$75,000,000 More Oats in 3 Years

We take our hats off to Dr. H. C. ("Pat") Murphy and his associates for giving Iowa farmers at least $75,000,000 more income from oats in the 3 years 1943, 1944 and 1945.

Dr. Murphy is the man who selected the varieties Tama, Boone, Marion and Control for disease-resistance. These varieties have brought Iowa farmers huge increases in crop yields and improved quality of oats. These new varieties have so much more resistance to rust and smut than the older ones that they have far surpassed them in yield.

These varieties by conservative estimate gave Iowa farmers 109,142,243 bushels and $75,220,029 more income than they would have obtained from Gopher and Richland, the highest yielding of the older varieties, in the 3 years 1943, 1944 and 1945.

The estimates are based upon about 67 percent of the oats grown in Iowa in 1943 being of these new varieties, 90 percent in 1944 and 98 percent in 1945. The prices used in arriving at the increased values were the Nov. 15 market prices in 1943 and 1944 which were 72 and 65 cents a bushel and for 1945 the Sept. 1 parity price of 69 cents a bushel.

Because of the large acreages of the new smut and rust-resistant varieties the old varieties, Gopher and Richland, probably produced better crops than they would have if these other resistant varieties were not being grown so widely. These new disease-resistant varieties shielded the older ones from smut and rust.

Clinton in the tests to date has surpassed Tama, Boone, Marion and Control to about the same extent as these varieties did Gopher and Richland. If Clinton continues to do so, Iowa farmers can look forward to still better oat crops in the future.

Thanks, Dr. Murphy, and your collaborators and co-operators of the Iowa Agricultural Experiment Station and the USDA.

About the Cover—

It may not be appropriate to be combining oats on the cover page of this October Farm Science Reporter—but how would you like to have a 141-acre field that would give you a yield of 102 bushels of 40-pound oats to the acre?

That's what this one did. It is the field of Wayne Robinson, north of Marshalltown (near Albion) who grew this field of Clinton oats under contract for Iowa State College.

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Clinton oats in a test plot at the Agronomy Farm of the Iowa Agricultural Experiment Station at Ames. Note the strong, upright plants. Among Clinton's more undesirable features are irregularity in height, date of maturity.

By H. C. MURPHY and L. C. BURNETT

A VARIETY of oats that promises to turn the poor oats years into good ones will be grown by a few farmers in every county of Iowa in 1946, and if the carefully laid plan of producing seed works out satisfactorily, then it should be in many Iowa farmers' fields by 1947.

Many of you no doubt know something about Clinton oats, for it has been grown in community trials all over the state for several years. It has rather consistently outyielded all other named varieties with which it has been compared. It has the stiffest straw and weighs out better than any other variety tested in Iowa. It is not as uniform as we would like for height and varies slightly in maturity.

In Clinton oats, Iowa farmers should have in wet years a variety that will outyield Tama, Boone, Marion and Control about as much as these varieties did the older ones—Gopher and Richland (Iowa 105). In 48 Community Grain trials reported for 1945, the average yield of Richland and Gopher was 57 bushels to the acre; Marion, Tama and Boone averaged 70 bushels—13 bushels more than Gopher and Richland; and Clinton yielded an average of 84 bushels to the acre—14 bushels more than the average for Tama, Boone and Marion.

Clinton's Record

Clinton is a medium tall, yellow, early oat (1 day later than Tama, Boone and Richland, but 3 days earlier than Marion). The kernels are plump and the hulls thin. It grows about 2 inches taller than Tama and Boone. Clinton outyielded Tama, Boone and Marion by an average of about 14 bushels to the acre in the 1945 community trials in Iowa, but what about the other years? We have a comparison of Clinton with Tama, Boone, Marion, Gopher and Richland over a period from 1938 to 1945 in tests of the Iowa Station at Ames and Kanawha. In these tests (see the table) it has outyielded Tama an average of nearly 15 bushels to the acre; it is ahead of Boone an average of 16½ bushels to the acre. It has outyielded Marion nearly 17 bushels to the acre. Clinton has produced an average of 27 and 28½ bushels more to the acre than the older varieties—Gopher and Richland.

The Community Grain trials indicate that Clinton is as well adapted or has about as much advantage over other varieties in one part of the state as another.

It Outyields Tama, Boone, Marion, Control About Like These Did the Older Varieties
Dr. Murphy is shown at the left in an oat nursery at the Iowa Station where he is injecting rust spores into plants of a variety known to be susceptible to all races of both crown and stem rust. The adjacent sections are given a natural test for rust resistance because of the opportunity rusts have to spread from the rows which are infected.

If we should run into a cycle of years when rusts do not bother, Iowa farmers may find that Clinton does not yield much better than Tama, Boone, Marion and Control, but in the wet years when diseases “go to town,” Clinton has shown a marked advantage.

In the rust-free years, even though Clinton may not show any great advantage in yield, it should be superior in its strength of straw and in weight per bushel. In fact its very stiff straw, which gives a long period for safe harvest, may be the quality that farmers will like most, for Clinton has the ability to stand up on very rich soil and this ability to stand continues for 10 days to 2 weeks after it is ripe.

Because of its sturdy straw, we should be able to delay harvest until Clinton is fully ripe and thus get away from the trouble of heating in the bins which many have had with Tama, Boone and these other new varieties. You can leave Clinton in the field longer and permit it to dry out well before it is cut or combined. In that way, it can be put into the bin in a condition that will not cause trouble from heating.

With the old varieties in which the hulls made up a relatively large proportion of the grain, one could harvest the oats much greener, and even if they were binned with considerable moisture in them, they would be less likely to heat because of the big portion of hull. That is not true with Tama, Boone and the others released with them, and it is not true of Clinton. They are all thin-hulled.

Because of its sturdy straw, it may be feasible to combine Clinton oats “direct” while standing in the field—after they have become well dried out. Of course there is a limitation to the time they can stand before they will go down, but they should stand much longer and should stand up on much richer soil than the older varieties, including those like Tama and Boone.

Plan for Distribution

Careful consideration has been given to the method of distributing Clinton oats so as to make them available to the largest number of Iowa farmers in the shortest possible time.

In the fall of 1943 the Agricultural Experiment Station turned its seed of this new variety over to the Committee for Agricultural Development for increase and distribution.

