Sampling Procedure Used to Estimate Number of Deliveries Made

The number of retail deliveries was estimated for each company by selecting a sample of route days and counting the deliveries made on these days in the route books. The retail routes were numbered, and the days of the year were numbered in pairs (consecutive days). (The days were numbered in pairs to avoid variance caused by unequal splitting of the route served by one man in two days.) Tippett's *Random Sampling Numbers* was used to select six digit numbers, the first three of which supplied the sample route number and the last three of which supplied the sample dates.

The samples for the number of wholesale deliveries made on mixed routes for both companies and the sample for the number of wholesale deliveries made on wholesale routes for one company were similarly selected. However, the data came from daily route reports rather than from route books.

The daily route reports for the other company did not contain the number of deliveries made for wholesale routes. For that company the number of wholesale deliveries made on wholesale routes was estimated by determining the average number of wholesale route days operated and the average number of customers per route. This estimate did not involve sampling.

Quackgrass CONTROL

Agricultural Experiment Stations of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, and Alaska and the United States Department of Agriculture cooperating.

STATION BULLETIN 434

JUNE, 1956

NORTH CENTRAL REGIONAL PUBLICATION NO. 71

FOREWORD

The material in this regional publication is based on research carried out as station projects by the contributing agricultural experiment stations. Although "quackgrass control" was organized as a sub-project under the NC-10 project, Eradication or Control of Weeds and Other Undesirable Plants, the research was not financed from allotments of the Regional Research Fund.

Contributions on the control of quackgrass were received from Alaska, Illinois, Iowa, Kansas, Michigan, Minnesota, Ohio, North Dakota, South Dakota, and Wisconsin. Authors of the bulletin are R. S. Dunham, Minnesota, editor; K. P. Buckholtz, Wisconsin; L. A. Derscheid, South Dakota; B. H. Grigsby, Michigan; E. A. Helgeson, North Dakota; and D. W. Staniforth, Iowa.

The authors acknowledge with thanks the assistance given them by other members of the Technical Committee: N. J. Volk, Indiana, administrative advisor; W. C. Elder, Oklahoma; O. H. Fletchall, Missouri; O. C. Lee, Indiana; N. E. Shafer, Nebraska; F. W. Slife, Illinois; R. L. Taylor, Alaska; C. J. Willard, Ohio; and J. W. Zahnley, Kansas.

QUACKGRASS CONTROL

Quackgrass is one of the more troublesome weeds plaguing farmers in the north central United States today. It can be controlled with proper cultural practices and with the use of certain chemicals. However, quackgrass is sometimes difficult to distinguish from other wheatgrasses or from perennial ryegrass and bromegrass. Therefore, a brief description of the plant is given, followed by methods of telling it from several other grasses.

HOW TO IDENTIFY QUACKGRASS

Quackgrass (*Agropyron repens* L.) is a perennial grass that spreads by seeds and underground stems (rhizomes). The rhizomes spread laterally in the upper 3 to 6 inches of soil. They are capable of producing new plants at each node (joint), so that this weed spreads rapidly, forming a dense sod.

Plants are normally 18 to 30 inches tall, depending upon soil fertility and moisture conditions.

The leaves are flat and about ¼-inch wide. The first ones produced in the spring are covered with a dense mat of fine, gray hairs on the base of the leaf blade and on the leaf sheath (lower, tubelike portion of the leaf that encircles the stem). Each succeeding leaf on the stem has fewer hairs, until the top leaves have few or none. These hairs are often invisible in the fall unless a magnifying lens is used.

The leaf blades are somewhat constricted below the tip. The leaf sheath is split and hairy, and the auricles are large and clawlike. (See figure 1.)

Rhizomes are 1/16-inch or more in diameter, white when young, and may be several feet long. The nodes on the rhizome, from which both new shoots and fibrous roots often arise, are scaly in appearance.

The heads ("spikes") are 3 to 5 inches long, with two rows of spikelets (small seed-bearing units). The flat side of the spikelet is toward the rachis (central axis of the spike), as shown in figure 1A. A spikelet may have 3 to 8 seeds. Each seed is about ½-inch long by 1/16-inch wide, and straw-colored to yellowish brown when ripe.

