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Effect of Seed pelleting and foliar nutrition on growth of soybean

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Abstract : Field experiments conducted during *rabi* seasons of 1998 and 1999 in red sandy clay loam soils, under irrigated condition at Agricultural College and Research Institute, Madurai revealed that seed pelleting with ammonium molybdate 250 mg kg^{-1} and ferrous sulphate 500 mg kg^{-1} of seed in *Rhizobium* inoculated seeds produced improved growth parameters of soybean and yield. The same way benzyladenine foliar spray 25 ppm 2 times in association with DAP 2% and KCl 1% produced higher grain yield and are considered as efficient practice in improving the growth parameters of soybean. *(Key words : Seed pelleting, Foliar nutrition)*

Soybean (*Glycine max* (L.) Merr.) is a leguminous oilseed crop having worldwide adaptation. Seed pelleting with micronutrients showed higher dry matter production in legumes (Ponnusamy and Vijaya, 1997). Iron is required both by legume host *and Bradyrhizobium* for a range of physiological and biochemical processes (Sinclair, 1975). Foliar spray of different growth regulators influence growth characters of soybean (Dashora and Jain, 1994). In view of the scanty information on combined effect of iron and molybdenum and a suitable growth regulator, the present investigation was undertaken to study the influence of iron and molybdenum seed pelleting in association with *Rhizobium* and growth regulator and micro nutrient spray individually with DAP and KCl on growth of soybean.

Materials and Methods

Field experiments were conducted during *rabi* seasons of 1998 and 1999 at Agricultural college and Research Institute, Madurai. The soil was red sandy clay loam and the soil nitrogen, phosphorus and potassium status are given below. The experiments were laid out in split plot design with three replications. Soybean var Co 1 was used.

Initial soil status

Nutrient element	1998	1999
Available N (kg ha^{-1})	220	215
Available P (kg ha^{-1})	14.5	13.6
Available K (kg ha^{-1})	260.8	268.2

The treatments were,

(A) Mainplot: Seed Pelleting

M_1 - Control
M_2 - Ammonium molybdate 250 mg kg^{-1} of seed
M_3 - Ferrous sulphate 500 mg kg^{-1} of seed
M_4 - Ammonium molybdate 250 mg + Ferrous sulphate 500 mg kg^{-1} of seed.

(B) Sub Plot: Foliar Spray

S_1 - DAP 2 %+ KCl 1 %
S_2 - S_1 + Nutrient mixture
S_3 - S_1 + Benzyladenine 25 ppm
S_4 - S_1 + Salicyclic acid 100 ppm
S_5 - S_1 + Maleic hydrazide 100 ppm

Note: Nutrient mixture prepared from 0.5% $MgSO_4$, 0.25%, $ZnSO_4$, 0.25% $MnSO_4$ and 0.1% borax, Foliar spray twice at flowering (45 DAS) and 15 days after first spray (60 DAS) and *Bradyrhizobium japonicum* seed inoculation @ 600 g ha^{-1} and recommended fertilizer dose of 20:80:40 kg NPK ha^{-1} were followed.

Results and Discussion

Plant height and Leaf Area Index (LAI) (Table 1).

Seed pelleting of various micronutrients significantly influenced the crop height at blooming (60 DAS) and at harvest stages (90 DAS). Seed pelleting of ammonium molybdate 250 mg and ferrous sulphate 500 mg kg^{-1} of seed produced the tallest plants of 55.21 and 56.77 cm at 60 DAS and 72.3 and 74.76 cm at 90 DAS during 1998 and 1999 respectively. It was followed by seed pelleting with ammonium molybdate alone. Among the different treatments, spray application of benzyladenine 25 ppm significantly produced the tallest plants of 71.93 and 73.98 cm at harvest during 1998 and 1999 respectively.

