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QUALITY PROPERTIES OF WHEAT SEED THRESHED ON MOBILE THRESHER "ERNET" TYPE V-08

KVALITETNA SVOJSTVA SEMENA PŠENICE OVRŠENE NA MOBILNOJ VRŠALICI "ERNET" TIP V–08

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ABSTRACT

The examination results on threshing ten wheat varieties on the reconstructed mobile thresher "Ernet" type V-08 in small experimental plots in the village Globoder are presented in this paper. The threshing process is an integral part of the collection of seed wheat and was conducted on experimental plots immediately after the manual mowing of the crops. During the testing the following qualitative characteristics of each variety were determined: seed moisture, weight of 1000 grains, hectoliter mass, germination energy and germination. The thresher's cleaning quality was determined by taking the average sample from the bags in which the seeds were collected after threshing. The samples were taken in the process of threshing wheat in the experimental fields, and then in the laboratory of the Institute for Forage Crops in Globoder-Krusevac clean and broken seed, other varieties, inert matter and weed were subsequently separated for each cultivar. The study aim was to examine the quality of different varieties wheat seed, as well as practical application and evaluation of the operating quality of the reconstructed mobile thresher, "Ernet" type V-08.

Key words: *wheat seed, germination energy, seed germination, mobile thresher, broken seeds.*

REZIME

U radu su prikazani rezultati ispitivanja pri vršidbi deset sorata pšenice na rekonstruisanoj mobilnoj vršalici „Ernet" tip V-08 na malim oglednim parcelama u ataru sela Globoder. Proces vršidbe je sastavni deo ubiranja semenske pšenice i obavljen je na oglednim parcelama odmah nakon ručnog košenja useva. Pri ispitivanju za svaku sortu određena su sledeća kvalitativna svojstva: vlažnost semena, masa 1000 zrna, hektolitarska masa, energija klijanja i klijavost. Kvalitet čišćenja vršalice određivan je uzimanjem prosečnog uzorka iz kesica u koje je seme prikupljeno nakon vršidbe. Uzorci su uzimani u procesu vršidbe pšenice na oglednim poljima, a zatim u laboratoriji Instituta za krmno bilje u Globoderu-Kruševcu naknadno je za svaku sortu izdvojeno čisto i polomljeno seme, druge vrste, inertne materije i korov. Cilj ispitivanja bio je ispitivanje kvaliteta semena pšenice različitih sorata, kao i praktična primena i ocena kvaliteta rada vršidbenog uređaja rekonstruisane mobilne vršalice „Ernet" tip V-08.

Ključne reči: *seme pšenice, energija klijanja, klijavost semena, mobilna vršalica, polomljeno seme.*

INTRODUCTION

Wheat (*Triticum aestivum*) is one of the most important field crop in Serbia and other countries of the Balkan Peninsula, as well as throughout the world due to the production of bread for human consumption (*Babić et al., 2010; Vučković, 1999; Đokić, 2003; Štatkić et al., 2008; Barać et al., 2005; Barac et al., 2011*). Over 70% of population in the world is feed on wheat bread. Out of the total arable areas on the Earth that include about a billion acres, about 23% are occupied by the wheat-grown areas. Wheat bread is characterized by high protein content (16 - 17%), carbohydrates (77 - 78%), fat (1.2 - 1.5%) and good digestibility (*Jevtić, 1996*). Wheat is important in the milling industry, the industry of bread, biscuits, brewery, pharmaceutical industry and dextrin industry. The straw is used as bedding in livestock breeding and it can also be used as biofuel. The bran as a by-product is used as a concentrated animal feed and it also serves to improve the quality of bread.

According to the areas on which it is grown in Serbia, wheat ranks second behind corn. As the most significant field crop in Serbia in 2011 wheat was harvested on the area of 493006 ha with an average yield of 4.2 t ha^{-1} (*Statistical Yearbook of the Republic of Serbia, 2012*).

