"Influence of Organic Nutrient Enrichment on Growth Pattern, Flowering and Biochemical Profiling in Bottle Gourd (*Lagenaria siceraria*) (Mol.) Standl.) Var. Kashi Ganga"

ABSTRACT

The present investigation was carried out with title at Organic Research Farm (ORF), Department of Horticulture, Institute of Agricultural Sciences, Bundelkhand University, Karguanji, Jhansi, Uttar Pradesh during the *Kharif*-2022 with a view to identify the effects of different combinations of organic nutrition and its role in growth, yield and quality of Bottle gourd variety Kashi Ganga. The experiment was laid in Randomized block design with 8 treatments and 3 replications with different combination in RDM and application of organic nutrition. Under this experiment, overall, 8 treatment was taken T_0 Control (water spray), T_1 (100% Farmyard Manure), T_2 (100% Poultry Manure), T_3 (100% Vermicompost), T_4 (50% Farmyard Manure + 50% Neem cake), T_5 (50% Farmyard Manure + 50% Vermicompost), T_6 (50% Neem cake + 50% Poultry Manure) and T_7 (33% Farmyard Manure + 33% Vermicompost + 33% Poultry Manure). Based on above experimental finding it may be concluded that the treatment T_7 (33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost) was found to be best in the terms of growth yield and quality of Bottle gourd. While the highest net return was found in the T_7 and the highest B:C ratio was found in the same with 6.10.

Keywords: *Bottle gourd, Farmyard Manure, Neem Cake, Poultry Manure, Vermicompost*

INTRODUCTION

Bottle gourd, scientifically known as *Lagenaria siceraria* (Mol.) Standl., Calabash, also known as bottle gourd, is a vine grown for its fruit. Bottle gourd are horticulture crop belongs to the family *Cucurbitaceae* bearing chromosome number 2n=22 [31]. fruits have a variety of shapes: they can be huge and rounded, small and bottle-shaped, or slim and serpentine, and they can grow to be over a metre long [20].

The bottle gourd may have been carried from Asiato Africa, Europe, and the Americas during human migration, [19] or by seeds floating across the oceans inside the gourd. It has been proven to have been globally domesticated and existed in the New World) during the Pre-Columbian era. Bottle gourd is a diploid of parentage [19]. The bottle gourd is a commonly cultivated plant in tropical and subtropical areas of the world and was eventually domesticatedin southern Africa. Stands of *L. siceraria*, which may be source plants and not merely domesticated stands, were reported in Zimbabwe [16]. Bottle gourds are grownby direct sowing of seeds or transplanting 15- to 20-day-old seedlings. The plant prefers well-drained, moist, organic rich soil [22].

The plant produces night blooming white flowers. The male flowers have long peduncles, and the females have short ones with an ovary in the shape of the fruit[29].

Hand pollination can be used to solve the problem. Pollen size is ~60 microns [27]. .Raw Bottle gourd is 96.1% water, 0.2% protein, 2.5% carbohydrates and contains negligible fat. In a 100-gram reference amount, raw bottle gourd is a source vitamin C (6 mg) with moderate contents of thiamine (0.23 mg), Nicotinic acid (0.20 mg) and magnesium (5 mg), Calcium (20 mg), Phosphorous (10 mg), Potassium (87 mg) [23]. Bottle gourd has valuable anti-cholesterol property. In India area under Bottle gourd productionin India accounts to 1.58 million hectares with production of 31.42 metric tonnes in year 2021-22[18].

Bihar ranks first in area and production of Bottle gourd in year 2021-22 followed by Uttar Pradesh and Madhya Pradesh. In Uttar Pradesh area under production is 2.38 thousand hectares while production is estimated to be 5.09 million tonnes for year 2021-22. (Source: NHB, Ministry of Agriculture & Farmers Welfare, Government of India, 2021-22.) [21].

Organics are plant and animal wastes that are used as a source of nutrients for plants. They release nutrients when broken down. Natural or synthetic chemicals that contain nutrients for plants are called fertilizers [18]. Though, Manures contains low nutrient per unit amount not only improve soil properties, but also have a longer residual effect than fertilizers with a high nutrient content [29].

Applying FYM improves soil fertility. On an average well decomposed farmyard manure contains 0.5 per cent Nitrogen (N), 0.2 per cent Phosphate (P_2O_5) and .0.5 per cent Potassium (K_2O) [28].

Vermicompost is rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55- 2.25%), micronutrients, beneficial soil microbes and contain 'plant growth hormones & enzymes [25,26,27].

