feeding loss was calculated. Of the plants tested by this leaf-disk test, 16 were selected and combined into two experimental varieties, UC63 and UC68. None of the selected plants had high resistance to weevil feeding, but they all suffered less feeding than the plants tested with them.

### Plant selections

Selections were also made by subjecting seedling plants to adult weevil feeding. In 1969–70 over 94,000 seedlings from superior seed lines were treated in this manner and about 450 plants were saved and intercrossed to form a germplasm pool called UC67. The 450 selected plants will be subjected to the more rigid leaf disk test later to identify the plants with the highest resistance to weevil feeding. UC67 seed will be used in tests with other varieties for further seedling selection, intercrossing, and plant testing.

Work on crosses between California varieties and non-adapted, weevil-resistant plants has been deferred for the present because progress in breeding a new variety will be more rapid if resistance can be found within adapted varieties, as now appears possible. An early source of a low level of weevil resistance used in crosses was associated with reduced egg laying but also with the undesirable characters of decumbent growth and small stems. The variety, Team, is another source of resistance. It is winter dormant, susceptible to the spotted alfalfa aphid, moderately resistant to the alfalfa weevil, and resistant to anthracnose, leaf spot, and pea aphid. Crosses with Team would be valuable and will be made as soon as possible.

### Limited testing

Limited testing of new experimental varieties has been conducted by personnel at the University of California Imperial Valley Field Station and by farm advisors in Tulare and San Diego Counties. Results of these tests to date show reduced feeding or larval counts on the four experimental seed lines tested, two of which appear to be of good agronomic type. Although these preliminary results are encouraging, they have not been exacting enough to definitely prove an increased level of weevil resistance or to indicate how these seed lines might perform in large-scale field tests.

Variety tests containing all seed lines which might be adapted to California conditions are being conducted throughout California. Some of these tests should provide information on the level of resistance now available in seed lines and whether this resistance will be useful to alfalfa growers. In addition to seed line testing, continued seedling selection, plant testing, and recombination will be conducted on material from all areas in California. This type of program (called "recurrent selection") is expected to increase weevil resistance from its present low level to progressively higher levels with each cycle. Germplasm from the variety Team will be introduced into the program when possible to add new genes for weevil resistance and other characters.

### Future program

In the future, the program to develop varieties resistant to the alfalfa weevil will be carried out under a four-point plan involving: (1) selection within adapted seed lines; (2) crosses with non-adapted weevil resistant materials; (3) testing of materials; (4) improvement of techniques. Selections of weevil-resistant plants will be made within a broad base of germplasm adapted for all regions of California where the alfalfa weevil is a problem. Resistance, which is expected to be low in the initial selections, will be increased to higher levels through a recurrent selection program. Crosses of California materials with non-adapted, weevil-resistant materials will be made, when possible, to provide new genes for weevil resistance, other plant characteristics, and a second approach to the problem.

### Seed lines

Seed lines will be produced at all important stages in the improvement program and tested over a geographic area broad enough to provide rapid and reliable information. Seed lines judged superior to existing varieties will be released as they are identified even though more improvement in weevil resistance is possible. New techniques and procedures such as use of juvenile hormones, non-aestivating strains of weevil, rearing chambers, and evaluation methods will be modified, if necessary, and incorporated into the program as conditions permit. The improvement program is designed for flexibility and can proceed as rapidly as conditions will permit.

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*W. F. Lehman is Associate Agronomist, University of California Imperial Valley Field Station, El Centro. E. H. Stanford is Professor and Agronomist, Department of Agronomy and Range Science, University of California, Davis.*

# AIR POLLUTIO
# IN SWEET CO

H. JOHNSON, JR. · J. W. 

**A research project in southern California originally aimed at seeking resistance to sugar cane mosaic virus in sweet corn has also shown that genetic resistance to air pollution also exists in certain varieties. This was not entirely unexpected, since air pollution resistance is known to exist within other plant species. Tobacco varieties, for example, vary widely in susceptibility to ozone; and petunia varieties vary widely in susceptibility to PAN (a photo-chemical pollutant). Smog-resistant varieties of sweet corn should be of particular interest to growers for the summer and fall harvest periods in Los Angeles, Orange, and western Riverside counties.**

On May 14, 1969, 34 sweet corn hybrids from six seed companies were planted in replicated trial at Riverside. Twenty-nine of these hybrids were also planted in a commercial grower's field west of Los Angeles on April 26. The month of June was cool at both locations, but temperatures increased at the end of the month and July was generally hot. Air pollutants (total oxidants) rose to high levels in late June and early July, and remained variably high throughout the month (graph 1). Oxidants were measured daily at the University of California Air Pollution Research Center, Riverside, and temperatures were recorded at a weather station about 200 yards from the planting area. From these records maximum daily levels were charted to show the conditions prevailing when damage occurred.

