1. INTRODUCTION
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The practice of growing fruit plants is rooted in antiquity. Probably throughout the entire history of human civilization fruit have been regarded as a necessity and a luxury and their intensive cultivation has been followed in the wake of advancing civilization.

A major problem facing the mankind in the present century is to feed its evergrowing population. The population in India by 2001 AD touched one billion. As per the dietary allowances recommended, the annual per capita needs of fruits are 49 kg. Therefore, the annual production of fruits should reach 44 million tonnes to provide adequate quantity of fruits for the population in the next six years. Population in NE India is also increasing day by day and need of the day is to go for a massive consistent production. The development of fruit growing which seems possible and which is now beginning will be of great benefit to the country. Fruits constitute an essential part of balanced nutritional diet. It is a ready source of energy with the unique capacity to guard against many deficiency diseases. Fruit can supply more than one third of requirement of calories, vitamins and minerals, sugar, starch, citric acid, protein etc.

The high demand of the pineapple fruit and its products among the consumers is due to its attractive qualities in sweetness, high nutritive value, supplying rare food energy, minerals and vitamins viz. A, B, C and flavour (Singh and Singh 1974). It is a rich source of digestive enzyme (Proteolytic) 'bromelin'. It is highly valued as fresh fruit.
The edible portion of the fresh fruit contains 80-85% water, 12-15% sugars, 0.6% acid, 0.4 to 0.69% protein, 0.5% ash, 0.1% fat some amount of fibre and vitamin A and C (10-25 mg/100 gm).

Pineapple (*Ananas comosus* L. Merr., family Bromeliaceae), is one of the most important commercial tropical fruit. It is only the member of the family Bromeliaceae having great importance although a few of 900 varieties are cultivated for different purposes such as extraction of fibre from the leaves (viz. *Ananas sativus*, *A. magdalenae*) and for ornamental purposes. (*A. sativus* variegata, Guzmania, Neo-regelia). It is a perenniel monocotyledonous herb, with a short basal stem producing adventitious roots below and a crown of spirally arranged leaves and produces a single syncarpous fruit on a terminal inflorescence.

Pineapple, queen of the tropical fruit grows well in NE India and some other states of South India such as Tamilnadu, Karnataka, Maharashtra, Andhra Pradesh, Goa etc. The chief growers of pineapple in the world are Hawaii, Malaysia, Cuba, Phillipines, Taiwan, Mexico, Thailand etc. Probably wild Brazilian pineapple *Ananas microstachys* Lindl. is ancestor and Brazil is its place of origin.

Pineapple can be cultivated successfully both on plains and hilly slopes. It grows well on a wide range of soil from new alluvium of submontane tract as well as the laterite soils of hills of NE region (Bhattacharyya 1965) but the soil must be well drained. The crop tolerates a wide range of rainfall from 75 cm to 500 cm. The suitable temperature for the growth of pineapple ranges from 60°F to 90°F. Pineapple is one of the most popular fruits of the tropical region and is also grown extensively in the high humid subtropics in the world.

In India approximately 57.06 thousand hectares are under the pineapple cultivation with an annual production of 0.77 million tonnes and an average yield of 13.48% ha. It covers 1.73% of total area and 2.4% total fruit production.
Assam is one of the important pineapple growing areas which covers an area of 12.7 thousand hectares with annual production of 164.9 lakh metric tonnes with an average yield of 13.14 metric tonnes/ha (Anon 1993). But the average yield of pineapple in Assam is awfully low in comparison to all India average (Ao 1995).

There are about 20 cultivated varieties for fruits and all are propagated vegetatively as they produce parthenocarpic fruit. Suckers, slips and crowns are generally used as planting materials. The suckers produce fruit in about 17 months, slips in 20 months and crowns in 22-24 months after plantation (Collins 1960).

