The Soy Bean.

Graduating Thesis.

Chas. A. Scott.

Outline.

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Introduction.

Every bushel of grain shipped out of our state carries with it the fertility of our soil that is required to produce it. This vast amount of fertility is never returned.

To illusterate the defects of our present system of agriculture, we ship our grain and hay to Denmark and Sweeden to feed their dairy cows, and the waste products enrich their soil. They in return compete in the world's markets with our dairy products. Thus we pay the freight on our grain and hay from our farms to foreign ports, and then pay the freight on their butter to London. This is only one example of many that might be named.

The remedy is to consume our crops within our own boarders, produce such crops as may be

utilized in the production of beef, pork, milk, and wool. The waste products will then be returned to our fields. The question is now being asked, how long can our present system of farming continue until the depleting effect is noticeable? Queries are now coming from the older cultivated parts of the state, concerning the kind of fertilizer most suitable for their conditions.

Commercial fertilizers are expensive and we cannot afford to use them under our present system of extensive farming. The thing we need is a crop that can be grown in a short rotation that will add fertility to the soil instead of robbing it, we also need a crop rich in protein to supplement our grain crops that are so deficient in this constituent. All our grains and hay, with the exception of alfalfa and

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clover, are deficient in protein, but are abundantly rich in carbohydrates and fats. The dairy cow, the beef steer, the hog, or the sheep, to yield the greatest possible return of milk, flesh, or wool must be fed the elements necessary for their production, and these must be fed in proper proportion.

Feeding a ration containing an excessive amount of either carbohydrates or fats is simply wasting the amount that is in excess. To supply this deficiency of protein in our grains, and to balance up the ration, it is the custom to buy such concentrated feeds as linseed and cottonseed meals.

The agricultural scientists and practical farmers have been devoting their efforts toward securing a crop that would to some extent meet the demands of the farmer and stockbreeder. Now after eleven years of experiments

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with the Early Yellow Soy Bean, it is recommended as a valuable crop worthy of the attention of every Kansas farmer.

History.

The Early Yellow Soy Bean is a native of Japan where it has been grown for hundreds of years, being generally used for human food. It was introduced into the United States in 1890 by Professor Georgeson, at that time Professor of Agriculture at the Kansas State Agricultural College. The Early Yellow Soy bean was the only one of a large number of varieties that were tested, that proved to be valuable under Kansas conditions.

Description.

"The soy bean is a legume and grows an upright branching stalk, from two to three feet high. The branches come out near the

ground and grow upward near the main stem; the number of branches depends upon how closely the plants are grown. The pods when ripe, are short, flat, brown and fuzzy, containing from one to four beans, usually three. The pods grow very close to the stem, from the surface of the ground to the tips of the branches, there being often as many as two-hundred pods on a single plant. The blossoms are not prominent and vary from a pale white to a violet blue. The leaves are large and irregular in shape, borne on long stems, and drop off as the beans ripen. The beans are about as large around as the common navy bean, but not so long, and are a rich yellow color."

Characteristics

The soy bean responds readily to good soil and plenty

of moisture, but will grow well and produce a crop on soil too poor and dry for the ordinary grain crop." One of the commendable features of this crop is its ability to withstand severe drouths. The entire plant is covered with fine fuzzy hair which prevents excessive evaporation of moisture from the surface of the leaves and stems. In regard to their ability to withstand dry weather we will quote from some letters received at the Kansas Station.

Mr. Bolsinger, Effingham, says, "Dry weather does not hurt them, and land that will yield forty bushels of corn per acre will produce twenty bushels of soy beans."

Mr. C. O. McLane, Uniontown, says. "Soy beans will stand more dry weather than any thing else on the farm".

Mr. H. J. Gifford, Haviland, says, "I think soy beans insect proof. also I never saw it hot or dry enough to

cause them to wilt." Many others also expressed their opinion similarly.

The root system of the soy bean is moderately extensive, the tap root is about four or five inches long and throws out numerous side branches which ramify in all directions. When certain bacterial organisms are present in the soil, tubercles are formed on the roots, and the free nitrogen of the air is assimilated by the plant and stored in the tubercles. If the organisms are not present, the soil may be innoculated by earth taken from a field where they are known to exist.

Another commendable feature of the soy bean is the fact that it is free from attack of chinch bugs, the only insect that has attacked it to any great extent is the grasshopper.

Several reports have been received at the Kansas Station, stating the crop had been entirely destroyed by grasshoppers, or that not a plant had been left for a rod or two along the side of the patch.

These reports came from farmers in the western part of the state; growing from one half to an acre of beans. Such small patches are always at a disadvantage, and are more or less neglected in a busy season.

The rabbits are the worst enemies the soy beans have, and especially when in small patches, in large fields it is only along the border of the field that either the grasshoppers or rabbits cause any trouble.

Planting.

The Early Yellow Soy beans do well in a remarkably wide range of season. They may

be planted in May and be harvested in time to get a crop of wheat in, in the fall, or they may be grown after the wheat crop has been harvested.

