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THE BLUEWEED AND ITS ERADICATION



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THE BLUEWEED AND ITS ERADICATION

BY

R. E. KARPER.

Weeds are comparatively an unimportant factor in farming in West Texas, which largely accounts for the large acreage that can profitably be farmed by one man. They are, however, an important factor in cultivation, as experiments at this station have shown that, where other conditions were equal, weed growth alone has taken an average annual toll of 50 per cent. of the grain yield of a crop of milo for a period of four years.

The blueweed is the worst weed pest inhabiting this section and causes a greater annual loss of yield in crops than any other weed. A clearer understanding of the habits of this weed and of the means of eradicating it will lead to systematic effort in dealing with this pest both on cultivated farms and on new lands.

DESCRIPTION.

The blueweed (*Helianthus ciliaris*) usually grows to a height of one to two feet. The leaves are mostly opposite, long and slender, and much crinkled and bristly along the margins. The flower head is yellow and otherwise similar to that of the ordinary sunflower, except in size, the diameter of the head being an inch to one and one-half inches. The disk or central part of the flower is of a dark brown color and contains fifty to one hundred and fifty seeds. This disk is filled with chaff, which is quite apparent late in the season. The seed resemble small sunflower seed, and are of a brown color. The weed bears 1 to 50 seed heads to the plant.

The plant is of a peculiar blue-green or gray-green color, due to the white powdery substance which is found on the stem and leaves. The crushed leaf or stem has a rather peculiar strong odor resembling that of the sunflower. This pungent odor is characteristic and is easily detected when the atmosphere is heavy. When traveling along a road, one often gets a whiff from a nearby patch of this weed.

As will be seen from its botanical name, the blueweed is a near relative of the common sunflower. The root is perennial and sends out underground stems upon which buds are present every few inches.

DISTRIBUTION.

This species of blueweed is found in West and Southwest Texas, Western Oklahoma, and in New Mexico and Arizona. In Texas it is distributed quite irregularly from Dallam and Lipscomb counties in the

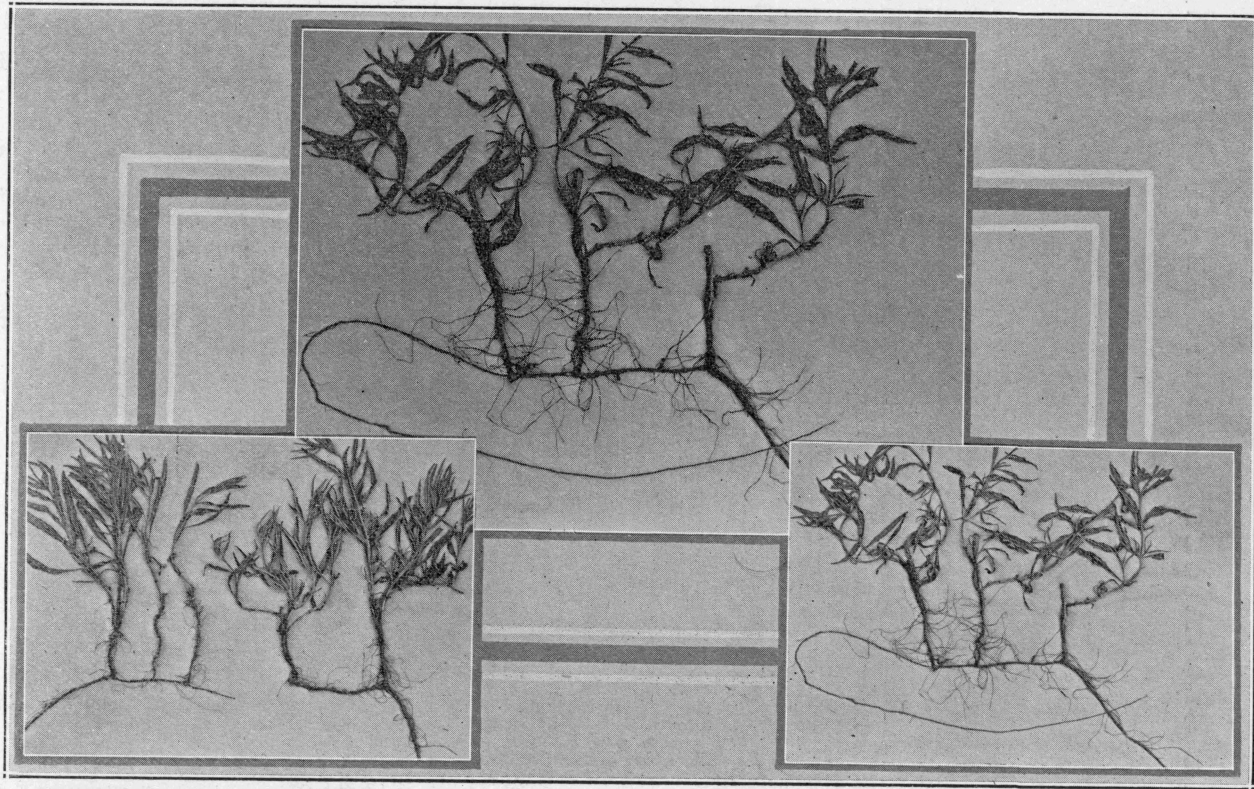


Figure 1. Showing the rooting habits of the blueweed. Every few inches at regular intervals on the underground stems buds are formed from which arise new plants. Note where these plants have been previously cut off below the surface with a hoe and new stems put out.

