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Impact of Growth Regulators on Cormel Production and Dormancy Breaking in Elephant Foot Yam [*Amorphophallus paeoniifolius* (Dennst.) Nicolson]

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Abstract

Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson) is a popular tropical tuber crop grown for its starchy corms. It is propagated through both corms and cormels. A field experiment followed by post-harvest study was conducted during 2008-2010 at Regional Centre of Central Tuber Crops Research Institute, Dumuduma, Bhubaneswar, India, to find out the effect of growth regulators on cormel production, dormancy breaking and sprout growth. The results revealed that pre-harvest foliar spraying (at 5 and 6 MAP) followed by post-harvest application (soaking the corms for 30 min) of thiourea 200 ppm reduced corm dormancy by 21 days and increased the sprout growth. Pre-harvest application of potassium nitrate 200 ppm was found to be effective in inducing cormels. This growth regulator can be tried in cormel producing varieties for better cormel production.

Key words: *Amorphophallus paeoniifolius*, cormels, gibberellic acid, potassium nitrate, sprouts, thiourea

Introduction

Elephant foot yam (*Amorphophallus paeoniifolius* (Dennst.) Nicolson), a popular tropical tuber crop, is commercially cultivated in Andhra Pradesh, Bihar, West Bengal, Orissa, Gujarat, Kerala and North-Eastern states of India (Nedunchezhiyan and Byju, 2005; Nedunchezhiyan et al., 2006). The botanically modified stem 'corm' is consumed as a vegetable after boiling, baking and frying (Nedunchezhiyan et al., 2002; Nedunchezhiyan, 2008). Young leaves are also used as vegetable after chopping and boiling. Pickle, a delicacy recipe preferred by Indians is also prepared from elephant foot yam corms (Nedunchezhiyan and Misra, 2008). Corms are rich in minerals and vitamins (Nedunchezhiyan et al., 2008). Elephant foot yam has great export potential especially to West Asia, Australia, USA and Europe. The production potential of this crop is 50.0 t ha^{-1} (Nedunchezhiyan et al., 2002). This crop is propagated through corms and cormels.

Whole corm or cut corm pieces (500-750 g) having part of apical meristem is mainly used as seed material. A great portion (about 25 %) of the harvested produce is lost as source of planting material. At times, it is very difficult to provide a large quantity of quality planting materials. Cormels are also a good source of planting material. The apical bud of the cormels sprouts simultaneously with the corms, irrespective of the size, once dormancy is broken. Hence, farmers separate the cormels from the corms immediately after harvest and use as seed material.

'Gajendra' a popular variety of elephant foot yam is grown throughout India for its low acridity and high yields. It produces smooth type corms without any cormels. But rarely produces smaller size one or two cormels in hard soil. Hence, farmers use corms as planting material. It requires huge quantity of seed material i.e. 5.0 to 6.0 t ha^{-1}, which is very difficult for transporting to distant places.

Growth regulators were found to hasten sprouting (Nedunchezhiyan and Mohankumar, 1997; Kumar et al., 1998; Bhagavan, 2005) and sprouting percentage (Dhua et al., 1988; Das et al., 1995; Kumar et al., 1998; Bhagavan, 2005) in elephant foot yam. Mukherjee et al. (2009) reported that thiourea had greater influence in breaking dormancy. Soaking bottom corm setts for 6 h in thiourea, KNO_3, gibberellic acid and ccc (chlormequat) increased sprouting percentage and growth (Das et al., 1995). Dhua et al. (1988) reported that 250 g basal corm portion treated with 200 mg thiourea, 500 mg KNO_3, 0.02 ml CCC per litre increased sprouting percentage of cut pieces. Bhagavan (2005) reported that foliar spraying of potassium nitrate (KNO_3) (1-2%), thiourea (0.5-1.0%) and ethephon (500-1000 ppm) recorded early and increased sprouting of seed corms.

Available literature showed that growth regulators were used for breaking dormancy and increasing the sprouting percentage. However, it can also be used for cormel production. Hence, the present investigation was undertaken to study the effect of pre and post- harvest application of growth regulators on cormel induction and development, breaking dormancy and sprout growth in elephant foot yam.

