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High Fertilizer Rates Placed Near Seed Benefit Wheat/Canola

Studies, using fluids on zero- and conventional-till, show greater risk with canola than wheat.

Summary: *In our studies, high rates of fluid fertilizer were placed near to wheat seed, using a one-pass seed and fertilizer application in zero- and conventional-till systems, with minimal effect on crop emergence and grain yield. The system worked best on clay soils with high moisture-holding capacity, and in years when rainfall and soil moisture were not limiting crop growth. Most consistent response was to N, although responses were observed to phosphate on clay soil, and to phosphate, potassium, and sulfur on sandy loam. The presence of high concentrations of fertilizer near the seed reduced crop emergence, particularly for canola, and on sandy loam soil. Reduction was greatest in 1995 when spring seeding weather was hot and dry. In 1996, when spring weather was cool and wet, crop emergence was less affected. The system carries greater risk for canola because this crop is more sensitive than wheat to large quantities of fertilizer near the seed row Reduction in crop emergence did not produce a proportional reduction in crop yield; in fact, yield per individual plant was higher at low than at high crop density.*

Wheat and canola, under study in this report, are important crops to the economy of Western Canada. They occupy the greatest acreage and have the potential of producing an excellent return on investment. The crops are produced on either zero- or reduced-till systems. Seeding and fertilization are significant parts of production costs. In zero-till, producers seek to optimize fertilizer-use efficiency while reducing soil disturbance to conserve moisture and reduce weed growth. N fertilizer generally is either surface broadcast (an inefficient method of fertilization that produces N losses via volatilization) or banded at seeding. Phosphate is banded with the seed or in the N band. The use of fluid fertilizers is rapidly becoming an accepted practice on the prairies because they provide:

- ease of mixing
- ease of incorporating additives and securing homogeneity of mixture
- convenience of mechanical handling
- ease of blending desired amounts of nutrients
- reliability of fluid application systems.

Wheat and canola require large amounts of N and P for optimum yield. For wheat, the current recommendation is to drill all P fertilizer directly with the seed and preplant band N fertilizer. For canola, no more than 22.4 lbs/A of P_2O_5 should be placed with the seed. Higher levels should be banded away from seed. N should banded away from the seed for better seedling emergence. Under a strict zero-till system, preplant banding is not possible. Thus, N is surface broadcast or side-banded at time of seeding, and P is placed in the seed row or with the N band. These operations may involve a minimum of two passes. Because the banding of N at seeding on zero-till soils has not been evaluated, producers tend to use relatively low rates of N.

