



Nutrient Management in Underutilized Vegetable Crop Ivy Gourd [*Coccinia grandis* (L.) Voigt]

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Authors' contributions

This work was carried out in collaboration among all authors. Author NKP has conducted research work, wrote manuscript along with statistical analysis. Author DDC has helped in manuscript writing. Author DTD has helped to design and execute experiment. Author MBT has helped in field work during research. All authors read and approved the final manuscript.

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ABSTRACT

Background: Ivy gourd is the most nutritious and healthy vegetable among the underutilized vegetable crops. To increase the production effective nutrient management is key tool.

Methods: The experiment on growth and yield improvement in ivy gourd through integrated nutrient management was conducted in a randomised block design with three replications at Regional Horticulture Research Station in ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat.

Results: An application of 50% RDF (Recommended Dose of Fertilizer) + Bio-compost had a beneficial effect on growth parameters like minimum days to flowering (35.83 days) and fruit harvest (47.11), maximum dry biomass of shoot (8.41 kg) and dry biomass of root (840 g) with near to neutral fruit pH (6.8). Maximum length of fruit (5.12 cm), diameter of fruit (1.80 cm), weight of fruit (4.57 g), maximum fruit yield plant⁻¹ (1.64 kg), highest fruit yield (16.60 t ha⁻¹), maximum leaf nutrient content (N - 1.753 ppm, P - 0.456 ppm, K - 1.653 ppm) and soil nutrient status (N - 211.77

kg ha⁻¹, P₂O₅ - 69.52 kg ha⁻¹, K₂O - 498.96 kg ha⁻¹) were also noted in 50% RDF + Bio-compost as compared to other treatment.

Keywords: Growth parameters; nutrient status; underutilized vegetable; yield parameters.

1. INTRODUCTION

India is an agricultural country and 70% of rural household depends directly on agriculture for their livelihood in India [1]. Indian council of medical research (ICMR) recommended daily uptake of 300 g vegetables/day including 125 g green leafy vegetables, 100 g root vegetables and 75 g other vegetables [2]. Ivy gourd [*Coccinia grandis* (L.) Voigt] is an underutilized vegetable mostly grown by smallholder farmers whose technical efficiency for this emerging crop is not well known. It is necessary that empirical evidence to be developed on technical efficiency to optimize its production and promotion. It is a perennial cucurbitaceous vegetable, grown almost throughout the India. The tender fruit of this crop is used as a cooked vegetable. This plant is much valued in the indigenous system of medicine in the treatment of diseases such as skin infections and diabetics. The fruit contains appreciable amounts of iron, vitamin A and vitamin C. The tender shoots of the plant are sometimes used as pot-herbs. This crop is a dioecious but the female plant is capable of producing parthenocarpic fruits.

It has been established that nutrient plays an important role in the improvement of fruit and yield in little gourd. Nitrogen is absorbed by plants in huge amount and it is most limiting factor for crop production. Whereas, application of organic fertilizers with inorganic fertilizers supplies nitrogen, phosphorus, potash and other micro nutrient in trace quantity. Under such conditions, balanced nitrogen and other nutrients are highly imperative to obtain higher yield.

Little gourd is widely cultivated in Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Maharashtra and some place of Gujarat. Information pertaining to research work on its commercial cultivation in India and Gujarat is very limited. Therefore, keeping the above point in view an attempt has been made.

2. MATERIALS AND METHODS

A field experiments was conducted in *Kharif* season at Vegetable Research Scheme, Regional Horticulture Research Station, ASPEE

