Effect of the preceding crop and the crop rotation on seed yield of oilseed rape in NW Germany

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ABSTRACT

Information about the effect of the preceding crop (combination) or crop rotation on the seed yield of oilseed rape (OSR) is extremely scarce. 15 different crop rotations with 20 up to 100 % of OSR were tested over a 14-year period. According to the principles of crop rotation experiments, each single component of these 15 rotations was present every season. All OSR plots were planted on the same date, regardless of the preceding crop, in order to avoid any interactions due to different sowing dates. In addition, three blocks were treated differently with regard to the nitrogen fertilization (80/100 vs. 120/100 kg N ha^{-1}) and fungicide application against *Sclerotinia sclerotiorum* (no, yes). Averaged over all treatments, the seed yield varied considerably between the years (2.7 - 5.2 t ha^{-1}). OSR following peas (3.9 t ha^{-1}) or barley (3.8 t ha^{-1}) yielded more than following wheat (3.6 t ha^{-1}). Lowest yields (3.4 t ha^{-1}) were observed if the preceding crop was OSR. In addition, the pre-preceding crop affected the seed yield. Compared to wheat or peas, OSR grown two years before decreased seed yield. The effect of the directly preceding crop was larger than that of the pre-preceding crop. A higher percentage of OSR (40 % and more) in crop rotations decreased seed yield. However, a favourable preceding crop like peas was able to partly compensate for the negative effects of the rotation. The results show that OSR like wheat clearly responds to a favourable preceding crop and crop rotation.

Key words: Oilseed rape – preceding crop – cop rotation – seed yield

INTRODUCTION

In the most rotation trials, oilseed rape (OSR) was used as a favourable preceding crop for (winter) wheat, but seldom as test crop. Based on 35 field trials during 1983-1988 at 21 sites in Sweden, Anderson (1990) reported only small effects of different preceding crops on the seed yield of spring rape and spring turnip rape. However, a significant interaction between the preceding crop and the nitrogen fertilisation occurred. In Denmark, during 1983 and 1991, trials were carried out with different intervals between OSR in the crop rotations (Jakobsen and Olsen 1992). Growing OSR every second and every third year caused a reduction in yield compared with OSR grown for the first time. Growing OSR every fourth and every fifth year did not reduce yield.

The objective of this paper was to examine the effects of the preceding crop (combination) and the crop rotation on the seed yield of autumn sown OSR.

MATERIALS AND METHODS

The long-term rotation experiment was carried out in 1988-2001 on a pseudogleyic sandy loam (Luvisol) at the Hohenschulen Experimental Farm of the University of Kiel, located in the NW of Germany some 15 km west of Kiel (Schleswig-Holstein). The climate of NW Germany can be described as humid. Total rainfall averages 750 mm annually at the experimental site with ca. 400 mm received from April to September, the main growing season, and some 350 mm during October to March.

The field experiment was originally laid out to compare 15 different crop rotations (of which two did not include OSR, Table 2). These rotations included winter wheat, winter barley, winter OSR, peas and oats, and ranged from continuous cropping to five course rotations. According to the principles of crop rotation experiments, each single component of these 15 rotations was present every season. Within the year, the sowing date of OSR was the same in all plots. In addition, three blocks were treated differently with regard to the nitrogen fertilization (80/100 vs.

120/100 kg N ha^{-1}) and fungicide application against *Sclerotinia sclerotiorum* (no, yes). In all years, no symptoms of *Plasmodiophora brassicae* (clubroot) was observed.

RESULTS

OSR seed yield varied considerably between the 14 years, ranging from 2.73 t ha^{-1} in 1991 up to 5.27 t ha^{-1} in 2001. Since no significant interaction between the preceding crop and the year as well as the block occurred, the effects of the preceding crop (combination) and the crop rotation are shown as averages of the years and the treatments.

