1940

4-H Sugar Beet Club Demonstration : Extension Circular 12-51-2

Nebraska
1940 COOPERATIVE EXTENSION WORK IN AGRICULTURE AND HOME ECONOMICS Extension Circular 12-51-2
U. of N. Agr. College & U. S. Dept. of Agr. Cooperating
W. H. Brokaw, Director, Lincoln

4-H SUGAR BEET CLUB DEMONSTRATION

Content of problem material:

Sugar beets can be grown successfully in western and central Nebraska largely because of suitable soil, climatic conditions, and the availability of water for irrigation. The following factors are of great importance in the establishment of the industry in these sections of the state.

1. The average temperature during growing season is from 65° to 70° F.
2. There are very few days that have temperature above 95° F.
3. The cool nights are favorable for sugar production in the roots and aid them to store sugar.
4. The growing season is 120 to 145 days.
5. Plenty of moisture, in part supplied by irrigation.
6. In general the harvest season is very dry and cool with an abundance of sunshine, an essential aid in harvesting the crop.

PROBLEM I

Project Goals

1. Size of project shall be ½ acre or more.
2. The project is open to boys and girls between the ages of 12 and 20, inclusive.
3. Each member should have a contract with a sugar company in his own name.
4. Seed may be furnished by the company with which the contract is written.
5. Club members shall keep an accurate record during the season in a record book.
6. The official weight of the crop shall be that given by the company after taring in the usual manner.

Suggested Activities

1. That each club develop one experimental demonstration plot showing one or more of the following:
   a. A fertilizer demonstration on (1) rate of application, (2) different analysis of fertilizer, (3) broadcast or row application.
   b. Width of row demonstration.
   c. Spacing demonstration in row.
   d. Varieties.
2. Each member take part in demonstration and judging work.

3. Each club develop a demonstration team and also a judging team.

4. Exhibiting. Each member should make an exhibit of seven beets at a local, county, or district show or fair. The exhibit shall be selected from the club member's project. The beets shall be of medium size, uniform in shape and size, free from prongs or large roots and they should be prepared by removing the top and brushing the beets with a soft brush.

Rotation

Some advantages of a crop rotation:

1. Maintains crop production.
2. Assures better use of irrigation water.
3. Helps in weed control and lessens diseases and pests.
4. Saves labor by distributing the work more evenly thruout the year.

Essentials of a Good Rotation: Every crop rotation should include alfalfa, sweet clover, or other legumes. The use of barnyard manure is necessary to maintain the productiveness of the land. A cultivated crop like corn, potatoes, or sugar beets is needed at intervals. All rotations should include forage for livestock to be fed on the farm.

Rotation examples: Definite recommendations for all localities of the various crops to use in the rotation cannot be given. Several that have given satisfactory results are listed in the following table:

Rotations	First Year	Second Year	Third Year	Fourth Year	Fifth Year	Sixth Year	Seventh Year	Eighth Year
A	Grain* Alfalfa	Alfalfa	Alfalfa	Alfalfa	Potatoes	Beets	Manured Beets	
B	Grain* Alfalfa	Alfalfa	Alfalfa	Alfalfa	Potatoes	Beets	Grain	Manured Beets
C	Grain* Alfalfa	Alfalfa	Alfalfa	Alfalfa	Corn	Beets	Beans	Manured Beets
D	Grain* Sw.Clover	Sw.Clover** Potatoes	Beets	Manured Beets				
E	Grain Sw.Clover	Potatoes	Beets					
F	Grain Alfalfa	Alfalfa	Alfalfa	Manured Potatoes	Beets	Grain	Manured Beets	

* Grain used as a nurse crop for alfalfa

** Sweet clover plowed under in the spring as a green manure crop.

Potatoes fit well in most rotations unless the land is not adapted; then corn, wheat or beans can be grown in their place, as in rotation C.

Effect of Rotation on yield: Two or three year rotation without legumes or manure produced no better yields than a continuous crop. As time went on, all rotations containing alfalfa or sweet clover showed an increase while all one-crop systems showed a decrease.

21814mh

Effect of Legumes: Sugar beets produced 18.7 tons to the acre when grown in a cropping system with alfalfa and only 11.7 tons per acre in rotations where alfalfa was not used, no manure being applied in either case.

Other good examples of results of alfalfa in rotations are as follows:

Two years of alfalfa added to a rotation of potatoes and beets increased the twenty-five-year average yield of potatoes 133 bushels and the yield of beets 6.1 tons per acre.

Two years of alfalfa added in rotation with oats and beets caused an increase of 22.1 bushels of oats and 5.2 tons of beets per acre.

Two years of alfalfa added in rotation with potatoes and oats caused an increase of 115 bushels of potatoes and 25.6 bushels of oats per acre.

