Indian Journal of Agronomy **46** (3) : 506–510 (September 2001)

Effect of nutrients and growth regulators on nutrient uptake and productivity of soybean (*Glycine max*)

K. RAMESH, V. THIRUMURUGAN AND B. CHANDRASEKHARAN

Department of Agronomy, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore 641 003

Received: March 2000

ABSTRACT

A field experiment was conducted at Agricultural College and Research Institute, Madurai, during 1998 and 1999, to study the influence of nutrients and growth regulators on the productivity and nutrient uptake of soybean [*Glycine max.* (L.) Merr.]. Pelleting soybean seeds with ammonium molybdate 250 mg/kg and ferrous sulphate 500 mg/kg inoculated with *Bradyhizobium japonicum* resulted in significantly higher number of branches/plant, pods/plant and seed yield, and enhanced the uptake of macro-nutrients. The similar trend was observed in foliar spray of benzyl adenine 25 ppm in association with DAP 2% and KCl 1% at 45 and 60 days after sowing.

Key words : Soybean, Seed pelleting, Ammonium molybdate, Ferrous sulphate, Benzyl adenine, Nutrient uptake

Soybean is a short-duration crop having worldwide adaptation. The main physiological predicaments in pulses like flower drop and premature pod shedding are perhaps associated with nutrient deficiency and hormonal imbalance (Kalitha *et al.*, 1995). Dey and Ghosh (1980) reported beneficial effect of molybdenum on nitrogen content of soybean. Application of molybdenum, cobalt and iron together in *Rhizobium*-inoculated crops showed 2, fold increase in nodules plant (Sharma and Ghonsikar, 1976). Application of molybdenum @ 1 kg /ha to a neutral soil increaseds the uptake of N, P, K and S in legumes (Dwivedi *et al.*, 1996). Hence to find out the effect of micronutrient seed pelleting and foliar application of nutrients and growth regulators on productivity and nutrient uptake of soybean the present investigation was carried out.

MATERIALS AND METHODS

The field experiment was conducted during winter (*rabi*) season of 1998 and 1999 at Agricultural College and Research Institute, Madurai, Tamil Nadu. The soil was red, sandy clay loam, with low available nitrogen (220 kg/ha), medium available phosphorus (14.5 kg/ha) and potas-

sium (260.8 kg/ha). The experiment was laid out in split-plot design with 3 replications.

Main plots consisted of seed pelleting and subplots had foliar spray treatments. Foliar spray was done at 45 and 60 days after sowing. Nutrient mixture was prepared with 0.5% $MgSO_4$, 0.25% $ZnSO_4$, 0.25% $MnSO_4$ and 0.1% borax. The recommended packages of practices were followed. The seeds ('Co 1') were inoculated with *Bradyrhizobium japanicum* @ 400 g/ha and recommended dose of fertilizer (20, 80 and 40 kg N, P and K/ha) was followed uniformly. The plant samples drawn for dry-matter production at harvest stage were used for the chemical analysis of nutrient content by the standard methods and uptake of N, P and K was worked out by multiplying the N, P and K content with dry-matter production.

RESULTS AND DISCUSSION

The seed pelleting with ammonium molybdate 250 mg / kg and ferrous sulphate 500 mg/kg produced significantly more branches/plant (Table 1). It was followed by pelleting the seeds with ammonium molybdate alone. It might be due to the active participation of iron and molybdenum in nodulation and subsequent remobilization of nitrogen to the growing plant. Application of Fe and Mo may have increased the nitrogenase activity as each nitrogenase molecule contains 2 Mo atoms, which are associated with 24–6 iron atoms/ molecule (Marschner, 1986). Benzyl adenine foliar spray stimulated more branches/plant. It may be due to the production of higher quantity of chlorophyll in leaf tissue, which may have altered the reproductive morphology.

