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Response of Plant Growth Regulators and Micronutrients on Growth, Yield of Cowpea (*Vigna unguiculata* L.)

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ABSTRACT: The field experiment was conducted during *kharif* 2020 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh, to study the response of plant growth regulators and micronutrients on growth, yield of Cowpea (*Vigna unguiculata* L.). The treatments consist of seven plant growth regulators (Superzyme gold, Root master. Superzyme, Boost, Americana, Sea bomb) and one micronutrient (Microl-F), and one respective control was used. The Experiment was designed in Randomized Block Design consists of eight treatments each replicated thrice. It was observed that T_3 Superzyme 900 ml/ha foliar spray at 25 and 45 Day after sowing was recorded as best treatment for obtaining growth and yield attributes such as plant height (122.72 cm), number of branches per plant (5.90), pods per plant (11.60), seed yield (903.03 kg/ha), stover yield (1423.33 kg/ha). While net returns (90,514.50 INR/ha) and B:C ratio (2.0) were also observed with the application of Superzyme 900 ml/ha foliar spray at 25 and 45 days after sowing. It reveals from the study that application of Plant growth regulators and Micronutrients contribute to enhance the rate of crop development and yield in cowpea by increasing pods.

Key words: Plant growth regulators, Micronutrients, Foliar spray, Growth, Yield

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is an annual legume. It is native to central Africa. It belongs to family Fabaceae. It is commercially grown throughout India for its green pods which are used as vegetable. It is one of the most ancient human food sources and has probably been used as a crop plant since Neolithic time (Chevalier, 1964). Cowpea is an important food legume and a versatile crop grown between 350 N to 300 S of equator covering Asia Oceania the Middle East and Southern Europe, Africa & USA (Fery, 1985). Pulse crops enrich the soil through symbiotic nitrogen fixation from atmosphere. Besides being a rich source of protein, they maintain soil fertility through biological nitrogen fixation in soil and thus, play a vital role in sustainable agriculture (Kumar *et al*., 2018). It is an inexpensive source of vegetable protein. The protein content ranges from about 3-5% in green leaves, 4-5% in immature pods and 25-30% in mature seeds. The amino acid profile reveals that lysine, leusine and phenylanine content are relatively higher in cowpea (Bressani and Elias 1980). In India vegetable cowpea is grown over an area of 23,012 ha with production of 1,33,587 tons of green pod and productivity of 5800 kg/ha. The leading states are UP, Bihar, Jharkhand, West Bengal, Odisha etc. Cowpea is called as vegetable meat due to high amount of protein in grain with better biological value on dry weight basis. Composition of Cowpea Green Pod (per 100 g of edible portion) Moisture 84.6 g, Phosphorus 74 mg, Protein 4.3 g, Iron 2.5 mg, Fat 0.2 g, Vitamin A 941 I.U., Minerals 0.9 g, Riboflavin 0.09 mg, Fibre 2.0 g, Thiamine 0.07 mg, Carbohydrates 8.0 g, Nicotinic acid 0.9 mg, Calcium 80 mg, Vitamin C 13.0 mg (Aykroyd, 1963). Important reasons for low average yield of cowpea at farmer's field were the continuous cultivation of traditional low potential cultivars, use of low seed rate and improper agronomic practices. Among many crop production constraints, appropriate plant growth regulators and micronutrients are the most important, which contribute substantially to the seed yield of cowpea. Hence, yield enhancing cultivation methods like usage of several PGRs needs due attention. PGRs are being used extensively in agriculture. However, they have limited impact and applications toward yield and quality parameters **(**Pandey *et al.*, 2001). Soil application of plant growth regulators have the potential to influence crop growth and yield, Foliar application of GA_3 at early vegetative leaf stage and at flowering stage have also been shown

to enhance the rate of crop development and yield in cowpea by increasing pods. Application of PGRs in the form of foliar spray at pre flowering stage helps in improving physiological efficiency along with crop productivity (Dashora and Jain 1994). Micronutrients are trace elements which are required by the cowpea crop in less amounts and play an active role in the plant metabolic functions in shortage will show deficiency symptoms and crop yields are reduced. Application of micronutrients mixture ensure the balanced supply of nutrients which in turn helps in improving the nutritional quality of pulses (Divyashree *et al*., 2018). The application of micronutrient fertilizer at basal dose may not reach the crop requirement for root growth and nutrient use. Foliar application is effective for micronutrients as 90% fertilizer utilized by the plant when applied in foliar form (Manasa and Devaranavadagi 2015). Widespread and extensive occurrence of B and Zn deficiency has been reported in the cultivable soils of Arunachal Pradesh (Debnath *et al.,* 2018). The main objective of the investigation to study the response of plant growth regulators and micronutrients on growth, yield of Cowpea.

