Dry Bean

Canada-Saskatchewan Irrigation Diversification Centre

Fertility Management for Dry Bean Production under Irrigation

Research Highlights: March 2001

Introduction

Dry bean requires adequate nitrogen (N), phosphorus (P), potassium (K) and sulphur (S) to maintain optimum growth and yield. Dry bean response to P has been well documented and, under irrigation, the need for S is less likely as irrigation water can supply adequate S. However, research was needed to determine dry bean response to N and K. Also, the timing, rate and placement of fertilizer needed to be tested as this can have a significant influence on crop yield and disease problems, especially under the relatively cool and short Saskatchewan growing season.

Micronutrients such as Boron (B), Copper (Cu) and Zinc (Zn) are also essential for optimum growth and yield although they are required in smaller amounts. Micronutrient requirements are dependent on plant uptake, soil availability and growing season conditions. Levels of soil micronutrients have generally been considered adequate for dry bean production, however, response to supplements had not been tested.

Nitrogen

Optimizing dry bean yield requires the proper balance between nitrogen fertilizer applications and nitrogen fixation through inoculation. Although up to 30% of N requirements can be met by using an appropriate inoculant, starter N fertilization is often required as a supplement until nodules become functional.

Field trials were conducted at the Canada-Saskatchewan Irrigation Diversification Centre (CSIDC) to determine the benefits of applying starter N fertilizer and a granular inoculant on CDC Expresso black bean and CDC Camino pinto bean.

There was a significant yield benefit from applying 25-50 kg N/ha (22-45 lb/ac) at seeding. Starter N fertilizer did not affect seed weight. This indicates that increasing yield was due to more seeds and not larger seed size. There was no significant yield response to the granular inoculant.

If soil tests indicate nitrogen levels below 34 kg/ha (30 lb/ac), it is generally recommended that 34 kg N/ha (30 lb/ac) should be applied.

Applying all of the required N at seeding may inhibit N fixation. Early application may also result in excessive vegetative growth leading to a lower seed yield and a greater risk of disease. By delaying N application to a later growth stage, a greater proportion of N may be utilized for seed production, producing more and/or larger seeds, rather than vegetative growth.

A field trial was established to determine the effect of late N application on yield and seed quality of irrigated dry bean. Treatments included 25 kg N/ha (22 lb/ac) as ammonium nitrate applied at seeding, at early flower, at mid-late flower, and at early pod fill. All treatments received a side band application of 10 kg N/ha (9 lb/ac) and 45 kg P_2O_5/ha (40 lb/ac) at seeding. Soil tests indicated an average of 119 kg N/ha (107 lb/ac) at 60 cm (24 in) depth. Seed yield for NW 63 small red bean was significantly increased with late nitrogen application at early pod fill compared to

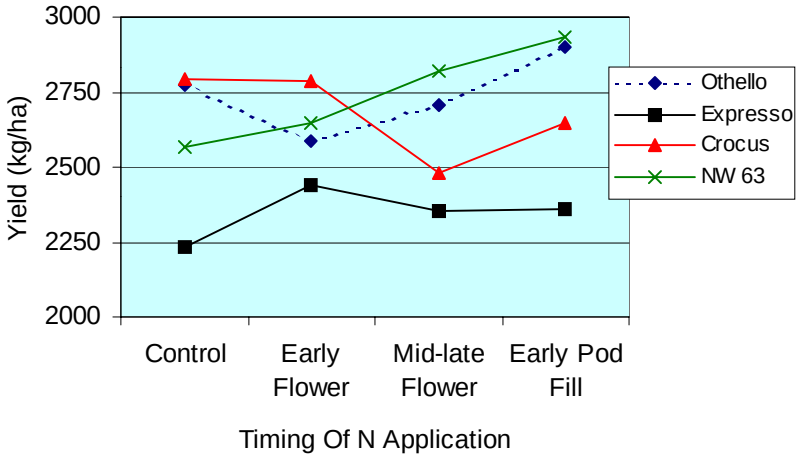

Figure 1. Dry bean yield response to late fertilization.

the control treatment (Figure 1). There were no yield differences for any of the other cultivar x late nitrogen application time combinations. Seed size, as indicated by seed weight, showed no consistent trend associated with the late nitrogen applications.

