A L F A L F A F O R T H E K A N S A S F A R M E R .

B Y

W A L L A C E N . B I R C H .

ALFALFA FOR THE KANSAS FARMER.

The Waste of Soil Fertility.

When we see the vast amount of wheat and corn which is annually shipped out of our state we are forced to exclaim, "How long can this continue?" For the last ten years Kansas has produced an average annual crop of 149,127,402 bushels of corn and 47,451,487 bushels of wheat. Of this immense product only a comparatively small portion is fed or consumed within the borders of the state. The large part is shipped each year into other states and to foreign countries. What does this mean? It means that if we do not stop farming on the robbery plan we will soon be where the farmers of Eastern United States are who have either abandoned their farms or are compelled to spend vast sums for fertilizers each year in order to secure paying crops. The little state of Maryland alone spends over six millions of dollars annually for commercial fertilizers. Kansas farmers have not been concerned about maintaining the fertility of the land. They crop the land continuously, selling the grain and burning the straw, stubble and stalks in order to get them out of the way. This is simply robbing the soil of its fertility and the time is sure to come when the Kansas farmer will realize that such robbery never pays in the long run.

Let us notice for a moment the extent to which the farmer is robbing his land. Table I gives the total amount of the three main elements of plant-food, Nitrogen, Phosphoric Acid and Potash contained in one acre of average land, in the first eight inches, the second eight inches, and the first sixteen inches from the surface.

Table I - Plant food in an acre.

Depth of sample	Number of samples analized.	Nitrogen.	Phosphoric acid (P_2O_5)	Potash (K_2O)
		pounds	pounds	pounds
1st 8 inches of soil.	34	3217	3936	17,597
2nd 8 inches of soil.	10	4069	1816	6,843
1st 16 inches of soil.))))	34 & 10	7286	5752	24,440

The above figures show the total amount of these ingredients contained in the soil, but they do not make any allowance for the fact that a large part of this fertility is not in a condition to be available as plant-food.

Table II gives the amounts of these elements in an average crop of some of our principle cereals.

Table II - Plant-food removed from an acre by an average crop.

Crop.	Yield per acre. Grain	Straw or stalks.	Nitrogen	Phosphoric acid (P_2O_5)	Potash (K_2O)
	bushels	pounds	pounds	pounds	pounds
Corn	30	2200	56	18	40
Wheat	15	2300	35	9	15
Oats	45	2300	44	16	37
Barley	40	2200	54	21	49

Table III shows the number of years necessary to totally exhaust the supply of these three elements in the first sixteen inches of soil, by raising average crops of corn, wheat, oats or barley.

Table III.

Showing how long soil will last.

Crop	Yield per acre.		Years to exhaust		
	Grain	Straw or stalks.	nitrogen	phosphoric acid	potash
	bushels	pounds			
Corn	30	2200	130	320	600
Wheat	15	2300	200	640	1630
Oats	45	2300	165	360	660
Barley	40	2200	135	275	500

An examination of Table III shows that if the total amount of nitrogen in the first sixteen inches of soil was available as plant-food for corn it would take only 130 years to exhaust the soil by raising corn, selling the grain and burning the stalks as many farmers do. But these are theoretical figures; expereince shows that in a much shorter time, by continuously cropping with one crop, the land becomes unproductive. A large part of the nitrogen is wasted by ordinary cropping methods, a large part is unavailable as plant-food and long before the supply of available nitrogen is exhausted the crops will be too small to yield a profit. Land with a low percentage of nitrogen and humus will not produce a profitable crop without the addition of fertilizers and on the average soil, continuous cropping with wheat or corn for twenty years will usually reduce the nitrogen supply to the point of unprofitable farming. Long before the crops become wholly unprofitable from lack of nitrogen the profit can be increased by its addition and most of us will live to see the day when it will be nec-

essary to add nitrogen to make any profit. Even if we do not expect to reap the results of our careless farming, we should take pride enough in the future of our State, and interest enough in our descendants to leave the soil in as good condition as possible, especially when we can do it with profit to ourselves.

It is only a matter of short a time until our crops will be reduced because our land is wearing out. Even now the bad effects of our one crop system of farming can be noticed in the older portions of the State. Yet, we continue this wholesale robbery of the land, when we could do much to keep up the soil fertility with no loss of profits and more often the profits will be increased by proper, scientific methods of farming.

In the first place we should return the straw and stalks to the land, either directly or as manure from the animals to which the crops are fed. Many farmers in the wheat belt, if they do not burn the straw, feed it to animals or use it as bedding and then allow the manure to lay year after year in open yards where it wastes and does no good. Putting the manure upon the land would not only add plant-food, but by increasing the humus, the soil texture would be improved, thus giving greater water capacity, better tilth, a more favorable environment for the plant roots, and hence larger and more valuable crops. For actual plant-food which would be returned in this way, we have but to consult Table IV, which explains itself.

