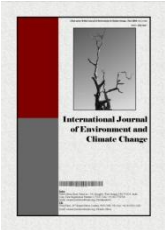

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Effect of Manure and Fertilizers on Growth and Yield of Pipali (*Piper longum*) in Assam Conditions

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

An experiment was conducted in the Experimental Farm Garden, at Assam Agricultural University, Jorhat to see the influence of manure and fertilizers on growth and yield of Pipali (*Piper longum*) in Assam conditions. Result revealed that maximum yield (576.25kg/ha dry) was obtained when manure and fertilizers was applied @ 175:75:75 kg ha^{-1}(NPK) + FYM 10 ha^{-1} + Neem cake 5q ha^{-1} and minimum yield of (318.67 Kg/ha dry) when only manure @ FYM 10 ha^{-1} was applied in field. Hence, we conclude that the long pepper is an organic matter and fertilizer loving crop and application of higher levels of organic manures and fertilizers improved both plant and soil nutrient status.

Keywords: Pippali; neem cake; fertilizers

1. INTRODUCTION

"Pippali is a shrub with erect and slender branches belonging to the family piperaceace. Pippali commonly known as Indian long pipper, pipli or pippali, a flowering plant plant which grow throughout year" [1,2]. "Leaves are simple, alternate, stipulate and petiolate or nearly sessile. Flowering is nearly throughout the year; inflorescence is spike; fruit greyish green or darker grey berries. It is believed to be originated from North east India especially in hotter parts of India ranging from central Himalayas to Assam" [3]. "Pippali is normally cultivated for its medicinal

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property which are being largely exploited in the ayurvedic industry for different diseases in humans. Long pepper (*Piper longum* L.) is one such important medicinal plant where the spikes contain alkaloids piperine (1.25%) and piplartin [5], while roots contain piper longuminine (0.25 %) and piper longumine (0.02 %), besides piperine". Long pepper forms one of the important constituents in the treatment of various human ailments under ayurveda, siddha and unani medicine systems of India and also in modern pharmacopeias. Besides fruit, the roots and thicker parts of stem are cut and dried and used as an important drug known as piplamul.

The purpose of the experiment was to see the effect of manures and fertilizers on growth and yield of *Piper longum* at various level of fertilizer and manure. "The use of chemical fertilizers and organic manure has both positive and negative effects on plant growth and the soil. Chemical fertilizers are relatively inexpensive, have high nutrient contents, and are rapidly taken up by plants. However, the use of excess fertilizer can result in a number of problems, such as nutrient loss, surface water and groundwater contamination, soil acidification or basification, reductions in useful microbial communities, and increased sensitivity to harmful insects" [5]. "Organic manure has a number of shortcomings, including low nutrient content, slow decomposition, and different nutrient compositions depending on its organic materials, compared to chemical fertilizers. However, organic manure has multiple benefits due to the balanced supply of nutrients, including micronutrients, increased soil nutrient availability due to increased soil microbial activity, the decomposition of harmful elements, soil structure improvements and root development, and increased soil water availability. Application of organic manure increases organic elements' availability in soil, thereby improving the nutrient use efficiency (NUE) of crops and alleviating the harmful impact of climate change on crop production" [6].

2. MATERIALS AND METHODS

2.1 Geographical Location of the Experimental Site

The experiment was carried out at the Experimental Farm Garden, Deptt of Horticulture at Assam Agricultural University, Jorhat the experimental site is situated at an elevation of 172m above mean sea level, latitude of 26.7886° N and longitude of 94.2140° E. The mean maximum temperature during the period of experiment ranged from 21.55° C to 26.48° C while, the mean minimum temperature ranged between 17.7°C to 18.52°C. Similarly, the relative humidity, rainfall and sun shine hours ranged from 86.92-90.33 per cent, 2134.67- 2324.65 mm and 6.8-9.5 hr, respectively.

