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UNIVERSITY OF IDAHO
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Director

BEAN PRODUCTION IN IRRIGATED SECTIONS OF IDAIHO

BY

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100-Acre Bean Field, Twin Falls County

COOEPRATIVE EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS OF THE STATE OF IDAHO UNIVERSITY OF IDAHO COLLEGE OF AGRICULTURE AND UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

AGRONOMY

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SUMMARY

Idaho ranks first among the states in acre yield and fourth in total production of beans.

Altho the bean is a tropical or semi-tropical plant, it is adapted to sections that have a frost-free period of from three to four months.

Seed bed preparation must be thoro and complete. The most fertile soil always gives the largest returns. Ground should be irrigated before planting and worked thoroly to kill the weeds. Beans usually are planted with the regular type of planter at the rate of 60 pounds per acre. June 1 to 10 is the average date of planting in Idaho.

Cultivation must be thoro and frequent. Irrigation water, especially on heavier soils, should be applied in light runs.

Harvesting usually is done with a two-row cutter and the plants are shocked and dried in the field. A regular bean huller is recommended for the threshing.

Beans occupy the position of "clean-up" crop in the rotation.

The most serious diseases are bean mosaic and dry root rot.

Insects that are now injurious or are apt to become a menace are the bean weevil, seedcorn maggot, Mexican bean beetle, cutworm and wireworm.

Certification of seed for planting in Idaho has become necessary on acount of diseases.

Cooperative marketing of commercial dry beans is quite important in southern Idaho.

The by-products from the bean crop are valuable additions to the list of livestock feeds.

BEAN PRODUCTION IN IRRIGATED SECTIONS OF IDAHO

BY
R. E. BROSSARD
AND
RALPH S. BRISTOL

INTRODUCTION

The production of beans has come into prominence in certain irrigated sections of southern Idaho during the past few years. In fact it has become a leading industry in one section, the Twin Falls tract, where in point of acreage it was exceeded only by alfalfa in 1924 and 1925.

In 1925 Idaho ranked sixth among the states in acreage of beans, with 72,000 acres. Of this amount Twin Falls County had about 45,000 acres—and ranks fourth in total bean production, having produced 1,584,000 bushels. The average acre yield, 22 bushels, is the highest average of any state. This rank in acreage for both the State and Twin Falls County, has remained practically constant during 1926 and 1927, while the yield per acre in both instances has increased, being 23.7 bushels per acre for the state and about 27 bushels per acre for Twin Falls County during this period.

From the standpoint of returns, beans are probably the most valuable crop grown. As a consequence of the large acreage and the value of the crop, great interest has been aroused in other parts of the State, particularly in the irrigated sections near the Twin Falls tract, including portions of Cassia, Minidoka, Jerome and Gooding Counties. These sections have produced good quality beans, which have yielded very well for the past two years, and although so far the acreage has been small, it undoubtedly will increase.

Some beans have been grown on the Twin Falls tract since it was opened in 1905. Until 1910 only enough for local needs was produced, but after that time growers

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The general discussion in this bulletin was written by R. E. Brossard, County Extension Agent in Twin Falls County, and Ralph S. Bristol, Assistant Extension Agronomist. The discussion of bean diseases was prepared by C. W. Hungerford, Plant Pathologist, and the discussion of bean insect pests by Claude Wakeland, Entomologist of the Idaho Agricultural Experiment Station.

began to ship beans out of the county. During this period and in fact until 1917 the chief varieties were the Lady Washington, Little Navy, Navy and some Red Mexican. Since 1917 the acreage has grown quite steadily, until in 1924 it reached a peak of approximately 55,000 acres. As Twin Falls has about reached its maximum acreage consistent with good farming methods, any further expansion of the industry must come from the counties in the surrounding territory.

With this development have come better knowledge of how to grow the crop and more modern methods in handling it. At the present time well established, economical methods of culture and harvest are used by practically all growers.

VARIETIES

Two types of beans are grown in the section: Commercial dry beans and seed of garden varieties. The chief commercial variety is the Great Northern, which comprises about 75 per cent of all the beans grown. Since its introduction in 1917, it has taken the place of the Lady Washington and the Navies. Red Mexican beans are still grown, but not in large quantities.

The Great Northern is a medium white bean, the average size of the seed being about as follows: 1-2 inch long, 5-16 inch wide and 3-16 inch thick. Large size beans will run about 74 to the ounce, medium size 84 to the ounce and the smaller about 90 to the ounce. The plant itself makes a rank growth in rich soil, its tendrils matting across a 24-inch row. On poorer soils it grows quite erect, the tendrils whorling from the top of the plant. It is very prolific, giving high yields where proper cultural methods are used, and it matures early. In some cases it may be harvested within 70 days from the time of planting, but on an average 80 to 85 days are required for maturing the crop. These facts, as well as its marketability have made it the most popular variety in the Twin Falls section. It was introduced there in the spring of 1917, some seed coming from Washington, D. C., and some being brought in from Montana, and grown on a contract basis. The development of the industry since that time has been very rapid.

Seed of the garden varieties is put out by seed companies on a contract basis. Farmers deliver all beans grown by them to these companies after harvest, at stip-

ulated prices per pound. Seed beans thus grown include such varieties as the following: Burpee's Stringless Green Pod, Giant Stringless Green Pod, Red Valentine, Black Valentine, Refugee (1,000 to 1), Refugee XX, Bountiful, Longfellow, Giant Valentine, Davis White Wax, Wardwell Kidney Wax, White Creaseback, Pencil Pod Black Wax, Curries Rust Proof Black Wax, Champion Bush, Dwarf Golden Carmen, Improved Kidney Wax, Tennessee Green Pod, Brittle Wax, Webber Wax, Sure Crop, Black Pole, Ruby Dwarf, Horticultural, Full Measure, Improved Golden Wax, Kentucky Wonder, Red Kidney and others.

Seed beans annually comprise from 15 to 25 per cent of the bean crop.

