JOHN J. McELROY

Relationships of agricultural burning and Air Pollution studied in preliminary experiments

Air pollution—smog—causes California farmers, principally growers of flowers and vegetables, a total annual loss of approximately eight million dollars in returns from crops rendered unsalable by smog.

Fire is commonly used as a tool in the disposal of agricultural wastes—prunings, stubble—and for brush clearance in range improvement programs. Burning vegetative materials cause smoke and emit gases, including hydrocarbons—olefins—and thereby, contribute to the air pollution that injures certain crops.

Ethylene—one of the air polluting olefins—causes heavy annual losses to the orchid, rose, carnation, and bedding plant industries in the Los Angeles and the San Francisco Bay areas. Orchid plants used in controlled fumigation experiments definitely confirmed that very low concentrations of ethylene are injurious to the plants.

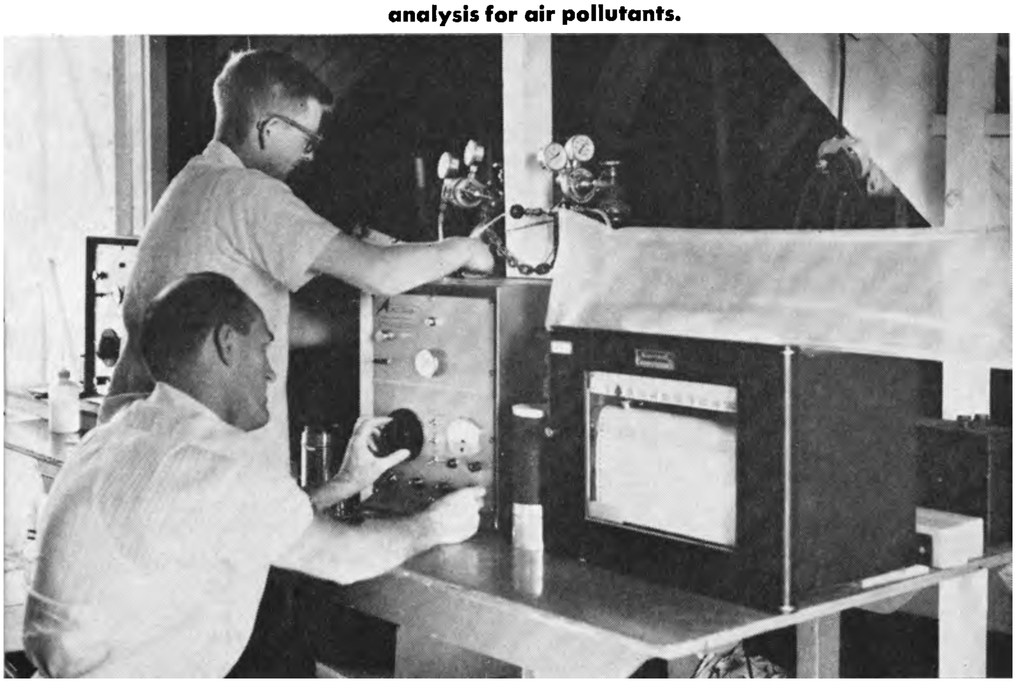
Studies initiated in 1959 were designed to investigate and to minimize air pollutants resulting from disposal of agricultural waste materials.

In some areas of California fire has been replaced by other methods of disposing of crop residues and wastes of agricultural production, as in the San Joaquin Valley, where prunings from orchards and vineyards are commonly chopped and incorporated into the soil. The development and widespread use of chemical weed control methods along roadsides and ditchbanks may have the added benefit of reducing weed populations that usually are burned.

A survey in Alameda, Santa Clara, and Contra Costa counties indicated that substantial proportions of the prunings from orchards and vineyards in those counties are burned. In Alameda County disposal of grain stubble by burning—where double cropping is practiced—is necessary. In Santa Clara County, 38% of the acreage of old strawberry fields is burned.

