



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; 8(10): 1028-1033
Received: 13-08-2025
Accepted: 17-09-2025

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Growth performance of Arbi (*Colocasia esculenta*) under *Eucalyptus tereticornis*-based agroforestry system in plains of Chhattisgarh

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DOI: <https://www.doi.org/10.33545/2618060X.2025.v8.i10n.4110>

Abstract

The experiment, conducted during 2019-20 at Indira Gandhi Krishi Vishwavidyalaya, Raipur, studied the yield performance of Arbi (*Colocasia esculenta*) under *Eucalyptus tereticornis*-based agroforestry system in Chhattisgarh. It evaluated the effects of *Eucalyptus* on growth and yield of two Arbi varieties (Indira Arbi-1 and Arbi CG-II) and assessed the growth behavior of *Eucalyptus*. Two treatments, T₁ (recommended dose of fertilizers: N:P:K- 80:60:60) and T₂ (no fertilizer), were applied in a factorial randomized block design and replicated five times. Growth and yield attributing traits were observed in which Colocasia growth parameters were found maximum for for T-1 x V-1 interaction T-1 RDF (N:P:K- 80:60:60) and V-1 (Indira Arbi-1) yielded superior results across plant height (84.78 cm), leaf number (9.54), leaf length (33.04 cm), leaf width (29.22 cm), and Leaf Area Index (1.598). *Eucalyptus* growth attributes such as the tree height increased by 0.69 m with (mean annual increment (MAI) of 1.06 m, and the diameter at breast height (DBH) grew by 0.67 cm (MAI: 1.20 cm) during the year. During the research work Challenges faced such as reduced transpiration, increased relative humidity under the canopy, and efficient utilization of photosynthetically active radiation (PAR) by the *Colocasia* crop under the canopy of eucalyptus tree. Study has implications for the cultivation of shade crops such as Arbi and Haldi under agroforestry systems.

Keywords: Agroforestry system, intercropping, alley cropping, Arbi (*Colocasia esculenta*), *Eucalyptus* (*Eucalyptus tereticornis*)

Introduction

Agroforestry systems have gained attention worldwide for their potential to enhance agricultural productivity while promoting environmental sustainability. Agroforestry systems integrate trees with crops and/or livestock on the same land, and have emerged as sustainable alternatives to conventional agriculture. These systems not only enhance productivity but also contribute to biodiversity conservation, soil health improvement, and climate resilience. One significant aspect of agroforestry is its impact on crop performance under the canopy of trees, influencing microclimate, soil properties, and nutrient availability. (Fahad *et al.* 2022) [4]. Understanding its performance in agroforestry systems, particularly under *Eucalyptus* canopies, is crucial for optimizing agricultural production in such environments.

The *Eucalyptus*-based agroforestry system stands out due to the unique characteristics of *Eucalyptus* trees, which provide multiple benefits such as timber and fuel wood production, soil improvement by minimise soil erosion and water logging condition, carbon sequestration and other ecosystem services. (Nair, 1993; Jose, 2009; Leakey, 2014) [8, 6, 7]. *Colocasia esculenta*, commonly known as taro originated in South Central Asia, probably in India or Malaysia. It is a staple crop in many tropical and subtropical regions, valued for its edible corms and leaves valued for its tolerance to waterlogged conditions and adaptability to diverse agroecological settings.

The growth performance of *Colocasia esculenta* in agroforestry systems can be influenced by various factors, including light availability, microclimatic conditions, nutrient cycling, and root competition with tree species. Understanding these dynamics is crucial for optimizing agricultural production while minimizing environmental impacts. Studies have shown that under