GRASSES CONFUSED WITH QUACKGRASS

Western Wheatgrass

Western wheatgrass (*A. smithii* Rydb.) is the species most often confused with quackgrass. The leaves of quackgrass are flat and relatively smooth, while those of western wheatgrass are rough on the upper surface, have saw-toothed edges, and are generally bluish green.

Quackgrass has hairs on the sheaths and at the base of the blades, especially on the lower leaves. It has short ligules and short clawlike auricles, as shown in figure 2. Western wheatgrass has no hairs on the leaf blades or sheaths. It has short ligules and long, non-clawlike auricles that are sometimes reddish brown.

Both grasses possess rhizomes and produce dense sods. The rhizomes of western wheatgrass, however, are less extensive. This usually results in small patches of the wheatgrass, easily killed by farming operations.

Ryegrass

Ryegrass is commonly mistaken for quackgrass in newly seeded lawns. Ryegrass seed is often included in lawn-grass mixtures because it germinates quickly

to give an early cover of grass. Frequent mowing, however, generally kills it.

Perennial ryegrass (*Lolium perenne L.*) and Italian ryegrass (*Lolium multiflorum Lam.*) cross freely when grown close to each other. The common or domestic or "annual ryegrass" is a mixture of types that probably resulted from hybridization. The mixture includes annuals and biennials or short-lived perennials.

Quackgrass can be distinguished from ryegrass by the presence or absence or rhizomes. Quackgrass has rhizomes and fibrous roots; ryegrass has only the fibrous roots. The leaves of ryegrass are smooth and glossy; the blades and sheaths of the lower leaves of quackgrass are hairy. Auricles of ryegrass vary from very small in the perennial types to prominent in those types that resemble Italian ryegrass. The auricles of quackgrass are clawlike.

After heading, quackgrass can be distinguished from ryegrass by the way the spikelets are attached to the rachis, as shown in figure 1 (A and C).

Slender Wheatgrass

Slender wheatgrass (*A. trachycaubum* Maltes) can be distinguished from quackgrass most easily by the root system and type of growth. Quackgrass has a rhizomatous root system that forms a dense sod. Slender wheatgrass has a fibrous root system and bunch-type growth. Moreover, quackgrass has hairs on the blades and sheaths of the lower leaves and clawlike auricles (see figure 2), while slender wheatgrass has smooth leaves and little or no auricle. Both have hairs on the ligules.

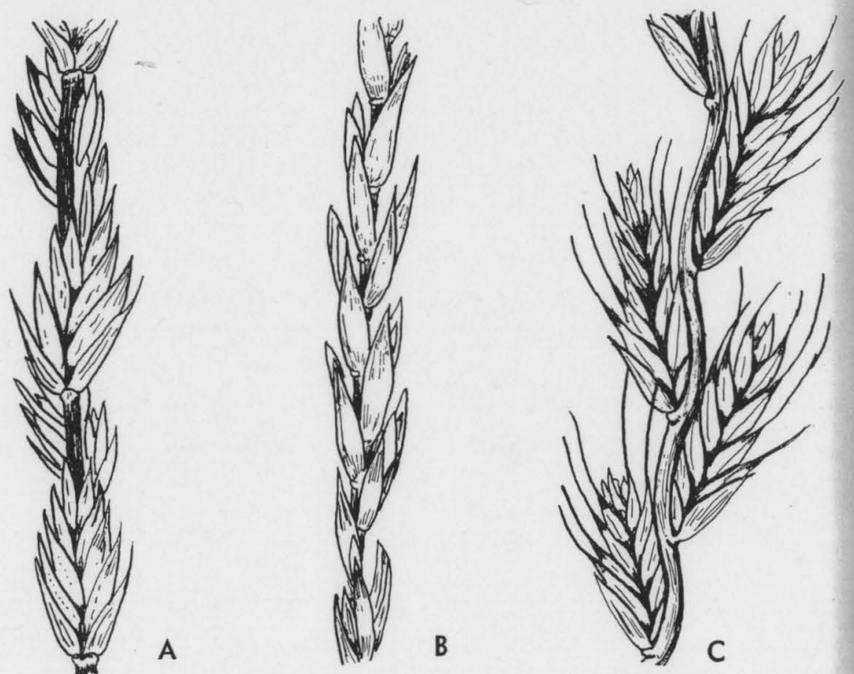

Fig. 1. Portions of spikes of quackgrass and perennial ryegrass. (A) Side view of quackgrass showing how flat side of spikelet is attached to the rachis. (B) A view of the same spike of quackgrass shown in A after it was turned one-fourth turn. (C) Ryegrass spike viewed from same angle as in B, showing that the narrow edge of spikelet is attached to the rachis.

edges to overlap. This characteristic is shown in figure 2.

