Original Research Article

Exogenous application of organic and inorganic nutrients and their impact on agronomical traits, yield and quality of vegetable cowpea[*Vignaunguiculata* (L) Walp]

Abstract

The study was undertaken on heavy black soil at Regional Horticulture Research Station, Navsari Agricultural University, Navsari, Gujarat (India) in order to analyze the effect of foliar application of organic and inorganic nutrients on growth, yield and quality of vegetable cowpea. The field was thoroughly ploughed and harrowed followed by land levelling using wooden plank. Basal dose of manure and fertilizer of 20:40:00 kg ha^{-1} was incorporated in the soil during land preparation. The seeds were planted 45 cm between rows and 30 cm between plantslaid out in aRandomized Complete Block Design with nine treatments replicated three times. Treatments were as follows: Control (T_1), 2 % Panchagavya(An organic solution made from cow dung, cow urine, cow butter, cow curd and cow milk) (T_2), 3 % Panchagavya (T_3), 0.5 % Novel plus organic liquid nutrients (T_4), 1 % Novel plus organic liquid nutrients (T_5), 1.5 % Novel plus organic liquid nutrients (T_6), 0.5 % Micronutrient grade IV (T_7), 1 % Micronutrient grade IV (T_8) and 1.5 % Micronutrient grade IV (T_9).The observations were made at the intervals of 60 and 90 DAS and data was collected on plant growth, yield and quality parameters. Results showed that the application of 1 % Novel plus organic liquid nutrients (NOVEL) (T_5) exhibited maximum plant height (35.73 and 56.93 cm,respectively), number of leaves per plant (39.27 and 52.73, respectively) at 60 and 90 days after sowing (DAS) and increasedleaf area (162.14 cm^2). Substantial effect of foliar application of 1 % Novel plus organic liquid nutrients (NOVEL) (T_5) was detected in yield parameters viz., number of clusters per plant (12.07), number of pods per plant (58.00), marketable pod yield (6.04 kg/plot). Furthuer to this, 1 % Novel plus organic liquid nutrients indicated notable effect on protein content of pods (24.04 %), iron (Fe) content (220.12 ppm) and zinc (Zn) content (62.76 ppm) of cowpea pods at final harvest. Novel Plus organic liquid nutrient can play a major role in growth, yield and quality in vegetable cowpea production.

Keywords

Novel organic liquid nutrient (NOVEL), foliar spray,vegetable cowpea, growth, yield

1. INTRODUCTION

Cowpea [*Vignaunguiculata* (L) Walp] being in the family of Fabaceae is an important leguminous crop believed to be originated in Central Africa. It is self-pollinated annual herb with an extensive growth habit. It is also known as lobia, black-eye pea and southern pea. Predominantly, cowpea is grown in summer and winter (*kharif)* season in India, often cultivated as an intercrop in pigeon pea, maize, sorghum and tapioca. Due to expansion growing habit, it covers the ground area leading to reduction in erosion. Cowpea merited with resistance to drought, wider adaptability to soil types, improving soil nutrient status by N-fixation and having a high protein content, it is being crowned as an important vegetable across the nation. Cowpea is shallow rooted crop and flourishes well under low fertile soil and low moisture condition. It can fix atmospheric nitrogen in the soil by their symbiotic relationship with a specific soil bacterium (*Rhizobium* spp.). Regular intake of cowpea seeds helps to ameliorate the new cell development which boosts the immunity of the body(Salih, 2013).There has been a major role of macro and micro nutrients in major plant morpho-physiological processes such as respiration, metabolic activation of the enzyme, photosynthesis, chloroplast formation, chloroplast synthesis and hormone biosynthesis (Nijjar, 1985). However, routine practices of using extravagant chemical fertilizers, their amounts and method of application have led to loss of nutrients in soil and water resulting in eutrophication. In order to sustain a higher yield potential and de-escalate the nutrient

