planting spots (Table 1). Its increase in the 4th and the subsequent groups is caused by carrying out forest plantations treatment which is quite expensive.

The direst cost appeared to be the largest in the conditions of bonitet class Ia. Besides a direct cost, the sum of expenses on creation of forest cultures included general production expenses that on the Ministry of forestry average 16.6% of direct expenses.

Finally it appeared that the sum of production expenses for creation of 1 hectare of forest cultures fluctuates from 1,151,300 (the class of bonitet III) to 3,906,000 thousand roubles (class of bonitet Ia). For calculation of stumpage value of wood we used 2012 year charges on the standing wood.

According to the tables of a course of growth of pine forest stands, considering bonitet class, the total average gain of wood was defined [10]. The amount of large, medium, small wood and the firewood in the total average gain was determined according to the commodity table [10, page 237].

By multiplication of stumpage value of wood of the total average gain by the felling age (80 years) we received the stumpage value of wood at the felling age. This value appeared to be the smallest in the bonitet class V (10,296,000 thousand roubles) and the greatest – in bonitet class Ib (71,912,000 thousand roubles) (Table 2).

To adduce delayed cash flows (expenses on creation of forest cultures and estimation of timber volume at the age of final felling) we use discount coefficient [11] that is calculated according to the formula

$$K_d = \frac{1}{\left(1+E\right)^t} = \frac{1}{\left(1+0.3\right)^{80}} = 0.09,$$

where E is a discount rate (in the forestry it's accepted in limits 0.01–0.05); t is the age of felling.

Table 1

Production costs of creation of 1 hectare of forest cultures, thousand roubles

Cost item	Bonitet class/planting						
	V/1th	IV/2th	III/3th	II/4th	I/5th	Ia/6th	Ib/6th
Tariff salary fund	108.1	102.5	99.9	242.0	379.9	520.3	516.6
Bonus and other payments	140.5	133.2	129.9	314.6	493.8	676.4	671.6
Basic salary payment	248.6	235.7	229.8	556.6	873.7	1196.7	1188.2
Supplement to wages and salaries	24.9	23.6	23.0	55.7	87.4	119.7	118.8
Charge on payroll	93.0	88.1	86.0	208.2	326.8	447.5	444.4
Equipment maintenance expenses	598.5	580.6	571.8	897.5	1205.7	1522.8	1508.1
Direct materials cost	86.0	79.6	76.8	74.2	67.3	63.2	59.8
Direct cost total	1051.0	1007.6	987.4	1792.2	2560.9	3349.9	3319.3
General expenses of production	174.5	167.3	163.9	297.5	425.1	556.1	551.5
Expenses of production total	1225.5	1174.9	1151.3	2089.7	2986.0	3906.0	3870.3

Economic benefits and efficiency of expenses on pine forest regeneration

Bonitet class	Stumpage value at the age of 80 years, thousand roubles	Present estimate of wood reserves, thousand roubles (Qw = 0,09)	Cost of creation of forest cultures Cc, thousand roubles	Economic efficiency E, thousand roubles	Efficiency of expenses on forest regeneration, %
V	10 296	926.6	1 225.5	−298.9	−
IV	18 088	1 627.9	1 174.9	453.0	38.6
III	26 456	2 381.0	1 151.3	1 229.7	106.8
II	36 512	3 286.1	2 089.7	1 196.4	57.3
I	46 536	4 188.2	2 986.0	1 202.2	40.3
Ia	60 336	5 430.2	3 906.0	1 524.2	39.0
Ib	71 912	6 472.1	3 870.3	2 601.8	38.7

We received the given reserves estimate by multiplying wood reserves estimate at the age of final felling by discount coefficient.

The difference between the above wood reserves estimate and expenses on forest cultures creation makes economic benefit of pine forest regeneration. It appeared that in the conditions of V bonitet class forest regeneration is unprofitable. But that adverse growing conditions on the territory of Belarus are met extremely seldom, making only 0.4% of the area of pine formation [12].

The efficiency of forest regeneration expenses are calculated according to the formula

$$E_e = \frac{E}{C_C}\ 100\%.$$

The greatest value (106.8%) appeared to be for forest stands of the bonitet class III where forest cultures treatment isn't provided.

