Variant Growing Systems at Three Winter Rapeseed Cultivar Types (Line, Hybrid and Genetically Modified Hybrid)

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ABSTRACT

Yield indices at three different winter rapeseed cultivar types (line, hybrid and genetically modified hybrid) were studied in three growing systems (intensive - yielding 4 t/ha, standard – 3 t/ha, and low-input for the yield 2 t/ha). Growing systems differed mainly in the soil preparation before sowing, sowing rate, level of chemical treatment and fertilization (mainly by nitrogen). The introduction of generative organs (buds) of winter rapeseed depends on the growing intensity, cultivar and weather. A higher reduction of generative organs appeared in the hybrid cultivars in comparison with the line cultivar.

In the low input system the plants were more invaded by pests and fungoid diseases and had a minor root system, which caused the lower yield. This growing system is less stabile in the yield (field voles, slugs and moisture during the emergency period). The highest yield was reached in the intensive variant with the higher input levels. The yield comparison of hybrid cultivars (modified and unmodified) showed a higher yield than in line cultivar. Genetically modified hybrid proved comparable results with the unmodified one in all the studied indices.

Key words: winter rapeseed - growing systems - genetically modified hybrid - reduction of generative organs - yield

INTRODUCTION

The yield of oilseed rape is created by the number of plants per unit area, number of pods per plant, number of seeds per pod and thousand seed mass (TSM) (Petr, 1989, Diepenbrock and Becker, 1995). The yield obtained in practical production does not reach the oil rape potential which, according to many authors, ranges from 7-8 $t.ha^{-1}$ (Vašák et al, 1997; Kuchtová et al, 1999). The reduction of generative organs is one of the main reasons of decreased yields in comparison with its yield potential.

MATERIALS AND METHODS

Experiments with three different variety types of winter oilseed rape were established in the Research Station of Czech University of Agriculture in Červený Újezd*: line variety – Lirajet (in 2001/02 – Navajo), hybrid variety – Pronto (in 2001/02 – Embleme) and genetically modified (GM) hybrid – tolerant to glufosinate (Liberty Link) in three different growing technologies (intensive, standard and low input). The technologies differ mainly in the soil preparation before sowing, sowing rate, fertilization (mainly nitrogen) and chemical treatment (Table 1).

*405 above sea level, mean annual temperature 7.7°C; sum of precipitations 549 mm, during the vegetation period (April – September) 13.9°C and 361 mm.

Table 1. Main differences in agrotechnique in individual growing technologies.

Autumn	**Intensity**	**Standard**	**Low input**
Soil preparation	ploughing (20-22 cm)	ploughing (18-20 cm)	stubble ploughing
Fertilization P, K, Mg	yes	yes	no
Sowing rate (seeds/m^2)	60	80	80
Fertilization N (before sowing + during vegetation period)	30+20	0+20	no
Herbicide [1)]	Butisan Star	Lasso Microtech + Command 4EC	Lasso Microtech + Command 4EC
Insecticide + fungicide	yes	no	no
growth regulator	Horizon 250EW+ Retacel Extra R68	Retacel Extra R68	no

Spring	Intensity	Standard	Low input
Nitrogen total/number of doses	210/4	150/3	150/2
Growth regulator	Caramba	no	no
Stimulation TSM	Atonik	Relan (Rexan)	no
Foliar fertilizer	Campofort B	no	no
Fungicide	yes	no	no
Insecticide against pod pests	yes	no	no
Ripening regulation	yes	yes	no

1) at GM variety – application of Liberty herbicide

In the frame of each technology and each variety 10 plants were labelled (2 weak, 2 above average and 6 average plants) in which the numbers of generative organs (butonisation and green ripeness) were found out. The area of one replicate was 79.2 m^2.

RESULTS AND DISCUSSION

In 1999/00 the creation of generative organs (buds) was significantly higher (791 buds per average plant) than in other variants (standard – 535, low input – 547 buds per plant). In 2000/01 there were no significant differences among variants. The intensity had the lowest number of generative organs. But the total number of generative organs was higher by 25 % (intensity) till 114 % (standard) in comparison with the previous year 2000/01 (Table 2). This higher pod creation could be explained by different development of weather in the spring period in both years. In the vegetation period 1999/00 May and April were warm and dry. This caused fast finishing of flowering of oilseed rape and the assimilates were used for the growth and development of young seeds and pods, not for the growth and development of additional buds. In 2000/01 the cooler and damper spring caused the longer flowering period of oilseed rape. Even the buds, which would die away in normal weather conditions, were vital. The inter-year difference in bud creation was lower in the intensive variant (199 buds) compared with standard (609 buds) and minimalization (464 buds) or in the intensive growing regardless of the year could be reached stable yields.

Table 2. Number of generative organs (buds and pod) per one average plant and their reduction (%) in three variety types at three levels of growing (Červený Újezd, 1999/00 and 2000/01).

