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EXAMINATION OF SOME QUALITY FEATURES OF OATS GROWN IN CONDITIONS OF ORGANIC PRODUCTION

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Abstract

The research was conducted in 2015 and 2016, at 11 oats genotypes in terms of organic production. Three of the populations were domestic: *Krivogastani, Trebenista* and *Kuceviste*. The rest were introduced varieties, including *Rajac, Slavuj* and *Lovcen* from Serbia and varieties: *Kupa, Baranja, Explorer,Sampionka* and *Istra* from Croatia.

In the first year of the study, the energy of germination of oats seed ranged from 70% in variety *Rajac*, up to 96% for the variety *Kupa*. In the second year of the study, the energy of germination was 81% for the variety *Kupa*, to 96% in variety *Istra*. While comparing the varieties it is pointed out that there are statistically significant differences.

The total germination of oat seeds, cultivated under conditions of organic production, is statistically different between different genotypes, in both years of research. In 2015, the variety *Rajac* showed minimum germination (70%), and in 2016, the variety *Lovcen* (82%). Variety *Krivogastani* showed the greatest over all germination in both experimental years (96% in 2015 and 97% in 2016).

Regardless the year and the mode of production, the best genotype of the tested variants for the highest absolute mass of grain, it proved the variety *Istra* with 34,6g in 2015 and 29,6g in 2016. The smallest absolute mass in both experimental years had the *Krivogastani* population, 12.3g in 2015 and 14.9g in 2016. There is statistically significant difference between varieties.

Key words: variety, population, energy of germination, germination, absolute mass

INTRODUCTION

Oat (*Avena sativa* L.) is one of the oldest cereals, known first as weeds in cereal crops, and then grown as an independent culture, because of its high economic qualities - high protein content with a better balanced amino acid composition (Moudry,1992; Yeoh & Watson,1981; Frey,1977), than other cereals, a favourable relationship between nutritional properties and high digestibility, which determine oats as an indispensable concentrated forage in the diet of domestic animals.

The agricultural significance of the oats is due precisely to the quality of the grain and the small requirements about the conditions of cultivation, so it can succeed in the areas where other cereals produce low yields (Spasojević et al., 1984). With the development of the food industry and the growing need for healthy and dietary food, the significance of the oat for balanced nutrition of people has increased. Oat breeding aims at producing as high yielding varieties as possible, but some irreplaceable properties of the grain are also required in connection with the production of valuable food and nutritional products (Савова, 2007; Георгиев et al., 2003).

Oat is a cereal crop that prefers moist and cold climates, but due to the constant increase in air temperature and uneven precipitation in the last ten years, efforts are being made to create new varieties adapted to the new modified conditions (Кузмова К., 2009). Oat is very sensitive to drought and low temperatures (Božić et al., 2013). Insufficient and irregular

precipitation in spring also negatively affects the yield of oats (Barut, 2003).

Genotypes with a high percentage of total germination and development have a high selectivity value and if involved in the selection process can lead to improved crop growth, its competitiveness and productivity (Шевелуха, 1992; Станков et al., 2010; Станков et al., 2008; Вълчев et al., 2010). The energy of germination and germination rate of the seeds describe their physiological characteristics that enable them to quickly grow in the soil and be tolerant towards the various negative environmental factors (Lekić, 2001; Milošević et al., 2010).

Oat is one of the most suitable cereals for organic production (Lockeretz, 1981). This is in accordance with the studies and other authors (Galie et al., 2004), who examined varieties of oats in organic production conditions, established that oats are a very suitable cereal organoleptic crop, bearing in mind the high yields they received which ranged from 4 to 5 t / ha.

The purpose of the study was to analyse some biological and physical properties such as the energy of germination, total germination and the absolute mass of oat grains in conditions of organic production, which will determine which variety or population is most suitable for growing in the climatic conditions, which are characteristic for Strumica region.

