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DIFFERENTIAL RESPONSES OF VARIOUS Amino ACID BASED GROWTH SUBSTANCES ON BIOCHEMICAL ESTIMATIONS, YIELD AND YIELD COMPONENTS OF SOYBEAN (*GLYCINE MAX* (L.) MERRILL)

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Abstract:

Soybean (*Glycine max* (L.) Merrill) belongs to family Fabaceae is one of the most important protein and oilseed crops throughout the world. Its oil is the largest component of the world's edible oils. It is native of China. It has emerged as one of the important commercial crops in many countries. Soybean is also known as the "Golden bean" or "Miracle crop" because of its multiple uses. Higher seed yield of any crop can be achieved only through proper combinations of a cultivar, environment and agronomic practices. The basic component of living cells is proteins, with building block material, Amino acids. Studies have proved that Amino acids can directly or indirectly influence the physiological activities of the plant. In present study field experiments were conducted at the Research Farm Adhartal, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P.) during *Kharif* season of 2015-2016. The experiment was laid out in RBD with thirteen replications. Sampling for growth analysis was done at the fixed intervals of 15 days from 20 days after sowing onwards till harvest. Five plants were randomly selected from each treatment and replications for growth analysis and biochemical estimations were carried out at maturity stage .Result revealed that treated soybean possessed higher number of seeds/plant (95.66), seed index (7.70 g), which in turn had reflected in highest seed yield (11.06 g/plant and 1317 kg/ha). Treated plants were registered highest biological yield performance (23.37 g/plant) and (3008.59 kg/ha) resultant of comparatively higher magnitudes of physiological parameters. Treated plants also possessed higher protein (%) (38.40), carbohydrate (%) (28.27), fibre (%) (4.13) and fat (%) (18.71).

Key words: Growth substances, soybean, (*Glycine max* (L.) Merrill), Biochemical Estimations, yield and yield components

Introduction

Soybean is a crop of multiple qualities as it is both a pulse and oilseed crop. In India, It contributes around 25% of total edible oil pool of the country. The area planted with soybeans worldwide was 102.4 million hectares, with total production of 261.6 million tons in the same year (FAOSTAT, 2015). The main soybean producing states in India are Madhya Pradesh (56 percent), Maharashtra (37 percent), and Rajasthan (11 percent). All India soybean production is 86.426 Lakh MT and average yield is 784 kg/ha on 110.656 lac ha. Madhya Pradesh is known as the "Soybean State" of India, comprising 55% of the total national area of soybean cultivation. In Madhya Pradesh the area under soybean cultivation during *Kharif* 2015 was 59.062 lac ha and production was 86.426 lac MT and average yield was 781kg/ha during *Kharif* 2015 (SOPA 2015). Madhya Pradesh is the soybean bowl of India, contributing 65-70 per cent of country's soybean production, followed by Maharashtra, Rajasthan and Karnataka which is much below the average national and world productivity.

The soybean cultivars have variability for physiological and morphological attributes of growth and productivity. The productivity efficiency of any cultivar depends on its functional yield attributes which provide a basis for evolving better plant ideotype through breeding with higher yield potential and its maximum realization in a given set of environmental conditions. Higher seed yield of any

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crop can be achieved only through proper combinations of a cultivar, environment and agronomic practices.

The basic component of living cells is proteins, with building block material, Amino acids. Proteins are formed by sequence of Amino acids. The requirement of Amino acids in essential quantities is well known as a means to increase yield and overall quality of crops. The application of Amino acids for foliar use is based on its requirement by plants in general and at critical stages of growth in particular. Plants absorb Amino acids through stomata and are proportionate to environment temperature. Foliar nutrition in the form of protein hydrolysate (known as Amino acids liquid) as foliar spray provides readymade building blocks for protein synthesis. HYTD (Agrinos, Mumbai) is a liquid formulation contains chitin, chitosan, glucosamine and free L-Amino acids from natural source through 100% organic fermentation process. It is ideal for seed treatment, which will result in increased seed germination index, improved vigour of seedlings, strengthened crop's root formation and cell structures. Presence of L-Amino acids in HYTD supplements the requirement of seed/plant and increased protein synthesis, drought alleviation and all other stresses. Keeping in view of the above facts the main objectives of this study were (i) To investigate the effect of Amino acid based growth substances on Yield and yield components and (ii) Quality of soybean.

