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Effect of integrated nutrient management on growth and yield of little gourd (*Coccinia grandis* L.)

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Abstract
The present investigation entitled "Integrated nutrient management studies in little gourd (*Coccinia grandis* L.)" was carried out at College of Horticulture, Dapoli (M.H), Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth Dapoli, Dist. Ratnagiri during year 2021-2022. The experiment was laid out in Randomized Block Design with ten treatments and replicated thrice including different organic manure (Vermicompost, FYM and Neem Cake) and biofertilizers (Azotobacter and PSB) in combination with inorganic fertilizers. The various treatments were T_1-FYM 10 t/ha and RDF (100:50:50 NPK/kg/ha), T_2-RDF + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_3-25% RDF + Vermicompost @ 5 t/ha, T_4-25% RDF + Vermicompost @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_5-50% RDF + Vermicompost @ 5 t/ha, T_6-50% RDF + Vermicompost @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_7-25% RDF + Neem cake @ 5 t/ha, T_8-25% RDF + Neem cake @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_9- 50% RDF + Neem cake @ 5 t/ha, T_{10}- 50% RDF + Neem cake @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha. The effect of integrated nutrient management including Vermicompost, FYM, Neem Cake and biofertilizers in combination with inorganic fertilizers on growth and yield parameters of little gourd was studied during the investigation period.
The result indicated the beneficial effect of integrated nutrient management on various yield parameters of little gourd. The application 50% RDF with Vermicompost @ 5 t/ha (T_5) significantly influenced the yield and yield attributing characters i.e. number of days required for flowering from planting (122.11 days), number of fruits per plant (905.00), number of harvest (54.33), yield per plant (8.93 kg), yield per plot (26.32 kg) and yield per hectare (21.20 t), whereas Treatment T_6 i.e. 50% RDF with Vermicompost @ 5 t/ha and Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha recorded maximum performance with respect to vegetative parameters i.e. diameter of vine at 240 days (26.38 mm).

Keywords: NPK, FYM, vermicompost, biofertilizers, yield, little gourd

1. Introduction
Little gourd (*Coccinia grandis* L.) is an underexploited tropical vegetable crop belonging to family cucurbitaceae with chromosome no 2n = 24. It is commonly known as ivy gourd, scarlet gourd, scarlet fruited gourd, small gourd, *tindoli* or *ghilodi* (Gujarat), *tindora*, *kundaru*. It is popularly known as "*Tondali*" in Maharashtra. In India, it is commercially cultivated in southern, eastern, and western regions, mainly in state like Karnataka, Tamil Nadu, Kerala, Maharashtra, Gujarat and West Bengal (Patel *et al.* 2014) [4].
Little gourd is semi-perennial creeper having economic life of 3-4 years. This vine has aggressive climbing properties and spreads easily over fences, trees, shrubs and other supports. The leaves are arranged in alternate form. Tendrils from leaf axils assist climbing. Flowers are solitary, white in colour and open during night hours. Fruits are usually ovoid or elliptical or cylindrical having a length of 4-10cm and a thickness of 1-2cm. They are smooth, green, with or without white stripes when immature and scarlet red on opening. Botanically, the fruit is pepo. It is dioecious in nature but fruit development take place parthenocarpically hence only female plants are planted in field (Patel *et al.* 2014) [4]. In India, the Konkan region of Maharashtra is situated in the between of Arabian ocean and Western Ghats with warm and humid climate. The region is characterised with high annual rainfall from June to September. Such climatic condition are ideally suited for cultivation of little gourd. As the region is in visibly of metropolitan cities like Mumbai and Pune there is consistent market demand for the little gourd fruits. It has attracted the cultivation due to consistent production as well as high market rates. Hence, recently its cultivation is increasing in sole and intercrop in fruit orchards. Inspite of potential crop has remained underexploited as far as standardization of cultivation practices are concerned and no systematic research is conducted on agronomical aspect like nutrient, irrigation and integrated pest and disease management etc.

Little gourd, though remained underexploited crops it has attracted the attention of cultivation due to high demand and attractive prices in the market. The organically produced little gourd will fetch even better market prices besides improving quality of produce. The demand for organically produced agricultural commodities by health cautious customers is also increasing, hence the standardization of practices for organic nutrient management is needed for hours.

