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**REPORTER**

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## The AUTHORS

OSCAR E. TAUBER is research associate professor of entomology and zoology at the Iowa Station. Dr. Tauber in this issue discusses the new insect killer, DDT, which has had so much publicity. He is in charge of work at the Iowa Station in which DDT is being used on squash, potatoes and cabbage.

Dr. Tauber has been at Iowa State College since 1930. His work is mainly concerned with teaching, though he is employed by the Station during the summer. He is a native of Decatur, Ill., where he attended James Millikin University and later the University of Illinois. He received his master's degree and Ph. D. from Iowa State College.

The rest of the authors of this issue have been introduced in previous issues. They are: W. H. PIERRE, head of the Agronomy Section at Iowa State College; G. M. BROWNING, Soil Conservation Service, who is located at Iowa State College; SELDON W. CAREY, roadside improvement engineer of the Iowa Highway Commission; MAURICE E. HEATH, in charge of the Soil Conservation Nursery, Ames; C. P. WILSIE, research associate professor in the Farm Crops Subsection of the Iowa Station.

### A Caution About Use Of DDT

The word is about that next year the army and navy will not need all of the DDT that is being manufactured and that it will be for sale.

While DDT has proved to be a wonderful insecticide for certain of the insect pests, it also can and does kill some of the valuable insects, such as bees. Then, too, whether or not it may have injurious effects on animals and on human beings who eat crops treated with it is not fully known.

In other words, the chemical has been in use such a short time that just how, when and where to use it are not fully known. It will be well to go with caution in spreading this material about for it may do more harm than good if it is not used properly—and even the entomologists say they have not yet learned as much as they want to about its use.

Considerable work has been done by the Minnesota Station with DDT on potatoes—one of Minnesota farmers' main crops. Minnesota workers believe that under their conditions it shows great promise for use on potatoes. It has effectively controlled the Colorado potato beetle, the flea beetle, leafhoppers and others. In their tests of 2 years, DDT was used against the potato insects in comparison with about 30 other insecticides in five commercial potato fields in various sections of the state.

### The Women's Article? Next Time

We have promise of a good article next issue on some of the problems of cooking which are common to the Iowa farm homemaker. Dr. Pearl P. Swanson, who is in charge of research work in home economics at the Iowa Station, has promised something for the next issue.

### Indiana's Corn Borer "Pulverizer"

Please do not grab your pencil and write to the Indiana Agricultural Experiment Station, Purdue University, and ask where you can get one of the machines that can be attached to your corn picker to kill the corn borers that are in the stalks at picking time—because the machine is not yet being produced commercially. Writing to the Purdue workers will be a waste of your time and will take some of the Purdue men's time to answer any such inquiries.

But the machine which they are perfecting at the Indiana Station shows a good deal of promise. Their kill of around 95 percent of the borers in the stalks is really promising. Besides, it will leave the field in such shape that we can continue to farm in pretty much the same manner as we have in the past.

Plowing the cornstalks under deeply and thoroughly has been one of the methods used and recommended for controlling the borer. In parts of Iowa it would be a tremendous handicap to the growing of oats and other spring-sown small grains if we have to take time out to plow the ground before the crop can be sown. This machine that pulverizes the stalks as they pass through the mechanical picker gives much hope for a method of avoiding that deep plowing.

In tests reported by the Indiana Station, they got their better results from late fall or late spring than from early spring plowing. The most borers emerged from 5-inch deep plowing as compared with deeper plowing. For all soil types, 44.5 percent emerged from 5-inch plowing as compared with 38 percent at 7-inch burial and 20 percent at 10 inches.

The Indiana workers also found it more important to plow clean in the heavier type soils where clean plowing is most difficult.

### Is Your Silo Ready?

At this time it looks as though Iowa farmers who have silos might be able to put them to good use this fall—if the corn crop doesn't "make it," and some of it probably won't.

So now is a pretty good time to be checking up to make sure the silo is in shape to handle the crop. Those who are in sections where trench silos work may want to try building one of those.

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Editor: FRED E. FERGUSON

Art Director: SIDNEY H. HORN (on leave)

Editorial Advisory Board: R. H. Porter, chairman; Pearl P. Swanson; T. J. Maney; C. H. Van Vlack; Dwight L. Espe; Harold Gundersen; John B. Peterson; and Carl Malone.

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# Let's Examine CROP ROTATIONS

WE HAVE BEEN so involved in producing the crops the government has asked for to help win the war that we are in danger of losing sight of the need of growing good rotations for maintaining fertility and producing high yields per acre.

Iowa farmers are now growing nearly a third more acres of corn and soybeans than they did in 1941—the combined acreage of these two crops is nearly 3½ million acres more than it was in 1941. With this increase in the acreage of row crops has come a decrease in the soil conserving crops—the hay and pasture.

Though this change has been necessary, it is time now to check up on just what the change means. We need to get ourselves ready for a “right face” or a “left face” if not an “about face” in our cropping system.

## Soil Fertility Declining

How much has this change in our cropping system increased soil depletion on Iowa farms? The rate of depletion has been over one-half faster since 1941 than before, a careful study shows.

The growing of intertilled crops such as corn and soybeans not only uses plant food much faster, but the loss from erosion is greater, too, on rolling land. On the other hand, legume sod crops add nitrogen and organic matter to the soil which following crops can use, and legumes greatly reduce soil erosion. So when we grow fewer acres of these soil conserving crops and put into their place crops that rapidly take away plant food and increase erosion, it's easy to see why our soil fertility has gone down rapidly since 1941.

## Legumes “Core” of Rotation

The first and most important requirement of a good crop rotation is that it contains plenty of legumes. Sod crops of legume-grass combination produce much

# ROTATIONS

They Make Big Differences in the Crop Yields at Present Time and in the Future

By W. H. PIERRE and G. M. BROWNING

feed per acre and, in addition, they do these things:

1. Increase the yields of other crops in the rotation.
2. Help maintain soil fertility, particularly the nitrogen and organic matter.
3. Produce good soil tilth.
4. Help control erosion.

The number of years the land should be kept in meadow or pasture during the rotation varies with the kind of soil and the steepness of the slopes. The less the organic matter content of soils or the steeper the slope the larger should be the proportion of soil conserving crops in the rotation. In all cases, however, the legume crop is the first requirement or “core” of the rotation.

## Corn Yields Increased

How much can you expect legumes in the rotation to increase the yield of corn? You can get a partial answer to this from two experiments at our Experimental Farm in Page County. In one of these experiments corn has been grown continuously for 13 years

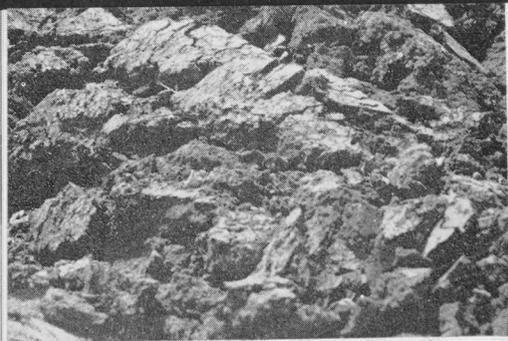
on the same plots, while plots beside them were in a 3-year rotation of corn, oats and red clover.

During the 13 years the corn grown continuously on the same land averaged 31.8 bushels per acre, while that grown in a 3-year rotation averaged 54.0 bushels—an increase of over 22 bushels an acre for rotation. Moreover, the difference in yield between the two treatments is rapidly getting greater (see the graph, p.4). In the last 5 years (1940-44) the corn grown in the rotation averaged 71.2 bushels per acre while that grown continuously averaged only 23.9 bushels per acre.

In another experiment using three different rotations, the most striking result was the large benefit obtained from sweetclover. Where sweetclover was grown in oats and turned under the following spring for corn, the yield of corn was increased an average of 26 bushels per acre (graph, p. 5). This shows the marked benefit that would be obtained each year in the yield of corn if all the small grain in Iowa were seeded down to a legume or legume-grass mixture. Many thousands of acres of

The previous cropping system affects the rate corn grows as well as the yield. Left, continuous corn, 13th year, yield 26 bu. per acre; center, corn in rotation of corn-oats-red clover, yield 86 bu; right, corn following 12 years alfalfa, yield 106 bu. The picture shows part of experiment at Experimental Farm, Clarinda, to study effect of cropping systems on soil and water loss and yields. Photo, July 22.