In Santa Clara and Alameda counties, it is the normal practice to burn insect infested prunings. The shot hole borer, for example, develops high populations in deciduous fruit tree and vineyard prunings. In April, 1959, prunings from an Alameda County orchard were divided into two lots. One lot was put through a rotary chopper, the other lot was left as taken from the trees. The two lots were again divided and one of each buried separately. The remaining two lots were left on top of the soil. Cages were put on the soil surface over the two buried lots and over the lots left above ground. Shot hole borers emerged only from the non-chopped prunings left above ground. Also, that lot was the only one to show reinfestation. Because the 1959 tests were incomplete and the findings inconclusive tests are continuing.

Smoke samples brought to field laboratory in polyethylene bags under analysis for air pollutants.



Monitoring Burns

A program of monitoring stubble burns and controlled range burns was undertaken to measure the olefins produced by agricultural fires.

Sampling of the air began when a stubble clearance fire was started and continued at specified time intervals. Air samples, pumped into polyethylene bags with small hand bellows, were collected on the upwind side of the fire, at the fire site, and at periodic points up to 20–25 miles downwind. Air samples for analyses for oxides of nitrogen and oxidants were taken at distances of one to five miles from the fire. Samples of particulate matter—solids—were taken by electrically operated automatic smoke samplers at selected locations one-half to ten miles from the fire.

Airplane sampling was undertaken at two stubble burns. Frequently the smoke plumes were lifted out of reach of the ground level monitoring stations.

Samples from given sites were delivered to a central station where the analytical instruments were located.

At least ten hydrocarbons were identified in varying concentrations from test fires in barley stubble in Kern County, rice stubble in Yolo and Sutter counties and a controlled range burn in Madera County.

In general, ethylene was the gas found in highest concentration, occurring as high as 4 ppm—parts per million—in the Yolo rice stubble burn. Concentrations of propylene were also generally higher than other gases except ethylene.

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AIR POLLUTION

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In most cases, the rest of the gases occurred at less than 1.0 ppm and often at less than 0.05 ppm.

The highest concentrations of given gases were found at the fire site. In samples taken from one to several miles downwind from the fire, the hydrocarbon values dropped to pre-burn levels. The pre-burn level for ethylene at the Madera range burn seldom exceeded 0.1 ppm, while most of the other gases were absent or present only in trace amounts. The pre-burn level of ethylene at the Kern barley burn varied from 0.1 to 0.22 ppm, but samples taken during the burn at from one to five miles distant were somewhat higher—from 0.1 to 0.4 ppm —possibly resulting from additional sources.

The samples taken by airplane were collected at elevations of 100′ to 3,000′ above the fire. The samples from 100′ above the fire gave 0.3 to 0.5 ppm of ethylene, while other samples from greater heights or distances usually gave less than 0.05 ppm.

Preliminary Findings

These preliminary experiments indicate that the amount of hydrocarbons from range and stubble fires is low. The concentration of ethylene in the densest smoke was 4 ppm, and auto exhausts have been reported to contain concentrations as high as 500 ppm. The rice stubble burns revealed high concentrations of particulates in the air. At the Madera range burn, 20% of the particulate matter was of organic origin.

Oxidants and oxides of nitrogen from the diluted smoke of the test burns were found to be present in relatively small quantities. The amounts of lead found in particulate matter samples were low in all cases.

The Madera control burn covered about 1,200 acres of rangeland. Approximately 160 acres of the area were dense brush and trees that had been mashed with a bulldozer. The remaining acreage was grassland with scattered trees and shrubs. The burn consumed about 50% of the grass and litter; 89% of the standing trees and shrubs; and 95% of the mashed brush and trees. The total amount of fuel consumed was estimated at 1,700 tons. Because the type and quantity of fuel burned may have bearing on the air pollutants released, future studies will give greater emphasis to fuel consumption.

John J. McElroy, Special Projects, Agricultural Extension, University of California, Berkeley, was Chairman of the Coordinating Committee of the studies reported.

