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INFLUENCE OF SOWING PERIOD AND FERTILIZATION ON THE NAKED OAT CROP GROWN IN THE ILFOV COUNTY

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Abstract

Naked oat is a spring cereal crop with a good yield potential and high nutritional grain value owing to its high content of protein, fiber, fat and minerals. The trend of climate change by increasing temperatures and aridity has a negative influence upon plant growth and crop yield stability. Analyzing the evolution of climatic conditions for the Ilfov area (Southeastern Romania) in the past 10 years (2006-2015), we observed an increase in average temperature by 1.5°C and a decrease in the annual rain autumn amount by 45.4 mm.
Research was conducted for the naked oats crop (GK Zalan variety) and the purpose was to analyze plant growth and yield potential by sowing the crop in autumn, as compared with the spring crops and the influence of mineral fertilization. All the analyzed parameters (panicles/sqm; number of panicle/plant; yield grain /panicle; thousand grains weight; hectolitre mass, grain yield) had maximum values for the autumn sowing period (October) and $N_{100}P_{50}$ fertilization level. Grain yield was 3,962 kg.ha^{-1} exceeding the spring crop yield by 55% (2,550 kg.ha^{-1}).

Key words*: naked oat, Avena nuda L., sowing period, fertilizer, yield.*

INTRODUCTION

Avena nuda L. (naked oat) is an oats variety in which the grains are naked after harvest.
Naked oat grains have a high nutritional value owing to their high content in protein, fiber and fat. The nutritional value of *Avena nuda* L. is higher compared to other cereal crops (Ahokas, 2005; Biel, 2014; Wood, 2007; Zarkadas, 1995), being classified as a functional food. Naked oat has a high content in β-glucan, favourably influencing the cholesterol content, as well as the functionality of the cardiovascular system and digestive system.
In temperate climate conditions naked oat is a spring cereal crop.
Naked oat has a good yield potential depending on the technology applied (Mut et al., 2016; Klimek-Kopyra et al., 2015).
The trend of climate change, i.e. increasing temperatures and aridity, has a negative influence upon plant growth and crop yield stability. According to NMA, in Romania between 1901 and 2008 average temperature increased by approx. 0.8°C, and rainfalls decreased quantitatively. These changes were more significant after 1970 for the Southern and Eastern areas of the country. Forecasts for the next period reveal continous warming and significant reduction of rainfalls especially in summer (Romania's National Strategy on Climate Change 2013-2020).
Finding technical solutions to limit the impact of climate change on crops and food resources is a priority for agricultural research.

MATERIALS AND METHODS

Experiments were placed at the Experimental Field of Moara Domneasca Didactic Farm (Ilfov County) on a chromic luvisol with a moderately acidic reaction.
Research started by analyzing the evolution of climatic conditions in the past ten years (Table 1) relative to the average annual values of the area (Normal). During 2006-2015 an increase in average temperature of 1.5°C and a reduction in the annual rainfalls amount of 45.4 mm were observed.
In winter (December-February) the average temperature for 2015-2016 was 0.27°C, compared to -1.12°C normal values.
In these climatic conditions we considered appropriate a review of the technological elements (sowing date, culture density, variety,

dosage and type of fertilizer, soil tillage system, etc.), especially for some spring crops.
Research was conducted for the naked oat crop *Avena nuda* L. Biological material was represented by GK Zalan variety.

