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16. Abstract

Wild oat (Avena fatua L.) and jointed goatgrass (Triticum cylindricum[Host] Ces.) plants growing along roadsides are perceived as a seed reservoir for infesting adjacent wheat fields. Treatments were sought for these grassy weeds growing on roadsides to reinforce cleanup programs initiated by wheat farmers.

Spring mowing and pre-emergence treatments were unsatisfactory for controlling wild oat and jointed goatgrass. However, post-emergence treatment with 1½ lbs ai/A of glyphosate after all plants emerged and before heading completely controlled these weeds without damaging the permanent turf.

Research is continuing with lower rates of glyphosate and comparison of alternative materials with glyphosate as standard.

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CONTROL OF WILD OAT AND JOINTED GOATGRASS ON TEXAS ROADSIDES

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Research Report 902-2
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State Department of Highways and Public Transportation

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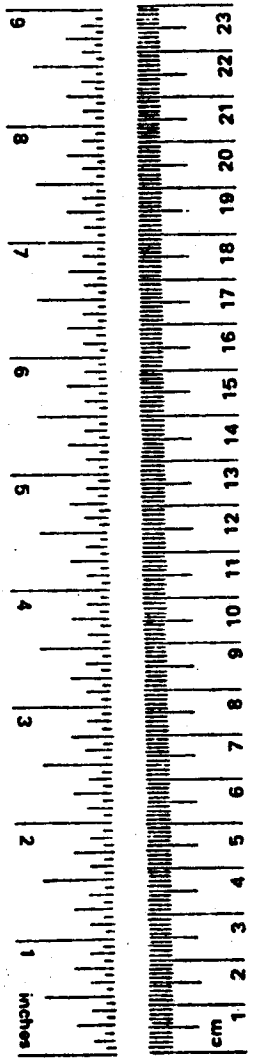
College Station, Texas

January 1986

METRIC CONVERSION FACTORS

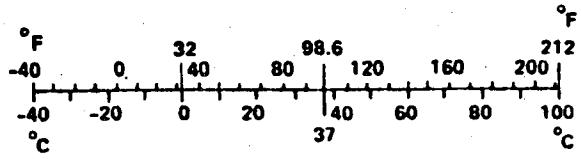
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



* 1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

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Test Sites were furnished by Mr. Jimmy L. Stacks, District Engineer, and Mr. William I. Presson, Maintenance Construction Superintendent, SDHPT, District 3, and by Mr. Lewis H. White, District Engineer and Mr. Terry L. Keener, Supervising Maintenance Engineer, SDHPT, District 25. Candidate herbicides were furnished by the cooperating chemical companies. Line drawings were made by Jan Blankenship.

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Key Words: Wild oat, Jointed goatgrass, Wheat, Roadside Vegetation Management

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SUMMARY

Wild oats (*Avena fatua* L.) and jointed goatgrass (*Triticum cylindricum* [Host] Ces.) (Gould 1969) plants growing on roadsides are considered by wheat farmers to be a seed reservoir for infesting adjoining grain fields. The State Department of Highways and Public Transportation entered into an informal agreement in 1982 with the Texas Wheat Producers Association to control these grassy weeds on roadsides as reinforcement to cleanup programs initiated by adjoining wheat farmers.

A good turf of perennial warm season grasses seems to offer very little competition to these cool season grassy weeds. Also, wild oat and jointed goatgrass grow adjacent to native pasture as well as to wheat, but they are not a threat to livestock.

Mowing was compared with herbicidal treatment in seven counties in North Central Texas beginning in 1982. Mowing was unsatisfactory as a permanent control. It is difficult to use because the time period for effective mowing may be a week or less.

Pre-emergence herbicide treatment also was unsatisfactory. However, post-emergence application of 1 1/2 lbs ai/A of glyphosate as a water spray with Nalcotrol® added, applied after plant emergence and before heading, completely controlled wild oat and goatgrass without damaging desirable perennial grasses. None of the herbicides labelled for wild oat control in wheat performed satisfactorily on oat plants in various stages of development. A recommended chemical treatment for goatgrasse in wheat has not been developed.

IMPLEMENTATION STATEMENT

Research has progressed to the point that herbicidal control of wild oat and jointed goatgrass should be tested on a field scale. SDHPT District 3 (Wichita Falls) will apply glyphosate to infested roadsides during spring 1986 using standard spray equipment.

