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## Effect of graded levels of nitrogen on yield of turmeric, nutrient content and uptake under *Acacia mangium* based agroforestry system in Alfisol

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**Abstract**

Field experiment was carried out to study the effect of four levels of nitrogen (100%, 80%, 60% and 40% recommended dose of N) along with 100% recommended dose of P and K on yield of turmeric, nutrient content and uptake by turmeric under thirteen year old plantation of *Acacia mangium* based Agroforestry system in Alfisol at Central Experiment Station, Tetawali Block, Wakawali during *Kharif* season of 2019 and compared with absolute control. The result showed that application of 100% N + 100% PK ( $T_2$ ) recorded the highest rhizome yield (30.44 q ha<sup>-1</sup>), nutrient content and uptake by plant and rhizome, which was found to be at par with 80% N kg ha<sup>-1</sup> + 100% PK kg ha<sup>-1</sup> in all cases. Thus, considering the yield of turmeric, nutrient content and uptake by plant and rhizome, application of 80% N kg ha<sup>-1</sup> + 100% PK kg ha<sup>-1</sup> was found to be beneficial in lateritic soils of Konkan region from the view point of saving 20% nitrogen fertilizer as well as getting higher rhizome yield under *Acacia mangium* based Agroforestry system.

**Keywords:** Turmeric, *Acacia mangium*, agroforestry, rhizome yield, nutrient content, nutrient uptake

**Introduction**

*Acacia mangium*, also known as *mangium*, is one of the most widely used fast-growing tree species in plantation forestry programmes throughout Asia and the Pacific. Its desirable properties include rapid growth, good wood quality and tolerance of a wide range of soils and environments. *Acacia mangium* is well adapted to a wide range of soils and environmental conditions. It grows rapidly in sites with low levels of soil nutrients, even on acidic soils and degraded sites. It performs well on lateritic soils, i.e. soils with high amounts of iron and aluminium oxides (Otsamo, 2002) [5]. Moreover, under Agro-forestry system, *Acacia mangium* is recommended for building up soil fertility and to be planted as a source of nutrients in lateritic soils of Konkan region (Anonymous, 2017) [1]. *Acacia mangium* is a N<sub>2</sub>-fixing tree legume and has become a major plantation tree species in the tropical humid and sub-humid zones. In addition to being a major pulp-wood producer, the tree has a good potential to restore soil fertility as a fallow species in Agro-forestry systems, and as a fuel species.

Turmeric is a non-traditional crop in Konkan region of Maharashtra. However, the climatic and soil conditions seem to be suitable for its cultivation in this region. The successful cultivation of this crop under *Acacia mangium* based Agro-forestry system will not only provide an opportunity to generate income, but will also be an option to restore soil fertility and as a fuel species. Hence, the present experiment was designed to study the effect of nitrogen levels on yield of turmeric, nutrient content and uptake by turmeric grown under *Acacia mangium* based Agro-forestry system in Alfisol of Konkan.

**Materials and Methods**

Field experiment was carried out during *Kharif* 2019 at Central Experiment Station, Tetawali Block, Wakawali, Dr. B.S. Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, with four nitrogen levels (100%, 80%, 60% and 40% recommended dose of N) along with 100% recommended dose of P and K, applied to turmeric Cv. Salem grown under thirteen year old

plantation of *Acacia mangium* under Agro-forestry system and compared with an absolute control in Randomized Block Design with five treatments and four replications. Nitrogen @ 250 kg ha<sup>-1</sup> was applied in two splits viz., first dose of 50 per cent N @ 45 days after planting and second dose of 50 per cent at 105 days after planting in the pertinent treatments. Phosphorus @ 150 kg ha<sup>-1</sup> and potassium @ 150 kg ha<sup>-1</sup> were applied in a single dose before the time of planting in the pertinent treatments. Treatment wise plots were harvested separately, the rhizome collected from each net plot were weighed and rhizome yield per plot was recorded which was subsequently expressed on hectare basis. Nitrogen, phosphorus and potassium content in plant and rhizome was determined by the procedure outlined by Tandon (1993) [8], Kanwar and Chopra (1978) [4] and Piper (1966) [6], respectively. The nutrient uptake was calculated considering the dry matter yield, rhizome yield and nutrient content in plant and rhizome at the harvest stage.