Table IV.

Crop	Yield per acre. Grain	Stalks or straw.	Nitrogen Total	Straw or stalks.	Phosphoric acid Total	Straw or stalks.	Potash Total	Straw or stalks.
	bushels	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Corn	30	2200	56	22.88	18	6.38	40	30.8
Wheat	15	2300	35	13.57	9	2.75	15	11.7
Oats	45	2300	44	14.26	16	4.60	37	28.5
Barley	40	2200	54	25.15	21	5.76	49	40.1

From Table IV it will be observed that of the 56 pounds of nitrogen contained in an average crop of corn, nearly 23 pounds are in the stalks, hence could easily be returned to the land. This means that the drain of nitrogen from the soil which in raising corn would be less than two-thirds of what it is now if the farmer would take care of the stalks. The same result would be obtained by returning to the land, the straw of wheat, oats and barley. We find also that returning the stalks and straw would reduce the drain of phosphoric acid in about the same proportions as it would that of nitrogen, and that three-fifths to four-fifths of the potash would be returned by the proposed method.

But the farmer could with profit do much more to maintain the fertility of his land than merely to return the straw ans stalks to the land. He is not forced to raise the grains and ship them out of the State and so get nothing but straw and stalks to return to his land. Wheat is usually too expensive to feed, but there is nothing to prevent our feeding the other grains and returning the manure to the land, neither is there anything to prevent our raising other crops besides wheat. Of course some wheat should be grown, but no farmer should

risk his income year after year in any one crop. There are several good reasons for this. In the first place, if that crop fails one season he may be obliged to go in debt for living expenses, until another crop is grown. Again the farmer can find profitable employment for a greater portion of each year if he raises a diversity of crops. By growing several crops or by mixed husbandry, help may be profitably employed the whole year, thus doing away largely with the problem of getting harvest hands. Finally the land will not produce the same crop year after year without letting the yield decrease materially, thus decreasing the profits as well as the fertility of the soil. Most of the land devoted almost entirely to wheat growing would raise, with an equal amount of profit, corn, oats, barley, Kafir-corn, alfalfa and grasses. Many of these grasses could be fed to cattle, horses, sheep, and swine and shipped out of the State as livestock, beef, pork, mutton, milk, butter, or cheese. The farmer would find profitable employment in caring for the stock in winter when the wheat farmer is doing nothing and living, often by drawing on next year's crop which may never materialize. Also the stock farmer has a large amount of manure to put on his land, while the wheat farmer has only the straw and he usually burns that.

A great Kansas crop, alfalfa, has done more for the Kansas farmer's land than any crop except clover, and it will do more for it than clover if it is given the opportunity. It will surpass clover for two reasons; one is, that it yields more and better feed, and the other is that it will grow profitably on a greater variety of soils and in a greater diversity of climates than will clover.

Professor H. M. Cottrell, formerly Agriculturist at the Kansas

Experiment Station, says that he believes that fully 90 per cent of the tillable land of Kansas is adapted to the growing of alfalfa, and that there are very few farms in the State that do not have at least a small patch that will grow it profitably. It grows well on light sandy soil, but much better on heavy soils. It thrives best on the bottoms where the subsoil, while not sandy or gravelly, is porous, and permanent water is from fifteen to thirty feet below the surface. On real light sandy soils, alfalfa is usually short lived, espeaially if used for hog pasture. If the soil is very light it is often difficult to secure a stand on account of the drifting of the soil which destroys the young plants before they become established.

Owing to the difficulty of getting the seed-bed properly prepared, failures to secure a good stand are rather common, but perseverence, and a well prepared seed-bed will give success, and once a good stand is secured, heavy crops may be expected for many years.

Land that is subject to overflow should not be planted to alfalfa as it is apt to be destroyed if overflowed for more than forty-eight hours, while less time than that will often injure it, especially on poorly drained land.

On the farm at the Kansas State Agricultural College, alfalfa makes an annual average yield of over three tons of cured hay per acre, on high upland where the subsoil is a stiff hard clay and permanent water is one hundred and eighty feet below the surface.

Crops to grow previous to seeding to alfalfa.- Alfalfa may be seeded after almost any crop if care is taken to have the land free from weeds and the seed-bed is well prepared. However, the best crops to raise on land that is intended for alfalfa are the legumes, clovers, Canada field peas, cowpeas and soy beans. These crops will increase

