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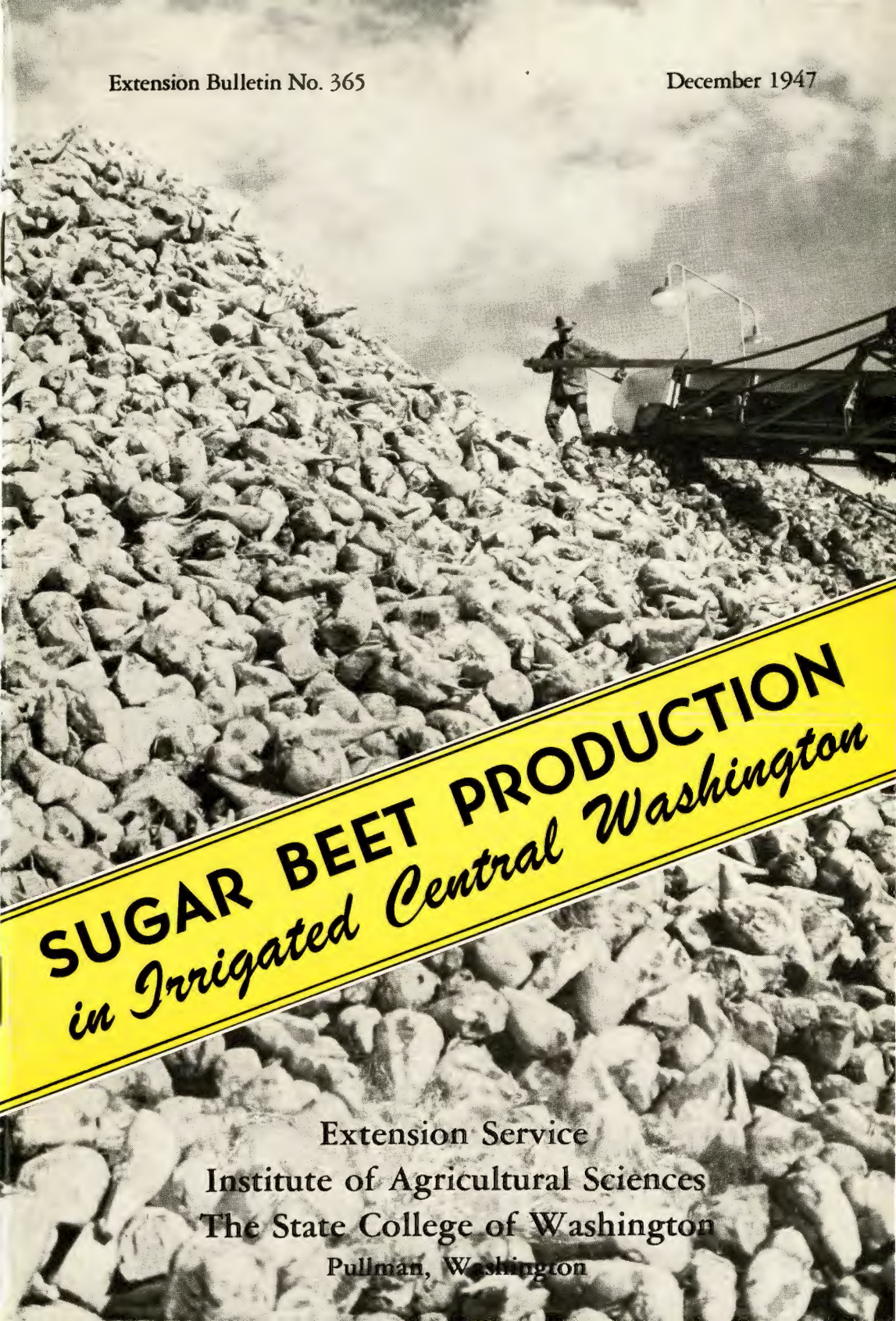

