CROP PRODUCTION

Prisyazhnaya I.M. *

All-Russian Scientific Research Institute of Soybean, Blagoveshchensk, Russia

* Corresponding author (irenpris[at]mail.ru)

STUDY OF SOYA GRAIN DAMAGE DURING HARVESTING AND PART-TIME WORK
Research article

Abstract

An important role in increasing soybean production is to reduce indirect crop losses from grain crushing, especially when harvesting and processing crops. Experimental data on the content of crushing and microdamage in soybean grains obtained during combine harvesting are given. The agrotechnical assessment of soybean harvesting showed that when harvesting soybeans, the crushing value is at the level of 1.5... 4.8% and is a smaller percentage than in seeds prepared for sowing 3.2... 6.34%. It was determined that the percentage of crushing in seeds does not decrease, but, on the contrary, increases in crushing by 1.32... 2.1 times and in microdamage from 1.34% to 5.89%. Crushed soybean grain in seeds makes an oilseed impurity by the value that increases the seeding rate. This part of the expensive seed material is needlessly sown in the soil. Micro-damage during sowing in the soil by 60% does not give seedlings. It is possible to prevent these losses when a combine harvester for collecting seed grain is introduced into production (Patent of the Russian Federation No. 2679508).

Keywords: soybean, combine, harvesting, part-time work, seeds, crushing, microdamage, germination.

Присяжная И.М. *

Всероссийский научно-исследовательский институт сои, Благовещенск, Россия

* Корреспондирующий автор (irenpris[at]mail.ru)

ИССЛЕДОВАНИЕ ПОВРЕЖДАЕМОСТИ ЗЕРНА СОИ ПРИ УБОРКЕ И ПОДРАБОТКЕ
Научная статья

Аннотация

В увеличении производства сои важная роль отводится снижению косвенных потерь урожая от дробления зерна, особенно при уборке и обработке урожая. Приведены опытные данные по содержанию дробления и микроповреждения в зерне сои, получаемом при комбайновой уборке урожая. Агротехническая оценка комбайновой уборки сои показала, что при уборке сои величина дробления находится на уровне 1,5…4,8% и составляет меньший процент, чем в семенах, подготовленных к посеву 3,2…6,34%. Определено, что процентное содержание дробления и в семенах не снижается а, наоборот увеличивается по дроблению в 1,32…2,1 раза и по микроповреждению с 1,34% до 5,89%. Дробленое зерно сои в семенах составляет масличную примесь на величину, которой увеличивается норма высева. Эта часть дорогостоящего семенного материала бесполезно высевается в почву. Микроповреждения при высеве в почву на 60% не дают всходов. Предотвратить эти потери возможно при внедрении в производство комбайна для сбора семенного зерна (Патент РФ № 2679508).

Ключевые слова: соя, комбайн, уборка, подработка, семена, дробление, микроповреждение, всхожесть.

1. Introduction

Soybean, with a high content of protein and fat, is the most important crop of the Far East. The area of its crops in Russia is increasing annually, which is due to the constantly growing demand for soybean products from the food and feed industry [1, P. 69].

Soybean cultivation technology provides for the use of modern technology during the entire period of cultivation from sowing to harvesting soybeans [2, P. 330]. The use of innovative soybean cultivation technologies ensures a high yield. In increasing soybean production, an important role is played by reducing direct and indirect crop losses (the content of broken and micro-damaged grains in seeds) obtained during grain harvesting, part-time work and seed harvesting [3, P. 16].

A lot of work is devoted to the issue of reducing damage to soybean grain during harvesting and post-harvest work [4, P. 17]. Moreover, each researcher, studying a separate working element of the threshing-separating or transporting device of the combine, finds a certain technical solution that allows significantly reducing damage to soybean grain in its pure form [5, P. 26]. At the same time, the authors experiment in laboratory conditions on grain, the physical and mechanical properties of which cannot fully correspond to natural conditions [6, P. 237].

The resistance of the soybean grain to mechanical damage is largely predetermined by its humidity. When treating seeds with conditioned humidity of 12–14%, a minimum of damage is noted. Mechanical damage increases when treating both dry (at W = 8%) and wet (W = 18%) seeds [7, P. 37], but the type of damage changes. Dry seeds from impact and pinching break down mainly into small parts, and at the same time the seeds contain a large amount of finely chopped grain. The crack of the shell and cotyledons during further processing leads to the loss of the embryo and the decay of grain on the cotyledons (halves) [8, P. 51]. In the general form of damaged seeds are broken across the grains and seeds with a broken part of the cotyledon and a knocked out germ [9, P. 48]. Wet seeds are deformed under load, and as a result, the total mass of damaged seeds consists of flattened, fractured grains and grains with dents and breakage of the shell [10, P. 82].

