Environment and Ecology 41 (2) : 741—745, April– June 2023
ISSN 0970-0420

Effect of NAA on the Induction of Flowering in Pineapple var Queen at Different Growth Stages

Dunihiyo Pasi, C. P. Suresh, Khamrang Mathukmi, Yumnam Somi Singh, Animaka Gurung

Received 6 October 2022, Accepted 3 February 2023, Published on 24 April 2023

ABSTRACT

The present experiment was conducted in the experimental field of Department of Horticulture, North Eastern Hill University (NEHU), Tura Campus, Meghalaya, during the year 2021-2022. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Artificial induction of flowering in pineapple has been tried with various plant growth regulators in the past and some degree of success has been achieved. Seven stages of growth i.e 15-20 leaves stages, 20-25 leaves stages, 25-30 leaves stages, 30-35 leaves stages, 35-40 leaves stages, 40-45 leaves stages and 45-50 leaves stages were treated with 10 ppm NAA. A control plant for each treatment was maintained. The treatment was repeated three times at an interval of two days. The data were recorded on flowering and fruit characters after completion of flowering as influenced by treatment of 10 ppm NAA on different growth stages. After application of 10 ppm NAA, the growth stage at 45-50 leaves required the least days to flowering, maximum flowering duration, girth of the fruit and length of fruit after completion of flowering. Maximum flower length and highest percentage of flower setting was recorded in growth stage of 40-45 leaves.

Keywords Pineapple, NAA, Flowering, Fruiting.

INTRODUCTION

Pineapple (*Ananas comosus*) is a humid subtropical plants and it is one of the commercially important fruit crops in India. It belong to the family Bromeliaceae with chromosome number n=25. Pineapple is native to South America (Brazil) and ranks third as the most important tropical fruits after banana and mango (Zhang *et al.* 2014). In local language (Garo), it is called Anaros. It is an herbaceous monocotyledonous perennial plant. It can tolerate drought as it is a xerophytic and CAM plant. To date, more than 100 varieties of pineapple exist in which only 6 to 8 varieties are grown commercially (Steingass *et al.* 2020).

Queen pineapple is one of the five groups of pineapple cultivar, it can be differentiated from others cultivars by its serrated leaves. The plants are medium vigour and moderate in size. Queen is the early variety which ripens in June and July. This cultivar is mostly cultivated in northeast India and it is

Dunihiyo Pasi[1], C. P. Suresh[2], Khamrang Mathukmi[3]*, Yumnam Somi Singh[4], Animaka Gurung[5]
[2]Professor, [3,5]Guest Faculty, [4]Assistant Professor
Department of Horticulture, North Eastern Hill University, Tura Campus, Meghalaya 794001, India
Email: mkhamrang.agri13@gmail.com
*Corresponding author

suitable for table purpose but not for canning. Queen pineapple is spiny, golden yellow in color. The fruits are small in size ranging from 1.0 to 1.25 kg and it became yellow color on the surface when ripens. It has pleasant aroma and flavor.

Pineapple crop is a highly potential fruit crop in north eastern region because of its climatic suitability and the possibility of controlling the season of flowering and fruiting to make the fruits available throughout the year or allowing off season fruit harvests when fruit demand are higher. Chemical substances, growth regulator or phyto-regulators have been widely used in the induction of pineapple flowering (Liu *et al.* 2018). Although Meghalaya has large area under pineapple cultivation but its productivity is still low due to lack of proper technical knowhow as the farmers from the region practice an age old traditional methods of farming. Therefore the present study was conducted to contribute to the knowledge and technique for induction of flowering in pineapple, which will boost the pineapple production in the state.

MATERIALS AND METHODS

The present experiment was conducted in experimental field of Department of Horticulture, North Eastern Hill University (NEHU), Tura Campus, Meghalaya, during the year 2021-2022. The experiment was laid out in a Randomized Block Design (RBD) with three replications. Seven stages of growth i.e., 15-20 leaves stages, 20-25 leaves stages, 25-30 leaves stages, 30-35 leaves stages, 35-40 leaves stages, 40-45 leaves stages and 45-50 leaves stages were treated with 10 ppm NAA. A control plant for each treatment was maintained. The treatment was repeated three times at an interval of two days. The data were recorded on flowering and fruit characters after completion of flowering as influenced by treatment of 10 ppm NAA on different growth stages.