MATERIALS AND METHODS

This experiment was laid out during *kharif* 2020 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, (U.P.) which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the Mean Sea Level (MSL) on sandy loam soil, have moderately soil P^{H} (7.2), organic carbon (0.22%), available nitrogen (219 kg/ha), phosphorus (12.3kg/ha) and potassium (235.7 kg/ha). The climate of the region is semi-arid subtropical. The experiment was laid out in Randomized Block Design. The treatments consist of seven plant growth regulators (Superzyme gold, Root master, Superzyme, Boost, Americana, Sea bomb) and one micronutrient (Microl- F), where three treatments are applied as soil application (Superzyme gold, Root master, Americana) and four treatments are foliar spray at 25 and 45 DAS interval (Superzyme, Boost, Sea bomb and Microl-F) and one respective control was used. The Treatments comprised of T_1- Superzyme gold-12 kg/ha (Liquid seaweed extracts 4.0% + calcined bentonite granules – to make 100%), T_2- Root master-13 kg/ha (Mycorrhizal biofertilizer), T_3- Superzyme-900 ml/ha (Gibberellic acid- 0.001% + protein hydrolysed -2.5% +seaweed extracts – 3.0% + $FeSo_4.7H_2O$ - 2.3 % + $MnSo_4.3H_2O$ - 1.4% + $ZnSo_4.7H_2O$ -3.9% + $MgSo_4.7H_2O$ - 4.3% + Emulsifier -1.0% + water - 81.59 %), T_4- Boost- 600 ml/ha (ATCA- 5.0% + folic acid - 0.1%), T_5-Americana-7.5 kg/ha, T_6- Sea bomb 500 ml/ha (combination of enzymes, seaweed extracts and organic matter), Microl- F 300 ml/ha (Fe- 2.0% + Mn– 0.5% + Zn- 4.0% + Cu– 0.5 %), T_8- control treatment (RDF 20:40:20 NPK kg/ha). There are 8 treatments replicated thrice during *kharif* season 2020.

RESULTS AND DISCUSSION

A. Plant height

Observations regarding the plant height of Cowpea are given in the Table 1 and there was an increasing trend of the values at successive stages. The analysis on plant height was observed to be significantly higher in all the different growth intervals. At 75 DAS, the highest significant plant height (122.72 cm) was observed with the application of Superzyme 900 ml/ha which was statistically on par with the application of Root master 13 kg/ha recorded plant height (116.30 cm). Followed by other treatments plant height (115.49 cm) with the application of Americana 7.5 kg/ha, plant height (110.44 cm) with the application of Microl-F 300 ml/ha, plant height (107.52 cm) with the application of Sea Bomb 500 ml/ha, plant height (106.97 cm) with the application of Boost 600 ml/ha, plant height (105.63 cm) with the application of Superzyme gold 12.5 kg/ha, plant height (95.54 cm) with respective control treatment. Increased plant height with GA_3 spray may be due to rapid cell elongation in apical region of the plant. Emongor (2007) reported same findings who indicated that exogenous application of GA_3 increased plant height and number of trifoliate leaves. Plant height increased significantly due to the application of plant growth regulators. Among these, GA_3 recorded maximum plant height when applied at the rate of 150 ppm at 40 DAS and 55 DAS (Manjri *et al*., 2018) reported similar results related to plant height.

Table 1. Response of plant growth regulators and micronutrients on plant height of cowpea.

Treatments	Plant height (cm)				
	15 DAS	30 DAS	45 DAS	60 DAS	75 DAS
Superzyme gold 12.5kg/ha	10.94	30.43	85.95	96.83	105.63
Root master 13 kg/ha	11.90	36.10	98.97	107.31	116.30
Superzyme 900 ml/ha	11.97	36.60	107.06	113.42	122.72
Boost 600 ml/ha	10.83	32.13	88.53	97.30	106.97
Americana 7.5kg/ha	11.58	35.90	95.78	105.75	115.49
See bomb 500ml/ha	11.42	29.33	88.28	99.01	107.52
Microl-F 300 ml/ha	11.51	30.23	76.59	99.10	110.44
Control (20:40:20 NPK kg/ha)	10.85	32.10	82.32	90.11	95.54
F-test	NS	NS	S	S	S
SEm±	0.78	5.86	3.91	3.35	3.40
CD (P=0.05)	-	-	8.40	7.18	7.30