Three years of alfalfa added in rotation with potatoes, oats and beets, increased the yield of potatoes 107 bushels, oats 21.2 bushels and beets 4 tons per acre.

Rotations may be divided into three classes--short, medium, and long. The medium and long rotations are better than the short as they are not so hard on the land and they help in the control of disease. Sweet clover fits well into a short rotation as the second-year crop can be plowed under or used for pasture. The effect of sweet clover is shown when used in a four-year rotation on a partially run-down soil.

1st year small grain sweet clover.
2nd year sweet clover pastured.
3rd and 4th year sugar beets.

Before the land was seeded to small grain and sweet clover, sugar beets averaged 11.8 tons. Sugar beets on these same plots, after sweet clover pasture, averaged 20.5 tons for the first crop and 17.8 tons per acre for the second crop.

(Medium length rotation)

At the Mitchell Experiment Station, Scottsbluff, Nebraska, several different rotations have been under observation since 1912. This medium rotation has proven very profitable.

Grain seeded in alfalfa
Alfalfa 3 or 4 years
Potatoes
Sugar beets
Sugar beets manured

(Long Rotation)

This rotation may be suggested as a practical rotation in which we do not have the extremes of no alfalfa or else half of the total acreage in alfalfa.

Small grain and alfalfa
Alfalfa 3 or 4 years
Potatoes, corn or sorghum

21814mh

Beets
Small grain and sweet clover
(Sweet clover may be plowed under or used for pasture or hay second year.)
Potatoes, corn or sorghum
Beets

The rotation may be 9 to 11 or even 12 years in length. Alfalfa will occupy the land only 25, 30, or 33 percent of the time, instead of 50, 43, or 0 percent of the time as in the list of rotations A to F.

Effects on the yield of crops following sugar beets: Where legumes and manure are used in a good rotation system, the growing of a sugar beet crop does not seriously affect the yield of the crops that follow it in the rotation. In fact, any crop in a good rotation, including beets and a legume, generally yields more than the same crop grown continuously.

Topics for Discussion:

1. Each member present the rotation practiced on a farm he is familiar with, and follow this by general club discussion bringing out desirable rotations.
2. Selection of sugar beet field.
3. Effect of rotation upon yield.
4. Short vs. long rotations.

PROBLEM II

Use of Fertilizers

Fertilizing of soil is necessary in order to restore the chemical elements taken from the soil by growing crops.

Plant Nutrients: The elements necessary for plant life may be divided into two classes, namely, the "fertilizing" elements and the "trace" elements. Of the former, nitrogen, phosphorus and potassium are the most important with calcium, magnesium and sulphur close seconds. Of the "trace" elements, iron, manganese, boron, zinc and copper are the most important. The trace elements must be present in small amounts or injury may result to the plant.

Carbon enters the plant in the form of carbon dioxide gas, through the pores of the leaves. Hydrogen is supplied from water. Oxygen comes in through the leaf pores and also in the water.

Kinds of Fertilizers

The three general forms of fertilizers are barnyard manure, green manure, and commercial fertilizers.

Barnyard Manure: This is usually the most effective fertilizer to use with the sugar beet crop. It not only supplies nitrogen, phosphorus and the other mineral elements needed for crop growth, but also stimulates bacterial and chemical action in the soil.

Approximately 80 percent of the nitrogen and phosphorus, and 50 percent of the organic matter of food consumed by farm animals is voided in the manure. The greater part of these elements may be returned to the soil if the feed lot manure is well handled. Proper storage and handling of manure will help to check the heavy drain on these elements incurred by the production of high crop yields.

Amount of Application: Applications of 5 to 12 tons of barnyard manure will give good yields of beets without materially reducing the sugar content.

The value of a ton of manure in terms of increased yield in five rotation comparisons at the Scottsbluff Substation has ranged from $2.32 to $4.62 per ton with a mean value of $3.72 per ton. The highest yields of all crops were obtained where both alfalfa and manure were used, and where the manure was applied before the beet crop.

Residual Effects: Nebraska Experiment Station Bulletin #318 shows that heavy applications of manure each year are not necessary to maintain yields at satisfactory levels. Good yields for a period of 25 years have been obtained in a six-year rotation of potatoes, oats, sugar beets, and three years of alfalfa, with a 12-ton application of manure to the sugar beet crop. This single application is equivalent to a two-ton application annually over the whole period of the rotation.