Glyphosate, because of its performance in small-plot tests for controlling these grassy weeds and its widespread use within SDHPT, is recommended for field testing under these guidelines:

1. Material rate: 1.0 lbs ai of glyphosate (1.5 qts Roundup®) per acre; with 8 oz. of Nalcotrol per 100 gallon of spray mixture.
2. Treatment date: March 17, 1986 until heads appear (usually mid-April). This approximates 5 weeks for effective application.
3. Treatment site: Roadsides adjacent to wheat fields in Baylor and Wilbarger counties as designated by the District Engineer.

Concurrently with this operational program, research will seek to identify lower rates of glyphosate yielding satisfactory performance. Also, alternative materials will continue to be tested using glyphosate as a standard treatment.

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INTRODUCTION

Wild oat (*Avena fatua* L.) and jointed goatgrass (*Triticum cylindricum* [Host] Ces.) plants growing on roadsides are considered by farmers to be a seed reservoir for infesting adjoining small grain fields. In 1982, the State Department of Highways and Public Transportation (SDHPT) entered into an informal agreement with the Texas Wheat Producers Association to control wild oat on roadsides as reinforcement to cleanup programs initiated by adjoining grain farmers. Roadside mowing schedules were re-aligned in an effort to prevent wild oat plants from producing seed. At the same time, a test program was initiated to develop chemcial controls for wild oat.

Goatgrass is another aggressive annual weed in wheat fields. It is not as visible as wild oat, but wheat contaminated with goatgrass is severely docked by elevator operators. Goatgrass has become an increasing concern since the wild oat study began. Since these two grassy weeds are often found together, a single effective treatment for both is desirable.

WEED ECOLOGY

Both weeds were originally introduced into wheat regions in the northern and central Great Plains. Wild oat is a native of Europe (Lee et al., 1980) and jointed goatgrass, a wild wheat, is from Asia (Fenster et al., 1980). Both have spread from the point of original discovery. Wild oat infestations were reported from five counties in North Central Texas and adjacent Oklahoma in the early 1960's (Greer and Peeper, 1981). Presently, this weed is found over most of eastern, central and northern Texas (Correll and Johnston, 1970). Jointed goatgrass is found in the same general area of Texas (Gould, 1969), so it has spread rapidly since it was first noted in Kansas in 1937 (Fenster, et al., 1980). Palmer (1984) identified jointed goatgrass from central and Panhandle Texas counties beginning in 1973.

The initial introduction of these weeds likely occurred as a contaminant of seed grain. Today, a number vehicles exist for transporting seed of these weedy grasses, including seed grain, feed grain, contaminated combines, roadsides mowers, open grain trucks, and drainage water.

Both of these aggressive annual grasses are prolific seed producers. Wild oat plants in Texas and Oklahoma tiller more extensively than those growing in more northern climates (Greer and Peeper, 1981) with a correspondingly heavier seed load. Seed from each of these plants have variable periods of dormancy, and some seed from a single crop live for several years in the soil. Seed of both weedy grasses germinate during the same time as wheat. Wild oat seed continues to germinate until early spring, resulting in a stand of plants at several stages of development. Wild oat is not restricted to areas adjacent to those cropped with wheat, and it is also found on roadsides adjacent to native pastures in North Central Texas.

Since these plants germinate at the same time as wheat, it is necessary to look at vegetative parts to identify seedlings and plants prior to heading. Several characteristics can be used to identify wild oat. Viewed from above, the first leaf of a wild oat seedling twists to the left while the first wheat leaf twists to the right. In wild oat, the ligule is an elongated, papery white, bluntly pointed structure. Wheat has a very short, blunt ligule and claw-like auricles which surround the stem (Fig. 1). Wild oat can be distinguished from cultivated oat varieties by the hairs on the seed and the long, black twisted terminal awn (Fig. 2).

Jointed goatgrass in Texas usually has a much finer stem than wheat. Like cultivated wheat, it also has auricles at the base of the blade. A jointed goatgrass spikelet contains two to four flowers arranged in a compact cylindrical spike. The glumes on the terminal spikelets have much longer awns than do lower spikelets (Fig. 3).

