Phenology and Control of Common Broomweed on Texas Rangelands¹

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Highlight

Common broomweed (*Gutierrezia dracunculoides* (DC.) Blake) were effectively controlled with 2,4-D at 0.125, 0.25 or 0.5 lb./acre applied during stem elongation around May 15. The same rates of 2,4-D were less effective when applied in early April prior to complete emergence of the common broomweed seedlings or in mid-June after initiation of floral branches. Picloram combined with 2,4-D at 0.063, 0.125 or 0.25 lb./acre of each herbicide controlled 94 to 100% of the common broomweed population regardless of application date. Dicamba was more effective when applied in early spring than were equal rates of 2,4-D. Control of common broomweed from applications of picloram or dicamba in early April was attributed to residual herbicide activity on seedlings germinated subsequent to treatment. However, no treatment prevented germination and establishment of common broomweed in the fall following application of herbicides in the spring.

Common broomweed (*Gutierrezia dracunculoides* (DC.) Blake), an annual composite, occurs in grasslands from northern Kansas to the Gulf Coast and from western New Mexico to central

Iowa (Anonymous, 1970). Common broomweed reproduces from pubescent achenes, 1 to 1.5 mm long and 0.25 to 0.5 mm at their widest point. The upper half of the single-stemmed plant is much-branched and produces 5 to 10 small, yellow ray flowers per branch. Depending on site conditions common broomweed may grow from 5 to 10 dm tall. It is not toxic to livestock and is grazed by sheep and goats. However, cattle apparently do not utilize it to a great extent.

Common broomweed can become a serious problem where overgrazing or drought reduces the grass cover on ranges. It invades most Texas rangelands with no observable preferences as to soil type. Efforts to control common broomweed with herbicides on semiarid rangelands have met with varying degrees of success. Since data on common broomweed have not been available, most control methods have evolved from ranchers' experience. Research on other herbaceous broadleaved weeds in grasslands such as musk thistle (*Carduus nutans* L.) (Feldman et al., 1968) and scotch thistle (*Onopordum acanthium* L.) (Young and Evans, 1969) has shown that the stage of plant development influences susceptibility to herbicides. Little data are available on phenology of common broomweed and the interrelation of growth stage with its susceptibility to herbicides. The objective of this study was to investigate the possible interaction of phenological development with susceptibility of common broomweed to several herbicides.

Materials and Methods

Experiments were established in 1969 on a tobosagrass (*Hilaria mutica* (Buckl.) Benth.)-buffalograss (*Buchloe dactyloides* (Nutt.) Engelm.) range near Spur, Texas to evaluate several herbicides and herbicide combinations for the control of common broomweed. An upland site was selected near College Station for similar studies in 1970. The range was occupied by scattered little bluestem (*Andropogon scoparius* Michx.) plants, but most of the cover was composed of an-

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nual grasses such as annual dropseed (*Sporobolus neglectus* Nash) and little barley (*Hordeum pusillum* Nutt.). A dense, uniform stand of common broomweed existed at both locations.

Herbicides were applied to overwintered seedlings during stem elongation or after the common broomweed initiated formation of floral branches. The herbicides were applied to 7 by 25-ft plots with hand sprayers at Spur and each treatment was replicated 4 times. The treatments were applied in triplicate to 17 by 75-ft plots with a truck sprayer near College Station.

The studies were designed as randomized complete blocks arranged in split plots. Dates of treatment, corresponding to the various phenological stages of common broomweed, served as main plots and herbicide treatment as subplots. Herbicides and rates applied in 10 gpa water at both locations were (2,4-dichlorophenoxy)acetic acid (2,4-D) at 0.125, 0.25 and 0.5 lb./acre, 4-amino-3,5,6-trichloropicolinic acid (picloram) combined with 2,4-D at 0.125 and 0.25 lb./acre of each herbicide and 3,6-dichloro-*o*-anisic acid (dicamba) at 0.125, 0.25 and 0.5 lb./acre. Additional treatments at Spur included (2,4,5-trichlorophenoxy)acetic acid (2,4,5-T) at 0.125, 0.25 and 0.5 lb./acre, 2,4,5-T combined with picloram at 0.125, 0.25 and 0.5 lb./acre of each herbicide and 2,4,5-T combined with dicamba at 0.25 lb./acre of each herbicide. Additional treatments at College Station included 2,4-D at 1 lb./acre, picloram at 0.125, 0.25 and 0.5 lb./acre, picloram combined with 2,4-D at 0.063 lb./acre of each herbicide and dicamba combined with 2,4-D at 0.063, 0.125 and 0.25 lb./acre of each herbicide.