Green Manure: Where there is not enough barnyard manure, a soil improving program should stress the need for green manure. This is particularly important on the lighter soils, where the farmer is not financially able to feed enough stock to provide sufficient manure for his needs. Green crops plowed under provide humus for soil improvement. Legumes as alfalfa and sweet clover are best, because they are able to take nitrogen from the air. Non-legumes as oats, rye, barley and sorghum may be used as green manure, but they are not equal to the legumes for soil improvement. Sweet clover should be plowed under in the spring when from 1 to 1½ feet high after which potatoes, corn, or beans may be planted.

Commercial Fertilizers: In the commercial sense there are three elements used extensively in the United States, namely, nitogen, phosphorus, and potassium. They are used to supplement the supply in the soil rather than as the principal source. Nebraska soils are almost always well supplied with potassium. Nitrogen can usually be supplied more economically by the use of legumes and manure rather than by the purchase of nitrogenous fertilizers. Manure also contains some phosphorus, but on many soils in North Platte Valley more phosphorus is needed than is supplied in manure. This need may be met by applying superphosphate fertilizer. Superphosphate is rather extensively used in this section of Nebraska. No other form of commercial phosphate fertilizer has been found as effective.

Whether or not superphosphate will be profitable on beets can be found out only by trying it in the field, and measuring the yields obtained in the phosphated and unfertilized parts of the field. Small but profitable differences in yield cannot be estimated by the appearance of the crop; they can be detected only by weighing the beets.

If superphosphate is used it will usually be most effective if placed in the row close to and slightly below the seed at the time of planting. Broadcasting the superphosphate and working it into the soil just before planting is usually fairly satisfactory.

Topics for Discussion:

1. Manure compared to commercial fertilizer.
2. Determining the need for fertilizer.

3. Expense of fertilizing compared to returns from the land.
4. Each member tell how land is fertilized by good farmers in his community.

Reference Material: U.S.D.A. Farmer's Bulletin 1645 - pp. 9-11.

PROBLEM III

Seed Bed Preparation for Beets

Preparation of Small Grain Field:

Discing: As soon as the grain has been threshed the ground should be double disced. In fact, it is a good practice to shock the grain in straight rows and immediately disc the ground between the rows, finishing the field as soon as the grain is threshed. The advantages to be gained by discing are many and it should always be done on stubble or trashy fields. The disc cuts up cloddy or trashy soil and provides a surface mulch to be plowed under. Thus there is turned down against the bottom of the furrow a fine soil that forms a close contact with the undisturbed sub-soil. If plowing is not preceded by discing, there is danger of turning under clods that may not break up in subsequent operations. As a result air pockets are formed so that many roots do not come into close contact with soil particles and the feeding surface of the plant is reduced. Early discing of the field also covers weed seed and shattered grain that will be sprouted by either the moisture in the soil or by showers that may come later, thus giving a cleaner field the next spring.

Plowing: Plowing is now in order on most types of soil exceptions being the light sandy soils and the alkali soils which should be spring plowed. Depths of plowing is determined partly by depth of preceding plowings. In the fall one to one and one-half inch of new raw soil may be turned up while in the spring it is not advisable to plow over one-half inch deeper than has been done in the past. In general eight to ten-inch depth is recommended.

Preparation of Alfalfa and Sweet Clover Ground.

Alfalfa: Two common methods are used in the preparation of the seed bed on alfalfa ground. A recommended practice is to plow under the third cutting, generally irrigating the ground before plowing. The advantage of this new method is the value of the green manure obtained and the earlier plowing of the field, giving a more complete rotting of the roots, crowns and stems than can be obtained on later plowing. The other method consists of harvesting the third crop and immediately crowning the alfalfa. This is done by plowing the field at a depth as shallow as possible, keeping the plow in the ground so that the crowns of all the alfalfa plants are cut off. This is then followed by a harrowing with a spike harrow, bringing the crowns to the surface and knocking them free from the soil. After the crowns have been allowed to dry out, double discing, followed by plowing, is in order.

Sweet Clover: Sweet clover ground when plowed in the fall is handled in the same manner as plowing under the third cutting of alfalfa. Sweet clover can be plowed under the first year it is grown by removing the nurse crop of grain with which it is generally seeded, irrigating and allowing it to get a good growth before plowing. Another practice is to plow it under in the fall of the second year, after pasturing it the first part of the summer.

Packing: Both sweet clover and alfalfa ground should be thoroughly packed after plowing. This packing eliminates air pockets, and causes quicker rotting of the roots and crowns of the preceding crop.

It is not recommended to plow sweet clover or alfalfa fields in the spring for a beet crop. In fact unless a fairly thorough rotting of the roots and crowns is obtained in the fall after plowing, it is recommended that an intervening crop be grown before the beets are planted.

Preparation of Corn Ground

On corn ground it is sometimes necessary to break down the stalks by dragging a heavy timber or railroad iron over the fields. A thorough discing may then be given followed by plowing. The practice of burning stalks should be discouraged; instead they should be thoroughly cut up before plowing.