A good turf of perennial warm season grasses offers very little competition to cool season wild oat and jointed goatgrass plants which grown during fall and winter and produce seed in early spring. It is not unusual to find these annual grasses infesting a good stand of dormant johnsongrass (*Sorghum halepense* [L.] Pers.), vine mesquite (*Panicum obtusim* H. B. K.), silver bluestem (*Bothriochloa saccharoides* [Swartz] Rydb.), sideoats grama (*Bouteloua curtipendula* [Michx.] Torr.), bermudagrass (*Cynodon dactylon* [L.] Pers.) and other perennial grasses. Infestations of these weedy annual grasses on roadsides cannot be treated with such agronomic practices as crop rotation, fallow, selective grazing, intensive cultivation or herbicide incorporation

suggested for cultivated lands (Banting, 1982; Greer and Peeper, 1981; Lee et al., 1981; Wiese, 1980). However, dormant perennial warm-season grasses tolerate herbicides which cannot be applied safely to annual smallgrain crops. The purpose of these studies was to develop an herbicidal control for cool-season annual grasses which does not harm the perennial grass sod on a roadside.

EXPERIMENTAL PROCEDURES

A research and field testing program supported by SDHPT was initiated in 1982 to compare chemical treatment with mowing to control wild oat on roadsides. County Extension Agents in Archer, Baylor, Foard, Hardeman, Knox, Wichita, and Wilbarger counties identified infested roadsides and advised local maintenance sections on mowing schedules.

A number of herbicides applied pre- or post-emergence are recommended for controlling wild oat in wheat throughout the United States and Canada (Greer and Peeper, 1981; Sharma, 1979; Wiese, 1980). A recommended chemical control does not presently exist for jointed goatgrass in wheat (Palmer, 1984). A systematic series of pre- and post-emergence applications were installed beginning in the fall, 1982, and included several materials labelled for use in wheat. Nine materials (Table 1) were applied pre-emergence in the fall, 1982, and twelve materials in the fall, 1983. Twelve materials were applied post-emergence in April, 1983 (Table 2), and seven materials were applied in April, 1985 (Table 3). A test was not installed during the dry spring, 1984. Earlier tests were applied using a tractor-mounted boom sprayer; 1985 treatments were applied from a cluster nozzle, a component of a standard SDHPT roadside sprayer. Nalcotrol® was added to the 1985 sprays at 8 oz. per 100 gallons of solution.

Post-emergence treatments were made each year to plants in thrifty growing condition. Treated stands contained several generations of wild oat plants ranging from seedlings to plants with tillers in early boot.

Each test was applied as a randomized block with three replications. Performance of earlier treatments was ranked on a relative scale; 1985 treatments were compared by weed inventories before and after application.

RESULTS AND DISCUSSION

Mowing is an expensive and ineffective method for controlling wild oat and jointed goatgrass. Cooperating districts scheduled an additionaly full-width, spring mowing for infested roadsides. For mowing to be a successful control, wild oat and jointed goatgrass must be mowed after the bud is elevated enough to be clipped but before a pollinated flower in the boot has developed into a viable seed. The time span connecting these events is extremely short, often less than a week. Scheduling mowing is further complicated by weather delays and by irregular plant development in a stand of wild oat containing plants of different ages. Further, mowed plants have been observed to develop additional flowering tillers if growing conditions remain favorable. County Extension Agents estimated in 1983 that control ranged from 50% to 100% (Cure, 1983; Henry, 1983; Hinsley, 1983; Siepel, 1983; Wilson, 1983; Wise, 1983), depending upon the influence of the conditions listed above. Even with the satisfaction of seeing these offending plants mowed, the cost-effectiveness of mowing as a control measure proved questionable.

Pre-emergence treatments (Table 1) were unsuccessful in preventing germination and establishment of wild oat plants. Post-emergence treatments, on the other hand, regularly controlled wild oat and jointed goatgrass (Table 2).

The same herbicidal materials applied post-emergence in early April of 1983 and 1985 were consistent in controlling wild oat and jointed goatgrass (Figs. 4 and 5). Glyphosate applied at a rate of 1.5 lbs per acre ai gave complete control of both weedy grasses each year. The higher rates of fenoxapropethyl (HOE-00661), fluazifop-butyl (Fusilade®) and haloxyfop-methyl (Verdict®) matched the performance of glyphosate on wild oat in 1983, but control was less in 1985. Jointed goatgrass also was controlled by HOE-00661, but it tolerated haloxyfop-methyl.

The area treated with glyphosate was completely brown two weeks after treatment in both years. After four weeks in 1985 and five weeks in 1983, the permanent grasses were beginning to grow. After eight weeks in 1985, the areas treated with glyphosate were completely green (Fig. 4). In 1983 fenoxapropethyl treatment killed existing vegetation, but not in 1985. Other 1985 treatments and 1983 applications of fluazifop-butyl and haloxyfop-methyl

induced some discoloration and plant stunting; higher rates of haloxfop, fenoxapropethyl and fluazifop-butyl caused considerable reduction in wild oat stand. Both wild oat and jointed goatgrass in all treatments except glyphosate overcame these initial effects as reflected in the final ratings and stand counts (Fig. 5). The broad spectrum of plant development emphasizes the susceptibility of wild oat in the seedling stage to these materials as well as to diclofop-methyl.

