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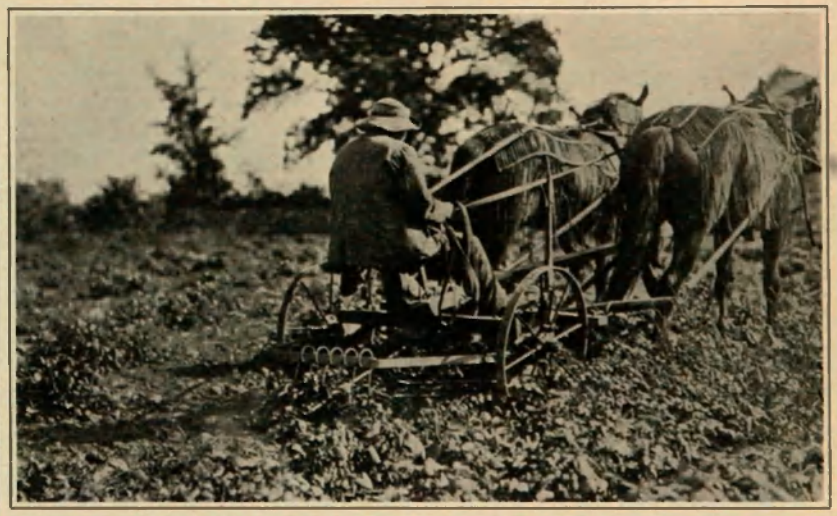
BEANS IN COLORADO AND THEIR DISEASES

By

ALVIN KEZER and WALTER G. SACKETT



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BEANS IN COLORADO

By ALVIN KEZER

SUMMARY

Beans are becoming an increasingly important crop in Colorado.

They are well adapted for both dry farming and irrigated conditions.

The "Plains" section is almost entirely adapted for the growing of beans. They do well also in mountain valleys at altitudes not to exceed 7,000 feet. In many localities 6,000 feet is too high for their proper growth because of the shortness of the season and the tendency of early and late frosts.

Beans are an excellent cash crop, with a well established market and market facilities.

In Colorado the chief market bean is the pinto. Navies, teparies and the Red Mexican or Red Miner are grown to some extent.

Many beans are being grown under contracts with seed houses. These beans represent a number of different varieties produced for seed, because of peculiar advantages for clean seed which the semi-arid climate possesses. The chief danger of seed bean contracts is injury to standard markets by growers attempting to throw rejected seed onto the standard markets.

Beans are a hot weather crop, consequently, they should not be planted until frost danger is past. In most localities this will be approximately June 1st.

Planting should be shallow. Planting may be done preferably with the regular bean planters. Corn planters with bean plates may be used. The ordinary grain drill, stopping the proper number of holes, is feasible where necessity requires.

Beans are a shallow-rooted crop. Consequently, the first cultivation should be the deeper. Later cultivation should be as shallow as the first cultivation, or even shallower. Cultivation should not be over 3 inches.

In irrigated districts, beans should be irrigated so as to keep the beans growing. A very dark green color is generally indicative of a need of water. Beans should not be irrigated later than full bloom on most soils, as later irrigation will delay maturity

and not increase yield materially. Ordinarily one to two irrigations are sufficient.

Harvesting should be done preferably with a bean harvester. This is especially true where any considerable acreages are planted. On very small acreages, they may be harvested by taking the mold board off the plow or by using a shovel.

Beans shatter in thrashing very easily, consequently the bean huller should be used unless the acreages are very small. There are special attachments which may be used on the regular grain separator, provided the separator is run at very low speed. Patches of one to two acres can be thrashed with a flail as cheaply as by machine unless a machine is near. Machines for cleaning are available and should be used, as they increase market value.

Pinto beans, the chief Colorado market sort, will average from 300 to 800 pounds under dry lands and may yield as high as 1,800. The same beans will average from 1,200 to 2,000 pounds under irrigation, and may yield as high as 3,000 pounds or even above.

Market prices may be increased by putting beans up in uniform packages and having them thoroly cleaned.

Bean straw should be carefully saved, as it is a valuable feed. This applies especially to dry lands.

Beans make an excellent rotation crop. Wheat on the dry land after beans will do as well as after clean summer fallow most seasons.

The yield of beans may be increased and their quality improved by wise field selection.

Seed beans should be hand picked to get uniform quality and freedom from disease. Care should be taken not to plant beans which have been frost bitten.

There are many diseases which affect beans. The best methods of controlling these diseases is the picking of clean seed and following a rotation. Beans should not be planted on the same land two years in succession. Two to three years should elapse before beans are again planted on the same land.

INTRODUCTION

The Colorado bean acreage has been steadily growing for the last ten years. The rate of growth in 1915 and 1916 has been as great as in the previous eight years. According to the Bureau of Statistics, United States Department of Agriculture, 38,000 acres were grown in Colorado in 1916, a jump from 21,000 acres in 1915, and 20,000 acres in 1914. The total production of the State in this period has jumped from 18,000,000 pounds to 25,440,000 pounds, in round numbers. In other words, the acreage has increased 81%

and the total production has increased in the same period about 41%. The 1916 yield per acre was low on account of one of the worst drouths in the history of the Colorado Plains. The seasons of 1914 and 1915 were especially favorable, with high average acre yields.

Beans are well adapted for growing in nearly all sections of the plains. Beans are a hot weather crop and as a consequence must be produced in the frost-free period. To successfully produce a bean crop, the season should be at least 95 days in length; 95 to 100 days should be the minimum. A season of this length is seldom found above an average of 6,000 feet in elevation. There are localities where the slopes are favorable and the soils sandy, where the seasons are somewhat longer, permitting the production of beans at altitudes as high as 7,000 feet. If the season is bright and rather warm, some of the early varieties may be matured in as short a season as 60 days. A cloudy season, however, always lenghtens the growing period. Cool, cloudy weather may extend the growing season, especially if rains accompany these weather conditions or if irrigation is given. In such cases the season required for maturity may be as long as 130 days, too long for many sections even 6,000 feet in altitude.

The pinto bean, which formerly went under the name "Mexican", is by far the most important market bean, as it exceeds in acreage and total production all other beans produced. The seed industry beans, which are of numerous varieties, are the only ones which begin to compete in acreage with the pintos. These seed beans are largely produced under contracts with seed houses and consequently do not reach bean markets.

While beans may be successfully grown practically anywhere on the plains, at altitudes below 6,000 feet, they are most abundantly grown in Weld County and Las Animas County. They may be as successfully grown in other places, but development in other regions has not yet been carried to the extent which these two counties have made. The realization of the value of beans as a cash crop, and the ease with which they fit into a rotation by throwing in an annual cultivated crop, will very likely tend to increase their general production.

