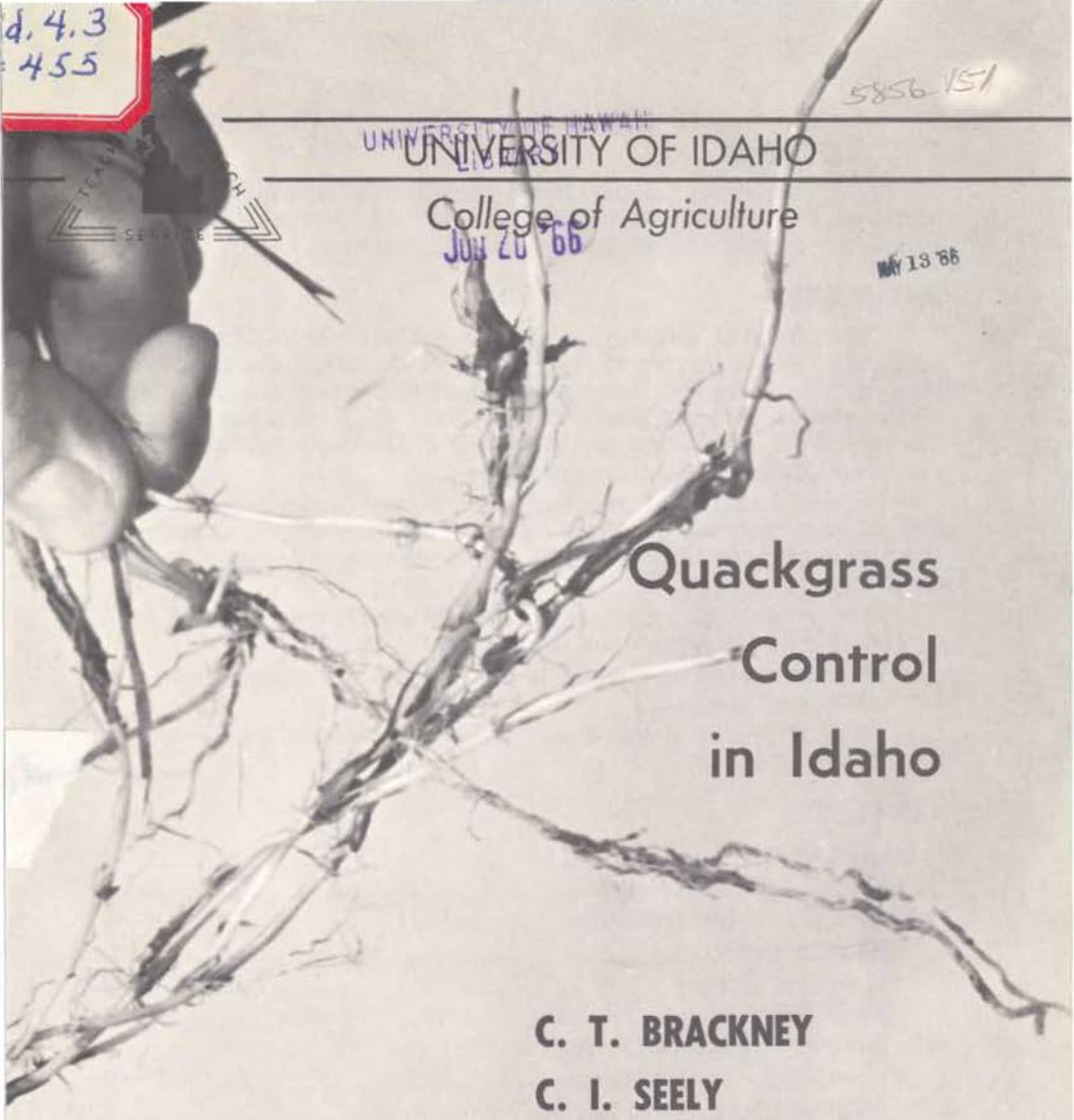
UNIVERSITY OF IDAHO
College of Agriculture



Quackgrass Control in Idaho

C. T. BRACKNEY
C. I. SEELY

IDAHO Agricultural Experiment Station

Bulletin No. 455
March 1966

THE AUTHORS

C. T. Brackney is Superintendent of the Sandpoint Branch Experiment Station and Associate Agronomist. Clarence I. Seely is Professor, Agronomist and Extension Agronomist.

