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Idaho Perennial Weeds

Their Description and Control

by

H. L. SPENCE and H. W. HULBERT

COOPERATIVE EXTENSION SERVICE IN AGRICULTURE AND HOME ECONOMICS OF THE STATE OF IDAHO UNIVERSITY OF IDAHO COLLEGE OF AGRICULTURE AND THE UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING

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IDAHO PERENNIAL WEEDS

Their Description and Control

by

H. L. SPENCE and H. W. HULBERT[1]

WEEDS have become one of the greatest farm problems in Idaho. Although the control of weeds is one of the oldest problems connected with agriculture, it still remains the most important one. No single farming requirement demands such universal and unceasing attention as do weeds. The expense of fighting weeds represents the largest part of the labor cost required in producing crops.

In Idaho the seriousness of the weed situation is well evidenced by the increased number of requests for identification and methods of control for the various noxious weeds. It is impractical to attempt to cover all the troublesome weeds found in the State in a single publication, therefore, only perennial weeds which are the most serious menace to Idaho agriculture are discussed in this bulletin.

Plants which are native to a country seldom become its serious weed pests. This fact is clearly evidenced by the fact that over 99 per cent of our present weeds have been introduced from foreign countries. Weeds arrived with the first immigrants from the Old World. Families seeking a new home brought with them seeds of crops which they had produced in their native land. These seeds were planted and with them came weeds. When the first crops were harvested the weeds had increased with them. New lands were broken, and gradually these pioneers forged through the wilderness into new areas, breaking the virgin soils and planting the crops which supplied their existence. From early times the spread of weeds can be traced until today every state is well infested. Alfalfa seed from Russia and Turkestan; vegetable and flower seed from the Netherlands, France, Germany, and England; grasses from Australia and New Zealand; soybeans from the Orient; and ships ballast from every port in the world—all have contributed heavily to infest our fields with new weed pests.

Weeds are a tremendous problem. They have made vast inroads into Idaho agriculture in the comparatively short period of time that our lands have been cultivated. While the importance of eradicating our present infestations of weeds cannot be over emphasized, a still greater problem lies in the prevention of future spread of weeds. This can only be accomplished by farmers using increased care in selecting seed stocks and becoming so thoroughly acquainted with the growth habits of serious weeds that they can readily identify them when they first appear in their fields. Patches of perennial weeds too often become well-established before their seriousness is realized and an effort to identify and control their spread is made.

Plates illustrating the more serious perennial weeds and their seeds are presented to aid farmers in identifying weeds. The accompanying plant and seed descriptions are also planned to be of value in identification.

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[1]Extension Agronomist and Agronomist, Agricultural Experiment Station, respectively.

The various recommended methods of control described have been made from the results of an extensive experimental program conducted by the Department of Agronomy, University of Idaho Agricultural Experiment Station, over a long period of years. Every known herbicide has been experimented with on each weed and under the wide variations of soil and climatic conditions which we have within the state. Likewise, extensive experiments have been conducted with clean cultivation as a means of eradicating weeds and recommendations drafted from the results of these trials.

Description of Serious Perennial Weeds

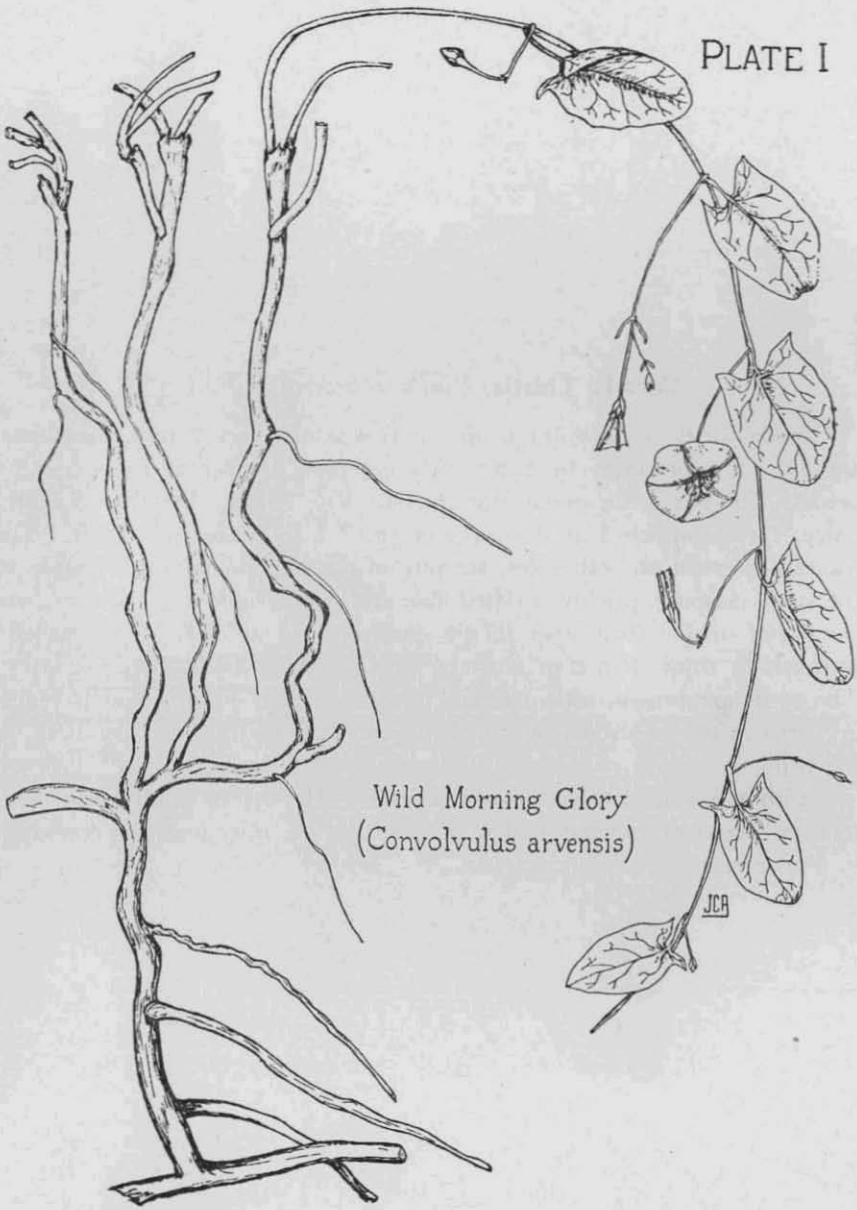
Wild Morning Glory, *Convolvulus arvensis, L.*

This species is the most destructive of the morning glory family, spreading by creeping, horizontal roots and seeds (*Plate I*).[1] On these creeping roots numerous buds form at frequent intervals and start new plants, making a thick mat upon the ground, or twining about any upright plant or object present. The leaves are alternate, smooth, entire oval to oblong arrow-shaped. Flowers range from white to pink in color and are about an inch across. The seed pods are spherical, papery, straw-colored and contain four brownish-black, pear-shaped roughened seeds about an eighth of an inch in length.