MATERIAL AND METHODS

The tests were carried out in 2015 and 2016, in field and laboratory conditions. Field experiments were placed on the experimental field at the Faculty of Agriculture, "Goce Delcev" University - Stip in Strumica, and the laboratory analysis were carried out at the Faculty of Agriculture laboratories.

11 oats genotypes have been analysed, three of which are domestic populations (*Krivogastani, Trebenishta* and *Kuceviste*), three Serbian genotypes (*Rajac, Slavui, Lovken*) and five genotypes are of Croatian origin (*Kupa*, *Baranja, Explorer, Championka* and *Istra*).

The trials were set in three repetitions, distributed by the random block system method, with a dimension of the basic parcel of 5 m2.

The distance between the variants was 0.50 m, and between the repetitions 1 m. The distance between rows was 20 cm. The seed rate of 550 grains per 1m2 was used. The basic soil treatment was performed at a depth of 35 cm. Prior to sowing, additional processing and fertilization with 30 t/ha biological fertilizers were carried out, according to the regulations for organic production.

Before the harvest, material from plot of 1m2 for laboratory analysis was taken (30 plants of each parcel were used, i.e. 90 plants of each variant)

The biological and physical properties of the grains (energy of germination, total germination and absolute mass) were examined according to international methods of ISTA.

The obtained results were processed statistically according to the method analysis of variance, and the differences were tested according to the LSD test.

CLIMATE CONDITIONS

In the period of two-year trials, the meteorological indicators for average monthly air temperatures in Celsius were monitored and monthly sums of precipitation in millimetres.

For the period of ten years, 2004/2014, the average annual temperature in Strumica valley (Table 1) was 13.5°C, and an average fall of 663.9 mm precipitation (Table 2).

The schedule of precipitation (Table 2) by months and by seasons is quite unbalanced. The most robust mass of rain, for a period of ten years, is in October with an average of 80.1mm. The driest month, with the lowest average amount of precipitation is August 39.9mm.

The analysis of the temperatures in the period of research 2015-2016 (Table 1) showed a high similarity with the average annual temperatures in the Strumica valley at the ten-year average. The mean annual temperature in 2015 is 0.3°C higher than the multiyear average, and in 2016 is 0.4°C higher than the average.

It must be noted that the amount of precipitation and temperature smaller or larger than average amount is sufficiently reliable factor for the successful completion of the vegetation, i.e. good yield.

According to the data in Table 1, it can be concluded that the average monthly air temperatures during the spring oats (March - July) vegetation, in the two years of testing, are the lowest in the first month of the oat vegetation, i.e. in March (from 7.2 - 9.5 °C), and the highest in July (25.5 - 26.7°C). These mid-month temperatures, which prevailed in the two years of testing, are considered good for growing oats.

Spring oat is known as low temperature sensitive culture and should not be grown in areas where temperatures fall from -10 to -14°C, before forming a snow cover. But the degree of resistance depends on the large extent on the stage development, the stages of organogenesis, the sowing time, the species, the variety, the availability of soil with nutrients, the duration of the low temperatures, the humidity of the soil, etc. The temperature is considered one of the key factors in the germination process (Forcella, 1998).

Table 1. Average monthly temperatures in Celsius

Year	Month												Ann. amount of temp.	Average ann. temp
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
2015	2,8	5,3	7,2	12,4	19,8	21,4	26,7	24,9	20,1	13.8	8,8	3,0	5052,2	13,8
2016	1,4	9,4	9,5	15,5	16,9	23,5	25,5	24,2	19,1	13,4	7,2	1,3	5073,5	13,9
2004 - 2014	2,4	4,1	8,8	13,5	18,2	22,4	25,1	24,9	19,4	12,6	7,8	3,4	4927,5	13,5

Table 2. Amount of monthly precipitation in mm

Year	Month												Ann. amount of precipitation in m
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
2015	50,4	81,4	83,0	16,6	16,1	40,1	6,6	65,6	95,0	102,9	54,4	0,0	612,1
2016	61,3	23,5	135,5	52,5	96,2	38,3	18,7	18,7	31,4	64,3	53,3	0,0	593,7
2004 - 2014	43,5	51,5	50,5	44,0	66,3	60,1	52,0	39,9	61,0	80,1	48,3	66,9	663,9

For successful vegetation, oats require a lot of water and are therefore considered as cereal that has the greatest need of it.

