treatment tanks. A standard depth of 5 cm was used. Temperatures at the various horizontal locations fluctuated less than 1°C over a 24-hr period. The 4-cm location was selected as most representative.

The third part of the test involved effect of location within the tank on soil temp. Four pots, each with a thermocouple, were located in the middle, end, and 2 corners of each treatment tank. Three treatment tanks were used. Location within individual tanks produced less than 1°C fluctuation from the selected soil temp.

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Foam Sprays of Plant Growth Regulating Chemicals on Rose Shoot Development at Cutback[1]

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Abstract. **Expanded foam sprays of (2-chloroethyl)phosphonic acid (ethephon), 6-(benzylamino)-9-(2-tetrahydropyran-yl)-9H-purine (PBA), and 6-benzylamino purine (BA) at 1000 and 2000 ppm applied at plant cutback increased the total number of flowering stems per plant and the number of stems from axillary buds within 30 cm of the bud union, compared with conventional sprays of the same chemicals and concentration. Sprays of plant growth regulators were most effective when applied at cutback, with less benefit from treatments 3 weeks before cutback or 1 or 3 weeks after cutback. No chemical or method of application effectively promoted shoot development from the bud union.**

Although plant growth regulating chemicals 2,3,5-triiodobenzoic acid (TIBA) and cytokinins in lanolin stimulate the development of new basal shoots from axillary buds of greenhouse rose plants, spray applications fail to provide sufficient endogenous levels for the response (1, 4, 6). Zieslin et al. (8) found the best branching response of 'Baccara' rose resulted from ethephon sprays when a thin score had been made above the basal axillary buds. Recently, applications of growth regulators in floral "Oasis" foam and a shaving cream foam have promoted the development of basal rose axillary buds (3, 4).

Low-expansion foams have been used as a carrier to reduce the spray drift of herbicides and plant growth retardants (5, 6). Foam sprays enhance growth regulator uptake by providing close contact for absorption between the chemical and plant during a longer period. Hield (5) reported succinic acid-2,2-dimethylhydrazide (SADH) applied in expanded foam increased the wetting duration 4 to 20 times and doubled the chemical retardation effect on the growth of oleander, compared with liquid sprays of the same concn. This study was undertaken to determine the effectiveness of plant growth regulators applied in expanded foam sprays in stimulating basal and axillary shoot development of 'Forever Yours' rose.

PBA, BA and ethephon were applied as conventional liquid sprays and expanded foam sprays to the union with the understock and lower 30 cm of canes. Liquid spray and foam spray applications of PBA and BA were applied at 100, 500, 1000 and 2000 ppm; ethephon was applied at 1000 and 2000 ppm. The surfactant Tween-20 (0.1% polyoxyethylene solution) was added to conventional PBA and BA sprays. Commercial "Agrifoam" at 3% v/v was added with the growth regulator immediately prior to generating the expanded foam spray in the Waukesha Foam Generator. Foam sprays were applied at 35 kg/sq cm (500 psi) with coverage as shown in Fig. 1 and conventional liquid sprays at 10.5 kg/sq cm (150 psi) using a portable power sprayer. All treatments were made in the greenhouse on cloudy afternoons from 3 to 5 PM, which allowed foams to remain moist for 28 to 40 hr depending on temp and sunlight.

Four benches of 400 five-year-old 'Forever Yours' rose plants in adjoining greenhouses were used in the study. Each treatment was applied to 16 plants (4 replications of 4 plants) 3 weeks before cutback (April 22nd), at cutback, and 1 and 3 weeks after cutback. Only one application was made of each treatment time. All plants were cutback May 13th to 60 cm, with very few leaves remaining on the canes. Treatments applied 3 weeks after cutback were to plants with 2.5 to 7.5 cm axillary shoots.

Fig. 1. Expanded foam spray treatments at union with understock and lower rose canes, 18 hr after application.

Foam treatments, including the Agrifoam control, caused extensive foliar necrosis to expanding leaflets and some killing of developing shoots. Conventional sprays of PBA and BA at 1000 and 2000 ppm caused a temporary foliar chlorosis and ethephon at 2000 ppm produced a slight leaf malformation.

Plants treated with ethephon, PBA or BA at 1000 and 2000 ppm in foam had significantly more total flowering stems than the control. With similar chemicals and concn, foam sprays produced more flowering stems than conventional sprays (Table 1). Most flowering stems generally developed from treatments applied the day of plant cutback, and the least, because of Agrifoam injury, from treatment 3 weeks after cutback. No significant differences in mean no. of flowering stems resulted between PBA and BA treatments at 1000 and 2000 ppm, but 2000 ppm ethephon was superior to 1000 ppm.

None of the chemicals or methods of application effectively promoted the development of flowering stems originating from the plant bud union (Table 2). Ethephon, PBA and BA at 1000 and

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Table 1. Effect of growth regulations and application method on flowering stems per rose plant, 9 weeks after cutback.