ADAPTATION

The bean is a tropical or semi-tropical plant and is therefore very susceptible to injury by frost. It succeeds well, however, in localities where there is a period of at least three to four months of the year free from frost. The common bean is not so particular as to soil, but grows best on one that is moderately light and well drained. It will thrive on poor soil better than many other crops and this fact has led to the expression, "It's good enough for beans." Beans do, however, react wonderfully to good treatment and Idaho's enviable record of having the highest acre yield of any state in the Union, and of producing beans of exceptionally good quality, has come about thru the use of fertile soils.

Altho the bean is a legume and hence a nitrogen gatherer, good results are obtained thru the use of nitrogenous fertilizers.

CULTURAL METHODS

Seed Bed Preparation

Stubble Ground—Preparation of the seed bed should begin long before time to plant the crop. Where beans follow grain crops, the ground should be plowed in the fall and the stubble turned under deep. It is good practice to disc the stubble before plowing, cutting it up in good shape so that it becomes well rotted during the fall and winter. This makes more plant food available for the succeeding crop, and avoids possible trouble in cultivating. The ground should be left in the rough state over

the winter in order better to absorb precipitation and to take advantage of the freezing and thawing which leaves the soil in better physical condition.

As soon in the spring as possible the ground should be worked down, preferably with the disc first and with the discs set fairly straight. This should be followed by the spike-tooth harrow and this by the heavy drag or leveler. Some growers prefer leaving the ground in this condition so that whatever weeds are in it will sprout. However, the harrow should follow the leveler immediately to break up the smooth surface of the ground and avoid excessive evaporation. The harrow is kept moving at regular intervals, disturbing the soil so that sprouting weed seeds will not be allowed to root at all firmly. In either case the harrow must be used after a rain to break up the capillary attraction thus established, and to prevent evaporation. Whichever method is used, it is important to remember that a good deep mulch should be maintained at all times until the crop is planted.

Bean Ground and Potato Ground—When beans follow beans, a top dressing of manure gives splendid results and is always desirable. If enough manure is not available the bean straw not consumed by livestock should be spread back on the ground. If the ground is rich in humus, plowing is not necessary, the ground needing only to be disced up well in early spring and then worked down as if it were stubble ground. Where several crops of beans have been grown on the same ground, without the application of manure, plowing each year is essential and spring plowing is preferable, as otherwise the soil, because of lack of humus, is inclined to run together and become too firm.

With potato ground excellent results have been obtained by simply cleaning up the trash and discing it up for the crop of beans. If the land is foul with weeds these usually are allowed to start growing and are then plowed under, and the surface is worked with the harrow to kill any that might start after plowing.

Alfalfa Ground—The bean crop following alfalfa has given fine results. Alfalfa ground may be crowned in the fall of the year and plowed deeply in the spring. Another practice which is coming into more general use is to allow the alfalfa to grow in the spring until it reaches a height of from 6 to 8 inches, then plowing it under for a green manure crop. Immediately after plowing the disc should be used. The discs should be set straight and

should run with the furrow, not crosswise, in order to cover the alfalfa thoroly and seal up all cracks in the soil, thus assuring quick decay of the green manure.

Where a good job of plowing is done and the alfalfa is turned under well, no trouble has been experienced in cultivating the crop. Different cultivator tools than where potatoes or beans or grain preceded, should be used. The knives and duck feet should be replaced by bull tongues, which will not catch or pull out the alfalfa, as will the other tools. Some farmers use the bull tongue shanks, but make a tongue 2 3-4 to 3 inches wide to take the place of the bull tongue.

Corn Ground—Where corn ground is used, a good method is to cut down the corn stalks with a bean cutter, and then to disc the stalks, cutting them into short lengths before plowing. If the stalks are disced when dry they will cut up fairly well, but if they are wet it is practically impossible to get good results. Where corn is grown on heavy soil and makes very rank fodder which is not assimilated by the stock, the worst might be cleaned up by burning, but this method is to be avoided if possible, as all such plant refuse should be returned to the land.

Planting

After the ground has been thoroly worked into a good seed bed in the spring, no matter what crop was grown previously, frequent stirring of the soil is essential to kill weeds and maintain good tilth. It is better to dispose of the weeds before the beans are planted than afterwards, as this saves expensive hand labor and hence materially cuts down the cost of production per acre.

From 15 to 25 days before planting the ground is corrugated and irrigation water is applied. The length of time elapsing between this irrigation and the planting will depend upon the ability of the soil to hold water. If the soil can hold water for a considerable period, the earlier application is desirable. The ground then has an opportunity to warm up and when the crop is planted the plants fairly pop out of the ground and start life with a vigor not otherwise obtained. As soon as possible after this irrigation the ground should be disced or spring-tooth harrowed, floated and gone over by the spike-tooth. It is left thus until planting time. In preparing the ground it should be kept in mind that beans have a shallow, semi-tap root-system and like a warm, mellow seed bed. If the

preparation has been thoro, the crop will react accordingly.

Method of Planting and Date of Seeding—The average planting dates for the district range from June 1 to June 10. Some beans are planted the latter part of May and some up until June 20, but most growers plant the first week in June, weather permitting.

The regular four-row bean and beet planter is used. From 55 to 65 pounds of the Great Northern variety (average 60 lbs.) are planted to the acre, in rows usually 24 inches wide. On fertile soil this row width can be extended to 26 or 28 inches, some growers preferring the wider row. The beans should be planted from 2½ to 4 inches deep. With this amount of seed a plant will be placed, theoretically, about every three inches in the row, which is close enough.

Thru the use of the harrow and the weeder, and thru injury by other cultivations, the plants will be thinned out somewhat without lessening the harvest, provided a good stand is obtained in the first place.

Several makes of good planters are handled by machine companies. A grain drill having feed cups adaptable to beans may be used with fair success. The width of the row can be regulated by stopping some of the feed cups.

Cultivation

A thoro preparation of the seed bed leaves the soil in excellent tilth, comparatively free from weeds, and hence lessens the number of subsequent cultivations necessary. Most growers follow the planter with a spike-tooth harrow, with the teeth set fairly straight. A wooden harrow is preferred, as it has more teeth than the iron harrow. This operation is repeated about twice after the beans are up and until the plants are fairly large. The harrow is sometimes replaced by the weeder.

Care should be taken not to harrow when the beans are just coming thru the ground, or in the "crook." The harrow or weeder should be run with the row, not crosswise, as that tends to move the latter out of line and make later cultivations unsatisfactory.

