

DOI: <https://doi.org/10.23649/jae.2019.2.10.4>

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Received: 23.05.2019; Accepted: 26.06.2019; Published: 08.07.2019

ECONOMIC JUSTIFICATION OF THE BREEDING PROCESS OF CREATING A NEW APPLE VARIETY

Research article

Abstract

The article presents the calculations of the capital costs of the breeding process in stages. After determining all the expenses at specific stages, the minimum amount of funds for the implementation of the entire selection process was calculated. It amounted to 15.5 million rubles.

Given the focus of breeding varieties, there is a need to justify the method of payback. Among all, the most rational is the reimbursement and multiplication of funds from deductions from the sale of seedlings. Such a method is possible due to obtaining copyright for the resulting variety. With minimal cost, the variety can be recouped through the sale of 155,000 pieces seedlings.

Keywords: breeding process, apple seedlings, copyright, royalties.

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Получена: 23.05.2019; Доработана: 26.06.2019; Опубликована: 08.07.2019

ЭКОНОМИЧЕСКОЕ ОБОСНОВАНИЕ СЕЛЕКЦИОННОГО ПРОЦЕССА ВЫВЕДЕНИЯ НОВОГО СОРТА ЯБЛОНИ

Научная статья

Аннотация

В статье представлены расчеты капитальных затрат на проведение селекционного процесса поэтапно. После определения всех расходов на конкретных этапах, была подсчитана минимальная сумма денежных средств на осуществление всего селекционного процесса. Она составила 15,5 млн. руб.

Учитывая целенаправленность выведения сорта, существует необходимость в обосновании способа окупаемости. Среди всех наиболее рациональным является возмещение и приумножение денежных средств за счёт отчислений с продажи саженцев. Такой способ возможен благодаря получению авторских прав на полученный сорт. При минимальных затратах сорт удастся окупить за счёт продажи 155000 шт. саженцев.

Ключевые слова: селекционный процесс, сеянцы яблони, авторские права, роялти.

1. Introduction

The development of new varieties is an important direction in agriculture, ensuring the stable and continuous development of the industry, meeting consumer demand and solving the whole issue of providing the population with food. In each country, with developed agriculture, selection work is carried out on the breeding of new varieties, hybrids, as well as the production of clones of already known and popular varieties.

In Russia, breeding is mainly carried out at the expense of scientific programs funded by the state [1], while abroad, some large companies themselves carry out the breeding of varieties, thereby obtaining high profits through royalties (selling copyright on varieties), with sales of seed or planting material.

In horticulture, the selection process differs from other industries in the exceptional duration of the very period of breeding varieties, which can often reach twenty-five years (the period from conducting hybridization to the transfer of the variety to state trials). At the same time exclusively large areas and resources are used. In the domestic literature there is practically no data of

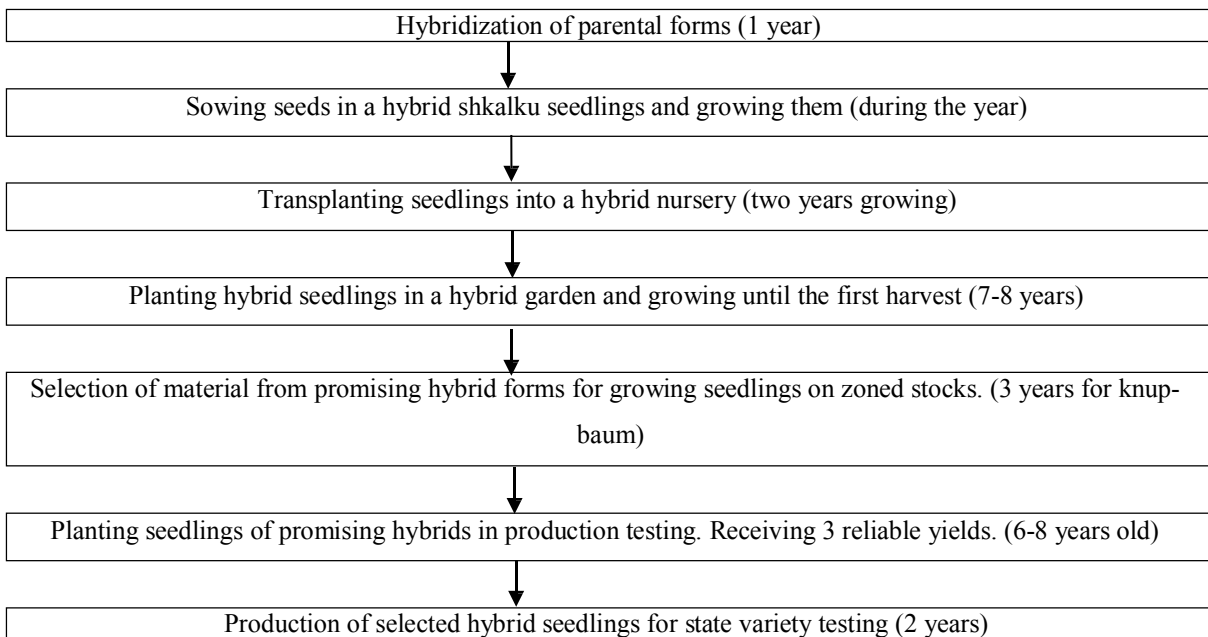
economic calculations to determine the cost of breeding a single variety. Although it is the economic feasibility and payback of the project are key to the success of the production of any commercial product, which may be a variety.