SUGAR BEET PRODUCTION *in Irrigated Central Washington*

Extension Service
Institute of Agricultural Sciences
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Pullman, Washington

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Cover Photo by Times *Staff Photographer H. J. Vallentyne, Jr.*

SUGAR BEET PRODUCTION
In Irrigated Central Washington

By
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INTRODUCTION

Prior to 1900, the Washington Experiment Station in co-operation with farmers demonstrated that the irrigated sections of the state and especially the Yakima Valley were well adapted to the production of sugar beets. No beets were grown, however, for commercial sugar production until 1917 when a sugar factory was established at Yakima, with other factories being constructed later at Toppenish and Sunnyside. At that time, sugar beet varieties were not resistant to the curly-top disease. By 1924 the sugar beet yields had been reduced to a point where they could no longer be grown profitably, and the factories were closed.

The curly-top disease is caused by a virus which is transmitted by the beet leafhoppers occurring in abundance in this area. The weather conditions from year to year influence the beet leafhopper populations, and the maximum disease injury occurs if the beet leafhoppers attack the plants in the seedling stage of growth.

In 1918 the U. S. Department of Agriculture began to develop curly-top-resistant varieties and rapidly expanded the program. Scientists doing sugar beet breeding work for the Division of Sugar Plant Investigations developed a commercially desirable variety resistant to curly top. This was called U. S. No. 1. Following this, many improved varieties and strains were developed by the U. S. Department of Agriculture and co-operators.

With the development of varieties resistant to curly top, a beet sugar factory was reconstructed at Toppenish in 1936 and commercial sugar beet planting was resumed. U. S. No. 1 was grown at that time, followed by U. S. No. 34 in 1938, A600 in 1939, U. S. No. 12 in 1940, and U. S. No. 22 in 1943, which was followed later by the U. S. Improved No. 22.

During the past eleven years, approximately 13,000 acres of sugar beets have been grown annually under irrigation in Yakima, Walla Walla, Benton, and Kittitas counties in central Washington.

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Table 1. Returns Per Acre From Sugar Beets in Central Washington

	Average Acre Yield	Returns Per Ton		Average Gross Returns Per Acre
		From Company*	From AAA**	
1938	14.7	$4.56	$1.78	$ 93.20
1939	16.5	4.57	1.93	107.25
1940	16.3	4.99	1.78	110.35
1941	18.4	6.48	1.90	154.19
1942	20.4	6.72	2.44	186.86
1943	21.2	8.22	2.40	225.14
1944	14.7	9.77	2.42	179.19
1945	19.6	10.05	2.49	245.78
1946	21.0	Final returns not available		

* Data from the Utah-Idaho Sugar Company, Toppenish, Washington
** Data from AAA Office, Yakima, Washington
1936-1937 yields not available

Photo by H. P. Singleton, July 14, 1938.

Fig. 1.—Sugar beets growing on reclaimed white alkali land near Outlook, Washington. Yields of 20 to 30 tons per acre have been obtained from this field.

Sugar beets in this area are grown under contract with the sugar processing company. The acre-value of sugar beets is high, as shown in Table I, making the crop suitable for land of high value because it is a dependable source of cash income and furnishes beet tops for livestock feed.

SOILS FOR SUGAR BEETS

The majority of the soils in central irrigated Washington are alkaline and light in texture. Sandy loams and loams predominate, but there are some silt loams and clay loams. All of these soils are well suited for sugar beet production, provided that they are deep, and that management practices maintain an adequate supply of active organic matter. The sands and loamy sands which occur in small scattered areas are less suited to sugar beet production since they hold less moisture and must be irrigated more often than the heavier soils. Frequently the wind blows the sand against the small, young plants, injuring or cutting off the stems.

When properly irrigated, sugar beets can withstand more severe alkali conditions than many other crops. They have been successfully grown on white alkali soils (see Figure 1) when adequate drainage was provided and frequent light irrigations applied.