SUMMARY

This study of quackgrass and its control was conducted over a 12-year period, largely at the Sandpoint Branch Experiment Station. At one time this weed pest almost eliminated the usefulness of the station for production of any crop. C. T. Brackney started his work with quackgrass at the station in the early 1950s. Quackgrass no longer limits crop production.

Effective control of quackgrass by tillage depends upon reduction of root reserves and dessication of the underground parts of the plant. Proper timing of cultural operations is essential to successful control.

Proper selection of crops for use on quackgrass infested land can be of material assistance in quackgrass control.

The proper use of chemicals is a desirable supplement to tillage methods of control.

Dalapon has been the most useful chemical for the control of quackgrass in Idaho.

CONTENTS

COVER PHOTO

The creeping underground stems of the quackgrass plant are one of its identifying features. Small pieces of these underground stems can produce new plants, making control of the plant difficult.

Quackgrass Control in Idaho

C. T. BRACKNEY

C. I. SEELY

Scope of the Problem

Quackgrass, **Agropyron repens** (L.) Beauv., is one of the most widespread weed problems in Idaho, occurring in all counties. The most severe infestations in the state are in Bonner County (20,000 acres) and Boundary County (17,500 acres).

As in all other northern states, quackgrass is a primary noxious weed in Idaho. Seed from fields for which certification has been requested becomes ineligible when uncontrolled quackgrass stands are present in the field or when quackgrass seed is found in the crop.

ADAPTATION AND IDENTIFICATION

Quackgrass is a perennial reproducing by means of seeds and jointed rhizomes (creeping underground stems). The rhizome system is concentrated from 3 to 6 inches below the soil surface. Each rhizome terminates in a hard, sharp point which can penetrate hard soils and will often grow several feet during a growing season. Vertical shoots and a fibrous root system are produced at each joint. Unrestricted quackgrass patches are roughly circular in outline, a feature typical of plants spreading by means of creeping underground roots or stems. Small pieces of rhizomes are capable of producing new plants, a factor which increases the difficulty of control.

Growth Habit

Quackgrass grows on practically any type of soil. It has a fairly high moisture requirement and is not a weed problem in low rainfall areas of the state except under irrigation. It has some tolerance to alkali conditions and considerable tolerance to poor drainage. Quackgrass has survived smothering conditions (ice) in

northern Idaho which destroyed stands of improved hay and pasture grasses. After establishment it is quite drought-tolerant.

Means of Spread

Quackgrass spreads by means of seeds and rhizomes. During tillage operations rhizomes are broken up and may be spread to clean fields. They become attached to cultivation equipment or cling to wheels of farm machinery. It is often spread from farm to farm in hay and grain crops and in bedding. Live seed may be present when forage crops are harvested for hay. When this hay leaves the farm, potential infestation goes with it.

Quackgrass has been widely spread through crop seeds. Its seed is difficult to distinguish and separate from many crop seeds. This is one reason certified seed is one of the wisest investments a farmer can make.

The seed of quackgrass is shorter-lived in the soil than that of many weedy plants. It retains its viability for a maximum of about four years (3,10). This, and the shallow rooted nature of the plant are distinct advantages to the farmer from the standpoint of effective control.

Identification of Quackgrass

In the vegetative stage, quackgrass is easily confused with bromegrass, ryegrass, and certain wheatgrasses. The following key can be used in separating these grasses. Organs used in identification are demonstrated in Figure 1.

A. Bunch grasses without rhizomes producing only a fibrous root system.
   1. Spikelet placed narrow edge to rachis—Ryegrasses
   2. Spikelet placed flat side to rachis—Slender Wheatgrass

B. Sod-forming grasses producing fibrous roots on joints of the rhizomes.
   1. Inflorescense a panicle, leaf sheath closed, auricles absent—Smooth Bromegrass
   2. Inflorescense a spike, leaf sheath split for entire length, auricles present.
      a. **Basal leaf sheath hairy overall.** Leaf blades sometimes hairy but not along leaf edges. Rapid spreading plants with little or no bunchiness ever showing. Seeds usually awned, may be only awn-tipped—Quackgrass
      b. **Basal leaf sheath hairy only along edges and continuing up leaf blade for a short distance.** Plants often show bunchiness due to slower growing rhizomes; usually awnless but sometimes awn-tipped—Intermediate Wheatgrass

A primary feature distinguishing quackgrass from intermediate wheatgrass is the date of maturity. Quackgrass heads 2-3 weeks ahead of intermediate wheatgrass.