Potassium

Soil available K is generally considered adequate for dry bean production, however, response to additional K needed to be tested. A series of trials were established at CSIDC on soils considered to have adequate levels of K. Potassium chloride (0-0-60) was side banded at rates of 0, 10, 20, 30, 40 and 50 kg K_2O/ha (0, 9, 18, 27, 36 and 45 lb/ac). Dry bean showed no consistent response to K fertilizer in terms of yield, seed size, days to flower, days to maturity, or seedling establishment.

Micronutrients

Dry bean is known to be prone to Zn deficiency, especially on high pH soils or under cool, wet conditions early in the growing season. Zn application may also shorten time to maturity, an important consideration for the short growing season of the northern prairie region. However, the response of dry bean to micronutrient supplements, including Zn, needed to be tested.

Research trials were established to examine the effects of granular and foliar micronutrient applications. Treatments included 11 kg Cu/ha (10 lb/ac) applied as granular Copper sulfate, 0.6 kg Cu/ha (0.5 lb/ac) applied as liquid Copper chelate, 11 kg Zn/ha (10 lb/ac) applied as granular Zinc sulfate, 0.6 kg Cu/ha (0.5 lb/ac) applied as liquid Zinc chelate, 3 kg B/ha (3 lb B/ac) applied as granular Borate, and 0.3 kg B/ha (0.3 lb B/ac) applied as liquid Boron. The granular treatments were side band applied during the seeding operation while the foliar treatments were applied at 10% flower. Varieties in the trial included Othello pinto bean, CDC Expresso black bean and AC Skipper navy bean.

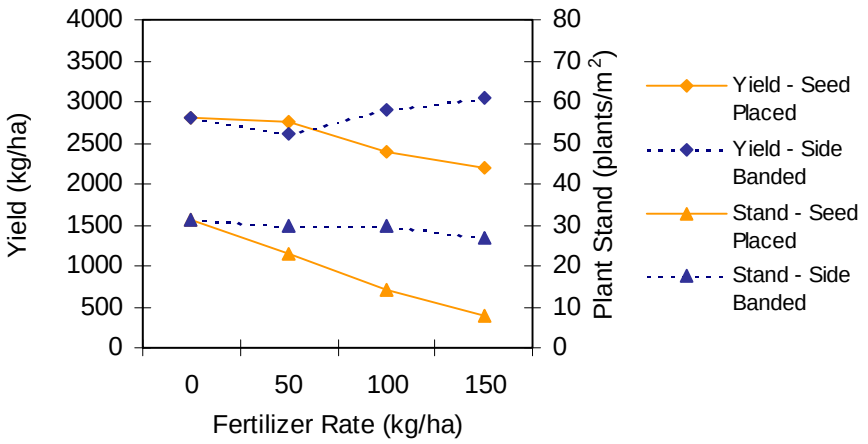

Figure 2. Bean yield and stand response to fertilizer rate and placement.

Results from this three-year study indicated that even where soil available micronutrient levels were low there was no consistent response to the micronutrient applications in terms of plant stand, yield, seed size, days to flower, or days to maturity.

Fertilizer Placement

Placement of fertilizer with the seed can cause seedling damage and reduce plant stand. Seed placed fertilizer may also reduce the effectiveness of *Rhizobium* inoculant resulting in lower N fixation. A field trial was established at CSIDC to study the sensitivity of dry bean to increasing rates of seed placed and side banded fertilizer on a sandy loam soil. A fertilizer blend of 13-20-10-10 applied at rates of 0, 50, 100 and 150 kg fertilizer/ha (0, 45, 90 and 135 lb/ac) was evaluated for Othello pinto bean.

The Othello pinto bean was sensitive to seed placed fertilizer, reducing both plant stand and seed yield, relative to side band application (Figure 2). This effect was most marked at higher fertilizer rate. The lower yield for the seed placed treatment was likely due to lower stand establishment (Figure 2). As well, maturity was delayed by placement of fertilizer with the seed compared with side band placement.

Dry bean is also sensitive to placement of micronutrient fertilizers. In one trial, seed placed granular Cu fertilizer had such a toxic effect that no plants emerged.

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The Bottom Line...

Results from CSIDC research have indicated that the current soil test guidelines adequately predict the micronutrient requirements of irrigated dry bean. Seed placed fertilizer can reduce plant stand and seed yield of dry bean. Monitoring of soil fertility through an adequate soil testing program is the best way to determine fertilizer requirements.

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