Pods/plant

Among various seed pelleting chemicals, ammonium molybdate 250 mg / kg and ferrous sulphate 500 mg/kg recorded higher pods/plant (Table 1). The effective nodulation and N supply induced by Mo and Fe may have enhanced the pods/plant. Benzyl adenine foliar spray registered the highest pods/plant. It may be owing to altered floral morphology and reproductive morphology induced by benzyl adenine through enhanced photosynthetic capacity.

Seed yield

Seed pelleting of ammonium molybdate 250 mg/kg and ferrous sulphate 500 mg/kg combination registered the highest seed yield (Table 1). Enhanced nodulation and nitrogen supply and the remobilization of nutrients to reproductive parts might have enhanced the yield. It corroborates the findings of Kishore *et al.* (1991) and Maurya *et al.* (1993). Various foliar spray treatments exerted a significant influence on seed yield. Benzyl adenine foliar spray showed a significant influence on seed yield. Benzyl adenine may have induced receme enlargement leading to the formation of more secondary vascular tissues presumably resulted in greater potential for the translocation of assimilates to the pods. Similar results were obtained by Manian *et al.* (1987) in soybean.

Nitrogen uptake

Seed pelleting and foliar spray treatments showed perceptible change on

Table 1. Effect of seed pelleting and foliar sprays on productivity of soybean

Treatment	Branches/plant		Pods/plant		Seed yield (kg/ha)	
	1998	1999	1998	1999	1998	1999
Seed pelleting						
Control (M_1)	4.7	4.8	45.0	50	1,395	1,482
Ammonium molybdate 250 mg/kg seed (M_2)	5.8	5.9	67.4	71	1,601	1,687
Ferrous sulphate 500 mg/kg of seed (M_3)	5.3	5.4	51.4	55	1,508	1,586
Ammonium molybdate 250 mg + ferrous sulphate 500 mg/kg seed (M_4)	6.3	6.4	70.6	76	1,766	1,849
CD (P=0.05)	0.15	0.17	3.02	2.06	48.9	74.2
Foliar spray (twice at 45 and 60 days*)						
DAP 2% + Kcl 1% (S_1)	5.3	5.4	51.5	54.5	1,330	1,465
S_1 + nutrient mixture* (S_2)	5.5	5.6	58.8	63.1	1,592	1,646
S_1 + benzyladenine 25 ppm (S_3)	5.9	6.0	66.7	71.3	1,757	1,843
S_1 + salicylic acid 100 ppm (S_4)	5.7	5.7	62.3	66.3	1,657	1,747
S_1 + maleic hydrazide 100 ppm (S_5)	5.3	5.2	55.0	59.1	1,502	1,554
CD (P=0.05)	0.18	0.19	4.37	3.01	59.7	80.2

*Nutrient mixture prepared with 0.5% $MgSO_4$, 0.25% $ZnSO_4$, 0.25% $MnSO_4$ and 0.1% borax

nitrogen uptake (Table 2). The uptake of N was favoured by seed pelleting of ammonium molybdate and ferrous sulphate. At harvest, seed pelleting of ammonium molybdate and ferrous sulphate recorded the maximum N uptake of 130.41 and 125.56 kg/ha during 1998 and 1999, respectively, followed by seed pelleting with ammonium molybdate alone.

Among the foliar spray treatments, benzyl adenine recorded the maximum N uptake, followed by spray of salicylic acid. This uptake might be possibly due to better plant growth, which led to improved foraging ability of roots. The reason for higher nitrogen uptake by benzyl adenine might be attributed to enhanced photosynthetic rate (Lee and Yang, 1983)

Phosphorus uptake

Seed pelleting significantly influenced P uptake, whereas foliar spray treatments did not influence P uptake significantly. Seed pelleting of ammonium molybdate and ferrous sulphate resulted in higher P uptake throughout the growth. Non-pelleted crop registered the lowest P uptake.

