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Control of Buttercup in Dallisgrass-Clover Pastures in Alabama

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Information contained herein is available to all without regard to race, color, or national origin.

Control of Buttercup in Dallisgrass-Clover Pastures in Alabama

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WEEDS IN PASTURES compete with forages for nutrients and sunlight thereby decreasing the production of desirable forage plants. Animals may also be forced to graze selectively and expend more energy obtaining forage.

There are at least 19 species of "buttercup" *(Ranunculus spp.)* found in the Southeastern United States (12). Two species, *R. abortivus* L. and *R. sardous* Crantz, occur in the pastures of the Black Belt region of central Alabama. These weeds are winter annuals and therefore compete with white clover in dallisgrass-white clover *(Paspalum dilatatum* Poir. and *Trifolium repens* L.) mixtures at a time when forage production is critical.

Several *Ranunculus* species are reported to cause livestock poisoning (3, 4, 5, 11). Although actual feeding trials have not indicated that these plants are poisonous, a toxic irritant, ranunculin, has been isolated from *Ranunculus* plants (2, 6, 7, 9).

Ranunculus abortivus and *Ranunculus sardous* are winter annuals, usually 6 to 25 inches tall, with kidney shaped basal leaves and stem leaves divided into three segments. Flowers are yellow, while the mature seeds are brownish. *R. abortivus* seed are somewhat flattened with a slight beak or protrusion (12). *R. sardous* seed are round with a rim extending around the seed, and covered with small wart-like protrusions.

Ranunculus sardous is controlled by MCPA (see Appendix table 1 for chemical names), MCPB, 2,4-D, or combinations of these (1).

It is difficult to control buttercup in dallisgrass-white clover pastures without damaging the white clover, which is injured by phenoxy-type herbicides. The objectives of the studies reported herein were to determine the effectiveness of selected herbicides in control of buttercup and the tolerance of white clover to these herbicides.

EXPERIMENTAL PROCEDURES

Field Experiments

Experiments were conducted at the Black Belt Substation, Marion Junction, Alabama, in 1970, 1971, 1975, and 1976 to determine the effectiveness

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of herbicides for the control of buttercup. A randomized complete block design with four replications was used in all experiments. Treatments were applied to an established pasture that was heavily infested with buttercup. Other species present included dallisgrass, white clover, primrose, and johnsongrass. Herbicides were applied broadcast in 15 to 25 gallons of water per acre with either a hand or tractor mounted sprayer. Plots were 5 x 25 feet in 1970 and 1971 and 12 x 20 feet in 1975 and 1976. Surfactant WK® was added to all spray mixtures at 0.5% v/v.

Experiments were also conducted on the same area to determine the optimum herbicide application date for control of buttercup. An experimental design similar to that described above was used. Treatments were evaluated by ratings and plant counts.

Greenhouse Experiments

Experiments were conducted in the greenhouse to determine the tolerance of established Regal-Ladino white clover to different formulations and rates of 2,4-D. Clover was grown in 8-inch pots in a conventional greenhouse potting mixture. Herbicides were applied as described for field experiments except that a conveyor belt sprayer was used. Dry matter yield of clover was used as an indicator of the effect of the herbicide. Plants were harvested 28 days after treatment and at 2-week intervals thereafter for a total of three harvests.

Laboratory Experiments

Hand-harvested *Ranunculus* seed were used to determine the conditions necessary for germination. The influence of mechanical scarification, temperature and germination medium was evaluated. Mechanical scarification consisted of mechanically scarifying seed for different periods of time. Temperatures were established in controlled cabinets ranging from 50 to 73°F and germination medium was either water or KNO_3 water solution.

Experiments were conducted in petri dishes using 100 seed per dish. Seed were kept in darkness except when being watered (usually after 5 days) and counted. Germinated seed were counted on the seventh day and every other day thereafter, through the seventeenth day.

The effect of 2,4-D amine on the water soluble sugar content of mature buttercup was determined since 2,4-D has been shown to increase the sugar content of some plants. If this were the case with buttercup, then cattle might find the weed more palatable and consequently consume it in greater amounts. The entire above ground portion of the plant was used for analysis. The water soluble sugars were extracted by the method outlined by Smith, et al. (13) and the content was then determined by the anthrone reagent method described by Morris (10).

The protoanemonin-phenylhydrazone complex procedure outlined by Mahran, et al. (8), was used to determine the ranunculin content of the two species being studied. Plants from the Black Belt Substation and from Montgomery County, Alabama, were evaluated.

