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Effect of Indole Acetic Acid (IAA) on Yield and Yield Contributing Parameters of Soybean

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Abstract: The study revealed that maximum biological yield, grain yield and minimum days taken to seed filling were observed at 10 ppm concentration. Seed weight, number of seed per plant and number of nodules per plant were not significantly affected by various concentrations. Maximum number of seeds/plant, biological yield and grain yield were produced when IAA was applied at 15 days after emergence stage. Seed filling duration, seed weight and number of nodules per plant were not significantly affected by growth stages.

Key words: Growth regulator, Indole Acetic Acid, Soybean.

Introduction

Yield in soybean (*Glycine max.* L) is in part the result of photosynthetic production and its partitioning to seed through physiological or morphological yield component. Some plants such as most grasses, have essentially no stem growth during the vegetative development and favour partitioning to leaves and roots. Soybean yield loss resulting from the leaf removal depends upon the amount of foliage removal and the stage of development at which defoliation occurs. Reduction in soybean yield is ultimately result of decline in the yield components like the number of pods per plant and seed size (Helsel *et al.*, 1987). Evidence is available that assimilate and plant growth regulators level interact to some degree in determining the fate of individual yield component and source sink manipulation. The effect of growth regulators on source-sink manipulation and interaction may be seen as acting either on the source, on the sink or the transport system between the two. A growth regulator may stimulate metabolic activity in the sink thereby increasing its utilization and thus stimulating source activity. The effect of growth regulators on enzymatic activity and elasticity of sink cells can have a dramatic effect on partitioning. Indole acetic acid, cytokinin and gibberellic acid when applied to third top leaf, increased source-sink translocation of C14 assimilates in soybean (Kaprov and Belozerrova, 1985). In bean seedlings, the main control over the distribution of source between root and shoot sink can be attributed to auxin and cytokinin concentrations in various sinks. Harmonal influences on initiation, development and abortion of flower and seed have a significant role on the sink-source relationship in crop. Keeping in view the above factors, it was worth while to design an experiment to study the effect of IAA at different concentrations and growth stages on yield and partitioning parameters of soybean.

Materials and Methods

The experiment was conducted in 1991 in RCBD (factorial) with three replications. There were 12 treatments in each replication. The sub plot size was 3 x 4 m^2. Row to row distance was 60 cm and plant to plant was 5 cm. Williams variety was sown at of 75 kg ha^{-1}. Growth regulator, its concentrations and time of application are given below.

A. Growth regulator
Indole acetic acid

B. Concentrations
1. 0 ppm (d0) 2. 5 ppm (d1) 3. 10 ppm (d2)
4. 15 ppm (d3)

C. Growth stages
1. 15 days after emergence (S1)
2. Flowering (S2) 3. Seed filling (S3)

Growth regulator was weighed and the ppm concentrations were calculated according to the standard formula of 1 mg/L = 1 ppm. Then the growth regulator was dissolved in water and sprayed in the field. All other agronomic practices were same as used for soybean production. The data were analyzed statistically according to the techniques outlined by Steel and Torrie (1980) and LSD test was applied to signify the treatment differences.

Results and Discussion

Seed filling duration (days): Data on seed filling duration are presented in Table 1. The analysis of mean values showed that IAA under various concentrations significantly affected the seed filling duration. As for as the affect of growth stages is concerned, though it was non-significant yet maximum figure was recorded at flowering stage followed by seed filling and 15 days after emergence. The interaction was non-significant. Maximum duration was observed in control and minimum in 10 ppm plots when sprayed at 15 days after emergence. While plants sprayed with 15 ppm at flowering stage took minimum days to seed filling. It might be due to various concentrations which accelerate the translocates in the plants and promote vegetative growth and hence took lesser number of days than the untreated plots (Baz *et al.*, 1989).

Seeds per plant (No): Data given in Table 2 revealed that growth regulator at various growth stages significantly effected the number of seeds per plant. According to the given table, maximum number of seeds/plant were recorded at 15 days after emergence followed by pod filling and flowering stage. Whereas IAA at various concentrations had no significant effect. Castro and Vella (1981) reported that concentrations play no vital role in the number of seeds per plant because growth regulator in generally has its effect on size and not on the number whereas if applied at proper stage then the assimilates were driven towards reproductive parts and may be possible to increase the number. While Egli (1976) stated that growth regulators, 2,4-D and Ethrel significantly increased the seed number but reduce the seed size.

Seed weight (g): Data given in Table 3 exhibited that no significant difference was observed to various concentrations as well as stages. However maximum seed weight was recorded at 10 ppm concentration and minimum in control plot. As far as the interaction is concerned, maximum seed weight was given by plants sprayed with 10 ppm at 15 days after emergence stage. Kaprov and Belozerrova (1985) stated that IAA alone increased photosynthetic rates while IAA and Kinetin increased source-sink translocation of C14 assimilates in soybean.

