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Mango Irrigation Management Guidelines

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INTRODUCTION

Irrigation management is crucial to the production of quality fruit. Water inputs must be geared to tree water requirements, soil factors and fruit physiological requirements.

NEW PLANTING

In a new planting, trees must be irrigated throughout the year, including dry periods which occur during the wet season, to enable rapid establishment of the tree. Water inputs should be appropriate to tree size. In general up to 100 L/tree/week should be sufficient for the first two years. The radius of the sprinkler should be appropriate to tree size. Many growers find that a sprinkler with a distributor plate (radius of 1.0 to 1.5 m) is adequate for up to three years. In subsequent years sprinkler radius should be less than 3 m to ensure that the water is delivered to the root zone under the canopy edge which also helps to reduce weed growth around trees. After the second wet season trees are generally only irrigated during the flowering and fruit development period. (July to November)

The soil type determines how early continuous irrigation can cease. Trees grown on light sandy and gravelly soils may require continuous irrigation for a longer period to allow them to develop an appropriate size canopy.

FRUITING TREES

In fruiting orchards there are three phases during the annual growing cycle where distinct irrigation management options need to be exercised.

- **Phase One**
  Pre-flowering, from the end of the wet season to the commencement of flowering (April to June/July).

- **Phase Two**
  Flowering and fruiting, from visible panicle bud differentiation to harvest (July to November).

- **Phase Three**
  Post harvest to the end of the wet season (November to April).

Phase one

In mature orchards (established fruiting trees) water is normally withheld from the end of the wet season until flowering. This period of low soil moisture is believed to encourage earlier and more synchronous flowering. Experimental evidence is still inconclusive but it is thought that cool weather (several weeks with night temperatures less than 15°C) is the main flowering trigger. However, irrigation withdrawal is thought to enhance the flowering trigger, particularly in a year where there is an inconsistent run of cool nights.

Phase Two

Irrigation is highly recommended from flowering until late fruit maturity. Some growers prefer to start irrigating after 50% of the tree is in flower and at least 50% of the flowers are open. Other growers will start irrigating from the commencement of visible flower panicle development in an attempt to speed up the flowering and fruit setting process. The present DPIFM recommendation is to start irrigating when at least 60% of the flower buds are visible.

The amount of irrigation is dependent on tree size (canopy cover), evaporation rates and evaporation replacement rate. Irrigation frequency is dependent on soil type (water holding capacity) and effective root depth.

The present irrigation input recommendations are based on a replacement rate (crop factor) of 0.70. Irrigation rates (Appendix 1) per tree depend on the size of the tree. Planting density and pattern interacts with tree size. Maximum percentage canopy cover in the orchard should be between 60% and 70%. This can be achieved by a few large trees (e.g. 100 trees/ha 10 x 10 m) or many smaller trees (e.g. 200 trees/ha 10 x 5.0 m).

Many growers choose to water for 24 or 36 hours at the start of the irrigating season. This may not be necessary particularly if using low radius (2.0-3.0 m) sprinklers because tree water requirement is lower during the first month of flower and fruit development. The use of a hand auger to establish watering depth is recommended, particularly during the first few weeks after irrigation commences. The wetted zone should be at least 40% of the under tree canopy area and good soil moisture should occur down to 60-80 cm. Saturated soil beyond 80 cm suggests that trees are being over watered.

Phase Three

Irrigation normally ceases a few weeks prior to harvest and is not recommenced until flowering in the following year. In years where the wet season begins late (late January, early February) the new vegetative flush may be delayed. This may influence the following flowering date with the most likely consequence being a later flowering. In situations where trees are grown on light soils and the build-up rains and wet season are late, trees should be irrigated to promote an early flush of growth. This should occur after pruning and fertiliser operations have taken place.

SOIL MOISTURE MONITORING

Monitoring of soil moisture status using tensiometers, neutron moisture probes or the capacitance based Environscan is an extremely useful management technique, particularly in larger orchards. Tensiometers are the simplest and least costly instruments to install and use. Tensiometers should be installed in groups of two or three with the shallower tensiometers at 20 and 40 cm and the deepest at 80 to 100 cm. Tensions in the two shallower depths should be kept under 30 to 40 kPa depending on soil type whereas tension at 80 to 100 cm should be between 40 and 60 kPa. See Agnote D19 “Tensiometers” for more details. The Neutron Moisture Probe and Enviroscan can give additional information such as watering depths and depth of water uptake which allows for further refinement of irrigation schedules. However, they require good computer and management skills to interpret. Needless to say these instruments should be considered by owner/managers of larger orchards. In all circumstances, regardless of water monitoring techniques, growers should record watering times and duration throughout the growing season.

