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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. It is hoped that such research will lead to the discovery of a growth regulator that will effectively control Leafy spurge by itself or have a synergistic effect when used in combination with an herbicide, thus providing more effective and inexpensive control.

An initial growth regulator screening study was conducted at the University of Wyoming Plant Science greenhouse in order to select growth regulators that showed activity on leafy spurge.

The growth regulators used in the initial screening study were 2,4-D amine, applied at rates of 1/16 lb. a.i., 1/8 lb. a.i., and 1/4 lb. a.i. per acre; Fruitone-N (1-naphthaleneacetic acid) applied at rates of 3, 6, and 12 grams a.i./A; ABG-3034 a cytokinin applied at rates of 3, 6, and 12 grams/A; Roundup (glyphosate) applied at rates of 1/32 lb. a.i., 1/16 lb. a.i., and 1/8 lb. a.i. per acre; PP333 an antigibberellin applied at rates of 3, 6, and 12 grams a.i./A; Cytex, a mixed cytokinin liquid concentrate extracted from marine algae tissue, applied at rates of 1, 2, 4, gallons a.i. per acre; and Pro-Gibb (gibberellic acid) applied at rates of 3, 6 and 12 grams a.i./A.

The herbicides used in the initial screening study were Banvel (dicamba) applied at a rate of 1.0 lb. a.i. per acre and Tordon (picloram) applied at a rate of 0.25 lb. a.i. per acre.

Leafy spurge plants were established from cuttings of stock plants, which included 20 mm of shoot and 30 mm of root, with individual cuttings planted in containers 6 inches in diameter by 7 inches in height. The plants were grown in a greenhouse at a temperature of 22 degrees C and were watered once daily. Growth to 8 inches took approximately 4 months at which time the plants were treated.

The experiment was a completely randomized design with two replications. Treatments were applied with a hand operated spray atomizer. A fine mist spray with pre-measured solutions of growth regulators and herbicides were applied singularly and in combination of the desired rates on June 12, 1982. The treatments were first evaluated on August 11, 1982, 60 days after treatment, with the evaluations-based on visual damage and fresh weight of the shoots. The visual evaluation showed a highly significant difference between treatments, with the Pro-Gibb + picloram treatment showing the greatest activity. There were no significant differences between treatments based on the fresh weight of the shoots. However, the treatment with the lowest shoot weight was picloram applied by itself at 0.25 lb. a.i./A.

After the first evaluation the spurge plants were allowed to regrow for 58 days and were evaluated on October 8, 1982, 118 days after the start of the experiment. The final evaluation was based on the height of the longest shoot, number of shoots per container, visual evaluation, shoot weight, and root weight. A statistical analysis showed no significant differences between treatments for any of the evaluations. However, treatments containing gibberellin and cytokinin resulted in the greatest activity on Leafy spurge growth and were selected for further study.

The growth regulators selected for additional study were Pro-Gibb (gibberellic acid) which was applied at rates of 3, 6, and 12 grams a.i./A and Cytex (mixed cytokinins) applied at rates of 1, 2 and 4 gallons/A.

The herbicides used were Tordon at a rate of 1/8 lb. a.i./A and Banvel applied at a rate of 0.5 lb. a.i./A. As in the previous screening study herbicides were applied at less than normal rates to observe any increased activity caused by the growth regulators.

Leafy spurge plants were established as in the earlier screening study. However, after approximately 5 months of growth in the greenhouse they were transferred to growth chambers with conditions set at 14 hours of daylight at 27° C and 10 hours of dark at 10° C, with an average relative humidity of approximately 40 percent. Plants were moved from the greenhouse to the growth chambers in order to stimulate growth and stabilize growth conditions. The experiment involving growth regulators selected from the previous screening study was a randomized complete block design with five replications. Treatments were applied on January 15, 1983 with a hand operated spray atomizer in the same fashion as for the previous screening study. Immediately prior to treatment the height of the main shoot and number of shoots per container were recorded, for comparison 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) a visual evaluation with 1 indicating no damage and 5 indicating a completely dead plant;
- 3) difference in plant height from time of treatment to time of evaluation;
- 4) weight of shoots dried at 60° C;
- 5) the number of buds per cm of root, which was determined by taking counts on the primary roots and dividing by the root length;

- 6) length of the longest primary root;
- 7) weight of the roots dried at 60° C;
- 8) and the difference in the number of shoots per container from time of treatment to time of evaluation.

Evaluation of the data indicate cytokinin at 2 gal/A significantly increased the number of crown buds when compared to the check. Whereas, gibberellin at 3 and 6 grams/A, gibberellin at 6 and 12 grams/A + picloram at 0.125 lb/A and cytokinin at 1 and 2 gal/A + picloram at 0.125 lb/A significantly decreased the number of crown buds when compared to the check. However, when the treatments containing growth regulators + picloram were compared to picloram alone there was no significant decrease in the number of crown buds.

With the exception of treatments where gibberellin and cytokinin were applied alone all treatments exhibited significant visual damage such as yellowing and twisting of stems and leaves, with the cytokinin at 4 gal/A + picloram showing the greatest visual damage than picloram applied alone at 0.125 lb. a.i./A. At the time of the evaluation no plants were completely dead.

Treatments showing a significant increase in plant height were gibberellin at 6 and 12 g/A and cytokinin at 1 gal/A. Cytokinin at 4 gal/A + picloram was the only treatment that significantly reduced plant height when compared to the check. Once again, however, it did not significantly reduce plant height when compared to picloram alone.

Treatments resulting in a significant decrease in shoot weight were gibberellin at 3, 6, and 12 grams/A + picloram with cytokinin at 1, 2, and 4 gal /A + picloram showing the greatest significant difference when compared to the check. None of the treatments significantly increased shoot weight. As before, the treatments did not significantly decrease shoot weight when compared to picloram applied alone.

The treatment showing the greatest reduction in the number of buds/cm of root was cytokinin at 1 gal/A + picloram. However, due to the wide variation of the number of buds/cm of root within treatments the reduction was not significant from any other treatment.

There were no significant differences between treatments for root length.

There were also no significant differences between treatments for root weight.

Although there was a wide difference in the number of shoots between treatments these differences were not significant due to the wide variation of shoot numbers within treatments.

Although cytokinin and gibberellin did increase the activity of the herbicides, especially picloram, in reducing shoot weight and vegetative growth they did not aid in reducing root growth and had no significant effect on the number of root buds. Even in the treatments where the growth regulators did increase the activity of the herbicides the increase was not significantly better than where the herbicides were used alone.

Results of these data would indicate Cytex (mixed cytokinins) and Pro-Gibb (gibberellic acid) are ineffective in aiding picloram and dicamba in controlling regeneration of Leafy spurge from viable root buds when used at the rates evaluated.