Flower Induction in Container-Grown Japanese Pear

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Introduction

Malaysia imported fresh fruits worth RM 500 million in the year 2000. These fruits included apples, pears, peaches, plums and the sub tropical fruits such as oranges and lychees. The pear group consisted of several types, including the most expensive type, the Japanese Pear, or locally known as *Nashi* in Japanese. The Japanese Pear has a characteristic shape like an apple and has a less grainy flesh as compared with the apple.

MARDI (Anon, 1981) used different types of fertilizers to inducing flowering in loquat and found that 1 dose of phosphate and 2 doses of potash gave positive response in the absence of nitrogen. With Chinese sand pear, MARDI also applied MgO together with the other nutrient (NPK). In pear Worden Seckel, also used dormancy breaking chemical such as Thiourcea and Potassium nitrate to induce growth. In pear, MARDI (Anon, 1983) also found that 1 dose of phosphate and 2 doses of potash in the absence of nitrogen had the most fruit yield. Without fertilizers the pear tree produced 0.205 kg and 0.96 kg fruits. With no nitrogen, 1dose of phosphate and 2 doses of potash, the fruit yield was 2.639 kg in 1982, 6.910 kg in 1983 with a total of 9.549 kg. MARDI (Anon, 1982) evaluate several apple cultivars on various rootstocks (M 7 and MM 106). With MM 106 rootstock, number of flowers per tree was 247, with 43% flower drop. With M 7, there were 170 flowers per tree with 48% flower drop. Anna cultivars tended to produce a large number of flowers irrespective of the rootstock, when compared with that of Ein Shemmer cultivars. Furthermore, the percent flower and fruit drop was also lower for Anna, indicating a resultant higher fruit number.

This study looked into the possibility of growing Japanese Pear in the lowland tropics with an objective of inducing flowering in container-grown, as well as field-grown trees. Attempts to grow temperate fruits in Malaysia have met with some degree of success. Some of the treatments carried out to induce flowering in apples include branch bending, stem girdling and leaf removal. It is hoped that similar techniques can be developed to induce flowering in Japanese Pear.

Materials and Methods

In 1997 several Japanese Pear seeds were germinated without any seed treatment. The percentage of germination was so low that fresh seeds were given cold treatment of 0-5 degree Celsius for 25 days. The seedlings were initially grown in Jiffy Peat Pots and later, were transferred to polythene bags. After several months, the seedlings were transferred to containers and some trees were transplanted to the field. After three years, the trees were subjected to several treatments to induce flowering.

In the first experiment, (Nazariah, 2000), used a solution of potassium nitrate (2.5 g) in every 500 ml of water to spray on four trees at every 2 week-interval. With ethereal, each 0.5 ml ethereal was mixed with 500 ml water and sprayed on 4 trees every 2 weeks. With the commercial chemical fertiliser, each 0.9 ml was mixed in 500 ml water to be sprayed on 4 trees every week interval. The following I was the technique for experiment 2 (Siti Hamidah, 2000), 18 trees were selected and each tree was used as control for comparison.

With eter (2-chloroethylphosphoric acid), each 1.0 ml eter in 1000 ml water was sprayed on 3 selected trees and sprayed every week interval. A 2.5-g Potassium Nitrate was mixed in 1000-ml water and sprayed on 3 trees every week. The combination of eter + potassium nitrate was sprayed every week for 3 months. In another treatment, the technique used was stem girdling + branch bending + leaf removal. Removing the bark of 1-2 cm wide around the stem was done for stem girdling. Stem that has been girdled was later stripped of the leaves and then bent slightly by pulling it down and tying to the ground.

The stem girdling + branch bending + leaf removal + eter treatment was done on 3 trees for 3 months. The stem girdling + branch bending + leaf removal + potassium nitrate was sprayed for 3 months, at 1 week interval. Other tree management includes spraying with insecticide and fungicide due to the wet weather and high incidence of fungus. A third experiment consisted of grafting buds from budwoods that had been placed in the freezer for 1 month.

Results and Discussion

Growers normally used potassium Nitrate solution sprayed on matured Mangoes and Thai Longan trees. In experiment 1, this technique did not produce any flower development. The cause for this negative result is unclear. One possibility could be due to prematurity of trees to make any conclusion, or it could be due to ineffective spraying.

Ethereal or ethylene has been used for flower induction in pineapple and for the production of latex in rubber. The negative result in this experiment may be due to the unsuitability of this hormone for this crop. The use of commercial fertiliser solution that comprised Potassium Nitrate also produced negative result. It is not clear why this fertiliser did not induce flowering of the trees.