the supply of available nitrogen so that there will be plenty for the young alfalfa plants until they are old enough to get their supply of nitrogen from the air, by means of the becteria which develop in the tubercles on the roots of the plants. The cowpeas and soy beans require cultivation which is an advantage if the crop is weedy. The Canada field peas and soy beans are off the ground early enough for fall seeding. Clover is an especially valuable crop on lands with a "hard-pan" subsoil, as it leaves the subsoil open and porous to a considerable depth, which is the best condition for the development of the alfalfa roots. By the time these have reached the hard subsoil below the depth to which the clover roots penetrated, the alfalfa plants are well enough established to continue to grow and send roots down deeper. Sometimes, especially on such lands, it is necessary to grow alfalfa a year or two and then plow it up and re-seed before a permanent stand can be secured. There are two reasons for this: A hard subsoil is more or less broken up by the roots of the first crop, giving more favorable soil conditions for the growth of the plants of the second sowing, again, the plants of the first seeding may not thrive because of the lack of the alfalfa bacteria. In new land the alfalfa bacteria are often scarce and not well distributed. The first seeding will allow them to multiply in sufficient numbers to inocculate the whole field. If, when the first seeding becomes unproductive, it be plowed up and a new seeding made on a well prepared seed-bed, a permanent stand is often the result. The stirring distributes the bacteria which have grown on the plants of the first seeding, so that the plants of the second seeding may be well supplied. It is usually advisable to grow some cultivated crop between the two seedings, as the cultivation distributes the bacteria more evenly, and the yield of the cultivated crop

on such land is sure to be large.

For spring seeding, land that has grown corn or Kafir-corn the previous season is usually satisfactory, though some report difficulty in securing a stand after Kafir-corn. The same may be said of sorghum. Probably the reason for this is that the supply of soil moisture is deficient. Kafir-corn and sorghum exhaust the supply of moisture to a greater extent than most other crops. Again, unless care is taken to prevent the evaporation of moisture during the preparation of the seed-bed there is danger of failure, from lack of moisture. If a good surface mulch is preserved from early spring until seeding time, a good catch may usually be secured. Alfalfa should not be seeded in the spring on land which has grown millet the year before, unless the millet was cut before any of the seeds were ripe. If any of the millet seeds had ripened, there will be enough of them shatter off to seed the ground, and volunteer millet is almost sure to injure if not destroy the alfalfa.

For fall seeding wheat and oats are excellent crops to grow previous to seeding to alfalfa unless the supply of nitrogen is deficient, when Canada peas or soy beans should be grown. If legume crops cannot be grown, similar results may be obtained by the use of stable manure. This should be applied to the land for the crop grown previous to the seeding to alfalfa, so that it will have time to decompose before the alfalfa is planted.

Preparation of the seed-bed.- Since alfalfa is adapted to a wide range of soils and climates, the method of preparing the soil must vary widely. Preparation that would bring success in one soil or climate would insure a failure in another.

If the subsoil is impervious to water it should be broken as deeply as possible. A subsoil plow run in the bottom of a lister furrow is an excellent method. If this can be done in the late fall and the furrow left open through the winter, the action of the frost will aid materially in loosening the subsoil, especially in the ridges where it will alternately freeze and thaw. Early in the spring, level the ridges down, let the soil have a little time to settle, harrowing or disking every ten days until time to seed. The harrowing will prevent the evaporation of much moisture, beside killing many weeds. A new crop of weeds will start up after each harrowing, only to be killed by the next. The land should be cultivated until it is free from weeds, or there is little chance of success with alfalfa. Alfalfa, when young is one of the tenderest of farm plants and weeds are almost sure to destroy it.

Where the subsoil is porous, late fall or early spring plowing followed in the spring by surface sultivation, each ten days from the time frost comes out till time to seed will usually give good results. If it is desired to sow in the fall the land should be plowed as soon as possible after the crop os removed, if plowing is necessary. Where plowing is unnecessary the disk harrow should be used, and either should be followed with the harrow each ten days until time to seed. The surface sultivation will keep the weeds down, and prevent the evaporation of the moisture which is usually so rapid from grain stubble fields.

Where it is necessary to sow soon after plowing, the subsurface packer should be used to firm the land. If the seed is sown on freshly-plowed unpacked land it is almost sure to fail unless the supply of rain is very abundant. If the weather is dry after seeding the fresh-

ly-stirred earth acts as a mulch and prevents the moisture from rising above the unstirred earth. Packing either with the packer or by rains restores the capillarity between the soil that was stirred by the plow and that beneath, so that the moisture will rise nearly to the surface where the roots of the young plants can reach it. On light sandy soil where the subsoil is porous, plowing is seldom necessary, in fact it is often a damage. In Kiowa County good results are obtained by allowing the land to lay a year or more without plowing. The crop of oats or wheat is taken off and during the fall and winter the volunteer grain is pastured heavily. In the spring the trash is burned and the land seeded with very little preparation. Often this method gives excellent results. As a rule it pays to thoroughly prepare the seed-bed, for the success of securing a stand is largely dependent upon a favorable seed-bed. Alfalfa seed is too expensive to be wasted on a carelessly prepared seed-bed.

Seeding.- Alfalfa should be seeded in early spring or early fall. Where the proper conditions of soil and soil moisture can be secured between August 15 and September 15, fall seeding is to be preferred. One reason is that the land does not lie idle so long as is necessary in spring seeding. Alfalfa sown in the spring usually produces no crop the first year, while alfalfa sown in the fall after the land has produced wheat, oats, Canada field peas, or soy beans will yield well the next year, in fact almost as well as if it had been sown the previous spring.