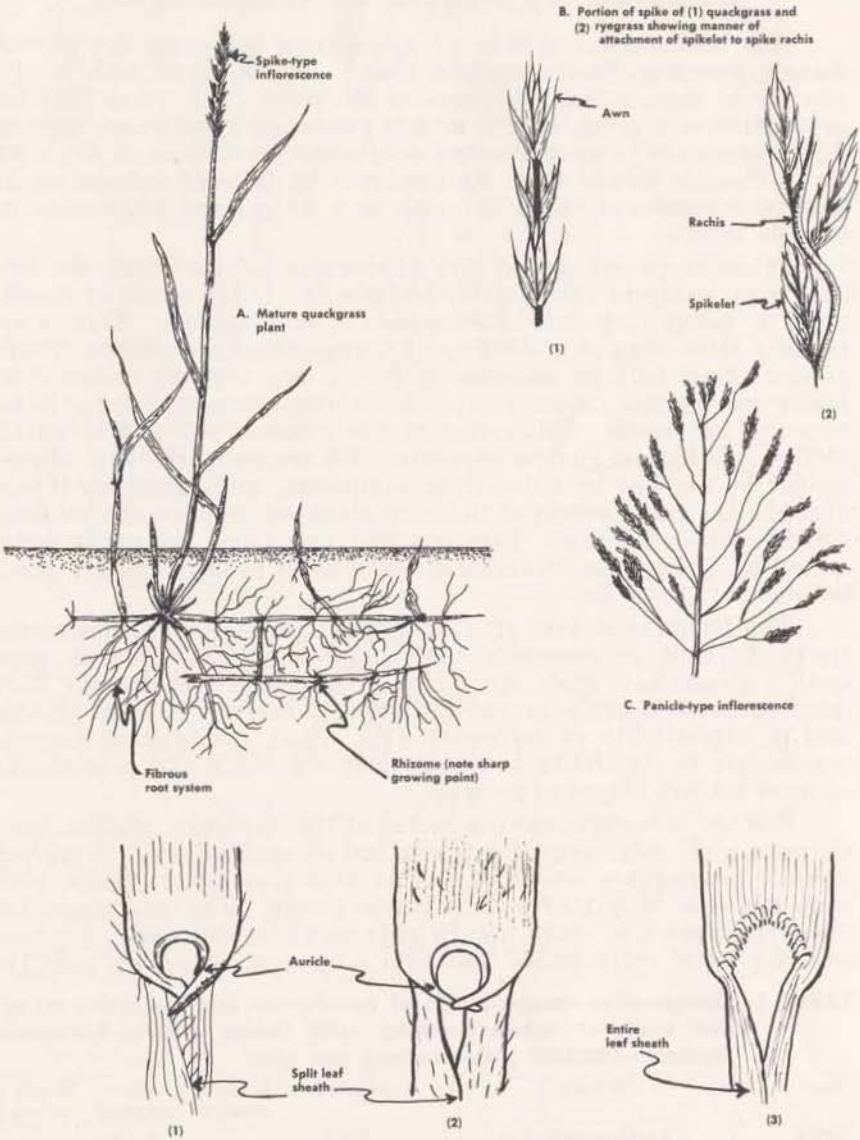


Figure 1—A. Mature quackgrass plant showing root and rhizome systems. B. Spike-type inflorescence, quackgrass on left and ryegrass on right. C. Panicle-type inflorescence found in bromegrass. D. From left to right portions of leaf blades and sheaths of intermediate wheatgrass, and quackgrass showing auricles and different positions of hairs on quackgrass and intermediate wheatgrass and bromegrass with neither hairs nor auricles.

