Division of Agricultural Sciences
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WEED CONTROL IN LETTUCE

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THIS LEAFLET. . . .

- names herbicides used in weed control
- discusses differences in herbicide usage in various areas
- describes techniques of herbicide application

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WEED CONTROL IN LETTUCE

WEED-FREE beds are essential for mechanized lettuce growing and harvesting. Additionally, weeds of several species serve as alternate hosts for mosaic disease of lettuce, and therefore must be controlled. In all, controlling weeds is a costly problem in California—a recent estimate placed control costs at approximately $4,000,000 annually, with about $7,000,000 in crop losses due to weed competition. Chemical control with herbicides has proved the most practical method of dealing with this problem.

WHAT HERBICIDES?

CDEC (Vegadex®), IPC, DCPA (Dacthal®) and benefin (Balan®) are currently the herbicides used for weed control in lettuce. CDEC is used at 4 to 6 pounds per acre but controls only a few weed species, and its margin of safety is narrow. IPC is used at about 6 pounds per acre with limited effectiveness when used alone but with considerable crop safety. DCPA is used at 6 to 8 pounds per acre, but little is now used because of insufficient safety in soils low in organic matter. Benefin at about 1 pound per acre usually gives good control, but is weak on some weed species such as groundsel, shepherdspurse, London rocket, nightshade and volunteer barley. Bensulide (Prefar®) has recently been registered for use.

WHAT WEEDS ARE CONTROLLED?

The major weed species found in lettuce plantings include barnyard grass, purslane, groundsel, shepherdspurse, volunteer barley, lambsquarter, goosefoot, pigweed, sow thistle, hairy nightshade, burning nettle, and knotweed.

Because weeds vary from one lettuce-growing area to another, as do soils, herbicide usage will also vary from area to area. The following general comments cover the main lettuce-growing area of the state: the Salinas, Imperial, and Palo Verde Valleys and Brentwood (in Contra Costa County).

THE SALINAS VALLEY . . .

Lettuce is planted almost every month of the year here, but the area's great variety of weeds and the fact that many of them are in the lettuce family makes control extremely difficult. For common nettle, chickweed and pigweed, CDEC at 6 pounds per acre gives some control. In winter, single applications of IPC at 6 pounds per acre can be effective for stinging nettle and volunteer barley. During spring and summer plantings, benefin at 1 pound per acre can control

pigweed, lambsquarter and purslane. IPC and benefin together will control hairy nightshade, burning nettle, and many other weed species which usually occur in summer—this combination of herbicides has given the widest and best control with most safety to lettuce. Bensulide is a narrow spectrum, pre-plant incorporated herbicide which has been recently registered for use in lettuce. It has a wide margin of safety for lettuce and, therefore, will be useful where there are susceptible weeds present such as barnyard grass, purslane and lambsquarter. It is weak on volunteer barley, mustard, London rocket, shepherdspurse, groundcherry, nightshade and others. These herbicides have given best results when shallow-incorporated with a power-driven rotary tiller prior to seeding.

Important weeds (in addition to those named) of the Salinas Valley are groundsel, sow thistle, knotweed, and others. All these require herbicide combinations for weed control, but even despite the use of such combinations complete chemical weed control is not always achieved.

IMPERIAL AND PALO VERDE VALLEYS . . .

In these valleys, lettuce is planted in fall and through early winter. Weed species include barnyard grass, pigweed, purslane, lambsquarter, volunteer barley and mustard. IPC has been good on some grass species (canary grass, volunteer barley, and wild oats) but is limited in the number of weed species it will control. CDEC has generally been ineffective and is therefore not recommended for use in these valleys. Although DCPA has been used by many farmers in the Imperial and Palo Verde valleys, results have not been consistent. The margin of safety to lettuce is too narrow for general recommendation in this area. Although benefin is somewhat weak on volunteer barley and cruciferae weeds, the margin of safety is fair to good. Combinations of benefin and IPC have given a wider spectrum of weed control than either herbicide alone.

