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Effect of Organic and Inorganic Fertilizers on Growth and Yield of Bottle Gourd (*Lagenaria siceraria)* Under Teak Based Agroforestry System

Imnatemsu[1], Neelam Khare[1], Sandeep Rout[2*] and Ronald Debbarma[1]

[1]College of Forestry, Sam Higginbottom University of Agriculture Technology & Sciences, Prayagraj, Uttar Pradesh, India-211007

[2*]Department of Agronomy and Agroforestry, M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Parlakhemundi, Odisha, India-761211

*Corresponding Author E-mail: sandeeprout1988@gmail.com

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ABSTRACT

The present investigation was carried during the summer season of 2019 at Forest Nursery and Research Centre, College of Forestry, SHUATS, Prayagraj, Uttar Pradesh. The experiments were laid out in the Randomized Block Design (RBD) with three replications and twelve treatments. The maximum vine length (3.98, 5.73, 7.33 cm) at 30, 60, 90 DAS, number of branches (5.33), length of the lateral branches (4.23 m), days to appearance to first flower (62.77), number of flower per plant (73.33), fruit length (35.00 cm), fruit weight (1.53 Kg), fruit diameter (19.13 cm), core diameter (18.25 cm), No. of fruits per plant (19.33) and total yield per plant (28.67 Kg.) were recorded in T_5(50% NPK + 50% Cow Dung Manurea. The results showed that the application of this combination to Bottle Gourd had increased the growth and yield under Teak based agroforestry system. Therefore it may be recommended for the Grower of Bottle Gourd under the Agroforestry system.

Keywords: *Bottle Gourd, Growth, Organic, Inorganic, Yield*

INTRODUCTION

Agroforestry is a collective name for land use systems and practices in which woody perennials are deliberately integrated with crops or animals on the same land management unit. The integration can be either in a spatial mixture or in a temporal sequence. There are normally both ecological and economic interactions between woody and non-woody components in Agroforestry" World Agroforestry Centre (Nair, 1993). Agroforestry is a sustainable land management system which increases the uses of land combines the production of crops including the crops and forest, plants/animals simultaneously or sequentially, on the same unit of land and applies management practices that are compatible with the cultural practices of the local population (King & Chandler, 1978).

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Bottle Gourd **(***Lagenaria siceraria***)** belongs to the family of Cucurbitaceae having chromosome no. 2n = 22**.** Bottle gourd originated in Tropical Africa and domesticated in Asia, Africa and New World. India is the second largest producer of vegetables in the world after China. According to recommendation given by India Council of Medical Research (ICMR) an average man with vegetarian or Non- Vegetarian food habit should consume 300 g vegetables per day, which include 125 mg leafy vegetables, 100 g of root vegetable and 75 g of other vegetables. In the year 2002, the total vegetable production of the country was 97.5 million tons from 7.59 million hectares of land (Gupta *et al.,* 2010). In the country, vegetable crops are grown only in 2.8% of total cultivated land and share 10% of the world's vegetable production with the productivity of 13.6 t ha^{-1}, which is quite low as compared to other advanced countries (Shanmugasundram, 2001).

During summer the crop is sown in February- March and the vines are allowed to spreads on the ground. The rainy season crop is grown in un-irrigated upland condition and sown in July – August; the vines are trained to climb on some artificial structure. The area and production of summer season crop is higher than the rainy season crop. In the temperate climate, the crop may be grown during summer – rainy season, if the temperature ranges from 15^0C to 25^0C available for 100-120 days. In tropical conditions, it can be grown throughout the year under irrigated conditions.

Different parts of the bottle gourd have medicinal properties also. It contains 96.3% water, 2.9% carbohydrate, 0.2% proteins, 0.5% fat, 0.5% mineral matter, 11 mg of vitamin C. It is a highly cross-pollinated crop in which a large amount of variation is observed in many economically important traits. Nutrient Arrangement involves an efficient and judicious supply of all the major and minor components of plant nutrients. Chemical fertilizer in combination with farmyard manure, compost poultry manure, vermicompost, neem cake, biofertilizer crop residues or recyclable waste and other locally available nutrient sources for sustaining soil fertility, health and productivity of the soil. The integrated supply and use of plant nutrients from chemical fertilizer and organic manures have been proved to produce higher crop yield than when each is applied alone in bottle gourd.