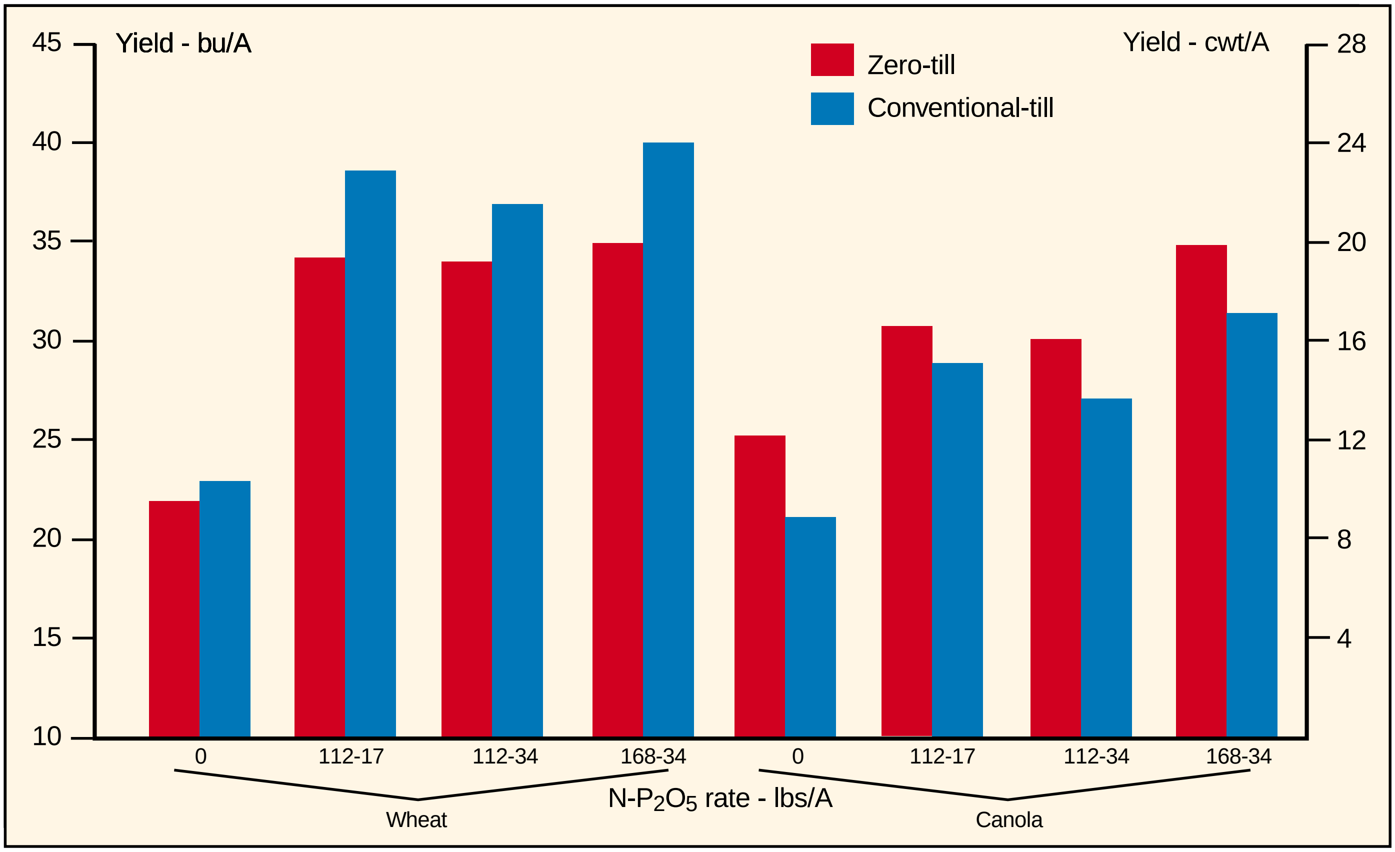
Minimum-till requires one pass to band N and a second to place seed and P It is less efficient in conserving soil moisture than zero-till. A single pass fertilization and seeding system, with low soil disturbance under zero-till, has the potential to improve fertilizer and moisture-use efficiency, and reduce cost of production while maintaining and/or improving crop yield and quality. The system has the potential for reducing labor cost, machinery use, and fuel consumption. Reduced soil disturbance will reduce soil erosion, nutrient loss, and conserve moisture.

This study evaluated technology to place N, P, K, and S fluids close to the seed (I-inch to side, one-inch below) with a fluid fertilizer zero-till seeder (Seedhawk) Under minimum soil disturbance in zero- and conventional-till. Objective was to enhance moisture and nutrient availability to wheat and canola. Crop emergence, nutrient-use efficiency, seed and straw yield, and seed quality were monitored.

