Overview of the HAL project SF02015 "Breeding low chill, high quality summerfruit varieties for the Australian industry"

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Background

This five year project commenced in July 2002 in response to grower requests for new low-chill varieties with fruit of high eating quality and tree adaptation to local growing environments. A scoping study was conducted in 2001-2002 which mapped out an overview of the Australian market, the major segments within the market, the potential for new segments and a strategy for developing new cultivars for this market.

Low-chill fruit quality is of high importance to the wider national stone fruit industry as it sets the standard for the start of the stone fruit season. Consumers purchasing high quality peaches, nectarines and plums in October and November will continue purchasing during summer. Consumers will not purchase high-chill fruit if they have had bad experiences with low-chill varieties. To consumers they are all just stone fruit regardless of their production in low-chill or high-chill regions.

Materials and methods

Lyrene (2005) summarises two methods for subtropical genetic improvement as follows: "There are two ways to breed for subtropical adaptation. One is to start with wild germplasm that is already adapted to the subtropics. Using this adapted germplasm, the breeder works to develop all of the horticultural characteristics needed in a commercial cultivar. The second approach is to start with elite cultivars available from colder areas and breed to adapt them to subtropical conditions."

In our current breeding program we have used both approaches. However we have been fortunate because the "wild subtropical germplasm" we have used is in fact vastly improved cultivars and selections that have been developed for over 50 years in low-chill breeding programs in Florida and Brazil. It has therefore been a matter of fine-tuning this material so that it is well-suited to our particular industry requirements.

Results and discussion

Seedling production

Over 16,000 seedlings have been produced during the four years of the breeding project. The majority of these seedlings have been nectarine and peach but about 15% have been for other summerfruit crops of plum, apricot, cherry and novel fruit types (Figure 1).

Figure 1. Novel fruit types from the low-chill summerfruit breeding program including peento nectarines, black-skinned blood plums and all-yellow nectarines.

In keeping with the original project directions we have aimed to produce the peach and nectarine selections as both yellow and white flesh (70%:30%), regular-acid/sugar balance and low-acid/sugar balance (80%:20%) and melting and non-melting flesh (50% of each).

High eating quality fruit

The main aim of this project is to produce well adapted low-chill peach and nectarine cultivars with high eating quality. There are many aspects of fruit quality including visual traits such as size, shape and colour and internal flesh traits such as sweetness, aroma, acidity, juiciness and texture. We are selecting for all these traits but today I would like to explain three of the strategies we are using to increase fruit sweetness.

One strategy is to increase the fruit development period (FDP) of the cultivar so that the fruit has a longer period on the tree in which to accumulate sugars. Growers wish to finish harvesting low-chill peaches and nectarines prior to the start of the high-chill season in late November. With the harvest date set by these market forces we still have variability in the flowering date by which to increase the FDP. At Nambour in Queensland a 250 chill unit (CU) peach will bloom about the third week of July whereas a 150 CU peach will flower about 2 weeks earlier. We are selecting heavily for these 150 CU and lower chilling requirement cultivars in our breeding project as part of this increased FDP strategy.

A second strategy is to use an assortative mating scheme whereby the highest sugar level selections are inter-crossed to produce seedling populations for further selection and improvement of fruit sugar level. Heritability of sugar level has been reported as low to moderate but these were in studies were the sugar content of fruit was measured on a subjective scale or using small samples of fruit (de Souza et al., 1998; Hansche et al, 1972; Hansche, 1986). We are studying methods of increasing the heritability of this trait by improving our methods of measurement and sampling techniques. Mr Suthin Promchot, a PhD student from Kasetsart University in Thailand worked in our program during the past season. One of the experiments he conducted was aimed at determining the most reliable method of sugar level measurement in our breeding populations. Initial analysis of these results indicate that as many as 10 fruits per seedling need to be measured in order to discriminate the sugar content differences needed for genetic improvement.

A third strategy is to alter the ratio of sugar to acid in the fruit and so change the perceived sweetness. This strategy has wider implications in breeding low-chill peaches that will be desired by Asian consumers (Wei, 2001). We are using the honey gene which reduces malic acid content in peach and nectarine producing fruit with a distinct low-acid flavour. Preliminary consumer reactions to these fruit have

been positive but further testing is necessary. Consumer acceptance of high and low acid peaches and nectarines can be high if the fruit are sweet enough but consumer responses to the two types of fruit differ (Crisosto and Crisosto, 2005).

Reduced Tree Size

The long growing season and rapid growth of low-chill summerfruit trees in subtropical locations produces far more vegetative growth than is required for optimum yield of high quality fruit. This excessive vigour is an unwanted cost to growers in terms of labour for summer and winter pruning, chemicals to control vigour and loss of yield and fruit quality. During the course of this project we have identified several peach and nectarine seedlings with a semi-dwarf growth habit that reduces tree size by 30-40% compared to standard cultivars (Figure 2). Further experiments are being conducted to analyse this tree architecture and incorporate the smaller tree size into new low-chill cultivars.

Figure 2. Semi-dwarf nectarine selection in foreground on left side, with standard peach cultivar on right side.

Grower Testing

Grower testing of new selections occurs concurrently with the testing of the material at Maroochy Research Station at Nambour. Grower cooperation in this part of the evaluation process allows us to obtain information on selection performance from a wide spread of environments in a short period of time.

To assist with this process we have conducted variety evaluation workshops for the grower testers. This allows a uniform standard of evaluation and increases the quality of the evaluation data.

New selections from the breeding program are currently on test at 12 grower properties in New South Wales and Queensland. In a new project (submitted to HAL in 2006) it is planned to include new testing sites in Western Australia and to test our medium-chill selections in southern regions such as Swan Hill.

Conclusions

This low-chill peach breeding project is employing consumer evaluation of fruit quality and grower testing of tree adaptation to produce new low-chill summerfruit cultivars for the Australian industry. The new cultivars are aimed to be of immediate benefit to low-chill fruit growers and to improve consumer satisfaction in the early part of the peach season and so have benefits to the whole of the Australian industry.

Literature cited

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