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Effect of Pre-sowing Seed Treatment with Growth Regulators on Germination and Vigour in Mungbean (*Vigna radiata* (L.) Wilczek)

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ABSTRACT An investigation was carried out during summer 2004 to evaluate the performance of four different mungbean varieties (Pusa Vishal, PS-16, Pusa-9531 and Pusa-9072), where pre-sowing seed treatment was given with five plant growth regulators viz. Gibberellic acid (GA), Benzoic acid (BA), Indole acetic acid (IAA), 2, 3, 5-triiodo benzoic acid (TIBA) and 2, 4-dichloro phenoxy acetic acid (2, 4-D), each with three concentrations (10^{-1}, 10^{-2}, 10^{-3} ppm). The improvement in germination and vigour was seen with TIBA and 2, 4-D in only two cultivars, both having 90% germination. In the other two cultivars with 95-96% germination, there was no improvement. Similarly the reduction with GA and IAA was seen in two cultivars with 90% germination except BA showing reduction in all the four cultivars.

Keywords: Mungbean, growth regulators, germination percentage, vigour index.

Mungbean (*Vigna radiata* (L). Wilczek) is an important pulse crop in India, grown on more than three million hectares. India accounts for about 60 per cent of the world's mungbean area and 47 per cent production. China has the world's highest yield levels, averaging 1.1 t/ha [1]

To realize the genetic potential of pulses, seed treatment with plant growth regulators can play a very important role [2]. To achieve high grain yields, an initial good start in terms of proper germination and seedling development for healthier establishment of plants in the field is of great importance [3]. Under this background, the present investigation was undertaken to study the effect of five different growth regulators on germination and vigour of the four mungbean varieties.

MATERIALS AND METHODS

The experiment was conducted during summer 2004 at IARI, New Delhi, on genetically pure seeds harvested in preceding *kharif*. Seed germination and vigour studies were carried out in the Seed Testing Laboratory of the Division of Seed Science and Technology, IARI, New Delhi. There were 64 treatment combination with four mungbean varieties viz. Pusa Vishal, PS 16, Pusa 9531 and Pusa 9072 and five plant growth regulators viz. gibberellic acid (GA), indole acetic acid (IAA), benzoic acid (BA), 2, 3, 5 tri-iodobenzoic acid (TIBA) and 2, 4-dichloro phenoxy acetic acid (2, 4-D) each having three concentrations (10^{-1}, 10^{-2} and 10^{-3} ppm) and one control for each variety. The experiment was laid out in four replications. All concentrations of the growth regulators used, were based on parts per million (ppm). The solubility of each growth regulator was guided by Merck Index [4]. One hundred seeds were placed in each Petri dish, which were lined with Whatman filter paper. Using a 30 ml pipette, 30 ml of each solution was poured into four Petri dishes, representing four replications, whereas in control treatment 30 ml of distilled water was poured in to each of the four Petri dish of each variety. After 24 hours, treated seeds (4x100) were placed between paper rolls (BP) in four replicates of 100 seeds each for germination at 25±2°C in a seed germinator. The root and shoot length of the normal seedlings were measured on 3rd, 5th and 8th days after the treatments. The seed germination percentage and seedling vigour were assessed as per the ISTA procedure [5].

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Table 1. Effect of plant growth regulators on germination percentage in four mungbean varieties

