Effect of Paclobutrazol and Potassium Nitrate on Off-season Fruit Production of *Mangifera indica* L.cv. Seintalone

Tin Moe Phyu*

Abstract

The experiment was conducted in the Oway Orchard, Indakaw Bago Region. Eighty numbers of 7 years old Seintalone mango trees which had approximately the same size, the same age were selected for observing the growth of Seintalone mango. Paclobutrazol (PBZ) treatment (2 g and 4 g) were applied to eighty Seintalone mango trees. Potassium Nitrate was applied 4 months after PBZ treatment when the new flushes became mature. The result of the effect of factor A indicated that the flowering percentage and total fruits produced from PBZ (4 g) treated trees were higher (54.78 % and 14.83) than that of PBZ (2 g). Factor B showed that 3 % KNO₃ spraying trees possessed the higher flowering percentage as well as the number of fruits (60.28 % and 18.80). The treatment of PBZ (4 g) and 3% KNO₃ were the best for the highest flowering and number of fruit. Therefore, PBZ and KNO₃ had affected on flowering and fruiting of *Mangifera indica* L.cv. Seintalone.

Introduction

Mango, *Mangifera indica* L., popularly known as the king of fruit, is an evergreen tree, grown under tropical and subtropical environments around the world. Mango belongs to the genus *Mangifera* of the family Anacardiaceae. Mango originated from the Indo Burma region, Northeast India and Northern Burma, and in the foothills of the Himalayas (Singh, 1987). The mango tree is well known for its biennial production, caused by irregular flowering due to asynchronize maturation of leaves. Biennial, alternate or irregular bearing signifies the tendency of mango trees to bear a heavy crop on one year (on year) and very little or no crop in another season, due to exhausted nutrition and thus unable to put forth new flesh thereby failing the yield in the next season. For overcoming biennial bearing habit, regular cultural operations are needed to have maximum of the tree in every year (Gill, 2004).

Seintalone mango is the most popular fruit crops in Myanmar. It is grown virtually in the country mostly on commercial scale, not only for local consumption but also for export. Irregular bearing is a serious problem affecting mango production where cv. Seintalone is suffering from this phenomenon. Paclobutrazol (PBZ) is a triazole compound that acts as a retardant by blocking gibberellins biosynthesis. It is a plant growth regulator showing much promise in controlling vegetative growth in fruit trees and thereby enhancing flowering, fruit set and fruit yield (Voon, 1997). Application of Paclobutrazol as soil drench and foliar spray were effective for promotion of flowering in mango, however, soil drench was more significant, convenient and cost effective. The rate of Paclobutrazol application depended on the size of tree canopy as well as on mango cultivars (Burondkar and Gunjate, 1991).

In the early 1970s, Barba and other researchers made a break through when they found out that spraying KNO₃ could modify the flowering behavior of mango varieties in Philippines. It boosted their local mango industry since KNO₃ spray made it possible for trees to bear fruit annually, thus breaking the biennial bearing habit. Moreover, KNO₃ can induce flowering at any month of the year permitting year-round fruit production. KNO₃ sprays, however, have been used to stimulate off-season flowering of mango especially in tropical regions.

Materials and Methods

The experiment was conducted in the Oway Orchard, Indakaw, Bago Region. Eighty, 7 years old Seintalone mango trees which were the same size were selected for the experiment.

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Experimental layout and treatments

Four treatments each with 20 replicates each were set up in a factor factorial design. Factor A was PBZ treatment while factor B was the KNO$_3$ treatment. Each treatment had 40 replicates. The total area was 26136 ft$^2$. The spacing between row and trees was 300 cm each. The total area was 9900000 cm$^2$. The treatments of this experiment were as follows:

$T_1 = 0\%$ KNO$_3$
$T_2 = 1\%$ KNO$_3$
$T_3 = 2\%$ KNO$_3$
$T_4 = 3\%$ KNO$_3$

Cultural management practice

**Light pruning:** After harvesting, light pruning was done for next production. Water sprout shoots, any branches that grow out of shape, weak branches, dead and diseased branches, narrow and weak crutch branches were pruned. Pruning helps increase fruit production, improves quality of fruits, attains desired size and shaped of crown, eliminates undesirable branches, and achieves dwarfing effect to enable the trees to be resistant to lodging and easy harvest.

**Weeding:** Weeding was done after pruning. Weeding of the whole plantation area was performed whenever it is necessary throughout the year to reduce competition of nutrients, fertilizer and water.

**Watering:** Watering was carried in every alternate week after pruning until cut 4 months before flowering. When the trees had fruit set watering was again carried out in every week.

**Fertilization:** Fertilization was done 10 days after pruning to hasten the new leaf flushes. A mixture of 14:14:14 of Nitrogen, Phosphorus and Potash 120 g/tree was fed to each tree in every 3 months interval.

**Insect, pest management:** The insecticide (Seven) and fungicide (Benomyll) was sprayed after new leaf flushes. Pest and disease management was done in every alternate month to prevent the damage of new flushes. When flowering, spraying was performed in an irregular pattern but when the size of the fruit becomes marble, spraying of insecticide and fungicide was done to prevent anthracnose and other fungus and diseases infection.

