Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6482

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 1494-1498 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Response of Cluster Bean to Foliar Application of PGRs on Biochemical Parameters

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Received: 19.03.2018 | Revised: 24.04.2018 | Accepted: 28.04.2018

ABSTRACT

An experiment was carried out, with a view to study the response of cluster bean to foliar application of PGRs on biochemical parameters at the Vegetable Research Scheme, Regional Horticultural Research Station of the Navsari Agricultural University, Navsari, Gujarat, India during Summer 2016 and 2017. The experiment was conducted in randomized block design with three replications, which included 13 treatments. Biochemical parameters like total chlorophyll content of leaves (498.41 mg 100g^{-1}), protein content (3.93 %), carbohydrate content (13.59 %), crude fibre content (3.33 %), vitamin C content (55.17 %), dry matter content (22.67 %), moisture content (77.33 %) and ash content (1.85 %) of cluster bean pod found significant on pooled analysis basis. Under biochemical parameters, response of treatment T_4 (GA_3 20 mg l^{-1}) was good.

Key words: *Cluster bean, Foliar application, PGRs and Biochemical parameters.*

INTRODUCTION

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is grown for its young tender green immature pods, which are used as a nutritive vegetable. Several attempts have been made to increase the yield potential of pulses, but they are primarily concerned with the use of fertilizers, pesticides and better management practices coupled with genetic improvement. But, very little attention has been given to the physiological processes and biochemical parameters, which limit the crop productivity. Application of growth promoting hormones *i.e.*, Plant Growth Regulators (PGRs) is a recent technique in this direction. Plant growth regulators are known to influence growth and development at very low concentrations but inhibit plant growth and development at high concentration[7]. Thus, application of plant growth substances on various leguminous crops which were found effective for increasing growth, yield and biochemical parameters have been attempted in present investigation to study the response of cluster bean to foliar application of PGRs on biochemical parameters.

Cite this article: Patel, H.B., Saravaiya, S.N., Patil, S. J., Raj, D., Suthar, H. and Bhanderi, D.R., Response of Cluster Bean to Foliar Application of PGRs on Biochemical Parameters, *Int. J. Pure App. Biosci.* **6(2):** 1494-1498 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6482

MATERIAL AND METHODS

An experiment was conducted at the Vegetable Research Scheme, Regional Horticultural Research Station of the Navsari Agricultural University, Navsari, Gujarat, India during Summer 2016 and 2017 on cv. Pusa Navbahar to investigate the response of cluster bean to foliar application of PGRs on biochemical parameters. The experiment was conducted in randomized block design (RBD), which included 13 treatments namely, T_1 : NAA 20 mg l^{-1}, T_2 : NAA 40 mg l^{-1}, T_3 : NAA 60 mg l^{-1}, T_4 : GA_3 20 mg l^{-1}, T_5 : GA_3 40 mg l^{-1}, T_6 : GA_3 60 mg l^{-1}, T_7 : Thiourea 250 mg l^{-1}, T_8 : Thiourea 500 mg l^{-1}, T_9 : Thiourea 750 mg l^{-1}, T_{10} : NAA 20 mg l^{-1} + GA_3 20 mg l^{-1}, T_{11} : NAA 20 mg l^{-1} + Thiourea 250 mg l^{-1}, T_{12} : GA_3 20 mg l^{-1} + Thiourea 250 mg l^{-1} and T_{13} : Control. The experiment included three replications. At the time of 50 % flowering, foliar sprays were made at early hours of morning to avoid dehydration effect at mid-day.

For recording different observations, five plants of cluster bean from each net plot area were selected randomly in the beginning and tagged with the labels.