Chlorates are very effective in the eradication of morning glory. Cultivation is generally recommended for larger areas. A few reports on the use of alfalfa as a smother crop have been received. This treatment, if a good stand of alfalfa is obtained, merely holds the weed in check until the crop is broken up. Salt and carbon bisulphide are effective controls under proper conditions.

[1]All weed plates reproduced from drawings made by Miss Jessie C. Ayres, State Seed Analyst.

PLATE I



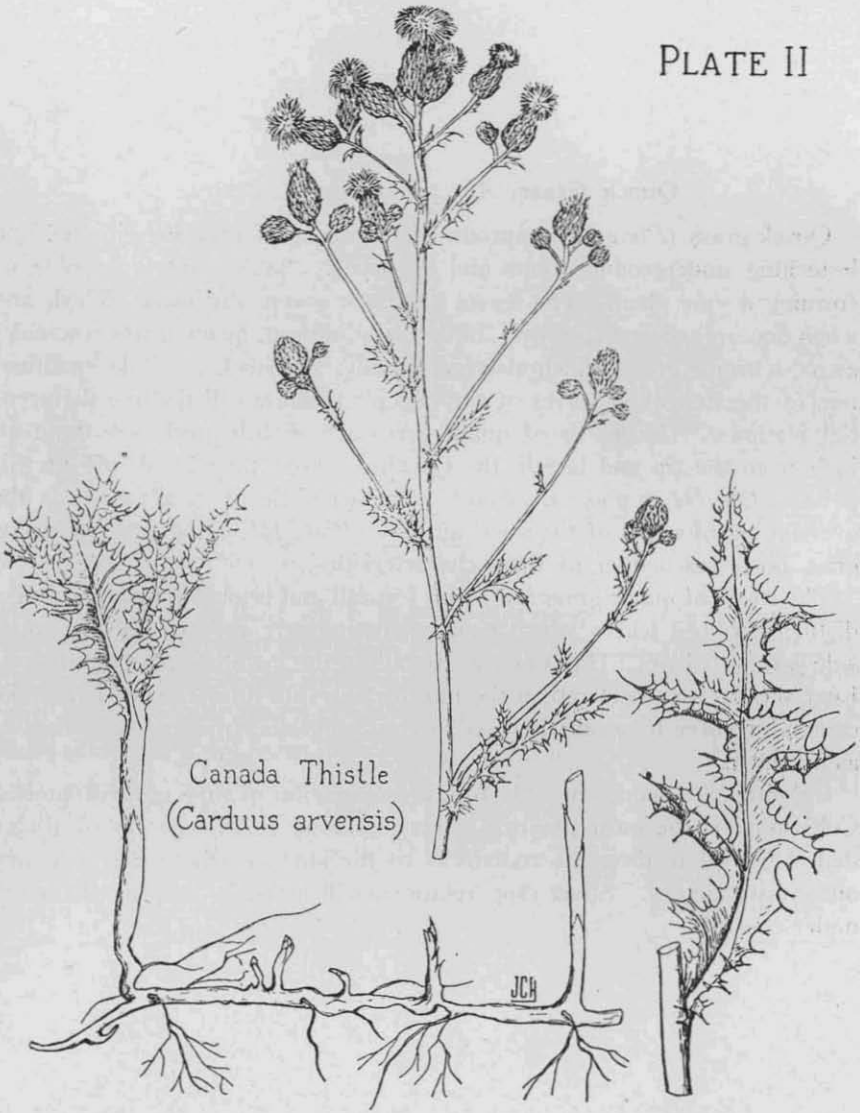
Wild Morning Glory
(Convolvulus arvensis)

Canada Thistle, *Carduus arvensis,* Robs.

Canada thistle *(Plate II)* is the most noxious member of the thistle family. It reproduces by extensively creeping horizontal roots and by seeds. The stems are green, upright, slender, hollow, smooth to slightly hairy, freely branched at the top and from 3 to 6 feet in height. The leaves are green on both sides, smooth on the upper surface, set close to the stem, clasping, prickly, ruffled-like, and deeply notched. Flowers are somewhat smaller than other thistle species, about an inch across, usually purplish in color, borne in clusters with top-most buds blooming first. The seeds are brown, satin-finished, elongated, and equipped with feathery bristles on the crown which aid in carrying them great distances by the wind.

Chemical eradication has proven generally effective in small areas. Cultivation, frequent mowing, and smother crops are other methods employed in its control.

PLATE II



Quack Grass, *Agropyron repens,* Beauv.

Quack grass *(Plate III)* reproduced by means of creeping, jointed and branching underground stems and by seeds. Each joint is capable of forming a new plant. The leaves are dark green, distinctly ribbed, and when dry, roll or curl spirally. Before heading out, quack grass resembles awnless brome grass, which also has running rootstocks. Close examination of the stems and leaves of the two plants shows distinctive differential features. The leaves of quack grass are slightly puckered about an inch from the tip and late in the growing season they break off at this point *(Plate III, b and c)*. Another characteristic of quack grass is the overlapping of edges of the sheaf auricles *(Plate III, a)*. Awnless brome grass possesses neither of these characteristics.

The stems of quack grass are 1 to 3 feet tall and bear flat, graying-green, distinctly ribbed leaves which usually are sparsely covered on the upper side with soft hairs. Hairs are not found on the lower sides of the leaves. Leaf sheaths are shorter than the internodes. The infloresence is a spike containing three to seven flowered, awned spikelets arranged in two rows as in wheat.

Chlorates are successful only for the eradication of undisturbed patches. Cultivation is the most practical control method. Any system of tillage that will tend to drag the rootstocks to the surface where they can dry out is satisfactory. Short crop rotations will assist in keeping the weed under control.