2. Methods

Soybean seed damage is a local or general destruction of grain as a single and complex biological system. Both in degree and in nature, these failures can be different. As a result of mechanical action on the part of working organs during threshing, soybean grain can be crushed, part of its shell is torn off, the embryo is knocked out or partially destroyed, part of the cotyledon is broken off. When the soldered grain is moved in screws and elevators, the grain is pinched in the gaps between the casing and screw of the screw or scraper and chute when it deviates, as a result its seed shell (peel) is damaged and soybean grain is broken into halves. Therefore, the soybean grain is damaged to various degrees during harvesting and part-time work, is not completely sorted on sieves during part-time work, and is contained in greater quantities in seeds prepared for sowing.

The content of soybean seed crushing was determined according to GOST 12036-85 "Seeds of the main culture" The crushing included five types of damage associated with loss of germination, these are the crushing of the seed along, the crushing of the seed across the cotyledons, quarters and finely crushed parts, and part of the cotyledon in the embryo region was repelled. Microdamage included the following types of damage associated with the destruction of the seed shell: this will knock out the embryo, cracks along and across the seed, including seeds passing through the embryo that have lost part of the shell.

There are many methods for determining micro-damaged seeds, and if we consider that the accuracy of determining micro-damaged seeds of all existing methods does not exceed, as in visual determination, we can dwell on the method of directly viewing seeds through a 7–8-fold binocular magnifying glass, which is most widely used in the practice of assessing seeds in tests of combine harvesters. For viewing and analysis, the selected sample is divided into parts with the help of a divider and three weighed portions weighing at least 100 grams of seeds are isolated. Each sample is divided into fractions, the separated fractions are weighed, the remaining seeds are viewed through a binocular magnifying glass, then microdammed ones are isolated, then the percentage is weighed and determined. The obtained data are recorded in tables.

3. Results

Analysis of the results of the agrotechnical assessment of soybean seeds obtained in 2021 during the actual harvesting of soybeans in the farms of the Amur Region in the optimal agrotechnical time with grain humidity of 13–16% by domestic and imported combines (Vector 410, Acros 530, Amur-Palesse KZS-1218-40, Claas "Tucano 430", Case IH 6088, "John Deere W650") shows that the bunker grain contained: weed impurity 0.42–2.1%, crushed seeds – 1.5–4.8%, micro-damaged – 0.6–1.34%, damaged by pests, diseases and frost − 1.64–11.6% (Table 1).

Table 1 – The quality of bunker grain during combine harvesting of soybeans in 2021 in seed farms of the Amur Region

Harvester brand, grade soi	Weed impurity, %	Crushing, %	Microdamages, %	Patients, eaten, frost, %	Weight 1000 seeds, g
Vector 410, soy grades Alyona	0,98	4,72	1,1	1,64	157,5
Acros 530, soy grades Alyona	0,42	4,83	1,15	1,9	154,7
Claas "Tucano 430", soy grades Alyona	1,82	1,4	0,71	3,7	147,2
"Amur– Palesse" KZS-1218- 40, soy grades Alyona	0,11	3,48	1,0	1,64	155,0
Vector 410, soy grades Sentyabrinka	0,98	4,72	1,1	1,64	175,5
John Deere W650, soy grades Batya	1,2	1,85	1,0	11,6	225,2
Claas "Tucano 430", soy grades Batya	2,1	3,63	1,34	6,6	211,0
Case IH 6088, soy grades Batya	1,22	1,5	0,6	7,3	213,4

A study of the sowing qualities of soybean seeds propagated in seed farms for sale to commodity producers shows that the use of an outdated combine park in harvesting and the deterioration of grain cleaning equipment do not allow obtaining high-quality seeds.

In the seeds of selection of VNII soybeans, DalNIIX, Canadian varieties cultivated in seed farms, the content of crushed and micro-damaged seeds is different. Maximum crushing (6.34; 5,73; 5,41; 3.2%) and microdamage (2.71; 4,34; 4,14; 4.97 %) was detected in seeds in the farms of the Tambov region on soybean varieties Persona, Alena, Lazurnaya, Prudence (Table 2).