the canopy of Eucalyptus trees, microclimatic conditions such as light intensity and temperature fluctuate, which can affect the growth, development, and yield of taro plants. This research seeks to investigate how *Colocasia esculenta* responds and interacts with Eucalyptus trees in agroforestry settings. The interaction between *Colocasia esculenta* and Eucalyptus trees involves complex mechanisms that affect growth, yield, and quality attributes of the crop. By assessing these factors, we aim to provide insights into the agronomic potential and ecological implications of integrating *Colocasia esculenta* within Eucalyptus plantations. In recent years, researchers have explored the potential of integrating *Colocasia esculenta* into Eucalyptus-based agroforestry systems to leverage the synergistic interactions between trees and crops. Key objectives include assessing growth parameters such as plant height, leaf area index, leaf length, leaf width and number of leaf, as well as evaluating physiological responses related to photosynthesis, water use efficiency, and nutrient uptake. Additionally, the study aims to quantify taro growth and quality attributes under varying degrees of shading and proximity to Eucalyptus trees. Such knowledge is essential for sustainable agriculture practices, promoting food security, and harnessing the synergistic benefits of tree-crop interactions in agroforestry systems.

By elucidating the performance of *Colocasia esculenta* in Eucalyptus-based agroforestry systems, this research contributes to broader efforts in sustainable agriculture and resource management. The findings will not only inform farmers and practitioners about the potential benefits and challenges of integrating taro with Eucalyptus but also offer insights into optimizing agroforestry practices for enhanced productivity and ecological resilience.

Materials and Methods

The experiment was conducted at Raipur, situated in the south eastern region of Chhattisgarh, India, at coordinates 21°23'39.77"N latitude and 81°69'44.30"E longitude, with an elevation of 295 meters above mean sea level.

The study commenced in July 2019, with the crop being harvested in March 2020. A factorial randomized block design was employed, incorporating two colocasia varieties (V1: Indira Arbi-1 and V2: Arbi CG-2) intercropped with eucalyptus trees spaced 6 m × 6 m apart. The colocasia plants were arranged at a spacing of 50 cm × 30 cm. Fertilizer application was carried out in three phases: an initial basal dose comprising half the nitrogen (N), half the potassium (K), and all the phosphorus (P), followed by two subsequent split applications of the remaining nitrogen and potassium—one-fourth at 30 days after sowing (DAS) and another one-fourth at 60 DAS. Irrigation was initiated immediately after sowing to enhance germination, with subsequent watering provided based on soil moisture levels and seasonal rainfall patterns.

The experimental field comprised black clayey soil classified as Vertisols, locally referred to as *Kanhar*. The soil was notably rich in organic carbon and essential nutrients, largely attributed to the annual deposition of organic matter from litterfall.

Statistical analysis

The data of all parameters of *Colocasia* collected precisely was tabulated, computed and statistical analysis done by using word-excel spreadsheet a open factorial randomize block design. The growth parameters data of eucalyptus height and DBH were summarized with standard deviation and presented

Microclimatic Observations

The Microclimatic observation such as, Temperature (°C), Relative humidity (%) PAR ($\mu\text{mol s}^{-1}\text{m}^{-2}$) were recorded every fifteen days interval, by using Digital Thermometer, Digital Hygrometer and LICOR photo quantum meter respectively at three different timings in i.e. Morning, Noon and Evening hours in each plot of colocasia crop.

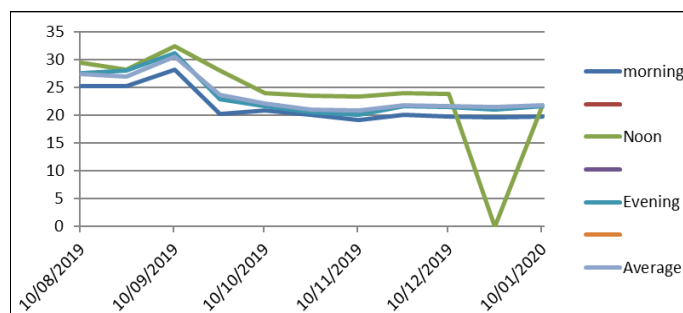


Fig 1: Micro-climatic feature Temperature in AFS.

