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Augmentation of physiological and quality parameters of taro (*Colocasia esculenta* L.) Schott) through organic manures

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ABSTRACT

A field experiment was conducted during February -August 2020 at Kollakudi village, Tiruvannamalai, Tamil Nadu, India to find the influences of organic manures on physiological and quality parameters of taro variety Sree Rashmi. The experiment was laid out in the randomized block design with nine treatments replicated thrice. Organic manures opted for the study include vermicompost, farm yard manure, phosphobacteria, neem oil cake applied in basal form, effective microorganisms, panchagavya, seaweed extract wassoil drenched on the day of sowing, 30th and 60thdays after sowing as per the treatment. The total cormel yield/ plant(618.94 g), total cormel yield / plot (24.13 kg), dry matter production (48.45 tha^{-1}), total starch (9.88%), total sugar (1.89%), total folate (24.12 µg/100g) were found to be maximum with RDF+ vermicompost (5t ha^{-1}) + sea weed extract (5ml/ litre) + phosphobacteria (2 kg ha^{-1}) . Among the organic manures, combined application of sea weed extract, vermicompost and phosphobacteria proved to be superior to others in respect of quality and physiological parameters. The minimum values of all these characters were recorded under control.

Key words: Organic manures, taro, yield, economics

INTRODUCTION

Taro, (*Colocasia esculenta* L. Schott) is an under exploited crop grown throughout all the tropics specially in warmer areas. It is the staple food in many countries like pacific, Caribbean, and Asia and a supplement to potatoes in southern United States. All the parts of the crop are consumed viz. petioles, leaves, corms, cormels for various preparations like curry, snacks, baby weaning food. This crop is used for multidimensional purpose viz. medicinal, ornamental, fodder and as vegetable. This tuber is excellent source of carbohydrate in which majority of starch is amylose besides it has numerous health benefits such as immune boosting, reducing weight gain and fatigue, lowering blood pressure, supports thyroid function. Though the continuous and wide use of synthetic fertilizer increases the yield of the crop and meeting the food security of the world, those plants do not have well established root and shoot system are poor in nutrients (Basumatary and Sailia, 2019). And the intensive food production leads to deteriotation of soil health, contamination of the food chain and water by persistent pesticide residues or nitrates, reduction in the nutrient and flavour in crop in addition to potential health hazards (Chandhini *et al.*, 2019). The alternative method which aims in sustainable and safe food production is organic method of crop production to maintain the soil health and ecofriendly with the maximum use of on-farm resources. In this context the organic manures like farm yard manure, vermicompost, neem oil cake, phosphobacteria are excellent soil amendments for the soil health and as well as for the plants. The sea weed extract has growth stimulating property because it contains amino acids and plant harmones like auxin and cytokinin (Priyadharshini and Madanakumarai, 2020). Panchagavya enhances biological efficiency of crops. Effective microorganisms enhance the physical and chemical and biological environment of soil; suppress the incidence of pests and pathogen (Avdeenko *et al.*, 2020). Thus, an experiment was conducted to study the efficiency and role of organic manures in combination with inorganic fertilizers in taro.