Generally Queen and Kew varieties are cultivated in Assam. In Queen variety, leaf margins are serrated with strong spines, eyes are deep, smaller fruits are with high flavour and sweetness. Flowering takes place during February to March and matures in June to July. In Kew variety, leaf margins are not serrated, eyes are shallow, larger fruit size with higher pulp and juice content. Flowering takes place in two distinct flushes. The first flush occurs during February to April and second occurs sporadically in July to August. The Kew variety is generally cultivated in major areas of Assam. The fruits are harvested from June to September. The pineapples which flower during June to July are harvested in November to December as winter crop. The major harvest period is limited to 30-40 days making gulf of fruits in the market and the rest of the year is the lean period (Ahmed 1984).

The agroclimatic condition of Assam is favourable for cultivation of various tropical fruits like pineapples. Pineapples are grown in Upper Brahmaputra valley zone and two hill districts in Assam. But they are grown both in hills and plains in a sporadic and unsystematic manner. So, the net returns from this commercial fruit are not encouraging due to unscientific cultivation. The yield potentiality of this crop is not satisfactory although its agroclimatic condition offers a wide scope
for extensive cultivation. Compared to other leading states of India, Assam remains backward inspite of its conducive climate for pineapple cultivation. The factors responsible for lower yield of pineapple are adaptation of traditional practice with dominance of food crops, poor infrastructural support, lower adaptation of new technology due to a number of constraints, predominance of uneconomic holding like small and marginal farmers (80%) which usually donot provide scope for adaptation of new technology (Upadhaya 1995). Not yet much attention has been given for growing high value, low volume crops like pineapple having marketing potential. The growers share of consumer's rupees varies from 15\% to 25\% depending upon the marketing potentialities. The most important disadvantage in pineapple cultivation is that all the cultivars of pineapple are associated with the problems of non-uniform growth, asynchronous flowering and consequently the irregular fruiting among the individual in a field. Even after 15-18 months of growth less than 20\% of the plants normally come to flower (Randhawa et al. 1970).

Asynchronous flowering causes not only difficulty in the uniform harvesting for canning industries, but also keeps the land under the same crop for a long time. On the otherhand, the quality of the fruits harvested in different months are not same or uniform due to climatic variation (Collins 1960, Huang et al. 1960, Ahmed and Bora 1989). If somehow pineapple production can be continued even in the winter seasons, the problem faced by the canning industries may be improved. So, the study with respect to control the time of flowering to harvest the fruit at a time is considered to be of immense importance from the commercial point of view.

The lack of uniform propagules i.e. planting material is also another major drawback in successive cultivation of pineapple. The technique of growing fruit has undergone a marked change during past sixty years. Since pineapple is important
fruit ideal for table and processing industry, artificial induction of flowering using various Plant Growth Regulators (PGRs) is the greatest advantage for ensuring regular supply of fruits. The irregular fruiting characteristic of pineapple has been moderately controlled in recent years by using suitable flower inducing chemicals. It is now well established that pineapple plant _A. comosus_ L. Merr. responds in a number of ways to application of plant growth regulators (PGRs). Dramatic changes in crop yield can be achieved by the use of PGRs in many plants including pineapple (Babylatha and Aravindakshan 1984, Ao 1995, Hazarika 1995, Maibangsa 1990). From the works of different workers it is evident that PGRs play an important role in the process of flower induction in pineapple. Pineapple plants can be induced to flower in the season or during the off season. As the pineapple plant is highly responsive to the different PGRs the possibility is wide open to induce flowering and harvest fruits at different times of the year. The high value low acreage fruits have been controlled by the use of synthetic growth substances and such compounds are now in use commercially for inducing fruit set, increased fruit size, hastening maturity etc. PGRs increase plant growth or divert photosynthate to the harvest product and thus contribute to increase the productivity (Morgan 1980). These substances exert recognisable effect upon the overall course of plant growth and development, but they do so in characteristically non-nutrient way. It has been conclusively shown that pineapple plants may be brought into fruits 2-6 months in advance of normal period. It has also been reported that PGRs bring fruits into maturity to satisfy particular market demand (Ali and Talukdar 1965).

