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Response of vegetable cowpea [*Vigna unguiculata* (L.) Walp.] to different biostimulants

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Abstract
An investigation was carried out on "Response of vegetable cowpea [*Vigna unguiculata* (L.) Walp.] to different biostimulants" was conducted at Vegetable Research Farm, Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India during summer, 2020. The cowpea variety AVCP 1 was used for this experiment. The experiment was laid out in randomized block design (RBD) with three replications and eight treatments *viz*., Control (T_1), Cow urine 6% (T_2), Novel Prime 2% (T_3), *Panchagavya* 3% (T_4), *Jivamruth* 3% (T_5), Vermiwash 10% (T_6), Seaweed extract 7.5% (T_7) and Seaweed extract 15% (T_8). Foliar application of biostimulants was performed at 15 days after sowing (DAS), 30 DAS and 45 DAS. Leaf area was affected profoundly and foliar application of treatment T_8 exhibited maximum leaf area (125.38 cm^2) at final harvest. Treatment T_3 performed better and recorded maximum number of pods (3.22 $plant^{-1}$), number of clusters (35.07 $plant^{-1}$), average pod length at second and fourth picking (14.14 cm and 14.17 cm, respectively), pod yield (0.220 kg $plant^{-1}$), total pod yield (11.25 t ha^{-1}), marketable pod yield (10.52 t ha^{-1}), maximum chlorophyll content of leaf (1681.97 mg 100 g^{-1}) along with pod (114.28 mg 100 g^{-1}) at second picking. Same treatment also recorded maximum protein content (6.13%) of immature seeds, maximum total soluble solids (7.77 ^oBrix) and minimum crude fibre content (13.18%). At sixth picking, maximum chlorophyll content of leaf (1657.95 mg 100 g^{-1}) was obtained with T_8 treatment and that of pod (114.06 mg 100 g^{-1}) was obtained with T_4 treatment. The highest net profit with BCR value was obtained with T_3 treatment. Effect of different biostimulants on days to first and 50% flowering, plant height at 25 DAS, 50 DAS and 75 DAS, average pod weight at 2nd and 4th picking and moisture content were found non-significant.

Keywords: Vegetable cowpea, biostimulants, cow urine, novel prime, *Panchagavya*, *Jivamruth*, Vermiwash, Seaweed extract

Introduction
Cowpea [*Vigna unguiculata* (L.) Walp.] Belongs to family Fabaceae, sub-family Papilionaceae and group Phaselea. Its cultivation is at least 5000 to 6000 years old. As per the record, first evidence of cultivation was found in West Africa where it was closely associated with the cultivation of sorghum and pearl millet. Cowpea is widely grown in Africa, Latin America, South East Asia and in the Southern United States. In Indian context, it is a minor pulse cultivated mainly in arid and semiarid tracts of Punjab, Haryana, Delhi, Andhra Pradesh, Odisha, West Bengal and West Uttar Pradesh along with considerable area in Rajasthan, Karnataka, Kerala, Tamil Nadu, Maharashtra and Gujarat. The main districts of Gujarat growing this crop are Sabarkantha, Banaskantha, Mehsana, Patan, Ahmedabad, Kheda and Anand.

Biostimulants like cow urine, *panchagavya*, *jivamruth*, vermiwash and seaweed extract have been used all over the world to improve crop yields. They are natural substances derived from plants and animals that stimulate plant processes at very low concentrations. When applied to the plants, found to influence metabolic processes of plants such as respiration, photosynthesis, nucleic acid synthesis and ion uptake.

These biostimulants are rich source of macro and micro nutrients that are required in different concentrations for better growth of plant. They also contain naturally occurring plant growth promoters like GA_3, cytokinin, NAA *etc*. in very good concentration.

Novel Prime (the unique internationally patented product of NAIP project, Navsari Agricultural University, Navsari, Gujarat) is an enriched sap of banana pseudo stem contains essential plant nutrients and naturally occurring plant growth enhancers like cytokinin, NAA, GA_3, macro and micro elements with botanical fungicidal property. It gave very enthusiastic results in many vegetables as well as other horticultural crops.