losses, it becomes very pertinent to evolve suitable technologies for vegetable production. Foliar application of soluble fertilizers is one of the tactics to reduce fertilizer unavailability through absorption, leaching or other process associated with soil application(Dehnavard et al., 2017). Therefore, in order to achieve the benefits of foliar feeding, combining proper methods of application and the best suited nutrient materials related to specific crops is essential. Hallock(1979) observed that foliar application of nutrients is better than soil application for increasing yieldin legume crops required not only adequate macronutrient but also micronutrients for increasing the bacterial activity of nodules.Eisa and Ali (2014) have indicated that foliar spray of micronutrient mix on cowpea significantly increased the plant growth and yield traits. Therefore, an optimum supply of micronutrients through foliar application under balanced condition is of utmost necessary for higher productivity. Along with chemical fertilizers, organic source of fertilizers for the crop production have been of keen interest these days to ease of operation, cost effective and better results. Numerous studies indicates the better plant growth and yield with application of organic source of nutrients as compared to inorganic fertilizers (Garcia et al., 2011) and (Aslani and Souri, 2018). Very few studieson the effect of foliar sprays of inorganic nutrients and organic nutrients (Such as NOVEL) were done on cowpea to check its feasibility for production and quality during summer in this region. Therefore, the present aimed to evaluate and compare foliar application of inorganic and organic nutrients for growth, production and qualitative traits in cowpea.

2. MATERIALS AND METHOD

2.1.Experimental site and planting

The field trial was conducted in summer season of 2018-19 at Vegetable Research Farm, Regional Horticultural Research Station, Navsari Agricultural University, Navsari (Gujarat). The experimental site soil was deep black, deep drainage with good water holding capacity. The experiment usedcowpea variety “Gujarat Dantiwada Vegetable Cowpea 2” (GDVC 2) which was released in 2012 from SDAU, Sardarkrushinagar, Dantiwada (Gujarat). The field was thoroughly prepared by ploughing and harrowing followed by land levelling with the help of wooden plank.Basal dose of manure and fertilizer as per the recommendation of 20:40:00 kg ha^{-1} were incorporated in soil during land preparation. The seeds were planted at a distance of 45 cm between rows and 30 cm between plants in the Randomised Block Design with nine threatments replicated three times.The treatments were as follows: Control (T_1), 2 % *Panchagavya* (An organic solution made from cow dung, cow urine, cow butter, cow curd and cow milk) (T_2), 3 % *Panchagavya* (T_3), 0.5 % Novel plus organic liquid nutrients (T_4), 1 % Novel plus organic liquid nutrients (T_5), 1.5 % Novel plus organic liquid nutrients (T_6), 0.5 % Micronutrient grade IV (T_7), 1 % Micronutrient grade IV (T_8) and 1.5 % Micronutrient grade IV (T_9). Irrigation was applied at the time of planting in all treatments using furrow method and subsequently irrigation was applied when needed. All other crop cultural practices were followed accordingly. Foliar application of nutrients wasdone at 30 and 60 days after sowing (DAS).The observations were made at the intervals of 60 and 90 DAS. Data was collected on plant height (cm), number of leaves per plant, leaf area,number of primary branches, clusters per plant, number of pods per cluster, number of pods per plant.Pod length and pod weight were calculated at 3rd and 6thpicking

and averaged. Pod yield per plot and pod yield per hectare were recorded within the total six pickings. Quality parameters such as crude fibre content (%), protein content (%), iron (Fe) content (ppm) and zinc content (ppm) were measured during 6th picking (final harvest). The NOVEL Plus organic nutrient which is an International Patented Product by NAU was used as one of the treatments and the content analysis of the product ispresented in Table1 (Champaneri*et al.*, 2021).

