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Effect of growing conditions and various organic sources on growth and yield of *Xanthosoma* (*Xanthosoma sagittifolium* var. L. Schott)

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ABSTRACT

The experiment entitled “Effect of growing conditions and various organic sources on growth and yield of *Xanthosoma* (*Xanthosoma sagittifolium* var. L. Schott)” was conducted at vegetable field, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli and Dist. Ratnagiri during kharif season in year 2025-26. The experiment was laid out in Factorial Randomized Block Design with two factors, eighteen treatment combinations and three replications. Two factors were studied the investigation viz. Factor- A) Growing conditions (S) and Factor- B) Various organic sources (N). From the investigation, the recorded parameters were significantly influenced by the growing conditions and various organic sources. S₁N₆ (under shade net house with FYM @ 30 t ha⁻¹ + Seaweed extract @ 3 ml L⁻¹ + Humic acid @ 1 ml L⁻¹) recorded significantly higher result in plant height (90.27 cm), total number of leaves per plant (19.82), petiole length (74.47 cm), leaf length (48.00 cm), leaf breadth (30.80 cm) and leaf area (1567.93 cm²). The herbage yield (11.92 t ha⁻¹), corm yield (5.98 t ha⁻¹) and cormels yield (3.27 t ha⁻¹) was observed highest in treatment combination S₁N₆.

Thus, based on the findings, it can be concluded that growing condition S₁ (shade net house) with organic sources i.e. treatment N₆ (FYM @ 30 t ha⁻¹ + Seaweed extract @ 3 ml L⁻¹ + Humic acid @ 1 ml L⁻¹) is highly promising for favorable outcome in Konkan agro-climatic conditions of Maharashtra.

Keywords: *Xanthosoma*, Tannia, Shade net house, Organic nutrient sources, FYM, Vermicompost, Seaweed extract, Humic acid, Growth and yield

Introduction

Xanthosoma sagittifolium var. L. Schott (family Araceae), commonly known as tannia or cocoyam, is an important tropical root and tuber crop cultivated in tropical and subtropical regions worldwide. The crop is primarily grown for its edible corms and cormels which are rich in carbohydrates and possess nutritional qualities comparable to potato (Onwueme *et al.*, 1994; Agueguia, 2000) [2, 1]. The tender leaves are also consumed as a nutritious vegetable owing to their high protein, vitamin, mineral, and antioxidant content. In addition to its food value, cocoyam has industrial applications in starch extraction, alcohol production, and pharmaceutical industries, while its foliage serves as livestock and poultry feed.

Cocoyam is widely cultivated in Southeast Asia, West Africa, Central America and the Pacific Islands. In India, it is grown mainly in Kerala, Maharashtra, Tamil Nadu, Karnataka, West Bengal, and the North-Eastern states. Among the edible aroids, xanthosoma is considered the most commercially important due to its high consumer preference, better cooking quality, low acidity and considerable market and export potential. Nutritionally, it is superior to several other root and tuber crops because of its highly digestible starch, relatively higher protein content and essential minerals such as calcium, phosphorus and magnesium (Onyenweaku *et al.*, 2007) [3]. Consequently, it is recommended as a suitable food for elderly individuals, diabetic patients, convalescents, and people with gastrointestinal disorders (Adekiya *et al.*, 2016).

Despite its economic and nutritional importance, cocoyam productivity is often constrained by poor soil fertility and inappropriate soil management, particularly in lateritic soils. Since the crop responds well to both organic and inorganic nutrient sources, integrated nutrient management (INM) practices have been developed to improve soil fertility and crop productivity. Research conducted at the ICAR–Central Tuber Crops Research Institute (CTCRI), Thiruvananthapuram, demonstrated that the combined application of farmyard manure and chemical fertilizers significantly enhances growth and tuber yield. Furthermore, appropriate soil tillage and the use of soil conditioners such as coir pith improve soil physical properties and contribute to sustainable cocoyam production. Therefore, optimizing soil and nutrient management practices is essential for improving the productivity and profitability of *Xanthosoma sagittifolium* var. L. Schott. cultivation.

2. Material and methods

The present research entitled “effect of growing conditions and various organic sources on growth and yield of xanthosoma (*Xanthosoma sagittifolium* var. L. Schott.)”, under agro-climatic conditions in the Konkan region in the Maharashtra region, was conducted at the Nursery No. 4 and High-Tech Nursery at College of Horticulture, Dapoli, during the *Kharif* season of 2025. The details of the materials and techniques utilized in the present investigation are provided below.

