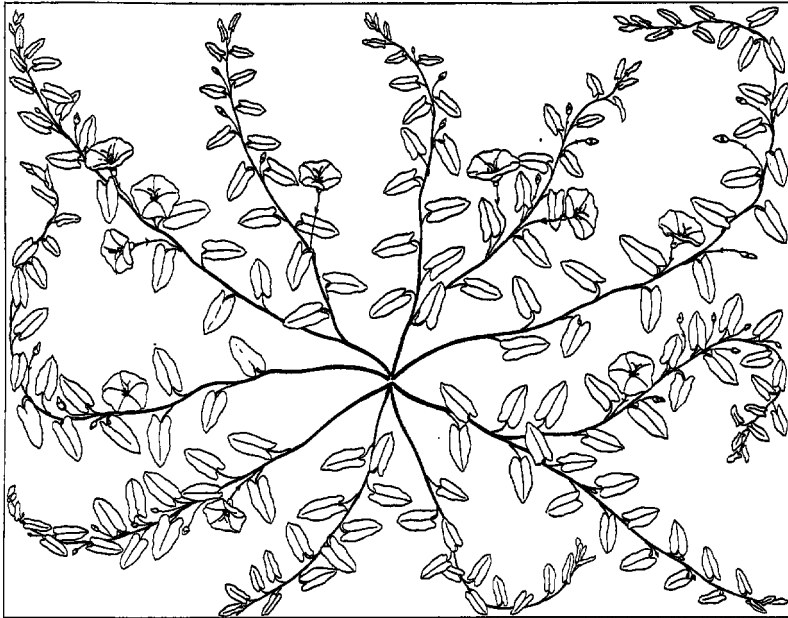


AGRICULTURAL EXPERIMENT STATION

KANSAS STATE AGRICULTURAL COLLEGE
MANHATTAN, KANSAS

DEPARTMENT OF AGRONOMY



A TYPICAL PLANT OF FIELD BINDWEED.

THE ERADICATION OF BINDWEED¹

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Bindweed (*Convolvulus arvensis*), the most destructive weed found in Kansas, is spreading over the state at an alarming rate. Heavily infested fields are practically worthless for small-grain production, because the roots sap the soil of moisture and plant food and the vines twine about the stems of the grain and prevent their

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proper development. The weed is so destructive and so difficult to eradicate that its presence in large areas on a farm will often reduce the sale value of the farm fully 50 per cent. In fact, there are many mortgage companies that refuse to loan money on farm land that is infested with this weed.

Some farmers have become alarmed over the steadily increasing infestation of bindweed, but in too many cases they do not fully



FIG. 1.—A bindweed plant, showing the flower, leaf, and twining habit of growth.

realize its seriousness and danger. Fortunately, on most farms where it occurs the infestation is confined to small patches which can be eradicated without excessive cost if attended to promptly. In such cases no effort nor expense should be spared to kill it, for if this is not done it gradually spreads until the entire farm is covered. When this condition is reached the cost of eradication will be almost prohibitive and the farm practically worthless.

WHAT IS BINDWEED?

Bindweed is often used as a general term that includes many species of perennial and annual weeds. Those of greatest danger to Kansas agriculture are perennials of the species *Convolvulus* and live from year to year on the land. The small or field bindweed (*Convolvulus arvensis*) is the most dangerous and destructive of them all and it is this species to which reference is made throughout

