
Stubble height and fertilizer N requirements for maximizing canola yield in the semiarid Canadian prairie

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Abstract

Canola is becoming a viable crop when grown under fallow in the semiarid prairie, but is also grown in longer rotations, most often direct seeded into standing stubble. Taller standing stubble provides the canola seedlings with a more favorable microclimate promoting more efficient use of water and increased yields compared to canola grown without the protection of standing stubble. When grown under the more limited moisture conditions of extended rotations but in the moisture conserving characteristics of taller standing stubble, we found canola yielded best with fertilizer N rates similar to those of the moister Black soil zone. Canola yields were consistently highest when fertilized with ≈ 100 kg N ha⁻¹.

Introduction

Previously, we conducted a field study using farm-scale seeding and harvesting equipment to assess the effect of stubble management on the microclimate, water use and seed yield of argentine canola (*Brassica napus* L. 'Arrow') in the semiarid prairie surrounding Swift Current (Cutforth et al. 2006). Tall (30 cm), short (15 cm) and cultivated stubble treatments were deployed in fall and in spring. An additional tall stubble treatment with extra fertilizer N (application rate recommended for the Black soil zone in the subhumid prairie) was included to assess the role of fertilizer in canola response to stubble management practices. The differences in wind velocity, soil temperature and solar radiation reaching the soil surface indicated significant modification of the microclimate by tall compared with cultivated stubble. Yields were highest from the tall stubble receiving extra fertilizer. Further research is needed to determine optimum fertilizer rates to maximize canola yields in the semiarid prairie. Comparing between stubble treatments deployed on fields that overwintered as tall stubble and which received equivalent rates of fertilizer, tall stubble increased canola yield by about 16% and WUE by about 11% compared with cultivated stubble. Crop water use was not affected by stubble management so the increased grain production was due to increased WUE.

Objective

Our objective was to assess the interactive effects of stubble management and rate of fertilizer N on the water use and seed yield of argentine canola (*Brassica napus* L. 'Arrow') grown in the semiarid prairie surrounding Swift Current. Further, we wanted to determine optimum fertilizer rates to maximize canola yields in the semiarid prairie.

Methods

A field study using farm-scale seeding and harvesting equipment was conducted over three seasons (2003-05). Argentine canola (*Brassica napus* L. 'Arrow') was seeded directly into the stubble treatments in early spring. Tall (30 cm), short (15 cm) and cultivated stubble treatments were deployed in spring just before seeding. Each plot received 70 kg ha⁻¹ of monoammonium phosphate (11-51-0) with the seed, 80 kg ha⁻¹ of potassium sulphate (0-0-50-17) broadcast at seeding, and ammonium nitrate (34-0-0) broadcast at seeding to establish N treatments of 0, 25, 50, 75, 100, 125 kg ha⁻¹, although each plot received 8 kg N ha⁻¹ from the 11-51-0 application. Grain yields were measured for each plot and water use was measured for each stubble height by N treatment combination. Pests (weeds and insects) were controlled using a variety of pesticides, all applied as per label instructions. Water use was the difference between soil water to 120 cm depth at seeding and harvest plus growing season precipitation.

Results

The stubble height by fertilizer N interaction was not significant. There were no differences in grain yield between stubble height treatments, although there was a general tendency across fertilizer rates for tall stubble to have the highest grain yield, followed by short stubble, and lastly by cultivated stubble with the lowest yield (Fig. 1). Yields increased to about 100 kg N ha⁻¹ and did not increase thereafter. Similar to results we have reported previously (Cutforth et al. 2006), water use was independent of stubble height and rate of fertilizer N (Table 1). These results are similar to those reported by Gan (personnel communication) and Ulrich et al. (2002).

Conclusions

Canola responded to increased fertilizer N in a similar manner across stubble height treatments. Canola yield maximized at fertilizer N rates ≥ 100 kg N ha⁻¹ in the semiarid prairie of southwestern Saskatchewan.

References

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Table 1. Water use as a function of year, stubble height, and rate of fertilizer N.

Stubble Height (cm)	Fertilizer rate (kg/ha ⁻¹)	Water use (cm)			
		2003	2004	2005	Average
Cultivated	0	116	287	184	196
	25	116	290	178	195
	50	116	290	177	194
	75	118	291	178	196
	100	117	291	178	195
	125	117	291	179	195
	Average	117	290	179	195
	Short	0	116	289	177
25		116	290	177	194
50		116	289	177	194
75		117	290	177	195
100		116	292	177	195
125		117	291	175	194
Average		116	290	177	194
Tall		0	116	288	175
	25	117	291	177	195
	50	116	291	177	195
	75	119	291	178	196
	100	117	292	178	196
	125	118	292	178	196
	Average	117	291	177	195

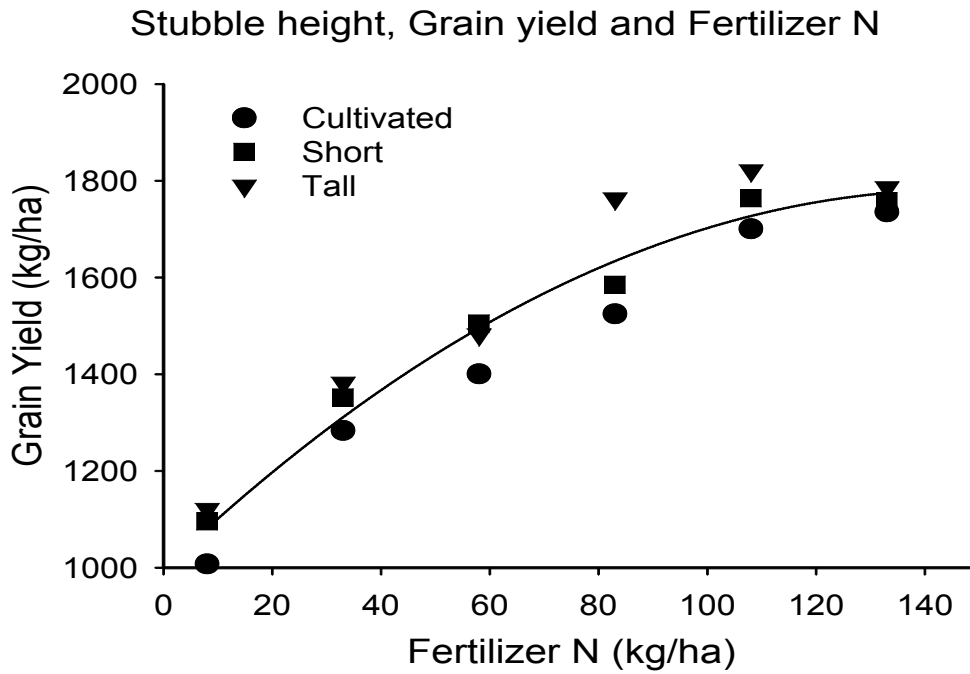


Figure 1. Relationship between stubble height, fertilizer N and grain yield for argentine canola cv. Arrow grown from 2003-05 near Swift Current in the semiarid prairie of southwestern Saskatchewan.