RESULTS

Results of the experiment initiated in April 1970 revealed substantial control of buttercup by the dimethyl amine salt and the butyl ester formulation of 2,4-D, table 1. These experiments indicated that essentially no control was obtained with later application when pastures were not grazed or clipped before the application of the herbicides.

In the fall 1970 and winter-spring 1971 experiments, excellent control of buttercup was obtained with application of 2,4-D amine in November or January at rates as low as 0.25 lb./A. When treatment was delayed until late March, a higher rate of 2,4-D amine was required to obtain acceptable con-

TABLE 1. CONTROL OF BUTTERCUP, BLACK BELT SUBSTATION, MARION JUNCTION, ALABAMA, 1970

Treatment	Rate/acre active ingredient	Date herbicide applied	
		April 3	April 30
Herbicide and formulation	Lb.	Pct. control	Pct. control
2,4-D, dimethyl amine salt.	0.5	78[1] abcd[2]	25 abcd
2,4-D, dimethyl amine salt.	1.0	90 abc	43 a
2,4-D, dimethyl amine salt.	2.0	95 ab	40 ab
2,4-D, butyl ester	0.5	73 abcde	30 abcd
2,4-D, butyl ester	1.0	88 abc	22 abcd
2,4-D, butyl ester	2.0	98 a	30 abcd
2,4-D, iso-octyl ester	0.5	50 de	10 bcd
2,4-D, iso-octyl ester	1.0	75 abcde	25 abcd
2,4,5-T, butyl ester	0.5	48 de	13 abcd
2,4,5-T, butyl ester	1.0	60 cde	12 bcd
2,4,5-T, oleyl diamine salt	0.5	15 fg	20 abcd
2,4,5-T, oleyl diamine salt	1.0	55 de	7 d
dicamba	0.2	10 fg	22 abcd
dicamba	0.4	35 ef	10 bcd
dicamba	0.8	48 de	32 abc
control (untreated)	–	0 g	0 d

[1]0 = no control; 100 = complete control of buttercup. Ratings made approximately 4 weeks after application.

[2]Numbers within a column followed by the same letter are not significantly different at the .01 level of probability.

TABLE 2. EFFECTIVENESS OF 2,4-D AMINE IN CONTROLLING BUTTERCUP WHEN APPLIED AT 3 DIFFERENT TIMES. BLACK BELT SUBSTATION, MARION JUNCTION, ALABAMA, 1970 AND 1971

Treatment	Rate/acre active ingredient	Date of herbicide application 13 November	29 January	31 March
Herbicide and formulation	Lb.	Pct. control	Pct. control	Pct. control
2,4-D, dimethyl amine salt.	0.25	85 1/ b 2/	100.0 a	57.5 c
2,4-D, dimethyl amine salt.	0.50	88 b	100.0 a	77.5 b
2,4-D, dimethyl amine salt.	1.00	100 a	100.0 a	90.0 a
Control (untreated).	0	0 c	0 b	0 d

1/ 0 = no control; 100 = complete control of buttercup. Ratings were made approximately 4 weeks after application.

2/ Numbers within column followed by the same letter are not significantly different at the .01 level of probability.

trol, tables 2 and 3. Control was obtained using only 0.25 lb./A. in January despite below freezing temperatures for two nights following treatment, table 4.

Results of experiments initiated in April 1975 indicated that acceptable control resulted with treatment of 2.0 lb./A. of 2,4-D amine or dicamba + 2,4-D at 0.5 + 1.5 lb./A., table 5.

Effective control of buttercup was obtained with each formulation of 2,4-D in 1976, table 6. Dicamba was ineffective even at rates as high as 1.0 lb./A. All of the above treatments were substantially more effective in 1976 than in 1975. The dicamba + 2,4-D mixture included in the 1976 experiment was highly effective at rates as low as 0.12 + 0.37 lb./A. Bentazon and metribuzin also were included as foliar treatments in 1976. Metribuzin was

TABLE 3. NUMBER OF BUTTERCUP PRESENT PER SQUARE FOOT BEFORE AND AFTER THE NOVEMBER 13 APPLICATION DATE

Treatment	Rate/acre active ingredient	Time of count	Number of plants ft^2
Herbicide and formulation	Lb.		plants/ft^2
2,4-D, dimethyl amine salt.	0.25	Before Nov., 1970	34 1/ b
		After April, 1971	2 a
2,4-D, dimethyl amine salt.	0.50	Before Nov. 1970	51 b
		After April, 1971	2 a
2,4-D, dimethyl amine salt.	1.00	Before Nov., 1970	39 b
		After April, 1971	1 a
Control (untreated).	0	Before Nov., 1970	37 b
		After April, 1971	29 b

1/ Numbers in column followed by the same letter are not significantly different at the .01 level of probability.