There are about 20,000 to 25,000 bushels of this seed to be distributed to Iowa farmers in 1946, and they will be allotted to the various counties on the basis of their 1944 oat acreage. None of

<table>
<thead>
<tr>
<th>Variety</th>
<th>Date ripe</th>
<th>Height</th>
<th>Amount of lodging</th>
<th>Test weight</th>
<th>Yield</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Before ripe</td>
<td>After ripe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>Inches</td>
<td>Percent</td>
<td>Percent</td>
<td>Pounds Bushels</td>
</tr>
<tr>
<td>Clinton</td>
<td>17</td>
<td>35</td>
<td>2</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
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<td>33</td>
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<tr>
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<td>52</td>
</tr>
<tr>
<td>Marion</td>
<td>20</td>
<td>37</td>
<td>27</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>Gopher</td>
<td>17</td>
<td>34</td>
<td>58</td>
<td>52</td>
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<tr>
<td>Richland</td>
<td>15</td>
<td>32</td>
<td>44</td>
<td>43</td>
<td>80</td>
</tr>
</tbody>
</table>

http://lib.dr.iastate.edu/farmsciencereporter/vol6/iss4/1
this seed will be available to farmers in other states in 1946. Some farmers in Indiana and Illinois can get Clinton through their state agricultural colleges. Seed was made available to these institutions for testing in 1939 and 1940 and for increase in 1945. It was agreed that the variety would be released simultaneously in these three central Corn Belt states.

Each Iowa county to receive Clinton oats must have a county seed distribution committee. The county extension directors will usually act as secretaries for these committees. All actively interested county organizations will be invited and urged to appoint representatives to these county committees. These may include the Farmers’ Union locals, county Farm Bureau, Grange, vocational agriculture groups, county agricultural conservation (AAA) associations, Soil Conservation districts and any others interested. Persons interested in growing Clinton oats should get in touch with their county committee. Don’t write to the college at Ames. Seed will go only to the persons selected by the county committee.

Choose Growers

From the information in the questionnaires and the members’ own knowledge and judgment, the county committees will make their selections and list the farmers—the prospective seed growers—in the order in which they consider them best fitted to produce seed for the farmers of that county. Each county committee will send its list of farmers, together with the questionnaires for each, to the Committee for Agricultural Development at Ames. This group will go over the questionnaires again and may eliminate any name if the facts in the questionnaire indicate that the person cannot be expected to produce a maximum amount of high quality Clinton seed.

The farmers chosen will be notified and invited to sign agreements and make their remittance for seed. The seed will be sent out in lots of 24 to 45 bushels. This will be sold to the farmers at $2.25 a bushel f.o.b. Ames or Marshalltown. It will be sent in 3-bushel bags. The farmers who are selected and agree to grow this variety must also agree to have it certified.

Those who get Clinton seed must agree to sell at least one-half the crop to other farmers for seed and they cannot sell more than 50 bushels to any one man without consent of the county seed distribution committee. The price limitation on the seed they sell will be $1.00 above the Des Moines December 1 price of U. S. No. 2 oats. No oats can be sold to anyone outside the county without the permission of the county seed distribution committee.

All of these and other restrictions have been put on Clinton oats to try to make it available to the most Iowa farmers in the shortest possible time and to assure that it will be handled by honest, capable farmers who have the soil and equipment to get the most possible high quality, clean seed from that distributed.

Clinton oats should have real advantage to the farmer who harvests with a binder, for their stiff straw makes it feasible to leave them standing in the field until they are fully ripe. This is an increase field, grown under contract for Agricultural Development Committee, Iowa State College, on the Joe Judge farm near Ames, Iowa.
How Clinton Originated

Hybrid seed has become a kind of magic term to many farmers because they have seen what hybrid corn seed can do to yields, its superiority in drouth years, its sturdy stalks and other advantages. Clinton oats is not a hybrid—it is a new variety that comes from hybrid origin. Oats in general are self-pollinated so that they are inbreds. If you want to cross two varieties of oats, the tiny flower must be opened and the pollination made by hand—a very tedious, slow process.

The oat breeding work at Ames is cooperative between the Bureau of Plant Industry, Soils and Agricultural Engineering of the USDA and the Iowa Agricultural Experiment Station. Clinton oats originated at the Iowa Station as a selection from a cross of D69 with Bond. Its value was determined in extensive tests in Iowa and in tests cooperative with the agricultural experiment stations in nearby states.

The parent D69 was developed from a cross of Richland and Green Russian. Bond came from Australia and was obtained with many others by the U. S. Department of Agriculture. Bond is a stiff-strawed, mid-season variety which produces a plump, reddish-yellow kernel. It is nearly immune from most of the races of crown rust (leaf rust) which are found in North America. It also is resistant to most races of both loose and covered smut, but it is susceptible to all races of stem rust. Clinton gets its stem rust-resistance from the other parent, D69.

25 Pounds to 1,207 Bushels

In one year Clinton oats was increased from 25 pounds to 1,207 bushels! In the fall of 1943 we sent 25 pounds of seed to the Arizona Experiment Station for a winter crop. It was sown under the direction of Dr. A. T. Bartel at Mesa, Arizona, in October, 1943. From this planting 67 bushels were harvested the next spring—May, 1944—and this seed was immediately expressed to the Aberdeen Substation of the Idaho Agricultural Experiment Station. There it was grown under the supervision of Superintendent J. L. Toevs. Arrangements for these increases in Arizona and Idaho were made in cooperation with the United States Department of Agriculture.

The seed was planted in Idaho in May, 1944, and 1,207 bushels were harvested in the fall of 1944 and shipped to Ames. So, from a 25-pound lot a year before, we had approximately 1,200 bushels in the fall of 1944. Had it not been for a severe windstorm before the crop was fully harvested in Idaho, we should have had around 2,000 bushels.

Clinton Isn’t Perfect

Despite its good record, Clinton has some weaknesses. First of all, it is a bit uneven in height and in date of ripening. Furthermore, it is susceptible to some of the races of crown rust—race 45, and similar ones.

There are races or “varieties” of the rusts just as there are of crops. For instance, there are 82 known races of crown rust (leaf rust), which has been the most important disease so far as oats are concerned. Although most oats are highly susceptible to race 45 and similar ones, this race has never caused any serious damage to the crop in Iowa. Race 45 is rather widespread throughout the United States, but so far it has always come into Iowa too late to seriously affect the yield.

