24. Weed Control Methods

This and the following chapter develop the subject of weed control on the basis of methodology. Subsequent chapters consider control problems by crop kinds, and in terms of specific weeds.

A multi-directional appraisal inevitably involves a certain overlapping of subject matter. For example, Canadian thistle *(Cirsium)* is discussed as one of the relatively important weed kinds in the North Central states. It also receives attention with respect to an elaboration of the usefulness of various herbicides (e.g. amino triazole); likewise, one can scarcely evaluate weed problems in certain crops without treating the role of this weed. Possibly this results in some redundancy; if so, the author presents no apology. Our subject is not susceptible to a linear approach.

CLASSIFICATION OF WEED CONTROL METHODS

Control methods will be considered under the following headings: (1) Mechanical, e.g. cultivation and mowing, (2) cultural or cropping, (3) burning, (4) biological, (5) chemical (treated in the following chapter).

Control procedures ordinarily involve mechanical, cultural, and chemical methodology. Discussion of these items separately does not imply that certain weeds are controlled by one method to the exclusion of others; usually a combination is employed. Farming necessarily involves a cropping procedure and cultivation. Most weeds can be controlled by the intelligent use of ordinary farming procedures.

MECHANICAL METHODS

Seed Bed Preparation

Seed bed preparation is of principal significance in the control of annual weeds. Its purpose is to reduce weed seed populations in the upper soil layers, prior to the planting of the crop. Plowing is followed by repeated shallow disking or harrowing, and may be carried out at

7- to 10-day intervals. The germination of weed seeds is stimulated and seedlings are destroyed. Such a procedure is especially advisable if an area is badly infested with annual weeds, in which case a late planted crop such as soybeans will allow the land to be repeatedly worked beforehand.

Some recent studies have questioned the effectiveness of repeated preplanting cultivations, and to this extent a definitive position on this topic may not be in order. Most weed control specialists appear to feel that further evidence is desirable before any extensive modification in the above concept is justifiable.

Cultivation

If annuals are the principal consideration, cultivation should be shallow (also for quackgrass) in order to avoid damaging crop roots and so as not to bring up further weed seeds from lower levels of the soil. The rotary hoe, discussed below, is especially valuable for seedlings of annual weeds.

Following harvest of small grains, weed infestations in the stubble sometimes become serious. In some instances, disking or harrowing to destroy the weeds and prevent seed production may be advisable. This may involve the decision as to whether maintenance of a legume understory or destruction of the weeds is most important.

With respect to the majority of perennials, cultivations should be timed, insofar as possible, to catch root reserves at the low point. This applies both to the seasonal cycle as previously discussed and the depletion of reserves after cutting. In general, cultivation is aimed to cut roots three to four inches below the soil surface. As previously discussed, a week may be required for plants to re-emerge and another week before sufficient foliage has developed so that food is produced faster than it is used for growth. Precise rate of emergence naturally depends upon the season and differs between weeds. Nothing is usually gained if cultivations are closer than at two-week intervals; under unfavorable growth conditions three weeks may be better.

Shallowly rooted perennials (e.g. quackgrass) may be subjected to starvation procedures as above described, or alternatively, the rhizomes may be amenable to destruction. The infestation or sod should first be disked to cut up the rootstocks and to facilitate subsequent cultivation. Succeeding operations should be carried out at regular intervals with a spring-tooth harrow even if there is little regrowth. The net result is that the root and rhizome system will be brought to the surface where a large proportion of the fragments will dry up and die. This procedure can follow removal of a grain crop or can be carried out in grassland. Its effectiveness can, in the latter situation, be increased if the area is heavily grazed or mowed prior to treatment.

Fallowing

Summer fallowing to conserve moisture is an accepted practice in much of the more arid portions of the Great Plains. It can also be employed as a method of controlling perennial noxious weeds without the complications of integrating control procedures with practices necessary to get a crop off the land. Fallowing usually is not recommended in the more humid portions of the North Central states. It is ordinarily possible to grow some kind of a crop at the same time the weed control is progressing.

Chemical summer fallows are receiving experimental attention in some of the western states.

Cultivation Tools

The use of the plow is followed by the employment of several kinds of implements which, by working the soil, keep subsequent weed growth down.

