Study on the maturation of pineapple. (Ananas comosus L.) I. Method of applying ethephon for hastening fruit maturation.[1]

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ABSTRACT

The study of using ethephon (2-chloroethane phosphonic acid) at 0, 3,000 and 6,000 ppm sprayed around the fruits compared with dipping the chemical into the crowns, was conducted at Don Khun Huai district, Petchaburi province from October 1977 to April 1978. It was shown that ethephon can hasten the harvesting time of the fruits compared to the control treatment. The maturity response was more pronounced when the chemical was sprayed around the fruits and this was seen in all concentrations under investigation. The implication of this method of hastened harvesting for the pineapple industry was discussed,

INTRODUCTION

Pineapple *(Ananas comosus* L.*)* is one of the economic fruit crops in Thailand. Besides being sold as a table fruit, pineapple can be canned as a fruit or as juice. The fruit can also be processed into various products such as jam, cake etc. These various uses increased the potential of exporting pineapple in various forms which caused the expansion in acreage of pineapple growing in the country. To meet the rise in productivity, many new cultural techniques such as using chemical to hasten flowering have been employed. The report of using ethephon at the rate of 1, 2 and 4 kg/ha (181, 363 and 726g/rai) was known to be 100% effective in stimulating flowering of pineapple plants (Cook and Randall, 1968). When urea was added to ethephon solution the increase in flowering as well as more uniformity in fruit maturation would be obtained (Dass et al., 1975). In Thailand the rate of ethephon that many farmers are practicing is 150-250 ppm plus 3% urea. This combination was found to induce flowering up to 98% (Piya, 1978). Besides inducing of flowering, ethephon can induce the uniformity of fruit maturation and thus reducing the number of harvest when sprayed to the immature fruits, (Wee and Ng, 1971). This would reduce the cost of production. In Thailand this method of inducing uniform maturation of pineapple has not been studied especially in terms of the right stage of fruit growth where ethephon gives best response.

MATERIALS AND METHODS

Pineapple plants of 9 months old grown in the private farm at Don Khun Huai district, Petchaburi province were used in this study. The plants were selected for their uniform size before 250 ppm ethephon plus 3% urea were

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dripped to eht apical at the rate of 50 ml. per plant. The application was done in the morning on October 9, 1977. After inducing flowering for 19 weeks (February 18, 1978), 240 plants with uniform immatured fruits were selected for the experiment which was designed as factorial in randomized complete block having 2 factors. Factor A represents the methods of applying ethephon consisting of 1) spraying chemical around the fruits and 2) dripping the chemical on the crowns of the fruits. Factor B represents the ethephon concentrations levels of 0, 3,000 and 6,000 ppm. There were 4 replications with 6 treatment conbinations in each replication. Ten pineapple plants were used in each treatment combination which comprised a total of 240 plants.

Ethephon in the concentrations described were applied to the plants at 19 weeks after flowering had been induced (i.e. Febuary 18, 1978). Details of the treatments were as follows :

Treatment 1 : - having pure water sprayed on the fruits (control 1)

Treatment 2 : - having pure water dripped on the crown (control 2)

Treatment 3 : - 3,000 ppm ethephon sprayed on the fruits

Treatment 4 : - 3,000 ppm ethephon dripped on the crown

Treatment 5 : - 6,000 ppm ethephon sprayed on the fruits

Treatment 6 : - 6,000 ppm ethephon dripped on the crown

In each treatment the plants received 30 ml. of ethephon concentrations.

All plants were left growing until the fruits showed sign of maturity by changing of fruit color to yellow, then they were harvested and analysed for various parameters.

RESULTS

1. **Days to harvest.** The time taken from the induction of flowering to harvest for each treatment was tabulated in table 1

Spraying the chemical directly to the fruits can shortening the harvesting time compared to the method of dripping the chemical on the crown. This was seen in all levels of ethephon concentration. The difference on method of application was greater with an increase in ethephon concentration (Figure 1). It was noticed that in both methods of application, ethephon can shorten the days to harvesting of pineapple fruits.

2. **Fruit size.** At harvest, fruits in each treatment were weighed as an index of fruit size. The figure was shown in Table 2.

Table 1. Effects of ethehnon on harvesting time (days) averaged of 40 plants.

