BRASSICA NAPUS, OTHER CROPS, AND FERTILIZER NITROGEN INFLUENCE ON THE PERFORMANCE OF WHEAT IN ROTATION.

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ABSTRACT

Two field experiments evaluating rotational crop influence and fertilizer N on wheat yield were established in 1993. Winter wheat grown in crop year 1994 yielded most in one experiment after dry pea and less after Canola, rapeseed, crambe, wheat and barley. In another experiment, winter wheat yielded most after dry pea and less after crambe, rapeseed, mustard, barley, Canola, and wheat. Nitrogen fertilizer treatments did not influence winter wheat yield across or within previous crop treatments in either experiment.

INTRODUCTION

Brassica napus crops have the potential to become an important rotational crop with cereals in the Pacific Northwest of the USA. Information on the rotational influence of previous crops on wheat is needed for a realistic analysis of rotational crop benefit and to establish the cropping system economic return that should be attributed to rapeseed/Canola.

MATERIALS AND METHODS

Experiment 1: Influence of previous crop on winter wheat.
Eight treatments established in 1992-93, crop year1 at Moscow, Idaho include: winter rapeseed under high and low N fertility, winter wheat, crambe, Canola (1), Canola (2), spring barley, and spring dry pea. For crop year2, 'Madsen' winter wheat was established over each previous crop plot area. On 30 Mar, 1994, N was applied at 56, 112, 168 and 224 kg/ha in a split-plot arrangement on each previous crop area. Agronomic performance of the winter wheat was compared relative to the previous crop rotational effect and spring N fertilizer rates.

Experiment 2: Influence of previous winter rapeseed green manure or crop residue and spring crop influence on winter wheat.
Seven rapeseed green manure or crop residue management treatments and six spring crops established in 1993, crop year1, near Lewiston, Idaho include: winter rapeseed under high and low N fertility, spring wheat, crambe, Canola, yellow mustard, spring barley, and spring dry pea. Rapeseed green manure or crop residue management treatments include: herbicide kill at vegetative stage in the spring then incorporating or not, cutting at mid-bloom and incorporating or not, and after harvesting incorporating crop residue immediately or let stand until usual field work timing. For crop year2, winter wheat was established over each previous crop plot area. In the spring, N was applied at 0, 22, 44, 67, and 89 kg/ha in a split-plot design on each previous crop area. Agronomic performance of the winter wheat was compared relative to previous crop/management rotational effect and spring N fertilizer rates.

Table 1. Rotational winter and spring crop performance, carryover N and wheat yield response to previous crop and N fertility, Moscow, ID, USA, 1993 and 1994

	1993		1994 Winter Wheat		
1993 Crop	Grain Yield	Residual N, 0-30cm	Grain Yield	Bulk Density	Plant Height
	kg/ha	kg/ha	kg/ha	g/L	cm
Winter Rape (High N)	2112	25	5590	862	84
Winter Rape (Std. N)	2069	43	5595	853	85
Spring Canola (1)	624	22	5725	874	84
Spring Canola (2)	1451	28	5995	887	82
Dry Pea	1696	21	7275	887	88
Crambe	1969	15	5455	863	83
Spring Barley	5368	11	4715	844	80
Winter Wheat	3650	20	5255	872	84
LSD 0.05	693	11	740	18	n.s.
1994 N fertilizer kg/ha					
56			5725	890	83
112			5725	872	83
168			5725	862	84
225			5591	848	85
LSD 0.05			n.s.	6	n.s.

Table 2. Rotational crop and rapeseed biomass management influence on wheat yield and performance, Upper Tammany, ID, USA, 1993 and 1994

1993 Crop/Biomass Treatment	Grain Yield	Bulk Density	Plant Height
	kg/ha	kg/L	cm
Rape-early incorporated	2620	818	71
Rape-early sprayed	2185	821	70
Rape-bloom incorporated	2745	826	72
Rape-bloom sprayed	2615	832	67
Rape-harvested incorporated	2855	838	72
Rape-harvested	2540	829	70
Rape high N-harvested	2660	824	70
Spring Canola	2340	820	69
Spring Wheat	1820	817	67
Spring Barley	2485	719	64
Dry Pea	3435	841	73
Crambe	3010	839	71
Yellow Mustard	2690	826	68
LSD 0.05	630	18	n.s.

RESULTS AND DISCUSSION

Regional yield expectations were exceeded in the trial at Moscow by 50% for spring barley, equaled by winter wheat, winter rapeseed, one spring Canola variety and by crambe, reduced for dry pea, and very low for one spring Canola variety (Table 1). After the 1993 crops, residual soil N in the top foot was highest for winter rapeseed and spring Canola, although overall the residual N levels were not high. Wheat yield in 1994 was 600 kg/ha higher ($p=0.10$) following pea than for the next highest yielding previous crop of spring Canola. Wheat yields were not different among Canola, rapeseed and crambe previous crop treatments, but were lower after winter wheat and spring barley. Wheat yield after spring barley was depressed by competition with volunteer barley that was weeded during the crop season. Wheat grain bulk density and plant height varied directly with the differences in yield. Spring N fertilizer applications produced no interactions of previous crop and N treatments. There was a reduction in grain test weight as N rate increased. These N responses were different than results from 1993 previous crop experiments that showed yield response with up to 157 kg/ha N and an interaction of previous crop and N fertilizer rate. The differences in response are most likely attributable to environmental differences between the years; 1993 was cool with normal precipitation and allowed a long period of N uptake and utilization, while 1994 was warm and dry, especially late in the cropping year.

The 1993 crop yields were limited at the Tammany site due to weed competition and insect damage. The best previous crop treatment was pea followed by crambe (Table 2). Wheat yields were lower after winter rapeseed, spring Canola, yellow mustard, spring barley and spring wheat. Wheat yields at Tammany are lower than at Moscow, but had many similar trends in the previous crop treatment influences on winter wheat performance. The additional spring N fertilizer treatments at Tammany did not increase yield, but did reduce test weight. No interactions were found for previous crop treatment and fertilizer N.

Winter wheat yield results from the winter rapeseed green manure or crop residue treatments of the Tammany experiment were separated by orthogonal contrasts for comparison. The early green manure treatments produced the lowest 1994 wheat yields (Table 2). By incorporating, rather than not, rapeseed tissues there was 300 kg/ha more wheat yield ($p=0.002$) than not incorporating. This breakup and mixing of the rape tissues with the soil appears to have a beneficial impact on soil or microbial properties influencing the following crop performance.