Some growers do not harrow or use the weeder after the beans are up, but start with the four-row cultivator as soon as the rows can be seen plainly.

In the use of tools on the four-row bean and beet cultivator the best growers again differ. The majority use knives and duck feet for the first two cultivations and the corrugator shovels the third or last time thru, three cultivations usually being all that are required. For the first cultivation the knives are set with shanks against the row and the blades toward the center, with the duck foot between.

For the second cultivation the knives are reversed, the end of the blades being next the bean row, the duck foot between. This position throws some dirt against the beans and tends to hill them up, which is desirable. Sometimes enough ridge is formed by this method that the shovels are not necessary, but ordinarily the last operation with the cultivator is with the shovels—to make the corrugations for the irrigation water. Many farmers use the weeder or harrow in between applications of the four-row cultivator, or at least until the beans are 4 to 6 inches high.

Fig. 1. Weeder in Use.

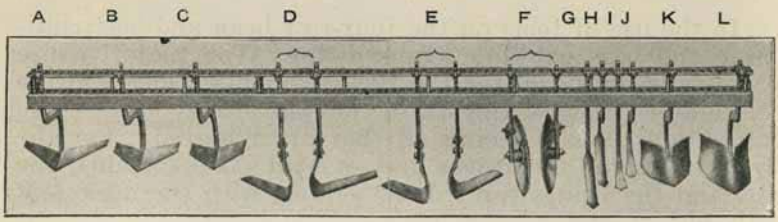

Fig. 2. Tool Bar for Beet and Bean Cultivator Showing different tools that can be furnished. (Courtesy of the John Deere Company.)

No. 6 Duck Foot 12" (A).
No. 5 Duck Foot 10" (B).
No. 4 Duck Foot 8" (C).
No. 7 Large Weeding Knives (D).
No. 6 Small Weeding Knives (E).
No. 3 Disc Weeders (F).
No. 3 Diamond-Pointed Bull Tongue (Straight Shank) (G).
No. 4 Diamond-Pointed Bull Tongue (Curved Shank) (H).
No. 5 Deer Tongue (Straight Shank) (I).
No. 6 Deer Tongue (Curved Shank) (J).
No. 3 Irrigating Shovel, Small (K).
No. 4 Irrigating Shovel, Large (L).

These duck feet can also be bolted to straight shank G.

The other method of cultivation is to do all stirring of the soil before the beans are up, with the harrow or weeder. After they are up the four-row cultivator is the only implement used. The first cultivation is deep and is done with a specially made tool, a 3-inch bull tongue on each side of the row with the duck foot in the center. The discs are used at about the second cultivation to throw dirt from the center toward the beans, hilling them up well.

The one thing to keep in mind in cultivating is that the first cultivation should be the deepest, and closer to the plant than subsequent ones. The bean is a shallow rooted plant and as the root system gets established any cultivations which disturb it will check the plant growth. Plants should be well hilled up so that they will not come in contact with the irrigation water, or the ground, as this tends to discolor the beans.

IRRIGATION

On the lighter soils of the district three irrigations will be necessary to mature the crop in normal seasons. The heavier soils will require only two irrigations and the river soils may require only one. Since the lighter soils predominate, the majority of farmers irrigate three times. Water is applied only to every other row. The most desirable time to apply the first irrigation is just as the plants are budding. The length of time of the runs will depend on the soil, the length of the row, the lay of the ground, etc., but as a rule 24-hour runs are not too long, altho some apply for only 12 hours.

The second irrigation, which usually comes when the pods are well set, will need to be practically as long a run as the first; the third, applied to insure the pods filling well, usually needs run only 12 hours. In every case the water should be run thru the same rows.

HARVESTING

Cutting—The beans should be allowed to become fairly ripe before they are cut. Some farmers have cut beans when only a few pods are yellow. When cut at this stage the grade is lowered because of color and there is apt to be considerable shrinkage, the loss from this cause being greater than if the beans were cut when more ripe, even tho some shatter on the ground. A bright lustrous color is desirable and this can be obtained only in fully mature beans.

A two-row wheel-type bean cutter is generally used. This machine cuts the beans just below the surface of the ground and pushes the two rows together into one windrow. Three to four men follow the cutter, setting over the windrows and shocking them into small, well rounded piles. The shocks should be small on the bottom and as high as can be handled later at one forkful. Good shocks are important and more time can be spent profitably on this operation than is usually given. Where shocks are well made there is less danger of damage to beans from storms than where they are spread out over the ground, and not well rounded up.

The four-row cutter also is now being used with success. Some farmers have made four-row cutters which are pushed by a tractor. The side delivery rake is also used to some extent to make one windrow from four rows

of beans. The shockers then follow the rake. Less help is needed with this method and the beans are cut at a slightly greener stage.

When a combine harvester is used the beans are usually not shocked, but are left in the windrow. It is good practice, especially if the ground contains considerable moisture, to go thru the field setting the shocks over to one side on dry spots to prevent damage by the ground moisture which will rise to the top of the ground under the shocks or windrows. If they are caught by rains in the shocks, they should be turned as soon as the ground dries, as contact with the moist ground will in a short time cause discoloration. The seeds absorb moisture readily.

Fig. 3. Cutting and Piling Beans.

Stacking—Practically all of the beans are threshed directly from the field, being either hauled to a stationary huller, or picked up from the shock or windrow by combined harvesters which are now being used to some extent.

Unless the beans can be hulled soon after cutting, it is good practice to stack them, as the weather usually is uncertain at this time of the year. A layer of straw a foot or more thick is spread on the ground and the beans are stacked on top. The straw keeps the ground moisture from the beans and also acts as a catch for the bean seeds shattered out in the stacking process.

The stacks should be covered or capped with straw 12 to 15 inches thick, so that rain will not leak thru and discolor the beans.

In case of a wet fall when the beans cannot be stacked in the usual manner, the crop can be saved by stacking in the dryest possible condition in narrow ricks about 10 feet wide. Straw scattered in layers thruout the stack will help absorb any moisture present. Poles or fence posts placed in the stack will help ventilate the beans. Fence panels placed in the shape of an inverted V with the wet beans stacked around them have proven successful.

