Post-Emergence Application of Liquid Swine Manure in East Central Saskatchewan

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Introduction

In early 1997, the Prairie Protein Action Committee was established and one of its objectives was to identify ways to meet the increasing demand for wheat with specific protein quality and quantity (Fowler et al. 1998). The main areas of concern were low protein levels in western Canadian wheat and increased competition on the world market for high protein wheat. To address these concerns, one of the objectives was to identify research needs relating to the production and management of wheat protein.

Protein quality can be enhanced by genetic improvement or by N fertility management. Among the main objectives in plant breeding programs are the need to increase yield and protein. However, the two traits have generally been found to be negatively related. This negative relationship may be as a result of dilution of the protein concentration as carbohydrates in the endosperm increase with yield. Thus, genetic improvement may have a small contribution toward enhancement of protein content in wheat. Hucl et al. (1998) found that less than 3% of variations in protein concentration in spring wheat was due to genetic variation, whereas over 80% of the variation was due to environmental effects, which include N fertility. Campbell et al. (1997) noted that in the Brown soil zone of Saskatchewan, 18% of the protein variation was due to N fertility. Within a cultivar, up to 99% of the variability in grain protein could be due to soil N variability (Fowler 1986). Hence, N fertility management is key to improving protein quality in wheat.

Livestock manure application as a N source to boost yield and protein of wheat offers an alternative to chemical N fertilizers. There is opportunity to enhance protein levels in cereals and achieve protein premiums by delaying manure application and applying it post-emergent to cereals. Delayed manure application also helps widen the window of application and reduce manure application costs. Hence, the objective of this study was to determine the effects of low disturbance, post-emergent liquid swine manure injection on wheat protein and yield in east-central Saskatchewan. This paper presents the results of the first two years of this three year study.

Materials and methods

The experiment was initiated in 2000, near Leroy, east central Saskatchewan in the Black Soil zone. Two sites were selected each year, 2000 (Troop and Henning) and 2001 (Leroy 1 and Leroy 2). In each year, the spring wheat sites were established on either cereal or canola stubble,

but on a field that had never received manure before. At each site, the experimental plots were demarcated in a wheat field already fertilized according to soil test recommendations. At the tillering stage (approx 4 wks after seeding), swine manure was injected into the soil using the PAMI manure tanker truck fitted with low disturbance coulter injection system. Four rates of manure application (none, low, medium and high) were used. The low rate was applied at 11000 L ha^{-1} (equivalent to 22 kg NH_4-N ha^{-1} and 30 kg total N ha^{-1} in 2000, and 24 kg NH_4-N ha^{-1} and 37 kg total N ha^{-1} in 2001). The medium and high rates were double and triple multiples of the low rate , respectively.

Swine manure application was made at different time periods: end of May, mid-June, end of June. An undisturbed control plot was included, thus bringing the number of treatments to 13. The treatments were arranged in a RCBD with four replications at each site.

Results and discussion

In 2000, post-emergent application of liquid swine manure increased both grain yield and grain protein content at the Troop and Henning sites (Fig. 1). At both locations, the typical quadratic response to N application was observed for end of May application, with grain yield declining at the high rate. However, relative to the disturbed check, the response at Henning was not significant. For mid June and end of June application, a reversed quadratic response was observed at Troop, indicating increasing yield even at the high rate. At Henning, no significant response to swine manure relative to the disturbed check was observed in grain yield, whereas significant linear increase in grain yield was observed for the end of June application. At both locations, a linear increase in grain protein content was observed, regardless of the time of swine manure application. On average, at the highest manure application rate, grain protein increased by 2% protein in 2000.

In 2001, post-emergent application of liquid swine manure decreased grain yield at both locations (Fig. 1). The more delayed the application, the more the decrease in grain yield. Post-emergent application of swine manure at the end of May resulted in grain yield similar to that observed in the undisturbed check at both locations. Grain protein, on the other hand increase linearly by an average magnitude of 1% protein.

These findings show that under normal growing conditions (as in 2000), post-emergent application of swine manure can increase both grain yield and protein content. The quadratic response with end of May application, suggests that early post-emergent application of swine manure at high rates may have caused excessive vegetative growth and associated low grain yield. In contrast, later application of swine manure under these conditions was more effective in boosting both grain yield and protein. However, this is under normal growing conditions where the crop can utilize the late applied nutrients, as well as fully recover from any physical damage that may have been caused by the injection itself. The higher grain yield observed in the disturbed check than in the undisturbed check in 2000 indicates that, not only did the crop recover from the physical damage, but the disturbance also enhanced crop performance. Under the droughty conditions of 2001, the opposite was the case. In 2001, poor crop recovery from physical damage coupled with poor utilization of manure nutrients resulted in poor yield with marginal protein increases. It is important to note that in both years, the fields had received N

fertilizer at the time of seeding according to recommended rates, so the wheat was not expected to be highly responsive to post-emergent N application in terms of yield increase.

