MAY 2021

ALL ABOUT ALMONDS

ALMOND BREEDING

NATIONAL ALMOND BREEDING PROGRAM

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CONTENTS

Introduction

The almond industry in Australia has been well established for nearly a century. The cultivar Nonpareil has been here since 1882 and many other cultivars which were relied on came from Europe or the USA. A national almond breeding program was initiated by the Almond Board of Australia to expand the choices of cultivars available and to breed almonds better suited to our environment. The University of Adelaide began the breeding program in 1997 by crossing 49 different combinations of parents resulting in 1,230 progeny which were planted in 1998 at Lindsay Point, Victoria, in the very first primary evaluation trial. Since 1997 the breeding program has achieved 348 different parental combinations using 86 parents. These parents have included a combination of Spanish, French, American, Italian, Russian and Australian cultivars. The choice of which parent to use is affected by their tree and nut characteristics. Also by the heritability of each trait which varies enormously. One important trait that was chosen from the very beginning was self fertility. Luckily this trait is dominant so theoretically when crossing a self-fertile with a non-self-fertile tree, half the progeny will carry the Sf (self-fertility) allele.

To start with we had to import Sf pollen from Europe as there were no Sf trees in Australia. The breeding program then imported several Sf cultivars which went through quarantine and are now in the Australian almond germplasm collection at the Waite campus of the University of Adelaide (Figure 1).

Once a crossing matrix has been decided on, pollen is collected from all male parents (Figure 2). In some cases this needs to be collected the year before as the pollen donor trees may flower later than the female. The pollen can be stored in the freezer for a few years if necessary. Mother trees are bagged to keep out pollinators and hand hybridisation is used to fertilise the flowers.

Evaluation of progeny

Once the progeny (seeds) have been collected from the mother trees the following season, the seeds are cold stratified under moist conditions until they germinate. It takes several months until the seedling trees are large enough to be planted at a primary evaluation site. The first evalaution then takes place at year three when the trees have enough nuts to evaluate. These trees are closely planted to minimise space requirements.

For primary evaluation we measure several kernel and nut characteristics that are important for commercial reasons. Traits that are scored include nut and kernel weight, skin colour, taste, shelling percentage, doubles, shell seal & appearance. Trees that score highly are then budded onto rootstock and planted out at commercial spacing for the secondary evaluations. The percentage that make it to secondary evaluation is approximately 2%.

Up until 2019, all primary evaluations sites were at Lindsay Point, Dareton and Monash. Since then the primary plantings are at the Almond Centre of Excellence (ACE) in Loxton. Secondary evaluation sites are spread across the almond growing regions, both on growers properties and the ACE. During this phase of the evaluations we are looking for tree habit, productivity, disease tolerance, vigour, bearing habit, flowering time, harvest time, & self-fertility.

The secondary evaluation trials take several years to fully evaluate each selection to gain an accurate assessment of productivity. Previous experience has shown that the better selections often out yield Nonpareil early in the secondary trials indicating their lifetime performance. Tertiary trials are a larger scale with 100 of each superior selection grown across the regions.

Figure 1. National almond germplasm collection at Waite campus, Urrbrae SA.

Figure 2. Pollen extraction from almond buds.

New Australian cultivars

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Figure 3 confirms that the new self-fertile cultivars produce many self-pollinated nuts in a commercial orchard.Kernel mass did not differ significantly between self-pollinated and cross-pollinated nuts. These results suggest that single-variety blocks of self-fertile varieties could be established successfully without the need for polliniser rows.

Figure 4 shows the cumulative yield of the first five cultivars released, compared to Nonpareil of the same age in the same block. These results are from the secondary trial planted in 2006 at Lindsay Point.