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MATERIALS AND METHODS

The study was conducted during February- August 2020 at Annamalai University, Tamil Nadu, India. The experimental field was located at Tiruvannamalai district of Tamil Nadu, India. The experimental area was a tropical region, located at 12.15˚ North latitude, 79.09˚ East longitude at an altitude of 168m above mean sea level. The experiment was laid out in randomized block design comprising of 9 treatments, replicated thrice. The treatments were T_1: RDF+12.5t FYM ha^{-1},T_2: RDF+12.5t FYM ha^{-1} + 3%panchagavya + 2kg phosphobacteria ha^{-1},T_3: RDF+ 12.5t FYM ha^{-1} + 5% panchagavya + 2kg phosphobacteria ha^{-1}, T_4: RDF + 5t vermicompost ha^{-1}+ 2kg phosphobacteria ha^{-1},T_5: RDF+ vermicompost (5t ha^{-1}) + seaweed extract (3ml/litre) + 2kg phosphobacteria ha^{-1},T_6: RDF+ 5t vermicompost ha^{-1} + seaweed extract (5ml/litre) +2kg phosphobacteria ha^{-1},T_7: RDF+ 1t neem oil cake ha^{-1} +2kg phosphobacteria ha^{-1},T_8: RDF+ 1t neem oil cake ha^{-1}) + effective microorganisms (1:500) + 2kg phosphobacteria ha^{-1},T_9: RDF+ 5t vermicompost ha^{-1} + effective microorganisms (1:1000) +2kg phosphobacteria ha^{-1}. Farmyard manure, Vermicompost, Neem oil cake, phosphobacteria was applied as basal form. Seaweed extract, effective microorganisms, and panchagavya were soil drenched on the day of sowing, 30th and 60th days after sowing as per treatments. Taro variety selected for study was Sree Rashmi. The tubers were sown at a spacing of 45 x 45 cm in ridges and furrows. The observation was recorded by randomly selecting five plants from each plot. The observations recorded for the study was total cormel yield/plant(g), total cormel yield/plot(kg), dry matter production (tha^{-1}), The folate content of the cormels was estimated by Reversed-phase high performance liquid chromatography (RP-HPLC) equipped with fluorometric detection (Ndaw *et al.*, 2001). The total starch of the cormels was estimated by colorimetric method for determination of sugars and related substances. (Dubois *et al.*, 1996).The total sugars of the cormels were estimated by colorimetric method for determination of sugars and related substances. (Dubois *et al.*, 1996).The statistical analysis of data was done by using DSAASTAT. For treatments showing significance, critical differences were worked out at five percent probability level. Net income was obtained by deducting all costs from gross income. B: C ratio was calculated by dividing the gross income with total cost of cultivation.

RESULTS AND DISCUSSION

Yield parameters

Yield parameters (Table 1) viz., the total cormel yield/ plant (618.94 g) and total cormel yield/ plot (24.13 kg) was recorded maximum withRDF+ vermicompost (5t ha^{-1}) + seaweed extract (5ml/litre) + phosphobacteria (2kg ha^{-1}).The maximum yield may be due to the role of sea weed extract as it contains plant growth promoting harmones like cytokinins. These cytokinins in vegetative part are associated with nutrient partitioning, whereas in reproductive organs, they are associated with nutrient mobilization, cytokinins shifts the prepared photosynthates from vegetative part to the developing cormel and promotes the further cormel growth and its quality. While vermicompost help the soil to create an environment suitable for root growth by increasing microbial diversity and improving biological activities like respiration, nitrogen mobilization and mineralization of mineral nutrients. Free living bacterium in phosphobacteria secretes certain organic acid like fumaric acid, succinic, acetic acid. These organic acids help to solubilize the insoluble phosphate in the soil to soluble form and thus making it available to the plants. The results were to be in parallel with the findings of Divya *et al.*(2015), Priyadarshini and Madhanakumari .(2020).

Physiological parameters

Taro plants treated with organic manures showed a prominent increase in physiological parameters (Table1). The highest dry matter production of 48.45 t $ha^{-1}$was observed with RDF+ vermicompost+ sea weed extract @5ml + phosphobacteria Application of sea weed extract prominently increased the plant height, vegetative growth which significantly helped in increasing the dry matter accumulation of plant. Improved growth may be due to certain growth promoting constituents and osmoprotectant betaines in the extract, Similar findings were also reported by Paramanick *et al.* (2013) and Selvam and Sivakumar. (2014).

