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Influence of pre-harvest application of growth regulators on the yield and quality of Elephant Foot Yam (*Amorphophallus paeoniifolius* Dennst.)

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Abstract

The present investigation aimed to study the effect of pre-harvest application of growth regulators on the yield and quality of elephant foot yam, Amorphophallus paeoniifolius Dennst. Thirteen pre-harvest treatments with Cycocel, Ethrel and Kinetin were used individually and in combination with Ridomil at different concentrations 15 days and 30 days before harvesting. Among the pre-harvest treatments, combination of Cycocel @ 500 ppm + Ridomil @ 0.5% sprayed 30 days before harvest in elephant foot yam recorded the highest mean corm weight (820.60g) and yield 36.70 t/ha. After harvest, the corms were stored in a well-ventilated dry room in 60-75 % relative humidity. Among the thirteen treatments, there was a significant loss in corm weight, starch content, dry matter, and oxalate content during storage. The corm weight was significantly higher in T8 (791.60 g) followed by T11 (773.30 g) and T2 (695.10 g) after six months of storage. There was no significant loss in starch and dry matter content of corms in all the treatments during storage. The starch content of elephant foot yam ranged from 8.96 to 10.20%, dry matter content ranged from 21.50 to 25.00%. The oxalate content is significantly lower in T8 (115.5 mg/100g) followed by T2 (120 mg/100g) and T9 (123 mg/100g).

Keywords: *Elephant foot yam, growth regulators, corm weight, starch, dry matter, the oxalate content*

Introduction

Elephant foot yam *(Amorphophallus paeoniifolius* Dennst.) is one of the most profitable tuber crops grown in the subtropical and tropical regions of the world. It belongs to the family, Araceae. It has long been used as a local staple food after cereals and pulses in many countries such as the Philippines, Java, Indonesia, Sumatra, Malaysia, Bangladesh, India, China, and South East Asian countries [1]. In India, it is cultivated in an area of 32,000 ha with a production of 8.08 lakh tonnes [2]. In India, it is cultivated in Andhra Pradesh, West Bengal, Gujarat, Kerala, Tamil Nadu, Maharashtra, Uttar Pradesh, and Jharkhand. It has special significance due to its high production potential and high starch content [3], high productivity, easy cultivation, stable market price, and less incidence of pests and diseases. Corms are consumed after cooking and baking. Value added products like elephant foot yam pickles and chips are prepared. Elephant foot yam pickle is very popular in Eastern India. Elephant foot yam corms contain a protein content of 9.81±2.5 g/100 g (dry weight basis), ascorbic acid of 76.65 ±10.5 mg/100g (dry weight basis), low fat content [4], phosphorus (34 mg/100 g), calcium (50 mg /100 g), vitamin A (434 IU/100 g), crude protein (2.14%), fat (0.46 %), calcium (32.1 mg/100 g) and crude fiber (1.68%) and dietary fiber [5]. Corms have anti-inflammatory properties [6], anti-microbial [7], hepatoprotective [8], and antioxidant properties [9], [10]. Corms are also effective anti-diabetic agents for streptozotocin induced diabetic rats [11]. Corms also contain anti-nutritional factors, such as oxalate and phytate.

Amorphophallus is slowly attaining the status of a cash crop due to its tremendous production potential, and huge domestic demand as an ingredient

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in various delicious cuisines. It is also cultivated as an intercrop with turmeric and under coconut and banana. Ethephon thiourea, potassium nitrate, kinetin [12], [13], and CCC were effective in promoting the sprouting of corms. Chemicals influence the dormancy breaking [14], yield, and quality in elephant foot yam [15]. The major problem associated with the consumption of fresh elephant foot yam is acridity due to oxalate content [16]. Acridity is experienced as an irritative (itching-stinging-burning) sensation in the mouth and throat. Oxalate is considered to be anti-nutritional and toxic [17]. Ingestion of a higher amount of oxalate (2 g) can be fatal to humans [18]. Oxalates can also get deposited in the kidney and cause renal stones, leading to renal failure. Reduction of acridity/ oxalate will benefit in better utilization of corms for food purposes. Cooking reduces oxalate content. On storage of corms, oxalate gets reduced. Corms can also be cured in naturally ventilated barns or other storage structures. Curing is less effective if the damage to corms is extensive. Fungicide treatment may be necessary if base trimming is practiced [19].

Curing can also be achieved at elevated temperatures in high humidity environments, but chemical application to suppress sprouting has been suggested to cause an inhibitory effect on wound healing and periderm formation. Keeping this in view, the study was conducted to study the effect of pre-harvest treatments on the tuber weight, yield, starch, and calcium oxalate contents of elephant foot yam.