The total chlorophyll content of fresh leaf samples of cluster bean was determined using method as described by Sadasivam and Manickam[10]. Expressed the amount of total chlorophyll present in the extract in mg 100 g^{-1}. The protein content was estimated using Lowry's method as described by Sadasivam and Manickam[10]. Expressed the amount of protein in %. The carbohydrate content of pod was determined using method as described by Sadasivam and Manickam[10]. Expressed the amount of carbohydrate in %. The crude fibre content (%) from cluster bean green pods was determined using method as described by Sadasivam and Manickam[10]. Vitamin C also known as ascorbic acid. The vitamin C content of pod (mg 100 g^{-1}) was determined using method as described by Sadasivam and Manickam[10]. The dry matter and moisture content of pod (%) was determined using method as described by Dev Raj *et al.*[5]. The ash content of pod (%) was determined using method as described by Dev Raj *et al.*[5]. The collected data were subjected to statistical analysis as per Panse and Sukhatme[9].

RESULTS AND DISCUSSION

Looking at the pooled analysis, the results were significant for total chlorophyll content of leaves. The total chlorophyll content of leaves was recorded between 204.96 to 498.41 mg 100 g^{-1}. Similar trend observed as in first year as well as second year trial. Treatment T_4 recorded higher total chlorophyll content of leaves (498.41mg 100 g^{-1}) and it was significantly superior treatment. GA_3 significantly increasing the net photosynthetic rates which enhance ultra structural morphogenesis of plastids and increase the rubisco activity which increase the concentrations of total chlorophyll in the leaves. The variation in chlorophyll content due to growth regulators may be attributed to decreased chlorophyll degradation and increased chlorophyll biosynthesis. The results are in conformity with some early reports *viz.*, Bora and Sarma[2] and Singh *et al.*[11] in pea; Ibrahim *et al.*[7], Zewail *et al.*[13] and Amin *et al.*[1] in faba bean.

The perusal of the pooled data further revealed that the protein content of pod obtained under different treatments varied from 3.30 to 3.93 %. Maximum protein content of pod (3.93 %) was obtained from the plants applied with GA_3 20 mg l^{-1} (T_4) and it was significantly superior treatment. The minimum protein content of pod of 3.30 % was recorded in the treatment T_{13}, which was at par with T_9. Due to enhanced photosynthesis and more efficient nitrogen metabolism protein content of pod was increased. The results are in agreement with the findings of Choudhary *et al.*[4] in cluster bean; Golakiya *et al.*[6] in cowpea; Bora and Sarma[2] and Singh *et al.*[11] in pea; Ibrahim *et al.*[7] , Zewail *et al.*[13] and Amin *et al.*[1] in faba bean.

The perusal of the pooled data further revealed that the cabohydrate content of pod obtained under different treatments varied from 11.17 to 13.59 %. Similar result and trend observed as in first and second year trial. The maximum carbohydrate content of pod (13.59 %) was observed in the T_4 and it was significantly superior treatment. It might be due to balanced C/N ratio and increased photosynthetic area, which might have increased the synthesis of carbohydrates which was translocated to pods. The results are in accordance with the findings of Choudhary *et al.*[4] in cluster bean; Singh *et al.*[11] in pea; Ibrahim *et al.*[7], Zewail *et al.*[13] and Amin *et al.*[1] in faba bean.

Crude fibre content of pod (%) was observed higher with the application of GA_3 20 mg l^{-1} (T_4) and it was significantly superior treatment. This might be due to exogenous application of plant growth regulators (GA_3 and NAA) which stimulated and enhance the enzymatic activities that increased the quality like fibre content in pods. The results are in line with the findings of Golakiya *et al.*[6] in cowpea. (Table 1)

With regard to the pooled mean, vitamin C content of pod varied from (41.38 to 55.17 mg 100 g^{-1}). The highest vitamin C content of pod (55.17 mg 100 g^{-1}) was achieved in the treatment T_4 (GA_3 20 mg l^{-1}), which was statistically at par with the treatments T_1, $T_{11,}$ T_7, T_2. T_{12} and T_5. PGRs may act directly on the loading of the assimilates from the leaf and transport to the pods. Gibberellin is known to play a crucial role in the sugar metabolism of plants. Gibberellins actively participate in the hydrolysis of sucrose and starch. As ascorbic acid is synthesized from sugars, particularly L-glucose, any increase in sugar content in pods would be conducive to the higher synthesis of Vitamin C in pods. This type of result is also reported by Choudhary *et al.*[4] in cluster bean and Pandey *et al.*[8] in pea.

