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LADINO CLOVER SEED PRODUCTION IN CALIFORNIA

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CALIFORNIA AGRICULTURAL
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CIRCULAR 554

THIS CIRCULAR DESCRIBES

- what Ladino is, and what you should know about certification of seed
- what varieties offer what advantages to growers
- how to prepare land and manage crops for maximum yields
- basic principles of weed control
- how to recognize major diseases
- important insect pests

Harvesting and post-harvesting techniques are discussed and illustrated, and major insect pests are pictured for easier identification.

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LADINO CLOVER SEED PRODUCTION IN CALIFORNIA

INTRODUCTION

Ladino *(Trifolium repens* var. *latum)*, believed to be a naturally developed large form of common white clover, was first brought to the U. S. from northern Italy in about 1891. Since then selections have been made from the original introductions at various locations in the U. S., and several Experiment Stations have produced improved varieties better adapted for local requirements. Today, Ladino is the basic legume in California's irrigated pastures and the state now produces most of the nation's Ladino seed.

Ladino is a rapid-growing, long-lived, true clover, spreading by means of creeping stems (stolons) which elongate rapidly and take root at the joints if soil is moist. Leaves, stems and flower heads of Ladino generally are from two to four times as large as common white clover, but they are similar in shape, color, and markings of leaves and flower heads. The plants usually have most of their roots in the top 18 to 24 inches of soil, and obtain most of their moisture from the upper 12 inches. However, on deep, open soils Ladino may send roots down as far as 5 feet. Young or thin stands thicken rapidly, and grazed or clipped stands will produce another mature crop in 21 to 28 days.

Ladino clover is palatable and adaptable, and when grown with grasses and other legumes provides highly productive and nutritive pasturage; although primarily a pasture crop, it can also be used for hay and silage. Ladino is extensively planted in the more humid eastern half of the U. S. and in the west's irrigated areas. It survives the winters of most northern states if properly managed in the growing season. Good management includes fertilization, well-timed grazing or mowing, and a compatible grass association. Ladino can be expected to become even more widely used as new varieties of the plant are developed to meet needs of local areas.

Fig. 1. Characteristic growth pattern of Ladino clover stem. The creeping stems elongate and take root at the joints in moist soil. Note the growing point of horizontal stem at extreme right. Blossoms of increasing maturity are shown to the left of the first flower bud in this photograph.

Table 1. Ladino clover seed production in California

Year	Acres harvested	Yield per acre	Production (cleaned seed)	Price per pound received by farmers
		pounds	*pounds*	*dollars*
1969	16,000	305	4,880,000	0.70
1968	12,500	295	3,688,000	0.71
1967	12,000	300	3,600,000	0.63
1966	14,500	290	4,205,000	0.48
1965	14,500	340	4,930,000	0.46
1964	16,000	320	5,120,000	0.53
1963	17,000	365	6,205,000	0.49
1962	18,500	305	5,642,000	0.61
1961	19,000	230	4,370,000	0.58
1960	21,000	205	4,305,000	0.60
1959	16,000	260	4,160,000	0.55
1958	13,000	315	4,095,000	0.49
1957	11,000	280	3,080,000	0.28
1956	18,000	310	5,580,000	0.35
1955	15,000	275	4,125,000	0.53
1954	14,000	245	3,430,000	0.52
1953	24,000	245	5,880,000	0.33
1952	46,000	195	8,970,000	0.90
1951	46,000	120	5,520,000	1.20
1950	35,000	120	4,200,000	1.20
1949	14,000	107	1,500,000	1.30
1948	13,000	90	1,200,000	1.60
1947	7,000	80	560,000	1.50
1946	7,000	83	580,000	1.25
1945	10,000	52	520,000	1.40
1944	7,000	60	420,000	1.75
1943	2,000	85	170,000	1.00
1942	2,800	75	210,000	0.85
1941	2,800	100	280,000	0.40

Certification requirements. Nearly all Ladino clover seed grown in California is certified by the California Crop Improvement Association, whose office is on the Davis campus of the University of California. Detailed certification standards listing all requirements with which a seed grower must comply are available from your local University of California Farm Advisor's office.

Certification of any seed crop is designed to maintain genetic purity without mixture with other varieties or crops, and to insure the consumer that seed is of known variety and quality.

To produce certified Ladino seed a grower must:

- Become familiar with California Certification Standards for Ladino Clover (see your Farm Advisor for standards).
- Plant approved seed stock on eligible land.
- File applications required by the certification standards.
- Meet all cultural requirements as to weed control, field history, and isolation as prescribed in the certification standards.
- Pass field inspection and clean-seed sample inspection.
- Have all harvesting equipment inspected by the Agricultural Commissioner's office.

Where seed is grown. California clover seed production is concentrated in irrigated areas of Glenn, Sacramento, and Tehama Counties, but counties with a seed-growing history include Butte, Colusa, Madera, Mendocino, Placer, San Joaquin, Siskiyou, Stanislaus, Sutter, Yolo, and Yuba. Satisfactory seed crops can be grown in most of the state, but not in areas having temperatures of 100 to 110° F for 5 or more days in a row, as such heat tends to significantly retard seed production. High winds at harvest time (July, August, and September) can severely damage windrowed seed crops. Bad weather or snow at harvest time will interfere with harvesting and will lower seed quality.

Soil and irrigation requirement. Heavier soils are well-suited for Ladino seed production. Ladino does well on shallow soil underlain by a tight clay layer or a hardpan, even if the restricting layer is within 12 to 18 inches of the surface. Tight soils, and soils having relatively impervious hardpan or tight clay layers, tend to keep irrigation water in the plants root zone. Saline soils are unfavorable for Ladino. On deep, open, friable, fertile soils seed production is seldom successful because of difficulty in irrigation management — over-irrigation frequently occurs, causing excessive vegetative growth that lodges and promotes germination of seeds in the head.