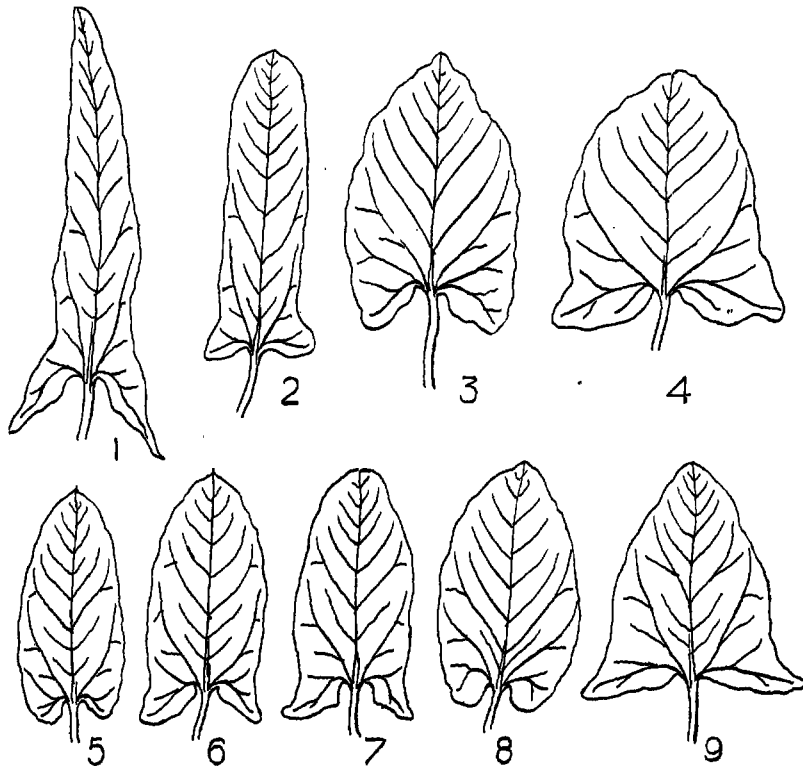


FIG. 2.—Type forms of field bindweed leaves found in the vicinity of Manhattan.

this circular. Other species of some importance in Kansas are hedge bindweed (*Convolvulus sepium*) and trailing bindweed (*Convolvulus repens*). All of these belong to the morning-glory family and are sometimes referred to as “wild morning-glory.” While they are all troublesome weeds, the one that is extremely dangerous is the small or field bindweed.

HOW TO IDENTIFY BINDWEED.

Bindweed can be distinguished from other types of "wild morning-glory" by its habit of growth. (Fig. 1.) Like the other members of the morning-glory family, it makes a vigorous growth of vines, which twine around and climb up any object of support, such as other weeds, the stems of small grain, or woven-wire fences. Its roots, on the other hand, fill the soil to a sufficient depth to compete very effectively with most crops for the available moisture and plant nutrients.

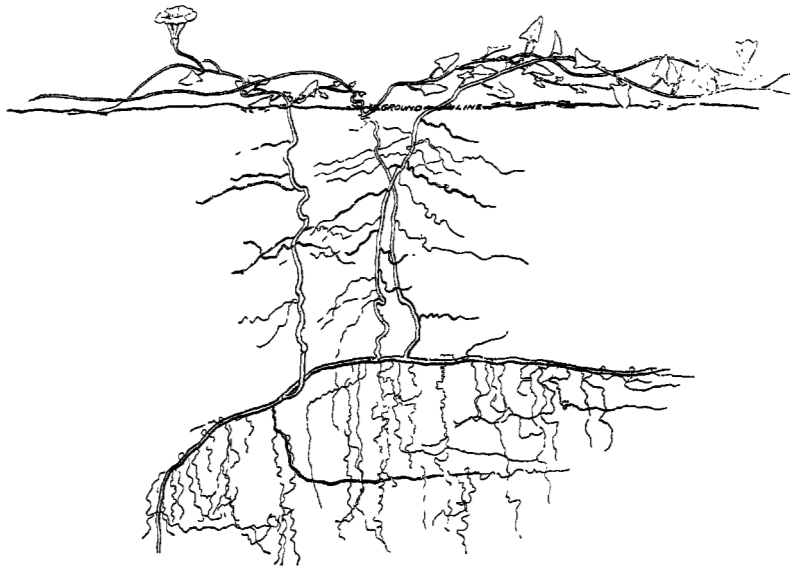


FIG. 3.—Field bindweed, showing underground root system.

The leaves of field bindweed are relatively small and smooth, somewhat arrow-shaped, but not so narrow near the point as in some species. The leaves on different plants, and to some extent on the same plant, vary in shape, at least nine type forms (fig. 2) having been found in the vicinity of Manhattan. The flowers are usually white, but sometimes pink, or white with pink. They are bell-shaped like the common tame morning-glory, but are scarcely half as large and are much less ornamental. The seeds are borne in a straw-colored almost spherical pod, about one-fourth of an inch in diameter. In this pod there are usually four brownish-black seeds about one-eighth of an inch long. Each seed usually has one convex side and two flattened sides, with the points and edges rounded

off so that the shape of the seed may be compared with that of a quarter of a peeled orange. The seed coat is slightly roughened by a covering of raised dots, which are readily seen with the aid of a hand lens. The dots have no regular arrangement.