The perusal of the pooled data further revealed that the dry matter content of pod obtained under different treatments varied from 16.50 to 22.67 %. The maximum dry matter content of pod (22.67 %) was observed in the T_4 and it was significantly superior treatment. Due to higher photosynthetic ability, higher dry matter produced and transferred to the sink *i.e.*, pods. Similar result was also noted in cluster bean by Chogatapur, Shilpa and Chandranath[3] in plant density and bio-inoculants experiment also.

The pooled data further revealed that the moisture content of pod varied from 77.33 to 83.50 %. The maximum moisture content of pod (83.50 %) was observed in the T_{13} and minimum moisture content of pod (77.33 %) was observed in the T_4. Application of GA_3 to cluster bean plants increased dry matter but decreased the water content *i.e.*, moisture content. Moisture content of pod (%) influenced by application of plant growth regulators which accelerated and modified the growth and development of plants. It was also observed by Choudhary *et al.*[4] in cluster bean and Golakiya *et al.*[6] in cowpea. (Table 2)

The perusal of the pooled data further revealed that the ash content of pod varied from 1.07 to 1.85 %. The maximum ash content of pod (1.85 %) was observed in the T_4, which was significantly superior treatment. Minimum ash content found in T_{13} which was at par with T_9. The effect of foliar application of plant growth regulators on ash content of pod (%) was found significant and higher in treatment GA_3 20 mg l^{-1} (T_4). The ash content is a measure of the total amount of minerals present within a food. Higher ash content occurred due to higher translocation of photosynthates and mineral nutrients from vegetative parts towards the developing pods and ultimately quality of pods increased. The present finding was in agreement with those reported by Tripathi, Parul and Pandey, Rajshree[12] in phytochemical screening of cluster bean also.

Table 1: Effect of different treatments on biochemical parameters *viz.*, Total chlorophyll content of leaves (mg 100 g^{-1}), Protein content of pod (%), Carbohydrate content of pod (%) and Crude fibre content of pod (%) of cluster bean cv. Pusa Navbahar

Treatments	Total chlorophyll content of leaves (mg 100 g^{-1})			Protein content of pod (%)			Carbohydrate content of pod (%)			Crude fibre content of pod (%)		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1	448.35	446.41	447.38	3.68	3.68	3.68	12.19	12.22	12.21	2.50	2.67	2.58
T_2	344.37	342.43	343.40	3.54	3.58	3.56	11.83	11.80	11.82	2.17	2.17	2.17
T_3	217.80	215.86	216.83	3.32	3.33	3.33	11.27	11.24	11.25	1.50	1.50	1.50
T_4	499.38	497.44	498.41	3.92	3.94	3.93	13.58	13.61	13.59	3.33	3.33	3.33
T_5	344.35	342.41	343.38	3.42	3.46	3.44	11.52	11.54	11.53	2.00	2.00	2.00
T_6	330.32	328.38	329.35	3.38	3.37	3.37	11.45	11.41	11.43	2.00	2.00	2.00
T_7	363.97	362.03	363.00	3.66	3.67	3.67	11.91	11.94	11.93	2.50	2.50	2.50
T_8	308.61	306.67	307.64	3.36	3.37	3.37	11.39	11.36	11.37	1.83	1.83	1.83
T_9	223.14	221.20	222.17	3.31	3.32	3.32	11.20	11.21	11.20	1.50	1.50	1.50
T_{10}	343.63	341.69	342.66	3.39	3.40	3.40	11.49	11.47	11.48	2.00	2.00	2.00
T_{11}	341.99	340.05	341.02	3.67	3.68	3.68	12.16	12.14	12.15	2.50	2.50	2.50
T_{12}	351.75	349.81	350.78	3.49	3.52	3.51	11.82	11.79	11.81	2.00	2.00	2.00
T_{13}	205.93	203.99	204.96	3.29	3.31	3.30	11.15	11.18	11.17	1.00	1.00	1.00
Year Mean	332.58	330.64	331.61	3.50	3.51	3.50	11.77	11.76	11.76	2.06	2.08	2.07
S.Em. ±	3.16	3.16	2.00	0.11	0.10	0.07	0.36	0.40	0.24	0.08	0.09	0.06
C.D. at 5 %	9.22	9.22	5.65	0.31	0.30	0.19	1.05	1.16	0.68	0.24	0.27	0.16
C.V. %	1.64	1.65	1.65	5.34	5.12	5.23	5.29	5.86	5.58	6.90	7.79	7.36
YT : S.Em. ±			3.16			0.11			0.38			0.09
YT : C.D. at 5 %			NS			NS			NS			NS