Irrigation requirements depend on soil type, soil depth, and prevailing temperature. Gravelly or sandy soils require an irrigation schedule of 5 to 10 days, and heavy clay or deep loam soils require a 7 to 17 day schedule for good seed production. Water percolation losses on well-drained soils results in a demand for two to three times more water than is needed on heavier soils.

LADINO CLOVER VARIETIES

Until recent years, commercial Ladino clover seed was sold as certified or common Ladino clover because improved varieties had not been developed. Today, several new varieties have come into production and have been tested at the Experiment Station and in county trials.

Ladino. This is the basic pasture legume in most humid or irrigated areas of the U. S.—85 to 90 per cent of the Ladino clover seed grown in California is of this variety. It comes from original Landino introduced from Italy and grown in selected foundation seed fields in California and Oregon. Leaves are trifoliate, and normal petiole length is 9 inches or more; the plant is hairless, and seeds vary in color from brown to yellow.

Espanso. Espanso (formerly called Granladino) was selected from the most desirable plants from a natural giant-type found at Lodi, Italy. The selected plants were grown under severe drought conditions and only surviving plants were combined to produce the variety. In the U. S., it appears to be inferior to existing commercial varieties in seed production but similar in forage yield. Espanso's distinctive characteristics are vigorous spring and fall growth, persistence in the summer, and noticeably longer petioles and larger leaves. Planting stock produced under OECD (Organization for Economic Cooperation and Development) regulations is supplied from Italy.

Merit. This 30-clone synthetic variety was developed and released by Iowa State University in 1961 from selections made from California and Oregon certified seed. Merit looks like Ladino but is more uniform for the true type (characterized by large leaves and long petioles); it has shown superior yield, good winter survival, and summer drought tolerance in the states of Iowa, Illinois, Wisconsin, and Minnesota.

Regal. This was developed by the Alabama Agricultural Experiment station and released in 1962 to a private company for exclusive production. It is a synthetic of five clones selected for stand persistence and yield under conditions found in the southeastern U. S., where it is more persistent and consequently more productive than any commercially available Ladino or white clover.

Pilgrim. Pilgrim, which was released in 1953, is a synthetic variety of 21 clones originating from seed collected from older Ladino pastures in the northeastern states and Canada. The principal objectives in the development of Pilgrim were to purify seed stock of the large type, and to establish a continuing source of breeder seed of the same genetic composition. Breeder seed is produced and maintained by the Washington Agricultural Experiment Station.

Tillman. This is a six-clone synthetic variety developed by the South Carolina Agricultural Experiment Station and the U.S.D.A. Parent plants were selected for profuse branching of stolons, sparse flowering, persistence of stands, general disease resistance, and improved forage production in South Carolina. Released in 1969, the probable areas of adaptation are the areas in the southern states adapted to Ladino. It is superior to other Ladino varieties in persistence of stand and forage production in South Carolina.

PREPARING LAND

Land should be prepared so as to provide for the most economic and uniform application of irrigation water and to facilitate cultural and harvesting operations. The contour check system of irrigation is successful for irrigated pastures when properly modified, but is rarely used in Ladino seed production (except where each contour check can be immediately and completely drained following irrigation to avoid seed damage from germination and drowning of plants). Sprinkler irrigation may be used where land leveling is not practical. Clover seed fields require frequent irrigation, and so it is important that land be properly prepared to minimize labor costs. (Additional information on preparing land for irrigation can be found in University of California circular 408, *The Border Method of Irrigation.*)

Strip-check irrigation

The most widely used and probably the best method of land preparation for producing Ladino seed is the strip-check system, although more land leveling is required for this than for any other type of flood irrigation. Strip checks require grade only in the direction in which water flows down the check, and this grade may or may not be uniform. Grades of 0.2 to 0.5 foot per 100 feet are desirable for covering the ground quickly. Steeper slopes are used where soil resists erosion, and where it would be inadvisable to level the field uniformly because of cost, soil structure, and soil depth.

The first step in preparing land is earth moving. This should be based upon a contour map of the field showing the direction and percentage of slope and the location of cuts and fills indicating the amount of grading, hauling, and filling required to level the field. After land is leveled, it should be plowed or disced and smoothed with a float or land plane before border levees are built. It is best to plane diagonally across the field first, and then lengthwise down the field. After levee building, the field is irrigated to settle the fills, and then it is important to harrow or disc and plane the checks to obtain a uniformly smooth field surface.

Road graders, or special custom-built attachments for tractors which build the borders and level the ground between them in one operation, are used in some areas for levee building. Disc ridgers, crowders, or alfalfa checkers are also used, but with these it is necessary to work strip checks a second time to cross-level the land between borders.

The size and shape of levees is important: they should have a base width of about 4 feet and a settled height of about 6 inches. Such levees will be covered with clover plants so that the entire field will be productive and harvesting equipment can easily move across them. When levees are first constructed they are composed of loose earth and are irregular in shape. Before being seeded they should be compacted and smoothed with a ring roller. Width, length, and grade of checks will depend upon shape of the field, topography, amount of water available, and type of soil.

Checks are usually directed so that water moves down the steepest natural slope; this reduces the amount of cross-leveling needed, but if the field has a water-penetration problem the practice may not be desirable. Water penetration is generally increased when the slope is reduced; this can be accomplished by further land leveling or by altering direction of the checks. If the land has considerable side fall, strips should be made narrow. The difference in elevation between any two adjacent checks should not be over 2½ inches.

Length of strips depends on the shape of the field and the rate at which water penetrates soil. In sandy soil, much water may be wasted by deep percolation at the upper ends of the strips if they are too long. This can sometimes be partly corrected by increasing the amount of water turned into each check.