Despite early discoloration of cool-season annual grasses in areas treated post-emergence, only sulfometuron-methyl in 1983 tests caused any lasting effect on perennial warm-season grasses. A variety of native grasses desirable for roadside stability appeared to suffer no harmful effects from any of the other materials. Interception of the applied spray by the taller weedy annual grasses and a date of treatment which precedes the initiation of new growth by the perennials produced this observed selective action.

It should be emphasized that treatment with glyphosate is recommended for roadside use. Persons considering it for use on growing wheat should be prepared to sacrifice treated areas, since it is not selective at the rate specified.

Table 1. Pre-emergence herbicical treatments applied for control of wild oat on roadsides, November 1982.

Material	Rate/A (ai)
Atrazine	1.5 lb
Atrazine + metolachlor	5.6 lb
CGA - 82725	0.25 lb & 0.75 lb
Diphenamid	6.0 lb
EL - 500	2.0 lb & 4.0 lb
Metribuzin	1.0 lb
Mobay 0860	1.0 lb & 3.0 lb
Oryzalin	3.0 lb
Triallate	2.0 lb & 3.0 lb

Table 2. Post-emergence herbicidal treatments applied for control of wild oat on roadsides, April 1983.

Material	Rate/A (ai)	Relative Performance* 2 Weeks post treatment Site A	2 Weeks post treatment Site B	5 Weeks post treatment
Atrazine	1.0 lb	6.8	4.0	7.0
	2.0 lb	7.0	4.6	7.2
Atrazine + metolachlor	3.4 lb	7.0	6.0	6.5
	6.8 lb	6.5	7.4	7.0
CGA-82725	0.25 lb	3.2	2.6	6.5
	0.75 lb	4.7	3.4	7.0
Diclofop-methyl	0.4 lb	3.2	-0-	4.2
Haloxyfop	2.0 oz	1.5	2.0	10.0
	5.0 oz	1.9	2.0	10.0
	8.0 oz	3.8	4.0	10.0
EL 500	2.0 lb	N/A**	-0-	-0-
	4.0 lb	N/A	-0-	-0-
Fluazifop-butyl	0.25 lb	1	2.0	7.2
	0.50 lb	1.4	4.6	10.0
Glyphosate	1.5 lb	9.8	9.7	10.0
Fenoxapropethyl (Hoe 00661)	0.75 lb	8.4	8.6	9.0
	1.50 lb	N/A	9.8	10.0
Metribuzin	1.0 lb	6.8	4.6	7.2
Mobay 860	1.0 lb	1.5	-0-	2.0
	3.0 lb	2.5	-0-	4.0
Oryzalin	3.0 lb	1.5	-0-	1.5
Sulfometuron-methyl	2.0 oz	1.5	3.6	10.0

* Rating scale 0 - 10; 0 = no effect
** No application

Table 3. Relative abundance of wild oat before and after post-emergence treatment, 1985.

Material	Rate Lb/A	Frequency of Occurrence - Percent		
		Pre-treatment	4 Weeks Post-treatment	8 Weeks Post-treatment
Amitrole	2.00	53	50	57
AXF 1254	0.0625	55	57	93
	0.2500	43	27	43
Diclofop-methyl	0.75	53	33	57
	1.25	58	30	70
Fluazifop-butyl	0.15	65	25	60
	0.30	72	7	30
Glyphosate	1.00	62	0	0
Haloxyfop-methyl	0.0625	55	27	43
	0.1250	50	7	23
HOE-00661	0.75	77	33	37
	1.50	67	17	27
No treatment	-0-	53	70	90