The two pictures show how the cropping system affects the cloddiness (soil tilth). Above, in corn continuously for 10 years; below, second year of corn in a rotation of corn, corn, oats, clover. Marshall silt loam.

oats and wheat still are not seeded to legumes in sections of Iowa.

Where corn was grown in a 4-year rotation of corn, oats, followed by clover and timothy for 2 years, the yield of corn was 32 bushels higher than when grown in a corn-oats rotation. In poor crop years the differences in yield may be smaller than those obtained in the good crop years of 1942-1944. However, the differences between the poor and good rotations will probably become greater the longer the treatments are continued.

### Organic Matter, Nitrogen

One of the most important reasons why crop yields decrease when land is kept in grain crops such as corn and oats is that these crops lower the nitrogen and organic matter content of soils. Nitrogen is needed by plants in large quantities. With too little nitrogen, plants turn pale green and make spindly growth.

When legumes are brought into the rotation the crop following has a dark green color, an indication that it is getting plenty of nitrogen. Inoculated legumes do not depend on the soil for nitrogen, but absorb it from the air through the nodule bacteria on their roots. Both the roots and tops of legumes contain large amounts of nitrogen taken from the air. When these are plowed under, both

nitrogen and organic matter are added to the soil.

At the Agronomy Farm at Ames we have studied the loss of organic matter from soils cropped differently for a period of 20 years. We found that where corn was grown continuously on Clarion loam soil, the loss of organic matter amounted to 18.3 percent. When grown in a 3-year rotation of corn, oats and clover the loss was reduced to 11.7 percent.

The difference obtained in a similar experiment on Marshall silt loam soil was even greater. Where corn was grown continuously for 10 years, 15.6 percent of the organic matter was lost while the loss was only 0.9 percent where a 3-year rotation of corn, oats and clover was followed. (See table 1.)

### Erosion, Runoff Decreased

Another important reason for following a good rotation which includes legume and grass sod crops is to reduce soil erosion and conserve water. Close growing crops, like legumes and grasses, protect the soil from erosion and enable it to absorb more of the rainfall. This has been well demonstrated from studies carried on at the Experimental Farm in Page County during the past 14 years. The average loss of soil from the different crops of a 3-year rotation was as follows: From corn, 18.4 tons per acre per year; from oats, 10.1 tons; and from clover sod, only 0.2 ton. (See table 2.) This shows that practically no soil was lost where red clover, alfalfa or bluegrass was grown, but large losses occurred where corn was grown.

Yields are low when corn is grown continuously. Note the increasingly higher yield from the rotation with clover. Marshall silt loam.

The runoff was also much greater with corn.

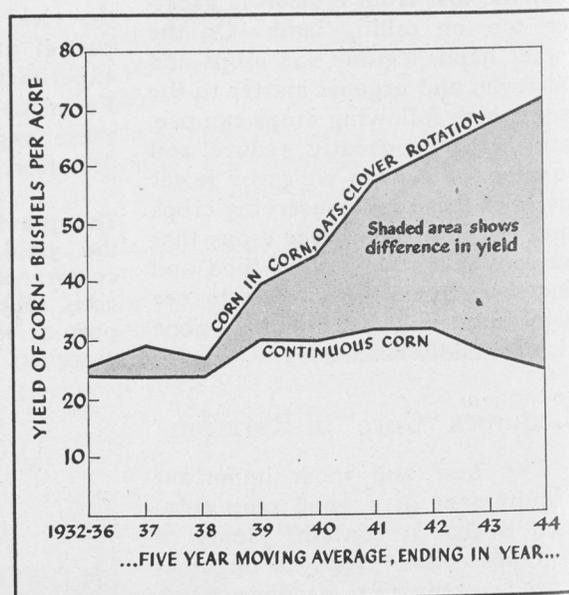
Legumes and grasses in the rotation also reduce the loss of soil and water during the years following the plowing of the sod. In the experiment on Marshall silt loam (table 2), land in corn following clover in the rotation lost less than one-half as much soil and only two-thirds as much water as where corn followed corn.

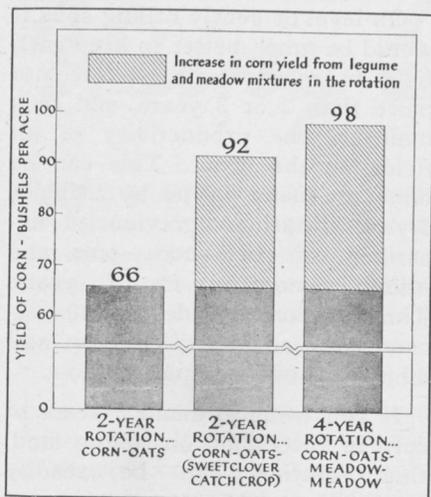
The reason for this difference is that sod crops improve the physical properties or tilth of the soil. This makes it possible for the soil to absorb more water so there is less water to run off and cause soil erosion.

The beneficial effect of sod on soil tilth is shown in the accompanying photographs on this page. Following continuous cropping with corn the soil turned up in large clods when plowed, whereas the corn ground that had been in clover 2 years previously had very few large clods and was in good physical condition when plowed.

### Fitting Rotation to Soil

The kind of rotation that should be followed on a given farm depends on the fertility of the soil and how easily it erodes. In general the less the organic matter content of the soil and the more





Legumes in rotation increase the yield of corn. Marshall silt loam, Soil Conservation Experimental Farm, Clarinda, Ia. (Years 1942-44.)

sloping the topography the greater should be the proportion of legume and grass sod. On soils of rolling topography, rotations should be supported by such erosion control practices as contouring or terracing. The use of these practices will reduce the proportion of sod crops needed in the rotation.

We shall discuss briefly a few examples of some standard rotations that fit different general soil conditions.

### Group A—Level Soils

Since these soils are not subject to erosion, the proportion of legumes in the rotation need not be as large as on soils of rolling topography. One of the most common rotations followed on such soils is a 4-year rotation of **corn—corn—oats—clover**. This rotation provides for 50 percent of the land in corn or for a 1 to 2 ratio of soil conserving to intertilled crops. If soybeans are grown, part of the corn land may be used for soybeans without changing the general rotation plan.

We have had such a 4-year rotation of **corn—corn—oats** and **clover-timothy** meadow on plots at the Agronomy Farm at Ames since 1915, and good crop yields have been maintained. During the past 5 years the yield of first-year corn on these plots has averaged 63.3 bushels per acre where the soil received no other treatment during

this period, and 80.5 bushels per acre where lime, manure and phosphate had been used regularly. This experiment is located on Webster soils, which are high in organic matter and quite level.

### Group B—Gently Rolling

On many gently rolling soils or on only moderately productive soils the ratio of soil conserving to intertilled crops should be about 1 to 1 instead of 1 to 2 as in Group A above. This type of rotation is best illustrated by the 3-year rotation of **corn—oats—clover**. It is a rotation that has been followed by many farmers in some sections of the state. One objection to it where one desires to grow alfalfa is that it has only 1 year of sod. In order to overcome this objection and still maintain a ratio of soil conserving to intertilled crops of 1 to 1, a 5-year rotation of **corn—corn—oats** and 2 years of an **alfalfa-bromegrass** mixture can be used. In this rotation 40 percent of the land is in corn instead of 33 percent as in the 3-year rotation of **corn—oats—clover**.

### Group C—Rolling to Hilly

A third group of soils are those on which about 2 acres of soil conserving crops need to be grown for each acre of intertilled crops to control erosion and maintain fertility. These are the rolling to hilly soils. A common rotation for these soils is a 4-year rotation of **corn—oats** and 2 years of **alfalfa-bromegrass** mixture. It has only 25 percent of the land in corn and permits good control of erosion during the 2 years of sod, but it needs to be supplemented with such erosion control practices as contouring, strip cropping or terracing.

