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Study on dropping behaviour of water apple (*Syzygium aqueum)* fruit

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Abstract
The problem of fruit drop is a big issue in water apple fruit. Premature bud and fruit drop is a serious problem in water apple production and quality. Growth regulators, hydrogen peroxide and phloemic stress are important tools to improve the quality and reduced the pre-harvest fruit drop of water apple. Growth regulators, hydrogen peroxide and phloemic stress are important tools to improve the quality and reduced the pre-harvest fruit drop of water apple. During the early growth stages, excessive fruit drop is caused by cultural and environmental factors that affect pollination, flower fertilization and fruit set. The role of PGR acts as a messenger and required only in small amount at low concentration to regulate the flowering and other developmental process. Two type of chemical with two different concentrations were used in this experiment, one is 2,4-D 5mg/l and 10mg/l and the another one is NAA 5mg/l and 10mg/l. This study was conducted with the aim to determine bud and fruit dropping and of water apple fruit and to find the better remedies to minimize those losses. It was observed from the study that, growth regulators had significant effect to reduce dropping in water apple fruit and 2,4-D causes minimum losses as compared to NAA. This study will be very beneficial for water apple fruit growers.

Keywords: water apple, growth regulators, dropping, pre-harvest

Introduction
The Water apple (*Syzygium aqueum)* is a non-climacteric tropical fruit species. It is also known as Water apple, rose apple or java apple. Its pear-shaped fruits are usually pink, light-red, red, green, sometimes greenish-white, white or cream-colored and are generally crisp, with sweet taste or aromatic flavor (Morton, 1987) [7]. The species presumably originated in Malaysia and other South-east Asian countries. It is widely cultivated and grown throughout Malaysia and in neighbouring countries such as Thailand, Indonesia and Taiwan (Moneruzzaman *et al.*, 2011) [6]. The composition of Water apple per 100 g edible portion is water with more than 90% portion, protein 0.7 g, fat 0.2 g, carbohydrates 4.5 g, fiber 1.9 g, vitamin A 253 IU, vitamin B1 and B2 with traces amount, VIT C 8 mg, and energy with 80 kJ/100 g (Wills *et al*., 1986) [8]. The problem of fruit drop is a big issue in water apple fruit. Premature bud and fruit drop is a serious problem in water apple production and quality. Growth regulators, hydrogen peroxide and phloemic stress are important tools to improve the quality and reduced the pre-harvest fruit drop of water apple. During the early growth stages, excessive fruit drop is caused by cultural and environmental factors that affect pollination, flower fertilization and fruit set. Unhealthy foliage and fruit damaged by diseases, insects and abotic factors also can result in early fruit drop. Most of the premature fruit drop is normally heavier on young trees especially if they are extremely vigorous. There is not much else a grower can do to reduce fruit drop other than trying to keep the trees in a good state of vigor and avoid moving through the orchard with equipment and sprayers that can knock off loose fruit. Plant growth regulators application and girdling have significant effect on flowering and fruit quality improvement. Chen *et al*. stated the formation of abscission layer at the stem point lead to fruit drop from unbalanced of auxins, cytokinins and gibberellins.

The aim of this research is:
1. To determine bud, flower and fruit dropping of water apple fruit.
2. To find the better treatment and preventive measures that resulted minimum fruit drop, flower drop and bud drop and pre mature fruit abscission of water apple fruit.

Material and Methods
This study was carried out at the experimental orchard of KVK, Begusarai, Bihar, during March 2019 to June 2019. 10 years old water apple plants were selected. Plants are spaced at 8×5 cm. Plants were grown under natural environmental conditions and exposed to natural

variations of solar radiation, air temperature and humidity. To Count the number of floral buds, flowers, bud drop, fruit buds, fruits and fruit drop, three branches at each direction i.e, East, West, North, South, of each tree were selected for evaluation. The number of floral buds, flowers, bud drop, fruit buds, fruits and fruit drop was recorded on selected branches on each direction of each tree.

Two type of chemical with two different concentrations were used, one is 2,4-D 5mg/l and 10mg/l and the another one is NAA 5mg/l and 10mg/l. 1st application was done before emergence of buds and 2nd application was done at the time of fruit set. Total 5 treatments including control were taken and each treatment has 4 replications.