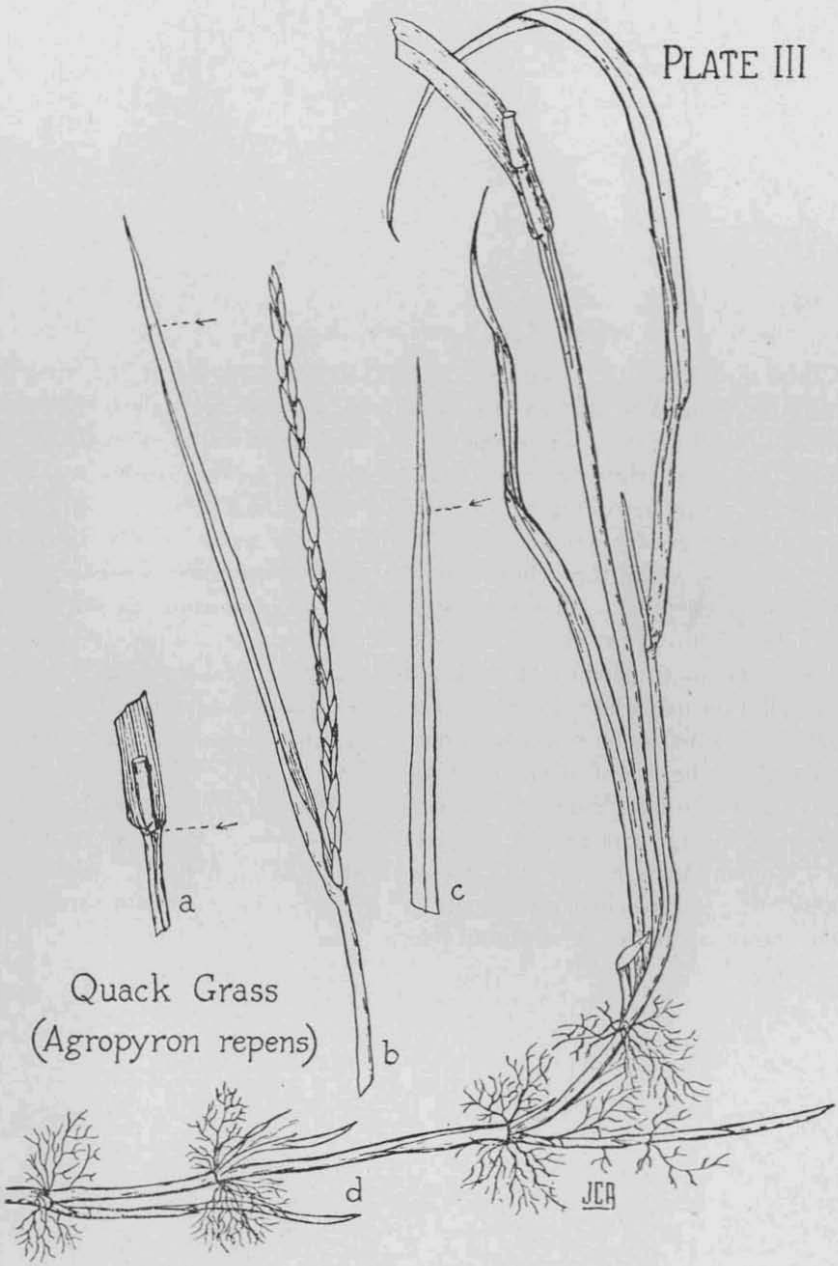


PLATE III
a
b
c
d
Quack Grass
(Agropyron repens)
JCA

White Top, *Lepidium draba,* L.

White top *(Plate IV)* seeds abundantly, has creeping rootstocks and is rapidly becoming a serious weed pest in many sections of Idaho. Although it thrives on all types of soil, it seems to prefer slightly alkaline conditions.

The foliage of white top is of a grayish-green color. Its leaves vary in size and shape according to the fertility of soil and periods of growth. Those of first growth as shown in Plate IV-a, are more slender, inclined to have stems, while those borne on the flower stems are usually more circular and clasping. Abundant moisture in the soil seems to cause the upper leaves to grow more circular. Unfavorable growing conditions cause the plants to produce elongated, less clasping foliage. The flowers are small, greenish-white, borne in large dense clusters, giving a showy appearance and hence the common name white top. The seeds are reddish-brown, about the size of alfalfa seed, and borne in heart-shaped pods. The seed cannot be successfully separated from those of alfalfa or red clover.

Unusually large amounts of chlorates are necessary to eradicate white top. Cultivation is effective in the control of large areas. Carbon bisulphide is effective in irrigated areas. Salt can be used in waste land where other methods are impracticable.

PLATE IV

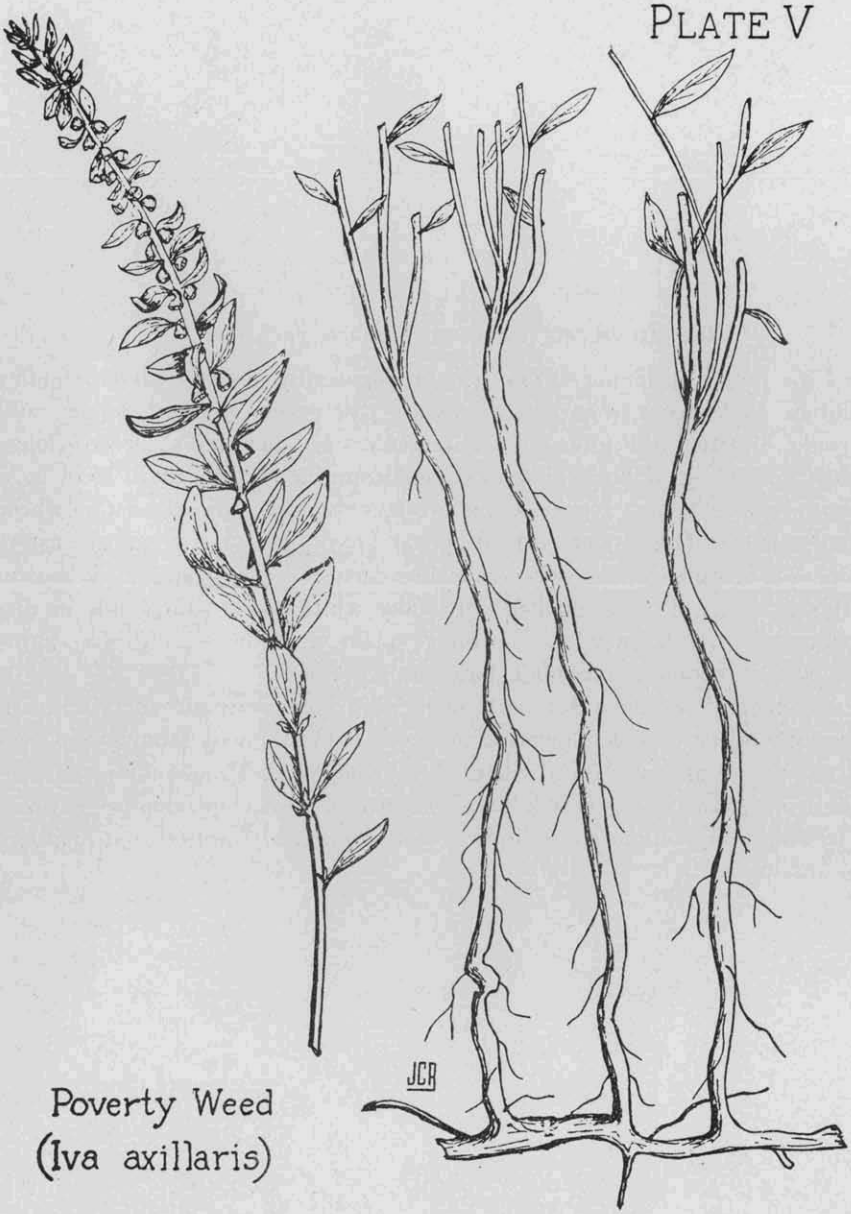
Hoary Cress
(Lepidium draba)

Poverty Weed, *Iva axillaris,* Pursh

Poverty weed *(Plate V)* propagates by means of extensive, tough, woody, creeping roots and seed. It has a wide range of adaptability, endures dust, drought, and alkaline soils. The plant emits an unpleasant odor, making forage and hay distasteful to livestock. Stems are erect, light green, slightly branched, and from a few inches to 2 feet in height. Leaves are narrowly oblong, light green, numerous, of thick, firm texture, stemless, smooth, and from one to one and a half inches long. Flowers are greenish-yellow, rather inconspicuous, solitary, drooping, and borne in the leaf axils. The seeds are egg-shaped, flattened, and vary in color from green to almost black.