### One or Two Years of Corn?

In two of the rotations that have been described, corn is grown 2 years in succession. With the Group B soils, many farmers grow 2 years of corn in succession in order to have more than 1 year of sod and still maintain a fairly high amount of corn or intertilled crops.

The disadvantage of this system



Vetch cover crop seeded in corn on Aug. 14. Photograph was taken Oct. 21. Experimental Farm, Clarinda.

is that the growing of 2 years of corn in succession is conducive to soil erosion. Moreover, the question has often been raised as to the comparative yields of first and second-year corn. Tests at the Agronomy Farm at Ames and at the Soil Conservation Experimental Farm in Page County help answer this question. The results obtained are shown in table 3.

In all experiments the first-year corn outyielded the second-year corn. During the favorable crop years of 1943 and 1944 the first-year corn averaged 20.8 bushels or 30.2 percent higher than second-year corn at Clarinda and 11.7 bushels or 13.5 percent higher at Ames. The long time averages which include a number of dry or unfavorable seasons give values of 6.1 to 8.5 bushels in favor of first-year corn, or an average of about 16 percent. The reason for these differences is that the beneficial effect of the legume sod in making nitrogen available and improving soil tilth (physical condition of the soil) only partially carries over into the second year.

### Use of Cover Crops

The shortcomings of a rotation with 2 years of corn or intertilled crops in succession can be partly overcome by seeding a legume

**TABLE 1. THE EFFECT OF CROP ROTATION ON LOSSES OF SOIL ORGANIC MATTER.**

Cropping system	Clarion loam	Marshall silt
	Ames Percent loss in 20 yrs. (1918-38)	loam Clarinda Percent loss in 11 yrs. (1931-41)
Continuous corn	18.9	15.6
2-year rotation (Corn—oats)	16.1	.....
3-year rotation (Corn—oats—clover)	11.7	0.9
Modified 4-year rotation (Corn—oats—legume hay—wheat)*	10.2	.....

\* Kept in alfalfa for 5 years out of 20.

cover crop in the first-year corn. Not only will the cover crop protect the soil from erosion but it will supply nitrogen for the second-year corn.

Rye and vetch or sweetclover on land supplied with lime, and rye and vetch on unlimed or acid areas have been successful as cover crops when broadcast with a cultivator attachment or endgate seeder either before or after the last cultivation of corn, or when seeded in standing corn with a one-horse grain drill about Aug. 15. In about 1 year out of 5, on an average, good stands will not be obtained at the time of last cultivation because of July or early August drouths or because of grasshopper or chinch bug injury. Seedings of rye and vetch made between Aug. 15 and Oct. 1 seldom fail, but those

made about Aug. 15 make the most growth. Seeding of sweetclover should be made by Sept. 1.

### Use Alfalfa-Bromegrass

During recent years the experience of many farmers and the results of experimental work have emphasized the value of alfalfa and bromegrass grown together as a perennial hay and pasture crop. An alfalfa-bromegrass meadow or pasture produces a large yield of high quality feed on adapted land and is very effective in controlling erosion. So we may expect an increase in the acreage of this important crop combination in the next 10 years.

You may wonder, "How can I best fit this valuable crop regularly into my rotation and at the same time grow the desired acreage of intertilled crops?" Hilly and steep fields should, of course, be in grass-legume pastures or meadows as much of the time as possible in order to protect the land from erosion. The problem is with the less rolling land, or the land that is in regular rotation. There is a strong tendency to keep the alfalfa-bromegrass meadow or pasture 3 to 4 years, or as long as it is producing well. The result is that the other cropland on the farm is kept in corn or non-legume crops for several years in succession—a situation that reduces yields and encourages erosion.

On level or gently rolling soils it would be much better to keep each field in meadow or pasture not more than 2 or 3 years, and thus maintain the productivity of all fields on the farm. This can be done on many farms by using a 5-year rotation, previously described, of corn—corn—oats and alfalfa-bromegrass for 2 years. This rotation provides for 40 percent corn or intertilled crop and 40 percent of perennial meadow.

If you want to avoid 2 years of corn in succession on rolling land, this rotation can be readily changed to a 6-year rotation of corn—oats (with sweetclover crop for green manure)—corn—oats—and 2 years of meadow. In this rotation, the two corn crops do not occur in succession, and a legume crop precedes each corn crop. At the same time 33 percent of the land is in corn.

In some tests reported by the Wisconsin Agricultural Experiment Station the best hay is made when the day is real hot and the hay dries rapidly. In fact, artificially dried hay is the best source of carotene for livestock.

Hay which is never exposed to sunlight contains practically no vitamin A, says G. Bohstedt of the University of Wisconsin. On the other hand, too long exposure will bleach out the carotene.

**TABLE 2. EFFECT OF KIND OF CROP AND OF CROPPING SYSTEM ON LOSSES OF SOIL AND WATER. (1933-44)**

(Marshall silt loam, 9% slope, Clarinda)

Cropping system	Crop	Soil losses	
		(tons per acre)	Runoff (% of rainfall)
Continuous corn	Corn	38.3	18.2
Rotation of corn, oats and clover	Corn	18.4	12.6
	Oats	10.1	9.9
	Red clover	0.2*	1.8*
Continuous alfalfa	Alfalfa	0.01	2.2
Continuous bluegrass	Bluegrass	0.03	1.2

\* Does not include 1936 and 1937 when stands of clover were not obtained.

**TABLE 3. A COMPARISON OF THE YIELD OF CORN THE FIRST AND SECOND YEAR AFTER SEEDING TO LEGUME.**

Location of experiment	Years	Yield in bushels per acre		
		1st year corn	2nd year corn	Decrease in 2nd year corn
Old Rotation, Ames, Webster silt loam	1917-38	62.4	53.9	8.5
New Rotation, Ames, Webster silt loam	1943-44	98.5	86.8	11.7
B-Terrace Experiment, Clarinda, Marshall silt loam	1931-44	43.6	37.5	6.1
New Rotations, Clarinda, Marshall silt loam	1943-44	89.4	68.6	20.8

# Using Sod On Highways

**WE BUILD** curbs and gutters for our city streets and use eaves troughs and spouting on our houses to dispose of runoff water. But what about the road ditches on our highways?

On the primary and secondary road systems of Iowa there usually are large investments per mile of constructed road. It is here that the use of grass sod, in addition to other vegetative practices (Farm Science Reporter, April 1945), can immediately protect those areas over which runoff water flows.

Proper sodding of intercepting and roadside ditches prevents gullying and undercutting and sliding of slopes. Failure to build sod channels often results in roadside areas becoming isolated as gullies develop, thus making mowing and other maintenance operations impossible. This also increases the hazards to traffic as the gullies encroach on the roadway. Adjacent farm land also suffers as backslopes erode and fences wash out. Often sod structures are much better in carrying water than mechanical structures, and the sod structures cost less.

## Where to Use Sod

The soil type, soil fertility and the amount of runoff all help determine whether one needs to sod or whether the ditch can be seeded. When the fertility is high it is possible to obtain a good stand of vegetation in some road ditches by sowing seed, provided rainfall is not excessive while the stand is becoming established. But the chances of grasses becoming established by seeding before a severe rain occurs are slim. Therefore we recommend sodding these areas in the first place. Generally all ditches on a 3 percent grade or steeper should be sodded. There are cases where, because of soil type, sod will be needed on even flatter grades than 3 percent.

We have found that where farm lands slope toward the highway



Here is an Iowa road (Highway 60 north from 2nd Avenue of Des Moines) with flattened, mowable slopes. This obviously makes weed control much easier. Also, slopes of this type do not slide as readily in wet seasons.

By SELDON W. CAREY and MAURICE E. HEATH

and contribute runoff from fields, intercepting ditches should be constructed as shown in fig. 1 and the channel of the ditch sodded to prevent cutting and gullying. There will be instances when water from adjacent farm fields must reach the roadside sodded channel over the backslope of the cut. Sod flumes play an important part in the disposal of this runoff water, as shown in fig. 2.

Another important use for grass sod in highway construction is to protect mechanical structures, including wing walls of bridges, culverts and concrete flumes, and provide sod collars for concrete and steel entrance pipes. The use of sod in this manner helps materially in tying the mechanical structure into the roadbed and furnishes much needed protection to prevent side cutting and the undermining of structures.