B. Number of branches/plant

Observations regarding the number of branches per plant of Cowpea are given in the Table 2 and data showed an increasing tendency from 45 to 75 DAS. At 75 DAS highest no. of branches per plant (5.90) was recorded with the application of Superzyme 900 ml/ha which was statistically on par with the application of Root master 13 kg/ha recorded number of branches per plant (5.43). Followed by other treatments number of branches per plant (5.33) with the control treatment, number of branches per plant (5.20) with the application of Americana 7.5 kg/ha, number of branches per plant (5.13) with the application of Boost 600 ml/ha, number of branches per plant (5.03) with the application of Sea bomb 500 ml/ha, number of branches per plant (4.80) with the application of Superzyme gold 12.5 kg/ha, number of branches per plant (4.73) with the application of Microl-F 300 ml/ha. Number of branches per plant gradually increased from 45 to 60 DAS and reached a steady condition with the application of GA_3. The results were in consonance with the works of Abdul *et al.* (1988) who noticed significantly increased number of branches per plant by increasing the concentration of GA_3 (50 to 100 ppm) in pepper.

C. Yield attributes and Yield

The data presented on yield attributes and yield of Cowpea were statistically analyzed and have been presented in Table 3. The maximum number of pods per plant (11.60) was observed significantly higher with the application of Superzyme 900 ml/ha, which was statistically on par with Root master 13 kg/ha recorded number of pods per plant (11.00). Followed by other treatments number of pods per plant (9.60) with the application of Boost 600 ml/ha, number of pods per plant (9.00) with the control treatment, number of pods per plant (8.30) with the application of Superzyme gold 12.5 kg/ha, number of pods per plant (8.13) with the application of Sea bomb 500 ml/ha, number of seeds per plant (7.60) with the application of application of Americana 7.5 kg/ha, number of seeds per plant (7.26) with the application of Microl-F 300 ml/ha. The maximum number of seeds per pod (10.80) was observed with the application of Superzyme 900 ml/ha, which was higher overall the treatments. Followed by other treatments number of seeds per pod (10.33) with the application of Root master 13 kg/ha, number of seeds per pod (9.66) with the control treatment, number of seeds per pod (9.46) with the application of Boost 600 ml/ha, number of seeds per pod (9.40) with the application of Americana 7.5 kg/ha, number of seeds per pod (9.26) with the application of Microl-F 300 ml/ha, number of seeds per pod (8.60) with the application of Superzyme gold 12.5 kg/ha, number of seeds per pod (8.06) with the application of Sea bomb 500 ml/ha.

Table 2: Response of plant growth regulators and micronutrients on branches/plant of cowpea.

Treatments	Branches/plant		
	45 DAS	60 DAS	75 DAS
Superzyme gold 12.5kg/ha	3.13	4.73	4.80
Root master 13 kg/ha	3.60	5.16	5.43
Superzyme 900 ml/ha	4.03	5.56	5.90
Boost 600 ml/ha	2.60	4.80	5.13
Americana 7.5kg/ha	2.73	5.06	5.20
See bomb 500ml/ha	2.83	4.93	5.03
Microl-F 300 ml/ha	3.20	4.66	4.73
Control (20:40:20 NPK kg/ha)	2.80	5.06	5.33
F-test	S	S	S
SEm±	0.21	0.18	0.22
CD (P=0.05)	0.45	0.40	0.49

Table 3: Response of plant growth regulators and micronutrients on yield attributes of cowpea.

Treatments	Post- harvest					
	Number of Pods/plant	Number of Seeds/pod	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
Superzyme gold 12.5kg/ha	8.30	8.60	126.66	753.10	1366.67	35.52
Root master 13 kg/ha	11.00	10.33	130.66	870.06	1380.00	38.66
Superzyme 900 ml/ha	11.60	10.80	131.00	903.03	1423.33	38.82
Boost 600 ml/ha	9.60	9.46	129.00	744.26	1126.67	39.76
Americana 7.5kg/ha	7.60	9.40	125.66	664.43	1170.00	36.22
See bomb 500ml/ha	8.13	8.06	129.66	599.03	946.67	38.77
Microl-F 300 ml/ha	7.26	9.26	124.00	842.96	1316.67	39.04
Control (20:40:20 NPK kg/ha)	9.00	9.66	130.00	620.16	1150.00	35.03
F-test	S	NS	NS	S	S	S
SEm±	0.29	1.69	2.43	15.68	17.50	0.55
CD (P=0.05)	0.63	-	-	33.65	53.07	1.67