Fields infested with poverty weed should not be seeded to any of the small grains. The weed is a vigorous plant and has been known to crowd out corn. Alfalfa seems best fitted to combat it. Infested fields should be seeded heavily to alfalfa, and the crop cut for hay. In cultivated fields thorough and intensive cultivation will assist in keeping the weed under control.

PLATE V



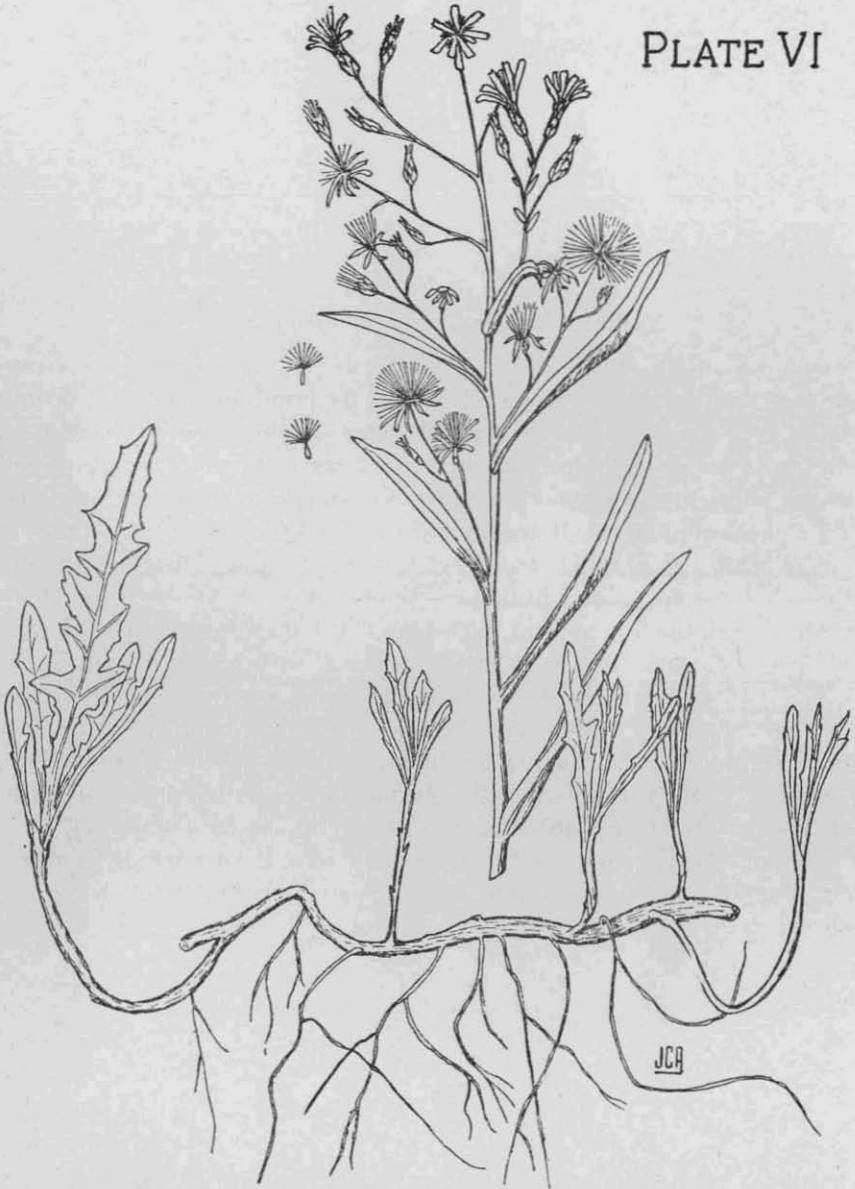
Poverty Weed
(Iva axillaris)

Blue Flowering Lettuce, *Lactuca puchella,* D. C.

Blue flowering lettuce *(Plate VI)* propagates by underground rootstalks and to some extent by seeds. Stems are pale green, smooth, slender, and from 1 to 4 feet in height. The lower leaves are dark bluish-green, elongated, deeply cut or notched, smooth and connected to the main stem by a short, smaller stem. Upper leaves are lance-shaped, smooth, not notched, and stemless. The flowers, which appear from June to August, are aster-blue and arranged in loosely branching clusters. Seeds are dark-brown, ribbed, flattened, and supplied with silky white down which aids in dissemination by the wind. The entire plant, including its fleshy, light-colored root-stocks, contains a bitter, milky juice.

Chemicals, for the most part, have been comparatively ineffective in the eradication of blue flowering lettuce. Prevention of seeding and frequent persistent cultivation will eradicate the weed. Hand pulling or hoeing is effective in newly infested, small areas. In beet producing sections, this crop is a good one to use in the rotation on fields infested with patches of this pest.

PLATE VI



Blue Flowering Lettuce (Lactuca pulchella)

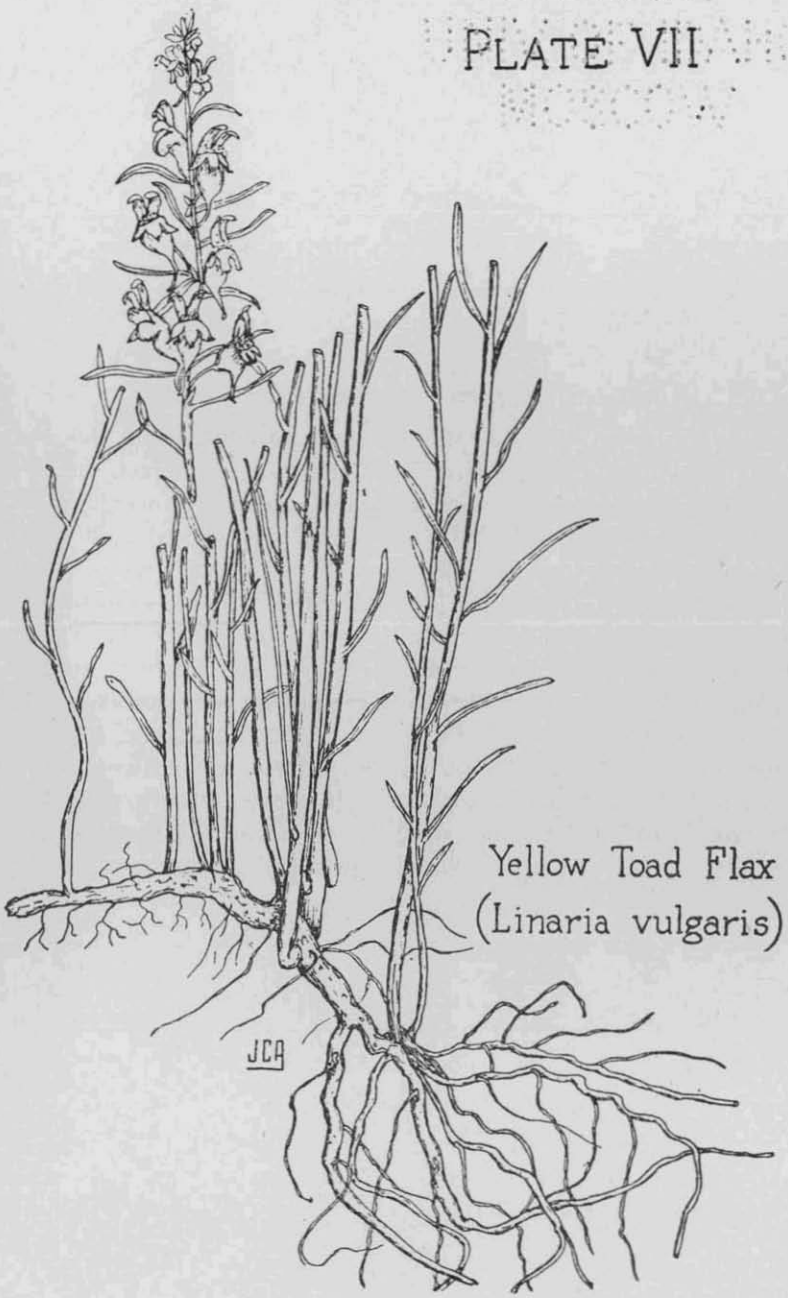
Yellow Toadflax, *Linaria vulgaris,* L.