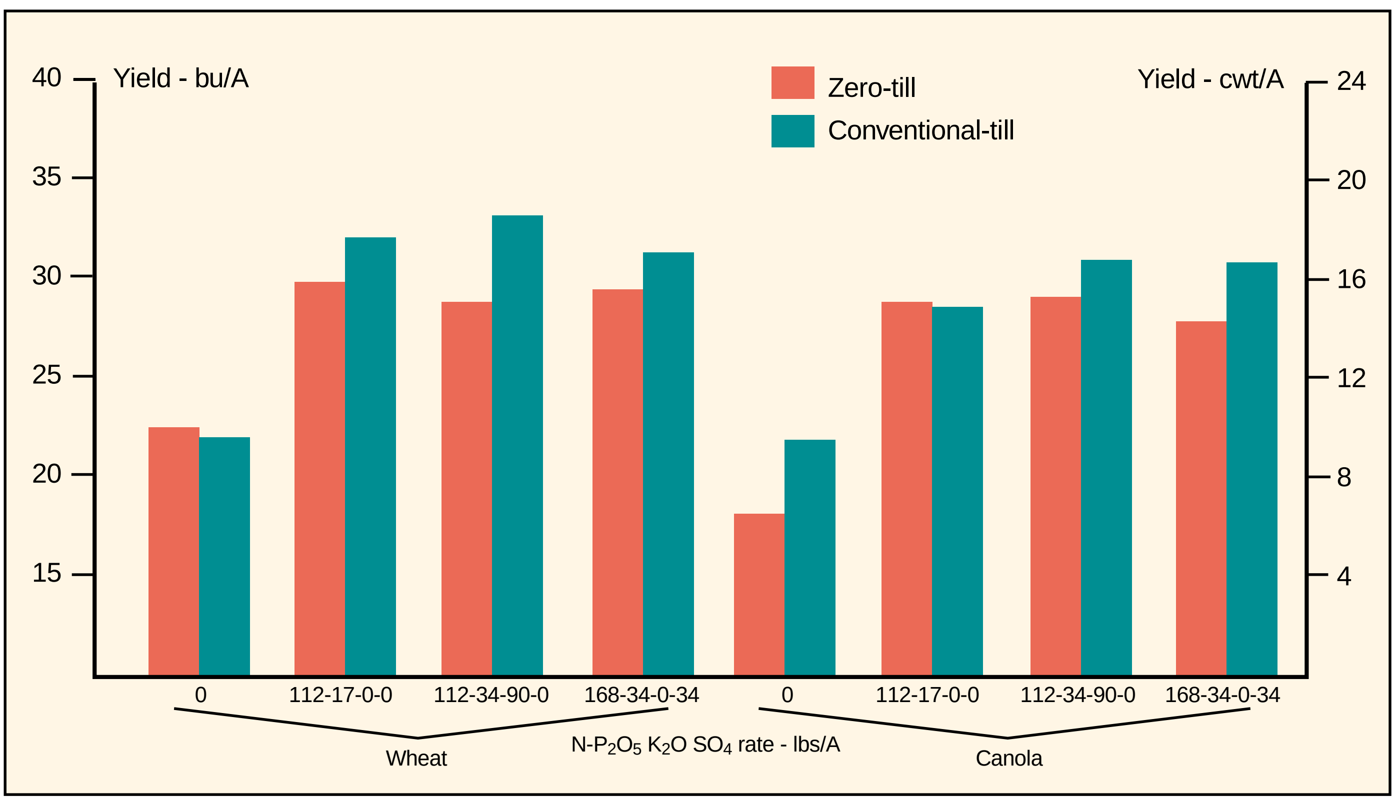
Crop response

Clay loam soil. Banding N and P close to the seed at planting increased wheat and canola seed yield under both tillage systems (Figure 1). For equivalent rates of fertilizer, the highest yields of wheat were in conventional-till, while for canola they were on zero-till. It is probable that canola, having a higher water requirement than wheat, obtained more water from the zero-till than from the conventional-till system. For wheat, the conventional-till system promoted earlier emergence and better stooling because of warmer soil. Wheat responded to all levels of N and P Canola response to N was good but response to P was marginal and was probably masked by reduced emergence caused by high rates of N. In general, at high rates of fertilizer application crop yield may have been depressed by reduced plant emergence.

Sandy loam soil. In general, wheat yields on conventional-till were greater or equivalent to those on zero-till (Figure 2)—in spite of the fact that



Fugure 1. Effect of single pass seeding and fertilizer banding near seed on wheat and canola yield under zero- and conventional-till on a clay loam soil, Bailey and Grant, 1996.



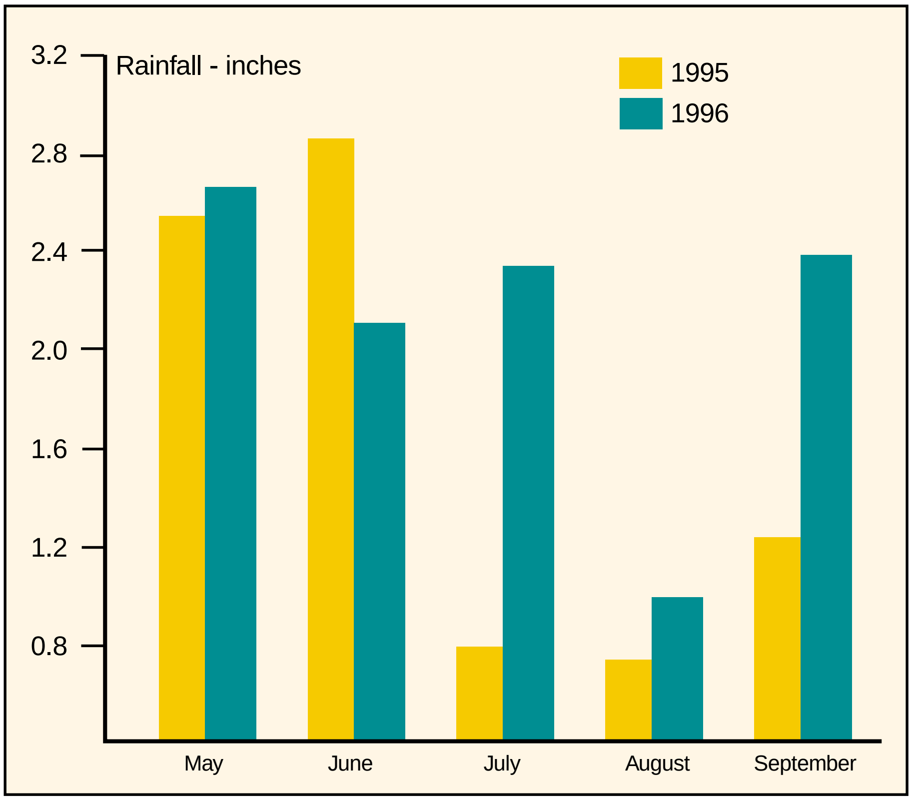
Fugure 2. Effect of single pass seeding and fertilizer banding near seed on wheat and canola yield under zero- and conventional-till on a sandy loam soil, Bailey and Grant, 1996.