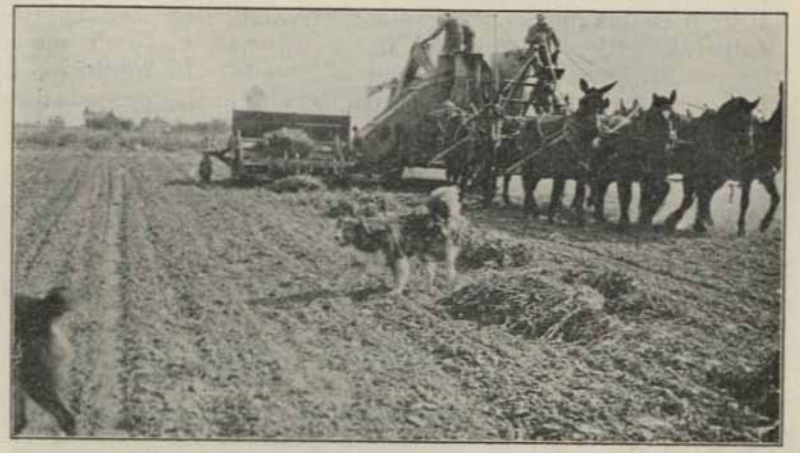

Fig. 4. Threshing Direct From Field With Combine.

Threshing—Threshing is done in the majority of cases with a regular bean huller. Most threshermen carry these as part of their regular equipment. A small machine designed primarily as an individual farmer machine is now on the market, however, and doing very good work. The combined harvester which picks the beans up from the windrow or pile and threshes them as it moves thru the field is also coming into use. Use of the grain separator is practicaly a thing of the past, altho fairly good results can be obtained by removing all but one row of the concave teeth and half of the cylinder teeth, and slowing the speed of the cylinder to from 300 to 400 revolutions per minute.

Threshed beans going into the sack should be watched carefully, regardless of what machine is used. If the beans are broken or split and no whole pods are going over, a row of concave teeth should come out. It might be necessary to decrease the speed, or increase it, depending on the moisture in the straw.

Bean hullers usually make a regular fall run the same as clover hullers and grain machines. Prices paid for hulling the past year were 15 to 17 cents per bushel on a recleaned basis.

PLACE IN ROTATION

The bean crop is a desirable one to grow because it lends itself readily to almost any system of crop rotation. It is a cash crop as well as a cultivated crop and by the cultural methods employed in its growth it furnishes a means of cleaning the ground of weeds. In addition, it is a legume. It follows alfalfa, grain crops or potatoes very well. Good crops also have been produced after beets.

Some suggested rotations follow:

Alfalfa	3 years
Potatoes	1 year
Beans	1 to 2 years
Wheat or Barley	1 year (seeded to alfalfa in grain)

or

Alfalfa	3 years
Beans	2 years
Corn or Beets	1 year
Grain	1 year (seeded back to alfalfa)

or

Alfalfa	3 years
Potatoes or Beets	1 year
Grain	1 year
Beans	1 year
Grain	1 year (seeded back to alfalfa)

DISEASES

One of the reasons why beans can be grown for seed to better advantage in Idaho than in many other states is that our bean growing sections are comparatively free from those diseases which are carried on the seed. In fact, the only two bean diseases which are of much importance in Idaho are mosaic and dry root rot, while in the bean growing sections of the eastern part of the United States a number of other diseases are common and destructive. Due to the semi-arid conditions which prevail in the intermountain sections of the northwest and the relatively low humidity which is found even under irrigation, it is very doubtful whether diseases like anthracnose and bacterial blight will ever be serious. Both of these diseases have undoubtedly been brought into Idaho many times on infested seed and yet they are very rarely seen in bean fields. All of the bean producing sections in Idaho are comparatively new and the soils are fairly free from soil-infesting disease organisms. By practicing rotation and by not growing beans on the same soil more than once in four or five years, it will be possible to keep under control those diseases which are carried over from year to year in the soil.

Bean Mosaic

Mosac is the most serious bean disease in Idaho at the present time. Altho it is well distributed thruout the state, it has not become as serious as it has been in some of the eastern states. Precautions should be taken at once, however, to clean up seed stock in order to keep the disease in check.

Mosaic is one of the so-called virus diseases and is similar to potato mosaic in many ways. The appearance of diseased plants in the field depends somewhat upon whether they are infected during the growing season or whether they result from infected seed. Plants from infected seed are usually smaller than normal, are a lighter green in color, and the leaves have a characteristic curled and mottled appearance which has caused them to be called curly leaf plants. The mottling is due to dark and light areas irregularly distributed over the leaf surfaces. In severe cases unequal growth of these areas may cause a distorted and blistered appearance. The plant on the right in Figure No. 5 shows the characteristic appearance of a badly diseased plant. Plants which become infected

during the growing season present this mottled appearance only on the new leaves which develop after infection takes place.

Bean mosaic is carried from year to year by means of infected seed. Seed once infected will produce infected plants and there is no known method of seed treatment which will prevent the development of the disease. Certain species of aphids or green plant lice and possibly other insects may carry the infection from diseased to healthy plants in the fields.

The control of mosaic depends upon the use of disease-free seed. Careful roguing of all diseased plants from a

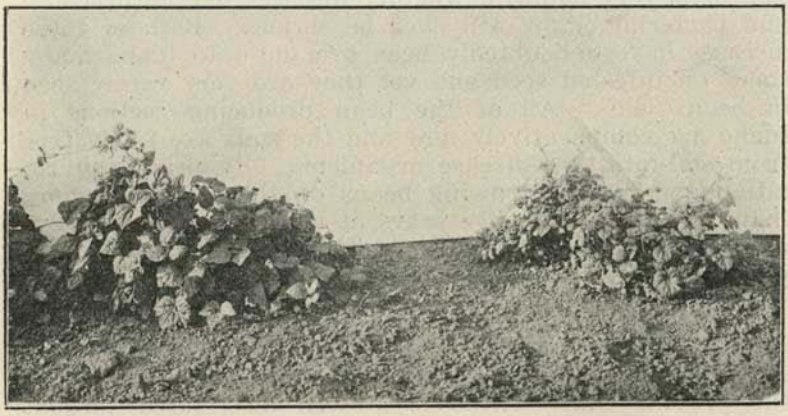

Fig. 5. Effects of Bean Mosaic. (Hungerford)

seed plot grown at least one-eighth of a mile and if possible one-quarter of a mile from other bean fields is the only way to produce mosaic-free seed. This seed plot should be carefully examined at least once every week and every plant showing even slight signs of mosaic should be pulled and taken from the field.

