RESPONSE OF NEW WINTER RAPE VARIETIES TO THE SOWING DENSITY

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INTRODUCTION

Before cultivation of new varieties the recognition of their response to basic agrotechnical factors, including also such one, as the sowing rate, is necessary. The optimum density of plants under different soil and climate conditions can ensure a favourable structure of the stand and higher yields of winter rape varieties /Clarcke and Simpson 1987, Demidowicz 1977/.

The investigations carried out so far /Geisler and Heunung 1981, Muśnicki 1977, Songin 1977/ have proved that the different sowing rates and consequently a different density of stands differentiate very distinctly the state of plants before winter and frost resistance of plants, which can affect level and structure of the yield.

The aim of the present work was to determine the response of new varueties and strains of winter rape to different sowing rates. It has been assumed that different density of plants of new varieties of winter rape can lead to various changes in the structure of plants, their size and frost resistance as well as in their yielding in the central-eastern part of Poland.

MATERIAL AND METHODS OF INVESTIGATIONS

The investigations carried out in 1982/83, 1984/85 and 1985/86 comprised the Jet Neuf variety and double-improved varieties and strains, viz.: Jantar, MAH-281 and BKH-180, Start. Three sowing densities, viz.: I - 80, II - 160 and III - 240 of germinating seeds per 1 m^2 were applied. The sowing rates were established each time on the basis of the laboratory estimation of power and energy of the germination as well as of the estimation of field emergence capacity /EEC/.

Three microplot experiments were established by the split-plot method in 4 replications on brown soil type and soil lessive subtype, with medium P and K content, slightly acid reaction /pH 6,5-6,7/ and the bonitation class of IIIa and IIIb.

In every year before sowing mineral fertilizers at the rates of 80 kg P_2O_5 and 150 kg K_2O per hectare were applied. The nitrogen fertilization was applied in spring as the foliar dressing at 2 rates by 70 kg per hectare.

Sowing was performed within last ten days of August /22--27^{th}/. After emergance of plants before winter /in November/ and after wintering /in April/ the density of plants, i.e. their number per 1 m^2, was estimated. Before winter and during harvest of ripe plants many biometric measurements in every treatment of the experiment were carried out. On the basis of statistically elaborated measurement results conclusions concerning response of particular varieties to the stand density and yielding ability of the winter rape varieties tested were drawn. In view of small size of plots, the seed yields in g from 1 m^2 are hardly reliable in the estimation of yields of particular varieties.

INVESTIGATION RESULTS

The plants emerged on the $5-7^{th}$ day since the sowing date, i.e. in the forst days of September. Only in 1984, when August was poor in rainfalls and soil was overdried a delay in emergence by further 5-6 days took place. Variable atmospheric conditions resulted also in a reduction of the field emergence capacity /FEC/ and of the stand of plants. The 3-year mean density of plants in autumn in particular treatments of sowing density was as follows. Ist density - 70 plants/m^2, IInd density - 128 plants/m^2, IIIrd density - 185 plants/m^2 /Fig. 1/. These results prove also that along with increasing sowing rate decreases the FEC value and intensifies the process of reduction of the number of plants after emergence in connection with the interaspecific competition. The results of the performed measurements have

proved on the one hand a decrease of the number of developed rosette leaves and hypocotyl diameter and a considerable increase of the height of apical bud above the soil surface /Table 1/. In consequence the density of yielding plants amounted, on the average, in subsequent sowing density treatments to 52, 76 and 86 plants per 1 m^2, respectively /Fig. 1/.

The double-improved /two-zero/ varieties didnot differ significantly with regard to the final density of yielding plants, although the BKH-180 and MAH-281 strains characterized by a somewhat less frost resistance, whereas the one--zero variety of Jet Neuf distinguished itself with the highest frost resistance /Table 1/. The fact should also be taken into consideration that the double-improved varieties were stronger infested by pests and damaged by wildlife, particularly by hares. If these damages did not affect the frost resistance of plants, they would undoubtedly create favourable conditions for infestation of plants with pathogenic fungi.

Such traits, as number of pods per plant and of embranchments, diameter and height of the stalk, underwent considerable changes depending on the final density of plants. The numerical values of the above traits decreased along with increasing density of plants in the stand /Table 2/. However, the greatest changes occurred in the number of pods formed by one plant. Also distinct varietal differences were observed, in particular the Jet Neuf variety formed the highest number of embranchments and the least number of pods as compared with the remaining varieties, among which it was the Jantar variety, wich distinguished itself with the longest stalk and the highest number of pods formed by one plant as compared with the remaining varieties.