Just what this race may do in the future cannot be predicted. It is possible that eventually it may build up enough to cause serious damage to Clinton. A number of years ago when Richland and Iogold were two of our important varieties, it was predicted that their resistance to stem rust would not continue to hold up because they were susceptible to certain races of rust which at that time had not been important. Richland and Iogold were widely grown for many years, however, without serious damage from these races of stem rust. The same thing could happen to Clinton with race 45 and similar races of crown rust.

Races 8 and 10 of stem rust have been known for many years, and since 1943 they have built up to the extent that they have caused damage to the varieties susceptible to them. Richland, Iogold, Boone, Tama, Vicland, Control, Cedar and Marion all are susceptible to races 8 and 10 of stem rust. Clinton is resistant to races 8 and 10 and to the other common races of stem rust.

In contrast to the build-up of races 8 and 10 of stem rust, which
Stills another view of the Wayne Robinson increase field being inspected by Dr. Murphy before harvest. Dr. Murphy is 6 feet 1½ inches tall. Clinton ordinarily grows about 2 to 3 inches taller than Tama. Note that there is some irregularity in height in this field, with a few plants much taller than the rest. The oats in the foreground that appear to be lodging were actually knocked down by transportation of machinery along this edge of the field. Clinton oats have the stiffest straw of any named variety tested in Iowa, Indiana and Illinois.

have increased with the growing of more susceptible varieties of crown rust, race 41, to which Tama, Boone, Control and Vicland are highly susceptible, has not increased materially even though these varieties are now widely grown. It may be that race 45 will not increase and cut down the advantage of Clinton.

Rusts Compete

Rusts compete with one another somewhat as plants do. If one is eliminated others may come in. There is also some crossing of races, bringing in new ones. There are 82 known races of crown rust, 13 races of stem rust, 31 races of loose smut and 14 known races of covered smut. Additional races certainly will be found.

Treat Seed Oats

Many farmers have been of the opinion that if they were growing an oat variety that was resistant to

Clinton’s Advantages

We believe that Clinton oats has three distinct advantages over other varieties now grown in Iowa. They are:

1. Higher yielding ability.
2. Stiffest straw of any variety now available. In some of the community grain trials birds have been noted lighting on these sturdy Clinton plants and picking out the plump kernels. Some other varieties are not strong enough to hold a blackbird or a sparrow, but Clinton is.
3. Higher test weight. The kernels are plump and the hulls thin. They will provide a much more valuable oats for feeding.

Clinton should prove a real boon to Iowa farmers. While it is not perfect, our tests show that it is superior to anything else so far available. Considerable Clinton seed should be available in 1947 and enough for everyone in 1948.
Winter condition of contoured grapes following pruning in February. The vines were planted a foot from the down-hill edge of a 4½-foot bench terrace. The furrow and ridge above the cultivation strip retard runoff. Cover here is Korean lespedeza and Kentucky bluegrass.

What to do with the land that is so hilly and steep that it cannot be farmed in the usual way is a problem on many Iowa farms. We have been trying to get an answer to this problem in a joint research project of the Iowa Agricultural Experiment Station and Soil Conservation Service of the USDA.

For studying the problem the government dropped into our laps a 187-acre farm in southern Iowa at Floris. The farm had been so badly eroded that all of the topsoil gone over most of it and even some of the subsoil had been washed away from parts of it. In Iowa we have a lot of fertile, nearly level or rolling land that good farming practices will keep producing cultivated crops well. But on many farms there are areas so steep that they cannot be farmed in the usual manner.

This farm on which we started working in 1937 was poor enough that it had been unable to support a family, so that it had been sold to the government at $10 an acre.

In the 8 years that we have been working on this problem, we feel that we have made some progress. We have demonstrated that soil of this kind—very hilly and with most of the topsoil gone—will produce certain crops successfully. We have found that it will produce grapes, plums, nut trees, post trees, farm forage trees (such as honey locust with high sugar content, bur oak and selected persimmons), high tannin sumac, figured walnut and other trees for veneering, conifers for Christmas trees and trees of various kinds for shelter belts, woodlots and even for lumber production.

Fruit Yields

Here are the yields we have obtained on this extremely hilly, badly eroded soil: Grapes up to 8 pounds per vine, or about 2 tons to the acre; plum yields as high as 5 to 6 bushels to the tree and an average of ¾ bushel per tree from 5-year-old trees (Superior variety) in 1942. These best yields of grapes and plums have been obtained by using the best horticultural practices such as spraying and the best adapted varieties found, but without the use of any kind of fertilizer on the soil. The crop from one plum tree in one season has sold for enough to pay for the land at the price it was purchased—$10 an acre.

The crops listed above are not the usual kind of crops we think of producing on Iowa farms, but neither are these steep areas the usual kind of farm land. We must find crops that fit this kind of soil to get the most from it.

Forest or Pasture Land?

In the past the answer to the problem of how to use our soils of different degrees of slope has seemed simple—rotation cropping for level to moderately hilly land—pasture and forest for steep, hilly land. Recently we have learned that because livestock injure trees, it cannot be pasture and forest for hilly land, but we must decide whether it should be pasture or forest.

There really is no set rule for deciding how to use steep land, but we do know that we must keep this soil “nailed down” with roots of grasses and legumes or with trees and woody plants.

Pasture and Woody Plants

In our experiments at the Cooperative Hillculture Farm at Floris, we have shown that you can grow grasses and legumes such as are usually used for pasture or meadow in strips between contour rows of fruit trees or other kinds of trees, vines or shrubs. These strips of grass and legume crops hold the soil in place, build it up and prevent water runoff.

This means that we can produce fruit and other valuable crops on soils where erosion control would be impossible with our usual Iowa cultivated crops. This permits us to use grasses and legumes along with woody plants (trees and vines) to conserve soil and water to the advantage of both kinds of plants and at the same time produce valuable fruit crops or other woody plant crops.

We do not pasture these strips
in between the trees. They are established and grown to help conserve soil and water. In this way we obtain the beneficial soil conserving effects of pasture, meadow and woody plants growing in the same sort of plant communities as they do in nature around the edges of woods. If you like a bit of hunting occasionally, you may be interested to know that these provide fine wildlife areas.

