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## CROP PRODUCTION

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### STUDY OF SOWING QUALITIES OF SOYBEAN SEEDS IN SEED FARMS OF AMUR REGION

Research article

#### Abstract

An analysis of soybean seeds prepared for sowing in the farms of the Tambov, Konstantinovsky and Ivanovo districts of the Amur Region was carried out. In the farms of the surveyed areas, in the structure of sown areas, the main soybean crop is cultivated, which constitutes a share in the structure of crop rotation of more than 70 %. For sowing, 9 varieties of soybean are prepared by the Soybean Institute and 2 varieties of breeding in Canada and Ukraine. Of the 9 varieties, 7 belong to medium ripe and 2 varieties to late ripe groups. The area of soybean sowing in the region is 70 % occupied by the breeding varieties of the Soybean Institute. The quality of the tested seeds of 9 soy varieties is not at the proper level. Of the 27 seed lots tested, 9 varieties of 10 lots (37%) belong to the second category (according to the purpose, these seeds of the second and third reproductions sown on seed plots of seed farms). Weather conditions in 2020 unfavorably developed on the quality of soybean grain harvesting. To improve the situation under the sowing of 2021, in the whole region, the share of elite soybean seeds, the production of the Soybean Institute, increased 1.8 times.

**Keywords:** soybeans, variety, seeds, harvester, damage, carcasses of cotyledons and embryo, part, laboratory and field germination.

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### ИССЛЕДОВАНИЕ ПОСЕВНЫХ КАЧЕСТВ СЕМЯН СОИ В СЕМЕНОВОДЧЕСКИХ ХОЗЯЙСТВАХ АМУРСКОЙ ОБЛАСТИ

Научная статья

#### Аннотация

Проведен анализ семян сои, подготовленных к посеву в хозяйствах Тамбовского, Константиновского и Ивановского районов Амурской области. В хозяйствах обследованных районов, в структуре посевных площадей, возделывается основная культура соя, составляющая долю в структуре севооборота более 70 %. Для посева подготовлено 9 сортов сои селекции Института сои и 2 сорта селекции Канады и Украины. Из 9 сортов 7 относятся к средне спелой и 2 сорта к позднеспелой группам. Площадь посева сои в области на 70 % занята сортами селекции Института сои. Качество проверенных семян 9-и сортов сои не находится на должном уровне. Из проверенных 27 партий семян 9 сортов 10 партий (37 %) относятся ко второй категории (по назначению эти семена второй и третьей репродукции, высеваемые на семенных участках семеноводческих хозяйств). Погодные условия 2020 года неблагоприятно складывались на качество уборки соевого зерна. Для улучшения создавшейся ситуации под посев 2021 года в целом по области в 1,8 раза увеличилась доля элитных семян сои, производства Института сои.

**Ключевые слова:** соя, сорт, семена, комбайн, повреждение, тещины семядолей и зародыша, отбита часть, лабораторная и полевая всхожесть.

#### 1. Introduction

In the Amur Region, according to the Ministry of Agriculture, the sown area of soybeans in 2021 was 882 thousand hectares. Soybean saturation in crop rotation is maintained at a level of slightly more than 70% [1, P. 20]. Recently,

agricultural producers are purposefully increasing their own production and use of seed material of the necessary reproductions, as they are provided with appropriate support from the state [2, P. 16].

Seed quality is a critical factor in increasing crop yields, including soybeans. Only with high biological and qualitative characteristics of seeds are the potentials of the variety fully used [3, P. 56].

All mechanized work related to the production of soybean seeds is currently carried out by machines designed for sowing, harvesting and harvesting grain crops. The used complex of machines with structural features and technological modes of operation does not fully meet the requirements of the whole set of physical and mechanical properties and features of soybean culture [4, P. 55].

The great disadvantage of machines used in the harvesting and underworking of soybean seeds is noted in the high degree of mechanical damage to grain [5, P. 9]. The amount of mechanical damage to soybean during harvesting together with frost and damaged pests in some years is up to 20% [6, P. 60].