Table 1. Effect of seed pelleting and foliar spray on growth parameters of soybean

Treatments	1998				1999			
	Plant height (cm)		LAI (60 DAS)	DMP at harvest (kg ha^{-1})	Plant height (cm)		LAI (60 DAS)	DMP at harvest (kg ha^{-1})
	60 DAS	Harvest			60 DAS	Harvest		
M1	44.50	55.16	2.64	4225	46.41	57.13	2.69	4442
M2	53.16	65.60	2.78	4843	55.27	67.61	2.83	5079
M3	51.22	63.80	2.71	4537	52.96	65.88	2.73	4773
M4	55.21	72.30	2.91	5317	56.77	74.76	2.94	5.567
SEd	0.70	05	0.02	54.1	0.49	2.98	0.02	60.6
CD (P = 0.05)	1.72	7.45	0.04		1.20	6.82	0.06	141.4
Foliar spray								
S1	45.50	53.83	2.68	4022	47-50	56.16	2.70	42')')
S2	51.70	63.88	2.75	4824	53.41	65.88	2.75	5032
S3	55.80	71.93	2.98	5289	57.80	73.98	3.05	5586
S4	53.63	69.83	2.81	5020	55.06	72.11	2.8')	5247
S5	48.48	61.63	2.63	4500	50.49	63.58	2.67	4687
SEd	0.97	2.23	0.04	86.3	1.03	2.41	0.05	87.2
CD (P = 0.05)	1.97	4.56	0.07	211.1	2.11	4.99	0.10	213.5
M x S								
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Effect of seed pelleting and foliar spray on CGR of soybean (g m^{-2} day^{-1})

Treatment	1998			1999		
	0-30 DAS	0-60 DAS	0-90 DAS	0-30 DAS	0-60 DAS	0-90 DAS
Seed pelleting						
M1	4.11	5.05	4.69	4.08	5.02	4.93
M2	4.84	6.24	5.38	4.88	6.28	5.64
M3	4.43	5.65	5.08	4.45	5.69	5.30
M4	5.23	6.83	5.90	5.31	6.87	6.19
SEd	0.08	0.11	0.07	0.08	0.13	0.11
CD (P = 0.05)	0.20	0.26	0.17	0.18	0.29	0.25
Foliar spray						
S1	4.67	4.87	4.47	4.64	4.95	4.70
S2	4.65	6.30	5.36	4.69	6.27	5.59
S3	4.68	6.71	5.86	4.76	6.69	6.21
S4	4.6')	6.54	5.58	4.62	6.52	5.87
S5	4.62	5.29	5.06	4.69	5.40	5.21
SEd	0.11	0.13	0.09	0.12	0.14	0.12
CD (P = 0.05)	NS	0.28	0.18	NS	0.30	0.28
M x S						
CD (P = 0.05)	NS	NS	NS	NS	NS	NS

Micronutrient seed pelleting generally influenced LAI significantly at 60 DAS. Seed pelleting of ammonium molybdate 250 mg and ferrous sulphate 500 mg kg^{-1} of seed registered the highest LAI of 2.91 and 2.94 at 60 DAS during 1998 and 1999 respectively. It was followed by seed pelleting, of ammonium molybdate alone. Various foliar spray treatments imparted significant influence on LAI at 60 DAS. Highest LAI of 2.98 and 3.05 at 60 DAS was noticed in soybean receiving foliar spray of benzyladenine 25 ppm during 1998 and 1999 respectively. Interaction between seed pelleting and foliar spray was not significant.

Dry matter production (DMP) (Table 1)

Dry matter production was greatly influenced by seed pelleting, and foliar spray. Seed pelleting with ammonium molybdate 250 mg and ferrous sulphate 500 mg kg^{-1} of seed produced the highest DMP of 5317 and 5567 kg ha^{-1} at harvest during 1998 and 1999 respectively. It was followed by seed pelleting, of ammonium molybdate alone. Among the different foliar spray treatments, benzyladenine spray registered highest DMP of 5289 and 5586 kg ha^{-1} at harvest during 1998 and 1999. It was followed by foliar spray of salicylic acid. Minimum DMP was recorded in control treatment. The interaction between seed pelleting and foliar spray was not significant.