Materials And Methods

Research experiments were conducted on 'Studies on pre-harvest treatments on postharvest quality of elephant foot yam *(Amorphophallus paeoniifolius* Dennst.) variety Appakoodal local' in the experimental field of Tamil Nadu Agricultural University, Coimbatore during 2017-18. The experiment was laid out in a randomized block design with thirteen treatments replicated thrice each in a plot size of 4.5 m x 4.5 m. The corms were planted at a spacing of 90 x 90 cm. The experimental field view of elephant foot yam is shown in Fig.1. Two crops were raised for two consecutive years, and post-harvest and storage studies were conducted. Before harvesting the elephant foot yam, the following thirteen pre-harvest treatments usingCycocel, Ethrel, and Kinetin were used individually and in combination with Ridomil at different concentrations 15 days and 30 days before harvesting for improving the quality of the storage life of elephant foot yam.

T_1 - Control,
T_2- Cycocel @ 500 ppm at 30 days before harvest,
T_3 - Ethrel @ 250 ppm at 30 days before harvest,
T_4 - Kinetin @ 100 ppm at 30 days before harvest,
T_5 - Cycocel @ 500 ppm at 15 days before harvest,
T_6 - Ethrel @ 250 ppm at 15 days before harvest,
T_7 - Kinetin @ 100 ppm at 15 days before harvest,
T_8 - Cycocel @ 500 ppm + Ridomil @ 0.5% at 30days before harvest,
T_9 - Ethrel @ 250 ppm + Ridomil @ 0.5% at 30days before harvest,
T_{10}- Kinetin @ 100 ppm + Ridomil @ 0.5% at 30days before harvest,
T_{11}-Cycocel @ 500 ppm + Ridomil @ 0.5% at 15 days before harvest,
T_{12} -Ethrel @ 250 ppm + Ridomil @ 0.5% at15 days before harvest,
T_{13} -Kinetin @ 100 ppm + Ridomil @ 0.5% at15 days before harvest.

After eight months, the corms were harvested and stored at room temperature under well ventilated and dry room with a relative humidity of 60-75 %. The data were recorded on mean corm weight (g), corm yield (t/ha), starch content (%), dry matter content (%), and oxalate content (mg/100 g) at the weekly intervals to assess the quality of the treated elephant foot yam. The data were subjected to statistical analysis [20].

Fig. 1: Field view of Elephant Foot Yam

Results And Discussion

The results of mean corm weight (g), corm yield (t/ha), starch content (%), dry matter content (%), and oxalate content (mg/100 g) are given in Table 1. There was a significant difference in mean corm weight after the pre-harvest application of growth regulators. It is

Table 1: Effect of pre-harvest treatments on yield and quality of Elephant foot yam immediately after harvesting

Treatments	Mean corm weight (g)	Corm yield (t/ ha)	Starch content (%)	Dry matter content (%)	Oxalate content (mg/100 g)
T_1	390.00	16.70	10.15	22.25	693.00
T_2	722.60	**31.30**	10.84	**24.00**	**151.00**
T_3	563.60	28.50	10.42	21.00	595.00
T_4	488.00	22.20	10.28	23.00	181.00
T_5	721.60	30.90	10.70	22.00	184.00
T_6	540.60	29.30	10.41	22.50	183.00
T_7	434.30	19.70	10.24	20.00	393.00
T_8	**820.60**	**36.70**	11.03	23.00	**151.00**
T_9	679.60	30.90	10.55	21.03	204.00
T_{10}	528.60	24.50	10.31	23.25	280.00
T_{11}	**806.30**	32.40	11.00	20.78	232.00
T_{12}	587.30	28.90	10.51	22.25	356.00
T_{13}	410.60	18.90	10.23	21.50	356.00
Mean	**591.82**	**26.99**	**10.51**	**22.04**	**304.54**
CD (p=0.05)	0.27	0.34	1.54	0.88	0.58
SEd	0.54	0.68	2.08	1.66	1.16

Table 2: Effect of pre-harvest growth regulators on corm weight, starch and dry matter content of Elephant foot yam during storage

Treatments	Mean corm weight(g)		Starch content (%)		Dry matter content (%)	
	Three months	Six months	Three months	Six months	Three months	Six months
T_1	373.30	359.30	9.65	9.41	25.25	23.75
T_2	695.30	695.10	9.83	9.75	**27.00**	**25.00**
T_3	541.00	528.00	9.20	9.03	23.50	22.00
T_4	464.60	456.30	9.08	8.96	24.90	24.00
T_5	700.05	683.15	10.00	9.72	24.15	23.00
T_6	518.30	512.60	10.01	9.85	25.00	23.50
T_7	403.30	402.60	9.90	9.65	23.20	21.50
T_8	795.60	**791.60**	10.25	10.03	26.00	24.50
T_9	649.30	641.00	10.01	9.86	25.75	23.05
T_{10}	512.00	489.60	9.89	9.80	27.20	25.25
T_{11}	**806.30**	773.30	**10.53**	**10.20**	24.00	22.78
T_{12}	572.30	564.30	10.03	9.91	24.30	23.25
T_{13}	398.60	381.60	9.97	9.82	24.00	22.50
Mean	**571.53**	**559.88**	**9.87**	**9.69**	**24.94**	**23.39**
CD (p=0.05)	0.725	0.352	0.267	0.468	0.979	0.711
SEd	1.453	0.705	0.534	0.936	1.958	1.423