Critical water periods are the stages of the formation of generative organs (about 15 days before tasselling) and the time of intense growth (until the tasselling) (Vasilevski, 2004).

In Table 2, it can be noted that during the vegetation period of the oats, the precipitation scales are relatively good and correspond to the needs of the oats.

Oats have the greatest need for water in relation to other cereals, due to the large leaf mass that it forms during vegetation. The oats transpiration coefficient ranges from 400 to 570, but it largely depends on the variety, agro-technical measures, the type of soil, relative humidity of the air, etc.

RESULTS AND DISCUSSION

Energy of germination

Energy of germination defines as the percentage of normally germinated seeds in relation to the number of seeds set for germination, determined after the expiration of the time provided for the first assessment, i.e. for determining the energy of germination.

The energy of germination of the seeds reflects the seed's vitality, so that after the sowing, it yields uniform, healthy and strong holes in a relatively short time and in relatively good skinning conditions. The energy of germination may vary depending on the action of the seed and the ecological factors (Rajnpreht, 1990).

In the first year of the study, the germination energy of oat grown in organic production (Table 3) ranged from 70% in the *Rajac* variety to 96% in the variety of *Cupa*. In the second year of the study, the germination energy was 81% in the varieties of *Cupa*, up to 96% in the variety of *Istra*. Compared between varieties, there are statistically significant differences.

Germination

Determining the seeds germination is one of the most important ways of assessing seed material, and' spinning is the ability of the seed to sprout when it comes in favourable conditions. Germinated seed is the one that in a certain time develops a root and a stem not less than the length of the seed that is considered proper. The term total germination of seeds means the percentage of normally developed germinant in relation to the total number of seeds placed on germination, determined after the expiry of the time provided for the final evaluation. Water, temperature, light, oxygen together with soil characteristics are the factors that have the greatest impact on the germination of seeds (Gorai & Neffati, 2007).

The total germination of the seeds is the most important biological parameter for the quality of the seeds, on which its longevity depends.

This important biological parameter for seed quality (Table 3), in both years of research, is statistically different in different genotypes and ranges from 70% to 96%. In 2015, the variety *Rajac* showed the lowest percentage of germination (70%), and in 2016 it was the *Lovken* variety (82%), while the *Krivogastani* variety showed the highest total germination in both experimental years (96% in 2015 and 97 % in 2016).

The germination of the seeds in the studies of some authors (Спасова, 2008), were slightly higher, ranging from 80% to 99%, and the lowest seeds of the *Rajac* variety (87%) were observed in the first year of the trials.

Absolute mass of the grain

The absolute mass of the seed is a mass of 1000 air-dry grains and is expressed in grams. It tells us about the nature of the endosperm of the grain or the internal structure of the grain.

Better laxity gives a higher absolute mass, and is important when determining the amount of sowing rate in cereals.

Absolute mass is a feature of the species and variety, but in the same variety, it may be different, depending on the conditions of production (Đekić et al. 2010). In our investigations, the conclusion was confirmed.

Regardless the year and the way of production, the best genotype of the examined variants with the highest absolute mass of grain was the variety *Istra* (34.6 g in 2015 and 29.6 g in 2016). The lowest absolute mass in both years had the *Krivogastani* population, 12.3 g in 2015 and 14.9 g in 2016, as well as the *Kuceviste* variety (14.9 g in 2016). Among the varieties, there is a very significant statistical difference.