Seeds by definition are used for the reproduction in agriculture or for survival and subsistence of plant species under natural conditions. Quality seed has a great impact on the yield of the crop plants. On the quality of seeds primarily affect genetic traits, applied cultural practices, agro-ecological conditions, procedures in finishing making of the seed starting from threshing, reception, drying, packaging and storage of seeds (*Marić, 1987*). Produced from quality seed plants have faster growth, provide healthy plants that are resistant to various stress conditions (tolerate drought, low temperatures better, they are less subject to diseases and pests). For the production of quality seed a long production process is required starting from the sowing and includes controlling the crops in the field, through testing the seeds quality in the laboratory and ending with the finishing process.

One of the basic indicators of seed vigor of which its use value depends on is certainly the germination. It represents the percentage of germinated seeds for a certain time under certain conditions. High seed germination provides the crop that will achieve the best structure in the field, uniform germination of crops enabling high yields of excellent quality. The biological property of seeds is particularly important in practical terms because it directly affects the amount of seed for sowing per unit area. If seed germination is greater the less quantity of seed for sowing is needed and vice versa (Dolijanović and Brońić, 2004). For grain agricultural products the concept of thousand grains mass is introduced, determined by a count of 1000 grains, and then their mass using analytical scale is determined (*Babić and Babić, 2007*).

When threshing wheat in whole grain mass the content of impurities, broken and poor grain is undesirable, both in seedy goods and also in grain used for processing, since it makes more difficult the process of cleaning and storage of seeds, as well as

the quality of the resulting product. The operating parts of harvesting device are limiting factors for the thresher operating quality. By the improper adjustment and increased inflow of mass being threshed the percentage of impurities is increased and also the losses of threshing machines. The number of factors that affect the quality of the cleaner is large: the moisture of crops and seeds, compliance of the drum-concave gaps with drum revolving speed, screens setting, fan speed, openness of side fan covers. With the appropriate combination of drum-concave clearance with drum speed depending on the condition of crops the least amount of impurities are obtained. If all of the factors are not harmonized then the amount of impurities increase. The aim of the threshing process is to get as high as possible quantity of quality seeds without impurities.

In the wheat harvest using harvesters in conditions of Vojvodina the quality of harvested seeds was very high, with a high content of whole seeds and low content of broken seeds, small grain seeds and impurities *(Đević et al., 2004; Malinović et al., 2005; Barać et al., 2006)*. Seed grain size distribution is significant for cleaning, grading and separation. *(Babić et al., 2010)*. By the Law on seeds and planting material wheat seed quality must comply with statutory norms for seed material with the lowest seed purity of 97%, minimum germination of 82%, with the highest moisture content in the seeds of 15%, without the presence of other types of seeds and weeds (Official Gazette of SFRY no. 47, 1987).

MATERIAL AND METHOD

Testing the quality of mobile thresher Type V-08 in threshing wheat seeds were carried out in 2013. year on the sample plots in the village Globoder (Fig. 1). The size of basic plot was 5 m^2 (4 m x 1.25 m). Before harvest, the state of the crops, the presence of weeds has been determined and plant height measured. The crop was laid with partial weed. The average plant height from the base to the top of the ear ranged from 75.3 cm in the variety X to 93.0 cm in the variety VIII. Sowing of all experimental plots was carried out on 19th November and the sprouting was recorded on 29th November 2012. Prior to threshing each plot was previously mowed by hand, and then complete harvest mass was collected from the ground and gradually thrown into the thresher. The threshing of one variety lasted until the whole seed and straw left the threshers. The quality of threshing was determined by taking an average sample from the bag collecting the threshed seeds from the thresher. In the lab from the average sample the whole, poor and broken seed, weeds and other inert materials were separated and weighed on an analytical balance. Seed purity is the ratio of the given seed variety and the amount of the various impurities contained in the sample.