Ethephon concentration (ppm)	Methods of application	
	Sprayed on the fruits	Dripped on the crown
0	172 a*	172 a
3,000	164 c	167 b
6,000	153 d	162 c

* Means followed by similar letter are not signficantly different at 5 % level by Duncan's Multiple Rangee Test.

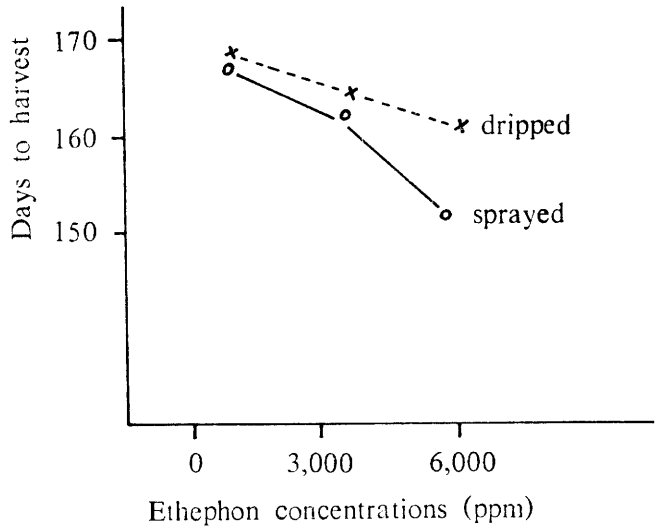

Fig. 1 The relation of ethephon concentrations and methods of application on the time of harvesting.

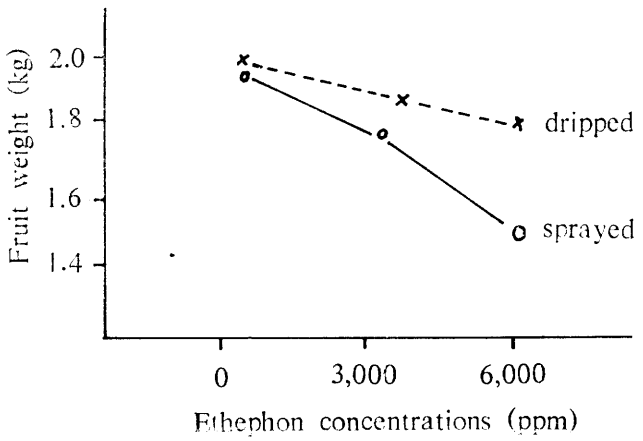

Fig. 2 The relation of ethephon concentration and methods of application on fruit weight.

Table 2. Effects of ethephon on fruit weight (kg) averaged of 12 fruits

Ethephon concentration (ppm)	Methods of application	
	Sprayed on the fruits	Dripped on the crown
0	2.00 a*	2.02 a
3,000	1.76 b	1.95 a
6,000	1.46 c	1.81 b

* Means followed by similar letter are not significantly different at 5% level by Duncan's Multiple Range Test.

Table 3 Effects of ethephon on percent of total soluble solid content of the fruits (data expressed as percent of total soluble solid averaging from 12 fruits)

Eethephon concentration	Method of application	
(ppm)	Sprayed on the fruits	Dripped on the crown
0	17.63 ab*	18.09 a
3,000	17.25 ad	17.96 a
6,000	16.61 b	16.95 ab

* Means followed by similar letter are not significantly different at 5% level by Duncan's Multiple Range test.

Table 4 Effects of ethephon on acid content of the fruits (data expressed as mg. of acid equivalent, averaging from 12 fruits)

Ethephon concentration	Methods of application	
(ppm)	Sprayed on the fruits	Dripped on the crown
0	8.38 c*	8.38 c
3,000	8.75 b	8.75 b
6,000	9.05 a	9.10 a

* Means followed by similar letter are not significantly different at 5% level by Duncan's Multiple Range Test.

Direct spray of ethephon to the fruits caused a smaller fruits than those received ethephon via dripping on the crowns. This was observed in all levels of ethephon studied. The difference in fruit weight was greater as the concentration of ethephon rose (Figure 2). Regardless of the method of application, ethephon applied to the immatured fruits can reduce the fruit weight.

3. Fruit quality Quality of the harvested fruits expressed as total soluble solid and acid content as well as the pressure of the flesh was reported in the following manner.

3.1 Total soluble solid content. At harvest, the fruits in each treatment were squeezed and 10 ml of the juice was measured for total soluble solid percentage using refractometer. The data was tabulated in Table 3.

