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Effect of seed pelleting on growth, yield and morphological parameters in soybean (*Glycine max* L.)

Rathod T.H.*[1] and Jadhao S.D.[2]
[1] Department of Agril. Botany, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 004 (M.S.) India
[2] Post Harvest Technology Scheme, Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 004 (M.S.) India

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The present study was undertaken to assess the effect of seed pelleting on growth, yield and morphological parameters in soybean during kharif 2000-01. Various materials like adhesive, filler and chemicals were used for seed pelleting. Mean plant height was significantly improved by seed pelleted with thiram + CMC + filler. Seed pelleted with DAP + CMC + filler, thiram + CMC + filler and CMC alone recorded 0.0965, 0.0332 and 0.03 g / dm^2/ day of net assimilation rate (NAR) at 45-60, 75-90 DAS and at harvest stage respectively. There was a steady declines in leaf area ratio in all treatments up to harvest. All pelleting treatments recorded significantly higher leaf area ratio than control. Seeds pelleted with thiram + CMC + filler recorded seed yield of 28.76 q ha^{-1} followed by borax + CMC + filler (27.58 q ha^{-1} seed yield). However, seeds pelleted with thiram + CMC + filler was found beneficial in recording highest pod per plant, number of seeds per pod, test weight (100 seed weight), harvest index, oil content and seed yield per plant. All pelleting treatment noted rapid increase in CGR (crop growth rate), RGR (relative growth rate) and LAI (leaf area index).

Key words : Net assimilation rate, Crop growth rate, Relative growth rate, Leaf area ratio, Test weight and Harvest index.

INTRODUCTION

SOYBEAN (*Glycine max* L. Merrill) belongs to family leguminaceae, sub family fabaceae and genus Glycine L. often referred as a wonder crop or 'Golden bean', has a tremendous nutritive value (41 % protein, 20.9% carbohydrates, 19.20%, oil and rich sources of vitamin A,C, D,E, K and Calcium). Soybean is cultivated in Maharashtra in Amravati, Buldhana, Chandrapur, Gadchiroli, Nagpur, Nanded, Parbhani and Wardha district. Now a day the area under soybean crops is increased. The pelleting provides early growth advantage of seed i.e. invigoration of seed, protection for disease and pest, synergetic effects of fungicides, nutrients and hormones and protection against stresses. The seed coated with certain substances (referred as pelleting) enhance yield, improved quality and emergence, Coating of seed with adhesive in combination with active ingredient, has been reported to be effective. (Moude and snett, 1998). Looking to the benefits of pelleting, present study was undertaken to asses seed pelleting on growth and morphological parameters in soybean.

MATERIALS AND METHOD

The present investigation was undertaken to evaluate the effect of seed pelleting on growth, yield and morphological parameters in soybean during kharif 2000-2001. Various materials like adhesive, filler and chemicals were used for seed pelleting. The experiment was laid in Randomized Block Design, replicated four times with 16 treatments. The treatments were: control (No Pelleting) (T_1), Carboxy methyl cellulose (CMC) 2% (T_2), maida 10% (T_3), gum acacia 5% (T_4), DAP (3 g/kg of seed) + CMC 2% + filler (T_5), DAP+ maida + filler (T_6), DAP+ gum acacia + filler (T_7), ZnSO4 (0.3 g/kg of seed) + CMC + filler (T_8), ZnSO4 + maida + filler (T_9), $ZnSO_4$ + gum acacia + filler (T_{10}), borax (0.1 g/kg of seed) + CMC + filler (T_{11}), borax + maida + filler (T_{12}), borax + gum acacia + filler (T_{13}), thiram(3 g/kg of seed) + CMC + filler (T_{14}), thiram + maida+filler (T_{15}), thiram + gum acacia + filler (T_{16}).

These substances were thoroughly mixed and the slurry prepared. And the pelleting of seed was carried out. The pelleted seeds were air-dried treatment wise separately and used for field and laboratory study.

RESULTS AND DISCUSSION

Effect of seed pelleting on morphological parameters

Plant height is an important morphological parameter exhibiting direct relationship with grain yield. Plant height recorded at various growth stages as influenced by seed pelleting are presented in Table 1, showed that there was rapid increase in growth which continued up to 90 DAS, thereafter slowed down. At 45 DAS, significantly maximum height was recorded in borax + CMC + filler (29.30 cm) followed by thiram + CMC + filler (29.07) as compared to control. At pod filling stage (90 DAS), seeds pelleted with thiram + maida+filler recorded maximum height (35.37 cm). At harvest all the treatments maintained significantly more height than control.

