INTERACTION OF ENVIRONMENTAL CONDITIONS AND ROUNDUP APPLICATION

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Roundup for weed control does better in terms of rose damage if humidity is maintained as low as possible. Otherwise, use a higher night temperature to reduce damage to dormant buds.

Several rose growers have used the herbicide Roundup® for weed control in rose benches at the recommended concentrations. They have seen some very serious herbicide damage to the rose plants. The herbicide damage was observed as malformed shoots and tended to be sporadic damage (Fig. 1). At one time of the year, damage would be observed and other times there would be no damage. The purpose of these experiments was to investigate the interaction of the environment and the herbicide concentration necessary to elicit damage, and then determine if there was an optimum environmental condition that would elicit the response vs. minimizing any herbicide damage.

Figure 1. Typical shoot malformation on roses when plants were treated with Roundup®.

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Materials and Methods

The rose varieties 'Royalty' and 'Sonia' were propagated on their own roots, grown in 20 cm pots, following standard cultural procedures. After approximately 9 months the plant material was established so that they exhibited characteristics similar to mature plants. These plants had a leaf canopy which was subtended by canes with secondary bark development. Plants were grown in individual pots.

The environments that were used are explained in Table 1. The environmental parameters applied were: 1) either a low or high relative humidity, or 2) various day-night temperature combinations. Four environments were chosen for their similarities to environmental conditions which exist in Colorado rose greenhouses throughout the year. High relative humidity was achieved with a high pressure mist system during the daylight hours, maintaining as high a relative humidity as possible (up to 85% relative humidity). The low humidity environment (less than 40% relative humidity) had no supplemental high pressure mist system.

Table 1. Environmental conditions under which roses were grown when various concentrations of Roundup® were applied.

Mist	Temperature set points				Environmental Code
	Night	Day	Cool 1	Cool 2	
+	61°	75°	81°	90°	+61° F
+	70°	81°	90°	100°	+70°
-	61°	75°	81°	90°	-61°
-	70°	81°	90°	100°	-70°

The night temperatures were either 61°F or 70°F. The day temperatures were raised to 75°F or 81°F by heating. First stage cooling occurred at 81°F or 90°F respectively with second stage cooling at 90°F or 100°F respectively. The

environmental codes are indicated in Table 1. All cultural procedures used were according to standard rose cultural procedures, although flowers were cut at the first five leaflet leaf to develop a strong canopy.

A shoot and leaf malformation rating scale of 1 to 3 was used, with (1) being no visible shoot or leaf malformation observed, (2) indicating less than 50% shoot or leaf malformation, and (3) greater than 50% shoot or leaf malformation.

Experiment 1 The concentration of Roundup® applied to 'Sonia' ranged from 0 to 25%. Five plants per treatment were treated on May 7 with approximately 5 ml of Roundup®, which wetted the stem to run-off. Although application of Roundup® to the shoots is not recommended, we applied it to run-off to determine if there was an interaction between uptake of the herbicide and concentration in the different environments. Three weeks after treatment, the damage to both the shoots and leaves was determined. Plants were cut back to 16 in. and, two weeks later, the plants were rated for severity of shoot and leaf malformation.

Experiment 2 The interaction of frequency, concentration and environment to Roundup® application was investigated. The treatments consisted of 1% Roundup® applied once, twice or three times on a weekly basis. A 2% and 3% rate was applied once. The effect of Roundup® on shoot or leaf malformation was assessed three weeks after application using a 1 to 3 scale. The plants were then cut back to 16 in. and shoot regrowth was assessed for shoot or leaf malformation, on the 1 to 3 scale.

Results and Discussion

Experiment 1 There was no shoot malformation observed on the original 'Sonia' shoots regardless of concentration. When various Roundup® concentrations were applied in two different temperature environments (61°F no mist or 70°F no mist) the shoot regrowth showed more malformation in the 61°F environment than in the 70°F environment (Table 2). In the 61°F environment, shoot damage began at the 2% concentration with severe malformation occurring at 5%. In the 70°F environment, shoot damage began at the 3% and severe malformation did not occur until 15% concentration was used (Fig. 2). There appears to be a temperature interaction with concentration at low relative humidities.

Experiment 2 When the response of original 'Royalty' shoots to environment and Roundup® concentrations was observed, the 70°F no mist environment produced more damage to the original shoots, regardless of concentration, than any of the other environments (Table 3). A single application of Roundup®, either at 1%, 2% or 3%, caused similar amounts of shoot malformation (Fig. 3). Multiple applications of 1% Roundup® produced some of the most severe damage to original shoots, although, at times, the damage severity was not different from a single application.

Figure 2. Severe shoot malformation of dormant lateral buds when plants were treated with Roundup® then pruned to encourage lateral shoot growth.

Table 2. Influence of Roundup® concentration on 'Sonia' rose shoot regrowth when plants were treated, then two weeks later cut back to 15 in. and allowed to grow for 3 weeks.

The rating scale is:1 = no visible shoot malformation
2 = less than 50% shoot malformation
3 = greater than 50% shoot malformation

Roundup® concentration	Environment	
	-61° F	-70°
0%	1.0	1.0
1%	1.0	1.0
2%	1.8	1.0
3%	1.8	2.0
5%	3.0	2.3
10%	3.0	1.8
15%	3.0	3.0
20%	3.0	3.0
25%	3.0	3.0

Table 3. Interaction of environment, Roundup® concentration and application frequency on original shoot growth 3 weeks after first application, and shoot regrowth two weeks after cutback to 15 in.

The rating scale was:1 = no visible shoot malformation
2 = less than 50% shoot malformation
3 = greater than 50% shoot malformation

Environment	Concentration — Frequency of application					
	0	1%-1×	1%-2×	1%-3×	2%-1×	3%-1×
	Original Shoots					
+61° F	1.0	1.3	1.8	1.8	1.0	1.0
+70°	1.0	1.7	1.0	1.8	1.7	1.8
-61°	1.0	1.2	1.3	1.2	1.0	1.0
-70°	1.0	2.7	2.3	1.3	2.5	2.5
	Shoot Regrowth					
+61° F	1.0	2.2	2.5	2.3	2.8	2.5
+70°	1.0	1.0	1.2	1.8	1.2	1.8
-61°	1.0	1.0	1.5	3.0	1.3	2.7
-70°	1.0	1.0	1.0	1.7	1.5	1.5

Figure 3. Damage to reproductive and blind shoots when 1% Roundup® was applied to plants grown in the -70° environment.

The shoot regrowth response to Roundup® was completely different from the response observed on the original shoots. At high relative humidities, greater foliage malformation occurred as compared to no mist. Those treatments where a maximum amount of foliage malformation occurred to the original shoots (70°F no mist), showed very little damage to shoot regrowth. Whereas the 61°F night temperature plus mist exhibited little damage in the original shoots, but very serious damage in shoot regrowth. Malformation of the original shoots is not a good predictor of damage to quiescent buds and subsequent shoots. In fact, it appears that there is a good relationship between environments which promote damage to the original shoots and a lack of damage to shoot regrowth.

The recommendations from this study are: 1) When Roundup® is applied to roses for weed control, an environment with a low relative humidity should be used. 2) When high relative humidity is present use a higher night temperature to minimize damage to dormant buds. 3) Attempts should be made to minimize Roundup® on plant material.