

Effect of Growth Regulators on Physiological and Biometric Parameters of Soybean (*Glycine max* (L.) Merrill.)

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Abstract

A field experiment on soybean variety MAUS 162 was conducted to study the effect of foliar spray of growth regulators viz. GA₃ and IBA on growth and yield of soybean along with to study correlation between seed yield and its attributing traits at Department of Botany, VNMKV, Parbhani during kharif 2014. Observation were recorded as plant height, number of branches per plant, number of leaves per plant, leaf area per plant (cm²), total dry weight per plant (g) at 30, 45 and 60 days after sowing. Different growth & yield parameters viz. absolute growth rates (mg/day/plant), relative growth rate (mg/g/day), net assimilation rate (mg/cm²/day), leaf area index (LAI), crop growth rate (CGR) (g/cm²/day) and leaf area ratio (LAR) estimated at 0-30, 31-45 and 46-60 days after sowing for all parameters except for LAI and LAR, which was estimated at 30, 45 and 60 DAS. Results revealed that spraying of growth regulators showed influence on the growth, development and yield of soybean. The GA₃ increased the pod size, number of grains per pod and yield per hectare. GA₃ 250 ppm was found effective in increasing vegetative growth parameters as well as yield and yield attributing characters. Further detailed research work is needed on the physiological aspects of growth, development and yield to explain the effects of these growth substances.

Key words : Soybean, growth regulators, yield, growth parameters, correlation

Introduction

Application of growth regulators is new concept to enhance the productivity of crop plants. Growth regulators are chemicals, which participate in the control of growth of plants. In last few years it has been well established that certain organic compound present in plants control the growth of plants which are exceedingly called phytohormones growth promoting substance or growth regulators. Auxins are organic substances which promote growth along the longitudinal axis, when applied in low concentration to shoot of plant. IAA is only naturally occurring

auxin in the plant, but NAA, IBA, etc. are synthetic chemicals which are similar to IAA in its biological activity. All chemical activities an auxin, have common structural features in their molecules.

Investigations on gibberellins have been extended to several important phenomenon in plant life, such as elongation of stem, expansion of leaves, production of dry matter, elimination of dwarfism, root growth, breaking dormancy, cell division and several metabolic processes. GA₃ is natural product of higher plants, which is useful to prevent genetic and physiological dwarfism, breaking

of dormancy cell elongation and controlling fruit growth. The present investigation, was undertaken to study effect of growth regulators on physiological and biometric parameters sprayed at 30 DAS on soybean crop.

Materials and Methods

A field experiment on soybean variety MAUS 162 was conducted to study the effect of foliar spray of growth regulators *viz.* GA₃ and IBA on growth and yield of soybean along with to study correlation between seed yield and its attributing traits at Department of Botany, VNMKV, Parbhani during *khariif* 2014. The experiment was laid out in randomized block design with 3 replications and seven treatments as given below. The crop was sown in plot of 2.25m X 4m to apply each treatment separately, following a spacing of 45 x 5 cm between and with rows of 4m length. Observation were recorded as plant height, number of branches per plant, number of leaves per plant, leaf area per plant (cm²), total dry weight per plant (g) at 30, 45 and 60 days after sowing. Different growth & yield parameters *viz.* absolute growth rates (mg/day/plant), relative growth rate (mg/g/day), net assimilation rate (mg/cm²/day), leaf area index (LAI), crop growth rate (CGR) (g/cm²/day) and leaf area ratio (LAR) estimated at 0-30, 31-45 and 46-60 days after sowing for all parameters except for LAI and LAR, which was estimated at 30,45 and 60 DAS. The experimental treatments were T₁ GA₃ 100 ppm (Gibberellic acid), T₂ GA₃150 ppm (Gibberellic acid), T₃ GA₃ 250 ppm (Gibberellic acid), T₄ IBA 100 ppm (Indole butyric acid), T₅ IBA 150 ppm (Indole butyric acid), T₆ IBA 250 ppm (Indole butyric acid) and T₇ Control.