Table 2 gives recommended lengths for checks of different widths and for various rates of flow on clay and clay loam soils. If slopes are steep, strips longer than 800 feet should be limited in width to 15 feet or less. For porous loams and sandy loams, delivery rates for the sizes of checks given in the table should be increased from two to five times—or shorter checks should be used. This permits water to cover ground quickly without much water being applied at any one irrigation (water velocity should be kept low enough to prevent erosion). The first 8 to 12 feet of the checks may be left perfectly level so that water will be uniformly

Table 2. Proper sizes of strip-checks for clay loam and clay soils

Flow delivered to each strip		Length of check for various widths of strip			
Cubic feet per second	Gallons per minute	10-feet wide	15-feet wide	20-feet wide	25-feet wide
			Feet		
0.2	90	440	...	...	...
0.3	135	660	440	...	...
0.4	180	880	660	440	...
0.5	225	880	660	440	440
0.6	270	1,320	880	660	440
0.7	315	1,320	880	660	440
0.8	360	...	1,320	880	660
0.9	405	...	1,320	880	660
1.0	450	...	...	1,320	880
1.2	540	...	...	1,320	880
1.5	657	...	...	...	1,320

distributed between levees before it moves down the checks. To insure uniform coverage over full width of checks, land between borders must be carefully cross-leveled. The unit head (rate of delivery of water into each check) may vary from 0.2 to 1.0 cubic foot per second (90 to 450 gallons per minute); this head can be regulated by changing the number of checks irrigated at one time.

The lower end of the checks should be left open to drain off excess water. Ponding at the lower end of the runs rapidly drowns the clover and causes growth of such weeds as dock, plantain, sedges and water grass. Adequate drainage should be provided for collecting and removing surplus water from the low end of the field. Surplus water may be used for irrigating other fields. Strip-check irrigation is not recommended for seed production on sandy soils, steep slopes, or where only small flows of water are available; if seed is grown under these conditions, sprinkler irrigation is advisable.

Fig. 2. Immediately below: good leveling, even distribution of water with surplus running to drainage ditch.

Fig. 3. Bottom of page: improper leveling of land causes drowning of plants.

Sprinkler irrigation

Preparation for sprinkler irrigation is similar to that for strip-check irrigation except that levees are not constructed. Sprinklers are used in sandy soil or on steep slopes, or on unleveled land, and where only a small flow of water is available. The sprinkler system must be designed to fit the existing water flow and land conditions. Where feasible, the strip-check system is preferred.

Seedbed preparation

The same fine, firm seedbed used in planting irrigated pastures is recommended. Such a seedbed has a firm, moist zone covered by 2 to 3 inches of moist well-worked soil free from big clods and large air pockets. The surface soil should be firmed by cultipacking before seeding—a loose, cloddy seedbed filled with air pockets may result in a patchy, thin stand. A preliminary irrigation before planting settles fills and reveals low areas and other irregularities that can be corrected before seeding; it also firms the soil and provides an even moisture supply for germinating seed. If it has rained just before seeding, preliminary irrigation can be omitted. After irrigation or rain the field should be planed if irregular settling has occurred. A final harrowing should be given just before seeding.

A broadcast application of 25 to 30 pounds per acre of nitrogen and 13 to 17 pounds of phosphorus per acre (that is, 30 to 40 pounds per acre of P_2O_5) just before final harrowing is recommended for establishing a stand. On many California soils where clover is grown for seed, Ladino responds to applications of phospohrus. The amount needed for maximum yields may vary considerably with area and soil type; when needed, it is estimated that a normal crop of Ladino seed of 300 to 500 pounds will use about 26 pounds of phosphorus (60 pounds of P_2O_5, or 300 pounds of single superphosphate) as fertilizer. The complete fertilizer requirement for the first year should be applied before seeding. It is important to use a material containing sulfur, as this is often deficient in soils suited for clover seed production.

MANAGEMENT OF NEW SEEDINGS

Time to plant. Depending upon local conditions and the current weather patterns, seeding should be done between September 15 and November 15. Planting in the early fall insures larger and more productive Ladino plants in the first crop year, with seed yields approaching normal for established fields in the area.

Spring seedings are preferable if fields are foul with winter-growing weeds. Satisfactory yields may be attained from seedings made from February 15 to March 20. Seed yield gradually decreases to uneconomic levels from seedings made after March 20, through April 30. In areas of severe winter frosts, planting should be completed early enough in fall to insure seedling establishment before the first hard freeze is likely to occur.

Inoculating seed. Before being sown on newly-leveled fields, Ladino clover should be inoculated with nitrogen-fixing bacteria.

Companion crops. The use of a companion or nurse crop is not recommended when planting a Ladino clover seed field unless the soil is blowsoil, peat, or very sandy.

Planting stock required. Only registered or foundation seed (available from local seedsmen) may be used to grow certified seed. Fields seeded with common Ladino are not eligible for cer-

tification; on such fields, 2 years of producing other crops is required to insure destruction of all white clover.

Seeding rates, equipment, and methods. The recommended seeding rate is 3 to 4 pounds per acre by airplane or ground equipment; airplanes are generally used to seed fields bigger than 15 acres and are especially useful in seeding fields having wet seedbeds. One pound of seed is equivalent to about 17 plants per square foot, and 10 to 15 seedlings per square foot is considered an acceptable seedling stand—very thick stands delay the onset of spring bloom as much as 10 to 20 days. Early fall planting (September 15 to October 15) usually requires light irrigations every 4 to 10 days until fall rains eliminate this need.

When a dry field is seeded subsequent fall and winter rains dissolve the clods covering the seed, but best results are usually obtained if the dry field is cultipacked after seeding. Harrowing gives less satisfactory results if it barely covers the seeds. Discing should never be employed, as seeds will be buried too deeply. Ground-seeding equipment includes: tractor- or trailer-mounted broadcase seeders, grain drills with special grass-seeding attachments, alfalfa drills, and hand-operated cyclone seeders. These can be used satisfactorily, if properly adjusted. Seed-covering precautions recommended in airplane seeding apply equally to these methods of seeding.

Care of new stands. Surface soil should not be allowed to dry out during the germination period—such drying accounts for more unsatisfactory stands than any other single factor. Early fall and late spring seedings require frequent and light irrigations timed to keep surface soil moist; this prevents crusting and enables germinating plants to emerge. Fall seeding is best, as rains may be expected to help the germination process. Regardless of date of planting, however, surface soil should never be permitted to dry out for more than a day or two until a satisfactory stand is attained and the plants have at least four or five true leaves. In general, Ladino is slow in getting established.

