

University of California
Division of Agricultural Sciences

PROJECT PLAN/RESEARCH GRANT PROPOSAL

Project Year 2008-2009

Anticipated Duration of Project: on-going with review

Anticipated Start Date: 4/01/08

Anticipated Termination Date 3/31/09

Project Leader Gale H. McGranahan

Location Wickson Hall, U.C. Davis

Cooperating Personnel: C. Leslie, W. Hackett, N. Manterola, A. Dandekar, M. Aradhya, B. Beede, B. Olson, B. Coates, J. Caprile, J. Grant, K.K. Anderson et al.

Project Title WALNUT IMPROVEMENT PROGRAM

Keywords varieties cultivars, breeding, rootstocks, blackline

Commodity(s) Walnut Relevant AES/CE Project No.

Problem and its Significance:

The California walnut industry relies on the Walnut Improvement Program (WIP) to produce cultivars superior in yield and quality to those currently available and to solve specific problems. Specific problems that are being addressed in the program include late harvest dates, lack of an in-shell replacement for Hartley, blackline, rootstock diseases and pests, codling moth, and blight. The WIP is also preparing for the future by developing new breeding technologies, new evaluation techniques, and an understanding the inheritance of traits.

Objectives:

The objective of the Walnut Improvement Program is to provide the California walnut industry with genetically superior walnut cultivars and rootstocks while improving the efficiency of genetic improvement through new mating designs and molecular tools. Specific objectives for this year are listed with their "Plans and Procedures". Detailed methods are available in Walnut Research Reports.

Plans and Procedures

Breeding Program. The goal is to develop new cultivars that are precocious, high yielding, with high quality nuts and kernels and a range of harvest dates, most notably early harvest dates. Low susceptibility to blight and codling moth is also desirable.

- a) Germinate full-sib seed from controlled crosses and establish in nursery prior to planting in the UC Davis seedling block for evaluation.. The crossing design through 2009 is shown at the end of this section including number of seed obtained from 2007 crosses
- b) Continue maintenance and evaluation of materials already in the breeding program. See Walnut Research Reports for list of materials under evaluation.
- c) Reproagate selections identified at "crack out" into selection blocks at Davis, Kearney and Chico for evaluation in cooperation with Bill Olson and KAC staff.
- d) Cooperate with growers and Farm Advisors to establish, maintain and evaluate field trials of advanced selections and new cultivars. See Walnut Research Reports for list of field trials.

- e) With Patrick Brown, explore possibility of boron tolerance in 90-27-21 identified at Scheuring's as less damaged by boron than other selections.

Crossing Design 2007-2009 with nuts Harvested, 2007

Early harvesting

High quality	91-77-6	91-77-40	91-90-41	91-96-3	92-80-11	94-19-85	94-20-5	94-20-28	95-7-13	95-11-14	95-18-23
90-31-12	45				42		12		91		
92-70-12											
93-28-20	34	29		76	83	11	17		6		
94-19-29	19		45		22		31				
94-19-45			96	50			2				
95-11-22	48						32		71		
95-26-16											
95-26-17					22						
95-26-22				29	23		37				
95-26-37									138	17	

Backcross breeding program. The goal is to develop new cultivars with hypersensitivity to cherry leafroll virus (CLRV) through backcross breeding.

- Evaluate progeny from backcrosses using the DNA analysis for the marker linked to hypersensitivity and standard nut and kernel characteristics.
- Generate the next generation of backcrosses through open pollination and controlled pollinations of hypersensitive selections that have superior shell and kernel attributes with selected *J. regia* parents.
- Cooperate with growers and Janet Caprile and Bill Coates to evaluate performance of hypersensitive advanced selections and to provide material for testing the effect of infected pollen on hypersensitive selections.
- Identify cooperators to establish new trials of advanced hypersensitive selections.

Rootstock improvement. The goal is to develop superior clonal rootstock through breeding, selection (in cooperation with Kluepfel, Browne, and McKenry), to solve the major rootstock problems encountered by growers. These include nematodes, crown gall, Phytophthora and CLRV.

- Address the crown gall problem and provide proof of concept for A. Dandekar's gene silencing construct by micropropagating the 40 new transgenic lines based on 3 new Paradox somatic embryo-derived lines and evaluating their response to crown gall with Dan Kluepfel and establishing them in field trials on campus.
- Complete patenting process for VX211 and RX1. The patents have been submitted and nurseries licensed.
- See also report and proposal on Walnut Rootstock Improvement and Propagation for status on CLRV-tolerant WIP rootstocks (Hackett and McGranahan). Establish field trials.

New tools for genetic improvement. The goal is to develop new tools that will improve the efficiency of breeding or genetic engineering of walnuts as the technology becomes available.

- Develop a mapping population for generation of markers especially for color harvest date and lateral bud fruitfulness. The ideal population consists of at least 200 trees that will segregate for a gene of interest. The parents we have chosen are Idaho and Chandler which should generate a population varying in lateral bud fruitfulness, kernel color, phenology, heterodichogamy and codling moth sensitivity. Development of the population requires controlled crossing, trait evaluation and maintenance of the population at 15 foot spacing for 10-15 years. .
- Cooperate with David Tricoli in development of somatic embryo cultures from developing anthers or other maternal tissue to generate rootstock or cultivar-true somatic embryo lines for

genetic engineering. We have successfully generated lines from Chandler and Burbank (Paradox) through immature anther methods adapted from grape.

- c) Cooperate with Jan Dvorak in the walnut genomics initiative, provide material and advice.