## Results and Discussion

### Yield

The fresh rhizome yield of turmeric varied from 16.58 to 30.44 q ha<sup>-1</sup> and straw yield varied from 679.17 to 273.96 kg ha<sup>-1</sup> with the application of graded doses of nitrogen under *Acacia mangium* based Agro-forestry system (Table 1). Application of different doses of nitrogen along with recommended doses of P and K (from treatment T<sub>2</sub> to T<sub>5</sub>) significantly increased the rhizome yield over control (T<sub>1</sub>). The application of 100% N + 100% PK (T<sub>2</sub>) recorded the highest rhizome yield to the tune of 30.44 q ha<sup>-1</sup>, but treatment T<sub>2</sub> was found to be at par with T<sub>3</sub> (i.e. 80% N + 100% PK) indicating the saving of 20% nitrogen dose. In remaining treatments, T<sub>4</sub> (60% N + 100% PK) and T<sub>5</sub> (40% N + 100% PK) were at par. The lowest rhizome yield of turmeric i.e. 16.58 q ha<sup>-1</sup> was found in the control treatment (T<sub>1</sub>).

**Table 1:** Yield of turmeric as influenced by nitrogen levels under *Acacia mangium* Agro-forestry system

Treat. Code	Treatment	Rhizome Yield (q ha <sup>-1</sup> )
T <sub>1</sub>	Control	16.58
T <sub>2</sub>	100% NPK	30.44
T <sub>3</sub>	80% N + 100% PK	25.70
T <sub>4</sub>	60% N + 100% PK	21.56
T <sub>5</sub>	40% N + 100% PK	19.34
S.E.±		1.54
C.D. at 5%		4.74

The increase in yield was attributed to better N uptake, which lead to production of more nitrogenous compounds in plant tissues and resulted in efficient plant metabolism (Borah and Langthasa, 1994) [3]. The improvement in the yield of turmeric may be ascribed to the improved vegetative growth due to N fertilization facilitating photosynthesis thereby increasing translocation of organic food materials towards the sink from stem and leaves which accelerated the formation and development of greater sink size and weight, thus increasing the rhizome yield.

### Nutrient Content

Graded increase in nitrogen, phosphorus and potassium content in plant and rhizome was observed with the graded doses of nitrogen (Table 2). The highest NPK content in plant and rhizome was noted with the application of 100% N +

100% PK (T<sub>2</sub>), which was at par with treatments T<sub>3</sub> and T<sub>4</sub> in case of N content in plant and rhizome as well as P content in plant. T<sub>2</sub> was at par with treatments T<sub>3</sub> in case of P and K content in rhizome. Treatments T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub> and T<sub>5</sub> were at par in case of K content in plant.

The significant increase in N content in plant with the application of graded doses of nitrogen along with recommended doses of P and K (from treatment T<sub>2</sub> to T<sub>5</sub>) under *Acacia mangium* Agro-forestry system could be attributed to increasing availability of nutrients from leaf litter that the leaf litter after decomposition release macro and micro-nutrients to soil solution, besides the direct addition of nitrogen through fertilizer to the available pool of the soil; which becomes available to the plants, resulting in higher uptake.