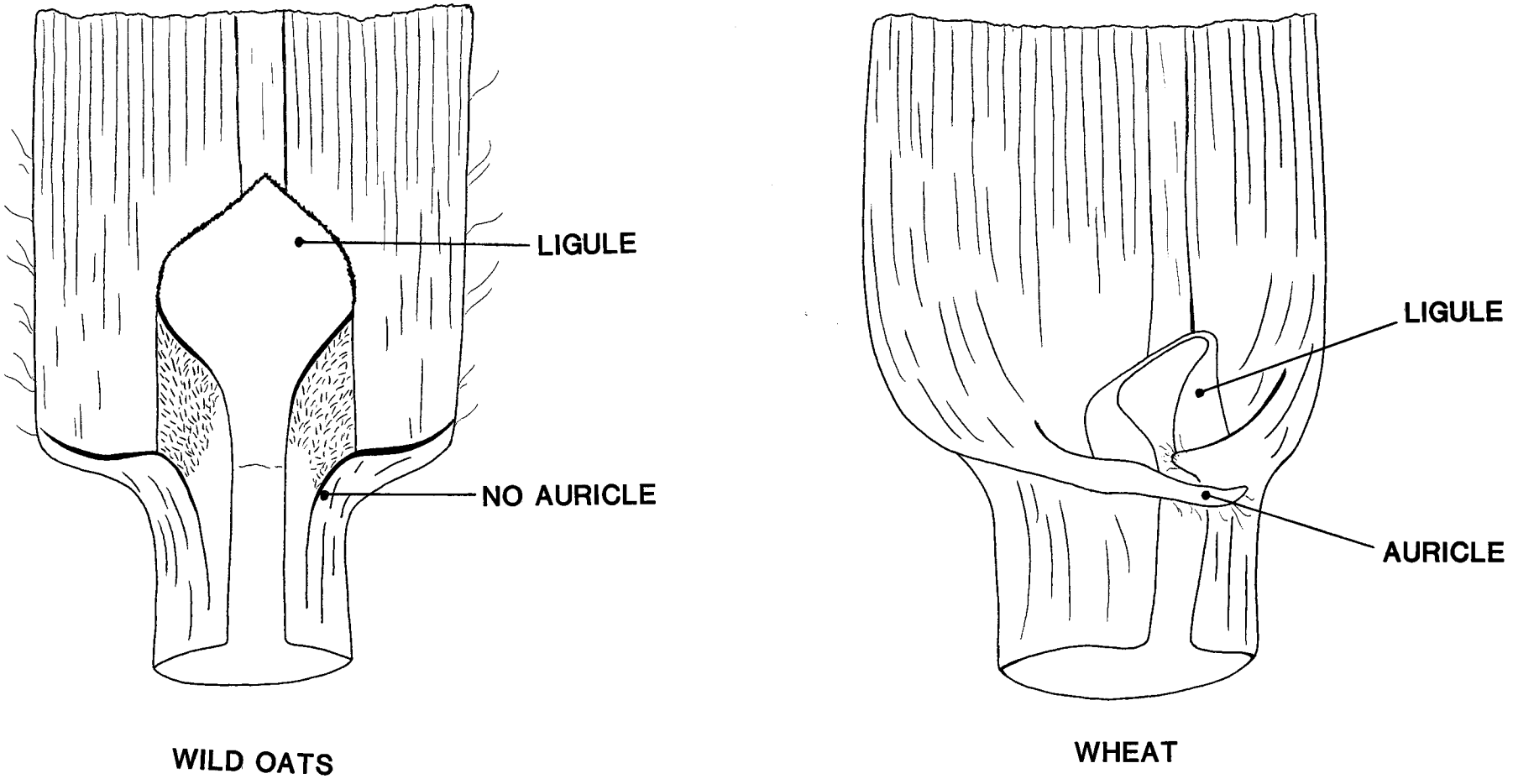

Figure 1. A distinctive ligule and an absence of auricles distinguishes wild oat from wheat (After Lee, et al., 1980).