Results and Discussion

The data on different biometrical observations is presented in Table 1. Results revealed that GA₃ 250 ppm significantly

increases the plant height at all the stages of growth and at par with GA₃ 150 ppm and IBA-250 ppm. The positive effects of growth regulators on plant height were recorded by many others^[4,8]. This could be attributed to enhanced cell multiplication and cell elongation. It is also reported that IBA induced plasticity in cell wall, causing water diffusion pressure deficiency, which resulted in water uptake and causing cell elongation and consequently increased plant height.

Further, GA₃ 250 ppm significantly increase the number of branches as compared to other concentrations of growth regulators over the control. The trends in case of number of leaves showed that there was considerable effect of all the concentrations of GA₃ and IBA. The GA₃ 250 ppm was more effective among the various concentrations in this regard. This could be due to its activity of cell multiplication. It could also be possible due to more number of internodes, thus more number of leaves, consequently more leaf area of plants^[2].The increasing trends of total dry weight showed that there was more accumulation of dry matter in plant due to spraying of GA₃ and IBA(Table 1). This was maintained upto 60 DAS. The dry weight was also increased at various stages of plant growth. Among the various concentrations, GA₃ and IBA (250 ppm) was most effective in increasing total dry matter.

GA₃ 250 ppm significantly increases the number of leaves as compared to other concentrations of growth regulators over the control. The positive effect of growth regulators spraying on number of leaves were observed earlier also^[2, 8]. Foliar application of GA₃ 250 ppm was more effective for inducing 50 per cent flowering. All the growth regulators hastened the flowering period as compared to the control^[6].

Table 1 Effect of growth regulators on different biometric observations in soybean

Treatments	Height of plants (cm ²)			No. of Branches per Plant			No. of leaves per plant			Leaf area (dm ²)			Total dry weight per plant (g)		
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
T ₁ - GA ₃ 100 ppm	16.09	33.15	44.86	7.67	11.79	12.15	10.77	34.36	54.98	4.72	10.20	20.60	2.65	9.32	12.24
T ₂ - GA ₃ 150 ppm	15.60	32.53	47.33	8.33	11.67	12.36	10.80	35.23	54.42	4.89	10.67	20.87	3.09	10.01	12.60
T ₃ - GA ₃ 250 ppm	17.04	34.65	49.29	9.00	12.52	13.23	11.76	37.38	58.13	4.83	13.63	22.44	3.88	11.26	13.46
T ₄ - IBA 100 ppm	15.18	30.77	45.65	8.00	11.00	12.05	10.33	34.33	52.97	4.68	11.06	20.74	2.82	9.28	11.68
T ₅ - IBA 150 ppm	15.67	31.51	46.47	8.33	11.33	12.07	11.17	34.36	53.79	4.73	10.68	20.87	3.26	9.75	11.47
T ₆ - IBA 250 ppm	16.13	32.71	47.20	8.67	11.33	12.58	11.07	34.30	54.71	4.79	10.60	21.37	3.45	9.88	12.35
T ₇ - Control	14.87	28.46	41.60	7.33	9.98	10.45	9.67	30.97	48.84	4.77	9.77	16.05	2.52	8.60	10.39
General mean	15.80	31.97	46.06	8.19	11.37	12.13	13.20	35.74	54.73	4.77	10.94	20.42	3.095	9.729	12.029
SE ±	0.667	1.126	1.347	0.430	0.448	0.487	0.482	1.335	1.595	0.220	0.421	0.831	0.172	0.368	0.442
CD at 5%	NS	3.399	4.066	NS	1.353	1.470	NS	4.030	4.815	NS	1.271	2.509	NS	1.111	1.335
CV %	7.308	6.099	5.065	9.100	6.823	6.954	7.735	6.717	5.117	7.999	6.663	7.049	9.628	6.550	6.365

Effect of growth regulators on growth parameters is presented in Table 2. In growth parameters all the observation of AGR, RGR, NAR, CGR, LAR and LAI are based on general mean. From data it is clear that there was very little effect on increase or decrease of growth functions due to spraying of GA₃ and IBA. However, GA₃ 250 ppm resulted in highest increase on AGR, RGR, CGR, NAR, LAR and LAI compared to other treatments and control at all growth stages. Many workers studied such growth parameters^[2,3].