2.1. Experimental site

The field experiment was conducted at Nursery no.4 and high-tech nursery at College of Horticulture, Dr. Balasaheb Sawant Konan Krishi Vidyapeeth, Dapoli (M. S.).

2.2. Climate and weather condition

The location of Dapoli is situated 240 meters above mean sea level (MSL) in the western coastline area of Maharashtra. On a global map, its geological location is 17°46'0" North latitude and 73°11'0" East longitude. During the trial period (June to February), the average minimum and maximum temperatures were 17 °C and 20.95 °C, respectively. In the span of the harvest, Dapoli received 3000-4000 mm of precipitation annually, which distributed from June to November. Throughout the trial period (June 2025 to December 2025), the average relative humidity was reported at 85%.

2.3. Experimental details

Crop	:	<i>Xanthosoma</i> (<i>Xanthosoma sagittifolium</i> var. L. Schott)
Year	:	2025-2026
Design of experiment	:	Factorial Randomized Block Design (FRBD)
Treatments	:	18
Replications	:	3
No. of plants per treatment	:	30

2.4. Treatment details

3. Results and discussion

3.1. Effect of growing conditions and various organic sources on plant height (cm)

The interaction significantly influenced plant height at all growth stages. At 150 DAS the highest plant height (90.27 cm) was observed in S_1N_6 (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹). Whereas the minimum plant height (69.87 cm) was recorded in S_3N_2 (open condition and FYM @ 30 t ha⁻¹). The highest plant height was consistently recorded in S_1N_6 , where the shade net house provided a favourable environment and the combined application of FYM, seaweed extract and humic acid improved nutrient availability and plant growth. Tania *et al.* (2021) [4] and Tiwari *et al.* (2025) [5] similarly recorded the highest plant height in turmeric and taro with vermicompost and biofertilizer-based organic nutrition, supporting the present findings.

3.2. Effect of growing conditions and various organic sources on petiole length (cm)

The significant effect of interaction of growing conditions and various organic sources on petiole length at maturity. The petiole length (74.47 cm) was maximum in S_1N_6 (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹) and treatment combination which was at par with S_1N_4 (74.20 cm). However, the minimum petiole length (39.80 cm) was measured in S_3N_2 (open condition and FYM @ 30 t ha⁻¹) treatment

combination at maturity stage. The enhanced petiole elongation under S_1N_6 may be attributed to the favourable microclimate created by the shade net, along with the synergistic effects of FYM, seaweed extract and humic acid. FYM improves soil structure, moisture retention and nutrient availability, while seaweed extract contains bioactive compounds that promote cell division, cell elongation and vegetative growth. Humic acid further enhances nutrient uptake and root activity, thereby supporting vigorous shoot development and petiole elongation. The present findings are in close agreement with the reports of Jayapal *et al.* (2019) [6] and Mahalakshmi *et al.* (2021) [7] who reported that integrated application of organic manures and biostimulants under favourable growing conditions significantly improved vegetative growth in tropical tuber crops, including *Xanthosoma*

3.3. Effect of growing conditions and various organic sources on leaf length (cm)

The interaction effect between growing conditions and various organic sources were found to be significant for the leaf length of plant at maturity. Maximum leaf length (48.00) was found in treatment combination S_1N_6 (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹) had significant). While, the minimum leaf length (24.27 cm) was recorded in treatment combination S_3N_2 (open condition and FYM @ 30 t ha⁻¹). The moderated light intensity and higher relative humidity under the shade net (S_1) triggered shade-adaptive morphological responses specifically cell elongation and lamina expansion while mitigating photo-oxidative stress. Simultaneously, the biostimulants in N_6 supplied natural growth hormones like auxins and gibberellins while enhancing root hydraulic conductivity and nutrient uptake, thereby maximizing turgor-driven cellular extension and structural leaf growth. Similar beneficial effects of integrated organic nutrient management on vegetative growth of tuber crops were reported by Mahalakshmi *et al.*, (2021) [7] in elephant foot yam.

