EFFECTS OF SEED TREATMENT WITH INSECTICIDE ON THE GERMINATION, NUTRIENTS, NODULATION, YIELD AND PEST CONTROL IN BEAN (*PHASEOLUS VULGARIS* L.) CULTURE.

M. H. CALAFIORI & A. A. BARBIERI [1]

(1) Agronomic Engineering Course – CREUPI. Espírito Santo do Pinhal – SP – Brazil. E-mail: cpagrpin @ rantac.com.br.
Aceito para publicação em:

RESUMO

EFEITO DE TRATAMENTO DE SEMENTES COM INSETICIDA NA GERMINAÇÃO, NUTRIENTES, NODULAÇÃO, PRODUÇÃO E CONTROLE DE PRAGAS EM FEIJOEIRO (*phaseolus vulgaris* L.).

Ensaios foram instalados no "campus" experimental II do Curso de Engenharia Agronômica - CREUPI - Espírito Santo do Pinhal - SP, em outubro de 1998, março de 1999 e outubro de 1999. O delineamento experimental foi blocos ao acaso com 5 repetições. Os tratamentos foram: A- testemunha; B- NPK; C- NPK + tiametoxam 700 WS (35 g i.a./100 kg de semente); D- NPK + tiametoxam 700 WS (70 g i.a./100 kg de semente); E- NPK + tiametoxam 700 WS (140 g i.a./100 kg de semente); F- NPK + carbofuram 350 TS (700 g i.a./100 kg de semente); G- tiametoxam 700 WS (35 g i.a./100 kg de semente); H- tiametoxam 700 WS (70 g i.a./100 kg de semente); I- tiametoxam 700 WS (140 g i.a./100 kg de semente); J- carbofuram 350 TS (700 g i.a./100 kg de semente). A adubação foi baseada na análise de solo. As avaliações foram feitas para germinação, teores de nutrientes nas folhas, nodulação, produção e população de *Thrips tabaci*, *Diabrotica speciosa*, *Bemisia tabaci* e *Empoasca kraemeri*. Os resultados permitiram concluir que: a) o maior número de plantas germinadas ocorreu em tiametoxam (35 g i.a.) + NPK; b) o melhor controle para *D. speciosa* foi o tiametoxam (70 g i.a.) sem NPK; c) todos os tratamentos, com exceção do NPK e da testemunha, controlaram *T. tabaci* durante o segundo e terceiro ensaios; d) *B. tabaci* foi controlada nas estações seca e chuvosa pelos inseticidas sozinhos ou com NPK; e) *E. kraemeri* foi controlada somente no terceiro ensaio por todos os tratamentos, exceto NPK e a testemunha; f) o maior número de nódulos viáveis ocorreu em tiametoxam (70 g i.a.) + NPK durante o primeiro teste e em tiametoxam (35 g i.a.) na estação seca e no terceiro teste todos os tratamentos apresentaram número menor do que o tratamento sem inseticida e NPK; g) os resultados de teores de nutrientes foram diferentes nas estações chuvosas e seca; h) a produção da estação seca foi maior no tratamento com NPK e tiametoxam (70g i.a.) + NPK.
Palavras-Chave: efeito tônico, *T. tabaci*, *D. speciosa*, *B. tabaci*, *E. kraemeri*.

ABSTRACT

Trials were carried out in experimental campus II of Agronomic Engineering Course – CREUPI – Espírito Santo do Pinhal – SP, in October, 1998, March, 1999 and October,1999 with bean, variety Carioca. The experimental design was complete randomized block with 5 replications. The treatments were: A- control; B- NPK; C- NPK plus thiamethoxam 700 WS (35 g a.i./100 kg of seeds); D- NPK plus thiamethoxam 700 WS (70 g a.i./100 kg of seeds); E- NPK plus thiamethoxam 700 WS (140 g a.i./100 kg of seeds); F- NPK plus carbofuran 350 TS (700 g a.i./100 kg of seeds); G- thiamethoxam 700 WS (35 g a.i./100 kg); H- thiamethoxam 700 WS (70 g a.i./100 kg); I- thiamethoxam 700 WS (140 g a.i./100 kg) J- carbofuran 350 TS (700 g.a.i/ 100 kg).The fertilization was based on soil analysis.The evaluations were made for germination, grades of nutrients in the leaves, nodulation, yield and population of *Thrips tabaci*, *Diabrotica speciosa*, *Bemisia tabaci*, *Empoasca kraemeri*.The results allowed to conclude: a) the greatest germination occurred in thiamethoxam (35 g.a.i) plus NPK; b) the best control to *D. speciosa* was thiamethoxam (70 g.a.i) without NPK; c) all treatments, excepting NPK, controlled *T. tabaci* during the second and the third test; d) *B. tabaci* was controlled in dry and rainy season by the insecticides alone or together with NPK; e) *E. kraemeri* was controlled only in the third test by all treatments, excepting NPK and the control; f) the greater number of viable nodules occurred in thiamethoxam (140 g.a.i.) plus NPK during the first test and in thiamethoxam (35 g.a.i.) in dry season, and in the third test all treatments presented smaller number than treatment without insecticide and NPK; g) the results of nutrients grades were different in dry and rainy season; h) the yield of dry season was greater in the treatment with NPK and thiamethoxam (70g.a.i.) plus NPK.
Key Words: tonic effect, *Thrips tabaci, Diabrotica speciosa, Bemisia tabaci, Empoasca kraemeri.*

INTRODUCTION

The bean plant is a subsistence culture, however, lately, the cultivated area has increased and thus also the insect-pests. Modern technologies are already used, because there isn't harvest without fertilizers and insecticides/fungicides.