Such treatment moves the excess salts downward and keeps the surface salt concentration low enough to avoid injury to the plants and prevents the soil from crusting. Your County Agricultural Extension Agent or sugar beet Field Man should be consulted concerning the problem areas.

CROP SEQUENCE AND MAINTENANCE OF SOIL ORGANIC MATTER

The supply of total soil organic matter in the irrigated area of central Washington is relatively low. Good management practices must be carried out to maintain the active organic matter in the soil.

The use of the proper crop rotation not only returns organic material to the soil, but reduces the danger from disease and insect pests. If sugar beets are grown on the same land for several years with adequate manuring and fertilization practices, the sugar beet nematodes can increase to a point where production is no longer profitable.

A rotation should include seeding of alfalfa alone or with a small grain companion crop, three or four years of alfalfa, followed by three or four years of row crops. If four years of row crops are grown, an early maturing crop may be used the second or third year, followed by a leguminous green manure crop such as winter peas. Sweet clover in the Yakima Valley is not recommended in rotations for the growing of sugar beets. Sugar beets may be grown following alfalfa, or alternated with other row crops.

Where sugar beets are to follow alfalfa in the cropping sequence, additional organic material may be added the year before by allowing some alfalfa growth after the second cutting of hay, irrigating, and then plowing. This method also helps avoid cultivation trouble from alfalfa roots the next season.

Wheat should not precede row crops in the rotation as it encourages high wireworm populations. Sugar beets may follow field corn in rotation, providing an adequate fertility level is maintained. Dry corn stalks and similar materials should have additional fertilizer added to the soil to hasten decomposition.

SUGAR BEET TOPS ARE VALUABLE FOR ANIMALS OR, WHEN DECOMPOSED IN THE SOIL, AS A PLANT FOOD

15-ton beet crop produces about 6 tons of tops which contain	50 lbs[1] nitrogen and 11 lbs. phosphoric acid (P_2O_5)
20-ton beet crop produces about 8 tons of tops which contain	67 lbs. nitrogen and 15 lbs. phosphoric acid (P_2O_5)
30-ton beet crop produces about 12 tons of tops which contain	100 lbs nitrogen and 22 lbs phosphoric acid (P_2O_5)

[1] Based on nitrogen and phosphorus percentages from Morrison, F. B., *Feeds and Feeding,* 1943.

Manure is an excellent fertilizer for maintaining high yields of sugar beets. It also helps to maintain organic matter in the soil. Twelve or more tons per acre, depending on the fertility level of the soil, should be used when available. Manure with a high straw content is valuable in adding organic matter to the soil, but it is usually advisable to supplement it with commercial fertilizers if a high level of fertility is desired.

THE USE OF COMMERCIAL FERTILIZERS AND APPLICATION METHODS

With the large acreage in sugar beets and other row crops, adequate supplies of manure are usually not available for maximum yields, and commercial fertilizers are commonly used for sugar beets. It should be stressed that good yields of sugar beets cannot be obtained, regardless of the amounts of commercial fertilizer used, if the organic matter in the soil is allowed to reach a low level. Commercial fertilizers must be used to supplement good rotation and manuring practices.

Sugar beets respond readily to commercial fertilizers of the proper analysis. If fertilized, the young plants emerge earlier than those not fertilized and grow more rapidly, resulting in better stands and stronger plants.

Kind of Fertilizer to Use:

Nitrogen is one of the most important fertilizer elements needed. It may be supplied by fertilizers such as sulfate of ammonia, ammonium nitrate, ammonium phosphate, etc. Ammonium phosphates contain both nitrogen and phosphorus and are known by various trade names. Two grades are usually available: one called 11-48 and the other 16-20. The first contains 11 per cent nitrogen and 48 per cent available phosphoric acid, and the second contains 16 per cent nitrogen and 20 per cent available phosphoric acid. Fertilizers containing sodium should not be used on alkaline soils commonly planted to sugar beets in the valley, as sodium is objectionable from the standpoint of alkalinity, and in "puddling" the soils.