3.4. Effect of growing conditions and various organic sources on leaf breadth (cm)

According to the finding the plant showed significant effect noted on combination of growing conditions and organic sources on leaf breadth of xanthosoma at maturity. The treatment combination S_1N_6 (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹) that recorded the maximum width of leaf (30.80 cm) was recorded and which was at par with S_1N_4 (29.20 cm) as well as in treatment combination S_3N_2 (open condition and FYM @ 30 t ha⁻¹) the minimum leaf width (14.67 cm) was recorded. The superior performance of S_1N_6 indicates that the favourable microclimate under shade net combined with integrated organic nutrient management created ideal conditions for vegetative growth and leaf expansion. Conversely, the open condition combined with FYM alone was less effective in promoting leaf growth because of greater environmental stress and comparatively lower nutrient-use efficiency. Similar findings were reported by Haque *et al.* (2009) [8] in bottle gourd and these findings are in accordance with Mahalakshmi *et al.* (2021) [7] and Jayapal *et al.* (2019) [6], who reported that integrated application of organic manures with bio stimulants significantly improved vegetative growth in tropical tuber crops.

Factor A : Growing conditions

Growing conditions	
S_1	Under shade net house condition
S_2	Under coconut orchard (well established)
S_3	Open Condition

Factor A : Organic nutrient sources

Organic nutrient sources	
N_1	RDF (80:60:80 NPK kg ha ⁻¹) + FYM @ 15 t ha ⁻¹
N_2	FYM @ 30 t ha ⁻¹

(continued on next page)

Factor A : Growing conditions

N ₃	Vermicompost @ 5 t ha ⁻¹
N ₄	FYM @ 30 t ha ⁻¹ + Humic acid @ 1 ml L ⁻¹
N ₅	Vermicompost @ 5 t ha ⁻¹ + Seaweed extract @ 3 ml L ⁻¹
N ₆	FYM @ 30 t ha ⁻¹ + Seaweed extract @ 3 ml L ⁻¹ + Humic acid @ 1 ml L ⁻¹

3.5. Effect of growing conditions and various organic sources on leaf area (cm²)

The data regarding effect of interaction of growing conditions and various organic sources on leaf area was significant at mature stage. The maximum area of leaf (1567.93 cm²) at the maturity was recorded in the S₁N₆ (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹) treatment combination. On the other hand, in the S₃N₂ (open condition and FYM @ 30 t ha⁻¹) treatment combination, leaf area was observed minimum (462.80 cm²). The enhanced leaf development under S₁N₆ may be attributed to the synergistic effect of favourable growing conditions and combined organic inputs, which improved nutrient availability, root development, water uptake and physiological activity, ultimately promoting cell division and leaf expansion. Seaweed extract and humic acid are known to stimulate plant growth and nutrient-use efficiency, thereby increasing photosynthetic surface area. The above results are in close conformity with the findings of Nedunchezhiyan *et al.* (2017) [9] in elephant foot yam crop.

3.6. Effect of growing conditions and various organic sources on total number of leaves per plant

The interaction effect of growing conditions and various organic nutrient sources on total number of leaves were found to be significant. The maximum leaves (19.13) were recorded in S₁N₆ (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹) which was at par with S₁N₄ (18.87) and S₁N₃ (18.33). Whereas, the minimum number of leaves (11.80) was obtained in S₃N₂ (open condition and FYM @ 30 t ha⁻¹). Similar results were reported by Hector *et al.* (1990, 1991), who observed improved leaf production under partial shade in xanthosoma crops. Comparable findings were also reported by Suja *et al.* (2017) [10] who found that balanced organic nutrient management significantly increased the number of leaves and overall vegetative growth in elephant foot yam and other tropical root and tuber crops.

3.7 Effect of growing conditions and various organic sources on herbage yield per hectare

The interaction effect between growing conditions and organic sources had a statistically significant effect on the herbage yield per hectare of xanthosoma. The highest herbage yield (11.92 t ha⁻¹) was observed in S₁N₆ (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹), while the lowest yield (8.38 t ha⁻¹) was with the S₃N₂ (open condition and

FYM @ 30 t ha⁻¹) per hectare. The higher yield may be attributed to the favourable microclimate under shade, which promoted vegetative growth, leaf expansion and efficient moisture utilization, together with improved nutrient availability from integrated organic inputs. In contrast, the lowest herbage yield was recorded in S₃N₂, i.e. open condition + FYM @ 30 t ha⁻¹. Higher temperature, light intensity and moisture loss under open conditions may have restricted vegetative growth and consequently reduced herbage production. These findings are in agreement with reports by Kolambe *et al.* (2014) [11] in elephant foot yam, Jayapal *et al.* (2019) [6] on integrated nutrient management in tannia and Mahalakshmi *et al.* (2021) [7] on the beneficial effects of humic acid and seaweed extract in tuber crops.