On the other hand, the BKH-180 strain with a relatively small density of plants in all the experiment treatments was characterized by the highest number of embranchments and relatively small number of pods /Table 2/, what can

beár evidence of ist less potential yielding abilities, particularly at smaller density of plants. Additional measurements /Table 3/ have proved that the mean number of pods on the main stalk is approximate /21-23 pods/ whereas the number of pods from lateral shoots is most strongly differentiated depending on variety and sowing density.

The average number of seeds in a pod depended to the highest degree on the variety, but underwent also a strong differentiation in years, not revealing any dependence on the sowing density /Table 4/.

The highest number of seeds in a pod was in the Jet Neuf variety, while the lowest value of this trait was found in the Jantar variety and BKH-180 strain.

The weight of 1000 seeds appeared to be the most stable trait, despite rather distinct varietal differences, Jet Neuf and Jantar varieties were characterized by a higher value of this trait /4.7 g/, while the Start variety formed every year smaller seeds, the weight of 1000 seeds being 4.2 g.

In the final estimation it should be noted that the tested varieties and strains of winter rape differently responded to the density of plants in the stand, caused by different sowing rates and growth conditions.

The highest yielding ability has been found in the Jet Neuf variety as compared with the double-improved varieties. Among the compared double-improved varieties with a fairly high yielding distinguished itself the Jantar /MAH-181/ and MAH-281 strains.

CONCLUSIONS

On the basis of the results as presented above it be stated that winter rape varieties respond differently to different sowing rates varying from 80 to 240 germinating seeds per 1 m^2, what resulted in much less different final density of plants on area unit.

The reduction of the initial density of plants and ther frost resistance under the investigation conditions was different depending on varieties and sowing density.

Different response of varieties to the final density of the stand manifested itself in different height and diameter rape plant stems, the number of lateral shoots and the number of pods formed on them lateral shoots of rape plant.

The number of seeds in one pod and the weight of 1000 seeds depended mainly on the plant variety /genotype/ and to the least degree on the density of plants in the stand.

These changes resulted in different formation of the yield structure and the yielding ability of particular varieties. With higher and stable yielding ability distinguished itself the Jet Neuf variety as comparred with the two-zero varieties, particularly the Start variety and the BKH-180 strain.

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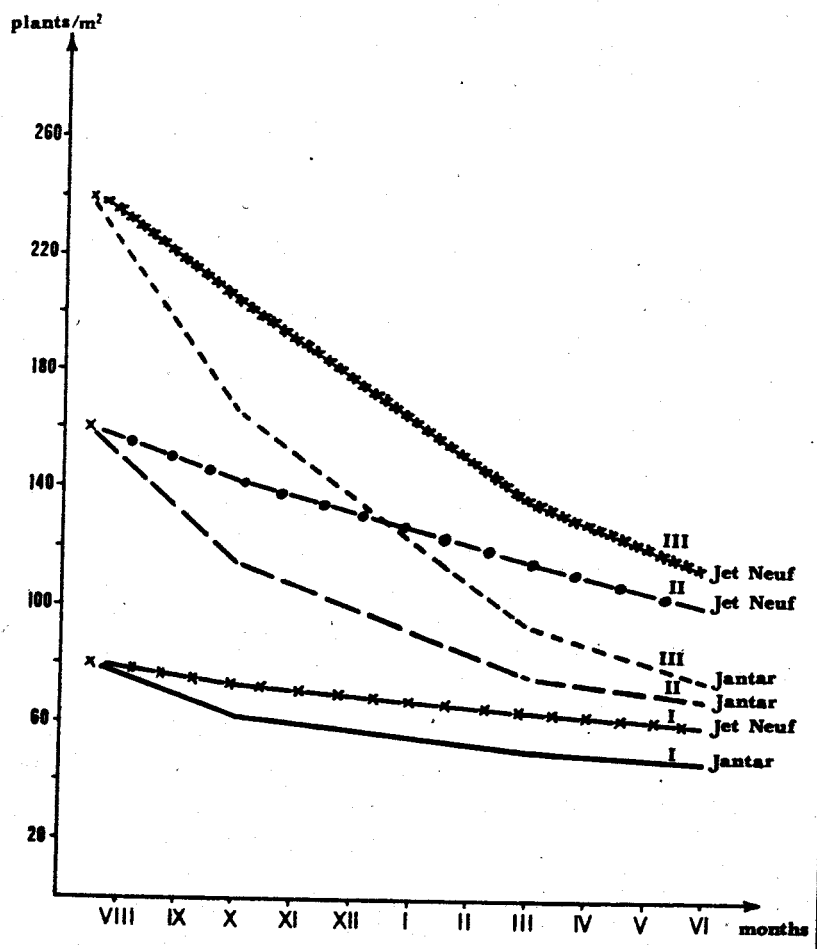