Being a totally botanical product Neem cake contains 100% natural NPK content and other essential micro nutrients as N (Nitrogen 2.0% to 5.0%), P (Phosphorus 0.5%to 1.0%), K (Potassium 1.0% to 2.0%), Ca (Calcium 0.5% to 3.0%), Mg (Magnesium 0.3% to 1.0%), S (Sulphur 0.2% to 3.0%), Zn (Zinc 15 ppm to 60 ppm), Cu (Copper 4 ppm to 20 ppm),Fe (Iron 500 ppm to 1200 ppm), Mn (Manganese 20 ppm to 60 ppm). It is rich in both sulphur compounds and bitter limonoids [20,18,16].

Poultry manure contains higher nitrogen and phosphorus compared to other bulky organic manures. The average nutrient content is 3.03 per cent N; 2.63 per cent P_2O_5 and 1.4 per cent K_2O. Organics such as FYM, Poultry manure and Vermicompost not only promote increased yields and improved crop quality, but also maximize the genetic potential of plants and the presence of nutrients enhances root development, fruit set, affects the vitality and health of plants [11,22,24].

Nutrients are fundamental forbalanced nutrition and a tremendous tool to help farmers in increasing crop yield and quality [13,14,17]. The current experiment was conducted in order to help in understanding the growth pattern, flowering and biochemical profiling in bottle gourd by organic nutrient enrichment. Therefore, present study of analysis in Bottle gourd crop was carried out to identify the best treatment combination with high yield, early maturing suited to Bundelkhand zones of U.P.

MATERIALAND METHODS

The present investigation was done to understand the effect of organic nutrition at different doses combination on fruit growth, yield and quality of Bottle gourd variety Kashi ganga. The details of the materials used, and the procedures adopted in the investigation, which was carried out at Organic Research Farm (HRF), Karguanji, Jhansi Department of Horticulture, Institute of Agricultural Sciences, Bundelkhand University, Jhansi during the *Kharif* season of 2022 aredescribed under the following heads.

In general, soil properties of experimental site showed a typical sandy soil of Bundelkhand region of Uttar Pradesh. Soil was sandy loam in texture, slightly alkaline in reaction and having low electrical conductivity, very low in organic carbon, low in available nitrogen, low in available phosphorus and moderately high in available potassium given in table 2 and 3. Observations were recorded at different stages of growth periods. The data were statistically analysed by the method suggested by [30].

Table 1 Treatment Details

S. No.	Treatment Symbols	Treatment combination
1	**T_0**	Control (Water spray)
2	**T_1**	100% Farmyard Manure
3	**T_2**	100% Vermicompost
4	**T_3**	100% Poultry Manure
5	**T_4**	50% Farmyard Manure + 50% Neem cake
6	**T_5**	50% Farmyard Manure + 50% Vermicompost
7	**T_6**	50% Neem cake + 50% Poultry Manure
8	**T_7**	33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost

Table 2 Physical and chemical properties of soil at Organic Research Farm (IAS, BU, Karguanji, Jhansi).

S. No.	Particulars	Mechanical Properties
1	Fine Sand (%)	42.0
2	Silt (%)	38.2
3	Clay (%)	20.1
4	Textural class	Sandy loam

Table 3: Chemical composition of the soil

S. No.	Ingredients	Quantity
1	Soil pH	7.1
2	Organic carbon (%)	0.52
3	Available Nitrogen (N)	142.33 kg/ha
4	Available Phosphorus (P)	4.56 kg/ha
5	Available Potash (K)	206.11 kg/ha

Source: Soil analysis was done by KVK (Krishi Vigyan Kendra, Jhansi, U.P.).

RESULTS AND DISCUSSION

A) Growth Parameters

The data pertaining to Vine length is presented in Table 4. for various days of transplanting.

The treatment with the combined use of 33% Farmyard Manure, 33% Poultry Manure, and 33% Vermicompost (T_7) resulted in the longest vine length across all stages of growth, with a significant increase from 2.09 m at 30 DAS to 3.33 m at 60 DAS. This suggests that a balanced combination of organic amendments can maximize vine elongation, likely due to a well-rounded nutrient profile. Treatment T_1 (100% Farmyard Manure) showed moderate vine growth with 1.68 m at 45 DAS and 2.19 m at 60 DAS, indicating that farmyard manure can be beneficial but not as effective as the combination of inputs followed by T_2 (100% Vermicompost) also contributed to

substantial vine length, especially at 45 DAS (1.83 m) and 60 DAS (2.10 m). Vermicompost may enhance soil structure and nutrient availability, contributing to improved vine growth [5,8,9,10]. T_3 (100% Poultry Manure) showed similar trends, with good vine growth observed at 45 DAS (1.85 m) and 60 DAS (2.22 m), suggesting that poultry manure can also have a positive effect on vine elongation [3,6,9,11].