Materials and Methods

A field experiment on vegetable cowpea var. AVCP 1 was conducted at Vegetable Research Farm, Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat, India during summer 2020. The experiment was laid out in randomized block design with a set of treatments comprised of Control (T_1), Cow urine 6% (T_2), Novel Prime 2% (T_3), *Panchagavya* 3% (T_4), *Jivamruth* 3% (T_5), Vermiwash 10% (T_6), Seaweed extract 7.5% (T_7) and Seaweed extract 15% (T_8), replicated thrice. The experimental soil was deep black, having good water holding capacity. As per recommended dose, whole quantity of well decomposed FYM (15 t ha^{-1}) applied to each plot after layout preparation and mixed thoroughly with soil and whole quantity of inorganic fertilizers (20:40:00 NPK kg ha^{-1}) were applied in form of urea and single super phosphate at the time of sowing. The planting was done at the spacing of 45 cm × 30 cm with gross plot size 2.7 m × 2.4 m and net plot size 1.8 m × 1.8 m. Foliar application of biostimulants was performed at 15, 30 and 45 DAS.

The total chlorophyll content of fresh leaf and pod samples of 2nd and 6th picking stage as well as crude fibre content of green pods were determined by using method described by Sadasivam and Manickam (1996) [9]. Total nitrogen percentage from immature cowpea seed was determined by Kjeldahl method and the percentage of protein in the immature seeds was calculated by multiplying total nitrogen to factor 6.25 (Scheffelen *et al*., 1961) [14]. Total soluble solids of green cowpea pods were recorded by using digital refractometer at room temperature and expressed in °Brix. Moisture content was estimated in percentage by using the method given by Sarma, 2015 [11]. Statistical analysis of the data pertaining to growth, yield and quality parameters were analysed as per the methods described by Panse and Sukhatme (1985) [7].

Results and Discussion

Growth Parameters

The data on growth parameters *viz*., days to first and 50% flowering, plant height at different growth stages and leaf area were depicted in Table 1.

Days to first flowering

The data on days to first flowering as influenced by different treatments showed the range in between 53.00 to 56.00 days after sowing (DAS). Though, the difference among the treatments was found non-significant, minimum days required for first flowering (53.00 days) was recorded with T_4 treatment and maximum (56.00 days) was recorded with T_1 treatment (control).

Days to 50% flowering

Here also, the difference among the treatments was found non-significant, minimum days required for 50% flowering (59.00 days) was recorded with two treatments *i.e*., T_3 and T_4 and maximum (62.67 days) was recorded by T_1 treatment.

Plant height (cm)

A perusal of the data reveals that the plant height at 25, 50 and 75 DAS were not affected due to different treatments under study. The range of plant height at 25 DAS was varied from 16.57 cm to 19.77 cm; at 50 DAS it was recorded in-between 46.77 cm to 52.13 cm and at 75 DAS it was recorded in-between 67.03 cm to 83.73 cm. Though, the difference in plant height was found non-significant at all three growth stages *i.e*., 25, 50 and 75 DAS, maximum plant height (19.77 cm, 52.13 cm and 83.73 cm, respectively) was recorded with different concentrations of seaweed extract. In initial growth stage *i.e*., 25 DAS, it was measured better with lower concentration of seaweed extract whereas at later stages *i.e*., at 50 and 75 DAS, it was found better with higher concentration.

Leaf area (cm^2)

Leaf area at final harvest as influenced by different treatments was found significant and T_8 treatment recorded maximum of 125.38 cm^2 leaf area, but statistically remained at par with T_3 and T_4 treatments. Minimum leaf area (110.36 cm^2) was recorded under T_1 treatment.

According to Challen and Hemingway, 1965 [1], seaweed extract contains fair amount of growth regulators such as auxins (IAA and IBA), gibberellins, cytokinin and macro and micro elements. Satodiya and Chauhan, 2012 [12] described that the presence of these elements might increase the auxin level of tissues or enhance the conversion of tryptophan to IAA, leading to the enhanced activity of cell division and cell elongation. Similar finding was obtained by Savaliya (2020) [13] in cowpea.