Threshing was carried out on 22. 07. 2013. year at very favorable hydro-meteorological conditions. After completion of the threshing of each variety the quality of harvested wheat seed was determined in the laboratory where the following seed properties were analyzed: 1000 grains weight, seed moisture, hectoliter mass, germination energy, germination and seed purity. The weight of 1000 wheat seed was determined by taking the 8 x 100 seeds where the seeds were manually separated. Hectoliter mass is the weight of the seed in the volume of 1 hl (100 liters). It is determined by hectoliter (Schopper) scale with a cylinder capacity of 0.4 l. When the mass of seeds in a volume of 0.4 l is measured, the hectoliter mass is determined by calculation. Germination energy and seed germination was determined after germination in the hot bed of the Institute of Forage Crops in Globoder-Kruševac. Germination viability is the speed and uniformity of germination. Determination of germination viability was performed on the fourth day after placement in the hothouse, and seed germination on the eighth day after the placement in the hothouse according to standards for testing wheat seed. The temperature in the hot bed was set at 21^{o}C with the mode 16 hours a day, 8 hours a night. Seed germination is the percentage of germinated seeds for a certain time under certain conditions. It is determined by the germination test and expressed as a percentage. Germination is one of the most important biological characteristics of seeds and based on it future development of the crop and its density can be predicted. To determine the germination the seeds were placed in plastic containers on the ground for germination of filter paper with a certain amount of water. Germination is the most important parameter for determining the amount of seeds for planting.

Fig. 1. Threshing wheat in a mobile threshing machine "ER-NET" Type V-08

Technical characteristics of the tested mobile thresher "ER-NET" Type V-08 are shown in Table 1.

Table. 1. Technical features of a mobile thresher "ERNET" Type V-08

Parameters	V-08
Engine power (kW)	29.5
Drum width (mm)	500
Drum diameter (mm)	350
Number of drum rails	6
Drum revolution (min^{-1})	450-1000
Sieve surface (m^2)	0.49
Clearance drum-concave (mm)	20-8
Weight (kg)	470
Height x width x length (mm)	2020 x 1350 x 3300

Using variator in the tested tresher, the number of drum revolutions can be regulated. The clearance between the drum and concave can be controlled. The orientation and volume of air flow can be regulated by the secondary sieve opening. For threshing wheat the bottom sieve was used with round holes of 6 mm in diameter. Separation of chaff from seed happens at the lower sieve. Clean seeds passing through the lower sieve fall on the collecting table below it and are collected into a suitable container through the outlet opening of threshing machine. The reconstructed threshing machine in comparison to the previous structure differs in that instead of drive drum pulleys drive is realized by the variator enabling a more simple change of the gear ratio that is the change of the number of revolutions. The distance between the drum and concave is also adjusted through the threaded spindle.

RESULTS AND DISCUSSION

One of the most important indicators of the threshing machine operating quality in addition to the amount of losses on trashing device is the quality of the threshing that is the extent of damage and mechanical damage of wheat seed. The quality of harvested wheat seeds is shown in table 2. From inert material

soil had the highest share as well as straw and crop residues, shriveled grain and a certain percentage of broken seeds. The lowest quality of harvested wheat seed was recorded in the variety IX and amounted to 83.7%. The content of inert material in the form of chaff, straw, crop residues and broken seeds (3.2%) was very high at 13.2%. In the sample from weeds common knotgrass (*Polygonum aviculare* L.) was present with 3.1%. Such a high content of inert materials can be due to a larger content of harmful plants and the uneven operation of the threshing device due to insertion of a larger quantity of threshing mass. The highest percentage of pure seed was recorded in the variety X (92%), with 7.6% of inert material in the form of chaff, soil, straw, poor seeds and broken seeds (0.09%). Weeds in the form of sorrel (*Rumex spp*.) and bindweed (*Convulvus arvensis*) were present with 0.4%.