## Shaping Ditch and Flume

In general, the roadside ditch and flume areas to be sodded can

be roughed out mechanically with such equipment as a tractor and plow, grader or bulldozer. In the future probably specially designed equipment will be available for shaping ditches before sodding.

We have found the flat-bottom channel, ranging in width from 4 to 12 feet, depending upon the topography and area of the watershed concerned, is very satisfactory. The finished sod channel should have a 6-inch minimum depth. With the use of flat-bottom sodded channels the runoff water is spread out and has less depth and flows more slowly than a V-shape or rounded bottom channel.

## How to Use Sod

The sod usually is cut from a good clean bluegrass or bromegrass pasture. The strips are cut to a uniform width and thickness of 1 to 1½ inches throughout for bluegrass and somewhat thicker for bromegrass. The sod strips should be not less than 36 inches



The above workman is placing sod in a newly graded and shaped roadside ditch. The sod furnishes immediate channel protection from runoff. During the establishment, the sod should never be allowed to get dried out. Immediately after laying, the sod and sodbed should be thoroughly soaked to facilitate tamping which brings the sod in close contact with the sodbed. This eliminates voids beneath the sod and retards moisture losses.

in length. The strips are laid crosswise of the channel. In general, not more than 18 hours should elapse between the cutting and the laying of the sod. Be careful to prevent the sod from drying.

Prior to laying sod, the soil in the channel and flume-bottom areas should be loosened to a depth of 1 inch and thoroughly dampened if it is not already moist. A commercial fertilizer, preferably a 10-6-4, should be applied at the rate of 10 pounds per 1,000 square feet and worked well into the sodbed. The sod strips should be packed tightly together

so that no open joints are left between strips. We have found it important in constructing sodded channels to extend every tenth strip about 3 feet beyond the edge of the channel. These "wings" encourage water to enter the sod channel and prevent cutting and gullyng along the sides.

We have found that it is well to tamp the sod and stake the sodded waterways with 12-inch pointed lath. This helps to prevent the loss of newly laid sod as a result of excessive runoff caused by heavy rains. The stakes can be spaced approximately 30 inches apart and driven at an angle

against the direction of the water flow until they extend  $\frac{1}{2}$  inch above the top of the sod. Not more than one hour should elapse between laying and watering the sod. You should thoroughly soak the sod and sodbed at least 1 inch deep. All sod should be kept moist until it is well established.

If sod channels are to be installed in wide ditches or borrow-pits, be sure the channels are placed at the low point of the ditch. The earth areas adjacent to all sodded channels and flumes should be mulched 5 feet wide to prevent washing of silt onto the sod.

### Time to Sod

Inasmuch as sodding is a part of the vegetative program, which includes sowing of grasses and legumes and stabilizing crops and mulching, it is best to do sodding on new construction in early spring (late March through May 30) and late summer (August 15 to October 1). It is possible, however, to do sodding throughout the summer and somewhat later in the fall, provided the sod is kept moist until it becomes rooted and established. The watering of sod needs to be done for approximately 30 days if there isn't sufficient rainfall.

There will be times through the year when new construction will lay unprotected because the season is not right for establishing vegetation. Such construction usually is revegetated at the earli-

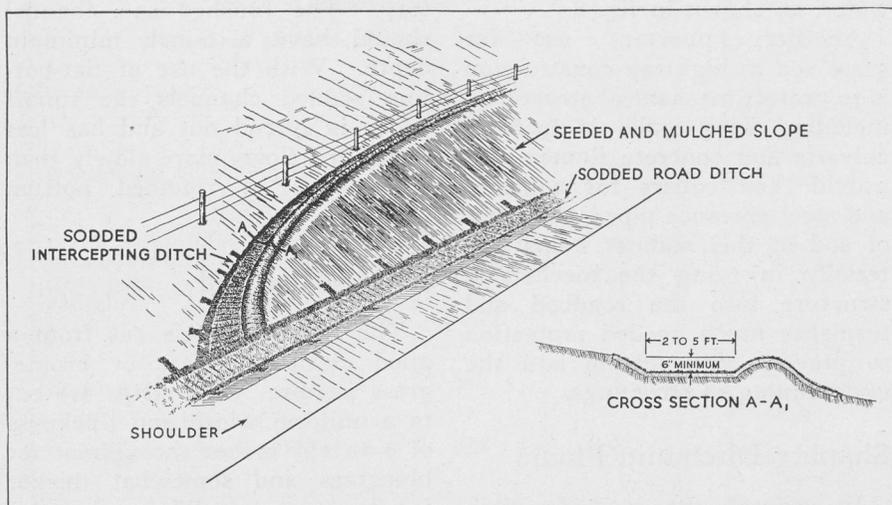


Fig. 1. Sodded intercepting ditch tied into sodded road ditch.

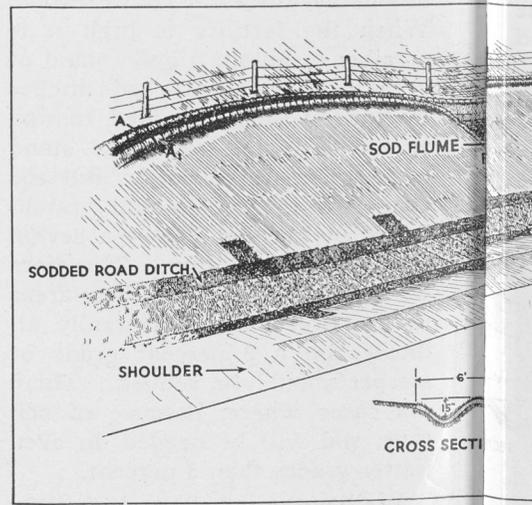


Fig. 2. Sodded flumes installed to alter c

est possible date when grasses and legumes can be established.

### Kind of Sod

Over most of Iowa we have used bluegrass sod with good results for the sodding of channels, roadside ditches and sod-flume work. However, in the western tier of Iowa counties, where bluegrass is not very well adapted, such sod as bromegrass or bromegrass-blue-stem wheatgrass mixtures should be used on the well drained areas for flume and channel construction.

We have found reed canarygrass, because of its vigorous, spreading root system and its ability to withstand considerable moisture, valuable for the poorly drained areas. It's a good plan to establish reed canarygrass areas of 1/10 to 1 acre in size as a local source of root and sod material. The sod can be used on new construction as well as in maintaining old construction.

All sod material used should be free of noxious and secondary noxious weeds and should be taken from good, solid, thick-growing stands.

### Vegetation Maintenance

During the first year where grasses and legumes are seeded in the spring the roadside areas should be mowed periodically to control weeds. In general, the early fall seeded grasses on the



Here is a newly sodded roadside ditch showing sod "wings." These wings are necessary to prevent gullies from forming along the sod channels. As the water flows from the adjacent slopes to the low point of the ditch it is forced into the sodded waterway. Note that here the seeding, mulching and sodding have been done at the same time. This is highly desirable.

more fertile soils will form good cover the following spring and summer. These areas should be observed frequently, however, and clipped when necessary to control weeds. If the growth of the stabilizing crop is heavy and vigorous, mowing will be very beneficial to prevent it from dominating the young grasses and legumes.

The well established grasses and legumes will benefit from several mowings during the year. It is important that the channel and flume areas be mowed frequently enough to prevent heavy top growth from developing and thinning the sod which would result in damage from heavy runoff. A

dense sod is needed in these areas to insure carrying runoff from heavy rains.

The roadside right-of-way area should be observed closely the first year while grasses and legumes are becoming established. It may be necessary to reseed and re-mulch small areas as well as make repairs on sodded structures. Here the old adage, "A stitch in time saves nine," is very applicable.

In those areas where vigorous, fast-growing annual weeds are prevalent, it is important that adapted vegetation be established in order to help control annual weeds.