Besides soil climatic factors and cultivars it is not sufficient for analysis of disease resistance and best quality fruit and seed for further utilization. The majority of farmers are still using fertilizer Urea, DAP, MoP and FYM for giving recommended doses of fertilizer and organic manure but not in a particular proportion so there is a need to search a required dose of organic fertilizer and chemical fertilizer in combination to get optimum yield.

Teak (*Tectona grandis*) is one of the most important timber trees of India and South-east Asia. The species is indigenous to India and the South-east Asian region. In India teak is distributed naturally in the peninsular region below 24N latitude. The most important Teak forests are found in Madhya Pradesh, Maharashtra, Tamil Nadu, Karnataka and Kerala besides Uttar Pradesh (small extent), Gujarat, Odisha, Rajasthan, Andhra Pradesh and Manipur. Teak has also been introduced in different parts of the world outside its natural occurrence in South-east Asia, Pacific, East and West Africa, the Caribbean, South America and Central America regions.

Teak sheds leaves from November to January. The flowers appear from June to September and fruits ripen from November to January. Teak is also used in a variety of ways apart from its use as timber. Various parts of the tree, including the wood are credited with medicinal properties. Kernels yield fatty oil (about 2 per cent). Flowers are considered useful against a number of diseases such as biliousness, bronchitis and urinary discharges. Both flowers and seeds are considered diuretic. Leaves are used in indigenous medicine and their extract indicates complete inhibition of Mycobacterium tuberculosis. The

leaves also contain yellow and red dyes, which have been recommended for dyeing of silk, wool and cotton. The leaves are occasionally used as plates for dining purposes, for making cheap umbrellas and for thatching temporary huts in some places. The bark is regarded as an astringent and considered useful in bronchitis. Various valuable compounds have been isolated and identified from the wood, bark, root and leaves of the tree. Activated charcoal can be prepared from its saw dust. The successful cultivation of Bottle Gourd under agroforestry system required information assessment of the system. The information on these aspects of Teak based agroforestry system involving various organic and inorganic fertilizer is mearger. Keeping in view of the importance of the crops, an investigation was made to study the effect of organic and inorganic farmers on the growth and yield of Bottle Gourd under teak based agroforestry system.

MATERIALS AND METHODS

The present investigation was conducted in the nursery and research center, College of Forest ry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, during 2019. All the facilities necessary for cultivation, including labour were made available in the university.

Prayagraj is situated at an elevation of 78 meters above sea level at 25.87^0 North latitude and 81.15^0 E longitudes. This region has a sub-tropical climate prevailing in the South-East part of U.P. with both the extremes in temperature, *i.e.*, the winter and the summer. In cold winters, the temperature sometimes is as low as 32^0F in December – January and very hot summer with the temperature reaching up to 115^0F in the months of May and June. During winter, frosts and during summer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4 (cm) with maximum concentration from July to September months with occasional showers in winters (Maurya et al., 2016).

From the analysis, it is evident that the soil of the experimental field was sandy loam in texture, poor in phosphorus and comparatively rich in nitrogen and potash, with slightly acidic in reaction. Land between the tree was dug up with the spade and brought to fine tilt with the thorough digging, the field was levelled and weeds and grasses were removed with the help of rake and plot were made 2 × 2.5 m size following by planking and levelling. The pre – sowing operation was carried out in the experimental plot as required. The experiment was laid out in Randomized Block Design with 12 treatment and 3 replications. The different treatments were allocated in each replication. The variety taken for the study was CO1. The treatments as follows: T_0- control, T_1- 100% NPK, T_2- 100% cow dung manure, T_3- 100% FYM, T_4-100% vermicompost, T_5- 50% NPK + 50% cow dung manure, T_6- 50% NPK + 50% FYM, T_7- 50% NPK + 50% vermicompost, T_8- 75% NPK + 25% cow dung manure, T_9- 75% NPK + 25% FYM, T_{10}- 75% NPK + 25% vermicompost, T_{11}- 25% NPK + 25% FYM + 25% cow dung manure + 25% vermicompost.

Observation of the parameters was recorded as due to the large population of plants it was not possible to record the observations of each and every plant. Hence the technique of random sampling was adopted for recording the observations on various parameters of the plant. Three plants from each plot were selected and tag at random for the observation to record the different parameters at successive stages of growth, Vine length (m), Number of branches, Length of lateral branch (m), Days taken to first flower appearance, Number of flowers per plant, Fruit length (cm), Fruit weight (Kg), Fruit diameter (cm), Total yield per plant (Kg) and Number of fruits per plant.

