Table 5. Effect of harvest date on yield, pod number, and mean pod weight of mature dry red chile ('California Mild') at location H in Roswell, N.M., 1981. Treatments were replicated 8 times.

Harvest dates 1981	Marketable yields[z] (MT/ha)	No. pods[z] 1.0 m.	Mean pod wt (g)	Color[y] (ASTA)
15 Oct.	3.8	55.0	6.6	120
30 Oct.	3.5	52.1	6.4	113
13 Nov.	3.4	56.7	5.7	117
1 Dec.	3.4	53.4	6.1	128
Significance (linear)[x]	NS	NS	**	NS

[z]Correlation coefficient between number of pods and yield = 0.91**.
[y]Analysis conducted after 1 Dec. 1981.
[x]Significant at 1% level (**) or nonsignificant (NS).

loss with stored dried powder (1, 2, 3), and it is possible the color in whole pods similarly degrades in storage. No definite reason for the difference is suggested.

The results support the conclusion that yields are reduced linearly by 0.5% per day as harvest is delayed past early November. vember. Delayed harvest did not alter color under the conditions of these tests. A producer would be able to reduce losses from late harvests by gathering all red pods, including those on the ground, a practice which is only partially achievable under commercial circumstances.

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Response of Shore Juniper To Ozone Alone and in Mixture with Sulfur Dioxide and Nitrogen Dioxide

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Abstract **A single 4 hour exposure of shore juniper, *Juniperus conferta* Parl., to 0.3 ppm O_3, alone or in combination with 0.15 ppm nitrogen dioxide and/or sulfur dioxide, produced a significant number of small (<3 mm), elongate, tan foliar lesions 2 to 4 days after exposure. The injury symptoms were not identical to those associated with shore juniper decline.**

Shore junipers, growing in North Carolina often show chlorosis of basal needles, progressing to necrosis and proceeding up the plant stem. The absence of obvious biotic causes of shore juniper decline (SJD) suggested that ozone (O_3) or other atmospheric pollutants may cause or contribute to SJD. The contributions of edaphic parameters to SJD have been reported elsewhere (3).

Conifers generally are less susceptible to O_3 injury than hardwoods (1, 2), and different species of the same genus often do not respond to pollutants in the same way (5, 7). Responses of junipers to O_3 vary (8). Exposures at 0.1 ppm O_3, 6 hr/day for 4 consecutive days in each of 4 weeks followed by an additional week of like exposures at 0.2 ppm caused increased shoot elongation of *J. chinensis* L. 'Pfitzeriana' (Pfitzer juniper) but did not affect shoot elongation of *J. sabina* L. 'Tamariscifolia' (Tamarix juniper). Similar exposures to 0.2 ppm followed by 0.4 ppm O_3 inhibited shoot elongation of Tamarix juniper but not Pfitzer juniper. Neither species developed visible symptoms of injury due to O_3.

Nitrogen dioxide and sulfur SO_2 may act additively or synergistically with O_3 to produce injury to plants (10, 11, 13). Acute exposure often produces visible symptoms on sensitive species (6, 7), whereas chronic exposure under natural or controlled conditions produces changes in growth (6, 8, 9). This study was undertaken to determine if shore juniper is sensitive to acute exposure to O_3 alone and in combination with NO_2 and SO_2.

Cuttings were rooted in sand in the greenhouse. After 1 year, cuttings were transplanted to a 1 soil : 1 sand : 1 peat mixture (by volume) in 10 cm clay pots and were grown outside under shade. Plants began developing new growth about 2 months prior to exposure. One month prior to exposure, plants were moved to a charcoal filtered greenhouse maintained at about 30°C. Plants were 28-months-old at the time of exposure (July).

Shore juniper plants were divided into 3 groups of 32 plants. Each group of 32 plants was exposed separately for one 4-hr period to charcoal filtered air, 0.3 ppm O_3, 0.15 ppm NO_2, and 0.15 ppm SO_2 alone and in all possible combinations (8 treatments). Each treatment contained an experimental unit of 4 plants. Thus, the experiment involved 96 plants (3 replications, 8 treatments, and 4 plants per treatment). The pollutants were dispensed into continuous stirred tank reactor (CSTR) exposure chambers (4) located in a charcoal filtered air greenhouse. Ozone was generated by electrical discharge in dry oxygen. Nitrogen dioxide and SO_2 were supplied from separate tanks containing 1% of each gas in dry nitrogen. Ozone and NO_2 concentratons were monitored with chemiluminescence monitors (Monitor Labs, Inc., San Diego, CA 92121) and SO_2 with a flame photometric analyzer (Meloy Laboratories, Inc., Springfield, VA 22151). Gas analyzers were calibrated using a portable Model 8500 Monitor Labs calibrator. Exposure chambers were monitored continuously during exposure and ranged from 27° to 37°C with a mean of 33°. One week after exposure, visible injury was evaluated by counting the number of lesions. Data were analyzed by ANOVA as a 3 × 2 factorial experiment in a completely randomized design.

