TECHNICAL NOTES

Influence of Ethrel on Phenological Development in Honey Mesquite

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Highlight: *The influence of ethrel on the phenological development of mature honey mesquite (*Prosopis glandulosa *var.* glandulosa*) was studied from February 15, 1971, through May 8, 1972. Ethrel (250 ppm) applied in aqueous solution in winter or early spring of 1972 decreased flower production during the spring, 1972. Ethrel applied as a pretreatment, therefore, could be quite important in relation to chemical control of honey mesquite since herbicidal mesquite kills are inversely proportional to flower production. Ethrel did not affect any other phenological event nor did it exhibit any ability to synchronize the phenological events in honey mesquite.*

Ethylene is a naturally occurring plant growth regulator used by horticulturists and pomologists for several years to synchronize phenological events in various plants. It has often been used to synchronize and accelerate fruit ripening in many plants (Burg and Burg, 1967; Burg, 1965; Edgerton and Blanpied, 1968; Russo, Dostal, and Leopold, 1968; Anderson, 1969; Byers, Dostal, and Emerson, 1969; and Crane, Marei, and Nelson, 1970). Flower production was induced in Cayenne pineapple (*Ananas sativas* var. Cayenne) plants when they were sprayed with 2-chloroethanephosphonic acid (Cooke and Randall, 1968). Taun and Bonner (1964) reported dormancy in potato tuber buds could be broken by ethylene. Rhizome development was stimulated in Johnsongrass (*Sorghum halepense*) and quackgrass (*Agropyron repens*) when treated with 2-chloroethylphosphonic acid (Anonymous, 1969). Moir (1970) reported that ethylene has been used to stimulate latex production in rubber trees (*Hevea brasiliensis*).

The lack of effective herbicidal control of honey mesquite (*Prosopis glandulosa* var. *glandulosa*) partially results from 1) the stage of development of the trees, 2) the diversity of phenological stages represented by the trees, and 3) the relative abundance of flowers present at the time of herbicide application. Mesquite has the capacity to release as many as four sets of flower buds during the growing season, depending upon environmental conditions (Greer, 1967). Consequently, at any given time during the growing season there may be an array of stages in flower production ranging from closed flower spikes to pods that are nearly mature. Morgan (1969) found that 2-chloroethanephosphonic acid applied to honey mesquite seedlings caused defoliation and, subsequently, growth of formerly inactive basal buds. Basal buds remain inactive until the top of the plant is damaged or destroyed.

This study was initiated to determine the ability of ethrel[1] (2-chloroethylphosphonic acid), an ethylene producing compound (Yang, 1969), to regulate the phenological events in honey mesquite. Specific objectives were to determine 1) the ability of ethrel to regulate bud burst and relative abundance of flowers produced and 2) the time of application and concentration of ethrel most effective in synchronizing the phenological events.

Procedures

This study was conducted on 825 permanently marked trees growing on a deep hardland site (Stegall-Slaughter Association) on the Post-Montgomery Estate ranch near Post, Texas. The experimental design consisted of 5 randomized complete blocks and 11 treatments (Table 1) applied to the trees on 15 different dates from February 1, 1971, through March 31, 1972. The trees were treated biweekly during the growing season and monthly during the remainder of the year. The trees were not treated from mid-April, 1971, until mid-August, 1971. No tree was treated more than once.

Table 1. Ethrel treatments applied on 15 different dates from February 2, 1971, through March 31, 1972, in an attempt to regulate the phenological development of honey mesquite.

Ethrel (ppm)	Carrier
0 (Control)	none
0	distilled water
0	distilled water + glycerol (10%)
50	distilled water
50	distilled water + glycerol (10%)
250	distilled water
250	distilled water + glycerol (10%)
1000	distilled water
1000	distilled water + glycerol (10%)
5000	distilled water
5000	distilled water + glycerol (10%)

At the time of ethrel application, soil temperature (6, 12, 18, and 24-inch depths), air temperature, relative humidity, and soil water content (percent) were measured. Soil water content was determined in 6-inch increments from the surface to a depth of 2 ft. The average soil water content per treatment date was determined from three gravimetric samples. The soil temperature (average from three replications per treatment date) was determined by inserting a glass laboratory thermometer into a 3/8-inch hole to the desire depth.