Dry Root Rot

The dry root rot disease is caused by a species of Fusarium, a fungus similar to the one causing the fusarium wilt of potatoes. The fungus lives in the soil from year to year and attacks the roots and base of the stem of the bean plant. Figure No. 6 shows its effect upon the root system of beans grown in the greenhouse in soil artificially contaminated with the fungus which causes the dis-

ease in Idaho. Note the contrast between the roots produced by the healthy plants on the left and those produced by the diseased plants on the right.

This disease caused considerable loss in the bean producing sections of southern Idaho in 1924 and the loss was especially heavy in Twin Falls County. Dry root rot is usually more severe under irrigated conditions in Idaho. The roots of apparently healthy plants may be infected with the disease organism and no serious harm may result unless climatic conditions are favorable for the development of the disease.

Hot weather with dry winds and low humidity may cause excessive evaporation from the leaves and result in serious losses when the plants are infected with the fungus

Fig. 6. Effect of Dry Root Rot on Bean Plant. (Hungerford)

causing the dry root rot. Under these conditions the infected plants present a very characteristic appearance. They are somewhat dwarfed, the leaves are yellowed and often turn brown and drop off, and death of the plants may occur. The yield is materially reduced on plants which survive until the end of the season. Reddish brown streaks often appear on the stems of the plant extending an inch or more above the surface of the ground. This last sympton is the best way to distinguish the disease from the effect of the rhizoctonia fungus, which may attack beans under certain conditions, and from dwarfing and yellowing caused by unfavorable soil conditions.

No very satisfactory control measures have been developed for the dry root rot disease. Cultural practices which will keep the bean plants growing vigorously thruout the early part of the season so that the root system will become well established should aid in controlling the disease. Crop rotation and keeping of bean refuse and manure containing bean straw off fields soon to be planted to beans also should aid.

INJURIOUS INSECTS

The Bean Weevil

(Mylabris Obtectus Say)

Of the several species of bean weevils only one has been found infesting beans in Idaho. This species is often called the common bean weevil. It has not been known to cause injury to growing beans and, to date, has been only in seed beans shipped in from other states. Its range in the United States is wide but its occurrence ap-

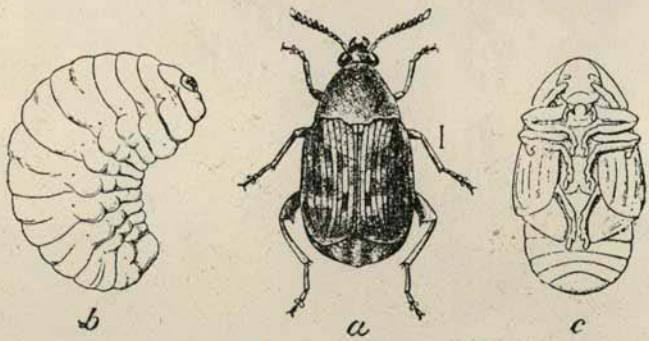

Fig. 7. Common Bean Weavil—(a) Beetle; (b) Larva or Grub; (c) Pupa. The short line to the right of the beetle (a) represents its real length.—Farmers' Bulletin 1275 (Chittenden.)

pears to be limited to low elevations and areas of mild winter temperatures. It eventually may become established as a pest in some of our districts of low elevation, or in others following years of mild winter weather, but is not likely ever to become a major pest.

Some adults hibernate in the fields while others breed successive generations in beans stored in warm places. Adult females fly from storage or hibernating quarters early in the spring and from then on can be found on bean plants. In the field, eggs are laid thru cracks in the pods or thru holes gnawed by the female beetles. All varieties of beans are affected. The tiny grubs hatching from the eggs make their way into the beans where they feed and grow to maturity, and adults emerge thru holes they gnaw in the beans. When beans are harvested they may appear to be sound but may contain small larvae that continue feeding, develop to adults, and emerge in storage.

The economic importance of the bean weevil in Idaho at present is due to the possibility of its introduction into the bean growing districts in seed obtained outside of the state. Growers should purchase nothing but seed which is known to be free from weevil infestation or which has been thoroly fumigated.

Fig. 8. Seed Injured by Bean Weevil—Intercepted in shipment from another state.

Seedcorn Maggot

(Hylemyia Cilicrura Rond)

The seed corn maggot is the most injurious insect affecting beans in Idaho. Its appearance is periodic. Several seasons in which the insects are completely absent from the fields may be followed by a year in which thousands of acres of bean planting are destroyed. The maggot is most numerous and causes greatest injury during seasons in which the soil is unusually moist and cool at planting time and during the period when seeds are germinating and sending forth sprouts.