New stands intended for seed production should not be grazed during their first year because grazing then frequently results in reduced first-year seed yields. If weeds become a problem at this time, forage should be shredded or chopped with a flail machine; mowing or rotary-shredding are not recommended as they tend to concentrate or windrow the debris. Selective herbicides are available for control of most weed problems.

Weed control in seedling Ladino. If weeds are numerous in new stands they may thin out the clover because of weed competition and contamination of clover seed with weed seed. Where annual weeds such as ryegrass, burclover, canarygrass, knotweed, and oxtongue thistle are so prevalent that they prevent establishment of a satisfactory stand of clover, spring sowing of clover is recommended. Weeds germinate and emerge during the winter when moisture is available, but they can be destroyed during spring seedbed preparations, thus minimizing the competition for the ensuing clover crop.

Weed prevention is the first step in weed control in new seed fields, and can be accomplished by selecting only clean fields or by practicing rotational programs that will insure weed-free land. Weed control around irrigation outlets, fences, and on adjacent land is especially important.

Effective herbicides for new stands are available. Weed control recommendations are published each year by the University —see your local University of California Farm Advisor for these.

Fig. 4. Above: Russian knapweed.

Fig. 5. Left: Yellow star thistle seedling.

Fig. 6. Below: Yellow star thistle.

Fig. 7 (top left). Ladino clover infested with dodder.

Fig. 8 (top right). Buckhorn (narrowleaf plantain) seedling.

Fig. 9. Buckhorn (narrowleaf plantain).

Fig. 10. Oxtongue thistle seedling.

Fig. 11 (above). Oxtongue thistle. Fig. 12 (top right). Curly dock. Fig. 13. Young curley dock.

CARE OF ESTABLISHED STANDS

Grazing or shredding established stands. Grazing or shredding early lush spring growth in established stands helps to control weeds and promotes a rapid, even, abundant flowering growth and a more uniform set of seed. Grazing should begin about May 5 and be completed by May 15, and a 3- to 4-inch stubble should be left. If a field has been grazed heavily as a substitute for clipping, it also must be clipped to increase uniformity of flower formation. Fields pastured in the winter and early spring should be allowed to regrow at least one month after grazing before clipping in early May.

Spring cleanup in preparation for a seed crop is best accomplished by grazing and clipping, shredding, or removal of green forage by chopping and ensiling. Grazing wet stands results in a rough field surface which causes greater than normal seed losses at harvest time (livestock should not be pastured in wet Ladino seed fields).

Because Ladino is slow to dry, making hay is not compatible with seed production; haying may reduce seed yields by delaying irrigation; this will cause stunting of the clover and will increase grassy weed establishment.

Fig. 14. Harvesting wilted forage in windrow during spring cleanup.

Fig. 16. Spring cleanup with self-unloading van for hauling forage or green feed.

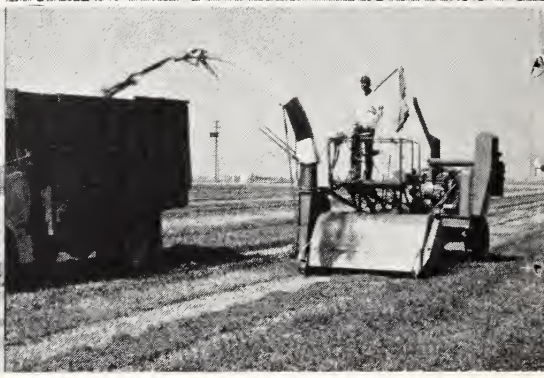

Fig. 15. Spring cleanup: self-propelled swather (top) and custom-made chopper (bottom).

Weed control in established stands. Preventive weed control should be continued through the life of the stand. Weeds should not be allowed to seed on irrigation borders, ditches, fence rows, service areas, etc. Rogueing should be continued every year to prevent the invasion of new or noxious weeds such as dodder, dock, buckhorn, johnsongrass, etc. Herbicides for controlling weeds must be coordinated with a program of grazing, shredding, rogueing, crop rotation, and proper irrigation.

In established Ladino seed fields some of the troublesome broadleaf weeds are: dodder, buckhorn (narrowleaf plantain), white top (hoary cress), oxtongue thistle, yellow star thistle, and dog fennel. Troublesome grassy weeds included: watergrass, ryegrass, sedge, johnsongrass, dallisgrass, perennial pigeongrass (knotroot bristlegrass), and lovegrass.

No seed field containing any primary noxious weeds such as hoary cress, camelthorn or Russian knapweed is eligible for certification. Any infestation should be treated and regularly checked to prevent regrowth of noxious plants—a list of such weeds is available at your Farm Advisor's office.

All equipment used to apply herbicides should be checked for proper functioning and accurate calibration.

Fertilizers. Field strip tests, soil tests, and plant tissue analysis will help to determine fertilizer requirements, but full-scale application should be made only after field tests show the type of response to fertilizers. See your Farm Advisor

Fig. 17. This shows results of proper weed control around irrigation outlets and roadway.

about procedures for making and interpreting such tests.

Nitrogen should never be required on established stands of well-inoculated clover, but seedlings may be benefited by an application of 25 to 30 pounds per acre applied just before seeding. Such an application is best made as a mixed fertilizer containing 13 to 17 pounds per acre of phosphorus (30 to 40 pounds per acre of P_2O_5) in addition to the nitrogen.

Many soils adapted for Ladino clover culture are deficient in phosphorus, and a soil analysis may help determine if a soil would be more productive with added phosphorus. Soils containing less than 10 to 15 ppm of phosphorus (sodium bicarbonate extraction method) should receive 26 to 43.5 pounds per acre of phosphorus (60 to 100 pounds per acre of P_2O_5) disced into the seedbed before planting. and annual topdressings of 26 pounds per acre of phosphorus (60 pounds per acre of P_2O_5). Because Ladino clover is shallow rooted, available phosphorus and sulphur may be rapidly depleted in the active root zone. Decreased availability of these nutrients in unfertilized clover seed fields may account for diminishing seed yields in the second or third season. Sulphur can often be supplied as a fertilizer component of a phosphorus fertilizer.