extreme northern tier of counties in the Panhandle south to the Rio Grande. The blueweed is quite general throughout the Panhandle and South Plains section, where it is the most destructive and difficult weed pest to contend with that inhabits this region. Lesser infestations are found in the "Breaks" or broken country east of the High Plains and are again present in troublesome quantities to the south and east in and about Tom Green, Concho, and McCullough counties and south and west in the Rio Grande and Pecos valleys. In general the blueweed is a common and troublesome weed over that portion of West Texas lying on and west of the 100th meridian.

The blueweed is native to this section and grows more or less unobserved in the pastures until the land is sodded and put under cultivation, when it rapidly spreads and comes into prominence. Cultivated fields which have been poorly farmed and become thickly set with blueweeds, if left to go back to grass, will, in a few years, be almost completely occupied by grass, the blueweed having been crowded out and rendered quite inconspicuous in the sod again.

While this weed normally seems to prefer the low ground and is found usually in the "sinks" or shallow lake beds, and on their margins growing on soil of the Randall Clay series, its growth is by no means confined to soil of this type nor to low spots or lake beds. It thrives and may be found growing in sandy loam soils as well as on the more heavy phases, but not usually on very light or deep sand. When present it is usually on the best land and is seldom found on shallow soil or chalky or gravelly areas.

HABITS OF GROWTH AND REPRODUCTION.

Being a perennial the blueweed propagates itself by its underground roots, which live over from year to year, and it also produces seed. The root system consists of both running rootstalks and feeder roots. The running, or propagating roots are more or less horizontal and are found at a somewhat shallow depth, while the feeder roots penetrate the ground to a greater depth. The soil is filled with a network of roots and rootstalks, on each of which are borne numerous small fibrous roots. It is largely from these running roots that the blueweed spreads and reproduces itself and this point must be borne in mind when its eradication is attempted. Every few inches at irregular intervals on these underground stems buds are formed from which new plants grow and find their way to the surface of the ground, where they grow and produce seed and store up energy and food whereby the running roots are able to further extend themselves and form new plants. When these plants are cut off new stems and leaves are put out immediately below where they were cut off and growth is resumed.

In cultivated land the pest appears mostly in patches which have a somewhat roundish form, are quite regular in outline, and vary in size from a small fraction of an acre to several acres. It does not spread very rapidly but is more inclined to concentrate its efforts in making a dense growth, crowding out cultivated plants and other vegetation. There is a common opinion that the blueweed "poisons" the land. It is not known that any toxic substance is given off by this weed. The