Normally, these chemical products are analyzed about efficiency for the control of pests and diseases. There are factors that can suffer their interference or that can influence their efficiency and they aren't studied. Maxwell & Harwood (1958) confirm this and they conclude that soil insecticide can change the nutritious value of host plant.

Maxwell (1972) asseverate that the LD_{50} of several insecticides can vary above 100% depending on source of food or insect diet.

However, some other aspects have awakened the interest of researchers. Camargo *et al.* (1981) observed that the carbofuran and aldicarb when they were applied in soil, they didn't interfere on bean nodulation.

Following this research line, Medeiros *et al.* (1982) evaluated the influence in this culture of carbofuran on nodulation, germination and yield culture and they concluded that there wasn't interference of the insecticide on nodulation, but there was control of thrips, leafhopper and aphid.

Carbofuran and aldicarb were used combined with different sources of potassium by Pallini Filho *et al.* (1987) at the experiment with peanut. Treatments with aldicarb presented greater increase of nodules. Both insecticides showed greater number of nodules in the KCl presence.

Another parameter studied is the influence of these products on the plant nutrients. Fouche *et al.* (1977) applied aldicarb in orange, variety Valencia, in South Africa, and they observed an increase of potassium grade in the leaves when compared with KNO_3, KCl and K_2SO_4 application in spraying.

The increase in the aldicarb application on citric orchard in Florida induced Wheaton *et al.* (1985) at research of its influence on yield, fruit qualities and nutrients. Plants treated with aldicarb suffered lesser damage by frost and in the second year there was increase of yield, of phosphorus and calcium.

Anania *et al.* (1988 a, b) studied the effect of the aldicarb on leaves of lemon tree, variety Taiti and peanut obtaining increases of potassium and phosphorus.

Calafiori *et al.* (1989) obtained increase of N-P-K in the leaves of coffee tree treated with aldicarb, disulfoton and carbofuran.

Souza Neto & Teixeira (1991) showed increase of nutrients in roots and aerial part of corn treated with carbofuran. Also, Oya *et al.* (1991) observed increase of potassium and phosphorus in the tomato leaves with aldicarb and carbofuran.

The yield was analyzed by Junqueira *et al.* (1988) when they associated aldicarb with fertilizers on potato plant and they concluded that there was greater yield.

Fachini *et al.* (1991) treated seeds of corn with insecticides and zinc and there was increase of nutrients and production in the treatments with thiodicarb plus zinc. Carbofuran plus N-P-K also induced at greater yield.

Godfrey & Holtzer (1992) studied the effect of soil insecticides on corn physiology and concluded that the responses of the plant are related to interaction of insecticides with environmental conditions, especially, soil moisture.

The effect of fertilizers on the insecticide and on entomogenous efficiency for pest control was observed by Veronesi *et al.* (1990), Pianoski *et al.* (1990), Zambon *et al.* (1991), Castanheira *et al.* (1993), Tanzini *et al.* (1993), Cardoso *et al.* (1995) and Crnkovic *et al.* (1995).

This test was realized to verify if these parameters are influenced by thiamethoxam.

MATERIAL AND METHODS

Trials were carried out in experimental campus II of Agronomic Engineering Course – CREUPI – Espírito Santo do Pinhal – SP, Brazil, in October, 1998, March, 1999 and October,1999 with bean (*Phaseolus vulgaris* L.), variety Carioca.

The experimental design was complete randomized block with five replications. The treatments, dosages are in the Table 1.

The fertilization was based upon soil analysis. Bean was spaced 0,5m with 15 seeds/meter. The plots had 4 rows of 5m of length. Irrigation was by sprinkling and weeding was manual. The seeds were treated with *Rhizobium tropici* in the laboratory and after they were taken to the field where the seeds were placed in a sterilized plastic bag for the treatment by thiamethoxam and right after they were planted.

Evaluations were made for: the) germination – number of germinated plants was counted at one meter on two central rows; b) foliar analysis - twenty leaves per plot were collected during the flowering on two central rows and so they were analysed in Analysis Foliar Laboratory ; c) nodulation – roots of ten plants/plot were collected during the flowering and viable nodules (nodules containing the reddish pigment characteristic of leghemoglobin) were counted; d) *T. tabaci, D. speciosa, B. tabaci* and *E. kraemeri* were evaluated by examining twenty plants/plot and one leaf/plant; e) yield was determined by picking twenty plants on two rows in each plot. The data were transformed to root of x or root of x+0,5 to normalize them and then subjected to analysis of variance and the treatment averages were compared by Tukey's test. The treatment efficiencies, were expressed as a percentage, using Abbott's formula (1925).

Table 1. Treatments, dosages of the products utilized in the test with seed treatment in bean plant. Espírito Santo do Pinhal – SP – 1998/1999.

Treat.	Commercial Name	Common Name	Dosage	
			g a.i./100 kg	g c.p./100 kg
A	——	——	——	——
B	NPK	NPK	——	——
C	NPK + Cruiser 70 WS	NPK + thiamethoxam	35	50 g
D	NPK + Cruiser 70 WS	NPK + thiamethoxam	70	100 g
E	NPK + Cruiser 70 WS	NPK + thiamethoxam	140	200 g
F	NPK + Furadan 350 TS	NPK + carbofuran	700	2 *l*
G	Cruiser 70 WS	thiamethoxam	35	50 g
H	Cruiser 70 WS	thiamethoxam	70	100 g
I	Cruiser 70 WS	thiamethoxam	140	200 g
J	Furadan 350 TS	carbofuran	700	2 *l*

RESULTS AND DISCUSSION

Plant germination (Table 2), at the first test, during rainy season, was greater for the treatments with NPK plus thiamethoxam 700 WS (35 g.a.i.), NPK plus thiamethoxam 700 WS (70 g.a.i.). The best treatment, during the third test, in rainy season, was NPK plus thiamethoxam 700 WS (35 g.a.i.) and during the third test, in rainy season, it was NPK plus thiamethoxam 700 WS (70 g.a.i.) and NPK plus carbofuran 350 TS. The insecticide with or without NPK didn't affect the germination in the test realized during rainy season.

