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Yield performance of Turmeric (*Curcuma longa)* under *Eucalyptus tereticornis* based Agroforestry System in Plains of Chhattisgarh

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A B S T R A C T

Study was conducted to determine the shade loving turmeric can be a potential cover crop under the plantation program hence yield performance of *Curcuma longa* (Turmeric) under Eucalyptus based Agroforestry system, where two variety ranga and roma of turmeric crop was cultivated at in open field and under 20 years old eucalyptus plantation at 3x 3m spacing, three spacings *i.e.* S-1 (50cm x 50cm), S-2 (50cm x 30cm) and S-3 (40cm x 30cm). The yield obtained from open field was 225.79 qha^{-1} while it was reduced by 33.77% under eucalyptus plantation. In case of variety Ranga (V-1) produced maximum yield of 196.06 qha^{-1}as compare to roma (V-2) 179.53 qha^{-1}Among the crop spacing maximum yield of 197.63 qha^{-1} was recorded at S-1 spacing. The cultivation of cover crop under tree crop plantation is the land utilization management which in beneficial for tree crop and finally to growers of plantation as economical viable system.

Introduction

The importance of agroforestry has been increasing gradually especially as regards its potential for optimizing land use in the tropics. Its primary aims are the production of food, timber, fuel, medicinal and aromatic plants and many more non timber forest products.

Exotic tree eucalyptus a fast growing and promising short duration MPTs is planted for timber, fuel, wood essential oil and pulp, at large scale in each sector to get production of wood and essential oil for variances. *Curcuma longa* or Turmeric, is a native to Indian continent and it prefer spartial shade. Therefore in most suitable crop to cultivated under tree as cover crop to utilize the land space.

Here a study was conducted to cultivation the Turmeric varieties under eucalyptus plantation as silvi- agriculture system.

Materials and Methods

The climate of the study area was dry sub-humid tropical with an average rainfall of 1250 mm. Most

of the rainfall (90%) is received during monsoon season from mid June to mid September. The meteorological feature during crop period the average 32^0C maximum temperature and minimum 25^0C, where the relative humidity mm was recorded87% during sowing period and the harvesting period. The maximum minimum was recorded average temperature 38.2^0C and 19.3^0C, respectively with 57% relative humidity, 9.3 sun shine hours were recorded at harvest i.e. in month of March.

The soil of Raipur belongs to four different orders viz., Entisols, Vertisols, Inceptisols and Alfisols. The black clayey soil of experimental field belongs to the order Vertisols and it is locally known as Kanhar.

This Kanhar soil are characterized by fine texture, sticky nature, angular blocky structure, low to medium Nitrogen, high Potassium and low to medium Phosphorus with low Organic matter. The soil of experimental area is very rich in organic carbon and other nutrient because of the addition of litter in the soil every year.

The turmeric varieties viz Ranga (V1) and Roma (V2) were cultivated at three crop spacing S-1 (50cm x 50cm), S-2 (50cm x 30cm) and S-3 (40cm x 30cm) in open field (control) and under 20 years old eucalyptus plantation at 3x 3m spacing from July to March I.E. 240 days.

The field was prepared thoroughly by deep plugging with tractor drawn cultivator three times. Weeds and crop residue were removed manually.

The soil prepared in fine tilth with application of FYM where NPK applied 120N, 60P & 60K kg/ha in form of Urea, SSP & Murate of Potash.

The experiment was laid out in a Factorial randomized block design (RBD) 4 replication. Crop as turmeric was harvested a maturity and yield data analyzed for statistically significance.

Results and Discussion

The yield of weight of rhizome was found 225.79 qha^{-1} in open field (CS-1) and 149.80 qha^{-1} in AFS (CS-2) which was 33.77 % less in AFS with significant variation. The variety was record V-1 in 196.06 qha^{-1} and V-2 in 179.53 qha^{-1} with non-significant variation. In case of spacing, it was estimated in order of S-1 > S-3 > S-2 in ranged of 175.76 $qha^{-1}$to 197.63 $qha^{-1}$with non-significant variation. The interaction of CS x V showed non-significant variation with maximum 245.67 qha^{-1} in CS-1 x V-1 followed by 205.92 qha^{-1} for CS-2 x V-2 while minimum was 146.45 qha^{-1} in CS-2 x V-1 interaction. The interaction of CS x S showed non-significant variation with maximum 246.31 qha^{-1} in CS-1 x S-1 followed by 215.67 qha^{-1} for CS-1 x S-3 while minimum was 136.12 qha^{-1} in CS-2 x S-2 interaction. The interaction of V x S showed non-significant variation with maximum 201.17 qha^{-1} in V-1 x S-3 followed by 200.16 qha^{-1} for V-1 x S-1 while minimum was 164.67 qha^{-1} in V-2 x S-2 interaction. The interaction of CS x V x S showed non-significant variation with maximum 252.76 qha^{-1} in CS-1 x V-1 x S-1 followed by 243.05 qha^{-1} for CS-1 x V-1 x S-3 while minimum was 132.48 qha^{-1} in CS-2 x V-1 x S-2 interaction.

