Table 2. Visual phytotoxicity[z] evaluation of 15 cultivars of transplanted bedding plants treated with post-transplant herbicides.

Species	Chloramben (4.5 kg/ha)	EPTC (4.5 kg/ha)	Alachlor (3.4 kg/ha)	DCPA (11.2 kg/ha)	Diphenamid (6.7 kg/ha)	Napropamide (3.4 kg/ha)	Butralin (3.4 kg/ha)	Trifluralin (2.2 kg/ha)	Nonweeded control	LSD 5%
	Visual phytotoxicity rating									
Ageratum Houstonianum Mill. cv. Blue Serf.	1.7	1.0	1.7	1.0	1.0	1.0	2.3	1.0	1.0	1.2
Amaranthus tricolor L. cv. Tricolor Splendens Perfecta.	9.3	2.7	2.3	4.3	2.7	2.7	4.0	4.0	1.7	3.0
Antirrhinum majus L. cv. Floral Carpet Mix.	4.0	4.0	4.0	4.0	2.7	2.7	2.7	1.7	1.0	ns
Celosia argentea L. cv. Golden Torch.	9.7	4.0	1.7	2.3	5.7	4.0	3.3	1.0	1.0	4.6
Chrysanthemum morifolium Ramat. cv. Minnautumn	2.7	1.0	1.0	4.0	1.0	1.0	1.0	1.0	1.0	ns
Dahlia pinnata Cav. cv. Early Bird Mix.	1.0	1.0	1.0	1.7	2.0	1.0	1.0	1.0	1.0	ns
Dianthus chinensis L. Rainbow Pink.	10.0	4.0	1.0	1.0	2.0	4.7	3.0	1.0	1.0	4.1
Pelargonium hortorum Bailey. cv. Sprinter Red.	5.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.6
Petunia hybrida Vilm. cv. Candy Apple.	3.3	1.0	1.0	1.7	1.0	1.0	1.0	1.0	1.0	1.3
Petunia hybrida Vilm. cv. Snow Cap.	1.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	ns
Salvia splendens Sello. cv. St. Johns Fire.	8.3	4.7	10.0	4.7	1.0	3.7	4.0	3.7	1.0	4.8
Tagetes patula L. cv. Lemon Drop.	4.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
Tagetes patula L. cv. Moonshot.	2.7	1.0	1.3	1.0	1.7	1.7	1.0	1.0	1.0	1.2
Verbena hybrida Vass. cv. Ideal Florist's Strain.	9.0	1.0	1.0	1.0	1.0	1.0	3.7	1.0	1.0	1.0
Zinnia elegans Jacq. cv. Lilliput Mix.	1.0	1.0	1.7	1.7	1.0	1.0	1.7	1.0	1.0	ns

[z]Visual rating scale: 1.0 (no injury) to 10.0 (complete plant kill).

a planting of annual bedding plants (Table 1).

An evaluation 2 months after herbicide applications showed that all of the herbicides in this study, with the exception of chloramben, produced only minimal phytotoxicity on annual bedding plants (Table 2). Alachlor caused excessive plant phytotoxicity to salvia transplants but could be successfully employed on other annual bedding plants if so labelled. Both chloramben and butralin injured many cultivars and they should not be employed as post-transplant applications to annuals at least at the rates employed in this test.

Napropamide injury as foliar chlorosis and leaf burn was observed on the celosia, dianthus and salvia transplants (Table 2). As a result of the excellent overall weed control with napropamide, this material might be used for weed control on selected annuals.

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Changes in Ambient SO_2 by Rhododendron and Pyracantha[1]

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Abstract. **The capacity of rhododendron (*Rhododendron catawbiense* Michx., cv. Nova Zembla) and firethorn (*Pyracantha coccinea* M. J. Roem. var. Lalandii (Duren) Dipp.) to change ambient SO_2 levels in a closed fumigation system was studied. *P. coccinea* removed greater quantities of SO_2 at faster rates than *R. catawbiense.* Differences in leaf surface characteristics between the 2 species suggest that at least part of the SO_2 uptake mechanism may involve a surface-mediated response to the pollutant.**

The ability of vegetation to alter air quality remains a controversial subject, although numerous studies show that plants possess at least the potential to ameliorate air contamination. However, the efficiency of the process remains largely unresolved (8).

Although the relative sorptive capacities of many tree species have been reported (2, 5, 7) very little information exists on the uptake of gaseous pollutants by shrubs and woody ornamentals. Thorne and Hanson (6) included a single species each of *Bougainvillea* and *Camellia* in their research on ozone absorption, and Roberts (5) used 4 ornamental species in his investigation of SO_2 sorption by woody plants. In both these studies, however, the uptake of gaseous pollutants was measured either by cuttings or by individual leaves. In this investigation we measured SO_2 depletion by intact plants of 2 popular woody ornamentals.

Three- and 12-month-old rooted cuttings of rhododendron and firethorn, respectively, were potted in 2 peat:2 perlite:1 soil, (v/v) in 10-cm plastic containers and were grown under a 16-hr photoperiod in the greenhouse for 7 months before experimentation. During this period, all plants were watered daily and fertilized weekly with a modified nutrient solution (3).