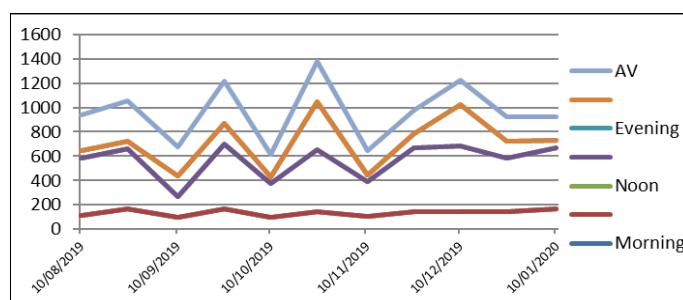


Fig 2: Micro-climatic feature PAR in AFS.

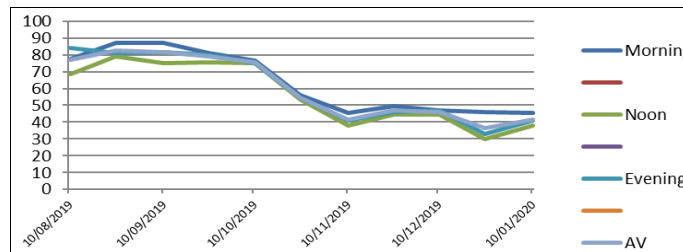


Fig 3: Micro-climatic feature RH in AFS

Results and Discussion

Growth parameters of colocasia crop

1. Growth parameter

The growth parameters of colocasia viz; Plant height (cm), Number of leaves (leaves plant⁻¹), leaf length (cm), leaf width (cm) and leaf area index are observed during the course of investigations are presented in Table 1-Table 5. The results reveal that growth parameters such as plant height, number of leaves plant⁻¹, leaf length, leaf width and leaf area index affected non significantly by source of fertilizer treatment. Analysis of variance by source of variety revealed that plant height, number of leaves plant⁻¹, leaf length, leaf width and leaf area index showed significantly effect by source of variety. Analysis of variance of source Treatment × Variety interaction showed non significant effect for all yield parameters

1.1 Plant height (cm)

The study revealed that fertilizer treatment significantly increased colocasia plant height ($P < 0.05$) at key growth stages

(Table-1), with the highest height observed in T-1 (fertilizer) at 165 DAS (80.03 cm) compared to T-2 (78.25 cm). Early growth (30 DAS) also showed greater heights in T-1 (23.44 cm) than T-2 (20.36 cm). Varietal effects were significant at most growth stages, with Indira Arbi-I (V-1) consistently outperforming Arbi CG-II (V-2) in plant height. At 165 DAS, V-1 reached 83.10 cm, while V-2 was 75.18 cm. V-1 also exhibited a faster growth rate throughout the experiment. The interaction between fertilizer and variety was statistically significant ($P < 0.05$), the T-1 $\times$ V-1 combination resulted in the highest plant height (84.78 cm), highlighting the combined benefit of fertilizer and superior variety.

Height of colocasia plants is found highest with fertilizer treatment as compare to growth without fertilizer whether it was found maximum in V-1 and minimum in V-2 this might be due to nutrient availability into the soil and genetic variability of different variety. Similarly Rajeskumar and Vijoykumar, (2001)^[11] reported that the highest plant height was (74.40 cm) recorded with 120 kg N/ha. in colocasia. Pant *et al.* (2010)^[9] also found that nitrogen application improve growth of colocasia crop when grown under poplar (*Populous deltoids*) based agroforestry system. Choudhary *et al.* (2011)^[2] reported variation in plant height among different taro cultivar/ variety when grown under different agroclimatic conditions.

Table 1: Plant height (cm) of *Colocasia esculenta* crop under Eucalyptus based AFS

