Gibberellic Acid Enhances Chemical Defoliation of Hydrangeas

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Before cold storage, hydrangeas require defoliation for bud development, uniform forcing, and reduction of the incidence of foliar pathogens, such as *Botrytis cinerea*. Current methods have serious limitations, such as the need for air-tight storage [with apples (Post, 1959) or vaporized sodium methyl dithiocarbamate (Kofranek and Leiser, 1958)], the use of high doses of chemical [10,000 mg butyne diol (BD)/liter (Koths et al., 1973)], or undesirable plant responses, such as reduction in plant and inflorescence size upon forcing [ethephon sprays (Shanks, 1969; Tjia and Buxton, 1976)].

The ideal defoliation treatment would allow for rapid leaf abscission; use small amounts of chemical, use open-air facilities, and have no adverse effects on the plants. Defoliant efficacy can be doubled by incorporating GA₃ at 35 to 350 mg-liter⁻¹ into sprays applied to cotton (Morgan and Durham, 1975). Therefore, in this study, GA₃ was examined as a means to promote hydrangea defoliation in a short time using low concentrations of available defoliant.

Experiment 1. Plants of 'Merritt's Supreme', each with two shoots, were received 17 Oct. 1988 and placed in a greenhouse maintained at 25 ± 2C/14 ± 2C (day/night). On 24 Oct. 1988, plants received the spray treatments indicated in Table 1, Expt. 1. Applications were made at the rate of 408 ml of solution/1 m² of bench. Plant diameter was 16 ± 1 cm at time of spray. The experiment consisted of seven replications of single plants in a completely randomized design. Percent defoliation was calculated daily for each plant for 14 days after treatment. However, defoliation did not commence until 3 days after treatment and no further defoliation occurred after 7 days post-treatment. Therefore, only data for 3 and 7 days after treatment are presented. On 2 Nov. 1988, all remaining foliage was removed and plants were placed in 4.5 ± 1C dark storage. Plants were removed from the cooler on 7 Dec. 1988, potted one per 1.3-liter plastic container, and placed in a 23 ± 2C/15 ± 2C (day/night) greenhouse. Anthesis was recorded for each inflorescence when the first flower opened and shed pollen. Shoot length and inflorescence diameter were recorded at

anthesis for both shoots of each plant.

All BD treatments effectively defoliated plants by day 3 (Table 1). Treatment with 2500 to 15,000 mg tributyl phosphorothioate (TPTA)/liter alone did not result in effective defoliation by day 3, but effective defoliation was achieved by day 7 for all treatments within 7500 to 15,000 mg-liter⁻¹. Incorporation of 50 mg GA₃/liter into 5000 to 15,000 mg TPTA/liter increased defoliation over plants receiving no GA₃. Although previous researchers achieved effective defoliation with ethephon (Tjia and Buxton, 1976), no effect was observed in this study (data not shown). The lack of response could be due to cultivar differences in sensitivity to ethephon, the amount of solution applied per plant, or temperatures used during the two studies. Gas chromatography analysis (Goudey et al., 1987) of ethylene evolution of the ethephon used in this study indicated the presence of the active ingredient (data not shown). Defoliation treatment did not affect days to anthesis, shoot height, or inflorescence diameter upon forcing (data not shown); experimental averages were 85 ± 5 days, 23 ± 3 cm, and 17 ± 2 cm, respectively.

Experiment 2. On 4 Nov. 1988, eight plants each received the treatments indicated in Table 1, Expt. 2. Plant diameter averaged 17 ± 1 cm at time of spray. Treatment application techniques, greenhouse conditions, and data collected during defoliation were the same as for Expt. 1. On 10 Nov. 1988, all remaining leaves were removed and plants were placed into 4.5 ± 1C dark storage. Plants were removed from the cooler on 22 Dec. 1988 and treated as described previously.

Butyne diol at 5000 mg-liter⁻¹ effectively defoliated plants by day 3; GA₃ did not enhance defoliation (Table 1). The addition of GA₃ did increase the efficacy of 2500 mg BD/liter, and percent defoliation was greater on both day 3 and 7. Although TPTA increased defoliation, as compared to controls, neither TPTA treatment resulted in effective (≥90%) defoliation, even by day 7. Defoliation treatment did not affect days to anthesis, shoot height, or inflorescence diameter upon forcing (data not shown); experimental plants averaged 83 ± 2 days, 31 ± 2 cm, and 18 ± 1 cm, respectively.

These experiments demonstrate that GA₃ can increase defoliant efficacy at lower concentrations of BD and TPTA. The enhanced efficacy of the defoliant plus the decreased time requirement for the defoliation process is beneficial for hydrangea producers, allowing more rapid defoliation with the use of less chemical defoliant.

Table 1. Percent defoliation for hydrangea plants 3 and 7 days after spraying with either butyne diol (BD) or tributyl phosphorothioate (TPTA) with or without GA₃.

Spray treatment (mg-liter ⁻¹)	Percent defoliation ^a	
	Day 3	Day 7
Experiment 1		
Control	0	0
Control + GA ₃	0	0
BD		
7,500	93	100
10,000	100	100
12,500	100	100
15,000	100	100
10,000 + 50 GA ₃	82	93
TPTA		
2,500	4	44
5,000	14	67
7,500	55	99
10,000	47	93
12,500	83	97
15,000	74	100
5,000 + 50 GA ₃	90	100
10,000 + 50 GA ₃	100	100
15,000 + 50 GA ₃	98	98
F tests		
ANOVA	***	***
Control vs. BD	***	***
Control vs. TPTA	***	***
BD, linear	NS	NS
10,000 BD, 0 vs. 50 GA ₃	**	NS
TPTA, linear	***	***
TPTA + GA ₃ , linear	NS	NS
TPTA, 0 vs. 50 GA ₃	***	***
Experiment 2		
Control	0	1
Control + GA ₃	0	0
BD		
2500	17	60
5000	90	98
2500 + 50 GA ₃	73	93
5000 + 50 GA ₃	85	100
TPTA		
2500	5	58
2500 + 50 GA ₃	33	75
F tests		
ANOVA	***	***
Control vs. BD	***	***
Control vs. TPTA	***	***
BD, 2500 vs. 5000	***	***
2500 BD, 0 vs. 50 GA ₃	***	***
5000 BD, 0 vs. 50 GA ₃	NS	NS
TPTA, 0 vs. 50 GA ₃	***	NS

^aSingle-degree-of-freedom contrasts within columns conducted on arcsin-transformed data. NS, **, ***Nonsignificant or significant at 0.01 ≥ α > 0.001 or at α ≤ 0.001, respectively.

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