Table 1. Climatic condition of Moara Domnească, Ilfov

Month	Temperature (°C)			Rainfall (mm)		
	Normal	Average 2006-2015	2014-2015	Normal	Average 2006-2015	2014-2015
October	11.0	12.3	**11.8**	35.8	48.24	**64.2**
November	5.3	6.8	**6**	40.6	24.5	**49.1**
December	0.4	1.4	**1.4**	36.7	46.5	**84.6**
January	-3.0	-1.5	**-1.5**	30.0	36.0	**33.4**
February	-0.9	0.9	**2**	32.1	16.9	**21.4**
March	4.4	6.5	**6.2**	31.6	26.9	**65.0**
April	11.2	12.6	**11.7**	48.1	39.5	**2.0**
May	16.5	17.6	**18.6**	67.7	63.2	**33.6**
June	20.2	21.6	**21.0**	86.3	70.5	**56.8**
July	22.1	23.4	**25.3**	63.1	51.1	**5.2**
August	21.1	23.6	**24.3**	50.5	38.0	**48.4**
September	17.5	18.3	**18.8**	33.6	48.7	**88.0**
Average °C Sum -mm	**10.5**	**11.96**	**12.1**	**556.1**	**509.87**	**551.7**

The purpose of the research was to analyze plant growth and yield potential by sowing the naked oat crops in autumn, as compared with the spring crops.
Sowing was conducted in two periods: Period I - 18 October 2014 and Period II - 28 March 2015.
The effect of three fertilizations (N_0P_0, $N_{100}P_0$, $N_{100}P_{50}$) on plant development and crop yield was analyzed. Nitrogen fertilizer was applied in divided doses, 50% of the dose at sowing and 50% during vegetation and phosphorus fertilizer (as NP 20:20 complex fertilizer) was applied at sowing.
During the vegetation period observations and biometric measurements were conducted.

RESULTS AND DISCUSSIONS

Influence of sowing period and fertilization upon naked oats crop density

Naked oat crop in May (Table 2) at sowing presented a higher density in the variants fertilized with up to 12% ($N_{100}P_{50}$), compared to the unfertilized variants. At spring sowing crop density was between 277 and 291 plants/sqm.

Table 2. *Avena nuda* L. crop density (plants/sqm) in spring, depending on sowing period and fertilization

Variants	Period I - October			Period II - March		
	No. of plants/sqm	%	Diff	No. of plants/sqm	%	Diff
N_0	228	100	Ct	277	100	Ct
N_{100}	245	107	17	291	105	14
$N_{100}P_{50}$	256	112	28	283	102	6

Influence of the sowing period and fertilization on the number of panicles

An important component of yield was the number of harvested panicles.
The data presented in Table 3 show that, depending on fertilization, the number of panicles/sqm was between 242 and 350 panicles/sqm for the autumn sowing period while for the spring sowing period was between 264 and 322 panicles/sqm.
$N_{100}P_0$ fertilization generated a 35% increase for the autumn sowing period and a 17% increase for the second sowing period, and nitrogen and phosphorus fertilization resulted in an increase of 45% in Period I and 22% in Period II.

Table 3. Panicles density to naked oat crop depending on sowing period and fertilization

Variants	Period I - October			Period II - March			PI com. PII %
	No. of pn/sqm	%	Diff	No. of pn/sqm	%	Diff	
N_0	242	100	Ct	264	100	Ct	22
N_{100}	327	135	85	310	117	46	17
$N_{100}P_{50}$	350	145	108	322	122	58	28

Phosphorus-based fertilizer had a higher effect to the oat sown in autumn, as the number of panicles was 9% higher.
The number of panicles formed by the productive twinning of oat plants (Table 4) was favourably influenced by fertilization in both sowing periods; maximum results were recorded for autumn sowing 1.33-1.37 panicles/plant. For the variant sown in March, there were 1.06-1.14 panicles/plant on average, the productive twinning being influenced more strongly by low rainfalls in April and May

(31% of the value of rainfalls in the area). Naked oat sown in autumn resulted in an increase in the number of panicles/plant by 11-25%, compared to the crop sown in March.

Table 4. Number of panicles/plant in naked oat crops depending on sowing period and fertilization

Variants	Period I - October			Period II - March			PI comp. PII %
	No pn/pl	%	Diff	Nr pn/pl	%	Diff	
N_0	1.06	100	Ct	0.95	100	Ct	111
N_{100}	1.33	125	0.27	1.06	111	0.11	125
$N_{100}P_{50}$	1.37	129	0.31	1.14	120	0.19	120

Figure 1. Naked oat plants development depending on sowing period (Left - Period I, Right -Period II) at 6/19/2015

Influence of the sowing period and fertilization upon grain yield

Sowing period and fertilization strongly influenced the nude oats yield level in 2015 (Table 5).