Sugar beets require considerable amounts of available phosphorus. Several kinds of phosphorus fertilizer may be used, such as treble superphosphate (about 42 per cent available phosphoric acid), superphosphate (about 16 to 20 per cent available phosphoric acid), the different ammonium phosphate fertilizers previously mentioned, and others. Raw rock phosphate has no place as a fertilizer in this area.

Potash (potassium) fertilizers are seldom needed in this particular area, as the soils are almost always high in this nutrient.

Lime is not needed on the Yakima Valley soils, as calcium, a constituent of lime, is found in large quantities in these soils. This is also true for sulfur, although it is sometimes recommended in reclaiming certain alkali conditions where sugar beets are grown.

At present, minor elements are not commonly recommended for sugar beets. Certain minor elements when not needed are very toxic to most plants even in small amounts.

Rates of Fertilizer Application:

The rates of fertilizer application vary with the individual fields, depending on the rotation used, amounts of manure applied, soil type, and the general fertility level of the field. Fertilizer applications should be made annually for the beet crop.

In general, on fields receiving 10 to 15 tons of manure per acre, or those previously in alfalfa, an application of 40 to 80 pounds of

nitrogen with 40 to 60 pounds of phosphoric acid (P_2O_5) per acre is recommended. On other fields, the nitrogen applied should be from 60 to 120 pounds, and the phosphoric acid (P_2O_5) from 40 to 80 pounds per acre. When high rates of phosphoric acid (P_2O_5) have been applied on preceding crops, or the soils are known to be high in this nutrient or in nitrogen, the rates of application should be reduced accordingly.

High rates of phosphoric acid (P_2O_5) with low rates of nitrogen are not advised, as no benefits are obtained from excessive use of phosphate fertilizer.

Various fertilizers may be used together to obtain the proper nitrogen and phosphorus levels. For instance, if a 10-20-0 fertilizer is used (10 per cent nitrogen, 20 per cent phosphoric acid (P_2O_5), 0 per cent potash), 300 pounds per acre would supply 60 pounds of phosphoric acid (P_2O_5) but only 30 pounds of nitrogen per acre. If 80 pounds of nitrogen were needed, the additional 50 could be supplied by adding 238 pounds of ammonium sulfate or 151 pounds of ammonium nitrate.

The percentage of available nitrogen and phosphoric acid is always placed on the fertilizer bags or labels. Your County Agricultural Extension Agent or sugar beet Field Man may be consulted concerning the fertilizers and rates of application.

Methods of Fertilizer Application:

The fertilizer may be applied by broadcasting and working into the soil during seed preparation, or it may be applied as a side dressing after the beets have been blocked and thinned. With the latter method, the fertilizer is applied to the side of the row, far enough away so as not to injure the roots and about two to four inches deep. A combination of applying one half of the fertilizer by broadcasting, and side dressing the remainder early in the season has also proved satisfactory. Trials have shown no advantage from several side dressings during the season, as compared with the same amount of fertilizer applied early in one side dressing.

Experiments have not been satisfactory in this area with fertilizer side placement, that is, making the application in bands a short distance away from the seed with separate furrow openers at the time of seeding.

Putting fertilizer with the seed is an undesirable practice, especially on sandy soils, as "burning of seedlings" may occur if the soil becomes dry.

PREPARATION OF THE SEED BED

The soil should be fall plowed for sugar beets. Where alfalfa sod is to be plowed, it should be disced heavily, or crowned by shallow plowing, followed by a deep plowing. A good way to eliminate roots, and to add green manure, is to allow the third cutting of alfalfa of the preceding year to grow to a height of about 12-16 inches, irrigate, and then disc it down before plowing. Spring plowing of fields in alfalfa or field corn leaves the undecomposed roots and corn stalks which adversely affect proper seed bed preparation and tillage practices. Applications of nitrogen fertilizer should be made to decompose this material as rapidly as possible. Sweet corn should be harvested, irrigated, chopped with a corn stalk cutter or heavy disc, or both, and plowed under immediately.

