Susceptibility of Prunus Rootstocks to Herbicide Injury

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In the spring of 1970, a two year study was initiated to screen eight *Prunus* rootstocks for suspebtibility to herbicides currently used in Arkansas orchards. Previous observations in a plum variety planting containing two rootstocks suggested the possibility of variation in herbicide susceptibility.

Fifty plots were established; each containing one of eight *Prunus* rootstocks obtained commercially as rooted layers or seedlings (Table 1). Plants were set 18" apart in the row. A 10' space separated plots in the row and rows were set 15' apart. The soil at the Nashville, Arkansas, Peach Substation is a well drained, acid, Saffel-Dierks gravelly sandy loam. Planting was done in April. Six weeks later, after growth had started, each plant received ⅙ lb. ammonium nitrate. The second year each received ¼ lb. NH_4NO_3 in April.

One-half of the plots were used for herbicide applications in 1970; the other half were held for a duplication of the experiment in 1971 after 1 year in the field. Plots receiving herbicide treatments in 1970 were cultivated once in the month after planting; the others were cultivated three times prior to July 7, 1970. On June 17, Paraquat at 1 lb/A was sprayed in a band down each side of the 1970 herbicide plots to eliminate weed seedlings. All growth below 10" had previously been stripped from the rootstocks. On June 20, 1970, preemergence herbicides (Table 1) were applied to the clean soil surface in a 3' band on each side of the plots. Plots were replicated 3 times. A plastic shield was used to assure no herbicide drift to plant foliage. The same procedure was used when applying herbicides to the 1971 plots the following June.

Excellent weed control (over 80% of the plot surface free of weeds for 90 days) was obtained from all herbicides in both years. Data are not presented as they are not pertinent to this report.

Phytotoxicity was noted within 28 days after the 1970 herbicide application. Rainfall of 1.1" fell after 5 days followed by 0.4" 10 days later and 1.7" 20 days after treatment. Symptom expression increased in intensity as the season progressed (Table 1). The 'Nemaguard' peach stock was the only one which appeared to recover as measured by a symptom reduction. Phytotoxicity to simazine and particularly dichlobenil tended to develop later than that for diuron or terbacil. By September, herbicides had proved fatal to several trees and others were near death. Residual herbicide effect, measured by phytotoxic symptom development, appeared after growth started in 1971. On seven stocks, residual phytotoxic symptoms to one or more herbicides developed to an equal or greater degree than in 1970.

Dichlobenil was notably more phytotoxic the second year after application than the first on 3 stocks, although the degree of phytotoxicity appeared to be inconsequential as did 1971 symptoms. Because some stocks had received a fatal dose of herbicide in 1970, there was no opportunity to observe residual effects on an equal number of trees.

The effect of preemergence herbicides on growth of *Prunus* rootstock

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was determined in 1970 by measuring total linear growth and trunk diameter increase from May through October. Calculations include measurements on trees which died during the season. The residual herbicide effect on growth, determined in 1971, was based on random terminal measurements and trunk diameter increases on surviving trees. These measurements were not analyzed statistically because of plots missing due to tree losses.

Total linear growth in 1970 varied among rootstocks. The 'Lovell' peach was the most vigorous and the 'American' plum the least. However, none of the rootstocks showed a significant linear growth reduction due to a herbicide treatment. The mortality of cherry stocks occurred after terminal growth was completed. Thus, though eventually toxic to the plant, herbicides were not particularly debilitating during the summer growing season.

Trunk diameter increase, a manifestation of late season growth, was significantly affected by herbicide in the case of 'Mahaleb', 'Tomentosa', 'Myroblan-24C', and 'Marianna' rootstocks. In each, the failure to increase in diameter was associated with the use of terbacil at a 4 lb. rate and reflected fatal conditions in the tree.

The residual effects of herbicides on tree growth, based on summary data, do not appear to be important. Likewise there was no apparent reduction in tree growth on established stocks receiving herbicide treatment in 1971.

By late fall 1970, herbicides had killed 29 stocks or 13.4% of the planting (Table 2). Terbacil was the most

Table 1. Tolerance of *Prunus* rootstocks to preemergence herbicides.