The main roots of field bindweed are long, slender cords about

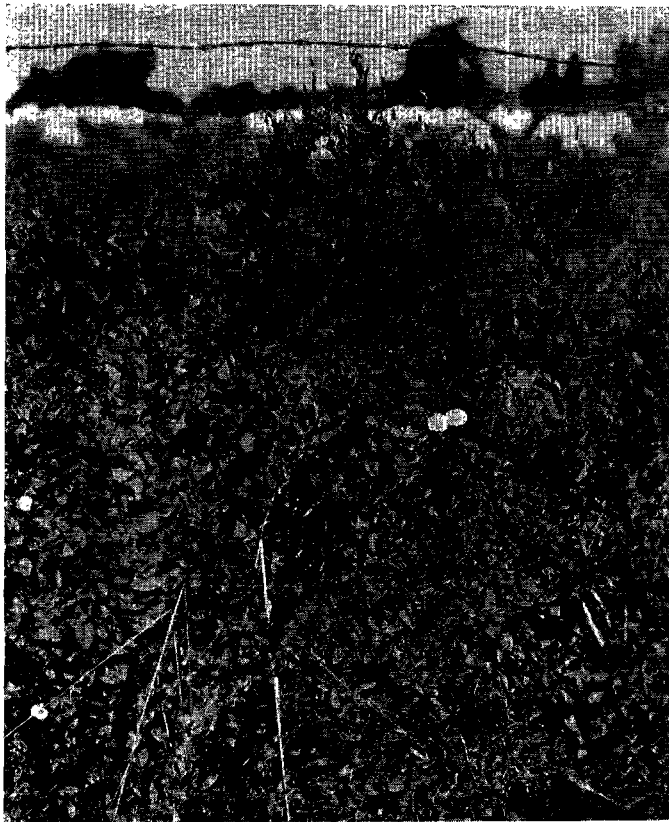


FIG. 4.—Bindweed climbing a woven-wire fence. The trailing and twining vines overrun and often completely smother wheat and other small grain.

one-eighth of an inch in diameter, with many smaller branch roots and fine fibrous roots. Quite a number of the roots run horizontally in the surface layer of soil. (Fig. 3.) On these roots buds form at varying intervals and start new plants. Many roots, however, extend downward farther than those of most annual crop plants.

The growing period of bindweed is from early spring until after one or more killing frosts in the fall. (Fig. 4.) During periods of

extreme drought it may appear to be dead, but this is only a surface condition.

Hedge bindweed has leaves and flowers twice as large as those of field bindweed, and its leaves come to a more slender acute point. The distinguishing feature of trailing bindweed is its hairy leaves, which are relatively small. Both hedge and trailing bindweed have underground stems or rootstocks that differ to some extent from the slender, cord-like roots of field bindweed. If one has a plant growing on his farm that resembles field bindweed a specimen should be sent to the Kansas Agricultural Experiment Station for identification. No chance should be taken, since the best time to kill bindweed is while the patch is small.

HOW BINDWEED STARTS AND SPREADS.

Bindweed is spread both by seeds and roots. The first foothold in a field or locality usually comes from seed scattered in seed grain or from threshing machines. One county agricultural agent in a western Kansas county found that a carload of oats containing bindweed seed had been shipped into his town for seed. Upon discovering this, he took measures that prevented the sale of the oats. The seeds may be further scattered locally by feed grown on bindweed land. The seed is also scattered in the manure of animals grazing on bindweed land or consuming feed containing bindweed seed. Commercial feed, chicken feed and screenings bought on the market frequently contain bindweed seed. Fortunately, wind plays but a small part in scattering the seed, but it may occasionally move some seeds during periods of soil drifting in western Kansas.

After a bindweed plant gets started, its roots spread gradually a few feet each year, so that before long the infestation covers an irregular area several rods across. This area continues to enlarge and serves as a center from which new areas start. New areas usually start from pieces of roots carried by tillage implements. Bindweed, if not checked, may, therefore, overrun a farm in from ten to twenty years.

Because of the rapid spread of bindweed by tillage implements, one of the first things to do when an area of bindweed is discovered is to isolate the patch upon which it occurs. This patch should not be cultivated with the rest of the field, but should be worked by itself. The implements used in working the patch should be carefully cleaned to remove all clinging vines and roots, and the crop grown upon the area burned in order to prevent the spread of the weed by means of seed.