VARIETIES

The chief market variety is the pinto. The pinto bean was formerly called the Mexican. This name, however, is inappropriate, as there are numerous other Mexican varieties. The name "Mexican" as a consequence did not mean any definite bean. "Pinto" applies to a specific bean.

The pinto bean is about the same shape as the kidney bean, so well known as a garden variety. It is also about the same size as the kidney bean just mentioned. The pinto is buff-colored, is speckled with tan to brown spots and splashes. In many places in the southwest the pinto is called the Mexican tick bean. The name "pinto", however, has become so well established that it should be universally used.

While the pinto is the chief market bean, other beans are grown and frequently do well. The navies are grown and produced to a small extent—both the pea bean and the little navy. For garden purposes considerable quantities of kidney beans and "snaps" are grown. In most of our territory the season is too short for the proper development of limas; consequently, they do not figure in our bean problem to any extent. In parts of Colorado the Red Mexican or Pink Mexican, or Red Miner, is grown. This bean, however, is more extensively grown in New Mexico and Arizona and other points of the Southwest than in Colorado.

PREPARATION OF THE SOIL

Beans will grow on almost any kind of soil, from adobes to light sandy loams. They do best, however, on warm, sandy loams and sandy silts. Preparation of the soil for beans should commence prior to the season in which the beans are grown and should take into consideration proper rotation and manuring. The soil should be prepared by plowing. Wherever fall plowing may be done without danger of serious fall blowing, the soil should be plowed in the fall. In the spring this land should be worked down into a seed bed, making as good a seed bed as would be made for beets or corn. Where spring plowing is done it should be done early.

Beans respond to good preparation. Consequently enough attention should be paid to disking, harrowing and compacting the seed bed. In some sections listing has been attempted as the method of preparing the soil for bean planting. Listing, however, is poor practice, except upon soils which cannot be safely plowed, because of their very strong tendency to blow. Where the land is prepared by listing, there is a tendency to slow up the development of the crop and delay maturity. In addition to these handicaps, beans planted by the listing method are more difficult to harvest; especially if there is damp weather during the harvest there is likely to be much damage to the pods by coming in contact with the soil. The tendency to pick up adobe soil or stones is increased at harvesting time. If listing is done at all, it should

be very shallow so as to make the furrow to be filled about the growing plants as shallow as possible.

It is not always necessary to plow land in preparing a bean seed bed. Where the land was well plowed the year previous and in wheat, a good seed bed may be prepared without plowing, provided the wheat stubble is disked right after the binder to keep down weeds in the fall. The spring preparation may consist of disking when the weeds start, which will destroy the weeds and prevent the formation of a crust, and then disking and harrowing immediately before planting. After a cultivated crop such as corn, which has been well cultivated, a seed bed may often be prepared by disking and harrowing.

On irrigated lands after sugar beets or potatoes, it is not necessary to plow in preparing a bean seed bed. Disking, leveling and harrowing will be sufficient in these circumstances.

PLANTING

Care in Selecting Seed Beans.—The importance of getting good seed beans is sufficient to warrant special care in picking the seed. It is worth while taking a little extra care in Colorado on account of the short seasons. In many localities there is danger of beans being frost bitten in the early fall. Sometimes this light freezing will very materially weaken the germ so that the crop will have very small germinating power, altho the frost may not be sufficient to injure the beans seriously for market purposes. Care should therefore be taken not to use beans for seed which have been frost bitten before full maturity.

Many of the diseases which affect beans leave spots on the beans themselves. One of the most effective remedies in combatting bean diseases is to pick out plants for seed which are not affected by the disease. Accordingly all seed beans should be from plants selected in the field and hand picked. Plants having discolored beans with strange colored spots should be rejected, planting only from those having bright, clean seed.

These statements hold, no matter what variety of beans are planted.

Time to Plant.—Beans are a hot weather crop. Seed is injuriously affected if it is planted in cold soil. Germination will not take place while the soil is cold, and if the soil happens to be wet enough, rotting may take place before the soil warms up sufficiently to permit germination.

Beans will not stand any frost. The very slightest degree of frost is apt to kill them entirely. On account of these reasons, beans should not be planted until the soil is thoroly warmed up.

In most Colorado sections this will be the last week in May or early in June. Successful plantings have been made as late as the first week in July, but the grower is tempting fate too much to make a practice of such planting, as frosts are likely to occur as early as the 25th of August.

While pinto beans and some of the teparies and a few of the Mexican and Indian varieties have been matured in 60 days or less, it normally takes about 90 days to mature a crop even for these short-season beans. In those seasons when frosts hold off until late in the fall, late planting will often make a crop, but frosts do not always hold off until late.

Method of Planting.—If there is any considerable acreage of beans to be put in, a bean planter should be procured, or a corn planter with bean plates. In Colorado beans should always be planted in drills so that the bean planters or corn planter should be so arranged as to drill the seed one in a place. It is possible to make use of a grain drill by stopping up the proper number of holes, in fact, many beans are successfully planted with such an implement. The type of grain drill having a revolving cup feed is adapted for this kind of planting.

Most of our grain drills have 7 or 8 inches between the drill holes. Stopping up three drill holes would therefore plant 28 inches apart, which is about right for irrigated planting. With a 7-inch drill, stopping up five holes, that is, leaving open the first and sixth drill, would plant 42 inches apart, which is about right for dry land. Some dry lands are strong enough to justify planting 36 inches apart. Stopping up four drill holes, leaving the first and fifth open, would plant 35 inches apart, which is about right.

Under irrigated conditions the rows should be about 28 inches apart. On dry lands, they should be from about 3 to 3½ feet apart. Under very dry conditions it is sometimes advisable to plant 7 feet apart and cultivate all of the intervening space. For irrigated conditions the drill should be thick enough to make one plant every 4 to 6 inches. This will require around 30 to 35 pounds per acre of seed for pinto beans. It will require a greater number of pounds for larger beans and a somewhat smaller number of pounds for the small pea beans.

For dry land conditions beans should, under normal conditions, be planted in rows about 3½ feet apart and in drills in the row 10 to 12 inches apart. If dry land conditions are a little severe, or uncertain, the space can be made a little further in the drills, say from 12 to 16 inches. According to the rate of drilling, it would take from 8 to 20 pounds of seed to plant an acre under dry land conditions. For an average planting, probably about 15

pounds per acre will be used. Where the rows are made 7 feet apart, under very severe conditions, the planting should be 6 to 8 inches in the drills.