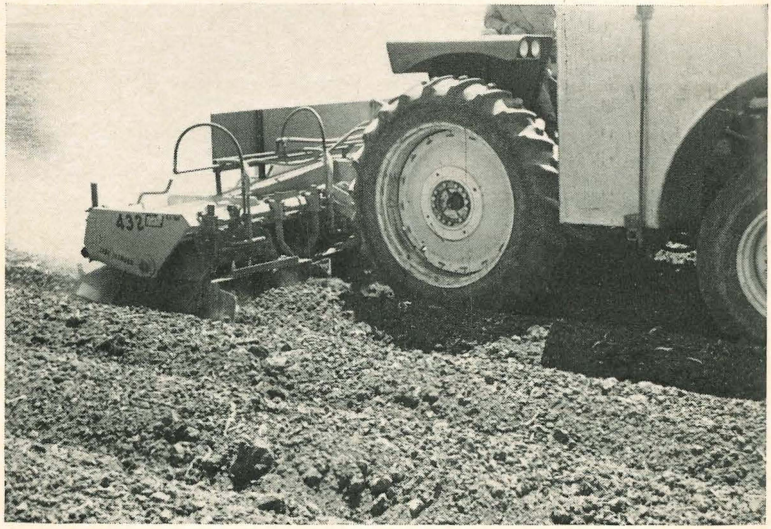
Bensulide has been very effective on early fall plantings where barnyard grass, purslane and lambsquarter are the main weed species.

BRENTWOOD . . .

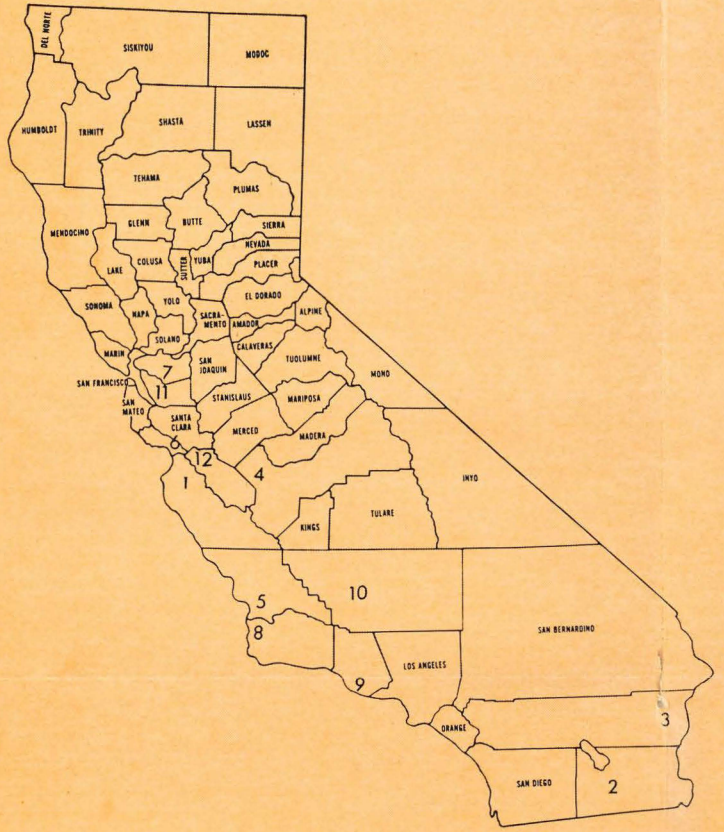
Lettuce in this area is planted in late summer, when volunteer barley, purslane and barnyard grass are the major weeds (although pigweed, shepherdspurse, mustard and others are often present). Fall plantings can be troubled with late-germinating mustard species. Benefin is usually effective against purslane and barnyard grass, but is much less so on volunteer barley and mustard. However, IPC is one of the better herbicides against volunteer barley, so a combination of IPC and benefin has shown good results. Bensulide has given good results when susceptible summer weeds predominate. Shallow disking in of the herbicides or combinations, and bedding up has been successful in this area; however, more consistent weed control has been obtained with power-driven tillers in University of California field trials. Because disking is a cheaper method of herbicide incorporation it is quite widely used; however, power incorporation gives more consistent results and it will be used increasingly until a more effective method of weed control is developed for the area.

HOW TO APPLY HERBICIDES . . .

Thorough mixing (incorporation) of herbicide with the soil produces better weed control and a more uniform crop stand. Because furrow irrigation is generally practiced in California's lettuce-growing areas, proper incorporation is doubly important.