The experiments were evaluated on July 1, 1969 and on August 28, 1970 at Spur and on August 24, 1970 at College Station by recording the number of live common broomweed plants in two, 2 by 4-ft sampling areas per plot. The plots at both locations were observed in late September or early October for emergence of common broomweed seedlings following fall rains.

Analyses of variance were conducted after adding 1 to the density in each sample and converting each sum to its logarithm. This transformation is suggested by Steel and Torrie (1960) for analysis of positive integers which cover a wide numerical range. The data are presented as percent reduction in number of live plants in the treated plots as compared to the appropriate untreated plots.

Common broomweed in untreated plots and outside the experimental area were used for phenological measurements. At approximately two week intervals, phenological stage, height and number of leaves were recorded for common broomweed in these areas. Similar observations were recorded periodically across Texas from Spur to College Station from 1968 to 1970 to substantiate data from the experimental areas.

Results and Discussion

Average dates for sequential phenological stages were surprisingly similar between the research locations during the study period. Differences in growth rate or phenological development of common broomweed were not noted in the subhumid area as compared to the semiarid site near Spur. By mid-March, common broomweed seedlings had emerged at both study locations (Fig. 1). Most seedlings were found in protected areas such as at the base of established grass plants. Rate of seed-

FIG. 1. Generalized height growth curve and phenological activities for common broomweed from March to October during 1968 to 1970 from College Station to Spur, Texas.

ling emergence began to decline by mid-May at both locations. Also present in early March were overwintered plants, about .1 dm in height, with 2 to 3 true leaves. These plants occurred as the result of fall germination. Since a rosette is defined as a "basal cluster of leaves produced on a very short stem" (Porter, 1959), the overwintering stage of common broomweed is often referred to as the rosette. However, since a central stem with discernible internodes was readily apparent, common broomweed germinated in the fall will be referred to as "overwintered seedlings" in this paper. By April 1, the stems of some plants were rapidly elongating but most were still in the seedling stage. The few plants with stem growth were .15 to .3 dm tall and had 4 to 6 well expanded leaves. Stem elongation was initiated in the entire population by May 1, and growth was rapid to the last week in May. On May 15, the common broomweed were 1 to 1.5 dm tall and were readily visible in the associated vegetation. Floral branches were evident near the stem terminal by June 1. The plants ranged from 3 to 5 dm tall. On most plants, all floral branches were formed by June 15. Floral buds were fully formed by the first week in July. Some flowering occurred from July 15 to September 1, but peak flower production occurred in September and October.

There was not a significant difference between study locations or years in the reaction of common broomweed to herbicides in this study. Common broomweed were most susceptible to herbicides

Table 1. Average reduction (%) in number of live common broomweed plants after treatment at various stages of growth with several herbicides and herbicide combinations near Spur and College Station, Texas in 1969 and 1970, respectively.¹

Time of treatment		Study location ²	
Phenological stage	Date	Spur	College Station
Seedling	April 1	80 ab	83 a
Stem elongation	May 15	92 a	90 a
Floral branching	June 15	72 b	50 b

¹ Plots were evaluated in late August at both locations.

² Means within a location followed by the same letter are not significantly different at the 5% level.

during stem elongation at both locations (Table 1). The average reduction in number of live plants by herbicides was less after the onset of floral branching. In most cases, spraying older plants caused typical reactions to herbicides such as epinasty but did not prevent achene production.

No reduction in common broomweed stand in late summer and fall resulted from spraying with 0.125 lb./acre of 2,4-D on April 1 (Table 2). This was due to germination subsequent to 2,4-D application. Increasing the 2,4-D rate from 0.125 to 0.25 or 0.5 lb./acre increased the percentage of common broomweed seedlings controlled. Regardless of 2,4-D rate, there was a trend towards increasing the control of common broomweed at initiation and elongation of the central stem. However, there was a reduction in percentage of common broomweed killed at all rates of 2,4-D if treatment was delayed until formation of floral branches. Control levels of common broomweed from applications of 2,4,5-T near Spur were similar to those obtained with equal rates of 2,4-D at the same dates.