Weeds are less apt to be troublesome in the fall. The alfalfa must be sown early enough to make a vigorous growth before winter or it will winter kill. Alfalfa plants while very young are too tender to live over winter. Weeds are less apt to be troublesome in the fall,

and the following spring the alfalfa begins growth before most of the weeds, and is large enough to keep possession of the ground when the weeds are ready to start. When the alfalfa is sown in the spring it has only an even chance with the weeds. If crab grass is in the field it is almost certain to kill spring-sown alfalfa to such an extent that it makes an unprofitable stand and must be plowed up. In the eastern part of the State it is usually easy to obtain proper conditions for fall seeding, and generally speaking it is more satisfactory to sow in the fall. In the western part of the State, however, it is usually too dry for fall seeding, and spring seeding is the rule.

As to the amount of seed to use, successful alfalfa growers differ widely. Some use only ten to fifteen pounds, while others use as much as thirty pounds per acre. Where everything is favorable, the lesser amount is sufficient, if it can be evenly distributed, but under ordinary conditions it is best to use plenty of seed. If too little seed is used, labor and seed are both wasted, for a poor stand which must be plowed up is the result.

Broadcast seeding is a success where air and soil are moist, but if there is much wind the soil will drift and the young plants will be destroyed before they are deeply rooted.

Professor Cottrell in his bulletin "Growing Alfalfa in Kansas", recommends twenty pounds per acre, sown with a press drill, the seed mixed with an equal bulk of coarse corn-chop, bran or fine saw dust and drilled both ways, one-half of the seed being sown at each seeding. With the drill there is more danger of getting the seed in too deep than too shallow, especially if a disk drill is used. A general rule for planting is to plant at a depth equal to twelve times the

diameter of the seed, and with a seed so small as that of alfalfa, there is little danger of sowing too shallow provided the seed is well covered.

Cultivation.- Disking is the principle form of cultivation required, and many an alfalfa field grows well and yeilds good crops without disking. The disking is advisable though, especially in the drier parts of the State. Alfalfa over two years old should be disked thoroughly early each spring, and it may sometimes be disked with advantage immedialtely after each crop of hay is removed. The disks should be set rather straight and weighted quite heavily. This treatment will provide an earth mulch which will serve to prevent evaporation of soil moisture which rapidly takes place on a new mown field. The splitting of the crowns of the plants by the disk, causes the development of more buds, so that each plant produces more stalks.

First cuttings.- When the alfalfa has become well established, frequent cutting appears to invigorate the plants, While the plants are small the field should be mowed often enough to keep the weeds from getting above the alfalfa. Do not allow the weeds to get so large that they will require raking off to avoid smoothering the alfalfa. If weeds are not troublesome, the alfalfa should be mowed at least twice during the first season, but it should not be clipped too short when the plants are young and tender as the tendency will be to weaken and perhaps destroy the more feeble plants. Old fields of alfalfa shouls always be cut early in order to keep up the vigor of the plants. The later crops will be larger if the first ones are taken early. The bad effects of late cutting are especially noticable on the second crop if the first is allowed to stand too long. The second grows slowly and makes an inferior crop.

Protection from enemies.- As cultivation includes protection from all enemies, the gopher and prairie dog may be mentioned here. Poison is the only means of combatting them. The gophers are fond of sweet potatoes, apples or raisins and eat them greedily, even when they contain strychnine. A little sweetening with molasses of sugar will increase their apetite for poisoned fruits. It is a comparatively easy matter to find their runways by pushing a wagon rod into the soil around the fresh mounds. After the runways is located, open a hole to it large enough to admit a poisoned bait. This is easily done with a pointed stick. Then drop the bait into the hole and the work is done. The gopher will soon come to close up the opening and while he is there will eat the poison. "Perseverence is the price of success". here. A few fresh mounds show that there are a few live gophers and that means that there will soon be more if they are not at once destroyed.

Wheat poisoned with strychnine and scattered through prairie-dog town in early spring or late fall is an excellent means of preventing ravages by these little animals.

Crab grass is one of the worst enemies of alfalfa. Land that is badly infested with crab grass should not be seeded to alfalfa as there is much danger of the crab grass killing the alfalfa before the latter is old enough to live through any treatment that will destroy the crab grass. If there is only a little crab grass in the soil, and the alfalfa is seeded in the fall, the chances of success are good. The alfalfa gets the start of the weeds, and by the time the crab grass appears the alfalfa is able to withstand disking. Thorough disking followed by the harrow early in the spring and immediately after each crop is taken off, will, often keep the crab grass in check.

