Project Number 82-O6
Project Title: Navel Orangeworm Controlled Atmospheres as an alternative Method for Control in Stored Almonds

PROJECT NO. - 81- - Controlled Atmospheres

COOPERATOR: USDA-ARS-CA-HI-WR
Horticultural Crops Research Laboratory
Plant Protection and Quarantine
5578 Air Terminal Drive
Fresno, CA 93727

PROJECT LEADER: Dr. Edwin L. Soderstrom

PERSONNEL : David G. Brandl

I. OBJECTIVE: To develop a low oxygen atmosphere as an alternative method for insect control in stored almonds.

II. INTERPRETIVE SUMMARY: This year's research has shown that a 100 foot tall by 25-foot diameter concrete silo filled with inshell almonds could be purged to a suitable oxygen level (0.5 percent) in 8 hours. This time is within the calculated time of 12 hours. Navel orangeworm pupae placed in the airspace at the top of the silo (80°F) were all killed within 60 hours after purge. Indianmeal moth pupae required only 36 hours.

Data collected in this and prior tests show the importance of storage tightness. It is recommended that storages be periodically pressure tested and resealed as necessary.

III. Experimental Procedure: A low oxygen atmosphere generator was leased from the California Raisin Advisory Board and was installed at the California Almond Growers Exchange in Sacramento. Five concrete silos 100 feet tall by 25 feet in diameter (49,000 cubic feet) were connected to a manifold to allow any one or combination to be treated simultaneously. The generator was operated with natural gas and had an output atmosphere capacity of 10,000 cu feet per hour. Silo number 5 was prepared by placing temperature probes and gas sample tubes at intervals down the center of the silo and then filling it with inshell Nonpareil almonds.

The generator was started and vented until the output atmosphere reached 0.5% oxygen. Then the atmosphere was introduced into the bottom of the silo. Temperature and oxygen levels at various sites were determined

throughout the test. Insects were removed at 12 hour intervals after the purge phase was completed.

IV. Results: Temperature in the silo ranged from 60°F at the bottom to 80°F in the overhead space. At 10,000 cubic feet per hour, the silo was purged to 0.5 percent oxygen in 8 hours. The maintenance rate thereafter was 2,000 cubic feet per hour. This high rate of maintenance was later found to be due mainly to leakage at the silo outloading chute.

Insects kill times were as follows:

Elapsed time after 8h purge (hours)	Percent mortality	
	Indianmeal moth	Navel orangeworm
12	34	10
24	84	15
36	100	62
48	100	96
60	100	100

V. Discussion: Silo purge time of 8 hours was within our calculated time of 12 hours. Temperatures of the nuts (60°F) were colder than expected, however cool weather preceded our tests. Insect kill times correlated well with those found in our previous laboratory and field studies.

The leakage problem that occurred shows that industry storages should be checked for sealing. It is recommended that pressure testing should be made periodically on all storages and where necessary proper maintenance be carried out prior to use of controlled atmospheres and other fumigants.

Future research should be to complete the silo test after adequate sealing is obtained. Laboratory studies should be initiated to find methods of reducing the insect kill times, especially at colder temperatures. Studies would involve other additive gases such as carbon dioxide and

nitrogen at various ratios and as pre or post treatment phases, and to study the mode of action of atmospheric components.

VI. Publications:

Soderstrom, E. L., and D. G. Brandl. 1982. Antifeeding effect of modified atmospheres on larvae of the navel orangeworm and Indianmeal moth (Lepidoptera: Pyralidae). J. Econ. Entomol. 75: 704-705.

United States Department of Agriculture
Agricultural Research Service
Western Region California-Hawaii Area
P.O. Box 8143 Fresno, California 93747

Horticultural Crops Research Laboratory
Protection and Quarantine Research Unit
Telephone: (209) 487-5334

December 30, 1982

Mr. Dale Morrison
Director of Research
Almond Board of California
P. O. Box 15920
Sacramento, California 95813

Dear Dale:

Enclosed is the annual report on Project No. 81, "Controlled Atmospheres" prepared by Dr. E. L. Soderstrom and D. G. Brandl.

It was a pleasure seeing you again at the Almond Workshop. We will look forward to working with you during the coming year.

Best wishes for a Happy New Year.

JOHN M. HARVEY
Research Leader

Enclosure