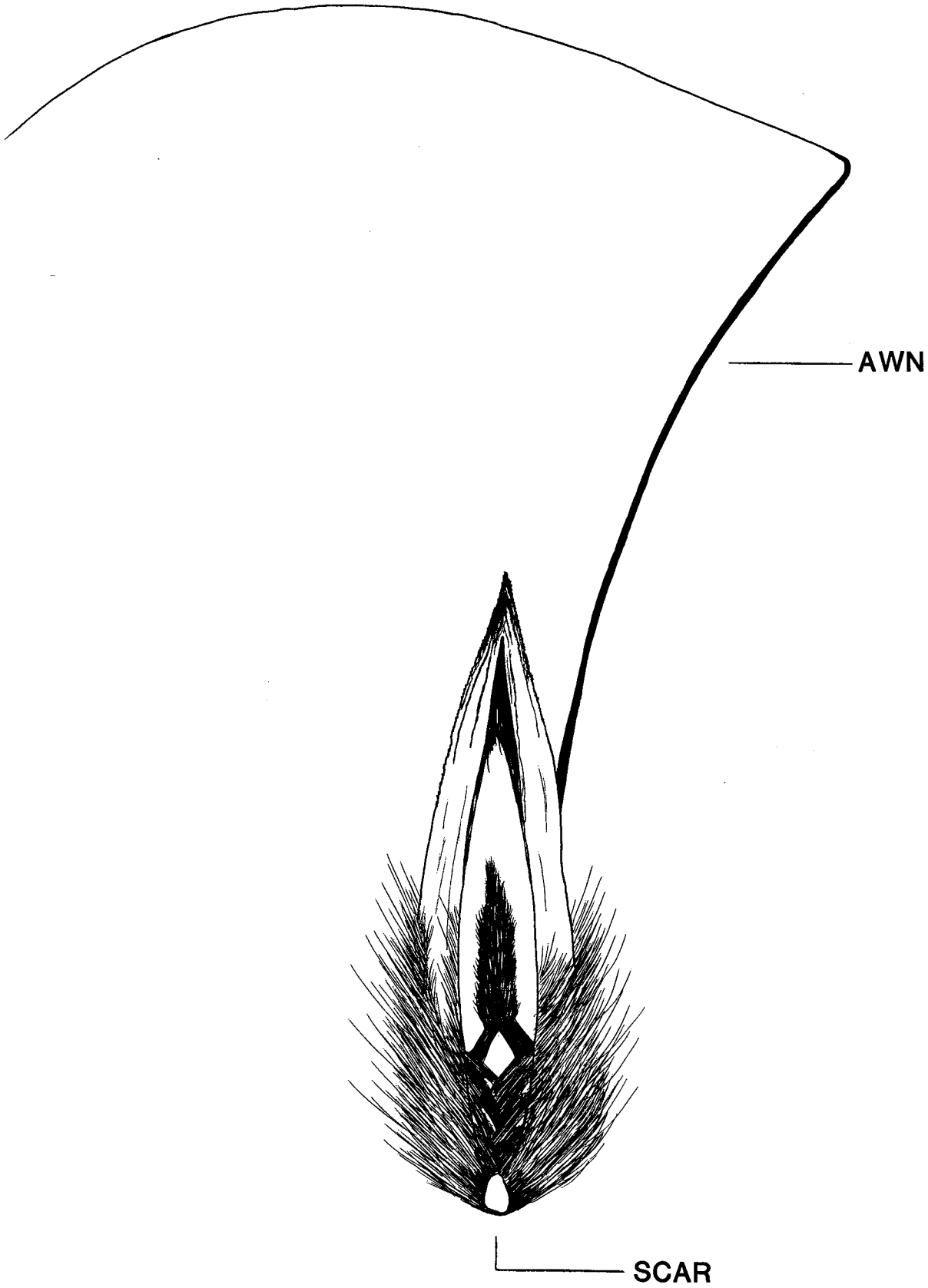

Figure 2. Wild oat seed have a hairy covering, a long black awn and a distinctive scar at the base.