TABLE 4. DAILY MAXIMUM AND MINIMUM TEMPERATURES FOR 7 DAYS FOLLOWING EACH APPLICATION OF 2,4-D AMINE, BLACK BELT SUBSTATION, MARION JUNCTION, ALABAMA

Day	Nov. 13, 1970		Jan. 29, 1971		March 31, 1971	
	Max.	Min.	Max.	Min.	Max.	Min.
	°F	°F	°F	°F	°F	°F
1	57	39	55	23	74	37
2	62	42	68	31	71	42
3	58	43	73	40	71	44
4	47	30	47	23	61	33
5	48	24	43	23	68	33
6	56	25	44	27	70	38
7	69	47	54	43	59	36

ineffective at rates below 1.0 lb./A. whereas bentazon effectively controlled buttercup at rates as low as 1.0 lb./A.

Greenhouse results indicated that Regal Ladino white clover will withstand low rates of 2,4-D amine, butyl ester, and iso-octyl ester if application is delayed until after stolon development. Over all harvests, treatment with

TABLE 5. CONTROL OF BUTTERCUP WITH SELECTED HERBICIDE APPLIED MARCH 5, 1975 AND CONTROL ESTIMATES MADE APRIL 2, 1975, BLACK BELT SUBSTATION, MARION JUNCTION, ALABAMA

Treatment	Rate/acre active ingredient	Control
Herbicide and formulation	Lb.	Pct.
2,4-D dimethyl amine	0.25	0[1/] e[2/]
2,4-D dimethyl amine	0.50	3 e
2,4-D dimethyl amine	1.00	33 bc
2,4-D dimethyl amine	2.00	95 a
2,4-D iso-octyl ester	0.50	10 de
2,4-D iso-octyl ester	1.00	50 b
dicamba + 2,4-D.	0.12 + 0.37	0 e
dicamba + 2,4-D.	0.25 + 0.75	45 b
dicamba + 2,4-D.	0.50 + 1.50	85 a
dicamba + 2,4-D.	1.00 + 3.50	100 a
dicamba	0.12	0 e
dicamba	0.25	0 e
dicamba	0.50	0 e
dicamba	1.00	0 e
control (untreated)	–	0 e

1/0 = no control; 100 = complete control of buttercup.
2/Numbers within a column followed by the same letter are not significantly different at the .01 level of probability.

TABLE 6. CONTROL OF BUTTERCUP WITH SELECTED HERBICIDES, BLACK BELT SUBSTATION, MARION JUNCTION, ALABAMA, APRIL, 1976

Treatment Herbicide and formulation	Rate/acre active ingredient Lb.	Control Pct.
2,4-D, dimethyl amine	0.28	90[1] ab[2]
2,4-D, dimethyl amine	0.56	90 ab
2,4-D, dimethyl amine	1.12	93 a
2,4-D, dimethyl amine	2.24	73 abc
2,4-D, iso-octylester	0.56	88 ab
2,4-D, iso-octylester	1.12	99 a
dicamba + 2,4-D	0.12 + 0.37	100 a
dicamba + 2,4-D	0.25 + 0.75	99 a
dicamba + 2,4-D	0.50 + 1.50	100 a
dicamba + 2,4-D	1.00 + 3.50	99 a
dicamba	0.12	23 fg
dicamba	0.25	20 fg
dicamba	0.50	41 def
dicamba	1.00	56 cde
2,4-DB, amine	0.25	81 abc
2,4-DB, amine	0.50	90 ab
2,4-DB, amine	1.00	96 a
bentazon	1.00	90 ab
bentazon	2.00	90 ab
metribuzin	0.25	35 ef
metribuzin	0.50	45 f
metribuzin	1.00	65 bcd
control (untreated)	–	0 g

1/0 = no control; 100 = complete control of buttercup. Ratings were made approximately 4 weeks after application.

2/Numbers within a column followed by the same letter are not significantly different at the .01 level of probability.

0.50 lb./A. of these formulations reduced dry weight yield of white clover 30 to 40 percent, while 0.25 lb./A. of the amine formulation reduced yield 20 percent. Higher rates reduced yield more, but rates as high as 1.0 lb./A. did not destroy the stand of clover, table 7.

Germination experiments indicated that buttercup seed germinate well at temperatures of 62 to 73°F. However, since scarification of seeds was required for good germination, a hard seedcoat is indicated. This is considered to support previous work (1) indicating that application of herbicides for more than 1 year will be required to eliminate buttercup as a problem weed in pastures.