Table 2. Number of germinated bean plants at the tests with thiamethoxam, during 3 periods. Esp. Sto. do Pinhal – SP –1998/1999.

Treat.	1st test			2nd test			3rd test		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	18.70	4.324 a	—	17.40	4.169 ab	—	14.10	3.732 a	—
B	21.00	4.582 b	-12.30	16.10	3.926 ab	7.47	39.50	6.283 b	-180.14
C	29.00	5.385 e	-55.08	28.00	5.279 b	-60.92	42.00	6.479 b	-197.87
D	29.80	5.458 e	-59.36	10.80	3.281 a	37.93	43.70	6.610 b	-209.93
E	20.40	4.516 b	- 9.09	21.00	4.555 ab	-20.69	42.90	6.550 b	-204.26
F	25.70	5.069 d	-37.43	16.60	4.065 ab	4.60	43.70	6.610 b	-209.93
G	25.80	5.079 d	-37.97	18.10	4.250 ab	- 4.02	43.00	6.557 b	-204.97
H	29.50	5.431 e	-57.75	15.20	3.899 ab	12.64	43.00	6.556 b	-204.97
I	24.60	4.960 d	-31.55	15.20	3.899 ab	12.64	42.50	6.519 b	-201.42
J	22.90	4.785 c	-22.46	16.70	4.071 ab	4.02	42.70	6.533 b	-202.84
F		183.475 **			3.140 ns			56.049 **	
CV		0.846%			9.941%			2.684%	
Tukey 5%		0.170			1.670			0.680	

** significant at 1%. ns- non significant.

Table 3. Damage by *D. speciosa* on bean plants at the tests with thiamethoxam, during 3 periods. Esp. Sto. do Pinhal – SP –1998/1999.

Treat.	1st test			2nd test			3rd test		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	18.85	4.303 a	—	19.40	4.373 b	—	26.85	5.157 c	—
B	22.25	4.610 a	-18.04	8.60	2.898 a	55.67	12.00	3.438 b	55.31
C	26.55	5.060 a	-40.85	6.50	2.529 a	66.50	3.90	1.970 c	85.48
D	23.25	4.732 a	-23.34	5.90	2.312 a	69.59	3.35	1.806 a	87.52
E	21.35	4.537 a	-13.26	6.25	2.453 a	67.78	3.15	1.773 a	88.27
F	19.60	4.373 a	- 3.98	5.10	2.144 a	73.71	3.25	1.843 a	87.34
G	20.90	4.490 a	-10.88	6.90	2.514 a	64.43	2.65	1.615 a	90.13
H	18.80	4.292 a	0.27	5.28	2.129 a	72.81	2.50	1.565 a	90.69
I	22.15	4.596 a	-17.51	6.10	2.443 a	68.56	2.75	1.628 a	89.76
J	20.00	4.324 a	- 6.10	8.25	2.823 a	57.47	2.65	1.699 a	89.20
F		1.964 ns			9.734 **			65.699 **	
CV		7.486%			15.679%			12.716%	
Tukey 5%		0.825			1.015			0.696	

ns- non significant. ** significat at 1%.

Table 4. Number of *T. tabaci* on bean plants at the tests with thiamethoxam, during 3 periods. Esp. Sto. do Pinhal – SP –1998/1999.

Treat.	1st test			2nd test			3rd test		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	2.00	1.414 bcd	—	18.95	4.358 b	—	22.55	4.720 c	—
B	2.10	1.445 cd	- 5.00	5.75	2.443 a	69.66	12.35	3.410 b	45.23
C	1.80	1.340 abcd	10.00	3.30	1.911 a	82.59	2.75	1.628 a	87.81
D	0.60	0.763 ab	70.00	4.05	1.898 a	78.63	1.75	1.288 a	92.24
E	1.40	1.171 abcd	30.00	3.65	1.912 a	80.74	1.30	1.131 a	94.24
F	0.60	0.775 abc	70.00	2.35	1.567 a	87.60	1.75	1.302 a	92.24
G	2.40	1.549 d	-20.00	4.50	2.083 a	76.25	1.35	1.133 a	94.01
H	1.70	1.289 abcd	15.00	3.55	1.868 a	81.27	1.35	1.092 a	94.01
I	1.50	1.224 abcd	25.00	3.50	1.881 a	81.53	1.35	1.143 a	94.01
J	0.60	0.724 a	70.00	2.65	1.671 a	86.02	2.14	1.298 a	92.24
F		6.761 **			20.054 **			40.038 **	
CV		14.260%			16.694%			21.517%	
Tukey 5%		0.677			0.877			0.950	

** significat at 1%.

It was made several evaluations of pests during each test. *Diabrotica speciosa* was observed through its damage (Table 3). The results of the second and third test presented significance. The efficiency (Abbot 1925) was up 50% during the second test, dry season, but it didn't obtain 80%.

The efficiency was above 85% for all treatments, excepting the treatment with NPK, in the third test, during the rainy season. Thiamethoxam (70 g.a.i.) controlled better this pest.

