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The activity of selected mixtures of plant growth regulators and herbicides on leafy spurge

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Regeneration of leafy spurge from viable root buds is a major problem encountered in its control. While certain herbicides have been shown to be effective in controlling shoot growth they appear to not be as effective in destroying the root systems from which new shoots can develop. Growth regulators were researched to assess their potential value for increased herbicide activity, stimulation of dormant buds and effects upon vegetative growth. Thus, requiring less herbicide and providing more efficient and inexpensive control.

The selection of plant growth regulators (PGR's) was based on the results of a previous greenhouse screening study in which the activity of selected mixtures of seven PGR's and two herbicides was evaluated.

The growth regulators were 2,4-D (2,4-dichlorophenoxyacetic acid) liquid concentrate marketed by Dow Chemical Co., glyphosate (N-(phosphonomethyl) glycine) liquid concentrate marketed as Roundup® by Monsanto Commercial Products Co., gibberlic acid (2,4a,7-trihydroxy-l-methyl-8-methylenegibb-3-ene-1,10-carboxylic acid 1-4 lactone) liquid concentrate marketed as Pro-Gibb 2% by Abbott Labs, PP333 (antigibberellin) 50% wettable powder manufactured by ICI Americas Inc., ABG-3034 a cytokinin (6-benzyladenine) 2% liquid concentrate manufactured by Abbott Labs, a mixed cytokinin liquid concentrate extracted from marine algae tissue (cytokinin as Kinetin) 0.01%, marketed as Cytex by Atlantic and Pacific Research, Inc., and NAA (1-naphthaleneacetic acid) 3.1% wettable powder marketed as Fruitone-N by Union Carbide Agricultural Products Co., Inc.

The herbicides used were dicamba (3,6-dichloro-o-anisic acid) liquid concentrate marketed as Banvel by Velsicol Chemical Co. and picloram (4-amino-3,5,6-trichloropicolinic acid) liquid concentrate marketed as Tordon 22K by Dow Chemical Co.

The experiment was a completely randomized design with two replications. Evaluations were based on height of longest shoot, number of shoots per container, visual evaluation, and shoot and root weights. None of the parameters evaluated provided any statistically significant difference between treatments. However, treatments containing gibberellin and cytokinin resulted in the greatest activity on leafy spurge growth and were selected for further study. Subsequently, an experiment to determine the activity of the selected mixtures of PGR's and herbicides on leafy spurge was conducted at the University of Wyoming Plant Science Greenhouse.

The PGR's were a gibberellic acid liquid concentrate (Pro-Gibb® 2% by Abbott Labs, Chicago, Ill.) and a cytokinin liquid concentrate (Cytex by Atlantic Pacific Research Inc., North Palm Beach, Fla.). The herbicides were picloram and dicamba.

Leafy spurge plants were established from cuttings of stock plants, which included 20mm of shoot and 30mm of root, with individual cuttings planted in containers 15.2cm in diameter by 17.8cm in height. After approximately 5 months the plants were transferred to growth chambers with conditions set for 14 hours of day light at 27º C and 10 hours of dark at 10º C with a relative humidity of approximately 40%.

The experiment was a randomized complete block design with five replications. Treatments were applied on January 15, 1983 with a band operated spray atomizer. A fine mist spray with premeasured solutions of growth regulators and herbicides were applied singularly and in combination at the desired rates. The herbicides were applied at less than normal rates to observe any increased activity caused by the PCR's. Immediately prior to treatment the height of the main shoot and number of shoot per container were recorded, for comparison of these factors at the conclusion of the experiment.

The experiment was concluded on March 4, 1983 (49 days following treatment) and evaluated with respect to the following parameters: 1) The number of buds on the crown; 2) the number of buds per cm of root, which was determined by taking counts on the primary roots and dividing by the root length; 3) a visual evaluation with 1 indicating no visual damage and 5 indicating a completely dead plant; 4) difference in plant height from time of treatment to time of evaluation; 5) difference in the number of shoots per container from time of treatment to time of evaluation, 6) length of the longest primary root; 7) weight of oven dried shoots; and 8) weight of oven dried roots (Table 1).