WHERE BINDWEED OCCURS IN KANSAS.

Bindweed was introduced into Kansas by early immigrants from Russia and Germany, who brought it in seed wheat and millet. It has spread gradually in the last forty years, until every county probably has at least a trace of it. There are no statistics available as to the acreage infested, but some estimate of the weed's distribution has been made, based on the authors' observations and upon information received from county agricultural agents.

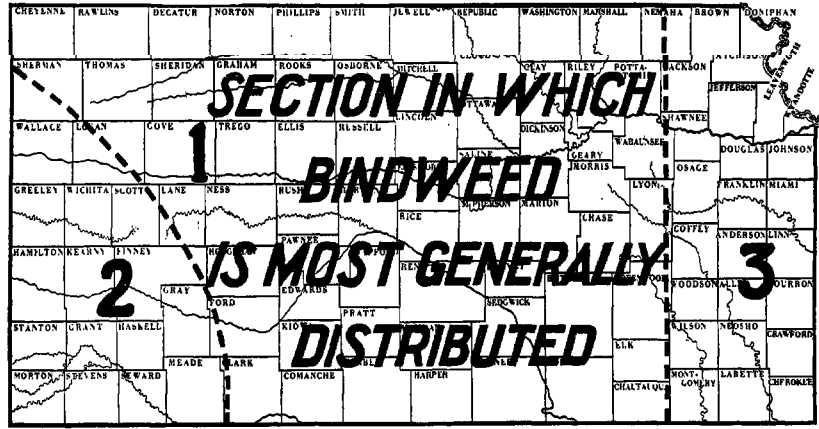


Fig. 5.—A map of Kansas, showing the distribution of bindweed.

Figure 5 shows the state of Kansas divided into three general sections as regards the distribution and importance of bindweed. Section 1 coincides closely with that of the most extensive hard-winter wheat area. In this area is found most of the bindweed of the state. The per cent of farms infested in this section varies from one to fifty in the different counties, but fortunately the area on each farm infested is usually only a few square rods. Areas of an acre or more are, however, not uncommon in Marion, McPherson, Ellis, Russell, and Thomas counties, and in extreme cases areas of from 80 to 160 acres have become so nearly covered with bindweed as to be practically worthless in their present condition.

In section 2 bindweed is not of much importance, but will probably become so as this section develops agriculturally and as the wheat acreage increases. A trace of bindweed is already found in the Meade and Gray county wheat areas and in the irrigated districts of Finney and Kearny counties.

In section 3 bindweed is not so serious a problem as in section 1,

and is not likely to become so. A trace of it is, however, reported from most of the northeastern Kansas counties and from a few in southeastern Kansas.

INJURIOUS EFFECTS OF BINDWEED.

The reasons for considering bindweed an unusual peril to Kansas agriculture are: (1) It monopolizes all the land it infests, so that crop production is rarely profitable. (2) It is continually spreading. (3) It is extremely difficult to eradicate.

Wheat is the crop most commonly grown on bindweed-infested fields, and the farmer is often satisfied with the returns if there is enough clean land in the field to make a fair crop. On the actual bindweed areas, however, the yield of wheat is usually less than half the normal crop, and under droughty conditions is usually a failure. Other small grains are likewise unable to compete with bindweed.

Even such vigorous-growing plants as the sorghums may suffer greatly from bindweed competition unless rainfall is heavy and timely through the season. At the Fort Hays Experiment Station the yields of close-drilled sorghum on bindweed land have been compared with those of the same crop on clean land.

For the normal date of seeding, in early June, the average yield of sorghum on clean land for four years, 1919 to 1922, was 3.92 tons, and on bindweed land 2.06 tons per acre. From late seeding, the first week in July, the average on clean land was 3.54 tons, and on bindweed land that had been intensively worked up to seeding time, 1.92 tons per acre. A comparison of Sudan grass was also made for the normal date of seeding each of these years. On clean land the average yield was 2.2 tons per acre, and on bindweed land 1.54 tons. The quality was also much poorer from bindweed land, as the feed crops did not mature normally.

CONTROL OF BINDWEED.