The evaluations didn't present significance in the first test and the efficiency was negative, because there was much rainfall that affected the insect population.

Treatments with thiamethoxam were efficient for the control of thrips (Table 4) during the second and third test. Thiamethoxam (70 g.i.a.) plus NPK, carbofuran 350 TS plus NPK and carbofuram 350 controlled thrips in the first test, however they didn't obtain 80% of efficiency.

Whitefly didn't occur in the first test. All treatments controlled this pest in dry season (Table 5) and at the third test, realized during rainy season, only the treatment with NPK didn't control whitefly. The insecticide efficiencies with or without NPK were greater than 86% in both periods. There was greater population during rainy season.

The bean leafhopper (Table 6) occurred only in the tests during rainy season. The results weren't significative at the first test. Efficiencies were above 84%, excepting the treatments with NPK, at the third test. In spite of both tests have occurred in rainy season, the results were differents because at the first one there was much rain that affected the insect population.

The evaluation of viable nodules (Table 7) showed increase with regard control, for all treatments, excepting thiamethoxam 700 WS – 70 g.a.i. with and without NPK and NPK plus thiamethoxam 700 WS (35 g.a.i.), at the first test.

Table 5. Number of *B. tabaci* (genotype B) on bean plants at the tests with thiamethoxam, during 2 periods. Esp. Sto. do Pinhal – SP – 1998/1999.

	2nd test			3rd test		
TRAT.	**average**	**transf. average**	**%EF**	**average**	**transf. average**	**%EF**
A	9.70	3.161 b	—	18.10	4.182 c	—
B	1.50	1.355 a	84.54	10.35	3.009 b	42.82
C	1.10	1.264 a	88.66	2.50	1.555 a	86.19
D	0.40	0.943 a	95.88	1.95	1.367 a	89.23
E	0.70	1.070 a	92.78	2.05	1.412 a	88.67
F	0.80	1.078 a	91.75	2.45	1.555 a	86.46
G	0.70	1.087 a	92.78	1.80	1.340 a	90.06
H	0.50	0.988 a	94.85	1.45	1.186 a	91.99
I	0.60	1.031 a	93.81	1.45	1.186 a	91.99
J	0.70	1.043 a	92.78	1.89	1.363 a	89.56
F		5.422 **			18.594 **	
CV		31.012%			25.189%	
Tukey 5%		1.639			1.112	

** significat at 1%.

Table 6. Number of *E. kraemeri* on bean plants at the tests with thiamethoxam, during 2 periods. Esp. Sto. do Pinhal – SP – 1998/1999.

	1st test			3rd test		
TRAT.	**average**	**transf. average**	**%EF**	**average**	**transf. average**	**%EF**
A	1.50	1.354 a	—	24.75	4.928 d	—
B	2.15	1.531 a	-43.33	12.50	3.498 c	49.50
C	1.70	1.381 a	-13.33	3.75	1.915 b	84.85
D	1.95	1.478 a	-30.00	2.50	1.577 ab	89.90
E	2.10	1.554 a	-40.00	2.85	1.682 ab	88.49
F	0.85	1.088 a	43.33	2.70	1.625 ab	89.09
G	1.05	1.210 a	30.00	2.05	1.431 ab	91.72
H	1.55	1.317 a	- 3.33	1.90	1.376 ab	92.32
I	1.45	1.324 a	3.33	1.45	1.194 a	94.14
J	1.75	1.388 a	-16.67	2.00	1.402 ab	91.92
F		0.968 ns			65.959 **	
CV		21.178%			14.308%	
Tukey 5%		0.702			0.718	

** significat at 1%.

The number of nodules was greater than the control for all treatments, in the second test and smaller than the control, excepting treatment with NPK, at the third test.

Insecticide affected the nodulation at the third test. This result was different from that obtained in the first one also realized during rainy season probably because there was much rainfall during all development of the first trial. The treatments with insecticides presented smaller number of viable nodules however they also showed smaller number of non functional nodules (Table 8).

Tables 9; 10; 11 show the evaluation results of foliar analysis. The nutrients analysed were nitrogen, phosphorus, potassium, sulphur, boron and zinc.

There wasn't significance, in the first test for nitrogen, sulphur, boron and zinc. All treatments, excepting thiamethoxam – 140 g.a.i., presented smaller quantities of phosphorus than the control, however NPK was smaller than insecticides. With potassium occurred the same, but thiamethoxam (35 g.a.i.) plus NPK, thiamethoxam (70 g.a.i.) plus NPK and only NPK had more potassium than the control.

Table 7. Evaluations of viable nodules bean plants at the tests with thiamethoxam, during 3 periods. Esp. Sto. do Pinhal – SP – 1998/1999.

	1st test			2nd test			3rd test		
Treat..	**average**	**transf. average**	**%EF**	**average**	**transf. average**	**%EF**	**average**	**transf. average**	**%EF**
A	67.20	8.146 a	—	14.60	3.679 a	—	112.40	10.599 e	—
B	75.40	8.462 a	-12.20	18.80	4.272 a	- 28.77	125.40	11.193 e	-11.57
C	79.00	8.765 a	-17.56	20.40	4.160 a	- 39.73	62.60	7.907 c	44.31
D	64.40	7.947 a	4.17	16.80	3.665 a	- 15.07	83.20	9.119 d	25.98
E	87.60	9.219 a	-30.36	19.20	4.160 a	- 31.51	52.40	7.232 bc	53.38
F	71.40	8.367 a	- 6.25	32.80	5.585 ab	-124.66	46.20	6.782 ab	58.90
G	57.00	7.404 a	15.18	67.60	8.189 b	-363.01	74.20	8.610 d	33.99
H	66.00	8.064 a	1.79	23.20	4.377 a	- 58.90	54.60	7.837 bc	51.42
I	80.20	8.621 a	-19.35	31.20	4.926 ab	-113.70	38.00	6.163 a	66.19
J	73.60	8.542 a	- 9.52	16.00	3.744 a	- 9.59	50.00	7.067 b	55.52
F		0.526 ns			3.477 **			131.681 **	
CV		18.372%			35.150%			3.946%	
Tukey 5%		3.272			3.504			0.690	

ns- non significant. ** significat at 1%.