Of the many beans planted only a few are put in by plowing shallow and dropping the beans in every third or fourth furrow, covering the beans by plowing and then packing and harrowing afterwards to compact the surface soil over the beans. This is not a good practice, but can sometimes be used in very small patches. Where large plantings are made, a bean planter adjusted to plant in exactly the proportion desired, should be used.

CULTIVATION

Beans of all varieties are rather shallow-rooted surface feeders. Consequently all cultivation after the crop starts should be shallow. The most important part of the cultivation should be done in the preparation of a seed bed. Immediate cultivation should commence about the time the rows can be seen in the field. Where the stand is extra good, beans may sometimes be harrowed a time or two if care is taken to do this work when the young vines are perfectly dry. If the soil is a little moist and the vines moist, the young vines will be found to be quite brittle so that harrowing will break off a large number. With the surface of the soil rather dry and the plants dry, the young plants are tough and will stand harrowing.

Some of the weeders on the market are excellent tools to use at this time.

The first cultivation with the regular cultivator should be the deepest. This first cultivation should not be over 3 to 4 inches

Cultivating dry-land pinto beans in El Paso County

deep. Later cultivations should be as deep or slightly shallower than the first cultivation. When the first cultivation is made, the roots have not extended very far into the space between rows. The stirring of the surface layer at that time by the cultivator makes a dry layer on top. If this is maintained the beans will root below the dry layer. Cultivation should be aimed primarily to keep down weeds and prevent the formation of a crust. Usually all cultivation should cease by the time the first pods commence to set. Sometimes the plants have grown enough so that cultivation should cease before this time. Care should be taken never to cultivate when the young bean plants are wet, as they are easily broken at such times, and when so broken are very susceptible to certain bean diseases. Under irrigated conditions cultivation should follow irrigation, as soon as the surface moisture and the plants will permit. The aim should be to prevent the loss of water by cultivation rather than to furnish water by excessive irrigation.

Irrigating Beans.—A study has been made of bean irrigation in eight Colorado counties. This study shows conclusively that it is fully as easy to over-irrigate beans as to under-irrigate them. As an average of all results obtained, two irrigations give higher yields than three or more irrigations. There was some difference as to quality of land; very open gravelly lands would stand more irrigation than sandy loams, loams and clay loams.

In irrigated regions beans should be given water when they show a need for water, namely, when the plants show a very dark green and commence to wilt during hot periods of the day. If the plants are light green and growing vigorously, irrigation may often be delayed unless it is necessary to irrigate to get the water.

Beans in irrigated districts will usually be planted in rows around 24 or 28 inches apart. The first step in irrigation is to use a furrow opener and make furrows between the rows. Water is run down these furrows under proper control, until the soil is moistened laterally and to a depth of at least 2 feet. This figure 2 feet is a relative one. Sometimes there is moisture enough in the subsoil at less than 2 feet from the surface when the surface needs irrigation. In such cases a lighter run of water will suffice. The last irrigation should very seldom be given after the blooming period; just as the plants are coming into bloom is as late as water should be applied in ordinary seasons, and on ordinary soils. Later irrigations delay the maturity of the crop and endanger proper ripening, because of possible frost injury. Such later irrigations do not materially increase the yield of beans.

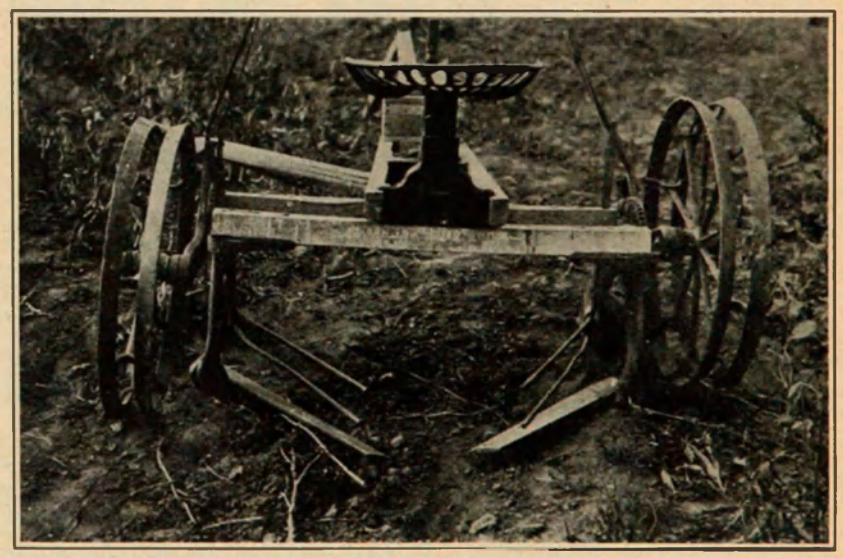
The chief consideration, either on irrigated land or dry land, is good thoro cultivation. Such cultivation should be given as soon after irrigation as possible to get onto the land, and on dry lands such cultivation should be given after rains as soon as it is safe to work the soil. Cultivation should not be given after the vines begin to run, which is about the blooming period, as previously mentioned.

HARVESTING

All harvesting methods can be classified into hand harvesting and machine harvesting.

Hand harvesting is only adapted to small patches. Hand harvesting is usually done by either pulling the vines or cutting them off just under the surface of the ground with a sharp shovel. The vines thus pulled or cut off are shocked by means of pitch forks.

The best machines for harvesting beans are the regular bean harvesters. These machines cut the bean plants off just below the

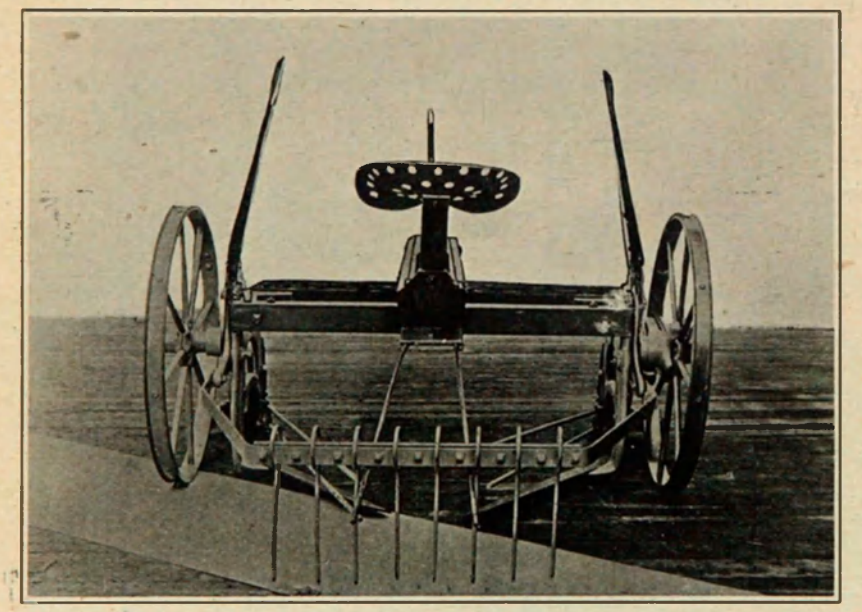


A common type of bean harvester

surface of the ground and by means of fingers push two rows together into one harvested row. The most up-to-date machines have bunching devices on the machine which bunch the cut vines into small, neat bunches. These bunches can be dressed up a little by a man with a pitch fork, for curing. Many of the machines, however, have no bunching device. In this case the bunching must

be done by hand. Men follow the machine with pitch forks putting the cut beans into neat shocks.