DAS	30	45	60	75	90	105	120	135	150	165	180
Treatment											
T ₁	23.44	26.74	35.16	43.74	55.2	57.38	62.00	68.38	74.31	80.03	75.32
T ₂	20.36	25.45	33.76	41.38	50.74	54.46	61.54	66.52	71.82	78.25	75.16
S.Em $\pm$	0.91	1.24	1.18	1.55	1.08	1.29	1.29	0.47	0.54	1.29	1.14
S.Ed $\pm$	1.29	1.75	1.67	2.20	1.53	1.82	1.82	0.67	0.76	1.83	1.62
CD (5%)	2.88	NS	NS	NS	3.41	NS	NS	1.49	1.7	NS	NS
Variety											
V1	24.86	30.46	37.76	46.28	57.28	57.82	66.64	68.04	73.82	83.1	77
V2	18.94	21.73	31.16	38.84	48.66	54.02	56.9	66.86	72.31	75.18	73.48
S.Em $\pm$	0.91	1.24	1.18	1.55	1.08	1.29	1.29	0.47	0.54	1.29	1.14
S.Ed $\pm$	1.29	1.75	1.67	2.20	1.53	1.82	1.82	0.67	0.76	1.83	1.62
CD (5%)	2.88	3.91	3.73	4.89	3.41	NS	4.06	NS	NS	4.08	NS
Interaction of TR X Va											
T ₁ $\times$ V1	25.8	32.04	39.76	48.64	60.00	58.40	67.60	69.60	75.00	84.78	76.96
T ₁ $\times$ V2	21.08	21.44	30.56	38.84	50.4	56.36	56.4	67.16	73.62	75.28	73.68
T ₂ $\times$ V1	23.92	28.88	35.76	43.92	54.56	57.24	65.68	66.48	72.64	81.42	77.04
T ₂ $\times$ V2	16.8	22.02	31.76	38.84	46.92	51.68	57.4	66.56	71.00	75.08	73.28
S.Em $\pm$	1.29	1.75	1.67	2.20	1.53	1.82	1.82	0.67	0.76	1.83	1.62
S.Ed $\pm$	1.83	2.48	2.37	3.10	2.16	2.57	2.58	0.95	1.08	2.59	2.29
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Number of leaves per plant

The number of leaves per plant in colocasia (Table-2) was significantly affected by fertilizer treatment ($P < 0.05$) at several growth stages, including 30, 60, 75, 150, 165, and 180 DAS, but not at 45, 90, 105, 120, and 135 DAS. At 165 DAS, the highest number of leaves was recorded in T-1 (9.52) compared to T-2 (8.96). Early growth (30 DAS) also showed significant differences, with T-1 at 2.5 leaves and T-2 at 2.34 leaves. Overall, fertilizer treatment consistently resulted in a higher number of leaves per plant. Variety significantly influenced the number of leaves at specific growth stages (75, 90, 105, 120, and 180 DAS), but differences were non-significant at 30, 45, 60, 135, 150, and 165 DAS. At 165 DAS, Indira Arbi-I (V-1) had a slightly higher number of leaves (9.25) than Arbi CG-II (V-2) (8.96). Early growth stages showed minimal and non-significant variation between varieties. The interaction between fertilizer and variety was mostly non-significant, except at 135 DAS. The highest number of leaves was observed in the T-1 $\times$ V-1 combination (9.54), followed by T-1 $\times$ V-2 (9.50), and the lowest in T-2 $\times$ V-2 (8.96). Combinations involving fertilizer consistently outperformed those without fertilizer across the experiment.

Number of leaf per plant is highest with fertilizer treatment as compare to without fertilizer, whether it was found in V-1 and minimum in V-2. The difference in number of leaves per plant might be due to the genetic variation of crop reported by Paul and Bari, (2011)^[10] and nutrient uptake capacity by colocasia varieties. Similarly improvement in number of leaf per plant by application of nitrogen fertilizer also reported by Pant *et al.*

(2010)^[9]. The difference in number of leaves per plant in different colocasia variety were also reported by Dwivedi and Sen (2001)^[3], Rao *et al.* (2008)^[12] and Choudhary *et al.* (2011)^[2].