Yield Parameters

All yield parameters were significantly affected by different treatments under study and recorded higher values in T_3 (Novel Prime 2%) treatment except average pod weight at both picking, in which difference was found non-significant (Table 2).

Number of pods $cluster^{-1}$

The data indicates that also treatment T_3 recorded maximum number of pods (3.22 $cluster^{-1}$), but statistically remained at par with T_8, T_4 and T_6 treatments. Minimum number of pods (2.24 $cluster^{-1}$) was observed under T_2 (cow urine 6%) treatment.

Number of clusters $plant^{-1}$

Here also, treatment T_3 found best and recorded maximum number of clusters (35.07 $plant^{-1}$). This treatment was statistically remained at par with T_8, T_4, T_6 and T_7 treatments. Minimum number of clusters (26.33 $plant^{-1}$) was observed under T_2 (cow urine 6%) treatment.

As we saw earlier that this treatment produces higher leaf area, which might be associated with increased leaf area that naturally produced more photosynthates and the movement of these photosynthates from source to sink might help in increasing number pods $cluster^{-1}$ as well as number of clusters $plant^{-1}$. Moreover, it may be due to Novel plus organic nutrients consisting lavish amount of macro and micro nutrients, which ameliorate photosynthetic activities, leads to augment in production and allocation of carbohydrates and photosynthates (Kalariya *et al*., 2018) [5]. The result of present investigation is also corroborated with the finding of Champaneri (2020) [2] in Indian bean.

Table 1: Effect of different biostimulants on growth parameters of vegetable cowpea cv. AVCP 1

Treatments		Days to first flowering	Days to 50% flowering	Plant height (cm)			Leaf area (cm^2)
				25 DAS	50 DAS	75 DAS	
T_1	Control (No spray)	56.00	62.67	17.20	50.93	72.23	110.36
T_2	Cow urine (6%)	54.67	62.00	18.53	46.77	81.77	111.80
T_3	Novel Prime (2%)	53.67	59.00	16.57	49.27	72.60	124.17
T_4	*Panchagavya* (3%)	53.00	59.00	18.33	50.23	74.57	123.45
T_5	*Jivamruth* (3%)	54.00	60.67	18.87	49.57	67.03	111.61
T_6	Vermiwash (10%)	54.33	60.67	17.70	51.40	74.23	115.56
T_7	Seaweed extract (7.5%)	53.33	59.33	19.77	50.23	78.40	120.26
T_8	Seaweed extract (15%)	53.67	59.67	17.93	52.13	83.73	125.38
S.Em. ±		1.25	0.86	1.23	2.71	4.86	1.10
C.D. at 5%		NS	NS	NS	NS	NS	3.34
C.V.%		4.00	2.47	11.77	9.39	11.13	1.62

Average pod length (cm)

At second picking, maximum average pod length (14.14 cm) was recorded with spraying of Novel Prime 2% (T_3), which was remained at par with T_4, T_6 and T_8 treatments. Minimum average pod length (12.77 cm) was recorded with control (T_1). Similar trend was observed at fourth picking. Here also, treatment T_3 produced longer pods (14.17 cm), but statistically remained at par with T_4, T_8 and T_6 treatments. The shorter pods (12.73 cm) were also obtained from same treatment *i.e*., control.

Presence of gibberellic acid in Novel Plus organic liquid nutrients might play major role and increase the rate of cell elongation process (Naik, 2006) [6]. Similar results have also been observed by Champaneri (2020) [2] in Indian bean and Patel *et al*. (2017) [8] in green gram.

Average pod weight (g)

Though, the effect of different biostimulants on average pod weight was found non-significant at both the stages, the range of average pod weight at second and fourth picking varied from minimum 3.53 g to maximum 3.76 g at second picking and minimum 2.73 g to maximum 3.11 g at fourth picking.

Yield

Pod yield (kg plant^{-1})

The data, given in Table 3 shows significant effect of different treatments on pod yield. Treatment T_3 found superior and gave best results with maximum pod yield (0.220 kg plant^{-1}), but remained statistically at par with T_8, T_4, T_6 and T_7 treatments. Minimum pod yield (0.165 kg plant^{-1}) was obtained under control (T_1).

