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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. *GA_3 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 (cm^2) , 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/cm^2/day), leaf area index (LAI), crop growth rate (CGR) (g/cm^2/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 thatspraying of growth regulators showed influence on the growth, development and yield of soybean. The GA_3 increased the pod size, number of grains per pod and yield per hectare.GA_3 250 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

Soybean (*Glycine max* (L.) Merill) belongs to family Leguminoaceae with sub family Papilionaceae. It is a native of South Asia and its wild type had been identified in China. It is being cultivated since long time in China, but afterwards, it has spread in countries like Brazil, America, (Hymowitz, 1970). It was introduced in India in 1970-71 mainly due to its rich protein and edible oil content (Andole, 1984). Soybean grown successfully in subtropical and tropical regions.

In any production programme the seed yield and quality parameters are directly or indirectly controlled by environment under which crops are grown.The strategy to boost the level of crop productivity would be through the adoption of package of practices comprising use of seeds of high yielding varieties, adequate doses of fertilizers, growth regulators, plant geometry and protection chemicals.

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,

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production of dry matter, elimination of dwarfism, root growth, breaking dormancy, cell division and several metabolic processes. GA_3 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 to study the effect of GA_3 and IBA on various physiological aspects of growth and development and correlation of various physiological parameters with yieldin soybean.

Materials and Methods

A field experiment on soybean variety MAUS 162 was conducted to study the effect of foliar spray of growth regulators *viz*. GA_3 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. 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 (cm^2) , 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/cm^2/day), leaf area index (LAI), crop growth rate (CGR) (g/cm^2/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 .

Treatments Details

T_1	GA_3 100 ppm (Gibberellic acid)
T_2	GA_3 150 ppm (Gibberellic acid)
T_3	GA_3 250 ppm (Gibberellic acid)
T_4	IBA 100 ppm (Indole butyric acid)
T_5	IBA 150 ppm (Indole butyric acid)
T_6	IBA 250 ppm (Indole butyric acid)
T_7	Control

Results and Discussion

The data on different biometrical observations is presented in Table 1. Results revealed that GA_3 250 ppm significantly increases the plant height at all

Table 1: Effect of growth regulators on different biometric observations in soybea

Treatment	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	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	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	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	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	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	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	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
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 $\pm$	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			

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

Treatment	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)		
	0-30DAS	31-45DAS	46-60DAS	0-30DAS	31-45DAS	46-60DAS	0-30DAS	31-45DAS	46-60DAS	30DAS	45DAS	60DAS	0-30DAS	31-45DAS	46-60DAS
T_1	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	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	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	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	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	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	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
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

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

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	177.76	109.48	168.25	47.26	2.57	11.20	1.26	24.02	46.15
T_2	158.32	106.60	165.59	51.05	2.62	11.64	1.28	24.90	46.45
T_3	124.48	121.11	166.70	54.42	3.11	12.57	1.31	25.68	47.73
T_4	166.27	119.18	177.49	50.10	2.73	11.81	1.25	24.29	46.01
T_5	145.24	109.54	182.03	50.25	2.72	11.89	1.27	24.77	46.57
T_6	138.97	107.22	172.96	52.81	2.77	11.92	1.28	24.98	46.74
T_7	188.90	113.60	154.48	40.25	2.21	9.83	1.11	21.56	43.21
Mean	157.14	112.39	169.64	49.45	2.68	11.55	1.25	24.31	46.45
SE $\pm$				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

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.

the stages of growth and at par with GA_3 150 ppm and IBA-250 ppm. The positive effects of growth regulators on plant height were recorded by Zhao *et al.* (1995) and Yadav *et al*. (2015). 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, GA_3 250 ppm significantly increase the number of branches as compared to other concentrations of growth regulators over the control. The positive effect of growth regulators spraying on number of branches were observed by Ghuge (1999) in soybean. The trends in case of number of leaves showed that there was considerable effect of all the concentrations of GA_3 and IBA. The GA_3 250 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. Similar findings observed and supported by Deotale*et al*. (1998) in soybean.The increasing trends of total dry weight showed that there was more accumulation of dry matter in plant due to spraying of GA_3 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, GA_3 and IBA (250 ppm) was most effective in increasing total dry matter.

GA_3 250 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 by Zaid and Singh (1993) and Deotale*et al*. (1998) in soybean more number of leaves helped in production and accumulation of photosynthesate, resulting into more production of biomass, higher dry matter accumulation coupled with higher partitioning ratio towards economic yield.Foliar application of GA_3 250 ppm was more effective for inducing 50 per cent flowering. All the growth regulators hastened the flowering period as compared to the control. Similar results were observed by Mehtre and Lad (1995) in soybean.

Effect of growth regulators on growth parameters is presented in Table 2.Ingrowth 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 GA_3 and IBA. However, GA_3 250 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 this growth parameters such as Deotale *et al*. (1996) in soybean, Kalita and Day (1992) in green gram.

The effects of all the concentration of GA_3 and IBA on different yield components were found significantly superior over control (Table 2 and 2a). In general GA_3 250 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 GA_3 250 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 due to growth substances was also reported by Mehtre and Lad (1995).

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 contributetowards seed yield. Das *etal.* (1989) and Amaranth *etal.* (1990) also obtained similar result in soybean. 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.

From the present investigation it may be conducted that growth regulators had influencethe growth, development and seed yield of soybean further, GA_3 250ppm found effective in investigating vegetative growth parameters as well as yield and its correlated traits.

References

Amarnath, K.C.N., Vishwanath, S.R. and Chennakeshwa,B.C. (1990). Phenotypic and genotypic correlation coefficient of some quantitative characters in soybean. *Mysore J. Agric. Sci*. **24**(4):445-449.

Das, M.L., Rahman, A. and Miah, A.J. (1989). Correlation path coefficient and regression studies in soybean. *Bangladesh J. Agric. Res.* **14**(1):27-29.

Deotale, R.D., Maske,V.G.,Sorte, N.Y.,Chimakar, B.S. and Yerme, A.I. (1998). Effect of GA_3 and NAA on morpho-physiological parameters of soybean. *J. Soils and Crops.* **8**(1):91-94.

Ghuge, V.R. (1999). Effect of growth regulators on growth and yield of soybean. M.Sc. (Agri.) Thesis, MAU, Parbhani.

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.

Narendra Singh Yadav, Baleshwar Gautam and S.S Gautam (2015). Effect of plant growth regulators in flowering and colour development.Technofame Journal of Multidisciplanary Advance Research, Volume 4 issue II, pp 62-66.

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.

Zaidi, P.H. and Singh,B.B.(1995). Dry matter partitioning and yield attributes of soybean as affected by soil salinity and growth regulators. *Legume Res.***16**(3-4):139-143.

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.