College of Horticulture and Forestry, NAU, Navsari, Gujarat to study the effect of nutrient management in ivy gourd. The organic manures viz., Farm Yard Manure (FYM), Vermicompost, Bio-compost, Neem cake, Castor cake were applied in soil as nutrient. Half dose of Nitrogen and full dose of Phosphorus and Potash applied at basal and remaining 50% nitrogen at 30 DAS in 100% RDF (100-50-50 NPK kg ha⁻¹). There were totally eleven treatments viz. T₁ - 100% RDF (100-50-50 NPK kg ha⁻¹), T₂ - FYM, T₃ - Vermicompost, T₄ - Castor cake, T₅ - Neem cake, T₆ - Bio-compost, T₇ - 50%RDF + FYM, T₈ - 50% RDF + Vermicompost, T₉ - 50% RDF + Castor cake, T₁₀ - 50% RDF + Neem Cake and T₁₁ - 50% RDF + Bio-compost along with three replications. The field was laid out in randomized block design. Each plot consisted rows of 2 m length with spacing of 1 m between rows. Cuttings were sown at the top of the ridges. After proper growth of plant training and pruning was provided. The crop was raised following the recommended intercultural and plant protection practices. In each plots five plants were selected at random and tagged for recording observations. Observations on growth parameters viz, days to flowering, days to fruit harvest, dry biomass of shoot, dry biomass of root, fruit pH were displayed in Table-1 while, observations on yield parameters viz, fruit length, fruit diameter, fruit weight, and fruit yield were demonstrated in Table-2 and nutrient content of soil and leaf i.e. leaf N, P, K and available soil nitrogen, phosphorus and potash were presented in Table-3.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The minimum days to flowering (35.83 days) and fruit harvest (47.11 days), higher dry biomass of shoot and root with near to neutral fruit pH was recorded with the treatment T₁₁ (50% RDF + Bio-compost) followed by T₁- 100 RDF kg ha⁻¹ in days to flowering, fruit harvest and fruit pH, while dry biomass of shoot and root was on at par with T₁, T₃. Whereas, the maximum days to flowering (46.11 days in T₈) and fruit harvest (57.34 days in T₄), minimum dry biomass of shoot and root (6.92 kg and 578 g in T₄) with acidic fruit pH (4.8

in T₂) was found during experimentation on ivy gourd. This may be due to improved nutrient uptake by plants in this treatment, resulting improved vegetative growth. The organic manure applied in the form of Bio-compost might have improved the physical and chemical properties of the soil and leading to the adequate supply of nutrients to the plants with sufficient water holding capacity and might have accelerate the growth parameters *i.e.*, days to flowering, days to fruit harvest, dry biomass of shoot, dry biomass of root and fruit pH. The combined application of Bio-compost leads to slow-release of nutrient during later stages and inorganic fertilizers increased the absorption of nutrients in early stage especially nitrogen which enhanced the cell division, cell elongation and increased the plant growth. These findings are in line with Mahmoud et al. [3], Vishwakarma et al. [4] and Kumar and Karuppai [5].

3.2 Yield Parameters

Yield and yield attributing characters like weight of fruit at edible maturity (g), length of fruit (cm), diameter of fruits (cm), fruit yield plant⁻¹ (kg) and total fruit yield (q ha⁻¹) were found statistically differed among the treatment applied in integrated manner *i.e.* organic and inorganic with or without combination during the course of investigation (Table-2). The maximum weight of fruit at edible maturity (4.57 g), maximum length of fruit (5.12 cm) and highest fruit width (1.80 cm) were recorded with combination of 50% RDF + Bio-compost which was on same bar with T₁ in fruit weight and fruit length. This increase in length, diameter and weight of edible fruit might

be due to combine application of organic and inorganic fertilizer which ultimately avail phosphorous content of plant tissue, which results in proper formation of nucleic acids and due to cell division average fruit weight might have increased. In addition, Bio-compost is slow releaser and provide nutrients throughout growth period. These findings are also in consonance with the findings of Arisha et al. [6], Arshad et al. [7] and Singh et al. [8].

An application of 50% RDF + Bio-compost gave highest fruit yield plant⁻¹ (1.64 kg) and total fruit yield (16.60 t ha⁻¹). Whereas, in case of T₄ - castor cake plant had lowest fruit yield plant⁻¹ (1.33 kg) and minimum fruit yield (13.30 t ha⁻¹) during the course of investigation. It might be due to the application of adequate amount of organic manures in combination with NPK (Nitrogen, Phosphorus, Potash). The reason for increasing fruit yield in ivy gourd was attributed to increased solubilization effect and availability of nutrients by the additions of organic manure *i.e.* Bio-compost and increased physiological activities leading to the build-up of sufficient food reserve for the developing sinks and better portioning towards the developing fruits. Besides, quick response of plant nutrients from inorganic based fertilizer, balanced C: N ratio, enhanced the synthesis of photosynthetic activities and production of auxin, amino acids and vitamins resulted in quantitative yield might be due to its additive effect on vegetative growth of the crop ultimately affecting the yield. Similar findings were also reported by Narayanamma [9], Kanaujia et al. [10], Baghel et al. [11], Nagar et al. [12] and Pradhan et al. [13].

