HORTIN II Co Innovation Programme

Towards cost effective, high quality value chains

Rambutan cultivation techniques

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The purpose of the HORTIN II programme is to contribute to the development of cost effective high quality value chains for vegetables and fruits. Among others this can be achieved when technology development takes place in close collaboration between public institutions, farmers and private companies.

In Indonesia, the programme is carried out by the Indonesian Vegetable Research Institute (**IVEGRI**) in Lembang and the Indonesian Centre for Agricultural Postharvest Research and Development (**ICAPRD**) in Bogor. In the Netherlands Applied Plant Research (**APR**), WUR-Greenhouse Horticulture (**GH**), the Agricultural Economics Research Institute (**AEI**) and the Agrotechnology and Food Science Group (**AFSG**), all part of Wageningen University and Research Centre, are the principal partners.

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1. Introduction

This literature survey, on the possibilities for extension of harvesting season of Rambutan by special measurements during the growing period and possibly by measures during the harvest period, is part of the HORTIN-II project, Horticultural Research Co-operation between Indonesia and The Netherlands, called “Product diversification and quality improvement Rambutan”.

The extension of the harvesting period in field grown crops has many consequences in farm management: better exploitation of harvesting machines; changes of requirements in hand labour and in personnel; reduction in specific investment and amortization, in production costs of the crop; after all revenues may change substantially (Vig 1975).

The consequences of an extended harvesting season should be reviewed not only on the level of a farm or a processing plant, but also in a vertical entanglement of the whole national food industry. Depending upon considerations aimed to increase the profitability of the end product in some cases the growers may be stimulated to extend the harvesting by season-dependent prices.

All of the above mentioned have to be calculated on the basis of the system of actual prices. As the validity of those calculations is temporary because of permanently changing costs and prices it is advisable to recalculate the system every two or three years.

Extension of the harvesting season can be approached from two different angles. There are cultivation methods that could regulate blooming and therefore the date of fruit ripening, on the other hand harvest and post-harvest treatments can do just this.

2. Cultivation methods

Rambutan is a non-climacteric fruit and needs to be harvested when fully ripe. Since fruit don't produce ethylene after picking, they need to ripen on the tree (Vendrell 2001). This shortens the harvesting season substantially. The harvesting period for Rambutan is November until March (4 month with a peak in December and January).

2.1. Clones

Most Rambutan trees propagated from seed are not true-to-type and are usually sour. Depending on the location, the Rambutan tree produces one or two crops a year. In Asia, the Rambutan produces a small crop between June and July, and a heavy crop between November and Januari (Pohlan, Vanderlinden et al. 2008). Currently the DC Fruit Crops is advocating the use of grafting selected varieties on old trees ('top working') to change cultivars and to modernize the sector. Young, crafted young trees are also available on the market but it is not know whether farmers produce their own seedlings or buy them at the markets. In general, there is hardly any specialisation in the sector and specialised nurseries were not observed during the survey conducted by the HORTIN II authors (Alex van Schaik 2008). Experiments conducted by Valmayor et al. (Valmayor 1970) showed that cultivar 'Seenjonja' with an average production of 41 kilos significantly out yielded 'Seematjan' and 'Maharlika' in three consecutive seasons. Selection of early and late blooming cultivars can extend harvesting season considerably.

2.2. Production regions

The production season of Thailand and Indonesia are not overlapping and complementary to each other. Some fresh Rambutan from Thailand is exported to Indonesia during the period of May – August. The harvesting season could be extended by cultivating Rambutan in other areas of Indonesia as well since recent data (2006) of the Directorate General Horticultural Production show that most of the Rambutan in Indonesia is produced in West Java, followed by East and central Java. Java as a whole is the centre for Rambutan production as compared with Kalimantan and Sumatra where relatively small quantities of Rambutan are produced. There are also some scattered orchards of Rambutan and homestead trees at Bali and the other Eastern Indonesian islands (Nusa Tenggara province). The production value of Rambutan is small as compared with other Indonesian fruit crops.