The rotary hoe is especially useful for small annual weeds in corn and soybeans. Its utilization when the crop and weed seedlings are small will reduce the number of cultivations needed with sweep or shovel cultivators. The rotary hoe consists of spoked disks with hooks around the margin. These (the hooks) will uproot small seedlings if the soil moisture is right and if the machine is pulled at proper speeds (usually 10 to 12 miles per hour). The hoe will not destroy well-established weeds or deep-rooted perennials. Its greatest usefulness with corn extends from pre-emergence until the crop is 2 to 8 inches high. The operation has been estimated to cost \$0.60 to \$1.00 an acre (depending on whether 2 or 4 row) and thus costs less than shovel cultivation, \$1.05 to \$1.35 per acre; also it can be completed much more rapidly.

Contrary to the above, some workers express reservations concerning the rotary hoe. They point out that the requirements of precise timing and crusting of soil surface are difficult to fulfill, and that if these conditions are not right, inadequate weed control will result. The value of the rotary hoe is limited to annual weeds. In crops like sorghum, considerable stand injury may ensue.

The duck foot cultivator is effective against perennial weeds. The sweeps should overlap three to four inches. The spring-tooth cultivator or harrow operated at a depth of two to three inches is also effective against such weeds.

Mowing

Mowing is pertinent for areas not subject to cultivation, e.g. pastures, hayfields, roadsides. Subsequent to small grain harvest, mowing may be the most applicable procedure to prevent seed formation by late season weed infestations. If properly timed, mowing can essentially prevent seed production of annuals and progressively weaken perennials.

Hand Operations

Hand operations, hoeing, spudding, or spraying scattered plants may nip an incipient infestation in the bud. Also, hand removal of the last survivors after a weed stand has essentially been brought under control is often necessary if eradication is desired. The hoe is still king in the home garden. Furthermore, probably more than half the total production of food in the world is still dependent on hand operations for weed control.

CULTURAL OR CROPPING METHODS

Competition

When weeds and crop plants grow together they compete for light, water, and mineral nutrients. Weeds are frequently successful because, under many conditions, they are better competitors than crop plants. However, farming practices are capable of affecting the degree to which crop plants can successfully compete with weeds. Strong germinating seed will give the crop a vigorous, close stand which, with a head start on the weeds, may make it difficult for them to get underway. On the other hand, poor seed, resulting in a spotty stand, will leave open areas in which the weeds will take over, ultimately dominating adjacent crop plants and reducing yield. Some crops are much better competitors than others, and the choice in terms of the weed situation will greatly influence the outcome. For instance, crops like sudan grass and soybeans are good competitors, while flax is relatively poor. Highly competitive crops are often planted for the primary purpose of reducing weed infestations. Varieties which are well-adapted to a given growing region will obviously compete better than poorly adapted varieties.

Management practices such as proper fertilization, liming if necessary, etc., are important as weed control measures as well as for their direct effect upon potential yield. Many weeds are capable of thriving under low fertility conditions while the crop plants are not. Increased fertility shifts the competitive balance in favor of the crop. An additional factor affecting weed-crop competition is grazing. Overgrazing is a basic cause of weedy pastures. Animals prefer selected grasses and legumes to weeds; if overgrazed, the ability of the forage species to compete with the weeds will be severely reduced. The reduction of the grazing value of our western ranges, together with the widespread invasion of annual weeds and the increased prevalence of poisonous species, is a consequence of overgrazing over a period of years.

Smother Crops

Most frequently employed smother crops include forage sorghums, sudan grass, soybeans (best in solid stands), alfalfa, or on bottom land, reed canary grass. Recommendations for the control or the reduction of many of our noxious weeds involve a clean cultivation followed by the use of a smother crop. In this way it is possible to get a crop from the land and reduce the weed problem simultaneously.

Smother crops have limitations, and decisions regarding their employment may be governed by a number of factors. Soybeans are good competitors after well established but, in their early stages of growth, need help from cultivation. The use of sorghum or sudan may be impractical if facilities for storing silage are not available. The effectiveness of specific smother crops depends upon the weed concerned; for example alfalfa is especially useful for Canadian thistle *(Cirsium)* and perennial sowthistle *(Sonchus)*.