Table 1. Effect of nutrient management on growth parameters on ivy gourd

Treatment	Days to flowering	Days to fruit harvest	Dry bio mass of shoot (kg)	Dry bio mass of root (g)	Fruit pH
T ₁ - 100% RDF (100-50-50 NPK kg ha ⁻¹) (Control)	38.36	49.64	8.13	795.50	6.6
T ₂ - FYM	41.66	52.94	7.32	628.50	4.8
T ₃ - Vermicompost	39.10	50.38	7.97	767.50	6.1
T ₄ - Castor cake	46.06	57.34	6.92	578.50	4.9
T ₅ - Neem cake	45.83	57.11	7.89	738.00	5.9
T ₆ - Bio-compost	44.81	56.09	7.80	752.00	6.3
T ₇ - 50% RDF + FYM	39.91	51.19	7.55	676.00	5.6
T ₈ - 50% RDF + Vermicompost	46.11	55.65	7.69	725.00	5.7
T ₉ - 50% RDF + Castor cake	42.42	55.19	7.47	658.00	5.7
T ₁₀ - 50% RDF + Neem cake	42.83	54.11	7.63	703.50	5.6
T ₁₁ - 50%RDF + Bio-compost	35.83	47.11	8.41	840.50	6.8
S.Em. ±	0.346	0.549	0.259	0.2930	0.203
CD @ 5 %	0.98	1.57	0.74	84.0	0.59
CV %	2.02	2.52	4.11	5.07	4.91

Table 2. Effect of nutrient management on yield and its attributes on ivy gourd

Treatment	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Fruit yield/plant (kg)	Fruit yield (t/ha)
T ₁ - 100% RDF (100-50-50 NPK kg ha ⁻¹) (Control)	4.43	4.88	1.27	1.55	15.59
T ₂ - FYM	3.90	4.43	0.95	1.37	13.70
T ₃ - Vermicompost	4.27	4.70	1.34	1.50	15.02
T ₄ - Castor cake	3.61	3.98	0.70	1.33	13.30
T ₅ - Neem cake	4.11	4.62	1.05	1.50	14.97
T ₆ - Bio-compost	4.28	4.78	1.27	1.55	15.50
T ₇ - 50% RDF + FYM	4.12	4.54	0.96	1.48	14.81
T ₈ - 50% RDF + Vermicompost	4.08	4.57	1.20	1.54	15.48
T ₉ - 50% RDF + Castor cake	4.26	4.49	0.83	1.44	14.36
T ₁₀ - 50% RDF + Neem cake	4.12	4.58	1.10	1.56	15.62
T ₁₁ - 50% RDF + Bio-compost	4.57	5.12	1.80	1.64	16.60
S.Em. ±	0.083	0.09	0.096	0.039	0.413
CD @ 5 %	0.24	0.262	0.27	0.11	1.18
CV %	4.89	4.88	11.49	6.48	6.75

Table 3. Effect of nutrient management on nutrient status of leaf and soil on ivy gourd