A 4-row incorporator for herbicides in row crops.



Important head-lettuce producing counties

County	1967 acreage
1. Monterey	50,340
2. Imperial	42,200
3. Riverside	7,314
4. Fresno	4,359
5. San Luis Obispo	4,110
6. Santa Cruz	4,060
7. Contra Costa	3,950
8. Santa Barbara	2,920
9. Ventura	2,777
10. Kern	1,940
11. Alameda	1,230
12. San Benito	954

The most efficient tool for incorporation is a power-driven rotary tiller. L-shaped teeth produce better mixing than do straight-tooth types, although the latter have better wearing qualities. Incorporation at about 2 inches is generally more effective than deep incorporation, as the highest amount of germinating weed seed is generally found in the first inch of soil. Lettuce seed, having more tolerance for herbicides than most species, can send roots past treated soil into the untreated area below. During cooler parts of the year, lettuce roots may have difficulty getting into the untreated soil and this can result in stand reduction or stunting, or both. Pre-irrigation of the seed bed will help incorporation, as will good working of soil to break up clods. The amount of water and the type of irrigation used in germinating lettuce seed, as well as soil composition and texture, will also affect activity of herbicides.

Because different areas have different weed species and soil types, and because irrigation methods can also vary, no detailed over-all recommendations for herbicides can be given. Therefore, in trying any herbicide for the first time the grower should treat a small plot first. Careful note should be made of soil and weed types, amount and type of irrigation, climatic conditions and timing of herbicide applications, and the vigor of the crop. By studying these the grower will discover procedures that will help solve his particular problem of weed control.

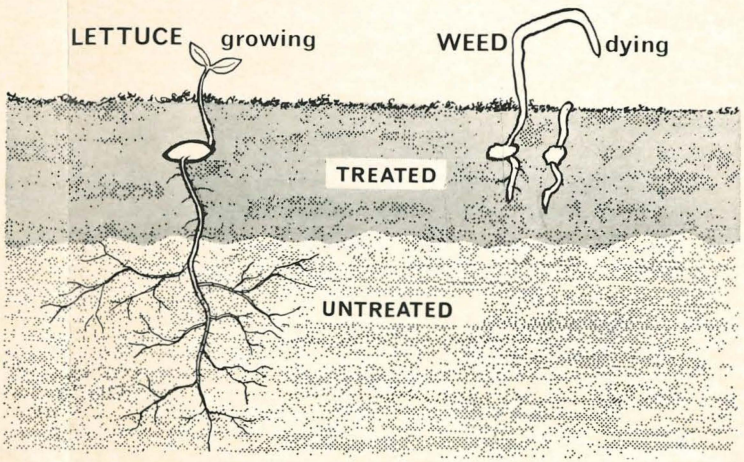
"L"-shaped teeth for incorporating herbicides.

Comparison of herbicide-resistant germinating lettuce (left) and susceptible weed seedling.

BAND TREATMENT

Band treatment with herbicides is a more economical method of using herbicides than treating over-all. The top, or a portion of a top, of the bed encompassing the seed row can be sprayed with herbicide, incorporated, and then planted. Shoulders and furrows can be mechanically weeded. In band treatment it is necessary to carefully calculate the herbicide on the basis of the total surface area of the soil that is sprayed. This means that if you are treating 20 inches of bed top on beds with 40-inch centers you need apply only half the amount of herbicide you would use on a broadcast acre basis. Another way of looking at this is: 1 pound of benefin will spray 2 acres of bed top, if the bed top comprises 20 inches out of the 40 inches—the slope of the bed sides and the furrow take up the rest and they will not be sprayed in band treatments.

Carefully weigh or measure the amount of herbicide



to be used. Volume measurements (and other approximate methods) of the powder are not sufficiently accurate. Liquid formulations should be measured volumetrically. Add the chemical to the tank after it has been partially filled with water and while the agitator is in motion. Continuous agitation is necessary to keep the material in suspension—even some emulsions will settle out without agitation. Mechanical or powerful hydraulic agitation is preferred; airjet agitation is not recommended because some herbicide may be trapped and become concentrated in the foam. If agitation is stopped, make certain that the herbicide is resuspended before continuing spraying (check by probing the tank, particularly when using wettable powders).