Rootstock	Herbicide rate	Phytotoxicity Rating[1]								
	Observation date	simazine 2	simazine 4	diuron 2	diuron 4	terbacil 2	terbacil 4	dichlobenil 4	dichlobenil 8	Avg.
Plum										
Marianna	9/10/70	0	.7	0	.7	1.7	3.0	0	0	.68
	7/17/71	.3	0	0	1.3	1.3	2.0	.6	2.0	.80
Myroblan-29C	9/10/70	.3	.3	1.0	2.3	2.7	4.0	1.3	.7	1.40
	7/17/71	1.0	0	1.7	1.7	1.3	—	1.3	1.7	1.07
Myroblan	9/10/70	.3	0	.7	2.0	1.7	3.0	0	1.0	.97
	7/17/71	.3	0	.3	1.7	.3	1.3	.6	1.0	.61
American	9/10/70	0	.7	.3	3.0	2.3	4.0	1.0	1.0	1.37
	7/17/71	0	0	0	2.7	1.7	—	1.0	1.0	.80
Cherry										
Mahaleb	9/10/70	1.0	1.0	1.3	3.6	4.0	4.0	.3	1.3	1.93
	7/17/71	0	0	1.3	—	—	—	1.3	2.0	.78
Tomentosa	9/10/70	0	0	.3	1.3	4.0	4.0	0	0	1.07
	7/17/71	0	0	1.3	2.0	—	—	.3	.6	.60
Peach										
Nemaguard	9/10/70	0	0	0	.3	.3	1.3	0	0	.21
	7/17/71	0	0	0	0	0	0	0	.3	.03
Lovell	9/10/70	0	0	0	.3	.7	1.7	0	0	.30
	7/17/71	0	0	0	0	0	0	0	0	0
AVG.	9/10/70	.20	.34	.45	1.71	3.12	3.12	.20	.50	—
	7/17/71	.04	.04	.0	.10	.68	1.12	.04	.23	—

[1]Phytotoxic symptom key: 0 = no symptom; 1 = light cholorosis; 2 = moderate chlorosis; 3 = severe chlorosis and necrosis; 4 = dead.

Table 2. Fatality to *Prunus* rootstocks caused by preemergence herbicides.

Rootstocks	Herbicide Rate	Tree Deaths[1] diuron 2	diuron 4	terbacil 2	terbacil 4	Total 1970	Total 1971	Total
	1970	0	0	0	2	2		
	1971	1	1		0		3	
Myroblan-29C	1970	0	1	1	3	5		
	1971	0	0	0	0		0	
Myroblan	1970	0	1	0	0			
	1971	0	0	0	0		0	1
American Plum	1970	0	0	3	3	6		
	1971	0	0	0	0		0	6
Cherry								
Mahaleb	1970	1	2	3	3	9		
	1971	0	1	0	0		1	
Tomentosa	1970	0	2	1	3	6		
	1971	0	1	0	0			7
Peach								
Nemaguard	1970	0	0	0	0	0	0	
	1971	0	0	0	0	0		0
Lovell	1970	0	0	0	0	0	0	
	1971	0	0	0	0	0		0
TOTAL	1970	1	6	8	14	29		
	1971	1	3	1	0		5	
	Total	2	9	9	14			34

[1]Out of total of 3. No deaths due to simazine or dichlobenil.

phytotoxic followed by diuron. Simazine and dichlobenil appeared relatively safe. The peach stocks were found to be the most tolerant to herbicides while the cherry stocks were the least. Additional deaths attributed to herbicide action occurred during the 1971 season. For the most part these followed the trends set in 1970 and quite possibly were to trees weakened the previous year.

Shortly after bud break in the spring of 1971, it was noted that a considerable number of trees in the non-herbicide treated plots were dead or dying. This condition was judged to be due to bacterial canker, caused by *Pseudomonas syringae*. No injury from this organism was observed in the plots that received herbicides in 1970 (Table 3). On the basis of this striking difference in the incidence of bacterial canker, it can be assumed that herbicides in some way altered the physiological condition of the trees which resulted in a host reaction to prevent bacterial canker development. This condition must have existed as plants went into the dormant season, a period of increased bacterial canker activity. It was not apparent as differences in linear or trunk growth made during the summer and early fall, yet it indicates a herbicide effect on the stocks.

Observations on leaf fall were made in Nov. 1971 to see if a relationship existed between bacterial canker susceptibility and herbicide treatments. Plots receiving herbicide in 1971 had a significantly earlier leaf fall. No relationship was found with respect to rootstocks. The most and least percent of leaf drop was in the two most susceptible of the eight stocks adding to the evidence that bacterial canker

Table 3. Observations on bacterial canker susceptibility and leaf fall of *Prunus* rootstocks as related to herbicide treatment.

Rootstock	% tree mortality due to bacterial canker[1]		% defoliation 11/11/71[2]		Average
	Herbicide plots	Non-Herbicide plots	Herbicide plots 1970	Herbicide plots 1971	
Plum					
Marianna	0	64.0	74.8	89.7	83.2 ab[3]
Myroblan-29C	0	36.0	45.2	49.4	47.8 c
Myroblan	0	24.0	40.8	50.4	45.1 c
American Plum	0	12.0	99.6	100.0	99.8 a
Cherry					
Mahaleb	0	8.0	88.2	82.6	85.1 ab
Tomentosa	0	12.0	86.5	81.8	83.9 ab
Peach					
Nemaguard	0	0.0	59.6	93.0	76.3 b
Lovell	0	8.0	72.8	95.4	84.1 ab
Average	0	20.5	69.9	80.2**	**

[1]Based on 25 plants 7/7/71, no bacterial canker mortality after that date.
[2]Based on surviving trees and before a killing frost.
[3]Values in the same column followed by the same letter are not significantly different.

