Adapting mango growing to a Mediterranean climate

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Introduction

A mango industry exists in the Gingin/Dandaragan area which is located 80 to 150 km north of Perth, Western Australia. This area has a Mediterranean climate which provides challenges to growing mangoes. The vast majority of Australian mangoes are grown further north. Funding was provided by the Northern Agricultural Catchments Council (NACC) to demonstrate techniques to help overcome climatic issues.

There are two main climatic issues for mango growers in this region:

In seasons with cool spring weather pollination and fruit set are reduced which can greatly reduce yield (this happened in the 2016/17 season).

Sunburn damage of mangoes results in up to 30% loss of marketable fruit in some years. Climate change modelling predicts that in the south west of WA the number of days above 40 degrees Celsius could almost double in the next 15 years. These events cause sunburn on the fruit.

Techniques to improve yield and quality

Demonstrations were established on growers properties in 2015 and 2016 to:

1. Delay flowering until temperatures were more suitable for successful pollination
2. Erect a net over the top of the mangoes to reduce sunburn
3. Access varieties that were more suitable to a Mediterranean climate.

Delaying flowering

Sukhvibul and Whiley (2000) found that 10 degrees at night and 20 degrees during the day was too cold for successful pollination of mangoes. Issarakraisila and Considine (1992), who conducted research at the Westralian Fruits property at Gingin, found that successful pollination largely occurred in late October/November. Research by Dag et al (2000) on the Coastal Plain in Israel showed that negligible pollination occurred in March (September our hemisphere). Fruit set usually occurred from flowering at April (October our hemisphere) onwards. Cool weather at flowering can also result in parthenocarpic fruit (nubbins).

This project aimed to delaying flowering until spring temperatures had warmed up sufficiently to allow successful pollination. Removal of early flowers stimulates the growth of dormant axillary buds which flower about 6 weeks later when temperatures have usually increased. The use of plant hormones such as gibberellic acid and ethephon, and desiccants to remove flowers have been used in other Mediterranean climates to delay flowering and increase fruit set and
hence yield. The reliability of such treatments has not been demonstrated to growers in our region.

Figure 1. Cool weather at flowering can result in parthenocarpic fruit (nubbins)

Three techniques were trialed to delay flowering.

1. Manual removal of flowers to promote a secondary flowering about 6 weeks later
2. Use to Gibberellic acid to delay flowering
3. Use of Ethephon to delay flowering

Removal of inflorescences by hand (2015)

Manual flower removal in mid-August 2015 did not result in a strong secondary flowering. Yield was greatly reduced. It is likely that in that year the inflorescences should have been removed earlier, however the appropriate timing of flower removal will vary from year to year with differing climatic conditions. Removal of flowers by hand is very time consuming and a chemical that can burn off the flowers is required.

Application of Gibberellic acid (2015)

The trees to which the gibberellic acid was applied did not reflower. We probably applied the gibberellic acid too late (mid July) or at too high a rate (100 ppm). The appropriate timing of
Gibbereillic acid application will vary from year to year with differing climatic conditions. This technique cannot be recommended until detailed trials over a number of year demonstrate the reliability of the technique.

Figure 2. Gibberellic acid was sprayed on trees in mid July to delay flowering (see trees in middle of the photograph)

Application of Ethephon (2016)

Mango growers in Bundaberg in Queensland have developed procedures for applying Ethephon to delay flowering until the temperatures are warmer so as to increase fruit set and yield, and delay harvest. The method used by these growers was trialled on two properties, one at Gingin and the other at West Gingin. The rate of application was Ethephon at 1000 ppm active ingredient. Two to three applications were applied from mid-August to mid-September at two weekly intervals.
Gingin Property

The treatments did delay flowering but the yield was greatly reduced. Also when three applications were applied unacceptable levels of leaf drop occurred. Ten litres per tree of the spray mixture was applied.

West Gingin Property

There was no response to the application of ethephon. The lack of response to the ethephon on this property may have been due to a lower volume of spray mixture (1 litre/tree) being applied.

Netting

Protected agriculture, such as greenhouses and areas netted with shade cloth, is increasingly being used in horticulture to counter extreme climatic conditions and improve fruit quality. Crops such as apples, stone fruit, grapes and vegetables are now being netted to change the micro climate and improve yield and produce quality. Mangoes are not netted in Australia as the climate in the major growing areas (Queensland and Northern Territory) is more suitable.
than south west Western Australia. These regions do not experience the amount of 40 degree days with no cloud that cause sunburn which are experienced in our region.

Figure 4. Sunburn on fruit

Netting was erected over 32 Kensington Pride mango trees at West Gingin in November 2015 (Figure 5). The sides of the structure were left open to allow access for insects to pollinate the crop. Both white and black net (30% shade) were trialled.

Figure 5. The netted structure over the mango trees
2016 Harvest

The February 2016 harvest showed no sunburn on the fruit beneath either colour netting. About 5 to 10 % of the fruit outside the netting was sunburnt. The fruit from under the net had a similar colour to the fruit outside. Temperature loggers were installed inside and outside the shelter. There was no difference in air temperature. As the netted structure was not erected over the mangoes until spring its effect on flowering could not be assessed. Further measurements were taken in 2017.

2016/17 Season and harvest

The spring and early summer of 2016 were considerably cooler than the long term average temperatures for this period. Flowering was two months later than the previous year. Yields in the region were about 10 to 20 % of the typical yields.

The cool spring weather delayed flowering and the level of flowering was also much reduced throughout the district. The level of flowering under the net was very poor as buds developed into shoots rather than flowers (Figure 6). There was no fruit under the netting.

![Shoot growth beneath the netting, very little flowering in 2016.](image)

In 2017 the black netting (30 %) will be removed and replaced with a less dense (15%) shade cloth. Netting systems that can be retracted in winter to allow light and warmth on to the buds to stimulate flowering and closed in summer to prevent sunburn should be investigated.

In the 2017/18 season the grower will make observations on the time of flowering, level of fruit set, fruit skin colour, level of sunburn/blemish and yield.
The netting demonstration needs to be run for more years to ascertain if mango yield and quality can be improved in order to determine if erecting such a shelter is likely to be cost effective. However, researchers have observed considerably better growth of young trees under netting (Peter Johnson DAFWA pers comm). The reduction of wind speed is critical to controlling the *Pseudomonas syringae*, which a devastating disease of young trees in the region. Netting also reduces wind speed.

**Varieties for a Mediterranean Climate**

The main variety grown in the Gingin area is Kensington Pride. Yields for this variety can be greatly reduced in seasons with a cold spring due to poor fruit set. For example, in the 2017 season yields were about 10 to 20 % of the average yield due to cool spring weather. Kensington Pride is a polyembryonic variety that originates from south east Asia. Varieties that originate from the north of India are more likely to be suited to the cooler Mediterranean climate.

The NACC funding was used to access three varieties from the Australian Mango Breeding Program and a variety trial is being set up on a growers property. [https://www.agric.wa.gov.au/mangoes/australian-national-mango-breeding-program](https://www.agric.wa.gov.au/mangoes/australian-national-mango-breeding-program)

The project tried to access some the Israeli varieties which were bred in a similar climate to the south west of Western Australia. However the company which had the rights to the varieties in Australia would not supply the small number of trees that were required for the trial. Trees from the Katherine breeding program (Lady Jane and Lady Grace) have been planted at Dandaragan and their performance is being monitored.

*Figure 7. The Lady Jane variety at Dandaragan*
References


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