2. Materials and Methodology

The " Effect of integrated nutrient management on growth and yield of little gourd (*Coccinia grandis* L.)" was carried out at College of Horticulture, Dapoli (M.H), Dr. Balasaheb Sawant Konkon Krishi Vidyapeeth Dapoli, Dist. Ratnagiri during year 2021-2022. The experiment was laid out in Randomized Block Design with ten treatments and replicated thrice. The various treatments were T_1 (Control) - FYM 10 t/ha and RDF (100:50:50 NPK/kg/ha), T_2- RDF + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_3-25% RDF + Vermicompost @ 5 t/ha, T_4-25% RDF + Vermicompost @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_5-50% RDF + Vermicompost @ 5 t/ha, T_6-50% RDF + Vermicompost @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_7-25% RDF + Neem cake @ 5 t/ha, T_8-25% RDF + Neem cake @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha, T_9 .50% RDF + Neem cake @ 5 t/ha, T_{10}- 50% RDF + Neem cake @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha. Dose of organic manure (Vermicompost and Neem Cake) were applied four split doses (at the time planting up to four month). Biofertilizers were applied two split doses whereas, treatment having chemical fertilizers (Urea, SSP and MOP) used as source of NPK. The full dose of phosphorous and potassium applied at the time of planting with four split dose of nitrogen applied at the time planting up to four month. The *Azotobacter* and PSB were mixed in organic manure and kept overnight then applied.

3. Results and Discussion

The results recorded during the investigation are summarized below.

3.1 Growth parameters

3.1.1 Girth of vine at collar region (mm)

The data regarding girth of vine at collar region are presented in Table.1 revealed that the variation in diameter of vine at collar region was non-significant at 30, 60, 90 and 120 DAP, whereas it was significant at 150, 180, 210 and 240 DAP. The maximum diameter of vine at 150 DAP was recorded in treatment T_8 i.e. 25% RDF + Neem cake @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha (11.94 mm while, lowest in treatment T_1 (9.17 mm). The highest diameter at 180 DAP (16.69 mm), 210 DAP (22.07 mm) and 240 DAP (26.38 mm) was found in treatment T_6 i.e.50% RDF + Vermicompost @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha (16.69 mm), whereas lowest in treatment T_1 at 150 DAP (9.17 mm), 180 DAP (13.41 mm) and 240 DAP (20.69 mm). This might be due to more uptake and more availability of different essential nutrients for crop growth. Nitrogen is very important nutrients which are responsible for enhancing cell division, cell enlargement and elongation. Source as it could be instantly available to the plant, whereas in later stages the nutrients available in organic form are available. The above are results in confirmation with the findings of Nayak *et al*. (2016) [3]

3.1.2 Number of main branches

Data pertaining number of branches to Table 2 concluded that effect of INM was found non-significant at 30, 60, 90, 120, 150, 180, 210 and 240 DAP.

3.1.3 Flowering parameter

The data presented in Table 3 recorded significant difference in days taken to flowering among different treatments. Significantly minimum days taken for flowering from planting (122.11 days) were recorded in T_5 i.e. 50% RDF with Vermicompost @ 5 t/ha which was at par with T_6 (122.55days), T_{10} (124.88 days), T_7 (127.00 days) and T_9 (127.11 days). The maximum days taken for flowering (133.44 days) from planting were recorded in T_1 i.e. 100% RDF (100:50:50 NPK/kg/ha). The earliness in flowering might be due to the use of inorganic fertilizers and vermicompost which might have help in increasing the production of growth promoting substance like GA_3 and IAA. Similar results were also reported by Meena *et al.* (2019) [2], Singh *et al.* (2018) [6], Malik *et al* (2017) [1] and Sahu *et al*. (2020) [5].

The number of days required from flowering to harvest showed non-significantly difference with the range 5.59 to 6.93. It indicated that various nutrient combination did not affect the initiation of flowering in little gourd which further gives indication that might be genetically controlled parameter.

Table 1: Effect of integrated nutrient management on diameter of vine at collar region (mm) of little gourd (*Coccinia grandis* L.)

