Features of soybean seed production of the northern ecotype at the first stages

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Abstract. The Chuvash Research Agricultural Institute - Branch of “Federal Agricultural Research Center of the North-East named N. V. Rudnitskogo”, has developed new scientific approaches to the selection of source material in the primary stages of seed production of soybean varieties of the Northern ecotype for soil and climatic conditions in the southern part of the Volga-Vyatka region of Russia. In primary seed nurseries, the selection scheme and the degree of rejection of plants are presented. The concept of primary seed production of modern varieties of the Chuvash Research Agricultural Institute is based on reducing the number of generations and is based on the characteristics of varieties of the Northern ecotype.

1. Introduction
Promotion of Northern ecotype soybeans to the central regions of Russia makes it necessary to improve strict compliance and timely implementation of technological techniques of the seed production. In particular, it is important to observe the zonal technology in the production of seeds of this valuable crop, which is valued in nutrition, and enrichment of the soil with biological nitrogen [1]. Limiting factors for formation of soybean seeds under conditions of Central Chernozem zone of Russia are the insufficient sum of active temperatures for the growth period and a long light day [2]. Introduction of soy in Chernozem zone occurs with the appearance of new early-ripening varieties of the Northern ecotype, adapted to local agro-climatic conditions of cultivation and provided stable yield by years [3]. Creating a new generation of soy varieties requires revision and improvement methodic issues of their seed production and variety substitution based on the innovation process as a factor of the intensification of grain production. Search for the most rational organization of seed production in the market conditions should take place simultaneously with the increase in sustainable production of original, elite and reproductive seeds while preserving the genetic purity of selective varieties [4].

2. Main part
Selection work on soybean in the Chuvash Research Agricultural Institute has been conducted for more than 20 years. As a result of much effective work done by the plant selection breeders of the Chuvash branch this unique crop has taken its rightful place among the traditional agricultural crops both in the region and in Russia. Seven varieties of soybean have been created by the Chuvash plant breeders: Chera-1, Lumaria, Memory Fadeeva, Chera, Chevle, Merchen, Tsivil. The first three patented varieties are allowed to be cultivated in the fourth region of the Russian Federation. All the varieties with potential grain yields up to 3.4 t / ha, adapted to long-day conditions with a possible growing area in the latitudinal...
range of 52 to 57° North latitude. Vegetation period in the Volga-Vyatka region is 90-100 days when the sum of active temperatures is set above 10 °C 1900°.

The duration of use in the production of the variety fully depends on a well-established system seed breeding. It involves compliance of the methods of production of elite seeds in order to obtain pure-grade conditioned seeds with high sowing qualities and yield properties. The potential of varieties is realized exactly through seeds [5, 6].

The Chuvash Research Agricultural Institute has developed and successfully completed the scheme of primary soybean seed production with reduced number of generations (table 1).

**Table 1. Classical scheme of seed production of Northern soybeans.**

| Generation             | Operation, procedure                                                                 |
|------------------------|--------------------------------------------------------------------------------------|
| Seed nurseries of selection | Selection of elite plants. Insurance fund – 100%                                    |
| Nursery of seed testing of the first year (PIP-1), not less than 300-450 seeds | Seed estimation on characters and features. Culling of the worst and selection of the best seeds. Insurance fund – 100% |
| Nursery of seed testing of the second year (PIP-2), not less than 90-120 seeds | Seed estimation, culling of the worst and selection of the best seeds. Insurance fund – 100% |
| Nursery reproduction (PR) | Seed reproduction, variety weeding, variety keeping in purity from infestation and affect. Insurance fund – 100% |
| Super elite            | Seed reproduction, variety weeding, variety keeping in purity from infestation and affect. Insurance fund – 100% |
| Elite                  | Seed reproduction, variety weeding, variety keeping in purity from infestation and affect. Insurance fund – 50% |

The scheme of primary seed production of soybean of the Northern ecotype in the Chuvash Research Agricultural Institute was reduced at the account of reducing the time of variety renewal in breeding nurseries, which reduced the cost of seeds. There are regulatory requirements and guidelines for setting up a nursery for cereal and leguminous crops, where it is recommended to select about 300 elite plants when organizing their seed production [7]. The selection of fast ripening soybean lines of the Northern ecotype is recommended to increase up to 1000-1500 plants taking into account the low reproduction rate and more severe culling of families in PIP-1 (from 20 to 3590) and PIP-2 (from 8 to 10%) and creating a 100 % insurance fund.

In all the first three nurseries, the most accurate assessment of each plant for compliance characteristics and properties of the supported variety take place. In primary soybean seed, production the evaluation of plants in test nurseries is most important. The degree to which it is objective, largely, depends on the genetic purity of the variety.