observed that the treatment T_8(Cycocel @ 500 ppm + Ridomil @ 0.5% at 30 days before harvest) recorded the highest mean corm weight (820.60 g) followed by the treatment T_{11}(Cycocel @ 500 ppm + Ridomil @ 0.5% at 15 days before harvest) with individual corm weight of 806.30 g as compared to control (390.00 g) of Appakoodal local variety of elephant foot yam. Similar findings were reported [21]. It was found that the treatment, T_8 (Cycocel @ 500 ppm + Ridomil @ 0.5% at 30 days before harvest) showed the highest yield of 36.70 t/ha followed by the treatment T_{11} (Cycocel @ 500 ppm + Ridomil @ 0.5% at 15 days before harvest) with the yield of 32.40 t/ha. There was no significant difference in starch and dry matter content of corms. There was a significant difference in oxalate content in the corms after the pre-harvest application of growth regulators. The oxalate content was significantly lower in T_8 (151.00 mg/100g) and T_2 (151.00 mg/100g) followed by T_4 (181.00 mg/100g), T_6 (183.00 mg/100g) and T_5 (184.00 mg/100g) compared to control T_1 with highest oxalate content (693.00 mg/100 g).

Storage Studies

The elephant foot yam after harvesting was stored in well ventilated and dry room. The quality of the yams after three months and six months of storage is shown in Table 2 and Figure 2. It was observed that under the well ventilated and dry room, yam can be stored for upto a period of six months. Similar findings were reported [22].

Among treatments, there was a significant loss in corm weight, starch content, and dry matter content during storage. Reduction in weight may be due to respiration and water loss. Growth regulators have an inhibitory effect on wound healing and periderm formation [23]. The corm weight was significantly higher in T_8 (791.60 g) followed by T_{11}(773.30 g) and T_2 (695.10 g) after six months of storage. There was no significant loss in starch and dry matter content of corms in all the treatments during storage. The starch content of elephant foot yam samples ranged from 8.96 to 10.20%, dry matter content ranged from 21.50 to 25.00%. The oxalate content is significantly lower in T_8 (115.5 mg/100g) followed by T_2 (120 mg/100g) and T_9 (123 mg/100g). A decrease in the total oxalate content of corms was found during storage [24].

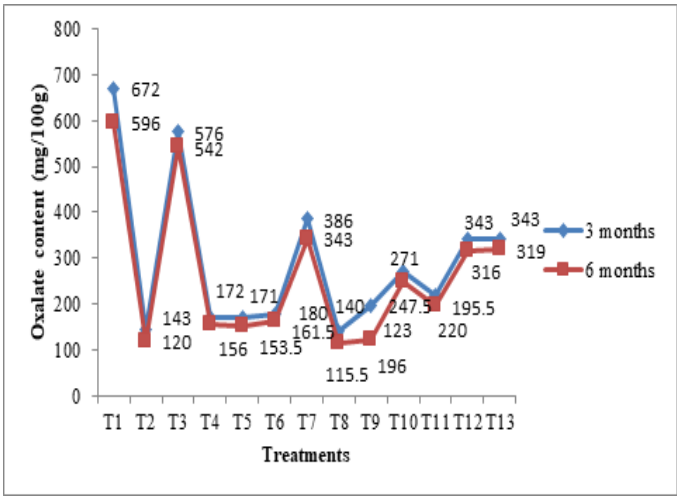

Figure 2: Effect of pre-harvest growth regulators on oxalate content of Elephant foot yam during storage

Conclusion

The results suggested that the pre-harvest foliar spray of Cycocel @500 ppm + Ridomil @ 0.5% 30 days before the harvest was found to be beneficial to improve the quality of elephant foot yam corms. The oxalate content is significantly lower in T_8 - Cycocel @ 500 ppm + Ridomil @ 0.5% at 30 days before harvest, (115.5 mg/100g) followed by T_2 - Cycocel @ 500 ppm at 30 days before harvest (120 mg/100g) and T_9 - Ethrel @ 250 ppm + Ridomil @ 0.5% at 30 days before harvest (123 mg/100g). The harvested corms are stored in sand or paddy straw under well-ventilated and dry rooms without much deterioration in biochemical changes and nutritional qualities for up to six months duration. Corms are substitution of cereals and research on their chemical composition is an important contribution to the field of the indigenous traditional system of food consumption.

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