Piston or centrifugal pumps are best for spraying rigs. Gear pumps are satisfactory, but tend to wear excessively with wettable powders. Use hoses and booms with small diameters to keep the velocity high and prevent settling of the wettable powders in transit to the nozzles. To prevent clogging, screens and strainers should be at least 50-mesh.

The pressure at which the rig is operated must be accurately controlled, and speed of movement across the field must be constant to obtain accurate and uniform coverage. With herbicide incorporators, ground speed must be commensurate with soil texture and the type of incorporation equipment. Always turn off the boom before the rig is brought to a stop.

Set the nozzles on the boom so that there is a slight

Band treatment in heavily weed-seeded experiment. Note clean bed top on left.

overlap at bed top or ground level. This compensates for the thinning effect at the edges of the fans. Overlap should be set in accordance with recommendations of the nozzle manufacturer and checked for accuracy. Nozzles giving a "flat fan" pattern of distribution are best because of the even pattern on the soil surface.

After using, clean spray equipment with several rinses of water.

CALIBRATION METHOD

A simple method of calibrating a spray rig for accurate application of herbicides is to determine the amount of carrier (water, in this case) needed to cover a known area and then calculate the amount of herbicide to be added. To do this:

1. Measure a known distance over which to run the rig. Multiply this distance by the width of the band or boom swath. This will give the area sprayed.
2. Fill the spray tank with a known amount of water. Drive the incorporator spray rig over the measured distance, *operating it at the same speed and pressure at which the spraying and the incorporation are to be done in the field.*
3. Measure the amount of water left in the tank and, by subtraction, find out how much water was applied over the measured area.
4. From this figure, calculate gallons per acre applied and the amount of herbicide to be added.

Example: Width of band swath = 20″ bed band × 4 bed spaces = 6.66 feet.
Measured distance = 1,000 feet
6.66 × 1,000 = 6,666 square feet area covered

$$\frac{6{,}666}{43{,}560 \text{ (no. of sq. ft. in acre)}} = 0.15 \text{ acre}$$

If it is found that 10 gallons of water were used in the calibration run, then $\frac{10 \text{ gallons}}{0.15 \text{ acre}} = 67.0$ gallons of water will be applied per acre.

If a 1 pound per acre rate is required, 1 pound of herbicide should be added for every 67.0 gallons of water in the spray tank. If the tank holds 100 gallons, the amount of herbicide to be added may be calculated as follows:

$$\frac{1 \text{ pound per acre}}{67.0 \text{ gallons per acre}} = \frac{X \text{ (capacity of spray tank)}}{100}$$

$$X = \frac{1 \times 100}{67.0} = 1.5 \text{ pounds of herbicide to be added to 100 gallons}$$

To determine the amount of water used in spraying, it is often convenient to calibrate a stick with notches on it at 5-gallon intervals. This can be done by adding 5 or 10 gallons of water at a time to the tank sitting in a level position and marking each level of the stick.

All nozzles on the boom must deliver the same amount of liquid; replace any nozzles that do not do so.

The amount of water used per acre is not important so long as adequate coverage is maintained. *The point to remember is to apply a known quantity of chemical to a known area.*

REMEMBER . . .

- Use correct herbicide for weed species present.
- Use correct rate: lower rates for sandy soils, higher rates for heavy soils.
- Make accurate applications.
- Use the best method of incorporation feasible, power rotary tiller preferred.
- Leave several untreated checks in the field.
- The first time you use an herbicide, treat only a small acreage.
- All pesticides are poisonous and must be handled with care.
- Observe precautions on the label regarding use of protective clothing and equipment, handling the chemical, storage, protection of pets, domestic animals, wildlife, fish, and crop plants.
- The grower is legally responsible for residues on his crop, as well as for problems caused by drift from his property to other property or crops.

The authors gratefully acknowledge the cooperation of F. Whiting, F. Robinson, O. McCoy, H. Ford, P. Mowbray, N. McRae, A. VanMaren, H. Kempen, B. Fischer, H. Hall, H. Johnson, and R. Brendler.

To simplify the information, it is sometimes necessary to use trade names of products or equipment. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

JANUARY, 1969

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Band treatment in heavily weed-seeded experiment. Note clean bed top on left.

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