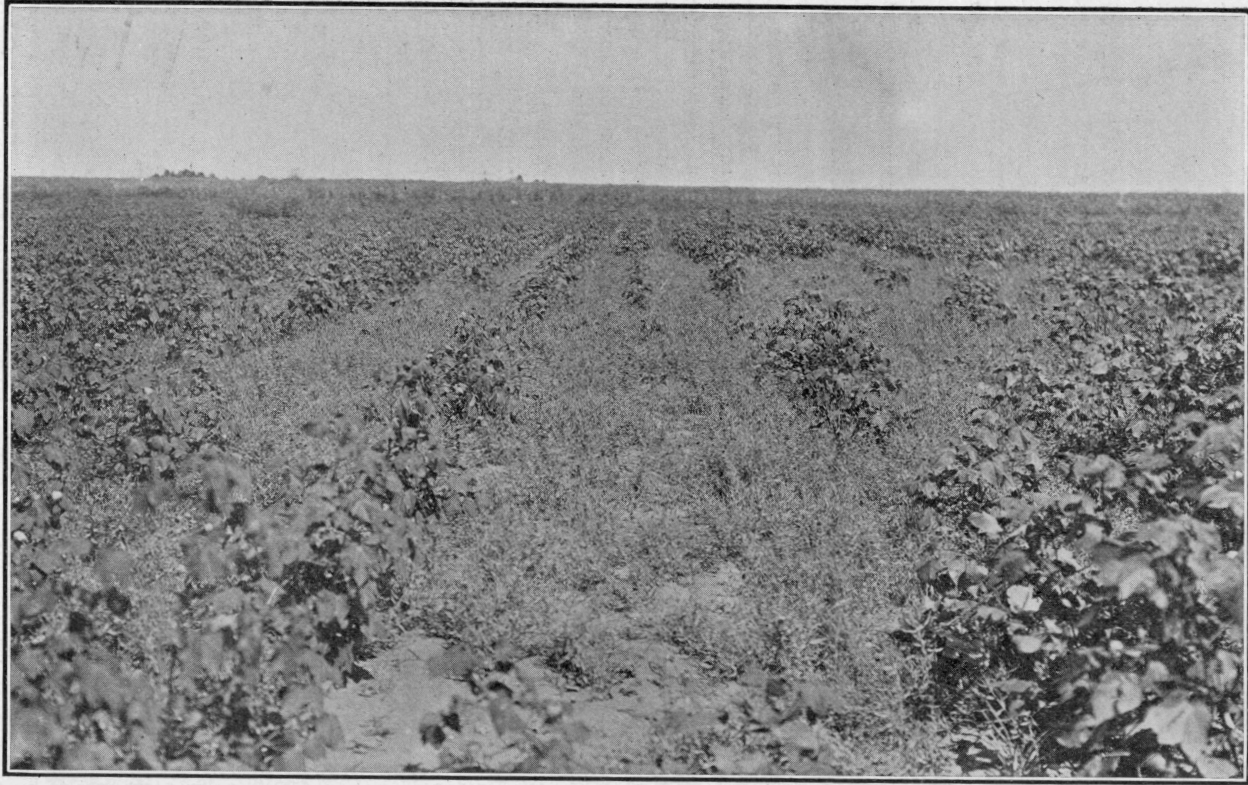


Figure 2. Showing the characteristic effect of the blueweed in a field of cotton. It occurs in patches, having somewhat regular outline and roundish form, and makes a dense growth, crowding out cultivated plants.

failure of crop growth in such areas is due for the most part to this weed's robbing the crop of available soil moisture. In years of abundant rainfall fair crop yields are made from infested areas, while in dry seasons little or no crop yield is produced, but the blueweed continues to thrive.

In the native pasture the blueweed is necessarily a shallow rooted plant to take advantage of the moisture in the top soil in competition with other weeds and the native grass. That it thrives with culture is shown by its behavior in cultivated lands, only moderately well tilled where it has persisted for years and is apparently getting thicker and spreading in many cases. When the land is put into cultivation and moisture penetrates to greater depths it sends its roots down deeply, obtaining a firmer hold and is able to more stubbornly resist efforts to eradicate it.

The best time to combat it, therefore, it would seem is when new land is first put into cultivation and before the weed has had an opportunity to establish such a deep root system. If these areas are thoroughly plowed and cultivated from the time the sod is first broken, eradication may be much more quickly and economically accomplished.

One of the first plants to put out growth in the spring is the blueweed. It sometimes appears as early as January or February. It grows throughout the summer, forming seed heads in June and July, and maturing them in August or September. The tops die with the first killing frost in the fall.

A large crop of seed is matured but very fortunately the seed are of extremely low viability. The writer has had this pest under close observation for the past five or six years and has not yet seen it naturally propagate a seedling from its seed. If it reproduces at all from seed it is certainly only to a very small degree, as otherwise in this region of high winds, the spread of this pest, owing to the large number of seed produced, would soon have reached such proportions as to have infested practically all cultivated areas. Most perennials propagate themselves both by seeds and underground parts and it is indeed encouraging to observe that in a warfare against the blueweed reproduction from seed seems to be a negligible factor. In such case this would mean that once eradication of a patch of this weed is accomplished completely new and serious infestations are unlikely to occur.

GERMINATION OF THE SEED.

In order to gain more definite information relative to the germinability of blueweed seed, germination tests were made, under various conditions, of twenty-two samples of seed, results of which are given in the accompanying table. These determinations were made by the Seed Analyst of the Experiment Station. The samples include seed produced in both the seasons of 1919 and 1920. Out of the twenty-two samples including 1950 seeds only nine of the samples and twenty of the seeds showed any germination. It will be seen that in general the seed require a long period for germination and when they do sprout it is at very irregular intervals. In one case after passing 109 days in the germinator one of the seeds responded.

Germination data of blueweed seed showing conditions under which test was made, number of days before germination took place and per cent of germination:

Conditions Under Which 100 Seeds Tested.	No. of Days Before Germination.	No. of Seeds Germinated.	Per Cent of Germination.
Room Temp.; light; bell jar.....		0	0
Room Temp.; light, sunshine; bell jar.....		0	0
Near radiator; light; bell jar.....		0	0
Near radiator; dark; bell jar.....		0	0
Room Temp.; dark; bell jar.....		0	0
Germinator 20-30° C., bell jar.....	32	1	1
Germinator 20° C., bell jar.....		0	0
Germinator 30° C., day; room in bell jar, night.....	43	1	1
Germinator 20-30° C.; blotting paper.....		0	0
Germinator 20° C.; blotting paper.....		0	0
On soil; room temperature.....		0	0
Under soil; room temperature.....		0	0
On soil by radiator; dark.....		0	0
Under soil by radiator.....	32	1	1
Blotting paper 20-30° C.; heavy seed.....	38 to 109	7	7
Blotting paper 20-30° C.; heavy seed.....	38 to 46	5	5
Cloth; 20-30° C.....		0	0
Cloth; 20-30° C.....		0	0
50 heavy seed; 20-30° C.....	18	2	4
50 heavy seed; 20-30° C.....	18	1	2
25 seeds; room temp.; light; bell jar.....	35	1	4
25 seeds; blotting paper; Germ., 20-30° C.....	17	1	4
Average.....			1.025