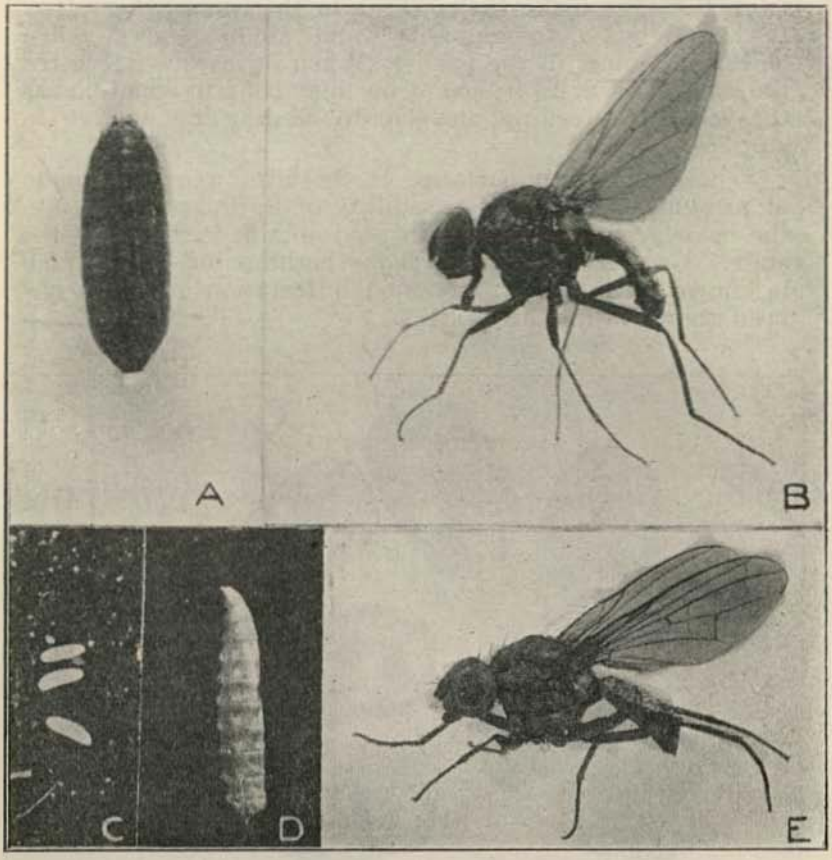

Fig. 9. The Seedcorn Maggot (Hylemyia cilicrura). (A) Puparium x8; (B) Parent fly, male x10; (C) Eggs, on dirt, x6; (D) Larva, x5; (E) Parent fly, female, x10. (From Memoir 55, Cornell Experiment Station.)

Little definite information is available concerning the life history and habits of this insect. The adult is a two-winged fly, much smaller than the house fly, but roughly resembling it in color and general appearance. There are supposed to be two generations a year. Adults emerge from the soil in the spring and deposit their eggs on decaying matter in the field or in the moist earth. During warm weather eggs hatch in two or three days and the tiny larvae make their way to the beans where they destroy the young sprout or eat into the beans or into the stem below ground. When fully grown the maggot is about one-quarter inch long, white, footless and tapering toward the head. Larvae pupate in the soil and in summer the pupal stage lasts for 10 or 12 days. Second generation adults then emerge and deposit their eggs. The winter is thought to be passed in the pupal state. The pupal case is elongate-oval, brown in color, about one-fifth inch long and is found in the soil from just below the surface to a depth of 2 or 3 inches.

Study of the life history of this insect has been rendered difficult because its appearance is periodic. No satisfactory method of control in the field is yet known. In general, injury is likely to be greater in heavy, moist, cool soil than in light, warm, well-drained soil. Investigators have shown, also, that a much better stand of beans is often obtained in an infested field when the seed is planted shallowly than when it is planted deeply. This may be explained by the fact that the soil for 3 or 4 inches below the surface is much cooler and more moist than that near the surface, that seeds planted deeply germinate slowly, and that many are likely to rot during wet seasons.

The procedure which has proven effective in Idaho in overcoming injury from this insect and which is being followed by many growers, is to plant beans at the earliest date that is believed safe in a given locality.

At that time the grower cannot know whether the season will be one of heavy infestation. His crop will be unaffected if conditions subsequently prove unfavorable for the breeding of the flies. If, however, heavy injury is done by maggots the grower can replant his field after loss of the first crop and there will yet be time for beans to mature.

It appears that the flies deposit their eggs over only a short period. Maggots infest the first planting of beans but by the time the loss is discovered and a second planting made they have entered the pupal stage and have

ceased feeding. Bean plants from the second planting are large enough to escape injury by the time larvae from the second generation of flies are produced. The expense of this method of control consists of the price of the seed and the cost of labor for one planting.

Mexican Bean Beetle

(Epilachna corrupta Muls)

The Mexican bean beetle is mentioned in this bulletin because it is the most destructive insect enemy of beans in the United States. Of Mexican origin it is now known to occur as far north as Wyoming and Utah, and is quite widely distributed in eastern and southern United States. It is not known in Idaho, but it is so rapidly extending its range that in time it is likely to find its way within our borders.

The adult of this insect is a lady-bird beetle and in appearance it resembles some of the larger lady-bird beetles that are commonly known as beneficial insects. Injury is caused by the feeding of both adults and larvae. They attack the leaves, blossoms and pods, but the greatest amount of injury is done to the leaves. Infested fields are often completely destroyed and all varieties of beans are attacked. Control is difficult and expensive. Should the grower find insects that are eating bean leaves and that he suspects might be the Mexican bean beetle, he will

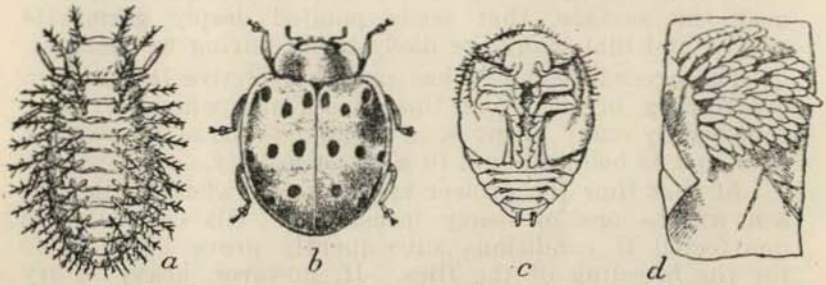

Fig. 10. The Bean Lady-bird or Beetle.—(A) Larva; (B) beetle; (C) Pupa; (D) Egg Mass, about 4 times natural size. (From Farmers' Bulletin No. 1074.)

render a distinct service to the bean growing industry of the state if he will kill the specimens with chloroform, place them in a small box and mail them for identification to the Entomological Field Station, Parma.

