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Effect of Different Level of NPK and CRF for Plant Growth and Rhizome Yield in Arrowroot (*Maranta arundinacea* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The present investigation was carried out to Effect of different level of NPK and CRF for plant growth and rhizome yield in Arrowroot (*Maranta arundinacea* L.) was conducted in the horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higgin bottom University of Agriculture Technology and Sciences, Prayagraj (U.P.) during July 2021- April 2022. The experiment was laid out in RBD with 11 Treatments with 3 replications. The results revealed that the treatment T_{10} 100% CRF(Control Release Fertilizer)performed the best in terms in Plant height (140.22), leaf length (49.06), leaf width (19.10), No. of tillers(14.33), fresh weight per plant (736.33), Number of rhizomes per plant (11.33), yield of rhizomes per plant (11.78), yield of rhizomes per hectare (81.81), Maximum cost benefit (3.50). Therefore, the treatment T_{10} 100% CRF is the best when compared to other treatments. As, the highest benefit cost ratio was observed in T_{10} 100% CRF. i.e. (3.50).

Keywords: Arrowroot; NPK; CRF; growth and rhizome yield.

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1. INTRODUCTION

Maranta arundinacea is native to Mexico, Central America and South America. It's been introduced within the West Indies, tropical Asia and Africa [1]. They're often found in cultivation throughout the tropics, but is significantly only within the West Indies (Bahamas, Antilles, especially Saint Vincent island).The true arrowroot of commercial importance is the West Indian arrowroot (*Maranta arundinacea L*.) of Marantaceae (2n-48). It's indigenous to tropical America and constitutes one among the main sources of food starch production within the tropics. In India arrowroot is cultivated in Uttar Pradesh, Bihar, Orissa, West Bengal, Assam and Kerala. Major arrowroot growing countries within the world are USA, Brazil, Philippines, India, Sri Lanka, Indonesia, China and Kenya [2].

The rhizomes are ready for harvest by 10-12 months after planting. Maturity is indicated by yellowing and wilting of leaves. At now, the stems go over or lodge. Harvesting is completed by exhumation the plants and separating rhizomes from the leafy stem. Yields vary enormously and range from 75-37 t/ha Composition of fresh rhizome is moisture-63.4 %; starch-25-30 %; crude protein-1.6%; fat- 0.2%; sugar and dextrin -21%; crude fibre-3.9 % attempt to ash -0.9% [3].

The most reliable and effective way to make the availability of nutrients coincide with plant requirements is by controlling their release into the soil solution, using controlled or slow release fertilizers. Using slow-release fertilizers rather than WSF for container-grown plant production has been reported to effectively limit the loss of nutrients [4,5], reduce nutrient runoff, improve nutrient use efficiency and reduce production costs. Also its one application can cover several applications of water soluble fertilizers [6]. Fertilizers with slow release mechanisms can probably meet the upper nutrient needs of chrysanthemums better than water soluble fertilizers. They even have better impact on the yield, flowering, a far better uptake of major nutrients and higher growth rate compared to water soluble fertilizers [7].

Nitrogen (N), phosphorus (P) and potassium (K) are primary nutrients required by the plants for the right growth and development [8]. Growth and development of plants is negatively suffering from the deficiency of any of these nutrients during their life cycle. Nitrogen plays a key role chlorophyll synthesis and subsequently in photosynthesis. Nitrogen plays a crucial role in vegetative growth of plants; thus, should remain available throughout this stage. The P increases cellular division and stimulates root growth and flowering. The P is found in the plant parts having high metabolism and rapid cell division; therefore, plays a task in the storage and transfer of energy released during photosynthesis and its deficiency delays plant maturity.

2. MATERIALS AND METHODS

The experiment was conducted at experimental research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj(UP) during 2021-22 during Kharif season in India. The rhizomes were collected from CTCRI (Central Tuber Crop Research Institute) Sreekaryam.. The pit was dug with 30×30×30 cm^3 and applied dose of FYM is 10 tonnes/ha and N, P, K is 50 kg, 25kg and 75kg/ha respectively. The experiment comprised of 11 treatments and 3 replications. . The experiment was laid out in RBD.