Table 2: Number of leaf (plant⁻¹) of *Colocasia esculenta* under Eucalyptus based AFS

DAS	30	45	60	75	90	105	120	135	150	165	180
Treatment											
T ₁	2.5	2.72	3.76	4.33	5.3	6.33	7.17	8.25	9.01	9.52	9.11
T ₂	2.34	2.61	3.6	4.22	5.24	6.23	7.09	7.76	8.71	8.96	8.45
S.Em $\pm$	0.03	0.04	0.05	0.03	0.03	0.04	0.05	0.04	0.08	0.07	0.13
S.Ed $\pm$	0.04	0.06	0.07	0.05	4	0.05	0.07	0.06	0.11	0.1	0.19
CD (5%)	0.09	NS	0.15	0.11	NS	NS	NS	NS	0.25	0.22	0.42
Variety											
V1	2.46	2.70	3.70	4.36	5.34	6.36	7.22	7.98	8.91	9.25	9.05
V2	2.38	2.63	3.66	4.19	5.2	6.2	7.04	8.03	8.81	9.23	8.51
S.Em $\pm$	0.03	0.04	0.05	0.03	0.03	0.04	0.05	0.04	0.08	0.07	0.13
S.Ed $\pm$	0.04	0.06	0.07	0.05	4	0.05	0.07	0.06	0.11	0.1	0.19
CD (5%)	NS	NS	NS	0.11	0.1	0.11	0.16	NS	NS	NS	0.42
Interaction of TR X Va											
T ₁ $\times$ V1	2.50	2.78	3.76	4.42	5.36	6.42	7.22	8.32	9.12	9.54	9.5
T ₁ $\times$ V2	2.50	2.66	3.76	4.24	5.24	6.24	7.12	8.18	8.9	9.5	8.72
T ₂ $\times$ V1	2.42	2.62	3.64	4.3	5.32	6.3	7.22	7.64	8.70	8.96	8.6
T ₂ $\times$ V2	2.26	2.6	3.56	4.14	5.16	6.16	6.96	7.88	8.72	8.96	8.3
S.Em $\pm$	0.04	0.06	0.07	0.05	0.04	0.05	0.07	0.06	0.11	0.10	0.19
S.Ed $\pm$	0.06	8.00	0.09	0.07	0.06	0.07	0.10	0.08	0.16	0.14	0.26
CD (5%)	NS	NS	NS	NS	NS	NS	NS	0.17	NS	NS	NS

Leaf size (length and width)**Leaf length (cm)**

The leaf length of colocasia (Table-3) was significantly influenced by fertilizer treatment ($P < 0.05$) at multiple growth stages (30, 45, 135, 150, 165, and 180 DAS) but not at others (60, 75, 90, 105, and 120 DAS). At 165 DAS, the maximum leaf length was observed in T-1 (31.73 cm) compared to T-2 (31.10 cm). Early growth (30 DAS) also showed higher leaf length in T-1 (7.30 cm) than T-2 (7.08 cm). Overall, leaf length was consistently greater under fertilizer treatment.

Varietal effects on leaf length were statistically significant ($P < 0.05$) at key growth stages (30, 45, 60, 90, 150, 165, and 180

DAS). At 165 DAS, Indira Arbi-I (V-1) exhibited the maximum leaf length (33.04 cm) compared to Arbi CG-II (V-2) (29.79 cm). During early growth (30 DAS), V-1 recorded 8.21 cm, while V-2 measured 6.20 cm. Indira Arbi-I consistently showed greater leaf length throughout the experiment.

The interaction between fertilizer and variety was not statistically significant but demonstrated the highest leaf length in the T-1 $\times$ V-1 combination (33.40 cm), followed by T-2 $\times$ V-1 (32.68 cm), with the lowest in T-2 $\times$ V-2 (29.52 cm). Interactions involving fertilizer consistently outperformed those without it.