Materials and Methods

The present study was conducted at the Research Farm Adhartal, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P.) during *Kharif* season of 2015-2016. The research experiment was laid out in a Randomized block design with thirteen replications and two treatments *i.e.* $\mathbf{T_1}$- control (untreated) and, $\mathbf{T_2}$- Treated Amino acid complex $\mathbf{T_2}$-Treated Amino acid complex @ 3ml/kg seed (seed coating with 5-7ml water) comprised of soybean genotype JS 97-52. Five plants were randomly selected from each treatment and replications for growth analysis and biochemical estimations were carried out at maturity stage.

1. Yield and yield attributing traits:

(a) Seed index or 100 seed weight (g) : One hundred seeds were taken randomly from finally cleaned seed of each plot and weighed separately by electronic balance.

(b) Seed yield (g/plant and kg/ha) : The Seed yield g/plant and kg/ha was recorded after threshing, cleaning and drying the grains. It is also known as economic yield.

(c) Biological yield (g/plant and kg/ha): Biological yield is the total yield of crop including economic yield and the Stover yield. The biological yield per plant and kg/ha was recorded after harvesting.

(d) Harvest index : Harvest index is the ratio of economic yield to the total biological yield expressed in percentage. It represents the efficiency of photosynthates translocation to economic parts (Synder and Carlson, 1984). While calculating the biological yield only the above ground parts were taken into consideration.

Statistical analysis

Analysis of observations was taken on different variables was carried out to know the degree of variation among all the treatments. The pooled data was statistically analyzed using Analysis of variance (ANOVA) through randomized block design (Fisher, 1967).

2. Biochemical estimations:

(a) Estimation of protein % in seeds: The nitrogen content was estimated by Micro Kjeldhal method (A.O.A.C., 1965).

(b) Determination of fat percentage: The fat content in the sample was estimated by pelican equipment socs plus based on principle of Soxhlet's extraction method as described in AOAC (1980).

(c) Estimation of total carbohydrate percentage: Total carbohydrates in the sample was estimated by the hydrolysis method as described in (AOAC, 1984).

(d) Total crude fibre: Total crude fibre was calculated as following.

$$\% \text{ Crude fibre} = W_2 - W_1 / \text{Weight of sample} \times 100$$

$\mathbf{W_1}$= initial weight of crucible,

$\mathbf{W_2}$= final weight of crucible

Results and Discussion

Yield and yield attributing traits

The effect of various Amino acid based growth substances on yield and yield components of soybean is presented in the table 1. The results showed that treated with Amino acid plants (7.70) possessed the higher magnitudes for seed index for soybean genotype investigated. The minimum was noted in control plants (7.29). These traits may be useful in a breeding program. Weight of 100 seeds (g) and the harvest index was significant at 5% (Zewail *et al*. 2014). Interaction effects of water deficit and time of spraying Amino acid on the characteristic of number of grains per row and 1000 grains weight were significant at the 5% level (Kasraie

et al. 2012). Soil application of nitrogen containing Amino acid improved all growth and yield related traits resulting in increased biomass production, economic yield and harvest index (Shahzad *et al*. 2014).

Seed yield per plant is the final expression of physiological and metabolic activities of a plant and a product of cumulative action of all factors contributing to better growth *viz.* number of pods / plant, no. of seeds / pod, number of branches per plant and seed index. Seed treatment with Amino acid indicated that the higher seed yield was registered in treated plants (1317 kg/ha). The minimum seed yield observed in control plants (1274 kg/ha) in soybean

Biological yield is the resultant of the interplay of a cultivar to phenological, morphological, physiological and biochemical factors which depend upon genetically

Table 1: Effect of seed treatment with Amino acid on yield and yield attributes of soybean.