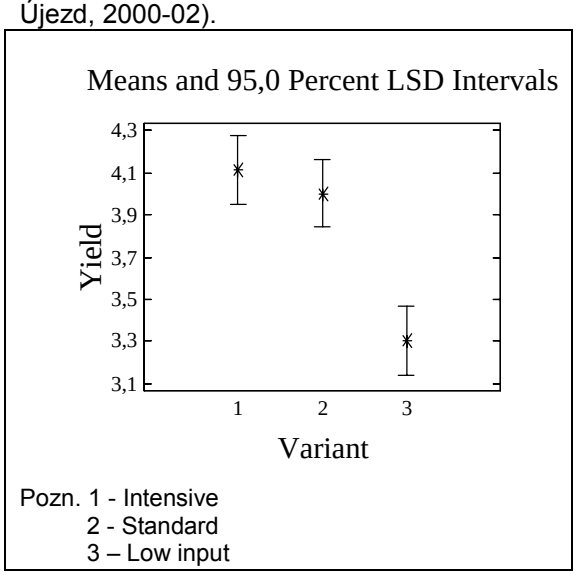
Technology	Variety	1999/00			2000/01		
		buds	pods	*reduction (%)*	buds	pods	*reduction (%)*
Intensity	Pronto (hybrid)	923,5	242,1	*74*	1167,6	356,8	*69*
	Lirajet (line)	825,5	238,6	*71*	704,9	317,2	*55*
	Liberty Linky (hybrid)	624,5	159,4	*74*	1096,5	344,3	*69*
	mean	**791**	**213**	***73***	**990**	**339**	***64***
Standard	Pronto (hybrid)	491,2	187,2	*62*	1077,8	330,1	*69*
	Lirajet (line)	666,1	271,2	*59*	1080,8	424,6	*61*
	Liberty Linky (hybrid)	446,7	154,9	*65*	1273,6	360,2	*72*
	mean	**535**	**204**	***62***	**1144**	**372**	***67***
Low input	Pronto (hybrid)	537,5	198,8	*63*	1091,2	345,8	*68*
	Lirajet (linie)	485,6	216,5	*55*	1113,7	455,7	*59*
	Liberty Linky (hybrid)	618,4	211,9	*66*	828,0	242,3	*71*
	mean	**547**	**209**	***61***	**1011**	**348**	***66***

In both years (1999/00 and 2000/01) a higher reduction of generative organs was found out in all technologies at hybrid varieties (modified and nonmodified) in comparison with the line variety. Hybrid varieties create more generative organs (influenced by heterosis) but on the other hand they have a higher reduction (e.g. the final number of pods is in hybrid varieties comparable with the line varieties). The higher reduction of generative organs in hybrid varieties proves the existing reserves in rapeseed technology (varietal agrotechnique, optimal nutrition, improvement of pod pests and mycotic diseases etc. The reduction of generative organs ranged from 30 to 60 % in main inflorescences, and it was much higher (82-95 %) in additional inflorescences regardless the variety and growing technology. The higher reduction of

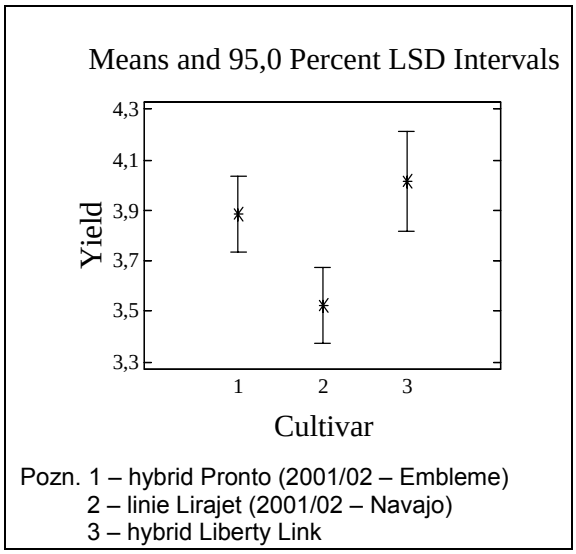
generative organs in additional inflorescences was due to their shading and competition linkages in the relationship to generative organs in the main inflorescences.

The three years experiments (2000 – 02) show evident differences in yields among different growing technologies (Graph 1). The highest mean yield was harvested from the intensive variant (4.1 t.ha^{-1}) and following standard variant (4.0 t.ha^{-1}). The low input variant with the lowest yield (3.3 t.ha^{-1}) was substantially different in statistical evaluation. Comparing individual variants we can see evident differences in the yield of hybrid (genetically modified and unmodified variants) and line varieties. The mean yield in hybrid varieties was 4.0 t.ha^{-1} against 3.5 t.ha^{-1} in the line variety. This difference was substantially different and was 0.5 t.ha^{-1}, i.e. 12.5 %. According to Schuster et al. (1999) cit. in Diepenbrock (2000), the results showed the increase in yields of hybrid varieties by 20 % in comparison with line varieties. The authors proved comparable results in the yields of genetically modified and unmodified varieties and in some cases the yields of GM oilseed rape were higher by 15 % compared with the unmodified varieties (Sauermann and Schuster, 2000). In our experiments the hybrid variety Liberty Link was by 0,1 t.ha^{-1} higher yielding in comparison with the unmodified variety (i.e. o 2.5 %). The higher yielding ability of hybrid varieties and in intensive growing technology was probably caused by the higher number of seeds per pod, because there are no significant differences in the number of pods per plant.

Graph 1. Yield of oilseed rape according to growing technologies and varieties in Červený Újezd, 2000-02).



Pozn. 1 - Intensive
2 - Standard
3 – Low input



Pozn. 1 – hybrid Pronto (2001/02 – Embleme)
2 – linie Lirajet (2001/02 – Navajo)
3 – hybrid Liberty Link

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