In the spring they should not be planted until the ground becomes warm and all danger of frost is over. They may be planted earlier but there is no gain as the plants would not be so thrifty. It is a good method to plant them after the corn is in, by this time the ground is well warmed up, thus insuring more prompt germination of the seed. Then by the time the beans are up there is an abundance of food for the grasshoppers and rabbits, and depredations may be avoided.

When planted after a crop of small grain, they should be gotten in just as soon as possible after the crop is removed from the

field.

The beans should be planted in rows thirty six to forty inches apart with the beans four to six inches apart in the row. "The ground should be in good tilth and as free from weeds as possible. Ground well prepared for corn is in good shape for soy beans, level culture is preferable, however some good yields have been obtained by listing and then harrowing until the ditches are nearly filled before planting."

Any drill that will handle such seed and drop it evenly and regularly may be used. A press drill is the most satisfactory implement yet found, the press wheels firms the soil about the bean insuring prompt germination if other conditions are favorable. When using a drill stop up all the holes

except those thru which the seed is to pass. The seed should be covered about two or three inches deep in moist soil

Cultivation.

Cultivation should begin as soon as it is at all necessary. If a dashing rain should come before the beans are thru, and a crust formed the field should be harrowed crosswise to the rows, this would probably destroy some of the plants but not as many as would break their necks trying to come thru, if the harrowing were not given.

The corn cultivator is the most successful implement to use in keeping the weeds down and the soil loosened up. The first cultivation may be deep and close to the plants, after the plants are larger only surface tillage is required, then bull tongues or

eagle claws may be used in place of the larger shovels. Cultivation should continue until the plants shade the ground completely or as long as it is necessary to keep a soil mulch to conserve the moisture. Cultivators with three or four shovels to the beam are preferable to two shovled cultivators. The surface should be left as near level as possible so as not to interfere with harvesting.

Harvesting.

The harvesting of the soy bean is the great objection to the crop. So far the farmers have grown only small patches to see how the crop is suited to their community. Nearly every method imaginable has been tried when it came to harvesting. Some cut the plants off with a hoe, some pulled them by hand, a few cut them with a scythe or corn knife, and piled them up in

cocks either by hand or with pitch forks. Others cut them with a mowing machine, or cultivator with knife attachment, and some even used a hoe to cut them off. All succeeded to a greater or less extent in getting their crop cut, but such methods are slow, wasteful and unsatisfactory at the best. Probably the only one of the above methods that is at all practical is the knife attachment on the cultivator beams.

The most successful and satisfactory implement for harvesting the crop is the regular bean harvester. This machine cuts two rows at a time and throws them together. A man with a team and one of these machines can cut ten acres a day easily. The Bidwell and the LeRoy bean harvesters have been tried on

the College farm and are recommended as doing satisfactory work.

"The crop should be harvested as soon as the pods turn brown and before the beans are fully ripe. If left until the beans are thoroughly ripe the pods will open and there will be considerable loss by shattering." As soon as cut the beans should be raked into windrows and immediately cocked and left to cure in the cocks. "When thoroughly cured and dry they may be threshed with an ordinary grain thresher, using blank concaves and running the machine slow enough to prevent cracking the beans."

Stacking the crop does not always prove satisfactory, they spoil in the stack in periods of continuous damp weather. When stacked, the stacks should be topped out with coarse hay, millet

or sorghum. When threshed the beans should be stored in a dry place in shallow shelves, allowing a free circulation of air. The beans heat very readily and if stored in close bins, or even in closely woven grain sacks and set up side by side they are almost sure to heat sufficiently to destroy the germinating powers of the seed.

Yield.

Like all other crops the yield depends upon the soil in which they grow, and upon the season. The yield as reported by 274 farmers through out the state, ranges from nothing to thirty one bushels per acre, for the crop of 1900. the average being twelve bushels per acre. The season was very unfavorable, it was exceedingly dry up until September first, and then there was about two weeks of continuous rain. This inter-

fered with harvesting in many cases, and when it quit raining the beans were so ripe they shattered badly. Those that had been harvested early were seriously injured by wet, either in the shock or in the stack.

"The College farm is upland the soil is thin and light, in 1898 the crop of thirty five acres of soy beans averaged thirteen bushels per acre. In 1899 seventy acres averaged fifteen and one half bushels per acre. In 1900 ninty five acres averaged five and one half bushels per acre. From this it is safe to conclude that had it been a more favorable year the average yield of the state would have been considerable higher.

Feeding Value.

As previously stated the soy bean is a valuable feed because it contains a large per

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cent of protein. The following table shows the digestible nutrients of the soy bean and some of our common feeds.

Feeds	Digestible nutrients in 100 pounds of feed		
	Protein	Carbohydrates	Fats
Soy beans	29.6	22.3	14.4
Flax seed	20.6	17.1	29.
Linseed meal old process	28.8	32.8	7.1
Bran	12.3	37.1	2.6
Oats	9.3	48.3	4.2
Corn	7.8	66.7	4.3

The above table of analyses shows soy beans to be equal in feeding value in protein to 2.4 times their weight of bran, 3.18 times their weight of oats, and 3.79 times their weight of corn. In the production of protein a crop of twelve bushels of beans per acre is of equal feeding value to 1728 pounds of bran, or seventy

one bushels of oats, or fifty four and one half bushels of corn.