Table 8. Evaluations of non functional nodules on bean plants at the tests with thiamethoxam, during 3 periods. Esp. Sto. do Pinhal – SP – 1998/1999.

	1st test			2nd test			3rd test		
Treat.	**average**	**transf. average**	**%EF**	**average**	**transf. average**	**%EF**	**average**	**transf. average**	**%EF**
A	8.00	2.758 a	—	36.40	5.813 b	—	64.20	8.008 e	—
B	5.40	2.349 a	32.50	10.20	3.066 a	71.98	77.80	8.811 e	-21.18
C	14.60	3.570 a	-82.50	10.80	3.047 a	70.33	10.40	3.178 ab	83.80
D	8.40	2.940 a	- 5.00	12.40	3.414 ab	65.93	27.60	5.225 d	57.01
E	6.80	2.676 a	15.00	18.80	4.056 ab	48.35	27.80	5.255 d	56.70
F	9.80	3.146 a	-22.50	11.40	3.188 a	68.68	15.20	4.099 bc	73.21
G	7.20	2.684 a	10.00	12.60	3.414 ab	65.39	18.80	4.308 cd	70.72
H	4.20	2.042 a	47.50	6.80	2.435 a	81.32	25.60	5.049 cd	60.13
I	8.60	2.860 a	- 7.50	9.80	3.062 a	73.08	8.20	2.850 a	87.23
J	7.40	2.713 a	7.50	11.20	3.132 a	69.23	10.40	3.190 ab	83.80
F		1.221 ns			3.304 **			74.046 **	
CV		30.226%			32.679%			10.429%	
Tukey 5%		1.787			2.412			1.111	

ns- non significant. ** significat at 1%.

The trial realized during dry season showed significance for nitrogen, phosphorus, potassium, boron and zinc. All treatments had more nitrogen than the control. Phosphorus was find in greater quantity than the control only in the treatments with NPK and carbofuran plus NPK. Treatments with NPK, thiamethoxam (35 g.a.i.) plus NPK and carbofuran plus NPK presented more potassium. All treatments, excepting thiamethoxam 35 g.a.i. and 70 g.a.i., showed more grade of boron. Grades of zinc were smaller for all treatments.

The results of the third test wasn't similar the first one and both were realized during rainy season. Data of nitrogen and sulphur, weren't significant. Treatments with thiamethoxam 35 g.a.i. and 70 g.a.i. presented more quantity of phosphorus than the control. Greater quantity of potassium was encountered in thiamethoxam (140 g.a.i.) plus NPK. This dosage didn't show similar result in other evaluations. There was more quantity of boron in carbofuran plus NPK. All the treatments presented smaller quantity of zinc than the control. The same effect of this nutrient occurred in the dry season test.

The analysis of the nutrients in all trials didn't show the influence of products or season, because of the treatments didn't present coincidence to conclusion.

Table 12 show the evaluations of yield in dry season. It wasn't possible to obtain the rainy season yield mainly in the first test due to excessive quantity of rain.

Only the treatment with carbofuran without NPK didn't display increase of the yield.

Table 9A – Foliar analysis of bean plants at the tests with thiamethoxam, during the first test. Esp. Sto. do Pinhal – SP – 1998/1999.

Treat.	Nitrogen			Sulfur			Phosphorus		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	43.20	6.571 a	—	2.44	1.557 a	—	4.98	2.231 c	—
B	42.20	6.496 a	2.32	2.16	1.467 a	11.48	1.30	1.138 a	73.90
C	43.80	6.617 a	-1.39	2.30	1.516 a	5.74	4.94	2.222 c	0.80
D	43.60	6.603 a	-0.93	2.26	1.503 a	7.38	4.74	2.175 bc	4.82
E	42.20	6.496 a	2.32	2.32	1.523 a	4.92	4.62	2.149 bc	7.23
F	42.00	6.480 a	2.78	2.20	1.483 a	9.84	4.40	2.093 b	11.65
G	43.40	6.587 a	-0.46	2.30	1.516 a	5.74	4.90	2.213 bc	1.61
H	42.60	6.526 a	1.39	2.20	1.483 a	9.84	4.70	2.168 bc	5.62
I	43.80	6.617 a	-1.39	2.28	1.510 a	6.56	5.10	2.258 c	- 2.41
J	42.60	6.526 a	1.39	2.32	1.523 a	4.92	4.70	2.168 bc	5.62
F		1.269 ns			0.945 ns			167.643 **	
CV		1.610%			3.934%			2.777%	
Tukey 5%		0.225			0.126			0.123	

ns- non significant. ** significat at 1%.

Table 9B – Foliar analysis of bean plants at the tests with thiamethoxam, during the first test. Esp. Sto. do Pinhal – SP – 1998/1999.

