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Effect of integrated nutrient management practices on turmeric [*Curcuma longa* (L.)] yield and economics under Karanj (*Pongamia pinnata*) based agroforestry system

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Abstract

A field experiment was conducted at Herbal garden of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during 2019-20 to assess the most efficient nutrients for cultivation of turmeric under Karanj based agro forestry system. It was laid out in a randomized block design with eight treatments and three replications were carried out on the field, the treatments were divided into T1 (100 % inorganic), T2 (75 % inorganic), T3 (50 % inorganic), T4 (75% inorganic + 25 % FYM), T5 (50 % inorganic + 50 % FYM), T6 (25 % inorganic + 75 % FYM), T7 (100 % FYM) and T8 (control zero fertilizer). The analyzed results showed that the maximum yield of fresh weight of rhizome was recorded 185.1 q ha^{-1} in T_7 and minimum yield of 66.8 q ha^{-1} in T_8 i.e. control zero fertilizer. The maximum yield of dry weight of rhizome was recorded 50.6 q ha^{-1} in T_7 followed by T_6: 25 % inorganic + 75 % FYM (41.2 q ha^{-1}) and minimum yield of 19.7 q ha^{-1} in T_8 i.e. control zero fertilizer. The highest gross returns (Rs 303600) and net returns per ha (Rs. 159862.5) were registered in T_7 treatment with 100% FYM and the lowest were recorded in the T_8 treatment with control zero fertilizer. The highest Benefit-cost ratio (2.11) registered in the T_7 treatment with 100% FYM while the minimum (1.01) was obtained with T_8 treatment with control zero fertilizer.

Keywords: INM, turmeric yield, economics and agro forestry system

Introduction

In India, agro-forestry is historically widely practiced in the context of shifting cultivation, a number of cereal crop systems, home garden structures, urban plantation systems, etc. A number of these agro-forestry structures have recently begun to break down for a variety of reasons. In many cases, agro forestry systems based on high diversity have been supplemented by cash crop systems simplified on low diversity and this is problematic in terms of conservation. In recent years, agro forestry was not modern; its significance has increased greatly, particularly in terms of its potential for maximizing tropical land use. The primary goals were food production, wood production, fuel production, medicine and herbal plants, and many other non-timber forest goods. It also helps to preserve the ecosystem and rehabilitate the land supplies that will be required for future production. The state of Chhattisgarh is declared as a herbal state after it came in existence. The farmers carry out the large scale plantations for timber and raw material for industries to meet out their requirements of raw material. Last three years onwards the large scale plantations of TBOs were carried out on wastelands and marginal lands for bio-diesel production purpose. The interspaces of these plantations also used for the cultivation of medicinal and aromatic plants. For crop-based agriculture the risk is greater than in a tree-based agro forestry environment. Compare with forest alone or crop-based farming program, the total benefit obtained from agro forestry system is large. Karanj (*Pongamia pinata*) is a fast growing deciduous tree originating in India and located in Asia, which is believed to be up to 20 metres tall. It is a deciduous tree that grows with a broad canopy that spreads in early summer equally broad in India height of about 15-20 metres; the leaves were a bright, brilliant burgundy and as the season progresses they grow to a glossy, deep green. Tiny

clusters of white, purple, and pink flowers develop on their roots during the year, ripening into brown seed pots. The tree is well adapted to extreme heat an d sunlight and dense lateral root network and its thick long taproot make it resistant to drought Blossom March- April. The Turmeric (*Curcuma longa* Linn.) belongs to the family of Zingiberaceae which includes more than 80 perennial rhizomatous herb varieties and has a significant presence in the tropics of Asia Africa and Australia. India is the largest producer, consumer, and exporter of turmeric in the world, and includes 40 of the greatest variety. Agro forestry provides the re silience to agricultural. Turmeric (*Curcuma longa* L.) is a herbaceous perennial species of the genus Zingiberaceae. It is an old one, the most essential one, which contains large quantities of protein (6.3%), lipids (5.1%), and carbohydrates (69.4%) which fibres (2.6%). Turmeric is rich in arsenic, calcium, magnesium and vitamin A nutrients. Turmeric is a horticultural root crop that is not only important as a spice and cosmetic, but also as a medicinal plant worldwide (Ishimine *et al.,* 2003). Turmeric, a big, long-lasting crop (8-9 months), reacts well to nutrition.

Materials and Methods

The present investigation on "Effect of integrated nutrient management practices on turmeric [*Curcuma longa* (L.)] yield and economics under Karanj (*Pongamia pinnata*) based agroforestry system" was carried out during session of 2019-20 at the Herbal Garden of Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) to assess the most efficient nutrients for cultivation of turmeric under Karanj based agroforestry system. The experiment was conducted during the month of Jun 2019 to march 2020. For this, the suitable experimental design was laid out on Randomize Block Design (RBD), wherein 8 Treatments and 3 Replications were carried out on the field, the treatments were divided into T1 (100 % inorganic), T2 (75 % inorganic), T3 (50 % inorganic), T4 (75% inorganic + 25 % FYM), T5 (50 % inorganic + 50 % FYM), T6 (25 % inorganic + 75 % FYM), T7 (100 % FYM) and T8 (control zero fertilizer). The turmeric crop was harvested manually in 24th of March 2020 when crop attained maturity stage *i.e.* the stem and leaves of crop get turn yellowing, withering and drying of standing crop. The light irrigation was given 4-5 days before the harvesting of turmeric crop. Harvesting was done by using a pick-axe, so that the plant could be removed with full root system. After removing the whole plant the rhizome were cleaned by removing stem residues and roots and they were washed thoroughly in water to remove the soil partials and each plots the root and seed yield of individual treatments per plot were recorded.