**Drenching Paclobutrazol (PBZ):** One week after emergence of the new leaf flushes, the modified amount of Paclobutrazol 2 g and 4 g m$^{-1}$ canopy diameter were drenched to the respective assigned trees.

**Spraying of KNO$_3$:** Potassium Nitrate (KNO$_3$) and Ethephon (1000 ppm) was sprayed 4 months after Paclobutrazol (PBZ) treatment to promote bud break and to induce off-season flower intensity.

**Bagging:** Mango fruits became egg size, the fruits were bagged with paper bags. The wrapping bag should be big enough to allow room for fruit development.

**Harvest:** Do not harvest mangoes before 120 days after induction due to avoid the immature condition of fruits. Fruits are either picked by hand or by a harvester (a net attached to the end of a bamboo pole with a loop or knife at the end). The harvested mature, insect-pest free fruits were selected as marketable fruits.
Data Collection

Effect of Paclobutrazol (PBZ) and Potassium nitrate (KNO$_3$) on flowering and number of fruit per plant were collected.

Results

Off-season fruit production of Seintalone mango

The experimental trees were soil drenched with 2 g and 4 g PBZ. The PBZ treatment was followed by the experimental design. Four months after PBZ treatment, when the leaves become dark green, 1 %, 2 %, 3 % of KNO$_3$ was sprayed to the respective trees. Three weeks after KNO$_3$ sprayed, the flowering was observed in the trees. Six weeks after flowering, the fruit set was observed. The fruits are harvested four months after fruit set.

In factor A, 4 g PBZ treated trees had higher percentage of flowering (54.78 %) and fruiting (14.83 number) than 2 g PBZ treated trees (53.18 % and 12.40). In statistics, new flushes, flowering and number of fruit were not significantly different (Table 1 and Figure 2).

Stage of fruit development

The fruit development was counted 10 days after flowering (DAF). At 10 DAF, the fruit in pepper size and its length and roundness were 0.5 cm and 1.0 cm. At 20 DAF, the fruit in bean seed size and its length and roundness were 1.0 cm and 2.7 cm. At 30 DAF, the fruit in marble size and its length and roundness were 2.0 cm and 4.0 cm. At 40 DAF, the fruit in pinpon size and its length and roundness were 3.7 cm and 7.3 cm. At 50 DAF, the fruit in egg size and its length and roundness were 5.5 cm and 9.5 cm. At 65 DAF, the fruit in tannis ball size and its length and roundness were 7.0 cm and 13.5 cm. At 75 DAF, the fruit in green mango size and its length and roundness were 9.5 cm and 16.5 cm. At 90 DAF, the fruit in mature size and its length and roundness were 13.0 cm and 25.2 cm.
Table 1. Effect of PBZ on Reproductive Characters of Seintalone Mango

<table>
<thead>
<tr>
<th>FA (PBZ)</th>
<th>Flowering (%)</th>
<th>Number of fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBZ (2 g)</td>
<td>53.18</td>
<td>12.40</td>
</tr>
<tr>
<td>PBZ (4 g)</td>
<td><strong>54.78</strong></td>
<td><strong>14.83</strong></td>
</tr>
<tr>
<td>F-test</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>5 % LSD</td>
<td>15.82</td>
<td>5.33</td>
</tr>
<tr>
<td>cv %</td>
<td>15.6</td>
<td>18.6</td>
</tr>
</tbody>
</table>

Figure 2. Effect of different concentrations of PBZ on flowering

Figure 3. Effect of different concentrations of PBZ on fruit set

Table 2. Effect of KNO₃ on flowering and fruit set of Seintalone mango

<table>
<thead>
<tr>
<th>FB (KNO₃ sprays)</th>
<th>Flowering (%)</th>
<th>Number of fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNO₃(0 %)</td>
<td>42.63</td>
<td>5.65</td>
</tr>
<tr>
<td>KNO₃(1 %)</td>
<td>55.13</td>
<td>13.15</td>
</tr>
<tr>
<td>KNO₃(2 %)</td>
<td>57.88</td>
<td>16.85</td>
</tr>
<tr>
<td>KNO₃(3 %)</td>
<td><strong>60.28</strong></td>
<td><strong>18.80</strong></td>
</tr>
<tr>
<td>F-test</td>
<td>ns</td>
<td>**</td>
</tr>
<tr>
<td>5 % LSD</td>
<td>22.3687</td>
<td>7.53631</td>
</tr>
<tr>
<td>cv %</td>
<td>65.6</td>
<td>87.6</td>
</tr>
</tbody>
</table>

** = highly significant, ns = non significant

Figure 4. Flowering after sprayed with KNO₃

Figure 5. Fruiting after sprayed with KNO₃
Table 3. Stages of the Fruit Development after Flowering