Grain yield had the highest level in the three variants of fertilization for the autumn sowing period. Fort the fertilizated variant $N_{100}P_{50}$ the recorded grain yield was of 3962 kg.ha^{-1}. The fertilizer resulted in yield increase of 1852 kg.ha^{-1} for nitrogen a dose of 100 kg.ha^{-1} and 2246 kg.ha^{-1} from the nitrogen and phosphorus. For the second sowing period (spring), the maximum yield level of 2550 kg.ha^{-1} was recorded for nitrogen and phosphorus fertilization, and the yield increase was 1145 kg.ha^{-1} for N_{100} and 1412 kg.ha^{-1} for $N_{100}P_{50}$ compared to the unfertilized variant.

Analyzing the sowing period effect on yield, it resulted that autumn sowing generated important yield increases of 365 kg.ha^{-1} for the unfertilized variant, i.e. 1145 kg.ha^{-1} for nitrogen fertilization and 1412 kg.ha^{-1} when $N_{100}P_{50}$ surpassed the oats yield sown in Period II by 27-55%.

Table 5. Sowing period and fertilization influence on naked oats yield

Variants	Period I – October			Period II – March			Diff PI-PII kg.ha^{-1}	PI comp. PII %
	kg.ha^{-1}	%	Diff	kg.ha^{-1}	%	Diff		
N_0	1716	100	Ct	1351	100	Ct	365	127
N_{100}	3568	208	1852	2423	179	1072	1145	147
$N_{100}P_{50}$	3962	231	2246	2550	189	1199	1412	155
LSD (5%) = 217 kg								

Influence of the sowing period and fertilization on some yield parameters

The analysis of several yield parameters (yield/panicle - YGP, a thousand grains weight - TGW, hectolitre mass - HM see, Table 6) shows that they were favourably influenced by autumn sowing and fertilizer applied. Thousand grains weight per panicle increased depending on fertilization with 0.20-0.34 g, TGW with 0.3-1.1 g and HM with 0.5-1.3 kg.

Table 6. Sowing period and fertilization influence on naked oats yield parameters

Variants	Period I - October			Period II - March		
	YGP g (%)	TGW g (%)	HM kg (%)	YGP g (%)	TGW g (%)	HM kg (%)
N_0	0.71 (100)	22.3 (100)	58.1 (100)	0.51 (100)	22.0 (100)	57.6 (100)
N_{100}	1.09 (153)	23.8 (107)	59.6 (102)	0.78 (153)	23.0 (105)	58.9 (102)
$N_{100}P_{50}$	1.13 (159)	24.2 (108)	60.0 (103)	0.79 (155)	23.1 (105)	58.7 (102)
YGP-yield grain panicle; TGW-thousand grains weight; HM-hectolitre mass						

CONCLUSIONS

Considering the conditions of the agricultural year 2014-2015, the results obtained show that the cultivation of the naked oats variety GK Zalan as winter grain leads to substantial yield increases under the pedological and climatic conditions of the Ilfov region.

In spring plants had a quick start of the vegetative development, a vigorous development with a higher capitalization of fertilizers and soil water reserve.

All the analyzed parameters recorded the highest values for the autumn sowing period and $N_{100}P_{50}$ fertilization level.

Grain yield was 3962 kg.ha^{-1}, exceeding the spring crop yield by 55%. Yield increase was 2246 kg.ha^{-1}, compared to the unfertilized variant and to variant $N_{100}P_0$, 394 kg.ha^{-1}. $N_{100}P_0$ fertilization generated an yield increase of 1852 kg.ha^{-1} for the sowing Period I and of 1072 kg.ha^{-1} for Period II.

These results lead to further research for the elaboration of an alternative naked oat crop technology in the context of climate changes.

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