Comparing the effects of the preceding crops, OSR grown after peas and barley yielded most with 3.90 t ha^{-1} and 3.80 t ha^{-1} (Table 1). Seed yield decreased significantly, if the preceding crop was wheat (3.64 t ha^{-1}). Lowest seed yield with 3.46 t ha^{-1} was observed after OSR. In addition, not only the directly preceding crop, but also the crop grown two years ago affected seed yield. OSR as pre-preceding crop significantly decreased seed yield compared with peas, if the preceding crop was a wheat or an OSR crop, or compared with cereals, if OSR was following barley. However, the effect of the pre-preceding crop was smaller than that of the directly preceding crop. Highest yields (>3.8 t ha^{-1}) were observed in OSR grown after wheat–peas, wheat-barley, oats-barley and peas-wheat as preceding crop combinations.

Table 1: Effect of the preceding and pre-preceding crop on the seed yield (t ha^{-1}) of oilseed rape (Hohenschulen Experimental Farm, NW Germany, 1988-2001)

Pre-preceding crop	Preceding crop	Yield (t ha^{-1})	
Wheat	Peas	$3.90^{a\ddagger}$	3.90^{a}
Wheat	Barley	3.86^{a}	
Oats	Barley	3.85^{a}	3.80^{a}
Oilseed rape	Barley	3.67^{ab}	
Peas	Wheat	3.84^{a}	
Wheat	Wheat	3.66^{ab}	3.64^{b}
Oilseed rape	Wheat	3.56^{b}	
Peas	Oilseed rape	3.58^{b}	
Wheat	Oilseed rape	3.47^{bc}	3.46^{c}
Oilseed rape	Oilseed rape	3.33^{c}	

‡ - Means with the same letter within a column do not differ significantly at p=0.05.

Table 2: Seed yield (t ha^{-1}) of oilseed rape (OSR) in different crop rotations (Hohenschulen Experimental Farm, NW Germany, 1988-2001)

No.	Crop rotation‡					% OSR
1	$3.33^{e\dagger}$	(monoculture)				100
2	3.58^{bcde}	Winter wheat				50
3	3.67^{bcd}	Winter barley				50
4	3.50^{cde}	3.39^{de}	Winter wheat			66
5	3.82^{abc}	Winter wheat	Winter barley			33
6	3.65^{bcde}	Winter wheat	Winter wheat			33
7	4.05^{a}	Winter wheat	Peas			33
8	3.68^{bcd}	3.55^{cde}	Winter wheat	Winter wheat		50
9	3.81^{abc}	3.58^{bcde}	Winter wheat	Peas		50
10	3.83^{abc}	Winter wheat	Peas	Winter wheat		25
11	3.85^{abc}	Winter wheat	Oats	Winter barley		25
12	3.91^{ab}	Winter wheat	Peas	Winter wheat	Winter barley	20
13	3.60^{bcde}	Winter wheat	Peas	3.79^{abc}	Winter wheat	40

‡ - The figures show the seed yield of oilseed rape within the crop rotation.
† - Means with the same letter do not differ significantly at p=0.05.

Table 2 shows the seed yield of OSR grown in different crop rotations. The lowest yield of 3.33 t ha^{-1} was observed if OSR was grown continuously. A higher percentage of OSR (40 % and more) in crop rotations decreased seed yield. However, a favourable preceding crop as peas was able to partly compensate for the negative effects of the rotation (eg. rotation no. 7 or 9.).

DISCUSSION

The results show that OSR like wheat clearly responds to a favourable preceding crop and crop rotation of approximately 10 per cent of the grain yield (Christen 1998). In general, the seed yield of oil-seed rape increased with the length of the break between two OSR crops, even when all the plots are planted on the same date. Investigations made in the same trial some years ago concerning the yield components revealed, that an unfavourable crop mainly decreased the number of pots per plant. The single seed weight was lowest in OSR grown after peas due to a high number of seeds per plant (Sieling et al. 1997).

A higher incidence of plant diseases seems to have a larger effect on seed yield than differences in the nitrogen nutrition of OSR due to the preceding crop combinations, especially the higher yield of oil-seed rape after a pea-wheat crop sequence. N supply in autumn (from fertilization or mineralization) does not or only slightly affect seed yield of oil-seed rape (Ogilvy and Bastiman 1992). Under the climatic conditions of Schleswig-Holstein, (re-)mineralization of soil N normally starts at the end of April/beginning of May, when N uptake by oil-seed rape decreased, so that oil-seed rape can only slightly use mineralized soil N for its yield formation (Teebken and Sieling 1995).

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