The appearance of water-soaked areas between the leaf veins was the first damage observed (July 3) at Riverside and new damage occurred on two subsequent occasions during the month of July. The first damage occurred as the earliest varieties were beginning to tassel. The water-soaked leaf areas (the initial symp-

# ON RESISTANCE
# RN VARIETIES

CAMERON · O. C. TAYLOR

tom of ozone injury) then become dry, brown, and necrotic within two or three days, as shown in the photographs. Young, fully-expanded leaves were the most susceptible, and the damage first occurred about midway between the leaf base and tip—at about the point where the leaf bends downward. Similar leaf injury was observed in the Los Angeles planting on July 5, although the damage was not as severe as at Riverside. The 1969 ratings shown in the table were made to indicate new damage, following the occurrence of each new period of injury.

Sixteen of the hybrids ranging from smog-susceptible to smog-resistant, plus three additional hybrids of unknown response, were planted at Riverside in 1970. Three dates of planting (May 6, May 19, and May 27) were used to provide a greater opportunity to evaluate damage if it occurred. An additional trial was planted on April 20 on a commercial farm near Chino, approximately 30 miles west of Riverside. This trial included nine of the varieties used at Riverside.

Air pollution damage to leaves of sweet corn variety in row to left contrasts with healthy leaves of resistant plants in row to right.

Graph 2 shows the conditions which prevailed at Riverside in 1970 during the periods when damages occurred, and subsequent ratings were made. Damage was observed and rated in the Chino planting on June 10. The plants were slightly over 3 ft tall, and the earliest varieties were beginning to tassel. Symptoms were typical of those observed in 1969, and the extent of damage is shown in the ratings in the table. The earliest planting at Riverside was rated on June 11, and found to have sustained slight to moderate damage. At this time the plants were approximately 2 ft high and not yet tasseling. Most of the damage was in the form of dry, brown, necrotic areas, as shown in the photos. In addition, a purple discoloration of the leaf tissue occurred around the necrotic areas in two of the varieties.

One variety, Valley Market, sustained fairly severe damage at this stage of growth, but at later periods and in all later plantings at Riverside it was essentially unaffected by smog attacks. This may indicate that some air pollution constituent was present in the early June smog attack which was different from that present in later attacks. This possibility seems further supported by the damage to the Chino planting, which probably occurred simultaneously with the June 11 Riverside damage. At Chino four varieties were affected which later showed no symptoms at all at Riverside. Higher temperatures and possibly other climatic changes may also have influenced physiological and growth characteristics causing an increase in resistance.

Subsequent ratings were made on the Riverside plantings at periodic intervals following high oxidant readings. Each rating recorded the intensity of new symptoms only, with the exception of July 20, when a "total effect" appraisal was made. In general, ratings on most dates showed the same relative effects of air pollution attacks on the varieties. From these ratings it can be seen that several varieties appear to be highly resistant to the type of smog which prevailed through most of the growing period.

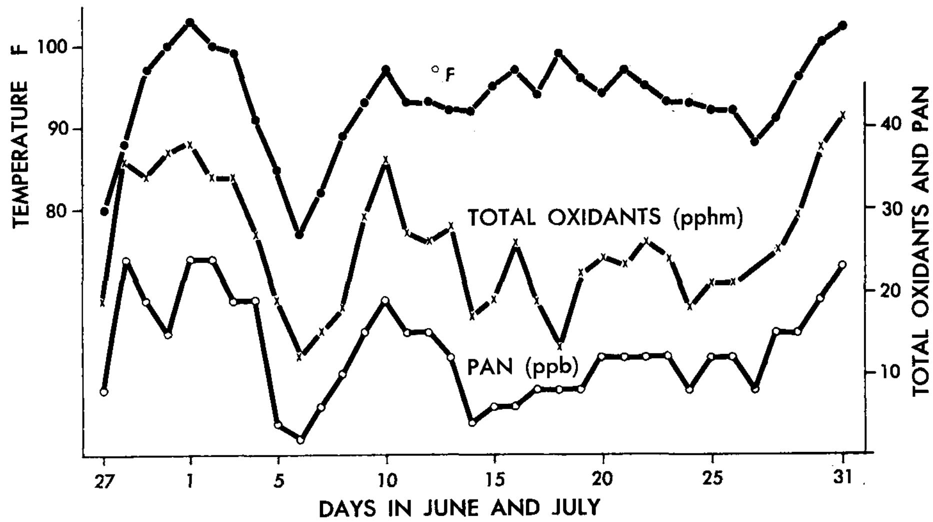
The horticultural characteristics of the varieties were variable in such factors as earliness, size, sweetness, tenderness, ap-

