# Physiological Response of Dry Bean to Residue Management

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## Abstract

The effect of residue management on dry bean (*Phaseolus vulgaris* L.) height, maturity, and yield was studied at two sites in Saskatchwan in 1999. Treatments were spring cultivated, mowed or unaltered prior to seeding. Preliminary results indicate no effect of residue management on maturity of either cultivar. Tillage reduced emergence in cultivated treatments compared to no-till, possibly by causing compaction, reducing macroporosity and creating conditions suitable for root diseases. Plant density differences largely determined yield, biomass at physiological maturity, and pod clearance. Yields were 682 kg/ha, 838 kg/ha, 880 kg/ha for cultivated, mowed and stubble respectively. Plant height was not significantly affected by tillage. Bean pod clearance under conventional tillage was 5% higher than under no-till, regardless of stubble height, possibly because of the lower plant density in cultivated treatments. Differences among treatments for internode length (Fig. 2a and b) were not statistically significant. Direct seeding of dry bean appears to be feasible.

## Introduction

Dry bean has considerable potential as a dryland pulse crop in the black soil zone of Saskatchewan, but basic agronomic research is needed to reduce production risk and harvest efficiency of the crop. Direct seeding may address several of the problems associated with dryland bean production. Residue management alters field microclimate during early stages of crop growth, which affects the structure and productivity of the plant at harvest (Cutforth and McConkey, 1997). Direct seeding conserves moisture, resulting in less yield loss due to drought (Enz et al 1988, Brun et al, 1986). Mascianica et al. (1986) reported an increase in harvested yield and plant height in snap bean due to a reduction in canopy wind speed and better mechanical support in standing stubble. The objective of this research was to identify tillage systems best suited to dry bean production in Saskatchewan. The effect of residue management on dry bean (Phaseolus vulgaris L.) height, maturity, and yield was studied at two sites in Saskatchwan in 1999. Data obtained from a site at Rosthern, SK is discussed here.

## Materials and Methods

**Experimental Design:** 2 factor RCBD factorial design with 4 replicates and two locations; Rosthern and Saskatoon.

**Treatments:**

1) Genotype: CDC Nighthawk and CDC Expresso.

2) Residue Management: Spring cultivated, mowed stubble and standing stubble.

**Plant Measurements:** Plant density, internode length and crop biomass at physiological maturity, pod clearance, yield per plant, and total grain yield.

**Microclimate Measurements:** Daily max., min. and average soil and canopy air temperatures, soil moisture, and precipitation.

**Analysis:** Analysis of variance ($\alpha$=0.05) and linear regression analysis.

## Results and Discussion

Emergence was affected by tillage treatment (Fig. 1a) and emergence differences determined yield differences (Fig. 1b) and biomass at physiological maturity (not shown). CDC Expresso yield (Fig 1c) was more closely related to emergence ($R^2$=0.67) than yield of CDC Nighthawk ($R^2$=0.37). CDC Nighthawk was damaged by fall frost, and we speculate that this is the reason for the lower $R^2$ value and lower average yield. Tillage may have affected emergence and yield by causing compaction, reducing macroporosity, creating differences in the effective seeding depth, and creating conditions suitable for root diseases. In contrast to our results, Vyn et al. (1998) attributed delayed growth and reduced yields of no-till soybean to unfavorable in-row seedbed conditions compared to plowed treatments. Soil temperatures were about $1^0$C higher in cultivated treatments compared to the two uncultivated treatments.

Plant height was not significantly affected by tillage. Bean pod clearance under conventional tillage was 5% higher than under no-till, regardless of stubble height, possibly because of the lower plant density in cultivated treatments. Differences among treatments for internode length (Fig. 2a and b) were not statistically significant. Residue management had no significant effect on maturity, and CDC Nighthawk flowered approximately 2 weeks later than CDC Expresso.