The phenological development and abundance of flowers were recorded at the time of ethrel application. The total reproductive potential of each marked tree was estimated. Leaf and flower production were estimated as a percent of the total reproductive potential of each tree. Although absolute values could not be ascertained, this subjective rating with relative values provided a way to avoid

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The report is College of Agricultural Sciences Publication Number T-9-120, Texas Tech University.

The authors wish to gratefully acknowledge the cooperation of Post-Montgomery Estate and Amchem Products, Inc. We wish to thank Mr. Robert Wadley, computer programmer, for his assistance in analyzing the data for this study.

Manuscript received April 9, 1973.

[1] Ethrel—Amchem 66-329 [2 lb ethrel A.E./gal. (alcohol base) water soluble]. Use of trade names does not constitute endorsement by either the authors or Texas Tech University but is for the convenience of the reader.

wordy descriptions that were less meaningful. These measurements were made weekly April 13 through August 31, 1971; monthly in mid-September and mid-October, 1971; and biweekly April 13 through May 10, 1972. No visible signs of bud activity could be detected during the dormant period. Therefore, phenological development was not recorded from November 1, 1971, through March 30, 1972.

Results and Discussion

Application of ethrel had no influence on the relative number of buds released from dormancy nor leaf development of honey mesquite. However, it was influential in regulating flower development.

Abundance of flowers has been shown by Dahl et al. (1971) to be second in importance to soil temperature in influencing mesquite control with 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T). Root kills did not exceed 12% on sites where flower production per tree exceeded 17%. Although no significant differences were detected among concentrations of ethrel, the greatest percentage of trees with the least amount of flower production in the spring, 1972, occurred when the trees were treated with 250 ppm ethrel applied in aqueous solution between January 15 and March 31, 1972 (Table 2). Leaves and flower spikes of honey mesquite growing on a deep hardland site within the vicinity of the study area usually emerge from dormancy about mid-April. Therefore, chemical control of honey mesquite could possibly be enhanced with a pretreatment of ethrel (250 ppm) applied during the early stages of bud burst.

Table 2. Honey mesquite trees (%) within the various ethrel treatments that produced less than 20% flowers during the spring, 1972. The trees were treated between January 15, 1972, and March 31, 1972.

Treatment	May 8, 1972
Control	48[1]
0 ppm ethrel + water	44
0 ppm ethrel + water + glycerol (10%)	40
50 ppm ethrel + water	56
50 ppm ethrel + water + glycerol (10%)	52
250 ppm ethrel + water	84
250 ppm ethrel + water + glycerol (10%)	44
1000 ppm ethrel + water	32
1000 ppm ethrel + water + glycerol (10%)	68
5000 ppm ethrel + water	48
5000 ppm ethrel + water + glycerol (10%)	72

[1]There were no significant differences (0.05 level) among any of the treatment means.

Increased gumosis was observed on the outer surface of the bark of trees that had been top killed or defoliated by application of high concentrations of ethrel (5000 ppm). The aerial portion of trees exhibiting gumosis were killed. Resultant basal sprouting followed injury to the aerial portions of the honey mesquite trees. However, ethrel had no influence on basal sprouting of the trees that were not top-killed.

Honey mesquite is well adapted to the semiarid regions of the southwest United States. The ability to release more than one set of buds from dormancy in a growing season allows the trees to survive and successfully reproduce under very dry conditions, although one or more sets of buds may be damaged by the dry conditions. Consequently it is difficult to alter this survival mechanism and ethrel did not exhibit any ability to synchronize the phenological events.

