Yield response of winter oilseed rape hybrids to sowing dates, nitrogen supply and fungicides in Northern Germany

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Abstract

Since 1994/95 sowing date trials have been conducted in Northern Germany (Hohenlieth) with eight to ten winter oilseed rape varieties. The sowing dates have been in week 32 (est. August, 10th), week 34 (est. August 23rd) and week 36 (est. September 8th). The seeding rates have been optimised for open-pollinated (OP) varieties with 40, 65 and 80 seeds per m^2 and for hybrids with 35, 50 and 50 seeds per m^2. On average over 12 years hybrids had higher yields as compared to OP varieties (+ 0.30 t/ha at the early sowing date, + 0.25 t/ha at the medium sowing date and + 0.51 t/ha at the late sowing date). Both variety types have shown their highest yields at medium (normal) sowing dates with an accumulated temperature sum in autumn of 531°C. Especially under late sowing conditions (394°C) hybrids have demonstrated less yield decline.

Since 1998 these trials have been extended by two different input levels of nitrogen and triazol fungicides. Input level 1 represents the usual farm practice with the application of 180 kg/ha nitrogen and one triazol treatment in autumn and spring. Input level 2 represents an increase of 60 kg/ha nitrogen and double sprayings of triazol in autumn and spring. The extra yield effects for hybrids have been 0.09 to 0.16 t/ha depending on the sowing date. OP varieties have shown a range of 0.09 to 0.15 t/ha depending the sowing date. The combination of normal sowing dates and the higher input level 2 reached maximum yields for hybrids as well as OP varieties. Under economic aspects, however, the input level 1 performed slightly better. OP varieties and hybrids responded similarly concerning sowing date and input levels.

Key words: *Brassica napus*, oilseed rape, sowing dates, nitrogen, triazol fungicides, hybrids

Introduction

Since 1994/95 sowing date trials have been conducted in Northern Germany (Hohenlieth) to evaluate winter oilseed rape (WOSR) varieties with specific adaptation for early and late sowing dates. These genotypes are interesting for practical farming, because rainy weather conditions may prevent an optimum sowing date. Since 1998 these trials are additionally treated with different cultivation inputs to evaluate a specific cultivation management. Another aim has been to evaluate whether hybrids would need another input level than OP varieties. Meanwhile the first generation of hybrids has been improved in standing power and disease resistance. Since 2002 hybrids of the second generation are tested in these trials.

Materials and methods

A portfolio of eight to ten WOSR varieties, shifted annually by new varieties, has been planted at three different sowing dates. They represented early sowing dates beginning of August, 10th to 12th (week 32), normal sowing dates end of August, 21th to 23th (week 34) and late sowing dates in September, 6th to 8th (week 36). The seeding rates were optimized according to sowing date and farmers' recommendations. They varied from 40 to 65 and 80 seeds per m^2 for OP varieties and 35, 50 and 50 seeds per m^2 for hybrids. The trial plots have been placed in a complete split plot design with four replications. Two replications have been treated with 180 kg/ha nitrogen and one triazol application in autumn and spring (input level 1) which is the common recommendation for farmers. The other two replications have been treated with 240 kg/ha nitrogen and double triazol applications in autumn and spring (input level 2). The triazols, tebuconazol and metconazol are fungicides which also perform as growth regulators. They enable to control the most important fungal diseases as black leg, light leaf spot and grey mould.

The trials have been conducted since 2002 with a special bordered plot design which has been developed by NPZ-Lembke (Frauen, 1996), one traditional plot (1.5 m x 7.5 m) with five rows bordered by two rows of the same genotype in each of the two neighbouring trial plots, which are not harvested. This "plot in plot" technique gives more accurate results than traditional single or double plots, because neighbour effects between varieties are significantly reduced (Büchse, 2002). The trials were harvested after swathing. The general cultivation management for the whole trial complex is identical concerning pest and weed control as well as an obligatory mid-flowering fungicide treatment against *Sclerotinia* stem rot.

The test site in Hohenlieth is located at 5 km distance from the Baltic Sea, approximately 100 km north of Hamburg, with 800 mm of annual rain fall, an average temperature of 7.9°C and a soil type classified as medium sandy loam.

Results

1. Sowing date and variety type

On the average of 12 years hybrids had superior yields in all sowing periods as compared to OP varieties. The yield difference varied from 0.3 t/ha under early sowing conditions to 0.25 t/ha under normal sowing conditions and up to 0.51 t/ha

under late sowing conditions (figure 1).