Yellow toadflax *(Plate VII)* spreads by means of medium deep, creeping roots and by seeds. Livestock dislike its taste and odor and do not molest it in grazing. Usually several stems develop from a single root. The stems are slender, erect, smooth, 1 to 2 feet tall, rarely branched, and contain milky juice. Leaves are numerous, narrow, pointed, stemless, and borne alternately on the flowering stems. Stalked flowers are borne on the constantly lengthening stem, new blossoms forming above as the old ones below mature. Later in the season, other flowers are borne on stems growing from the leaf axils as in the cultivated snapdragon. The flowers are yellow, about an inch in length, two-lipped, with a slender spur at the base. Seed capsules are brown, two-celled, and contain numerous wide-margined, flattened seeds. The seeds are dispersed readily, but are not equipped for wide distribution by the wind like those of Canada thistle.

During recent years this weed has become a serious weed pest in northern Idaho. Its present distribution is largely in the cut-over areas.

Chlorates have been used to successfully combat this weed. Cultivation, beginning with fall plowing and frequent tillage the following season, has been found effective in the control of this weed.

PLATE VII



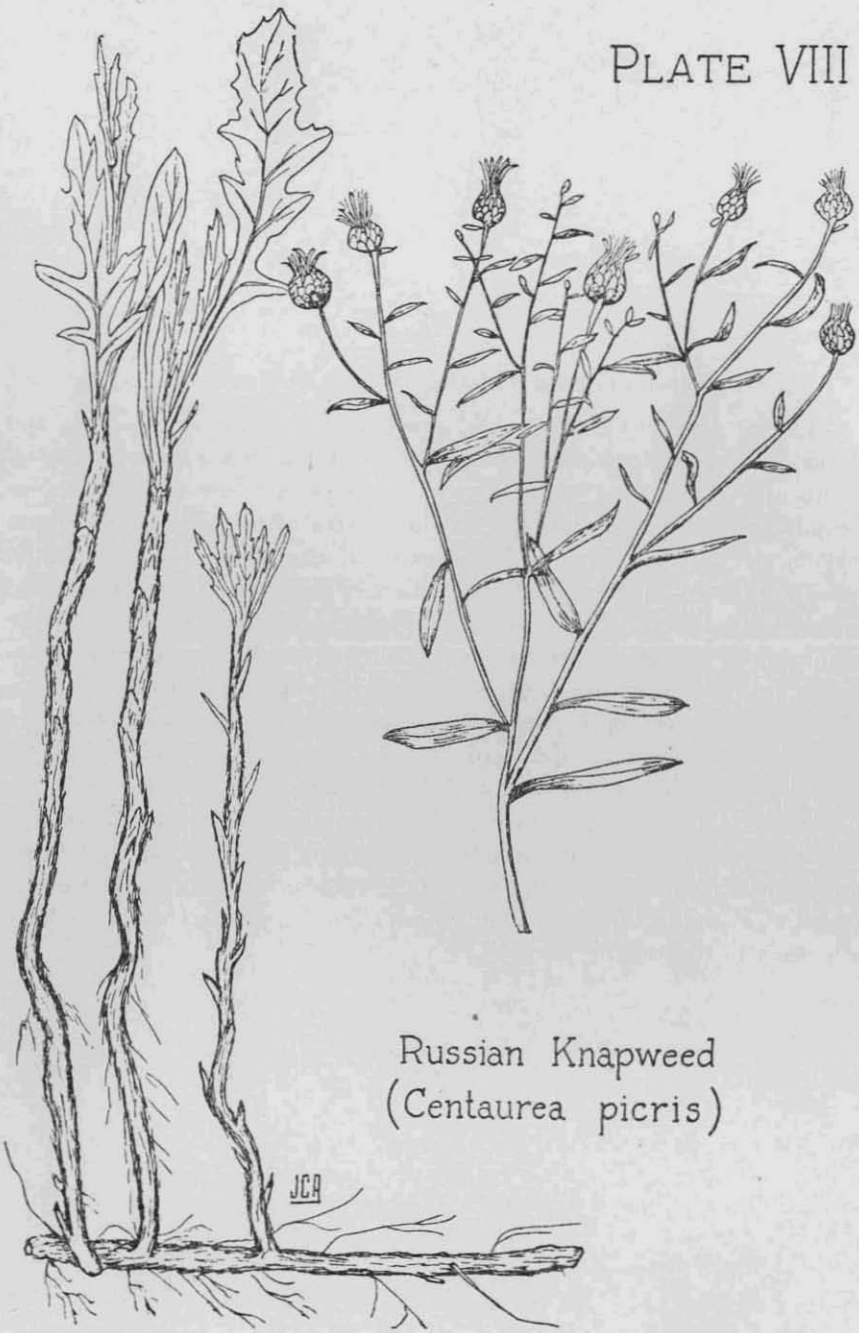
Yellow Toad Flax
(Linaria vulgaris)

Russian Knapweed, *Centaurea picris,* Pall.

Russian knapweed *(Plate VIII)* was first introduced into this country as an impurity in alfalfa seed from Turkestan. It is an erect, rather stiff, several stemmed perennial, with elongated, notched lower leaves and smaller, entire upper ones. The young stems are covered with soft gray hairs or nap. The flowers somewhat resemble those of bachelor's buttons, only smaller, pale lavender in color, and borne in loose, branching clusters. Seeds are somewhat larger than alfalfa, usually wedge-shaped, oblong, whitish-ivory in color, and crowned by whitish, stiff bristles. In general, the plant seeds sparingly. The underground creeping roots are black, woody, and scaly.