The ligules of quackgrass are short, while those of bromegrass are larger.

Table 1. Summary of vegetative characters by which quackgrass can be distinguished from several other grasses

Grass	Growth Habit	Leaf blade*	Leaf sheath*	Rhizomes*	Auricles*	Ligule*
QUACKGRASS	sod-forming	flat, smooth, hairy at base	hairy, split, overlapping	white	short, clawlike	short
BROMEGRASS	sod-forming	flat, smooth	smooth, continuous	tan	generally none	large, smooth
WESTERN WHEATGRASS	sod-forming	rolled, rigid, rough upper surface; saw-toothed edges	smooth, split	tan	long, colored	minute, smooth
SLENDER WHEATGRASS	bunch-type	flat, smooth	smooth, split	none	none	minute, hairy
RYEGRASS	bunch-type	flat, smooth	smooth, split	none	short	very short, membranous

** For location of these plant parts, see figure 2.*

Bromegrass

Bromegrass (*Bromus inermis* Leyss.) is sometimes mistaken for quackgrass, before either grass produces flowers. Both are rhizomatous and sod forming, but the rhizomes of quackgrass are white when the plant is young, while those of bromegrass are generally larger in diameter and tannish brown. Both grasses have flat, smooth, relaxed leaves. However, the blade and sheath of the lower leaves of quackgrass are hairy; those of bromegrass are smooth.

Both grasses have a constriction that resembles a "W" on the leaf blade. The location of the constriction is helpful in telling them apart. It occurs about three-fourths of the way up the blade on quackgrass and other wheatgrasses, one-half the way up on bromegrass.

The leaf sheath of quackgrass is open, and the margins overlap when the plants are young. The sheath of bromegrass is a continuous membrane that forms a complete tube around the stem and has no

Quackgrass has clawlike auricles; bromegrass generally has none (figure 2). The spike of quackgrass is shown in figure 1. The spike, when contrasted to the loose panicle of bromegrass, serves to distinguish the two grasses after flowering time.

A summary of vegetative characters of quackgrass and those grasses often confused with it is given in table 1.

SOURCE OF SPREAD AND INFESTATION

Quackgrass spreads by seed and by underground stems or rhizomes. It produces a great quantity of viable seeds, which may retain their ability to germinate for at least four years in storage or in the soil. It is difficult to separate the seeds of quackgrass from those of many of our common grasses. Crop seeds—especially the seed of grasses such as brome or crested wheatgrass—must be cleaned with extra care. If at all possible, sow only certified grass seed.

Hay, screenings, or other forage in-

fested with quackgrass often serve to spread its seed to new areas. Manure, mud on implement wheels or on the feet of animals, and improperly cleaned seeding or threshing equipment can also spread quackgrass to new locations.

An important source of spread is the rhizomes. These underground parts produce numerous buds, each capable of starting a new plant. They may grow through the soil for considerable distances, producing new shoots at frequent intervals. Rhizomes may be carried on the plow, on other tillage implements such as the field cultivator, or in pieces of mud on tractor or truck wheels—and thus spread the weed to uninfested fields. Topsoil brought in for spreading on new lawns should be chosen carefully, since it may be infested with quackgrass rhizomes.

CULTURAL CONTROL

Control of quackgrass on a field scale usually is attempted by cultural methods. These have the most success when tried before the field is planted to a crop. The aim is to destroy the top growth and all or most of the rhizomes. This can be done by (1) starving the plant by reducing its food reserves, (2) drying the rhizomes and top growth so that they die, and occasionally (3) exposing the rhizomes to freezing. Control of quackgrass by cultural operations depends on one or another of these methods, used alone or in combination.

Reduction of Reserves

The rhizomes of quackgrass normally have a large supply of carbohydrates and other food reserves that enables the plant to make shoot growth in the spring, or after a tillage operation that has destroyed the tops. Production of new shoot growth uses some of this stored reserve. Continually removing new shoot growth, before significant amounts of carbohydrates can be produced in the leaves and transferred to the rhizomes, will reduce reserves. If the top growth is removed a number of times, the rhizomes become weakened and die.