Basic accounting and observations are present in all parts of seed production. During vegetation phenological observations – the onset of the main phases (shoots, beginning and end of flowering, beginning and complete ripening). Determination of crop structure elements is based on trial sheaves cut before harvesting from two repetitions of the experiment with an area of one square meter [8]. The dynamics of accumulation of dry matter in the ontogenesis is done by weight method, leaves area is done by cut-out method in three repetitions. As a matter of record productivity of seed formation is calculated (the ratio of the number of completed seeds to the number of seeders in beans), the specific surface density of the leaf (the ratio of leaf mass to area), and microdistribution (the ratio of seed mass to the mass of the entire bean) [9].

In primary seed production, a strict system of placing generations in a field test in PIP-1 and PIP-2 is accepted: standard (seeds from the previous year's breeding nursery) is placed after 20 generations! To
obtain objective estimates between the test families in the nursery with a non-repeat placement we perform the following calculations: the standard put by with increased repeatability is used to find errors in the experiment, and the test generations are compared with the indicators of four STD closest to this generation [10, 11].

2.1. Nursery testing of 1 year seeds (PIP-1)
Is laid in the field of seed-growing rotation. The seeds of each elite plant are sown separately on a single-row plot of 1-1.5 m. by manual seeder. The distance between the rows is 45 cm. In every 20 generation a standard is placed, that is original seeds of the previous year of reproduction.

At different stages of the growing season of plants in the nursery the most thorough assessment and tough rejection is carried out. Due to the limited number of seeds, it is not possible to determine their planting features. They had to be judged by field germination. If it was lower, 50% seed was rejected, upon condition of rejecting 25-30% of the selected elite plants [12].

In the development phase heterogeneity of the seeds in the initial growth rates is shown well — some plants may lag far behind, others are in good advance, third ones have morphological manifestations. In this case if at least one plant found in the seed is divergent on morphotype or growth then the whole seed is rejected.

Evaluation of generations for resistance to fungal and viral diseases and their rejecting in prevalence is also done throughout the growing season. In case of a single prevalence phyto-cleaning is carried out when the number of affected plants exceeds 10% the whole generation is eliminated.

Positively evaluated seeds are harvested manually — in stint way. Each generation after threshing in the laboratory is evaluated in typicality, productivity, affect by pests and diseases, fulfillment and alignment of seeds. It is most important to conduct this evaluation work in nursery testing generations of first year (PIP-1), in which a large number of generations are concentrated.

2.2. The nursery testing of the second year seeds (PIP-2)
Is laid in the field of the primary seed growing. Each generation is sown in separate four–six row plots 4.5-9 square m with the help of the precise seeder CPP-8. Row spacing is 45 sm. The seeding rate is set at the rate of 0.40-0.45 million germinating seeds per hectare. For non-repeat placement of generations, the standard is placed through 20 generations, which allows you to neutralize the error of the experiment due to possible differences in the soil micro-relief, and therefore the level of moisture and nutrition.

In this nursery the assessment, the rejection of generations is carried out on all signs of typicality, effect of plants by pets and disease and in the same ways as in the nursery testing offspring of the year. By any deviations from the standard, generations are (culled) removed completely. Each positively estimated generation is harvested separately (in a stint way). The received grain is dried, cleaned and weighed. The prepared seeds are used for subsequent reproduction and formation of the insurance Fund incomplete need. The research results are processed by the method of correlation and dispersion analysis by the method of experimental work [13].

In the breeding nursery, the increase in seed yield is achieved due to less dense seeding (0.45 x 0.09 m) with an area of nutrition of one plant of 0.04 m² and norm sowing of 250 thousand of germinating seeds on hectare [14]. Further, the scheme is carried out to maintain cleanliness, accounting for the affect by pests and diseases. When it is necessary varietal weeding and seed accumulation for seeding as super elite and elite are also carried out. All the work stages are completed within 4-5 years. The given scheme of primary seed production for variety renewal is used to preserve the varietal and biological qualities of seeds used in production. For production crops, it is not advisable to use seeds after 2-3 reproductions, and much more to use mass reproduction. It is no coincidence that a properly organized varietal seed production is the most important factor for increasing productivity with long-term use of this or that variety in production [15].
3. Conclusions
The developed technology of soybean seed production of the Northern ecotype in the Chuvash Research Agricultural Institute makes it possible to reduce the links of primary seed production (PR-1 and PR-2), which allows you to speed up production of seeds when variety renewal, preserving the genetic purity of all inherited traits with a two-times negative selection in PIP-1 and PIP-2.

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