Results and Discussion

Fresh and dry weight of rhizome:

Harvested rhizomes were cleaned from shoot and root residues as well as from soil particles then weighed for yield of fresh rhizome and data are presented in (Table-1). The fresh yield of rhizome showed statistically significant where the maximum yield of fresh weight of rhizome was recorded 185.1 q ha^{-1} in T_7 and minimum yield of 66.8 q ha^{-1} in T_8 i.e. control zero fertilizer. The dry yield of rhizome showed statistically significant where the maximum yield of dry weight of rhizome was recorded 50.6 q ha^{-1} in T_7 followed by T_6 : 25 % inorganic + 75 % FYM (41.2 q ha^{-1}) and minimum yield of 19.7 q ha^{-1} in T_8 i.e. control zero fertilizer. Similar results was reports, Kumar *et al.* (2001) also studied maximum rhizome yield in Ailanthus + ginger combination than sole crops. Further Amin *et al.* (2010) also showed that partial shade (50±5%) foster maximum yield. They observed topmost rhizome yield (124.2 q ha^{-1}) under partial shade of mango tree.The higher dry rhizome yield per hectare observed in treatment T7 might be due to highest fresh rhizome yield and its attributes such as weight of mother: primary and secondary rhizome and number of mother: primary and secondary rhizomes. It could be inferred that early germination, vigorous growth and highest growth parameters which were observed in treatment T7 could also be attributed to high yield of

Table 1: Effect of integrated nutrient management practices on rhizome yield- fresh and dry weight (q ha^{-1}) of turmeric under Karanj based agroforestry system

Treatments	Rhizome fresh weight (q ha^{-1})	Rhizome dry weight (q ha^{-1})
T_1	106.1	28.1
T_2	95.5	25.4
T_3	81.0	22.3
T_4	123.5	33.4
T_5	138.3	36.4
T_6	155.3	41.2
T_7	185.1	50.6
T_8	66.8	19.7
SEm±	8.35	2.26
CD @ (P=0.05)	25.33	6.85

Table 2: Effect of integrated nutrient management practices on Benefit Cost Ratio of turmeric under Karanj based agroforestry system

Treatment	Cost of cultivation (Rs./ha)	Rhizome yield (q ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C Ratio
T_1	132779.1	28.1	168600	35820.9	1.26
T_2	130643.7	25.4	152400	21756.3	1.16
T_3	128158.3	22.3	133800	5641.7	1.04
T_4	139743.7	33.4	200400	60656.3	1.43
T_5	142958.3	36.4	128400	75441.7	1.52
T_6	146822.9	41.2	247200	100377.1	1.78
T_7	152437.5	50.6	303600	151162.5	1.99
T_8	117725	19.7	118200	475	1.00

rhizome per hectare similar results of earlier research carried -out Singh (2004) and Sanwal et al. (2007) in turmeric are in accordance with the present findings.

Cost of cultivation (Rs ha^{-1})

Data regarding cost of cultivation showed the highest (Rs.152437.5) was obtained under the treatment T_7, followed by T_6 (Rs.146822.9), T_5 (Rs. 142958.3), T_4 (Rs.139743.7), T_1 (Rs. 132779.1), T_2 (Rs.130643.7), and T_3 (Rs.128158.3), the lowest recorded in T_8 (Control) was (Rs.117725) (Table-2).

Gross return (Rs ha^{-1})

Data regarding Gross return showed the highest (Rs. 303600) was obtained under the treatment T_7, followed by T_6 (Rs. 247200), T_5 (Rs. 218400), T_4 (Rs. 200400)T_1 (Rs. 168600), T_2 (Rs. 152400), and T_3 (Rs. 133800) while the lowest recorded in T_8 (Control) was (Rs. 118200). (Table-2).

Net return (Rs ha^{-1})

Data regarding net return showed the highest (Rs. 151162.5) was obtained under the treatment T_7, followed by T_6 (Rs. 100377.1), T_5 (Rs. 75441.7), T_4 (Rs. 60656.3)T_1 (Rs. 35820.9), T_2 (Rs. 21756.3), and T_3 (Rs. 5641.7) while the lowest recorded in T_8 (Control) was (Rs. 475). (Table-2).

B: C Ratio

Data regarding benefit cost ratio (B/C) showed the highest (1.99) was obtained under the treatment T_7, followed by T_6 (1.68), T_5 (1.52) and T_4 (1.43), T_1 (1.26), T_2 (1.16), T_3 (1.04), while the lowest recorded in T_8 (Control) was (1.00). The data revealed that the highest gross returns (Rs 303600) and net returns per ha (Rs. 159862.5) were registered in T_7 treatment with 100% FYM and the lowest were recorded in the T_8 treatment with control zero fertilizer. The highest Benefit-cost ratio (2.11) registered in the T_7 treatment with 100% FYM while the minimum (1.01) was obtained with T_8 treatment with control zero fertilizer (Table-2). The outcomes of present study are similar to the results of Singh *et al.* (2004), Singh (2013) and Wakhare and Mehta (2006).

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