If this method is to be successful, the plant must not be allowed to build up its reserves. Food reserves are used until leaves are 2 or 3 inches long. After that it is probable that the plant is restoring, rather than reducing foods in the rhiomzes. Satisfactory control of quackgrass by cultivation requires frequent, timely tillage over a period of several months at least. It can usually be eradicated if tillage is continued one season—but the method is time consuming and the soil will be subject to erosion. If the quackgrass is allowed to make an abundant leaf growth, even occasionally, there is no possibility of complete depletion or complete control. When the grass is growing in fertile soil or has received an application of nitrogen-containing fertilizer, depletion is accomplished more rapidly.

Weather conditions during the spring usually do not favor killing quackgrass by drying. Best results during the spring, therefore, follow use of a cultivation program that reduces the food reserves of the plant. If the area has been fall-plowed, cultivate it whenever the leaf growth reaches 2 or 3 inches. Cultivate as late in the spring as possible before it is necessary to put in a crop. Then sow immediately after the last cultivation.

An implement which shears off the shoot growth is more effective than one that pulls the rhizomes to the surface. If there is considerable trash on the surface of the soil, a sharp disk may be most useful. Cultivators with sharp duckfoot shovels can be used if trash is not present.

Quackgrass-infested fields frequently must be plowed in the spring. If an early sown crop is planned, opportunity for control is limited. Allowing the quackgrass to start its growth, and then plowing it under deeply, gives some practical control. Since the plant is buried deeply, it is forced to produce a long shoot to reach the surface. This delays reappearance and weakens the weed. A crop which has been sown as soon after plowing as possible can then establish itself before regrowth of the quackgrass becomes serious. Deep plowing alone, however, is of limited value in reducing the infestation.

