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The effect of sowing date and plant density of winter oilseed rape (*Brassica napus* var. napus f. biennis L.) population

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SUMMARY

The experiment has been set up in the University of Debrecen Látókép Experimental Station in three different years (2014, 2015 and 2016), three different plant densities 200, 350 and 500 thousand ha^{-1}, four replications of the same nutrient supply with using a line spacing of 45 cm. In the experiment, the fore crop was winter wheat in each year. The amount of weeds was observed five times in the last experimental year (2016/2017). In the three experimental years, the highest yield was harvested from the early sowing plot with the highest plant density. On the basis of the Pearson's correlation analysis there was significant negative correlation (r=-0.583) between the effect of the annual year and yield of the hybrid.

Keywords*: winter oilseed rape, yield, hybrid, weeds, Pearson's correlation analysis*

INTRODUCTION

The economic significance of oilseed rape has been greatly increasing for the last few years (Amar et al. 2008), as rapeseed oil is being produced in a constantly increasing amount by the bioenergetics industry and food industry. Oilseed rape is the third most important cultivated oil plant in the world and the second in Hungary after sunflower.

The optimal selection of the sowing time of oilseed rape is very important for the germination, the development of homogenous stocks and over-wintering. In their experiments, Risnoveanu and Buzdugan (2011) found the interval between 5 and 10 September as the optimal sowing time.

In the domestic research, we can find only limited amounts of experimental data in connection with the nutrient supply and sowing time of oilseed rape (Pepó 2012).

MATERIAL AND METHODS

Our experiments were set up on calcareous chernozem soil in the Hajdúság, 15 km from Debrecen at the Látókép Plant Production Research Site of the University of Debrecen. The soil of the experiment is characterized by favourable physical, chemical and biological traits. The humus content of the calcareous chernozem soil of the experiment is 2.76%, its AL extractable P_2O_5 content is 133 mg kg^{-1}, and its AL extractable K_2O value is 240 mg kg^{-1}. The soil has favourable water management conditions. The soil saturated up to the field water capacity can store 578 mm water in the 0–2 m layer, 50% of which is disposable water.

The experiment design was set as split-plot, plot areas were 36 m^2 in four replications. Two different sowing times applied in the first experimental year (2014), while three in the second and third (2015, 2016). Three different plant densities were set in three years: 200, 350 and 500 thousand plants ha^{-1}. Uniform nutrient supply and a row spacing of 45 cm were applied. Winter wheat was used as pre-crop. In the first experimental year, in two different sowing times (I. 08/22/2014 and II. 09/09/2014, which was executed again due to poor emergence seeding 1/10/2014). In the second year were an early sowing date: August 28, average: September 12, late: September 23. In the third year were an early sowing date: 29 August, average: 12 September, late: 19 September. We harvested the experimental plots with a SAMPO plot combine harvester.

In the crop year of 2014/2015 (01/08/2014–30/06/2015) altogether 491.4 mm precipitation was measured during the vegetation period of rapeseed that is almost the same value as the several years' average value (*Table 1*). The precipitation in August (44.8 mm) was lower than the several years' average value (60.7 mm). In general, the weather of the vegetation period of 2015/2016 was favourable considering the vegetative and generative growth and yield production of rapeseed. The precipitation was 694.6 mm in the vegetation period of rapeseed (01/08/2015–30/06/2016) which is 1.5 times higher than the yearly average. The weather of vegetation period of 2016/2017 considering the vegetative and generative growth of rapeseed was very varied and in general very unfavourable comparing with the yearly average. The precipitation was 514.7 mm in total in the vegetation period of rapeseed (1 August 2016–30 June 2017) which is quite equal to the yearly average.

For the statistical evaluation of the experiment, we used SPSS 13.0 for Windows and Microsoft Excel 2010 programs. The statistical evaluation, the bifactorial variance analysis and correlation analysis were done according to Sváb (1981), with regression equations. In the correlation analysis, we determined the following types of correlations according to the r values: r<0.4: loose, 0.4–0.7: medium, 0.7–0.9: tight, >0.9: strong.

Table 1

Amount of precipitation (mm) and temperature (˚C) values during the vegetation period of rapeseed (Debrecen)

	Months											Total/Average
	VIII.	IX.	X.	XI.	XII.	I.	II.	III.	IV.	V.	VI.	
Monthly average precipitation (mm) 2014/2015	44.8	95.7	88.6	20.8	37.9	39.5	18.6	10.2	21.9	52.9	60.5	491.4
Monthly average precipitation (mm) 2015/2016	84	48.9	86.6	43.2	13.3	58.6	78.8	51	14.7	69.2	146	694.6
Monthly average precipitation (mm) 2016/2017	71.7	63.4	92.1	55.5	4	27.5	31.4	24.5	50.4	31.9	62.3	514.7
30 year's average precipitation (mm)	60.7	38	30.8	45.2	43.5	37	30.2	33.5	42.4	58.8	79.5	499.6
Monthly average temperature (°C) 2014/2015	19.8	16.7	11.2	6.4	2.4	1	1.5	6.2	10.1	15.8	19.9	10.1
Monthly average temperature (°C) 2015/2016	23.3	17.8	10	5.3	2.2	-2.3	5.5	6.4	12.5	15.7	20.1	10.6
Monthly average temperature (°C) 2016/2017	19.8	17.2	9.1	4.1	-2.3	-6.6	1.4	8.4	10.1	16.3	20.9	8.9
30 year's average temperature (°C)	19.6	15.8	10.3	4.5	-0.2	-2.6	0.2	5	10.7	15.8	18.7	8.9

RESULTS AND DISCUSSION

Table 2 shows the yields of seedrape in the growing seasons of 2014/2015, 2015/2016 and 2016/2017. The highest yield of all three years was harvested in the plots of the highest plant number of early sowing. The first year was 4344 kg ha^{-1}, the second is 5104 kg ha^{-1}, and in the third year 2514 kg ha^{-1}. In the first year the smallest yield was harvested from the parcel of average sowing and the lowest plant density. In the second year and a third year in late sowing, the highest crop yields were obtained. In the second year was from the parcel of highest plant density, in the third year was from the parcel of the lowest plant density.