The given analysis of calculation of economic efficiency was carried out in the conditions of the first class of the woods; their main growth feature is the lack of moisture. In the second class of the woods forest stands grow in the conditions of excess of moisture, and soil cultivation is carried out by bedding up furrows with the subsequent planting of seedlings in breasts. If this kind of soil cultivation applied, in the conditions of excess moisture content water in furrows often stagnates and a single-sided root system is formed, which reduces stability of trees against a windfall.

In the forest stands of the 7th group of planting (bonitet classes I and Ia) that belongs to the 2nd class of forests, topsoils aren't exposed to excess moistening, and cultivation is better to be carried out by a miller to spud the soil by strips pattern. Using the same technology of production of forest cultures, the resulted expenses on their creation and economic benefits will comply with bonitet classes I and Ia.

A certain simplification of the described method of calculating the economic efficiency should be mentioned. Probably while calculating cost of forest regeneration it's rational to consider also expenses on conducting fire-safety, forest-protecting and other measures.

In the cost of the end production, besides stumpage value, it is expedient to include the cost of other forest benefits [5]. In addition, huge ecological and social importance of forest can't be estimated in terms of money.

Available researches show that the cost of some special functions of forest considerably exceeds the cost of wood production [13].

For example, in Germany socially useful functions of forest are estimated at 53 billion Deutschemarks, and its wood production is estimated 3.1 times less. In Japan while estimation of Arshiyami forestland they came to a conclusion that the income from its growing time benefits 6 times more than wood costs.

Conclusion. Forest regeneration by means of creation of forest cultures is one of the ways allowing to increase the forest efficiency. While finding the solution of a question of forest cultures creation it is necessary to consider huge ecological and social value of forest. Even if there are no economic benefits that can be observed in the extreme conditions of growth of forest stands (bonitet class V), creation of forest cultures is still very advantageous.

References

1. Характеристика государственного лесного фонда Республики Беларусь // Лесное и охотничье хоз-во. – 2002. – № 1. – С. 4–5.

2. Писаренко, А. И. Искусственные леса. В 2 ч. Ч. 1 / А. И. Писаренко, Г. И. Редько, М. Д. Мерзленко. – М.: ВНИИЦлесресурс, 1992. – 308 с.

3. Стратегический план развития лесного хозяйства Беларуси / М-во лесного хоз-ва. – Минск: Минлесхоз, 1997. – 178 с.

4. Погребняк, П. С. Общее лесоводство / П. С. Погребняк. – М.: Сельхозиздат, 1963. – 400 с.

5. Справочник работника лесного хозяйства / под ред. И. Д. Юркевича, В. П. Романовского, Д. С. Голода. – Минск: Наука и техника, 1986. – 623 с.

6. Русаленко, А. И. Эколого-флористическая классификация сосновых лесов Беларуси / А. И. Русаленко // Вес. Нац. акадэміі навук Беларусі. Серыя біял. навук. – 1996. – № 2. – С. 5–12.

7. Юзафовіч, Г. В. Фарміраванне каранёвых сістэм сасны звычайнай у культурах / Г. В. Юзафовіч, А. І. Русаленка // Труды БГТУ. Сер. I, Лесное хоз-во. – 2000. – Вып. VIII. – С. 121–127.

8. Миронов, В. В. Экология хвойных пород при искусственном лесовозобновлении / В. В. Миронов. – М.: Лесная пром-сть, 1977. – 232 с.

9. Юзафовіч, Г.В. Фарміраванне пароднага саставу сасновых насаджэнняў пры лесаадnaўленні ў залежнасці ад глебава-грунтавых умоў: аўтарэф. дыс. … канд. с.-г. навук: 06.03.01 / Г. В. Юзафовіч; БДТУ. – Мінск, 2004. – 22 с.

10. Нормативные материалы для таксации леса Белорусской ССР / под ред. В. Ф. Багинского. – М.: УБНТИ-лесхоз, 1984. – 308 с.

11. Методические рекомендации по оценке эффективности научных, научно-технических и инновационных разработок: утв. НАН Беларуси и ГКНТ Респ. Беларусь 03.01.2008. – № 1/1.

12. Юркевич, И. Д. Сосновые леса Белоруссии: типы, ассоциации, продуктивность / И. Д. Юркевич, Н. Ф. Ловчий. – Минск: Наука и техника, 1984. – 176 с.

13. Бобров, Р. В. Беседы о лесе / Р. В. Бобров. – М.: Мол. гвардия, 1979. – 240 с.