The germination was uniformly low in all cases. In the case of four samples the light seed was blown out and only the heavy seed tested. These four samples show a much higher per cent. of germination than the others, which, of course, raises the average. Considering the whole number of samples tested, there was an average germination of only one per cent. and when the selected samples of heavy seeds are omitted the per cent. was considerably less than this amount. Considering the low viability shown by these tests under ideal artificial conditions, it would seem that very few natural seedlings are produced, which fact is further borne out by the apparent lack of such seedlings in infested areas where abundant seed is produced. Seed which were collected and planted in the open ground and irrigated to give maximum conditions for growth gave no seedlings.

An examination of the seed shows them generally to be light and of doubtful appearance as to germinability, frequently many of them being empty and some having been eaten out by an insect. When the seed is fully developed but still slightly green and yet retained in the head they have a plump appearance. It is probable that deterioration of the seed takes place quite rapidly, or that there is an age or temperature factor concerned or some other requirement which if properly fulfilled would induce more perfect germination.

EXPERIMENTS IN ERADICATION AND CONTROL.

With the view of gaining more knowledge of the habits of the blueweed and determining some practical and efficient methods of its eradication and control experiments were conducted in the seasons of 1917 to 1919 at Substation No. 8. This station is located at Lubbock in the South Plains region. The soils of this section belong for the most part to one of two classifications, the reddish soils of the Amarillo

series, and the brown or dark brown soils of the Richfield series. The blueweed grows on either of these soils as well as on the Randall clay which occupies the numerous lake basins scattered throughout the Plains.

The station farm itself does not contain an area thickly infested with the blueweed, and of sufficient size to conduct tests of this kind. In order to obtain a suitable and representative area a piece of land was selected some four miles from the Station. The soil of this area was Amarillo clay loam. Scarcity of labor at this time and the distance from the base of operation made it somewhat difficult to conduct the work in an altogether satisfactory manner, but information of practical value was obtained relating to the eradication and control of this pest and the merits of various cultural operations for this purpose established.

A location was selected which had a thick and uniform stand of blueweeds and was divided into one-twentieth acre plats to receive treatment as follows:

- Plat 1. Cut weeds with weeder-blade attached to cultivator.
- Plat 2. Plowing and reploting seven inches deep.
- Plat 3. Plowing and reploting four inches deep.
- Plat 4. Listing and relisting seven inches deep.
- Plat 5. Listing and relisting four inches deep.
- Plat 6. Listing and lister planting cotton in 3-foot rows.
- Plat 7. Listing and lister planting cotton in 6-foot rows.
- Plat 8. Listing and relisting to keep down weed growth until June 15, when milo was lister planted.

The first five of the above plats were thus fallowed, growing no crop, but receiving treatments as specified without any other intervening tillage.

Six smaller plats, one square rod in size, were laid off as check plats. One was hand-hoed, one was smothered, one was treated with salt, and the others were treated with other chemicals.

This project was started in the fall of 1917, but the fall and winter were so dry that cultural operations on the plats could not be done before the following spring. The whole field, including the platted area, was thoroughly disked in the winter of 1917-18 and listed early in April, 1918, and these operations should be counted against the treatment of the plats this season. The season of 1918 proved to be an extremely dry year, which was of assistance in subduing the weed, but made cultural operations difficult. For this reason also stands of the crops planted were difficult to obtain on plats 6, 7, 8, and because of the further fact that they were too distant to be given timely cultivations they were dropped from the test.

Treatments were given on all plats on uniform dates as follows: May 22, July 6, and September 24, 1918, and April 15 and June 3, 1919.

Cutting With Weeder-blade.—A "weeder-blade" had been devised on the station for cleaning roadways, weed patches, and fallow areas. The attachment consists of a long, straight, heavy blade similar to a godevil blade but heavier, which is fastened to the shanks of a riding cultivator and set nearly flat with the ground. This is let into the ground the desired depth with the levers, cutting clean below the surface. This