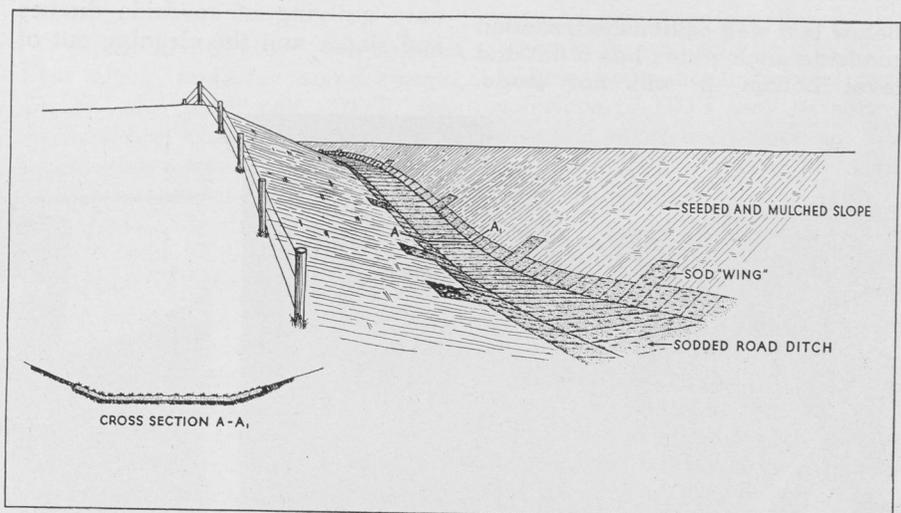
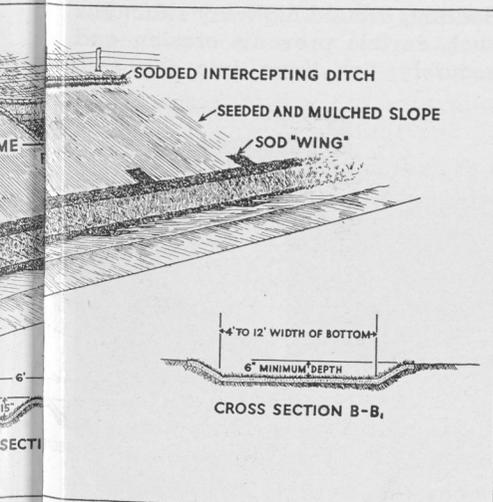


Fig. 3. A road ditch from cut to fill sodded to prevent washing.

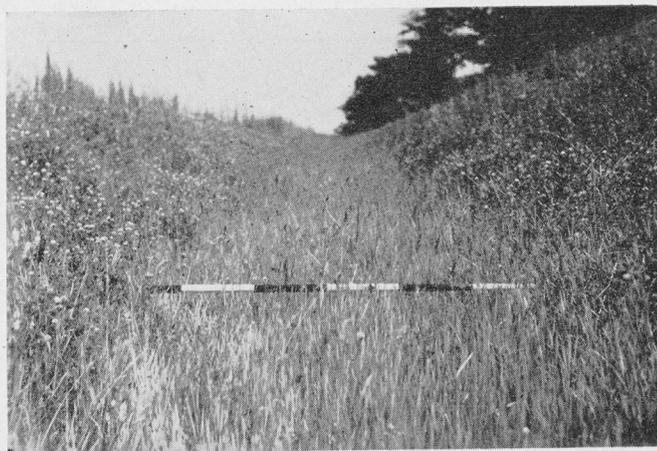


Adapted grasses and legumes are very efficient in controlling most annual weeds and retarding spread of perennial weeds along roadsides. Here is a good vigorous stand of brome grass along a secondary road adjacent to the Chris H. Jensen farm in Audubon County. The county supervisors cooperated with Jensen in making a mowable slope.

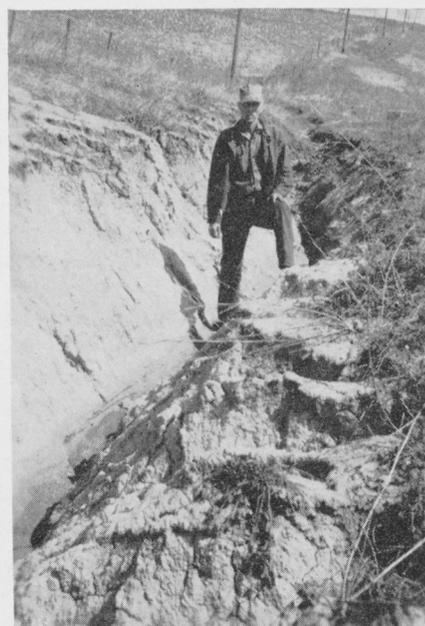
### The Economical Aspects

Protecting roadsides with vegetation has been found economically sound. Vegetation is living, reinforcing material which constantly tends to re-establish and perpetuate itself, even after excessive rains. Root yield determinations of various grasses indicate that there may be much more plant growth below than above ground.

Below is a well established, sodded roadside ditch which has a flat and level bottom—it will not erode.



Right: Gullying of roadside ditch caused by lack of immediate vegetative protection. This is a common highway problem. When roadside ditches are sodded immediately after highway construction, along with other vegetative practices of seeding and mulching, gullies generally can be prevented from forming.



We have found that regrading cannot take the place of vegetative techniques. We must "fasten" this soil down with crop roots before it has washed away, thereby eliminating the cost of regrading.

A good vigorous growth of adapted grasses and legumes is most efficient in controlling annual weeds. Grasses also form the basis of a slightly appearance of the roadside right-of-way. The proper use of grass sod and root material furnishes much protection to mechanical structures by tying them into the earth part of the road.

A well stabilized right-of-way area, with adapted grasses and legumes and sodded structures, together with adequate conservation practices on the contributing watershed areas of the adjoining farm lands, will practically eliminate gullying of roadside ditches and slopes and the cleaning out of

culverts and other similar structures.

It probably will be found most practical on the secondary road system to start the intensive job of revegetation on the new highway construction and expand it to present roads as reconstruction work is undertaken.

We feel that with proper county-farmer cooperation, a great saving can be made to the counties and to the farmers where adequate vegetative practices are made a part of the road building program. With the proper use of vegetation, grading costs can be reduced, gullies prevented, more efficient weed control measures used, and a more slightly roadway developed, of which the community can be proud.

Sodding around highway structures such as this prevents erosion and securely ties them into the soil.



# Sizing Up DDT

An Effective Killer Of Some Insects, But Its Exact Place Has Not Been Determined

## SUMMARY

1. DDT hasn't been used long enough to fully determine its dangers and usefulness.
2. For many insects it appears to be no better or not as good as insecticides now in use.
3. Its effect on the soil and long-lived plants is not known.
4. It kills many harmful insects effectively, but also some beneficial ones.
5. Its most promising use seems to be in control of stable flies, houseflies, mosquitoes and possibly other household insect nuisances.
6. Disease carrying insects such as lice, fleas, bedbugs, mosquitoes will come closer to eradication than ever before.
7. It shows promise with certain vegetable crops, such as potatoes, squash and cabbage, in controlling insects.
8. It may prove valuable in controlling lice on chickens and in poultry houses.
9. Use it with care until more is known about HOW, WHEN and WHERE to use it.

**A** LOT OF people have now heard about "DDT." Part of this hearsay is true; part isn't; much is misleading. Perhaps we can satisfy some curiosity and correct some erroneous impressions about this much publicized material. Is it really proving to be as good for killing insects as its first reports indicated? We'll see.

The three initials—DDT—stand for the first letters of the hyphenated syllables making up the name of a chemical, dichloro-diphenyl-trichloroethane. When chemists and entomologists want to be more formal, they call it 2,2-bis-(*p*-chlorophenyl)-1, 1, 1-trichloroethane. All of that is quite a mouthful, so most of us fall back on the simpler "dee-dee-tee."

By OSCAR E. TAUBER

DDT is poison in capital letters for numerous insect species which carry illnesses to man, or eat his crops, or make him uncomfortable, or soil his food.

## Dates Back to 1874

Is DDT a new chemical compound? Not exactly. It doesn't occur naturally; notice of what it contains and how it is made was first published in 1874 by a young chemistry student named Othman Zeidler in Strasbourg, France. At that time only its properties such as color, odor, melting point, etc., were recorded. Apparently nothing was done to determine its value for killing insects. What, then, brought on this recent attention to DDT?