DETRIMENTAL EFFECTS OF QUACKGRASS

The detrimental effects of quackgrass on crops are widely known; however, the conception that it can be lived with is still popular in some areas. Workers in Michigan (14) found that the production of a given weight of dry matter as quackgrass tops reduced grain yields more than an equivalent production of dry matter as Canada thistle tops. An apparent 28 percent infestation of quackgrass reduced yields as much as a 53 percent infestation of Canada thistle.

When crops are seeded into quackgrass infested land, the new crop must compete with established plants. If the stand of quackgrass is heavy, this will often result in crop failure. This is especially true when slow-developing forage crops are seeded. Yields of row crops such as potatoes and corn are severely reduced by heavy quackgrass stands due to the extreme competition for moisture and nutrients. Cultivation of row crops is not usually an effective quackgrass control measure. Rhizomes in the row proper cannot be reached by cultivation equipment, and extensive tillage disturbs the root system of the crop plant which normally extends rapidly across the row. Tuberous and root crops are easily penetrated by quackgrass rhizomes producing an inferior quality product.

The harmful effects of quackgrass in forage crops are sometimes difficult to recognize. Although quackgrass makes good quality grass hay when cut early, it has been shown that both bromegrass and early cut orchardgrass surpass it in total protein and in digestibility of nutrients (9). Also, bromegrass exceeds quackgrass in its ability to retain nutritive value and palatability at more mature stages of growth.

Pasture investigations conducted at the Sandpoint station have shown a yield advantage for a mixture of orchardgrass, Manchar smooth bromegrass and Alta fescue over quackgrass when both were growing in mixtures with ladino clover. The advantage for the orchardgrass mixture was 23 percent under dryland conditions and 26 percent on irrigated land over a two year period (Table 1).

TABLE 1: Comparative forage yields of quackgrass and the Idaho standard mixture* when growing with ladino clover. Sandpoint Station—1953-54 yields in tons per acre.

Year	No.	Mixture	Irrigated	% mix 1 of mix 2	non-irrigated	% mix 1 of mix 2
1953	1	Ladino-std. mix	4.65		2.27	
	2	Ladino-quackgrass	3.13		2.41	
				149		136
1954	1	Ladino-std. mix	2.95		2.67	
	2	Ladino-quackgrass	2.90		2.42	
				102		110
1953-1954 Ave.				126		123

* Standard grass mixture made up of Alta fescue, Manchar smooth bromegrass and orchardgrass.

Recent research in Europe and the United States (8) has shown that toxic substances are produced by quackgrass which inhibit the growth of crop plants such as alfalfa, wheat and oats. In those studies, yield and germination were reduced when these crops were either planted on quackgrass infested land or supplied with water which had been leached through quackgrass infested soil. In addition, there is evidence (7, 8) that dead quackgrass materials harbor some of the disease organisms which attack crop seedlings and cause certain root rots. These studies, however, indicate that these inhibitory substances disappear rather readily from the soil.

CULTURAL CONTROL OF QUACKGRASS

Spring growth and the regrowth after disturbance of quackgrass takes place at the expense of reserve food materials stored in the roots and rhizomes in the form of carbohydrates and other organic materials. Total reserves in an undisturbed stand gradually diminish from early spring to about the heading stage, reaching their lowest point about July 1 (1). During regrowth following tillage, reserves are utilized until leaves reach a height of 2-3 inches after which time the movement is reversed (3).

Reduction and exhaustion of root reserves is basic to effective quackgrass control, especially when weather or soil conditions make drying of underground parts difficult. Partial reduction can be achieved prior to cultural operations by placing stress on the reserves before cultivation is initiated. Heavy application of nitrogen fertilizer will induce more top-growth and a greater reduction of root reserves (3) and will reduce soil moisture supplies.

Heavy, close pasturing of quackgrass stands prior to cultivation will also assist in reducing root reserves. To be effective, top-growth should not be allowed to reach a height greater than 2-3 inches, so the demand will be almost continuous.