Table 1. List of different level of NPK and CRF treatment combination

Treatments Notation	Treatment combinations
T0	100 % Recommended Dose of Fertilization (50:25:75 kg/h)
T1	90 % RDF +10 % CRF
T2	80 % RDF +20% CRF
T3	70 % RDF +30% CRF
T4	60 % RDF +40% CRF
T5	50 % RDF +50% CRF
T6	40 % RDF +60% CRF
T7	30 % RDF +70% CRF
T8	20 % RDF +80% CRF
T9	10 % RDF +90% CRF
T10	100% CRF

3. RESULTS AND DISCUSSION

3.1 Growth Variables

Data analysis on the days to germination on effect of different level of NPK and CRF for plant growth and rhizome yield in arrowroot the earlier germination was seen in the treatment T10. The maximum germination DAS (21.00) was recorded in the treatment T460 % RDF +40% CRF and minimum germination day (17.50) was recorded in T10100% CRF from Table 2. Earlier germination found in the treatment T10 this may be due to the presence of suitable sandy soil, very deep well drained with shallow water table or better permeability to moist. The view was supported by kamal et al. [9], Narayan et al. [10] and Chandra leela et al. [11] in bottle gourd.

The maximum plant height, leaf length and leaf width at 30, 60, 90 DAS and day before harvest (cm) was recorded in the treatment T10100% CRF followed by treatment T9 10 % RDF +90% CRF and minimum plant height was recorded in treatment T0100 % RDF (50:25:75 kg/ha). Which might be due to higher levels of N, P and K, which found suitable for arrowroot which is helpful in cell elongation of leaves use to development of cell and rapid cell division and cell elongation in meristematic region of plant due to production of plant growth substance and this may be due to abundant supply of plant nutrients and water which led in the growth of arrowroot. This finding correlates the findings of Tumbarc et al., (2002) in Chilli, Sundar et al., [12] in Lettuce. These results are in close conformity with the findings of Utgikar et al. [13], Reddy [14] and Patel et al. [15] in Isabgol.

The maximum Number of tillers per plant at 30, 60, 90 DAS and day before harvest(cm) was recorded in the treatment T10100% CRF (2.00),followed by treatment T9 10 % RDF +90% CRF (1.50) and minimum Number of tillers per plant (1.25) was recorded in treatment T0100 % RDF (50:25:75 kg/ha). Increase in number of tillers per plant might be due to increased growth of plant in the form of height and number of leaves, which accumulated more photo synthates and thereby increased number of tillers per plant. These findings are in the close conformity with the findings of Utgikar et al. [13] and Saho et al., [16] in is abgol.

3.2 Yield Variables

The maximum fresh weight per plant (276.75) was recorded in the treatment T10100% CRF, followed by treatment T910 % RDF +90% CRF (252.08) and minimum fresh weight per plant (108.92) was recorded in treatment T0100 % RDF from Table 3. In Arrowroot, increased vegetative growth results in increased production and storage of photo synthates in rhizomes which accounts for higher yield. In the present study also a significant increase in rhizome yield was observed with increased NPK levels. In general, yield levels increased with an increase in fertilizer levels and highest yield of fresh rhizome. Muralidharan et al. [17], Rao et al. [18], Swamy et al. [19] and Shankaraiah et al. [20] observed increased rhizome yield with increase in level of nutrients in turmeric. Randhawa et al. [21] reported significant influence of NPK levels on rhizome yield in ginger.

The maximum Numberofrhizomes perplant (11.33) was recorded in the treatment T10100% CRF, followed by treatment T910 % RDF +90% CRF (11.25) and minimum Number of rhizomes per plant (9.25) was recorded in treatment T0100 % RDF. The maximum Rhizome yield per plot(4.43) was recorded in the treatment T10100% CRF, followed by treatment T910 % RDF +90% CRF (4.03) and minimum Rhizome yield per plot (1.74) was recorded in treatment T0100 % RDF. The application of N and K favoured the metabolic and auxin activities in plant and ultimately resulted in increased fruit size, number of fruits per plant, fruit weight and yield per hectare. These findings are similar of those reported by Ismail et al. (2009), Nedunchezhiyan et al. [22], Pant et al. [23] and Zhang Fu Chun et al. [24] in Taro.

The maximum Rhizome yield per hectare(4.43) was recorded in the treatment T10100% CRF, followed by treatment T910 % RDF +90% CRF (4.03) and minimum Rhizome yield per hectare (1.74) was recorded in treatment T0100 %. The application of N and K favoured the metabolic and auxin activities in plant and ultimately resulted in increased yield per hectare. These findings are similar of those reported by Ismail et al. (2009), Nedunchezhiyan et al. [22], Pant et al. [23] and Zhang Fu Chun et al. [24], Mohan et al., [25] in Taro.