Table 3: Leaf length (cm) of *Colocasia esculenta* crop under Eucalyptus based AFS

DAS	30	45	60	75	90	105	120	135	150	165	180
Treatment											
T ₁	7.30	9.43	11.68	14.26	18.17	21.00	25.03	27.24	29.60	31.73	29.87
T ₂	7.08	9.73	11.32	14.13	19.14	20.07	24.72	26.59	29.04	31.10	28.53
S.Em $\pm$	0.07	0.21	0.18	0.23	0.43	0.30	0.27	0.28	0.20	0.21	0.36
S.Ed $\pm$	0.10	0.30	0.26	0.32	0.61	0.43	0.38	0.39	0.28	0.29	0.51
CD (5%)	0.22	0.66	NS	NS	NS	NS	NS	NS	0.63	NS	1.14
Variety											
V1	8.21	10.30	12.38	14.45	19.57	21.01	25.19	27.29	29.97	33.04	31.25
V2	6.20	8.86	10.62	13.94	17.74	20.06	24.56	26.54	28.67	29.79	27.15
S.Em $\pm$	0.07	0.21	0.18	0.23	0.43	0.30	0.27	0.28	0.20	0.21	0.36
S.Ed $\pm$	0.10	0.30	0.26	0.32	0.61	0.43	0.38	0.39	0.28	0.29	0.51
CD (5%)	0.22	0.66	0.58	NS	1.37	NS	NS	NS	0.63	0.65	1.14
Interaction of TR X Va											
T ₁ $\times$ V1	8.30	10.46	12.56	14.62	18.42	21.44	25.42	27.68	30.30	33.04	31.25
T ₁ $\times$ V2	6.30	8.40	10.80	13.90	17.92	20.57	24.64	26.80	28.90	30.06	28.64
T ₂ $\times$ V1	8.12	10.14	12.20	14.28	20.72	20.59	24.96	26.90	29.64	32.68	31.40
T ₂ $\times$ V2	6.04	9.32	10.44	13.98	17.56	19.56	24.48	26.28	28.44	29.52	25.66
S.Em $\pm$	0.10	0.33	0.26	0.32	0.61	0.43	0.38	0.39	0.28	0.29	0.51
S.Ed $\pm$	0.14	0.47	0.37	45.00	0.86	0.60	0.53	0.56	0.40	0.41	0.73
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Leaf width (cm)

The leaf width of colocasia (Table-4) was significantly affected by fertilizer treatment ($P < 0.05$) at 45, 60, 75, 105, 120, and 150 DAS but was non-significant at 30, 90, 135, 165, and 180 DAS. At 165 DAS, the highest leaf width was recorded in T-1 (28.45 cm) compared to T-2 (27.90 cm). Early growth (30 DAS) showed greater leaf width in T-1 (6.11 cm) than T-2 (5.90 cm). Fertilizer consistently enhanced leaf width throughout the experiment.

Varietal effects on leaf width were significant ($P < 0.05$) at 45, 60, 75, and 105 DAS but non-significant at later stages. At 165 DAS, Indira Arbi-I (V-1) had the highest leaf width (28.74 cm) compared to Arbi CG-II (V-2) (27.59 cm). During early growth (30 DAS), V-1 recorded 6.14 cm, while V-2 measured 5.91 cm. Indira Arbi-I consistently showed greater leaf width than Arbi

CG-II.

The interaction between fertilizer and variety was statistically non-significant. However, the highest leaf width was observed in T-2 $\times$ V-1 (29.22 cm), followed by T-1 $\times$ V-1 (28.26 cm), with the lowest in T-2 $\times$ V-2 (25.66 cm). Interactions involving fertilizer showed improved leaf width compared to those without it.

Length and width of leaf found more with fertilizer treatment as compare to without fertilizer and also found highest leaf length & width in V-1 than V-2. It may be due to presence of rich nutrients in soil, nutrient uptake capacity of varieties, availability of optimum sunlight and temperature to shade loving plant colocasia under eucalyptus & genetic variability. similarly Bhuiyan *et al.* (2012) [1] also reported that nutrients is important for better growth of leaves under 25-30% shade