Table 2 – Analysis of the quality of soybean seeds of various varieties taken from seed farms of the Amur oblasti

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
	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
	1,09	2,6	0,91	192,3
"Luxury"	1,01	1,71	0,57	148,1
	0,38	2,0	1,47	161,7
"Umka"	3,88	2,54	1,0	173,5
Konstantinovsky Districtc, 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
	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
	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

In the seeds of the farms of the Konstantinovsky district on the varieties Prudence, Alena and Umka, the crushing value is slightly lower and is (5.74; 3,76; 3.55%), but significantly higher microdamage (5.89; 5,14; 1,34%). The amount of crushing and micro-damage is much lower in the seeds of farms in the Ivanovo region. In this area, during the construction of a seed plant, the movement of soybean grain on non-damaging belt conveyors is introduced. Here, the crushing of soybean seeds in the varieties Umka, Dauria and Prudence is (4.64; 3,21; 2.44%) and microdamage (1.77; 2,52; 3,94%). The smallest mass of 1000 seeds in the marked varieties is possessed by small seeds of soybeans of the Persona variety (114.4–117.9 g), the crushing of which is 6.34–3.44%, and microdamage is located within 2.71–0.73%. The highest mass of 1000 seeds is a variety – Prudence (180.3 g), in which crushing is located within 2.44–5.74%. And the Lazurnaya variety (174.8 g), the crushing of which is 4.30–5.41% and microdamage – 4.14–4.35%. The above seed quality data for the three areas of the area show that the highest amount of mechanically damaged soybean seeds is observed in the Canadian breeding variety Prudence; from varieties of selection of VNII soybeans – Person, Alena, Azure.

5. Conclusion

1. An analysis of the agrotechnical assessment of soybean grains during combine harvesting and seeds of part-time workers prepared for sowing shows that the content of crushed and microdampled grains in seeds does not decrease, but, on the contrary, increases in crushing by 32% and microdamination by 3.7 times. And this does not mean that crushed grain is not sorted on the screens of grain cleaning machines. It's just that when working part-time and moving in screws and noria, soybean grains receive new damage and their content in seeds, does not decrease, but, on the contrary, increases.

2. When updating the combine park for timely harvesting of grain and soybeans and improving the quality of marketable grain, farms are advised to purchase new, productive combine harvesters of models: Case IH 6088, John Deere W650, Claas "Tucano 430," which receive better quality grain when threshed.

References

1. Фокина Е.М. Новые сорта сои для дальневосточного региона / Е.М. Фокина, Г.Н. Беляева, С.А. Титов // Дальневосточный аграрный вестник. — 2020. — № 3(55). — С. 68–75. — DOI: 10.24411/1999-6837-2020-13035

2. Синеговская В.Т. Селекция сои как инструмент решения задач импортозамещения в Дальневосточном федеральном округе / В.Т. Синеговская, Е.М. Фокина // Труды кубанского государственного аграрного университета. — 2018. — № 72. — С. 328–331

3. Система земледелия Амурской области / под общ. ред. Тихончука П.В. — Благовещенск : Изд-во Дальневосточного ГАУ, 2016. — 570 с., (4) с., (1) л. карта

4. Кочегура А.В. Селекция сортов сои разных направлений использования для регионов России / А.В. Кочегура, А.В. Щегольков, Д.Е. Зима // АПК NEWS. — 2018. — № 8. — С. 16–19

5. Катюк А.И. Источники хозяйственно ценных признаков для селекции сои в условиях лесостепной зоны Среднего Поволжья / А.И. Катюк, Е.В. Зуев, Н.В. Анисимкина // Масличные культуры. Научно-технический бюллетень Всероссийского научно-исследовательского института масличных культур. — 2016. — Вып. 3 (167). — С. 22–26

6. Ващенко А.П. Соя на Дальнем Востоке / А.П. Ващенко и др.; под науч. ред. А.К. Чайка; Россельхозакадемия, ДВ РНЦ, Примор. НИИСХ. — Владивосток : Дальнаука, 2014. — 435 с.

7. Фокина Е.М. Каталог сортов сои / Е.М. Фокина, Г.Н. Беляева, М.О. Синеговский [и др.]; под общ. ред. В.Т. Синеговской // ФГБНУ ФНЦ ВНИИ сои. — Благовещенск : ООО «ИПК «ОДЕОН», 2021. — 69 с.