Shallow Plowing and Spring Toothing

Shallow plowing (4 to 6 inch deep) in the fall which exposes weakened rhizomes to freezing temperatures may result in a significant quackgrass kill, especially if low temperatures occur before snow covers the ground (3). This method is most effective when followed in the spring by further tillage. In areas where a late-seeded crop such as beans or corn is to be grown, cultivation at 10-day intervals from early spring until time to seed the crop will assist in control.

Drying Underground Parts

Very effective control of quackgrass is obtained by drying underground parts when weather and soil conditions allow. Basic

items to consider are when and how control measures should be initiated and how often they should be applied.

The stand should be allowed to grow to late hay stage (about July 1) to exhaust soil moisture. A spring application of 30-50 pounds of available nitrogen will induce abundant growth which aids in reducing soil moisture and root reserves.

Cultivation can be initiated either by shallow plowing or by repeated use of a spring toothed field cultivator. In the latter case cultivation should be shallow (1-2 inches). The machine should be adjusted to go slightly deeper each time over until all rhizomes are disturbed (3). Soil should be worked to a depth of about 4 inches.

Shallow plowing is the preferred method because all growth is stopped immediately and, when done properly, a large proportion of the entire mat of quackgrass rhizomes is exposed at once to the atmosphere. Plowing without subsequent tillage will not often give adequate control of quackgrass because of summer (heat) dormancy. Dormant rhizomes, when protected even in a well-dried furrow slice, are capable of regrowth and will re-establish the stand when good growing conditions occur.

When the furrow slices are dried, cultivation should begin. Heavy sods should be disked to cut the sod sufficiently to prevent implement clogging during subsequent cultivation. However, excessive use of the disk will cut rhizomes in such small pieces that the efficiency of cultivation equipment in dragging them to the surface will be impaired (Figure 2).

Figure 2—These quackgrass rhizomes were brought to the surface by the straight teeth of the field cultivator shown in Figure 3 and will be completely killed by a few days of exposure to a dry atmosphere.

Figure 3—A field cultivator of this type has proved to be a very effective implement for bringing quackgrass rhizomes to the soil surface. Note rhizomes on the surface in the foreground.

Control with Field Cultivator

An efficient tool for bringing rhizomes to the surface is a field cultivator (Figure 3). Equip the implement with straight teeth rather than duck feet since the latter are more easily clogged. The occasional use of a spring-tooth harrow will assist in breaking up large chunks of sod and clods which may keep small pieces of rhizomes from drying.

Frequency of cultivation will depend upon atmospheric conditions. In hot, dry weather most rhizomes will be killed in 4 to 5 days and the field can be reworked. Maximum delay between cultivations is about 10 days in order to prevent restoration of food reserves.

Cultivated fields will often show scattered quackgrass plants when growth starts in the spring. These plants usually have low vigor because of entering the winter in a weakened condition with low root reserves. Begin working the field as early in the spring as is practicable and cultivate at 10-day intervals until seeding time. This will usually eliminate most of the plants which have survived the winter.

Tillage following spring or fall grains in areas with a short growing season does not give adequate control of quackgrass when intensive tillage has not been applied during the preceding season. Harvest takes place too late and in a few of the northern Idaho counties abundant rainfall occurs too soon to allow effective control. Cultivation following harvest of spring grains gave a reduction in quackgrass stands in experiments conducted on the Sandpoint station, but control was not satisfactory. Quackgrass stands

TABLE 2. Comparison of results of quackgrass control attempts by tillage methods* following different crops. Sandpoint Branch Station. 1952-1954 inclusive.

Treatment	Date control initiated	Percent quackgrass stand			
		5-8-52	5-10-53	9-22-53	9-30-54
Plow 6" following hay harvest**	Aug. 15	100	8	3	1
Plow 4" following spring barley	Sept. 1	75	50	50	25
Plow 4" following winter wheat	Sept. 1	55	65	65	71

* All plots were worked at 10-day intervals with a field cultivator (Figure 3) following plowing until late fall.

** Repeated about Sept. 1 following spring oats in 1953 and 1954.

actually increased where tillage methods were used in conjunction with annual cropping to winter wheat (Table 2).