While a regular bean harvester is desirable and should always be used if there is any considerable acreage of beans grown, they may be harvested by using a breaking plow of the rod type, or by using a common sod plow with the mold board removed. Such expedients are much better than hand work on patches an acre or more in size, but should only be used on small patches where the size of the patch is not large enough to justify the purchase of a regular harvester.



One of the newer bean harvesters with bunching attachment

Harvesting Period.—Opinions differ as to the proper time of harvesting. But experience and experimental work both show that if the beans are allowed to become completely ripe on the vine, heavy loss occurs from shattering. A good rule to follow is to harvest when the pods are turning yellow but have not yet dried out; at this stage there will usually be about half of the pods yellow ripe and a few still showing some green, providing the beans are ripening uniformly. When cut at this yellow-ripe stage, the beans will ripen up in the shock during the curing process and the loss in weight by drying out is very much less than the

loss in weight thru shattering if the beans are allowed to become too ripe.

Care of Harvested Beans.—The beans thus cut with the harvester should be made into small shocks. The height of the shock will be just as high as possible, and have the shock stay erect. In windy plains sections small round shocks are less likely to be blown away or thrashed out by blowing. In drying weather the shocked beans will cure rapidly. If it is impossible to thrash them when cured, it would be far better to stack them in neat stacks so as to prevent loss by blowing, discoloration from weather conditions and also to leave the land free for cultivation. If the beans have been properly shocked, there will be very little shattering in stacking as the stacking can be done early in the day,

A good field of dry-land pinto beans ready for harvest

or loss may be prevented by covering the hay rack or bean rack with canvas. In building a stack a bottom should be made with straw and the stack should be topped out with straw and weighted. If straw or millet is not at hand to be used for this purpose, a stack cover of canvas or corrugated iron will be advisable if any considerable time is to elapse before thrashing.

The harvesting process, together with summer cultivation, leaves the land in excellent shape for fall planted crops such as wheat, or even for spring planted crops, as plowing is not necessary after the tillage given the beans.

THRASHING

Beans split very easily unless handled with care. Split beans are docked on the market. Consequently, tools should be used which split the minimum of beans. It is for this reason that the regular bean hullers or bean thrashers should be used for thrashing the crop.

There are a number of manufacturers having bean hullers on the market. It is possible by using some of the modern attachments to thrash beans with the regular grain separator. This should not be done unless a bean huller is so expensive, acreage considered, as to make it inadvisable. Where the grain separator is used to thrash beans, special attachments are put in and the cylinder is run at a very slow speed. Usually all the concave teeth with the exception of one row are removed.

Where a grower has only one-half an acre, or one acre, it is sometimes easiest and cheapest to thrash out his beans with a flail. Fifteen to eighteen hundred pounds a day can be thrashed out in this way by a single man.

Very few of the thrashing machines on the market will properly clean beans for the market. Consequently, machines called bean cleaners have been devised to clean up the beans ready for marketing. If any considerable acreage is grown, it would pay to have a bean cleaner to clean the thrashed beans before they are put on the market. Where only small acreages are grown, neighbors might well co-operate in the purchase of a cleaner, as one cleaner would do the work for several small growers.

YIELD

The Colorado pinto is the great market bean for Colorado. As has already been said, it is grown on more acres than all other kinds of beans combined. The average yield of pintos per acre on the dry lands in 1914 and 1915 was close to 800 pounds. In 1916 the average varied from 300 to 600 pounds per acre, with total failures in some neighborhoods. The season of 1916 was one of the driest in the history of the Colorado plains. The average yield of Colorado pintos on irrigated lands in 1914 and 1915 was 1,400 pounds per acre. In 1916 the average pinto yield under irrigation was close to 1,600 pounds per acre. Yields as high as 2,000 pounds per acre have been produced on the dry lands and as high as 3,200 pounds have been produced on irrigated lands. These higher yields are by no means average, but they show the possibilities of the crop when all conditions are made favorable.

A good set of pinto beans; after a light frost

MARKETING

One of the most important problems in the marketing of beans is to have a clean, high-grade, uniform product. Mixed beans, with discolored, broken beans, seriously docks the price. Since the pinto outyields most other beans in practically all the Colorado bean-growing sections, it should constitute the chief market bean.

Machine-cleaned pintos will usually sell on the market within a cent of the price asked for hand-picked navies. The actual net return on pintos will usually be higher than for navies, because the cost of cleaning is not so great and the rejections under good market conditions are a great deal less.

In abnormal years, like 1916, buyers will take almost any kind of a bean, but even in 1916 buyers were paying a premium for uniform lots of clean, well-graded pintos. In some localities pintos are handled in bulk. Where this is true a uniform grade and cleanness should prevail in the bulk delivered. Many bean markets, however, require that the beans be bagged for shipment. Where such is the case, the beans should be thoroly cleaned and graded. Uniform, standard quality should be bagged in bags of uniform size and marking. The marking suggested is "100 Pounds Colorado Pintos". The remaining marking can specify the grower and address when so desired.

Growers will be able to receive much better prices where a uniform product is produced and where the entire neighborhood

is growing one kind of bean. This is due to the fact that the marketing costs are lower under such conditions.

With the exception of one season, Colorado pintos have netted the growers around 4 to 4½ cents for the past eight or ten years. In 1916, prices much higher than this prevailed. But 1916 prices were as abnormally high as 1912 prices were abnormally low. At 4c a pound to the grower, pintos constitute a reliable cash crop which will return good acre net profits to the grower.