Treatment	Diameter of vine at collar region (mm)							
	30 days	60 days	90 days	120 days	150 days	180 days	210 days	240 days
T_1- FYM@10 t/ha +RDF (100:50:50 NPK/kg/ha)	3.35	4.75	6.03	7.97	9.17	13.41	16.48	20.69
T_2- RDF + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	3.76	4.71	5.78	7.96	9.88	13.95	17.04	21.19
T_3- 25% RDF + Vermicompost @ 5 t/ha	3.13	4.05	5.66	8.06	10.84	15.52	18.20	21.49
T_4- 25% RDF + Vermicompost @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	3.35	4.28	5.03	7.28	8.53	15.94	19.42	22.32
T_5 -50% RDF + Vermicompost @ 5 t/ha	3.49	4.32	5.55	8.10	10.70	16.07	20.58	25.97
T_6- 50% RDF + Vermicompost @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	3.25	4.43	6.05	8.18	10.28	16.69	22.07	26.38
T_7 -25% RDF + Neem cake @ 5 t/ha	3.62	4.91	5.99	8.63	10.97	15.81	20.26	22.63
T_8- 25% RDF + Neem cake @ 5 t/ha + + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	3.55	4.40	6.03	8.26	11.94	16.03	20.78	22.70
T_9- 50% RDF + Neem cake @ 5 t/ha	3.25	4.21	5.80	8.52	10.95	14.95	18.91	24.85
T_{10} -50% RDF + Neem cake @ 5 t/ha + Azotobacter @5	3.50	4.36	6.20	8.27	10.51	15.87	20.72	24.54

kg/ha + PSB @ 5 kg/ha								
Mean	3.43	4.44	5.82	8.12	10.38	15.43	19.44	23.28
S.Em±	0.28	0.30	0.39	0.48	0.61	0.61	0.48	0.74
CD at 5%	-	-	-	-	1.81	1.83	1.43	2.21

Table 2: Effect of integrated nutrient management on number of main branches of little gourd (*Coccinia grandis* L.)

Treatments	Number of main branches							
	30 days	60 days	90 days	120 days	150 days	180 days	210 days	240 days
T_1- FYM @10 t/ha +RDF (100:50:50 NPK/kg/ha)	1.00	1.33	2.00	3.00	3.33	4.00	4.33	5.33
T_2- RDF + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	1.33	1.67	2.33	3.33	4.00	4.33	4.67	5.33
T_3- 25% RDF + Vermicompost @ 5 t/ha	1.00	1.33	1.67	2.67	3.67	4.00	5.00	6.00
T_4- 25% RDF + Vermicompost @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	1.00	1.67	2.00	3.33	3.67	4.67	5.67	6.67
T_5 -50% RDF + Vermicompost @ 5 t/ha	1.00	1.33	2.33	3.67	4.67	5.00	6.00	7.00
T_6-50% RDF + Vermicompost @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	1.00	1.33	1.67	3.33	4.33	4.67	6.33	6.67
T_7 -25% RDF + Neem cake @ 5 t/ha	1.67	1.67	2.33	3.33	3.67	4.00	4.67	6.67
T_8- 25% RDF + Neem cake @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	1.00	1.67	2.00	3.67	4.33	5.00	6.00	5.33
T_9- 50% RDF + Neem cake @ 5 t/ha	1.00	1.00	1.67	3.33	4.00	4.33	5.33	6.33
T_{10} -50% RDF + Neem cake @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	1.00	1.33	2.33	3.00	4.33	5.00	5.67	6.00
Mean	1.07	1.43	2.03	3.27	4.00	4.50	5.37	6.07
S.Em±	0.15	0.33	0.39	0.59	0.40	0.58	0.64	0.56
CD at 5%	-	-	-	-	-	-	-	-

Table 3: Effect of integrated nutrient management on different flowering and fruiting parameters of little gourd (*Coccinia grandis* L.)