FIG. 1 Plant density changes of two varieties [plants per 1 m²]

Table 1

Sowing density effect on some traits of rape plants before winter and their frost resistance

Variety	Sowing density	Numb. of plants before winter per 1 m^2	Number of develope rosette leaves per 1 plant	Hypocotyl diameter in mm	Height of apical bud in mm	Winter herdiness of plants %
Jet Neuf	I	70	7.3	6.0	4.1	88.1
	II	142	6.0	4.9	5.0	80.1
	III	204	5.5	4.0	5.7	66.8
Jantar /MAH-181/	I	62	7.1	6.0	3.7	83.5
	II	114	6.0	4.9	4.7	67.3
	III	167	5.5	4.0	5.6	57.8
MAH-281	I	71	7.7	6.6	3.5	74.0
	II	129	6.4	5.6	4.6	59.5
	III	184	5.8	4.5	5.3	53.2
BKH-180	I	69	7.1	6.8	3.2	77.0
	II	124	6.4	5.2	3.9	60.4
	III	187	5.9	4.5	4.4	50.2
Start	I	75	8.0	6.8	3.4	81.7
	II	132	7.0	5.5	4.5	66.3
	III	180	6.4	4.6	5.1	57.8

Table 2

Sowing density effect on some morphologic traits of plants

Variety	Sowing density	Numb. of plants before harvest per 1 m^2	Height of plan ts, cm	Stalk diameter mm	Numb. of embrauchments of the ist order per plant	Mean number of pods per plant
Jet Neuf	I	59	135	9.2	8.2	130
	II	99	132	8.5	6.8	98
	III	113	128	7.9	6.4	87
Jantar /MAH-181/	I	47	153	10.8	7.3	227
	II	69	147	9.6	6.8	155
	III	76	144	8.9	6.0	129
MAH-281	I	52	146	10.2	7.3	203
	II	71	138	8.4	6.0	131
	III	83	138	7.9	6.1	120
BKH-180	I	49	141	10.2	6.3	148
	II	66	140	8.6	5.6	109
	III	82	132	8.1	5.5	102
Start	I	53	140	10.1	7.8	164
	II	76	138	8.8	7.0	116
	III	88	133	7.8	5.9	103

Table 3

Number of pods on a main stem and of lateral embranchments depending on variety and sowing density

Sowing density	Kind of shoots	Jet Neuf	Jantar	МаН-281	ВКН-180	Start	$\bar{x}$
I	Main	22.0	22.1	25.7	23.1	20.6	22.7
	Lateral	108.0	205.0	177.5	125.0	143.7	151.8
	Total	130.0	227.1	203.2	148.1	164.3	174.5
II	main	21.2	21.6	22.8	22.9	20.4	21.8
	Lateral	77.0	133.5	108.2	86.1	96.0	100.2
	Total	98.2	155.1	131.0	109.0	116.4	122.0
III	Main	19.7	21.2	22.6	22.6	20.4	21.3
	Lateral	67.3	107.9	97.6	79.4	82.6	87.0
	Total	87.0	129.1	120.2	102.0	103.0	108.3

Table 4

Mean number of seeds per pod, mean for the whole plant

Sowing density	Jet Neuf	Jantar /МАН-181/	MAH-281	ВКН-180	Start	$\bar{x}$
I	22.2	18.6	16.2	15.5	19.1	18.3
II	22.3	19.6	16.2	16.5	18.7	18.5
III	21.3	19.4	17.0	16.2	19.3	18.6
$\bar{x}$	21.9	19.2	16.5	15.7	19.0	