It is easier to prevent bindweed getting a start on the farm than to eradicate it after it is started. Every precaution should be taken to prevent its starting. One should be on the watch for bindweed seed whenever seed grain, chicken feed or commercial feed is purchased. Since bindweed seed is also frequently carried on the farm in threshing machines, it is a good precaution to examine old stack bottoms and areas where stacks have stood in the past for the presence of the weed. Bindweed is also carried from farm to farm by road-grading machinery. A piece of root catching on a road grader may be carried several miles before it is dropped. In this way, and from

seed scattered from wheat wagons and threshing machines, new areas often start along roadsides. Bindweed is also carried by railroads and scattered along the right of way. The railroad right of way passing through the farmstead should be examined occasionally for the presence of the weed.

When a bindweed area is discovered it should be so managed that it will not spread either by seed or roots. If the area is small the weed should be eradicated at once. If the area is large it may not be practical to attempt to eradicate all the bindweed at once. In that event, the field should be handled in such a way that the weed will not spread, and some kind of progressive system adopted for eradicating a few acres at a time.

METHODS OF ERADICATING BINDWEED.

While bindweed is difficult to eradicate, it can be killed. The method that should be used to kill it will depend upon the location and the size of the area covered by the weed. If the area covered by the weed is large—that is, more than an acre in size—the methods used must be as economical as possible, and preferably employed as an incident in the profitable production of some crop or live stock. On the other hand, if the area infested by the weed is small the matter of expense is less important, but it is important that the weed be killed quickly in order to reduce the danger of its becoming scattered to other parts of the farm.

DESTROYING SMALL PATCHES OF BINDWEED.

Small patches of bindweed can be destroyed by the following methods: (1) Salting; (2) continuous cultivation; (3) continuous cultivation accompanied by pasturing with hogs.

Salting Bindweed.

The application of salt is the most immediately effective method of eradicating bindweed, and perhaps one of the best when the patches are very small.

Many salt companies handle a cheap grade of "bindweed salt" for this purpose.² A limited amount of experience at the Dodge City Branch Experiment Station and among farmers has indicated that the minimum amount of salt to use is ten tons to the acre. In a more extensive test at the Fort Hays Branch Experiment Station the

2. Cheap grades of salt for salting bindweed can be purchased from the following companies: Morton Salt Company, Kansas City, Mo.; Carey Salt Company, Hutchinson, Kan.; Barton Salt Company, Hutchinson, Kan.; American Salt and Coal Company, Kansas City, Mo.; Feeders' Supply Company, Kansas City, Mo.; Sterling Salt Company, Sterling, Kan.; Independent Salt Company, Kanapolis, Kan.

conclusion was reached that twenty tons was about the proper amount to apply at first, followed by a second application to any plants that would inevitably be missed by the first application. Twenty tons to the acre amounts to almost one pound to the square foot, or a layer about one-fifth of an inch thick.

In the experiment at Hays, six plots of one-tenth of an acre each were salted during the period from June 27 to July 1, 1919, at the respective rates of 8, 12, 16, 20, 24 and 28 tons per acre. At the close of the season there was no bindweed left on the 28-ton plot, five or six weak plants on the 24-ton plot, and about five dozen plants on the 20-ton plot. The stand of bindweed left was estimated as 15 per cent on the 16-ton plot, 40 per cent on the 12-ton plot, and 75 per cent on the 8-ton plot.

Salt is too expensive to use over large areas and it ruins the soil for crop production for an indefinite period. Salted spots are objectionable from the standpoint of appearance and tillage, as the soil assumes a whitish color and sticky structure like gumbo. The greater the annual rainfall the sooner the salt is leached from the soil. No immediate way of counteracting the effect of salt is available, but in eastern Kansas some degree of productiveness may be regained in a few years if the land is heavily manured and cultivated with the rest of the field. In western Kansas there are areas salted ten or more years ago that are still bare or are growing only Russian thistles.

Salt has a place in the control of bindweed, but it should be limited to the smallest areas, such as fence rows, roadsides, or such scattered areas in the fields as one is willing to sacrifice in order to prevent the weed from spreading further. Salt is impractical as a method of eradicating bindweed on a large area of land; neither is it advisable to use salt around the farmstead where an area of bare, unproductive land would be objectionable.