The maximum test weight (131.00 g) was observed with the application of Superzyme 900 ml/ha, which was higher overall the treatments. Followed by other treatments test weight (130.66 g) with the application of Root master 13 kg/ha, test weight (130.00 g) with the control treatment, test weight (129.66 g) with the application of Sea bomb 500 ml/ha, test weight (129.00 g) with the application of Boost 600 ml/ha, test weight (126.66 g) with the application of Superzyme gold 12.5 kg/ha, test weight (125.66 g) with the application of Americana 7.5 kg/ha, test weight (124.00 g) with the application of Microl-F 300 ml/ha. The maximum seed yield (903.03 kg/ha) was observed significantly higher with the application of Superzyme 900 ml/ha, which was statistically on par with the application of Root master 13 kg/ha recorded seed yield (870.06 kg/ha). Followed by other treatments seed yield (130.66 kg/ha) with the application of Root master 13 kg/ha, seed yield (842.96 kg/ha) with the application of Microl-F 300 ml/ha, seed yield(753.10kg/ha) with the application of Superzyme gold 12.5 kg/ha, seed yield (744.26kg/ha) with the application of Boost 600 ml/ha, seed yield (664.43kg/ha) with the application of Americana 7.5 kg/ha, seed yield (620.16 kg/ha) with the control treatment, seed yield (599.03 kg/ha) with the application of sea bomb 500 ml/ha. The maximum stover yield (1423.33 kg/ha) was observed with application of Superzyme 900 ml/ha (1423.33 kg/ha), which was statistically on par with the application of Root master 13 kg/ha recorded stover yield (1380.00 kg/ha).Followed by other treatments stover yield (1366.67 kg/ha) with the application of Superzyme gold 12.5 kg/ha, stover yield (1316.67kg/ha) with the application of Microl-F 300 ml/ha, stover yield (1170.00 kg/ha) with the application of Americana 7.5 kg/ha, stover yield (1150.00 kg/ha) with the control treatment, stover yield (1126.67 kg/ha) with the application of Boost 600 ml/ha, stover yield (946.67 kg/ha) with the application of sea bomb 500 ml/ha. The maximum harvest index (39.76%) was observed significantly higher with the application of Boost 600 ml/ha, which was statistically on par with Microl-F300 ml/ha recorded harvest index (39.04 %), Superzyme 900 ml/ha recorded harvest index (38.82 %), Sea bomb 500 ml/ha recorded harvest index (38.77 %), Root master 13 kg/ha recorded harvest index (38.66 %). Followed by other treatments harvest index (36.22 %) with the application of Americana 7.5 kg/ha, harvest index (35.52 %) with the application of Superzyme gold 12.5 kg/ha, harvest index (35.03) with the control treatment. Concerning the effect of GA_3, the results showed that the application of GA_3 at 25, 50 and 75 ppm induced significant increase in all parameters of yield and yield components when comparing to the control untreated cowpea plants as reported by Salem M. Al-Amri (2018). Gibberellic acid can stimulate rapid stem and root growth, induce mitotic division in the leaves of some plants, and increase seed germination and ultimately crop production. Crop yield depends on the accumulation of photo-assimilates during the growing period and the way they are partitioned between desired storage organs of plant. Similar results are reported by Ferdowsi Noor *et al.,* (2017) revealed that significantly higher number of pods/plants, seeds/pod, test weight, seed yield and stover yield were recorded under application of gibberellic acid respectively.

Table 4: Response of plant growth regulators and micronutrients on economics of cowpea.

Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR /ha)	B: C ratio
Superzyme gold 12.5kg/ha	46,090.00	1,12,965.00	66,875.00	1.4
Root master 13 kg/ha	44,890.00	1,30,509.00	85,619.00	1.9
Superzyme 900 ml/ha	44,940.00	1,35,454.50	90,514.50	2.0
Boost 600 ml/ha	45,255.00	1,11,639.00	66,384.00	1.4
Americana 7.5kg/ha	44,715.00	99,664.50	54,949.50	1.2
See bomb 500ml/ha	44,415.00	89,854.50	45,439.50	1.0
Microl-F 300 ml/ha	45,570.00	1,26,444.00	80,874.00	1.7
Control (20:40:20 NPK kg/ha)	43,590.00	93,024.00	49,434.00	1.1

Plate 1. Spaying of plant growth regulators and Picking of pods in cowpea crop at DAS at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, during *kharif*, 2020.

Seaweed fertilizers exhibit strong growth promoting activities and act as bio stimulants in the crop production. Increase in the shoot length, leaf number and yield obtained in this study could be attributed to the presence of growth promoting macro and micronutrients in the seaweed extracts as reported by Raguraman *et al*., (2019).