Fruit on the Hills

One of the best uses that can be made of some of these steep hills is to put them into production of fruit crops, we have concluded. Few farm families have enough fruit in their diet. Studies made in southern Iowa show that only about 5 farms out of each 100 produce as much fruit as the farm family needs. Usually, too, the small acreage that is used for fruit is the most nearly level—the most valuable land on the farm though it may not be most suitable for fruit. We need to turn to the hilly spots that have eroded, or would erode if we farmed them, for the place to plant our fruit trees and vines.

The fruit to be grown will probably be one of the following: Apples, pears, plums, peaches, cherries, grapes, cane fruits and strawberries. Peaches probably should not be attempted except in the three or four southern tiers of Iowa counties, and even there one cannot be too sure of getting a crop. The average farmer will probably be interested in growing two or three kinds of fruit, depending on his neighbors for other kinds. If you are in doubt about the varieties of fruit to plant in your region, consult the horticulturists at Iowa State College for recommendations.

Preparing for Planting

Here are our general recommendations for preparing the soil, based on our experiments at Floris:

1. Contour Planting. On hilly land, all fruit should be planted in rows on the exact contour. If the slope is not too steep, two or three or even more rows of cane fruit may be placed on one contour strip or bench terrace. Generally there should be only one row of fruit trees to each bench with the space between rows conforming to the original slope of the orchard.

2. Terraces, Regular Type or Bench. No larger terrace structure should be built than is necessary to control erosion. We have found that much of the problem of holding the soil in place can be done by growing pasture and meadow plants between the rows. This is a lot cheaper than building regular terraces and has the added advantage of not breaking up the original structure of the soil and helping build the soil while it is holding it down.

So we feel that terraces of the regular type probably should not be built unless you find that one or two terraces with a slight grade are needed to carry off some of the water from the slope. Even where this is necessary, we find that bench terraces on the exact contour should be used for the rows of fruit between the terraces.

If you are bothered about the problem of building these terraces, get in touch with the soil conservation technician in your district and with his help you can build the regular terraces with a plow. The fruit trees can then be placed on this terrace as well as on the plowed contour strips or bench terrace.

You can prepare the plowed contour strips or bench terraces for planting your orchard very easily and simply by using a horse-drawn plow, disk and harrow. Before starting to make the bench terraces, you should have all of the contour lines staked at the correct
plowed space left between the rows to prevent erosion.

After the contour strips are plowed they should be thoroughly disked and harrowed. If they are prepared in the early spring before planting, the disked and harrowing can immediately follow the plowing operation. If the plowing is done in the fall, our experiments show that it is better to delay disked and harrowing until the next spring. In fields having enough plant cover so that the space between the rows is protected over winter, the bench terraces have proved to be in better condition for early planting when the plowing was done in the fall before.

3. Plant Cover Between the Rows of Trees. Maintaining a good vegetative cover between the bench terraces (1) protects and builds the soil on the slope and (2) furnishes a handy source of mulching material. Usually mixtures of legumes and grasses make the best cover. The following crops have given good results: Korean lespedeza with or without bluegrass; birdsfoot trefoil and bluegrass or brome; alfalfa and brome-grass; prairie grass mixtures and two or three good pasture seedling mixtures. The higher the yield from the interplanting mixture, the more rapidly the soil will be improved, since none of the plant cover material is removed from the slope, but one must be careful to see that the grasses and legumes do not compete too much with the trees.

Soil and water have been conserved best when the plowed contour strips were prepared in fields already covered with vegetation. A good weed cover is much better than no cover. Weed covers can be replaced with legume-grass mixtures before or after the bench terraces are made. If you need to prepare a seedbed for the legume-grass mixtures, make sure that all of the strips are not plowed at once, leaving the entire slope unprotected from erosion.

In the experiments where the orchard was established on practically bare cropland, the tree rows were staked at the proper distance and the interplanting strips of grasses, legumes or mixtures were established the year before the bench terraces for the trees were prepared and planted. To plant the orchard on cropland, the first year a winter cover of hairy vetch and rye may be planted in the interplanting area as late as the first week in September the previous fall.

Placing Space, Location

The spacing between the rows of trees and vines will not be uniform because the rows are located on the contour. Spacing between two rows of each kind of fruit should not be closer than the smaller figure in the accompanying table. Two rows of apples, for example, should not be closer than 33 feet.

If the space between two adjacent contour rows of the same fruit becomes twice this space, a short row may be put in. The space between plants in the row can be reduced when the space between the contour rows becomes greater. Between rows of different fruits, you can adjust the distance by averaging the least spacing for the two fruits.

For erosion control it seems better to place the row of trees near the lower side of the bench terrace and cultivate only on the upper side. The distance from the edge of the bench on the lower side should be not less than 1 foot for grapes, about 2 feet for plums, peaches and cherries, and about 3 feet for strawberries.

### RECOMMENDED SPACING OF FRUIT PLANTS AND TREES

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Space between rows, feet</th>
<th>Space in rows, feet</th>
<th>Fruit</th>
<th>Space between rows, feet</th>
<th>Space in rows, feet</th>
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<tbody>
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<td>18 - 22</td>
<td>Blackberry</td>
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<td>3 - 4</td>
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<td>Currant and gooseberry</td>
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<td>16 - 18</td>
<td>Black raspberry</td>
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<td>16 - 18</td>
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<td>Grape</td>
<td>8 - 10</td>
<td>8 - 10</td>
<td></td>
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</tbody>
</table>

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Seven-year-old Thomas walnuts growing in individual half-moon shaped basins. The basins are constructed and located so that they will catch and hold all of the water which falls upon the steep slopes.
feet for apples. Apples and pears are the only trees which give much better results when planted in a row down the middle or slightly below the middle of the bench whether cultivated on one or both sides. Mulched trees or vines can be planted down the middle of the terrace because no room needs to be left on either side for cultivation.

Cultivating Methods

It is better to cultivate on only the upper side of the bench terrace than on both sides because of the difficulty of maintaining the downhill shoulder of the bench if it is kept tilled and bare by cultivation. This is especially true where the fruit is planted on steep slopes where the bench terraces must be narrow. For this reason it is better, if possible, to plant larger trees, such as apples and pears, on more gentle slopes where wider bench terraces can be made which will allow for at least 8 feet of cultivation or mulching. For some varieties of these larger trees cultivation or mulching on both sides of the row seems desirable.