In irrigated sections of southern Idaho, the practice of cultivation following the harvest of early-maturing crops has been successful. This is true only where there is a relatively long growing season. It has been successfully used following the harvest of grain, peas, beans and either canning or silage corn. The field should not be irrigated after harvest. It should be plowed or otherwise worked immediately after harvest and cultivated at 10-day intervals until fall. Early-season cultivation before late-season crops such as beans or corn are seeded will assist in control.

After a field is free of quackgrass growth, a potential infestation is still present due to the ability of seeds of the weed to remain viable in the soil for a period of several years. Seedlings will appear in any crop planted. Grain stubble should be plowed or otherwise worked immediately after harvest. Cultivation should follow at 10-day intervals as late in the fall as land can be worked.

It has been recommended in some areas that quackgrass rhizomes be raked, hauled from the field, and burned. However, once quackgrass rhizomes are dried up, they are dead and incapable of growth. In addition, they will add significant amounts of organic matter to the soil although not as much as some improved grasses. Table 3 shows the relative root production per acre in the surface 6 inches of soil of various grasses grown in mixture with alfalfa on the Sandpoint station. In this case, quackgrass was volunteer.

CROP COMPETITION IN QUACKGRASS CONTROL

In warmer areas of the United States, smother crops are often recommended as an effective tool for quackgrass control (3, 16). To be effective, smother crops must produce a dense shade on the ground prior to significant emergence of quackgrass. Shade reduces the manufacture of food materials in the leaves by photosynthesis consequently limiting root growth and the storage of root reserves.

Smother Crops

The choice of smother crops under Idaho conditions is limited. In the south-central and south-western sections of the state, Sudan grass is recommended for temporary or emergency forage purposes. This crop, due to its rapid growth and thick stands, is effective as a smother crop (3, 11). It can be used only on irrigated land. In other areas of the state, oats and oat-pea mixtures harvested for hay or silage are about the only choice. This will not, in most cases, effectively smother out quackgrass, but dry out the soil and thereby provide for greater dessication from cultivation following harvest. The crop should be well fertilized to provide for rapid, rank growth and should be harvested early (about flowering stage) to permit late summer and fall cultivation. Tall-growing oat varieties such as Swedish Select and Victory should be used.

Adapted Grass-Legume Mixtures Effective Control

Quackgrass stands may build up in fields devoted to forage crop production. This is especially true when a legume such as alfalfa is seeded alone. The use of one or more well-adapted grass species in mixture with alfalfa and other legumes will not only greatly suppress quackgrass spread but also has many other advantages. Work done in Michigan (13) has shown that adapted smooth bromegrass varieties are effective agents in quackgrass control in that area and permit the initial control of quackgrass obtained by cultural operation to be spread over a period of several years. Similar observations have been made on the Sandpoint station with respect to other grass species. Good stands of orchardgrass effectively suppress the spread of quackgrass under northern Idaho conditions.

Grasses seeded outside or on the border of their best area of adaption will be suppressed if not completely crowded out by quackgrass. At Sandpoint, grasses such as slender, crested and intermediate wheatgrass were completely eliminated by quackgrass when planted on infested sites on the Mission soil series. Intermediate wheatgrass without quackgrass competition will usually survive on the Mission soil.

TABLE 3. Root production in tons per acre in the surface 6 inches of various grasses including quackgrass when grown in mixtures with alfalfa. Sandpoint Branch Station, 1959.

Mixture	Alfalfa	Grass	Total
		Tons per acre	
Alfalfa—Greenar int. wheatgrass	1.51	1.28	2.79
Alfalfa—Manchar sm. bromegrass	1.31	2.01	3.32
Alfalfa—Latar orchardgrass	1.46	2.96	4.42
Alfalfa—quackgrass (volunteer)	1.52	1.55	3.07

Other grasses including Bromar mountain bromegrass, Tualatin tall-oatgrass, Chewing fescue and creeping red fescue effectively resist invasion of quackgrass in northern Idaho. The latter

two species are good choices for seeding fence rows and roadways in order to prevent quackgrass invasion. None of these grasses will eliminate quackgrass, but they will effectively suppress its spread and resist its invasion.

Leguminous crops such as alfalfa, red clover, and ladino clover are not as sensitive to the vigorous competition of quackgrass as are some of the grass species until sodding conditions become extreme. However, it is desirable that adaptable grasses be planted with these legumes in order to resist quackgrass invasion.