Table 1: Nutritional composition of Novel plus organic liquid nutrient

Content	**Mean**
Nitrogen (N)	0.071 %
Phosphorous (P)	0.016 %
Potassium (K)	0.158 %
Sodium (Na)	0.059 %
Calcium (Ca)	0.026 %
Magnesium (Mg)	0.147 %
? (S)	0.015 %
Iron (Fe)	742.00 ppm
Manganese (Mn)	11.53 ppm
Zinc (Zn)	2.30 ppm
Copper (Cu)	0.26 ppm
Ureas activity	63-81 U/ml/min
Gibberrellic acid	110.2-205.0 mg/l
Cytokinin	137.8-244.3 mg/l

2.2.Weather and climate of experiment site

During the growing season (March to June 2019) maximum and minimum temperatures (39.4°C) and (28.2°C) were recorded and it was the hot summer season in the region. Relative humidity was mild (73.10%) with a maximum sunshine hour of (10.8 h) during peak crop growth stage.

2.3.Estimation of Fe and Zn

Fe and Zn content of the pods were estimated at the final harvest by following the diacid mixture method of Elwell and Gridley (1967). The dried, digested and filtrated samples were analyzed using atomic absorption spectrophotometry.

2.4.Estimation of protein

Nitrogen content of pods wasanalyzed using Kjedahl method and further protein content (%) in pod was calculated using multiplication factor 6.25 (Anonymous, 1960).

2.5.Estimation of crude fibre

Crude fibrecontent (%)for pods was estimated at the final harvest by taking pods of five tagged plants from each treatment. Two grams of sample was mixed with ether or petroleum ether to remove fat and boiled and 2g of dried sample was mixed with 200 ml of H_2SO_4 for 30 minutes and then filtered through muslin cloth and washed with boiling water until substance was free of acid. The residue was boiled with 200 ml of NaOH for 30 minutes and filtered through muslin cloth again and washed with 25 ml of boiling H_2SO_4followed with 50 ml portion of water and 25 ml alcohol. The residue was removed and transferred to pre-weighted petri plate (W_1, g) then dried for 2 hours at 130 ± 2°C, cooled in a

desiccator and weighed (W_2, g). Ignited for 30 minutes at 600 ± 15°C, and cooled in a desiccator and reweighed (W_3, g) according to Maynard(1970).

$$\text{Crude Fibre (\%)} = \frac{\text{Loss in weight on ignition } (W2-W1)x(W3-W1)}{\text{Weight of original sample (g)}} \text{ x } 100$$

2.6. Statistical analysis

The parameter data were analyzed using Indo-Stat statistical software. The ANOVA test was performed and the significance differences between mean values was determined using Tukey's (CD = 0.05) test.

3 RESULTS AND DISCUSSION

3.1.Effect of foliar application of organic and inorganic nutrients on growth parameters

Foliar application of nutrients significantly influenced the plant growth characters (Table 2). The result revealed that foliar application of 1 % Novel plus organic liquid nutrients (T_5) recorded the maximum plant height(35.73 cm and 56.93 cm) and number of leaves (39.27 and 52.73) at 60 and 90 DAS, respectively.There has been an increase in leaf area (162.14 cm^2) with the same treatment. This effect might be attributed to availability of nitrogen which stimulates the plant growth. Nitrogen being the major constituents of chlorophyll, protein and amino acid, their synthesis could have been escalated by the adequate supply of nitrogen from the Novel plus organic liquid nutrients. Further to this might be due to Novel plus organic liquid nutrients which contains plant growth regulators such as gibberellic acid, cytokinin and micro nutrients (Mn, Cu and Zn) which enhance the cell division and cell elongation which results into rapid elongation of internodes that might have upscaled the plant height. It also enhance the conversion of tryptophan to IAA leading to the enhanced activity of cell division and cell elongation through the effect of gibberellic acid and cytokinin singly or due to combine effect due to phytohormone content of Novel Plus organic liquid nutrient.Moreover, nitrogen increases the cation exchange capacity of plant roots and makes them potent in absorbing other nutrient ions like $H_2PO_4^-$, K *etc.* These findings are in line with the results reported by Kalariyaet al., (2018[a]) in okra, Anonymous (2012 and 2014) in banana, and Desai Supalet al.,(2018).