Table 1: Effect of organic manures on the physiological and quality parameters of taro

Treatments	No of cormels / plant	Total cormel yield/ plant (g)	Total cormel yield/ plot (Kg)	Dry matter production (tha^{-1})	Total starch (%)	Total sugars (%)	Total folate µg/100g
T_1	5.46	95.46	3.72	4.76	8.35	1.59	18.64
T_2	15.88	427.96	16.69	21.39	9.43	1.81	22.72
T_3	10.55	233.57	9.10	11.66	8.87	1.71	20.52
T_4	12.66	329.14	11.79	15.11	9.11	1.75	21.38
T_5	13.64	342.36	13.35	17.11	9.26	1.77	21.85
T_6	20.34	618.94	24.13	30.93	9.88	1.89	24.12
T_7	7.64	158.99	5.73	7.38	8.57	1.64	19.52
T_8	8.52	172.87	6.74	8.64	8.66	1.66	19.84
T_9	18.22	524.55	20.45	26.21	9.67	1.85	23.54
S. ED	0.86	7.00	0.91	0.53	0.07	0.013	0.22
C.D (p=0.05)	1.84	14.84	1.94	1.13	0.18	0.03	0.55

Quality parameters

Quality parameters (Table 1) showed that application of sea weed extract had a greater beneficial influence on the quality attributes of the crop and showed elevated increase in the amounts of total starch and total sugars. The highest value of these quality parameters was noted with RDF+ vermicompost+ sea weed extract @5ml + phosphobacteria with 9.88 % and 1.89% , respectively. The enhancement in total sugars, total starch may be due presence of carbohydrates, protein, free amino acids, polyphenols and nitrogen content in sea weed extract treated plants. Similar findings were reported by Elsharkawy *et al.* (2019) and Vasantharaja *et al.* (2019).The maximum folate content was found withRDF+ vermicompost+ sea weed extract @5ml + phosphobacteria with 24.12 µg. Since the sea weed extract has high amino acids which are known as building blocks of proteins in plants beside number of additional functions in the regulating of metabolism may be main reason for improving the quality (Al Juthery *et al.*2018). Seaweed extract tends to increase the folate content of product and serves as excellent agents that maintain soil conditions Eswaralakshmi and Hariprasanth (2019).

Table 2: Economics of taro cultivation using organic manures

Treatments	Cost of cultivation ($Rs\ ha^{-1}$)	Gross Income ($Rs\ ha^{-1}$)	Net income ($Rs\ ha^{-1}$)	Benefit cost ratio
T_1	41622.58	50000	8877.42	1.20
T_2	84672.32	213900	125227.68	2.52
T_3	83652.94	116600	32947.06	1.39
T_4	87922.92	151100	63177.08	1.73
T_5	88463.28	171100	82636.72	1.93
T_6	91514.38	300000	208485.62	3.24
T_7	60485.72	73800	13314.28	1.22
T_8	66582.28	86400	20817.72	1.29
T_9	90255.82	270000	156463.33	2.99

Economics

In any of the management technology, the benefit cost ratio analysis is to be focused to access the suitability for adoption of the particular treatment. Among the various treatments application of RDF+ vermicompost+ sea weed extract @5ml + phosphobacteria recorded the highest Gross income of Rs.300000 ha^{-1}, net income of Rs. 208485.62 and benefit cost ratio of Rs. 3.24 followed by RDF+ neem oil cake + effective microorganism (1:1000) + phosphobacteria with gross income of Rs.270000 ha^{-1}, net income of Rs. 156463.3 and benefit cost ratio of Rs. 2.99 and the least value was noted under T_1 RDF+ farm yard manure - control with gross income of Rs.50000 and net income of Rs. 8877.42 and benefit cost ratio of

Rs. 1.20, respectively (Table 2). Application of sea weed extract increased the overall growth as well as yield and quality parameters of the crop due to various active substance in it. Similarly, effective microorganisms also have the ability to promote the yield and quality due to presence of micro and macro elements and bioactive compounds Priyadharshini and Madhanakumari, (2020).

It may be concluded that from the result that the sea weed extract, vermicompost, phosphobacteria proved to be feasible to substitute the synthetic fertilizers. This practice can be recommended to farmers for increasing the yield and enhancing the productivity of the crop thereby improving the monetary return.

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