Table 2. Effect of different level of NPK and CRF on growth releated traits of Arrowroot

Treatment	plant height(cm)					Leaf length(cm)					Leaf width(cm)					No. of tillers				
	30 DAS	60 DAS	90 DAS	120 DAS	DBH	30 DAS	60 DAS	90 DAS	120 DAS	DBH	30 DAS	60 DAS	90 DAS	120 DAS	DBH	30 DAS	60 DAS	90 DAS	120 DAS	DBH
T0	21.08	37.50	63.63	86.03	105.89	15.61	21.28	26.49	38.26	46.96	4.01	7.55	11.08	13.35	17.84	1.25	3.25	6.50	9.50	13.08
T1	21.40	37.83	63.63	86.08	106.13	15.83	21.28	26.88	38.34	47.00	4.19	7.68	11.12	13.45	17.93	1.25	3.25	6.58	9.58	13.17
T2	21.98	37.86	63.82	86.17	106.25	15.82	21.36	26.93	38.63	47.37	4.34	7.76	11.13	13.86	18.04	1.33	3.50	6.58	9.67	13.33
T3	22.08	37.89	63.78	86.15	106.59	16.57	21.97	27.68	38.66	47.11	4.52	7.80	11.18	13.62	17.92	1.42	3.33	6.67	9.83	13.67
T4	22.08	38.06	63.93	86.27	106.28	16.50	21.34	27.33	38.98	47.08	4.42	7.78	11.19	13.53	18.03	1.33	3.50	6.75	9.75	13.33
T5	22.03	38.36	64.30	86.83	106.31	16.01	21.31	27.23	38.86	47.23	4.43	7.72	11.19	13.48	17.94	1.42	3.50	6.58	9.75	13.50
T6	22.17	38.24	64.72	86.14	106.25	16.09	21.48	27.27	38.57	47.43	4.41	7.72	11.20	13.55	18.06	1.25	3.58	6.67	9.67	13.17
T7	22.22	38.03	63.87	86.63	106.40	16.23	21.67	27.54	38.66	47.51	4.43	7.78	11.18	13.46	17.98	1.33	3.33	6.58	9.92	13.33
T8	22.43	38.32	63.97	86.71	106.45	16.42	22.17	28.11	39.16	47.77	4.53	7.86	11.18	13.73	18.05	1.33	3.42	6.67	9.67	13.42
T9	22.68	38.92	64.43	87.45	106.59	16.59	22.19	28.24	39.48	47.79	4.56	7.86	11.28	13.88	18.18	1.50	3.58	6.92	10.00	13.92
T10	27.26	44.37	71.48	90.47	110.44	18.25	25.58	30.02	40.13	49.06	5.00	8.28	11.48	14.65	19.10	2.00	4.25	7.58	10.67	14.33
S.Ed (±)	**0.71**	**0.57**	**0.67**	**0.58**	**0.70**	**0.52**	**0.47**	**0.49**	**0.39**	**0.44**	**0.18**	**0.14**	**0.08**	**0.22**	**0.18**	**0.09**	**0.14**	**0.21**	**0.21**	**0.32**
C.D.(0.05)	**1.49**	**1.19**	**1.40**	**1.21**	**1.46**	**1.08**	**0.98**	**1.01**	**0.82**	**0.92**	**0.37**	**0.29**	**0.17**	**0.47**	**0.38**	**0.19**	**0.28**	**0.45**	**0.43**	**0.67**
C.V.	**3.88**	**1.81**	**1.27**	**0.82**	**0.82**	**3.89**	**2.63**	**2.15**	**1.23**	**1.13**	**4.96**	**2.21**	**0.88**	**2.00**	**1.22**	**7.92**	**4.73**	**3.89**	**2.60**	**2.90**

Table 3. Effect of different level of NPK and CRF on yield traits of Arrowroot

Treatment	Fresh weight per plant(gm)	Number of rhizomes per plant	Rhizome yield per plot(kg)	Rhizome yield per hectare(t/ha)
T0	108.92	9.25	1.74	12.10
T1	138.92	9.25	2.22	15.43
T2	164.92	9.42	2.63	18.32
T3	173.08	9.50	2.77	19.23
T4	184.83	9.58	2.95	20.53
T5	194.17	9.58	3.10	21.57
T6	200.42	9.67	3.20	22.26
T7	207.50	9.67	3.32	23.05
T8	228.83	11.08	3.66	25.42
T9	252.08	11.25	4.03	28.00
T10	276.75	11.33	4.43	30.75
S. Ed (±)	**0.60**	**0.36**	**0.01**	**0.07**
C.D.(0.05)	**1.26**	**0.76**	**0.02**	**0.14**
C.V.	**0.38**	**4.45**	**0.43**	**0.38**

4. CONCLUSION

The present investigation was concluded that the different levels of NPK and CRF treatments rendered their significant effect on almost all the growth and yield characters of arrowroot that the treatment T_{10} i.e. application of 100 % CRF was found superior in terms of days to germination, plant height (cm), leaf length (cm), leaf width (cm), number of tillers per plant, fresh weight per plant (gm), yield of rhizome per plot (kg) and yield of rhizome per hectare (t/ha) was found suitable for application in kharif season arrowroot cultivation for better growth and yield.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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