Replication	Seed yield (g/plant)		Seed Yield (kg/ha)		Biological yield (g/plant)		Biological yield (kg/ha)		Seed index(g)		Harvest index (%)	
	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated
1	7.19	8.81	249	250	21.15	19.46	762.34	811.30	7.01	7.42	41.65	46.95
2	11.52	14.20	1611	1638	23.25	28.88	3503.16	3507.00	7.31	7.37	49.17	49.55
3	15.83	16.16	1916	1999	31.80	32.04	4204.12	4217.89	7.19	7.39	49.41	50.82
4	11.69	12.50	1583	1611	27.08	27.62	3753.88	3801.96	8.27	8.95	43.17	45.26
5	12.27	17.33	1472	1527	23.14	29.58	3738.88	3788.53	6.62	6.92	41.48	44.64
6	5.19	5.81	194	216	10.71	12.04	514.10	572.40	7.26	7.44	43.11	53.25
7	7.33	7.84	1361	1472	14.78	15.64	3047.04	3517.27	7.01	7.41	49.59	50.13
8	7.90	8.85	1749	1777	16.78	16.80	3672.90	3731.70	8.28	8.27	47.02	52.74
9	5.06	5.60	1249	1305	11.03	10.01	2935.15	3066.75	8.15	8.78	50.45	50.86
10	6.25	7.88	1416	1472	17.07	25.02	3582.48	3724.16	6.12	6.75	41.34	44.49
11	7.19	8.94	249	277	19.46	22.63	762.34	763.82	7.01	7.89	36.95	39.51
12	14.20	14.23	1600	1638	28.88	29.21	3310.00	3507.00	7.37	7.87	48.72	49.17
13	14.37	15.83	1916	1944	28.06	32.04	4101.84	4204.12	7.19	7.74	49.41	51.21
Mean	**9.69**	**11.06**	**1274**	**1317**	**20.82**	**23.37**	**2922.35**	**3008.59**	**7.29**	**7.70**	**45.47**	**48.39**
SEM±	0.28		6.32		0.58		25.75		0.06		0.58	
CD 5 %	0.87		19.46		1.79		79.35		0.20		1.79	

Table 2: Effect of seed treatment with Amino acid on biochemical estimations in soybean seed.

Replication	Protein (%)		Fat (%)		Fat (%)			
	Control	Treated	Control	Treated	Control	Treated	Control	Treated
1	39.75	38.25	19.21	19.25	3.58	3.79	28.90	29.40
2	39.49	39.65	19.86	19.98	4.42	4.48	28.89	29.34
3	39.52	38.54	19.15	19.28	3.92	4.11	29.10	29.30
4	39.14	39.58	18.47	18.49	3.90	4.38	29.25	29.50
5	39.21	39.54	19.59	19.78	4.10	4.51	29.44	29.84
6	36.11	36.94	16.11	16.52	3.20	3.40	25.01	25.41
7	36.85	36.89	17.52	17.55	3.99	4.01	26.22	26.33
8	36.02	36.19	17.55	17.63	3.92	4.11	26.57	26.58
9	36.74	36.98	17.22	18.22	3.90	4.08	26.35	26.42
10	38.52	38.76	17.88	17.96	4.10	4.25	26.89	26.98
11	38.25	38.59	19.25	19.25	3.79	3.97	29.10	29.40
12	39.61	39.65	19.84	19.98	4.38	4.48	29.34	29.64
13	38.18	38.18	19.28	19.34	3.97	**4.11**	**29.30**	29.40
Mean	**38.05**	**38.40**	**18.53**	**18.71**	**3.94**	**4.13**	**28.03**	**28.27**
SEM±	0.064		0.053		0.028		0.033	
CD 5 %	0.199		0.164		0.086		0.104	

controlled ability of the plants to synthesis translocate and store yield relevant substances. The biological yield refers to the dry weight of whole plant including root weight. Treated plants were recorded significantly higher biological yield/plant (23.37 g). However control plants were observed the lowest biological yield/plant (20.82 g). Treated plants was observed higher biological yield (3008.59 kg/ha). Whereas, the lowest value was reported under control plants (2922.35 kg/ha). Control plants recorded the minimum seed yield (20.82 g/plant) due to poor performance of yield components. Combined application of nitrogen fixing bacteria and Amino acid spraying can be helpful in developing of production and yield in *Vigna radiate* (Pedramminaee *et al*. 2013).