Treat.	Potassium			Boron			Zinc		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	34.60	5.879 ab	—	52.20	7.221 a	—	56.60	7.522 a	—
B	32.00	5.655 a	7.51	56.40	7.496 a	- 8.05	55.00	7.414 a	2.83
C	34.80	5.899 ab	-0.58	47.40	6.876 a	9.20	58.80	7.666 a	-3.89
D	35.80	5.981 b	-3.47	46.00	6.780 a	11.88	54.60	7.388 a	3.53
E	33.40	5.778 ab	3.47	49.00	6.991 a	6.13	57.60	7.580 a	-1.77
F	32.40	5.690 a	6.36	47.40	6.871 a	9.20	53.40	7.306 a	5.65
G	34.60	5.882 ab	0.00	49.60	7.042 a	4.98	57.60	7.587 a	-1.77
H	32.20	5.673 a	6.94	51.80	7.195 a	0.77	56.60	7.523 a	0.00
I	33.00	5.744 ab	4.63	51.00	7.117 a	2.30	52.20	7.221 a	7.77
J	34.00	5.831 ab	1.73	52.00	7.208 a	0.39	54.00	7.342 a	4.59
F		3.826 **			1.490 ns			1.669 ns	
CV		2.168%			5.514%			3.301%	
Tukey 5%		0.268			0.832			0.525	

ns- non significant. ** significat at 1%.

Table 10A – Foliar analysis of bean plants at the tests with thiamethoxam, during the second test. Esp. Sto. do Pinhal – SP – 1998/1999.

Treat.	Nitrogen			Sulphur			Phosphorus		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	40.40	6.356 a	—	2.56	1.596 a	—	4.18	2.044 def	—
B	40.40	6.356 a	0.00	2.46	1.567 a	3.91	4.24	2.059 ef	-1.44
C	40.80	6.387 ab	- 0.99	2.54	1.593 a	0.78	2.52	1.584 a	39.71
D	41.40	6.434 ab	- 2.48	2.54	1.593 a	0.78	3.56	1.887 b	14.83
E	40.40	6.356 a	0.00	2.62	1.618 a	-2.34	3.60	1.897 bc	13.88
F	42.00	6.481 bc	- 3.96	2.40	1.548 a	6.25	4.52	2.126 f	-8.13
G	46.80	6.841 d	-15.84	2.58	1.606 a	-0.78	3.82	1.954 bc	8.61
H	43.00	6.557 c	- 6.44	2.36	1.536 a	7.81	3.94	1.985 cde	5.74
I	41.80	6.465 abc	- 3.47	2.44	1.562 a	4.69	3.78	1.944 bc	9.57
J	41.60	6.450 abc	- 2.97	2.62	1.618 a	-2.34	3.84	1.960 bcd	8.13
F		40.079 **			1.106 ns			61.263 **	
CV		0.799%			3.893%			2.154%	
Tukey 5%		0.110			0.131			0.089	

** significat at 1%. ns- non significant.

Table 10B – Foliar analysis of bean plants at the tests with thiamethoxam, during the second test. Esp. Sto. do Pinhal – SP – 1998/1999.

Treat.	Potassium			Boron			Zinc		
	average	average transf.	%EF	average	transf. average	%EF	average	transf. average	%EF
A	30.20	5.495 bcd	—	23.40	4.837 a	—	59.40	7.707 d	—
B	32.00	5.656 d	-5.96	28.20	5.310 c	-20.51	48.40	6.957 c	18.52
C	30.60	5.532 cd	-1.33	25.40	5.040 b	- 8.55	48.20	6.942 c	18.86
D	29.20	5.403 abc	3.31	25.80	5.079 b	-10.26	43.80	6.618 ab	26.26
E	28.80	5.366 abc	4.64	29.00	5.385 c	-23.93	44.60	6.678 abc	24.92
F	31.40	5.603 d	-3.97	27.60	5.253 c	-17.95	46.80	6.841 bc	21.21
G	28.20	5.310 a	6.62	22.00	4.690 a	5.98	41.20	6.418 a	30.64
H	29.00	5.385 abc	3.97	25.60	5.059 b	- 9.40	47.40	6.884 bc	20.20
I	28.40	5.328 ab	5.96	22.60	4.754 a	3.42	40.80	6.533 a	27.95
J	28.80	5.365 abc	4.64	25.00	5.000 b	- 6.84	45.00	6.708 abc	24.24
F		10.318 **			53.141 **			31.366 **	
CV		1.533%			1.415%			2.084%	
Tukey	**5%**	0.178			0.152			0.303	

** significat at 1%.

Table 11A – Foliar analysis of bean plants at the tests with thiamethoxam, during the third test. Esp. Sto. do Pinhal – SP – 1998/1999.

Treat..	Nitrogen			Sulphur			Phosphorus		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	37.20	6.099 a	—	2.60	1.612 a	—	4.16	2.309 a	—
B	36.80	6.066 a	1.08	2.60	1.612 a	0.00	4.28	2.069 a	- 2.89
C	37.40	6.115 a	- 0.54	2.64	1.625 a	- 1.54	4.54	2.129 ab	- 9.14
D	37.20	6.099 a	0.00	2.62	1.618 a	- 0.77	4.46	2.112 ab	- 7.21
E	37.60	6.132 a	- 1.08	2.66	1.631 a	- 2.31	4.50	2.120 ab	- 8.17
F	37.60	6.132 a	- 1.08	2.52	1.587 a	3.08	4.98	2.232 b	-19.71
G	37.20	6.099 a	0.00	2.56	1.600 a	1.54	4.04	2.010 a	2.89
H	37.00	6.083 a	0.54	2.50	1.581 a	3.85	4.04	2.010 a	2.89
I	37.60	6.132 a	- 1.08	2.56	1.600 a	1.54	4.32	2.078 a	- 3.85
J	36.40	6.033 a	2.15	2.66	1.631 a	- 2.31	5.30	2.057 a	- 1.92
F		1.902 ns			1.560 ns			5.920 **	
CV		0.852%			1.930%			2.931%	
Tukey	**5%**	0.111			0.066			0.130	

ns- non significant. ** significat at 1%.