Treatments	Days required for flowering from planting	Days required from flowering to harvest
T_1- FYM @10 t/ha +RDF (100:50:50 NPK/kg/ha)	128.66	6.93
T_2- RDF + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	126.55	6.64
T_3- 25% RDF + Vermicompost @ 5 t/ha	133.44	6.30
T_4- 25% RDF + Vermicompost @ 5 t/ha +Azotobacter @5 kg/ha + PSB @ 5 kg/ha	130.55	6.32
T_5 -50% RDF + Vermicompost @ 5 t/ha	122.11	5.65
T_6-50% RDF + Vermicompost @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	122.55	5.59
T_7 -25% RDF + Neem cake @ 5 t/ha	127.00	6.72
T_8- 25% RDF + Neem cake @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	133.00	6.46
T_9- 50% RDF + Neem cake @ 5 t/ha	127.11	6.77
T_{10} -50% RDF + Neem cake @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	124.88	6.56
Mean	127.58	6.39
S.Em±	1.99	0.33
CD at 5%	5.91	-

3.1.4 Yield and yield attributing characters

The data pertaining in Table 4 revealed that effect of integrated nutrient management recorded significant response on yield and yield attributing characters. The application 50% RDF with vermicompost @ 5 t/ha (T_5) significantly influenced the yield and yield attributing characters. The maximum number of fruits per plant (905.00) was recorded in treatment T_5 i.e. 50% RDF with vermicompost @ 5 t/ha, whereas minimum number fruits were found in T_2 i.e. RDF (100:50:50 NPK/kg/ha) + Azotobacter @ 5 kg/ha+ PSB @ 5 kg/ha. The better results obtained in T_5 might be due to availability of nutrients constantly and throughout the production period as the treatment consisted both 50% of recommended dose through inorganic fertilizers and remaining through organic sources.

Significantly highest number of harvest (54.33) was observed in T_5 i.e. 50% RDF with vermicompost @ 5 t/ha, whereas minimum number of harvest recorded in T_1 i.e. control, maximum yield per plant (8.93 kg), yield per plot (26.32 kg) and yield per hectare (21.20 t) was recorded in T_5 i.e. 50% RDF with vermicompost @ 5 t/ha, whereas minimum yield per plant (7.03 kg), yield per plot (21.01 kg) and yield per hectare (16.49 t) was observed in T_1 i.e. control (FYM @ 10 t/ha + RDF 100:50:50 NPK/kg/ha). reason behind increasing yield and yield attributing characters might be due to application of inorganic fertilizers with organic manure (FYM and Vermicompost) which might have improve the physical as well as chemical properties of soil thus making more availability of essential elements to the plants and also provide both major and minor nutrients specification in optimum range which in turn develop favourable condition for plant growth and development.

Table 4: Effect of integrated nutrient management on various yield and yield attributing characters of little gourd (*Coccinia grandis* L.)

Treatments	Number of fruits per plant	Number of harvest	Yield/plant (kg)	Yield/plot (kg)	Yield/ha (t)
T_1- FYM @ 10 t/ha +RDF (100:50:50 NPK/kg/ha)	832.67	51.00	7.03	21.01	16.49
T_2- RDF + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha	821.00	49.00	7.16	22.04	17.73
T_3- 25% RDF + Vermicompost @ 5 t/ha	883.67	50.00	7.22	22.14	17.84
T_4- 25% RDF + Vermicompost @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	805.67	51.33	7.72	22.99	18.54
T_5 -50% RDF + Vermicompost @ 5 t/ha	905.00	54.33	8.93	26.32	21.20
T_6-50% RDF + Vermicompost @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha	899.00	53.67	8.63	26.07	20.99
T_7 -25% RDF + Neem cake @ 5 t/ha	882.67	52.00	8.10	24.15	19.48
T_8- 25% RDF + Neem cake @ 5 t/ha + Azotobacter @ 5 kg/ha + PSB @ 5 kg/ha	866.00	53.00	7.91	23.09	18.62
T_9- 50% RDF + Neem cake @ 5 t/ha	877.00	52.67	8.02	23.42	19.50
T_{10} -50% RDF + Neem cake @ 5 t/ha + Azotobacter @5 kg/ha + PSB @ 5 kg/ha	886.00	53.33	8.33	24.55	19.80
Mean	865.86	52.03	7.90	23.57	19.07
S.Em±	21.57	1.07	0.25	0.93	0.045
CD at 5%	64.10	3.19	0.76	2.77	0.13

4. Conclusion

Thus from the present investigation, it can be revealed that integrated nutrient management treatments rendered significant effects on the various vegetative parameters, yield and yield attributing characters. Among various treatments tried, T_5 i.e. 50% RDF + Vermicompost @ 5 t/ha recorded higher yield and yield attributing characters.

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