Dodder is an enemy of alfalfa, but seldom does much damage in this State. This is a parasitic plant which entwines itself around the alfalfa plant and draws its nourishment from the plant by means of suckers sent into the stems. The treatment is to cut the spots before the dodder seeds and burn the plants on the spot. If the ground is moist the alfalfa will not be injured by the treatment. Care should be taken in buying alfalfa seed, to get seed which contains no dodder seed.

Pasturing, Harvesting and Storing.- Pasturing is undoubtably the easiest method of harvesting, but it is not always the most economical. Even when the alfalfa is pastured it should be mowed regularly, otherwise many plants will be allowed to bloom and produce seed, which is a great tax upon the vitality of the plant. As a hog and colt pasture alfalfa is a success. Alfalfa under two years old should not be pastured with any kind of stock. Hogs should not be allowed on the field in winter or at any time when the growth is short, for if feed is scarce above ground, they do not hesitate to dig the plants out by the roots, thus injuring the stand.

As a cattle and sheep pasture alfalfa is not entirely a success, owing to the danger from bloat. Often the animals die, the losses perhaps overbalance any profits that may come from the pasturing. Many farmers pasture it with success but the risk is always great. The writer has seen cows pastured on it for months with no apparent injury, and then suddenly bloat almost to the point of death. Early cutting is desirable in order to secure a good quality of hay, as well as for the preservation of the vigor of the plants. When the first crop is cut early the later crops yield well. At the Kansas Station a strip was cut through the field at the first cutting when about 1/10

of the plants were in bloom, and another when the plants were past full bloom. The early cut strip made three good crops and a small fourth cutting, while the late cut plot produced only two cuttings, both of smaller yields than the corresponding crops from the early cut plot.. The reason for the small yields of the first crop was that the leaves largely dropped off leaving only the stems for hay. The light growth of the second crop seemed to be due to a lack of vigor in the plants.

Table V shows the protein content of alfalfa cut at different stages, data taken from analyses made at the Kansas and Colorado Stations.

Table V - Protein in Alfalfa.

Stage of cutting.	Protein.	
	Kansas	Colorado.
	Per cent	Per cent.
Coming in bloom.	———	18.5
One-tenth in bloom.	18.5	———
Half in bloom.	17.2	14.6
In full bloom.	14.4	12.9

Table VI shows the results of five years experiments at the Utah Station in cutting alfalfa st different stages and using the crop for the production of beef. The average production per year per acre is given in the table.

Table VI - Beef Production by Alfalfa hay.

Stage of cutting.	Hay per acre.	Beef produced per acre.
	tons.	Pounds.
In first bloom.	5.35	706
In full bloom.	4.90	562
Half Blooms fallen.	4.55	490

Table V shows that a ton of early cut hay contains four per cent more protein than a ton of late cut hay.

Table VI shows that the early cutting produced 0.8 tons more hay and 216 pounds more beef per acre than the late cutting. The production of beef per ton of alfalfa hay at the Utah Station is given as follows:

Table VII.

Stage of cutting.	Beef produced per 1 ton alfalfa hay. Pounds.
In first bloom.	132
In full bloom.	115
When half of blooms had fallen.	108

From the experiments at the Utah Station we learn that early cutting produces not only more hay on each acre, but that each ton of early cut hay will produce more beef than a ton of late cut hay. From the Kansas and Colorado Stations we have proof that each ton of early cut hay contains more of the expensive element of Kansas feeds, protein, than a ton of the late cut hay. Since more tons are secured by the early cutting, and if each ton is more valuable than if cut later, there seems to be no good reason for cutting late.

The leaves begin to drop as the blooms come on and if the plants are in full bloom a large part of the leaves are lost in cutting. Since the leaves contain about four times as much protein as the stems it is plain what makes the difference in protein content shown in table V. In curing alfalfa the object is to to dry it with as many of the leaves retained as possible. The alfalfa should be cured with as many of the leaves shaded as possible. When this is done the leaves help to draw the moisture from the stems. Where the leaves are exposed to the direct sunlight they soon die, hence cease to aid in dry-

ing out the stems. The stems should be exposed to the air as much as possible without giving the leaves too much sunshine. The hay should be handled no more than is absolutely necessary, as the more it is handled the more leaves will be shattered off. Professor William P. Headden at the Colorado Station estimated that with the most careful handling the loss from falling leaves was between fifteen and twenty per cent, while with careless work the loss might be as high as sixty or sixty-five per cent.

If the hay is left in the swath too long it is easily possible to dry the leaves so they will break, while the stems still contain enough moisture to cause heating in the stack even to the point of combustion. There is little danger of fire if care is taken to dry the leaves slowly so that the stems are well cured. A little heating will do the hay no damage. Cattle will eat with a relish hay that is brown from heating. The writer once placed before a herd of forty cows, alfalfa of the second crop just ready to stack, and some of the first crop which was a dark brown color from heating. As the cows had been eating the old hay for two weeks it would be reasonable to expect them to desire a change and choose the new-mown hay. Not so, only one or two tasted the new hay before they had eaten all the old hay they could reach.