Table 2: Effect of foliar application of organic and inorganic nutrients on growth parameters

Treatment	Plant Height (cm)		Number of Leaves per Plant		Leaf Area (cm^2)	No. of Primary Branches per Plant
	60 DAS	90 DAS	60 DAS	90 DAS		
T_1 : Control (No spray)	24.70	39.87	29.13	39.47	110.12	3.47
T_2 : Panchagavya (2 %)	29.10	45.10	32.27	42.53	123.01	3.80
T_3 : Panchagavya (3 %)	29.60	48.17	32.07	42.80	126.11	3.87
T_4 : Novel plus organic liquid nutrients (0.5 %)	31.60	53.13	34.93	50.00	141.13	4.00
T_5 : Novel plus organic liquid nutrients (1 %)	35.73	56.93	39.27	52.73	162.14	4.20
T_6 : Novel plus organic liquid nutrients (1.5 %)	30.40	48.67	34.00	46.20	134.05	4.07
T_7 : Micronutrient grade IV (0.5 %)	29.70	47.07	33.60	45.93	125.77	3.93
T_8 : Micronutrient grade IV (1 %)	30.93	50.90	35.27	48.80	132.90	4.00
T_9 : Micronutrient grade IV (1.5 %)	31.57	51.80	35.80	49.40	137.72	4.07
S.Em. ±	**1.73**	**2.80**	**1.67**	**2.18**	**7.48**	**0.17**
CD (P=0.05)	**5.20**	**8.39**	**5.01**	**6.52**	**22.44**	**NS**
C.V. %	**9.89**	**9.88**	**8.51**	**8.12**	**9.78**	**7.34**

(**Panchagavya - an organic nutrient solution made using cow urine, cow dung, cowmilk and jaggery)*

3.2. Effect of foliar application of organic and inorganic nutrients on yield parameters

The results in Table 3 showed no significant difference on number of clusters per plant, number of pods per plant and pod yield however, maximum number of clusters per plant (12.07), number of pods per plant (58) and pod yield (6.72 kg/plot) were attained with foliar application of 1 % Novel plus organic liquid nutrients (T_5). The number of pods per cluster (4.81), average pod length (15.52 cm) and average pod weight (2.48) were also recorded with a 1% foliar spray of Novel plus organic liquid nutrient. The number of clusters per plant was closely associated with growth components like plant height, leaf area and number of leaves per plant. The findings are in line with those reported byManani (2019) in cluster bean.Lavish amount of macro and micro nutrient which ameliorate photosynthetic activity leads to augment in production traits and allocation of carbohydrates and photosynthates which ultimately increases the production and productivity of the crop (Singhal et al., 2015). The findings are similar to those reported by Kalariyaet al. (2018[b]) in okra; Patel et al. (2017) in green gram and Deoreet al. (2010) in chilli.The augmentation in yield is closely associated with components like maximum number of clusters per plant, number of pods per plant, leaf area and number of leaves per plant. Additionally, this effect might be contributed to easy assimilation of nutrients and balance in NPK ratio leads to improved crop production. 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 and Mehta et. al., 2017).The

results are further in accordance with the finding of Shah (2019) in sweet potato, Patel et al. (2018) in cabbage, El-sayed et al. (2012) in legume pea,Patil and Kolambe (2014) in garlic, Salunkhe et al. (2013) in onion and Deore et al. (2010) in chilli.

