Chemical Control of Paragrass (*Brachiaria mutica* (Forsk.) Stapf) in a Humid Upland Area[1, 2]

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INTRODUCTION

Paragrass (*Brachiaria mutica* (Forsk.) Stapf = *Panicum purpurascens* Raddi) occurs extensively throughout the humid tropics, particularly in waterlogged soils, where it is often utilized for pasture. In warm swampy areas, its luxuriant growth provides abundant forage of acceptable quality. On upland soils, Paragrass is resistant to drought (3) but the growth is slower than many other grasses and the forage is stemmy. Beef production on Paragrass at Orocovis, Puerto Rico was only two-thirds that obtained when Pangola, Guinea, or Napier grasses were used (2). Hence, there are extensive areas of Paragrass which should be replanted to more productive pasture grasses. Paragrass is also a weed in cultivated areas, ditches, etc., and is especially troublesome in crops such as plantains, bananas and sugarcane.

In pastures Paragrass is difficult to control by grazing management because it is less palatable to cattle than the more desirable species. It is also difficult to control by mechanical means because the stolons of any unkilled plants rapidly spread over the open soil. Portions of stems which come in contact with the soil also root freely at the nodes and then send out numerous stolons. This vigorous stoloniferous growth quickly competes with pasture or crop seedings and may kill out a new planting.

Two experiments in Hawaii (4) compared several soil-applied herbicides, but results were poor on a dense lowland sward except at high rates of the potent soil herbicides Karbutilate and Bromacil. On an upland sward, high rates of Bromacil, Karbutilate, Diuron, and two herbicide combinations were effective in controlling Paragrass growth for 5 to 12 months. However, most of the materials effective on Paragrass would be expected to

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have persistent phytotoxicity to most crop plants which might be subsequently planted in the treated areas. Little other information is available pertaining to materials and application techniques for controlling Paragrass.

The following report furnishes data from an experiment established to test several chemicals and methods of application on an established sward of Paragrass in the uplands of Puerto Rico.

TABLE 1.—*Herbicides applied to Paragrass*

Common name	Chemical name	Supplied as —
1. Dalapon	2,2-dichloro-proprionic acid	sodium salt, 74% a.e.
2. Dalapon plus TCA	Dalapon plus trichloroacetic acid	46.5% a.e. Dalapon 26.2% a.e. TCA (sodium salt)
3. Asulam	methyl-4-aminobenzene sulfonyl-carbamate	sodium salt, 40% a.e.
4. Amitrole-T	3-amino-*s*-triazole (plus ammonium thiocyanate)	50% Amitrole
5. Karbutilate	*m*-(3,3-dimethylureido) phenyl-*tert*-butylcarbamate	80% WP
6. Diuron	3-(3,4-dichlorophenyl)-1,1-dimethylurea	80% WP
7. Kerb*	N-(1,1-dimethylpropanyl)-3,5-dichlorobenzamide	75% WP

* Trade name, Rohm & Haas Co.

MATERIALS AND METHODS

The experiment was located on a sloping site at the Corozal Substation on Humatas clay loam. The plots were laid out over an existing sward of vigorously growing Paragrass 30 to 40 inches tall.

In two replications, one-half of each main plot was cut and the forage removed. In a third replication, only the uncut sward was used. The initial application of chemicals was made on all plots when the regrowth on the clipped plots reached 6 to 8 inches in height. The chemicals used are listed in table 1. In two of the treatments (Diuron and Karbutilate), single applications of 2, 4, and 6 pounds per acre were made on subplots within the clipped and unclipped plots. In the other treatments, repeat applications were made at (a) 4 weeks and (b) 8 weeks after the initial application using reduced rates on selected subplots as indicated in tables 2 and 3. All applications were applied using 25 gallons per acre, except for Dalapon + TCA (trichloroacetic acid) (50 gallons/acre). A non-ionic spreader-sticker was incorporated in all the sprays.

TABLE 2.—*Ratings of Paragrass control at Corozal Substation; chemicals applied to original swards (unclipped plots); average of three replications except as noted*

Treatment	Rate	Number of applications	Percent control at indicated number of weeks after initial application						
			2	4	6	8	12	16	20
	Pounds								
Dalapon	6	1	58	80	95	86	57*	32*	25*
	3	2		†	97	97	74	43*	10
	3	3				†	92	67	35*
Dalapon	10	1	68	89	96	88	63*	33*	35*
	5	2		†	97	98	85	52*	35*
	5	3				†	98	82	60
Dalapon + TCA	6+3.4	1	62	88	92	83	48*	13	8
	3+1.7	2		†	96	99	77	52	20
	3+1.7	3				†	90	77	45
Dalapon + TCA	10+5.6	1	73	90	96	87	50*	13	5
	5+2.8	2		†	98	99	88	57	13
	5+2.8	3				†	99	86	45
Asulam	1.5	1	0	33	40*	23	3	0	0
	1.0	2		†	57	58	22	0	0
	1.0	3				†	33	0	0
Asulam	3	1	0	35	85*	57	7	0	0
	2	2		†	85*	90	70	12	0
	2	3				†	82	50	8
Amitrole-T**	5	1	58	60	55*	35*	5	0	0
	3	2		†	85	78	25	0	0
	3	3				†	25	10	10
Dalapon + AM-T**	6+2	1	80	85	75	48*	10*	5	0
	3+2	2		†	95	91	25*	10	8
	3+2	3				†	65	35*	18
Karbutilate	2	1	3	7	10	18*	0	0	0
	4	1	10	15	23*	25*	0	0	0
	6	1	23	52	55	59	37	7	7