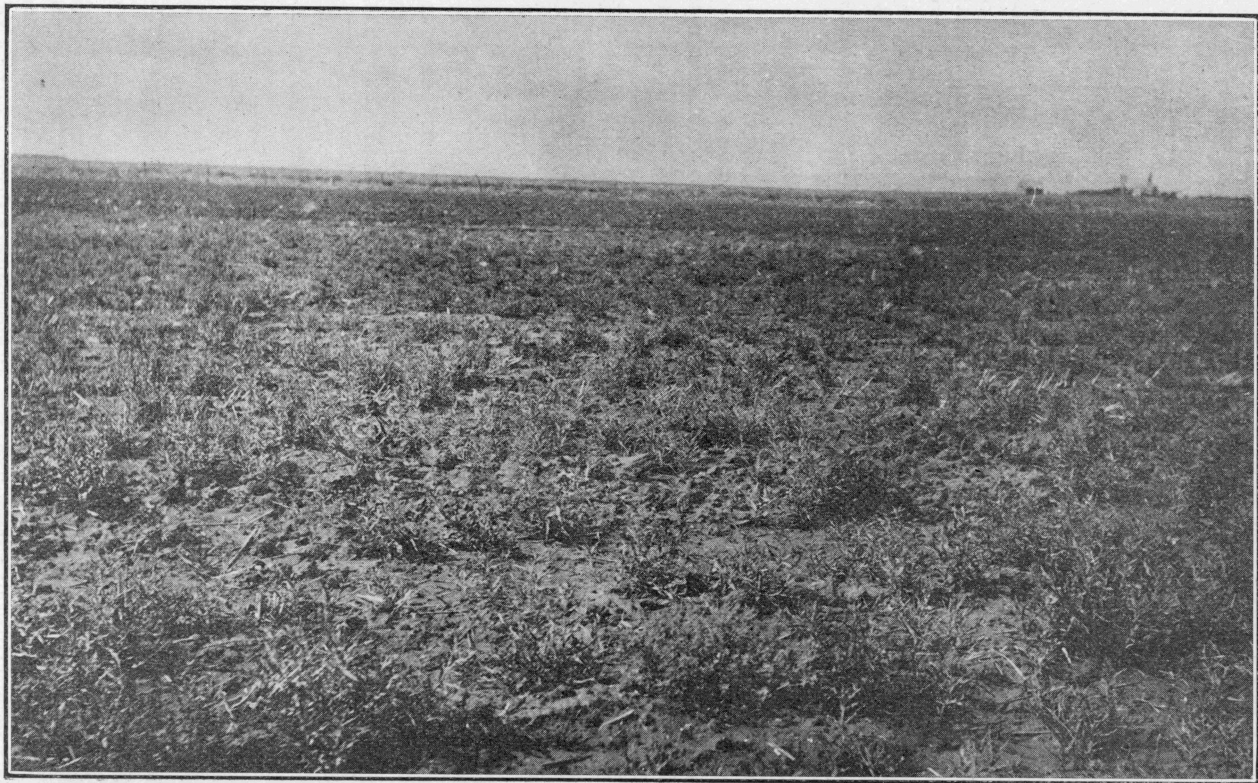


Figure 3. A thick and uniform infestation of the blueweed in cultivated land, as it appeared on the plats at the beginning of the experiments in eradication.

implement covers the ground rapidly and does good work, especially where the land is free from trash and in good tilth.

Plat No. 1 received treatment with this implement. At the end of the season of 1918 this plat still showed a large number of weeds uniformly over the area, but they were thinned out somewhat and their vigor considerably weakened when compared with the growth on the check plat. Treatment the second season still further weakened the plants and reduced the number but did not succeed in eradicating it. Fig. 4 shows this implement in operation. A comparison of the plats shows this method to be about as efficient as the shallow listing.

Deep Plowing.—Plat No. 2 was plowed seven inches deep with a walking plow tearing up the roots of the weed deeply. This treatment was attended by good results from the start and on July 6, the date of the second plowing, only a few of the weeds were still in evidence and putting out new growth. At the end of the first season there were a few scattering weeds still left but this method proved far superior to any of the others. Actual counts, April 15, 1919, showed 395 weeds putting out growth on this plat. These few remaining weeds were completely destroyed the second season.

Shallow Plowing.—The shallow-plowed plat was plowed four inches deep with a walking plow. This treatment did not show to be as satisfactory at the end of the first season as the deep plowing, but it was superior to the other methods. At the beginning of the second season there was a total of 828 weeds showing on this plat or twice the number on the deep-plowed area. These were practically all killed out the second season, but a few scattering weeds remained which were not destroyed. These, however, could quickly be eliminated by hand labor or by cropping efficiently.

Deep Listings.—The land was prepared with a lister equipped with a 14-inch point. The depth of the listing on this plat was seven inches. The weeds were materially thinned out the first year, there remaining only about one-third as many as on the non-treated or check plat, but more than eight times as many as remained on the deep-plowed plat.

Shallow Listing.—Plat No. 5 received the same treatment as the one above except the lister was run only about four inches deep. This treatment gave very poor results, there being at the beginning of the second season slightly more than twice as many weeds still living as on the deep-listed area and more than sixteen times as many as on the deep-plowed area. These were thinned out still further the second season as they were on the deep-listed plat also, but by no means was eradication complete.

