

Control of Resistant Broadleaf Species in Puerto Rico Pastures using Mixtures of 2,4-D with Picloram and Dicamba^{1, 2}

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ABSTRACT

Tordon 101 Mixture (4-amino-3,5,6-trichloropicolinic acid and 2,4-D) applied in two locations to pangolagrass (*Digitaria decumbens*) pastures at the rates of 0.28, 0.56 and 1.12 kg/ha (1/4, 1/2 and 1 lb/acre) and Banvel (3,6-dichloro-o-anisic acid and 2,4-D) at the rates of 1.12, 2.24 and 4.48 kg/ha (1, 2 and 4 lbs/acre) controlled broadleaf weeds effectively and increased pangolagrass stand significantly, regardless of the rate of application.

INTRODUCTION

Dairy farming and beef cattle raising are two of the most important agricultural operations in Puerto Rico. Land formerly used for crops has been increasingly turned into pastures. In 1973, pastures in Puerto Rico covered 333,806 ha (824,500 acres) while crops occupied 159,834 ha (394,790 acres). Cattle population increased by 10.9% between 1963 and 1973. This increase contrasts sharply with the reduction in area occupied, volume of production, and income produced by traditional crops. Sugarcane acreage, for instance, decreased by 56.4% from 1963 through 1973.^{4, 5}

The tropical climate of the Island promotes plant development, including numerous undesirable plants. In pastures, many weeds are broadleaf species. The so-called "brushkiller" mixtures of 2,4-D and 2,4,5-T are presently used to control these species. However, these chemicals are not effective against certain brushes, such as *Sida acuta*, *S. cordata*, *S. rhombifolia*, *Borreria verticillata* and *Mimosa pudica*.⁶

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⁴ Anuario de Estadísticas Agrícolas de Puerto Rico, Estado Libre Asociado de Puerto Rico, Departamento de Agricultura, 1971-72.

⁵ Enfoques y Programa de Investigación, Estación Experimental Agrícola, Colegio de Ciencias Agrícolas, Universidad de Puerto Rico, Recinto de Mayagüez, Río Piedras, P.R., enero 1971.

⁶ Vélez, I. y van Overbeek, J., Plantas Indeseables en los Cultivos Tropicales, Editorial Universitaria, Río Piedras, P.R., 1950.

Grazing and chemical control of sensitive weeds eliminate natural competition and help proliferate the above-mentioned noxious species.

MATERIALS AND METHODS

A dairy and a beef cattle farm of Juncos and Dorado, respectively, were chosen for the experiments. Both had pangolagrass (*Digitaria decumbens*) pastures. The soil at Juncos is an Inceptisol, subgroup Typic Eutropept; at Dorado it is an Entisol, subgroup Typic Troposamment. Each location represents the tropical climate of the Island.

The chemicals used were 1:4 mixtures of picloram (4-amino-3,5,6-trichloropicolinic acid) and 2,4-D at rates of 1.4, 2.8 and 5.6 kg/ha (1.25, 2.50 and 5.0 lbs/acre); and 1:2 mixture of dicamba (3,6-dichloro-o-anisic acid) and 2,4-D at rates of 3.36, 6.72 and 13.44 kg/ha (3, 6, and 12 lbs/acre). These ingredients are present in the commercial formulations of Tordon 101⁷ at 0.06, 0.12 and 0.24 kg/l (0.5, 1.0, and 2 lbs/gal), and Banvel + 2,4-D at .08, .16, and .32 kg/l (0.66, 1.32, and 2.64 lbs/gal).

Plot size was 0.023 ha (2,500 ft²). Each rate was replicated three times and laid out together with three untreated plots in a balanced incomplete block design at each site. These areas were either fenced or kept from pasturing for the duration of the experiment.