The combined treatments, particularly T_4 (50% Farmyard Manure + 50% Neem Cake) and T_5 (50% Farmyard Manure + 50% Vermicompost), resulted in better vine growth than individual treatments. Treatment T_5 (50% Farmyard Manure + 50% Vermicompost) had the highest vine length at 60 DAS (2.93 m), surpassing the individual manure treatments, indicating the synergistic effect of combining different organic amendments [1,3,6,24,26]. However, the treatment control (T_0) showed the shortest vine lengths at all stages (0.96 m at 30 DAS, 1.34 m at 45 DAS, and 1.70 m at 60 DAS), supporting the hypothesis that organic amendments promote better vine growth compared to no treatment[2,4,5,25].

2. Number of branches per plant

Treatment T_2 (100% Vermicompost) showed a significant increase in the number of branches (5.17), suggesting that vermicompost may be particularly effective in enhancing branching due to its nutrient richness and ability to improve soil structure. T_3 (100% Poultry Manure) also promoted a higher number of branches (4.67), indicating that poultry manure is beneficial for branching, possibly due to its high nitrogen content[7,9,11,12].

The combination treatments, such as T_5 (50% Farmyard Manure + 50% Vermicompost) (4.58 branches) and T_6 (50% Neem cake + 50% Poultry Manure) (4.42 branches), showed improved branching compared to the control and individual treatments, but they were not as effective as the combined treatment of T_7. Control Treatment (T_0): The control (T_0) exhibited the lowest number of branches (3.85), confirming that organic treatments significantly enhance the number of branches per plant compared to no external amendments[8,10,15].

B) Earliness parameters

1. Days to first male flowering, female flowering, and days to first fruit picking

Among the different applications of organic nutrition, the minimum days to first male flowering was seen in T_7 with 34.67 days, followed by T_1 with 35.78 days whereas maximum days to first flowering 40.08 days was recorded in T_0. Among the application of organic nutrients minimum days to first female flowering was seen in T_7 with 44.17 days, followed by T_1 with 44.63 days whereas maximum days to first female flowering 50.36 days was recorded in T_0. Among the applications of organic nutrition, the minimum days to first fruit picking was seen in T_7 with 75.92 days, followed by T_1 with 76.75 days whereas maximum days to first fruit picking 82.12 days was recorded in T_0. The data of three parameters are given in table 5

The application of organic treatments significantly influenced the timing of flowering and fruit picking in bottle gourd. In the present experiment treatment **T_7 (33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost)** was the most effective treatment, resulting in the earliest male and female flowering as well as the quickest fruit picking. This suggests that a balanced combination of organic inputs is beneficial for accelerating the growth and development of bottle gourd followed by other treatments like **T_1 (100% Farmyard Manure)** and **T_2 (100% Poultry Manure)** also showed good results but were less effective than the combined treatments. The control group showed the latest flowering and fruit picking, reinforcing the advantages of organic amendments in enhancing crop performance as reffered by [11,14,17,19].

C) Yield parameters

Fruit yield per plant (kg/plant) and Fruit yield per hectare (q/ha)

The maximum average yield per plant (11.47 kg/plant) were recorded in treatment T_7 followed by T_6 i.e., 10.74 kg/plant and the lowest average yield per plant (7.10 kg/plant) were observed in T_0. The maximum average yield per hectare (611.96 q/ha) were recorded in treatment T_7 followed by T_6 i.e., 572.92 q/ha and the lowest average yield per hectare (378.77 q/ha) were

observed in T_0. Nutrition play an important role in improving productivity and quality of fruit. Nutrition's doses increased the vigour of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of [9,17,20].

D) Total soluble solid (^{0}Brix) and Protein content

From the data presented in table 6. The maximum T.S.S. (6.28 ^{0}Brix) was observed in treatment T7 followed by T4 with 5.10 ^{0}Brix. The minimum T.S.S. (2.81 ^{0}Brix) was noticed in treatment T0. The Ascorbic acid content among different treatments varied significantly. The maximum Ascorbic acid content (4.20 mg/100g) was observed in treatment T7 followed by T4 with 4.06 mg/100g. The minimum Ascorbic acid content (2.93 mg/100g) was noticed in treatment T0. The maximum protein content was reported under the treatment T7 (33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost) followed by T5 (50% Poultry Manure + 50% Vermicompost) with 4.20. It may be noted that nutrition play an important role in improving productivity and quality of fruit. Nutrition's doses increased the vigour of plants, assimilating area, size of fruit, thereby resulting into higher weight of fruit. These results are in close conformity with the findings of [10,15,18,19].

Conclusion

From the above experimental finding it may be concluded that the treatment T_7 (33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost) was found to be best in the terms of growth yield and quality of Bottle gourd.

