

Persistence of 2,4,5-T in Grasslands of Texas

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Introduction

Herbicide (2,4,5-trichlorophenoxy)acetic acid (2,4,5-T) is widely used to improve rangelands by controlling weeds and brush. Recent accusation of 2,4,5-T as a possible environmental contaminant has prompted further investigations as to its residual characteristics and longevity. Morton et al. (7) using radioisotopic methods, indicated the average half-life of 2,4,5-T, (2,4-dichlorophenoxy)acetic acid (2,4-D), and 3,6-dichloro-*o*-anisic acid (dicamba) was about 2 weeks in native grasses at College Station and Spur, Texas. Half-life of the three herbicides was about 3 weeks in litter. Sixteen weeks after application of 1/2 and 2 pounds per acre (1b/A) of 2,4,5-T, concentration was usually below 6 ppm in the grasses. Rainfall was important in accentuating the disappearance of the herbicides.

Baur et al. (2) applied 2 lb/A of the 2,4,5-T ester to native grasses at Victoria, Texas. Six months after treatment concentrations averaged 60 and 170 ppb for 2,4,5-T acid and ester, respectively.

Applications of the triethylamine salts of a 1:1 mixture of 2,4,5-T and 4-amino-3,5,6-trichloropicolinic acid (picloram) (Riesel, Texas) at 2 lb/A resulted in residue levels of 24,500 and 28,011 ppb, respectively, on grass 3 days after treatment in December 1970. After 38 days, 2,4,5-T and picloram concentrations were about 2,000 ppb each. Rainfall of .02 inches occurred 30 days after treatment. Significant loss of the herbicide was attributed to photodecomposition. Five months after treatments and after receiving 5.5 inches of rainfall, herbicide concentrations were below 35 ppb¹. Klingman (4) reported esters of 2,4-D were rapidly hydrolyzed to 2,4-D acid in forage plants within 1/2 hour after spraying and residue levels dropped from 58 ppm to 5 ppm in 7 days after spraying the butyl ester at 2 lb/A.

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Bovey, R. W., E. Burnett, C. Richardson and M. G. Merkle. 1971. Unpublished data.

Klingman (5) stated that 2,4,5-T at 1/2 to 3 lb/A persists 2 to 5 weeks in the field in warm moist loam soil. Recent reviews (3, 6) indicate the length of persistence of 2,4,5-T varies depending upon climatic conditions and population of soil micro-organisms, but usually does not carry over from one growing season to the next regardless of application rates.

Montgomery and Norris (6) indicated that decomposition of 2,4,5-T in the organic layers of the forest floor is relatively rapid (87% in 2 months) and movement into the subsoil and streams is unlikely.

We studied the residual levels of 2,4,5-T in range and pasture forage grasses and soils at five locations in Texas at several times after application to determine initial concentrations and rate of disappearance.

Materials and Methods

The propylene glycol butyl ether esters of 2,4,5-T were sprayed at 1/2 and 1 lb/A on triplicate, 10 by 30 foot plots at five locations in Texas on June 3 to 11, 1971. Sprays of 2,4,5-T were applied in water at 20 gallons per acre with a 5 foot hand carried boom. No spray additives were used. Experiments were established in northcentral (Stephenville), northeast (Overton), west (Sonora), south (Refugio) and southcentral (Bryan) Texas.

The soil at Stephenville was Windthorst fine sandy loam supporting predominately little bluestem (Andropogon scoparius Michx.). At Overton Coastal Bermudagrass (Cynodon dactylon (L.) Pers.) grew in a Troup fine sandy loam. A mixture of sideoats grama (Bouteloua curtipendula (Michx.) Torr.), purple threeawn (Aristida purpurea Nutt.), curlymesquite (Hilaria belangeri (Steud.) Nash), fall witchgrass (Leptoloma cognatum (Schult.) Chase), and several annual forbs occurred at Sonora on a Terrant stony clay. At Refugio, Arizona cottontop (Digitaria californica (Benth.) Henr.) and Gulf cordgrass (Spartina spartinae (Trin.) Merr.) occupied the study area. The soil was Victoria clay. At Bryan, the native grass was longspike silver bluestem (Bothriochloa saccharoides (Swartz) Rydb. var. longipaniculata (Gould) on an Erving clay loam.

Published extraction and gas chromatographic techniques were used in these experiments for determination of 2,4,5-T acid in grasses (2) and soils (1). The data were corrected for extraction efficiency for grasses (80%) and soils (70%) and for the natural occurring contaminates chromatographing at the same retention time as 2,4,5-T. Collection of grass samples were: immediately, 6, 12 and 26 weeks after treatment. Samples were sealed in plastic bags and taken to the laboratory. Those not processed immediately were

frozen for later analysis. Soils were sampled immediately, 6 and 12 weeks after treatment. Three cores, 1½ by 6 inch from each plot, were combined in plastic bags. Depths of sampling are shown in Table 3. Soil samples were frozen if not processed immediately.