Hand-hoeing as a method of eradication was the least efficient of any of the treatments, reducing the number of weeds only about one-fifth over those on the non-treated plat. Hoeing was slightly less effective than cutting with the weeder blade, probably owing to the fact that the latter cut the weeds farther below the surface. While both these operations as well as the listing treatments still left a large number of weeds, they showed much less vigor than those on the check plat. The results



Figure 4. Cutting weeds on Plat 1 with the "weeder blade." Shows appearance of plat and growth of weeds April 15, 1919, after one year's treatment with this instrument.

show that in order to accomplish complete eradication by these methods the work would have to be done at more frequent intervals and pursued for a longer time, and that the desired end can be attained much more quickly and easily by thorough plowing.

Hand-hoeing, hand-pulling, and similar very intensive work is not to be discouraged as there are many cases where only such measures can be employed and they will certainly, if persistently followed out, eliminate this pest, but where possible, less costly and more practical methods should be used. Hoeing and pulling supplementing cultural methods of eradication and as clean-up measures will often be necessary. After a rain when the ground is thoroughly wet, blueweeds can be pulled most effectively. The roots will then break deep in the ground and this practice in itself will in time rid the land of this pest.

These experiments have shown conclusively that the blueweed can be killed out completely in less than two years' time by fallowing the land and plowing at intervals of about two months during the growing season. This is not only a rather remarkably short time but also fewer treatments are given and less labor is expended than would be expected to accomplish the riddance of this persistent pest. It should be stated here that the fact that the season of 1918 was very dry was undoubtedly of great help in facilitating the eradication and it is probable that in wet seasons a greater number of operations would be necessary to accomplish the same results. When the ground is wet the roots and pieces of roots will again take hold in the soil and grow. Much better results will be had if the plowing can be done when the soil is dry, but when once started it must be pursued vigorously to the end or the work will be as good as lost. There is a fallacious idea existing that it is impossible to kill the blueweed. While there is no high and easy road to success in combating this pest it can be destroyed by energetic and methodical cultural practices. There are also occasional farmers who bear evidence of having thus succeeded in ridding their premises of this weed. A continuous effort is necessary to suppress this weed, but the labor is well repaid by the deliverance of the soil from this intruder, which causes a great loss every year in the yield of cultivated crops.

Application of Salt.—Salt applied at the rate of 5, 10, and 20 tons to the acre killed the blueweeds. Eight to ten tons should be used for permanent eradication. Land upon which salt has been applied in such quantities will remain unproductive for a long time, especially in regions of light rainfall. There may be some cases in which this method would be desirable; however, in view of the fact that this weed does not spread rapidly, one would not have gained much in getting rid of a weed patch and adding an unproductive area in its stead.

Covering or Smothering.—Where patches occur in small areas, particularly about the farmstead, it is often practicable to cover them with tarred paper, building paper not easily torn, or sheets of galvanized iron. Thus the light is shut out and the pest smothered.

In the spring of 1919 small patches of blueweed were covered to a depth of two feet with dirt in an attempt to smother it. This proved useless as the weeds soon grew through this covering. They will likewise penetrate or grow through a mulch of straw or manure unless