RESULTS AND DISCUSSION

Days taken to flowering

In the present investigation, it was observed that treatment T_7 (10 ppm NAA at 45-50 leaves stage) showed the least days (22.78 days) to flowering (Table 1). From this experiment it was observed that NAA induced flowering more effectively in treatment T_7 (10 ppm NAA at 45-50 leaves stage). This may be attributed to the fact that plant growth regulators induce flowering by promoting ethylene production inside the plant, more precisely in the meristematic zone where the absorption of the product is faster. The stem apex is more sensitive to the effects of endogenous auxin due to the more intense cellular activity. Further, ethylene is known to form an active complex by linking to a receptor molecule that elicits a series of reactions, including modifications in the expression of genes, leading to a wide diversity of physiological effects. Similar result was also reported by Kumari *et al.* (2020a) in pineapple. The treatment T_8 (control at 15-20 leaves stage) showed maximum days (119.78 days) to flowering. This may be because of the fact that an elevated rate of vegetative growth can inhibit or delay pineapple flowering by reducing its sensibility to the floral stimuli. Similar result was reported by Kumari *et al.* (2020a) where application of NAA at a higher concentration delayed the period of first flower initiation.

Flowering duration

A perusal of the data presented in Table 1 showed that among the different treatment for flowering duration (days), maximum flowering duration (28.33 days) was observed in treatment T_7 (10 ppm NAA at 45-50 leaves stage) which was at par with T_6 (10 ppm NAA at 40-45 leaves stage) (28.23 days). However, minimum flowering duration was recorded in treatment T_1 (10 ppm NAA at 15-20 leaves stage) (13.33 days). Similar results were reported by Kumari *et al.* (2020b) in pineapple.

Flower length (cm)

The maximum flower length (23.68 mm) was recorded in treatment T_6 (10 ppm NAA at 40-45 leaves stage) which was at par with T_5 (10 ppm NAA at 35-40 leaves stage) (23.46 mm), T_7 (10 ppm NAA at 45-50 leaves stage) (23.43 mm) and T_4 (10 ppm NAA at 30-35 leaves stage) (23.28 mm), while minimum length of flower (17.61 cm) was observed in treatment T_8 (control at 15-20 leaves stage). The flower

Table 1. Effect of NAA on days taken to first flowering, flowering duration (days), length of flowers (cm) and number of plants which set flower (%).