Herbicides were applied with a unit consisting of a 3 hp gasoline engine powering a high volume pump and a spray hand gun with a no. 9 disc orifice. Total volume of chemical and water sprayed was 496 l/ha (52 gal/acre). Adjuvant Adsee 100-880 was added at 1.7 l/ha (0.18 gal/acre).

The herbicides were applied on 13 and 14 December 1973 at Juncos and Dorado, respectively. Both areas, which had pangolagrass and a wide variety of noxious plants firmly established, were left undisturbed. The species present in the experimental plots in both sites were previously identified. These were then either counted or their stands estimated two days before treatment application. A final count was made 95 days after the herbicide sprays. Weed vigor was rated visually, as indicated below:

- 1 Little or no effect
- 0.75 Less than 50% of top growth dead
- .50 Over 50% of the top growth dead, but not complete top kill
- .25 Complete top kill with resprouting from root collar of lateral roots
- 0 Complete kill, total disappearance or no resprouting

Percent of brush control was then calculated.

Pangolagrass stands were also estimated at both dates (table 1).

⁷ Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico or an endorsement over other equipment or materials not mentioned.

TABLE 1.—*Pangolagrass* pasture stand in brushkiller-treated plots in cattle farms at Juncos and Dorado, Puerto Rico¹

Treatment	Formulation— emulsion con- centrate	Active ingredient	Average stand			
			Juncos		Dorado	
			0 days	95 days	0 days	95 days
	<i>L/ha</i>	<i>Kg/ha</i>	—%—			
1. Tordon 101	4.7	0.28 kg picloram + 1.12 kg 2,4-D	48	91	47	97
2. Tordon 101	9.4	0.56 kg picloram + 2.24 kg 2,4-D	35	98	77	100
3. Tordon 101	18.7	1.12 kg picloram + 4.48 kg 2,4-D	30	88	80	100
4. Banvel + 2,4-D	6.2	1.12 kg dicamba + 2.24 kg 2,4-D	13	83	68	86
5. Banvel + 2,4-D	12.4	2.24 kg dicamba + 4.48 kg 2,4-D	47	80	67	99
6. Banvel + 2,4-D	24.8	4.48 kg dicamba + 8.96 kg 2,4-D	28	72	50	96
7. Check			42	63	63	73

¹ Results recorded as visual estimate of stand before and after the application of the herbicides. Each estimate is a value averaged from three plots and agreed upon by two observers.

Samples for residue determination were obtained at four different dates. Two pounds of grass and one pound of soil were gathered before application of the chemicals, and at 30, 60, and 90 days thereafter. Grass was clipped at eight random places in each plot and soil samples were obtained from two depths: 0-20 cm (0-8 in) and 20-40 cm (8-16 in). Samples were deep frozen at -10° C and later shipped in dry ice to the corresponding herbicide manufacturer for residue analysis.

RESULTS

Results of these tests are summarized in tables 1, 2, and 3. Table 1 shows that the pangolagrass stand in the experimental plots at Juncos

TABLE 2.—Summary of percentages of kill and/or disappearance of weed species in pangolagrass pastures at Juncos treated with Tordon 101 and Banvel + 2,4-D at three dosages¹

Treatment	Formulation— emulsion con- centrate	Active ingredient	Weed Control				
			A ²	B	C	D	E
	L/ha	Kg/ha	%				
1. Tordon 101	4.7	0.28 kg picloram + 1.12 kg 2,4-D	100	97	97	100	100
2. Tordon 101	9.4	0.56 kg picloram + 2.24 kg 2,4-D	100	100	100	100	100
3. Tordon 101	18.7	1.12 kg picloram + 4.48 kg 2,4-D	100	100	100	100	100
4. Banvel + 2,4-D	6.2	1.12 kg dicamba + 2.24 kg 2,4-D	100	75	75	100	100
5. Banvel + 2,4-D	12.4	2.24 kg dicamba + 4.48 kg 2,4-D	90	82	82	100	100
6. Banvel + 2,4-D	24.8	4.48 kg dicamba + 8.96 kg 2,4-D	97	88	88	100	100
7. Check			3	3	3	47	47

¹ See footnote 1, table 1.