The variance of F-calculated value of (MSS (T)/ EMS) for treatment was greater than the F-table value at 5% and 1% level of significance, the variance between treatments was considered to be significant. If the F-calculated value is less than F-tabulated value, the differences between treatments were

considered to be non-significant. Statistical significance of variation due to genotype was tested by comparing calculated values to Table F values at the one per cent and five per cent level of probability (Gomez & Gomez, 1984).

Table 1: Effect of organic and inorganic fertilizer on Bottle Gourd growth and yield attributes of Teak

Teak trees	At the time of sowing of bottle gourd			At the time of harvesting of bottle gourd		
	Tree height (m)	DBH (m)	Volume (m^3)	Tree height (m)	DBH (m)	Volume (m^3)
T_1	12	0.114	0.073	12.2	0.118	0.080
T_2	11.5	0.106	0.061	11.52	0.110	0.065
T_3	11.5	0.123	0.082	11.58	0.127	0.086
T_4	11	0.164	0.139	11.3	0.168	0.150
T_4	10.8	0.148	0.111	11.95	0.152	0.130
Mean	11.36	0.131	0.093	11.61	0.135	0.102

RESULTS AND DISCUSSION

The maximum vine length (m) was recorded maximum in T_5 (50% NPK + 50% cow dung manure) (3.98, 5.73, 7.3 respectively at 30, 60, 90 DAS with 7.33 m, while the minimum vine length was recorded in T_0 (Control) with 4.10 m. The maximum number of branches was found in T_5 (50 % NPK + 50% cow dung manure) with (5.33) while the minimum number of branches was (2.33) was recorded in treatment T_0 (Control). Similar results in the case of plant height significantly higher (66.86 cm) were also reported by Kumar et al. (2015), in Linseed in teak based agroforestry system. Prakash et al. (2002) also reported that organic manures like FYM increase the plant height of *E. officinalis*, as compared to control. These results are in conformity with the findings of Yadav et al. (2000). The maximum length of lateral branches was recorded in T_5 (50 % NPK + 50% Cow dung manure) with (4.23 m), while the minimum Length of lateral branches (m) with (2.10 m) was recorded in treatment T_0 (Control).The minimum days taken to flower was recorded in T_5 (50 % NPK + 50% Cow dung manure) with (62.67), while the maximum days taken to flower with (85.67) were recorded in treatment T_0 (Control). The maximum number of flowers per plant were recorded in T_5 (50 % NPK + 50% cow dung manure) with (73.33), while the minimum number of flowers per plant with (57.67) was recorded in treatment T_0 (Control). The data on the Number of flowers per plant, after application of Organic and inorganic fertilizer as influenced by NPK and organic manures (FYM, Vermicompost and Cow dung manure) in different treatment combinations was recorded and are presented in table 2. Critical analysis of data displayed clearly marked out the obvious difference among the treatments with respect to number of flowers per plant.

Based on the data it is found that treatment T_5 (50 % NPK + 50% cow dung manure) was recorded maximum number of flowers per plant after application of organic and inorganic fertilizers with (73.33), while the minimum number of flowers per plant with (57.67) was recorded in treatment T_0 (Control) (Khare et al., 2016).

There was a significant increase in the number of female flower per plant due to different treatment combinations. Which is due to the incorporation of organic manure. These results are conformity with the findings of Jose et al. (1998) in Bottle Gourd. The increase in growth parameters such as growth may be due to the application of Organic Manure, which facilitates quick and greater availability of the plant nutrients thus produce a better environment plant growth.

The data on fruit length (cm), after application of organic and inorganic fertilizer as influenced by NPK and organic manures (FYM, Vermicompost and Cow dung manure) in different treatment combinations was

recorded and are presented in table 2 Critical analysis of data displayed in table 2. marked out the obvious difference among the treatments with respect to fruit length (cm).

Based on the data it is found that treatment T_5 (50 % NPK + 50% cow dung manure) was recorded maximum fruit length (cm), after application of organic and inorganic fertilizers with (35.00 cm), while the minimum fruit length (cm) with (19.00 cm) was recorded in treatment T_0 (Control).

The integrated use of N.P.K. along with organic manure significantly influenced the length diameter ratio of fruit. The data on fruit weight (Kg), after application of Organic and inorganic fertilizer as influenced by NPK and organic manures (FYM, Vermicompost and Cow dung manure) in different treatment combinations was recorded and are presented in table 3. Critical analysis of data displayed in clearly marked out the obvious difference among the treatments with respect to fruit weight (Kg).

