The influence of Soil Preparation on the Growth Stand and Productivity of Winter Rapeseed (*Brassica napus*, L.)

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ABSTRACT

Three year experiments with ten different types of soil preparation with the main partition according to the depth of soil cultivation (ploughing, surface ploughing) and according to the time of realisation (after the previous crop harvest, immediately before sowing = fresh preparation) showed substantial differences in the reaction of rapeseed and spring barley. The best emergence and the highest yields were obtained in the variants with the soil preparation immediately before sowing, namely if the soil was cultivated by the fresh ploughing. The fresh soil preparation reduced the harms caused by spring barley as a weed. The differences were caused by the different type of germination and emergence, dependent on the saturation by water and air. Cereals are more water demanding and their emergence depends on the capillary soil activity. Rapeseed is more air demanding and emerges out from the upper soil lager. Water demands are low, dew – drops are sufficient.

Variants with the reduced soil preparation (surface ploughing) showed lower rapeseed yields and a high level of spring barley harms. The most reliable and also most economical rapeseed sowing type after cereal crop is the stubble ploughing, soil leveling and sowing within one day period. This preparation also decreases weeding of dicotyledonous weeds.

Key words: winter rapeseed – emergence – soil preparation – cereal fall out (waste grains) – weed control – dew - clodness

INTRODUCTION

Concentration of oilseed rape exceeds 11% of cultivated soil since 1999. Vašák et al. (2000) estimate the rapeseed portion sown after cereal crops about 90% and nearly 50-60% of rapeseed grown without ploughing. Rapeseed emergency has been worse and the unsatisfactory soil preparation and the weedy grain occurrence has been extremely increasing.

The cultivation without ploughing supports the weed infestation and decreases oilseed rape yields (Budzyński, Jankowski, Szczebiot, 2000). *Poaceae*, mainly *Agropyron repens*, show a strong allelopathic activity (Mikulka, 2002). Therefore the wasted cereal grain, especially if the straw is not gathered, have been the most dangerous weeds. Even if the physiology of rapeseed germination differs from cereals, the same growing technology has been used for the stand establishment.

MATERIALS AND METHODS

Exact experiments concerning winter oilseed rape-variety Navajo in 1999/00, 2000/01 and 2001/02 are presented in this contribution. Experimental locality: Research Station of the Czech University of Agriculture - Červený Újezd, 405 m above sea level, deep soils with a tendency for clods creation. Mean annual temperature 7,7 °C, precipitations 493 mm, 16,6 °C and 64 mm in August.

Growing period (August-July: August – soil preparation, September – July – vegetation period and harvest). 1999/00: 9,1 °C and 496 mm, in August 17,4 °C and 21,2 mm, therefore dry and warm weather, clods. 2000/01: 8,8 °C and 523 mm, August 18,8 °C and 42,6 mm, dry and warm weather, clods. 2001/02: 8,2 °C and 630 mm, August 19,0 °C and 107,5 mm, 26 rainy days in September, therefore soil wetting. Four replicates, plots 3,1 x 10 m. Previous crop: 1999 spring barley, 2000 and 2001 winter wheat. 200 kg per ha, i.e. 500 kernels per m^2 of spring barley was sown as a weed into the stubble (12.8.1999, 15.8.2000, 29.8.2001). The straw coming from the previous crop was gathered.

Table1. Survey of experiment variants and time periods.

Operation / variant	1	2	3	4	5	6	7	8	9	10	Term 1999	Term 2000	Term 2001
Waste grain sowing	X	X	X	X	X	X	X	X	X	X	12.8.	15.8.	29.8.
Stubble ploughing[1] after cutting[2]	X	X	X	X	X	X					12.8.	15.8.	30.8.
Seed ploughing[3]					X	X	X				18.8.	21.8.	30.8.
Roundup			X								30.8.	4.9.	4.9.
Fresh[4] stubble ploughing[1]		X									31.8.	4.9.	4.9.
Fresh[3] ploughing[5]	X							X	X		31.8.	4.9.	4.9.
Rapeseed sowing[6]	X	X	X	X	X	X	X	X	X	X	1.9.	5.9.	6.9.
Graminicide[7]						X			X		24.9.	4.10.	11.10.

[1]Stubble ploughing: disk harrowing, 8-10 cm, [2]"after cutting" – the operation was finished immediately after the harvest and straw collection, [3] "seed ploughing" – ploughing around 2 weeks before sowing, [4]"fresh" – the operation was made closely before sowing (1 day), [5]ploughing: 18-20 cm of depth, [6]Sowing: Oyord sowing machine, depth of 2 cm on the stubble surface in the variant 10, Sowing rate: 90 seeds (1999), 70 seeds (2000), 60 seeds (2001), [7]Herbicides were not applied on dicotyledonous weeds.

RESULTS AND DISCUSSION

Number of clods (Table 2) in the variants with ploughing was significantly higher compared with the variant without ploughing. Only 1-5% of straw were found out on the surface in the variants with ploughing while 20-90%:

- The straw on the soil surface can be extracted by rains and dew drops. The straw extract has a negative influence on the rapeseed germination and growth (Vašák et al., 2000).
- The clods after drying (after 1-2 days after ploughing) cold down during the night. Thus they reached the temperature of the dew –point and condensated the dew-water. This character is missing at the rapeseed germination.
- The shallow soil preparation to 8-10 cm significantly supports the cereal germination, because the unsoftened part of the soil is capillarity active. The cereal grain forced into the soil (mainly 3-8 cm) will germinate very intensively and intensively compete with the rapeseed and dicotyledonous weeds, mainly after stubble ploughing, after cutting.

Soil preparation damaging the soil capillarity secures enough water from the air and the aeration is positive for rapeseed germination and growth. It has a negative effect on the cereal grain germination and its growth.

