

Plant Density Effects on Shade Avoidance and Yield of Navy Beans Under Weed-Free and Weedy Conditions

Increasing plant densities resulted in greater yields, but enhanced shade avoidance characteristics like thinner stems, fewer branches and higher pods and did not reduce weed biomass.

HERBICIDE OPTIONS IN dry beans are limited and herbicidal weed control is often supplemented with inter-row cultivation. Other integrated weed management (IWM) tools are worth exploring to improve this uncompetitive crop's competitive ability, like row width, plant density and seeding date.

Plants will develop shade avoidance characteristics, or competitive characteristics, in response to detecting neighbouring plants. Once plants detect a neighbouring plant's presence, they try to grow to avoid that neighbour, resulting in thinner, longer stems and fewer branches. If plants dedicate too many resources to developing these characteristics when resources are limiting, yields will be reduced.

This research further investigated the yield-density relationship from the previous project, *Evaluating Row Width and Plant Density for Dry Beans* (page 4), under weedy and weed-free conditions, while also investigating the effect of seeding date.

At Carman in 2017 and 2018, a weed-free experiment was hand-planted in

7.5" rows at three plant densities (48, 96, 192,000 plants/ac). Shade avoidance characteristics like stem thickness, branch number, first internode length and lowest pod heights were evaluated in this weed-free experiment. A second, weedy experiment was established evaluating early (May 26 to 29) and late (June 14 to 19) seeding dates for two navy bean varieties (T9905 and Envoy) planted in 15" rows and at five plant densities (20, 40, 80, 160, 320,000 plants/ac). This experiment was used to generate yield-density relationships under weedy conditions.

Excessively dry conditions in 2018 resulted in the loss of the early-seeded experiment and poor emergence in the late-seeded experiment.

Yields increased with greater plant densities. Under weed-free conditions, increasing density also enhanced shade avoidance characteristics, resulting in thinner stems, fewer branches, longer first internodes and higher pods.

T9905 navy beans showed a better competitive response than Envoy navy beans, meaning they maintained yield

with fewer plants under weedy conditions and developed fewer shade avoidance characteristics (Figure 1). T9905 has an indeterminate, upright growth habit, while Envoy is a determinate bush-type. Selecting competitive, upright varieties and planting at moderate densities are critical for maintaining yield when adequate weed control cannot be achieved.

In many crops, higher plant densities contribute to less mid-season weed biomass, a measure of weed pressure. In these experiments, increasing plant densities did little to reduce weed biomass under weedy conditions. However, weed pressure was very intense in these experiments. It can also be noted that the late-seeded experiment had less weed biomass than the earlier-seeded, likely due to seedbed disturbance at planting contributing some weed control.

A logical next step from this research would be to evaluate more dry bean varieties with different growth habits, in conjunction with other IWM tools, to improve dry bean competitiveness under weedy conditions. ▀

Figure 1. Yields (kg/ha) of Envoy and T9905 navy beans planted early (late May) or late (mid-June) under weedy conditions at Carman in 2017 and 2018. The red dotted line represents average weed biomass (grams/m²).