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Table 4 Effect of organic nutrition on Vine length (m) of the Bottle gourd.

Treatment Notation	Treatment details	30 DAS (in m)	45 DAS (in m)	60 DAS (in m)
T_1	100% Farmyard Manure	1.11	1.68	2.19
T_2	100% Vermicompost	1.55	1.83	2.10
T_3	100% Poultry Manure	1.48	1.85	2.22
T_4	50% Farmyard Manure + 50% Neem cake	1.65	1.94	2.23
T_5	50% Farmyard Manure + 50% Vermicompost	1.26	2.10	2.93
T_6	50% Neem cake + 50% Poultry Manure	1.51	1.88	2.25
T_7	33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost	2.09	2.71	3.33
T_0	Control	0.96	1.34	1.70
Mean		**1.45**	**1.92**	**2.37**
'F' Test		**S**	**S**	**S**
C.V.		**12.19**	**7.55**	**6.55**
S.E.(m)		**0.10**	**0.08**	**0.09**

C.D. at 5%	**0.31**	**0.26**	**0.27**

Table 5 Effect of plant growth regulators on the number of branches per plant of bottle gourd.

Treatment Notation	**Treatment details**	**In numbers**
T_1	100% Farmyard Manure	4.33
T_2	100% Vermicompost	5.17
T_3	100% Poultry Manure	4.67
T_4	50% Farmyard Manure + 50% Neem cake	4.17
T_5	50% Farmyard Manure + 50% Vermicompost	4.58
T_6	50% Neem cake + 50% Poultry Manure	4.42
T_7	33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost	5.30
T_0	Control	3.85
Mean		**4.56**
'F' Test		**S**

C.V.	**8.99**
S.E.(m)	**0.24**
C.D. at 5%	**0.73**

Table 6 Effect of organic nutrients on days to first male flowering, first female flowering and first fruit picking of Bottle gourd.

Treatment Notation	Treatment details	Days to first male flowering	Days to first female flowering	Days to first fruit picking
T_1	100% Farmyard Manure	35.78	44.63	76.75
T_2	100% Poultry Manure	37.25	45.00	76.75
T_3	100% Vermicompost	36.50	45.92	77.67
T_4	50% Farmyard Manure + 50% Poultry Manure	36.75	45.83	77.59
T_5	50% Poultry Manure + 50% Vermicompost	38.75	46.67	78.42
T_6	50% Farmyard Manure + 50% Vermicompost	38.17	47.66	79.41
T_7	33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost	34.67	44.17	75.92
T_0	Control	40.08	50.36	82.12
Mean		**41.51**	**37.24**	**46.28**
'F' Test		**S**	**S**	**S**
C.V.		**2.76**	**2.02**	**1.25**
S.E.(m)		**0.59**	**0.54**	**0.56**

C.D. at 5%	**1.82**	**1.66**	**1.72**

Table 7 Effect of organic nutrition on Average fruit yield per plant and fruit yield per hectare of Bottle gourd.

Treatment Notation	Treatment details	Fruit yield per plant (kg/plant)	Fruit yield per hectare (t/ha)
T_1	100% Farmyard Manure	8.36	445.90
T_2	100% Poultry Manure	7.41	395.29
T_3	100% Vermicompost	8.47	451.48
T_4	50% Farmyard Manure + 50% Poultry Manure	8.63	460.07
T_5	50% Poultry Manure + 50% Vermicompost	9.63	513.60
T_6	50% Farmyard Manure + 50% Vermicompost	10.74	572.92
T_7	33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost	11.47	611.96

T_0	Control	7.10	378.77
Mean		**1.63**	**8.98**
'F' Test		**S**	**S**
C.V.		**7.32**	**7.34**
S.E.(m)		**0.37**	**19.96**
C.D. at 5%		**1.14**	**61.13**

Table 8 Effect of organic nutrition on Total soluble solid and Protein content of Bottle gourd.

Treatment Notation	Treatment details	T.S.S.	Protein Content
T_1	100% Farmyard Manure	3.80	3.70
T_2	100% Poultry Manure	4.70	3.67

T_3	100% Vermicompost	3.72	3.80
T_4	50% Farmyard Manure + 50% Poultry Manure	5.10	4.06
T_5	50% Poultry Manure + 50% Vermicompost	4.34	4.13
T_6	50% Farmyard Manure + 50% Vermicompost	3.78	3.80
T_7	33% Farmyard Manure + 33% Poultry Manure + 33% Vermicompost	6.28	4.20
T_0	Control	2.81	2.93
Mean		**4.40**	**4.32**
'F' Test		**S**	**S**
C.V.		**1.32**	**6.36**
S.E.(m)		**0.03**	**0.14**
C.D. at 5%		**0.10**	**0.43**