Fall Plowing

Fall plowing is recommended strongly on all heavy soils - in fact on all soils with the exception of the light, sandy soils, sandy loam soils and alkali soils. The plowing of the alkali soils in the fall gives time for a concentration of the salts in the surface of the soil beforeplanting time in the spring. This concentration of the alkali prevents a good germination of the seed and burns off or injures the plants after germination. Plowing soils in the fall makes for retention of winter moisture and permits seed bed preparation for early planting in the spring. The freezing and thawing which occurs during the winter and early spring breaks down the soil particles in the plowed fields and makes the plant food more readily available. By this mellowing process less crust condition is encountered in the spring than is the case with spring plowing.

In some fields during a dry fall there is not enough moisture in the soil to permit a good job of plowing. If water is available it may be necessary to disc the manure thoroughly into the soil and delay the plowing until early spring. It is not advisable to fall plow if the soil is turned over in big clods.

Records kept, and made available by the Great Western Sugar Company show that fall plowing in their districts in 1937 produced .49 of a ton more per acre than early spring plowing and 2.84 tons per acre more than late (after April 1st) spring plowing. While the record is only quoted for 1937, yet similar increases from fall plowing are shown year after year.

Spring Preparation of Seed Bed

Fall plowed land can easily be worked down in the spring by discing or spring toothing followed by one or more harrowings. It is then floated or leveled with a land leveler and again harrowed as the last operation before planting.

As mentioned before, it is necessary to plow some fields in the spring. Manure should be disced in immediately after spreading. Plowing should be done as early as possible, care being taken to avoid plowing the ground too wet, which causes hard clods which cannot be worked down, and a poor seed bed.

Records given above show that fall plowing yields ½ ton per acre more than early spring plowing, yet early spring plowing shows 2.35 tons more per acre than late spring plowing.

Immediately following the spring plowing the field should be harrowed at least once, packed with the disc set straight or leveled with a float or land leveler, and harrowed again before planting.

In districts where it is common practice for beets to follow potatoes, the ground is usually prepared by discing or spring toothing, dispensing with the plowing operation. Manure is generally applied to the preceding crop, although it may be spread and thoroughly disced into the soil.

21814mh

Alkali Soil

Alkali soil should not be plowed until conditions are right for planting. Plowing, working down immediately into a seed bed and planting, will give the seed a chance to germinate before the concentration of the alkali on the surface occurs.

A finished well-prepared seed bed will be firm and free from air pockets. A seed bed of this kind will feel springy when walking on it and will show very slight depression from the horses feet while planting.

Extra care and work put in on the preparation of the seed bed will ordinarily return big dividends in the way of increased yields.

Topics for discussion:

1. The effect of seed bed preparation on germination.
2. Discuss the different steps in preparing the seed bed. (Grain ground, alfalfa and sweet clover, and corn ground.)
3. Deep plowing vs. shallow plowing.
4. Fall plowing vs. spring plowing.
5. Visit fields and discuss condition of the soils.

PROBLEM IV

Planting

Description: What is commonly called the sugar beet seed as furnished the growers, is not a true seed like a grain of corn or wheat, but is a seed ball composed of the dried flower parts and the seed produced by each flower of a flower cluster. When the beet seed matures, the flower parts dry and the seed or germ is held firmly within them. The seed balls vary in size containing from one to five seeds.

Steckling Method: Until recent years, most beet seed was imported from European countries. Under old methods the production of seed requires a tremendous amount of hand labor. Being a biennial plant, seed is planted in the spring and the same care, with the exception of thinning, is given the crop as in raising beets for sugar. In the early fall, the beets are dug, the leaves cut off above the crown and the "stecklings" as they are called, are siloed in shallow pits and covered with dirt to protect them from freezing. The next spring the good stecklings are reset and the seed crop produced. Nearly all the work is done by hand labor.

Over-Wintering Method: In the United States, a new method of producing beet seed has recently been developed. In New Mexico experiments were conducted by planting beet seed each month of the year in order to find the proper time of planting to obtain maximum yields of sugar in that territory. It was discovered that beets planted in August and September sent up seed stalks the next spring. Frost stopped the growth of the immature beets the same as if they had been dug and siloed in pits. The seed could be harvested by machines and most of the high priced hand labor was eliminated.

Development of Seed Strains: In the United States curly top and leaf spot had caused serious damage. These diseases were not prevalent in European countries and no seed had been developed resistant to them.

With the development of beet seed production in the United States plant pathologists have developed strains of beet seed which are resistant to different diseases and are much superior under our conditions than any foreign strains that can be obtained. As a result, very little foreign seed is being planted in this region at the present time.