Growth regulators	Dose (ppm)	Pusa Vishal			PS 16			P-9531			P-9072		
		3rd DAT	5th DAT	8th DAT	3rd DAT	5th DAT	8th DAT	3rd DAT	5th DAT	8th DAT	3rd DAT	5th DAT	8th DAT
Control		70.00	85.34	90.00	70.66	93.34	96.66	65.34	87.34	90.00	68.00	92.00	95.34
GA	10^{-1}	65.34	80.00	87.34	68.66	90.00	95.34	58.66	83.34	86.66	64.34	90.66	94.00
GA	10^{-2}	63.34	78.66	85.34	70.66	91.34	96.00	56.66	80.66	83.34	68.00	90.00	96.66
GA	10^{-3}	62.66	76.66	84.66	71.34	93.34	96.66	55.34	79.34	82.00	70.00	91.34	96.00
BA	10^{-1}	57.34	65.34	75.34	61.34	80.66	90.66	45.34	75.34	78.66	60.00	78.00	89.00
BA	10^{-2}	58.00	67.34	76.00	63.34	83.34	91.34	46.66	76.66	79.34	64.00	80.66	85.34
BA	10^{-3}	60.66	70.66	80.66	65.34	85.34	93.34	48.66	78.66	80.66	66.66	83.34	87.34
IAA	10^{-1}	64.00	78.00	86.00	65.34	92.66	95.34	57.34	81.34	84.66	67.34	90.00	93.34
IAA	10^{-2}	62.66	77.34	83.34	71.34	94.00	97.34	55.34	79.34	82.66	70.00	91.34	95.34
IAA	10^{-3}	61.34	75.34	81.34	72.66	95.34	97.34	52.66	78.66	80.66	72.00	93.34	97.34
TIBA	10^{-1}	71.34	84.66	91.34	71.34	93.34	96.00	60.66	84.66	88.66	65.34	90.66	92.66
TIBA	10^{-2}	72.00	86.34	92.00	75.34	94.66	96.66	61.34	85.34	89.34	70.00	92.00	94.00
TIBA	10^{-3}	73.66	87.34	93.66	76.66	96.66	97.34	64.66	87.34	92.66	72.00	93.34	95.34
2, 4-D	10^{-1}	71.34	85.00	90.00	73.34	93.34	96.66	66.66	87.34	90.00	70.66	91.34	94.66
2, 4-D	10^{-2}	72.72	86.66	91.34	75.34	95.34	97.34	67.34	89.34	93.34	72.00	93.34	96.00
2, 4-D	10^{-3}	74.00	88.00	94.00	77.34	97.34	98.00	70.66	90.66	94.66	73.34	94.00	97.34
CD at 5%													
Growth regulator (G)		2.213	1.729	1.660	2.187	2.394	2.260	2.057	2.095	1.361	3.016	2.772	2.299
Dose	(D)	1.714	1.339	1.286	1.694	1.854	1.750	1.593	1.623	1.054	2.336	2.147	1.780
	GxD	3.834	2.996	2.876	3.788	4.147	3.914	3.563	3.630	2.358	5.223	4.801	3.982
Control vs rest		2.361	1.845	1.771	2.333	2.554	2.410	2.194	2.235	1.452	3.217	2.957	2.452

GA = Gibberellic acid; BA= Benzoic acid; IAA= Indole acetic acid; TIBA= 2, 3, 5-tri-idobenzoic acid; 2, 4-D= 2, 4-dichlorophenoxy actic acid DAT = Day after Treatment

RESULTS AND DISCUSSION

Effect on germination percentage

TIBA and 2, 4-D significantly increased the germination percentage at initial stages in all the varieties as compared to other growth regulators. At lower concentration of both of these chemicals, the germination percentage was maximum. The minimum germination percentage (45.34%) was recorded in 10^{-1} dose of BA on 3rd day in the variety Pusa-9531 and the maximum percentage (98.00%) was recorded on 8th day in 10^{-3} dose of 2, 4-D in the variety PS-16. In all the four varieties, across all the five growth regulators and for all the doses, there was an increase in germination percentage with time from third to fifth to eighth day after seed treatment. Even after third observation on the eighth day after seed treatments, in none of the treatments 100% germination was achieved, indicating the presence of hard seeds in all the varieties. Between 2, 4-D and TIBA, the former was more affective. This finding is in close agreement with the observations in other pulse crops [6, 7].

A clear cut difference at varietal level for response to various growth regulators was also observed in the present study. The genotype PS-16 showed most consistent response to all the chemicals except for BA and the germination percentage was better or at par with the control. Other genotypes showed mixed response and both GA and BA at all doses reduced germination in genotypes Pusa Vishal and Pusa 9531 significantly. The results obtained in the present study showed an inhibitory effect of 2, 4-D in higher dose (10^{-1} ppm) as compared to the lower dose (10^{-3} ppm), agreeing closely with the work of the earlier workers [8, 9]. The increased germination with 2, 4-D as being reported here was earlier also observed in *V. radiata* (10). Lower concentration of (10^{-3}) of both TIBA and 2, 4-D has encouraged

Table 2. Effect of plant growth regulators on vigour index (G%×TSL)