**SMOG DAMAGE RATINGS ON SWEET CORN HYBRIDS ON VARIOUS SAMPLING DATES, 1969 & 1970†**

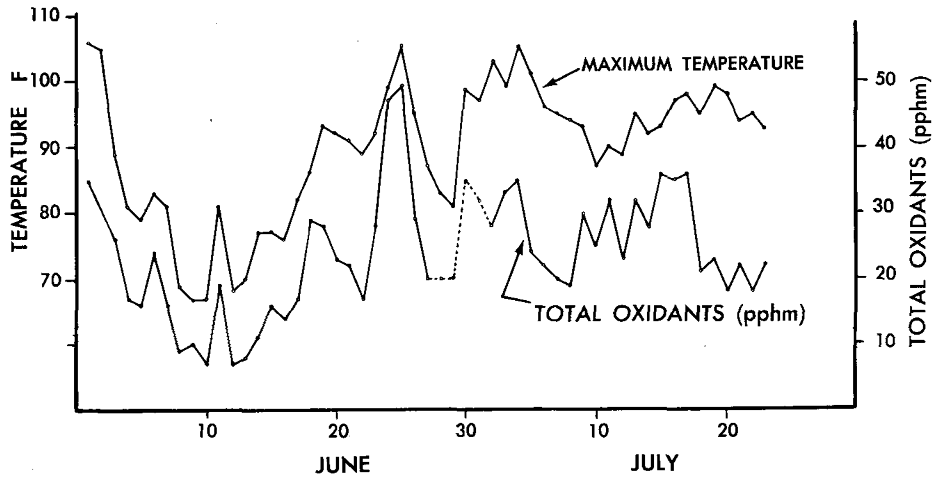
| Variety‡ | 1969 (Riverside & LA) | | | | 1970 (Riverside) | | | | | | | | | | | 1970 (Chino) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Riv | LA | Riv | Riv | Planted May 6 | | | | Planted May 19 | | | | Planted May 27 | | | Planted 4-20 |
| | 7-5 | 7-5 | 7-17 | 7-31 | 6-11 | 6-19 | 6-25 | 7-1 | 6-25 | 7-1 | 7-10 | 7-20 | 6-25 | 7-10 | 7-20 | 6-10 |
| E 3596 | 1 | 1 | 1 | 1 | 2.0 | 1.3 | 1.0 | 1.0 | 1 | 1 | 1 | 1† | 1 | 1 | 1† | * |
| Continental | * | * | * | * | 2.0 | 1.0 | 1.0 | 1.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2.0 |
| Jubilee | 1.3 | 1 | 1 | 1 | 2.7 | 1.1 | 1.0 | 1.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 3.5 |
| 58-1804 C | * | * | • | * | 2.7 | 1.0 | 1.1 | 1.0 | 1 | 1 | 1 | 4 | 1 | 1 | 4 | 1.3 |
| Bonanza | * | * | * | * | 2.7 | 1.3 | 1.0 | 1.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5.8 |
| Valley Market | 3.3 | 4 | 1 | 1 | 7.0 | 2.0 | 1.0 | 1.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4.8 |
| Buttersweet | 2 | 4 | 1 | 1 | 3.7 | 1.0 | 1.0 | 1.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4.5 |
| Earlibelle | 3.3 | 1 | 1 | 1.5 | 3.3 | 1.3 | 1.6 | 1.0 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 6.3 |
| Golden Cross Bantam "T" | 4 | 4 | 1 | 1.5 | 4.7 | 3.7 | 1.6 | 1.0 | 4 | 1 | 1 | 1 | 1 | 1 | 2 | 4.5 |
| NK 75 | 5 | 4 | 4 | 1.8 | 2.0 | 1.0 | 3.3 | 1.3 | 3 | 1 | 4 | 5 | 1 | 4 | 5 | 3.5 |
| Golden Queen | 6.3 | 4 | 4 | 7 | 5.0 | 1.5 | 3.0 | 1.0 | 5 | 1 | 4 | 6 | 3 | 1 | 4 | * |
| Gold Winner | 8.5 | 7 | 1 | 2 | 3.7 | 1.0 | 4.0 | 1.0 | 5 | 1 | 3 | 5 | 4 | 1 | 3 | * |
| Monarch Advance | 9.0 | 9 | 9 | 8 | 2.0 | 1.0 | 7.6 | 4.6 | 5 | 1 | 7 | 8 | 4 | 6 | 8 | * |
| 66-2596 | 9.8 | 9 | 2 | 4 | 4.0 | 1.3 | 9.0 | 2.6 | 8 | 3 | 9 | 8 | 8 | 8 | 8 | * |
| 51036 | 9.3 | 7 | 9 | 9.3 | 1.7 | 1.0 | 8.3 | 6.6 | 6 | 1 | 8 | 9 | 4 | 8 | 9 | * |
| Imperial | 7.3 | 9 | 6 | 5 | 2.7 | 1.0 | 8.3 | 5.6 | 7 | 1 | 9 | 9 | 9 | 9 | 9 | * |

* Not included in this planting.
† Ratings are cn a scale of 1 (no visible damage) to 10 (very severe damage).
Ratings indicate added damage cn successive dates, except for July 20, 1970 which indicates "total effect."
‡ Some entries are experimental hybrids from various seed companies.