Killing Bindweed by Intensive Cultivation

Another practical method of killing bindweed, especially when it occurs in relatively small patches, is by intensive cultivation. Most farmers who have had experience in fighting bindweed are of the opinion that cultivation aids the growth of the weed. This is true if the cultivation is not frequent and thorough and if a part of the plants are not killed above ground by the implements used in cultivation. It has been found by careful experimental work that if bindweed is kept cut off three inches or more below the surface of the soil during one entire growing season, most of the plants die be-

cause of exhaustion of the supply of plant food in the roots. Such a process requires tillage every week or ten days during the season of active growth. At the Fort Hays station it has involved from fifteen to twenty-seven tillage operations during a year, with an average of about twenty. These treatments include plowing in the spring, re-plowing or heavy double disking occasionally after heavy rain when the ground is baked or when there is heavy growth of vines. For the most part, the tillage was performed with a spring-shovel cultivator equipped with ten-inch sweeps. (Fig. 6.) From 85 to 99 per



FIG. 6.—A spring tooth cultivator equipped with 10-inch sweeps used to destroy bindweed.

cent of the bindweed was eradicated by this method in one season. Complete eradication has required about a dozen cultivations or plowings the second year. Ground thus handled should be listed in the fall or extensive soil blowing will occur during the winter. Attempts to grow wheat on such intensively fallowed land were unsuccessful at Hays on account of soil blowing.

Intensive cultivation, if properly done, is the most thorough method of eradication. It not only starves out the roots, but tends to cause germination of many of the latent seed. Some seed will undoubtedly remain in the ground in a dormant condition for sev-

eral seasons even where this method is followed. For this reason bindweed land should not be planted to small grain for a number of years after the weed itself has been killed. Another point in favor of intensive cultivation is, that at Hays the work is in part paid for eventually by increased yields of subsequent crops. It may be that this condition would not exist, however, farther east under greater rainfall. At the Nebraska Agricultural Experiment Station at Lin-



FIG. 7.—A home-made bindweed cultivator designed by Alex J. Rupp, Ellis county, Kan.

coln it has been observed that the soil was in a very unproductive condition after two years of intensive cultivation.

On the other hand, it should be remembered that cultivation intensive and frequent enough to control bindweed is an expensive process. The work is wasted if not done with sufficient thoroughness to kill the bindweed. It is usually too expensive to handle any considerable acreage properly, and hence if this method is to be tried it should be limited the first year to an area that one is sure of being able to handle.

There is some advantage in having special sweeps or knives on some implement for use incultivating bindweed land, but it is not absolutely necessary. (Fig. 7.) At the Colby station, thirty bindweed areas of a few square rods each were handled in 1922 by plowing in the spring, and then double disking very heavily about every ten days.

The intensive cultivation or fallow system is the most practical when the bindweed areas are conveniently located so that they can be cultivated quickly and at small expense. The success of the plan will depend upon the thoroughness with which the work is done. If the work is done in a half-hearted manner so that a part of the weeds escape the cultivator, or if the intervals between cultivation are too long so that the weed has an opportunity to manufacture food in the leaves and store it in the roots, the work will be ineffective. The method will succeed only for the man who does his work promptly and thoroughly.

Intensive Cultivation Accompanied by Pasturing with Hogs.

If the bindweed patch is so located that it is possible to utilize the land for hog pasture during the time that it is being cultivated, the hogs will assist in the destruction. Hogs relish bindweed roots and they root actively for them if their noses are not rung nor slit. When hogs are used in this way it is not necessary to cultivate as frequently, and most of the work should be done with the plow. If the ground is plowed deeply every few weeks it will be worked with greater ease by the hogs and the weed will be destroyed more rapidly. The owner should provide too many rather than too few hogs; and should provide other pasture and feed to keep them growing. A number of farmers have reported the eradication of bindweed by means of hogs alone without cultivation. It is undoubtedly possible to kill bindweed in this way providing a sufficient number of hogs are confined on the area to prevent the growth of the weed. Under most conditions, the loss on the hogs will be too great where they are kept hungry enough to root thoroughly for the bindweed roots. The best plan, when hogs are used, is to depend upon the hogs eating the roots that are turned up by the plow and to cultivate the ground frequently enough to prevent the weed making any appreciable amount of growth. Hogs handled in this way will make better gains because of the bindweed, and the labor required to kill the weed will be less because of the hogs.

DESTROYING LARGE AREAS OF BINDWEED.

The methods of killing bindweed discussed above apply to areas of small size, varying from a small patch to a few acres. With the exception of the intensive cultivation method, they are impractical for large areas of land, and the intensive cultivation method will prove expensive and difficult to carry out on a large scale.