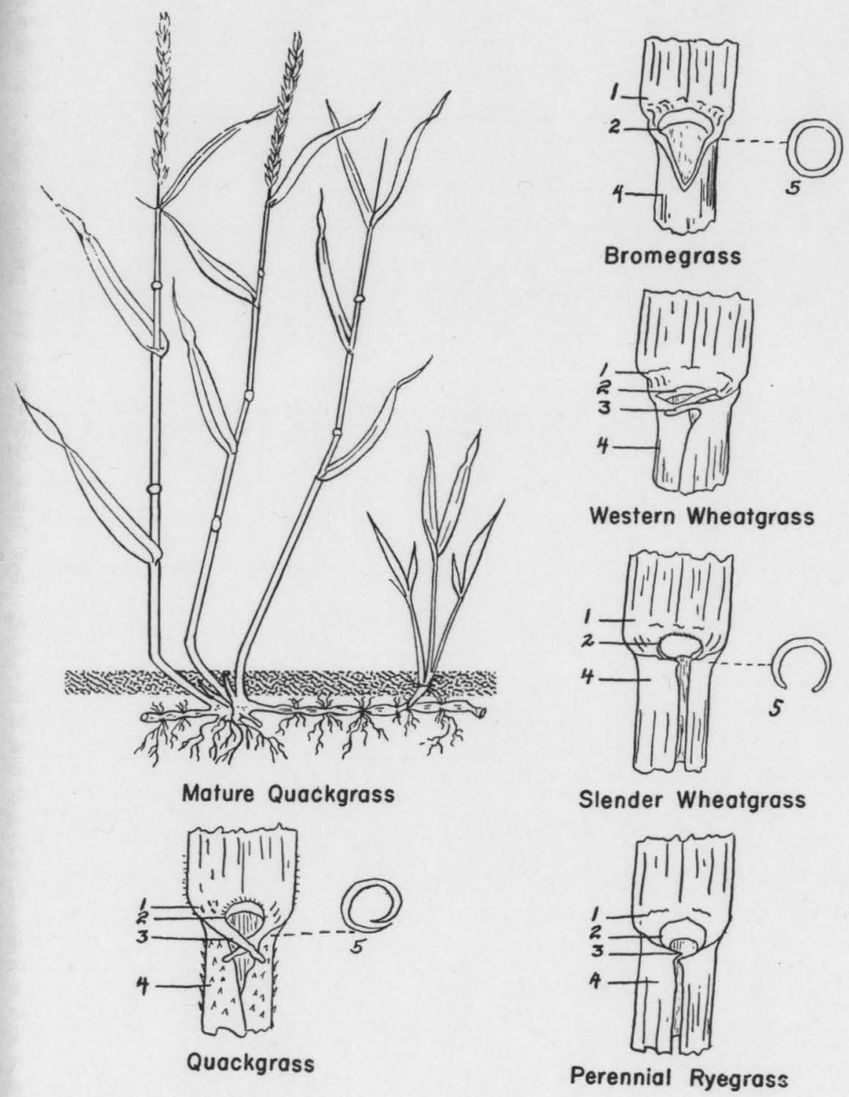

Fig. 2. A mature quackgrass plant, with a young plant growing from the same rhizome. The detailed drawings of the young leaves of Quackgrass, Bromegrass, Western wheatgrass, Slender wheatgrass, and Perennial ryegrass show the difference in (1) base of the leaf blade, (2) ligule, (3) auricles, (4) leaf sheath, and (5) the cross-section of the leaf sheath.

Drying of Underground Parts

Quackgrass roots and rhizomes can be killed by drying. The drying process is most successful during the summer and fall, when the temperature is high and the humidity low and the rhizomes become fully exposed to the drying section of the air.

It is not possible to expose all of the rhizomes at one time, because they are so thoroughly mixed in with the surface soil. Repeated cultivations are necessary to bring to the surface all fragments that have been buried. Cloddy soils require more thorough tillage than loose soils. Quackgrass fragments enclosed in clods, partially covered with soil, or anchored to the subsoil are not likely to be dried sufficiently to be killed.

Under favorable conditions, killing will occur in 4 or 5 days. During dry periods, frequent tillage is desirable to expose as large a portion of the rhizomes as possible. A heavy duty, spring-toothed field cultivator has been most successful for this operation. The implement must be sturdy and capable of close adjustment. Considerable power is required to operate this tool in heavy infestations.

Best results are obtained from working up old hay fields and pastures. In such areas the underground growth of the quackgrass is predominantly within 2 or 3 inches of the surface. Consequently, the cultivations need be only a few inches deep. The sod on old fields may be very dense, but usually can be broken up if the implement is set to go only an inch or two deep during the first operations. The sod is broken more thoroughly by cultivating the field in several directions.

After the surface is broken, adjust the implement to cultivate more deeply. All of the rhizomes can then be loosened. The springing and dragging action of the teeth tends to lift the fragments of rhizomes to the surface.

Implements which have the teeth set closely may become clogged if there is a dense mass of quackgrass rhizomes. This can be overcome in part by removing some of the teeth from the cultivator, or by tilling the area with a sharp disk. Disking cuts the rhizomes into smaller fragments.

In some areas, a spike-toothed harrow or rod weeder is used to aid in bringing rhizomes to the surface. Local soil conditions and the equipment available will determine this part of the program.

Under extreme conditions, the rhizomes are sometimes raked together and hauled from the field. This is not only laborious—it also results in the loss of organic matter useful in preventing erosion and in maintaining the physical condition of the soil.

Frequency of tillage depends on the weather conditions during late summer and fall. Under good drying conditions, it is beneficial to till the area as frequently as every 4 or 5 days. However, the physical structure of some soils is seriously damaged by tillage during damp periods. If such weather persists, the most practical procedure is occasional tillage with a disk whenever a few inches of leaf growth develop. Such treatment will deplete the quackgrass reserves and will tend to weaken the growth of the weed.

Very dense sods are sometimes plowed before attempting the tillage operations. Under such conditions, plow very shallow. Otherwise, burying the quackgrass rhizomes contained in the upper layer of the soil makes it more difficult to bring them to the surface for drying. The sods on fields that have been plowed are likely to clog the cultivator. Disking the plowed areas will pulverize the sod strips sufficiently to avoid this difficulty. Ordinarily there is no benefit derived from plowing before starting cultivation.

Grazing the field closely during the spring and summer prior to cultivation reduces the vigor of quackgrass to make control easier. If the quackgrass is harvested from the area as hay, start cultivation soon after the first crop has been removed. When two cuttings of hay are taken, the season is usually so far advanced that best conditons for drying are past. Fertilization, with the equivalent of 50 pounds or more of nitrogen in the early spring of the year tillage is started, will increase the yield of hay or forage on the area and thus aid in reducing the food reserves stored in the quackgrass rhizomes.