Harvest index is the partitioning of dry matter between grain and vegetative plant as economic yield is the function of biological yield where harvest index describes partitioning of the net photosynthates to economic and non-economic plants parts which to some extent is under genetic control. In other words it estimates the partitioning of the dry matter between the seeds and the stem and leaves (Synder and Carlson, 1984). These results are in conformity with (Kasraie *et al*. 2012). Treated plants showed the significant higher harvest index (48.39%). Whereas control plants noted minimum harvest index in soybean variety JS-97-52 (45.47%). These plants may be utilized in a breeding program for enhancing the capacity to transfer food material in to the economic parts of the plant. Control plants (45.47) were found to be associated with the lowest harvest index. This investigation is supported by the finding of (Zewail *et al*. 2014).

1. Biochemical Estimations: The effect of various Amino acid based growth substances on biochemical estimations of soybean is presented in the table 2. The seed quality parameters showed a significant variation due to growing environmental condition as well as genotypes. Percent seed protein content and seed protein yield expressed marked effect of growing circumstances and genotypes. Amino acid treated plants had significantly higher protein (38.40%). However, the control plants registered the minimum protein (38.05%). These traits may be utilized in a breeding program for increasing nutritive value of soybean. Exogenous application of Amino acids either under control water or different salinity levels caused increases in total carbohydrates % and protein % compared with the corresponding salinity levels in sunflower plant (Sadak *et al*. 2012).

It is revealed from the data that the maximum fat noted under treated plants (18.71%) as compared to untreated pants (18.53%) in soybean. Karima *et al*. (2015) reported that essential oil percent and yield increased by all treatments of the three Amino acids. The three Amino acids treatments increased total phenols and total indoles. Amino acid treatments resulted in quantitative differences in these components of the essential oil. The means compression obtained that highest essential oil content were achieved by Kadostim under irrigation interrupted from seed filling stage by the treatment of Amino acid (Sani 2011).

It is revealed from the data that the significantly maximum carbohydrate was recorded under treated plants (28.27%). Minimum carbohydrate was noted in untreated plants (28.03%). Abd El Monem *et al*. (2007) concluded that, there is a close relationship between the effect of Amino acids and the stimulation of the photosynthetic output (soluble sugars, polysaccharides and total carbohydrates) of faba bean plant. Thus, increases the efficiency of solar energy conversion which maximizes the growth ability of faba bean and consequently increases its productivity. Application of Amino acids as a foliar spray caused increases in the contents of total carbohydrates and polysaccharides of stressed and non stressed plants (Awad *et al*. 2007). Exogenous application of Amino acids either under control water or different salinity levels caused increases in total carbohydrates % and protein % compared with the corresponding salinity levels (Sadak *et al.* (2012).

Treatment plants with Amino acid @ 3 ml/kg of soybean seed had significant higher fibre content (4.13%). Whereas the minimum fibre was noted in control plants (3.94%) in soybean seeds. The fibers are generally associated with increasing laxative value. Salmani *et al*. (2012) reported in ten vegetable soybean 75 genotypes along with the control that the fiber content was ranged from 1.89-2.69 %. These results are in conformity with Salwa *et al* (2014) observed that physiological and biochemical studies on drought tolerance of wheat plants by application of Amino acids. Similarly the investigation is supported by the findings of Zahra *et al*. (2015) observed that the foliar application of Amino acid, at suitable concentrations, had positive effects on the content of secondary metabolites, antioxidants and antioxidant activity. The stimulated values of biochemical constituents strengthened the role of the applied Amino acids in the metabolism of *Aloe vera* plant.

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