One-horse cultivators, 5-shovel and double shovel, may be used to good advantage in bench terrace cultivation. Care must be taken in the use of the double shovel plow not to plow deep enough to injure the roots. For all of the fruits mulching gave at least as good results as cultivation and better erosion control. We expected more injury from plant diseases and insect pests because of mulching, but as yet (in 8 years) it has not developed. All pasture and meadow plants grown between the fruit rows, if not used on the benches for mulch, should be left in place to build up the soil of the orchard.

A method which has proved quite practical is to plant the rows of fruit trees slightly wider apart than the recommended spacing and maintain permanent strips of vegetables or truck crops down the middle of the interplanting space. On each side of a row of fruit trees on a cultivated or mulched bench terrace is a strip of permanent grass, legume or mixed cover. Beyond this on each side is a strip of vegetable or truck rows, beyond this a strip of the grass and legumes and then the tree row on a bench terrace.

Value of Other Uses

The value to the farm of making other uses of hilly land than for rotation cropping, pasture or forest will depend chiefly on the interest and effort of the farmer and the acreage and condition of the land available for these uses.

As soil conservation farm plans are completed for an increasing number of the farms in Iowa, it is becoming apparent that there is available, on almost every farm, at least an acre or two which is better adapted to fruit growing and other permanent agricultural crops than for anything else. On many farms the home site is the steepest and most broken part of the farm. On these farms the hillculture orchard can well be placed close to the house and barnlot and be included in an over-all plan for the use and beautification of the home site and its protection from erosion and from wind. On other farms the unused area may even be on the "back 40."

We can hardly overestimate the value to the farm family of fruit and other woody plant crops which can be produced with little effort right at home under conditions which will insure complete erosion control and rapid soil building. No little part of the value of putting our hilly land to work is the interest which the entire family may have in it and the better use which can be made of the time of the different members of the family in off seasons.

Many of you may feel that your farm has too little cropland and too much rough, hilly land. A little well directed study and effort on the problem of the use of this excess hilly, eroded land can lead to a well developed plan for its full use. Practically all of the uses for hilly land which have been adapted or developed on the Iowa Cooperative Hillculture Farm may be expanded so that, on a given farm, one or more of them may be utilized to add materially to the income of the farm.

Seven-year-old Underwood plum trees cultivated on the upper side only. The plant cover used between the rows on the Lindley loam subsoil is Korean lespedeza and Canada bluegrass. Both do well here.

Below: A 7-year-old plum tree in bloom on mulched bench terrace on the contour. These Minnesota plums have produced well on eroded soil.
MANURE...

By H. B. CHENEY and A. J. ENGLEHORN

GOOD FARMERS for years have considered the manure produced on their farms a valuable fertilizer and many carefully conducted experiments have shown that these farmers have been right.

Here are some of the highlights of the value of manure which have come from our experiments at the Iowa Station, from experiments elsewhere and from calculations:

1. The manure produced on an average quarter section farm in Iowa is worth as much as the combined value of the oat and hay crops of the farm, or one-third the value of the corn crop.

2. The manure produced in the barns and lots has a crop producing value four times that of the limestone and commercial fertilizer used on the average Iowa farm.

3. On a highly fertile, dark-colored soil (Webster) at the Agronomy Farm at Ames, manure has been applied over a 30-year period at the rate of 8 tons to the acre once each 4 years in a 4-year rotation of corn, corn, oats and clover-timothy hay, and it has increased the value of the four crops in the rotation $19.12 an acre using 10-year average prices. Each ton of manure had an actual value of $2.39 in increasing the crop yields.

4. Manure applied to less fertile soils than the Webster has given even better yields, and its value per ton is higher when applied in amounts smaller than 8 tons per acre each 4 years.

5. The organic matter has declined only a third as fast where manure has been applied to soils as where it hasn't in plots at the Agronomy Farm of the Iowa Station. This was over a 20-year test period. Organic matter gives the soil its life, prevents it from baking and becoming cloddy, gives it capacity to hold water and makes more plant food available.

6. Because manure increases yields, the same amount of labor and power used in preparing the seedbed, planting, tending and harvesting a crop will give more bushels of grain or more tons of hay. Applying manure makes it possible to produce the same amount of crop from fewer acres.

7. A ton of well-preserved, mixed manure (bedding and dropings of animals) contains plant food equal to about 100 pounds of a 10-5-10 commercial fertilizer; that is, 10 pounds of nitrogen, 5 pounds of phosphoric acid and 10 pounds of potash.

8. Manure helps prevent soil erosion by making the soil able to absorb more of the water which falls on it so that less water runs off. It also stimulates plant growth, which slows down surface runoff and favors water absorption.

9. Manure alone is not enough on most Iowa soils. Many of them are acid and need lime to grow legumes. Addition of phosphate fertilizer with manure and limestone is highly profitable on many Iowa farms. On sloping soils, contour tillage is essential.

10. Because manure increases yields, the same amount of labor and power used in preparing the seedbed, planting, tending and harvesting a crop will give more bushels of grain or more tons of hay. Applying manure makes it possible to produce the same amount of crop from fewer acres.

11. A ton of well-preserved, mixed manure (bedding and dropings of animals) contains plant food equal to about 100 pounds of a 10-5-10 commercial fertilizer; that is, 10 pounds of nitrogen, 5 pounds of phosphoric acid and 10 pounds of potash.

12. Manure helps prevent soil erosion by making the soil able to absorb more of the water which falls on it so that less water runs off. It also stimulates plant growth, which slows down surface runoff and favors water absorption.

13. Manure alone is not enough on most Iowa soils. Many of them are acid and need lime to grow legumes. Addition of phosphate fertilizer with manure and limestone is highly profitable on many Iowa farms. On sloping soils, contour tillage is essential.

Manure's Importance

Livestock on the average 160-acre Iowa farm produces about 280 tons of manure each year. Of this, 240 tons are available for cropland and the remainder falls on permanent pasture. Perhaps 1/3 of that available for cropland is dropped directly in the fields and the remainder, 160 tons, is dropped in the barns and lots. On the basis of its ability to increase crop yields, a ton of manure is worth about $2.40 using 10-year average prices. In terms of crop-producing value the average Iowa farm produces manure worth $570.