Variants with stubble ploughing and without ploughing showed the lowest numbers, rapeseed biomass and vice versa, the highest parameters in barley (Table 2). Variant 2 (stubble ploughing after cutting and fresh stubble ploughing) was the most successful one. Variants with ploughing (1, 5, 6, 7, 8, 9) showed the highest numbers in rapeseed plant biomass and converse in barley, namely in the case of fresh ploughed variants (1, 8, 9). In comparison with variants without ploughing they had the highest number of dicotyledonous weeds. The wasted grain suppressed weeds. Generally the most successful appeared to be the variant with ploughing with graminicide application (6, 9). Variants 1 and 8, fresh ploughing without graminicide, were very close to the previous variants. Fresh ploughing is able to suppress the dicotyledonous plants very intensively.

The seed yields of oilseed rape (Table3) correspond to the numbers and biomass of plants which are in a negative correlation with the plant biomass of wasted grain. Therefore there are some significantly unsuccessful variants 2,3,4 without ploughing (Table 3). The best were the variants without ploughing + graminicide (6,9), mainly No. 9 with fresh ploughing. Variants without graminicides with fresh ploughing (1 and 8) were the second in seed yields and evidently overcame variants 5,7 with traditional preparation, with the seed ploughing about two weeks before rapeseed sowing. Consolidation of soil after 2 weeks in August was not very presumable. Dry clods inhibit rapeseed germination. But the deeper got in, wasted grain suppresses rapeseed plants.

The best variant for oilseed rape is the fresh ploughing without previous stubble ploughing (8, 9). It is the cheapest one from all the ploughing systems for soil preparation (No. 2) Fresh ploughing without stubble ploughing significantly suppresses the wasted cereal grain as well as the dicotyledonous weeds. It supports the rapeseed emergence, its competition ability and seed

yields. Therefore, the soil preparation and sowing of rapeseed should be inherently different from the preparation for winter cereals.

1. The soil preparation should be oriented to water consumption obtained from dew, not to soil capillarity water, which supports growth and competition ability of the wasted cereal grain.
2. The soil preparation without ploughing significantly supports the development of cereal wasted grain, suppresses winter rapeseed and dicotyledonous weeds.
3. Fresh ploughing (immediately before sowing) represents the best results in comparison with the seed ploughing (around 2 weeks before rapeseed sowing) considering the number and weight of rapeseed biomass, rapeseed yields, by contract in the barley wasted grains and dicotyledonous weeds.

Table2. Clods and straw on the soil surface (13.9.1999, 19.10.2000 and 15.10.2001) Number of oilseed rape plants, weight of fresh biomass and wasted grains 3.11.1999, 13.11.2000, 15.10.2001 (number of plants) and 23.4.2002 (biomass weight).

Var.	Clods per m^2			Straw on the soil surface (%)			Rapeseed plants per m^2)			Rapeseed biomass (g per m^2)			Barley biomass (g per m^2)		
	1999	2000	2001	1999	2000	2001	1999	2000	2001/02	1999	2000	2001/02	1999	2000	2001/02
1	15	15	35	2	0	2	34	53	47	176	356	644	457	68	78
2	3	1	30	30	20	20	53	44	38	24	198	538	401	113	573
3	0	6	15	80	50	60	16	38	29	2	90	382	529	291	387
4	0	6	10	60	50	65	27	21	40	7	50	746	497	319	576
5	25	10	25	1	2	2	42	53	41	101	320	680	250	90	213
6	25	10	25	1	2	2	54	54	38	304	425	859	4	1	21
7	35	10	20	5	2	5	50	60	28	150	296	282	104	100	78
8	20	12	35	5	2	5	46	52	47	275	354	1397	367	209	91
9	20	12	35	5	0	5	38	63	50	352	483	2077	26	1	29
10	0	0	XX	90	80	XX	9	12	XX	1	8	XX	532	350	XX

Table3. Harvest of technological experiment, yields of winter rapeseed, spring barley wasted grain and winter wheat from 4 replicates. Statistically different variants in 1999-2001

Var.	Yield (t per ha)					Statistically different variants			
	Winter rapeseed			Barley		Biomass		Yield	
	1999/00	2000/01	2001/02	1999/00	2001/02	Rapeseed	Barley	Rapeseed	Barley
1	2,248	5,193	1,714	1,486	0,581	3,9,10	5,9,10	3,10	2,3,4,6,9,10
2	0,340	4,425	1,099	3,935	1,652	6,9	6,7,9	9	1,6,7,8,9,10
3	0,228	3,581	0,785	3,721	2,078	1,6,8,9	5,6,7,9	1,9	1,6,7,8,9,10
4	0,545	1,941	1,168	3,370	1,967	7,8,9	5,6,7,9	9	1,6,7,8,9
5	1,856	4,519	1,620	3,564	0,425	6,9	1,3,4,6,9,10	10	6
6	2,671	4,423	1,503	0,200	0,049	2,3,7,10	2,3,4,5,10	10	9,10
7	1,601	4,869	0,859	1,564	0,526	4,6,9,10	2,3,4,10	9,10	2,3,4,6,9,10
8	2,176	5,080	1,644	0,723	0,377	3,4,10	XX	10	2,3,4,10
9	4,512	5,299	2,396	0,013	0,079	1,2,3,4,5,7,10	2,3,4,5,10	2,3,4,7,10	1,2,3,4,7,9,10
10	0,148	1,692	XX	2,783	XX	1,6,7,8,9	5,6,7,9	1,5,6,7,8,9	1,6,7,8,9

Spring barley wasted grain in 2000/01 and 2001/02 freered out, but in 2001/02 the winter wheat wasted grains survived

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