2.2 Design and Layout of the Experiment

For the experiment three months old healthy, vigorous and uniformly rooted cuttings of elite germplasm of Pippali (JPL-19) from Bokakhat district of Assam was used and planted in field at a spacing of 60×40 cm. The experiment was conducted in randomized block design (RBD) with varied levels manure and fertilizer, T_1: FYM 10 ha^{-1}, T_2: Neem cake 5q ha^{-1}, T_3: FYM 10 t/ha + Neem cake 5q ha^{-1}, T_4: NPK 100:50:50 kg ha^{-1}, T_5: NPK 100:75:75 kg ha^{-1}, T_6: NPK 100:50:50 kg ha^{-1} + FYM 10 ha^{-1}, T_7: NPK 100:50:50 kg ha^{-1} + Neem cake 5q ha^{-1}, T_8**:** NPK 100:50:50 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}, T_9: NPK 150:75:75 kg ha^{-1} + FYM 10 ha^{-1}, T_{10}: NPK 150:75:75 kg ha^{-1} + Neem cake 5q ha^{-1} and T_{11}: NPK 175:75:75 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}, T_{12}: Control (RDF) comprising 12 treatments tried on long pepper. All the manures and fertilizers was added at the time of land preparations. Regular irrigation, weeding and inter-culture operations were carried out during the period of experimentation.

2.3 Observation Recorded

2.3.1 Morphological features

Influence of integrated nutrient management on morphological features like Leaf size (cm), Leaf length and breadth ratio of leaf, Vine length (Cm), Catkin length (Cm), Catkin breadth (Cm) and Catkin colour at maturity after 280 days of planting was recorded for both with support and without support.

2.3.2 Yield parameters

Effect of integrated nutrient management on yield attributing characters like number of catkins/ plant, Fresh yield/ha (Kg) and Dry yield/Ha (Kg), t was recorded after harvesting.

Table 1. Influence of integrated nutrient management on morphological features of Pipali (*Piper longum*)

Treatments	Leaf size	Length & breadth ratio of leaf	Vine length (cm)	Catkin length (cm)	Catkin breadth (cm)	Catkin color at maturity
T_1: FYM 10 ha^{-1}	40.54	1.03	115.21	3.30	1.04	Black
T_2: Neem cake 5q ha^{-1}	48.34	1.05	118.54	3.30	1.05	Black
T_3: FYM 10 t/ha + Neem cake 5q ha^{-1}	50.62	1.07	125.58	3.38	1.07	Black
T_4: NPK 100:50:50 kg ha^{-1}	58.12	1.05	125.34	3.50	1.06	Black
T_5: NPK 100:75:75 kg ha^{-1}	58.33	1.06	127.41	3.48	1.05	Black
T_6: NPK 100:50:50 kg ha^{-1} + FYM 10 ha^{-1}	60.67	1.07	126.03	3.60	1.08	Black
T_7: NPK 100:50:50 kg ha^{-1} + Neem cake 5q ha^{-1}	63.12	1.02	130.65	4.40	1.05	Black
T_8: NPK 100:50:50 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}	65.23	1.05	127.24	4.68	1.10	Black
T_9: NPK 150:75:75 kg ha^{-1} + FYM 10 ha^{-1}	60.15	1.07	125.14	4.08	1.06	Black
T_{10}: NPK 150:75:75 kg ha^{-1} + Neem cake 5q ha^{-1}	62.15	1.03	125.47	4.05	1.07	Black
T_{11}: NPK 175:75:75 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}	65.67	1.03	135.24	3.80	1.08	Black
T_{12}:Control (RDF)	58.23	1.03	125.23	4.45	1.07	Black
CV	3.07		4.03	2.73		
CD at 5%	2.76	NS	3.71	0.17	NS	

Table 2. Effect of integrated nutrient management on yield parameters of Pipali (*Piper longum*)