Freezing of Underground Parts

Rhizomes exposed to the air over winter are likely to be killed. Drying occurs during the winter, and if temperatures are lower than about 20° F. the rhizomes may also be killed by freezing. Quackgrass and other perennial plants usually escape injury during the winter because of the insulation offered by the soil itself as well as by stubble and snow on the surface.

For control by this method, it is essential to expose as many of the rhizomes as possible late in the fall by tillage. Even then, many of them will remain covered with soil—so complete kills should never be expected following such treatment. An early snowfall prior to killing temperatures can also provide sufficient insulation for the rhizomes, so that killing rarely occurs under such conditions.

Leave fields that have been broken up in the fall as rough as possible at the last cultivation before winter. This will reduce wind and water erosion and may result in some additional kill of the quackgrass by freezing. Quackgrass plants that have been weakened by tillage, and have not had the opportunity to build up reserves, will be injured more severely by winter temperatures.

If the infested area cannot be cultivated during the early fall months, some beneficial effects will follow late fall tillage alone. Since the control will be obtained only on plant parts exposed on the surface, make every effort to loosen as many of the rhizomes as possible. The success of these practices is variable—but a significant reduction in stand results if the winter is open and freezing weather occurs before snowfall.

In Crops

Corn offers an opportunity for control of quackgrass by tillage during the growing season. Most thorough control results when the crop is planted in checked rows. This allows cultivation in two directions and reduces the uncultivated area to a small space immediately around the hills. The use of checked corn is not satisfactory, however, where contouring and strip cropping is necessary to control erosion.

Cultivation of quackgrass is also possible in potatoes, soybeans, and other row crops. But with crops planted in drilled rows, cross-cultivation is not possible.

Cultivation for control of quackgrass in a growing crop is handicapped because the crop plants should not be disturbed. Corn plants rapidly develop a root system that extends across the rows.

Injury to corn is more likely the more deeply the field is cultivated and the closer to the corn plants the soil is tilled. The root pruning resulting is frequently not recognized, but careful studies have shown that it occurs in many fields.

A cultivator fitted with sharp duckfoot shovels is the most practical tool for reducing injury of this type. Use of narrow shovels requires deep tillage to break up the soil surface and secure control of annual weeds. Quackgrass fragments which such tools bring to the surface are not likely to be killed by drying, because the weather is usually too cool and moist during the cultivating season to allow much killing. Broad shovels cut the shoots and leaf growth to prevent the plant from increasing its reserves. Regrowth occurs, but the plant is progressively weakened.

Sudangrass, Japanese millet, common millet, buckwheat, and closely drilled soybeans are possible choices as smother crops. These crops make their best growth when sown late in the spring and when fertility and moisture conditions are favorable. The growth of the cover crop must be rapid and very dense to get the maximum control. Most smother crops are best used as silage or pasture, although hay may be obtained from some of them under good drying conditions.

In Gardens

Quackgrass is often the most serious weed in gardens. It makes such a prolific growth during the spring that the small seedlings of vegetable crops are greatly handicapped. Hoeing and hand weeding

are effective, even though the quackgrass produces new growth within a few days.

It is impractical to use field equipment in gardens, as a rule, but where possible it should be employed. Usually there is no opportunity to lift the rhizomes to the surface to kill them by drying, but reduction in reserves can be accomplished without undue difficulty.

Garden areas infested with quackgrass should be planted to crops with vigorous seedlings or to crops that are transplanted. Corn, tomatoes, cabage, and squash are good choices. Do not plant small-seeded vegetables such as carrots, beets, and onions in quackgrass-infested areas. Large-seeded vegetables such as sweet corn or beans, or transplanted crops such as cabbage or tomatoes, do best in these areas—for, being widely spaced, they can be hoed readily.

In order to eliminate quackgrass by reducing its reserves, remove the top growth as rapidly as it appears. This will probably require hoeing or cultivation once a week during the spring months. During the summer the quackgrass will not recover as rapidly. Removal of the top growth every 2 weeks may be sufficient.