Soybean grain is mechanically damaged during harvesting. Harvesting in the climatic conditions of the Far East is often complicated by sharp changes in night and day temperatures, which in some years range from + 18 to - 13° C, and with precipitation. Late ripe, and partially medium ripe soy varieties, due to over wetting, sown at suboptimal dates, do not have time to mature [7, P. 153]. This leads to the establishment of rigid soaking regimes, as a result, the crushing of soybean grains reaches 12-15 %, micro-damage up to 8-10 %, the content of frost seeds and damaged by pests is more than 5 % [8, P. 73].

Soy grains are brought to sowing conditions at complex grain treatment complexes, which also mechanically damage soy. In this regard, when developing the technology of obtaining quality seeds, it is necessary to consider the issue of their preservation from mechanical impacts leading to high crushing and micro-damage during harvesting and underwork [9, P. 549].

Soybean grain, as a whole, under the action of external forces arising during threshing and underwork, is mechanically damaged and to a greater or lesser extent changes its shape or is destroyed with the appearance of cracks on the seed, the recaptured part of the cotyledons of grain, halves and the finely divided part of grain (Fig. 1, 2, 3).



Figure 1 – Grain cracks contained in seeds prepared for sowing

This type of soybean grain damage, when mined, is practically undisclosed, due to almost identical dimensional characteristics with the whole grain and, depending on the variety, occupies a certain percentage in terms of content in the seed material and, together with frost and damaged pests, significantly degrades the quality of soybean seeds. This part of the seeds in laboratory and field conditions only germinates by 10% and produces seedlings and not all plants, remaining for harvesting, provide yields at the level of the corresponding variety.



Figure 2 – Part of the grain is recaptured



Figure 3 – Halves and finely divided portion of soybean grain contained in seed material

In size 1 and 2, the type of damaged seeds differs little from whole seeds. They cannot be isolated during part-time work, and they are contained and sown in a certain amount along with prepared seeds. The 3rd type of damage, although significantly different in dimensional characteristics from whole seeds, is not completely sorted and up to 4-5 % is contained in seeds.

The purpose of the research was to identify the content of micro in developed seeds by soy varieties in the seed farms of the main sowing districts of the Amur region. The main task was to identify a decrease in their laboratory and field germination during the sowing of these damaged seeds.

## **2. Methods**

The research of sowing qualities of seeds of early ripening and mid-season grades of soy was conducted on the seeds prepared for crops in large-scale seed-growing enterprises of Tambov, Konstantinovskiy's and Ivanovo Districts of the Amur region of the Amur region. Samples weighing 2kg (using the sampling method) and laboratory conditions in accordance with GOST 12036-80 - GOST 12047-80 were taken in farms from a batch of soybean seeds prepared for sowing.

On the isolated damaged and whole seeds of soybeans of fast and medium-ripe varieties, a field finely divided experiment was carried out according to the scheme of the selection process. The purpose of the experiment was to determine the effect of the use of micro (fractured) and macro (part of cotyledons is beaten) damaged seeds on their laboratory and sowing qualities. Whole seeds were sown for control. The repetition of experiments is quadruple. The sowing rate was 220 thousand germinating grains. Statistical processing of the study results was carried out according to the method of Dospekhov B.A. [10, P. 256].

An analysis of the quality of soybean seeds selected from the farms of the Tambov, Ivanovo and Konstantinovskiy districts of the Amur Region showed that in these areas seed farms cultivate and receive seeds of 11 varieties of soybeans, of which 9 varieties of selection of the Soybeans Institute, one variety "Prudence" of the Canadian selection and "Terek" of the Ukrainian selection.

