Breaking the paradigm in lowland tropics under sub irrigation system: Nitrogen application and bean yield.

H. Aidar, M. Thung, J. Kluthcouski, D. M. Soares
Embrapa Arroz e Feijão. Caixa. Postal 179. 75.375-000 Santo Antônio de Goiás/GO, Brazil

The lowland tropics supposed to be not appropriated for bean production, because of high temperature and normally the domain of the rice production during the rainy seasons. The expansion of bean production to lowland tropics with subirrigation (raising the water table) is attractive. Common bean diseases do not develop under these conditions because of the relative low humidity and dry period during the whole crop cycle and the producing healthy bean seeds due to less chemical application for plant protection. Average bean yield is around 2 Mg ha^{-1} with the technologies adopted from the highland area using the same cultivars and fertilizer rates. Split N applied at planting and the side dressing at 21 days after emergence (DAE) as practiced in highland regions not proved adequate to meet the N requirement during the peak demand. High soil organic matter (SOM) and stubble left by the previous crop (rice) induces high microorganism activities, hence fixed temporary the applied N. Reducing the rice stubble by burning is forbidden recently due to the new pollution or environment law, aggravating N deficiency.

The objectives of these experiments were 1. to obtain the optimum rate of N at planting in 4 cultivars, 2. the optimum N rate applied at planting in combination of different dates of side dressing with 45 kg N ha^{-1} as urea; and 3. the interaction between N and P on bean yield.

Experiments were conducted in 2004 in split plot design with four repetitions with net plot of 10 m^2. The main plots are the basal treatments at planting and the subplot either the cultivars or the side dressing time. Potassium was applied at the rate of 60 K_2O kg ha^{-1} and 80 P_2O_5 kg ha^{-1} to all plots in the first and second experiments. In the third experiment 60 K_2O kg ha^{-1} as potassium chloride was given as basal application and varying the N and P doses. The soil characteristics are shown in Table 1. The soil was high in organic matter and phosphorus, but deficient in Mn. The best cultivar obtained from the first experiment was cv. Carioca at the dose of 90 N kg ha^{-1} and urea as the N source. The second experiment showed that 90 N kg ha^{-1} as urea applied before planting without any side dressing gave the highest yield. This means that total N applied at planting was sufficient to obtain the highest yield in this environment without causing burning to the plants during the germination or excessive vegetative growth before flowering period. Very late side dressing as 25 DAE proved to be ineffective.

The third experiment showed the highest bean yield was obtained from the combination of 30 P_2O_5 kg ha^{-1} and 90 N kg ha^{-1}. Higher doses than this did not increased yield significantly. These results concludes that under lowland tropics with subirrigation system a total N dose up to 90 N kg ha^{-1} can be applied before planting without causing burning to the seedlings and phosphorus up to 30 P_2O_5 kg ha^{-1} proved to be adequate rate for this environment.

These experiments showed that there are still room for yield improvement through better cultural practices e.g., N application at planting time and better adapted cultivars for this region. It will be verified whether the same result can be obtained in the second year on the same site, so that this practices can be recommended to all farmers of the region.

Table 1. Soil chemical characteristics of the lowland tropic, 2004.

Depth	pH	Ca	Mg	Al	H + Al	P	K	Cu	Zn	Fe	Mn	O.M.
(cm)	Water	mmol$_c$/dm^3				mg/dm^3						g/dm^3
0-10	5,8	43,2	11,2	1	90	32,5	145	1,7	4,2	82	16	54
10-20	5,9	42,0	10,7	1	91	30,6	78	1,6	3,5	85	17	50

Table 2. The effect N levels applied at planting on yield of 4 cultivars in the Lowland Tropic, 2004.

N* kg ha^{-1} at planting	Cultivar				
	Carioca	ETA*	Carioca Precoce	BRS Valente	Mean
			Yield (kg ha^{-1})		
0	1.707	1.244	985	1.074	1.252 c
45	2.660	2.324	2.337	2.480	2.450 b
90	3.116	2.547	2.574	2.709	2.736 a
135	2.742	2.480	2.402	2.386	2.502 b
Mean	2.556 a	2.149 b	2.074 b	2.162 b	

LSD (5%): 108; CV (%): 10.9; * Urea fertilizer

Table 3. The effect of N levels at planting and time of side dressing on yield of cv Carioca grown in the Lowland Tropic, 2004.

N* kg ha^{-1} at planting	Side dressing in days after emergence				
	Not applied	0*	10	25	Mean
			Yield (kg ha^{-1})		
0	1.707	2.585	2.074	1.508	1.969 c
45	2.660	2.621	3.115	2.713	2.778 b
90	3.116	2.967	3.148	3.026	3.064 a
135	2.742	2.987	3.003	2.677	2.852 b
Mean	2.556 b	2.790 a	2.835 a	2.481 b	

LSD (5%): 157; CV (%): 8.2. Side dressing with 45 N kg ha^{-1}, urea fertilizer.

Table 4. Combinations of N and P doses on yield of Carioca in Lowland Tropic, 2004.

N kg ha^{-1} at planting	P_2O_5 (kg ha^{-1})			
	0	30	80	Mean
		Yield (kg ha^{-1})		
0	2.105	1.870	1.707	1.894 c
45	2.630	3.048	2.660	2.779 a
90	2.563	2.804	3.116	2.828 a
135	2.280	2.562	2.742	2.528 b
Mean	2.394 b	2.571 a	2.556 a	

LSD (5%): 124; CV (%): 15.5