2.3. Dry period

There is very little literature available on cultural methods that could extend the harvesting period. Rambutan needs a dry spell of about 2 to 3 months to induce flowering. Recommended cultivars such as 'Rapiah', 'Lebak Bulus', 'Binjai' and 'Garuda' have been described by the Directorate of Fruit Crops (DG Hort. Production). Artificial flower induction by applying water after a dry spell is not practiced in Indonesia. In Thailand however, several cultural techniques to induce flowering and therefore setting the date for the harvesting season, are being using as follows.

2.4. Flowering induction

To induce flowering of a vigorous tree, complete fertilizer, 16-16-16 or 13-13-12 (N:P:K), and chicken manure are applied just after harvest. If the period of plant preparation is in the rainy season, irrigation may be unnecessary. Dry spells in excess of seven days necessitate irrigation. A suggested watering regime is 60 to 65% of pan evaporation (Salakpetch 2005).

Different ways of pruning just after harvest to promote strong vegetative growth could influent the harvest season as well. Also pruning of the unnecessary branches within the canopy may be removed to improve light conditions. Other practices mentioned by Salakpetch (Salakpetch 2005) could be used to extend the harvesting season:

2.4.1 Agro techniques during flower induction and development

Rambutan trees require prolonged water stress for about 2 to 4 weeks to induce flowering. Rambutan is ready to undergo an induction period when the terminal leaves of the latest flush are mature, and the wet season has ended. When the terminal leaves grow upright and both margins slightly bent upward after the trees have been exposed to water stress, a large amount of water (about 10 mm applied only once) is applied to stimulate flowering. More water may be required if there are strong winds. About 7 to 10 days after irrigation, the terminal shoots will develop and turn from black brown to golden brown colour. Another 10-mm irrigation is then applied to stimulate flower bud growth (Chandraparnik, Salakpetch et al. 1992). A recommended irrigation regime is 75% of pan evaporation to promote flower bud growth and development. The development of panicles from floral bud mergence to full bloom is only 3-4 weeks.

2.4.2 Practices during fruit set and development

Rambutan flowers are small, greenish pubescent (600 to 2,000 flowers/panicle) and usually functionally unisexual. Flower lack of odour, but secret nectar at anthesis to attract honeybees, which affect pollen transfer. The trees have been generally classified into three groups according to flower characteristics. Male trees produce only staminate flowers. About 40 to 60% of the seedling population is usually male trees. These trees are important pollen source for fruit-set process. Pollen is shed only for three to four hours in the morning of flower opening. Trees produce hermaphrodite flowers are functionally female. This type of flowers is receptive at anthesis and remains for up to 48 hours. Trees produce hermaphrodite flowers, some of which are functionally female, and some are functionally male. This is the most common form in cultivar selection. Since the (3.4.2) type of flowers is widely seen in cultivated rambutan, cultural techniques to convert or improve sufficient flowers to a functional male status for adequate pollination are required to improve fruit set. Assisted pollination by hanging male panicles collected from the male trees directly onto functionally female hermaphrodite panicles when the hermaphrodite flowers are about 50% bloom on each panicle. This is one of the cultural techniques to improve fruit set. The male panicles were left until the fruits are set and start to develop. This technique is labor-intensive and requires a large number of male panicles. Pollen grains collected from the male trees in an amount of 0.5 to 1.0 L may be mixed in 20 L of water and sprayed onto the hermaphrodite trees when the panicles develop to 50% full bloom. The second application, a week later, is recommended.

Another technique to improve adequate pollination is to graft the male scions onto the hermaphrodite trees. One grafted tree may provide adequate pollen for about 5 hermaphrodite trees. Planting male trees in a row of hermaphrodite trees with ratios of male: hermaphrodite varying form 1:5 to 1:10 is also recommended in newly established orchards. A spray of 1-naphthylacetic acid (NAA) (4.5% stock solution diluted at a concentration of 1 ml/L of water) applied to hermaphroditic panicles located particularly at the top part of the trees about a meter apart at the time of early bloom (the majority of panicles is 5% bloom) converts the hermaphrodite flowers to functionally male flowers. If a dilute concentration of NAA (1 ml NAA stock solution/10 L water), is applied to the whole tree when the majority of the panicles are about 5% bloom, all hermaphrodite panicles will be converted to male functional panicles. In this case, the treated tree will act as a pollen source. After pollen is shed, the treated panicles will be cut off and the new coming panicles will be the (3.4.3) type and set fruit easily. Beehives can be placed in the orchard to increase bee activities for pollination.