DDT was first used as an insecticide in Switzerland 4 or 5 years ago. During the war Swiss entomologists, like entomologists all over the world, ran into a shortage, not only of rotenone and pyrethrum, but also the old standby insect-killer, lead arsenate, which was not manufactured in Switzerland. In their search for substitutes, probably all kinds of chemicals were tested.

Chemical literature was combed for clues, and, for some reason, what we now call DDT was selected for trial. It proved almost miraculous against flies and some other insects, and saved the Swiss potato crop from the potato beetle—the same "Colorado" beetle that is a pest in this country.

At that time the Swiss manufacturers called their product by the trade name *Gesarol*. Samples found their way to the United States, where entomologists of the U.S.D.A. Bureau of Entomology and Plant Quarantine were searching for pyrethrum replacements needed by the armed forces in the



Applying DDT dust to one of the potato plots in 1945 at the Iowa State College Insectary Garden.

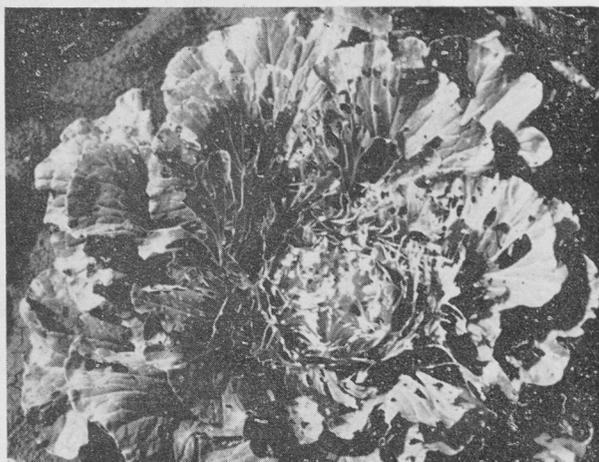
control of mosquitoes, lice, fleas and other insects which are possible disease carriers among troops. Some of the test results were spectacular.

## Cleans Out the Lice

Clothing dusted with DDT powder gives almost complete protection against body lice for as long as 3 weeks. DDT powder is also effective against head lice and crab lice. Cotton and woolen garments dipped in DDT solutions may be worn and laundered six to eight times and still be effective in killing body lice. Special weak solutions of DDT may be sprayed over the entire body as an auxiliary treatment for complete delousing of all three types.

The part taken by DDT dusts in preventing a widespread typhus epidemic in Naples, Italy, has been widely publicized. Residents of the town were infested with lice. As many as 60,000 persons per day were treated with DDT. Nearly the entire population was dusted; the disease subsided; thousands of lives were undoubtedly saved in this one town.

Since these initial successes, the



This head of cabbage shows typical damage by the common cabbage worms when no insecticides of any kind have been used. Compare it with head on the opposite page which was dusted with DDT

story of DDT has become more familiar. It has been found toxic against many other different pests including: Bedbugs, ticks, houseflies, stableflies, some cockroaches, various ants, some subterranean termites, bean leaf roller, cabbage looper, cabbage worm, cowpea and rice weevils, flour beetles, southern army worm, squash bug, some aphids, cotton bollworm, tarnished plant bug, white-fringed beetle, tobacco moth, tobacco flea beetle, some grasshoppers, European corn borer, Oriental fruit moth, California red scale, potato flea beetle, pea aphid, onion thrips, Japanese beetle, codling moth larvae, adult mosquitoes, tussock moth larvae, grape leafhopper, and many others—all of which makes DDT sound like the long-hoped-for miracle insecticide.

### Not Always Best

Though there's no "fly in the ointment," there are certain dull spots on the glamour of DDT. It is true that DDT will kill the insects mentioned above, and others, too, but, so far at least, in some cases it is no better than insecticides already in use. For example, 3 percent DDT was no better than the standard pyrethrum method for the cross-striped cabbage worm; 10 percent DDT was not superior to 1 percent dinitro-o-cresol or 1 percent dinitro-o-cyclohexylphenol against a certain stinkbug; 3 lbs. of DDT in 100 lbs. of bran was no more effective as a grasshopper bait than 1 qt. of 32 percent sodium arsenite solution per 100 lbs. of bran; and so on—other similar comparisons could be found. In some cases where DDT is no bet-

ter than material now used, it would be ruled out, if for no other reason, because of its present higher cost.

According to some published data, DDT is inferior to older insecticides for some purposes. Without mentioning details of the tests, DDT isn't as good as nicotine for the spirea and cotton aphids. DDT is comparatively ineffective against the boll weevil and the cotton leaf worm. DDT did not control the sugar cane borer as well as synthetic cryolite. DDT grasshopper baits were inferior to sodium fluosilicate baits.

When compared with rotenone, DDT is of little value in Mexican bean beetle control. The tartar emetic-brown sugar spray against onion thrips was better than DDT treatments. As a dust for killing mosquito larvae, DDT is no more useful than paris green; but 1 to 2 quarts of 5 percent DDT dissolved in kerosene is as effective as 18 to 20 gallons of fuel oil per acre.

### Tests in Iowa

Last summer, in the Insectary Gardens on the Iowa State College campus, we set up experiments to test DDT dusts on potatoes, cabbage and squash. With Irish cobbler potatoes, 3 percent DDT dust effectively controlled the Colorado potato beetle and the potato leafhopper as well as the potato flea beetle and potato aphid, although the infestation of the last insect was not heavy.

On cabbage 1 percent DDT dust gave slightly better control against the imported cabbage worm than did 1 percent rotenone. The 1944

populations of squash bugs and striped and spotted cucumber beetles were exceptionally low, but the number of squash vine borers was extraordinarily high. However, 3 percent DDT dust gave almost perfect protection against the borer, which is very difficult to keep in check. Even 1 percent DDT dust gave much better control than the widely used 8 percent calcium arsenate in gypsum. The 1 percent DDT was also as good as 1 percent rotenone, which was about half as good as 3 percent DDT when measured by pounds of squash produced.

In general, our results with DDT at the Iowa Station have been similar to those of entomologists elsewhere; more tests will be conducted this year. Larger amounts of DDT have been released for experiments so that field trials of greater extent will be possible. Occasional use at Ames of DDT for dog and cat fleas, for bedbugs and for roaches has proved highly successful.

### Poison Man, Animals?

If DDT is so potent against some insects, the question naturally arises: Is it also toxic to man and other animals? Tests on chickens, rabbits, rats and mice have shown that DDT is a poison for higher animals. So far, no deaths of human beings, attributable to DDT poisoning, have been recorded, but presumably the chemical is toxic to man, also.

Apparently, ordinary precautions about inhaling the dust should be followed; greater care needs to be taken when using DDT sprays, especially if in oil solutions, for it is believed to be absorbed through the skin when in liquid form. However, many other highly toxic compounds such as arsenicals and hydrogen cyanide gas have long been used as insecticides, and are safe when certain rules are sensibly followed.

DDT's widespread toxicity to forms of life other than insects must sometimes be taken into consideration. When wooded areas have been airplane-dusted with DDT to control certain forest insects, some dust has fallen into streams and killed such aquatic animals as fish and crayfish.

## Kills Beneficial Insects

Does DDT sometimes kill beneficial insects? Yes—bees coming to orchards which have been sprayed with DDT during the blooming season are likely to be innocent victims. DDT also kills some valuable insects such as ladybird beetles which feed on other insects such as aphids.

In some orchards and gardens, DDT poisonings have killed some beneficial as well as harmful insects. Subsequently, red spiders or mites, or some aphid species—all relatively immune to DDT—increase tremendously to injurious levels simply because their natural insect enemies have been eliminated. A useful balance of nature has been upset. Such results have been reported from certain regions where codling moth control was attempted with DDT sprays.

## Harm Plants, Soil?

Will DDT harm plants? California workers have recorded spotted leaf injury to apple and pear foliage when DDT was used in certain oil sprays. Tomatoes treated with DDT are reported to have a decreased yield. Our Insectary Garden tests showed no harm to Irish cobbler potato, late flat Dutch cabbage, Chicago warted Hubbard squash and butternut squash. Acorn squash treated with DDT, however, showed some stunting, especially in earlier periods of growth. Some varieties of cucumbers and muskmelons were slightly "yellowed" after heavy applications of DDT dust. Much more research needs to be done with this phase of DDT's use.