At harvest, seed pelleting with ammonium molybdate and ferrous sulphate registered the maximum P uptake, followed by ammonium molybdate alone. The micronutrients Fe and Mo might have

Table 2. Effect of seed pelleting and foliar spray on nutrient uptake (kg/ha)

Treatment	1998			1999		
	N	P	K	N	P	K
Seed pelleting						
M_1	101.16	17.24	65.78	104.53	17.87	66.92
M_2	119.22	19.28	71.92	121.61	20.30	72.42
M_3	109.48	18.19	68.96	111.08	19.18	69.45
M_4	130.41	20.19	76.10	125.56	21.19	76.60
CD (P = 0.05)	1.47	0.44	3.52	1.51	0.48	0.62
Foliar spray						
S1	98.4	18.19	68.98	100.16	19.19	67.47
S2	115.87	18.72	70.81	112.04	19.18	71.31
S3	128.63	19.20	72.06	131.39	20.20	72.56
S4	122.47	18.96	71.15	124.71	20.03	71.65
S5	109.97	18.56	70.47	107.19	19.58	70.96
CD (P = 0.05)	3.18	NS	NS	NS	NS	NS

Details of treatments are given in Table 1

enhanced nodulation, nitrogen fixation and root growth and its foraging ability. As iron could create a condition conducive for the formation of functional N_2 fixing nodule in legumes and Mo, a component of nitrogenase system required for nitrogen fixation combined in seed pelleting, might have aided in better root growth and P uptake.

Potassium uptake

Soybean responded positively to various seed-pelleting treatments and increased K uptake, when soybean seeds were pelleted with ammonium molybdate and ferrous sulphate, whereas foliar spray treatments did not influence the potassium uptake significantly.

At harvest, seed pelleting with ammonium molybdate and ferrous sulphate recorded the maximum K uptake. It was followed by seed pelleting with ammonium molybdate alone during the same years. As Mo and Fe had a direct bearing on the nodulation and nitrogen assimilation, resulting in active growth and might have accelerated macronutrients uptake from the soils.

There was no interaction between seed pelleting and foliar spray of nutrients and growth regulators for the macronutrients. It could be concluded that pelleting soybean seeds with ammonium molybdate 250 mg/kg and ferrous sulphate 500 mg/kg inoculated with *Bradyrhizobium japanicum* as well as foliar spray of benzyl adenine 25 ppm in association with DAP 3% and KCl 1% at 45 and 60 days after sowing is a better management practice to improve the productivity and nutrient uptake of soybean.

REFERENCES

Dey, B.K. and Ghosh, A. 1980. Response of soybean to N and molybdenum fertilization. *Indian Agriculturalist* **24** : 239.

Dwivedi, S.K., Singh, Meer Nigam, P.K., Patel, R.S. and Agrawal, V.K. 1996. Nutrient status in various plant parts of soybean as influenced by phosphorus and molybdenum application. *Crop Research* **12**(3) : 375–382.

Kalitha, P., Dey, S.L. and Chandra, K. 1995. Influence of foliar application of phosphorus and NAA on nitrogen, dry matter accumulation and yield of green gram cv. AAV-34. *Indian Jounral of Plant Physiology* **38** (3) : 197–202.

Kishore, K., Maurya, B.R. and Ram, P.C. 1991. Effect of iron and molybdenum nutrition on nodulation, symbiotic nitrogen fixation and grain yield of urd bean. *Narendra Deva Journal of Agricultural Research* **6**(1) : 189–193.

Lee, W. and Yang, S. 1983. Enhancement of soybean fruit development by cytokinins. *Journal of Science and Engineering* **20** : 161–170.

Manian, K., Natarajarathinam, N., Ramasamy, R. and Mohana Sundaram, K. 1987. Senescence and its role in soybean productivity. *Journal of Agronomy and Crop Science* **159** : 202–205.

Marschner, M. 1986. *Mineral Nutrition of Higher Plants.* Academic Press, New York.

Maurya, B.R., Kishor, K. and Ram, P.C. 1993. Effect of iron and molybdenum on urdbean. *Journal of Maharashtra Agricultural Universities* **18**(1) : 128.

Sharma, H.N. and Ghonsikar, C.P. 1976. Effect of micronutrient on nodulation in cow pea. *Soil and Fertilizers* **16**(3) : 110–115.