The red Mexicans, the spotted Indian beans and teparies do not have a standard market in this section. They are grown extensively in the Southwest. In fact, the pink bean in southern California, Arizona and New Mexico is quite generally grown and is perhaps the most common bean on the market, but for those sections to which Colorado normally ships, namely, the South and East, pintos and navies are the types known. Navy beans may be successfully grown under Colorado conditions, but they require much more hand work and care. Consequently, they are much more expensive to produce. While they bring higher prices on the market, the spread between navies and pintos is usually not over one cent. This spread will be more than obliterated by the increased cost of preparing navies for market. Besides, there will be a very much lower rejection in grading and cleaning from pintos than from navies, so that a greater proportion of the crop will actually reach the market.

Market grades have been established for the pinto beans. These grades have been adopted by the bean buyers' associations. It is quite probable that the Bureau of Markets may standardize grades for this crop. When such is done, it will be much easier for growers to prepare a standard product for the market. A standard product can be marketed to a better advantage than an unstandardized product, because very much less inspection is required to determine the quality of the product offered, where beans are so standardized and graded as to permit them to be sold on grade and sample without the necessity of sampling each individual bag.

Communities could do much in helping out their market problem by growing uniform quality and following market demands as to package and cleaning.

COST OF PRODUCING BEANS

It is impossible to give exact figures which will really represent the cost of producing beans, as so many factors enter into the cost of production on different farms. On dry land it was found that beans could be raised with as little labor as corn. The aver-

age amount of labor, therefore, required to produce an acre, would be equivalent to about 15 man hours per each acre of beans per year, and about 42 horse hours. The labor cost of producing a bean crop on the dry lands will probably run from a minimum of $5 to a maximum of $8 per acre. To this labor cost must be added interest and depreciation on machinery used and interest on the land or rentals.

The cost of producing beans under irrigation will give a labor cost somewhat higher, running from $9 to $15 per acre. Under irrigation, in addition to machinery costs, which will be quite comparable to those on the dry land, there will be added the cost of irrigation, water rentals or ditch up-keep. Land rentals, or interest on land investment will be consequently higher.

It is possible that where a farmer does all his own work, he will be able to produce beans on the dry lands for from $5 to $7 per acre, and under irrigation for from $15 to $30 per acre, depending upon the locality and land conditions and land values. If all labor must be hired, it is quite possible that the efficiency of labor will be lower and the price somewhat higher than normal going wages in dry land and irrigated regions because if all labor is hired, it will usually be wanted at times when everybody is busy and as a consequence more will have to be paid for the labor. This will likely raise these estimated costs somewhat.

For two years, during which studies were made on the dry lands, it was found that the cost of operations for the production of beans varied from a minimum of $2.15 per acre to a maximum of about $6 per acre. The cost of operations included the cost of all horse and man labor and does not include seed costs, interest and depreciation on machinery or land rentals. The differences in cost were due to differences in number of cultivations and the manner of preparing the seed bed. In computing these costs, 15c per hour was allowed for the value of man labor and 10c per hour for horse labor. Where the farmer is doing the work himself, if he allows these costs, he is, of course, paying himself wages at these rates. Labor is occasionally cheaper than these prices and in rush periods is often higher. The figure given was found to be the average paid in dry-land regions for two successive years, the average being the average wages paid for the entire season, and not the average paid during rush periods.

USE OF BEAN STRAW

The bean straw and hulls after the beans have been thrashed out will yield from one-half to three-quarters of a ton per acre on dry lands, and somewhat heavier yields will be received from

irrigated lands. This bean straw is capable of utilization. Especially on the dry lands every bit of bean straw should be saved and fed. Enough experience has already been obtained to indicate that on the dry lands if bean straw is fed with silage that it will return a food value nearly as great as alfalfa. If the bean straw is fed with other dry feeds, it is not as valuable as alfalfa. In fact, it appears to return about one-half the feeding value if fed with dry feeds, and almost as much as alfalfa when fed with succulent feeds. The utilization of bean straw, therefore, constitutes a very material addition to the feed supply under dry land conditions.

BEANS IN ROTATION

Under irrigated conditions, beans furnish an opportunity for a cultivated cash crop, which is their chief value in irrigated rotations. Some types of weed pests can only be cleaned up where a cultivated crop can be introduced. Beans furnish such a crop, which may not only be cultivated, but hoed. On the dry lands, however, beans have a still greater value, because they furnish a cash cultivated crop well adapted for dry lands and capable of returning very good money values, dry-land possibilities considered. It has been found by experience that wheat, after a bean crop which has been well cultivated, will yield as well as after summer tillage or a summer fallow. Since they will usually pay well for growing, beans may be produced on lands which in many cases would be without a crop.

On the dry lands beans have a tendency to build up the soil. If the bean straw is fed to livestock and the manure properly applied to the land, the beans will be a decided, positive asset. If bean growing is a part of the regular farming system, the beans themselves should be grown in rotation. There are many bean diseases which tend to not only reduce the yield of beans, but to reduce their salability. One of the best methods of fighting these diseases is to plant beans in rotation, that is, never plant beans two years in succession upon the same land. At least two or three years should intervene in order that the land may not become inoculated with the diseases which affect the bean crop.

IMPROVEMENT OF PINTO BEANS BY SELECTION

The greater proportion of the planting of pinto beans has been done with little or no seed selection. Sufficient experimental work has been done to show that as much progress may be made from selection with pinto beans as is sometimes done with corn in the corn belt. The bean plants are mostly self-fertilized, thus, if a good strain is once obtained, no further selection within

the strain is necessary, because the strain is a pure line and breeds true. Every pinto bean grower who is making a business of bean production should start a seed patch. The start should be made by selecting plants in the field. In making selection, the following points should be watched for:

1. High individual plant yield
2. Early maturity
3. Uniform ripening of pods on the plant
4. Freedom from disease

To make a seed plat, the seed of each of these selected bean plants should be planted by itself in a row. These rows are really

A desirable type of plant—dry-land pinto beans

comparative tests of the value of the selections. The high-yielding rows which are produced represent the mother plants which it is desirable to keep. All the seed from high-yielding rows having other desirable characteristics should be saved. If one strain

should prove to be very much better than all others, this should be saved for seed and increased to the fullest extent possible. In this way the entire bean acreage will soon be planted from this high-yielding, early-maturing, even-ripening, disease-free strain.

Preliminary work with bean selection shows that it is easily possible to increase the yield 25 per cent by selection alone. To increase the yield this much would pay for all of the extra work of starting a seed patch and testing out in comparative tests the various selections, thus enabling the grower to pick out the highest-yielding strain of his crop from which he may eventually plant his entire crop. It will pay to hand select seed to get seed of uniform marking, uniform size and freedom from disease, even if time and conditions do not permit the better work of the selection of pure, high-yielding strains.