Given the high economic importance of the breeding process, there is a need to justify the cost of carrying out this process

2. Methods

To determine the cost of breeding a variety, it is necessary first to draw up a breeding program that takes into account the period of each of the stages, which will make it possible to obtain a variety with the desired qualities, as well as bring the entire process to its transfer to state trials [2]. The standard selection process for breeding the apple hybridization variety is presented in Figure 1.

Table 1 – Scheme of the selection process for the cultivation of apple varieties by hybridization
The stages of the breeding process for the cultivation of a variety (F1) method of hybridization



It consists of the following steps:

The hybridization process, which in turn consists of:

- selection of pairs (s) of parental forms with given qualities;
- directly interbreeding with the castration of maternal flowers and artificial pollination,
- at the end of the growing season, fruit is harvested after hybridization, followed by seed extraction.

Sowing seeds in shkalku seedlings [3]. Hybrid seedlings are selected for primary signs of resistance to biotic factors (scab, powdery mildew) [4]. In this case, the output is determined by the level of rigidity of the selection. When conducting a field selection for disease resistance, sometimes the rigidity of selection can be at least 90% of germinated seedlings. Selected seedlings will later be planted in a hybrid nursery.

Bookmark a hybrid nursery and grow seedlings to sizes suitable for laying a hybrid garden. This period is two years. In the process of growing hybrid seedlings, observations are made on the main indicators that are taken into account in the juvenile period [5]. This, as a rule, reveals signs of wildness, early recovery from dormancy, late fall of leaves, vigor of growth, resistance to diseases. In the northern areas of crop cultivation, the degree of freezing of one-year growth is also taken into account. Often in a hybrid nursery, the intensity of selection can be up to 80%.

Grown and rejected material, which is of value later planted in a hybrid garden, where trees grow until the end of the juvenile period and entering into a stable fruiting. According to the fruits, their quality and the characteristics of fruiting, the work with the original plants is completed and in the future the selected forms will multiply vegetatively for laying the production gardens. Since the juvenile period in an apple from the moment the first true leaf appears, until the first flower appears and the fruit forms, it is usually 10 years, the total period from the moment the seeds germinate until the fruit quality is confirmed can not be less, but vice versa can be 11 ... 13 years old. Thus, the period of cultivation of a hybrid garden before the selection of promising hybrids can be at least 7 ... 8 years from the time the garden was planted. Trees are taken care of, taken behind plantations of a thickened type, grafted on vigorous seedling rootstocks - planting pattern 6x4 m, crown shape sparsely layered or semi-planar [6]. It is impossible to obtain a stable harvest in such a garden, since the seedlings will produce very different-quality fruits and differ significantly from each other in terms of the end of the juvenile period. It is by the end of the unproductive period that the breeder can judge the intensity of the hybrid form. Therefore, the plants entering the fruiting and quickly increasing the harvest are selected. As a rule, the selection rigidity may be at least 80% of the original trees. It should also be noted that for further selection in the production study it is desirable to have at least ten promising hybrid forms that will be compared to the control zoned and widespread varieties in a more competitive way. Thus, initially, no less than: (10 pieces of hybrid on the way out) / (20% of the output of prospective hybrids) should get into the hybrid garden 100 (%) = 50 trees. With a 6x4 m planting scheme, this will be at least 0.12 ha per hybrid generation (crossing series).