During the development of panicles, an irrigation regime of 75% of pan evaporation is applied to promote their growth and development. The same amount of water is applied until the end of the first week after anthesis to promote growth and development of fertilized ovules.

2.4.3 Agro techniques during fruit growth and development

Rambutan trees require irrigation regimes at an amount of 80 and 85% of pan evaporation when fruits are two to five weeks and older than six weeks after anthesis, respectively. Regular and consistent watering regimes are crucial for fruit growth and to prevent fruit split. Fruit splitting always occurs after heavy rain if irrigation is not adequate and inconsistent during various stages of fruit growth. The fruit size may be increased if a single panicle retains about eight to ten fruits only. Therefore, fruit thinning is recommended. The thinning should be made and completed not later than the fourth week after anthesis. A complete fertilizer should be applied to the soil during this period of fruit development. The period from anthesis to fruit maturity is normally 3.5 to 4 months.

2.5. Physiological active substances

Kondo et al. showed the rise and fall of different substances in the fruit towards ripening (Kondo, Nimitkeatkai et al. 2002), (Kondo, Posuya et al. 2001) and (Kondo 2001). However, none of these physiological processes seem to been compliant yet in order to extend the harvest season.

3. Harvest and post harvest methods

3.1. Water loss and low temperature

For a good quality fruits need to be picked at least twice a week. In Indonesia and Malaysia fresh fruits are marketed per bunch and in Thailand fruits are sold individually. Not only will the produce be more homogeneous, also the harvesting period will be extended further. Moreover the shelf life of the Rambutan is short (a few days only). Rambutan rapidly lose their attractive appearance after harvest due to a superficial pericarp browning. Storage at high humidity minimizes fruit desiccation and may, therefore, delay browning onset. Rambutan fruit pericarp browning beyond a commercially saleable level occurred at a weight loss of 25% to 40%. This depended on duration and storage relative humidity (RH) (Margaret Landrigan 1996). In other research Landrigan (Landrigan, Morris et al. 1996) found that the development of browning was preceded by water loss and concomitant declines in water potential of spinterns and skin. As water potential decreased cell turgor also declined. There was a strong negative correlation between water potential and browning such that as browning score increased, water potential declined. Similarly relative water content showed a negative correlation with browning. Water was lost from intact Rambutan fruits via spinterns and replaced by water from the skin.

Keeping the fruits moist prolongs the post harvest life of the fruits. Shrink foliage wrapping of fruits have a positive effect on the shelf life and the quality of the fruits.
Besides protecting the fruit from drying out, shading and cooling (5 – 10°C) also has a positive effect on the shelf life and the quality of the fruits. Thailand has cold packaging facilities in place in the major production centres contributing to a better quality of the Rambutan..

3.2. Post harvest processing

A distinct feature of the Thai Rambutan sector as compared with Indonesia is the presence of a mature canning industry (Salakpetch 2005). Processes Rambutan canned in syrup, pure or mixed with pineapple chunks is popular with consumers. There is no large scale processing Rambutan at Java. It was reported (Alex van Schaik 2008) that the only factory processing Rambutan – sometimes in combination with pineapple – is PT. Agrosari Sentraprima in North Sumatra. It was learned from Thailand that the export of canned Rambutan could be lucrative, also making the Rambutan sector more robust. In the case that Rambutan is canned at the peak of the harvesting season, processing can help to a certain extent to stabilize prices in these periods of over supply. Processing Rambutan during the peak season might provide an alternative outlet for professional as well as homestead producers and could help keep prices at a more acceptable level.

4. Conclusions

In order to either extend the cultivation period or the harvesting period, the following advices should be taken into account.

- Very little is know in the international literature about ways to extend the harvesting season for Rambutan. Further research should be done to fill in this knowledge cap.
- Drying out, because of the large surfaces with hairs the fruits rapidly loose weight, and dry out. Keeping the fruits moist prolongs the post harvest life of the fruits. Shrink foliage wrapping of fruits have a positive effect on the shelf life and the quality of the fruits.
- Controlling the flowering of the trees by water stress and chemicals
- Controlled and modified storage facilities
- Vertical chain integration
- Choosing the right cultivar (early and late blooming) can extend harvesting season.

5. Literature

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