emergence on zero-till was generally higher than under conventional-till. For canola, crop emergence and yield on both systems were generally similar. The higher wheat yields on conventional-till soils were due to early stool development on warmer soils. On both tillage systems and for both crops there was a good response to N fertilizer and evidence of a moderate response to P, K, and S applications—even though crop emergence was significantly reduced at high fertilizer rates.

Table 1. Profile of soils and available nutrients for spring of 1995 and 1996, Bailey and Grant.

	Depth	Clay loam		Sandy loam	
	in.	1995	1996	1995	1996
		- - - - - lbs/A - - - - -			
pH (ppm)	0-6	7.8	7.8	7.5	7.5
NO_3-N	0-10	33.6	28.0	22.4	31.4
P	0-6	16.8	21.3	25.8	19.0
K	0-6	VH	VH	156.8	106.4
SO_4-S	0-10	VH	VH	28.0	40.3

VH = Very High



Fugure 2. Monthly summary of rainfall, May 1 to September 30, 1996, Bailey and Grant, 1996.

Crop emergence

Clay loam soil. In the relatively hot and dry 1995 season, high rates of N reduced crop emergence. But in 1996, under the influence of cool wet weather, application of N had no significant effect on wheat emergence but reduced canola emergence. In both years, wheat emergence was better on conventional- than on zero-till, while canola emergence was similar in both systems.

Sandy loam soil. Crop emergence on sandy loam soil was lower than on clay loam soil because of the greater water-holding and nutrient-binding capacity of clay as compared to sand. It may be that sand permitted easier movement of nutrient from fertilizer band into the seed row where it can affect seed germination. As was observed for the clay soil, crop emergence in 1996 was better than in 1995. In both years, wheat emergence on conventional-till was better than on zero-till, while canola emergence under both systems was similar. In both years, at the highest combined rates of fertilizers (N, P_2O_5, K_2O, and SO_4), crop emergence declined. Decline was greatest for canola.

In general, soil moisture at seeding and during germination in 1996 was good. Soils were relatively cool and there was a high plant emergence count. Furthermore, the presence of adequate soil moisture appeared to have modified the salt effect on germinating seeds caused by the presence of high rates of fertilizer—particularly N. This was not the case in 1995 when the seed bed was relatively dry, particularly on the sandy loam soil, and when the salt effect on the germinating seed would be great. Furthermore, some plants may have died on emergence as a result of high temperatures. There was some evidence that P enhanced emergence, particularly on clay soil. This was not the case for canola.

Conditions/methodology

Rainfall. The 1996 growing season was cooler and wetter than 1995, but temperatures increased rapidly as the season advanced. Although 1996 precipitation was below the long-term mean (Figure 3), it was well distributed and better than in 1995. Totals of accumulated precipitation for the '95 and '96 growing seasons were 66 and 78 percent of the long-term average, respectively.

Plots. A four-replicate randomized complete block experiment was conducted on a Souris fine sandy loam and a Newdale clay loam in the Black Soil Zone (Orthic Chernozemic soils) of the Canadian prairie.

Tillage. Wheat and canola were seeded in a zero-till system. On adjacent sites, they were sown on conventional-till lands where 50 percent of the previous year's crop residue had been incorporated into the soil.

Fertilizer. Fertilizer sources were: N = UAN (28-0-0), P = APP (10-34-0), K = Muriate of potash (0-0-12), and S = Ammonium thiosulphate (12-0-0-26S).

Sampling. Table 1 gives fertility status of sites for 1995 and 1996, based on spring soil samples. On the clay loam soil, both N and P were low. Thus, a yield response to applications of both nutrients could be expected. Nutrient status of the sandy loam soils was also very low, so crop response to applications of fertilizer could again be expected.

Weed control was achieved with postemergence herbicides applied at recommended rates. *Hoe Grass II* was applied on wheat and *Fusilade* was applied to canola. Persistent weeds in canola were controlled with an application of *Lontrel.*

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