This same average Iowa farm produces a $1700 corn crop, a $240 oat crop and a $240 hay crop. Accordingly, the crop-producing value of manure, when unwasted, is more than equal to the value of the hay and oat crops combined or to 1/3 the value of the corn crop. It is worth 1/8 of the value of all livestock on the average Iowa farm Jan. 1, 1945.
A rough estimate of the amount of manure produced on an Iowa farm can be easily made from the weight of crops fed. At the Ohio Agricultural Experiment Station, an average of 1.5 pounds of manure was produced for each pound of crops fed or used as bedding. This manure was all carefully saved and kept under excellent storage conditions. This quantity is not saved on the average Iowa farm. Actually the loss from manure dropped in the barns and lots through heating and leaching is more than 50 percent on most Iowa farms. With reasonably good care, 1.0 pound of manure should be available for each pound of crops used on the farm. This method of calculation along with estimates based on the numbers of different kinds of livestock were used in the above comparisons.

The importance of manure can also be illustrated by comparing its crop-producing value with that of limestone and mineral fertilizer. The manure produced in the barns and lots has a potential crop-producing value equal to four times that of the fertilizer and limestone used in table 1, 84 acres of land receiving manure will produce as much food as 100 acres without manure. Wise use of available manure allows greater production on the same number of acres.

Increases Crop Yields

The ability of manure to increase the yield of crops has been recognized for centuries. Manure helps even good productive soils. The effects of manure have been studied since 1915 on Webster soil, a dark, highly fertile soil at the Agronomy Farm at Ames. A 4-year rotation of corn, corn, oats, and clover-timothy hay was followed. Part of the plots received no treatment. Others received an application of 8 tons of manure once each rotation. The manure was applied to the clover sod and plowed under for corn.

This rate of manuring is practical on livestock farms where the yields of corn and oats are 56 bushels per acre and hay yields 2.75 tons per acre. Actually, if all of the crops were fed, about 12 tons of manure would be produced per acre per rotation. With good management and allowing for some sale of crops, 8 tons could be saved to apply to the land. On most Iowa farms the amount of manure produced will be appreciably less than this. Moreover, as much as 50 percent of the value is easily lost by careless handling.

While good yields were obtained without any treatment other than a good rotation, manure (see table 1) increased the yield of all crops even though the soil on which it was used was very fertile. The yield of corn was increased an average of 10.8 bushels per acre; oats, 3.7 bushels per acre; and clover hay 0.58 ton.

Clove Increase Largest

Surprisingly enough, the largest percentage increase in yield was obtained on the clover hay. Though the manure was applied ahead of the corn, the clover crop was increased 27 percent while the corn showed a 20 percent increase in yield. Similar results have been obtained in other experiments.

In this experiment, the manure resulted in increased crops worth $19.12 per acre per rotation according to calculations based on average farm prices for the period of 1934-1943. Each ton of manure produced increased crops worth $2.39. On less fertile soils even greater values than this are obtained. Also, manure applied at lower rates per acre usually gives larger increases per ton of manure.

The use of manure and other soil fertility and conservation practices means more production per acre; more food produced per farm; lowered production costs. On the basis of the data shown in table 1, 84 acres of land receiving manure will produce as much food as 100 acres without manure. Wise use of available manure allows greater production on the same number of acres.

Aids in Erosion Control

Manure is a big aid in decreasing soil erosion. Two of the primary causes of erosion are the loss of soil organic matter and insufficient vegetative protection. Ma-

<table>
<thead>
<tr>
<th>Crop*</th>
<th>Yield per acre</th>
<th>Increase per acre when manured</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No manure 8 tons manure**</td>
<td>In yield</td>
</tr>
<tr>
<td>Corn (bu.) (1st Yr.)</td>
<td>56.1</td>
<td>67.9</td>
</tr>
<tr>
<td>Corn (bu.) (2nd Yr.)</td>
<td>51.4</td>
<td>61.1</td>
</tr>
<tr>
<td>Oats (bu.)</td>
<td>60.0</td>
<td>63.7</td>
</tr>
<tr>
<td>Clover (tons)</td>
<td>2.12</td>
<td>2.70</td>
</tr>
</tbody>
</table>

*Includes 23 corn crops (1st yr.), 23 corn crops (2nd yr.), 23 oat crops and 19 clover crops.
**Manure applied on the clover sod.
***Based on average farm prices for 1934-1943: corn 60c per bushel, oats 35c per bushel, clover hay $0.50 per ton.
nure contributes towards the solution of both of these problems.

As shown in table 3, manure helps to slow up the decline in soil organic matter. This is done in two ways, by direct additions to the supply and by stimulating more plant growth. Improvement in plant growth also furnishes a more effective canopy of leaves and stems, which breaks the fall of the raindrops, thus slowing up surface runoff, increasing absorption and decreasing erosion.

Although manure can generally best be used for corn, there are badly eroded knolls and hillsides where it may have more value in establishing stands of legumes and grasses. It may mean the difference between success and failure in getting a good stand. It takes a good legume grass sod to control erosion on these areas.

The effect of heavy applications of manure on soil losses on Marshall silt loam subsoil under continuous corn is shown in fig. 1. In this experiment, manure was applied at rates of 8 and 16 tons per acre per year for each of 3 years. During the next 3 years the plots were continued without manure additions in order to study the residual effects. In view of the abnormally heavy rates—24 and 48 tons in 3 years—the average annual soil losses for the 6-year period are used.

It is evident that the addition of manure brought about a significant reduction in soil loss. Similar trends were also noted in surface runoff. The first 8-ton was somewhat more effective than the second 8-ton addition.

Slows Depletion

Manure slows the decline of soil organic matter. This is well illustrated by the data in table 3. On the Agronomy Farm fertility plots at Ames, several rotations and soil treatments have been studied continuously since 1915. In 1917 and 20 years later, in 1937, soil samples were obtained to study the effects of the various treatments on the soil.

The organic matter content of the soil declined under all systems of management, but much more rapidly under some systems than under others. Manure greatly slowed up the decline in organic matter depletion. Under continuous corn the decline with manure was only one-third as great as where no manure was used. Where manure was used in a 4-year rotation, organic matter losses were reduced to a very low level.

The trend in nitrogen content of the soil followed closely that of the organic matter, as might be expected since nitrogen is an essential part of soil organic matter or humus. In Iowa soils the organic matter contains close to 5 percent of nitrogen.