Very little is yet known regarding possible accumulation of DDT in soil, with subsequent effects on plant growth. We will need to wait for a verdict on this point.

## More Testing Needed

Now that we have sketchily looked over some of the good and bad points of DDT, what conclusions may we formulate? How useful will DDT be in combating insect pests, especially in Iowa?

Before we attempt to give an

answer, we should recall several pertinent factors about DDT. Its history as an insecticide has been short. There hasn't been time to explore it thoroughly. It is known to be useless, or practically so, for certain insects. For many pests, it is no better than materials commonly used.

Some published results have been contradictory—sometimes because of differences in the manner of testing. Neither its favorable potentialities nor its unfavorable characteristics have been completely evaluated. The human body's tolerance for DDT in all of its various modes of use has not been established; its effect on the soil or on long-lived plants after repeated applications has not been determined for sure.

In short, DDT is not going to be the complete solution for controlling harmful insects. As yet it should not be used indiscriminately. Better and different methods of application may broaden DDT's usefulness, while at the same time reduce any of its possible hazards.

## Its Probable Role

What, then, will probably be DDT's most promising future uses? Without doubt, one will be in giving man protection against such household nuisances as flies and mosquitoes. DDT's long-lasting residual effectiveness against the housefly is almost unbelievable. In some tests, DDT solution sprayed on unpainted wood was still able to kill flies by contact as long as 250 days after the original treatment.

Under actual conditions, one spraying of home or office or school walls and ceilings, thoroughly and correctly done each year, should do the trick. DDT has been successfully incorporated in certain types of paint for wood and plaster surfaces to give long lasting killing properties indoors.

Perhaps DDT will also be the housewife's answer to carpet beetles, silverfish and clothes moths.



Here is a cabbage plant of similar age, showing value of DDT dust in protecting it from cabbage worms.

Spraying of barns will probably do much to reduce to a minimum fly troubles in dairy barns, hog houses and other farm buildings.

A special powder containing DDT and which mixes with water will probably be available for spraying or even dipping farm animals. Eradication of disease-carrying insects such as lice, fleas, bedbugs, mosquitoes, etc., will come closer than ever before to realization.

It should come in handy to keep cat and dog pets free of fleas; it should have value in keeping down lice on hens and in henhouses. For certain vegetable crops, the potato as a notable example, DDT has much promise, but its selectivity in ability to kill insects and harm plants will limit its value. Under certain conditions, perhaps as a dormant spray, DDT may be the answer to certain problems of the orchardist.

At present, almost all available DDT is still going to the armed forces for protecting human beings against insects that carry disease. To the impatient farmer and fruit grower and gardener and housewife, we can only suggest a little longer wait until a larger supply of DDT is released, and until entomologists have had a chance to prepare tested recommendations.

DDT won't be the whole answer to all insect problems, but it will have a lot to say about some of them eventually.

# Better ALFALFA Coming

Varieties Which Are Resistant To Wilt Show Much Promise

**W**HY DO WE need new varieties of alfalfa? Thousands of farmers in Iowa can give us the answer. We need new varieties because we're having too much difficulty in maintaining vigorous, productive stands of the old varieties.

Alfalfa is Iowa's most important legume hay crop. During the past 25 years Iowa farmers have steadily increased their alfalfa from a few thousand to more than a million acres. Similar increases have taken place in the neighboring states just to the north and east.

The center of alfalfa production has shifted from the western states to the Midwest, and this has brought some accompanying difficulties. Seed supplies of the varieties best adapted to Iowa are not always sufficient. In many years there is a critical shortage. Winter injury is a problem that is always with us, and when less desirable varieties are sown, losses from winterkilling become greater. The use of the most hardy varieties, Ladak, Cossack and Grimm, greatly reduces winter losses, but even with these, the presence of ice sheets over flat and depressed areas results in some loss of stand.

## Bacterial Wilt

Another hazard, even more serious than winter injury, is bacterial wilt. This disease, caused by an organism (*Corynebacterium insidiosum*), was first reported in Iowa

By C. P. WILSIE

in 1923, and now is widely distributed throughout the United States. It is especially severe in the north central states and is more serious in areas with plenty of moisture than in dry areas. The wilt-causing bacteria enter the outer portions of the root through various kinds of wounds. Here we can see that wilt and winter injury go hand in hand. Winter injury causes cracks in the outer layer of the root, allowing the wilt organisms to enter. The infected plant becomes less vigorous and more susceptible to winter injury.

After the bacteria enter the root they get into the water-conducting tissues of the tap root where they multiply and eventually clog the conducting vessels. If you strip down the bark of the root, you will find a yellowish or brown slimy discoloration extending along the woody cylinder of the root.

Symptoms in the growing plant include a dwarfing in size, a light green or yellowish color of the leaves, with many fine stems coming from the crown. Occasionally, even in green, apparently normal plants, a wilting of the tips of the stems occurs in hot weather, indicating the presence of the disease.

In central Iowa wilt begins to be serious by the end of the second crop year. It may actually be present at the end of the first crop year, yet yields during the second



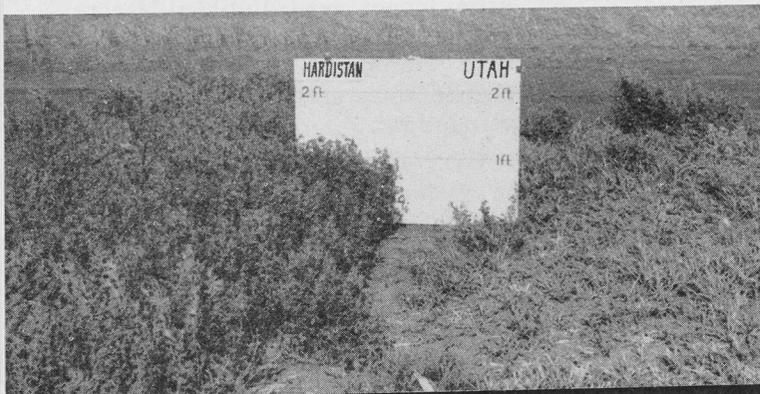
An excellent stand of Buffalo wilt-resistant alfalfa at the left. The plot of Baltic at the right shows mostly grass and weeds with only a few alfalfa plants remaining after 4 years. The original stands of both these varieties were perfect.

year usually are not affected greatly. During the third and fourth years, however, the disease increases rapidly, thinning stands of Grimm, Baltic and Common until there may be little left but weeds by the end of the fourth year. Ladak and Cossack persist a little longer than Grimm, but they, too, become badly depleted.

No control measures have been found, although good management practices may help to make the disease less serious. Frequent cutting and cutting in the critical fall period, Sept. 10 to Oct. 10, cause more rapid development of wilt. The only practical control appears to be in using resistant varieties.

In this 4-year-old stand, Hardistan (left) is winter hardy and wilt-resistant, while Utah Common is neither hardy nor resistant.

Of these four plants, only the one at the right is entirely free of wilt. The other three show varying stages of the disease.



## Wilt-Resistant Varieties

Several years ago the United States Department of Agriculture recognized the need for disease resistant and winter-hardy varieties and sent the late H. L. Westover on an exploration trip to Asia to collect alfalfa varieties. Some of the strains which he obtained in Turkestan proved to be resistant to alfalfa wilt. Through a cooperative program between the U. S. Department of Agriculture and the state experiment stations these strains, not entirely satisfactory in themselves, were used in breeding and developing new resistant varieties.

Ranger alfalfa was produced largely by the United States Department of Agriculture and the Nebraska Agricultural Experiment Station. It was developed by breeding and selection among lines tracing to the Cossack, Ladak and Turkestan varieties. It was made up by combining in equal portions seed of five lines, each of which had been tested for wilt resistance, winter hardiness, forage yields and seed production.

Much of Ranger's wilt resistance came from the Turkestan variety. Ranger has been tested widely in the United States and promises to become an important variety, particularly in the western part of the Corn Belt and states farther west. In Iowa it appears to have many of the characteristics of the Turkestan alfalfa, but probably yields a little more forage in the first year after it's seeded.