Soil in most California seed-growing areas has enough available potassium to grow a Ladino clover seed crop, and potassium or so-called complete fertilizers are rarely used on established seed fields. Potassium deficiency can be easily identified by the appearance of small white-yellow spots, usually near the margins of the leaflets; the edges later turn yellow and in severe deficiency may turn brown.

Irrigation. Plants should be watched closely for clues as to proper timing of irrigations: when leaves begin to cup to-

Fig. 18. Ladino clover leaves showing typical potassium deficiency.

gether, it is time to irrigate. This may occur in only a few spots (the sandy or hard spots at first) but if these areas constitute an important proportion of the field they should be used as guides. Apart from this, plant symptoms in the whole field should be the guide. Do not withhold irrigation until the entire field is wilting.

Irrigation water will usually have to be applied every 7 to 12 days in late spring and summer. On sandy or gravelly soil it may have to be applied every 5 to 10 days; on heavy soils of high moisture-holding capacity, the interval may be 7 to 17 days. In most seed-producing areas of California, Ladino requires from 3 to 5 acre-feet of water per acre annually; in interior valleys on open, permeable soils as much as 6 to 9 acre-feet may be required annually.

Each irrigation should be sufficient to replenish soil moisture to root depth. A soil tube is excellent for determining the depth at which moisture ends, but growers should also know the depth of soil and the zone of root distribution. From

Fig. 19. Soil tube for checking field moisture.

1 to 3 acre-inches of water per irrigation will usually be sufficient to replenish moisture, as larger applications will be wasteful and possibly harmful. Good drainage is essential for high seed-production of Ladino clover. Ponding of water at lower ends of fields in hot weather results in drowning large areas. Tail-water return systems are an economic way of conserving water and are recommended.

Ladino clover seed fields must be kept growing slowly through the production period. Too much water produces lush growth which will lodge; this exposes mature seedheads to moisture, and causes seeds to germinate in the head. Upright clover can be irrigated after seedheads have matured without damage, but lodged stands irrigated after 60 per cent to 70 per cent of the heads are mature produce lower yields.

Seed fields that are to continue production the following year must be irrigated immediately after harvest because stand reduction will occur after 30 to 40 days without water (reduction increases after harvesting because stolons are exposed to the hot sun). The first irrigation should be in late afternoon or at night to avoid serious injury to stolons.

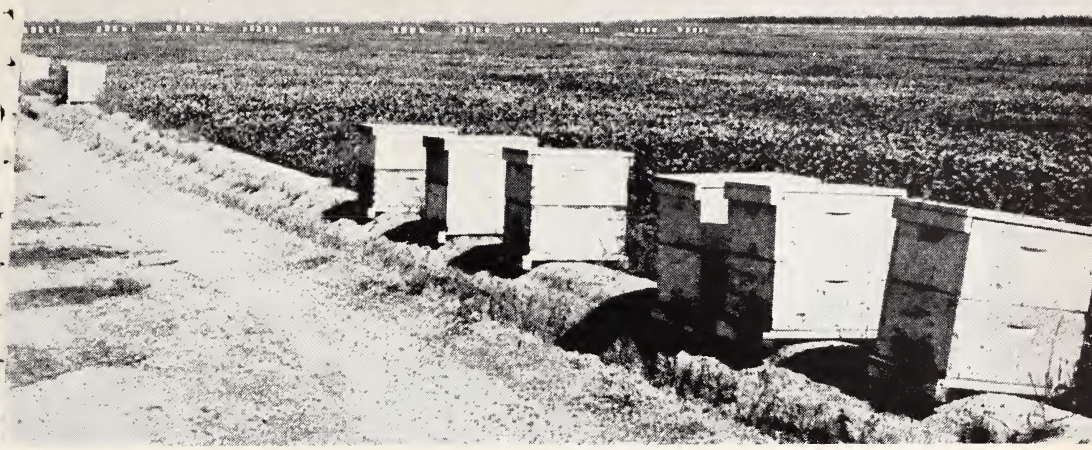

Fig. 20. Typical placement of beehives for Ladino production. Note the row of beehives in background of photograph.

POLLINATION

Ladino clover flowers are highly self-incompatible and therefore must be cross pollinated to produce seed. Wind is not an effective pollinating agent. Bumblebees and other wild bees, though helpful, are usually so few and so sporadically distributed that they cannot be relied upon for effective pollination.

Honeybees are effective pollinators, and most seed growers now use a minimum of one "strong" honeybee hive per acre; a few use 3 or 4 such hives per acre. (A strong hive has brood in not less than seven combs, and bees enough to cover no less than 15 frames in a 2-story hive.) Results of recent tests strongly indicate that 1 to 1½ strong hives per acre are sufficient for complete pollination.

Pollination service. Because honeybees are important in seed production, it pays seed growers to time applications of insecticides so as not to injure them. If harmful insecticides are to be used, there should first be an understanding between the seed growers, applicators, and beekeepers involved so that the bees can be protected or removed from the field. Various financial arrangements for the special use of bees as pollinators can be made between seed growers and beekeepers. Usually, the more hives supplied per acre the higher the charge per hive. Seedsmen, beekeepers, Farm Advisors, and Agricultural Commissioners are usually informed on current financial arrangements for honeybee pollinating service. Any agreement between seed producers and beekeepers should be on the basis of strong hives.

Bees should be moved into seed fields as soon as blossoming starts, usually within 10 to 14 days after spring grazing or clipping is completed. In most California seed fields, bees are moved in about May 15 to 25 and are kept through the blooming period, which may be as late as September. Beehives should be well distributed around and through the fields; they must be placed where they will remain dry during irrigation, and where beekeepers can easily reach them for maintenance.