Table 2. The purity of wheat seed after threshing in %

Var.	Seed structure	(%)	Weed species
I	Pure seed	91.3	
	Other species	-	
	Inert matter	7.6	Soil, chaff, crop residue, broken seeds (0.3%)
	Weed	1.1	Common knotgrass (*Poligonum aviculare* L.), sorrel (*Rumex* spp.)
II	Pure seed	91.8	
	Other species	-	
	Inert matter	6.1	
	Weed	2.1	Chaff, straw, crop residues, shriveled grain, broken seeds (0.98%)
III	Pure seed	88.7	
	Other species	-	
	Inert matter	7.7	Soil, chaff, crop residue, broken seeds (0.3%)
	Weed	3.6	
IV	Pure seed	90.8	
	Other species	-	
	Inert matter	5.6	Chaff, straw, shriveled grain, broken seeds (1,2%)
	Weed	3.6	sorrel (*Rumex* spp.), common knotgrass (*Poligonum aviculare* L.)
V	Pure seed	90.4	
	Other species	1.1	Barley
	Inert matter	8.3	Soil, chaff, crop residue
	Weed	0.2	Couch grass (*Agropyron repens* Beauv), field thistle (*Cirsium arvense* L.)
VI	Pure seed	90.4	
	Other species	-	
	Inert matter	7.0	Soil, chaff, crop residue
	Weed	2.6	Bindweed (*Convulvus arvensis*)
VII	Pure seed	88.0	
	Other species	-	
	Inert matter	9.6	Chaff, straw, shriveled grain, broken seeds (1.2%)
	Weed	2.4	Common knotgrass (*Poligonum aviculare* L.), couch grass (*Agropyron repens* Beauv)
VIII	Pure seed	90.8	
	Other species	-	
	Inert matter	5.6	Chaff, crop residue, soil, broken seeds (0.62%)
	Weed	3.6	sorrel (*Rumex* spp.), *Poligonum*
IX	Pure seed	83.7	
	Other species	-	
	Inert matter	13.2	Chaff, straw, crop residue, broken seeds (3.2 %)
	Weed	3.1	Common knotgrass (*Poligonum aviculare* L.)
X	Pure seed	92.0	
	Other species	-	
	Inert matter	7.6	Chaff, soil, straw, poor seed, broken seeds (0.09%)
	Weed	0.4	Sorrel (*Rumex* spp.), bindweed (*Convulvus arvensis*)

Design features and technical and technological possibilities of experimental thresher "ERNET" Type V-08, according to studies are such that samples of high purity even up to 98.52% can be obtained (*Djokic et al., 2012*). If in the experimental field a higher content of weeds is present and if the right mode is not used for threshing, the percentage of pure seed is reduced, i.e. the seed with a higher percentage of impurities in the form of chaff, parts of plant and ears, leaves are obtained. The quality of harvested wheat seed is affected by several factors, primarily the crop moisture, compliance of the drum-concave clearance with drum's number of revolutions, fan speed, as well as the size of aperture for air flow setting, setting of medium sieve aperture size and the proper selection of the diameter of the lower variable sieve. Impurities, broken and small grained seed in the threshed seeds are undesirable because they hamper the further process of cleaning and storing seeds and adversely affect the quality of the resulting product. Operating elements for cleaning are the limiting factor of seed cleaning quality (*Đokić et al.,2013*). Technological parameters and design of the threshing apparatus influence grain damage (*Špokas et al., 2008*).

The table 3. shows the yield of each variety of wheat, hectoliter mass, 1000 seed weight, germination energy, germination and seed moisture. The lowest yield was in the variety IX and amounted 1.820 kg on the area of 5 m^2, while the highest yield was 2.650 kg on the area of 5 m^2 in the variety IV. The average yield for all varieties was 2.342 kg on the area of 5 m^2. Hectoliter mass of seed is dependent on the shape, the purity and moisture. Better soaked and large seed has a higher hectoliter mass. The minimum hectoliter mass was 79.0 kg hl^{-1} in the variety IX, while the highest of 86.75 kg hl^{-1} was in the variety X. The average value of hectoliter mass for all varieties was 83.17 kg hl^{-1}.

