Source: AGRICULTURAL RESEARCH SERVICE submitted to CRIS

PREDICTING CROSS-POLLINATION AND NUT SET IN ALMOND ORCHARDS USING WEATHER, ORCHARD DESIGN AND THE SIZE OF THE POLLINATOR POPULATION

Sponsoring Institution	Agricultural Research Service/USDA	**Project Status**	NEW
		Funding Source	USDA INHOUSE
Reporting Frequency	Annual	**Accession No.**	0412675
Grant No.	(N/A)	**Project No.**	5342-21000-015-04T
Proposal No.	(N/A)	**Multistate No.**	(N/A)
Program Code	(N/A)	**Project Start Date**	Oct 1, 2007
Project End Date	Jul 31, 2010	**Grant Year**	(N/A)

Project Director
HOFFMAN G D

Recipient Organization
AGRICULTURAL RESEARCH SERVICE
(N/A)
TUCSON,AZ 85721

Performing Department
(N/A)

Non Technical Summary
(N/A)

Animal Health Component 50%

Research Effort Categories

Basic	50%
Applied	50%
Developmental	0%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
203	3010	1070	100%

Knowledge Area
203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants;

Subject Of Investigation
3010 - Honey bees;

Field Of Science

1070 - Ecology;

Keywords

pollination	honey	bee	osmia
degree	days		

Goals / Objectives
1. Determine the progression of bloom for almond cultivars based upon temperature, 2. Estimate the number of bees on trees of different cultivars throughout bloom, 3. Estimate the proportion of bees carrying cross-pollen while foraging almond blossoms, 4. Estimate cross-pollination rates and nut set, 5. Start programming the almond pollination software package, and establish an area on the Carl Hayden Bee Research Center WWW site to disseminate information on almond pollination and findings from this project to date.

Project Methods
Data from the field will be used to generate equations for a model. Data collected in subsequent years will be used to test the accuracy of the equation in predicting the progression of bloom, foraging activity by bees through bloom, the size of cross-pollinating population, cross-pollination rates and nut set. Weather conditions will be monitored in the orchard throughout the bloom. Begin to write computer program for the almond pollination software packing using data from the 2008 bloom season. Documents Trust with Almond Board. Log 33385. Formerly 5342-21000-014-28T (December 2008).

Progress 10/01/09 to 09/30/10

Outputs
Progress Report Objectives (from AD-416) 1. Determine the progression of bloom for almond cultivars based upon temperature, 2. Estimate the number of bees on trees of different cultivars throughout bloom, 3. Estimate the proportion of bees carrying cross-pollen while foraging almond blossoms, 4. Estimate cross-pollination rates and nut set, 5. Start programming the almond pollination software package, and establish an area on the Carl Hayden Bee Research Center WWW site to disseminate information on almond pollination and findings from this project to date. Approach (from AD-416) Data from the field will be used to generate equations for a model. Data collected in subsequent years will be used to test the accuracy of the equation in predicting the progression of bloom, foraging activity by bees through bloom, the size of cross-pollinating population, cross- pollination rates and nut set. Weather conditions will be monitored in the orchard throughout the bloom. Begin to write computer program for the almond pollination software packing using data from the 2008 bloom season. Documents Trust with Almond Board. Log 33385. Formerly 5342-21000-014-28T (December 2008). This report documents research conducted under a Trust Agreement with the Almond Board of California. Additional details of research can be found in the report for the in-house associated project 5342-21000-015-00D, Improve Nutrition for Honey Bee Colonies to Stimulate Population Growth, Increase Queen Quality, and Reduce the Impact of Varroa Mites. The goal of this project is to construct a mathematical model to predict cross- pollination and nut set in almonds. The model is packaged as a WWW-based program that is publicly accessible. The program generates cross- pollination and nut set predictions based upon orchard design and cultivars, weather conditions, and size of the honey bee population foraging on almond trees. We obtained data from 8 years of bloom at three different almond growing regions of California and used it to derive equations for the rate of blossoms opening and aging for the following cultivars: Nonpareil, California, Carmel, Mission, Butte, Padre and Sonora. Information obtained from previously published papers concerning foraging activity of bees and floral characteristics of almond cultivars also was incorporated into the model. Additionally, we derived equations to predict the foraging behavior and cross-pollination of blossoms by Osmia, a type of bee used to pollinate almonds, so that growers can simulate conditions where both honey bees and Osmia are present in orchards. Simulations indicate that cross-pollination by Osmia is more sensitive than honey bees to the arrangement of cultivar rows. The software package is complete and a working version is available at http://gears.tucson.ars.ag.gov /almopol/. We are currently developing more user-friendly screens to enable orchard information to be entered into the model and for the graphic display of simulation results. Monitoring of progress on this project is accomplished by conference calls, Laboratory meetings, annual reports and presentations to the Almond Board of California.