Experiments in feeding soy beans to hogs at the Kansas Station shows that the above relative value is not over drawn. The records show that when the ration fed the hogs consisted of one fifth soy beans and four fifths corn or kafir corn, the saving of feed required for the production of one hundred pounds of pork ranged from thirteen to thirty seven percent, the amount varying in the different experiments.

Soy beans have been used in place of linseed meal in the ration fed the dairy cows and were found to be equally as good in every respect. They make an excellent combination with kafir corn, as they counteract the tendancy to constipation and the hard texture of the butter. They keep the animals body in a loose

laxative condition. As a food for young stock they are among the very best, and all animals are very fond of them as will be seen by a glance at the reports of some of the farmers who have grown them.

J. M. Caldwell, Glenloch, says, "Cut with a mower. Heavy rains, and crop was abandoned as it lay in the field. Cattle finally turned in, and after getting a taste of the beans ate them down until the field was bare as a road, leaving sorghum, flax straw &c etc."

J. M. Caldwell, Garnett, says "Cattle, hogs, turkeys and other things foraged on them for six months, then threshed and secured nine bushels per acre."

Frank Hunn, Arrington, says "They are the best feed for young pigs I ever saw."

William Matthias, Huron, says "Yield sixteen bushels per acre. Pigs and poultry got a taste of the ripe beans, and made desperate raids on the field."

R. C. Johnson, Cottonwood Falls, says, "I estimate the yield at fifteen bushels per acre. Good thing. Have tried feeding to cows and hogs, and am satisfied they are worth five times as much as corn, when mixed with other feeds at the ratio of one to five, and are of immense value as a preventive of disease".

Many more similar testimonies might be added if it were necessary.

Soy beans cannot be fed alone as they are entirely too concentrated, but they supplement our common feeds and supply the deficiency in protein. They should constitute about one fifth the ration.

Soy beans can be fed

in almost any form. They can be handled easier and the quantity more easily regulated when threshed. They may be fed either whole or ground, but should be mixed with the other grains constituting the ration. The straw though very coarse is readily eaten by stock. Soy beans are also grown for a forage crop and are cut for hay before they reach maturity. In this condition they make an excellent feed, but there are other crops more suitable for this purpose, so we will not recommend their use in this respect, except when they can be grown as a cover crop, after a crop of small grain has been taken off.

As a Rotation Crop.

A very commendable feature of the soy bean is that it fits in nicely in a short rotation,

and when the crop is removed the ground is left in fine physical and chemical condition. The Soy bean possesses the power of assimilating the nitrogen of the air and stores large amounts in the tubercles upon its roots, thus leaving the soil richer in available plant food. The Soy bean makes it possible to have an excellent three year rotation in the wheat growing section of our state. The beans leave the soil in fine condition for wheat, the wheat may be followed by another crop of soy beans, and the next year by kafir corn.

Mr Rogler of Mattfield Green, reports an increase of five bushels per acre of wheat following soy beans, over that grown in an adjoining field where beans had not been grown. "On the College farm an increase in yield of all crops following the beans has been quite noticible."

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In section of the state where it is difficult to get a stand of alfalfa, there is nothing that will leave the soil in as good a condition for nourishing the young tender alfalfa plant, as the soy bean. The alfalfa can be sown in the fall after the beans have been harvested, the decaying bean roots and nitrogen containing nodules furnish an abundance of prepared nitrogenous food for the young alfalfa plants.

Summary.

In reviewing the reports of two hundred and ninty two farmers of this state, that raised soy beans in 1900 we can only conclude that soy beans are remarkably well adapted to the climatic conditions of Kansas, and to the needs of the Kansas farmers and stock raisers. The draw backs to this crop, are, the

ravages of the grasshoppers and rabbits, and the difficulty experienced in harvesting the crop. A few persons report too low a yield to be profitable.

None of these objections are such that cannot be overcome. The remedy for the first and second is plant larger fields so as to have enough for the grasshoppers and rabbits and then have enough left to pay for raising the crop. or else war must be waged against these enemies with relentless vigor.

The difficulty of harvesting is a solved question, plant enough beans to warrant the expense of purchasing a bean harvester.

The yield will increase as we understand better the nature of the plant, and adapt our system of farming to its requirements. So far all the experiments with soy

beans have been to determine the adaptability of the bean to our conditions, and determining its feeding value. The possibilities of increasing the yield by seed selection are very great, and it will require only time and perseverance to accomplish a marked improvement.

The fact that it withstands the drouth and is free from the attack of chinch bugs makes it a valuable crop for this state.

By growing soy beans the farmers can save the expense of buying the costly concentrated feeds and at the same time enrich the soil in which the plant grows.

All kinds of stock relish the grain and hay. The beans are suitable feed for the dairy cow, the fattening steer, the pig or the fattening hog, the sheep or the

goat, and if for no other reason the Kansas farmer should raise soy beans to increase the yield of the crops following.