3.8 Effect of growing conditions and various organic sources on corm yield per hectare

The combined effect of growing condition and various organic sources on corm yield per hectare of xanthosoma was found to be significant. The maximum corm yield per hectare (5.98 t ha⁻¹) was found in S₁N₆ (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹). However, the minimum corm yield per hectare (2.92 t ha⁻¹) was recorded in S₃N₂ (open condition and FYM @ 30 t ha⁻¹). The present findings are in close agreement with those reported by Kolambe *et al.* (2014) [11] in elephant foot yam, who observed higher tuber yield under integrated organic nutrient management. Similar results were also reported by Jayapal *et al.* (2019) [6], who found that the combined application of organic manures and biostimulants improved corm yield in tropical tuber crops. Agbede *et al.* (2020) [12] reported that integration of organic amendments significantly enhanced cocoyam yield through improved soil fertility and nutrient availability.

3.9 Effect of growing conditions and various organic sources on cormels yield per hectare

The interaction effect between growing conditions and various organic sources was found to be significant for the cormels yield per plot of xanthosoma. Highest cormels yield per plot (2.61 kg plot⁻¹) was found in treatment combination S₁N₆ (under shade net house condition + FYM @ 30 t ha⁻¹ + seaweed extract @ 3 ml L⁻¹ + humic acid @ 1 ml L⁻¹) and which was at par with S₁N₄ (2.55 kg plot⁻¹), S₂N₆ (2.53 kg plot⁻¹) and S₂N₄ (2.35 kg plot⁻¹). While, the lowest cormels yield per plot (1.05 kg plot⁻¹) was recorded in treatment combination S₃N₂ (open condition and FYM @ 30 t ha⁻¹). The superior performance of S₁N₆ may be attributed to the favourable microclimate under shade net conditions combined with FYM, seaweed extract and humic acid, which improved nutrient availability, moisture conservation, root development and photosynthetic activity, thereby enhancing assimilate translocation towards cormels. The findings are in conformity with those of Hector *et al.* (1990) [13], who reported that shaded environments improve tuber yield in xanthosoma. Similar improvements in tuber yield due to integrated organic nutrient application were reported by Kumar *et al.* (2017) [14].

Table 1. Effect of growing conditions, various organic sources and their interaction on plant height, total number of leaves and leaf area of *Xanthosoma*

Organic nutrient sources	Plant height (cm)				Total number of leaves per plant				Petiole length (cm)			
	Growing conditions				Growing conditions				Growing conditions			
	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN
N ₁	77.67	72.87	70.00	73.51	17.13	14.00	12.53	14.56	63.67	61.07	58.53	61.09
N ₂	76.73	73.00	69.87	73.20	16.40	13.33	11.80	13.84	44.67	43.47	39.80	42.64
N ₃	80.40	73.67	73.60	75.89	18.33	15.20	12.27	15.27	66.80	63.80	61.33	63.98
N ₄	81.00	77.47	73.13	77.20	18.87	15.53	13.20	15.87	74.20	71.60	68.80	71.53
N ₅	80.47	76.73	73.07	76.76	17.07	15.27	13.80	15.38	73.13	70.53	67.87	70.51
N ₆	90.27	86.20	82.93	86.47	19.13	16.60	14.53	16.76	74.47	71.53	69.00	71.67

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Organic nutrient sources	Plant height (cm)				Total number of leaves per plant				Petiole length (cm)			
	Growing conditions				Growing conditions				Growing conditions			
	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN
MEAN	81.09	76.66	73.77		17.82	14.99	13.02		66.16	63.67	60.89	
	S	N	S X N		S	N	S X N		S	N	S X N	
SEm±	0.28	0.40	0.69		0.14	0.20	0.35		0.09	0.13	0.23	
CD @ 5%	0.81	1.14	1.98		0.42	0.59	1.02		0.27	0.38	0.67	
F-test	SIG	SIG	SIG		SIG	SIG	SIG		SIG	SIG	SIG	