The amine formulation of 2,4-D when used at rates up to and including 1.0 lb./A. did not increase water soluble sugar content of above ground parts of the two buttercup species; therefore, no selective grazing of herbicide treated buttercup would be expected and cattle could be safely returned to

TABLE 7. YIELD OF ESTABLISHED REGAL LADINO WHITE CLOVER FOLLOWING APPLICATION OF 2,4-D

Treatment	Rate/acre active ingredient	Yield as percent of untreated control First harvest	Second harvest	Third harvest	Total yield
Herbicide and formulation	Lb.	Pct.	Pct.	Pct.	Pct.
2,4-D dimethyl amine salt . .	0.25	82 ab 1/	74 b	83 ab	80 b
2,4-D dimethyl amine salt . .	0.50	63 bcd	63 b	42 bc	61 bcd
2,4-D dimethyl amine salt . .	1.00	49 cd	37 c	25 c	44 defg
2,4-D dimethyl amine salt . .	2.00	47 cd	23 c	8 c	38 fg
2,4-D butyl ester	0.50	67 bc	83 ab	67 abc	71 bc
2,4-D butyl ester	1.00	49 cd	40 c	17 c	44 defg
2,4-D butyl ester	2.00	39 d	29 c	8 c	34 g
2,4-D iso-octyl ester	0.50	55 cd	74 b	67 abc	61 bcde
2,4-D iso-octyl ester	1.00	55 cd	63 b	50 abc	57 cdef
control (untreated)		100 a	100 a	100 a	100 a

1/Values within each column followed by the same letter are not significantly different at the .01 level of probability.

treated pastures within a few days. Also, the ranunculin compound was found only in trace amounts.

SUMMARY AND CONCLUSIONS

Both species of buttercup were controlled with selected formulations of 2,4-D, dicamba + 2,4-D, and bentazon.

Generally, the older the buttercup plants (or the later in the spring when herbicides are applied) the higher the rate of herbicide required for control. In these experiments effective control was obtained with late fall or winter application of 2,4-D amine provided there is sunshine and moderately warm (60°F) temperatures at application time. While rates of 2,4-D as low as 0.25 lb./A. gave effective control of buttercup in some experiments, consistent control could be expected with an application rate of 0.5 lb./A. This rate of 2,4-D amine should selectively control buttercup on established white clover.

Because buttercup seed has a hard seedcoat, a 3-to 4-year intensive spray program will probably be required to eliminate buttercup as a problem weed in pasture.

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APPENDIX

TABLE 1. CHEMICAL, COMMON, AND TRADE NAMES OF HERBICIDES INVESTIGATED

Common	Chemical	Trade
MCPA	[(4-chloro-o-tolyl)oxy] acetic acid	Several
MCPB	4-[4-chloro-o-tolyl)oxy] butyric acid	Several
2,4-D	(2,4-dichlorophenoxy) acetic acid	Several
dicamba	3,6-dichloro-o-anisic acid	Banvel
metribuzin	4-amino-6-tert-butyl-3-(methylthio)-astriazin-5(4H)-one	Sencor, Lexone
bentazon	3-isopropyl-1H-2, 1,3-benzothiadiazin-(4) as-triazin 3H-one 2,2-dioxide	Basagran

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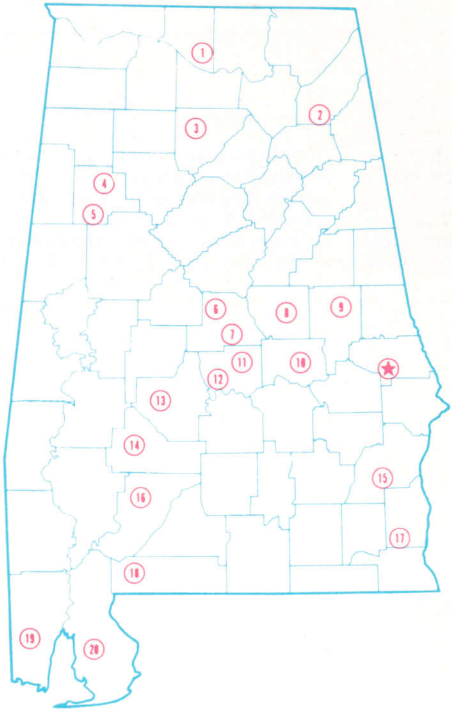

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
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11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Lower Coastal Plain Substation, Camden.
15. Forestry Unit, Barbour County.
16. Monroeville Experiment Field, Monroeville.
17. Wiregrass Substation, Headland.
18. Brewton Experiment Field, Brewton.
19. Ornamental Horticulture Field Station, Spring Hill.
20. Gulf Coast Substation, Fairhope.