Treatments	No of catkins/ Plant	Fresh yield/ ha Kg	Dry Yield/ ha Kg
T_1: FYM 10 ha^{-1}	46.68	2094.47	318.67
T_2: Neem cake 5q ha^{-1}	49.08	2214.67	337.68
T_3: FYM 10 t/ha + Neem cake 5q ha^{-1}	51.72	2346.23	358.40
T_4: NPK 100:50:50 kg ha^{-1}	57.06	2623.63	399.45
T_5: NPK 100:75:75 kg ha^{-1}	57.74	2657.80	400.67
T_6: NPK 100:50:50 kg ha^{-1} + FYM 10 ha^{-1}	63.02	2911.67	440.24
T_7: NPK 100:50:50 kg ha^{-1} + Neem cake 5q ha^{-1}	64.69	2954.87	446.23
T_8: NPK 100:50:50 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}	65.68	3154.87	478.23
T_9: NPK 150:75:75 kg ha^{-1} + FYM 10 ha^{-1}	60.36	2878.20	435.57
T_{10}: NPK 150:75:75 kg ha^{-1} + Neem cake 5q ha^{-1}	77.74	3767.31	565.55
T_{11}: NPK 175:75:75 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}	78.63	3791.67	576.25
T_{12}:Control (RDF)	57.67	2743.33	418.52
CV	2.39	4.56	2.75
CD at 5%	2.30	171.76	8.54

3. RESULTS AND DISCUSSION

Data presented in Table 1 revealed that all the morphological features like leaf size (65.67 cm), leaf length and breadth ratio (1.03cm), Vine length (135.24) , Catkin length (3.80 cm), Catkin breadth (1.08 cm) was found to be highest when Pipali plant was treated with manure and fertilizer @ NPK 175:75:75 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}. This was followed by in treatment number ten (NPK 150:75:75 kg ha-1 + Neem cake 5q ha-1). Lowest morphological features was found to be found in treatment number one where only FYM 10 ha^{-1} was applied (Table 1.).

3.1 Yield Parameters

Yield attributing parameters like number of catkin/ Plant (78.63), Fresh yield/ha (3791.67 Kg) and Dry yield (576.25 Kg) was found to be highest when Pipali plant was treated with manure and fertilizer @ NPK 175:75:75 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1}. This was followed by in treatment number ten (NPK 150:75:75 kg ha-1 + Neem cake 5q ha-1). Lowest morphological features was found to be found in treatment number one where only FYM 10 ha^{-1} was applied (Table 2).

Rao *et al .,* [7] reported that "application of 40 t ha^{-1} FYM and 125:50:160 kg N, P_2O_5 and K_2O ha^{-1} give higher dry spike yield (2412 kg ha^{-1}) and in turn increased the piperine yield (32.3 kg ha^{-1})". Further, the growth, yield and quality attributes were also significantly higher with this combination. Similarly Tapre *et al .,* [8] also applied NPK @ 100:50:50 kg + Neemcake 10q per hectare recorded significantly more dry berries yield and piperine yield followed by application of NPK 100:50:50 kg + 10 t FYM/ ha. According to Sim, [9], application of inorganic fertilizers @ 362 - 549 kg N, 206 - 549 kg P_2O_5 , 228 - 777 kg K_2O and 92 - 137 kg MgO ha^{-1} $year^{-1}$ improved the crop yield of *Piper nigrum*. Another worker like De Waard [10], also found that "increased in yield and yield attributing characters of *Piper longum* when organic manure and inorganic fertilizers @ 400 kg N, 180 kg P, 480 kg K, 425 kg Ca and 110 kg Mg ha^{-1} $year^{-1}$)". Thankamani *et al.,* [11] recorded "maximum fresh yield (2207 g $vine^{-1}$) in the treatment *Azospirillum* sp. +50% recommended N + Mg followed by application of NPK alone in *Piper longum".*

4. CONCLUSION

From this experiment we can conclude that applications of manure and fertilizer @ NPK 175:75:75 kg ha^{-1} + FYM 10 ha^{-1} + Neem cake 5q ha^{-1} in pippali gives better morphological and yield and yield attributing characters.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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