INCREASING BEAN YIELD THROUGH SITE-SPECIFIC CULTURAL PRACTICES AND ADAPTED LINES UNDER CENTRAL PIVOT IRRIGATION SYSTEM IN THE TROPICS

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Intensive pasture production for raising beef cattle under central pivot irrigation system has become a common activity in tropical region of Brazil. However, after 4 to 5 years the pasture production starts to decline because of soil fatigue and self-induced incompatibility of the pasture. So, is crop rotation of grass followed by maize/soybean, sorghum and bean in no-till planting has been introduced with moderate success. Bean yield is still too low due to nitrogen deficiency. Traditional side dressing with N several days after planting did not solved the problem in the area with high organic matter accumulation on the surface. In this region with low latitude and altitude and maximum air temperature around 35° C, bean growth cycle is reduced to less than 70 days. Bean can grow, however, in this region because night temperatures drop to below 28° C and soil maximum temperatures never exceed 30° C at 5 to 20 cm depth. Bean is planted during the dry winter period between May and September under irrigation, but average bean yield has never reached 2 t ha^{-1}. No commercial bred cultivar is available for this region.
The objectives of these experiments were to increase bean yield through better nitrogen application methods and evaluate the performance of new lines in the tropical environment.

Materials and methods: Three experiments were conducted at the Triangulo farm in Bonopolis/GO (13° 38' 11'' S; 49° 48' 37''; 290 masl) on Oxisols with the following soil characteristics.Ca 2.8, Mg 0.9 and K 0.26 (all in $cmol_c$ dm^{-3}) and 10.4 mg dm^{-3} of P. Soil organic matter is about 25.0 g dm^{-3} and on soil surface there was more than 8 Mg ha^{-1} of dry sorghum mulch. Perpendicular to the fertilizer application heavy-pneumatic bean planter drilled the seed at the rate of 18 seeds per m at the average depth of about 5 cm. The distance between rows was 45 cm. Basal fertilizers were applied at the rate of 90 kg P_2O_5 ha^{-1} and 50 kg K_2O ha^{-1} at planting. Before flowering period two chemigation with urea at 15 kg N ha^{-1} each were applied to promote the microbial activities for decomposing the organic matter. Split plot design with five replications was used, main plots were the N treatments and subplots were bean lines. Net plot size was 10 m^2 and the seed yield was adjusted to 13 % moisture content.
Experiment 1, Optimum doses of N: Four N doses of 0, 30, 60 and 90 kg ha^{-1} were incorporated into the soil 2 days before sowing. Satellite treatment with total of 60 kg N ha^{-1} as urea was applied as chemigation (four times 15 kg N ha^{-1}) between preflowering and flowering period. The ETA 15, ETA 10, Pitoco and BRS Radiante lines were planted as test materials.
Experiment 2, Optimum time for N application: The 60 kg N ha^{-1} as urea was applied at 10 and 5 days before sowing and at planting date. Cultivars tested were Rudá, Pérola, BRS Valente and Cranberry.
Experiment 3, Method of N applications for reducing soil compaction: Urea was applied parallel and diagonally (45°) to the sowing direction at the doses of 30 and 60 kg N ha^{-1}. The diagonal drilling of fertilizer was to avoid excessive soil compaction by tractor traffic near the bean rows on humid soil under central pivot system. The lines ETA 15, ETA 10, Pitoco and BRS Radiante were used for this experiment.

Results: Experimental data of experiments is presented in Tables 1 to 3. The overall yield was 2300 kg ha^{-1}, which is 300 kg ha^{-1} higher than the farmer's average yield. Maximum yield was 2775 kg ha^{-1} with the application of 60 kg N ha^{-1} and higher doses did not increase yield. The N application through chemigation gave the same yield as control treatment, probably due to high N volatilization losses. The best time for N side dressing was 10 days before planting. This suggests that 10 days was sufficient for releasing the fixed N by soil microorganisms and also reduced the salt concentration of the nitrogen fertilizer around the root zone. Similar results were obtained by Kluthcouski et al., 2006 in other crops. The diagonal alignment of the N application did not yielded as the standard parallel application, because bean roots do not spread laterally as those in the sub irrigation system (Santos et al.2002). Hence, the

plants could not absorb the N on the far side of the bean row. This fertilization recommendation is site specific and should not be applied to other region before similar research is conducted. In high temperature regions new lines such as ETA 15, ETA 10 (both type III) and Pitoco yielded more than 2300 kg ha^{-1}, about 300 kg ha^{-1} higher than the older cultivars such as Rudá, Pérola or BRS Radiante. This suggests that prostrate type III plants are better adapted to the high temperature regions than erect type II and still can be mechanically harvested through pulling, windrowing and combining.

Table 1. Yield (kg ha^{-1}) of four bean lines as affected by method and doses of N application at Triangulo farm in Bonopolis/GO, 2006.

Treatment (kg ha^{-1})	ETA 15	Pitoco	ETA 10	BRS Radiante	Average
60 N Central pivot	2185	2099	1518	1245	1762 c
0 N	2137	2162	1832	1235	1841 c
30 N	2923	2506	2378	1950	2439 b
60 N	3259	2834	2688	2317	2775 a
90 N	3060	2482	3156	2317	2754 a
Average	2713 a	2417 b	2314 b	1813 C	2314

CV (%) = 16

Table 2. Yield (kg ha^{-1}) of four bean lines as affected by the time of N application at Triangulo farm in Bonopolis/GO, 2006.

Treatment	Rudá	Pérola	BRS Valente	Cranberry	Average
At planting	2208	1982	1956	1633	1945 c
5 DBP	2517	2070	1955	1821	2091 b
10 DBP	2719	2433	2336	1964	2363 a
Average	2481 a	2162b b	2082b b	1806c c	2133

DBP = days before planting. CV (%) = 11.

Table 3. Yield (kg ha^{-1}) of five bean lines as affected by alignment and doses of N application at Triangulo farm in Bonopolis/GO, 2006.

Treatment (kg ha^{-1})	ETA 15	Pitoco	ETA 10	BRS Radiante	Average
0 N	2137	2162	1832	1235	1841 d
30 N Diagonal	2420	2650	2064	1587	2180 c
30 N Parallel	2923	2506	2378	1950	2439 b
60 N Diagonal	2373	2909	2382	1614	2319 bc
60 N Parallel	3259	2834	2688	2317	2775 a
Average	2622 a	2612 a	2269 b	1741 C	2311

CV (%) = 14

Literature:

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