ACCUMULATION OF MACRONUTRIENTS BY DIFFERENT COMMON BEAN CULTIVARS GROWN IN DIFFERENT PLANT DENSITIES IN CONVENTIONAL CROP SYSTEM

M.J.B. Andrade[1], N.M.B.Vieira[2], L.P. Carvalho[3] and P.M. Rezende[1]

[1]Departamento de Agricultura, Universidade Federal de Lavras, Caixa Postal 3037, 37200-000 - Lavras, [2]Universidade Estadual de Montes Claros, *campus* Janaúba, Caixa Postal 91, 39440-000, Janaúba, [3]Departamento de Ciência dos Alimentos, Universidade Federal de Lavras, Caixa Postal 3037, 37200-000 – Lavras, Minas Gerais State, Brazil

INTRODUCTION:

The aim of the current study was to follow the accumulation of macronutrients throughout the crop cycle in different cultivars of common bean with carioca seed type, grown under different plant densities in field experiments using a conventional cropping system.

MATERIALS AND METHODS:

The experimental design was randomized blocks with three replications and a 4x5 factorial scheme, involving four bean cultivars (Table 1) and five plant densities (75, 145, 215, 285 and 355 thousand plants.ha^{-1}). The soil preparation was carried out by one operation with plow and two operations with harrow. The experiment had not been irrigated. Each plot had four rows with 5.0 m length and spacing of 0.5 m between rows. At sowing (November, 2006), all the plots had received identical fertilization, determined by the soil analysis interpretation. The N fertilization at covering (at 21 days after emergency-DAE) was 30 kg.ha^{-1} of N, urea source. Every 10 days, samples of 10 plants were collected and dried under air circulation to 65-70°C, until constant mass, soon after they had been triturated and sent to the Laboratory of Leaf Analysis of the Soil Science Department (UFLA) for determination of the macronutrients content. The N content was evaluated by Kjedahls method while P, K, Ca, Mg, S were extracted by digestion by nitric and percloric acid and quantified in the extract (P colorimetrically, K- flame photometry; S-turbidimetry; Ca, Mg spectrophotometry of atomic absorption).

Table 1. Principal characteristics of the studied cultivars.

Characteristics	BRS Radiante*	Bolinha**	Ouro Vermelho*	Jalo EEP 558*
Commercial group	Others	Others	Others	Jalo
Seed color	cream / beige	yellow	red	yellow
Growth habit	I	II	II/III	III
100 grain's weight	44-45 g	32-33g	25 g	30-40 g
Stem	erect	erect	semi-erect	semiclimber
Cultural cycle	early	middle	normal	middle

* Ramalho & Abreu (2006), ** Alves (2008)

RESULTS AND DISCUSSION:

At flowering, large proportion of the each macronutrient is reached by the bean cultivars. The maximum accumulations of N, P, K, Mg and S are registered at the end of the crop cycle, wile the maximum Ca accumulation occurring around 50-60 DAE; the cv. Bolinha showed signifficative interation between DAE and plant population (Table 2). The cv. Ouro Vermelho accumulates more K, Ca, Mg and S (Table 3). The general decreasing order of accumulation is N>K>Ca>Mg>P>S.

Table 2. Accumulation of macronutrients (kg ha^{-1}) by four bean cultivars, in function of DAE.