² A. *Mimosa pudica*, B. *Sida acuta*, C. *S. rhombifolia*, D. *Urena lobata*, E. *U. trilobata*.

³ There was 20% control because the pasture was ungrazed and the grass stand suffocated the weeds.

and Dorado increased following the application of the broadleaf weed killers Tordon 101 Mixture, and Banvel + 2,4-D. The increased stand is attributed to the suppression of weeds by the chemicals. Table 2 indicates that the chemicals tested controlled effectively adult stage of sensitive plant (*Mimosa pudica*), tea weed (*Sida acuta*), arrowleaf sida (*S. rhombifolia* L.), bur weed (*Urena lobata*), and bur weed (*U. trilobata*) at the Juncos dairy farm, regardless of rates of application. Table 3 shows that the herbicides controlled buttonweed (*Borreria verticillata*), red morning glory (*Ipomoea rubra*), sensitive plant (*M. pudica*), tea weed (*Sida acuta* Bur), sida (*Sida cordata*), arrowleaf sida (*S. rhombi-*

TABLE 3.—Summary of percentages of kill and/or disappearance of weed species in pangolagrass pastures at Dorado treated with Tordon 101 and Banvel + 2,4-D at three dosages

Treatment	Formulation— emulsion con- centrate	Active ingredient	Weed Control, %										
			A ¹	B	C	D	E	F	G	H	I	J	
	<i>L/ha</i>	<i>Kg/ha</i>											
1. Tordon 101	4.7	0.28 kg picloram + 1.12 kg 2,4-D	97	100	100	97	97	97	90	90	90	—	
2. Tordon 101	9.4	0.56 kg picloram + 2.24 kg 2,4-D	82	100	100	100	100	100	97	97	97	60	
3. Tordon 101	18.7	1.12 kg picloram + 4.48 kg 2,4-D	64	100	100	100	100	100	93	99	93	—	
4. Banvel + 2,4-D	6.2	1.12 kg dicamba + 2.24 kg 2,4-D	69	97	100	75	75	75	87	87	87	59	
5. Banvel + 2,4-D	12.4	2.24 kg dicamba + 4.48 kg 2,4-D	69	97	87	82	82	82	87	87	87	68	
6. Banvel + 2,4-D	24.8	4.48 kg dicamba + 8.96 kg 2,4-D	58	100	94	88	88	88	90	90	90	61	
7. Check			0	30	2	2	2	2	2	2	2	0	

¹ A. *Borreria verticillata*, B. *Ipomoea rubra*, C. *Mimosa pudica*, D. *Sida acuta*, E. *S. cordata*, F. *S. rhombifolia*, G. *Urena lobata*, H. *U. sinuata*, I. *U. trilobata*, J. *Cyperus ligularis*.

² There was 10% control because the pasture was ungrazed and the grass stand suffocated the weeds.

folia L.), bur weed (*U. lobata*), bur weed (*U. trilobata*), and sedge (*Cyperus ligularis*) at the Dorado site, regardless of rates of application per acre as may be deduced from the indicated weed control percentages.

RESUMEN

La mezcla Tordon 101 (ácido-4-amino-3,5,6-tricloropicolínico y 2,4-D) y Banvel + 2,4-D (ácido 3,6-dicloro-o-anísico y 2,4-D), aplicados a parcelas experimentales de yerba pangola (*Digitaria decumbens*) en dos localidades, a las dosis de 0.28, 0.56 y 1.12 kg./ha. (1/4, 1/2 y 1 lb./acre) y 1.12, 2.24 y 4.48 kg./ha. (1, 2 y 4 lb./acre), respectivamente, controlaron eficazmente las malezas de hoja ancha y aumentaron significativamente el rendimiento de forraje en todas las parcelas tratadas.