Fruits from both methods of applying ethephon did not show any significant difference in total soluble solid content (Table 3).

However, with ethephon application the fruits tend to contain less soluble solid content compared with those receiving no ethephon.

3.2 Acid content. Acid content of the juice from those fruits receiving various levels of ethephon was shown in Table 4.

Fruits from both methods of applying ethephon did not show any significant difference in total acid content (Table 4). The acid content rose as the concentration of ethephon was increased in both applications.

3.3 Flesh firmness. The flesh firmness was measured by fruit pressure tester, the data was averaged from three locations in the fruits (the middle part and both ends) and presented in table 5.

There was significant difference in method of application. This was seen at 3,000 ppm ethephon concentration. However, there was no difference bet-

Table 5 Effects of ethephon on fruit firmness (data expressed as kg/cm^2 averaging from 12 fruits)

Ethephon concentration (ppm)	Methods of application	
	Sprayed on the fruits	Dripped on the crown
0	6.92 b*	7.11 b
3,000	8.64 a	7.13 b
6,000	9.45 a	8.65 a

* Means followed by similar letter are not significantly different at 5% level by Duncan's Multiple Range Test.

ween methods of application in the other concentrations tested, but the data indicated that spraying can cause a better fruit firmness and this firmness was more pronounced with the higher concentration of ethephon used.

DISCUSSION

Ethephon can hasten the maturity of pineapple fruits if they are subjected to the chemical at their immature stages. This confirmed our previous reports on the effects of ethephon on fruit maturation (Chalerlmgin et. al., 1979). By comparing the method of application, it was shown that spraying around the immatured fruits was more effective in inducing maturation than by dripping the chemical on the crown (Table 1). This may be due to the fact that by spraying around the fruit, the released ethylene may be able to diffuse faster so as to cause an effect on the flesh quicker than by dripping on the crown (Yang, 1969). Consequently it caused the fruit to turn yellow at the time the ripened stage was not reached without much change in fruit texture and fruit firmness. Therefore more flesh firmness was seen in this ethephon treated fruit than both controls (Table 5) which were ripened naturally. Becaused the harvest time was shorter in ethephon treated fruits, this may explain why there were less substrate in the fruits and/or slower changes of substrate to reducing total soluble solid which in turn causing less percent total soluble solid in the ethephon treated fruits (Table 3).

This study showed that spraying ethephon to the fruit can better induce harvesting than by dripping the chemical on the crown especially at the concentrations of 3,000 and 6,000 ppm ethephon.

As the concentration of ethephon increased the final fruit weight decreased (Table 2). This may be due to an inhibitory effect to ethephone on fruit growth (Leopold and Kriedemann, 1975).

Pineapple fruits hastened by ethephon contained higher total acid (Table 4) and more fruit firmness (Table 5) which agreed to other reports (Audinay, 1970; Bondad, 1972). However the percent total soluble solid was less in the ethephon induced fruits (Table 3). Similar result was reported by Liu (1977). This may be due to the property of ethylene in inducing fruit color (Abeles, 1973) thus, the color of ethephon treated fruits harvested 3 weeks earlier and that of control ones appeared to be similar and also there was more fruit firmness in the ethephon treated fruit Thus this method may be adopted for large scale pineapple production. By

harvesting earlier, less labor involved and we can induce the maturity at the time that fruits are most needed. Although these induced fruits contained more titrable acid and lesser percent soluble solid, the amount is still in the range accepted by canning factories but may not be suited for use as table fruits.

CONCLUSION

The study comparing methods of applying ethephon to hasten harvestiog of pineapple fruits using 3,000 and 6,000 ppm ethephon can be summarized as follows:-

1. Spraying ethephon around the immatured fruits (19 weeks after using ethephon to induce flowering) produced earlier crops, smaller but more fruit firmness than those received ethephon via dripping on the crowns.

2. There was no significant difference in the percent total soluble solid and amount of titrable acid in fruits receiving ethephon in both methods of application. An indication of higher titrable acid and percent total soluble solid was noticed in fruits receiving ethephon by dripping on the crowns.

3. In both methods of application, ethephon at 3,000 and 6,000 ppm, can hasten harvesting, and produce smaller fruits, lower percent total soluble solid but higher amount of titrable acid than those fruits not receiving ethephon.

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