DISEASES OF BEANS

By WALTER G. SACKETT

As mentioned elsewhere, the growing of beans in Colorado for seed purposes is one phase of the industry which has developed at a remarkably rapid rate, considering the length of time that the crop has been raised with this in view. In all probability, one reason for this has been the desire on the part of the seedsmen to obtain seed grown under conditions which normally tend to reduce the percentage of diseased seed. Such conditions obtain to a greater or less extent in both the dry land and the irrigated sections of the State. The absence of moisture in the form of rain, which tends to spread disease over the plants and from plant to plant, together with abundant sunshine are both valuable assets to the localities where beans are being grown.

Another consideration which made Colorado a desirable place for raising seed beans was the fact that until two years ago the disease question was practically negligible. There was plenty of disease-free land, new so far as bean culture was concerned, on which there was good reason to believe that no difficulty would be experienced for years to come in the line of plant diseases. But the inevitable has happened, and in the remarkably short space of two years.

Someone innocently planted diseased seed from which unhealthy plants developed, and from these as a starting point, it has been a relatively simple matter for the infection to spread from vine to vine, plant to soil, and field to field.

Where irrigation is practiced, the irrigating water, flowing as it does thru infected fields, carrying more or less trash and diseased soil with it, cannot be lost sight of as a means of disseminating the various ailments to which the bean is heir.

Our severe and prolonged winds which may assume the form of sand storms, transport quantities of soil, irrespective of whether it is diseased or not, from one locality to another. The mechanical injury to the pods and beans which results from this incessant pounding by the sand grains, not only weakens the plant, but also opens up the way for subsequent infection with germ-laden soil particles.

Some growers have failed to use beans in a rotation and have planted beans after beans on the same land, having lost sight of

the fact that, aside from this being poor farm practice, the dangers from disease are increased very greatly by such a procedure.

Little if any attention has been given either to the planting or the selecting of disease-free seed, with the result that we have built up a big seed business in a phenomenally short time, but a business which is destined to fail, as has been the history elsewhere, unless we can establish a reputation for our seed with respect to quality, purity and freedom from disease.

Now is the time to do this, before our fields become generally infected, and while the prevalence of disease is so slight that it can be controlled for the most part by the means that we have at our disposal.

For the present consideration, we shall confine the discussion of bean diseases to those which have been observed to occur in the State during the last two years, and which, if neglected, may prove a serious menace to the industry.

DESCRIPTION OF DISEASES

Bacteriosis or Bacterial Blight

Without doubt, the greatest damage to our bean crop during 1916 resulted from an attack of the bacterial blight. This is caused by a germ, *Pseudomonas phaseoli*, which enters the plants thru the breathing pores or stomata and thru wounds produced by mechanical injury.

The disease is common upon field, garden and lima beans and attacks leaves, pods, stems and seed. It is very conspicuous upon the pods and leaves and can be recognized most easily, perhaps, upon the former, particularly in the wax varieties. Here we find watery spots ranging in size from tiny specks to areas three-eighths of an inch and more in diamteer. They are usually irregular in outline and roughly circular in shape. On the wax varieties, the spots are translucent or watery, amber-yellow in color and frequently have a rosy-red margin. Their appearance, on the whole, is not unlike an ordinary blister, except that they are neither raised nor sunken. In the more advanced stages, they may be coated over with a thin, pale yellow or amber-colored crust which is composed largely of the bacteria which produce the disease. Ulcers in all stages of development can usually be found on a single pod. (See Fig. I.) When the lesions are numerous, they frequently coalesce, or run together, so that the whole side of the pod presents one continuous canker.

The injury to the leaves is very marked. In the early stages, irregular, watery spots can be found scattered over the surface

Fig. I.—Bean pods affected with Bacteriosis or Bacterial Spot

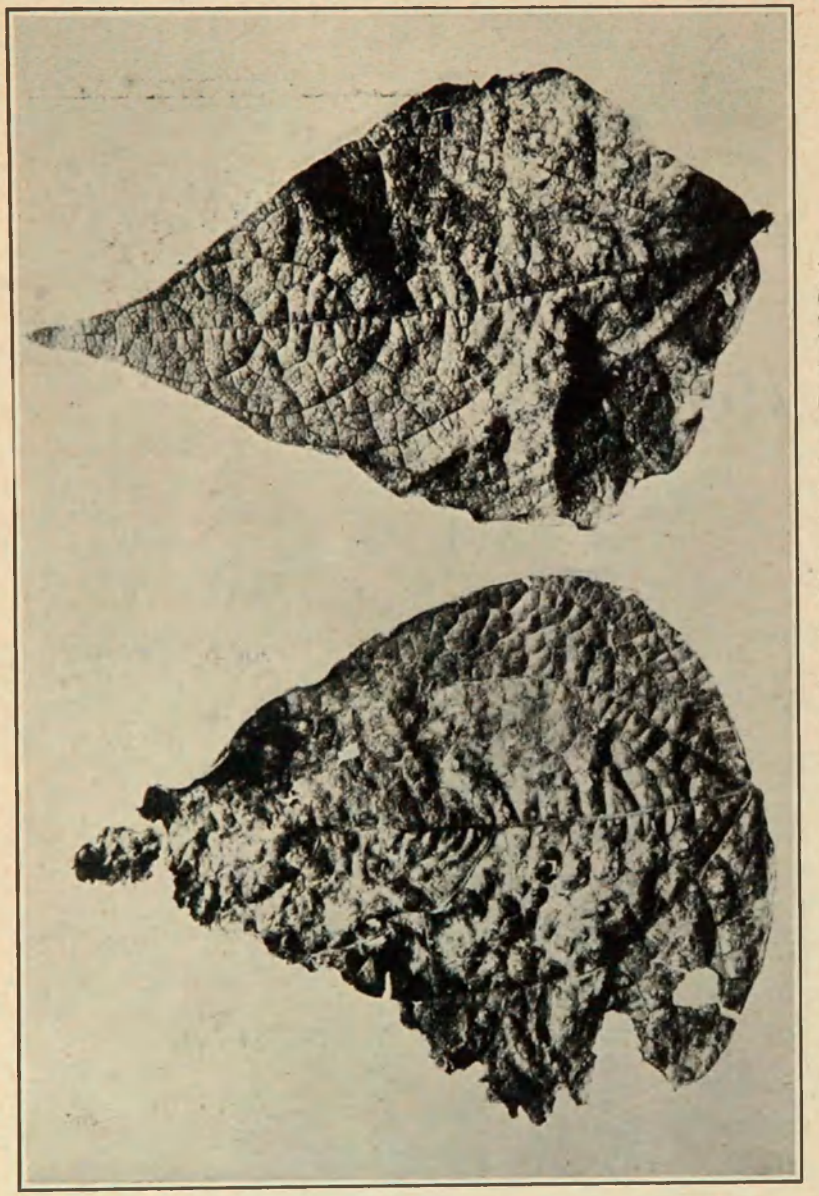


Fig. II.—Bean leaves affected with Bacteriosis or Bacterial Spot

which soon turn yellow and in a short time become frosty-brown in color. If the spots are numerous they will often coalesce and give the dry, brown leaf a peculiar blistered appearance. (See Fig. II.) The tissue in this condition is extremely brittle and is easily torn and broken, which accounts for the ragged condition of blighted leaves. The stems are affected in much the same way as the foliage.