Maximum number of leaves per plant were recorded in thiram + gum acacia + filler (44.10) and borax + CMC + filler (44.05) at 45 DAS.

However at 90 DAS, there is a marked increase in number of leaves per plant which was borax + gum acacia + filler (45.72) and borax + CMC + filler (44.65).

At harvest the number of leaves per plant were found to be reduced due to the senescence and shading. As the shoot elongates it bears number of branches. The data presented in respect of number of branches per plant as influenced by seed pelleting showed the maximum number of branches per plant which was thiram + gum acacia + filler (3.92), $ZnSO_4$ + maida + filler (8.00) and $ZnSO_4$ + maida + filler (8.27) respectively at 45, 90 DAS and at harvest stage, showing the positive effects of pelleting towards branching formation. Rest of the treatments were also produces more branches than the control.

The leaf area was increased at 45 DAS and then decreased rapidly with advance in age of the crop due to senescence and shadings. At 90 DAS all pelleting treatment showed significantly more leaf area over control. The similar results as regard to the plant height, number of leaves per plant, leaf area were reported by Deb and zeliong (1976), Boronskikh (1977), Mishra and Yadav (1989), Nagalur et al. (2002).

Effect of seed pelleting on growth parameters

Crop growth rate (CGR) denotes the amount of dry weight gained on the basis of unit area of crop in unit time. The data presented as regard to crop growth rate (g/day) of soybean was initially

* Author for Correspondence

Table 1: Effect of seed pelleting on morphological parameters

Treatment	Plant height (cm)			Number of leaves per plant			Number of branches per plant			Leaf area (cm^2/plant)		
	Days after Sowing			Days after Sowing			Days after sowing			Days after Sowing		
	45	90	At harvest	45	90	At harvest	45	90	At harvest	45	90	At harvest
T_1	26.48	32.95	33.05	38.08	38.14	20.46	2.42	5.90	6.02	987.21	862.30	280.21
T_2	28.07	34.65	34.15	37.10	41.30	22.65	2.62	5.52	5.87	983.05	1021.22	320.45
T_3	24.40	33.22	33.50	37.36	35.19	18.75	2.82	5.72	5.80	1050.61	930.94	296.69
T_4	27.50	33.17	33.87	38.32	32.33	18.76	2.60	5.92	6.00	1024.59	945.44	296.72
T_5	28.30	33.97	34.00	42.30	42.25	23.38	2.85	7.60	7.62	1074.34	1028.69	334.48
T_6	27.90	32.62	34.35	33.70	37.39	23.85	3.02	7.25	7.30	1091.54	910.14	340.60
T_7	28.22	33.52	34.20	43.60	42.44	24.42	3.50	7.77	7.80	1028.92	1035.39	360.39
T_8	28.27	34.37	34.42	44.01	38.19	19.90	3.31	6.47	6.67	1032.07	920.18	300.00
T_9	28.25	34.17	34.35	43.70	39.14	20.21	3.30	8.00	8.27	1033.09	905.35	305.16
T_{10}	27.15	33.07	34.80	35.70	36.49	21.34	3.30	6.27	6.30	1084.57	877.80	315.29
T_{11}	29.30	35.25	35.30	44.05	44.65	22.42	3.61	6.07	6.09	1161.97	1083.39	333.93
T_{12}	26.65	32.47	32.70	37.15	41.35	20.39	3.62	6.05	6.07	1057.36	1027.26	307.75
T_{13}	28.75	33.77	34.25	42.85	45.72	23.49	3.15	6.05	6.07	1057.63	995.19	325.78
T_{14}	29.07	35.15	36.37	41.46	39.60	26.40	3.62	6.05	6.06	1031.45	1110.12	385.68
T_{15}	28.57	35.37	35.37	39.75	40.91	21.22	3.15	5.80	5.82	1048.02	990.19	310.61
T_{16}	26.40	33.50	34.17	44.10	41.31	17.26	3.92	5.17	5.62	1045.23	1002.85	308.86
'F' Test	N.S.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m) ±	0.927	0.582	0.323	1.658	2.097	1.953	0.266	0.365	0.361	4.299	2.732	3.733
CD at 5%	-	1.635	0.907	4.657	5.890	5.485	0.748	1.027	1.016	12.076	7.674	10.487
CV (%)	6.690	3.44	1.875	8.041	10.426	17.559	16.784	11.517	11.147	0.819	0.558	2.332

slow and then noted rapid increase during 45-60 and then declined. Decreased CGR from 75-90 DAS may be due to cessation of plant growth. These finding are in conformity with the results of Battery (1970). Relative growth rate (RGR) represented the total dry matter gained by the plant. It is associated with the increase in dry matter of plant. The RGR was maximum at 45-60 DAS stage and then declines. In between 45-60 DAS, seeds pelleted with borax + CMC + filler and thiram