IRRIGATION FREQUENCY

In simple terms the more sandy and gravelly the soil, the more frequent irrigations should be. Two to three times per week will be appropriate for most sandy sites. Long irrigations on a sandy soil result in water draining beyond the depth of the effective root zone which is a waste of water and leaches away nutrients.

The use of a hand auger to determine irrigation depth can quickly alert you to potential deep watering problems. Moisture monitoring will allow an appropriate irrigation schedule to be established.

WATER REQUIREMENTS AND FRUIT DRY MATTER MANIPULATION

Some growers encourage the earlier development of 14% fruit dry matter (minimum market standard) by manipulation of irrigation inputs and cut off prior to harvest. This practice should be carried out with caution as low water inputs (less than 60% replacement) and early cut off (four weeks prior to harvest) will reduce fruit size and fruit quality and delay the development of fruit peel colour.

Work carried out by the Crops, Forestry and Horticulture Division to establish water requirements of mangoes, shows that fruit size increases with increasing amounts of water up to 100% evaporation replacement. Dry matter development is delayed with increasing water inputs. The current recommendation of 70% evaporation replacement is a compromise in terms of balancing the requirements for adequate fruit size, fruit quality and time to maturity.

FURTHER READING

Poffley, M. (1999). Mango Management - Flowering to Market. DPIFM. Agnote D9.

APPENDIX ONE - MANGO IRRIGATION GUIDELINES

Note: the irrigation rates presented in Table 1 are a *guideline* and should be used as a starting point. The actual irrigation rate should be determined for each site by the use of soil moisture monitoring methods.

Assumptions

- Crop Factor (Irrigation Replacement Rate) = 0.7
- Mean evaporation rate for Darwin and Katherine areas (July to November) = 8.0 mm/day.
- Canopy cover, expressed in m^2 per hectare (10 000 m^2) of land.

Method

1. Measure the canopy cover in your orchard as described in the following guidelines.

2. Calculate your tree density (trees per hectare).

3. Select the most appropriate canopy cover and tree density which describes your orchard in Table 1. Record the value where the grids meet. This value is your water requirement in litres per tree per week. e.g. canopy cover 5000 m^2, plant number per hectare 140. Water requirements are 1400 litres per tree per week. If your orchard statistics fall in between those listed in Table 1, select the nearest or a value in between the two extremes.

CANOPY COVER CALCULATIONS

Area of circle method

Use this method when the canopy of each tree is a separate unit. For example, in young orchards and or in wide row spacing situations:

- Measure the radius of a number of trees (10) at four locations around the canopy. Average the readings.

- Use the formula, area (m^2) = pi $(r)^2$, where pi = 3.1416 and r = average radius. For example, if the average radius (r) = 2.5m; then area = pi $(2.5)^2$ = 3.1416 x 6.25 = 19.6 m^2.

- Multiply the tree canopy area by the number of trees per hectare to calculate the canopy area per hectare. For example, if you have 160 trees/ha then 19.6 x 160 = 3136 m^2/ha.

Row crop method

Use this method when the tree canopies meet within the row. Note that this method will overestimate canopy cover if the trees are only just beginning to touch. If this is the case then the 'area of circle' method is more appropriate.

- Measure the canopy width from one side of the row to the other. Do so in at least 40 sites throughout your orchard. Average the readings.

- Multiply the average canopy width by the tree spacing within the row. For example, 6.5 m (average canopy width) x 5.0 m (tree spacing in row) = 32.5 m^2.

- Now multiply the canopy area per tree by the number of trees per hectare. For example, if 200 trees/ha then 32.5 x 200 = 6500 m^2/ha.

Table 1. Average mango tree water requirements (Darwin and Katherine areas) in litres per tree per week. Based on canopy cover and tree density

	Trees per hectare						
Canopy cover m^2/ha	**80**	**100**	**130**	**140**	**160**	**180**	**200**
1000	490	390	330	280	250	220	200
2000	980	780	650	560	490	440	390
3000	1470	1180	980	840	740	650	590
4000	1960	1570	1310	1120	980	870	780
5000	2450	1960	1630	1400	1230	1090	980
6000	2940	2350	1960	1680	1470	1310	1180
7000	3430	2740	2290	1960	1720	1520	1370
8000	3920	3140	2610	2240	1960	1740	1570

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