Deep plowing is recommended for sugar beets, but plowing should not be so deep as to bring up a great deal of subsoil which is low in fertility.

Seed bed preparation varies according to soil type, moisture content, and physical condition of the soil. Alternate floating (box leveler or a commercial leveler) and harrowing in some instances is sufficient. Where land is spring plowed it may be necessary in some instances to use a subsurface packer or a cultipacker. The preparation of the soil, regardless of the method used, should give a level, finely granular, firm seed bed, but it should not be packed too firmly. The soil should be worked at the proper moisture content to avoid leaving it in a lumpy condition.

In finishing the seed bed it should be cross harrowed before planting. This procedure helps prevent wind damage, and some growers have observed less early frost damage than on land which has been left smooth.

The proper preparation of the seed bed is the most important factor in securing good stands. The small seeds must be planted near the surface, and the seedlings are very delicate in the first stages of growth.

PLANTING

Sugar beets should be seeded as early as possible, depending on temperature and moisture conditions. It is well known among growers that early seeding, if good stands are obtained, will produce higher yields than will late planting. The usual time of seeding in

this area, depending on the soil and season, is about the first part of March. However, early planting should not be done at the expense of an improper seed bed.

Usually, 3 to 5 pounds of sheared seed, or 10 to 15 pounds of whole seed, are used per acre. The advantage of sheared seed is in obtaining single plants in the row, thereby making thinning easier. Whole seed is actually a seed-ball containing two or three seeds. The best seed of varieties which are resistant to curly-top disease is supplied to growers by the beet sugar company with whom the crop is contracted.

Four- or six-row planters are commonly used in this area with row spacings of 22 inches. Uniform spacing is preferable for mechanical harvesting to the alternate wide and narrow row widths. Many of the sugar beet planters in this area are equipped for sheared seed.

Depth of planting is extremely important in obtaining a good stand. On a firm, moist seed bed the earliest planting can be made at approximately ¾ inch. For later plantings and on light soils where the surface dries readily, a planting depth of 1 to 1¼ inches will give a greater assurance of adequate moisture for germination. In cases where it is planned to "irrigate the seed up," a depth of ½ inch is desirable, as the plants emerge sooner and will have less competition from weeds.

Two types of furrow openers are commonly used on sugar beet drills. One type uses a shoe, and the other a double disc opener. Careful adjustment of the drill must be made for each field, depending on the soil, to obtain uniform seeding. The press wheels should firmly cover the seed in moist soil. To eliminate possible stoppage of the seed openings, the drill should be in motion before the furrow openers are placed in the ground.

In planting a field, the depth of planting, the feed mechanism, the seed openings, and the press wheels should be checked several times and adjustments made as needed. When the main part of the field is seeded, it is advisable to cross plant the ends where the turning was done. This increases the acreage, and makes it easier to control weeds.

A good practice is to use ditching shovels on the beet drill in alternate rows. This marks out the field so that it is easier to reditch and also locate the beet rows for early cultivation. These ditches serve as a further purpose in helping to prevent the wind from blowing the soil and cutting off the seedlings. On light sandy soils, the

early ditching of each row is advisable as a precaution to help prevent wind damage. If necessary, irrigation water may be applied if the surface soil becomes dry.

BLOCKING, THINNING, AND HOEING

Blocking and thinning of the sugar beets requires careful supervision to assure good stands and subsequent yields. The blocking and thinning is ordinarily done when the plants have reached the "four-leaf" stage. If wireworms or seedling diseases are destroying stands at the "four-leaf" stage, it is advisable to delay the thinning until the plants become better established. If possible, early thinning should be done, for it is easier, cheaper, and produces higher tonnages than the late thinning. The early blocking and thinning also eliminates weeds which are hosts for certain insects. Insect damage to the leaves of small beets is more frequently observed in weedy fields. Prior to blocking and thinning, disc-type cultivators are used to cut away the soil to a shallow depth on both sides of each row. For whole seed plantings, the beets are blocked to the proper spacing with a short-handled hoe, and the remaining cluster of