CHEMICAL CONTROL OF QUACKGRASS

Chemicals are especially useful where tillage methods of controls are not practiced. It is vital that areas such as ditch banks, fence rows and other waste areas be cleaned up in order to eliminate a source of reinfestation of fields. Quackgrass can be eliminated from many such areas by judicious application of the proper herbicide. Chemicals may also find a place where, due to poor drainage or sub-irrigation, cultivation is ineffective.

During recent years, several chemical herbicides have been advertised as very effective in the control of quackgrass. Soil and climatic conditions have much to do with the effectiveness of the different chemicals in quackgrass control, and many of the tests upon which recommendations are based have been made under conditions very unlike those encountered in Idaho. Results on the Sandpoint station indicate that some chemicals claimed to be effective quackgrass killers under many conditions have absoluately no value in the northern Idaho area.

Chemicals for Spot Control

Five chemicals are of value in Idaho for spot control of quackgrass; however, all but one of these are too expensive for general field use. Cost for material alone will vary from about $15 to $100 per acre (See Table 4). Those which have proven to be effective are discussed below. All chemicals are somewhat hazardous to use; and the **directions for handling, including rates of application, given on the containers must be strictly followed.** In most instances, a second clean-up application will be required to kill plants missed by the first chemical application unless supplementary tillage control methods are used. However, in the tests run at Sandpoint station, the results indicated that if tillage methods are to be used, there is little advantage in using chemicals in combination.

MONURON (CMU) is a long-time soil sterilant which can be used along fence rows and ditch banks and around buildings for quackgrass control. A rate of about 25 pounds of the commercial product per acre is required. Under most conditions in the state, this material will be the most successful of the substituted ureas;

TABLE 4. Comparative cost of different herbicides when applied at rates sufficient to give good quackgrass control on non-cultivated land.

Material	Strength of commercial product	Suggested rate per acre	Approx. cost per acre for materials*
monuron (CMU)	80%	25 lbs.	$70
TCA	90%	100-150 lbs.	$40-$60
dalapon	85%	15 lbs.	$20
sodium chlorate	99%	800 lbs.	$120
atrazine	80%	15-20 lbs.	$55-$75
prometone	2 lbs. per gal.	5-7 gal.	$40-$60

* Costs vary depending upon quantity purchased and locality and hence these are guides only.

but under high rainfall conditions or conditions of excessive leaching, diuron (DCMU) may give better results and can be used at the same rate as monuron. Neither of these materials should be applied near any valuable plants or on cultivated ground since they are permanent soil sterilants when used at these rates. Follow the directions on the container for procedures and precautions to use in treating with these materials.

ATRAZINE is a long-time soil sterilant at high rates and a short-time soil sterilant at low rates of application. As a consequence atrazine may be used on either cultivated or non-cultivated land. Where cultivation is not possible rates of from 15 to 20 pounds per acre as required. On land which can be cultivated, rates of about 5 pounds per acre either in late fall or early spring can be used provided the area is to be planted to corn for 2 years. If a crop other than corn is planted injury can be anticipated. Rates of atrazine are markedly influenced by soil characteristics and directions on the container should be followed to avoid crop injury and to obtain the greatest benefit from this material.

PROMETONE is a liquid formulation of another soil sterilant that can be used for quackgrass control. It is chemically similar to atrazine but in tests conducted near Bonners Ferry during the period from 1962 to 1964 it proved to be a more effective herbicide where cultivation could not be practiced. Although more expensive per pound than atrazine the cost to obtain control was generally somewhat less. The period of soil sterility with prometone appeared to be shorter than with atrazine. Prometone is only registered for non-crop land use and directions on the label should be carefully followed.

SODIUM CHLORATE induces an intermediate period of soil sterility and in heavy rainfall areas may be used in cultivated fields. Applications should be made in early spring. In low rainfall areas, sodium chlorate should be restricted to uncultivated land and applied in the fall. A rate of about 5 pounds per square rod

sodium chlorate, so follow the directions on the container carefully. Sodium chlorate is usually applied dry.