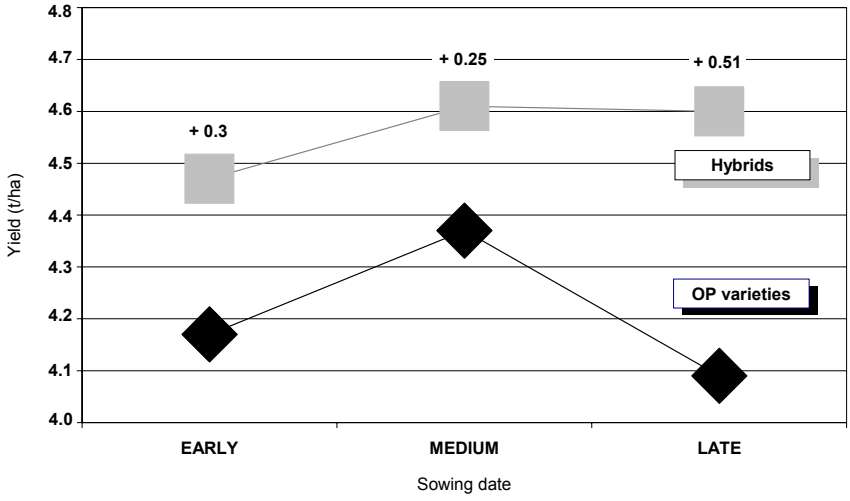

Fig. 1: Seed yield of OP varieties and hybrids at different sowing dates, Means of 1994/95 – 2005/06

OP varieties showed their yield maximum under normal sowing dates. They had a small decline of 0.2 t/ha under early sowing conditions and a strong decline of 0.28 t/ha under late sowing conditions. Hybrids have performed better under normal sowing conditions. They had a very small yield decline of 0.14 t/ha under early and no decline under late sowing conditions. In comparison to OP varieties, hybrids showed a higher yield potential and a broader optimum of sowing dates.

Table 1: Results of sowing date trials in Northern Germany (Hohenlieth), 1994/95 – 2005/06

Years	EARLY Week	Σ Temp. before winter (°C)	OP varieties (t/ha)	Hybrids (t/ha)	MEDIUM Week	Σ Temp. before winter (°C)	OP varieties (t/ha)	Hybrids (t/ha)	LATE Week	Σ Temp. before winter (°C)	OP varieties (t/ha)	Hybrids (t/ha)
1994/95	32	571	4.32	4.93	34	424	4.07	4.72	36	297	4.14	4.84
1995/96	32	800	1.55	1.58	34	600	3.46	3.59	36	441	3.28	3.7
1996/97	-	-	-	-	34	470	4.51	3.79	37	285	3.40	4.07
1997/98	-	-	-	-	34	486	3.44	4.30	36	296	3.68	4.50
1998/99	31	514	4.63	5.11	34	389	4.52	4.89	37	292	3.07	4.18
1999/00	32	762	4.56	5.01	33	592	4.75	5.18	36	444	4.46	4.90
2000/01	32	797	4.03	4.36	34	627	4.40	4.65	36	532	4.27	4.64
2001/02		769	-	-		577	188 mm of rainfall in September			447	No results due to weather conditions	
2002/03	33	655	3.91	4.21	34	492	3.95	4.20	36	346	3.76	3.96
2003/04	33	660	5.05	5.48	34	491	5.13	5.52	35	373	5.30	5.71
2004/05	33	722	4.22	4.38	-	Too wet for sowing			37	428	4.51	4.88
2005/06	33	827	5.25	5.14		690	5.41	5.27		541	5.10	5.19
Mean	32	708	***4.17***	***4.47***	34	531	***4.36***	***4.61***	36	394	***4.09***	***4.60***
Relative (%)			100	107.1			100	105.7			100	112.5

Source: Deutscher Wetterdienst, Station Kiel - Holtenau, NPZ, Hohenlieth

The 12-year survey of sowing date trials (table 1) shows for each year the relevant accumulated temperature sum from sowing until the end of growing before winter. In average the early sowing date reached an accumulated temperature sum of 708°C within a range of 514 to 827°C. The normal sowing date showed an average of 531 °C within a range of 389 to 690°C. The late sowing trials showed an average of 394°C within a range of 285 to 541°C. Hybrids were more tolerant towards suboptimal growing conditions with lower temperatures in autumn and winter, because the yield advantage under late sowing conditions towards OP varieties is increasing with the decline of the temperature sum.

2. Variety type and input of nitrogen and triazol

Since 1998 two different input levels have been applied at the sowing date trials. Input level 2 comprises an extra amount of nitrogen of 60 kg/ha and one additional triazol application both in autumn and spring.