Inasmuch as the beet crop is grown under contract for the various beet sugar companies, -- the contract usually stipulates that the seed used will be furnished by the sugar company. The cost is deducted from the payment of beets, growers having very little to do with its selection or purchase. The sugar companies realize the necessity of furnishing a high grade seed and make every effort to provide seed that will give the best results.

Drills

Types: Several types of planters or drills are in common use, namely fluted feed, hill drop, and single seed. These either have disc or show furrow openers. The fluted feed type is in most common use in this territory. This feed is similar to that of a grain drill and drops the seed in the row continuously. Under semi-arid conditions this seems to give a much better germination stand than the hill drop planter which drops the seed in hills at regular intervals. If there is not sufficient moisture a very uneven stand may result from hill drop planting, because seed in several successive hills may be in dry soil and will not germinate. If the beets in the hills are not thinned early the roots have a tendency to wrap around each other and the entire bunch may be pulled up in thinning. With the advent of cross blocking, single seed planters have been developed, but not enough information is available as yet to determine the full value of this method of planting. The principle of single seed planter is ideal and with some changes promises to be in general use in the future.

The disc drill with an adjustable depth band is the most commonly used drill in this area. This type of furrow opener insures a uniform depth of planting. With the shoe type furrow opener, seed is planted at a very uneven depth unless the operator is extremely careful and the seed bed is in perfect condition.

Adjusting: Drills should be given a thorough overhauling before planting time. Ditchers should be used on the drill as this gives wind protection and also facilitates subsequent operations such as irrigating for germination or blind cultivating. Care should be taken that ditchers are set in the middle of the row, that they are not too wide and that they will not run too deep as this will cause dirt to be thrown on the seed row.

Rate of Seeding: Not less than twenty pounds of seed should be planted per acre. Less seed is used with hill drop and single seed drills. The drills must be adjusted according to size of the seed balls. There are several methods of calibrating a drill for the amount of seed planted. One method is as follows: The seed box of the drill is cleaned thoroughly and the planting indicator is set at a reading expected to plant a certain number of pounds per acre. A bucket is placed under each seed tube and a drill wheel raised off of the ground. There are 26136 row feet of 20" rows in an acre. Having measured the circumference of the drill wheel the number of revolutions necessary for any given part of an acre can be calculated. By weighing the amount of seed in each bucket it can be determined if an equal amount of seed is planted in every row and from the total amount of seed in all buckets, it can easily be determined how much seed will be planted per acre at that particular setting of the planting indicator.

Another method commonly used is to clean out the seed box thoroughly and set the planting indicator at the desired pounds per acre. When planting is started, if an acre of ground is measured off and the amount of seed placed in the seed box is weighed and then after planting the measured acre the amount of seed left is weighed, the amount of seed planted at that particular setting of the planting indicator will be determined.

Spacing: The spacing of rows should be checked not only before planting but at various times during the planting season.

Depth of Planting: On disc type drills depth bands should be checked for proper depth planting. Boxings on the discs as well as press wheels should be inspected for undue play and wear which might allow them to spread and separate enough to do ineffective work.

On shoe type drills a plank should be placed under the shoes. Each shoe should be adjusted for depth. If shoes are worn or dull they should be sharpened. Shoes should all plant the same depth with firm tension on the press wheels. Seed is generally planted one inch deep and rarely ever over one and one-half inches. Great care should be taken that seed is not planted too deep. Sometimes too deep planting can be traced to improperly set press wheels. This should be watched carefully with the view in mind that if the press wheels leave the seed row in a depression or valley subsequent hard rains will tend to cover the seed to a greater depth. This condition also makes it difficult to break crust.

Other Adjustments: The marker stick should be set so that the width of "guess row" is the same as other rows.

The collar on the drive shaft that holds the spring shift in gear should be set up so that the drill is not slipping in and out of gear.

Press wheels should follow the discs or shoes. Care should be taken that narrow press wheels do not make too deep depressions over the rows.

The practice of attaching a small chain or horse shoe or other form of small drag behind each press wheel insures better seed covering and helps prevent crust.

During planting after every sack of seed or whenever necessary the drill should be opened to the limit to expel any accumulation of dust and other debris. If using a "can" type drill the cans should be cleaned out often.

If the planting season is wet a piece of rubber inner tube should be stretched around the tread of the press wheel to prevent the soil from sticking and being picked up by the face of the press wheel.

Some of the causes of a poor germination stand are: Planting with a drill in poor condition, planting on a poorly prepared seedbed, planting when ground is too wet, planting insufficient seed, planting too deep and careless irrigation for germination.