In the second experiment, a solution of phosphorus acid sprayed on the trees did not induce flowering. Phosphorus and potassium are the two nutrients that have played vital role in flower development. However, they failed to show any positive development. In

experiment 2, similar to as in experiment 1, the potassium Nitrate solution did not induce flowering. This seems to be consistent with the first result. Even the combination of phosphoric acid and potassium nitrate did not induce flowering. Other techniques should be tried since this combination did not work.

The technique of combining physical application of girdling, branch bending and leaf removal did not affect flowering. The techniques have been used for growing apples in Malaysia where they have proven successful. The physical technique is not consistent in apples.

The Japanese Pear trees responded to one treatment, in which, stem girdling successfully induced flowering in one Japanese Pear tree. Several flowers were formed from several branches. The other treatments did not result in any flower development. Stem girdling has been successfully done on apple trees, and this consistency in the effectiveness of this technique was also observed in Japanese Pear.

One theory in the induction of flowering is that the carbohydrate supply in the branches had increased over nitrogen supply and thus, encouraged the development of flowering compared to vegetative growth. There is a potential for this technique to be applied to induce flowering of Japanese Pear. In branch bending, the auxin and cytokine level, which are responsible for vegetative growth, that are suppose to be diluted by the bending, did not expose the endogenous ethylene. The presence of Gibberellins hormone for stem elongation is not dominant under branch bending. Micronutrient also had been shown to help stimulate flower production. Among these, micronutrient is believed to be important for shoot and flower bud development. However, in this experiment the boron application was not done. Probably, the next experiment should incorporate Boric acid since in tropical wheat, it has shown that application of Boric acid had helped flower and the yield produced in other countries. The level of starch in the stem is also important. In mangoes, it is very common for the growers to injure the stem, thus inducing flower development.

Theoretically, flowering is regulated by several factors, namely environmental factors for example temperature, sunlight and water. In temperature, cool temperature is responsible for inducing flowering in apples and peaches. Open sunlight is necessary for promoting flowers in many plants. Photoperiod is important for flowering in chrysanthemum. As for water, drought stress has induced flowering in most tropical fruit trees. However, flooding also induced flowering in wax apple.

Another technique often used is architectural technique. The pruning technique has been successfully used for most temperate and tropical fruits. Trellis growing is common for grape and passion fruits. The next technique is by other external factors such as salt for inducing coconut flowering and the use of hormones such as Gibberellin or GA3, GA4 and GA7. These hormones had been used in many fruit trees.

Conclusions

The experiment has shown that flowering can be induced in Japanese Pear trees by physical techniques, such as girdling. Stem girdling enabled the branch to accumulate enough carbohydrate to encourage flowering. Hormone, too, may play a part in inducing flowering. It has been established that auxin, synthesised in the shoot causes vegetative growth in the roots while cytokine, produced in the roots, travelled to the shoot and initiate vegetative growth. In the presence of these hormones, vegetative growth prevails and flowering is inhibited.

However, with stem girdling, one can inhibit the flow of vegetative hormones from and thus, exposing the effect of flowering hormone. Vegetative growth may be curtailed due to the lack of flow of cytokine from the root to the shoot. At the same time, it is possible that the carbohydrate level may increase substantially to induce flowering.

Other techniques such as the use of micronutrients like Boron or Boric acid should be explored. Gibberellins, too, should be tried in future experiment since GA3, GA4 and GA7 had been successful in promoting flowers in other fruit trees.

Benefits from the study

Seedlings have been produced from the mature trees by the use of cuttings from hardwood, semi-hardwood and softwood. The seedlings are now grown in polybags for future experimentation. The first phase of flower induction has been successful through girdling.

The trees can be vegetatively produced by cuttings or buddings if necessary. The plants are ready for distribution, however, the capacity for fruit development has to be studied thoroughly. Japanese Pear trees seem to grow vigorously and produced vegetative growth under lowland tropics. The presence of pest and some leaf disease are evident, but they can be controlled with specific pesticides and fungicides.

Literature cited in the text

None.

Project Publications in Refereed Journals

None.

Project Publications in Conference Proceedings

Mohamad Idris, Z.A. and Azizah, H. 2001. Flower induction in container-grown Japanese Pear. Faculty of Agriculture Seminar, Kuala Lumpur, Oktober 16-18.

Graduate Research

None.

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