There were traces of visible injury on the control plants and plants exposed to NO_2 and/or SO_2. These symptoms did not seem to be

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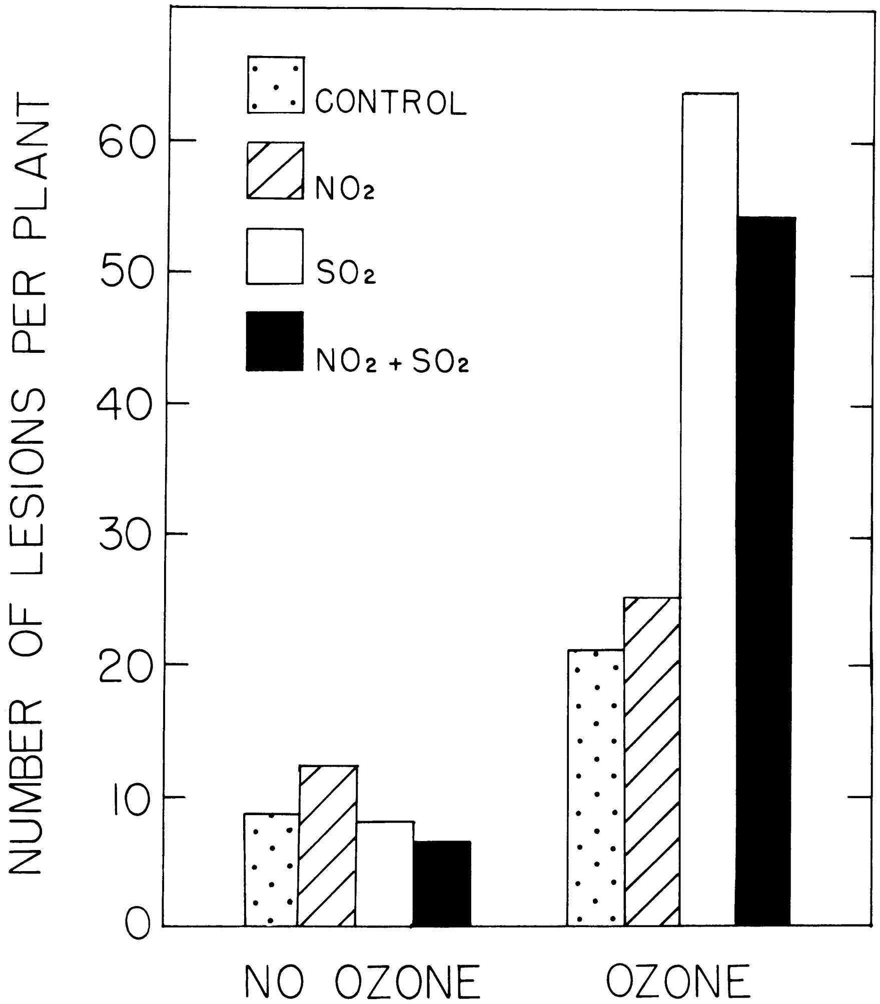

Fig. 1. Effect of ozone, alone and in combination with other gases, on the number of lesions produced on shore juniper needles. Regardless of the presence of other gases, an acute exposure to O_3 significantly increased ($P \leq 0.01$) the number of lesions. There were no statistical interactions among gases; hence, effects were additive. Nitrogen dioxide and SO_2 alone and/or in combination had no effect on lesion number. In the presence of O_3, SO_2 and NO_2 + SO_2 increased lesion number ($P \leq 0.05$). There were usually 7–12 lesions on the older needles of each plant.

related to exposure to these 2 pollutants alone or in combination. Similar injury symptoms were observed in mixture treatments containing O_3 and in the O_3 treatment only. These symptoms were on old needles.

Small (<3 mm), elongated, tan foliar lesions were observed 1st on recently developed needles 2 to 4 days after exposure to O_3 alone or in combination with NO_2 and/or SO_2. Lesions on needles from plants exposed to O_3 + SO_2 treatment generally were smaller than those on plants exposed to O_3 alone. No chlorosis was observed in association with the needle injury.

Plants exposed to O_3 alone developed more lesions, (22) than plants exposed to charcoal filtered air (9) ($P \leq 0.01$). In the absence of O_3, NO_2 alone or in combination had no effect on the lesion number. In the presence of O_3, however, the number of lesions due to SO_2 (63) and NO_2 + SO_2 (55), were additive compared to NO_2, SO_2, or O_3 alone ($P \leq 0.05$). The number of lesions due to NO_2 in the presence of O_3 did not differ from O_3 alone (Fig. 1).

Ozone concentrations as high as 0.4 ppm for 8 hr/day for 4 days did not produce visible foliar injury on 2 species of shrub juniper (8). A slightly reduced O_3 concentration (0.25 ppm) at a single exposure of 8 hr did not injure 9 of 18 coniferous tree species (2). Generally when plants were exposed once or several times to O_3 for 4–6 hr and visible injury was observed, it suggested that ambient O_3 concentrations, which would stress the plant each day also could result in foliar injury. Since shore juniper developed visible injury on needles after a single 4 hr exposure at 0.3 ppm O_3, it should be considered a relatively sensitive coniferous species in terms of acute exposures.

The concentrations of NO_2 (0.15 ppm) and SO_2 (0.15 ppm) are near ambient levels found in many urban areas, and it would be reasonable to expect that they would occur when O_3 is also present (12). Concentrations of NO_2 or SO_2, alone or in combination, did not cause injury to shore juniper on new needles. Nitrogen dioxide and SO_2 in the absence of O_3 have been shown to cause visible injury in several O_3 sensitive herbaceous plant species (10, 13). In our study, NO_2 and/or SO_2 further increased the needle injury when compared to O_3 alone. Since analysis of variance indicated no interaction between O_3 + SO_2, the joint action of SO_2 + O_3 was additive.

Visible symptoms of acute O_3 injury alone or in combination with NO_2 and SO_2 in shore juniper differed from those of SJD. Ozone injury was expressed as discrete lesions, whereas foliar symptoms of SJD were a general chlorosis progressing to necrosis, beginning with the old needles and progressing to the young needles. Although the symptoms were not similar to symptoms of SJD, and since shore juniper is sensitive to O_3 and to mixtures of O_3 with SO_2 and/or NO_2, chronic (repeated exposure) studies are required to determine if the SJD decline symptoms could be induced when shore juniper is exposed to these pollutants throughout the growing season.

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