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Effect of pre-sowing seed treatment with growth regulators on yield and yield contributing characters in mungbean [*Vigna radiata* (L.) Wilczek]

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Abstract

Seeds of four mungbean [*Vigna radiata* (L.) Wilczek] varieties, *viz.*, Pusa Vishal, Pusa 9072, Pusa 9531 and PS-16 were treated with five growth regulators including gibberellic acid, indole acetic acid, benzoic acid, 2,3,5 tri-iodobenzoic acid, and 2,4-dochlorophenoxy acetic acid. Each variety was treated at three concentrations of each of these five chemicals. The objective was to investigate the performance of these varieties, when their seeds were treated before sowing with these growth regulators. Application of the plant growth regulators, 2, 3, 5 tri-iodobenzoic acid (10^{-3} ppm) and 2, 4-dichlorophenoxy acetic acid (10^{-3} ppm) produced highest seed yield in all the four varieties. This was due to more positive contributions by high harvest index, 100-seed weight, seeds per pod and pods per plant towards grain yield.

Key words: Mungbean, growth regulators, seed yield, harvest index

Introduction

Vigna radiata (L.) Wilczek popularly known as green gram or mungbean has acquired the third place in the area sown after chickpea and pigeonpea among the pulse crops in India. Growth substances as presowing treatments have increased the grain yield either by enhancing the pod setting or seed number per pod in the various legume crops [1, 2]. Plant growth regulators are extremely versatile, as these can be used in many ways, *viz.*, treatment of soil and seedling or foliage and presowing seed treatment. All these methods have improved the economic yields, but the presowing seed treatment is the most cost effective method [3]. According to Taylor *et al.*, [4], the greatest use of the seed treatments has been to provide an inexpensive insurance against the rotting of the planted seeds by the soil fungi. Use of plant growth regulators has been described as an important method of crop improvement [5]. The present investigation was therefore, carried out to see the effect of five plant growth regulators in three concentrations on seed yield, harvest index (HI), 100-seed weight, seeds per pod and pods per plant in mungbean.

Materials and methods

The experiment was conducted in summer, 2003 under field conditions and repeated during summer, 2004 with four mungbean varieties Pusa Vishal, Pusa 9531, PS-16 and Pusa 9072. The seeds of the four varieties were treated with five plant growth regulators, namely indole acetic acid (IAA), benzoic acid (BA), 2, 3, 5 tri-iodobenzoic acid (TIBA), 2, 4-dichlorophenoxy acetic acid (2, 4-D) and gibberellic acid (GA), all in three concentrations (10^{-1} ppm, 10^{-2} ppm and 10^{-3} ppm).

One hundred seeds were placed in each of the petridishes, which were lined with Whatman filter paper. Fifty ml of each solution was poured into the four petridishes, representing four replications, whereas in the control treatments 50 ml of distilled water was poured into each of the four petridishes of each variety. After 24 hours, the treated seeds were sown in four replications in a Factorial RBD in the field. During presowing seed treatment, the temperature was maintained at 25 ± 2°C. At plant maturity, the yield contributing characters seed yield per plant, 100-seed weight, number of pods per plant, number of seeds per pod and H.I. were recorded on five randomly selected plants each treatment in each replication.

Results and discussions

The data of the effect of plant growth regulators on seed yield and yield contributing characters are presented in Table 1.

Pods per plant: Varieties treated with TIBA and 2, 4-D at all the doses had significantly more number of pods as compared to the respective control treatments. Except BA at the dose of 10^{-2} ppm and 10^{-3} ppm and IAA in variety Pusa 9531, all other growth regulator treatments had significantly more number of pods as compared to the controls in both the years. The dose 10^{-3} ppm (the least dose) of both TIBA and 2, 4-D induced more number of pods per plant in all the four

Table 1. Effect of various doses of growth regulators on yield and yield contributing characters of mungbean