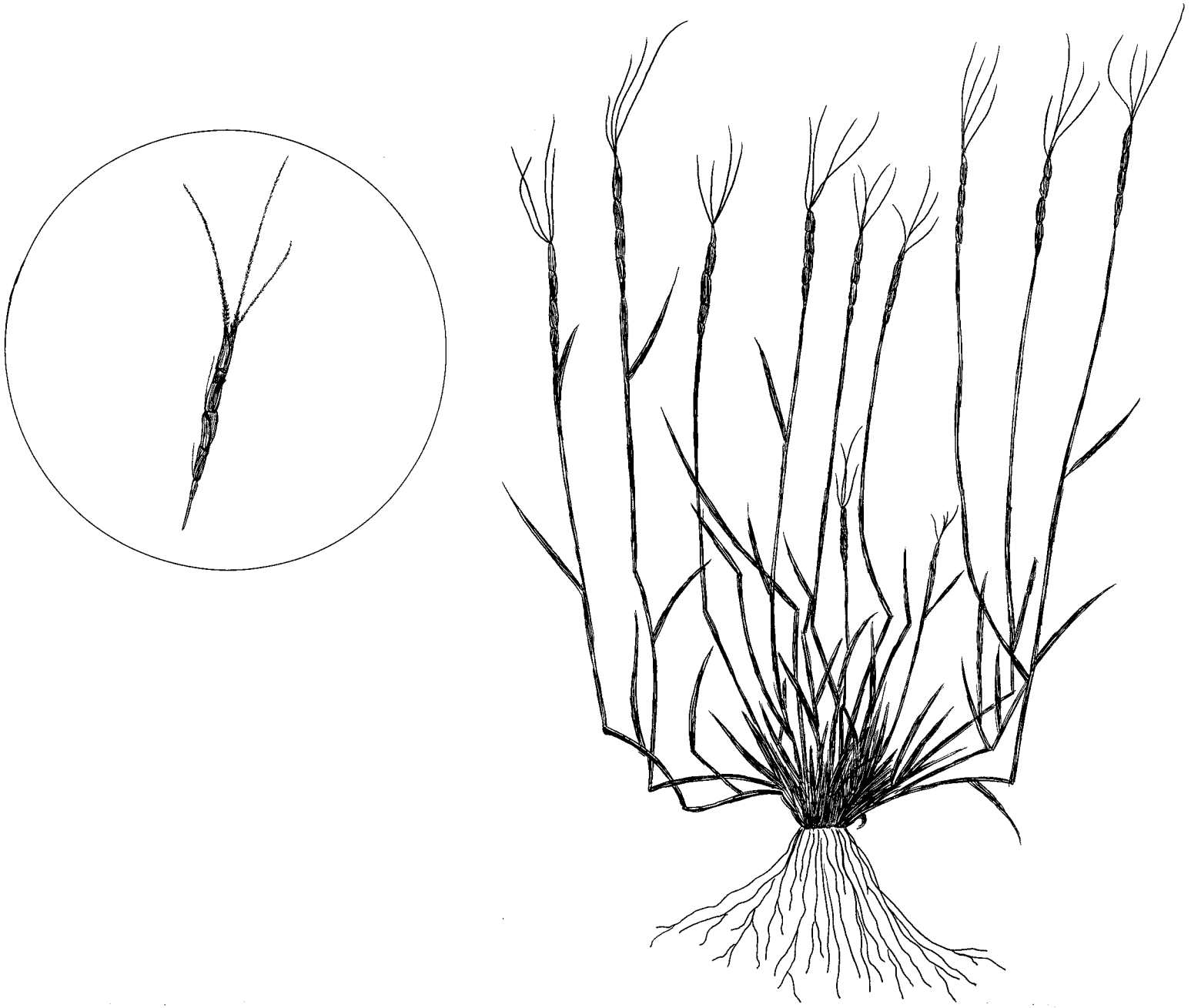

Figure 3. Jointed goatgrass plant with closeup of seedhead (After Fenster, et al., 1980).