Applications of dicamba at 0.125, 0.25 or 0.5 lb./acre on April 1 resulted in reductions of 99 to 100% in the number of live common broomweed (Table 3). As compared to the results from early 2,4-D

Table 2. Average reduction (%) in number of live common broomweed plants after treatment at various growth stages with three rates (lb./acre) of 2,4-D near Spur, Texas in 1969 and near College Station in 1970.¹

Time of treatment		2,4-D rate ²		
Phenological stage	Date	0.125	0.25	0.5
Seedling	April 1	0 a	51 c	84 de
Stem elongation	May 15	77 d	90 ef	98 f
Floral branching	June 15	37 b	53 c	50 c

¹ Plots were evaluated in late August at both locations.

² Means followed by the same letter are not significantly different at the 5% level. Means for control plots are "0 a."

Table 3. Average reduction (%) in number of live common broomweed plants after treatment at various stages with three rates (lb./acre) of dicamba near Spur, Texas in 1969 and near College Station in 1970.¹

Time of treatment		Dicamba rate ²		
Phenological stage	Date	0.125	0.25	0.5
Seedling	April 1	100 e	99 e	100 e
Stem elongation	May 15	84 d	94 de	98 e
Floral branching	June 15	33 b	49 c	95 e

¹ Plots were evaluated in late August at both locations.

² Means followed by the same letter are not significantly different at the 5% level. Means for control plots are "0 a."

applications, residual dicamba evidently attributed to increased effectiveness by controlling seedlings germinated after treatment. However, there was a trend for reduced control with plant age using dicamba except where 0.5 lb./acre was applied. A combination of dicamba at 0.25 lb./acre with 0.25 lb./acre of 2,4,5-T or with 0.25 lb./acre of 2,4-D did not significantly increase common broomweed control regardless of stage of growth as compared to 0.5 lb./acre of dicamba applied alone. A combination of 0.063 lb./acre of dicamba with 0.063 lb./acre of 2,4-D was not significantly different from 0.125 lb./acre of 2,4-D applied alone to common broomweed in the various growth stages.

Combinations of picloram with 2,4-D controlled 94 to 100% of the common broomweed regardless of herbicide rate or stage of plant growth when treated (Table 4). At Spur, 0.125 lb./acre of 2,4-D plus 0.125 lb./acre of picloram applied April 1 reduced the number of live plants 88% by the time of evaluation in late summer as compared to untreated plots. However, complete control was obtained with a mixture of 0.25 lb./acre of each herbicide at all stages of common broomweed growth near Spur. The same rates of 2,4-D and picloram in combination gave 100% common

Table 4. Average reduction (%) in number of live common broomweed plants after treatment with 2,4-D plus picloram at 0.125 or 0.25 lb./acre of each herbicide after application to various growth stages near Spur, Texas in 1969 and near College Station in 1970.

Herbicide rate ¹	Phenological stage when sprayed ²		
	Seedling (April 1)	Stem elongation (May 15)	Floral branching (June 15)
0.25	94 b	100 c	100 c
0.5	100 c	100 c	100 c

¹ Represents a 1:1 mixture of 2,4-D plus picloram. Plots were evaluated in late August at both locations.

² Means followed by the same letter are not significantly different at the 5% level. Means for control plots are "0 a."

broomweed control at College Station except where sprays were applied to plants during initiation of floral branching. The control from early application of picloram, as with dicamba, was possibly the result of root uptake as well as foliar absorption.

Picloram applied alone at 0.125, 0.25 and 0.5 lb./acre was no more effective than equal rates of picloram combined with 2,4-D or 2,4,5-T at a 1:1 ratio. Picloram applied alone gave complete common broomweed control except in plots treated April 1 where 0.125 lb./acre reduced the population to 75% of untreated plots.

Much of the spraying for brush control on rangelands is accomplished from May 15 to June 15. When herbicides such as 2,4-D and 2,4,5-T are utilized at the earlier date, these data indicate that control of common broomweed could be expected

as concomitant benefit. Herbicides with residual activity may be used effectively if the common broomweed population is not completely emerged.

Literature Cited

- ANONYMOUS. 1970. Selected weeds of the United States. U. S. Dep. Agr. Handbook 336. 463 p.
- FELDMAN, I., M. K. McCARTY, AND C. J. SCIFRES. 1968. Ecological and control studies of musk thistle. *Weed Sci.* 16:1-3.
- PORTER, C. L. 1959. Taxonomy of flowering plants. W. H. Freeman and Co., San Francisco. 452 p.
- STEEL, ROBERT G. D., AND JAMES H. TORRIE. 1960. Principles and procedures of statistics. McGraw-Hill Co., Inc., New York. 481 p.
- YOUNG, J. A., AND R. A. EVANS. 1969. Control and ecological studies of scotch thistle. *Weed Sci.* 17:60-62.