Growth regulators	Concentration	Characters											
		Pods per plant				Seeds per pod				100-seed weight (g)			
		Pusa 9531	Pusa 9072	Pusa Vishal	PS-16	Pusa 9531	Pusa 9072	Pusa Vishal	PS-16	Pusa 9531	Pusa 9072	Pusa Vishal	PS-16
Control		48.33	62.00	37.00	44.00	12.33	13.40	11.37	13.03	5.07	4.40	5.48	4.55
GA	10^{-1}	59.33	73.67	52.27	53.17	13.23	14.07	11.47	13.17	5.39	4.56	5.88	4.94
	10^{-2}	58.67	73.33	52.30	49.83	12.93	13.73	11.13	13.03	5.15	4.45	5.25	4.39
	10^{-3}	53.33	63.00	48.73	46.50	12.17	13.30	11.07	13.00	5.03	4.30	4.83	4.20
BA	10^{-1}	57.53	67.67	42.67	46.00	12.53	13.73	10.87	13.70	5.00	5.00	4.73	4.90
	10^{-2}	48.33	52.27	36.17	41.67	12.33	12.73	10.77	13.37	4.66	4.85	4.37	4.75
	10^{-3}	46.27	46.33	35.47	45.33	12.20	12.40	10.63	13.03	4.10	4.66	4.07	4.60
IAA	10^{-1}	48.27	79.17	50.23	65.57	13.13	14.07	11.57	13.10	5.48	4.58	5.92	4.66
	10^{-2}	49.23	71.23	47.43	55.67	12.33	13.40	11.10	13.07	5.30	4.45	5.00	4.56
	10^{-3}	49.67	66.33	47.67	55.27	12.07	12.73	10.97	12.70	5.00	4.30	4.75	4.43
TIBA	10^{-1}	62.17	70.67	49.27	52.29	12.07	13.07	11.13	12.70	4.98	5.00	4.98	5.00
	10^{-2}	61.67	72.67	53.43	59.67	13.73	13.40	11.47	13.03	5.49	5.70	5.47	5.28
	10^{-3}	65.27	77.33	54.23	66.00	13.87	14.37	12.97	14.37	5.77	5.99	5.78	5.45
2,4-D	10^{-1}	65.00	84.23	47.00	56.23	12.10	13.07	11.20	12.70	5.00	4.96	5.00	4.88
	10^{-2}	64.43	79.16	51.67	67.33	13.83	13.73	11.87	13.03	5.45	5.25	5.52	5.25
	10^{-3}	70.67	85.67	62.67	76.17	13.97	14.49	13.00	14.40	5.63	5.80	5.83	5.75
CD at 5%													
Growth regulators (G)		03.50	03.57	03.17	04.39	0.869	0.93	0.92	0.95	0.25	0.25	0.25	0.37
Dose (D)		02.71	02.76	02.46	03.40	0.673	0.72	0.71	0.73	0.20	0.19	0.19	0.29
G × D		06.07	06.18	05.50	04.60	1.505	1.61	1.59	1.64	0.43	0.43	0.42	0.47
Control *vs.* rest		03.74	03.81	03.38	04.68	0.926	0.10	0.98	1.10	0.26	0.26	0.26	0.39

Table 1 Contd.

Growth regulators	Concentration	Characters							
		Harvest index (%)				Grain yield/plant (g)			
		Pusa 9531	Pusa 9072	Pusa Vishal	PS-16	Pusa 9531	Pusa 9072	Pusa Vishal	PS-16
Control	O	17.10	21.59	21.20	29.22	11.50	12.45	12.44	15.39
GA	10^{-1}	20.44	20.08	19.37	35.77	15.64	16.00	13.34	15.82
	10^{-2}	18.19	20.00	19.85	33.80	13.23	14.62	12.06	15.10
	10^{-3}	15.64	19.50	20.76	32.11	10.27	12.12	12.00	12.12
BA	10^{-1}	11.41	26.41	20.40	28.30	07.38	11.80	11.73	12.90
	10^{-2}	11.32	22.85	16.90	27.31	07.30	10.87	09.07	11.40
	10^{-3}	11.00	20.04	19.95	25.90	06.82	08.70	08.96	10.00
IAA	10^{-1}	18.82	29.50	21.19	33.73	13.02	17.50	14.02	17.20
	10^{-2}	16.72	27.91	17.98	30.51	11.02	15.00	11.25	14.90
	10^{-3}	13.88	25.42	27.78	30.30	08.58	11.97	10.92	10.25
TIBA	10^{-1}	19.29	28.77	27.52	33.16	12.68	13.40	09.68	13.65
	10^{-2}	23.22	35.78	29.18	37.23	13.86	19.95	13.08	17.50
	10^{-3}	27.65	37.71	33.58	43.97	16.48	22.50	15.43	21.25
2,4-D	10^{-1}	21.04	29.22	28.87	35.65	10.08	12.70	09.53	12.12
	10^{-2}	24.39	36.79	39.43	40.13	13.72	16.15	12.55	15,05
	10^{-3}	32.36	39.11	40.95	44.32	17.53	22.00	16.38	19.50
CD at 5%									
Growth regulator (G)		00.35	00.45	00.37	00.50	1.372	1.733	1.949	1.460
Dose (D)		00.27	00.35	00.29	00.39	1.063	1.342	1.509	1.131
G × D		00.60	00.77	00.64	00.88	2.377	3.001	3.376	2.529
Control *vs.* rest		00.37	00.48	00.39	00.54	1.463	1.848	2.079	1.557

