Breaking the old paradigm in upland Oxisols: Nitrogen application for higher bean yield.

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The nitrogen is the most deficient nutrient in tropical soil (CIAT, 1990), followed by phosphorus (Thung, 1990). It has been estimated that 40% of bean production areas is N deficient, a constrain to modern bean production system. The N requirement in Brazil is determined by the foliar analysis and by the response curve and the soil organic matter (SOM) content, both determines the rate of N recommendation. High response was obtained in soils with low SOM and in soils with high SOM content the response of bean to N application is low to nil recommended to eliminate the side dressing. It was also recommended to split N application, where small amount (10 to 20 kg N ha^{-1}) at planting and the rest is applied at 15 to 21 days after germination (DAE). On high SOM the side dressing should be eliminated (Anghinoni et al., 1985). This recommendation was based on evaluations on soils recently opened for agriculture in the early 70's, where base saturation and aluminum toxicity and SOM were limiting. In the last decade, the soil fertility has gradually improved due to yearly high rates of cheap fertilizer application. Liming has neutralized the aluminum toxicity and organic matter on the upper soil layers has been accumulated due to direct planting and no tillage system. The recommendation of split N application of the year 70's is still used to this date, ignoring the progress has been made in cropping system and better soil fertility of the farm land. In irrigated bean production system, N deficiency has been frequently observed at post flowering period in commercial cultivars and yield obtained seldom reached over 3 Mg ha^{-1}, although yield potential of some cultivars is greater than 4 Mg ha^{-1}. Split N application does not satisfy the N supply and side dressing does not deliver N on time at the peak demand of the plant.

Two experiments in split plot design with four repetitions with cv. Carioca was conducted at ST Helena on fertile Oxisol (see Table 1 for soil chemical characteristics) on farm practicing minimum tillage for more than 15 years.

The objective of the first experiment in randomized block design with four repetitions was to verify the optimum rate of N applied at planting time on cv Carioca, varying between 0 to 135 N kg ha^{-1} as Urea applied at 8 cm depth. The basal treatments are 60 K_2O kg ha^{-1} as potassium chloride and 90 P_2O_5 kg ha^{-1} as simple superphosphate.

The second experiment in split plot design and four repetitions has the objective to determine the optimum basal application in combination with optimum time for side dressing. The rate for side dressing was 45 N kg ha^{-1}. The main plot was the N rates applied at planting time (0, 45, 90 and 135 N kg ha^{-1}) and the subplot was the time of side dressing (0, 10, 20 and 30 DAE). The net plot area was 10 m^2. Urea was used as N source and K and P rates were the same as in the experiment one.

Increasing rate of N at planting increased yield significantly and the highest yield was 4116 Mg ha^{-1}, obtained from plot with 90 N kg ha^{-1} applied at planting (Table 2). N rates higher than 90 N kg ha^{-1} did not increase yield. The yield component analysis showed that all yield parameters increased significantly with N application and further increase N rate did not always increase the yield components significantly. Hundred seed weight increased up to the rate of 90 N kg ha^{-1}

Results from experiment 2 showed that combination of 90 N kg ha^{-1} at planting with side dressing at 10 DAE gave the highest yield (5455 Mg ha^{-1}). It can be concluded that N is the limiting factor for high bean production and higher yield than 4 mg ha^{-1} can be obtained when adequate N rate was given at planting in combination with side dressing at 10 DAE. These results challenged the common practice of split N application in bean, where low rate was given at planting and higher rate during side dressing at 21 DAE.
It will be verified whether the same result can be obtained in the second year on the same site, so that recommendation can be applied for bean under central pivot irrigation system.

Table 1. Soil chemical characteristics of Oxisol of Santa Helena-GO, 2004

Depth	pH	Ca	Mg	Al	H + Al	P	K	Cu	Zn	Fe	Mn	O.M.
(cm)	$CaCl_2$	$Mmol_c/dm^3$				mg/dm^3						g/dm^3
0-20	5,1	32	10	3	64	42	1,5	3,0	1,9	12	6,9	33

Table 2. The effect of different rate of N applied at planting time on yield and yield component of CV. Pérola. St. Helena-GO, 2004.

N kg ha^{-1}*	Mean				
	Stand ($10m^2$)	Pods $plant^{-1}$	Seeds pod^{-1}	100 seed wt (g)	Yield (kg ha^{-1})
0	198a	13,8b	4,2b	22,1b	3.098d
45	200a	15,7ab	5,1a	24,5ab	3.834b
90	192ab	16,2ab	4,8ab	26,1a	4.116a
135	181b	17,9a	4,7ab	24,4ab	3.962ab
Mean	-	-	-	-	-
CV(%)	6,1	18,8	18,3	7,8	6,1
LSD (5%)	12,2	3,1	0,89	2,0	242,4

Table 3. The effect of N applications rates at planting time and application time of side dressing on yield of cv. Carioca in St. Helena-GO, 2004.

N* kg ha^{-1}	Side dressing in days after emergence					Mean
	Not Applied	0	10	20	30	
0	2.894	4001	3315	35401	3515	3453d
45	3995	4189	4162	3705	4123	4035c
90	3952	4473	5455	4232	4499	4462a
135	3861	4132	4924	4193	4268	4275ab
Mean	3626c	4199b	4464a	3918c	4101b	

LSD (5%): 205; cv (%): 7.9; Side dressing with 45 N kg ha-1 as urea; * applied before planting.

Literature:

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