Growth regulators	Dose (ppm)	Pusa Vishal			PS 16			P-9531			P-9072		
		3rd DAT	5th DAT	8th DAT	3rd DAT	5th DAT	8th DAT	3rd DAT	5th DAT	8th DAT	3rd DAT	5th DAT	8th DAT
Control		521.50	1250.23	1557.00	282.64	1190.09	1904.20	457.38	1270.80	1624.50	265.20	1150.00	1859.13
GA	10^{-1}	407.07	1114.40	1397.44	276.06	1166.75	1897.44	360.76	1179.26	1399.56	238.00	1128.05	1876.80
GA	10^{-2}	361.04	1054.04	1335.57	261.23	1116.17	1873.92	325.80	1101.01	1320.94	223.04	1098.00	1880.04
GA	10^{-3}	322.70	992.75	1295.30	264.34	1080.00	1840.06	294.86	1043.32	1266.90	202.55	1078.85	1809.50
BA	10^{-1}	200.69	735.08	1029.80	177.27	899.36	1709.85	99.75	719.50	1089.44	160.80	865.80	1579.20
BA	10^{-2}	226.20	797.98	1051.08	209.02	943.41	1735.46	121.32	771.97	1114.73	188.80	907.43	1617.19
BA	10^{-3}	248.71	872.65	1125.21	225.42	972.02	1791.19	141.11	825.93	1141.34	197.31	944.24	1672.56
IAA	10^{-1}	326.40	986.70	1272.80	283.37	1143.13	1802.02	243.70	878.47	1265.67	241.20	1115.41	1898.13
IAA	10^{-2}	281.97	897.14	1208.43	269.67	1111.08	1888.40	207.53	783.09	1210.97	225.40	1073.25	1844.83
IAA	10^{-3}	254.56	862.64	1150.96	238.49	1056.32	1824.81	176.41	759.07	1157.47	202.69	1021.50	1782.79
TIBA	10^{-1}	447.81	1177.91	1442.25	278.23	1162.08	1800.80	348.80	1269.90	1507.22	245.03	1110.59	1811.50
TIBA	10^{-2}	467.16	1187.60	1453.40	235.06	1211.65	1928.37	368.04	1292.90	1518.78	278.60	1154.60	1851.80
TIBA	10^{-3}	549.35	1271.57	1577.32	321.97	1250.78	1951.67	470.29	1323.20	1636.23	303.84	1194.75	1897.27
2, 4-D	10^{-1}	542.18	1264.20	1588.50	311.70	1204.09	1931.27	515.28	1324.95	1597.50	303.84	1155.45	1869.54
2, 4-0	ID^{-2}	578.12	1312.90	1634.99	331.50	1258.49	1961.40	548.82	1366.90	1694.12	313.92	1205.95	1915.20
2, 4-D	10^{-3}	606.80	1359.60	1729.60	348.03	1304.36	1994.30	593.54	1427.90	1767.30	326.36	1231.40	1956.53
CD at 5%													
Growth regulator (G)		10.94	17.01	37.83	5.63	23.19	38.48	6.40	17.73	28.36	2.44	22.38	37.33
Dose	(D)	8.47	13.17	29.31	4.36	17.96	29.50	4.96	13.73	21.97	1.89	17.34	28.92
	GxD	18.94	29.47	65.53	9.76	40.16	66.65	11.09	30.71	49.12	4.22	38.77	64.66
Control vs rest		11.66	18.15	40.36	6.01	24.73	41.04	6.83	18.91	30.25	2.60	23.87	39.82

GA = Gibberellic acid; BA= Benzoic acid; IAA= Indole acetic acid; TIBA= 2, 3, 5-triidobenzoic acid; 2, 4-D= 2, 4-dichlorophenoxy actic acid DAT = Day after Treatment

germination, because at lower doses they are known to promote the growth [10], and it is most evident in the initial stages of radical growth.

Effect on seedling vigour

Vigour index determines the state of the health of seedling and ultimately the state of the productivity of the plant. Higher the vigour index, better will be the yield of the plant. It was observed that growth regulator and dose both induced significant changes in vigour index. At lowest dose 2, 4-D and TIBA at all the intervals induced the highest vigour index as compared to the control and other growth regulators at any dose. Between various doses of TIBA and 2, 4-D, dose (10^{-3}) has generated the highest vigour index and at the other end, dose 10^{-1} of the same two chemicals has given the lowest vigour index. The impact of GA was the 3rd best at all the doses and at all the intervals. The effect of 2, 4-D (10^{-3}) and TIBA (10^{-3}) was significantly better than the control, whereas all other growth regulators and the corresponding doses were inferior to the control. In the treatments, which responded positively, the effect was most pronounced on third day itself, suggesting the treatment effect on early growth vigour of the seedlings.

In the present study, it has been observed that 2, 4-D and TIBA induced higher seed vigour in all the varieties studied. For other treatments like GA and IAA the vigour was comparable with control in most cases. However, with BA treatment it was significantly reduced in all combinations. These observations are in support with studies in soybean [11] and also confirm the observations in chickpea [12].

Pre-treatment with plant growth regulators viz. TIBA and 2, 4-D at different levels of viability of seeds, enhanced per cent germination and seedling

growth in the present study. Arya and Saxena [13] observed improved germination and vigour in seeds of mustard treated with GA_3, KIN, ETH and according to them this stimulation decreased linearly with decrease in vigour and viability. In the present study also the difference in response between varieties may be attributed to the initial vigour status of the seeds. Major benefits of seed treatment may lie only in highly germinable vigorous seed lots [14].

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