Selected promising hybrid forms are used for growing seedlings for their further use in setting the production trials. According to the methods of state testing [7], this requires at least 30 standard seedlings from each hybrid plant, as well as a corresponding number of seedlings of control varieties. If there are two controls that are used most often, then the number of seedlings required increases accordingly. Thus, it is necessary to grow at least in the nursery: 12 varieties / hybrids x 30 pcs. standard seedlings = 360 pcs. Taking into account the fact that, as a rule, the standard yield of seedlings can be 70% of the initially planted stock, and the planting area for growing seedlings of the "knip-baum" type [8] leaves 90x30 cm, the area of the nursery will be:

$$(360 \text{ pieces of seedlings}) / (70\% \text{ standard yield}) \times 100 (\%) = 514 \text{ pieces of plants in the nursery};$$

$$514 \text{ plants} \times (0.9 \text{ m} \times 0.3 \text{ m}) = 139 \text{ m}^2.$$

Growing seedlings in this area is carried out for three years.

Grown seedlings are used to set up a test garden using intensive technologies with the participation of control zoned varieties. The main task is to check the competitiveness of selected hybrid forms in an intensive garden with the most common zoned varieties for the rate of entry into fruiting, the level of yield increase, as well as the average productivity of at least three years. This stage is the final selection of hybrid forms. He, as a rule, can spend at least 6 ... 8 years. If we consider that the breeder has laid an intensive garden according to the planting scheme 3,5x1,0 m, this will require a plot area: 360 pcs. seedlings * (3.5x1.0 m) = 1260 m² = 0.12 ha. At the end of the observations, one of the ten hybrid forms selected is selected, which will then be transferred to state trials for further registration in the Register of breeding achievements approved for use in the Russian Federation [9].

The final process of introducing a new variety to the Register of Breeding Achievements Approved for Use in the Russian Federation is the transfer of planting material to the State Treasury Committee to study it at the variety plot, which is related to each specific zoning zone. For each plot, it is necessary to transfer seedlings in an amount of not less than 36 pieces of each derived form (variety) - to book an experiment in four replications of at least eight seedlings in each. For the cultivation of such a volume (saplings of the "knup-baum" type), the area of the next field of the nursery will be at least (40 saplings * (0.9 * 0.3 m) = 10.8 m²).

If we calculated the area of structural subdivisions on the areas of gardens and nurseries, starting after the hybrid garden, then the previous stages, to install their areas, need to be calculated "from the reverse", that is, from taking into account the required yield, taking into account the selection rigidity with recalculation to the area plant nutrition.

So, at least 50 hybrid plants from the nursery after selection with a hardness of 80% should go to the hybrid garden. The area of plant nutrition in a hybrid nursery is 0.7x0.3 m. In this case, the calculation is made:

Number of seedlings (in pcs.) Required for planting in a hybrid nursery: (500 pcs of seedlings in the garden) / (100-80 (% of selection rigidity)) * 100 (%) = 2500 pcs.

Hybrid nursery area (m²):

$$2500 \text{ pieces seedlings} \times (0.7 \times 0.3 \text{ m}) = 525 \text{ m}^2 = 0.053 \text{ ha}.$$

Like this calculation it is possible to calculate the area of the seedlings school. At the same time, the sampling rigidity is 90%, seed germination will be about 80%, the seed sowing scheme is 0.7x0.02 m. With such parameters, the area of seedling seedlings will be:

A) of seedlings for seed selection: (2500 pieces of seedlings after leaving a seedling school) / (100-90 (% of selection rigidity)) * 100 (%) = 25000 pieces.