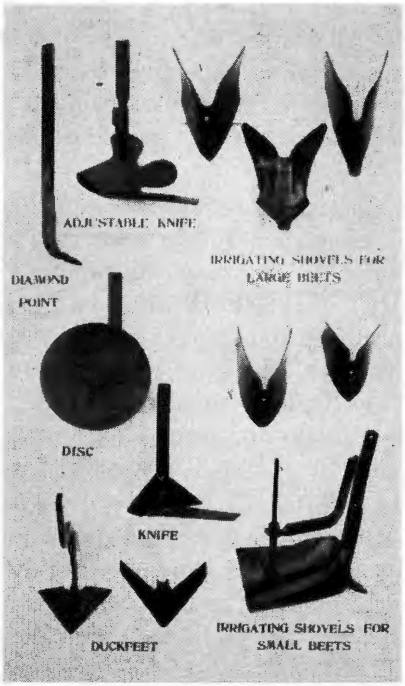

Fig. 2.—Types of cultivating and irrigating equipment for sugar beets.

plants is thinned by hand to one healthy plant. The usual practice is to space the sugar beets in the row from 10 to 12 inches, leaving single, healthy plants.

When sheared seed is used, some operators block with long-handled hoes, and, as individual seeds are planted, there is little thinning to do by hand. When the beets are being blocked and thinned the weeds are also removed. Ordinarily, two or more hoeings are made during the season, and where more than one beet is found in a cluster, thinning is done also.

CULTIVATION AND DITCHING

Four- and six-row sugar beet cultivators are used, depending on the type of equipment with which the sugar beet seeds were planted. The first cultivation should take place as soon as the sugar beets have emerged and the rows are visible.

The tools commonly used are shown in Figure 2. A preferred arrangement of these tools for the various cultivations is shown in Figure 3. In the early, awkward pre-thinning and blocking cultivation, the discs are set as closely as possible to the beets, leaving a narrow ridge. The discs are used as shields for the duckfeet to prevent covering the small plants. The knives partially fill in the cuts made by the discs, preventing excessive drying of the soil near the beets. Many operators set the tools closer on the guide row than on the other rows. Early cultivations must be made at a very slow operating speed.

Another alternate procedure for early cultivation, shown in Figure 4, is to use knives as close to the beets as possible, followed by small duckfeet. In the pre-thinning and blocking cultivation, discs are used, followed by duckfeet. In these cultivations the duckfeet must be carefully adjusted so as not to throw soil on the small beets. The purpose of the duckfeet is not only to control weeds, but to partially fill in the cut made by the discs.

After blocking and thinning, diamond points may be used on each side of the beets at a **shallow** depth. The diamond points lift the leaves, cultivate and throw a very small amount of soil between the beets. Knives should be used behind the diamond points. These may be followed by duckfeet as shown in Figure 3. All sugar beet cultivations should be **shallow,** as the sugar beet roots fill the space between rows at an early date and are close to the surface of the soil.

Cultivations should be made as often as needed to prevent weed growth. Early cultivations eliminate weed hosts for certain insects,