Care should be used in the purchase of alfalfa seed to be sure it contains no seed of Russian knapweed. Chlorates have proven very effective in the eradication of this weed. Cultivation, because of the heavy, tough rootstocks, has been of little value except for the prevention of further spread.

PLATE VIII



Russian Knapweed
(Centaurea picris)

Perennial Sow Thistle, *Sonchus arvensis,* L.

Perennial sow thistle *(Plate IX)* propagates by wind borne seeds and deeply creeping underground roots. The plant contains a milky juice and attains a height of 2 to 5 feet. Stems are stout, smooth, hollow between the joints, and finely grooved. The leaves are arranged alternately and vary in size and shape in different parts of the plant. In general the leaves are elongated, deeply notched, with a large terminal lobe, and turned back side or lateral lobes. The upper leaves are stemless, clasping the main stem by a heart-shaped base, edges slightly toothed and prickly.

Sow thistle flowers are small, yellow and grouped in flat-like clusters. The flowers, when open, resemble those of the dandelion. Seeds are reddish-brown, about an eighth of an inch long, flattened with a rough ridged surface, and tufted with fine, white hairs.

Chemicals, in most cases, have not been very satisfactory in the control of sow thistle. Prevention of seed production is the first step in control. New infestations should be destroyed before the rootstocks become established. Cultivation, frequent mowing, and the use of smother crops have been used to control the weed.

PLATE IX

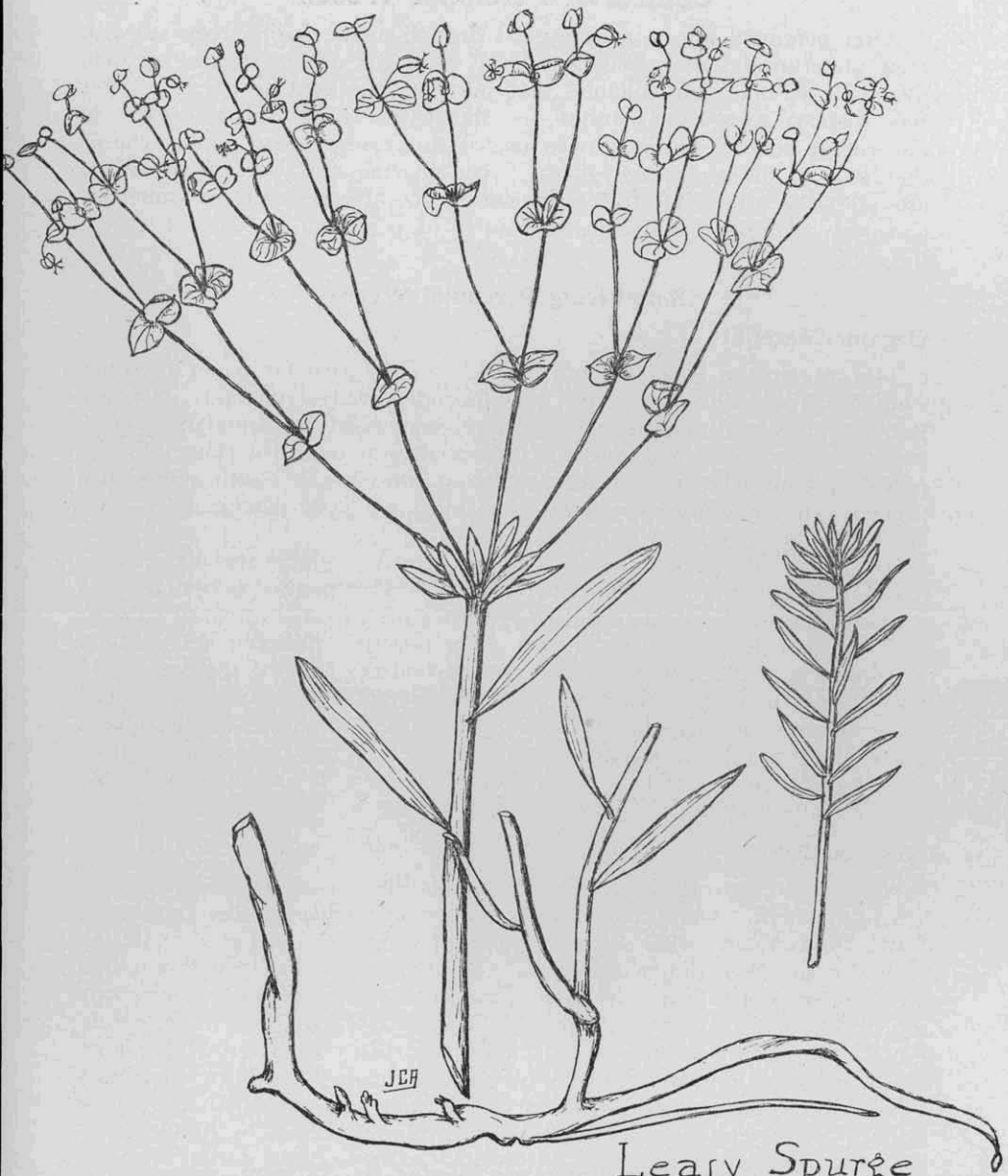
Perennial Sow Thistle
(Sonchus arvensis)

Leafy Spurge, *Euphorbia esula*

Leafy spurge *(Plate X)* is a perennial herbaceous plant with milky sap. The plant reproduces by seeds and creeping rootstocks. The stem is erect, from 1 to 3 feet high, unbranched, except at the top below the flower cluster. The leaves are long and narrow, about one-fourth inch wide, entire, pale green and alternate. Several staminate flowers and one pistellate flower are surrounded by a yellow, cup-shaped structure. The grayish seeds are borne in a three-seeded capsule which explosively opens and throws the seed in all directions. According to Hansen and Rudd[1] the seeds are often thrown as far as thirteen feet.

Large amounts of chlorates are essential for eradication of leafy spurge. Persistent and thorough tillage will successfully control this pest.

[1]Hansen, H. C., and Rudd, V. E. Leafy Spurge - Life History and Habits. No. Dak. Sta. Bul. 266, 1933.



Leafy Spurge
(Euphorbia esula)

Control of Perennial Weeds

After perennial weeds make a good growth in the spring they store in their underground root systems reserve food for use in starting growth the next season. Any method that prevents the replenishment of this food material causes the plants to use the reserve food already present in the storage roots. The continued use of this reserve food supply causes the roots to die and finally decay. Smothering and continuous tillage are practices often effective in depleting this food supply. Numerous chemicals are also effective in the control of perennial weeds with creeping roots.

Smothering Perennial Weeds

Organic Material

The covering of small perennial weed patches with tar paper or other smothering materials has been a recommended control method for many years. Straw and manure have been recommended for smothering purposes. Under most conditions such material is of doubtful value. To be of value, it must be piled on the patch to a considerable depth and tightly packed. In a few instances, very small morning glory patches have been eradicated by covering with sheet iron.