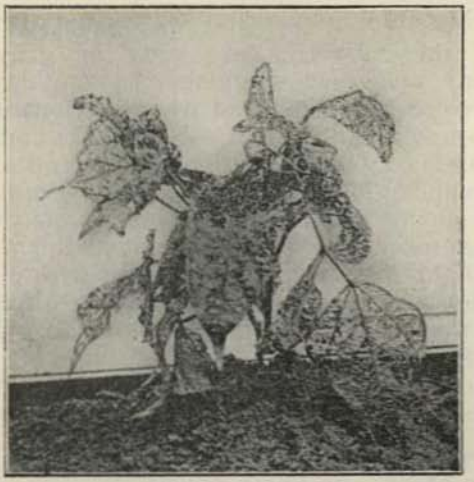

Fig. 11. A Plant Showing Typical Injury of the Mexican Bean Beetle. The leaves are so badly skeletonized that they will soon drop. (From Bulletin No. 271, Colorado Agr. College.)

Thrips

Injury to bean plants by an undetermined species of thrips has been observed in Idaho. The extent of injury has not been great, but in other states these tiny pests often cause serious damage. They chafe the epidermis of the leaves, causing it to assume a whitish or silvery sheen and the leaves sometimes turn a pale yellow color. Injured leaves become dry and parchment-like and are likely to drop prematurely.

Spraying is not effective under practical field conditions because of the protection offered the insects by the foliage. Thrips feed on numerous plants and seek protection under leaves, weeds, rubbish, etc. Keeping down weeds, cleaning up old bean fields after harvest, maintaining fertility to force vigorous growth and rotation of fields are the most effective preventive measures.

Cutworms

Beans, in common with many other crops, frequently suffer from attacks of cutworms which cut off the young plants at the surface of the ground. Cutworms, of which there are many species, are the larvae of dusky colored moths that fly at night. It is these moths or millers that, nearly every year, becomes a nuisance in June or early

July by flying into houses and fluttering around lights.

Most of the cutworms are gray or grayish-brown, smooth, shiny and very sluggish. In the daytime they remain concealed in the soil and when dug out usually curl up and "play possum." They eat at dusk, coming to the surface to feed. Eggs are laid on the ground or on plants near the ground. Most of the injury to beans is caused early in the spring by partially mature larvae that hatched from eggs the previous fall and survived the winter.

When a field is known to be infested with cutworms at the time beans are planted, injury can be almost entirely averted by the use of poisoned bran mash. The effectiveness of this material is due to the habit of the larvae of coming to the surface to feed at night. They are attracted to the mash and eat it freely. The formula follows:

Coarse bran	25 lbs.
White arsenic or Paris green	1 lb.
Molasses (beet sugar or cheap cooking)	2 qts
Lemons or oranges	3
Water, to make moist, crumbly mash	3-4 gal.

(1) Mix thoroly the bran and the poison. (2) Grind the lemons in a food chopper. (3) Mix the water, molasses

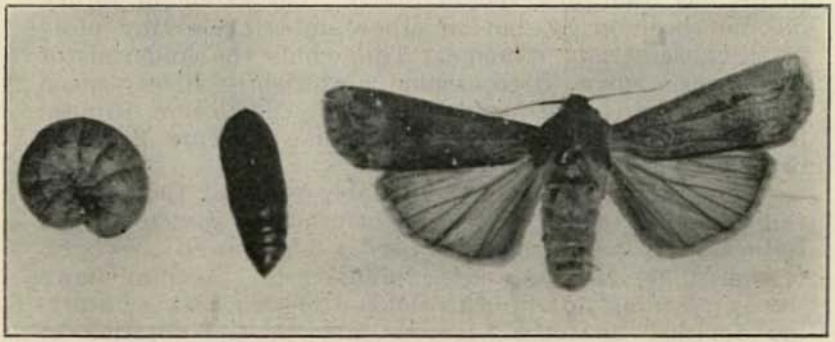

Fig 12. Larva, Pupa and Adult of the Black Cutworm (Agrostis ypsilon Rott.), a species common in Idaho. (Wakeland.)

and fruit juice and pulp. (4) Pour the liquid mixture over the dry mixture and stir the entire mass until it is thoroly mixed.

The mash, when completely prepared, should be moist but not wet and flakes should break apart when handfuls of the materials are broadcasted. It is effective only while moise so it should be broadcasted in the early evening just

before the cutworms become active. Usually 25 pounds of bran is sufficient for treating three acres of ground.

Cutworms are active in the spring before beans are planted. For prevention, the bran mash should be scattered after the beans have been planted and before the young plants appear above the surface of the ground. If cutworms are found to be attacking the plants after they are up, effective results may be obtained then by sowing the mash as directed, but loss cannot be entirely prevented.

Wireworms

Bean stands are quite heavily reduced by the work of wireworms in certain localities. The species *Pheletes occidentalis Cand*, that is most injurious to this state, appears to have been a native of the low, moist, sod land of the river and creek bottoms. With the advent of irrigation this species is extending its range until it has become a pest of very great importance in irrigated areas that are entirely removed from old water courses. As irrigation practices are continued and extended the damage from this pest doubtless will become more severe and widespread. It is a general crop feeder and is the most serious insect pest with which the farmers of Idaho have to contend.

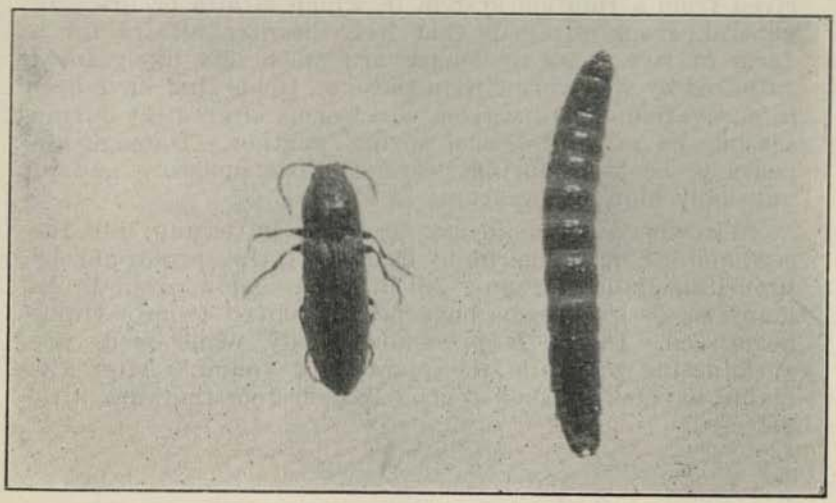

Fig. 13. Adult and Larva of the Wet-land Wirewom (Pheletes occidentalis cand.) which is the common injurious species in the irrigated sections of Idaho. (Wakeland.)