Recommendations for chemical control of insect pests are subject to frequent change, so growers should consult the current pest control program available at their Farm Advisor's office.

Because many pesticides are highly toxic to honey bees and beneficial insects, the farmer, the beekeeper, and the pest control operator must cooperate closely in order to minimize losses from chemicals. Whenever possible use material that is least toxic. When bees are present, the safest time and method of application of pesticides is at night with a ground applicator. Avoid drift of pesticides onto bee colonies or nearby crops and weeds in bloom. Do not contaminate water available to bees for consumption.

Important insect pests affecting Ladino clover seed production are discussed below. Your County Farm Advisor and seed company representative will help you identify these insects.

Lygus bugs. The lygus bugs, *Lygus hesperus* Knight and *L. elisus* Van Duzee, are sucking insects which feed on buds, flowers, and developing seeds, with resultant bud blast, flower drop, and shriveled seed. These bugs are usually the most serious pests of Ladino because they may be present throughout the entire time of seed set.

Lygus adults are approximately ¼ inch long, and are greenish to yellowish-brown with a raised light-colored V on the back. Young lygus bugs (nymphs) are greenish-gray with prominent black spots on the back in the later stages of development. Immature lygus bugs may be confused with aphids, but are readily distinguished from them by their red antennae and rapid movements.

Lygus bug treatments in Ladino clover fields are based on 2-sweep counts taken in 10 to 20 places throughout a field. Three or more 2-sweep counts are made in each place, and are taken with the standard sweep net having an opening 15 inches in diameter and a handle 26 inches long—each sweep is an arc of 180°. One step should be taken between each sweep so that each arc covers a series of plants undisturbed by the previous sweep. The borders of the field, and areas of heavy, lush growth, may have a significantly higher count than the remainder of the field, but all counts in a field are usually averaged and treatments are based on this. It is rarely practical to treat only portions of the field.

Spider mites. Spider mites commonly found on Ladino clover include the Atlantic mite, *Tetranychus turkestani* Vgarov and Nikolski; the Pacific mite, *T. pacificus* McGregor; the two-spotted spider mite, *T. urticae* (Kock); and the clover mite, *Bryobia praetiosa* Koch. These species occur singly or in combinations, and their relative numbers and over-all abundance varies from field to field and from season to season.

The clover mite does not normally cause economic damage in Ladino clover fields, but *Tetranychus* mites cause serious damage when abundant. Generally, infestations are not of any consequence on first-year stands, but damaging infestations are common in older stands, particularly in fields lacking enough water. Margins of fields subject to heavy dust accumulation on the plants are most susceptible to outbreak populations. Infested leaves become cupped, yellowish, and spotted. Heavily-infested fields rapidly take on a dried-out, reddish-brown appearance.

Spider mite treatments are usually advisable early in the season when 10 per cent of the leaves on the irrigation levees show mite injury. In June and early July, the stand should be treated when 25 per cent of the leaves on irrigation levees show spider mite injury. Rapid developing late-season infestations may damage a maturing heavy bloom, but control treatments 20 days or less before harvest are rarely profitable. If stands are severely attacked late in the season, it is best to start harvesting when the seed is mature. Regular and adequate irrigations tend to reduce the mite problem.

Ground sprayers are the most effective means of applying miticides to Ladino clover; aircraft applications are less effective because of inability to obtain coverage under the leaves. Ground-rig applications should be made at rates of 50 to 60 gallons of spray per acre (at 200 to 300 pounds per square inch pressure) to insure proper coverage.

Fig. 21. Adult lygus bug (top) and lygus bug nymph (bottom). The adult has a light-colored "V" area on its back; the nymph is characterized by reddish antennae, dark spots on the back, and rapid movements. Nymphs are often mistaken for pea aphids.

Aphids. Aphids are usually minor problems in Ladino clover seed production. The pea aphid, *Acyrthosiphon pisum* (Harris), is a large, green aphid most abundant in spring before seed production begins; in recent years, however, populations have continued throughout summer. When abundant it causes the stems to wilt and flower heads to shrivel. The clover aphid, *Aphis bakeri* (Cowen), is a dirty yellow-green color and is much smaller than the pea aphid; it is found in flower heads and on the stem beneath the stipules. This aphid prefers red clover and alsike clover but occasionally attacks Ladino clover. Pea aphids produce little honeydew, but clover aphids produce large amounts.

Natural control by predators and parasites of both of these aphids is common particularly from early spring through June. The factors causing such control should be carefully evaluated before aphid control measures are undertaken. Several predators (the most common being lady beetle and syrphid fly larvae) are active against aphid populations. A small wasp parasite, *Aphidius smithi*, frequently becomes an important control agent during late May and early June—large golden brown aphid mummies on the upper surface of the leaves indicate the presence of this beneficial insect. Under proper conditions a fungus disease (indicated by the presence of moldy pads on the plants) may decimate an aphid population.

The clover aphid should not be confused with the spotted alfalfa aphid, *Therioaphis maculata* (Buckton), which is a major pest of alfalfa but does not attack Ladino clover, red clover, or trefoil.

Fig. 22. Leaves (top two rows) and heads (third row from top) damaged by spider mites; the bottom row of heads shown here are from plants which were not damaged by spider mites.

Weevils. The clover root curculio, *Sitona hispidula* (Fabricius), attacks alfalfa and all clovers, particularly in young or declining stands. Major damage is caused by the larvae; these feed on roots and their damage is characterized by irregular longitudinal channels and pits on the roots. The larvae (which may be difficult to find) are minute, skin-pink, and have dark heads. Adults (weevils) feed on leaves and cause ragged-appearing leaflets; this damage is seldom serious.

Fig. 23. The green pea aphid, Acyrthosiphon pisum (Harris), shown feeding on a leaf.

Other weevils occasionally found in Ladino clover include the clover leaf weevil, *Hypera punctata* (Fabricius), which is ¼ inch or more long, and the clover seed weevil, *Miccotrogus picirostrus* (Fabricius), which is slightly less than ⅛ inch long and is a slate gray color.