In general, decumbent weeds such as morning glory are difficult to eradicate by smothering with organic materials. This method is best adapted to upright, growing weeds. Before covering the infested area, all rubbish and top growth should be removed. The covering material should then be applied so that it extends 4 to 5 feet beyond the edge of the patch. If tar paper is used the strips should be overlapped and the seams covered with soil or sealed together to form a solid roof. Canada thistle, quack grass, and St. Johnswort have been eradicated by the tar paper method. Unsuccessful results with morning glory have been reported from Idaho, California, and Utah.

Smother Crops

Numerous crops, thickly seeded are oftentimes used to hold perennial weeds in check. Hemp, sunflowers, millet, buckwheat, sudan grass, alfalfa, sorghum, and other vigorous rapid growing crops are used. Alfalfa is one of the most practical because it is cut frequently. Smother crops are more successful if the weeds are first weakened by tillage. Such crops are likely to be of greater value in holding late starting weeds in check. Smother crops are of little value in the control of early growing plants like white top. Morning glory and Canada thistle have been controlled by thickly seeded stands of alfalfa. Quack grass and perennial sow thistle are not effectively controlled unless previously weakened by tillage.

Controlling Perennial Weeds by Tillage

There is no quick and easy tillage method of ridding land of well established patches of perennial weeds. Since the top growth manufactures the food used by the plant, eradication by tillage requires sufficient effort to keep all top growth from appearing above the surface of the soil. The time necessary to effect eradication is dependant upon the amount of

stored up food and the thoroughness of the tillage. The completeness of eradication is in direct proportion to the thoroughness of the tillage, the timeliness of the operation, and the favorableness of the climatic conditions. In general, it is advisable to begin the tillage as soon as the first shoots appear.

Quack Grass

Tillage equipment which drags the rootstocks to the soil surface where they dry out and die is considered best for quack grass. Infested areas should be plowed anytime previous to seeding. Subsequent tillage with a spring-tooth harrow or heavy-duty, wheeled spring-tooth cultivator is most satisfactory. In some cases two or more plowings during the season facilitates the subsequent spring-tooth tillage. The second year a cultivated crop can be planted if the first season's work was thorough. If a cultivated crop is used, care should be exercised to eliminate all weed plants showing growth. Some farmers successfully use a duck-foot cultivator in place of the spring-tooth harrow.

Canada Thistle

Bare-fallow will control Canada thistle. Tillage should begin by plowing just previous to blooming time. The first plowing should be shallow enough to avoid disturbing the underground creeping rootstocks. A second, deeper plowing should be given late in the fall, turning up as many of the rootstocks as possible. Between the plowings, the area should be tilled with a duck-foot at sufficiently frequent intervals to keep down all top growth.

Wild Morning Glory

Tillage is less successful in the control of morning glory than for quack grass or Canada thistle. Usually, cultivations must be more frequent to keep down the new shoots. Spring plowing followed by a duck-foot or similar equipment is a satisfactory procedure. At least two seasons of frequent and thorough cultivation are necessary. An occasional replowing during the tillage season is often advantageous.

Perennial Sow Thistle

A duck-foot cultivator is the best tool for tilling areas infested with this weed. It is best to begin the tillage without plowing or discing. Just previous to the blooming period, plowing will facilitate the tillage operations. Sow thistle roots are brittle and cannot be dragged to the surface like those of quack grass. In some cases tillage is begun in late summer after the removal of the season's crop. If this procedure is followed, tillage should continue throughout the next summer.

Blue Flowering Lettuce

This weed occurs largely in the dry farm areas. Under these conditions the plant may be eradicated by two years of summer fallow supplemented by sufficient additional tillage operations to keep down all green growth.

White Top

Two seasons of thorough tillage followed by two years of check-rowed crops is the most economical and practical method for eradicating large infestations of this weed[1]. Irrigation of tilled areas did not facilitate or hinder the eradication of white top. This was due to the fact that carefully cultivated areas retained sufficient moisture to keep the weed plants growing vigorously. The tillage method should consist of early, deep plowing followed by sufficiently frequent cultivation with a duck-foot or rotary-rod weeder to keep down all green growth. A second plowing during midsummer greatly facilitated eradication and is essential if a rotary-rod weeder is to be used.

Chemical Control of Perennial Weeds

Extensive experiments with a large number of herbicides have been conducted throughout the state by the Department of Agronomy, Idaho Agricultural Experiment Station, since 1927. The suggestions and recommendations herewith presented are the direct results of this extensive experimental program. The various chemical treatments recommended and discussed herein have proven to be the most successful under Idaho conditions.

Chlorates

Chlorates, when properly applied in sufficient quantities, have proven generally effective in the control of perennial weeds with creeping roots or underground rootstalks. Sodium chlorate, pound for pound, is approximately 25 per cent more effective than commercial calcium or magnesium chlorates but also creates a more serious fire hazard unless applied dry to the soil.

Since 1927 nearly 4,000,000 pounds of chlorates have been used by Idaho farmers in weed eradication work.

Use Chlorates with Caution

In using sodium chlorate, extreme care must be used to keep fire away from sprayed patches after drying. Friction oftentimes sets the dry, sprayed patch afire. Clothes worn by the person doing the spraying should be washed before being worn again. Rubber boots, if available, should be worn when spraying and washed off with water after use. *Do not take any chances.* The dried spray material is a dangerous fire hazard. Commercial calcium and magnesium chlorate are slightly less dangerous but will burn readily after drying. All mixing of chlorate sprays should be done away from buildings, as sodium chlorate mixed with dust forms an explosive mixture.

Methods of Applying Chlorates

Chlorates usually are applied in a water solution in the form of a fine, misty spray, although recent experiments show dry applications to be

[1]Hulbert, H. W., Spence, H. L., and Benjamin, L. V. The Eradication of Lepidium draba. Jour. Am. Soc. Agron. Vol. 26, No. 10, 1934.

equally effective[1]. A fine spray gives a more uniform coverage of the weed area than is possible with coarser sprays. The application of the total amount of chemical necessary in two separate applications has given better results than an equivalent amount put on in one application. Spray treatments must be made carefully and thoroughly to insure satisfactory control.

In dry applications the powdered chlorate is dusted over the infested area at the proper rate by a uniform method. Dry applications are made on the soil usually by hand. This method eliminates the fire hazard, requires less chemical, and permits the use of shallow cultivation to prevent seeding of the weed plants.

When to Apply Chlorates

Although successful weed control has been obtained from early spring and summer applications, the best kills are secured from applications made after the plants have attained their full growth. This state is indicated by the appearance of the first flowers. After blooms appear, chlorate applications can be made at any time before the soil freezes. Complete kills have been obtained from applications made after all of the top growth had been killed by frost. If early applications are made, it is preferable to use a light treatment to prevent seed formation; then follow with a heavy second spray.

Dry chlorate applications should be made in late summer or early fall by dusting the dry powder over the infested area. Shallow tillage with a duck-foot may be used to keep down the weed growth and prevent seeding during the entire growing season before the treatment is applied. The elimination of this growth facilitates the application of the dry chemical. If desired the bare, tilled area may be treated by spraying. Dry treatments are effective because the chemical is applied directly to the soil and taken up by the roots of the weed plants.