Table 11B – Foliar analysis of bean plants at the tests with thiamethoxam, during the third test. Esp. Sto. do Pinhal – SP – 1998/1999.

Treat.	Potassium			Boron			Zinc		
	average	transf. average	%EF	average	transf. average	%EF	average	transf. average	%EF
A	21.20	4.604 abcd	—	18.40	4.282 abc	—	46.20	6.790 c	—
B	20.00	4.472 a	5.66	17.60	4.188 abc	4.35	39.20	6.257 ab	15.15
C	19.40	4.403 a	8.49	21.80	4.669 de	-18.48	39.80	6.302 ab	13.85
D	22.00	4.688 bcd	- 3.77	15.60	3.944 a	15.22	35.60	5.966 a	22.94
E	22.80	4.774 d	- 7.55	17.00	4.122 ab	7.61	36.40	6.026 a	21.21
F	22.20	4.711 cd	- 4.72	22.40	4.732 e	-21.74	40.40	6.356 abc	12.55
G	21.60	4.647 bcd	- 1.89	20.00	4.468 bcde	- 8.70	42.00	6.480 bc	9.09
H	20.60	4.538 abc	2.83	17.20	4.146 abc	6.52	39.00	6.244 ab	15.58
I	21.80	4.668 bcd	- 2.83	20.40	4.514 cde	-10.87	43.20	6.570 bc	6.49
J	20.80	4.557 abcd	1.89	19.00	4.358 bcd	- 3.26	39.60	6.292 ab	14.29
F		6.244 **			10.569 **			6.662 **	
CV		2.225%			4.009%			3.330%	
Tukey	**5%**	0.218			0.371			0.449	

* Averages not followed by same letter differ significantly at 5% level (Tukey/s test). ** significat at 1%.

Table 12 – Bean yield in the second test with thiamethoxam, during dry season. Esp. Sto. do Pinhal – SP – 1998/1999.

	Yield kg/ha		
Treat.	**average**	**transf. average**	**%EF**
A	709.25	26.618 ab	—
B	2511.25	50.014 d	-254.07
C	1445.75	37.654 bcd	-103.84
D	2065.00	44.912 cd	-191.15
E	1437.00	37.575 bcd	-102.61
F	1800.75	44.963 cd	-189.14
G	1148.75	32.428 abc	- 61.97
H	1809.25	41.778 cd	-155.09
I	1163.75	32.437 abc	- 64.08
J	405.75	19.993 a	42.79
F		9.436 **	
CV		16.214%	
Tukey	**5%**	14.528	

** significat at 1%.

The results of all trials allowed to conclude:

a) the greatest germination occurred in thiamethoxam (35 g.a.i) plus NPK; b) the best control to *D. speciosa* was thiamethoxam (70 g.a.i) without NPK; c) all treatments, excepting NPK, controlled *T. tabaci* during the second and the third test; d) *B. tabaci* was controlled in dry and rainy season by the insecticides alone or together with NPK; e) *E. kraemeri* was controlled only in the third test by all treatments, excepting NPK and the control; f) the greater number of viable nodules occurred in thiamethoxam (140 g.a.i.) plus NPK during the first test and in thiamethoxam (35 g.a.i.) in dry season, and in the third test all treatments presented smaller number than treatment without insecticide and NPK; g) the results of nutrients grades were different in dry and rainy season; h) the yield of dry season was greater in the treatment with NPK and thiamethoxam (70 g.a.i.) plus NPK.

LITERATURE CITED

Abbott, W.S., 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18 : 265-267.

Anania, P.F.R., C.L. de Oliveira, N.T. Teixeira, S. Zambon & M.H. Calafiori, 1988. Influência da aplicação de aldicarbe nos teores de N-P-K, nas folhas de limoeiro Taiti. Ecossistema, Espírito Santo do Pinhal. 13: 48-52.

Anania, P.F.R., N.T. Teixeira, M.H. Calafiori & S. Zambon, 1988. Influência de inseticidas granulados nos teores de N-P-K nas folhas de amendoim (*Arachis hypogaea* L.). Ecossistema, Espírito Santo do Pinhal. 13: 121-124.

Calafiori, M.H., N.T. Teixeira, H.A.P. Schimidt, P.F.R. Anania, F.I. Grando, R. Palazzini, R.C. Martins, C.L. Oliveira & S. Zambon, 1989. Efeitos nutricionais de inseticidas sistêmicos granulados sobre cafeeiro (*Coffea arabica* L.). Ecossistema, Espírito Santo do Pinhal. 14: 132-141.

Camargo, R.A.L., J.A. Turati, P.L. Cavasin, V.A. Morilha, M.H. Calafiori & J.F. Franco, 1981. Influência de sistêmicos granulados na nodulação de feijão (*Phaseolus vulgaris* L.). Ecossistema, Espírito Santo do Pinhal. 6 (1): 139-140.

Cardoso, A.M., A. Ferreira, A.F. Nascimento & M.H. Calafiori, 1995. Efeito de diferentes adubações na eficiência do *Baculovirus spodoptera* para controle de *Spodoptera frugiperda* (J.E. Smith, 1797) na cultura do milho (*Zea mays* L.). Ecossistema, Espírito Santo do Pinhal. 20: 124-130.