<table>
<thead>
<tr>
<th>DAF</th>
<th>Fruits</th>
<th>Length (cm)</th>
<th>Roundness (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Pepper</td>
<td>0.5</td>
<td>1.0</td>
</tr>
<tr>
<td>20</td>
<td>Bean seed</td>
<td>1.0</td>
<td>2.7</td>
</tr>
<tr>
<td>30</td>
<td>Marble</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>40</td>
<td>Pin pon</td>
<td>3.7</td>
<td>7.3</td>
</tr>
<tr>
<td>50</td>
<td>Egg</td>
<td>5.5</td>
<td>9.5</td>
</tr>
<tr>
<td>65</td>
<td>Tannis ball</td>
<td>7.0</td>
<td>13.5</td>
</tr>
<tr>
<td>75</td>
<td>Green mango</td>
<td>9.5</td>
<td>16.5</td>
</tr>
<tr>
<td>90</td>
<td>Mature</td>
<td>13.0</td>
<td>25.2</td>
</tr>
</tbody>
</table>

DAF = Day after flowering

Discussion and Conclusion

Seintalone is the best and most popular cultivar of mango produced in Myanmar and has great demand in the global market owing to its keeping quality, aroma, texture and flavour. Due to its inherent physiological disorders, we have not been able to achieve the expected production as well as quality. Keeping this in view, experiments were designed to find out suitable remedial measures to step up the production and maintain the quality by using plant growth regulators, Potassium nitrate.

In this experiment, the effective methods such as drenching of 2 and 4 g PBZ and spraying of KNO₃ to the selected 7 years old Seintalone mango trees. The experiment was carried out in 2 factors factorial of CRD. Factor A (FA) was PBZ drenching and that of factor B (FB) was KNO₃ spraying. Application of higher concentrations of PBZ had a negative effect on retarding the length of inflorescence and height of trees, and hastened leaves maturation (Yeshitela, 2004). According to Steffens et al. (1985), PBZ has the greatest effect on immature tissues which are still growing and differentiating. This could explain why PBZ affected predominantly the apical growth. The flowering percentage of 4 g PBZ treated trees were higher (54.78 %) than the 2 g treated trees (53.18 %). The total fruits produced by 4 g PBZ treated trees were superior (14.83) than that of 2 g treatment (12.40).

Nartvaranant et al. (2000) suggested that successful off-season flowering can be obtained using soil drench Paclorbutrazol with appropriate concentrations. The application of Paclorbutrazol is significantly lowered the vegetative growth, reduced the shoot length and fastened the profuse flowering and fruiting, regular yield with biennial (Buronkar et al., 1991). Hasdiseve and Tongumpai (1986) observed that soil application of Paclorbutrazol is the most effective in flower induction than foliar spray. The rate of application is dependent on the diameter of tree canopy.

Four months after PBZ treatment, spraying of Potassium nitrate for flowering and fruiting of Seintalone mango. The results showed that 3% KNO₃ spraying trees possessed the higher flowering percentage (60.28 %) than the other treatments. The use of nitrate can stimulate the anticipation of the flowering, independently of the different treatments and were significantly superior against the control (SaO Jose, 2000).

Barba (1974) observed that 3% KNO₃ can promote flowering in Carabao and Paho mango. Sarabia (1980) also observed that 3% KNO₃ can promote flowering and in Haden mango. However, KNO₃ is not a flowering hormone or stimulus that switched on flowering of trees that has already existing inflorescence to proceed. In this experiment, flowering was observed 21 days after KNO₃ treatment. Potassium nitrate induce flowering in mango was evident within seven days after treatment and was effective on shoots. The concentrations were between 1 to 8 percent that stimulated flowering (Bondad, 1979). It is therefore
concluded that application of 2 g of Paclobutrazol and 3% Potassium nitrate is suitable for Seintalone mango production in off-season.

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References


Maung Maung Htwe, (2003), "Myanmar agriculture sector review investment strategy formulation project", Food and Agriculture Organization of the United Nation.


Myanmar Agriculture Service, (2005), Methods of mango growing booklet, Department of Cultivation and Training, Yangon, Myanmar.


Thanda Aye, (2005), "Use of trunk injection technique and alternative compounds in promoting flowering of ‘Carabao’ Mango (Mangifera indica L.)", PhD dissertation, Department of Horticulture, University of Los Bonos, Philippine.


Appendices

Figure 1. The experimental site, Oway mango orchard
Figure 2. Cultural practice used for off-season fruit production of Seintalone mango

Light pruning  Weeding  Watering

NPK  Drench for fertilizer application

Application of PBZ  Spraying of KNO$_3$

Bagging the fruits  Harvesting
Figure 3. Flowering from drenching of PBZ and spraying of KNO₃ treatments

- **Inflorescence**
- **Hermaphrodite flower**
- **Male flower**

- One hermaphrodite flower and four male flowers
- One hermaphrodite flower and three male flowers
- One hermaphrodite flower and two male flowers

Flowering
Figure 4. Fruits from drenching of PBZ and spraying of $\text{KNO}_3$ treatments

Figure 5. Stages of the development of fruit