Applicability of deficit irrigation strategies in lychee and longan production in Thailand

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INTRODUCTION

Thailand is one of the biggest lychee (Litchi chinensis, Sonn.) and longan (Dimocarpus longan, L.) producing countries. Longan is produced in the lowlands, while lychee is restricted to upland areas, because it needs low temperatures for flower induction. The main production period for both fruit tree species is during the dry season. Thus, irrigation is necessary to obtain good yields at a marketable quality.

Water is an increasingly scarce resource all over Thailand. Periodically appearing droughts threaten agricultural production and are a source of conflict between upland and lowland farmers. For the single farmers irrigation is related to high energy costs for pumping. The situation is more severe as many farmers produce off-season during the whole dry season.

In order to save water, emphasis of research is put on increasing water use efficiency (WUE). Therefore, deficit irrigation strategies offer large water saving potentials. Namely, partial rootzone drying (PRD), a novel irrigation method, has been reported for many crops to increase WUE substantially. In PRD at each irrigation time only one side of the tree row is watered while the other side is left to dry to a pre-determined level, before being irrigated next. The plant's stress response decrease water consumption by closure of the stomata and decrease the vegetative growth. On the other hand, yield decline is minor. In Thailand PRD for longan trees has been investigated, without significant yield reduction as compared to well watered trees (Satienperakul et al., 2006).

MATERIALS AND METHODS

Production data from three years of longan cropping (Ongprasert et al., 2007) and two years of lychee cropping have been analyzed for irrigation, yield and WUE and the water requirement as well as the water saving potential was assessed based on weather data provided by "The Uplands Program" (Mae Sa Mai) and the Meteorological Department of Thailand (Chantabury, Lamphun).

Three types of farmers have been surveyed and compared with respect to water savings potentials and requirements to adapt their irrigation systems to practice PRD. 16 farms have been visited and the farmers interviewed by use of structured questionnaires: a.) Upland lychee-farmers in Mae Sa watershed, Chiang Mai Province b.) Longan farmers in the upper Ping River basin in Chiang Mai and Lamphun Provinces and c.) Longan Farmers in Chantabury Province, Central Thailand.

RESULTS AND DISCUSSION

In longan production in the lowland, PRD offers a good potential to save irrigation water. For lowland farmers who use more modern irrigation systems, costs of adaptation of the

systems are smaller. Increased management requirements on the one hand are balanced by lower energy costs for pumping, especially where farmers rely on deep wells. Thus, for longan farmers in the lowlands, PRD might be an interesting way to save water and reduce production costs.

The irrigation period in the uplands is too short as to make a substantial impact of the savings potential. Early rainfalls also interfere in the wet-dry cycle which is required to establish a successful PRD irrigation. Thus, even though it was found, that the physiological responses of lychee are generally in favor of PRD (Spreer et al., 2007) it seems hardly feasible in the upland areas. Moreover, irrigation systems used by many uplands farmers, rely on outdated technology, which make a precise allotment of water impossible. Changes in the systems would be much more costly as to be compensated by water savings. Potential benefits from water saving are difficult to be quantified, as water is not priced and is supplied to the fields by gravity. Thus, variable costs are minor.

CONCLUSION

For lowland farmers all prerequisites for a successful establishment of PRD are given: the drought period is long enough and the technology for precise water distribution is available. Furthermore, through pumping and maintenance of reservoirs, irrigation water is costly and improving WUE is economically interesting. We conclude that PRD should be widely recommended for longan farmers in areas that are affected by water scarcity.

For upland farmers neither the eco-physical conditions nor the socio-economical framework favor the establishment of PRD. Emphasis should be given to the research and establishment of appropriate irrigation technology, which reduce water consumption and improve WUE by more sophisticated ways of irrigation.

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Possible physiological mechanism of premature fruit drop in mango (*Magnifera indica* L.) in northern Vietnam

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KEY WORDS: Fruit abscission; microscopic studies; plant hormones; separation layer; stress physiology; vapor pressure deficit (VPD)

Mango (*Mangifera indica* L.) is one of the most important fruit crops worldwide. Although this subtropical fruit is primarily consumed in the main producing countries such as India, Indonesia, Brazil and the Philippines, there has been increasing demand for mango in the Northern hemisphere. Responding to the increasing global demand for fresh mango and processed mango products, Vietnam has expanded traditional production areas in central and southern Vietnam. Mangos are also produced by ethnic minorities with traditional crop management practices in the mountainous areas in the Northern Province of Son La. These highlands typically experience warm and dry climatic conditions that favour flowering and adequate initial fruit set of mango. However, mango fruit quality does not meet international market-orientated demands. Consequently the fruit is primarily consumed locally, however, the two main mango varieties 'Hoi' and 'Tron' become increasingly popular nationwide due to good flavor and taste.

Both varieties have relatively low tree performance due to mainly poor husbandry work. In addition, the climatic conditions in the mountainous areas of northern Vietnam with relatively hot, dry prevailing winds during the initial fruit set period aggravate the problem of severe fruit abscission, commonly known as premature fruit drop. However, the exact physiological mechanism of this process is not clear and requires further investigation. Understanding the physiological basis of premature fruit drop in mango is not only of scientific interest but it also helps farmers to improve or even replace existing traditional crop management practices to ensure economically sustainable cultivation of mango in this region.

Therefore, our working hypothesis suggest that in the mountainous regions of Northern Vietnam, the hot dry winds with an high vapor water pressure deficit (VPD) may cause premature fruit drop mid February to mid March. Moreover, throughout this period there is lack of precipitation and this may constitute a significant stress factor in typically non-irrigated mango orchards.

The experimental plot is located near the township of Yen Chau. The experimental design includes 20 randomly selected 10-year-old trees of 'Hoi' and 'Tron', respectively. Half of the trees were irrigated with micro-sprinklers (2 h every 4 days with 120 l/h) and the remaining trees served as non-irrigated control trees.

To investigate climatic impacts on fruit drop, an automated weather station (DELTA-T) recorded air temperature and relative humidity (RHT2nl-02), light intensity and sunshine hours (BF3), wind speed (A100R), wind direction (W200P/L) and rainfall (ARG100) within the orchard throughout the growing season.

Soil temperature probes (10108TM) recorded at 10-min intervals at 10 and 20 cm depth near one irrigated 'Tron' tree and at 10 cm depth near one non-irrigated 'Tron' tree. Theta-soil moisture probes (ML2x) recorded at 10 and 20