It then becomes necessary to supplement cultivation with other less expensive methods, even though the methods may be less effec-



FIG. 8.—Bindweed completely covering the ground between rows of soybeans 15 days after cultivating.

tive. The use of a smother crop is the most promising method under these conditions. The successful use of a smother crop depends on the use of a rank-growing, persistent plant, and on having favorable climatic and soil conditions. The smother-crop plan is best adapted to areas when the rainfall is sufficient to grow alfalfa or to keep sorghum growing continuously and rapidly. When the moisture supply is uncertain, the smother crop, to be practical, must be grown in connection with intensive fallow. There may be some latitude in the choice of smother crops, but alfalfa and sorghum are among the best. Sudan grass will do about as well as sorghum.

Using Alfalfa as a Smother Crop for Bindweed.

Alfalfa is the best smother crop to use on bindweed land providing the growing conditions are satisfactory for alfalfa. It is useless, however, to attempt to start alfalfa on bindweed land (fig. 8) without first weakening the bindweed by a period of frequent, thorough cultivation, and it is useless to attempt to use alfalfa in this way unless conditions are very favorable for starting and growing the crop. After alfalfa is established on bindweed land, its deep, constantly growing root system tends to compete more and more successfully with the bindweed roots for plant nutrients and moisture.

It is impossible to start alfalfa in the spring on bindweed land. The bindweed will outgrow and choke out the young alfalfa plants. Alfalfa to be successful must be sown in the fall on such land. The best plan is to start the preparation of the seed bed in the early spring about the time the bindweed begins to grow. The ground at this time should be plowed reasonably deep (five to six inches), and cultivation following should be frequent enough to prevent the bindweed making much growth above ground. The implements used during the fallow period and the methods of cultivation followed should be the same as that suggested under the intensive cultivation method discussed in a preceding paragraph. When the bindweed is kept well under control until the middle of August, an ideal seed bed for alfalfa is obtained and the bindweed weakened enough to prevent vigorous competition with the alfalfa. Alfalfa sown under favorable conditions between the middle and last of August will have made a good growth by the first hard freeze, which will kill back the bindweed plants that may have started with it. In the spring the alfalfa begins growth much earlier than the bindweed and is usually so strong and vigorous that it will choke out the bindweed in a period of a few years. The success of this plan depends, first, on having land adapted to alfalfa; second, on weakening the bindweed by a season of thorough cultivation; and third, on securing a good, thick stand of alfalfa distributed evenly over the land. When these conditions can be provided this is one of the cheapest and best methods of controlling bindweed.

Sorghum a Smother Crop for Bindweed.

Sorghum is the best annual smother crop to use in controlling bindweed in Kansas. Where there is an abundance of moisture and fertility to support a continuous, rapid growth, a thick seeding of close-drilled sorghum has been known to smother out almost all the bindweed in one season. This result was obtained both with close-

drilled sorghum and with close-drilled Sudan grass at the Fort Hays Experiment Station in 1915. In this instance the land received intensive cultivation until June 12, the seeding date, and the rainfall was abnormally heavy during the entire season. During the years 1919 to 1922, however, attempts similar to that of 1915 were made again at the Fort Hays station without success. This is accounted for by the fact that at some time before the sorghum made a very tall growth these seasons, a drought of several weeks occurred. During the drought the sorghum almost stopped growing, while the bindweed, with its deeper root system, continued to grow. It is not safe, therefore, to depend upon sowed sorghum to control bindweed, and it is very doubtful if it will ever completely eradicate it.

Results obtained at the Fort Hays station during the period, 1919 to 1922, indicate, however, that it may be possible to eradicate bindweed with a sorghum smother crop provided the period of intensive spring preparation of soil is extended to July 1. One plot was handled in this manner continuously from 1919 to 1922. In 1919 and 1920 but little progress was made in subduing the bindweed, but in 1921 it was almost completely eradicated, and the few weak plants remaining were killed out during the preparation period of 1922. It appears that the more prolonged period of preparation weakened the bindweed to some extent, and at the same time conserved moisture enough to insure a rapid and continuous growth of the smother crop.

The most successful plan of using sorghum as a smother crop appears to be alternating fallow with sowed sorghum. Close-drilled sorghum has been grown on bindweed land at Hays in a variety of rotations with fallow, each of which involved one or more years of intensive cultivation. In these rotations, from 85 to 99 per cent of the bindweed was eradicated by the first year of fallow, and very little was left, if any, after the tillage operations had been completed for seeding sorghum the second year. Sorghum, after a year of fallow, makes an excellent growth that is effective in smothering the weak bindweed plants in most cases. Such plants as remained after one year of fallow and one year close-drilled sorghum can be easily salted.