The use of PGRs in pineapple production dates back to late eighteenth century (1874) when people of Azores Island used smoke to induce premature flowering (Collins 1960).
Generally flowering in plants is induced by naturally synthesised hormones. Flowering can also be promoted, at least in some species by the external application of certain chemical compounds, for example, blooming of pineapple can be induced by treatment of the plants by acetylene or ethylene (Rodriguez 1932, Cooper and Reese 1942). Certain auxins such as α-NAA, 2,4-D also elicit the flowering reaction in pineapple under certain conditions when applied in suitable concentrations (Clark and Kerns 1942, van Overbeek 1946). PGRs have generally been applied to pineapple plant to enhance the growth, induction of early flowering, increased fruit size and quality giving greater yield. For this reason, they have normally been used relatively early in the life of the plant at or before the start of internode elongation (i.e. the growth of the plant) by which time the values of many important morphogenetic features have not already been determined.

The process of flowering in pineapple is influenced by different factors such as nutritional (Collins 1960, Bartholomew and Kadzimini 1977), hormonal (Gowing and Leeper 1961, Burg and Burg 1966, Das Biswas et al. 1983, Ao 1995), chemicals (van Overbeek 1946, Wee and Ng 1970), moisture (Hsio 1973, Tay 1974), environment (Teisson 1972, Leeper et al. 1962, Friend and Lydon 1979) and stages of growth (Das et al. 1965, Bartholomew and Kadzimini 1977). The response of pineapple to hormone treatment was found to be influenced by environmental factors (Lewcock 1939 and Mitchell 1962). Now, it is possible to induce flowering in pineapple during off season and it has been reported that flowering which normally extends over months can be squeezed into few weeks (Wee and Ng 1971). To spread the period of harvest sometimes the hormones are used in a portion of large field to bring these plants into fruit a little earlier than the rest of the field (Collins 1960).
The effect of NAA, ethrel and GA₃ on pineapple appeared to be satisfactory although many other synthetic hormones showed their reverse action on pineapple.

The most dramatic effect of GA₃ on plant is the elongation of stem (Kaufman and Jones 1974) since root and leaf show only weak response to GA. The elongation of stem results from the rapid elongation of internode due to increase in cell division and cell expansion. Flowering was induced upto 60% and 60.75% with GA₃ by Sharma (1970) and Hazarika (1995) respectively. Significant delay in fruit maturity along with increased weight and length of ethephon induced sugar loaf pineapple by the application of GA₃ either alone at 500 or 1000 mg/l or in combination with other growth regulators was reported by Norman (1978). But Hazarika (1995) reported that GA₃ treated plants produced fruits 8-12 days earlier than the control plants. Increased size, weight and quality of fruits due to GA₃ application was reported by Maibangsa (1990). GA₃ caused an increase in the sugar content of fruit (Kumar et al. 1975, Asi and Ali 1970, Huang 1973, Roy et al. 1980). Gowing and Leeper (1961) and Baruah (1966) found ineffectiveness of GA on flowering of pineapple.

The use of NAA to induce flowering in pineapple has been a commercial practice in Hawaii and in many other countries. NAA is able to bring flowering, increased flowering percentage, increased yield and also extend harvest period. Many workers tested NAA on pineapple plants and most of them obtained satisfactory results on pineapple and to induce more uniform fruited together with increased yield (van Overbeek 1946; Wee and Rao 1977; Balkrishnan et al. 1978; Roy et al. 1980; Das 1962; Ao 1995). Cent per cent flowering in pineapple due to NAA application was reported by van Overbeek (1946). Borah and Mohan (1993) also reported maximum flowering in pineapple (cv. Kew) with NAA 10 ppm. Similar results were also reported by Shahidullah and Hussain (1974) with planofix and Das (1964) with NAA.
Increased fruit size, weight and delayed fruit maturity due to NAA treatment was also reported. (Ali and Talukdar 1965, Kwong and Chiu 1968, Wee 1971, Das and Puruseth 1977, Misra *et al.* 1977, Mishra 1973, Hussain *et al.* 1973, Norman 1978). That NAA treatment increased the fruit yield was reported by Dalldorf (1985) and Huang (1973).