T1 - 2, 4-D 5 mg/l
T2 - 2, 4-D 10 mg/l
T3 - NAA 5mg/l
T4 - NAA 10mg/l
T5 - Control

The recorded data from different applications were compared. These structures were quantified at different stages from emergence of bud to fruit maturity. Floral buds are recorded, when at least first 10 inflorescenses appeared in a plant on a particular direction. Three branchlets were tagged in each direction in each plant for recording the data. Total number of flowers are calculated after complete opening of buds, means at full bloomed stage, then fruit set was recorded on the basis of number of fruitlets that is counted after 20- 25 days of full bloom. Total numbers of fruits at full maturity are recorded about 35-40 days after fruit set.

Bud Drop% = No. of buds - no. of flowers/No. of buds × 100

Flower Drop% = No. of flowers - No. of fruitlets/No. of flowers × 100

Fruit Set% = 100 - flower drop

Fruit Drop% = No. of fruitlets - No. of fruits/No. of fruitlets × 100

Fruit Ret% = 100 - Fruit Drop

The experiment was designed under Randomised Block Design RBD

Table 1: Data recorded for buds, flowers, bud drop, fruitlets and flower drop% after applications of different treatments

Treatments	buds	flowers	Bud drop%	fruitlets	Flower drop%
T1	42.25	28.25	32.75	17.50	38.25
T2	68.25	43.25	37.50	24.75	42.75
T3	92.00	57.25	37.75	34.25	37.75
T4	75.25	43.25	42.75	23.75	46.25
T5	61.25	33.00	46.25	17.25	48.00
CD	25.33	15.47	2.86	9.32	3. 64
CV%	25.24	25.49	4.90	26.81	5.77
SE (m)	8.56	5.23	0.97	3.15	1.23

Table 2: Data recorded for fruit set %, fruits, fruit drop% and fruit ret% after applications of different treatment

Treatments	Fruit set%	fruits	Fruit drop%	Fruit ret. %
T1	61.75	9.25	43.00	57.00
T2	57.25	12.00	52.75	47.25
T3	62.25	18.00	47.75	52.25
T4	53.75	10.75	55.00	45.00
T5	52.00	7.25	58.75	41.25
CD	3.64	4.93	2.73	2.73
CV%	4.29	29.06	3.59	3.80
SE (m)	1.23	1.66	0.92	0.92

Results and Discussions

This study reported that the application of 2, 4-D treatments had a significant effect on bud dropping, flower dropping and fruit dropping of water apple. Data from table no. 1 and 2, shows that the least dropping (bud drop 32.75% and fruit drop 43.00%) occur in T1, trees on which 2, 4-D 5mg/l was applied, followed by T2 (2,4-D 10mg/l) and T3 (NAA 5mg/l). The least flower dropping 38.25% occurs in T3 (NAA 5mg/l). The highest dropping (bud drop 46.25%, flower drop 48.00% and fruit drop 58.75%) occur in T5, which is under control. It is may be because, the use of auxins prevents dropping of fruit by maintaining the cells at zone of abscission, preventing the synthesis of hydrolytic enzymes such as cellulose, which decompose the cell wall. Davies and Zalman was observed that synthetic auxin (2, 4-D) significantly reduced the fruit drop in citrus fruits.

It is also observed that, the highest fruit set (62.25%) and fruit retention (57.00%) occur in T3 and T1 respectively and the least fruit set (52.00%) and fruit retention (41.25%) occurs in T5, which is under control.

It is concluded from table no.1 and 2, the highest number of buds, flowers, fruitlets and fruits occur in T3, trees on which NAA 5mg/l was applied, followed by T2 (2,4-D 10mg/l) and T4 (NAA 10mg/l). It is may be due to environmental factors, management practices and plant nutritional status. The differences in number of buds, flowers, fruitlets and fruits are may be due to difference in sunlight interception**.** There is no any study who reported that, the application of 2, 4-D or NAA treatments had any significant effect on generative and reproductive structures.

Conclusions

Water apple is one of the popular fruit in Malaysia and other South East Asian countries, which have a lot of commercial values due to its properties. The major problems faced by water apple production is bud drop, flower drop and premature fruit drop. There are so many causes of dropping in

water apple fruit, like pollination and fertilization failure, heavy rain and wind, insects, pests and mites attack. This study has found 2, 4-D application is better treatment for preventing dropping and increase fruit set and fruit retention in water apple fruits. NAA also had beneficial effect in prevention of dropping in water apple fruits. Under open and controlled conditions, about 58.75% fruit dropping occurs in water apple fruits, which can be minimize upto 15-20% under plant growth hormones treatments. So, PGR applications found to be very beneficial for minimizing the dropping in water apple fruits.

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