D. Economics

The data pertaining to economics as influenced by performance of plant growth regulators and micronutrients on growth, yield of cowpea been exhibited and has been presented Table 4. Application of Superzyme 900 ml/ha has recorded maximum gross returns (135454.50 INR/ha), net returns (90514.50 INR/ha) and B:C ratio (2.0) which was superior over rest of the treatments and minimum gross returns (89854.50 INR/ha), net returns (45439.50 INR/ha) and B:C ratio (1.0) were recorded with the application of Sea bomb 500 ml/ha. In the present study the highest gross and net return were obtained with application of Superzyme 900 ml/ha. Similar results are reported by (Jaiswal *et al.*, 2010) as application of gibberellic acid fetched the maximum gross return, net return and B:C ratio respectively.

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REFERENCES

Abdul, K.S., Saleh, M.M.S., and Omer, S.J. (1988). Effects of gibberellic acid and cycocel on the growth, flowering and fruiting characteristics of pepper. *Iraqi Journal of Agricultural Sciences*, **6**: **7**-18.

Aykroyd, W.R. (1963). ICMR Special Rept. Series, No. 42.

Bressani, R. and Elias, L.G. (1980). Nutritional value of legume crops for human and animal, 135.

Chevalier, A. (1964). Cowpea in Africa. Revue de Botanique Appliquce ctd. *Agriculture Tropicale*, **24**:128.

Dashora, L.D. and Jain, P.M. (1994). Effect of growth regulators and phosphorus levels on growth and yield of soyabean. *Madras Agricultural Journal*, **81**: 235-37.

Debnath, P., Pattanaaik, S.K., Sah, D., Chandra, G. and Pandey, A.K. (2018). Effect of boron and zinc fertilization on growth and yield of cowpea (*Vigna unguiculata* Walp.) in inceptisols of Arunachal Pradesh. *Journal of the Indian Society of Soil Science*, **66**(2): 229-234.

Divyashree, K.S., Prakash, S.S., Yogananda, S.B. and Chandrappa (2018). Effect of different methods of micronutrients mixture application on growth and yield of mung bean in Cauvery command area. *Journal of Pharmacognosy and Phytochemistry*, **7**(3): 3578-3582.

Emongor, V. (2007). Gibberellic acid (GA_3) influence on vegetative growth, nodulation and yield of Cowpea (*Vigna unguiculata* L. Walp.). *Journal of Agronomy*, **6**(4): 509-517.

Ferdowsi, Noor, Feroza, Hossain and Umme, Ara (2017). Effects of gibberellic acid on growth and yield parameters of French bean (*Phaseolus vulgarus* L.). *Journal of the Asiatic Society of Bangladesh, Science*, **43**(1): 49-60.

Fery, R.L. (1985). Improved Horticultural Industry in USA, *Research*, **53**: 187-204.

Jaiswal, V.K., Bahadur, V., Singh, D.B., Chaurasia, A.K., Toppo, R. and Singh, D. (2010). Effect of plant growth regulators on growth and yield of snowpea (*Pisum sativum* L.). *Progressive Agriculture*, **10**(3): 63-69.

Kumar, R., Yadav, R.K., Nitish Sharmaand Nikita Nehal (2018). Influence of plant growth regulators on yield and yield attributes of mung bean (*Vigna radiata* L.). *Journal of Pharmacognosy and Phytochemistry*, 98-100.

Manasa, L.P. and Devaranavadagi, S.B. (2015). Effect of foliar application of micronutrients on growth and yield of Maize (*Zea mays* L.). *Karnataka Journal of Agriculture Sciences*, **28**(4): 474-476.

Manjri, Akanksha Singh, Sarita Devi Gupta., Raj Bahadur. and Singh, A.K. (2018). Responses of black gram (*Vigna mungo*) to foliar applied plant growth regulators. *International Journal of Current Microbiology and Applied Sciences*, **7**: 4058-4064.

Pandey, A.K., Tripathi, R.S. and Yadav, R.S. (2001). Effect of certain growth regulators on growth yield and quality of rice (*Oryza Sativa* L.). *Indian Journal of Agricultural Research*, **35**(2): 118-20.

Raguraman, Vasantharajaa, Stanley Abrahama, L., Inbakandana, D., Thirugnanasambandama, R., Senthilvelana, T., Ayesha Jabeenb, S.K. and Prakash, P. (2019). Influence of seaweed extracts on growth, phytochemical contents and antioxidant capacity of cowpea (*Vigna unguiculata* L. Walp). *Biocatalysis and Agricultural Biotechnology*, **17**: 589–594.

Salem M. Al-Amri (2018). Functional activity of some growth regulators on yield components and endogenous hormones of cowpea plants (*Vigna sinensis* L.) *Agricultural Sciences*, **9**: 1229-1239.

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