Impacts
(N/A)

Publications

Progress 10/01/08 to 09/30/09

Outputs
Progress Report Objectives (from AD-416) 1. Determine the progression of bloom for almond cultivars based upon temperature, 2. Estimate the number of bees on trees of different cultivars throughout bloom, 3. Estimate the proportion of bees carrying cross-pollen while foraging almond blossoms, 4. Estimate cross-pollination rates and nut set, 5. Start programming the almond pollination software package, and establish an area on the Carl Hayden Bee Research Center WWW site to disseminate information on almond pollination and findings from this project to date. Approach (from AD-416) Data from the field will be used to generate equations for a model. Data collected in subsequent years will be used to test the accuracy of the equation in predicting the progression of bloom, foraging activity by bees through bloom, the size of cross-pollinating population, cross- pollination rates and nut set. Weather conditions will be monitored in the orchard throughout the bloom. Begin to write computer program for the almond pollination software packing using data from the 2008 bloom season. Documents Trust with Almond Board. Log 33385. Formerly 5342-21000-014-28T (December 2008). Significant Activities that Support Special Target Populations Data on blossom opening, honey bee foraging activity and nut set were collected from an almond orchard planted with Nonpareil, Fritz, and Monterey varieties. The data along with additional information obtained from previously published papers were incorporated into a web-based software package to predict nut set. The predictions are based upon orchard design, weather conditions, and size of the honey bee population foraging on almond trees. The structure of the model has been defined and programming of the software package is nearly complete. Initial nut set predictions from the model of relative amounts of nut set are accurate. We are incorporating information on other almond cultivars into the program, and adding components to capture the foraging behavior of Osmia. This will enable growers to simulate conditions where both honey bees and Osmia are present in orchards. An initial version of the program is available on the internet at http://gears.tucson.ars.ag.gov/almopol/. Monitoring of progress on this project is accomplished by conference calls, Laboratory meetings, annual reports and presentations to the Almond Board of California.

Impacts
(N/A)

Publications

Progress 10/01/07 to 09/30/08

Outputs
Progress Report Objectives (from AD-416) 1. Determine the progression of bloom for almond cultivars based upon temperature, 2. Estimate the number of bees on trees of different cultivars throughout bloom, 3. Estimate the proportion of bees carrying cross-pollen while foraging almond blossoms, 4. Estimate cross-pollination rates and nut set. Approach (from AD-416) Data from the field will be used to generate equations for a model. Data collected in subsequent years will be used to test the accuracy of the equation in predicting the progression of bloom, foraging activity by bees through bloom, the size of cross-pollinating population, cross- pollination rates and nut set. Weather conditions will be monitored in the orchard throughout the bloom. Documents Trust with Almond Board. Log 33385. Significant Activities that Support Special Target Populations Data were collected to derive equations to predict cross-pollination and nut set in almond orchards. The orchard used during the 2008 bloom season contained Nonpareil, Fritz, and Monterey. The structure of the model has been completed. Based upon bloom overlap and the number of days when foraging weather occurred, the model predicts that nut set on Fritz and Monterey would be higher than Nonpareil. This is because there were more days when bees could forage, but more importantly, compatible pollen was available for cross-pollination of Monterey and Fritz blossoms from the first day of bloom. The model would also predicts that set on Fritz would be higher than Monterey. This is because there would be compatible pollen from both Nonpareil and Monterey available early in Fritz bloom. Foraging populations would be established on Nonpareil and Monterey, and if significant pollen transfer in the hive was occurring, most of the pollen on the bodies of foragers would be from those two cultivars. Thus, the first Fritz blossoms visited on each foraging trip would be cross- pollinated. Indeed Nonpareil initially set only 39% of its blossoms into nuts compared with 48% for Monterey and 67% for Fritz. Progress on this project relates to National Program 305 (Crop Production) Component 3 Section B (Bee Management and Pollination).

Impacts

(N/A)

Publications