Table 2 : Effect of seed pelleting on growth function of soybean.

Treatment	Crop growth rate (g/day)			Relative growth rate (g/day)			Net assimilation rate (g/dm^2/day)			Leaf area ratio (cm^2/g)		
	Days after Sowing											
	45-60	75-90	At harvest	45-60	75-90	At harvest	45-60	75-90	At harvest	45-60	75-90	At harvest
T_1	0.954	0.725	0.142	0.295	0.0073	0.0005	0.0367	0.0300	0.0093	124.69	17.80	5.58
T_2	0.750	05.88	0.183	0.0235	0.0052	0.0015	0.0295	0.0204	0.0300	115.36	20.75	622
T_3	1.003	0.673	0.123	0.0285	0.0052	0.0029	0.0453	0.0315	0.0273	121.99	18.96	5.80
T_4	1.052	0.641	0.153	0.0297	0.0062	0.0013	0.0285	0.0283	0.0130	122.34	19.05	5.80
T_5	1.113	0.621	0.096	0.0282	0.0058	0.0012	0.0965	0.0198	0.0048	117.96	20.22	6.35
T_6	1.083	0.765	0.156	0.0282	0.0074	0.0012	0.0464	0.0270	0.0089	113.60	17.86	6.45
T_7	1.087	0.635	0.166	0.0292	0.0065	0.0010	0.0436	0.0213	0.0110	1140.50	20.16	6.90
T_8	1.065	0.535	0.149	0.0267	0.0044	0.0013	0.0435	0.0184	0.0120	101.40	17.85	5.60
T_9	1.071	0.540	0.089	0.0285	0.0045	0.0006	0.0407	0.0205	0.0069	109.53	17.40	5.72
T_{10}	1.004	0.550	0.182	0.0285	0.0057	0.0027	0.0352	0.0196	0.0134	124.49	17.63	6.15
T_{11}	1.162	0.605	0.127	0.0315	0.0055	0.0015	0.0352	0.0204	0.0040	130.01	20.46	6.37
T_{12}	1.170	0.715	0.172	0.0307	0.0065	0.0013	0.0417	0.0260	0.0094	118.93	20.17	5.82
T_{13}	1.150	0.430	0.384	0.0292	0.0039	0.0031	0.0421	0.0250	0.0207	110.77	19.61	5.92
T_{14}	1.217	0.405	0.265	0.0305	0.0037	0.0019	0.0427	0.0332	0.0150	111.43	20.77	6.85
T_{15}	1.184	0.500	0.179	0.0335	0.0032	0.0024	0.0402	0.0177	0.0120	129.30	19.02	6.02
T_{16}	1.015	0.550	0.185	0.030	0.0051	0.0032	0.0415	0.0182	0.0135	120.70	19.72	5.85
'F' Test	Sig.	Sig.	Sig.	Sig.	Sig.	N.S.	Sig.	Sig.	Sig.	Sig.	sig	sig
SE(m) ±	0.012	0.016	0.057	0.0009	0.0001	0.0003	0.0029	0.0011	0.0049	0.863	0.258	0.126
CD at 5%	0.035	0.047	0.160	0.0026	0.0003	-	0.0082	0.0031	0.0139	2.424	7.674	10.487
CV (%)	2.379	5.627	9.825	6.545	4.503	6.798	13.162	9.163	14.748	1.463	0.558	2.332

+ maida + filler (Table 2) recorded higher RGR, i.e. 0.0315 and 0.0335 g/day respectively than control.

Net assimilation rate (NAR) is measure of photosyanthesis. It was maximum at 45-60 DAS. The decrease in NAR with the advancement in plant age may be due to senescence of old leaves and reduced leaf area of young leaves. Leaf area ratio (LAR) is the ratio of total leaf area to total plant dry weight. Leaf area ratio was highest at initial growth stages (Tabel 2). There was a steady declines in LAI in all treatments up to harvest. All pelleting treatments recorded significantly higher LAI than control. The findings are in conformity with the results of Abbas *et al.* (1994).