Castanheira, R.S., E.R.B. Munhoz, G.P. Couto, A.M. Cardoso & M.H. Calafiori, 1992. Influência da adubação do milho (*Zea mays* L.) sobre a eficiência da *Beauveria bassiana* (Bals.) Vuill, no controle da *Spodoptera frugiperda* (J.E. Smith, 1797). Ecossistema, Espírito Santo do Pinhal. 18: 119-129.

Crnkovic, M.C., A. Ferreira, M.F.V. Adde & M.H. Calafiori, 1995. Experimento com granulado de solo para controle de tripes (*Enneothrips flavens* Mouthon, 1941) em diferentes adubações no amendoim (*Arachis hypogaea* L.) e observando a influência na formação de flores, ginóforo e produção. Ecossistema, Espírito Santo do Pinhal. 20: 131-142.

Fachini, A.C., C.K. Ramos, P.V. Miranda, L.J. Barbosa, M.H. Calafiori, N.T. Teixeira & C.S. Rodrigues, 1990. Tratamento de semente com inseticida e zinco influindo sobre nutrientes do milho (*Zea mays* L.) e controle da *Spodoptera frugiperda* (J.E. Smith, 1797). Ecossistema, Espírito Santo do Pinhal. 16: 69-87.

Fouche, P.S., D.H. Bester & G.H. Veldman. 1977. The influence of potassium applications and nematicides on the potassium nutrition of "Valencia" orange trees on replant citrus soil. J. Amer. Soc. Hort. Sci. 102 (5): 546-547.

Godfrey, L.D. & T.O. Holtzer. 1992. Effects of soil-incorporated insecticides and foliar-applied chemicals on corn gas-exchange parameters. Crop Protection, 11: 427-432.

Junqueira, F.M.A., M.A. Forner, M.H. Calafiori, N.T. Teixeira & S. Zambon, 1988. Aplicação de aldicarbe com diferentes dosagens e tipos de adubação influenciando a produtividade na cultura da batata (*S. tuberosum* L.). Ecossistema, Esp. Santo do Pinhal. 13: 101-107.

Maxwell, F.G., 1972. Host plant resistance to insects- Nutritional and pest management relationships. In: J.G. Rodriguez (ed.), Insect and mite nutrition. Amsterdan, North Holland Company, p. 599-609.

Maxwell, R.C. & R.F. Harwood. 1958. Increase reproduction of aphidas on plant affected by herbicide 2,4-dichlorophenoxyacetic. Bull Entomol.Soc.Am. 4:100

Medeiros Filho, S.T., A.D. Paulo & M.H. Calafiori. 1982. Influência do carbofuram, em diferentes métodos de aplicação, sobre a nodulação, germinação, produção e controle de pragas do feijoeiro (*P. vulgaris* L.). Ecossistema, Espírito Santo do Pinhal. 7 (1): 57-62.

Oya, K.L., J.B.D. dos Santos & N.T. Teixeira. 1990. Influência de inseticidas granulados sistêmicos, nos teores de nitrogênio, fósforo e potássio na parte aérea do tomateiro (*Lycopersicon esculentum*, Mill). Ecossistema, Espírito Santo do Pinhal. 16: 104-110.

Pallini Filho, A., M.H. Calafiori & N.T. Teixeira. 1987. Influência de inseticidas granulados sistêmicos e diferentes fontes potássicas na nodulação do amendoim (*Arachys hypogaea* L.). Ecossistema, Espírito Santo do Pinhal. 12: 64-65.

Pianoski, J., E. Bertucci, M.C. Capassi, E.A. Cirelli, M.H. Calafiori & N.T. Teixeira. 1990. Eficiência da *Beauveria bassiana* (Bals) Vuill no controle da *Diabrotica speciosa* (Germar, 1824) em feijoeiro, *Phaseolus vulgaris* L., cultivado em diferentes adubações. Ecossistema, Espírito Santo do Pinhal. 15: 24-35.

Souza Neto, J.C. & N.T. Teixeira. 1991. Aldicarbe e adubação influenciando na absorção de nutrientes pela cultura da batata (*S. tuberosum* L.). Ecossistema, Espírito Santo do Pinhal. 17: 57-65.

Tanzini, M.R., A.M. Cardoso, M.H. Calafiori & E.M. Occhiena. 1992. Efeito de potássio na eficiência de inseticida para controle de pragas (*Thrips tabaci* Lind., 1888) em amendoim (*Arachis hypogaea* L.). Ecossistema, Espírito Santo do Pinhal. 18: 130-140.

Veronesi, D.J., M.A. Sicchieri, M.A. da S. Bexiga, M.H. Calafiori & N.T. Teixeira. 1989. Efeito da adubação sobre a eficiência de inseticida para controle da *Diabrotica speciosa* (Germar, 1824) e mosaico dourado em feijoeiro (*Phaseolus vulgaris* L.). Ecossistema, Espírito Santo do Pinhal. 15: 5-10.

Wheaton, T.A., C.C. Childers, L.W. Timmer, L.W. Duncan & S. Nikdel. 1985. Efeito do aldicarbe sobre a produção, qualidade das frutas e situação das plantas cítricas na Flórida. Proc. Fla. State Hort. Soc., 1: 1-18.

Zambon, S., M.H. Calafiori, N.T. Teixeira & E.A. Cirelli. 1990. Efeitos na produção e controle de *Liriomyza* sp. na batata (*Solanum tuberosum* L.) pela adubação e inseticida sistêmico. Ecossistema, Espírito Santo do Pinhal. 16: 88-94.