Table 4: Leaf width of *Colocasia esculenta* crop under Eucalyptus based AFS

DAS	30	45	60	75	90	105	120	135	150	165	180
Treatment											
T ₁	0.136	0.151	0.182	0.231	0.371	0.554	0.735	0.941	1.393	1.533	1.448
T ₂	0.125	0.131	0.179	2.584	0.340	0.505	0.681	0.913	1.353	1.463	1.377
S.Em $\pm$	0.0035	0.0031	0.0036	0.003	0.01	0.03	0.01	0.02	0.013	0.01	0.04
S.Ed $\pm$	0.0050	0.0043	0.0051	0.005	0.01	0.04	0.01	0.02	0.018	0.02	0.06
CD (5%)	NS	0.01	NS	0.01	NS	0.04	0.03	NS	0.04	0.03	0.12
Variety											
V1	0.137	0.149	0.186	2.619	0.369	0.55	0.721	0.948	1.388	1.557	1.473
V2	0.124	0.133	0.175	0.196	0.342	0.509	0.695	0.906	1.358	1.439	1.352
S.Em $\pm$	0.0035	0.0031	0.0036	0.003	0.01	0.01	0.01	0.02	0.013	0.01	0.04
S.Ed $\pm$	0.0050	0.0043	0.0051	0.005	0.01	0.02	0.01	0.02	0.018	0.02	0.06
CD (5%)	0.011	0.01	NS	0.01	NS	NS	NS	NS	NS	0.03	0.12

Interaction of TR X Va											
T ₁ x V ₁	0.146	0.162	0.186	0.258	0.384	0.572	0.762	0.97	1.404	1.598	1.512
T ₁ x V ₂	0.126	0.14	0.178	0.204	0.358	0.536	0.708	0.912	1.382	1.468	1.384
T ₂ x V ₁	0.128	0.136	0.186	0.228	0.354	0.528	0.68	0.926	1.372	1.516	1.434
T ₂ x V ₂	0.122	0.126	0.172	0.188	0.326	0.482	0.682	0.9	1.334	1.41	1.32
S.Em±	0.0049	0.0043	0.0051	0.005	0.01	0.02	0.014	0.02	0.018	0.02	0.03
S.Ed±	0.007	0.006	0.007	0.007	0.03	0.03	0.02	0.03	0.025	0.02	0.04
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

LAI (Leaf Area Index)

The leaf area index (LAI) of colocasia (Table-5) was significantly influenced by fertilizer treatment ($P < 0.05$) at various growth stages, including 45, 75, 105, 120, 150, 165, and 180 DAS. At 165 DAS, T-1 (fertilizer treatment) recorded the highest LAI (1.533) compared to T-2 (1.463). During early growth (30 DAS), T-1 showed higher LAI (0.136) than T-2 (0.125). Fertilizer treatment consistently resulted in greater LAI throughout the experiment.

Varietal effects on LAI were significant at 30, 45, 165, and 180 DAS. At 165 DAS, Indira Arbi-I (V-1) had the highest LAI (1.557), while Arbi CG-II (V-2) had a lower value (1.439). Early growth stages (30 DAS) also showed significant differences, with V-1 (0.137) outperforming V-2 (0.124). Across the experimental period, Indira Arbi-I demonstrated superior LAI compared to Arbi CG-II.

The interaction between fertilizer and variety was statistically non-significant. The highest LAI was recorded in the T-1 × V-1 interaction (1.598), followed by T-2 × V-1 (1.468), with the lowest in T-2 × V-2 (1.41). Interactions involving fertilizer showed higher LAI than those without fertilizer.

LAI of colocasia crop was found more with fertilizer treatment as compare to without fertilizer and in case of variety higher LAI was observed in V- I than V-2. It might be due to proper nutrient application and difference in nutrient uptake capacity in varieties. Law- Ogbomo and remison (2008) observed that the leaf area index (LAI) increased significantly as the quantities of fertilizer applied increased. Joshi *et al.* (2017) observed significantly increased the leaf area index of tikhur with increasing fertilizer dose. Similarly Hossain *et al.* (2009)^[5] also observed the maximum LAI in all the cases of inorganic fertilizer application.

Table 5: LAI of *Colocasia esculenta* Crop under Eucalyptus based AFS.