The advantages of a soil well supplied with organic matter are well recognized. When a soil loses its organic matter, it becomes lifeless, runs together badly, bakes and becomes cloddy, loses its moisture-holding capacity and becomes lower in available plant food. A good supply of active organic matter is necessary in maintaining soil fertility.

Returns Plant Food

The ability of manure to increase crop yields is due largely to its content of nitrogen, phosphorus and potassium. A ton of well-preserved mixed manure contains plant food nutrients equal to about 100 pounds of a 10-5-10 fertilizer; that is, 10 pounds of nitrogen, 5 pounds of phosphoric acid and 10 pounds of potash. At present prices the total plant food in a ton of manure would cost about $2.32 if bought in commercial fertilizer. One should remember, however, that the plant food in manure is somewhat more slowly available than that in mineral fertilizer. A number of experiments have shown that the benefit of manure is distributed over a long period of time.

The amount of plant food returned to the soil in manure influences fertilizer requirements and consumption. In Iowa, the number of livestock units is the largest of any state in the nation. Accordingly, the amount of manure produced is proportionately large.

As shown in table 2, 372,000 tons of plant food are returned to cropland in Iowa annually, assuming that 60 percent of that available in manure is returned. This is over 15 times the plant food contained in commercial fertilizers sold in Iowa in 1944. Careless handling of manure results in losses of plant food equal to several times that contained in commercial fertilizers sold in 1944.

Manure Alone Not Enough

Manure alone is not a complete soil treatment. Most Iowa soils are acid and are improved by applying lime. On many soils, phosphate fertilizer and other mineral fertilizers are also needed for best results.

The need for a combination of soil fertility treatments is illustrated in fig. 2. Although manure alone increased the yield of alfalfa, the addition of lime and superphosphate increased it still further. In these experiments, manure was applied on the average at the rate of 2 tons per acre per year for the...
Corner crop in the rotation. Limestone was used in sufficient amounts to neutralize soil acidity. Superphosphate was used at the rate of 120 pounds per acre of a 20 percent material to all grain crops in the rotation.

The use of manure is, therefore, only one phase in a sound soil fertility and conservation program. It gives best results when used as a part of a good soil management program including adequate drainage, adapted crop rotation, liming of acid soils, use of commercial fertilizers, and contour farming and terracing on sloping soils.

Handling, Storing Manure

Careless handling and storing of manure often results in large losses. Greater returns can be obtained by:

1. Using sufficient bedding in barns and sheds to insure absorption of the liquid.

2. Hauling directly from the barns to the fields whenever possible. It should be plowed down or disked in as soon as possible, especially on sloping land.

3. Storing under a roof and on a water-tight floor. Manure keeps best when well compacted. Cattle sheds are ideal storage places.

4. Spreading ahead of corn.

5. Applying lightly. Greater returns per ton are obtained than with heavy applications. One should plan to cover all of the corn acreage.

6. Applying evenly.

**Penicillin for Mastitis**

Research is under way at various institutions with the use of the new drug, penicillin, for the cure of mastitis in dairy cows. The results reported have been promising.

The University of Illinois has reported that of 44 infected quarters treated, approximately 60 percent were cured after one treatment; seven quarters required two treatments and three quarters required three treatments. Only seven infected quarters (about 15 percent) remained infected after three separate infusions of penicillin. In this experiment 14 of 18 treated cows were cured.

Experiments with penicillin for mastitis are under way now at the Veterinary Research Institute of Iowa State College. Results of this work will be reported later.

Only six soybean strains out of a total of 3,000 tested at the Iowa Station in the period from 1937 to 1942 were sufficiently promising to warrant further trial. These selections will probably not be released as varieties but will be used as parents in the attempt to breed their desirable qualities into new varieties.

**“Pep” Bluegrass Pastures**

Experiments conducted by the Iowa Station at the Pasteure Improvement Farm, Albia, point the way to making bluegrass pastures produce more feed.

Two treatments of 5-acre pastures were compared side by side with untreated pastures. The check pastures (all of the treatments were in duplicate) received no treatment. Two pastures were treated with 3 tons of limestone per acre, heavily disked and reseeded to a mixture of clovers and lespedeza. The third set of pastures was limed, disked and reseeded in the same manner and in addition fertilized with phosphate.

Steers were then put on these pastures to determine the number of days of grazing that the pastures would stand and how much “beef” each would produce.

The pastures without treatment gave an average of 83½ days of grazing and the gain of the steers was 97.5 pounds each. In comparison, the pastures limed, disked and reseeded to the clover-lespedeza mixture gave an average of 111½ days of grazing and produced 143 pounds gain of weight per steer. This decided increase was obtained the first year after treatment in which the bluegrass sod was drastically torn up.

The steers on the pastures that were limed, disked, reseeded and given phosphate fertilizer treatment did not gain as well as those pastures not given phosphate the first year, but in 1945, the second year after treatment, the pastures with phosphate showed a decided advantage over those limed, disked and reseeded only.

These tests point out clearly that liming, diskling and reseeding with clovers and lespedeza can greatly improve southern Iowa pastures.

The clover-lespedeza mixture consisted of 5 pounds biennial white sweetclover, 3 of medium red clover, 2 of alsike and 10 of Korean lespedeza. Lime was applied in the fall and all pastures to be reseeded were springtoothed and heavily disked in the fall. The phosphated pastures received 250 pounds of 20 percent superphosphate in the spring.