Results and Discussion

Concentrations of 2,4,5-T varied from one location to the next when sampled immediately after treatment (Table 1). However,

TABLE 1

Concentration of 2,4,5-T (ppb) in native grasses at different time intervals after treatment at five locations in Texas.

Location	Rate (lb/A)	Time after treatment (wks)		
		0	6	26
		(ppb)	(ppb)	(ppb)
Bryan	½	140,300	3,120	0
"	1	144,000	5,930	2
Overton	½	39,300	60	44
"	1	52,900	220	17
Stephenville	½	48,200	1,280	0
"	1	38,400	2,650	51
Refugio	½	26,500	1,130	4
"	1	74,700	1,220	12
Sonora	½	31,700	40	0
"	1	55,900	410	0

density and height of the vegetation influences the amount of spray intercepted and concentration on a whole plant basis. As expected, residue levels were usually highest immediately after application of 1 lb/A than from 1/2 lb/A. Six weeks after treatment an overall average of 98% 2,4,5-T was lost from all treated areas. Loss of 2,4,5-T ranged from 93.1 to 99.9%. After 26 weeks, very little 2,4,5-T persisted in grasses at Overton, Stephenville and Refugio sites. Higher rainfall at Overton and Sonora (Table 2) appeared to hasten loss of 2,4,5-T (over 99%) by 6 weeks after treatment. However, 2,4,5-T loss from forage grasses at Refugio from 1/2 and 1 lb/A was 96 and 98%, respectively, 6 weeks after treatment and after receiving only 0.22 inches of rainfall. This strongly suggests that herbicide loss can be partially attributed to photo-degradation and volatilization², as well as by metabolism and dilution in the growing plants.

Initial concentrations of 2,4,5-T in the upper soil layer (0 to 6 inches) immediately after spraying ranged from 943 to 5,390 ppb or about 1 to 5 ppm (Table 3). Concentrations of 2,4,5-T

² Baur, J. R. and R. W. Bovey. 1971. Annual Report. Brush Control Studies. USDA-ARS, College Station, Texas. 77 p.

in the soil was much less than on grasses in the same plots due to interception of the spray by vegetation.

Six weeks after treatment, 2,4,5-T had essentially disappeared in soil at Bryan and Sonora, and 2,4,5-T concentrations at all other locations were low. Highest concentrations at 6 weeks occurred at

TABLE 2

Rainfall data at experimental sites*

Location in Texas	Accumulative rainfall (wks)		
	6	12	26
Bryan	1.67	7.64	21.19
Overton	2.61	5.30	14.00
Stephenville	1.58	11.81	26.14
Refugio	0.22	8.28	43.78
Sonora	4.35	17.43	24.20

* Rainfall 30 days prior to treatments was 6.13, 1.65, 5.85, 2.07 and 0.54 inches for Bryan, Overton, Stephenville, Refugio and Sonora, respectively.

TABLE 3

Concentration of 2,4,5-T (ppb) in soils at different time intervals after treatment at five locations in Texas

Location	Rate (lb/A)	Time after treatment (wks) and depth sampled (in)						
		0	6				12	
		(0-6)	(0-6, 6-12, 18-24, 30-36)	(0-6)	(6-12)	(12-18)	(18-24)	(24-30)
		(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
Bryan	$\frac{1}{2}$	943	0	0	0	0	6	3
"	1	3,027	1	0	0	0	6	1
Overton	$\frac{1}{2}$	2,173	5	0	0	1	1	0
"	1	2,966	17	6	0	0	6	1
Stephenville	$\frac{1}{2}$	3,383	103	5	-	-	0	0
"	1	5,000	101	0	4	-	0	0
Refugio	$\frac{1}{2}$	3,463	1	18	16	8	2	5
"	1	5,390	38	15	7	6	2	5
Sonora	$\frac{1}{2}$	2,013	0	3	-	-	7	2
"	1	4,808	4	3	-	-	5	4

Stephenville in the 0 to 6 inch layer. Samples below 12 inches could not be taken in some plots at Stephenville and Sonora because soil was impenetrable. Levels of 2,4,5-T in soil at 30 to 36 inches deep at other locations were less than 10 ppb indicating little leaching of 2,4,5-T. Twelve weeks after treatment, 2,4,5-T had disappeared or was less than 10 ppb at all locations. There was no apparent difference in 2,4,5-T dissipation rates due to rainfall.

Conclusion

The herbicide 2,4,5-T is relatively short lived in Texas grassland ecosystems and does not produce significant residues that persist from one year to the next at the rates and locations studied.

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