Cultivar	Nutrient	Regression	R^2 (%)
Jalo EEP 558	N	$Y= 2,552751 + 0,270073\ x + 0,005232\ x^2$	95,77
	P	$Y= 1,546980 - 0,057874\ x + 0,000156\ x^2$	91,98
	K	$Y= 0,480305 + 0,151709\ x + 0,003715\ x^2$	97,15
	Ca	$Y= -6,354678 + 0,697968\ x - 0,005085\ x^2$	81,13
	Mg	$Y= -0,484072 + 0,077824\ x - 0,000020\ x^2$	93,37
	S	$Y= -0,110939 + 0,037889\ x + 0,000058\ x^2$	95,69
BRS Radiante	N	$Y= -2,862843 + 0,631350\ x + 0,000290\ x^2$	79,68
	P	$Y= -0,446296 + 0,057872\ x + 0,000210\ x^2$	92,10
	K	$Y= -3,511032 + 0,484458\ x - 0,001608\ x^2$	89,27
	Ca	$Y=-6,726046 + 0,760801\ x - 0,007753\ x^2$	81,39
	Mg	$Y=-0,729224 + 0,106695\ x -0,000681\ x^2$	90,97
	S	$Y=-0,335356 + 0,058732\ x - 0,000338\ x^2$	92,99
Ouro Vermelho	N	$Y= -12,324369 + 1,327124\ x - 0,006238\ x^2$	82,68
	P	$Y= -0,296778 + 0,106324\ x - 0,0000237\ x^2$	86,32
	K	$Y= -3,204919 + 0,331758\ x + 0,003843\ x^2$	91,63
	Ca	$Y= -12,966067 + 1,218299\ x - 0,008724\ x^2$	92,86
	Mg	$Y= -1,044143 + 0,117457\ x - 0,000174\ x^2$	86,23
	S	$Y=-1,414437 + 0,132443\ x - 0,000220\ x^2$	92,83
Bolinha	N at 215*	$Y= -1,751540 + 0,373600\ x + 0,000941\ x^2$	84,23
	N at 285	$Y= -20,113270 + 2,220640\ x - 0,018531\ x^2$	90,98
	N at 355	$Y= -14,578836 + 2,132255\ x - 0,012888\ x^2$	92,30
	P at 215	$Y= -0,597096 + 0,052913\ x + 0,106578\ x^2$	84,32
	P at 285	$Y= -2,783199 + 0,248119 - 0,001970\ x^2$	85,38
	P at 355	$Y= -3,738039 + 0,327908 - 0,002166\ x^2$	77,59
	K at 215	$Y= 1,496467 - 0,029352\ x + 0,004518\ x^2$	92,98
	K at 285	$Y=-9,523853 + 0,982414\ x - 0,006271\ x^2$	94,98
	K at 355	$Y=-10,401975 + 1,186585\ x - 0,005212\ x^2$	87,81
	Ca at 285	$Y=-17,346703 + 1,618399\ x - 0,014868\ x^2$	76,26
	Ca at 355	$Y=-16,936917 + 1,755528\ x - 0,015393\ x^2$	76,39
	Mg at 215	$Y=0,201817 + 0,011150\ x + 0,000588\ x^2$	87,06
	Mg at 285	$Y=-2,682902 + 0,276498\ x - 0,002126\ x^2$	88,47
	Mg at 355	$Y=-2,729931 + 0,302017\ x - 0,001953\ x^2$	84,65
	S at 215	$Y=-0,222967 + 0,031707\ x + 0,000014\ x^2$	88,97
	S at 285	$Y=-1,654399 + 0,164519\ x - 0,001299\ x^2$	90,34
	S at 355	$Y=-1,922884 + 0,211422\ x - 0,001389\ x^2$	73,79

*At considered significant plant populations.

Table 3. Macronutrients accumulation (kg ha^{-1}) in the aerial part of the plant of four bean cultivars.

	N	P	K	Ca	Mg	S
Bolinha	31,70 a	3,50 a	24,74 b	14,24 b	4,93 b	2,46 b
Jalo EEP 558	44,03 a	4,60 a	27,83 b	13,89 b	4,39 b	2,66 b
BRS Radiante	34,50 a	4,11 a	19,51 b	7,23 b	3,05 b	1,96 b
Ouro Vermelho	42,16 a	4,65 a	41,52 a	30,11 a	8,18 a	6,75 a
Means	38,09	4,21	28,40	16,36	5,13	3,45

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