The effects of all the concentration of GA₃ and IBA on different yield components were found significantly superior over control (Table 2). In general GA₃ 250 ppm was more effective in increasing yield and yield

attributing characters, such as the number of pods per plant, number of seeds per pod, weight of straws per plant, weight of seeds, grain yield (q/ha) and harvest index(%). Among the different concentrations of growth regulators GA₃ 250 ppm found more effective than others, because of it acts as a chelating agent, it also prevent auxin oxidation, due to which contribution was more in increasing the yield as compared to other growth substance. Also the increase in grain yield was achieved by stimulating effects of growth substances of various yield contributing characters. This increase in soybean grain yield was due to growth substances^[5,6,7].

Table 2 Effect of growth regulators on different growth parameters in soybean

Treatments	Absolute growth rate (AGR) (mg/plant/day)			Net assimilation rate (NAR) (mg/plant/day)			Relative growth rate (RGR) (mg/plant/day)			Leaf are index (LAI)			Crop growth rate (CGR) (mg/plant/day)		
	0-30 DAS	31-45 DAS	46-60 DAS	0-30 DAS	31-45 DAS	46-60 DAS	0-30 DAS	31-45 DAS	46-60 DAS	30 DAS	45 DAS	60 DAS	0-30 DAS	31-45 DAS	46-60 DAS
T ₁ - GA ₃ 100 ppm	0.088	0.444	0.195	0.013	0.026	0.006	0.0141	0.0364	0.0079	2.10	4.53	9.16	0.027	0.117	0.052
T ₂ - GA ₃ 150 ppm	0.103	0.461	0.173	0.014	0.027	0.005	0.0163	0.0341	0.0067	2.17	4.74	9.28	0.031	0.130	0.046
T ₃ - GA ₃ 250 ppm	0.129	0.492	0.147	0.018	0.026	0.004	0.0196	0.0308	0.0052	2.15	6.06	9.97	0.039	0.157	0.036
T ₄ - IBA 100 ppm	0.094	0.431	0.160	0.014	0.025	0.005	0.0150	0.0345	0.0067	2.08	4.92	9.22	0.028	0.123	0.042
T ₅ - IBA 150 ppm	0.109	0.433	0.114	0.016	0.025	0.003	0.0171	0.0317	0.0047	2.10	4.75	9.28	0.033	0.120	0.030
T ₆ - IBA 250 ppm	0.115	0.429	0.165	0.016	0.026	0.005	0.0179	0.0305	0.0065	2.13	4.71	9.50	0.035	0.121	0.044
T ₇ - Control	0.084	0.405	0.119	0.012	0.025	0.004	0.0134	0.0355	0.0055	2.12	4.34	7.13	0.025	0.110	0.029
General mean	0.103	0.442	0.153	0.015	0.026	0.004	0.0162	0.0334	0.0061	2.12	4.86	9.08	0.031	0.125	0.040

Conti.....