Before starting the experiment, each container was inclosed in a polyethylene bag sealed at the base of the stem to minimize SO_2 absorption by the potting medium. After preconditioning for 1 hr in charcoal-filtered air, individual plants were transferred to a plexiglass fumigation chamber within which a steady-state SO_2 concn of approximately 0.5 ppm was maintained. Fumigation was discontinued at this point, and SO_2 depletion in the chamber was measured flame-photometrically by recording changes in pollutant concentration at 5-min intervals over a period of 0.5 hr. After removing each plant from the fumigation chamber, the experimental procedure was repeated with the foliage removed. Depletion rates were calcula-

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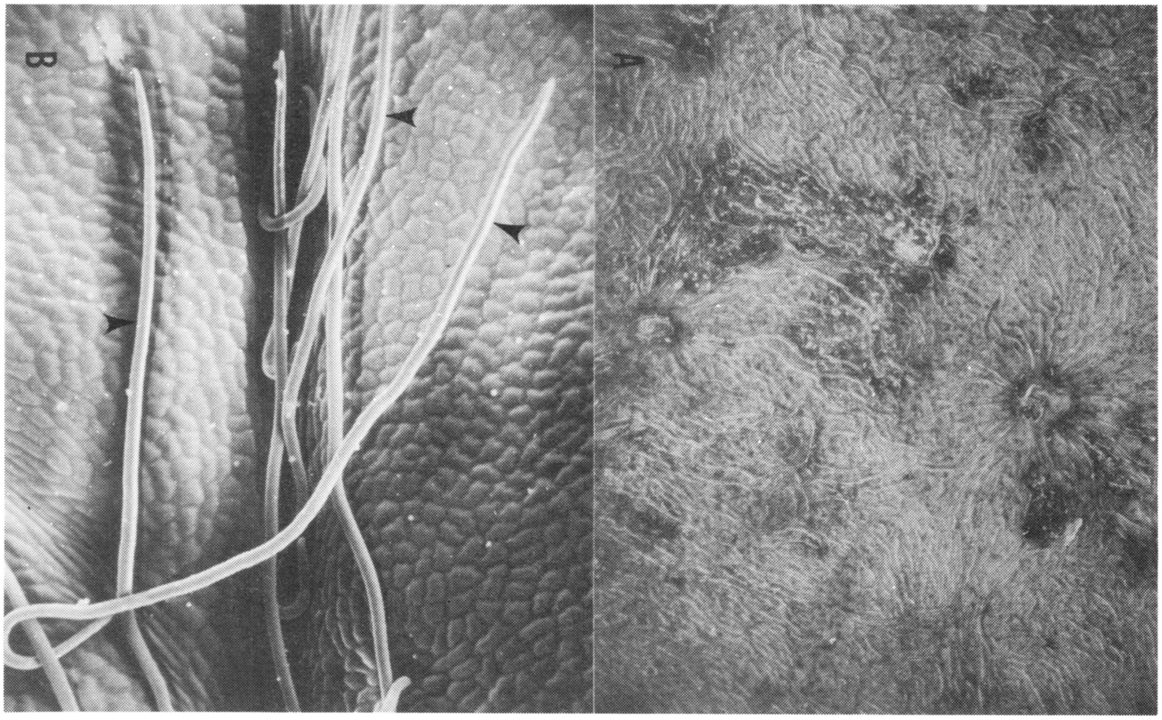

Fig. 1. Scanning electron photomicrographs (100×) of adaxial leaf surface features of *Rhododenron catawbiense* (A) and *Pyracantha coccinea* (B). Arrows indicate simple trichomes.

ted as the difference between the intact and the defoliated plant. The experimental procedure was repeated for 8 individual plants of each species, and the data were expressed on the basis of leaf surface area and leaf dry weight. The fumigation system was placed inside a growth chamber in order to maintain constant environmental conditions during each exposure ($27^{o} \pm 0.5^{o}C$, 52 ± 10% relative humidity, 2.5 klx combined fluorescent-incandescent light).

To study foliar surface features of each species, mature leaves were fixed in 3% glutaraldehyde in phosphate buffer washed in 0.1M phosphate buffer (pH 6.8), dehydrated with ethanol, then placed in amyl acetate and critically-point dried with CO_2. After mounting and gold-coating, the specimens were examined on a scanning electron microscope (SEM) at 5 kV.

We observed greater SO_2 depletion values with firethorn than with rhododendron (Table 1). This relationship was true for the data on both an area and a dry wt basis. Roberts (5) reported similar results with single leaves of *Pyracantha augustifolia* (Franch.) Schneid. and *Rhododendron maximum* L., although the uptake values in his study were somewhat lower than those reported here. Not only did firethorn remove appreciably more SO_2 than rhododendron, but the time required to reach maximum sorption was considerably less for the former species (Table 1).

Table 1. Uptake of ambient SO_2 in a closed fumigation system by intact plants of *Rhododendron catawbiense* and *Pyracantha coccinea*.

Species	SO_2 uptake (± SD)[z] ($mg \cdot dm^{-2} \cdot hr^{-1}$)	($mg \cdot g^{-1} \cdot hr^{-1}$)	Time to maximum uptake (min)
R. catawbiense	0.081 ± 0.029	0.127 ± 0.045	24.4
P. coccinea	0.128 ± 0.017	0.272 ± 0.096	18.1

[z]Avg of 8 replications.

This study was not designed to distinguish between absorption and adsorption of SO_2, thus we can only speculate on the relative importance of each phenomenon as it relates to the total sorption process. We did, however, observe differences in the surface features of the foliage from each species. Macroscopically, the young leaves of rhododendron were rather smooth and glaucous, while those of firethorn showed appreciable pubescence. The SEM confirmed that the adaxial surface of rhododendron leaves was free of pubescence, while the corresponding surface of firethorn exhibited numerous simple trichomes originating on the edges and from the veins (Fig. 1). These trichomes may be capable of trapping SO_2 directly. In addition, they increase the adsorptive surface area of the leaf. Although the majority of SO_2 probably diffuses into the leaf through open stomata (4), it has been observed that plants with irregular surface features are capable of removing gaseous pollutants such as ozone from the air (1). Thus, surface-mediated SO_2 uptake may also be an important consideration in species like *P. coccinea*.

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