Some effects of ethylene on plant metabolism are induction of flowering in Bromeliaceae, inhibition of cell elongation and internode elongation etc. In Pineapple, Rodriguez (1932) observed that ethylene application induced flowering. Clark and Kerns (1942) observed similar control in that species with auxin. Later experiment have revealed that auxin stimulation of pineapple flowering is a consequence of the stimulation of ethylene formation after auxin treatment (Burg and Burg 1966). So the use of ethylene now declined considerably being replaced by NAA (van Overbeek 1951). The ability of NAA to induce flowering in pineapple is that it has an ethylene releasing potential. The use of ethylene in agriculture has been limited because use of ethylene as a gas is of course impracticable in the field. Therefore, there is much interest with the ethylene releasing compounds. The agrochemical industry developed several commercial and experimental compounds which release ethylene and can easily be handled as liquid formulation. Ethephon (CEPA, Ethrel, 2-chloroethyl phosphonic acid) is the best known compound of this group. It is a stable liquid. It represents a new class of synthetic plant growth regulator which produce a variety of growth responses in plants (Hallaway and Osborne 1969, Jackson and Osborne 1970). These compounds degrades in presence of water evolving ethylene (Draber 1977). When it is applied, ethylene is directly released to the plant tissue and can thereby be used to regulate various phases of plant metabolism, growth and development (Cooke and Randall 1968). Ethephon seems to be a valuable tool for plant physiological investigations into ethylene action. The ability of auxin and other substances to induce ethylene
production is well known (Morgan and Hall 1962) and probably forms the basis for the successful induction of flowering by auxin (Burg and Burg 1966) which has been replaced by the application of ethephon (De Wilde 1971). It was reported that ethephon was a very effective forcing agent for flowering in pineapple (Cooke and Randall 1968, Dass et al. 1975, Randhawa et al. 1970, Ao 1995, Singh et al. 1999). Cent per cent flowering was recorded by the application of ethephon at one, two and four pounds per acre on Smooth Cayenne pineapple but the untreated plants remained vegetative. The higher concentrations were also found to hasten flowering and bring early maturity but retarded vegetative growth to some extent. Early flowering and early maturity of pineapple fruit due to ethrel treatment was reported by Mohan and Ahmed (1987) and Singh et al. (1999). Reduction in vegetative growth, slips and sucker production together with accelerated uniform flowering by the application of ethrel was reported (Norman 1981). Improved quality of fruits produced by ethrel treated plant was also reported by Ao 1995, Hazarika 1995, Singh et al. 1999).

The present experiment was carried out to study the effect of Gibberellic acid (GA$_3$), Napthalene acetic acid (NAA) and 2-chloro ethyl phosphonic acid (ethrel) on vegetative growth, flowering, fruit quality and yield of pineapple (cv. Queen and Kew). The study is expected to bring uniform flowering and fruiting in pineapple by the application of PGRs and the ripen fruits would be obtained at a time which would facilitate uniform picking and would maintain steady supply to canning industry. Observations on the following vegetative, metabolic and reproductive parameters were carried out after application of GA$_3$, NAA and ethrel by dripping method to have a deeper knowledge about the response of pineapple plants to applied PGRs.
(1) Vegetative growth: Number of functional leaves and length of 'D' leaf.

(2) Percentage of induction of flowering, flowering-harvest intervals.

(3) Quality of fruits in terms of sugars (reducing, non-reducing and total), poly saccharide, total titratable acidity, Vitamin-C and physical characters of fruits i.e. size and weight (with and without crown), number of slips and suckers.

(4) Expected yield (t/ha).