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Polluted Petunias

WHITE petunias are bearing the brunt of New Jersey's polluted air. Several times each month during past growing seasons petunia plantings have shown unmistakable symptoms of air pollution damage.

The middle-aged leaves become water-soaked, and then on further exposures to sunlight, the upper surfaces develop more or less necrotic bands and the lower surfaces appear to be glazed. Over the past four years, six to 14 such petunia-damaging episodes occurred annually (table 1).

Table 1.—Frequency of petunia-damaging episodes in New Brunswick, N. J.

Year	Month							
	Ma.	Ap.	My.	Ju.	Jy.	Ag.	Sp.	Oct.
1962	2	0	2	0	0	1	1	0
1963	0	1	2	0	3	3	3	2
1964	0	0	2	3	3	1	0	0
1965	1	1	1	1	1	1	1	0

Strangely enough, the sensitivity to this air contaminant is not shared by the petunia bearing colored flowers. In fact, even the presence of variegated coloring is associated with a degree of resistance. Table 2 lists the typical response of each variety observed in the field.

Although the white varieties were indeed more sensitive to the pollutant, there was considerable variation among individual plants. The more succulent the plant, the more severe was the damage. In commercial greenhouses where petunias were shaded with cheesecloth, the plants were relatively more succulent than those in unshaded areas and consequently more severely damaged. It was observed that when petunia plants were first removed from the greenhouse to the outdoors they were extremely sensitive, but on hardening their sensitivity diminished.

Nitrogen Content

In the Plant Biology greenhouse Snowstorm petunias were being grown in sand culture under conditions of low, medium and high nitrogen supply on two occasions when air pollution episodes occurred. The response of the plant varied according to its nitrogen status (table 3). When the nitrogen supply to the plant was limited (14 to 28 parts per million), petunia leaves were not visibly damaged, but when the supply was optimum (112 to 280 ppm), visible damage did occur to the foliage. It also appeared that excess N (1,120 ppm) rendered a plant less sensitive to the pollutant.

Table 3.—Nitrogen supply to petunia plants and degree of foliar air pollution damage

Experiment 1		Experiment 2	
N supply ppm	Damage	N supply ppm	Damage
14	none	28	none
112	severe	280	severe
224	severe	1120	slight

In the Horticulture greenhouse the authors were investigating the response of 10 petunia varieties to various photoperiods when an air pollution episode occurred in May, 1965. The plants had been divided into two groups, one with and the other without a black cloth covering from 4:30 p.m. to 8 a.m. Within each group, one series of plants received no additional light; a second, an additional 20 foot-candles of incandescent light from 11 p.m. to 1 a.m., and a third, the additional light from 5 p.m. to 11 p.m.

Colored Sorts

At this time of year the group without a cloth covering received almost two hours more of natural daylight in the morning and one hour at night. The color varieties—Jetfire, Red Cascade, Ballerina, Prima Donna, Zigzag, Cherry Tart and Minstrel—were not damaged, nor was the white variety White Sails. The white petunias, Snowdrift and Sonata, were always damaged when they had been growing under a black cloth, but they were never damaged when the black cloth was absent.

Two interpretations of the data are possible: (1) That the slightly longer light period in the absence of a cover either rendered the pollutant inactive or so altered the composition of the plant that it became more toler-

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Table 2.—Petunia varieties and their response to atmospheric pollution.

Sensitive varieties	Resistant varieties				
White	Mixed—White	Red	Pink	Purple	Blue
Alaska	Calypso	Cardinal	Ballerina	Balcony	Blue Lace
Albatross	Cherry Tart	Riches	Celestial Rose	Black Opal	Blue Lustre
Mikado	Comet	Comanche	Lyric		Blue Magic
Paleface	Crusader	Fire Chief	Maytime		Blue Mantle
Seafoam	Polaris	Jetfire	Pink		Light Blue
Snowcap	Sabre Dance	Red Cascade	Bountiful		
Snowdrift	Satellite	Red Ensign	Pink Pearl		
Snowstorm		Redwing	Prima Donna		
Sonata		Rosie	Royal Ruby		
White Frills		Tango	Sugar Plum		
White Magic		Velvet Ball			
White Riches					
White Sails					

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ant to the pollutant, or (2) that the pollutant did not remain concentrated above the plants in the absence of a covering.

The authors can offer some evidence at this time as to the identity of the pollutant. They know it was not ozone because ozone toxicity results in a different injury pattern, an irregular bleaching of the upper surface of the oldest leaves. They know it was not sulfur dioxide, because the colored varieties are equally sensitive as the white to SO_2. Moreover, many species are more sensitive to SO_2 than the petunia (eg, dahlia, marigold, begonia, violet), and they too would have been injured in nature.

The symptom pattern on all the white varieties of petunia is similar to that which the authors reported for Snowstorm petunia in the November-December, 1963, issue of New Jersey Agriculture.

Other researchers have produced similar damage on nonwhite varieties with several fumigant mixtures including NO_2 and hydrocarbons, irradiated automobile exhaust, irradiated ozone-olefin combinations, irradiated aldehydes and also peroxyacylnitrate (PAN).

In the episodes reported in this article, the role of PAN is doubtful, inasmuch as the oxidant content of the ambient air was consistently below average on the days that damage occurred. This is not to say that the white petunia is not sensitive to PAN under other circumstances. In New Jersey during periods of prolonged air stagnation that occur once or twice a year, the authors have seen damage to petunia as well as to a large group of PAN-sensitive plants such as dandelion, Swiss chard, beet, lettuce, endive and chicory. Air analyses at these periods confirmed an elevated oxidant concentration.

Hypothesis Unconfirmed

Hindawi and Altshuller (8) have since reported that irradiated formaldehyde does not injure petunia and that irradiated propionaldehyde injures only the upper leaf surface. Their test did not involve a white petunia but a pink one, Celestial Rose. While evidence appears to point to aldehydes as the pollutant responsible for the damage on white petunias under certain conditions, confirmation of the hypothesis awaits experimental fumigation with aldehyde compounds.

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