Grasshoppers. Damaging numbers of these pests usually result from migration from surrounding fields and uncultivated areas, and control is easiest when grasshoppers are young and before they move into the clover fields. Grasshoppers can, however, develop in the clover field, especially when seed production is repeated in the same field; in such cases, it is best to control them before the field comes into bloom. Because they feed on the flower heads and seed, even low numbers of grasshoppers may cause serious damage. Highest numbers occur in Ladino clover fields in late May and in June, but severe crop damage sometimes occurs as late as July.

The proper insecticide and dosage depends on the size of the grasshoppers and whether or not bees are present. In general, sprays give higher initial kill, continue to kill over a longer period, and require less insecticide per acre than do dusts.

Armyworms and cutworms. The western yellow-striped armyworm, *Prodenia praefica* Grote, is the most important caterpillar attacking Ladino clover stands in California. It is usually black, and has two prominent yellow stripes and many fine bright ones on each side; at maturity it is approximately 1½ to 2 inches long. Armyworms may be abundant from June to early September and are highly destructive because they feed on flowers. Damaging numbers may develop within a Ladino clover field, or move in from surrounding alfalfa fields being cut; insecticide barriers can prevent such invasions.

The beet armyworm, *Spodoptera exigua* (Hubner), occasionally becomes abundant in Ladino clover fields, but

controls for other pests usually keep it below serious damage levels.

Night-feeding cutworms may become a serious problem in spring or after harvest. These pests hide underground during the day and feed on plants at night. For best control, fields should be irrigated before applying insecticides.

Clover case bearer. The clover case bearer, *Coleophora spissicornis* (Haworth), is mainly associated with Ladino clover but occasionally attacks other clovers. These shiny, metallic black moths are found from early May until late August. The female lays eggs on freshly-opened flowers, and the larvae eat their way through the developing seeds and flowers. The larger larvae move about with their bodies encased in dried flowers, and thus are hard to detect in the flower heads.

Chemical control does not appear to be practical. To reduce damage from the clover case bearer, seed fields should be shredded, or pastured and shredded, in the spring and the seed crop should be started about May 15.

Miscellaneous pests. Thrips, leafhoppers, and other insects occasionally become abundant on clovers grown for seed. They are not considered serious and usually are eliminated by treatments for other pests.

Slugs, sowbugs, and pillbugs may become abundant in fields with heavy growth, and may cause severe damage by feeding on new buds. These pests can usually be kept at low numbers by frequently shredding spring growth or by removing it from the field.

DISEASES

Several diseases of Ladino clover are discussed here, chiefly to enable the grower to recognize them. Those caused by fungi do not appear to be of economic importance, but those caused by viruses and a mycoplasm may decrease high seed yields. (Mycoplasms are minute organisms and are classified as the smallest bacteria.)

Crown and root rot. Crown and root rot caused by the fungus *Sclerotinia sclerotiorum* occurs in winter and early spring, usually following rain, and symptoms vary with weather conditions and the type of plant tissues invaded. The fungus infects leaf and stem tissue, causing a soft, watery rot, and grows downward into the roots. During periods of high humidity masses of white fungus growths are visible, and these are soon followed by the appearance of black, irregularly-shaped bodies (sclerotia) whose presence is the best means of identifying the disease. Sclerotia are deposited on soil and serve as a means of survival for the fungus. During cool, moist weather in winter and early spring, sclerotia germinate and produce saucer-shaped fruiting structures about the color and diameter of a pencil eraser. These fruiting bodies produce numerous spores that are ejected into the air and help spread the fungus.

Pepper spot. This disease, caused by the fungus *Pseudoplea trifolii,* occurs abundantly in spring. Symptoms are numerous pinpoint-size, sunken, black lesions on leaves and petioles (the spots seldom increase in size on Ladino clover). Infected leaves soon die and often remain attached to the stems. The fungus survives in dead, infected plant debris and produces numerous spores when cool, moist conditions occur. Because there is little economic loss from the disease, no control is practiced.

Rust. Rust is caused by the fungus *Uromyces trifolii,* and is recognized by raised reddish-brown pustules on the underside of leaves. The disease may occur in early fall and late spring, but it is

Fig. 24. Pepper spot disease of Ladino.

Fig. 25. Rust pustules on Ladino leaflet.

rare in summer when temperatures are high and humidity is low. The disease is of little economic importance.

Mosaic viruses. Several of these occur in white clover, the most common being alfalfa mosaic virus and yellow bean mosaic virus. Several strains of both are known and disease symptoms vary. Often, a single plant may be infected with more than one virus at the same time; when this occurs the effect may be more severe than when a plant is infected with one virus only. The first symptom to appear usually is stunting of the plants—this is obvious in greenhouse tests but less noticeable in the field. The most striking symptom is the occurrence of irregular, yellow blotches on the leaves often accompanied by some deformity of the leaflets. Field and greenhouse tests have shown that these viruses cause reduced flowering and seed yield. One report (from Maryland) states that flower heads of infected plants were reduced 31 per cent as compared to an equal number of healthy plants of the same clone. Seed yield was similarly affected, but there appeared to be no effect on viability of seed from infected plants.

These viruses are transmitted by aphids, and as both vectors and viruses are common on several crop and weed hosts little apparently can be done to control them.

Aster yellows. Aster yellows is the most important disease of Ladino clover in terms of economic losses. The disease is transmitted by leafhoppers; it was previously believed to be caused by a virus, but recent studies have shown that the causal agent is a mycoplasm. However, other information developed over the years on vector relationships, host range, etc., remains valid. The leafhopper acquires the mycoplasm while feeding on diseased plants and after about 2 weeks can transmit the organism to healthy plants while feeding on them. The leafhopper can transmit the mycoplasm throughout its life span.

Ladino plants infected by aster yellows while young will not produce flowers.