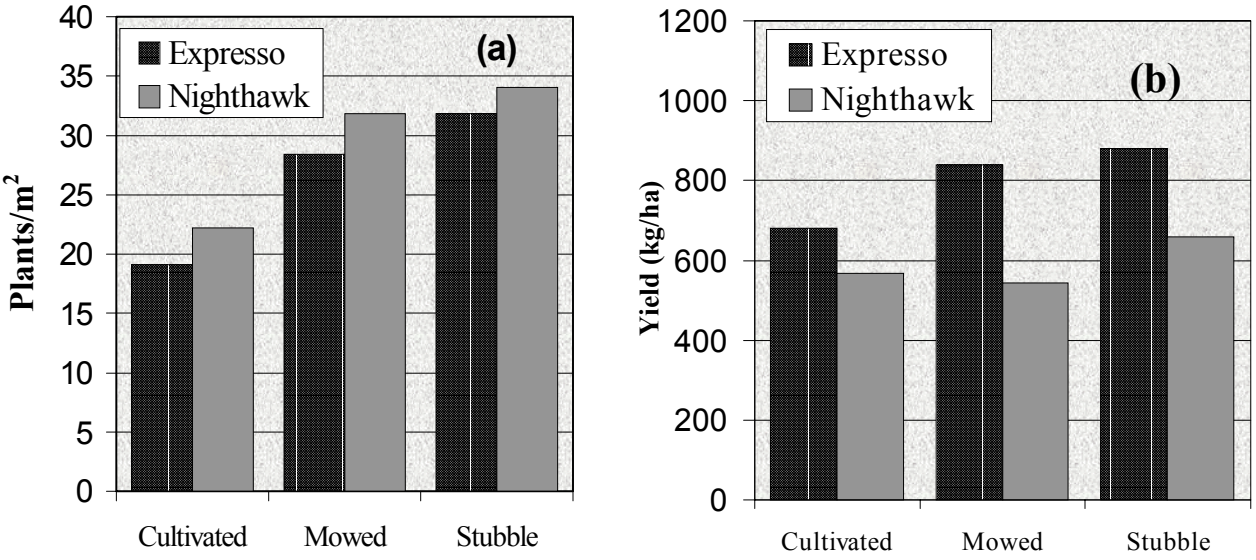


Figure 1. Black bean emergence (LSD= 0.8) (a), yield (LSD = 80) (b) for the Rosthern site.

