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ESN effects on canola establishment, weed competition and canola yield in a four-year study

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Introduction

- Canola is grown on 6 million ha in western Canada
- Herbicide-resistant and hybrid cultivars are widely grown
- No-till practices predominate in this area
- N fertilizer is a major input cost and can represent 60% of farm energy use
- N demand may be higher for hybrid than open-pollinated cultivars
- Farmers are interested in more effective and cost-efficient N fertilization strategies

Objective

Determine the merits of polymer-coated urea (Environmentally Smart Nitrogen ESN™) applied at recommended and higher than recommended rates on weed management plus canola yield in a no-till system

Materials and methods

- A four-year field experiment was conducted at five sites on the Canadian prairies
- Treatments included a) hybrid and open pollinated (OP) canola, b) ESN and urea fertilizer, c) 100% and 150% of soil test N fertilizer rates, and d) 50% and 100% of in-crop herbicide rates
- Both canola cultivars were glufosinate-resistant and the 100% herbicide rate treatment consisted of glufosinate at 500 g ai ha^{-1} plus clethodim at 15 g ai ha^{-1}
- N fertilizer was soil-banded 3 cm to the side and 5 cm below the seed row at seeding
- Canola was grown in rotation with barley in a no-till system and both crops of the rotation were grown each year
- Fertilizer form, fertilizer rate, and herbicide rate treatments were applied to the same plots in four consecutive years
- Canola and barley were arranged as split-blocks and all other treatments were arranged in a factorial design with four replications
- Data collected included canola density, canola and weed shoot N concentration determined at 4 and 8 WAE, weed biomass, canola yield, and canola oil concentration

Table 1. N fertilizer rates applied to attain 100% and 150% of soil test rates according to target canola yield at each site†.

	Lethbridge		Lacombe		Beaverlodge		Melfort		Scott	
	100%	150%	100%	150%	100%	150%	100%	150%	100%	150%
	kg N ha^{-1}									
2005	30	85	65	145	110	175	-	-	-	-
2006	90	145	110	170	90	160	110	190	85	140
2007	80	130	105	170	120	165	125	200	70	125
2008	65	110	95	150	70	135	90	120	70	105
2009	-	-	-	-	-	-	125	180	60	120

†Target canola yields for Lethbridge, Lacombe, Beaverlodge, Melfort, and Scott were 1.7, 2.5, 2.2, 2.5, and 1.7 T ha^{-1}, respectively.

Results and discussion

Canola density

- Canola plant density was not affected by any of the study treatments
- Fertilizer placed 3 cm to the side and 5 cm below the seed row was adequate physical separation preventing canola seedling injury

Canola tissue N concentration

- Canola N concentration was lower with ESN than urea in 7 of 11 site-years at 4 WAE and in 5 of 11 site-years at 8 WAE – But these values remained above the 20 g kg^{-1} threshold level at flowering required for optimum yield
- In 2 site-years where canola N concentration was the below the threshold value with the 100% N rate (with both ESN and urea), the 150% N fertilizer rate raised the N level above the 20 g kg^{-1} threshold

Weed tissue N concentration (Table 2)

- N concentration of wild oat, wild buckwheat, and catchweed bedstraw was consistently greater with the 150% compared with the 100% N fertilizer rate
- N concentration of these weed species was often lower with ESN than with urea; potentially reducing weed competitiveness and/or increasing N availability to the crop

Weed biomass

- Hybrid compared with OP canola reduced weed biomass in 13 of 16 site-years
- The 50% herbicide rate increased weed biomass in 16 of 18 site-years
- Weed biomass was often greater with 150% compared with 100% N rate but was unaffected by N fertilizer form

Canola yield (Table 3)

- Hybrid compared with OP canola gave higher yields in 15 of 20 site-years
- ESN and urea resulted in similar canola yields in 14 of 20 site-years
- Canola yield was greater with ESN than with urea in 4 site-years with both cultivars and in 1 additional site-year with the hybrid cultivar
- Canola yield was lower with ESN in 1 site-year
- An increase in N rate to 150% of the soil test increased the yield of both cultivars in 10 of 20 site-years and of hybrid canola in 3 additional site-years
- The 50% herbicide rate reduced canola yield in 11 of 20 site-years

Table 2. Wild oat, wild buckwheat, and catchweed bedstraw N concentration (g kg^{-1}) response to N fertilizer form and N rate determined 8 wk after emergence when competing with canola.