Treatment	Leaf N content (ppm)	Leaf P ₂ O ₅ content (ppm)	Leaf K ₂ O content (ppm)	Available N (kg/ha) in soil	Available P ₂ O ₅ (kg/ha) in soil	Available K ₂ O (kg/ha) in soil
T ₁ - 100% RDF (100-50-50 NPK kg ha ⁻¹) (Control)	1.726	0.408	1.560	201.62	45.50	473.25
T ₂ - FYM	1.290	0.184	1.210	188.20	54.95	445.01
T ₃ - Vermicompost	1.562	0.341	1.330	190.52	44.67	470.78
T ₄ - Castor cake	1.533	0.363	1.158	179.63	49.91	447.60
T ₅ - Neem cake	1.416	0.345	1.412	198.68	45.65	466.87
T ₆ - Bio-compost	1.623	0.368	1.431	201.48	61.49	463.08
T ₇ - 50% RDF + FYM	1.347	0.234	1.274	203.97	51.61	457.93
T ₈ - 50% RDF + Vermicompost	1.435	0.319	1.344	208.26	57.46	459.19
T ₉ - 50% RDF + Castor cake	1.547	0.260	1.263	201.19	61.33	446.55
T ₁₀ - 50% RDF + Neem cake	1.380	0.254	1.322	202.57	66.27	458.64
T ₁₁ - 50% RDF + Bio-compost	1.753	0.486	1.653	211.77	69.52	498.96
S.Em. ±	0.058	0.038	0.068	2.981	3.152	3.698
CD @ 5 %	0.15	0.11	0.21	7.36	9.45	9.12
CV %	11.82	10.53	9.95	3.63	4.84	6.97

3.3 Leaf and Soil Nutrient Status

Leaf N, P, K content (ppm) and available soil N, P₂O₅ and K₂O (kg/ha⁻¹) were significantly affected by various INM (Integrated Nutrient Management) doses of organic manure and inorganic fertilizers during the crop growth period in ivy gourd as shown in (Table-3). The maximum leaf N (1.753 ppm), leaf P₂O₅ (0.486 ppm) and leaf K₂O (1.653 ppm) content were observed in T₁₁ - 50% RDF + Bio-compost which was on same bar with T₁ - 100% RDF. However, the minimum leaf N, leaf P₂O₅ and leaf K₂O content was recorded in T₂ - FYM application. The leaf nutrient status in ivy gourd was enhanced significantly due to application of inorganic fertilizer along with organic manure in

an integrated manner. It might be have resulted in higher biological process and increased microbial activity and soil enzymatic activity helping for organics and inorganics in better availability of nutrients throughout the crop growth period which increase nutrient content in leaf. These might be the possible mechanisms for higher availability of all the nutrients under study. Application of micronutrients and organic manures might have released more micronutrients into the soil and also enhanced activities of microbes through producing more CO₂ converting it into organic acids thereby dissolving the inorganic salts present in the soil; thus, made more nutrient available and improved the fertility status of the soil. This is in confirmation with findings of Kameswari et al.

[14], Aanjanappa et al. [15] and Sharma et al. [16] Singh and Krishna Mohan [17]. Moreover, maximum soil available nitrogen ($211.77 \text{ kg ha}^{-1}$), soil available phosphorus (69.52 kg ha^{-1}) and soil available potash ($498.96 \text{ kg ha}^{-1}$) were noted in combine application of inorganic and organic treatment T₁₁ (50% RDF + Bio-compost) which was on same bar with T₈ in available nitrogen and T₆, T₉ and T₁₀ in available phosphorus. It might be due to application of micronutrients and organic manures might have released more micro-nutrients into the soil and also enhanced activities of microbes through producing more CO₂ converting it into organic acids thereby dissolving the inorganic salts present in the soil; thus, made more nutrient available and improved the fertility status of the soil. Application of inorganic fertilizer significantly changed the available nutrient status of soil at the harvest of crop. It is beyond doubt that when more nutrients are added through inorganic fertilizers, they are bound to remain in soil or they may be lost through leaching or lost by way of volatilization. This is in confirmation with findings of Kameswari et al. [14], Guenichi et al. [18], Aanjanappa et al. [15] and Sharma et al. [16] and Singh and Krishna Mohan [17].

4. CONCLUSION

On the basis of above findings, it is concluded that the treatment T₁₁ - (50% RDF + bio-compost) was recorded the best among all the treatments combinations of organic and inorganic sources of nutrients in terms of growth and yield attributes moreover, it also increases the leaf and soil nutrient status. Therefore, it is suggested that a dose of 50% RDF + bio-compost suitable is for the commercial cultivation of ivy gourd.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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