B) Seed for sowing with regard to germination:

$$(25,000 \text{ pieces of seedlings}) / (80\% \text{ germination}) \times 100 (\%) = 31,250 \text{ pieces of seed}$$

C) the area of hybrid seedlings shchorki:

$$31250 \text{ pieces of seeds} \times (0.7 \times 0.02 \text{ m}) = 437.5 \text{ m}^2 = 0.044 \text{ ha}$$

Having data on the areas and structure of the selection process, it is possible to calculate the cost of the whole process. To do this, you can use routing cards that are designed for all departments.

All costs of the breeding process can be divided into:

- Salary costs to a breeder scientist. The average salary of a breeder in Russia is about 50 thousand rubles per month. Given this, the breeder should receive 600 thousand rubles a year (50 thousand * 12 months) per year. Accordingly, for the entire production cycle of breeding a grade, the cost of paying the work to a scientist should be 15 million rubles (600 thousand * 25 years).

- Costs implementation of agrotechnological processes. This item is much more difficult in terms of cost accounting. For this purpose, calculations on technological cards that take into account all agrotechnical processes for plant laying and care, taking into account the cost of the wage fund with charges, fuel and lubricants, crop protection water, irrigation water, etc. Total cost indicators based on the areas of each structural unit used in the selection process are indicated in table 1.

Table 2 – Costs of technological work in the breeding process

Name of the structural unit	Area, ha	Period of use, years	Costs for the entire period, thousand rubles
School of hybrid seedlings	0,044	1	87,6
Nursery hybrid seedlings	0,053	2	32,1
Hybrid garden	0,12	8	142,9
Nursery growing selected hybrid forms	0,014	3	34,4
Garden varietal testing of selected forms	0,12	8	193,5
Nursery for the transfer of the selected hybrid form for registration of the variety certificate and to the state variety inspectorate	0,0011	3	2,8
in all		25	493,3

Thus, the entire selection process aimed at isolating one hybrid per variety and its transfer to the State Test for Registration will require at least 15.5 million rubles. This will be the minimum cost of the variety.

Since any scientific process of an applied nature must have a commercial outlet, the breeding of a variety must pay for itself by selling the copyright to the variety. Real as a copyright sale is the receipt of royalty payments [10] from the sale of planting material by nursery enterprises. In accordance with the Russian legislation, the amount of royalties may be within 4% of the value of the goods (in this case, seedlings). The average realizable price for apple-tree saplings of the "knip-baum" type is 250 rubles / pcs. Therefore, from each sapling as a copyright implementation for a variety, the breeder (right holder) will receive deductions in the amount of: (250 rubles per sapling) / 100 (%) * 4% royalties = 10 rubles / sapling. Thus, the volume of production of planting material of the cultivated variety, to the full payback of the costs incurred by the breeder, must be no less: (1,550,000 rubles. Costs for breeding the variety) / (10 rubles of royalties from the sale of one seedling) = 1,550,000 pieces of seedlings

If we take into account that saplings are used for laying the intensive type of gardens, the planting density of which is (10,000 square meters per hectare) / (3.5m * 1.0m) = 2857 der / ha, then the area under the gardens of this variety is may be less (1550000 varieties of seedlings) / (2857 der. / ha) = 542.5 ha.

Conclusions: Considering all the above production costs and salary, the minimum cost of obtaining one grade will be 15.5 million rubles. In case of successful state trials and obtaining a patent - copyright for the cultivated variety, it can be recouped through deductions from the sale of seedlings of this varieties. But there is an opportunity not only to get a return on the variety, but also to get additional profit.

Based on the fact that the selection of apple trees is a complex and expensive process, there is a need to calculate the necessary amount of cash for sorting. Accurate calculations will also allow to determine the cost price and, as a result, to calculate the recoupment.

3. Results

Considering all the above-mentioned production costs and wages, the minimum cost of obtaining one variety will be 15.5 million rubles. In case of successful state trials and obtaining a patent - copyright for the cultivated variety, it can be recouped through deductions from the sale of saplings of this variety. But there is an opportunity not only to get a return on the variety, but also to get additional profit.

Based on the fact that the selection of apple trees is a complex and expensive process, there is a need to calculate the necessary amount of cash for sorting. Accurate calculations will also allow you to determine the cost and, as a result, calculate the payback.

Conflict of Interest

None declared.

Конфликт интересов

Не указан.

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