For the harvesting of soybeans in the farms of the region there are 2.4 thousand pieces of combine harvesters of various brands and modifications, which are 73 % obsolete in terms of operational life up to 10 years. For one combine on average in the region there are 510 hectares, for Russia this figure is 354 hectares. But given that in the structure of the combine park, 20 % are Yenisei harvesters, physically and mentally worn out, the actual load on the combine harvester reaches 700 hectares, and in individual farms reaches 1000-1200 hectares.

### 3. Results

Given the use of obsolete equipment and the wear and tear of grain cleaning equipment, it is not necessary to expect good quality of own soybean seeds grown and mined directly in the farms of the main neighborhoods of the region.

Table 1 – Analysis of the quality of soybean seeds of various varieties taken from farms of the Tambov, Konstantinovsky and Ivanovo districts of the Amur region

Area, soy grade	Crushing, %	Cracks in the cotyledon and embryo region, %	Sick, frosty, pest-damaged, %	Weight 1000 seeds, g
Tambov District, Soybean Variety: «Kitrosa»	1,3	1,6	0,5	156,8
«Person»	6,34	2,71	0,73	117,86
«Evgenia»	1,8	3,65	0,35	186,5
«Azure»	4,30	4,35	0,15	171,06
«Alyona»	5,41	4,14	0,8	161,85
«Alyona»	5,73	4,34	0,53	167,0
«Prudence»	3,2	4,97	0,13	174,8
«Prudence»	1,09	2,6	0,91	192,3
«Luxury»	1,01	1,71	0,57	148,1
«Luxury»	0,38	2,0	1,47	161,7
«Umka»	3,88	2,54	1,0	173,5
Konstantinovsky District, Soybean Variety «Umka»	3,55	1,31	1,34	176,6
«Bonus»	1,64	1,66	2,28	174,1
«Luxury»	1,67	1,84	2,41	163,15
«Prudence»	5,74	1,87	0,72	174,7
«Prudence»	4,32	5,89	3,10	168,7
«Azure»	2,59	1,24	1,92	180,3
«Person»	3,44	0,73	0,74	114,4
«Alyona»	3,76	5,14	1,09	167,7
«Alyona»	2,16	2,63	5,14	162,76
Ivanovo District, Soy Variety: «Terek»	1,26	1,53	2,49	168,8
«Umka»	4,64	1,77	3,56	188,1
«Alyona»	1,0	1,48	1,34	171,0
«Luxury»	1,34	1,80	1,55	154,3
«Dauria»	3,21	2,52	1,01	165,8
«Prudence»	2,44	3,94	1,60	187,1

### 4. Discussion of results

It has been established that the breeding seeds of the Soybean Institute, Canadian and Ukrainian varieties have different contents of crushed and micro-damaged seeds. The largest amount of crushing (6,34, 5,41, 5,73 %) and micro in tervention (4,97, 4,14, 4,34 %) was found in the seeds of the Tambov district of the varieties «Persona», «Alena», «Lazurnaya», «Prudence» (Table 1), in the seeds of the Konstantinovsky district «Prudence», «Alena» and «Umka» the crushing value is slightly lower and is (5,74, 3,76, 3,55 %), but much higher (5,89, 5,14, 1,34 %). The amount of crushing and micro-damage is significantly lower in the seeds of the Ivanovo region. Here, crushing is (4,64, 3,21, 2,44 %) and micro-damage (3,94, 2,52, 1,77 %) in seeds of the varieties «Umka», «Dauria» and «Prudence». The smallest mass, of 1000 seeds, in the indicated varieties, are small seeds of soybeans of the «Person» variety (114,4-117,9 g), the highest «Prudence» and «Lazurnaya» (180,3-174,8 g). The above seed quality data for the three regions of the region show that the highest value of mechanically damaged soybean seeds is found in the Canadian selection variety «Prudence», from the selection varieties of the Soybean Institute: «Persona», «Alena», «Lazurnaya», and soybeans of the Ukrainian variety «Terek» and the selection varieties of the Soybean Institute «Bonus», «Nega» more resistant to mechanics.