Table 2: Effect of different treatments on biochemical parameters *viz.*, Vitamin C content of pod (mg 100g^{-1}), Dry matter content of pod (%), Moisture content of pod (%) and Ash content of pod (%) of cluster bean cv. Pusa Navbahar

Treatments	Vitamin C content of pod (mg 100 g^{-1})			Dry matter content of pod (%)			Moisture content of pod (%)			Ash content of pod (%)		
	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled	2016	2017	Pooled
T_1	55.17	55.17	55.17	20.00	20.67	20.33	80.00	79.33	79.67	1.73	1.77	1.75
T_2	52.87	52.87	52.87	19.00	19.00	19.00	81.00	81.00	81.00	1.30	1.43	1.37
T_3	41.38	45.98	43.68	17.33	17.00	17.17	82.67	83.00	82.83	1.13	1.17	1.15
T_4	55.17	55.17	55.17	22.67	22.67	22.67	77.33	77.33	77.33	1.83	1.87	1.85
T_5	52.87	50.58	51.73	18.33	18.33	18.33	81.67	81.67	81.67	1.23	1.33	1.28
T_6	45.98	45.98	45.98	18.00	18.00	18.00	82.00	82.00	82.00	1.20	1.23	1.22
T_7	52.87	52.87	52.87	19.67	19.67	19.67	80.33	80.33	80.33	1.57	1.63	1.60
T_8	43.68	45.98	44.83	17.67	18.00	17.83	82.33	82.00	82.17	1.17	1.20	1.18
T_9	41.38	41.38	41.38	17.00	17.33	17.17	83.00	82.67	82.83	1.03	1.13	1.08
T_{10}	48.28	50.58	49.43	18.00	18.33	18.17	82.00	81.67	81.83	1.20	1.27	1.23
T_{11}	55.17	55.17	55.17	20.00	20.00	20.00	80.00	80.00	80.00	1.70	1.73	1.72
T_{12}	52.87	50.58	51.73	18.67	18.67	18.67	81.33	81.33	81.33	1.30	1.37	1.33
T_{13}	41.38	41.38	41.38	16.33	16.67	16.50	83.67	83.33	83.50	1.03	1.10	1.07
Year Mean	49.16	49.51	49.34	18.67	18.79	18.73	81.33	81.21	81.27	1.34	1.40	1.37
S.Em. ±	1.96	1.84	1.27	0.42	0.42	0.27	0.42	0.42	0.27	0.04	0.04	0.03
C.D. at 5 %	5.71	5.37	3.59	1.22	1.22	0.77	1.22	1.22	0.77	0.11	0.12	0.07
C.V. %	6.89	6.44	6.67	3.88	3.87	3.87	0.89	0.89	0.89	5.08	5.08	5.08
YT : S.Em. ±			1.90			0.42			0.42			0.04
YT : C.D. at 5 %			NS			NS			NS			NS

CONCLUSION

From the research results of two years study and by considering the statistical analysis, it was inferred that foliar spray of GA_3 20 mg^{-1} at the time of 50 % flowering stage under south Gujarat Agro-climatic conditions gave better influence on biochemical parameters.

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