Some alfalfa growers mix dry straw or hay with the first crop of alfalfa to absorb the moisture and prevent heating. This is successful where the material is available. Others scatter a bucketful of salt or lime over each load of hay and report excellent results.

Stacking alfalfa out of doors with no protection for the stack, can scarcely be called a success in Kansas. The alfalfa alllows water to enter the stack and in a wet season it is sure to be spoiled to a

considerable depth. Where alfalfa must be stacked outside, the top of the stack should be of prairie hay, sorghum, cane or some such material that will turn water. If alfalfa is put into a barn special care should be taken to have it thoroughly cured, to guard against loss by burning. If the barn is not large enough to contain all the alfalfa it is safer to stack the first crop outside and put the other crops in the barn. The later crops are usually cured in dry weather, they seldom heat and perhaps never burn.

Some farmers are afraid to stack alfalfa in large stacks, fearing that this is one cause of spontaneous combustion. Professor Cottrell investigated this and could find no evidence to prove that their fear was well founded. The writer knows one farmer who has over forty acres in alfalfa, who makes one stack for each crop and never has any trouble from spontaneous combustion. The larger the stacks the smaller is the portion exposed as top, bottom and sides, so from that point of view the large stacks are preferable.

Causes for failures in growing alfalfa. The most common cause of failure is the careless or too hasty preparation of the seed-bed, or lack of patience in waiting for the proper condition of soil moisture. Kansans are always in a hurry, but it will not pay to hurry too much in starting alfalfa. Take time to prepare the seed-bed well, and wait until there is plenty of moisture in the soil before seeding. Often the farmer does not have time to plow his oat or wheat stubble immediately after harvest. He waits a month or more letting the moisture evaporate and the weeds grow. Then he plows, harrows and seeds his ground. The soil which is turned with plow is separated from that beneath by a layer of weeds. No time is given for the trash to decay or for the soil to settle. If care had been taken the ground

would have been plowed before the weeds grew too large. As a result of late plowing, soil is either dry or cloddy at the time of seeding or becomes loose and dry soon after seeding, in either case a failure to get a catch is the result.

In eastern Kansas where clover is common, a common cause of failure is late cutting. The successful clover grower wants to let his alfalfa go to the stage at which he would cut his clover. The result is a small yield of inferior hay.

Heavy pasturing or pasturing when the plants are too young, or failure to cut the weeds off a new field may be mentioned as among the common causes of failure to grow alfalfa profitably.

Comparison of Value of Alfalfa and other Crops.- When we compare the value of a crop of alfalfa with that of another crop which will grow on the same land, we become more surprised that there is not more land devoted to the growth of alfalfa. Even if it were as hard on land as wheat or corn, there would be more profit in it than in either of them.

Three dollars is a common estimate on the cost of putting an acre of corn in the crib. Where four crops of alfalfa are harvested the expense will vary from $4.50 to $7.00, per acre according to the amount of disking done and the facilities for stacking.

Thirty bushels of corn @ 33-1/3 ¢ per bushel, which is an average yield and at least a fair price, will bring only $10.00, leaving a profit of $7.00. If we take the low yield of three tons of alfalfa at a price of $4.00 per ton, we have a total income of $12.00 per acre, and can spend $5.00 for harvesting the crop and have as much profit as the corn will give. But land that will produce thirty bushels of

corn will produce four or five tons of alfalfa, and the price is almost sure to be more than $4.00 per ton, at least when corn is 33-1/3¢ per bushel.

Fifteen bushels of wheat at 50¢ gives $7.50 per acre for a crop of wheat. That is an average crop and a good price. The wheat can be raised for about $2.50 per acre, which leaves a profit of $5.00. In the above estimates on cost of production, labor only was considered, as interest, taxes, rent, etc. would be the same in all three cases.

But the Kansas farmer does not need to market his alfalfa as hay. There is a home market for it and one which will pay better than selling hay. An experiment at the Kansas Station with eighty head of steers, fed corn and alfalfa hay, showed that it required an average of 747 pounds of corn and 385 pounds of hay to make 100 pounds of beef worth $5.15. If we consider the hay worth $5.00 per ton and the corn 30¢ per bushel, we have the cost of the grain $3.90 and the hay nearly $1. which gives us a good market for our produce and a profit of 25¢ per hundred with which to pay for labor. When we consider the gain in gain in price on the weight of steers when put in the lot, and the value of the pork from the hogs which follow, there is a fair profit in feeding the steers.