* Results variable among replications.

** 2 replications; † repeat application made at this point.

The results were recorded as visual estimates of "kill" in terms of percent of injury, or percent of area covered by plant tissue considered to be dead or dying. Each estimate represents a value agreed upon by two or three skilled observers.

Although a replicated factorial design was used, the data were not statistically analyzed because (a) replication numbers were unequal among treatments, (b) the data consisted of subjective evaluations and (c) trends with time, including the onset of non-uniformity among replicates, were of major interest.

TABLE 3.—*Ratings of Paragrass control at Corozal Substation; chemicals applied to regrowth (clipped plots); average of two replications*

Treatment	Rate	Number of applications	Percent control at indicated number of weeks after initial application						
			2	4	6	8	12	16	20
	Pounds								
Dalapon	6	1	48	65	93	85	38*	20*	25*
	3	2		†	97	99	94	85	70
	3	3				†	95	85	80
Dalapon	10	1	78	88	95	93	68	35*	35*
	5	2		†	98	100	93	85	75
	5	3				†	97	93	88
Dalapon + TCA	6+3.4	1	60	85	91	96	80	70	65
	3+1.7	2		†	98	100	100	93	90
	3+1.7	3				†	100	95	90
Dalapon + TCA	10+5.6	1	73	90	99	98	85	83	80
	5+2.8	2		†	100	100	95	90	83
	5+2.8	3				†	100	99	90
Asulam	1.5	1	0	45	65*	38*	5	0	0
	1.0	2		†	75	83*	35*	10	10
	1.0	3				†	50*	35*	25*
Asulam	3	1	0	45	95	90	65*	35*	50*
	2	2		†	95	97	85	55	53
	2	3				†	95	83	78
Amitrole-T	5	1	75	50	55*	35*	0	0	0
	3	2		†	89	79	45	30	15
	3	3				†	40	35*	15
Dalapon + AM-T	6+2	1	78	85	75	55*	40*	40*	40*
	3+2	2		†	93	96	78	77	58*
	3+2	3				†	92	88	78
Karbutilate	2	1	20	13	25	5*	0	0	0
	4	1	35	58	55	53*	0	0	5
	6	1	60	90	82	73	35*	25*	25*

* Results variable among replications.

† Repeat application made at this point.

RESULTS

Two of the herbicides exhibited little or no phytotoxicity to Paragrass at the rates tested. Diuron at rates to 6 pounds per acre produced no visible symptoms. Kerb produced a transitory rolling of the apical leaf during its enlargement as noted 2 weeks after application of the chemical. The final application was made at the high rate of 5 pounds/acre but the results were similar.

The other five chemicals were effective in varying degrees, and the results are presented in table 2 (unclipped plots) and table 3 (clipped plots).

ORIGINAL UNCLIPPED SWARDS

On the unclipped plots (table 2), Dalapon at 6 pounds per acre gave good control for 8 weeks. A second application of 3 pounds per acre extended the period of good control for an additional 4 weeks. There was little benefit from a third application, but the higher rate appeared to give slightly better control for 8 weeks following the repeat applications.

There was no benefit from adding sodium TCA to the Dalapon at either of the rates tested.

Asulam gave poor control at the low rate, but good control for 4 weeks after each application when 3 pounds per acre was used initially and 2 pounds per acre thereafter.

Amitrole-T alone gave only moderate control which was quite variable and of short duration. When used in addition to the low rate of Dalapon, the control appeared to be poorer than the Dalapon alone.

Karbutilate showed a significant rate effect, with the high rate giving over 50 percent control for 8 weeks.

REGROWTH: CLIPPED SWARDS

On the clipped plots (table 3) most of the treatments gave better control and for a longer period of time. Two applications of Dalapon gave excellent control for 16 weeks (12 weeks after the repeat application), with 70 percent control still being obtained at 20 weeks. There was little benefit from a third application within the observation period. Higher rates were no better than basic rates. Addition of sodium TCA improved control considerably. A single application of Dalapon and TCA still provided 65 percent control nearly 5 months (20 weeks) after spraying at the low rate and 80 per cent control at the high rate. When two applications were employed, control was 90 percent at 20 weeks after the initial spraying.