8. 100 вопросов и ответов о возделывании сои (рекомендации для руководителей и специалистов сельскохозяйственных предприятий) / под общей ред. М.О. Синеговского. — ООО «Одеон», 2021. – 79 с.

9. Каталог сортов сои селекции всероссийского НИИ сои: коллективная научная монография / под общ. ред. В.Т. Синеговской. — Благовещенск, 2015. — 95 с.

10. Технологии возделывания сои // РосАгроХим, ГНУ ВНИИ сои, ГНУ ДальНИИМЭСХ. — М., 2010. — 46 с.

References in English

1. Fokina E.M. Novye sorta soi dlja dal'nevostochnogo regiona [New grades of soy for the Far East region] / E.M. Fokina, G.N. Belyaeva, Titov S.A. // Dal'nevostochnyj agrarnyj vestnik [The Far East Agrarian Bulletin]. — 2020. — № 3 (55). — P. 68–75. —DOI: 10.24411/1999-6837-2020-1303 [in Russian]

2. Sinegovskaya V.T. Selekcija soi kak instrument reshenija zadach importozameshhenija v Dal'nevostochnom okruge [Soy selection as the tool of the solution of tasks of import substitution in the Far Eastern Federal District] / V.T. Sinegovskaya, E.M. Fokina // Trudy kubanskogo gosudarstvennogo agrarnogo universiteta [Works of the Kuban state agricultural university]. — 2018. — № 72. — P. 328–331 [in Russian]

3. Sistema zemledelija Amurskoj oblasti [The system of agriculture of the Amur region] / ch. ed. Tikhonchuk P.V. — Blagoveshchensk : Publishing house of the Far East GAU, 2016. — 570 p., (4) p., (1) l. card. [in Russian]

4. Kochegura A.V. Selekcija sortov soi raznyh napravlenij ispol'zovanija dlja regionov Rossii [Selection of grades of soy of the different directions of use for regions of Russia] / A.V. Kochegura, A.V. Shchegolkov, D.E. Zima // APK NEWS. — 2018. — № 8. — P. 16–19 [in Russian]

5. Katyuk A.I. Istochniki hozjajstvenno cennyh priznakov dlja selekcii soi v uslovijah lesostepnoj zony Srednego Povolzh'ja [Sources hozyaystvenno valuable signs for selection of soy in the conditions of a forest-steppe zone of Central Volga area] / A.I. Katyuk, E.V. Zuev, N.V. Anisimkina // Maslichnye kul'tury. Nauchno-tehnicheskij bjulleten' Vserossijskogo nauchno-issledovatel'skogo instituta maslichnyh kul'tur [Oil-bearing crops. Scientific and technical bulletin of the All-Russian Research Institute of oil-bearing crops]. — 2016. — Issue 3 (167). — P. 22–26 [in Russian]

6. Vashchenko A.P. Soja na Dal'nem Vostoke [Soy in the Far East] / A.P. Vashchenko et al.; by scientific ed. A.K. Chaika; Russian Agricultural Academy, DV RNC, Primor. NIISH. — Vladivostok : Dalnauka, 2014. — 435 p. [in Russian]

7. Fokina E.M. Katalog sortov soi [Catalog of grades of soy] / E.M. Fokina, G.N. Belyaeva, M.O. Sinegovskiy [et al.]; ch. ed. V.T. Sinegovskaya // To FGBN FNTS of the All-Russian Research Institute of soy. — Blagoveshchensk : LLC IPC ODEON, 2021. — 69 p. [in Russian]

8. 100 voprosov i otvetov o vozdelyvanii soi (rekomendacii dlja rukovoditelej i specialistov sel'skohozjajstvennyh predprijatij) [100 questions and answers of soy cultivation (recommendation for heads and specialists of the agricultural enterprises)] / ch. ed. M.O. Sinegovskiy. — LLC Odeon, 2021. — 79 p. [in Russian]

9. Katalog sortov soi selekcii vserossijskogo NII soi: kollektivnaja nauchnaja monografija [Catalog of grades of soy of selection of the All-Russian scientific research institute of soy: (The collective scientific monograph)] / ch. ed. V.T. Sinegovskaya. — Blagoveshchensk, 2015. — 95 p. [in Russian]

10. Tehnologii vozdelyvanija soi [Technologies of cultivation soy] // RosAgroHim, I BEND the All-Russian Research Institute of soy, I BEND DALNIIMESKH. — M., 2010. — 46 p. [in Russian]