Based on the data it is found that treatment T_5 (50 % NPK + 50% cow dung manure) was recorded maximum fruit weight (Kg), after application of organic and inorganic fertilizers with (1.53 kg), while the minimum fruit weight (kg) with (0.97 Kg) was recorded in treatment T_0 (Control). The fruit weight was significantly effected by vermicompost with 25% of NPK.

The data on fruit diameter (cm), after application of Organic and inorganic fertilizer as influenced by NPK and organic manures (FYM, Vermicompost and Cow dung manure) in different treatment combinations was recorded and are presented in table 3. Critical analysis of data displayed in table.3 clearly marked out the obvious difference among the treatments with respect to fruit diameter (cm).

Based on the data it is found that treatment T_5 (50 % NPK + 50% cow dung manure) was recorded maximum fruit diameter (cm), after application of organic and inorganic fertilizers with (19.13 cm), while the minimum fruit diameter (cm) with (11.53 cm) was recorded in treatment T_0 (Control). The integrated use of NPK along with organic manures significantly influenced the length diameter ratio of fruit.

The data on core diameter (cm), after application of Organic and inorganic fertilizer as influenced by NPK and organic manures (FYM, Vermicompost and Cow dung manure) in different treatment combinations was recorded and are presented in table 4. Critical analysis of data displayed in table. 4 marked out the obvious difference among the treatments with respect to core diameter (cm).

Based on the data it is found that treatment T_5 (50 % NPK + 50% cow dung manure) was recorded maximum core diameter (cm), after application of organic and inorganic fertilizers with (18.25 cm), while the minimum core diameter (cm) with (10.83 cm) was recorded in treatment T_0 (Control). Enhanced flowering and vine growth might have resulted in a higher core diameter of fruit.

The data on total yield per plant (Kg), after application of Organic and inorganic fertilizer as influenced by NPK and organic manures (FYM, Vermicompost and Cow dung manure) in different treatment combinations was recorded and are presented in table 4. Critical analysis of data displayed in table clearly marked out the obvious difference among the treatments with respect to total yield per plant (Kg).

Based on the data it is found that treatment T_5 (50 % NPK + 50% cow dung manure) was recorded maximum yield per plant (Kg), after application of organic and inorganic fertilizers with (28.67 Kg) and while the minimum yield per plant (Kg) with (10.87 Kg) was recorded in treatment T_0 (Control).

The integrated use of N.P.K. along with organic manures improves the growth characters. Application of 50% NPK + 50% cow dung manure were given maximum vine length. This is clearly indicated that integrated use of nutrient helpful in cell elongation of leaves use to development of cell and rapid cell division and cell elongation in meristematic region of the plant due to production of plant growth substance and this may be due to abundant supply of plant nutrients and nitrogen which led in the gr owth of bottle gourd.

Table 2: Effect of organic and inorganic fertilizers on the growth of Bottle Gourd (*Lagenaria siceraria*) under Teak based Agroforestry System

Treatment No.	Treatment combination	Vine length (m) 30DAS	Vine length (m) 60DAS	Vine length (m) 90DAS	No of Branches	Length of lateral branch (m)
T_0	Control	0.98	1.97	4.10	2.33	2.10
T_1	100%NPK	1.56	3.56	5.37	4.33	3.17
T_2	100% fresh cow dung manure	2.08	4.34	6.63	3.67	3.67
T_3	100% Farm yard manure	2.18	3.67	5.17	4.00	3.33
T_4	100% vermicompost	1.88	3.20	5.90	3.67	3.67
T_5	50% NPK + 50% cow dung manure	**3.98**	**5.73**	**7.33**	**5.33**	**4.23**
T_6	50% NPK+ 50% FYM	2.74	4.45	6.17	4.33	3.10
T_7	50% NPK+ 50% vermicompost	1.98	4.98	6.23	4.33	3.83
T_8	75% NPK+ 25% fresh cow dung manure	2.00	3.99	6.53	3.33	3.43
T_9	75% NPK+ 25% FYM	3.11	5.00	6.00	3.83	3.83
T_{10}	75% NPK+ 25% Vermicompost	1.38	3.78	5.00	3.67	3.67
T_{11}	25% NPK+ 25% FYM+ 25% fresh cow dung + 25% vermicompost	2.33	4.53	6.10	4.50	3.73
	F-Test	**NS**	**S**	**S**	**S**	**S**
	C.D. at 0.5%	**0.12**	**0.24**	**0.48**	**0.76**	**0.72**
	S.Ed. (±)	**0.36**	**0.58**	**0.96**	**1.59**	**1.49**