Asulam at the low rate was relatively ineffective, but the high rate provided good control for 8 weeks or more after each application (in comparison to 4 weeks on the unclipped swards). The high rate of Asulam was thus equally as effective as the low rate of Dalapon; three applications (3+2+2 pounds/acre) provided good control for the entire 20-week observation period.

Amitrole-T behaved about the same on the clipped plots as on the unclipped plots.

Karbutilate gave somewhat better control on the clipped plots, with the highest rate (6 pounds/acre) providing good control for 6 weeks and 73 percent control at 8 weeks.

DISCUSSION

Dalapon was the most effective of the herbicides tested in controlling Paragrass. Control was improved by clipping the grass and spraying the regrowth. When regrowth rather than the unclipped swards was treated, the addition of sodium TCA to Dalapon gave a longer-lasting "kill". However, this material is more difficult to handle than Dalapon alone, and its use would therefore depend somewhat on individual conditions.

Multiple applications—using reduced rates for repeat sprayings—proved to be effective in extending the period in which Paragrass was effectively controlled. In most instances, multiple applications did not greatly increase the percent control during the period of maximum effectiveness.

The low rate of Dalapon was nearly as effective as the higher rate, indicating that 6 pounds per acre of Dalapon was adequate for the initial application and 3 pounds per acre for repeat applications, especially when regrowth, rather than older growth was treated.

Multiple applications of Asulam at the higher rates were highly effective in controlling Paragrass when applied to regrowth. However the same rates of Asulam gave only moderate control when applied to uncut swards.

Karbutilate (at rates up to 6 pounds/acre), and Amitrole-T were much less effective; and Diuron (up to 6 pounds/acre) and Kerb were ineffective in controlling Paragrass.

SUMMARY

Several herbicides were tested on Paragrass (*Brachiaria mutica* (Forsk.) Stapf = *Panicum purpurascens* Raddi) using two or more rates, and (except for Karbutilate and Diuron) one, two, and three applications at 4 weeks apart. The chemicals were applied both to tall Paragrass and short (6 to 8 inches) regrowth at the Corozal Substation in the uplands of Puerto Rico.

Sprays applied to regrowth generally gave better control and for longer periods.

Best control was obtained with Dalapon + TCA (trichloroacetic acid) applied twice (90 percent kill after 20 weeks). The low rate (6 pounds Dalapon plus 3.4 pounds TCA acid equiv./acre initially and one-half the rate at the repeat application) was fully as effective as the higher rate tested.

Dalapon alone was nearly as effective as the Dalapon + TCA combination on both older growth and regrowth, and Asulam was highly effective when applied to regrowth. Three applications of Dalapon (6+3+3 pounds/acre) or Asulam (3+2+2 pounds/acre) on Paragrass regrowth still gave approximately 80 percent control at 20 weeks following the initial application (12 weeks after the third application).

Amitrole and Karbutilate were less effective at the rates tested. Kerb and Diuron were ineffective.

RESUMEN

Se estudió la efectividad de varios yerbicidas a uno o más niveles y (excepto en el caso del Karbulate y el Diuron) a base de una, dos y tres aplicaciones a intervalos de 4 semanas, para reprimir la Yerba Pará (*Brachiaria mutica* (Forsk.) Stapf = *Panicum purpurascens* Raddi). Los agentes químicos se aplicaron tanto a la Yerba Pará bien alta como a la renacida después del corte, a una altura de 6 a 8 pulgadas. Las pruebas se hicieron en la Subestación de Corozal, ubicada en la región de mediania de Puerto Rico.

Las aspersiones que se aplicaron a la yerba después de renacer resultaron por lo general más efectivas y de acción más prolongada.

El mejor control se obtuvo del Dalapon + TCA (ácido tricloracético) aplicado dos veces (con un 90 por ciento de control después de 20 semanas). El régimen más bajo (6 libras de Dalapon más 3.4 libras de TCA, equivalente ácido, por acre inicialmente y luego la mitad al repetirse) fue tan efectivo como el régimen más alto en las pruebas que se hicieron.

El Dalapon aplicado por sí solo fue casi tan efectivo como el Dalapon combinado con TCA tanto con la yerba más vieja y de mayor crecimiento que con la que renació después de cortada. El Asulam fue tanbién muy efectivo con la yerba renacida.

Los resultados obtenidos mediante tres aplicaciones de Dalapon (6+3+3 libras por acre) o de Asulam (3+2+2 libras por acre) a la yerba renacida representaron aproximadamente un 80 por ciento de control a las 20 semanas de su aplicación inicial (o sea, a las 12 semanas después de la tercera aplicación).

El Amitrole y el Karbutilate fueron menos efectivos al aplicarse a los niveles ya ,ndicados. El Kerb y el Diuron resultaron ineficaces.
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