The average yield of sorghum after one year fallow at the Fort Hays station was 4.01 tons per acre for the three years, 1920 to 1922. That of sorghum seeded continuously on bindweed land for the same years was 2.34 tons. The fact that the fallow is at least partly paid for by the succeeding crops is also brought out by another compari-

son. Bindweed land continuously in sorghum for four years, 1919 to 1922, yielded a total of 8.23 tons of sorghum per acre, and none of the bindweed was eradicated. (Fig. 9.) Other bindweed land that was intensively fallowed in 1919 yielded 11.55 tons per acre for the total of the three years 1920, 1921 and 1922, and there was no bindweed left.

It appears from the results at the Fort Hays Experiment Station that a period of fallow followed by sowed sorghum is the most prac-

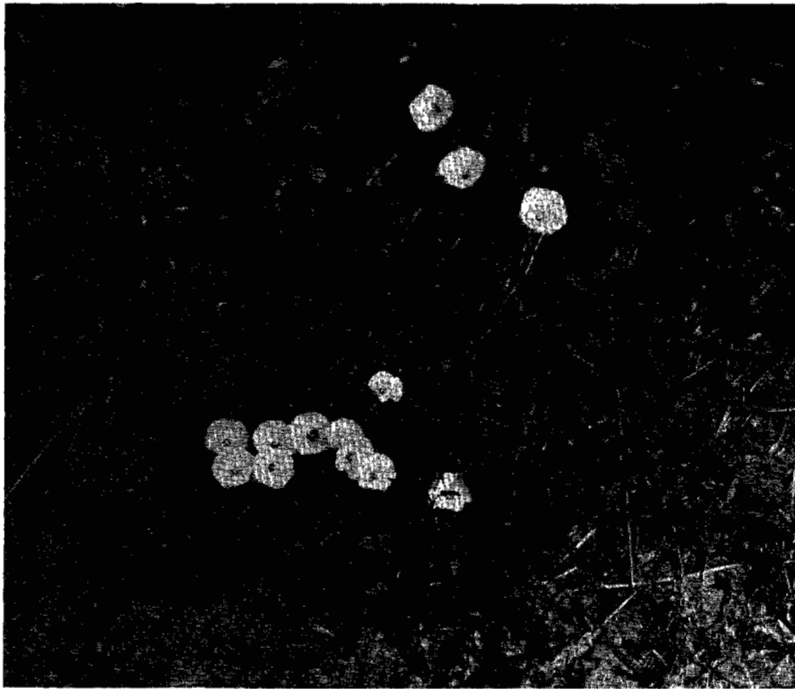


FIG. 9.—A bindweed plant in bloom. The flowers are white or pink, bell-shaped like the common morning-glory, but scarcely half as large.

tical method of eradicating bindweed when the weed occurs in large areas in central and western Kansas. The success of the plan will depend upon the thoroughness with which the work is done during the period of fallow. If this work is well done so that the bindweed is starved and weakened these methods will be successful. If the work is done in a poor, inefficient manner, this method will fail. One precaution should be observed in growing sorghum on bindweed land, and that is not to remove it for feed. It may contain bindweed seed. If this is done, bindweed may be scattered to other portions of the

farm. When, however, the bindweed is kept under control during the period of fallow and when the ground is thoroughly worked in the spring in advance of seeding the sorghum crop, the bindweed is weakened to such an extent that it will not usually produce seed. Under these conditions the sorghum may be fed. When the sorghum contains bindweed seed it should be burned on the land where it grew.

ERADICATE BINDWEED NOW.

Other less expensive methods of eradicating bindweed may be developed in the future, but at present the methods suggested above have been found the most practical. All of them require an investment of considerable labor or money, and in no instances has it been found possible to eradicate bindweed without constant, thoughtful attention to the work. When the menace of bindweed is fully appreciated and it is realized that land completely covered with bindweed is practically worthless for farming purposes, the importance of preventing small patches of bindweed spreading will be appreciated. While it may be expensive to eradicate small patches of bindweed, it is more expensive to permit them to spread and completely overrun the farm.