Quackgrass renews its growth during the cooler months of fall. If the infestation persists until this date, keep the top growth removed. Very often control programs in gardens fail because the remnant of quackgrass left in the soil in the fall is allowed to re-establish itself. Spading the infested areas in the late fall will expose many of the rhizomes to the air. This will help reduce the weed through the drying and freezing action that takes place over winter.

Either a sharp hoe or a small hand cultivator fitted with a sharp, flat blade will remove quackgrass shoots. It is necessary to sever the tops completely from the underground parts. Use of a tined tool is not satisfactory. Such a cultivator disturbs the soil and kills small weed seedlings—but it does not cut off the tops of quackgrass. Hoeing or cultivation will be more satisfactory when made frequently.

If the quackgrass is allowed to grow for a week or two, it will produce such a dense shoot growth that hoeing will be much more difficult. Pull stray shoots of quackgrass in the row or around the vegetable plants by hand. If allowed to remain, they will re-infest the area.

Some vegetables give a dense shade and serve as smother crops. Squash and pumpkins are most satisfactory. Use of these crops will reduce the hoeing otherwise needed late in the season. When using them, prepare the plot normally. Then plant somewhat more thickly than normal. Afterwards hoe or cultivate the area frequently enough to prevent the quackgrass from making more than an inch or two of growth. Continue the tillage until the crop has covered the area densely and it is no longer possible to work without damage to the crop.

A similar smothering effect can be obtained on small patches of quackgrass by covering them with heavy tar paper, sheet metal, or any weather-resistant material that will exclude light. If the shading material is left in place throughout one growing season, complete kills should be obtained.

In Lawns, Fruits, and Ornamentals

It is best to eliminate quackgrass from areas to be in lawns, small fruits, or various ornamentals before the planting is established. Repeated tillage by hand or by machinery for at least one season will be required. Crops which can be clean-cultivated may be grown on the area during this time. If plantings must be made in quackgrass-infested soil, the weed may be kept under control by digging and pulling the rhizomes. Unless this is done, the area will soon be completely infested and will have to be abandoned.

Partial control of quackgrass in lawns can be obtained by two management steps:

1. Water the lawn enough so that the grass never suffers from drouth.

2. Clip the grass about once a week at a height of about 1½ inches to maintain the lawn grasses in good vigor and to produce a firm dense turf.

These practices will be harmful to quackgrass because it does not have foliage capable of making the same short, dense growth as lawn grasses. The quackgrass will gradually thin out and, after a year or two of such management, will not likely be of much importance.

CHEMICAL CONTROL

Chemicals effective in eradicating quackgrass either are expensive or prevent use of the treated land for one or more seasons. This has resulted in a limited use of chemical control methods on large areas. Lower rates of application and cheaper treatments can be used to suppress growth for a season. The methods suggested below are of value chiefly for the control of small patches of quackgrass, to prevent the spread of infestation. Unless otherwise indicated, the chemicals should be applied as a water spray at a volume of 2 to 4 quarts per square rod.

Chlorate

Sodium chlorate will destroy quackgrass, but the chemical may remain in the soil for one or more growing seasons. Soil type and amount of rainfall affect the time required for dissipation of the chlorate. Apply 3 to 5 pounds per square rod in the fall.

CAUTION: Sodium chlorate is a definite fire hazard. Sodium chlorate itself will not burn, but if mixed with organic matter or sulphur the mixture becomes explosively inflammable and can readily be ignited by friction or a blow. Take every precaution possible to prevent the spilling of chlorate or its solution on floors or on truck beds. Remove clothing which has become wet with chlorate spray at once, and wash thoroughly. Use rubber boots instead of leather shoes when working with chlorate.

Dry applications of sodium chlorate are much less likely to produce a fire hazard in the treated areas than spray treatments. Livestock grazing in areas where the dry material has been spread may become poisoned by chlorate, especially if the animals do not have access to sufficient salt. Hence, it is advisable to keep stock away from treated areas until all crystals of chemical are dissolved by dew or rainfall.

TCA

Sodium trichloroacetate, TCA, is effective for control of quackgrass when applied in late summer or early fall. For best results apply 20 to 40 pounds per acre (⅛ to ¼ pound per square rod) after a thorough cultivation. Treatment with TCA at a rate of 80 to 100 pounds per acre (½ to ⅝ pound per square rod) is effective on undisturbed quackgrass sod. Removal of the top growth and a light disking after treatment will increase the kill.