Table 3. Quality properties of oats grown in organic production in 2015 and 2016

Variety / population	Energy of germination (%)	Germination (%)	Absolute mass of grain (g)
2015			
Krivogashtani	94	96	12,3
Trebenishta	86	86	24,7
Kuchevishte	80	88	20,1
Rajac	70	70	17,8
Slavuj	83	84	20,5
Lovken	91	91	25,6
Cupa	96	95	26,4
Baranja	90	90	24,3
Explorer	80	80	27,7
Shampionka	91	91	22,0
Istra	92	92	34,6
LSD 0,05 0,01	5.9 8.4	4.23 6.0	2,77 5,50

Variety / population	Energy of germination (%)	Germination (%)	Absolute mass of grain (g)
2016			
Krivogashtani	95	97	14,9
Trebenishta	89	92	19,9
Kuchevishte	90	91	14,9
Rajac	84	85	23,3
Slavuj	86	88	18,5
Lovken	90	82	19,3
Cupa	81	92	22,9
Baranja	92	93	16,0
Explorer	82	89	19,3
Shampionka	91	92	17,6
Istra	96	96	29,6
LSD 0,05 0,01	2.88 4.38	2.62 3.82	2,65 3,78

CONCLUDING REMARKS

Based on the two-year trials and the obtained results for the quality properties of oats grown in organic production, we can conclude that:

- The lowest energy of germination of the seeds had variety *Rajac* (70%) in 2015 and variety *Kupa* (81%) in 2016, and the highest, variety *Kupa* (2015) and the variety *Istra* (2016) with 96%.
- The *Krivogastani* varieties showed the highest total germination in both experimental years (96% in 2015 and 97% in 2016), and opposite, the lowest total germination had the variety *Rajac* (70%) in 2015, and the variety *Lovken* (82%) in 2016.
- The best genotype of the examined variants with the highest absolute mass of grain was the variety *Istra* (34.6 g in 2015 and 29.6 g in 2016), and the most unfavourable for growing in our conditions are *Krivogastani* population, 12.3 g in 2015 and 14.9 g in 2016, as well as the *Kuceviste* with 14.9g in 2016.

Accordingly, the variety *Istra* is the most suitable genotype of the examined 11 varieties for breeding in organic production in the conditions of Strumica region.

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ИСПИТУВАЊЕ НА НЕКОИ КВАЛИТЕТНИ СВОЈСТВА НА ОВЕС ОДГЛЕДУВАН ВО УСЛОВИ НА ОРГАНСКО ПРОИЗВОДСТВО

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Резиме

Испитувањата се вршени во 2015 и во 2016 година, на 11 генотипови овес при услови на органско производство, од кои 3 беа домашни популации: *кривогаштани, требеништа* и *кучевиште*, а останатите се интродуирани сорти и тоа: *рајац, славуј* и *ловќен* од Србија, и сортите: *купа, барања, експлорер, шампионка* и *истра* од Хрватска.

Во првата година од испитувањето, енергијата на 'ртење на семето од овес се движеше од 70% кај сортата *рајац*, до 96% кај сортата *купа*. Во втората година од испитувањето, енергијата на 'ртењето изнесуваше од 81% кај сортата *купа*, до 96% кај сортата *истра*. Споредено помеѓу сортите, укажува на констатацијата дека постојат статистички многу значајни разлики.

Вкупната 'ртливост на семето од овес, одгледувано при услови на органско производство, и во двете години на испитување е статистички различна кај различни генотипови. Во 2015 година сортата *рајац* покажа најмала 'ртливост (70%), а во 2016 година сортата *ловќен* покажа најмала 'ртливост (82%), додека популацијата *кривогаштани* покажа најголема вкупна 'ртливост и во двете опитни години (96% во 2015 и 97% во 2016 година).

Без оглед на годината и начинот на производство како најдобар генотип од испитуваните варијанти за добивање на висока апсолутна маса на зрно се покажа сортата *истра* со 34,6 g во 2015 година и 29,6 g во 2016 година. Најмала апсолутна маса и во двете години имаше популацијата *кривогаштани* и тоа 12,3 g во 2015 г. и 14,9 g во 2016 година заедно со *кучевиште*. Помеѓу сортите постои многу значајна статистичка разлика.

Клучни зборови: *сорта, популација, енергија на 'ртење, 'ртливост, апсолутна маса*