Evaluation of the data indicate cytokinin significantly increased the number of crown buds when compared to the check. Whereas, gibberellin, gibberellin + picloram, and cytokinin + picloram, significantly decreased the number of crown buds.

With the exception of treatments where gibberellin and cytokinin were applied alone all treatments exhibited some visual herbicide damaged such as yellowing and twisting of stems and leaves, with the cytokinin + picloram treatment resulting in the greatest visual damage. At the time of the evaluation no plants were completely dead.

Treatments providing a significant increase in plant height were gibberellin, and cytokinin. Cytokinin + picloram was the only treatment that significantly reduced plant height when compared to the untreated plants.

Treatments resulting in the greatest significant decrease in shoot weight were gibberellin + picloram and cytokinin + picloram. None of the treatments significantly increased shoot weight.

Parameters with no significant difference for treatments when compared to the check include the number of buds per cm of root, root length and weight, and difference in shoot number.

Although cytokinin and gibberellin did increase the activity of the herbicides, especially picloram, in reducing shoot weight and top growth they did not aid in reducing root growth and had no significant effect on the number of root buds. Results of this data would indicate cytokinin and gibberellin are ineffective in aiding picloram and dicamba in controlling regeneration of leafy spurge from viable root buds.

Table 1

Treatment	Rate		Number of Crown Buds	Number of Buds per cm of root	Visual Evaluation	Difference in Plant Height cm	Difference in Shoot number	Root Length cm	Shoot weight grams	Root weight grams
Gibberellin	3 g/A		7.0	0.6	1.0	16	0.6	57	1.5	2.4
"	6		10.5	0.6	1.0	18	1.0	55	1.6	3.2
"	12		7.0	0.4	1.0	18	1.8	50	2.0	4.3
Gibberellin + picloram	3	+ 0.125 lb/A	8.5	0.6	2.4	9	3.0	61	0.7	2.5
"	6	+ 0.125 lb/A	6.0	0.6	3.2	5	5.0	61	0.9	2.7
"	12	+ 0.125 lb/A	5.5	0.4	2.6	6	1.0	62	0.7	2.1
Gibberellin + dicamba	3	+ 0.5 lb/A	7.8	0.5	2.0	16	0.4	61	1.3	2.6
"	6	+ 0.5 lb/A	9.8	0.5	2.0	13	0.6	60	1.3	2.9
"	12	+ 0.5 lb/A	12.5	0.6	2.0	16	0.6	49	1.3	3.2
Cytokinin	1 gal/A		12.5	0.6	1.0	17	0.2	63	1.2	2.9
"	2 gal/A		16.3	0.5	1.2	16	0.8	49	1.8	2.8
"	4 gal/A		14.5	0.6	1.2	12	0.8	51	1.1	2.5
Cytokinin + Picloram	1 gal/A	+ 0.125 lb/A	6.5	0.3	2.4	4	-0.2	64	0.8	2.4
"	2 gal/A +	+ 0.125 lb/A	7.0	0.7	3.4	7	1.4	55	0.6	2.3
"	4 gal/A +	+ 0.125 lb/A	9.0	0.7	3.6	3	2.8	46	0.6	2.5
Cytokinin + dicamba	1 gal/A + 0.5 lb/A		11.8	0.4	2.2	15	0.0	55	1.2	3.5
"	2 gal/A +		9.3	0.5	2.2	9	4.0	56	1.0	2.4
"	4 gal/A +		8.5	0.6	2.4	11	-0.4	51	1.5	2.3
Picloram	0.125 lb/A		7.3	0.4	3.0	8	0.4	54	1.0	2.9
Dicamba	0.5 lb/A		9.8	0.5	2.4	9	1.4	61	1.2	4.1
Check	---		11.5	0.8	1.0	10	0.0	49	1.6	3.3
LSD (0.05)			4.4		0.62	6.96			0.6	
C.V. %			33	51	24	49	205	32	39	49

Values are the mean of five replications except for number of crown buds which is the mean of four replications.

[2]1 - no damage; 5 - dead.