Table 2

Yields of the analysed winter oilseed rape in 3 years

Sowing time	Plant density (thousand ha^{-1})	Yield (kg ha^{-1})		
		1st year	2nd year	3rd year
Early	200	3849	4890	2045
	350	4207	4912	2480
	500	4344	5104	2514
Average	200	~~2690~~	4752	1318
	350	2850	4757	2018
	500	3060	4696	1977
Late	200	-	4521	~~149~~
	350	-	4590	380
	500	-	~~4373~~	720

On the basis of the Pearson's correlation analysis (*Table 3)* there was significant negative correlation (r=-0.583) between the effect of the annual year and yield of the hybrid. Loose negative correlation (r=-0.341) can be noted between the sowing date and the yield of the hybrid.

Between the sowing date and yield of the hybrid (*Table 4*) there was medium negative correlation (r=-0.453). Showed that there was loose positive correlation (r=0.240) between the replication and yield of the hybrid.

Table 3

Correlation between the analyzed parameters (Debrecen, 2015–2016–2017)

	Year	Sowing date	Plant density	Replication	Yield
Year	1	0.231*	0	0	-0.583**
Sowing date	0.231*	1	0	0	-0.341**
Plant density	0	0	1	0	0.084
Replication	0	0	0	1	0.025
Yield	-0.583**	-0.341**	0.084	0.025	1

Note: *correlation is significant at the 0.05 level (2-tailed), **correlation is significant at the 0.01 level (2-tailed).

Table 4

Correlation between the analyzed parameters (Debrecen, 2015)

	Sowing date	Plant density	Replication	Yield
Sowing date	1	-0.086	-0.104	-0.453**
Plant density	-0.086	1	-0.031	-0.123
Replication	-0.104	-0.031	1	0.240*
Yield	-0.453**	-0.123	0.240*	1

Note: *correlation is significant at the 0.05 level (2-tailed), **correlation is significant at the 0.01 level (2-tailed).

We concluded that there was loose negative connection (-0.371) between the sowing date and yield of the hybrid (*Table 5*). Between the replication and yield of the hybrid there was loose positive correlation (r=0.239).

Medium negative correlation (*Table 6*) was found between sowing date and yield of the hybrid (r=-0.716). Loose positive correlation was found between replication and yield of the hybrid (r=0.254).

Table 5

Correlation between the analyzed parameters (Debrecen, 2016)

	Sowing date	Plant density	Replication	Yield
Sowing date	1	-0.086	-0.104	-0.371**
Plant density	-0.086	1	-0.031	-0.100
Replication	-0.104	-0.031	1	0.239*
Yield	-0.371**	-0.100	0.239*	1

Note: *correlation is significant at the 0.05 level (2-tailed), **correlation is significant at the 0.01 level (2-tailed).

Table 6

Correlation between the analyzed parameters (Debrecen, 2017)

	Sowing date	Plant density	Replication	Yield
Sowing date	1	-0.086	-0.104	-0.716**
Plant density	-0.086	1	-0.031	0
Replication	-0.104	-0.031	1	0.254*
Yield	-0.0716**	0	0.254*	1

Note: *correlation is significant at the 0.05 level (2-tailed), **correlation is significant at the 0.01 level (2-tailed).

The amount of the weeds was noted five times in the last experimental year (2017). I noted the species of weeds: *Sisymbrium Sophia*, *Capsella bursa-pastoris, Thlaspi arvense, Galium aparine, Triticum aestivum, Polygonum aviculare, Matricaria inodora* and *Papaver rhoeas*. At those plots where there were relatively low planting density the vegetation coverage was not perfect which indicated the opportunity of weeds that germinate during the autumn to find their optimal conditions to grow. Rapeseed vegetation with higher planting density covered the soil earlier which gave less possibility for the weeds to germinate and strengthen.

CONCLUSION

Overwintering of rapeseed (1 hybrid) in case of the application of three different plant densities and two and three different sowing times were studied on a chernozem soil type in the Hajdúság region in three different crop years. Yields of the low, medium and high plant density plots were 3849 kg ha^{-1}, 4207 kg ha^{-1}, 4344 kg ha^{-1}, 2690 kg ha^{-1}, 2850 kg ha^{-1} and 3060 kg ha^{-1} in the first and second sowing date in the experimental year (2014/2015). Yield of the low, medium and high plant density plots was 4890 kg ha^{-1}, 4912 kg ha^{-1}, 5104 kg ha^{-1}; 4752 kg ha^{-1}, 4757 kg ha^{-1}, 4696 kg ha^{-1} and 4521 kg ha^{-1}, 4590 kg ha^{-1}, 4373 kg ha^{-1} in the first, second and third sowing date in the experimental year (2015/2016). Yield of the low, medium and high plant density plots was 2045 kg ha^{-1}, 2480 kg ha^{-1}, 2514 kg ha^{-1}; 1318 kg ha^{-1}, 2018 kg ha^{-1}, 1977 kg ha^{-1} and 149 kg ha^{-1}, 380 kg ha^{-1}, 720 kg ha^{-1} in the first, second and third sowing date in the experimental year (2016/2017). On the basis of the Pearson's correlation analysis there was significant negative correlation (r=-0.583) between the effect of the annual year and yield of the hybrid. Rapeseed vegetation with higher planting density covered the soil earlier which gave less possibility for the weeds to germinate and strengthen.

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