Wireworms are slender, hardshelled, shiny larvae, yellow or yellow-brown in color. They are sluggish and crawl very slowly. When first emerged from the egg they are tiny, cream colored, and extremely hard to see. When fully grown, wireworms measure about ¾-inch in length. Adults emerge in the spring, eggs are laid in the soil, and the larvae produced from them live in the soil for about three years. Fully matured larvae pupate in the ground in the late summer or early fall. These transform to adults which remain in the soil all winter before emerging and which lay their eggs the following spring. There may be three different ages and generations of larvae present in one field at one time.

The adult of the wireworm is a slender, brown beetle about ⅞-inch in length. It is known as a click beetle because, when placed on its back it throws itself into the air with a snap or "click" and comes down on its feet.

No practical method for controlling these pests is known. Adults fly freely and may deposit their eggs in a field that previously was not affected. Conditions that may attract females for egg laying are unknown, hence there is no known way of averting an infestation. Numerous experiments have been conducted, without success, to kill the larvae with poisons. Attempts to protect seed by the use of repellants also have failed. Some benefit is derived from a rotation system in which alfalfa occurs. In general, crops on fields that have been in alfalfa for a term of five years or longer are much less likely to be attacked by wireworms than those on fields that have been in cultivation. Injury from wireworms is greatest during seasons having moist, cool spring weather. Damage appears to be least during years of little moisture and of unusually high temperatures in May.

Wireworms cause injury to beans by eating into the seed and killing the germ, by destroying the sprout, and by tunnelling into the stem. All injury is below ground. As many as 28 wireworms have been removed from a single bean seed. Injury is pronounced only while seeds are germinating or while the plants are young. After the plants have established a good root system they are little affected.

CERTIFICATION OF SEED

It has become necessary to pay more attention to the seed used in planting the crop, due mainly to the increasing amount of infection by the bean mosaic disease. This infection is carried within the seeds and its effect can only be dectected on the growing plant. Therefore it is necessary that all control measures be carried on during the growing season.

These control measures consist chiefly in roguing out

Fig. 14. Roguing Bean Field on Twin Falls Tract.

all diseased plants from fields already relatively free from disease and testing the seed from these fields in the greenhouse. Considerable work has already been carried on in this respect by the bean growers in cooperation with the University of Idaho.

In 1926 "Certified" seed was produced by farmers in the Twin Falls area for the first time. The amount grown in 1927 was increased considerably. Eventually enough seed of known origin and freedom from disease will be grown to supply the needs of the growers for seed.

The requirements for certification as carried on during 1927 are as follows:

Certification Requirements for Beans
Idaho 1927

1. For the season of 1927, fields to be certified must be planted from certified seed. Seed showing too great

a per cent of mosaic in the greenhouse tests, even tho field certified cannot be used for seed certification.

2. Only those fields favorably located for the control of mosaic shall be eligible for certification.

3. Application for inspection accompanied by inspection fee must be made to the State Seed Commissioner, Boise, before June 1 of any year. Under no circumstances will certification of beans be granted to any growers who fail to make application prior to the above date.

4. Fields must be thoroly rogued and infected plants carried from the field and destroyed before inspection is made.

5. Inspections will be made by an authorized agent of the State Seed Commissioner.

6. No tolerance will be allowed for anthracnose or bacterial blight. Fields may be rejected at the discretion of the inspector on account of infection with either of the above named diseases.

7. Fields showing more than 5% infection with mosaic at any time during the growing season, and more than 2% at the time of final inspection will not be certified. This tolerance may be lessened after 1927 by action of the certifying agency.

8. Inspection certificates will be issued on fields passing inspection. The crops from those fields will be sealed at the threshing machine by a deputy of the State Seed Commissioner. A fee of 5c per bag may be charged. All lots of certified seed must be checked thru the cleaning process and resealed by an authorized representative of the State Seed Commissioner's office. A fee of 2c per bag may be charged for this service.

Duties of Cooperating Parties

1. Growers will cooperate by using every precaution in roguing fields under supervision of the County Agent and Field Agronomist. It should be their aim to produce seed of the highest quality for planting in Idaho. Only those growers able and willing to make a special business of producing seed should attempt to raise certified seed.

2. It will be the duty of the Southern Idaho Bean Growers Association to encourage every farmer to use only certified seed, in order to produce maximum crops of disease--free seed.

3. *County Agent.* It shall be the duty of the County Agent to report applications for certification, cooperate with growers in securing seed and aid in the inspection of fields for certification.

4. *State Seed Commissioner.* It shall be the duty of the State Seed Commisioner to make or have made all field inspections; supervise sealing of bags at the threshing machine and the checking and resealing operations in the warehouse and to prepare a list of growers of certified seed. The minimum inspection fee shall be $3.50 for all fields of less than five acres. An additional fee of 25c will be charged for every acre above five.

MARKETING

From the hulling machines, the beans go to the warehouse where they are recleaned as quickly as possible. No hand picking of the Great Northern variety is necessary as a rule, unless the beans have been discolored thru damp weather, or stained from Nightshade. Seed beans are practically all hand picked.

The commercial beans are consumed mainly in the middle-western and southeastern United States. Practically 35 per cent of the crop is handled by the Southern Idaho Bean Growers Association, a co-operative marketing organization. The rest of the crop is sold to cash buyers or grown under contract for different distributing agencies. Practically all of these agencies put up packs of 100 pounds in bags branded to show the origin of the contents.

BY-PRODUCTS

Bean straw, if bright and fresh, makes very fine feed for cattle and sheep. It is an excellent feed for ewes before lambing and helps to tone them up. From trials made in Michigan (Henry & Morrison, "Feeds and Feeding") bean straw is *worth about* 50 *per cent as much as alfalfa hay for fattening lambs.*

Split and cracked beans make exceptional hog feed if thoroly cooked. They can be used to fatten lambs when fed in conjunction with hay and other feeds. Cull beans, fed to poultry as bean meal, have given as good results in the mash as pea meal, and can take the place of it.