Materials and Methods

A field experiment followed by post-harvest study was conducted during 2008-2010 at Regional Centre of Central Tuber Crops Research Institute (20º 14' 50" N and 85º 47' 06" E), Dumuduma, Bhubaneswar, India. In the field experiment the effect of pre-harvest foliar spraying of growth regulators was studied for two years 2008-09 and 2009-10 in acid Alfisols. The experiment was conducted in Randomized Block Design and the treatments were replicated thrice. The treatments consisted of T_1: control (no spray), T_2: thiourea (200 ppm) at 6 months after planting (MAP), T_3: gibberellic acid (200 ppm) at 6 MAP, T_4: potassium nitrate (200 ppm) at 6 MAP, T_5: thiourea (200 ppm) at 5 and 6 MAP, T_6: gibberellic acid (200 ppm) at 5 and 6 MAP and T_7: potassium nitrate (200 ppm) at 5 and 6 MAP. Uniform corm size of 500 ± 25 g was planted on 15 May 2008 and 10 May 2009 under drip irrigation. The crop was planted at 90 x 90 cm spacing and fertilized with FYM @10 t ha^{-1} and $N:P_2O_5:K_2O$ @ 80:60:80 kg ha^{-1}. The other recommended package of practices was also followed. The crop was harvested after full maturation (pseudostems completely dried at 7 months after planting). The plants were harvested treatment wise. The soil adhered to the corms were removed by washing in tap water and dried in partial shade for 3 days (curing). Ten corms from each treatment were selected and number of cormels per corm was counted. Then the corms were stored for recording sprouting time and percentage of sprouting.

The effect of post-harvest application of growth regulators was studied in the corms harvested from the experiment on pre-harvest application of growth regulators. The corms were soaked in growth regulators for 30 min. The experiment was conducted for two years *viz.*, 2008-09 and 2009-10. The treatments consisted of $P_1:T_1$ (control), $P_2:T_1$+thiourea 200 ppm, $P_3:T_1$+gibberellic acid 200 ppm, $P_4:T_1$+potassium nitrate 200 ppm, $P_5:T_2$+thiourea 200 ppm, $P_6:T_3$+gibberellic acid 200 ppm, $P_7:T_4$+potassium nitrate 200 ppm, $P_8:T_5$+thiourea 200 ppm, $P_9:T_6$+gibberillic acid 200 ppm and $P_{10}:T_7$+potassium nitrate 200 ppm. In each treatment 10 corms were studied. The treatments were replicated thrice. The time taken for sprouting and sprouting percentage was recorded. The data were analyzed using GENSTAT programme.

Results and Discussion

Pre-harvest foliar application of growth regulators significantly influenced the cormel development in smooth corm variety 'Gajendra' (Table 1). However, the maximum number of cormels produced was 1.8 per corm with 3.1 cm average length. Though these smaller size cormels are not suitable as planting material for commercial cultivation, they can be used for seed corm production combined with best agronomic practices. Pre-harvest spraying of growth regulators twice (5 and 6 MAP) recorded significantly higher number of cormels/ corm and cormel length than spraying once (6 MAP) and control (Table 1). Among growth regulators, potassium nitrate induced more number of cormels/ corm and cormel length than gibberellic acid and thiourea (Table 1). The present investigation indicated that growth regulators can be successfully used for cormel production in cormel producing varieties. Spraying of growth regulators twice before harvesting had better

Table 1. Effect of pre-harvest application of growth regulators on cormel and sprout production in elephant foot yam (mean of two years)

Treatment	No. of cormels/ corm	Cormel length (cm)	Days to 50% sprouting	Days to 100% sprouting	10 days after sprouting	
					Sprout diameter (cm)	Sprout length (cm)
T_1: control (no spray)	0.2	0.6	48	56	2.4	2.2
T_2: thiourea (200 ppm) at 6 MAP	0.4	2.0	43	48	3.0	2.9
T_3: gibberellic acid (200 ppm) at 6 MAP	0.6	2.1	45	50	2.8	2.7
T_4: potassium nitrate (200 ppm) at 6 MAP	0.8	2.4	47	52	2.7	2.5
T_5: thiourea (200 ppm) at 5 and 6 MAP	1.1	2.7	40	44	3.3	3.2
T_6: gibberellic acid (200 ppm) at 5 and 6 MAP	1.4	2.8	42	45	3.0	3.0
T_7: potassium nitrate (200 ppm) at 5 and 6 MAP	1.8	3.1	43	47	2.9	2.7
CD (0.05)	0.1	0.2	2	4	0.4	0.3

influence than single application. With regard to cormel induction and development, potassium nitrate was better than the other growth regulators.

Marked variation in number of days to 50 and 100% sprouting was observed due to pre-harvest application of growth regulators (Table 1). Pre-harvest spraying of growth regulators twice (5 and 6 MAP) significantly reduced the number of days for 50 and 100 % sprouting than spraying once (6 MAP) and control (Table 1). Pre-harvest spraying of growth regulators twice (5 and 6 MAP) reduced days for 50% sprouting by 5-8 days and days for 100% sprouting by 9-12 days. Whereas, single spraying (6 MAP) reduced days for 50% sprouting by 1-5 days and days for 100% sprouting by 4-8 days. Among the growth regulators, thiourea had better effect than the other growth regulators. Spraying thiourea twice (5 and 6 MAP) took significantly less number of days to 50% (40 days) and 100% sprouting (44 days) in elephant foot yam corm (Table 1). It was followed by gibberellic acid and potassium nitrate. Kumar et al. (1998) reported that thiourea was the most effective in breaking dormancy with 92 % sprouting in 75 days after harvest compared to 18% sprouting in the control.