Total pod yield (t ha^{-1})

The data on total pod yield presented in Table 3 shows significant differences between treatments. Maximum total pod yield (11.25 t ha^{-1}) was recorded with T_3 treatment, which was statistically remained at par with T_8, T_4 and T_6 treatments, which recorded 10.99 t ha^{-1}, 10.98 t ha^{-1} and 10.73 t ha^{-1} pods, respectively. Minimum total pod yield (8.28 t ha^{-1}) was recorded with T_1 treatment.

Marketable pod yield (t ha^{-1})

Results related to marketable pod yield, as influenced by different treatments, is also presented in same above mention table, which shows significant results. Maximum marketable pod yield (10.52 t ha^{-1}) was also recorded in same T_3 treatment, which was statistically at par with T_8, T_4, T_6 and T_7 treatments, yielded 10.38 t ha^{-1}, 10.37 t ha^{-1}, 10.05 t ha^{-1} and 9.82 t ha^{-1} pods, respectively. Minimum marketable pod yield (7.52 t ha^{-1}) was recorded with T_1 treatment.

Table 2: Effect of different biostimulants on yield parameters of vegetable cowpea cv. AVCP 1

Treatments		Number of pods cluster^{-1}	Number of clusters plant^{-1}	Average pod length (cm)		Average pod weight (g)	
				2nd picking	4th picking	2nd picking	4th picking
T_1	Control (No spray)	2.32	28.53	12.77	12.73	3.61	2.73
T_2	Cow urine (6%)	2.24	26.33	13.08	13.10	3.53	3.11
T_3	Novel Prime (2%)	3.22	35.07	14.14	14.17	3.73	3.00
T_4	*Panchagavya* (3%)	3.10	33.40	13.81	13.85	3.67	2.99
T_5	*Jivamruth* (3%)	2.53	30.27	13.15	13.17	3.53	2.87
T_6	Vermiwash (10%)	3.04	32.33	13.58	13.61	3.76	2.89
T_7	Seaweed extract (7.5%)	2.76	31.00	13.22	13.20	3.57	3.04
T_8	Seaweed extract (15%)	3.19	33.47	13.53	13.73	3.74	3.01
S.Em. ±		0.12	1.37	0.26	0.27	0.15	0.12
C.D. at 5%		0.35	4.17	0.78	0.81	NS	NS
C.V.%		7.13	7.61	3.31	3.45	6.98	6.74

Table 3: Effect of different biostimulants on yield of vegetable cowpea cv. AVCP 1

Treatments		Pod yield (kg plant^{-1})	Total pod yield (t ha^{-1})	Marketable pod yield (t ha^{-1})
T_1	Control (No spray)	0.165	8.28	7.52
T_2	Cow urine (6%)	0.168	8.42	7.79
T_3	Novel Prime (2%)	0.220	11.25	10.52
T_4	*Panchagavya* (3%)	0.207	10.98	10.37
T_5	*Jivamruth* (3%)	0.170	8.53	7.90
T_6	Vermiwash (10%)	0.192	10.73	10.05
T_7	Seaweed extract (7.5%)	0.191	9.19	8.82
T_8	Seaweed extract (15%)	0.218	10.99	10.38
S.Em. ±		0.01	0.64	0.57
C.D. at 5%		0.03	1.938	1.724
C.V.%		8.88	11.30	10.74

The augmentation in yield is closely associated with components like leaf area, number of clusters plant^{-1}, number of pods cluster^{-1} and pod length. These parameters recorded the highest values in Novel Prime 2% treatment. Additionally, this effect might be contributed to easy assimilation of nutrients and balance in NPK ratio of the stimulant, leads to improved crop production. Also, the application of water-soluble nutrients accelerates an uptake of water and nutrients, commanding higher photosynthesis and enhanced food accumulation in edible parts (Singhal *et al*., 2015) [16]. The results are in accordance with the findings of Savaliya (2020) [13] in cowpea, Champaneri (2020) [2] in Indian bean and Shah (2019) [15] in sweet potato.