As regard to seed yield per plant showed significant differences among all the treatments. Significantly highest seed yield per plant was produced by thiram + CMC + filler (30.37 g/ plant), followed by borax + CMC + filler (22.55g/plant) and $ZnSO_4$ + CMC + filler (26.43 g/plant). The pelleting treatments were found beneficial which promoted the photosynthetic assimilates, which ultimately reflected towards enhancing the seed yield. (Chhipa and Lal- 1976).

Table 3: Effect of seed pelleting on yield and yield attributes of soybean.

Treatment	Seed yield q ha^{-1}	Days to maturity	Pod per plant	Number of seed per pod	100 seed weight (g)	Harvest index (%)	Oil content (%)	Seed yield per plant (g)
T_1	22.70	99.75	73.04	2.50	11.55	32.69	19.32	16.29
T_2	23.51	99.00	78.55	3.53	11.67	37.72	19.10	19.26
T_3	23.17	98.25	76.14	2.49	11.30	35.23	19.07	17.75
T_4	24.66	98.75	74.69	2.67	11.55	42.10	19.70	21.47
T_5	25.55	98.00	77.66	3.20	11.70	45.01	20.00	23.29
T_6	24.25	99.00	74.80	3.12	11.62	36.85	19.57	19.31
T_7	26.43	96.50	78.64	3.30	11.80	48.81	20.07	25.30
T_8	26.95	98.50	90.62	3.52	11.87	49.77	20.27	26.43
T_9	23.22	97.25	87.54	3.02	11.82	35.31	20.22	18.63
T_{10}	23.04	98.50	76.08	3.05	11.65	34.20	19.65	17.42
T_{11}	27.58	98.75	98.02	3.75	12.00	52.51	20.32	27.55
T_{12}	24.56	96.50	74.05	3.54	11.55	40.37	19.72	21.20
T_{13}	25.51	98.50	77.81	3.60	11.77	41.40	20.05	22.55
T_{14}	28.76	98.50	100.31	3.82	12.14	54.48	20.65	30.37
T_{15}	25.80	98.75	91.41	3.51	18.87	42.95	19.35	23.18
T_{16}	25.89	97.50	74.09	3.39	11.49	46.38	19.17	24.31
'F' Test	Sig.	N. S.	Sig.	N.S.	Sig.	Sig.	N.S.	Sig.
SE(m)±	0.483	0.676	0.623	0.228	0.104	1.438	0.358	0.852
CD at 5%	1.339	-	1.751	-	0.294	4.039	-	2.394
CV (%)	3.851	1.377	1.530	13.735	1.787	6.453	3.626	7.344

The perusual of data (Table 3), revealed that thiram + CMC + filler (28.76 q/ha) followed by borax + CMC + filler (27.58 q / ha) and $ZnSO_4$ + CMC + filler (26.95 q/ha) recorded significantly highest seed yield per hactar than untreated control. Sundaresh and Hiremath (1982) reported chemical seed treatment improved oil per centage and yield of crop. The benefical effects of seed pelleting on yield were reponed by Thompson and Karireddy (1972), Khodzhaev et al. (1978) in cotton, Singh and Agrawal (1988) in soybean.

The data in respect of days required to maturity, the treatment DAP + gum acacia + filler (96.50 days), borax + maida + filler (96.50 days) and $ZnSO_4$ + maida + filler (97.25 days) were found earlier as compared to all the treatments. Seeds pelleted with thiram + CMC+ filler recorded 100.31 pods per plant, which was 37.33 percent more than no pelleting (73.04 pods / plants). The maximum number of seeds per pod was noted in T_{14} (thiram+CMC+filler) which was 3.82 seeds followed by seed pelleted with borax + gum acacia + filler (3.60 seeds per pod).

Significantly more (12.14 g) test weight was recorded by seeds pelleted with thiram + CMC + filler followed by seed pelleted with borax + CMC + filler which was 12 g. Harvest index and oil content were significantly influenced by seeds pelleted with thiram + CMC + filler, followed by borax + CMC + filler and $ZnSO_4$ + CMC + filler.

Beneficial effects of seed pelleting may be due to positive simulating effects on number of pods per plants, test weight and harvest index.

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