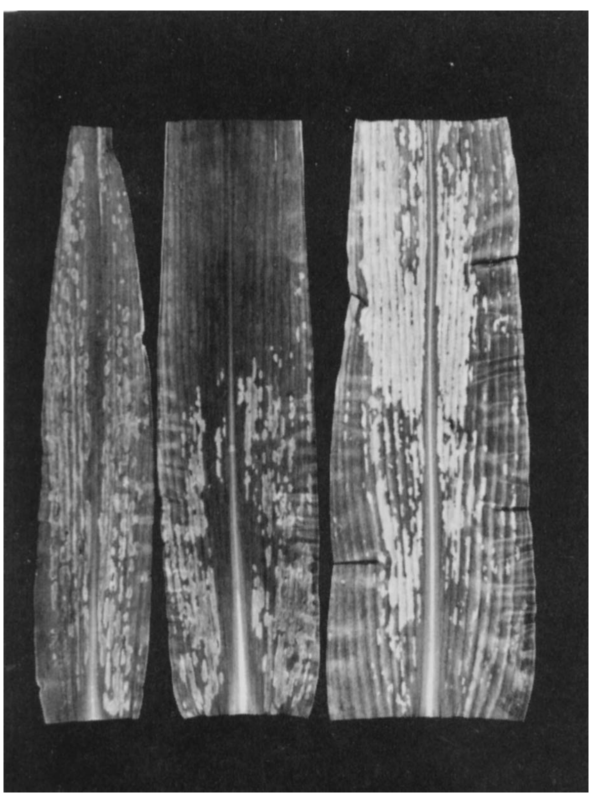
GRAPH 1. MAXIMUM LEVELS OF TEMPERATURE AND OXIDANTS AT RIVERSIDE, 1969




GRAPH 2. MAXIMUM LEVELS OF TEMPERATURE AND OXIDANTS AT RIVERSIDE, 1970




Air pollution oxidant damage to successively (left to right) older leaves on a sweet corn plant.



pearance, and yield. It is not certain how any of these factors were affected by the smog attacks, since no plants were grown in nonpolluted air. Leaf damage that occurred on some varieties was of considerable magnitude, and greatly reduced the photosynthetic area. It is probable that the reduction in some cases was great enough to have slowed growth or reduced yield or quality. In the 1969 Riverside planting, many ears with 2- or 3-inch sterile tips and shrivelled tip kernels were present among the severely damaged varieties, but only a few among the smog-resistant ones. Among the resistant varieties, most were of acceptable market quality, and a few proved to have highly desirable characteristics in the Riverside plantings. These included Bonanza, E-3596, Jubilee, and 58-1804C.

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*H. Johnson, Jr. is Extension Vegetable Specialist and J. W. Cameron is Geneticist, Department of Plant Sciences; O. C. Taylor is Horticulturist, Statewide Air Pollution Research Center, University of California, Riverside.*


# *Controlling* ROSE *in*


A. O. PAULUS


POWDERY MILDEW OF ROSE, caused by the fungus, *Sphaerotheca pannosa*, results in unsightly leaves and flowers and may cause reduced growth. Recently, several new systemic and non-systemic fungicides have become available. These studies were initiated to evaluate these new materials for powdery mildew control in southern California.

## Fall trial—1969

Thirty rose plants (in 5-gallon cans) of the variety Command Performance, were used per treatment, through the courtesy of the Howard Rose Company, Hemet. Each treatment was replicated five times.

The treatments with rates of materials per 100 gallons of water were: Actidione PM 0.027% 2 lb; Benlate 50W 8 oz; El 273 4.5% 20 ppm (190cc) and 40 ppm (380cc), and the check or no treatment. Applications were on an approximate 14-day spray schedule, November 3, 17 and December 1. Sprays were applied to run-off with a 2-gallon Hudson sprayer at 40 psi. Disease symptoms were rated on a scale of 0 to 5 on December 8—a "zero" rating indicating no disease symptoms, while a "five" rating indicated mildew completely covering both sides of the leaves and numerous mildew colonies on petiole and stem.

Applications of El 273 at 40 ppm on a two-week spray schedule gave significantly better results than all other materials tested. El 273 20 ppm, Benlate and Actidione were intermediate in control of rose powdery mildew and were significantly better than the check treatment.

## Winter plot—1970

This experiment was designed to compare different rates of fungicide and spray interval and to assess the effect of the addition of Nu-Film to the Benlate spray with relation to possible enhanced