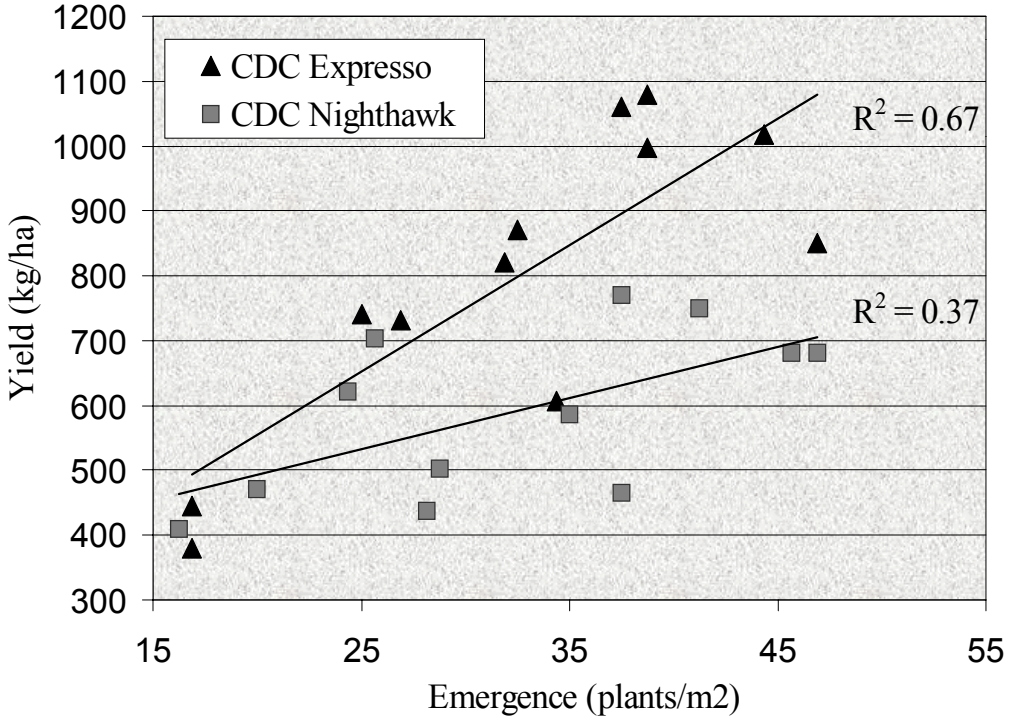


Fig. 2. Yield vs. Emergence for two bean varieties.

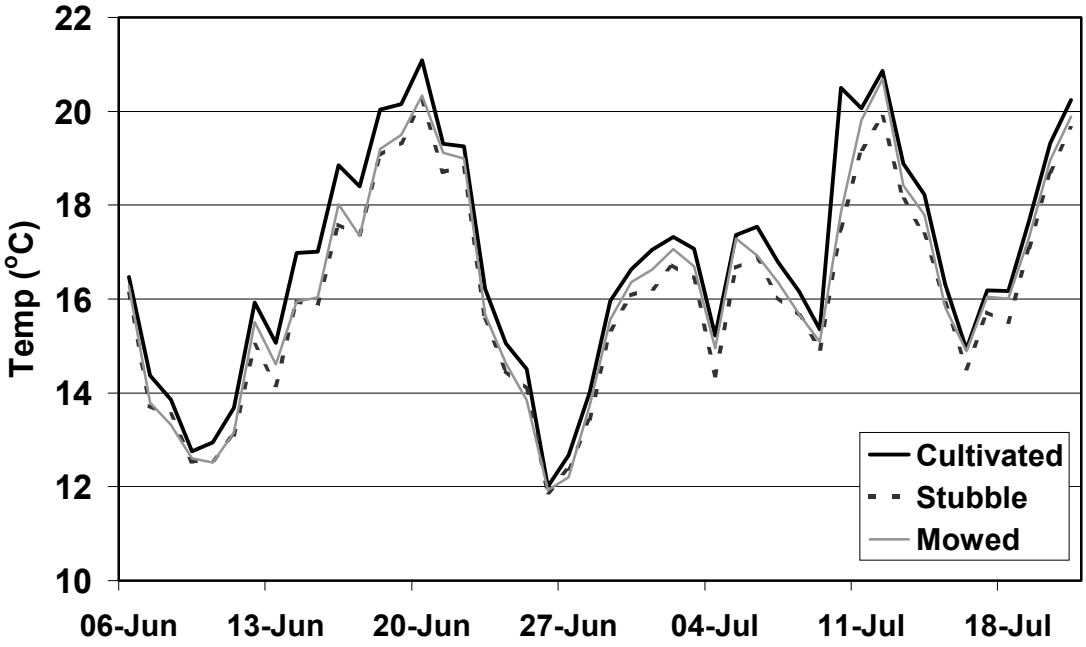


Fig. 3. Soil temperature at 10 cm depth for Saskatoon site.

## Conclusions

No-till dry bean production appears to be feasible. In a year when the moisture benefits of no-till are small and the potential disadvantages such as disease and lower soil temperature are significant, direct seeded plots can perform better than cultivated plots. Further research is needed to determine whether there are advantages to using a no-till system. The emergence problem in cultivated plots might have been alleviated with seed treatment. Since there is a strong relationship between plant density and yield, yield might also increase with seed treatment in moist, cool seasons.

## References

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