Abbreviations: GA = Gibberellic acid, BA = Benzoic acid, IAA = Indole acetic acid, TIBA = 2,3,5, tri-iodobenzoic acid, 2,4-D = 2,4 dichlorophenoxy acetic acid

varieties. Similar results were reported in chickpea [6] and groundnut [7] also.

Number of seeds per pod: In all the four varieties, TIBA and 2, 4-D induced a significant increase in number of seeds per pod at lowest dose of 10^{-3} ppm.

GA and IAA had almost the same effect but only at the higher dose of 10^{-1} ppm. Some doses of BA also have increased the number of seeds per pod as compared to the control but not significantly. In general, the increase in numbers of seeds per pod was better in Pusa 9531 and Pusa 9072 as compared to PS-16 and Pusa Vishal. Each of the growth regulators, their doses and the interactions between the growth regulators and the doses showed their significant impact on the number of seeds per pod. Similar results were obtained when the seeds of mungbean were treated with chlormequat chloride and naphthalene acetic acid [8].

100-seed weight: Significant impact of the growth regulators TIBA and 2,4-D at 10^{-3} ppm and GA and IAA at the dose of 10^{-1} ppm was observed on 100-seed weight in all the four varieties. At 10^{-1} ppm dose, TIBA and 2, 4-D in the varieties Pusa Vishal and Pusa 9531 and GA and IAA at the dose 10^{-3} ppm in all the varieties were inferior to the respective control treatments. BA at the dose of 10^{-3} ppm also gave lower 100-seed weight in the varieties Pusa 9531 and Pusa Vishal but gave higher seed weight at this dose and at 10^{-1} ppm in the varieties Pusa 9072 and PS-16 as compared to the respective control treatments.

Harvest index (HI): In all the four varieties, all the doses of TIBA and 2,4-D induced significantly higher HI as compared to the respective controls and all the doses of GA, IAA and BA in the decreasing order. The lowest dose 10^{-3} ppm of 2, 4-D was more affective than the corresponding dose of TIBA. BA at all the doses was significantly inferior in inducing the HI in all the varieties. The positive effects of TIBA and 2,4-D are probably as a consequence of getting more photosynthates diverted towards improving the yield components and thereby the HI. Results presented here indicate that GA and IAA could also possibly achieve better HI by modifying the yield components, but the dosages of the two growth hormones need to be further fine tuned. Similar results were obtained in groundnut [7] by presoaking seeds for 15 minutes with IAA and GA.

Seed yield per plant: Significant increase in seed yield per plant was observed at 10^{-3} ppm of TIBA and 2, 4-D in PS-16 and Pusa 9072, the latter chemical being more affective than the former. GA and IAA dose 10^{-1} ppm also induced better grain yield per plant, but it was substantially lesser than 10^{-3} ppm dose of TIBA and 2, 4-D. GA and IAA at 10^{-3} ppm in all the varieties were inferior to the respective control treatments. The fifth chemical BA at all the doses, in all the varieties was inferior to the control, but the loss was lesser in PS-16 than in Pusa 9072 and even lesser in Pusa 9531 and Pusa Vishal.

It can be concluded that TIBA and 2, 4-D induced better seed yield/plant at all the doses, more so at 10^{-3} ppm. This increase in seed yield by the application of TIBA as found in this study is in close agreement with the observations in soybean [9]. Similar results have been obtained also in chickpea [6], maize [10], beans, corn, potato and peas [11].

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