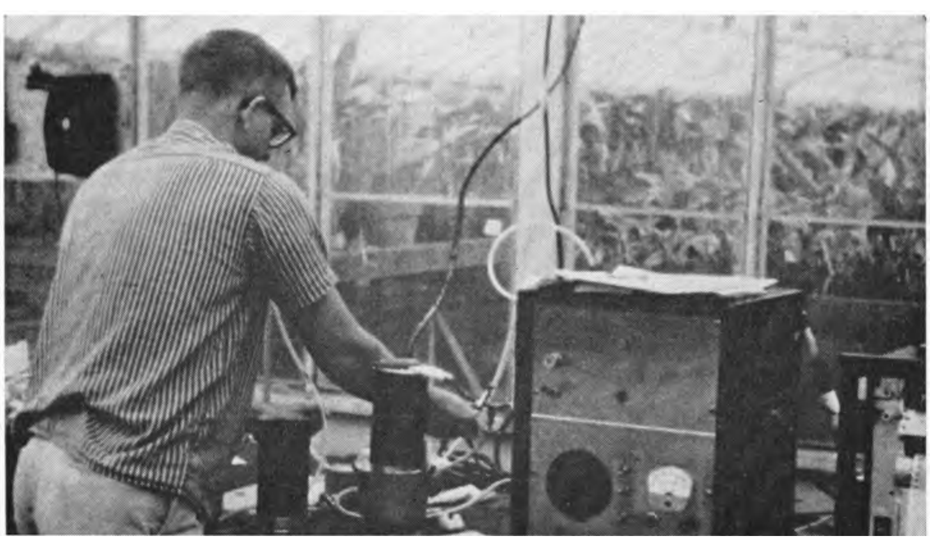
The foregoing article is based on cooperative research conducted by the University of California, State of California Division of Forestry, California Department of Public Health, United States Forest Service, Pacific Southwest Forest and Range Experiment Station and the Central Valley Range Improvement Association.

Gas Concentrations Identified in Air Pollution Tests

Hydrocarbon	Madera Range	Kern Barley	Yolo Rice	Sutter Rice
Ethylene	.8–1.4	2.0–3.0	.2–4.0	.6–1.2
Propylene	.3	.6–2.0	.1–2.0	.3–2.0
Butane	*T–.4	.1–.3	T–.1	.4–1.2
Acetylene	T–.3	.3	T–1.0	.1–3.0
Butene-1	T–.1	T–.4	T–.2	T–.2
Isobutylene	T	T–.6	T–.1	T–.2
3 methyl butene-1	0	T	T	.5–1.5
cis-butene-1	T–.3	T–.1	T	T
trans-butene-2	T–.2	.2	T	.2–.6
Butadiene	T–.1	T–.2	T–.6	T–.3

* T = trace—less than .05 ppm.

Conducting tests for ethylene injury to plants in controlled fumigation chamber.



Walter G. Jennings

Automation in cleaning

FOOD PROCESSING

plant equipment

Circulation cleaning of food processing equipment—by pumping detergent through it—has been adopted so rapidly in food plant operations that knowledge of basic principles has not kept pace with usage. A research program evaluating the variables in the cleaning process used films of milk labeled with a radioactive tracer, to simulate the soil to be washed from the equipment.

The decrease in radioactivity, studied under closely controlled conditions, measured the soil removal from the equipment. Theoretically, the soil is never completely removed, but a point is reached where so little soil remains that the surface can be considered clean for all practical purposes.

Turbulence—violent agitation—was shown to be of primary importance in the cleaning operation. Because turbulence is a function of velocity, pumps capable of handling large volumes are often used. In dead ends and large-diameter sections, turbulence may be so decreased that such areas are not satisfactorily cleaned by circulation. With the realization that high flow rates are required, an erroneous belief has developed that the system should be under a positive pressure. Actually, equipment cleans better when the flow is on the suction side, with the pump positioned to pull the solution through the equipment.

When air was bled into the system without causing a build-up of foam, it exerted a scrubbing action and assisted cleaning. Where foam built up, it cushioned the surface and inhibited cleaning.

High temperature improved cleaning operation, except that it may cause certain detergents—notably polyphosphates and some organic wetting agents—to break down. Evaluation of the action of highly alkaline detergents on milk films revealed that the speed of cleaning doubled for every 22½°F increase in temperature.

The study showed that equipment can be cleaned under conditions of, for example, low turbulence, by compensating with a higher concentration of detergent, higher temperature, or circulation for a longer period.

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