Table 3: Effect of organic and inorganic fertilizers on growth and yield of Bottle Gourd (*Lagenaria siceraria*) under Teak based Agroforestry System

Treatment No.	Treatment combination	Days to appearance of first flower	Number of flowers per plant	Fruit length (cm)	Fruit weight (kg)	Fruit diameter (cm)
T_0	Control	85.67	57.67	19.00	0.97	11.53
T_1	100%NPK	71.33	67.33	23.27	1.17	14.67
T_2	100% fresh cow dung manure	74.67	70.00	26.57	0.90	15.33
T_3	100% Farm yard manure	78.33	66.67	28.33	1.05	17.33
T_4	100% vermicompost	77.33	68.67	25.33	1.10	16.33
T_5	50% NPK + 50% cow dung manure	**62.67**	**73.33**	**35.00**	**1.53**	**19.13**
T_6	50% NPK+ 50% FYM	69.00	63.00	28.50	1.07	16.47
T_7	50% NPK+ 50% vermicompost	73.00	60.00	24.33	1.07	16.93
T_8	75% NPK+ 25% fresh cow dung manure	73.33	70.00	27.80	1.00	18.23
T_9	75% NPK+ 25% FYM	79.67	69.00	21.00	1.20	17.73
T_{10}	75% NPK+ 25% Vermicompost	80.67	63.33	25.93	1.10	18.10
T_{11}	25% NPK+ 25% FYM+ 25% fresh cow dung + 25% vermicompost	78.33	70.00	31.37	1.20	18.60
	F-Test	**S**	**S**	**S**	**S**	**S**
	C.D. at 0.5%	**1.49**	**2.05**	**2.19**	**0.15**	**0.58**
	S.Ed. (±)	**4.02**	**4.26**	**4.54**	**0.31**	**1.21**

Table 4: Effect of organic and inorganic fertilizers on growth and yield of Bottle Gourd (*Lagenaria siceraria*) under Teak based Agroforestry System

Treatment No.	Treatment combination	Core diameter (cm)	Number of fruits per Plant	Total yield per plant (kg)
T_0	Control	10.83	10.87	10.87
T_1	100%NPK	14.00	12.67	20.67
T_2	100% fresh cow dung manure	14.83	14.00	19.67
T_3	100% Farm yard manure	17.83	14.67	19.83
T_4	100% vermicompost	16.33	15.67	19.33
T_5	50% NPK + 50% cow dung manure	**18.25**	**19.33**	**28.67**
T_6	50% NPK+ 50% FYM	16.43	13.00	23.47
T_7	50% NPK+ 50% vermicompost	16.10	13.67	21.00
T_8	75% NPK+ 25% fresh cow dung manure	17.50	14.33	20.23
T_9	75% NPK+ 25% FYM	17.60	15.33	19.97
T_{10}	75% NPK+ 25% Vermicompost	17.13	17.67	20.13
T_{11}	25% NPK+ 25% FYM+ 25% fresh cow dung + 25% vermicompost	17.60	14.00	23.63
	F-Test	**S**	**S**	**S**
	C.D. at 0.5%	**1.99**	**1.42**	**1.80**
	S.Ed. (±)	**4.14**	**2.95**	**3.74**

The data on the number of fruits per plant, after application of Organic and inorganic fertilizer as influenced by NPK and organic manures (FYM, Vermicompost and Cow dung manure) in different treatment combinations was recorded and are presented in table 4. Critical analysis of data displayed in table clearly marked out the obvious difference among the treatments with respect to the number of fruits per plant.

Based on the data is found that treatment T_5 (50 % NPK + 50% cow dung manure) was recorded maximum number of fruits per plant, after application of organic and inorganic fertilizers with (19.33) while the minimum number of fruits per plant with (10.87) was recorded in treatment T_0 (Control) (Yadav, 2019).

This indicates that crops grown with incorporation of organic manures are benefited from it. It's not only as a source of nutrients but also provide good overall growth of crop (Arriage & Lowery, 2003) and crop yield (Nyiraneza & Snapp, 2007). Similar results were reported by Kaushik and Singh (2001) in the case of Wheat. Apart from nutrient light is a major limiting factor for the crop growth and yield under tree species Corroborative results were also re-ported by Tripathi et al. (2001).

CONCLUSION

It was concluded that the treatment T_5 (50% NPK and 50% cow dung manure) was found to be the best treatment in terms of maximum yield (28.67 Kg), so it can be recommended to the grower.

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