Table 3: The effect of foliar application of organic and inorganic nutrients on yield parameters

Treatment	Clusters/ plant	Pods per cluster	Pods per plant	Average pod length (cm)	Average pod weight (g)	Total pod yield (kg plot^{-1})
T_1 : Control (No spray)	9.93	4.51	44.73	12.80	2.31	4.85
T_2 : *Panchagavya* (2 %)	10.00	4.54	45.40	13.59	2.32	4.96
T_3 : *Panchagavya* (3 %)	10.40	4.59	47.60	13.62	2.35	5.30
T_4 : Novel plus organic liquid nutrients (0.5 %)	11.80	4.72	55.73	15.26	2.44	6.45
T_5 : Novel plus organic liquid nutrients (1 %)	12.07	4.81	58.00	15.52	2.48	6.72
T_6 : Novel plus organic liquid nutrients (1.5 %)	10.67	4.64	49.40	13.65	2.38	5.52
T_7 : Micronutrient grade IV (0.5 %)	10.60	4.62	48.93	13.31	2.36	5.43
T_8 : Micronutrient grade IV (1 %)	11.00	4.67	51.20	13.38	2.39	5.87
T_9 : Micronutrient grade IV (1.5 %)	11.53	4.68	53.93	13.94	2.40	6.15
S.Em. ±	**0.45**	**0.22**	**2.72**	**0.63**	**0.07**	**0.35**
CD (P=0.05)	**1.34**	**NS**	**8.16**	**NS**	**NS**	**1.04**
C.V. %	**7.08**	**8.23**	**9.33**	**7.85**	**5.31**	**10.57**

3.3. Effect of foliar application of organic and inorganic nutrients on quality parameters

Foliar application of organic and inorganic nutrients exhibited profound results for protein content (Table 4). The highest protein content(24.04 %), Fe content (220.12 ppm)and Zn content 962.76 ppm) in pods were noted with 1 % Novel plus organic liquid nutrients (T_5). The enhancement of quality contents supposedly attributed to higher uptake of nitrogen during growth period which upscaled photosynthesis, synthesis of protoplasm and protein for higher rate of mitosis. Application of 1 % Novel plus organic liquid nutrients accelerate the availability of elements & hormones, which could lead to enhanced metabolic activities and carbohydrate transformation of enzymes which ultimately enhances the quality characters of the pods.Similar effect was noted by Singhal et al. (2015).Additionally, boosts in Fe and Zn content might have contributed to the increased the capacity of plant to utilize ample amount of nutrients supplied through Novel plus organic liquid nutrients and better translocation of available micronutrients already available in Novel plus organic liquid nutrients(Anonymous, 2012). El-affifi et al. (2016); Fouda et al. (2017) estimated the same effect in cowpea by foliar fertilization.

Table 4: Effect of foliar application of organic and inorganic nutrients on quality parameters

Treatments		Crude Fiber (%)	Protein (%)	Iron (ppm)	Zinc (ppm)
T_1 :	Control (No spray)	12.33	20.69	182.39	52.57
T_2 :	*Panchagavya* (2 %)	12.39	21.91	191.90	55.22
T_3 :	*Panchagavya* (3 %)	12.46	22.38	197.29	56.85
T_4 :	Novel plus organic liquid nutrients (0.5 %)	12.72	23.91	219.34	60.45
T_5 :	Novel plus organic liquid nutrients (1 %)	12.76	24.04	220.12	62.76
T_6 :	Novel plus organic liquid nutrients (1.5 %)	12.59	22.70	210.94	58.69
T_7 :	Micronutrient grade IV (0.5 %)	12.52	22.59	209.30	58.57
T_8 :	Micronutrient grade IV (1 %)	12.62	23.32	214.43	59.30
T_9 :	Micronutrient grade IV (1.5 %)	12.70	23.47	216.63	59.92
S.Em. (±)		0.18	0.55	6.93	1.55
C.D. at 0.05 %		NS	1.64	20.77	4.64
C.V. %		2.50	4.17	5.80	4.60

4. CONCLUSIONS

Based on the study findings it can be concluded that foliar application of nutrients has significant effect on growth and productivityof vegetable cowpea. Novel plus (1%) organic liquid nutrient (NOVEL) developed and patented by Navsari Agricultural University, Navsari (Gujarat), Indiais recommended to the farming community for application at 30 and 60 days after sowing.

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