Rotations

Although rotations are practiced for several reasons, one of their greatest values is in weed control. Many weeds are widely tolerant of growing conditions, but the large majority of them thrive best with specific crops or under specific management procedures. Successful weed species are frequently those whose life cycle is similar to that of the crop with which associated. Such weeds tend to become progressively worse each succeeding year that the particular crop is grown. Rotations break this cycle; they change the habitat beyond the tolerance of the weeds. It has been stated that out of about 1,200 species commonly called weeds on the North American continent only about 20 are able to succeed under common rotations involving a cultivated crop, a small grain, and a legume or grass sequence.

BURNING

Burning has been used in the past and is still employed to some extent as a method to destroy weeds along railroad rights-of-way. It has been used to a limited extent in certain crops. Controlled burning in permanent pastures and in certain woodland areas, especially in the South, has been said to encourage grasses and improve the quality of the pasture.

BIOLOGICAL CONTROL

Biological control of weeds involves the encouragement of certain pests or parasites of these plants, either diseases or insects. Biological control has been employed with a considerable degree of success with several insect pests. It has not usually been successful with weeds. The problems are complex, involving not only the relationship between the insect or disease which may attack the weed, but the secondary relationship between that organism and its pests or predators. Likewise, there is always the problem of what other kinds of plants might be attacked or destroyed by the disease or insect pest of the weed. Two reasonably successful examples of biological control of weeds are those of the St. Johnswort *(Hypericum)* in the western United States and the prickly pear cactus *(Opuntia)* in Australia.

The potential of biological weed control is recognized. However, many workers have hesitated to invest efforts in this area without more concrete evidence as to direct usefulness. Studies have been conducted in California, the author (C. B. Huffaker), stating in part, "... there is little justification for the negligence of ecologists to appraise the role of insects and arthropods in the composition and structure of natural vegetation, or their unilateral emphasis of factors of the environment, such as rainfall, exposure, temperature, winds and edaphic conditions, or the competitive and inhibitive complexes."

Perhaps the above viewpoint has merit. The implications are not limited to the biological control of weeds but to the field in its total aspects. We need to know more about the biological sequelae of the variables of micro-environment, and possess a more complete identification of the niches which weedy species, crop plants, and other organisms occupy in a holoceonotic whole. An improved understanding of such biological mechanisms would allow us to better envision — on a long range basis — the possibilities of maintaining desired vegetational equilibria in crop production areas.

INTERRELATIONSHIP OF WEED CONTROL METHODS

As we have emphasized before, weeds are controlled by a combination of methods, not any one to the exclusion of others. Any cropping or cultural procedure involves the mechanical methodology suitable to the crops involved as well as the competitive action of these crops. And when crop rotation is brought into the picture, one is considering the additive effect of a given sequence of such measures.

The objectives of weed control procedures include the reduction or elimination of the competitive action of undesired plants. In accomplishing these objectives, it is economically desirable to accomplish weed control simultaneously with full crop production. It is not practical to forget everything else while measures to reduce weeds are given first priority. In order that this be feasible, it is essential to take full advantage of potential flexibility in crop sequences, possible variations in production methods, and the timing of specific operations.

Some examples: A considerable time range is possible for the planting of grain sorghums. If annual weed infestations are a limiting consideration, late planting is preferable inasmuch as it allows time for one or two preplanting workings of the soil to reduce the weed seed potential in the upper soil layers. Furthermore, sorghum germinates more rapidly and possesses better competitive ability in warmer soils.

The inclusion of smother crops in a rotation sequence may favor the reduction of certain perennial weeds. But smother crops are not employed as entities in themselves; they are related to preplanting and post-harvest cultivation measures. The choice of the smother crop may have considerable significance. A tall growing annual (e.g. sudan grass) will frequently have more applicability in weakening a vigorous weed stand than the lower growing perennial, alfalfa. But the latter, if maintained in vigorous condition, may find its greatest usefulness in essentially eliminating a previously weakened infestation of, for example, Canadian thistle — owing these merits to a combination of the competitive ability of established alfalfa and the harvesting procedures, i.e. mowing, to which this crop is often subjected.

The helpfulness of timing of control action against perennial weeds with respect to root reserve levels has already been discussed.

Chemical weed control is detailed in subsequent chapters and has not been included in the above examples. But the same philosophy is applicable: that a given chemical procedure is of value primarily to the extent that it dovetails with a total operational sequence, that it is not the chemical treatment alone, but the sequence of which it is a part which will determine the value of the chemical operation.