TCA disappears from soil more rapidly than sodium chlorate. But in sub-humid regions, the residual effects from fall applications may extend into the next growing season. Potatoes, flax, sugar beets, asparagus, alfalfa, birdsfoot trefoil, and oats generally are not affected by such residues. Fall-sown grains, corn, soybeans, field beans, and red clover may be severely damaged by residual TCA.

Monuron

The chemical 3-(p-chlorophenyl)-1, 1 dimethylurea, monuron, destroys most kinds of vegetation. It may be used to control quackgrass on nonagricultural land. Application of ⅛ to ¼ pound per square rod (20 to 40 pounds per acre) will give a complete kill, but toxic effects may persist for 2 to 4 years. Spring or fall applications generally are most effective. Cultivation, before or after treatment, does not affect the ultimate action of monuron but may reduce the immediate effectiveness.

Do not apply monuron to areas where feeder roots of trees or shrubs may be present, nor to areas where surface drainage may carry the chemical to desirable turf or ornamental plantings.

MH

Maleic hydrazide, MH, can be used for temporary suppression of quackgrass. Four to six pounds per acre, applied in spring or summer when the grass is 4 to 10 inches high and followed by plowing or thorough disking 4 to 8 days after treatment, will give seasonal control. Crop seeds sown after MH treatment are not affected by the chemical. Therefore, this method is useful in home gardens as well as in farm lands. Repeated use of the method for two seasons may be required for complete eradication of quackgrass.

Dalapon

Dalapon—sodium salt of 2, 2-dichloropropionic acid—is effective when applied to quackgrass that has a good growth of foliage from 4 to 10 inches tall. Fall treatments of 10 pounds per acre, followed in a week or two by plowing or other soil preparation, will give good control of quackgrass the following year. Repeated treatments will be necessary for eradication. Crops sown in the spring on treated areas will not be affected following such an application.

Dalapon may also be applied to quackgrass leaf growth in the spring. Application of 5 pounds per acre, when the grass is from 4 to 10 inches tall, is most satisfactory. This should be followed in about 2 weeks by plowing or some other form of soil preparation. Cultivated crops, smother crops, or clean tillage result in better control than small grains sown following treatment. Some hazard to crops follows the spring application; they should not be planted until 4 weeks after the application. Corn, wheat, red and alsike clovers, soybeans, and other types of beans are especially sensitive to small quantities of dalapon remaining in the soil.

A single application of 10 pounds of dalapon per acre in the early spring will give seasonal control in areas that cannot be cultivated. However, it may cause damage to shrubs or trees growing in the area. Two applications of 5 pounds per acre, with an interval of 6 weeks between treatments, will control the growth of quackgrass under mature fruit trees. Dalapon should not be used under trees that have not reached the fruiting stage.

Dosage ranges for all chemicals are broad enough to cover the entire region. However, local experiment stations should be consulted for the most effective rates in any particular area.

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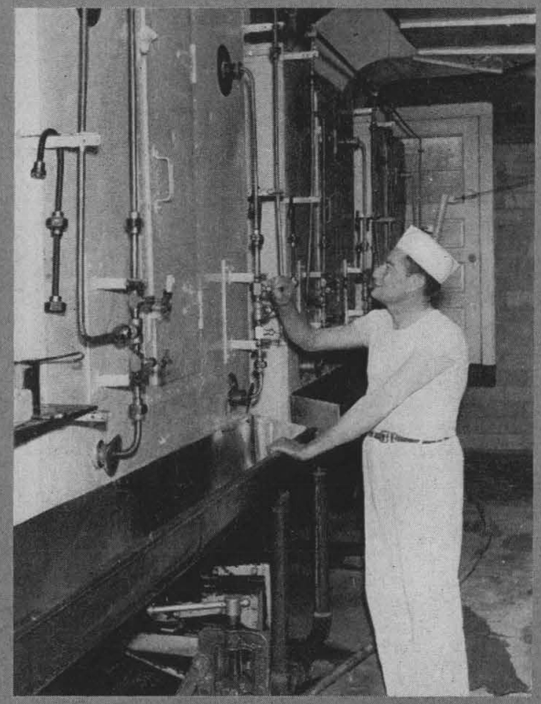
STATION BULLETIN 435 JUNE, 1956

Costs of Drying MILK...

in Specialized Drying Plants



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