DAS	30	45	60	75	90	105	120	135	150	165	180
Treatment											
T ₁	0.136	0.151	0.182	0.231	0.371	0.554	0.735	0.941	1.393	1.533	1.448
T ₂	0.125	0.131	0.179	2.584	0.340	0.505	0.681	0.913	1.353	1.463	1.377
S.Em±	0.0035	0.0031	0.0036	0.003	0.01	0.03	0.01	0.02	0.013	0.01	0.04
CD (5%)	NS	0.01	NS	0.01	NS	0.04	0.03	NS	0.04	0.03	0.12
Variety											
V ₁	0.137	0.149	0.186	2.619	0.369	0.55	0.721	0.948	1.388	1.557	1.473
V ₂	0.124	0.133	0.175	0.196	0.342	0.509	0.695	0.906	1.358	1.439	1.352
S.Em±	0.0035	0.0031	0.0036	0.003	0.01	0.01	0.01	0.02	0.013	0.01	0.04
CD (5%)	0.011	0.01	NS	0.01	NS	NS	NS	NS	NS	0.03	0.12
Interaction of Tr X Va											
T ₁ x V ₁	0.146	0.162	0.186	0.258	0.384	0.572	0.762	0.97	1.404	1.598	1.512
T ₁ x V ₂	0.126	0.14	0.178	0.204	0.358	0.536	0.708	0.912	1.382	1.468	1.384
T ₂ x V ₁	0.128	0.136	0.186	0.228	0.354	0.528	0.68	0.926	1.372	1.516	1.434
T ₂ x V ₂	0.122	0.126	0.172	0.188	0.326	0.482	0.682	0.9	1.334	1.41	1.32
S.Em±	0.0049	0.0043	0.0051	0.005	0.01	0.02	0.014	0.02	0.018	0.02	0.03
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Tree growth parameters:

The height (m) of *Eucalyptus tereticornis* was 21.58 m ± 2.84 before sowing of colocasia crop which increased by 0.69 m with MAI of 1.06 m while diameter at breast height (cm) of *Eucalyptus tereticornis* was 25.75 cm ± 1.91 before sowing of colocasia crop which increased by 0.67 cm with MAI 1.25 cm of twelve month of growth

Table 4.8: Growth characteristics Eucalyptus tree during crop period.

Characteristics	2019 Value	2020 Value	CAI	MAI
Total Ht. (m)	21.58±2.84	22.27±3.18	0.69	1.06
DBH (cm)	25.75±1.91	26.42±2.22	0.67	1.25



Plate 1: Colocasia in Eucalyptus based Agroforestry system (30 DAS)



Plate 2: Growth of colocasia crop under Eucalyptus based AFS (90 DAS)



Plate 3: Growth of colocasia crop under Eucalyptus based AFS (120 DAS)



Plate 3: Display of samples of variety (V1 & V2) with different treatment in AFS (T₁ & T₂)

Conclusion

The result revealed that highest yield was obtained 118.66 qha⁻¹ in fertilizer treatment and lowest 104.12 qha⁻¹ in T₂ where no fertilizer was used, which was reduced by 12.06% with statistically significant variation. In case of variety Indira Arbi-I produced better yield 114.286 q ha⁻¹ as compare to Arbi-CG-II which produced 108.1 q ha⁻¹ with non significant variation. The crop registered better growth and yield performance in T₁ (RDF) treatment, while variations under established Eucalyptus plantations was found, The cultivation of colocasia as cover crop showed better growth & yield performance, while the farmer can get extra income on harvesting of Eucalyptus. Thus Eucalyptus + Colocasia farming was found beneficial in economical point of view. Overall In this experiment colocasia crop showed better results for variety Indira Arbi-I thus it can be acceptable for cultivation as cover crop under AFS to generate Income.

Future scope

Further intensive research work about intercropping management practices with different fertilizer doses under different tree species will required. Also the study of microclimatic as well as bio-parameters under the intercropping land utilization program required for more effective recommendation of intercropping management practices.

Acknowledgement

The authors are thankful to the members of my advisory committee, Dr. M. N. Naugraiya (Professor - Forestry), College of Agriculture, Raipur for their valuable advises and suggestions for improving this manuscript. Without their kind co-operation it would have not been easy for me to complete this manuscript.

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