Time of Planting: Beets should always be planted <u>timely</u>. For the best development of the crop the sugar beet plant should be given as long a season as possible to grow. It will continue to grow as long as conditions are favorable and the rate of increase becomes greater as the plants become larger and have more foliage Thus the growth in a single day in the latter part of the season is many times the growth made in a day early in the season. This increasing rate of growth is checked by climatic conditions or harvest in the fall, and in order to take the fullest advantage of the climatic conditions that permit the most rapid growth, early seeding is recommended. It has been demonstrated time and again in commercial fields and also on experimental plots that the highest yields are obtained from the earlier seedings. However, it would be a mistake to slight the preparation of the seed bed in order to plant the crop a few days earlier than would otherwise be possible. Timely planting is generally considered in most of this area as planting done before April 20th.

21814mh

On a survey of approximately 6,000 different contracts in 1938 the following yields were obtained from "timely" planting and from late planting:

Timely planting - 14.43 tons per acre
Late planting - 13.28 tons per acre
Difference - 1.15 tons per acre

Width of Rows and Ridge Planting: The usual width between rows is 20 inches. Experiments show that this distance normally produces the best tonnage. In case of very flat fields it is sometimes advisable to plant in rows 16 and 24 inches or 18 and 22 inches apart.

On flat fields ridge planting can be successfully used provided irrigation water is available to allow for early irrigation for germination. This type of planting is not successfully used on land that has much slope.

In preparing for ridge planting the seed bed is prepared in the regular way. It is then ridged by the use of potato shovels on the cultivator. These ridges are then flattened down by using the corrugated roller. The rows are planted 14 to 16 inches apart on top of the ridges.

Topics for discussion:

1. How sugar beet seed differs from most other seeds.
2. The development of new varieties suitable for this section.
3. Advantages and disadvantages of each type of planter.
4. How rate of seeding affects the yield.
5. Calibrate a drill.
6. Depth of planting.
7. Effect of the planting on yield.
8. Ridge planting in this region.

PROBLEM V

Cultivation

By cultivation we mean the tillage operations used during the growing period of the crop, serving to break crust, prevent wind damage, kill weeds, improve the texture of the soil and insure the best plant growth.

Wind Damage and Crust Breaking

In this area it is necessary to minimize the damage that wind will cause to all types of soil. A smooth surface favors blowing of land, hastens evaporation and increases crust formations. Conversely a rough surface will reduce crust, retard wind damage and supply some protection against frost. Different types of soil require different treatments, but there are a few general methods applicable to all soil which tend to reduce wind damage and aid in preventing crust.

Harrowing the seed bed as the last operation before planting, using ditchers on beet drills and wherever possible planting the rows crosswise to the direction of prevailing winds are measures that simplify and increase the effectiveness of later operations under adverse conditions. Many schemes and implements have been designed to minimize wind damage and break crust, and covering a large acreage in a short time. Our spring storms are often of a severe nature leaving the soil smooth and sealed over, giving the fine particles of dirt and sand an opportunity to move unchecked across the surface. It is necessary to roughen this smooth surface to prevent wind damage. The most common method is to strip cultivate immediately after a storm using bull tongues, ditchers or duck feet on the cultivator.

Various tools have been designed for preventing and breaking crust. One type is known as the Marlin crust breaker. This consists of a seven-foot pole, about eight inches in diameter, in which sixty-penny nails with clipped heads are driven. It is made so as to fasten on the cultivator in conjunction with other tools and roll over the row. The action of the crust breaker is that the spikes roll directly over the row and loosen the soil or crust around the beets. Two sets of these rolls together with ditchers, bull tongues or duck feet may be attached to the cultivator breaking the crust on eight rows and roughening five rows to prevent wind damage. A cultivator so equipped should be able to cover thirty acres per day. Various similar tools have been designed.

Many stands of beets have been saved from wind damage or crust by the proper use of the harrow. As a rule the ordinary steel is too heavy to properly perform this work and for this reason the light wooden harrow will come nearer creating the ideal condition if used at the proper time. It is always easier to prevent wind damage or crust than to try to remedy it. In cases where a fairly good stand of beets is up, harrowing will cover a large number of seedlings and if followed by rain may result in a loss of stand.

In general a roller should not be used to break crust. This tool injures the young plants and if the soil is at all wet it packs the sub-soil causing a crust underneath and promotes conditions favorable to black root or damping off.

Cultivation: The first cultivation should be given as soon as possible after beets are up. This operation is mainly for the purpose of killing weeds and putting the soil in the best possible condition for blocking and thinning. Tools most commonly used are the knives and duck feet. This cultivation should be fairly close to the plant and as deep as it will be necessary to cultivate at any time during the season. The tools in the center of the row should be run as deep as the ditchers for irrigation will be later in order to keep a condition such that good ditches can be made at any subsequent time. Cultivated soil dries out depriving the plant of the nourishment it contains The surface soil is the richest part of the field. Excessively deep cultivating at any time reduces the effectiveness of this surface soil in nourishing the crop.