Quality Parameters

Chlorophyll content of leaf and pod (mg 100 g^{-1})

A perusal of the data reveals that the chlorophyll content of leaf at second and sixth picking was significantly influenced by different treatments under study (Table 4). At second picking the impact of Novel Prime 2% (T_3) was found best and recorded maximum chlorophyll content of leaf (1681.97 mg 100 g^{-1}). This treatment was statistically remained at par with T_4 and T_8 treatments whereas control recorded minimum chlorophyll content of leaf (1413.04 mg 100 g^{-1}). Same table represents the data on chlorophyll content of leaf at sixth picking also and showed overall minute decrease in all most all treatments except T_1 and T_8 than second picking. At this stage, treatment T_8 found best and recorded maximum chlorophyll content (1657.95 mg 100 g^{-1}) of leaf, which was statistically at par with T_3 treatment. Minimum chlorophyll content (1405.63 mg 100 g^{-1}) of leaf was recorded under T_2 treatment.

Same table also represents the data on chlorophyll content of pod at second and sixth picking and were found significantly influenced by different treatments under study. Maximum chlorophyll content of pod (114.28 mg 100 g^{-1}) was recorded with same treatment T_3 as of for leaf at same picking and was statistically remained at par with T_8, T_7, T_4 and T_5 treatments. Minimum chlorophyll content of pod (98.62 mg 100 g^{-1}) at second picking was observed under T_1 treatment whereas at sixth picking, maximum chlorophyll content of pod (114.06 mg 100 g^{-1}) was observed in T_4 treatment, which was at par with T_8, T_3, T_7, T_6 and T_5 treatments and the minimum chlorophyll content of pod (97.47 mg 100 g^{-1}) was also observed under control treatment.

It might be due to the fact that GA_3 retards chlorophyll degradation and helps in retaining higher leaf chlorophyll content (Faraji *et al*., 2011) [4] whereas, Sajid *et al*. (2015) [10] illustrated effectiveness of 6-Benzylaminopurine (BAP) in preventing chloroplast and chlorophyll degradation, which resulted into delayed leaf senescence of gladiolus cv. White Prosperity. Novel Prime consists both these PGRs in handsome amount. In present investigation, the positive effects of Novel Prime 2% on chlorophyll content in leaf, is in conformity with the findings of Supal Desai *et al*. (2020) [19] in tuberose.

Protein content (%) of immature seeds

The data on protein content of immature seeds at sixth picking are presented in Table 4 illustrates that two treatments T_3 and T_8 recorded maximum and same protein content (6.13%) of immature seeds and statistically remained at par with T_7, T_4 and T_6 treatments. Minimum protein content (5.25%) of immature seeds at sixth picking was observed under three treatments (T_1, T_2 and T_5).

According to Singhal *et al*. (2016) [17], the enhancement in protein content by application of Novel organic liquid nutrients supposedly attributed to higher uptake of nitrogen during growth period as well as availability of macro elements and hormones in Novel, which enhanced photosynthetic activity, carbohydrate transformation of enzymes and synthesis of protoplasm, which ultimately increase the protein content. Sivasankari *et al*. (2006) [18] attributed higher protein content to increased availability and absorption of necessary elements (N, K, Ca, Mg, Na and Zn) present in the seaweed extracts. Similar result has also been observed by Savaliya (2020) [13] in cowpea.

Moisture content (%)

Application of different biostimulants did not affect the moisture content of pod and the difference was found non-significant. The data shows that the moisture content of pod was varied from minimum 83.89% to maximum 86.31% (Table 4).

Crude fibre content (%)

Minimum crude fibre content of pod (13.18%) at sixth picking was analysed in treatment T_3, but statistically remained at par with T_4 and T_8 treatments. Maximum crude fibre content (14.25%) was observed under T_2 treatment.

Total Soluble Solids (ºBrix)

A perusal of the data (Table 4) reveals that the total soluble solids (TSS) of immature pods at sixth picking was significantly influenced by different treatments under study. Treatment T_3 found best and recorded maximum total soluble solids of pods (7.77 ºBrix). This treatment was statistically remained at par with T_4, T_8, T_6 and T_7 treatments. Minimum

total soluble solids of pods (7.23 °Brix) was observed under T_1 treatment *i.e*., control.