Sprout growth (diameter and length) at 10 days after sprouting was found significantly influenced by growth regulators and number of pre-harvest spraying (Table 1). Pre-harvest spraying of growth regulators twice (5 and 6 MAP) produced longer sprouts with maximum diameter than spraying once (6 MAP) and control. Among the growth regulators, thiourea produced sprouts with longer and greater diameter at 10 days after sprouting, irrespective of the number of sprays (Table 1). Pre-harvest application of thiourea 200 ppm at 5 and 6 MAP resulted in maximum sprout diameter (3.3 cm) and sprout length (3.2 cm) at 10 days after sprouting. The least sprout diameter and length was observed in the control treatment (Table 1).

Post-harvest application of growth regulators also reduced days to 50% (3-5 days) and 100% sprouting (5-7 days) (Table 2). Post-harvest spraying in combination with pre-harvest spraying produced

Table 2. Effect of pre and post-harvest application of growth regulators on sprout production in elephant foot yam (mean of two years)

Treatment	Days to 50% sprouting	Days to 100% sprouting	No. of sprouts/corm	10 days after sprouting	
				Sprout diameter (cm)	Sprout length (cm)
P_1:T_1 + control (no spray)	48	56	1.0	2.4	2.2
P_2:T_1 + thiourea (200 ppm)	44	49	1.4	3.2	2.9
P_3:T_1 + gibberellic acid (200 ppm)	44	51	1.2	3.0	2.9
P_4:T_1 + potassium nitrate (200 ppm)	45	51	1.1	3.0	2.8
P_5:T_2 + thiourea (200 ppm)	35	36	1.9	3.4	3.2
P_6:T_3 + gibberellic acid (200 ppm)	37	40	1.6	3.3	3.0
P_7:T_4 + potassium nitrate (200 ppm)	38	41	1.5	3.2	3.0
P_8:T_5 + thiourea (200 ppm)	33	35	2.3	3.8	3.6
P_9:T_6 + gibberellic acid (200 ppm)	34	37	1.8	3.5	3.2
P_{10}:T_7 + potassium nitrate (200 ppm)	35	37	1.7	3.4	3.2
CD (0.05)	3	4	0.2	0.3	0.2

significant synergetic effect on days to sprouting. Single pre-harvest spraying followed by post-harvest application of growth regulators resulted in 50% sprouting in 35-38 days, whereas 100% sprouting was obtained in 36-41 days. Two pre-harvest spraying followed by post-harvest application of growth regulators resulted in 50% sprouting in 33-35 days, whereas 100% sprouting was noticed by 35-37 days. Thus, two pre-harvest spraying and post-harvest application reduced dormancy period by 19-21 days. Among the growth regulators, thiourea was found most effective in reducing the dormancy period by 21 days than gibberellic acid and potassium nitrate (Table 2).

Post-harvest application of growth regulators induced more than one sprouts in some corms (Table 2). Application of thiourea 200 ppm produced on an average 1.4 sprouts per corm. Post- harvest application of growth regulators in combination with pre-harvest spraying of growth regulators resulted in more number of sprouts per corm. Two pre-harvest spraying followed by post-harvest application of thiourea 200 ppm produced 2.3 sprouts per corm. Induction of multiple sprouts in big corms is useful when setts were prepared for planting.

Post-harvest application of growth regulators also enhanced growth of sprout buds (Table 2). Maximum sprout diameter and length was observed in two pre-harvest spraying followed by post-harvest application of growth regulators than one pre-harvest spraying followed

by post-harvest application of growth regulators and control. Among the growth regulators, application of thiourea 200 ppm had profound effect on sprout bud development. Maximum diameter of 3.8 cm and length of 3.6 cm was observed at 10 days after sprout initiation in two pre-harvest spraying followed by post-harvest application of thiourea 200 ppm.

Conclusion

The present study revealed that two pre-harvest foliar spraying (at 5 and 6 MAP) followed by post-harvest application (soaking the corms for 30 min) of thiourea 200 ppm reduced the corm dormancy by 21 days and increased the sprout growth and development. Pre-harvest foliar spraying of potassium nitrate 200 ppm was found effective in inducing cormels. This growth regulator can be tried in cormel producing varieties for better cormel production.

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