Table 2. Effect of growing conditions, various organic sources and their interaction on plant height, total number of leaves and leaf area of *Xanthosoma*

Organic nutrient sources	Leaf length (cm)				Leaf breadth (cm)				Leaf area (cm ²)			
	Growing conditions				Growing conditions				Growing conditions			
	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN
N ₁	37.07	34.33	32.20	34.53	24.93	22.53	20.20	22.56	957.53	810.07	671.33	812.98
N ₂	28.20	26.40	24.27	26.29	17.73	16.60	14.67	16.33	629.40	521.73	462.80	537.98
N ₃	38.67	36.00	33.20	35.96	27.47	23.67	20.80	23.98	1105.13	894.07	753.20	917.47
N ₄	46.73	43.93	41.00	43.89	29.20	27.07	23.93	26.73	1396.60	1221.23	1010.53	1209.46
N ₅	39.73	37.20	34.47	37.13	28.20	24.27	22.33	24.93	1114.27	915.47	750.93	926.89
N ₆	48.00	45.13	42.33	45.16	30.80	27.33	24.53	27.56	1567.93	1324.20	1123.67	1338.60
MEAN	39.73	37.17	34.58		26.39	23.58	21.08		1128.48	947.79	795.41	
	S	N	S X N		S	N	S X N		S	N	S X N	
SEm±	0.10	0.14	0.24		0.19	0.27	0.47		12.34	17.45	30.23	
CD @ 5%	0.28	0.40	0.69		0.55	0.78	1.35		35.47	50.16	86.89	
F-test	SIG	SIG	SIG		SIG	SIG	SIG		SIG	SIG	SIG	

Table 3. Effect of growing conditions, various organic sources and their interaction on herbage yield, corm yield and cormels yield of *Xanthosoma*

Organic nutrient sources	Herbage yield (t ha ⁻¹)				Corm yield (t ha ⁻¹)				Cormels yield (t ha ⁻¹)			
	Growing conditions				Growing conditions				Growing conditions			
	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN	S ₁	S ₂	S ₃	MEAN
N ₁	10.94	9.43	8.57	9.65	3.64	3.56	3.49	3.56	2.20	1.95	1.70	1.95
N ₂	10.33	8.42	8.38	9.04	3.07	3.00	2.92	3.00	1.82	1.57	1.32	1.57
N ₃	11.30	9.39	8.68	9.79	4.33	4.24	4.16	4.24	2.40	2.15	1.90	2.15
N ₄	11.34	10.33	8.60	10.09	5.78	5.69	5.61	5.69	3.18	2.93	2.68	2.93
N ₅	10.94	9.82	9.10	9.96	5.34	5.28	5.21	5.28	2.92	2.92	2.67	2.83
N ₆	11.92	10.51	9.50	10.64	5.98	5.69	5.62	5.76	3.27	3.16	3.02	3.15
MEAN	11.13	9.65	8.81		4.69	4.58	4.50		2.63	2.45	2.21	
	S	N	S X N		S	N	S X N		S	N	S X N	
SEm±	0.08	0.11	0.18		0.01	0.02	0.03		0.02	0.02	0.04	
CD @ 5%	0.22	0.31	0.53		0.03	0.05	0.08		0.05	0.07	0.12	
F-test	SIG	SIG	SIG		SIG	SIG	SIG		SIG	SIG	SIG	

4. Conclusion

The present investigation clearly demonstrated that growing conditions and various organic sources significantly influenced the vegetative growth, yield and economic returns of *Xanthosoma*. On the basis of findings reported in present investigation, the following conclusion could be drawn. Among the growing conditions, shade net house (S₁) recorded significantly superior growth and yield parameters of *Xanthosoma* compared with coconut orchard (S₂) and open condition (S₃). Among the organic nutrient sources FYM @ 30 t ha⁻¹ + Seaweed extract @ 3 mL L⁻¹ + Humic acid @ 1 mL L⁻¹ (N₆) produced the highest plant height, number of leaves, leaf area, herbage yield, corm yield and cormel yield. The interaction Shade net house + FYM @ 30 t ha⁻¹ + Seaweed extract @ 3 mL L⁻¹ + Humic acid @ 1 mL L⁻¹ (S₁N₆) was found to be the best treatment combination for obtaining maximum growth and yield.

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