Application of Novel Prime 2% (T_3) recorded minimum crude fibre content and maximum TSS of green cowpea pods at sixth picking. This might be attributed to greater movement and availability of essential nutrients that might have accelerated the breakdown of complex polysaccharides into simple sugars and directs their accumulation in developing pods. The result obtained in the present investigation was also supported by the finding of Chetana Vasava *et al*. (2020) [3] in cluster bean.

Economics

Different biostimulants spray revealed profound impact on economics of cowpea cultivation. The application of Novel Prime 2% (T_3) noted the highest net profit of ₹ 1,96,650 ha^{-1} with BCR value of 1.65 as compared to rest of the treatments, which was followed by T8 (Seaweed extract 15%), obtained ₹ 1,93,141 ha^{-1} with BCR value of 1.63.

Table 4: Effect of different biostimulants on quality parameters of vegetable cowpea cv. AVCP 1

Treatments		Chlorophyll content (mg 100 g^{-1})				Protein content of immature seeds (%)	Crude fibre content (%)	Moisture content (%)	TSS (°Brix)
		2nd picking		6th picking					
		Leaf	Pod	Leaf	Pod				
T_1	Control (No spray)	1413.04	98.62	1419.20	97.47	5.25	13.88	83.89	7.23
T_2	Cow urine (6%)	1441.52	102.93	1405.63	102.74	5.25	14.25	84.65	7.28
T_3	Novel Prime (2%)	1681.97	114.28	1618.34	111.41	6.13	13.18	86.10	7.77
T_4	*Panchagavya* (3%)	1662.17	110.54	1596.19	114.06	5.84	13.37	85.82	7.58
T_5	*Jivamruth* (3%)	1510.68	108.75	1436.10	105.06	5.25	14.13	84.54	7.30
T_6	Vermiwash (10%)	1526.82	105.23	1523.86	109.63	5.84	13.60	85.27	7.51
T_7	Seaweed extract (7.5%)	1562.44	111.42	1497.79	110.31	5.85	13.73	85.15	7.49
T_8	Seaweed extract (15%)	1603.09	112.12	1657.95	111.55	6.13	13.43	86.31	7.54
S.Em. ±		32.74	2.46	17.72	3.21	0.13	0.25	1.03	0.11
C.D. at 5%		99.31	7.48	53.74	9.74	0.38	0.75	NS	0.35
C.V.%		3.66	3.95	2.02	5.16	3.84	3.12	2.08	2.65

Table 5: Economics of different treatments (₹ ha^{-1})

Treatments		Marketable pod yield (t ha^{-1})	Cost of cultivation (₹)	Gross Return (₹)	Net Return (₹)	BCR
T_1	Control (No spray)	7.52	104325	225600	121275	1.16
T_2	Cow urine (6%)	7.79	105650	233700	128050	1.21
T_3	Novel Prime (2%)	10.52	118950	315600	196650	1.65
T_4	*Panchagavya* (3%)	10.37	118219	311100	192881	1.63
T_5	*Jivamruth* (3%)	7.90	106178	237000	130822	1.23
T_6	Vermiwash (10%)	10.05	116659	301500	184841	1.58
T_7	Seaweed extract (7.5%)	8.82	110690	264900	154210	1.39
T_8	Seaweed extract (15%)	10.38	118259	311400	193141	1.63

Conclusions

On the basis of results obtained from present investigation, it can be concluded that the application of Novel Prime 2% enhanced leaf area, number of clusters $plant^{-1}$, number of pods $cluster^{-1}$, average pod length, pod yield $plant^{-1}$ as well as total and marketable yield along with quality parameters such as chlorophyll content of leaf and pod, protein content of immature seeds and TSS of green pods with lower down the crude fibre content. From the above enumeration and on the basis of economics, inference can be drawn that three sprays (at 15, 30 and 45 DAS) of Novel Prime 2% earned the highest net profit and BCR value.