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**Table 2. Plant Food Content of Manure and Commercial Fertilizer in Iowa, 1944.**

<table>
<thead>
<tr>
<th>Item</th>
<th>Total amount in tons</th>
<th>Estimated plant food in tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Fertilizer Manure—Total available for crops</td>
<td>99,900</td>
<td>24,700</td>
</tr>
<tr>
<td>Manure—Assuming 60% is saved and used on cropland</td>
<td>50,000,000</td>
<td>620,000</td>
</tr>
<tr>
<td>Manure—</td>
<td>30,000,000</td>
<td>372,000</td>
</tr>
</tbody>
</table>

**Table 3. Effect of Manure on the Organic Matter Content of the Soil.**

<table>
<thead>
<tr>
<th>Cropping system</th>
<th>Manure treatment</th>
<th>Average loss of organic matter lb. per acre</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous corn</td>
<td>None</td>
<td>18,100</td>
<td>18.9</td>
</tr>
<tr>
<td></td>
<td>8 tons in 4 yrs.</td>
<td>5,400</td>
<td>6.2</td>
</tr>
<tr>
<td>Modified 4-yr. rotation</td>
<td>None</td>
<td>8,600</td>
<td>10.2</td>
</tr>
<tr>
<td></td>
<td>8 tons in 4 yrs.</td>
<td>1,200</td>
<td>1.5</td>
</tr>
</tbody>
</table>

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Good Beef From Silage

WHEN WE PLANNED our cattle feeding tests in the fall of 1944 at the Iowa Station we did not know that Iowa would have some soft corn this year. But these tests point the way for good gains and satisfactory finish with corn silage and a limited amount of shelled corn. This test was made with medium to good grade native steers.

In our feeding tests of the past season we fed two lots (Lots 1 and 2) of steers a full feed of corn silage and no corn for 120 days, then finished them with only 60 days of shelled corn full-fed. These steers were fed for 180 days and made an average gain for the full feeding period of approximately 1.8 and 1.9 pounds per steer daily.

The daily feed per steer of these two lots for the first 120 days was 1½ pounds of soybean oilmeal, 1 pound of alfalfa hay, 1 ounce of mineral mixture and block salt self-fed, in addition to corn silage full-fed. After 120 days the corn silage supply was gone and the steers were put on prairie grass hay and were got onto a full feed of shelled corn as quickly as possible. The soybean oilmeal was limited to 1 pound per steer daily.

Corn 76 Days, 106 Days

Another lot (Lot 3) of steers was fed for the first 90 days the same as Lots 1 and 2, and then were put on shelled corn for 76 days when they were marketed. The steers of this lot made an average daily gain of approximately 1.9 pounds. They were fed 166 days. Corn silage was discontinued after 120 days and prairie hay fed in its place.

Lot 4 steers were fed the same as those of Lot 3 except that they received shelled corn for 106 days. They were started on shelled corn after 60 days full-feeding of silage. They were fed a total of 166 days, the same as Lot 3, and made an average daily gain of about 1.8 pounds per steer daily.

The steers of these two lots were fed for only 120 days when they were marketed. They made an average daily gain of 2.27 pounds daily per steer for Lot 5 (1½ pounds of soybean oilmeal) and 2.35 for Lot 6 (¾ pound daily of oilmeal).

Returns Per Steer

Because these steers were sold at different times of the year, it is difficult to make comparisons in the returns from the different rations, but for the first 120 days the average daily gains per steer were as follows:

<table>
<thead>
<tr>
<th>Lot</th>
<th>No corn</th>
<th>1.94 pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot 2</td>
<td>No corn</td>
<td>2.08 pounds</td>
</tr>
<tr>
<td>Lot 3</td>
<td>Corn 30 days</td>
<td>2.06 pounds</td>
</tr>
<tr>
<td>Lot 4</td>
<td>Corn 60 days</td>
<td>1.96 pounds</td>
</tr>
<tr>
<td>Lot 5</td>
<td>Corn 120 days</td>
<td>2.27 pounds</td>
</tr>
<tr>
<td>Lot 6</td>
<td>Corn 120 days</td>
<td>2.35 pounds</td>
</tr>
</tbody>
</table>

It is evident that if you want the most rapid gains with finish, then you must feed more shelled corn. But any of these rations made good gains—they did the job and made satisfactory beef of A grade or better. It was necessary to carry the steers of Lots 1 and 2 for 180 days, or 6 months, to make them weigh about the same as and approximate the finish of those in Lots 5 and 6. The steers of Lots 5 and 6 were ready for market in 4 months—120 days. Those fed shelled corn for 76 and 106 days required 166 days to attain about the same weight and finish.

The steers were put on feed in this experiment last Nov. 22 when they weighed an average of 820 pounds each. The average steers in Lots 1 and 2, after 120 days on a full feed of corn silage plus 60 days of shelled corn, weighed 1139 and 1140 pounds when they were sold in Chicago May 24. Lot 3 steers weighed 1136 each when marketed May 10; those in Lot 4 weighed 1115 when sold May 10; Lot 5 steers weighed 1101 when sold March 29 and those in Lot 6, 1102 at the same date.

Cost of Gains

Feed was charged to the steers at the following prices: Shelled corn $1 per bushel; soybean oilmeal $60 per ton; corn silage $8 per ton; all hay $20 per ton; mineral mixture $60 per ton; and block salt $20 per ton.

On the basis of the feed costs only (bedding, veterinary expenses, interest, labor, death losses, etc., were not included), to put on 100 pounds of gain it cost for the various lots:

<table>
<thead>
<tr>
<th>Lot</th>
<th>Cost of Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot 1</td>
<td>$14.84</td>
</tr>
<tr>
<td>Lot 2</td>
<td>$14.65</td>
</tr>
<tr>
<td>Lot 3</td>
<td>$15.00</td>
</tr>
<tr>
<td>Lot 4</td>
<td>$16.01</td>
</tr>
<tr>
<td>Lot 5</td>
<td>$15.57</td>
</tr>
<tr>
<td>Lot 6</td>
<td>$13.69</td>
</tr>
</tbody>
</table>

In arriving at these figures we found that the average steer had consumed for the entire period fed, the following amounts of feed:

| No. 2 | Days Sh. corn Silage HAY S. B. oil meal |
|-------|-----|-----|-----|
| Lot 1 | 180 | 15.5 | 5506 | 320 | 255 |
| Lot 2 | 180 | 15.2 | 5529 | 320 | 255 |
| Lot 3 | 166 | 20.0 | 4534 | 256 | 241 |
| Lot 4 | 166 | 24.5 | 3670 | 256 | 241 |
| Lot 5 | 120 | 23.0 | 2133 | 120 | 180 |
| Lot 6 | 120 | 28.3 | 2146 | 120 | 90 |

From our test we conclude that any of the methods of feeding will do the job, so if you have plenty of corn silage made from corn that looked as if it would not mature before frost, you can feed out medium to good grade steers satisfactorily with very little corn. It will take a little longer to put the finish on them if you limit the corn, but it can be done. The better the steers and the faster you want them to gain and finish, the more corn you need to feed.