Badly diseased plants lose their leaves early and fail to mature their seed. Spotted pods are unfit for the market as green beans, and seed from them is very apt to be diseased as the infection is communicated to the seed from the pod.

Pod-Spot or Anthracnose

Pod-spot or Anthracnose has been of relatively little importance thus far in Colorado bean fields, but because of its ravages in other localities, it seems advisable to become acquainted with its symptoms in order that it may be recognized should it become serious.

The disease makes its first appearance on the seed-leaves and stems of the seedling plants. It manifests its presence there by brown, discolored, sunken spots or ulcers, indicating rather clearly that the causal fungus, *Colletotrichum lindemuthianum,* has been carried over winter in the seed.

In due course of time, spores, by means of which the disease is spread, are produced in these early spots. Eventually they are blown, or otherwise carried, to the growing stems, leaves and pods, where they soon become established and begin their destruction.

On the leaves we find reddish or blackened areas developing along the large veins on the under surface. The veins may be eaten thru by the fungus and destroyed, while the blade shows numerous cracks or holes with shriveled, blackened margins. Leaves in this condition are practically worthless as food-building organs, and as a result the nutrition of the plant is greatly impaired; either the yield of seed is reduced appreciably or the seed fails to mature.

Previous to the time of blossoming, the attack has been concentrated against the leaves, and by the time the young pods make their appearance the fungus has become well established and is amply supplied with spores. These soon find their way to the young, tender pods where they produce rusty-brown or black sunken spots with reddish or yellowish margins. (See Fig. III.) These vary in size, much as the bacterial spots previously described. The spores of the fungus are produced in the center of the black ulcers and form little pink masses visible to the naked eye.

They are glued together with a mucilaginous material which sticks them securely to the spot. However, as soon as a drop of moisture touches them, the mucilage is dissolved and the spores are set free in the water. At this time any disturbance of the plant is apt to scatter the spores in the flying drop of water, and for this reason

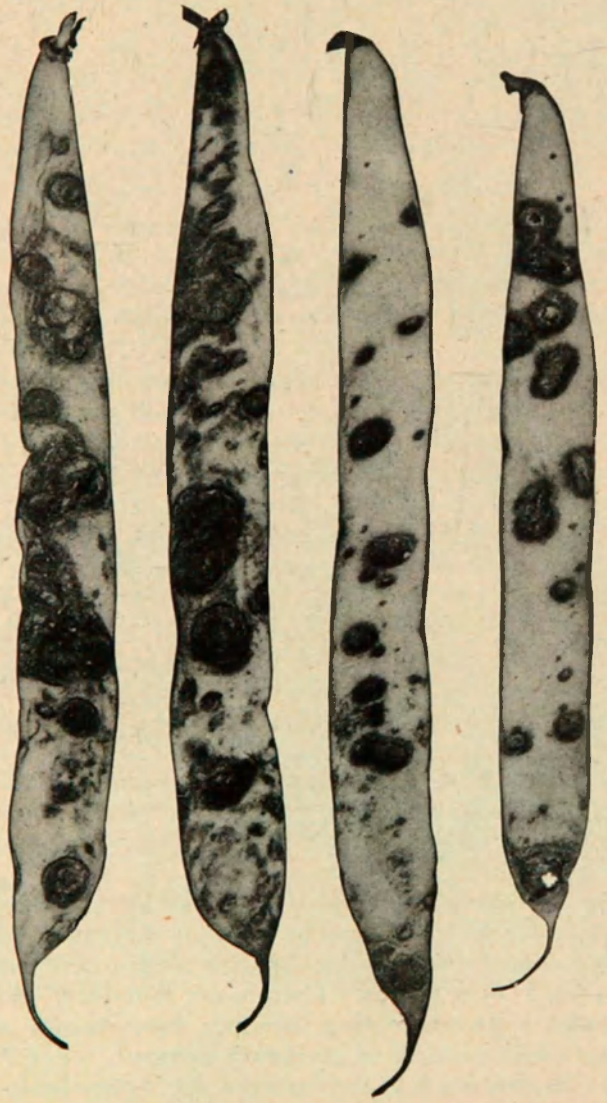


Fig. III.—Bean pods affected with Anthracnose or Pod Spot (After Whetzel. Bulletin 255, Cornell Experiment Station)

beans affected with anthracnose should never be cultivated while the dew is on them or while they are wet from a shower.

From the affected pods, the disease finds its way to the seed where it produces the familiar rusty-red or brown spots. In severe cases, the whole seed may be involved, altho ordinarily only a slight discoloration is produced on one side.

Bean Rust

Bean rust was observed in several fields last year, but it came so late in the season that little if any damage resulted. The causal fungus, *Uromyces appendiculatus,* attacks the leaves, stems and pods. The rust, as the name implies, can be recognized in its summer stage by the small, raised, rusty-brown powdery specks on the under side of the leaf which rub off easily with the fingers as a rusty-brown powder.

In the winter stage, the specks are black in color and occur on both surfaces of the leaf. When found on the upper side, they are usually surrounded by a light border, apparently where the green leaf tissue has been killed. (See Fig. IV.) While the rust is not uncommon, it has rarely been of sufficient economic importance to cause any considerable alarm. Of course, if the attack should come early in the season and be very general, the crop would suffer in proportion as the vitality of the plant was affected. As the disease winters over on the leaves, the destruction of these by burning offers the best means of eradication.

Bean "Streak"

For want of a better name, the term "Streak" is used here to designate what appears to be a new and undescribed disease of beans, which was observed in Colorado for the first time during the summer of 1916. Whether this is in reality something new, or merely a different manifestation of an old trouble, remains to be seen. It attacks stems, leaves and pods, the symptoms on the first two of these being much the same as with the bacterial blight. On the pods there appear peculiar rusty or orange-brown discolorations in the form of irregular splotches, just as if a brown stain had been spattered on them, and had run down in lines or streaks. (See Fig. V.) The side of the pod next to the plant is practically free from the discoloration, while the outer side may be more or less affected over its entire surface. The leaves are destroyed and the plants become defoliated before the crop matures.