Care of Weed Patches Before Treatment

Weed patches to be sprayed should be left undisturbed during the season previous to treatment. If the remainder of the field is to be cultivated, the weed patch should be isolated. Patches in grain crops may be sprayed immediately following harvest, applying the chemical to the portions of the weed plants left by harvesting machinery. Good kills of most weeds have been secured by mowing the patches just previous to treatments. In fact, where there is exceptionally heavy weed growth, it is advisable to mow and remove the top growth previous to spraying. Also, mowing the patch and allowing the weeds to make some new growth before spraying has proved satisfactory.

Care of Weed Patches After Treatment

Sprayed patches should be left undisturbed until late spring following treatment. Then if scattering plants occur, they can be destroyed by another chlorate application or by follow-up treatment with carbon bi-

[1]Hulbert, H. W., and Benjamin, L. V. Dry Applications of Chlorates. Ida. Agr. Expt. Sta. Circ. No. 74, 1935.

sulphide. Burning, irrigating, or cultivating the weed patch after treatment or any time before growth starts the following spring usually results in failure.

Commercial calcium chlorate is slower in its action than sodium and consequently it is especially important not to disturb such treatments until late the following spring.

The treated areas should be watched very closely for the appearance of seedlings, and, if these appear, they should be destroyed by a light, surface cultivation. Regrowth sometimes starts the following spring from old crowns. In this case cultivation will remove the danger of a reinfestation. Even after weed patches have again been put into crop production, they should be closely watched to prevent the growth of any seed which might have been in the ground and which will grow as soon as brought under proper conditions. Investigations by the United States Department of Agriculture have shown that wild morning glory seeds which had been lying dormant for 30 years, sprouted in two days when brought to the surface.

Dilution of Chlorate Sprays

The standard dilution for chlorate sprays is one pound of chemical to a gallon of water. Stronger dilutions have given decidedly poorer results with all weeds. The use of dilute solutions enables the operator to cover the infested areas thoroughly without the use of excessive amounts of

TABLE I. The rate of application of chlorates necessary to eradicate various perennial weeds in Idaho.

Kind of Weed		Rate of application in pounds per square rod			
		Sodium chlorate		Commercial calcium or magnesium chlorate	
Common Name	Scientific Name	Irrigated Soil	Non-irrigated soil	Irrigated Soil	Non-irrigated soil
Morning glory	Convolvulus arvensis	4	2	5	3
Canada thistle	Carduus arvensis	4	2	5	3
Russian Knapweed	Centaurea picris	4	2	5	3
White Top[1]	Lepidium draba	6	5	8	6
Perennial sow thistle	Sonchus arvensis	6	5	8	6
Quack grass	Agropyron repens	5	4	6	5
Blue Flowering lettuce	Lactuca pulchella	6	5	8	6
Poverty weed	Iva axillaris	4	2	5	3
Yellow toadflax	Linaria vulgaris	*	3	*	4
Leafy spurge	Euphorbia virgata	*	5	*	7

*Not yet found under irrigation.

[1]Best results are secured with white top when the chemical is applied in two applications. The first application should be made at the rate of one pound per square rod.

chemical. Strong solutions not only cause poorer kills but increase the cost of weed eradication by the use of more chlorate than is necessary. Table I tabulates the amount of chemical needed for eradication of perennial weed species in Idaho.

Carbon Bisulphide

Carbon bisulphide is effective at any time in the irrigated areas where the moisture content of the soil can be controlled. In many cases, spring applications in non-irrigated soils high in moisture content have been successful. This chemical is quite expensive and has been used in Idaho mainly for killing small patches and follow-up work.

Carbon bisulphide should be applied in two ounce doses in holes spaced 18 inches apart each way. The holes should be from 6 to 8 inches deep for white top or quack grass and from 8 to 10 inches deep for other weeds. As soon as the chemical is applied the holes should be thoroughly tamped to prevent the escape of the gas.

In using carbon bisulphide it is very important that the soil be well saturated with moisture to a depth as far as penetrated by the main roots of the weeds. Unless this is accomplished much of the gas will be lost and a spotted kill will result. When used under proper conditions and properly applied, carbon bisulphide can be very effectively used for eradication of small areas and for spotting of plants remaining after the application of chlorate or following clean cultivation.

Carbon bisulphide can be purchased by your county agent in drum lots at a cost of approximately 4½ cents per pound, f.o.b. Stege, California. A drum contains 55 gallons and weighs about 550 pounds. Five drums are required to treat an acre when used at the recommended rate.

Other Chemicals

A number of other commercial weed killers, usually highly recommended by those who sell them, have been tried carefully by the Experiment Station with unsatisfactory results. This group includes arsenicals, ammonium thiocyanate, and mono-chloronaphthelen, all of which have been complete failures under Idaho conditions.

In general, highly advertised, guaranteed 100 per cent methods sold at low prices, special machinery, and oil burners all are of doubtful value in the control of all perennial weeds propagating by underground creeping rootstocks.

Salt in sufficient quantities will kill all perennial weeds, but its use has been largely eliminated because of high cost and detrimental effect upon the soil.

Further information on chlorates may be obtained from Idaho Experiment Station Bulletin 189, *Methods Affecting the Efficiency of Chlorate Weed Killers* and from Circular 74, *Dry Applications of Chlorates*. These bulletins may be obtained by writing to the Director, Agricultural Experiment Station, Moscow, Idaho.

Publications on Agronomy Available for Free Distribution

Following is a list of the Agronomy publications of the Agricultural Experiment station and the Agricultural Extension Division, College of

Agriculture, University of Idaho, available for distribution. Any of these publications may be obtained free upon request. Write to the Agricultural Experiment Station, Moscow, or Agricultural Extension Division, State House, Boise, Idaho.

Agricultural Experiment Station Bulletins

115 *Field Pea Production in Northern Idaho*
120 *Forage Crops for the Non-irrigated Lands of Idaho*
141 *Growing Sunflowers for Silage in Idaho*
145 *Rate, Date and Depth of Seeding Winter Wheat Under High Altitude Conditions*
148 *Growing Clover Seed in Idaho*
158 *The Cut-over Lands in Northern Idaho*
169 *Alfalfa on the Cut-over Lands of Northern Idaho*
177 *Crops to Replace Spring Wheat in Northern Idaho*
178 *Grains for the Cut-over Lands of Northern Idaho*
181 *Rate of Seeding Peas*
186 *Tillage Methods for High Altitude Dry Farming*
189 *Methods Affecting Efficiency of Chlorates as Weed Killers*
199 *Adaptability of Alfalfa Strains and Varieties for Idaho*
201 *Reseeding Burned-over Lands in Northern Idaho*

Agricultural Experiment Station Circulars

35 *Federation Wheat*
60 *Puncture Vine—A new Pest in Idaho*
65 *Pure Seed Law*
71 *Reed's Canary Grass*
72 *Cultural Practices for Alfalfa in Northern Idaho*
74 *Dry Applications of Chlorates*

Technical Papers

120 *The Eradication of Lepidium draba (white top)*
121 *Effect of Seed Injury upon the Germination of Pisum sativum (Peas)*

Extension Division Circulars

36 *Idaho Law on Control of Noxious Weeds*