Treatment	Leaf area ratio (LAR)			Yield components					
	30 DAS	45 DAS	60 DAS	No. of pods/ plant	No. of seeds/ pod	100-seed wt.(g)	Grain yield (kg/plot)	Grain yield (q/ha)	Harvest index (%)
T ₁ - GA ₃ 100 ppm	177.76	109.48	168.25	47.26	2.57	11.20	1.26	24.02	46.15
T ₂ - GA ₃ 150 ppm	158.32	106.60	165.59	51.05	2.62	11.64	1.28	24.90	46.45
T ₃ - GA ₃ 250 ppm	124.48	121.11	166.70	54.42	3.11	12.57	1.31	25.68	47.73
T ₄ - IBA 100 ppm	166.27	119.18	177.49	50.10	2.73	11.81	1.25	24.29	46.01
T ₅ - IBA 150 ppm	145.24	109.54	182.03	50.25	2.72	11.89	1.27	24.77	46.57
T ₆ - IBA 250 ppm	138.97	107.22	172.96	52.81	2.77	11.92	1.28	24.98	46.74
T ₇ - Control	188.90	113.60	154.48	40.25	2.21	9.83	1.11	21.56	43.21
General mean	157.14	112.39	169.64	49.45	2.68	11.55	1.25	24.31	46.45
SE ±				1.967	0.138	0.42	0.036	0.74	0.30
CD at 5%				5.939	0.415	1.27	0.11	2.24	0.88
CV %				6.889	8.895	6.321	5.67	5.28	9.04

The correlation coefficient studies (Table 3) have indicated positive and significant correlation between seed yield and parameter like plant height, number of leaves, leaf area, total dry weight, number of pods and 100-seed weight indicating that these characters had major direct contribute towards seed yield^[1]. Total dry weight manifested positive and significant associated with rest of

the biometrical traits except 100-seed weight, indicating a certain inherent relation between them. A strong positive and significant association was observed between number of pods, 100-seed weight and leaf area per plant, suggested the importance of leaf area, there by photosynthetic surface towards its associated traits.

Table 3 Simple correlation coefficient between yield and its contributing traits in soybean

Character	Plant height (cm)	No. of leaves/ plant	Leaf area/ plant (dm ²)	Total dry weight (g)	No. of pods/ plant	100 seed wt. (g)	Yield (q/ha)
Plant height (cm)	1.000	0.940**	0.931**	0.872**	0.721*	0.627*	0.786**
No. of leaves/ plant		1.000	0.900**	0.856**	0.640*	0.442	0.680*
Leaf area/ plant (dm ²)			1.000	0.871**	0.882**	0.774**	0.921**
Total dry weight (g)				1.000	0.656*	0.542	0.754**
No. of pods/ plant					1.000	0.928**	0.981**
100 seed wt. (g)						1.000	0.936**

*Significant at 5 % level, **Significant at 1% level.

References

1. Das, M.L., Rahman, A. and Miah, A.J. (1989). Correlation path coefficient and regression studies in soybean. *Bangladesh Journal of Agriculture Research*, **14**(1):27-29.
2. Deotale, R.D., Maske, V.G., Sorte, N.Y., Chimakar, B.S. and Yermé, A.I. (1998). Effect of GA₃ and NAA on morpho-physiological parameters of soybean. *Journal of Soils and Crops*, **8**(1):91-94.
3. Kalita, P. and Day, S.C. (1994). Morphological growth and yield characters of green gram influenced by foliar application of P and NAA. *New Botanica*, **2**(1): 27-32.
4. Majid, F.Z., Begum, S. and Rehaman, A.(1980).Sunflower as oilseed crop in Bangladesh. Part-VIII. Effect of same hormones on sunflower. *Bangladesh Scientific Industrial Research*, **15**:174-175.
5. Maske, V.G., Deotale, R.D., Sorte, P.N. , Tale, B.D. and Chore, C.N.(1998). Influence of GA₃ and NAA on growth and yield contributing parameters of soybean. *Journal of Soils and Crops*, **8**(1):20-22.
6. Mehtre, S.S. and Lad,S.K.(1995).Effect of foliar application of growth substances on growth and yield. *Soybean Genetics Newsletter*, **22**:132-134.
7. Tagade, R., Deotale,R.D., Armarkar, N., and Chore, C.N. (1999). Influence of seed soaking in IAA and kinetin solutions on growth and yield of soybean. *Journal of Soils and Crops*, **9**(1):72-74.
8. Zhao, H., Lin, X., Shi, H. and Chang, S.(1995). Effect of phenolic components on physiological characteristics and yield of soybean. *Acta Agronomica Sinica*, **21**(3):351-355.