**Table 2:** NPK content (%) in plant and rhizome of turmeric as influenced by nitrogen levels under *Acacia mangium* Agro-forestry system

Treat. Code	Treatment	N (%)		P (%)		K (%)	
		Plant	Rhizome	Plant	Rhizome	Plant	Rhizome
T <sub>1</sub>	Control	0.96	0.84	0.41	0.41	1.08	1.37
T <sub>2</sub>	100% N + 100% PK	1.10	1.06	0.57	0.67	1.41	1.81
T <sub>3</sub>	80% N + 100% PK	1.04	1.02	0.54	0.63	1.40	1.73
T <sub>4</sub>	60% N + 100% PK	1.01	1.00	0.52	0.52	1.24	1.55
T <sub>5</sub>	40% N + 100% PK	0.99	0.93	0.45	0.45	1.22	1.49
S.E.±		0.03	0.021	0.04	0.014	0.08	0.032
C.D. at 5%		0.09	0.064	0.11	0.044	0.23	0.100

The enhanced P and K contents in leaf and rhizome under graded N application over control might be due to easy availability of these essential nutrients from the soil-applied inorganic fertilizer and their unhindered distribution to the foliage might have resulted in the higher uptake of these nutrients. Besides this, Aulakh and Malhi (2005) [2] noted that under conditions of high K availability, increasing the N

supply increases K concentration and uptake. Plants can absorb N either in cationic (NH<sub>4</sub><sup>+</sup>) or in anionic (NO<sub>3</sub><sup>-</sup>) form. There is a unique possibility of anion-cation as well as cation-cation interactions with K<sup>+</sup>. Most of the findings have illustrated that K<sup>+</sup> does not compete with NH<sub>4</sub><sup>+</sup> for uptake, rather it increases NH<sub>4</sub><sup>+</sup> assimilation in the plants.

### Nutrient Uptake

Graded increase in uptake of nitrogen, phosphorus and potassium by plant, rhizome as well as total uptake was observed with the graded doses of nitrogen (Table 3). The highest NPK uptake by plant, rhizome and total uptake was noted with the application of 100% N + 100% PK (T<sub>2</sub>), which was found to be significantly superior over all other treatments in case of N uptake by plant, rhizome and total

uptake as well as P and K uptake by rhizome and total uptake and followed by the treatment 80% N + 100% PK (T<sub>3</sub>). In case of P and K uptake by plant, treatment T<sub>2</sub> and T<sub>3</sub> were at par. Use of N under organic matter rich soil influenced the N, P and K uptake markedly which could be because of supply of these nutrients and improvement in the soil physical condition for better plant growth which ultimately led to higher N, P and K absorption (Sharma *et al.*, 2001)<sup>[7]</sup>.

**Table 3:** NPK uptake (kg ha<sup>-1</sup>) by plant and rhizome of turmeric as influenced by nitrogen levels under *Acacia mangium* Agro-forestry system

Treat. Code	Treatment	N			P			K		
		(kg ha <sup>-1</sup> )								
		Plant	Rhizome	Total	Plant	Rhizome	Total	Plant	Rhizome	Total
T <sub>1</sub>	Control	211.72	1387.51	1599.23	104.65	683.68	788.33	295.82	2264.54	2560.36
T <sub>2</sub>	100% N + 100% PK	1182.10	3216.92	4399.03	376.41	2037.08	2413.49	933.72	5516.92	6450.64
T <sub>3</sub>	80% N + 100% PK	681.27	2609.21	3290.48	279.15	1618.39	1897.54	718.58	4433.19	5151.77
T <sub>4</sub>	60% N + 100% PK	647.56	2146.68	2794.24	254.49	1127.57	1382.06	625.98	3361.80	3987.78
T <sub>5</sub>	40% N + 100% PK	543.69	1800.20	2343.88	207.31	876.01	1083.32	558.41	2873.81	3432.22
	S.E.±	150.06	147.26	181.27	33.41	92.06	93.23	87.26	269.05	267.67
	C.D. at 5%	462.39	453.75	558.55	102.93	283.67	287.27	268.88	829.02	824.76

### Conclusion

Considering the yield of turmeric, nutrient content and uptake by plant and rhizome, application of 80% N kg ha<sup>-1</sup> + 100% PK kg ha<sup>-1</sup> was found to be beneficial in lateritic soils of Konkan from the view point of saving 20% nitrogen fertilizer as well as getting higher rhizome yield under *Acacia mangium* based Agro-forestry system.

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