TCA is a material which is generally being replaced by dalapon for quackgrass control. Its period of soil sterility is relatively short under most conditions, and it is frequently used in cultivated fields. Applications should generally be made in the spring by spraying the quackgrass when it is about 8 to 10 inches tall. A rate of 100-150 pounds per acre in enough water to give good coverage is required. TCA is corrosive, and care should be followed in its use. Plowing a couple of weeks after application has generally improved kills with this material.

DALAPON is at present the cheapest and easiest to handle of the quackgrass killers. Results have been somewhat erratic, but the application of 15 pounds per acre of the commercial form has been adequate where good control can be obtained with this material. Spring applications should be made by spraying quackgrass when it is 8 to 10 inches tall. Enough water should be used to ensure thorough coverage (at least 40 gallons per acre). Where cultivation is possible, shallow plowing of the treated area about 2 weeks after spraying has usually been an advantage.

The period of soil sterility from dalapon is relatively short; and in areas of the state with long growing season, some short season crops may be raised after its application. This method is extensively used in bean production areas. Dalapon is applied early. Plowing and seeding of the bean crop follow respectively at two-week intervals. Do not plant beans sooner than 4 weeks after application of dalapon. This has resulted in good bean yields but has not given complete quackgrass control. Dry tillage following bean harvest has been an affective method of weed control and will materially improve the kill. In making pre-planting treatments with dalapon, follow directions on the container label carefully to avoid crop injury and herbicide residues.

REFERENCES

1. Arny, A. C. 1932. Variations in the organic reserves in underground parts of five perennial weeds from late April to November. Univ. of Minn. Tech. Bul. 84.
2. Behrens, R., R. E. Nylund and H. L. Hansen. 1959. Cultural and chemical weed control—1959. Univ. of Minn. Ext. Folder 191.
3. Dunham, R. S., K. P. Buckholtz, L. A. Derscheid, B. H. Grigsby, E. A. Helgeson and D. W. Stamforth. 1959. Quackgrass Control. North Central Reg. Pub. No. 71.
4. Harrington, H. D. and L. W. Durrell. 1944. Key to some Colorado grasses in vegetative condition. Colo. Agr. Expt. Sta. Tech. Bul. 33.
5. Hitchcock, A. S. 1951. Manual of the Grasses of the United States. United States Dept. of Agr. Misc. Pub. No. 200.
6. Idaho State Weed Survey. Agronomy Dept., Idaho Agr. Exp. Sta. 1955.
7. Kommedahl, Thor and J. B. Kotheimer. 1957. The role of quackgrass in root rots of cereals. (Abs.) Phytopathology 47:21.
8. Kommedahl, Thor, J. B. Kotheimer and J. V. Bernardini. 1959. The effects of quackgrass on germination and seedling development of certain crop plants. Weeds, 7:1-12.
9. Morrison, F. B. 1948. Feeds and feeding. The Morrison Pub. Co. Ithaca, N. Y., pp. 423, 1086-1089.
10. Robbins, W. W., M. K. Bellue and W. S. Ball. 1951. Weeds of California. Calif. State Dept. of Agr. Pub.
11. Sylvester, E. P. and A. L. Bakke. 1958. Quackgrass and its control. Iowa St. Col. Ext. Serv. Leaf. WC-34 (Rev.)
12. Warren, Rex and Virgil Freed. 1953. Quackgrass. Ore. St. Col. Ext. Bul. 734.
13. Wolcott, A. R. 1951. Bromegrass as an effective agent in quackgrass control. Mich. Agr. Expt. Sta. Quar. Bul. Vol. 33-4, pp. 343-350.
14. Wolcott, A. R. and R. F. Carlson. 1949. Weed competition in small grains in the upper peninsula. Mich. Agr. Expt. Sta. Quar. Bul. Vol. 31:4, pp. 482-487.

N. R. 7152 4M—1-66

PESTICIDE RESIDUES: These recommendations for use are based on the best information currently available for each chemical listed. If followed carefully, residues should not exceed the tolerance established for any particular chemical. To avoid excessive residues, follow recommendations carefully with respect to dosage, levels, number of applications, and minimum intervals between applications and harvest.

THE GROWER is responsible for residues on his crops as well as for problems caused by drift from his property to other properties or crops.