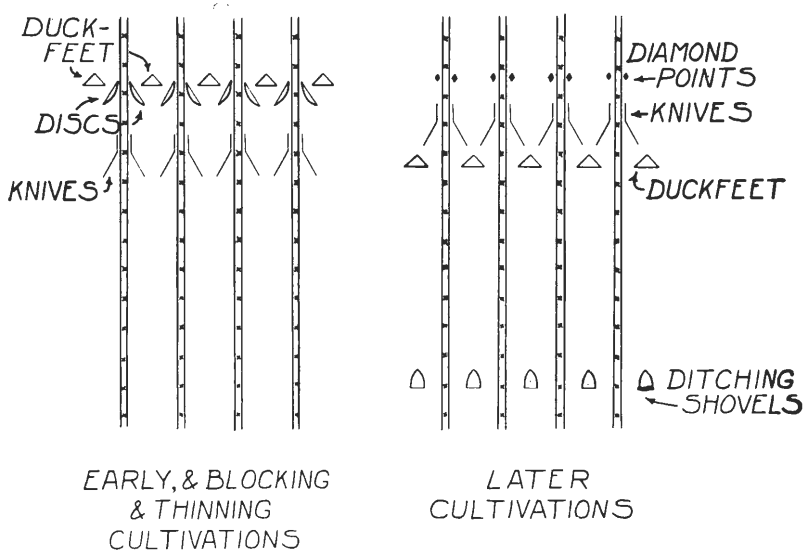

Fig. 3.—Diagrammatic arrangement of cultivating and ditching tools. This arrangement is preferred.

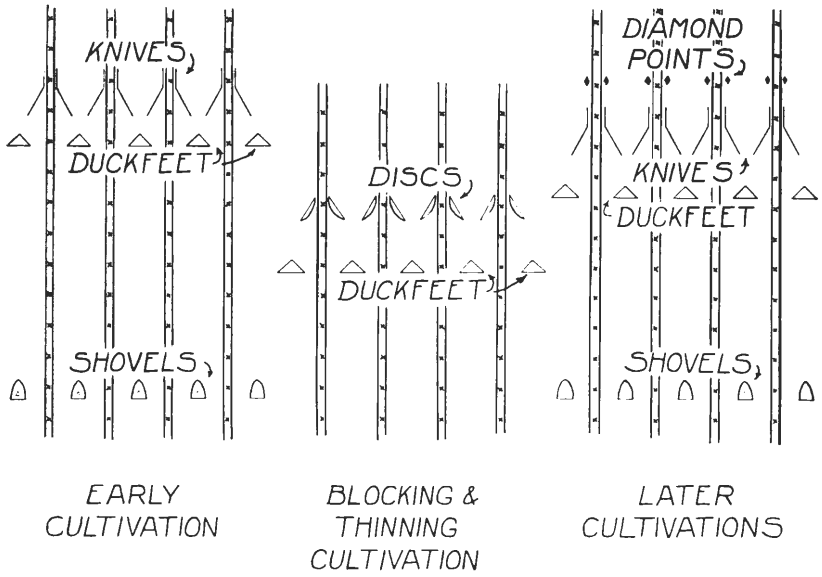

Fig. 4.—An alternate diagrammatic arrangement of cultivating and ditching tools.

and make it much easier to block and thin the beets. After blocking and thinning, each cultivation during the season should throw some soil towards the beets, forming a ridge which further controls weeds.

Although many growers stop the last cultivation when the beet leaves cover the rows, it may be necessary at times to cultivate after this occurs in order to further eliminate weeds and to reditch. Here again the tools near the beets should pick up the leaves in front of the other tools and the cultivation should be shallow.

Tools used on the cultivator bars, and their proper adjustment will vary with the soil type, weediness, the size of the beets, and the condition of the soil. Except for the pre-thinning operation, ditching is usually done, at the time of cultivation, with the shovels on the rear tool bar. Special shovels are available for ditching the beets. A good type to use during the first part of the season, is the one shown near the bottom of the photograph (Figure 2) with a smoothing device, which leaves a smooth furrow. In some instances when the ditches have become filled in, separate ditching operations are necessary. Ditches made at the time of planting are often only satisfactory for use as guides in reditching operations.

IRRIGATING

Sometimes when moisture conditions become unfavorable after seeding, an early irrigation is necessary to insure proper germination. This is especially true of light soils. On heavier soils, alternate rows are ditched with shovels on the beet drill at seeding time for this purpose. On sandier soils, it is safer to ditch each row at seeding time. This also helps to prevent wind erosion. Sugar beet seeds are planted very shallow, and the surface soil must be kept moist.