Buffalo alfalfa is a wilt-resistant variety developed by the Kansas Agricultural Experiment Station and the U. S. Department of Agriculture. This variety was de-

veloped from wilt-resistant plants found in an old field of Kansas Common. Buffalo has the characteristic favorable growth and recovery habits of Kansas Common, is wilt-resistant, and under Iowa conditions appears to have greater winter hardiness than Kansas Common. In a row nursery established in 1937 at Ames, Buffalo persisted for 7 years while Kansas Common was practically gone by the end of the fourth year.

## Forage Yields Compared

In 1940, when the first seed of these new varieties was available for replicated field trials, both Buffalo and Ranger were included in a strain trial we established at the Iowa Station. We compared forage yields for 4 years, three crops per year being harvested unless growth was poor in late summer. Comparative yields of forage and estimated stand survival at the end of 4 years for eight varieties included in this experiment are given in the accompanying table.

For the 4-year period, 1941 to 1944, inclusive, the Buffalo variety produced more forage than the others, followed closely by Ranger, with Ladak in third place. You can readily see from the data that the advantage of Buffalo and Ranger in yield came in the third and fourth crop years. This directly reflected the stand of plants as indicated in the stand survival record. After 4 years the stand of Buffalo and Ranger was estimated at 75 percent and 67 percent, respectively, while Grimm had a stand of but 11 percent and Baltic only 2 percent.

We are convinced that during the third and fourth years of the

stand the resistance to wilt begins to pay dividends. The forage yields of Buffalo and Ranger during 1943 and 1944 were more than twice as high as those of Grimm, Baltic, Kansas Common and Dakota Common.

A further examination of the data shows that during the first two crop years, Buffalo and Ranger had no advantage in yield over the other varieties. In fact, in this as well as other experiments, Ranger has produced somewhat less forage during the first year or two than has Ladak, Cossack or even Kansas Common.

## Seed Supply Limited

While limited quantities of commercial seed of Ranger alfalfa have been sold through the crop improvement associations of Montana, Nebraska and other states, there has been a much greater demand than supply.

According to a certified seed report by O. S. Fisher of the U. S. Department of Agriculture, a total of 29,340 pounds of seed were produced in 9 states from 1,715 acres of Ranger alfalfa in 1944. The acreage is increasing each year, and it has been estimated that the seed crop of Ranger in 1945 may possibly reach 100,000 pounds.

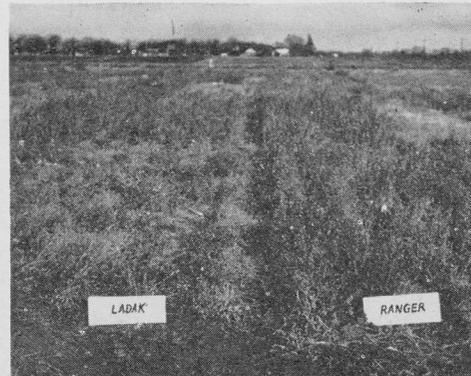
Buffalo alfalfa is being increased in western Kansas, but as yet no commercial seed is available. Ninety acres were harvested in 1944, producing approximately 1800 pounds of seed. Much of this seed was replanted for further seed increase, and 400 acres are now in production.

With little likelihood, then, that adequate seed supplies of these new wilt-resistant varieties of alfalfa will be available for several

Wilt resistance demonstrated in 4-year-old stand. Buffalo (left) is highly resistant, while Grimm (right) is one of most susceptible.

New stands of Ranger and Buffalo alfalfa in variety trial at Ames. No bacterial wilt was found in any of the varieties the first year.

Ladak is slightly more resistant to wilt than Grimm or Common, but not nearly as resistant as Ranger as shown here at end of 4th year.



COMPARATIVE YIELD AND STAND SURVIVAL OF ALFALFA VARIETIES AT AMES, IOWA, 1941-44. SEEDED IN 1940.

Variety	Tons of Hay Per Acre at 12 Percent Moisture					Stand Survival in Percent Nov. 1, 1944
	1941	1942	1943	1944	Average	
Buffalo	5.57	4.33	3.60	2.54	4.01	75
Ranger	5.39	4.43	3.55	2.34	3.93	67
Ladak	6.25	4.81	3.01	1.45	3.88	20
Cossack	5.78	4.45	2.61	0.97	3.45	16
Grimm	5.60	4.47	2.47	0.84	3.34	11
Baltic	6.11	4.85	2.10	0.26	3.33	2
Kansas Common	5.78	4.59	1.75	0.60	3.18	6
Dakota Common	5.64	4.62	1.94	0.34	3.14	3

Differences of 0.23 ton per acre (average yields) are significant at the 5 percent level.

years, what varieties shall we use in Iowa? A careful study of the table will give the answer.

All of these varieties produced excellent yields during the first two crop years after establishment. We must consider more seriously than we have ever done before the greater use of alfalfa in shorter rotations. When the stand is

to be used for 2 years only, or 3 at the most, Ladak, Cossack, Grimm and the northern commons will be satisfactory. Ladak and Cossack are preferred if they can be obtained. If you plan to leave the field for 3, 4 or more years, use Ladak or, better still, the new wilt-resistant varieties, Ranger or Buffalo, if you can get the seed.

## Indiana "Grinds" Corn Borers

A machine that can be attached to the mechanical corn picker and will kill 95 percent of the European corn borers that are in the stalks at the time of picking—that sounds pretty good.

The agricultural engineers of Indiana Agricultural Experiment Station, Purdue University, report that kind of results in the fall of 1943 and early 1944 in some tests which they made with a machine they have been perfecting in cooperation with the International Harvester Company. The original work in building this machine was done by R. H. Wileman.

The machine is not yet ready for production and it is not available to anyone who might want to buy one. They are not being produced, but the results which these workers at Purdue obtained are promising.

The work in building a machine of this kind was begun in the spring of 1942, and the machine was first tried out in the fall of 1942. On the basis of the experi-

ments made, the machine was changed and improvements made. In the fall of 1943 and the early part of the winter of 1944, it was used on a much larger scale and careful counts made in cooperation with Purdue entomologists to determine just how effective the machine had been in killing borers.

A series of nine tests were made under different field and stalk conditions. The first tests were made Oct. 18, 1943 and the last of them for that season on Jan. 25, 1944. The average borer kill for the nine tests was 95.3 percent. The percentage of kill in the nine tests was very close, ranging from 94 to 97 percent.

Briefly, the machine uses the hammer mill principle so that it pulverizes the stalks. The rotation of the hammer cylinder is opposite to the direction of travel of the machine and is adjusted to just clear the ground. With this arrangement the lower part of the stalk is pulverized as the machine moves into it, and the remainder

of the stalk is fed into the hammers by the snapping rolls. A section of hammer mill screen is provided to the rear of the cylinder to serve as a concave for the hammers to work against in pulverizing the stalks.

Aside from giving a high corn borer kill, the work of this attachment leaves the stalks in such a condition that they can be readily disked into the soil or plowed under. The material which it turns out is considerably finer than ordinary shredded fodder.

On 16 acres where the machine was used, the ground was double-disked and sown to wheat as soon as the corn was picked. Another 20-acre field was allowed to lie over winter and was then double-disked and sown to oats and alfalfa. In both fields a nice seed-bed was obtained—there were no stalks to bother the combine or binder when the small grain and hay crops were harvested.

It appears that the work of this type of pulverizer has many advantages and its use, aside from corn borer control, might be profitable and beneficial for any farmer using a corn picker.

## When Shall I Cut Clover?

In 1943 some experiments were made at the Iowa Station to try to determine when is the best time to cut medium red clover to get the best yield of forage and seed.

The first crop of red clover was cut at six different stages of maturity, starting with the bud stage, June 4, and ending when the clover was mature, July 23. Second crops were cut at three times from these six first cutting stages—the second cuttings being made at three stages of maturity—25 percent in bloom, full bloom and mature seed.

Forage yields of the clover were best, considering both quantity and quality of hay, when both the first and second crops were cut near the full bloom stage.

The most favorable cutting time if you want to produce seed, according to this work in 1943, was to cut the first crop for hay in the bud to early bloom stage and then harvest the second crop for seed.