Crop Growth Rate (Table 2)

Crop growth rate of soybean was significantly influenced by various seed pelleting chemicals and foliar spray practices.

Among the different micro nutrient pelleting, combined pelleting of ammonium molybdate 250 mg and ferrous sulphate 500 mg kg^{-1} of seed registered, a highest CGR of 5.23 and 5.31 g m^{-2} day^{-1} at 0-30 DAS, 6.83 and 6.87 g m^{-2} day^{-1} at 0-60 DAS and 5.90 and 6.19 g m^{-2} day^{-1} at 0-90 DAS during, 1998 and 1999 respectively. It was followed by seed pelleting of ammonium molybdate alone with 4.84 and 4 day at 0-30 DAS, 6.24 and 6.28 g m^{-2} day^{-1} at 0-60 DAS and 5.38 and 5.64 g m^{-2} day^{-1} at 0-90 DAS during the same period. Non pelleted soybean seeds registered slowest growth rate throughout the crop period.

Among the different foliar spray treatments benzyladenine foliar spray registered the highest CGR of 6.71 and 0.69 g m^{-2} day^{-1} at 0-60 DAS and 5.86 and 6.21 g m^{-2} day^{-1} at 0-90 DAS during 1998 and 1999 respectively. It was on par with foliar spray of salicylic acid resulting in CGR of 6.54 and 6.52 g m^{2} day^{-1} at 0-60

DAS. However, foliar spray of salicylic acid recorded significantly low CGR of 5.58 and 5.87 g m^{-2} day^{-1} at 0-90 DAS for the corresponding period. Control recorded the minimum CGR.

Seed pelleting with micronutrients had positive influence on various growth parameters plant height, leaf area index, dry matter production and crop growth rate. It must be ascribed to the fact that seed pelleting with micronutrients might had enhanced seed vigour resulting, in better seedling establishment and possibly due to accelerated metabolic activity of the seed. This falls in line with the observations of Ponnusamy and Vijaya (1997). The possible increase in seed vigour might have influenced height, leaf area index, plant and dry matter production. Further, the possible reason for growth components under seed pelleting with ammonium molybdate and ferrous sulphate might be due to the involvement of iron and molybdenum in nitrogenase enzyme complex and their active participation in biological nitrogen fixation. This corroborates the findings of Sharma and Chahal (1983), Leena (1994) and Selim (1994). Molybdenum acts as an agent for utilization of soil and fertilizer nitrogen and the supply of iron aids in formation of thylakoid membranes and for normal leaf growth and these observations fall in line with the findings of Anon (1980). It could therefore be inferred that the combined micro nutrient pelleting had a strong influence on soybean growth components. Nayak *et al.* (1989) confirmed that better plant growth was the reason for higher DMP in soybean. Hence, improved plant height and LAI have ultimately improved DMP. The experimental findings of Nayak *et al.* (1989) and Selim (1994) corroborated the above findings.

Benzyladenine have influenced positively the growth components. This may be attributed to the formation of higher quantity of leaf chlorophyll in the leaf tissues due to DAP, KCl and benzyladenine which enhanced photosynthetic rate of the plant in turn resulted in increased LAI and DMP (Dashora and Jain, 1994), because of increased nutrient content in leaf and subsequent benzyladenine spray, leaf chlorophyll had enhanced and increased the growth characters. These results are in conformity with the findings of Seetharani (1986) and Rajamohan (1989).

Seed pelleting of ammonium molybdate 250 mg kg^{-1} and ferrous sulphate 500 mg kg^{-1} of seed along with *Rhizobium* produced better results than *Rhizobium* alone and when superimposed by foliar spraying of DAP 2%, KCl 1% and benzyladenine twice (at flowering and after a fortnight) with regular crop management practices achieved higher growth of soybean when grown in red sandy clay loam soils.

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