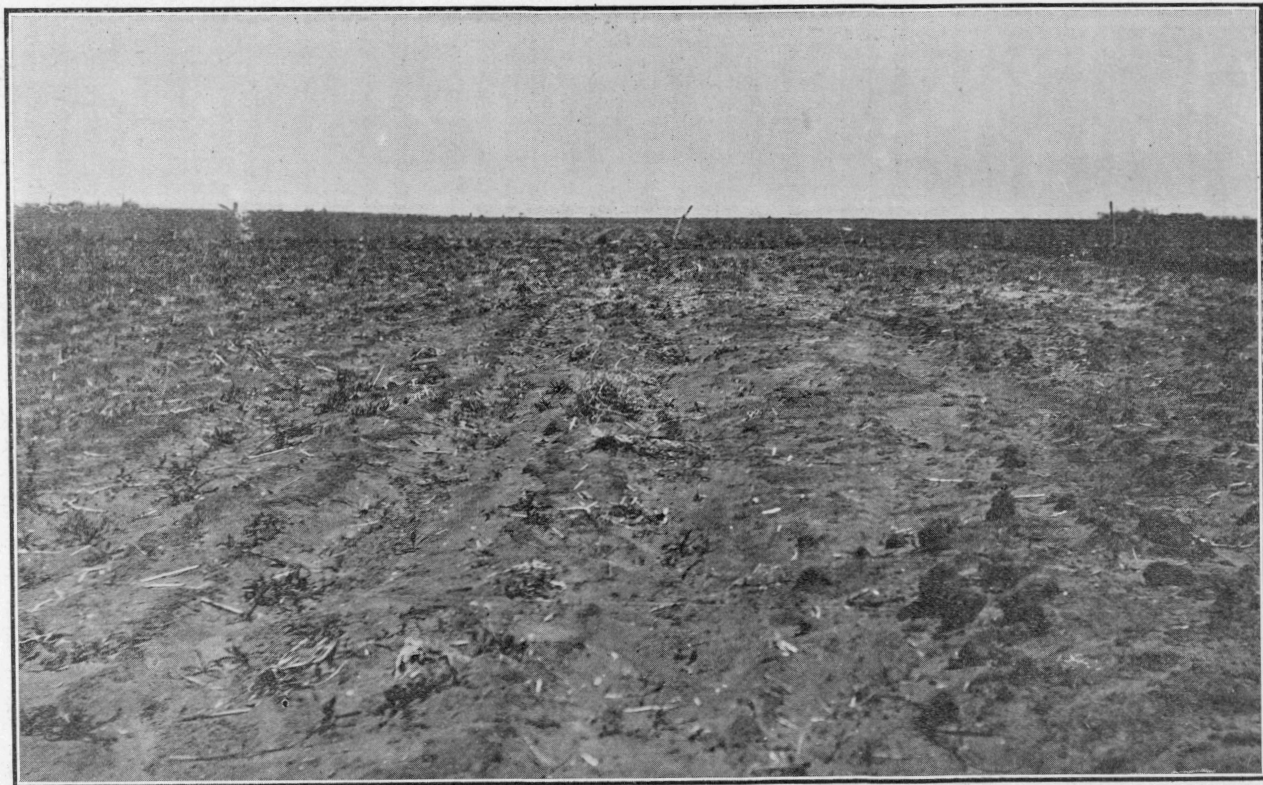


Figure 5. Shallow-plowed plat on right, and deep-listed plat on left; also deep-plowing on extreme right, and shallow listing on extreme left. Photographed April 15, 1919, after one season of work in eradication. Plowed areas are practically free from blueweed, while on the listed areas the pest is still in evidence.

the mulch be very thick. In this section of the State threshing is usually done in the fields and the straw is run or blown from the thresher into a large stack, where it remains for several years. If located over a blueweed patch whenever possible these stacks will form an effective smother.

The nature and occurrence of patches of this weed lend themselves well to the application of combative measures of this kind in a limited way.

CROPPING AND METHODS OF CONTROL.

The greatest objection to clean cultivation or fallowing is that no use is had of the land and this method would be impracticable on a large area. The blueweed infestations on any given farm are generally confined to relatively small patches which as a whole constitute a very small part of the cultivated area. Where this is true, eradication effected by deep plowing and clean cultivation is to be recommended.

If the infestations are large and scattered over a large area, obviously some cropping plans must be adopted, as otherwise the expense would be too great and the method impractical. When a large patch of the cultivated area is infested, the weeds are nearly always comparatively thin on the ground. A cropping plan including deep plowing, the use of a smother crop and clean cultural practices will prove the most efficient.

Observations and experiences of farmers in the blueweed infested sections indicate that wheat or other small grain makes an effective smother crop which keeps down the growth of this weed, but the land must be plowed or given other culture as soon as the wheat is harvested or the weeds will soon become established again. If the moisture conditions are favorable a catch crop of an early maturing sorghum can follow the wheat immediately and be given clean culture. Or the land can be kept clean-tilled or summer-fallowed and seeded again to wheat in the fall. Such continuous cropping will in a few years so weaken the weed that row crops can be grown profitably and by careful and efficient farming the eradication completed.

Sorghum planted thick at the rate of about two bushels to the acre will make a good smother crop. The land should be plowed deep and put in good condition and sorghum planted about the first of May. If an early maturing sorghum such as Freed or Black Amber is used, it can be taken off early and the land put in shape for wheat, rye or emmer, which can be used for winter pasture. If the fall and winter rains have been particularly favorable, a fair grain crop may be harvested. The crop of sorghum, however, is likely to deplete the soil of moisture so that the small grain should be plowed up after being pastured during the winter. The land should then be sowed broadcast to sorghum or Sudan grass or planted to some row crop to be given clean culture.

If large acreages of the farm are infested with the blueweed or it is well scattered over a considerable area it will be found advantageous to attack the problem of eradication on a progressive plan whereby a part of the land is fallowed on successive years until permanent eradication is accomplished. A block of ten, twenty, or thirty acres can be set

aside to be fallowed throughout the season. Thus all weed growth can be kept down on this area while the rest of the farm is cropped as usual. This fallow area should be deep-plowed and harrowed to drag to the surface or in piles all loose roots which would otherwise grow with the first packing rain. Continued plowing throughout the season will give the best results, but the culture can be varied. The weeder blade, disk, or cultivator can be used as needed, but no green growth should be allowed. This fallow area can be cropped the next season and will give increased yields by virtue of the additional moisture stored in the soil. Best results will be had and eradication more nearly completed by keeping this area plowed, listed, or cultivated and absolutely free from blueweed growth in the spring until as late as it is still safe to plant a row crop of quick-maturing grain sorghum such as dwarf milo or feterita. Such treatment if followed up with clean and thorough cultivation will very largely eliminate the weed with the loss of but the crop of a single season. Another similar area can be given the same treatment in years following until the infested areas have all been gone over. Weeds which still persist can be killed out with the hoe, by hand-pulling or the use of smother crops.