Table 3. Yield, hectoliter mass, weight of 1000 seeds, germination energy, germination and seed moisture

Sort	Yield at time on harvesting in kg per 5 m^2	Hectoliter mass (kg hl^{-1})	Weight of 1000 seeds (g)	Germination energy (%)	Germination (%)	Seed moist. (%)
I	2.270	85.0	45.21	91.0	93.0	12.4
II	2.050	82.27	42.54	89.0	91.0	13.0
III	2.180	82.87	38.81	89.0	89.0	10.9
IV	2.650	84.8	44.31	89.0	90.0	12.0
V	2.270	82.65	40.67	92.0	94.0	11.0
VI	2.550	79.6	42.15	90.0	93.0	13.4
VII	2.580	84.82	33.39	93.0	94.0	11.6
III	2.500	83.97	33.68	88.0	94.0	13.6
IX	1.820	79.0	41.28	90.0	90.0	11.0
X	2.550	86.75	44.15	93.0	95.0	11.6
$\overline{X}$	2.342	83.17	40.62	90.4	92.2	12.05

The absolute mass of seeds represents 1000-grain weight and is expressed in grams. The absolute weight of the wheat seed represents soaked seed and ranges between 30-50 g depending on varieties, cultural practices and meteorological conditions *(Mladenovski and Nikolovski, 2000).* The amount of seed that will be used for planting depends on the mass of 1000 seeds. It depends on seed size, moisture and physiological maturity of seeds. Larger seed provides a stronger root system, stronger tillering, thus achieving higher yield. For tested samples the lowest absolute weight was 33.39 g in the variety VII, while the highest was 45.21 g in variety I. The average value of the absolute mass of all varieties amounted to 40.62 g. Germination viability is the ability of seeds to germinate as much as possible in the shortest possible time. Seeds with higher germination energy have faster sprouting having an impact of seeds in the first stages of vegetative growth germinating uniformly and simultaneously. This ensures that the crop has an initial advantage and is more ready for the negative impact of climatic factors. Seed of the variety VIII had the lowest germination energy of 88% while wheat seed of varieties II, III and IV had uniform germination energy of 89%. The highest germination energy of 93% had seed varieties VII and X. The average energy of germination for all the cultivars was 90.4%. One of the basic indicators of seed vigor of which its use value depends on is certainly the germination. High germina-

tion seed provides the best crop structure in the field. Uniform crop emergence leads to high yields of excellent quality. Germination ranged from 89% in the variety III to 95% in the variety X. The average germination amounted to 92.2%, which was significantly higher value than the statutory standards. Seed moisture was rather uniform, with a minimum moisture content of 10.9% in the variety III and maximum seed moisture of 13.6% in the variety VIII. The average moisture of the wheat seed was 12.05%. Seed moisture is an important indicator of quality. The length of storage also depends on the seed moisture. The data in Table 3 show that all the wheat samples had seeds moisture favorable for long-term storage which according to the standards for seed material is 15%. In the process of the seed threshing the seed there also comes to damage and breakage of seeds. Damaged seeds with weeds seeds and other impurities with the increased humidity are spoiled more quickly because in these conditions the seeds are more susceptible to intensive breathing and increase in temperature of mass. In these conditions there is a high possibility of increasing the number of harmful microorganisms. These jointly lead to a drop in germination energy and germination, that is reduces the use-value of seeds.

CONCLUSION

In the process of threshing ten varieties of wheat seed using the mobile experimental thresher, "Ernet" Type V-08 quality parameters were investigated such as: seed purity, germination energy, germination, hectoliter and absolute weight, moisture. Based on the obtained results it can be concluded that the purity of seeds ranged from the lowest value of 83.7% to 92%. The hectoliter mass ranged from 79.0 kg hl^{-1} to 86.75 kg hl^{-1} with an average value of 83.17 kg hl^{-1}. The absolute weight ranged from 33.39 g to 45.21 g. The germination energy was from 88% to 93%. Germination ranged from 89% to 95%, which is significantly higher than the statutory minimum germination of 82%. The seed moisture ranged from 10.9% to 13.6%, which is lower than the statutory value amounting to 15% for wheat seed. Based on the results of threshing of wheat seed using the experimental mobile thresher "Ernet" Type V-08 it can be concluded that the device with the proper setup and operation mode corresponds to the purpose and also that the quality properties of the tested wheat varieties is satisfactory.

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