Eucalyptus tree growth

Tree growth characteristics *viz;* tree height (m), collar diameter (cm) and diameter at breast height 9 cm were recorded before sowing of turmeric crop *ie*. 2017 June and after the harvest of turmeric crop *i.e*. March 2018 and data are presented in table-3.

It is clearly depicted in table that height growth of *Eucalyptus tereticornis* was observed as 20.26m ± 2.97 before sowing of turmeric crop and found increased by 1.06 m with MAI of 1.12 cm after 12 months of growth. The collar diameter of *Eucalyptus tereticornis* was observed at 10 cm above the base29.27cm ± 2.91 before sowing of turmeric crop and it increased by 1.00 cm in 12 months i.e. growth period of turmeric crop.

Table.1 Yield parameter of turmeric (*Curcuma longa)* Eucalyptus based Agroforestry system.

Treatments	Weight of Rhizome (q/ha)
Cropping System (Cs)	
Open (Cs_1)	225.79
AFS (Cs_2)	149.80
Variety(V)	
Ranga (V_1)	196.06
Roma (V_2)	179.53
Spacing (S)	
50x50(S_1)	197.63
50x30(S_2)	175.76
40x30(S_3)	190.00
Cs x V Interaction	
Cs_1 x V_1	245.67
Cs_1 x V_2	205.92
Cs_2 x V_1	146.45
Cs_2 x V_2	153.15
Cs x S Interaction	
Cs_1 x S_1	246.31
Cs_1 x S_2	215.40
Cs_1 x S_3	215.67
Cs_2 x S_1	148.95
Cs_2 x S_2	136.12
Cs_2 x S_3	164.32
V x S Interaction	
V_1 x S_1	200.16
V_1 x S_2	186.85
V_1 x S_3	201.17
V_2 x S_1	195.10
V_2 x S_2	164.67
V_2 x S_3	178.82
Cs x V x S Interaction	
Cs_1 x V_1 x S_1	252.76
Cs_1 x V_1 x S_2	241.22
Cs_1 x V_1 x S_3	243.05
Cs_1 x V_2 x S_1	239.87
Cs-1 x V_2 x S_2	189.58
Cs-1 x V_2 x S_3	188.30
Cs_2 x V_1 x S_1	147.57
Cs_2 x V_1 x S_2	132.48
Cs_2 x V_1 x S_3	159.30
Cs_2 x V_2 x S_1	150.34
Cs_2 x V_2 x S_2	139.77
Cs_2 x V_2 x S_3	169.34

Table.2 Analysis of variance ratio ANOVAs

source	n	df	Mss	SEm±	SEd±	CD(at 5%)
Rep	4	3	1109.62	-	-	-
CS	2	1	69305.09	12.47	17.64	**35.27***
Variety	2	1	3278.48	12.47	17.64	NS
Spacing	3	2	1971.92	15.28	21.60	NS
Cs x V	4	1	6474.09	17.64	24.94	NS
CS x Sp	6	5	859.35	21.60	30.55	NS
V X Sp	6	5	157.84	21.60	30.55	NS
CsxVxSp	12	11	130.89	30.55	43.20	NS
Error	-	18	3733.91	-	-	-
Total	48	47	-	-	-	-

Table.3 Growth characteristics Eucalyptus plantation during Turmeric crop.

Parameters		CAI	MAI
Total Height (m)	21.29±3.01	1.03	1.12
CD(cm)	30.27±2.9	1.00	1.59
DBH(cm)	25.4±2.45	0.87	1.34

Perusal of table-8 showed that the diameter at breast height *of Eucalyptus tereticornis* was noted 24.53 cm ± 2.06 before sowing of turmeric crop it increased by 0.87 m in 12 months.

Yield of turmeric rhizome

Fresh weight yield of turmeric was highest in open field (CS-2) it might be due to in open field are received higher amount of sun light, absence of tree crop interaction and soil is more fertile in open field than yield of turmeric is higher. Performance of yield of turmeric with tree component depends upon availability of moisture, nutrients and light resource sharing between crops and trees. Oven dry weight yield of turmeric is higher in open field.

Similar results was reports, Bhardwaj *et al.,* (2011) studied maximum yield of ginger under *D. asper* than *D. hamiltonii* and concluded that ginger displayed good performance with *D. asper* under mid hill sub humid conditions. Maximum rhizome yield under bamboo canopy than sole crop can be explained based on shade loving nature of crop. 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.

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