Treatment	Days taken to first flowering	Flowering duration (days)	Length of flowers (mm)	Number of plants which set flower (%)	Grith of fruit after completion of flowering (mm)	Length of fruits after completion of flowering (mm)	Length of crown after completion of flowering (mm)
T_1 (10 ppm at 15-20 leaves stage)	97.67^{b}	13.33^{g}	19.37^{efg}	41.67^{fg}	47.08^{h}	46.47^{ef}	58.33^{e}
T_2 (10 ppm at 20-25 leaves stage)	96.33^{b}	13.83^{g}	21.86^{bc}	63.33^{d}	49.71^{gh}	47.64^{e}	60.13^{de}
T_3 (10 ppm at 25-30 leaves stage)	36.77^{e}	19.33^{cd}	22.37^{abc}	76.67^{c}	63.45^{cd}	77.93^{bc}	58.58^{e}
T_4 (10 ppm at 30-35 leaves stage)	34.67^{e}	20.33^{c}	23.28^{ab}	80^{c}	67.14^{bc}	86.14^{b}	59.5^{de}
T_5 (10 ppm at 35-40 leaves stage)	32.45^{e}	25.11^{b}	23.46^{ab}	90^{b}	71.96^{ab}	84.49^{b}	67.13^{c}
T_6 (10 ppm at 40-45 leaves stage)	24.83^{f}	28.23^{a}	23.68^{a}	100^{a}	76.97^{a}	101.56^{a}	76.97^{a}
T_7 (10 ppm at 45-50 leaves stage)	22.78^{f}	28.33^{a}	23.43^{ab}	96.67^{ab}	77.44^{a}	101.86^{a}	69.6^{bc}
T_8 (control, 15-20 leaves stage)	119.78^{a}	15.03^{fg}	17.61^{g}	26.67^{h}	36.22^{i}	38.72^{f}	56.83e
T_9 (control 20-25 leaves stage)	117.89^{a}	15.01^{fg}	18.22f^{g}	33.33^{gh}	38.24^{i}	39.7^{f}	59.13^{de}
T_{10} (control 25-30 leaves stage)	59.77^{c}	17.92^{de}	18.01^{fg}	41.33^{fg}	52.14^{fgh}	64.94^{d}	56.98^{e}
T_{11} (control 30-35 leaves stage)	58.67^{c}	17e^{f}	20.23^{de}	53.33^{e}	52.31^{fgh}	71.78^{cd}	58^{e}
T_{12} (control 35-40 leaves stage)	57.23^{c}	18.52^{cde}	19.55^{ef}	44.33^{f}	55.35^{efg}	71.74^{cd}	65.43^{cd}
T_{13} (control 40-45 leaves stage)	48.61^{d}	18.76^{cde}	21.53^{cd}	40^{fg}	58.54^{de}	84.63^{b}	74.54^{ab}
T_{14} (control 45-50 leaves stage)	47.03^{d}	19.89^{cd}	18.02^{fg}	53.33^{e}	57.57^{ef}	84.55^{b}	67.59^{c}
SEm (±)	1.68	0.65	0.53	2.72	1.90	2.58	2.05
CD at 5%	4.91	1.90	1.55	7.96	5.56	7.53	5.99

*Averages followed by the same letter belong to the same group (Duncan test at 5% probability).

length between the treated and control showed little difference among them.

Number of plants which set flower (%)

The plant which set 100% flower was in treatment T_6 (10 ppm NAA at 40-45 leaves stage) while treatment T_8 (control at 15-20 leaves stage) showed the least percentage (26.67%). This result is in close proximity to the finding of Kumari *et al*. (2020b) where application of PGRs in plants that contain 35-40 leaves stage resulted in 90.23% flowering. Pineapple tends to induced more flowering percentage when small amount of NAA at a concentration of 10 – 20 ppm were applied at the center of the pineapple. NAA is more efficient when applied around the period of natural differentiation. High concentrations of naphthalene acetic acid (NAA) could cause a complete inhibition of flowering and lower the percentage of flowering. Young plants with less number of leaves cannot be induced to flower successfully even if treated with plant growth regulators.

Girth and length of fruits after completion of flowering (mm)

Maximum girth of fruit after completion of flowering (77.44 mm) was observed in treatment T_7 (10 ppm

NAA at 45-50 leaves stage), while minimum girth of fruit after completion of flowering was recorded in T_8 (control at 15-20 leaves stage). The maximum length of fruit after completion of flowering (101.86 mm) was observed in T_7 (10 ppm NAA at 45-50 leaves stage), whereas, minimum length of fruit after completion of flowering (38.72 mm) was observed in T_8 (control at 15-20 leaves stage). Pal *et al.* (2015) also revealed that application of NAA at 10 ppm significantly increased the fruit weight and girth. NAA is one of the most effective plant growth regulators for increasing fruits size in pineapple. The beneficial effect of NAA on fruit weight and size has been also reported by Chumpookam *et al.* (2017) in pineapple. The increase in fruit length and girth may be due to acceleration in cell division and cell enlargement. This finding was similar with the finding of Sultana *et al.* (2016) in litchi, Prajapati (2014) in custard apple, Kamboj *et al.* (2017) in phalsa and Kulkarni *et al.* (2017) in mango. The significant difference in girth and length of the fruit may also be because of the increase in number of leaves.