Grain yield (kg ha^{-1}): It is evident from Table 4 that the effect of concentrations and stages on grain yield was highly significant. The table further indicated that maximum grain yield was produced at 10 ppm concentration, while best time of application was 15 days after emergence. This was due to the fact that all treated plants resulted in maximum number of seeds/plant, number of pods/plant and seed weight. Castro and Vella (1981)

Table 1: Effect of IAA applied at different concentrations and growth stages on seed filling duration (days) of soybean.

Stages	0 ppm	5 ppm	10 ppm	15 ppm	Mean
15 days after emergence	57.33	55.00	52.66	55.00	55.00 NS
Flowering	56.66	57.00	52.33	58.33	56.08 NS
Seed filling	57.66	54.33	54.00	56.00	55.50 NS
Mean	57.22 a	55.44 a	53.00 b	56.44 a	

Means followed by different letters are significantly different at 5% level of probability.
NS = Non-significant

Table 2: Effect of IAA applied at different concentrations and growth stages on number of seeds/plant of soybean.

Stages	0 ppm	5 ppm	10 ppm	15 ppm	Mean
15 days after emergence	82.00	82.66	84.00	81.66	82.58 a
Flowering	76.66	80.33	79.66	75.33	78.00 b
Seed filling	79.33	77.33	80.60	79.00	79.08 b
Mean	79.33 NS	80.11 NS	81.44 NS	78.67 NS	

Means followed by different letters are significantly different at 5% level of probability.
NS = Non-significant

Table 3: Effect of IAA applied at different concentrations and growth stages on 100 seed weight (g) of soybean.

Stages	0 ppm	5 ppm	10 ppm	15 ppm	Mean
15 days after emergence	13.92	14.47	15.42	15.39	14.80
Flowering	14.47	14.70	15.02	14.31	14.62
Seed filling	15.04	14.61	14.77	14.57	14.75
Mean	14.48	14.59	15.07	14.76	

Non-significant

Table 4: Effect of IAA applied at different concentrations and growth stages on grain yield (kg ha^{-1}).

Stages	0 ppm	5 ppm	10 ppm	15 ppm	Mean
15 days after emergence	1111.10	1277.76	1333.31	1263.88	1246.51 a
Flowering	1124.99	1166.65	1277.76	1208.32	1194.43 b
Seed filling	1097.21	1208.32	1236.10	1138.87	1170.12 b
Mean	1111.10 c	1217.58 b	1282.39 a	1203.69 b	

Means followed by different letters are significantly different at 5% level of probability.

Table 5: Effect of IAA applied at different concentrations and growth stages on biological yield (kg ha^{-1}).

Stages	0 ppm	5 ppm	10 ppm	15 ppm	Mean
15 days after emergence	4194.42	4583.31	4944.34	4611.08	4583.29 a
Flowering	4277.76	4305.53	4749.97	4388.86	4430.53 a
Seed filling	4305.53	4277.75	4361.09	4166.64	4277.75 a
Mean	4259.23 b	4388.86 b	4685.13 a	4388.86 b	

Means followed by different letters are significantly different at 5% level of probability.

Table 6: Effect of IAA applied at different concentrations and growth stages on number of nodules/plant of soybean.

Stages	0 ppm	5 ppm	10 ppm	15 ppm	Mean
15 days after emergence	3.77	4.10	4.33	3.66	3.96
Flowering	3.66	4.44	3.77	3.22	3.77
Seed filling	3.88	4.10	3.55	3.88	3.85
Mean	3.77	4.21	3.88	3.59	

Non-significant

sprayed soybean with 2000 ppm chlormequat, 4000 ppm daminozide, 100 ppm gibberellic acid (GA), 100 ppm IAA and found that daminozide delayed flowering and GA and IAA increased the flowering period. Maximum seed weight, pod weight, seed number and seed yield was recorded for plants treated with gibberellic acid.

Biological yield (kg ha^{-1}): Data given in Table 5 display significant difference between treated and controlled plots. It is obvious from the table that maximum biological yield was produced at 10 ppm concentration while minimum was recorded in control treatments. Fifteen days after emergence stage resulted in maximum biological yield followed by flowering and seed filling stage. The use of various concentrations at different stages enhanced the cell division vigorously and ultimately increased the vegetative growth (Baz *et al.*, 1989). Halwankar *et al.* (1984) reported that Cytozyme products containing cytokinin, auxin, trace elements and enzymes significantly increased yields.

Nodules per plant (No.): Data revealed non significant affect of concentrations as well as stages on the number of nodule per plant (Table 6). However maximum figure was shown by plots sprayed with 5 ppm concentration as against minimum with 15 ppm concentration. Among the treatments, maximum number of nodules/plant were recorded at 15 days after emergence stage followed by seed filling and flowering stage. This might be attributed to the fact that 5 ppm concentration at 15 days after emergence stage enhanced the vegetative growth of the crop hence maximum nitrogen fixation took place and more number of nodules were formed.

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