Treatment			Flowering stems per plant			
			Timing treatment to cutback			
Growth regulator	Method of application	Concn (ppm)	3 wks before	At cutback	1 wk after	3 wks after
Ethephon	Spray	1000	4.3a[z]	4.4a	4.1a	4.0ab
		2000	5.1b	5.5b	4.9ab	3.8ab
	Agrifoam	1000	4.7ab	5.8b	4.8a	3.3a
		2000	4.9b	7.1c	6.0b	3.4a
PBA	Spray	100	3.9a	4.2a	4.1a	3.9ab
		500	4.4a	4.5a	4.0a	4.6c
		1000	4.3a	4.5a	4.6ab	4.3bc
		2000	4.5ab	5.6b	4.4a	4.0ab
	Agrifoam	100	3.8a	4.1a	4.0a	3.5ab
		500	4.3a	5.3ab	4.5a	3.3a
		1000	4.4a	9.1d	7.6c	2.9a
		2000	5.5b	8.8d	6.5b	3.1a
BA	Spray	100	4.1a	4.3a	4.0a	4.1b
		500	4.0a	4.7ab	4.4a	3.7ab
		1000	4.4a	5.7b	4.3a	3.9ab
		2000	4.5ab	5.9b	4.8ab	4.3b
	Agrifoam	100	4.3a	4.1a	4.4a	3.0a
		500	4.0a	5.1ab	4.3a	3.6ab
		1000	4.5ab	7.3c	5.7b	3.2a
		2000	5.2b	8.0cd	6.4b	2.8a
Control	Spray	0	4.1a	4.3a	4.3a	4.0b
	Agrifoam	0	4.0a	4.1a	4.3a	3.3a

[z]Mean separation in columns by Duncan's multiple range test, 5% level.

Fig. 2. Expanded foam sprays of ethephon, PBA, and BA at 1000 and 2000 ppm applied at rose plant cutback promoted the development of the basal axillary buds.

2000 ppm frequently increased the no. of flowering shoots developing on the lower rose canes, with greater significance from foam spray treatments (Table 2). Most flowering shoots developed from the lower canes when the spray or foam spray treatments were made at cutback (Fig. 2).

The extent of the wetting period after treatment influences the level of growth regulator absorption into leaves, stems, and buds. Hield reported (5) that only half the SADH concn is needed for plant height control in a foam spray as a conventional spray, since foams break down and drain as a liquid over the covered plant parts. In the present study, no determination was made of the relative volume of growth regulator solutions retained or absorbed by the plant from the foam sprays or conventional sprays, but visual observation showed stems and axillary buds beneath foams were moist 24 hr after application. The longer period of wetting probably resulted in greater uptake accounting for the increased no of flowering shoots.

New basal shoots from axillary buds are necessary for greenhouse roses to maintain plant vigor and high flower production. Ethephon, PBA and BA foam sprays at 1000 and 2000 ppm at cutback effectively promoted basal shoots from axillary buds. No stimulation of shoots from the bud union resulted from a single foam application. Further studies are needed to determine chemicals and methods for promoting shoot development from the bud union, since these shoots have maximum vigor and allow the complete renewal of the rose canes.

Table 1. Effect of growth regulators and application method on flowering stems per rose plant, 9 weeks after cutback.

Treatment			Flowering stems per plant							
			Timing treatment to cutback							
			3 wks before		At cutback		1 wk after		3 wks after	
Growth regulator	Method of application	Concn (ppm)	bud union	canes	bud union	canes	bud union	canes	bud union	canes
Ethephon	Spray	1000	0.0	0.0	0.1	0.9	0.1	0.3	0.0	0.1
		2000	0.0	0.1	0.0	1.1	0.1	0.4	0.0	0.0
	Agrifoam	1000	0.0	0.4	0.1	1.9	0.0	0.8	0.0	0.0
		2000	0.0	2.0	0.1	4.2	0.1	1.6	0.0	0.4
PBA	Spray	100	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
		500	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0
		1000	0.1	0.4	0.0	0.7	0.0	0.2	0.0	0.0
		2000	0.0	0.8	0.1	1.3	0.8	0.4	0.0	0.1
	Agrifoam	100	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0
		500	0.0	0.0	0.8	2.7	0.1	0.8	0.0	0.8
		1000	0.2	0.4	0.1	5.1	0.1	4.7	0.0	0.6
		2000	0.3	1.8	0.4	4.4	0.3	2.1	0.0	0.4
BA	Spray	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		500	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1000	0.4	0.7	0.1	1.1	0.0	0.2	0.0	0.0
		2000	0.8	0.9	0.3	2.0	0.0	0.7	0.0	0.0
	Agrifoam	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		500	0.0	0.0	0.0	0.8	0.0	0.3	0.0	0.0
		1000	0.8	0.5	0.3	3.2	0.1	1.3	0.1	0.8
		2000	0.0	1.6	0.2	4.7	0.1	2.7	0.0	0.2
Control	Spray	0	0.0	0.0	0.0	0.3	0.1	0.2	0.0	0.1
	Agrifoam	0	0.0	0.0	0.1	0.7	0.0	0.2	0.0	0.1
	LSD 5%			0.8		1.7		1.3		0.6

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