Length of crown after completion of flowering (mm)

Perusal of the data presented in Table 1 for the length of crown after completion of flowering (mm) revealed that maximum crown length (76.97 mm) was recorded in T_6 (10 ppm NAA at 40-45 leaves stage) which was at par with treatment T_{13} (control at 40-45 leaves stage) (74.54 mm), treatment T_7 (10 ppm NAA at 45-50 leaves stage) (69.60 mm), while minimum length of crown after completion of flowering (56.83 mm) was observed in treatment T_8 (control at 15-20 leaves stage). NAA treated plants resulted in longer crown growth. Similar results were reported by Chumpookam *et al.* (2017).

CONCLUSION

Artificial induction of flowering in pineapple has been tried with various plant growth regulators in the past and some degree of success has been achieved. Chemical substances, growth regulator or phyto-regulators have been widely used in the induction of pineapple flowering. Pineapple plants are induced to flowering by the application of auxin such as ά-naphthalene acetic acid which probably operates by stimulating endogenous ethylene production. The application of 10 ppm NAA on different stages of growth has significant impact on flowering and subsequent fruiting of pineapple. After application of 10 ppm NAA, the growth stage at 45-50 leaves required the least days to flowering, maximum flowering duration, girth of the fruit and length of fruit after completion of flowering. Maximum flower length and highest percentage of flower setting was recorded in growth stage of 40-45 leaves.

ACKNOWLEDGMENT

The authors would like to thank the Department of Horticulture, North Eastern Hill University, Tura Campus for providing all the required materials for conducting the research.

REFERENCES

Chumpookam J, Aumkhruea T, Teankum S (2017) Effect of brassinosteriods and 1-naphthalene acetic acid on fruit quality of 'Pattawa' pineapple (*Ananas comosus* (L.) Merr.). *Acta Hort* 11(66): 125-130.

Kamboj N, Gandhi N, Singh S, Singh V (2017) Effect of gibberellic acid and naphthalene acetic acid on the physical parameters and yield of phalsa (*Grewia subinaequalis*). *Int Adv Res Sci Engg* 6 (1): 785-790.

Kulkarni SS, Patil SS, Magar SD (2017) Effect of plant growth regulators on yield and quality of mango (*Mangifera indica* L.) *CV* Kesha. *J Pharm Phytochem* 6 (5): 2309-2313.

Kumari U, Jha KK, Sengupta S, Misra S, Tiwary AK, Chakraborty M (2020a) Effect of NAA and ethrel on flowering characteristics of pineapple (*Ananas comosus* L. Merr.) Var Queen. *Int J Curr Microbiol* 9(11): 2319-2325 .

Kumari U, Jha KK, Sengupta S, Misra S, Tiwary AK, Lal HC, Kumar K (2020b) Studies on different growth regulators and stage of application on inflorescence induction and development of pineapple (*Ananas comosus* L. Merr.) Var Queen. *Int J Conserv Sci* 8(6): 1093-1095.

Liu CH, Liu Y, Shao XH, Lai D (2018) Comparative analyses of the transcriptome and proteome of Comte de Paris and Smooth Cayenne to improve the understanding of ethephon-induced floral transition in pineapple. *Cell Physio Biochem* 50(6): 2139-2156.

Pal R, Mahato SK, Chhetri B, Suresh CP (2015) Growth regulators influencing yield and quality of pineapple (*Ananas comosus* L. Merr). *Ecol Environ Conserv* 21(2): 885-890.

Prajapati RD (2014) Effect of plant growth regulators on growth, yield and quality of custard apple (*Annona squamosa* Linn.) *CV* Local. MSc thesis. Anand Agricultural University, Gujarat, India.

Steingass CB, Vollmer K, Lux PE, Dell C, Carle R, Schweiggert

RM (2020) HPLC-DAD-APCI-MSn analysis of the genuine carotenoid pattern of pineapple (*Ananas comosus* (L.) Merr.) infructescence. *Food Res Int* 127: 108-709.

Sultana S, Das G, Das B, Rudra BC (2016) Evaluation of various plant growth regulators in flower and fruit setting of Litchi. *I J Green Pharm* 10(4): 1-3.

Zhang JS, Liu J, Ming R (2014) Genomic analyses of the CAM plant pineapple. *J Exp Bot* 65(13): 3395–3404.