Table 2: Yield response of OP varieties to the higher input level 2

	EARLY		MEDIUM		LATE	
Years	Level 1 (t/ha)	Level 2 (t/ha)	Level 1 (t/ha)	Level 2 (t/ha)	Level 1 (t/ha)	Level 2 (t/ha)
1998/99	4.69	4.65	4.53	4.46	3.01	3.30
1999/00	4.67	4.58	4.72	5.08	4.48	4.55
2000/01	4.04	4.19	4.51	4.41	4.37	4.20
2001/02		No results due to weather conditions				
2002/03	3.83	4.05	3.87	4.09	3.60	4.03
2003/04	5.14	4.97	5.04	5.22	5.19	5.41
2004/05	3.96	4.48	Too wet for sowing		4.47	4.55
2005/06	5.03	5.48	5.42	5.40	5.07	5.13
Mean	***4.48***	***4.63***	***4.68***	***4.78***	***4.31***	***4.45***
Extra yield	*0.15*		*0.09*		*0.14*	

Table 3: Yield response of hybrids to the higher input level 2

	EARLY		MEDIUM		LATE	
Years	Level 1 (t/ha)	Level 2 (t/ha)	Level 1 (t/ha)	Level 2 (t/ha)	Level 1 (t/ha)	Level 2 (t/ha)
1998/99	5.2	5.18	4.86	5.00	4.13	4.26
1999/00	5.06	5.22	5.17	5.62	5.07	4.85
2000/01	4.31	4.52	4.69	4.72	4.73	4.68
2001/02		No results due to weather conditions				
2002/03	4.29	4.26	4.20	4.21	3.70	4.32
2003/04	5.46	5.49	5.47	5.58	5.60	5.82
2004/05	4.15	4.6	Too wet for sowing		4.82	4.94
2005/06	5.01	5.28	5.36	5.18	5.09	5.30
Mean	***4.78***	***4.94***	***4.96***	***5.05***	***4.73***	***4.88***
Extra yield	*0.16*		*0.09*		*0.15*	

On average the OP varieties showed a yield benefit of 0.15 t/ha for input level 2 under early sowing conditions, under normal sowing conditions 0.09 t/ha and under late sowing conditions 0.14 t/ha (table 2). Hybrids react similar to input level 2 with extra yields of 0.16 t/ha, 0.09 t/ha and 0.15 t/ha (table 3). These results show no significant difference between hybrids and OP varieties concerning yield response to higher inputs.

A closer look shows that especially cultivars sown at the early date responded extraordinarily in the last two years 2004 and 2005 to input level 2, as well as at the normal sowing date in 1999 and at the late sowing date in 2002 and 2003 for both hybrids and OP varieties. The advantage of input level 2 is shifting within the sowing dates from year to year and there is no general response pattern. Looking on the average results of the last four years the extra yield of input level 2 is slightly higher,

especially under early and late sowing conditions.

Discussion

The presented data shows a long-term advantage of hybrids compared to OP varieties with respect to yield potential and sowing date flexibility. Extra yields of hybrids for the three sowing dates with 7.1%, 5.7% and 12.5% advantage over OP varieties were significantly higher.

There is an interaction of temperature sum in autumn and yield. Additional factors like disease resistance and standing power of the cultivar further influence the final seed yield. Therefore this relationship is not too strong. These results support various studies showing that hybrids are more vigorous in autumn and fast-growing.

The extra yields of input level 2 were relatively low with 2 to 3% only. OP varieties and hybrids have shown similar yield reactions. Looking on the average of the last four years hybrids show no yield reaction under normal sowing dates at higher input levels. This can be explained by lesser impacts of fungal diseases during the last three years which would have reacted on the triazols. Then there has been no significant lodging pressure; due to the quite dry growing conditions in spring. Also the new varieties have been further improved in disease resistance and standing power. In general the yield potential in the trials has increased during the last three years, because there have been no severe stress conditions.

Conclusion

According to the results of this long-term trial study hybrids are significantly higher yielding than OP varieties, especially under demanding climatic conditions and the corresponding cultivation technology and management. They widen the optimum sowing period and show a higher tolerance towards low temperatures in autumn. Hybrids have advantages in field establishment, due to their higher vigour. Nevertheless OP varieties are also able to yield up to 5 t/ha under ideal growing conditions with temperature sums of 500°C or more in autumn.

The standard growing management using 180 kg/ha nitrogen and one application of triazol both in autumn and spring is obviously the best economic input level. Additional nitrogen and triazol applications are only paying in specific year and sowing date combinations. Hybrids and OP varieties reacted identically to input level 2.

The best economical yields in these studies were achieved with input level 1, both for hybrids and OP varieties. Prior own results have shown the trend that hybrids need a higher input (Baer, Frauen, 2003). This hypothesis cannot be confirmed any more.

References

Baer, A., Frauen M., (2003) Yield response of winter oilseed rape hybrids to sowing date, sowing density, nitrogen supply and triazol input. Proc. 11th International Rapeseed Congress, July 6-10, Copenhagen, Denmark, 887-889.

Büchse, A. (2002) Optimierung der Versuchstechnik bei Winterraps. UFOP-Schriften 18, 27-41.

Frauen, M. (1996) Optimierung der Versuchstechnik bei Winterraps. UFOP-Schriften 1, 10-20.