	N formulation		N rate	
	Urea†	ESN	100%	150%
Wild oat				
Lethbridge				
2005	27 a	24 b	25 b	28 a
2006	38 a	27 b	30 b	38 a
2007	19 a	16 b	15 b	19 a
2008	23 a	19 b	20 b	23 a
Lacombe‡				
2005	34 a	30 b	29 b	35 a
2006	39 a	31 b	33 b	38 a
2008	41 a	35 b	35 b	41 a
Beaverlodge				
2005	21 a	16 b	16 b	21 a
2007	35 a	30 b	30 b	34 a
Wild buckwheat				
Lethbridge				
2005	20 a	15 b	15 b	20 a
2006	38 a	25 b	28 b	36 a
2007	26 a	24 a	22 b	28 a
2008	23 a	18 b	19 b	22 a
Lacombe				
2006	42 a	36 b	37 b	42 a
2008	42 a	36 b	39 a	40 a
Beaverlodge				
2005	31 a	27 b	25 b	33 a
Catchweed bedstraw				
Beaverlodge				
2007	38 a	35 b	36 a	37 a
2008	32 a	27 b	28 b	33 a

†Means within a weed species, site, year, sampling time and treatment followed by the same letter are not significantly different ($P > 0.05$) according to Fisher's protected LSD

Table 3. Canola yield response to cultivar, N fertilizer formulation and N fertilizer rate.

	Cultivar		N formulation		N rate	
	OP†	Hybrid	Urea	ESN	100%	150%
	kg ha^{-1}					
Lethbridge						
2005	1230 b	1520 a	1390 b	1590 a	1460 a	1530 a
2006	2510 b	2690 a	2520 b	2670 a	2520 a	2660 a
2007	1020 b	1490 a	1230 a	1290 a	1170 b	1340 a
2008	1530 a	1650 a	1600 a	1570 a	1410 b	1760 a
Lacombe						
2005	3540 b	4280 a	3780 a	3830 a	3690 b	3920 a
2006	3210 a	3290 a	- ‡		3180 a	3370 a
2007	2020 b	2310 a	2230 a	2140 a	2090 a	2230 a
2008	2480 b	3460 a	3060 a	2900 a	2760 b	3190 a
Beaverlodge						
2005	2570 b	3420 a	2900 b	3110 a	2820 b	3440 a
2006	960 b	1500 a	1220 a	1240 a	1260 a	1200 a
2007	1420 b	1580 a	1600 a	1410 b	1430 b	1620 a
2008	670 b	830 a	690 a	800 a	620 b	870 a
Melfort						
2006	2300 b	2590 a	2470 a	2410 a	2340 b	2550 a
2007	2470 a	2360 a	2440 a	2380 a	- ¶	
2008	2110 a	2130 a	2100 a	2130 a	2090 a	2130 a
2009	1530 a	1580 a	1590 a	1510 a	- ¶	
Scott						
2006	2040 b	2360 a	2110 b	2270 a	2180 a	2240 a
2007	1910 b	2240 a	2020 a	2050 a	1920 b	2230 a
2008	1400 b	1720 a	1480 a	1590 a	1450 b	1670 a
2009	640 b	1020 a	840 a	820 a	- ¶	

†Means within a site, year, and treatment followed by the same letter are not significantly different ($P > 0.05$) according to Fisher's protected LSD

‡Canola yield was greater with ESN compared with urea fertilizer (3420 vs. 3160 kg ha^{-1}) with hybrid but not with OP canola at Lacombe in 2006

¶Canola yield was greater with 150% compared with 100% N fertilizer rate (2790 vs. 2510 kg ha^{-1} at Melfort in 2007; 1720 vs. 1430 kg ha^{-1} at Melfort in 2009; 1120 vs. 930 kg ha^{-1} at Scott in 2009) with hybrid but not with OP canola

Conclusions

- Advantages of hybrid canola compared with OP canola included reduced weed tissue N concentration, lower weed biomass, and higher canola yield
- The hypothesis that N demand would be greater with hybrid than OP canola was only supported in 3 of 20 site-years
- Both hybrid and OP canola had a positive yield response to the 150% N rate in 10 of 20 site-years – growers may be under fertilizing their canola crops
- ESN compared with urea expressed neutral to positive benefits
  - weed N tissue concentration was often lower with ESN indicating that crop-weed competition for soil N might be reduced
  - vegetative canola tissue N concentration was often lower with ESN but if soil N levels were higher later in the growing season this may benefit canola yield (occurred in 25% of the cases)
  - canola seed oil concentration was unaffected by ESN vs. urea in 19 of 20 site-years

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