There is more profit in feeding baby beef. The Kansas Station made 500 pounds of hay and 500 pounds of grain put as much gain on calves as to 750 pounds of grain and 400 pounds of hay put on the steers and the prices when the animals were fat were equal. Another good market for alfalfa is the hog. At the Kansas Station a bunch of hogs was divided into two lots as evenly as possible. Each lot was fed all the dry Kafir-corn meal the hogs would eat and one lot was given all the alfalfa hay the animals would consume. In nine weeks the hogs getting

the alfalfa hay had gained 90.9 pounds each and were ready for market, while those getting grain only had gained only 52.4 pounds each. The alfalfa fed hogs had eaten more grain, but had made a gain of 10.88 pounds for each bushel of grain and the 7.83 pounds of hay eaten with it, while the other lot had made only 7.48 pounds of gain for each bushel of grain. Of course the feeding value alone of the hay did not produce 3.4 pounds of pork from 7.83 pounds of hay. But the addition of hay to the ration gave variety and had its influence in causing the grain to be more thoroughly digested. If the farmer is feeding hogs on grain only, here is a market for his alfalfa. These hogs gave a gain of 868 pounds of pork for each ton of hay fed. At 3¢ per pound for pork the hay brought $26.00 per ton. Of course it is impossible to provide a market of this kind for any large quantity of hay, but it shows where to put hay when hogs are fattening. Pigs pastured on alfalfa and given a light feed of corn at the Kansas Station, gave, after deducting the probable gains from the corn, a gain per acre of alfalfa, of 776 pounds of pork, or over $23.00 per acre with no expense for harvesting. The writer has seen brood sows wintered on alfalfa hay come out in the spring in thrifty condition and with fine litters of pigs.

Foe dairy cows alfalfa is unequaled as forage. Protein is the expensive constituent of our feeds and alfalfa is nearly equal to bran in the amount of protein contained, and is always a cheaper source of protein than bran. The Kansas dairyman cannot afford to be without it. Not only is alfalfa necessary to produce milk and butter ecomonically, but growing stock of all kinds should have it. The writer has seen a herd of forty cows in all stages of the lactation period, averaging over twenty pounds of milk, testing over 4 per cent butter fat, on a daily ration of three pounds of bran and alfalfa hay and green alfalfa

cut and fed in racks. This herd would be called "scrub" cows, although several showed Herford breeding, and a few others had some Jersey blood.

When alfalfa is cut for green feed it may be cut younger than if cut for hay and the yield is increased by so doing. It is almost impossible to cure into hay alfalfa that has not some blossoms in it.

In the dairy memtioned above calves were weamed from milk as soon as they were eating grain well, always before they were a month old. They were allowed to pasture alfalfa and eat what bran and corn meal they would. They made good thrifty calves with this treatment. None of them bloated, though there is always danger on alfalfa pasture.

At the Kansas Station alfalfa was found to be a valuable hay for calves, when fed in connection with grain and skimmed milk or butter milk. If they are fed the alfalfa from the time they first begin to eat, and the grain is not too loosening, there will be no trouble from scours. We found difficulty in feeding alfalfa to calves under two months of age if they had been fed prairie hay. It was almost impossible to make the change from prairie hay to alfalfa slowly enough to avoid all trouble from scours, if the calves were getting skimmilk. It is probable that the change could be more easily made when buttermilk is fed. Buttermilk is not so loosening as skimmilk.

Where alfalfa is fed to calves with skimmilk it is well to have at least a part of the grain ration consist of Kafir-corn meal. This will balance the loosening effect of the alfalfa and skimmilk. One bunch of calves fed at the Kansas Station gained over two pounds per head per day, on a grain ration of one-half shelled corn and Kafir-corn meal fed with skimmilk and alfalfa hay.

Alfalfa bacteria.- An examination of the smaller roots of a thrifty alfalfa plant will show many small tubercles attached to the roots. The tubercles are swellings made on the roots by bacteria. When the bacteria come in contact with a root, they attach themselves to it, and, wounding it, cause the root to form a growth in which they make their home. The bacteria take the free nitrogen from the sir and combine it into forms available for plant-food, thus supply the plants with the most essential element of plant-food. Alfalfa contains a large amount of protein which is a compound of nitrogen. If it were not for the help of the bacteria, production of so much protein would soon exhaust the soil of its nitrogen. The bacteria enable the alfalfa to grow and yield heavily on land too deficient in nitrogen to produce other crops profitably. Alfalfa in starting should have a fair amount of available nitrogen near the surface, but after the plants are well started, and the bacteria have become well established, the crop will secure plenty of nitrogen from the air.

Where there are none of these bacteria in the soil the alfalfa uses the supply of nitrogen already in the soil. This proves to be too heavy a drain on the soil nitrogen, and in a year or two the alfalfa begins to die, and soon become unproductive. Where some patches die out and others thrive, the indication is that the bacteria are not well distributed. The treatment for this is given under the head of "Crops to grow before alfalfa". If there are none of these bacteria present in the soil, the treatment is to secure soil from land that has grown alfalfa successfully, and spread it over the land while preparing the seed-bed, or scatter it with the seed. The bacteria must be present or the alfalfa will be a failure. Not only will it refuse to produce profitable crops, but it will exhaust the supply of nitro-

gen in the soil.