The environmental parameters measured at the time of treatment did not significantly influence the effects of ethrel obtained in this study with the exception of the influence of soil water on those trees treated on May 10, 1971. Seemingly, bud set occurs during the spring 1 year prior to their expression. Significantly fewer buds of trees growing under relatively wet soil conditions broke dormancy the following spring, consequently, fewer flowers were produced. Possibly the energy fixed by these trees was used in foliage production, whereas under dry soil conditions, the available energy was used in flower bud development, insuring perpetuation of the population. This phenomenon deserves further study.

Summary and Conclusions

Ethrel exhibited only limited influence on the phenological events in mature honey mesquite trees. Although honey mesquite has the capacity to release as many as four sets of buds from dormancy in any given growing season, ethrel did not exhibit any ability to synchronize this development. It also did not affect leaf production.

However, ethrel was influential in regulating flower production. In relation to chemical control of honey mesquite, regulation of flower production perhaps could be the most important effect of ethrel. Honey mesquite trees that produce few flowers seemingly are easier to control with herbicides than trees that produce many flowers. Results of this study indicated that more trees sprayed with 250 ppm ethrel (aqueous solution) in the winter or early spring of 1972 produced fewer flowers in 1972 than trees sprayed at any other time during this study.

Honey mesquite is well adapted to its environment, consequently significant alteration of the natural sequence of phenological events in mature trees is very difficult.

Literature Cited

Anderson, J. L. 1969. The effect of ethrel on the ripening of Montmorency sour cherries. Hort. Sci. 4:92-93.

Anonymous. 1969. Ethrel. Amchem Products, Inc., Tech. Data Sheet H-96. 64 p.

Burg, Stanley P. 1965. Relationship between ethylene production and ripening in bananas. Bot. Gaz. 126:200-204.

Burg, Stanley P., and Ellen A. Burg. 1967. Molecular requirements for the biological activity of ethylene. Plant Physiol. 42:144-152.

Byers, Ross E., H. C. Dostal, and F. H. Emerson. 1969. Regulation of fruit growth with 2-chloroethanephosphonic acid. BioScience. 19:903-904.

Cooke, Anson R., and David I. Randall. 1968. 2-Haloethanephosphonic acids as ethylene releasing agents for the induction of flowering in pineapples. Nature 218:974-975.

Crane, Julian C., Nosr Marei, and M. M. Nelson. 1970. Growth and maturation of fig fruits stimulated by 2-chloroethylphosphonic acid. J. Amer. Soc. Hort. Sci. 95:367-370.

Dahl, B. E., Ronald E. Sosebee, and John P. Goen. 1971. Soil temperatures influence on mesquite control, p. 8. *In* Noxious Brush and Weed Control Research Highlights. ICASALS Spec. Rep. No. 51.

Edgerton, L. J., and G. D. Blanpied. 1968. Regulation of growth and fruit maturation with 2-chloroethanephosphonic acid. Nature 219:1064-1065.

Greer, Howard A. L. 1967. Mesquite control in Oklahoma. Oklahoma State Univ., Extension Facts No. 2760.

Moir, G. F. J. 1970. A radical approach to exploitation. Rubber Res. Inst. Malaysia. Planters' Conf. Preprint D-1. 8 p.

Morgan, Page W., Robert E. Meyer, and Morris G. Merkle. 1969. Chemical stimulation of ethylene and bud growth. Weeds 17:353-355.

Russo, Louis, Jr., H. C. Dostal, and A. C. Leopold. 1968. Chemical regulation of fruit ripening. BioScience 18:109.

Taun, Dorothy Y., and James Bonner. 1964. Dormancy associated with repression of genetic activity. Plant Physiol. 39:768-772.

Yang, S. F. 1969. Ethylene evolution from 2-chloroethylphosphonic acid. Plant Physiol. 44:1203-1204.