As the experience shows, damaged seeds germinate under laboratory conditions, and give 32-26 % lower germination energy and laboratory germination (Table 2). The speedy variety «September» and the medium-ripe «Nega» in the control version had almost the same germination energy of 95 and 94 %, laboratory germination of 97 and 96 % and field germination of «whole» seeds under control, amounting to 96,4 and 96,0 % (NSR<sub>05</sub> = 2,09 and 3,64 units). Seeds with cracks in the area of

cotyledons and embryos in the field germinated by 30% (NSR<sub>05</sub> = 4,62 and 4,13 units). Seeds with a broken part of the grain in the region of the embryo and cotyledons germinated in the field by 26,8 and 27,8 % (NSR<sub>05</sub> = 4,33 and 4,66 units).

Table 2 – Laboratory and field germination of soybean seeds of speedy and medium-ripe soybean varieties of Soybean Institute selection

Control, type of damage	Energy of germination, %		Laboratory viability, %		Field viability, %			
	Sentyabrin ka	Luxury	Sentyabrin ka	Luxury	Sentyabrin ka	HCP <sub>05</sub>	Luxury	HCP <sub>05</sub>
Control, whole seeds	95,0	94,0	97,0	96,0	96,4	2,09	96,0	3,64
Fetal and cotyledon cracks	25	30,0	31,6	33,0	30,4	4,62	30,0	4,88
Part of the grain in the germ and cotyledons region is beaten off	25,0	31,0	27,6	29,0	26,8	4,33	27,8	4,66

Germination energy, laboratory and field germination of damaged seeds are significantly reduced.

In the field, damaged seeds show a worse pattern, where fractured seeds germinated by 10.4 and 13.0 % and seeds with a broken part in two grades by 10.8%. This part of the damaged seeds reduced field germination by 3 times, compared to laboratory, while whole seeds practically did not reduce field germination.

Soybean seeds of the first and subsequent reproductions sown on seed plots in the farms of the surveyed area belong to the second category (according to the purpose, these seeds of the second and third reproductions sown on seed plots of seed farms). They should have a seed content of the main crop of at least 95%. Then if sick, frosty and damaged by pests, as well as micro-damaged seeds, giving 10% of seedlings in the field, are added to the crushing, then. of the 27 seed lots tested, 9 varieties of 10 lots (37 %) belong to the second category, the rest of 63% of the seeds can be sown in commercial areas.

An innovative update of the soybean harvesting technology, based on the creation of two-phase threshing devices with two-stream cleaning to combine, improving the quality of soybean seeds, due to the isolation and collection of the most mature, biologically full-fledged grain with less crushing, from under the first threshing drum. Cleaning and transporting this seed fraction into a separate hopper with minimal damage, and using this seed fraction on the sowing without additional processing, leads to the production of quality seeds. The relevance of the technical solution is confirmed by Russian Patent No. 2679508. The practical implementation of this technology for producing quality seeds ensures an increase in soybean yield up to 0.3 tons/ha.

## 5. Conclusion

1. In the seeds of soy prepared for crops from the checked 27 parties in farms of the seed-growing direction Tambov, Konstantinovskiy and the Districts of Ivanovskoye, 9 grades of selection of Institute of soy and 2 grades of selection of Canada and Ukraine, the size of crushing of grain is from 2,44 to 6,34 %, micro damages from 1,77 to 4,97 %. From the checked seeds of 9 grades of 10 parties of the second and subsequent reproduction, treat seeds of the second class, can be sowed on seed sites of seed-growing farms of the listed areas, the rest of 63% of seeds has to be sowed on the areas of commodity appointment.

2. Field experiment on crops of jointed seeds of soy and seeds with the beaten-off part of grain in the field of a germ and cotyledons shows that the field viability is lower than their laboratory viability and makes a little more than 26-27 %, i.e. this part of seeds in field conditions for 74-73 % doesn't give shoots.

### Conflict of Interest

None declared.

### Конфликт интересов

Не указан.

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