As a last resort in trashy land where knives will not work, discs may be used. Discs do not kill weeds and leave a ridge or strip next to the plants which dries out rapidly and forms a crust. Hand labor also has a tendency to hoe too deep in blocking after discs.

The number of cultivations required will depend upon the appearance of foul growth and the occurrence of rains. In cultivating sugar beets, more depends upon how thorough cultivating is done rather than the number of cultivations.

Sometimes it is necessary to cultivate a second time before blocking and thinning. After this operation another cultivation should be given as soon as possibl to push back some of the dirt to the plant that has been removed in blocking. Ordinarily knives and duck feet are used for this operation.

Crossblocking where practiced is an excellent cultivation.

It is as easy to puddle soil with a cultivator as with a plow. A soil that is too wet should not be cultivated. Bull tongues set a little deeper will break up any sole formed by earlier cultivations and may facilitate ditching.

21814mh

Repeated stirring of a dry mulch is not profitable and is an actual waste of labor. Ditching for irrigating is generally done with ditchers alone or in case of a sole, bull tongues are set ahead of the ditcher. The size of the ditches should be such as to allow a good job of irrigation. The size of the ditches then depends on the flatness of the field. They should never be deeper or larger than is absolutely necessary.

Beets should be reditched after irrigation to kill weeds and facilitate irrigation until top growth is large enough to shade the ground between rows, stopping weed growth, or when cultivation breaks off too many leaves.

Tools used in reditching vary according to the weeds present and the condition of the soil.

Topics for discussion:

1. Purpose of cultivation (crust - weeds - aeration).
2. How to cultivate to prevent wind damage.
3. Tools to use for first cultivation. Subsequent. (crust - weeds - knives)
4. Depth of cultivation.
5. Discuss methods of cultivating.
6. Discuss ditching.

PROBLEM VI

Irrigation

The sugar beet plant responds readily to a favorable moisture condition in the soil. It cannot be classed as either drought-resistant or a water lover; it requires an intermediate amount of moisture similar to that demanded by such crops as potatoes and the grains. The amount of labor expended on a crop of beets is so great that every effort should be made to maintain the most favorable moisture content in the soil in order that the yield of the crop may justify the expense necessary to raise it.

The sugar beet is adapted to irrigation farming. Most of the sugar beets raised in America are produced with the aid of irrigation water. Michigan is the only important beet-producing state in the United States that is not in the irrigated regior

Preparing land for irrigation: Considerable care should be taken in preparing land for irrigation. This often calls for a great expenditure of money to smooth a surface that is rough and to give a uniform slope to the land. Losses result from an uneven soaking of the land in which the beets on low places receive more water than they need before those on the higher land are properly watered. Scalding of plants on the lower spots, due to their being covered with water, is not uncommon.

Methods of irrigating beets: See Farmers' Bulletin 1645, pages 6, 7, and 8.

Water requirements of beets: The amount of irrigation water required to produce a maximum crop of beets varies with the sunshine, wind, rainfall, type of soil, and a number of other factors. It is impossible, therefore, to say that any given amount of water should be applied.

Excessive or deficient irrigation seriously injures the crop. Moderate irrigations applied at frequent intervals seem best for sugar beet growing. Light sandy soils require more water than heavy soils. A shallow sandy soil is able to

absorb and hold 5 to 6 inches or more of water at one irrigation. On sandy soils it may be necessary to irrigate every week during the summer months, while on other types of soil there may be no necessity for such frequent irrigations.

The beets should be irrigated whenever the leaves turn a dark green color or begin to wilt in mid-day and do not quickly recover at night. This is true whether the beets have only a few leaves or are nearing maturity. Early irrigations should not be as heavy as those later in the year.

Topics for Discussion:

Topics for discussion may be selected from members' personal experiences and also from the bulletin. The following subjects are important for a club discussion: (1) Different methods of irrigation; (2) Time of applying water; (3) Frequency of use; (4) Length of run; (5) Water requirements; (6) Measuring, and (7) Last irrigation.

PROBLEM VII

Historical Development

It is thought that the sugar beet originated in the Canary Islands along the Mediterranean Sea. In the 12th and 13th centuries it was cultivated in France and Italy and later in Germany, where in the 18th century a low grade sugar was made from beets. The first sugar beet factory was built in Persia in 1802 followed closely by several in France.

Napoleon became very interested in sugar beet production and established six experimental stations and set aside large tracts of land to be planted to beets. Sugar beet factories were built very rapidly in this period. There were more than 500 factories in Europe in 1838.