It is our purpose to make a study of this disease during the coming summer and to determine, if possible, its cause and control.

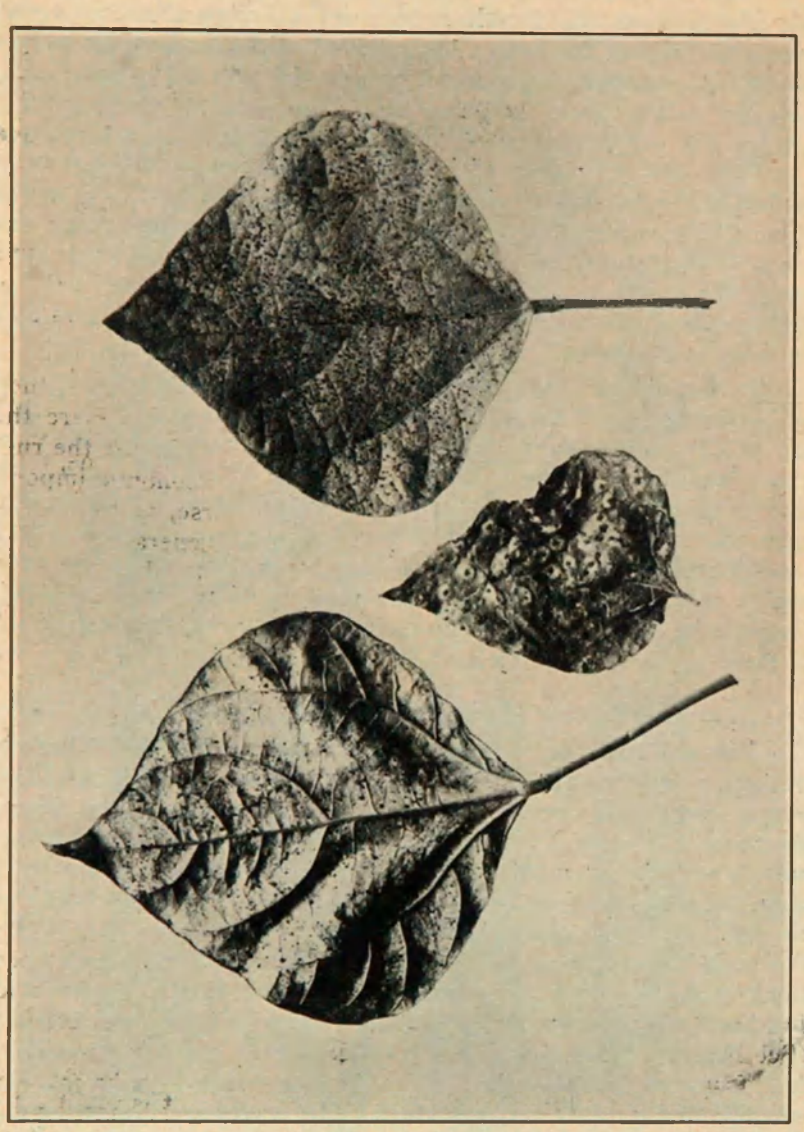


Fig. IV.—Bean leaves affected with Rust

Fig. V.—Bean pods affected with "Streak"

MEASURES OF CONTROL

The measures of control which can be recommended for any one of the diseases described, apply equally well to all. Accordingly, this phase of the question has not been taken up in connection with the individual diseases, but has been reserved for consideration as a whole.

1. Plant beans on the same land not oftener than once in three or four years, particularly if disease has been prevalent. Soils which once become thoroly infected as a result of continuous cropping are seldom safe to use for the same or closely related crops for years to come.

2. Wherever practical, destroy all diseased vines and trash by burning.

3. If the bean straw from diseased vines is to be fed, do not use the manure on a field that is to be planted to beans.

4. As far as possible, avoid cultivating the beans early in the morning when there is dew on them, or when they are wet with rain.

5. Hand pick disease-free pods, or if possible, select disease-free plants, for seed. Use these to plant a seed plat on land which has never raised beans and which is removed some distance from the main crop.

Remember that hand picking of seed as it comes from the flail or thrasher for the purpose of controlling disease is of no value, since it is impossible to detect even a small percentage of diseased seed.

6. Seed treatment for beans is of no practical value since any chemical that would penetrate the seed deeply enough to destroy the disease-producing organism would likewise be apt to kill the seed.

7. Spraying with Bordeaux mixture, 5-4-50 formula, even when done thoroly by competent persons, is at best unsatisfactory, unprofitable and only partially successful. However, if one

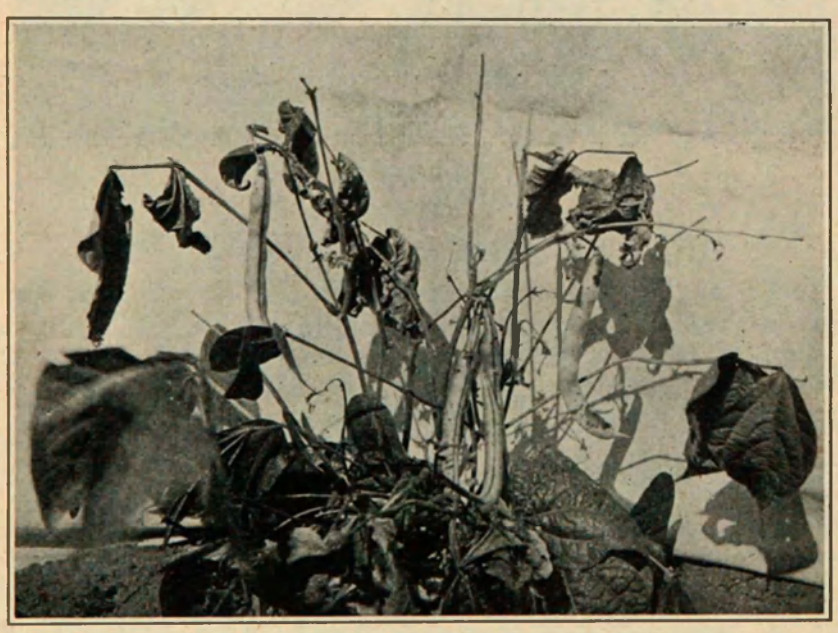


Fig. VI.—Bean plant affected with "Streak". (By courtesy of Dr. H. G. McMillan.)

desires to try this, the first application should be made when the plants have their first set of true leaves, repeated ten days later, and again just after blossoming. Remember that if any real benefit is to be derived, the stems, leaves and pods must be kept covered with the spray material.