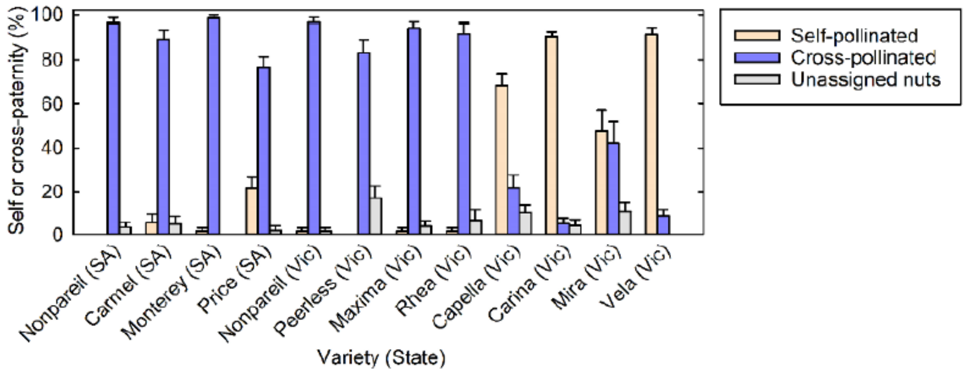

Figure 3. The percentage (mean + SE) of self-pollinated and cross-pollinated nuts from almond varieties in an orchard in South Australia (SA) and an orchard in Victoria (Vic). 'Unassigned nuts' could not be distinguished as self-pollinated or cross-pollinated at a 95% level of confidence.

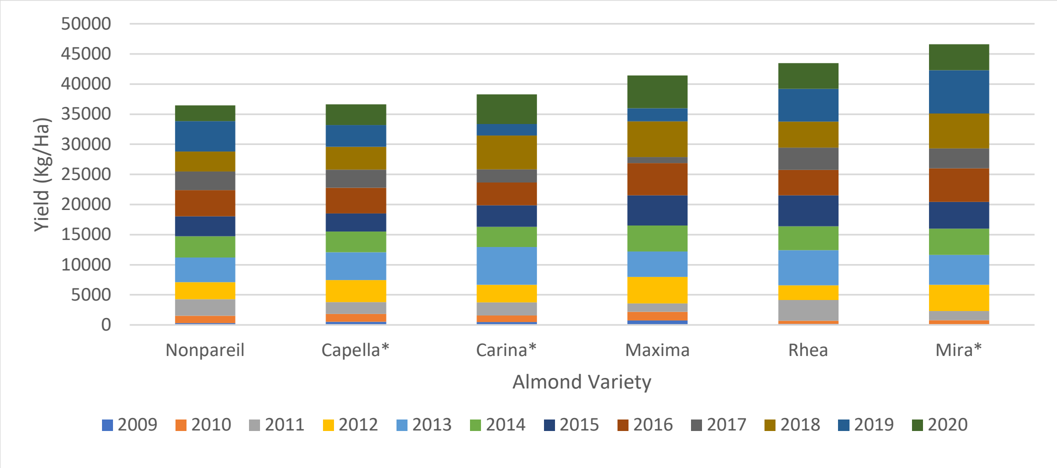

Figure 4. Cumulative yield of the new Australian cultivars and Nonpareil (2009 - 2020).

References

Wirthensohn, M. (2020) New cultivars from the Australian almond breeding program. HortScience 55,738-740.

Kamper W., Thorp, G. Wirthensohn, M., Brooks, P., Trueman, S.J. (2021). Pollen paternity can affect kernel size and nutritional composition of self-incompatible and new self-compatible almond cultivars. Agronomy 11, 326.

OTHER RESOURCES

Introduction to breeding - video
https://bit.ly/3t62JcS

Australian Breeding Varieties Update
https://bit.ly/3t4YAFW

PROJECT CODE

AL17005 Nation Australian Almond Breeding Program

The almond breeding program has been funded by Hort Innovation, using the almond research and development levy and contributions from the Australian Government. Hort Innovation is the grower-owned, not-for-profit research and development corporation for Australian

MORE INFORMATION

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