Effect of Alfalfa on the Soil.- As shown above, alfalfa as a crop will yield the farmer more profit per acre than wheat or corn. The extent to which wheat or corn drain the land of its available fertility has been discussed but nothing has been said of the fertilizing effect of alfalfa upon the land. Here is one of the strongest points in favor of alfalfa growing. While it is producing such profitable crops, it is also enriching the soil for the crops to follow, instead of impoverishing it as wheat and corn do. Alfalfa sends its roots deep into the soil, breaking up its compact condition and obtaining its mineral plant-food and water largely from the deeper subsoil. This plant-food is taken to the surface and made into hay or roots. Much of the hay is taken off but many leaves, 15 per cent or more, shatter off and are left on the field. This amounts to nearly a ton per acre annually that is left on the soil for fertilizer. Returning alfalfa to the soil differs from returning wheat straw or corn stalks to it. With the latter crops there is little nitrogen to give to the land, and what little there is has just been drawn from the land together with phosphoric acid and potash, so we are only taking back what was borrowed. But when alfalfa is returned to the land, the surface soil is made richer in nitrogen, phosphoric acid and potash and the supply of humus is increased, thus improving the texture of the soil. The alfalfa draws much of its phosphoric acid and potash from depths to which corn, wheat and barley never reach, and obtains its nitrogen from the air. So if we grew alfalfa on land and refused to return any of it as we would if we could, the upper soil would be just as rich in plant-food available to corn as if nothing had grown on it. When alfalfa is allowed to decay upon the land, a supply of

all three elements of plant-food is added. This is paying back more than was borrowed. When we remember that with the most careful hay making there is nearly a ton of alfalfa added to each acre annually, we can readily understand why land which has grown alfalfa for a few years gives large yields of wheat, corn, potatoes, etc., nitrogen is the element the soil is in most need of and alfalfa adds it rapidly.

But the mechanical effect of the alfalfa on the soil be noticed. Often it is of more improtance then even the addition of plant-food. Many soils are themselves heavy and waxy, and are underlaid with a "hard-pan" subsoil. When rain falls the water cannot sink into such soil, and the land remains wet until dried by surface drainage and evaporation. This is a slow process, and often before it is complete another rain has come. All this moisture is allowed to leave the land. Then when drouth comes there is no moisture below to come to the aid of the drouth-striken crop, and crop failure or inferior yield is the result.

Alfalfa changes these conditions. It adds humus to the soil, destroying the waxy consistency of heavy soils. It forces its roots deep into the "hard-pan" subsoil, breaking it up and allowing the air and water to enter, to aid in the work of disintegration and decay. When the alfalfa is plowed up and the roots decay the subsoil is left porous, and when the rains come, the water goes down into the subsoil where it is stored for use in time of drouth. This causes the surface soil to dry sooner after each rain, so that the farmer can cultivate the land and conserve the soil moisture.

By capillarity the soil moisture from below is drawn upward, making the surface soil more moist in dry weather, thus the

growing of alfalfa will do much to keep the soil supplied with the moisture for many years after the alfalfa is plowed up. The addition of the humus would prevent the land from becoming very hard in a dry time even if it had nothing to do with the conservation of soil moisture. Humus also aids in making available the mineral plant-food that was already in the soil in an unavailable form.

Accurate figures on the production of other crops after alfalfa are scarce, but many farmers assert that land which has grown alfalfa for a number of years is as rich as when the prairie sod was first broken. This seems to be a rather a strong statement, but when we remember the nitrogen and humus are the constituents most lacking in Kansas soils, and consider the amount of these that alfalfa adds, we dare not say the statement is an improbable one.

In Marion County alfalfa was grown for three years and then plowed up, and the land sowed to wheat. The yield of the first crop was forty bushels, the second forty-one bushels per acre. Adjoining fields having similar soils which had not grown alfalfa yielded twelve to fifteen bushels per acre.

Professor Buffum at the Wyoming Station seeded half of an acre of land to alfalfa and let it grow five years, while the other half of the land grew grain crops and potatoes in rotation. At the end of the five years the whole area was planted to field crops. Table VIII shows the results.

Table VIII - Showing increased Yields of Crops grown after Alfalfa.

Kind of crop.	Yield on alfalfa land.	Yeild on other land.	Increase of crop on alfalfa land.
	bushels	bushels	Per cent
Wheat	30	18	66-2/3
Oats	78	37	111
Potatoes	81	52	56

So much for the direct effect of alfalfa upon the soil. Indirectly it will do much. Most farmers will prefer feeding their alfalfa to selling it. This leads to stock raising, giving manure to spread on the land. In this way all the land on the farm will be kept in a better condition of tilth and fertility. Our farm products will leave the State in a concentrated form and we will have the residue with which to enrich our land. Let us begin to raise and feed alfalfa and travel the road which leads to successful farming.