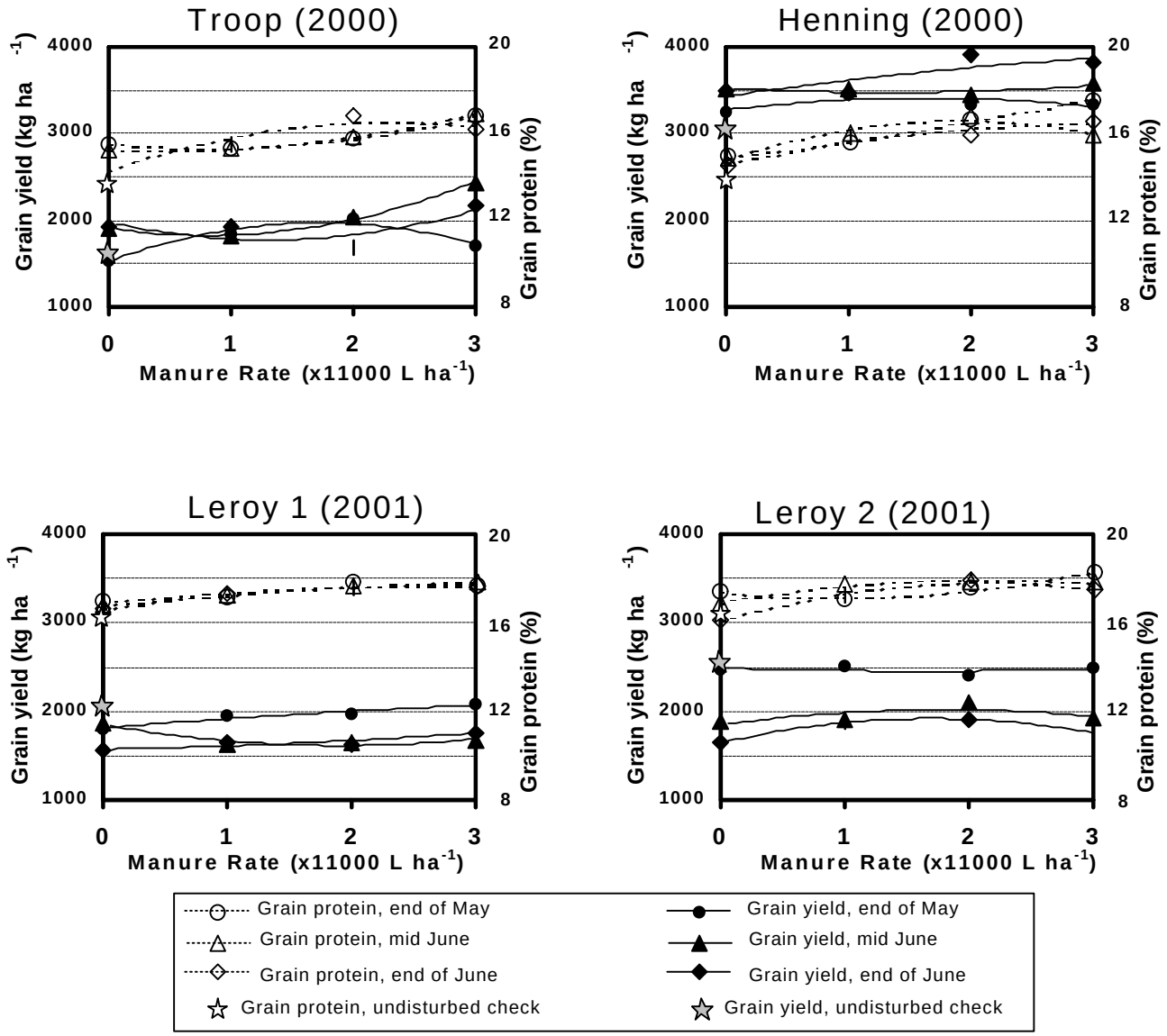

Fig.1. Effect of post-emergent application of liquid swine manure at different rates and time of application on grain yield and grain protein of spring wheat at Troop and Henning in 2000 and Leroy 1 and Leroy 2 in 2001.

Summary

Results from the first two years of this study have indicated that there is a strong possibility of enhancing both grain yield and grain protein by application of liquid swine manure post-emergent in a spring wheat crop. However, the magnitude of the response depends on the timing of the application and the environmental conditions as these affect crop N utilization and the impact of the disturbance associated with injection on yield. Under droughty conditions, wheat producers may refrain from applying manure after emergence.

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