Table 4. Comparison of *Prunus* rootstock tolerance to preemergence herbicides in year of planting to second season application.

Rootstock	Herbicide Rate Treatment Year	Phytotoxicity Rating[1]									
		simazine		diuron		terbacil		dichlobenil		Average	
		2	4	2	4	2	4	4	8	1970	1971
Plum											
Marianna	1970	0	0.7	0	0.7	1.7	3.0	0	0	.7	
	1971	0	0	0	0	0	2.0	0	0		.3
Myroblan-29C	1970	.3	.3	1.0	2.3	2.7	4.0	1.3	.7	1.4	
	1971	0	0	0	0	0	0	0	0		0
Myroblan	1970	.3	0	.7	2.0	1.7	3.0	0	1.0	1.0	
	1971	0	0	0	0	.5	.5	0	1.0		.2
American	1970	0	.7	.3	3.0	2.3	4.0	1.0	1.0	1.4	
	1971	0	0	0	0	1.3	2.0	0	.3		.4
Cherry											
Mahaleb	1970	1.0	1.0	1.3	3.6	4.0	4.0	.3	1.3	1.9	
	1971	0	.3	0	0	2.7	3.0	.6	.6		.7
Tomentosa	1970	0	0	.3	1.3	4.0	4.0	0	0	1.1	
	1971	.3	0	0	1.0	1.0	.6	.3	0		.4
Peach											
Nemaguard	1970	0	0	0	1.0	1.3	2.0	0	0	.5	
	1971	0	0	0	0	0	0	0	0		0
Lovell	1970	0	0	0	.3	.7	1.7	0	0	.3	
	1971	0	0	0	0	0	0	0	0		0
Average	1970	.2	.3	.5	1.7	2.2	3.1	.2	.5		
	1971	<.1	<.1	0	.1	.7	1.1	<.1	.2		

[1]Average phytotoxicity 9/10/70 and 8/8/71, scale 0 = no symptoms, 1 = light chlorosis, 2 = moderate chlorosis, 3 = severe chlorosis, 4 = dead.

susceptibility is a variety or species characteristic.

Although a 20.5% loss of trees to bacterial canker had occurred, the 25 plots not treated in 1970 were given herbicide application in 1971. These plots were cultivated on May 18, and herbicide applications were made on June 10, using the same materials and rates as in 1970. Three inches of rain fell within three weeks of application. The 1970 plots were not cultivated or given additional herbicide.

The tolerance of *Prunus* rootstocks to herbicides in the year after planting is markedly greater than in the year of planting (Table 4). No herbicide related fatalities were observed although it must be recognized that plant population for some stocks in some plots was limited due to the missing plants. As in the year of planting, terbacil, especially at the 4 lb. rate, proved to be most phytotoxic. The cherry stocks were again the most susceptible to injury while the established 'Myroblan' stocks appeared more tolerant to herbicides than in the year of planting.

Prunus rootstocks exhibited the least tolerance to the preemergence herbicides terbacil and diuron in the year of planting. Terbacil was also mildly phytotoxic the second season or when used the year after planting. All stocks established for one year showed increased tolerance to herbicides. The cherry stocks, *P. mahaleb* and *P. tomentosa* and the plum stocks 'Myroblan-29C' and 'American' plum were least tolerant to herbicides. By comparison, the peach stocks 'Lovell' and 'Nemaguard' exhibited the greatest tolerance to all herbicides in both years.

The appearance of light or even moderate marginal leaf chlorosis is a manifestation of herbicide phytotoxicity; but at this symptom development state, the herbicide is not debilitating to the plant.

An unexplained relationship noted between herbicide use and lack of bacterial canker development in such *Pseudomonas syringae* susceptible stocks as 'Marianna' plum and 'Myroblan-29C' offers further research opportunities.

Effects of Deflowering on the Highbush Blueberry *Vaccinium australe* Small[1]

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Deflowering of 3 highbush blueberry cultivars for 1, 2 or 3 years after planting resulted in no within-variety differences of plant size, berry size, yields for 2 years after completion of treatment or total cumulative yields. There were differences in plant and berry size among varieties.

Successful plant establishment and vigorous growth of highbush blueberries are promoted by deflowering in the year of planting. Some growers also deflower the less vigorous bushes in the second year (1, 2). However, crops of the second or even third year often are uneconomical to harvest be-

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