E. H. Dyer is known as the "Father of the American Beet Sugar Industry" as he established the first successful factory in the United States. This was in California in 1879, although several unsuccessful attempts had been made in other parts of the United States before.

Development in Nebraska

Hall County was the first to grow sugar beets (1888) and the first to have a factory which was built in Grand Island in 1890. To encourage the production of sugar the state at this time offered a bounty of one cent per pound on sugar produced in Nebraska. A factory was then established at Norfolk and Ames and in 1905 the Norfolk factory was moved to Lamar, Colorado.

In 1900-1901, certain railroad authorities, who were constantly on the lookout for new opportunities, became interested in the possiblities of growing sugar beets in the newly opened territory. Immediately these men became convinced that the valley was suited to sugar beet production under irrigation.

In the spring of 1908 the Great Western Sugar Company began raising sugar beets in the North Platte Valley. By 1910 sufficient beets were grown to warrant the building of a factory when the Ames factory was moved to Scottsbluff and enlarged. Five additional factories were erected in the North Platte Valley as follows: Gering, 1916; Bayard, 1917; Mitchell, 1920; Minatare, 1926; Lyman, 1927.

In 1905 about 250 acres of sugar beets were grown in the North Platte Valley with an average yield of 7 tons per acre, while in 1933, 88,000 acres were grown in Nebraska with an average yield of 12.12 tons per acre.

The average annual acreage of beets in Nebraska from 1928 to 1932 was 78,000 acres and the average annual yield was 1,006,200 tons. More than 90 percent of the entire crop was grown in the North Platte and Platte Valleys. Scotts Bluff County alone raised 646,500 tons on 48,000 acres, while Morrill County raised 148,000 tons on 12,000 acres.

In 1938 there were approximately 90 factories operating in the United States from Ohio west to California, located by states as follows: Colorado 18, Michigan 13, California 11, Idaho and Utah 8 each, Nebraska 7, Montana and Wyoming 5 each, Ohio 4, Minnesota, Washington and Wisconsin 2 each, and one each in Indiana, Iowa, Kansas, Oregon and South Dakota.

The six leading sugar beet producing states in 1938 were California, Colorado Michigan, Montana, Nebraska, and Idaho. Nebraska ranked fifth in acreage, fourth in yield per acre, fourth in production of beets, fifth in beet sugar production, and fifth in the price paid per ton for the beets.

The world production of sugar is about 30,000,000 tons, of which 11,000,000 tons is beet sugar. The United States produces about 1,270,000 tons of cane sugar and about 1,150,000 tons of beet sugar annually. From 20 to 25 percent of the sugar consumed in the United States is beet sugar.

Grower-Processor Relationship

All beets grown commercially for sugar-making purposes are grown under contract which are issued by the sugar companies, signed by an official of the company and by the beet grower. The principal points covered in the contracts include the acreage to be planted, the price to be paid for the beets, the methods of handling the crop, the time of harvest, and the regulation of delivery. The sliding scale or participating form of contract has been in most general use in the inter-mountain area during recent years. It provides for the payment to the grower for beets delivered at designated receiving stations of the company, at a price per ton determined by the sugar content of the beets, and the net selling price received by the company for sugar during a twelve months period, dating from October 1, of each year. The payment is made in accordance with the scale of prices under these two determining factors as included in the printed terms of the contract.

After the mutual agreement between the processor and grower has been entered into in the spring, the handling of the crop throughout the growing season and its marketing differs from any other grown in this area. Assistance in overcoming the many problems arising in the production of the crop is furnished by the processor through its representative, the fieldman, who is a trained agriculturist.

Each fieldman is assigned a certain district comprising several receiving stations and from 100 to 200 growers. After the beet contract is signed seed is furnished by the sugar company, help is given through suggestions regarding methods to be used in securing a good seed bed. Assistance is offered the growers in securing hand labor and supervision of the hand labor. Advice and help is also given in control of diseases and insect pests. Sampling of the soil to determine fertilizer requirements of not only the beet crop but all other crops is another service rendered. In short, the fieldman during the year devoted his efforts towards helping the grower produce better crops.

21814mh

Members of the agricultural staff of the various sugar companies are willing and ready to describe and explain contracts and agricultural problems to school classes or other interested groups. This close cooperation between the processor and the grower during the growing season is seldom found in the growing of any other crop. It tends toward a friendly spirit and a better understanding of the problems arising in the production of the beet crop.

The receiving of the beets during harvest in the different districts is handled by the fieldman who is in direct charge at the receiving stations in his district. The weighing, taring of the beets, sampling for sugar content, unloading and piling of the beets delivered above the requirements of the factory for its daily capacity is handled during a short period. The bulk of the crop is delivered during October and early November.

21814mh