If straight cropping to row crops is practiced, very good farming and clean cultivation, indeed, will have to be followed if headway is to be made in eradication. The land should be prepared by flat plowing, as it has been shown that the lister is a poor implement with which to subdue the blueweed even when the land is fallowed. If the lister is used, it can be made more effective by the use of a wide sweep which will cut practically through the bed; however, this will not equal the plow. Where grain sorghum is to be grown the land may be kept listed clean or disked to keep down all top growth of the weed until late and milo or feterita planted the latter part of May or first part of June with good results. This will result in giving the crop a better start to make a good yield, lessen the trouble in cultivation, and at the same time keep the weed under control by weakening its vitality.

Many farmers in cultivating the crop when they come to a thick patch of blueweeds "raise their plows" and drive on through, thinking there will be no crop produced there anyhow and there is no use in cultivating where the weed is growing thick. When the ground is listed in the winter they list on through the patch and loosen up the soil and help the weeds to thrive the next year. Whenever it is necessary to cultivate a crop infested with patches of blueweeds care should be taken to throw the plows in several notches deeper just before such patches are approached. A badly infested area of this kind should be uncropped and killed out by more intense measures. These roots are already well established and distributed throughout the soil so that unless the moisture supply is abundant they soon rob the crop of moisture and gain the advantage in growth, crowding out the cultivated crop, which is forced to struggle along on what moisture it can get in this unfair competition and eventually produces little or no yield. Listing through these patches or cultivating through them half-heartedly simply gives the weed good cultivation and tends to scatter it over uninfested areas by the roots which cling to the lister or cultivator sweeps.

Pasturing blueweed areas will be of little avail. Cattle will eat a little on this weed when it is young and tender, but it soon becomes too tough and apparently develops an odor or taste which is not relished by them and they will not eat it unless forced to do so. Hogs will graze on the weeds considerably when they are not too old and will continue to graze around on them somewhat during the summer, but unless the hogs are confined to a very limited area for a long time such grazing will not effect a permanent control.

A closer understanding of the blueweed and its habits of persistence if well kept in mind in laying out the farm and the location of the farmstead will save an endless amount of work and trouble later on in combating it. Because of the lack of such consideration and careful planning many farmsteads are found which are so badly infested with this weed that only by much effort and hand labor can the pest be eradicated and the grounds be made attractive or profitable. The buildings, fences, trees, and other obstacles about the farmstead make it almost impossible to do effective work with a team in eradication. Hand-hoeing is effective if persistently pursued, but is a long and tedious process entailing a large amount of labor. The worst infested areas can be avoided in locating the farmstead and left in pasture or in the field to be subdued by cultural methods and cropping practices.

The orchard should be located on an area free from blueweeds. It is practically impossible to keep this weed under control in an orchard which is infested with it. The trees will make very poor growth and remain unproductive and finally die prematurely. Orchards in this part of the State must be clean-tilled to be profitable. Numerous instances of lack of care in such locations are in evidence where the orchards are forced to struggle along in competition with the blueweed, resulting in short life of the trees and little or no profit to the owner.

The blueweed is a troublesome weed the same as Johnson grass, white horse nettle, bindweed, or most other perennial weeds, but it can be killed when attacked with vigor and an understanding of its habits. Success lies in keeping the plant from making any top growth. When this section of the State becomes more thickly settled and fewer acres per man are farmed better and more intensively, these infested areas will disappear more rapidly.

CONCLUSIONS.

The blueweed is a close relative of the common sunflower. It is a perennial and propagates itself largely from the underground stems which live over from year to year and are very persistent.

This species is found in parts of West and Southwest Texas where it is a native and grows inconspicuously in the sod. When the land is put into cultivation it becomes a troublesome pest.

The weed produces a large seed crop, but the seed, fortunately, are of very low viability, and reproduction in this way is very limited if at all.

Repeated germination tests of the seed have shown only about one per cent, of germination. The seed required a long time for germination and sprouted at very irregular intervals. The seed seem to be light, some being empty and some apparently destroyed by an insect.

Experiments in eradication of the blueweed have shown conclusively

that it can be killed out completely in less than two seasons by plowing at intervals of about two months during the growing season. Plowing seven inches deep proved more efficient than plowing four inches deep. Listing deep or shallow or cutting the weeds at the surface with a hoe or other implement proved ineffective as means of eradication, and shows that these operations would have to be done at more frequent intervals and pursued for a longer time and that the desired end can be attained much more quickly and easily by thorough plowing as required.

A combination of deep plowing, smother crops, and clean-tilled row crops will prove effective on larger and more thinly infested areas. The badly infested patches should be uncropped and the weed eradicated by more intense measures.

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