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References

1. Challen SB, Hemingway JC. Growth of higher plants in response to feeding with seaweed extracts. In: Proc. fifth international seaweed symposium held at Halifax, Canada, 25-28 August, 1965, 359-367.
2. Champaneri D. Response of Novel and Novel Plus organic liquid nutrients on Indian bean [*Lablab purpureus* (L.) Sweet]. Thesis M. Sc. (Horti.), Navsari Agricultural University, Navsari, India, 2020, 64-89.
3. Chetana Vasava, Archna Mahida, Patel NK, Dhara Gadhiya, Tandel BM. Effect of spacing and foliar spray of micronutrients on quality attributes and economics of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.]. Int. J Chem. Stud. 2020;8(3):2749-2751.
4. Faraji S, Naderi R, Ibadli OV, Basali T, Gasimov SN, Tamo M. Effect of post harvesting on biochemical changes in gladiolus cut flowers cultivar White prosperity. Middle-East J. Sci. Res. 2011;9:572-577.
5. Kalariya VD, Bhanderi DR, Patel NK, Vaghasiya JM. Effect of foliar application of micronutrients, Novel organic liquid fertilizer and sea weed extract on yield of okra [*Abelmoschus esculentus* (L.) Moench]. Int. J. Chem. Stud. 2018;6(3):1834-1836.
6. Naik VM. Effect of Triacontanol, NAA, GA_3, on growth and yield of Indian bean (*Lablab purpureus* L.) cv. Navsari Papadi Selection 1. Thesis M. Sc. (Agri.), Navsari Agricultural University, Navsari, India, 2006, 53-69.
7. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India, 1985, 152-161.

8. Patel HB, Shah KA, Barvaliya MM, Patel SA. Response of green gram (*Vigna radiata* L.) to different level of phosphorus and organic liquid fertilizer. Int. J Curr. Microbiol. App. Sci. 2017;6(10):3443-3451.
9. Sadasivam S, Manickam A. "Biochemical Methods" (2nd Ed.), New Age International Publishers, New Delhi, India, 1996, 1-256.
10. Sajid M, Anjum MA, Hussain S. Foliar application of plant growth regulators affects growth, flowering, vase life and corm production of *Gladiolus grandiflorus* (L.) under calcareous soil. Bulgarian J Agric. Sci. 2015;21(5):982-989.
11. Sarma A. Numerical Agronomy, Kalyani Publishers, Ludhiana, 2015, 167-179.
12. Satodiya BN, Chauhan VB. Response of growth, seed yield and its quality to source manipulation and plant growth regulators in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] cv. Pusa Navbahar. Int. J. Forestry Crop Improvement. 2012;3(1):30-33.
13. Savaliya P. Effect of foliar application of organic and inorganic nutrients on growth, yield and quality of vegetable cowpea. Thesis M. Sc. (Horti.), Navsari Agricultural University, Navsari, India, 2020, 56-72.
14. Scheffelen AC, Muller A, Vanschovenbury JG. Quick test for soil and plant analysis used by small laboratories. J. Agric. Sci. 1961;9:2-16.
15. Shah S. Response of sweet potato [*Ipomoea batatas* (L.) Lam.] to fertilizer levels and novel organic liquid nutrients. Thesis M. Sc. (Horti.), Navsari Agricultural University, Navsari, India, 2019, 51-73.
16. Singhal V, Patel GG, Patel DH, Kumar U, Saini L. Effect of foliar application of water-soluble fertilizers on growth, yield and economics of vegetable cowpea production. Int. Qua. J. Environ. Sci. 2015;7:79-83.
17. Singhal V, Patel GG, Patel DH, Kumar U, Kumar T, Bindiya P. Effect of the efficacy of foliar application of water-soluble fertilizers in vegetable cowpea. Res. Environ. Life Sci. 2016;9(12):1478-1481.
18. Sivasankari S, Venkatesalu V, Anantharaj M, Chandrasekaran M. Effect of seaweed extracts on the growth and biochemical constituents of Vigna sinensis. Bioresour. Technol. 2006;97:1745-1751.
19. Supal Desai, Patel BB, Aklade SA, Desai CS. Performance of tuberose cv. Prajwal as influenced by different plant growth enhancers. Indian J Pure App. Biosci. 2020;8(5):472-477.