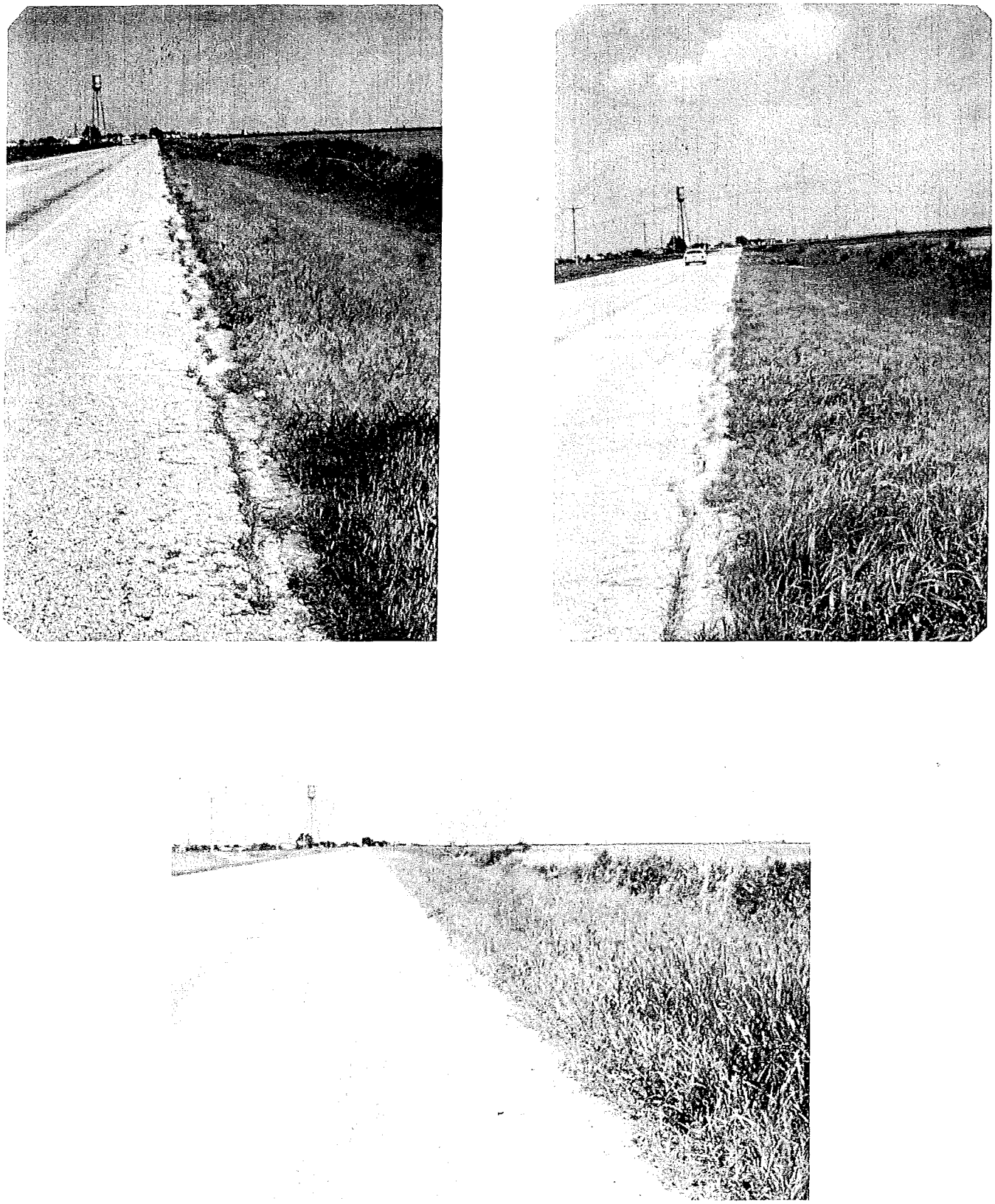

Figure 4. The same area treated with 1 1/2 lb ai/A glyphosate shows intial brownout two weeks post treatment (upper left), recovery of permanent grasses underway four weeks post treatment (upper right), and green perennial turf eight weeks post treatment (lower).

Figure 5. Glyphosate and the higher rates of haloxyfop, fluazifop-butyl and fenoxapropethyl drew a sharp line between treated and untreated goatgrass and wild oat eight weeks post treatment. Goatgrass plants were stunted and some were still green in plots treated with haloxyfop and fluazifop-butyl.

REFERENCES

Banting, J. D. 1982. Growth and Control of Wild Oat. Weeds Today. 13(4):1-4.

Correll, D. S. and M. C. Johnston. 1970. Manual of the Vascular Plants of Texas. Tex. Res. Found., Renner. 1881 pp.

Cure, L. B. 1983. Letter to F. L. Ragland, SDHPT, dated June 9, 1983.

Fenster, C. R., H. I. Owens and F. E. Westbrook. 1980. Jointed Goatgrass: How to Control It. U. S. Dept. Agr. Fact Sheet AFS 7-6-1.

Gould, F. W. 1969. Texas Plants: A Checklist and Ecological Summary. Tex. Agr. Exp. Sta. Misc. Public. MP-585 (rev.).

Greer, H. A. L. and T. Peeper. 1981. Wild Oat Control in Wheat. OSU Extension Facts No. 2772.

Henry, M. 1983. Letter to F. L. Ragland, SDHPT, dated July 12, 1983.

Hinsley, A. J. 1983. Letter to Terry Keener, SDHPT, dated May 31, 1983.

Lee, G. A., G. A. Mundt and M. E. Coleman-Harrell. 1980. Wild Oat: Identification and Biology. Univ. Idaho, Coll. Agr. Current Info. Ser. No. 540.

Palmer, R. D. 1984. Goatgrass Relationship Stops Control. Southw. Farm Press, p. 5, 18, Nov. 22, 1984.

Sharma, M. P. 1979. Wild Oat: A Billion Dollar Problem. Weeds Today. 10(3):5-6.

Siepel, C. 1983. Letter to Terry Keener, SDHPT, dated May 31, 1983.

Wilson, D. 1983. Letter to Terry Keener, SDHPT, dated May 26, 1983.

Wise, D. W. 1983. Letter to F. L. Ragland, SDHPT, dated July, 1983.