

BEAN PRODUCTION AS AFFECTED BY MIXTURES AND PLACEMENT OF FERTILIZERS

I. P. de Oliveira, J. Kluthcouski, H. Aidar, M. Thung¹, T. Cobucci, R. S. M. Santos and J.G. da Silva
Embrapa Arroz e Feijão. Cx. Postal 179. 75.375-000 Santo Antônio de Goiás. Brazil

Most chemical fertilizers are mineral salts and when dissolved in soil solution, near the proximity of fertilizer granulate has a high osmotic pressure. The bean root when come in contact with this high osmotic pressure solution, caused seedling injuries as well as mortality, and reduction of final plant population. High doses of phosphate fertilizer have reduced the final population up to 50%, potassium chloride up to 60% and the combination of high dose of both 74% reduction, when placed 5 cm beside the bean seed at the same depth (Vieira 1983).

In no-till system, seed injuries frequently occur when the fertilizer is placed close to the seeds. If the seed managed to germinate, it showed chlorotic and necrotic symptoms on the border of younger leaves. Nitrogen fertilizers such as ammonium sulfate, ammonium nitrate, sodium nitrate, urea, and potassium chloride produce the highest burning symptoms. Kluthcouski et al (1999) recommend fertilizer application at least 5 cm deeper than the seeds to avoid the leaves burning and allow the normal root growth.

The effect of mixtures and placement of chemical fertilizer on bean yield was studied in two experiments, conducted on an Oxisol at Santa Fe farm, in Santa Helena de Goiás/GO, Brazil, using cv. Perola and row spacing of 0.45 m and planted with initial population of 12 seeds m⁻¹. Chemical properties of the experimental site at 20cm depth were: P 40.6 mg kg⁻¹, K 164 mg kg⁻¹, Ca 5.7 mmol_c L⁻¹ and Mg 1.5 mmol_c L⁻¹. All micronutrient contents were above the critical levels. The organic matter content of the upper soil layer (0-20cm) was higher than 30g kg⁻¹.

The first experiment was to evaluate the effect of mixtures of potassium chloride and simple superphosphate fertilizer on final plant population and bean yield in the no-till farming system. The basal treatments were applied to all plots at the rate of 30 kg ha⁻¹ of N in form of urea and 70 kg ha⁻¹ as side dressing in form of ammonium sulfate at 21 days after germination. Mixture of simple superphosphate and potassium chloride were: a) 30 K₂O + 60 P₂O₅; the official recommended fertilizer doses for the State of Goiás, b) 45 K₂O + 23 P₂O₅ kg ha⁻¹, the amount of nutrient exported by bean seed from the field at harvest, and c) check without fertilizer. The fertilizer mixtures were placed about 5cm below the seeds. The second experiment was to evaluate the effect of 5 and 10 cm of fertilizer placement below the bean seeds on yield. The basal fertilizer doses were 350kg ha⁻¹ of complete fertilizer grade 2:20:20 plus 30kg ha⁻¹ as urea and side dressed with 70 kg ha⁻¹ as ammonium sulfate at 21 days after germination in no till planting system and in plots plowed with moldboard plow. The electric conductivity of the soil solution was measured, to characterize the soil salinity level.

The results of the experiments are shown in Table 1 and 2. With the increase of potassium chloride doses, the final plant population decreased and bean yield increased, however statistically not significant (Table 1). The reduction of final plant population did not affect the bean yield, because of the growth habit III of cv. Perola to compensate the low plant density by producing greater number of branches. The mixture of 45kg ha⁻¹ potassium chloride and 23kg ha⁻¹ of simple superphosphate produced the highest yield. This indicates that increase in bean yield is possible by increasing soil fertility in highly fertile soil.

Table 2 shows that the higher bean yield was obtained when the fertilizer is deeply placed either in no-till system or in plot prepared with moldboard plowing. Check plots without fertilizer

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prepared with moldboard plow produced higher bean yield than those in no-till system. This means that there is nutrient mobilization through mineralization process, when land is plowed. The highest final plant population was obtained from plot with deepest fertilizer placement, in no-till system as well in plots prepared with moldboard plow. Placing the fertilizer at 5cm depth cause yield reduction in moldboard plow plots, but not in no-till system. The electric conductivity was 0.23 dS m^{-1} in plots without fertilizer and 1.46 dS m^{-1} when fertilizers was placed 5 cm below the seeds at doses of 350 kg ha^{-1} in no till system. Yield reduction was non-significant, but MAAS (1986) reported that the critical salinity level for bean is around 1 dS m^{-1} . The large quantity of organic matter on the upper layer of the soil may act as a buffer, whereas, low organic matter content in the plowed plot reduced the bean yield as well as the final plant population. These results suggest that the doses of fertilizer used in both experiments were not high enough to increase the bean yield significantly in no-till system. The bean yield increased by placing the fertilizer at 10 cm, however statistically non nsignificant in no-till system.

Table 1. Effect of fertilizer mixtures on the final plant population (FPP) and bean yield in no till system at Santa Fe farm in Santa Helena de Goias/GO.

Fertilizer mixture (kg ha^{-1})	Final plant population (x 1000)	Yield (kg ha^{-1})
0 K_2O + 0 P_2O_5	182.2	2247
30 K_2O + 60 P_2O_5	162.5	2328
45 K_2O + 23 P_2O_5	145.0	2525
CV (%)	17	10

Table 2. Effect of depth of fertilizer placement in no-till system and in land plowed with mouldboard plow on the final plant population (FPP) and bean yield at Santa Fe Farm, Santa Helena/GO.

Fertilization placement (cm)**	Final plant population (x1000)		Yield kg ha^{-1}	
	No till system	Mold board plow	No till system	Mold board plow
Check***	246.1	228.4	2499	2899 a*
5 cm	238.6	219.7	2629	2520 b
10cm	232.7	249.3	2846	3087 a
Mean	239.1	232.5	2658	2815
			CV (%) = 11	

* The means in the same column followed by the same letters are not significantly different at $P < 0.05$.

** Fertilizer rate at planting: 350 kg ha^{-1} of complete fertilizer grade 2:20:20 plus 30 kg ha^{-1} as urea and side dressed with 70 kg ha^{-1} as ammonium sulfate.

*** Check without fertilizer

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