Early irrigations should be very light to avoid baking, compacting, and reducing the soil temperature.

Sandy soils require more frequent applications of irrigation water than do heavier soils, and the beets should be watched closely for signs of wilting. During the warm summer months when the beets are growing rapidly and evaporation is high, more water must be used than earlier or later in the season.

Soils which are high in "alkali" often appear moist during the season, when, actually, the moisture has reached a point where the salts need diluting and washing downward to enable the plants to get enough water to make good growth. Sugar beets on "alkali" soils need frequent irrigations regardless of the appearance of the soil.

Sugar beets, even when mature, do not take up water to any great extent below 30 to 36 inches in the soil. This means that light, frequent irrigations are superior to heavy, infrequent irrigations. There has been circulated among growers an opinion that by delaying the first irrigation as long as possible, the beets will form deeper roots. There are no facts to prove this opinion. The sugar beets should be watched closely from the time of seeding to harvest and water applied when needed to maintain vigorous growth. When the beets begin to wilt in midday, and do not quickly recover at night, immediate irrigating is necessary. Yields are reduced if the beets become completely wilted, with resultant drying of some of the leaves.

The beets should be irrigated until harvest. If the soil is in a fairly moist condition at harvest time, there is less loss from broken roots. The beets kept better in storage, and the soil is in better condition for fall work.

HARVESTING

Harvesting in certain sections of this area usually begins the latter part of September, and the peak of harvest is reached by the middle of October. The purchasing company notifies the growers as to when the different sugar beet stations will receive the crop.

When harvested by hand, the beets are first lifted by a double-pointed lifter. One- or two-row lifters are usually mounted on row-crop tractors. Some lifters are horse drawn. These lifters should be in good condition and carefully adjusted so as to loosen the beets without breaking off the roots. The beets are then picked up with a hook or prong on the end of a sugar beet knife. On small beets, the entire leafy portion with a part of the crown down to the lowest leaf scar is removed by a single stroke of the knife. On beets larger than four inches in diameter, several oblique or slanting cuts are made from the lowest leaf scar toward the top and center of the beet.

Excess leafy material on the beets is objectionable from the standpoint of extracting sugar. The receiving company samples and determines the tare on each load of beets, and a deduction is made accordingly. The beets, after being topped, are thrown into small piles from several rows; these are later thrown on trucks by hand. Some growers prefer to fork the beets on the trucks with blunt tined forks. In case the latter is done, a "V" drag is used to make smooth, clean alleys on which the beets are thrown.

Photo by courtesy of the Utah-Idaho Sugar Company.

Fig. 5.—A mechanical sugar beet harvester in operation on the Yakima Indian Reservation.

Photo by courtesy of the Utah-Idaho Sugar Company.

Fig. 6—A mechanical loader in operation in the Yakima Valley.

Fig. 7.—A receiving station in operation. Times *Staff Photo by H. J. Vallentyne, Jr.*

At present, many mechanical loading devices, which save a great deal of time and labor, are used in this area. Many mechanical lifters and toppers are being used, and are increasing in number. With mechanical harvesting, it is necessary to have the fields free of weeds for satisfactory operation of these machines.

The contracting company maintains receiving stations at convenient locations in the area, with proper equipment for unloading. The truck beds should be constructed to conform with the machinery used for unloading at the station designated for each grower.

To prevent possible losses from freezing during harvest, the grower should have his hauling operation regulated with the lifting and topping operations, so that there are few, if any, beets lifted and topped in the field at the end of each day. Frozen beets must be processed immediately, and cannot be stockpiled with unfrozen beets. The sugar beet Field Man or loading station operators should be consulted in case beets become frozen in the field.

THE USE OF SUGAR BEET BY-PRODUCTS

Details of the use of sugar beet by-products for livestock feeding may be obtained from Extension Bulletin 236, *Sugar Beet By-Products for Livestock Feeding,* available from your County Agricultural Extension Agent.

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