

**Project No. 93-M6 - Almond Variety Development**

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**Objectives:** CURRENT:

1. Develop methods for the efficient transformation/ regeneration of established almond varieties and for limiting the expression of inserted engineered genes to surface (non-kernel) tissue. Develop protocols for testing the genetic stability of such chimeric shoots.
2. Test genetic strategies for developing protection from Bud-Failure, aflatoxin contamination, NOW, and other disease and insect problems, and for self-fertility and improved tree yield.
3. Identify effective parental combinations resulting in high quality and yield, late flowering period and self-fertility. Continue studies to elucidate the underlying physiology and genetic control and inheritance of these traits.
4. Continue the generation and evaluation of breeding lines and selections at 1992 or higher levels. Characterize nut quality and yield potential of new progeny populations, breeding lines, and varietal standards.

LONG RANGE:

1. Develop replacement varieties for Nonpareil and its pollenizers which possess improved disease and insect resistance, self-fertility and a long range of bloom times and maturities.

2. Develop breeding strategies, including the effective use of newly available biotechnologies, for achieving rapid genetic improvements in almond varieties.

## **Results:**

The almond variety development project is a comprehensive program for applying genetic solutions to present and future almond production problems. It has three basic parts: a) the genetic improvement of the California germplasm base, b) the adaptation and application of the new genetic engineering/biotechnology methods to almonds, and, c) the development of new almond varieties with high field quality and improved yield and pest resistance.

### **a) The genetic improvement of the California germplasm base.**

We have demonstrated that inbreeding in almond, either by selfing or crossing between closely related varieties, reduces the vigor and yield of progeny trees. Most almond varieties presently planted in California have now been shown to be closely related, with many probably the progeny of early crosses between 'Nonpareil' and 'Mission'. Therefore, new germplasm has been brought into the program from European breeding programs and from related almond species and species hybrids. Crosses have been made between this introduced germplasm and established California varieties in order to invigorate progeny performance. These progeny are now coming into production, with several trees showing good nut quality combined with high production potential.

### **b) The adaptation and application of the new genetic engineering/biotechnology methods to almonds.**

The goal is to transform and regenerate plants from established and proven almond varieties, particularly 'Nonpareil', (rather than seedling material of unknown value). Low rates of genetic transformation have been achieved using 'particle bombardment' and Agrobacterium mediated methods. We are now working to increase the levels and consistency of transformation while targeting 'Nonpareil' shoot growing points to allow subsequent plant regeneration. Methods for the culture of very small shoot tip fragments are being developed to increase transformation rates and decrease chronic problems with low-titer endo-bacteria. Several micro-budding methods are also being developed and tested for synthesizing periclinal (epidermal) chimeras. If possible, this approach might allow the rapid incorporation of genetically engineered genes into the targeted variety's epidermal and hull tissue while leaving the kernel meat unadulterated.

### **c) The development of new almond varieties with high field quality and improved yield and pest resistance.**

Tree and nut evaluations have been made in 1993 on approximately 100 advanced breeding lines and 3000 progeny from more recent crosses. Approximately 3000 additional seedlings from 1993 crosses to newly introduced germplasm are now being planted. Advanced selections continuing to show promise include the late blooming selections: '2-19E', '2-43W', and '1-87W'; the highly productive selection '13-1'; and the self-fertile selection '25-75'. Several of these advanced items have been included in the new Regional Variety Trials as well as commercial orchard tests. Approximately 15 additional progeny from crosses between 'Nonpareil', 'Sonora', 'Solano', 'Padre', and 'Milo' and highly-productive species-hybrid germplasm have been selected for further testing due to their good performance and possible self-fertility. Selection '8010-22' shows particular promise due to its 'Nonpareil' type nut, high productivity and self-fertility, and virus negative trees have now been propagated for commercial testing.