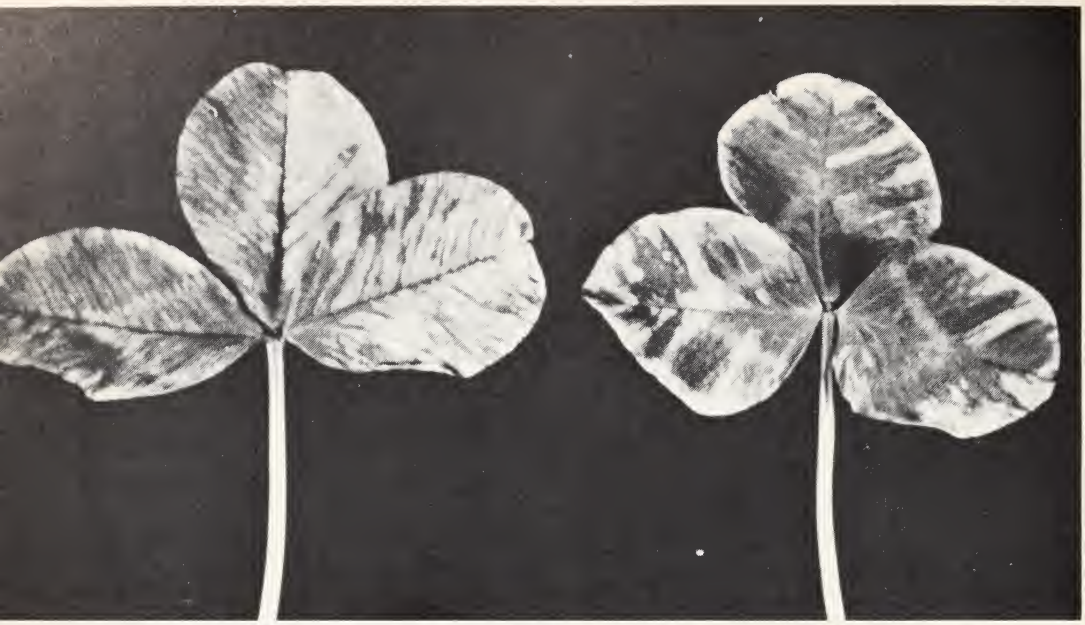

Fig. 26. Leaves from plants infected with alfalfa mosaic virus show yellow blotches.

Fig. 27. Runner infected by aster yellows (top) and normal runner (below).

Plants infected during flowering generally produce no seed; if seed develops, it is usually sterile. Infected plants are weaker and liable to drought damage, winter injury, and early death.

Many symptoms of the disease are quite striking, such as yellowing, bronzing or purpling of the leaves and malformation of the flower heads; normally white floral parts may be green when they emerge from buds. More commonly, flowers fail to develop and are converted into leaves so that clusters of small leaves appear in place of the normal head of flowers. A great range of this type of malformation can be found.

No control for aster yellows has been developed. There is little reason to believe that leafhopper control will provide disease control, and cultural practices for control are yet to be investigated. However, observations indicate that first-year fields remain relatively free of aster yellows and that the disease may not become serious until the second crop year. Perhaps present cultural practices can be modified so as to avoid buildup of the disease that ususally occurs during the second year.

Fig. 28. Ladino clover flower heads showing different symptoms of aster yellows. A normal, healthy flower head is shown at upper left. The disease usually stops flower development.

HARVESTING AND POST-HARVESTING PROCEDURES

Seed yields vary tremendously depending upon management and age of the stands. Second-year clover generally is the most productive, and well-managed second-year stands may produce as much as 700 pounds of seed per acre. Beginning in the third year, seed yields usually decline rather rapidly. The encroachment of weeds, including ryegrass, watergrass, dock, buckhorn, and dandelion, is a contributing cause to declining seed yields; this becomes increasingly evident in third- and fourth-year fields. New, improved weed-control methods may tend to strengthen the production potential of third year and older fields. Excessive drying out of stands during and after harvest undoubtedly kills many Ladino plants; spray-curing well-irrigated clover for seed harvest can help overcome such drought-induced damage.

Harvesting decisions. First-year stands should never be harvested twice. Because of the high per-acre cost of harvesting and the serious damage to clover caused by drying out fields to facilitate harvest, even older stands are seldom harvested twice in the same season.

Fig. 29. Ladino clover seed heads at different stages of maturity. From left to right: early bloom; full bloom but not pollinated; full bloom with lower half of head pollinated; head completely pollinated, but seed not fully mature. Seeds mature 18 to 26 days after pollination.

Seed harvest should not be started until a thorough examination of seed heads throughout the field is made. If the percentage of immature heads is too high, harvesting should be delayed until young heads have matured. Sometimes examination may reveal that the amount of seed in matured heads is too little, so it is essential to wait for additional production if harvest is to be worthwhile. Occasionally, inexperienced seed growers have harvested fields that could be used more profitably as pasture.) Examination determines not only the percentage of green heads and the quality of seed, but also the percentage of matured heads, many of which may be resting near the soil surface so that irrigation water could cause these seed to germinate. Irrigation is usually withheld for 2 to 3 weeks just before a field is cut or spray-cured for seed harvest.

Seed production. Figure 30 shows the pattern of Ladino seed production for the last month of a production period. During the last 2 weeks of the production period shown, there was a significant loss of mature seed because of irrigation water applied just prior to plot harvests made on July 21 and 29 and August 13. With proper water management and timing of harvest, the field harvest on August 18 and the plot harvest on August 5 could have been near the 600 to 800 pounds of total seed produced by these dates, instead of the 350 to 450 pounds actually harvested.

When to start harvest. Usually, the degree of bloom and seed-head maturity will serve as a guide as to when to stop irrigation in preparation for harvest. Seed requires 18 to 26 days to mature after pollination; therefore, the mature seed-head curve is similar to the bloom curve with a lag of 2 to 3 weeks. The bloom of Ladino clover cut-back on May 5 to 10 will sharply decline after mid-July. A rough approximation of potential seed yield can be obtained by calculating that 1 mature seed head per square foot equals about 4 pounds of seed per acre.

Well-managed Ladino clover seed stands normally will produce more than

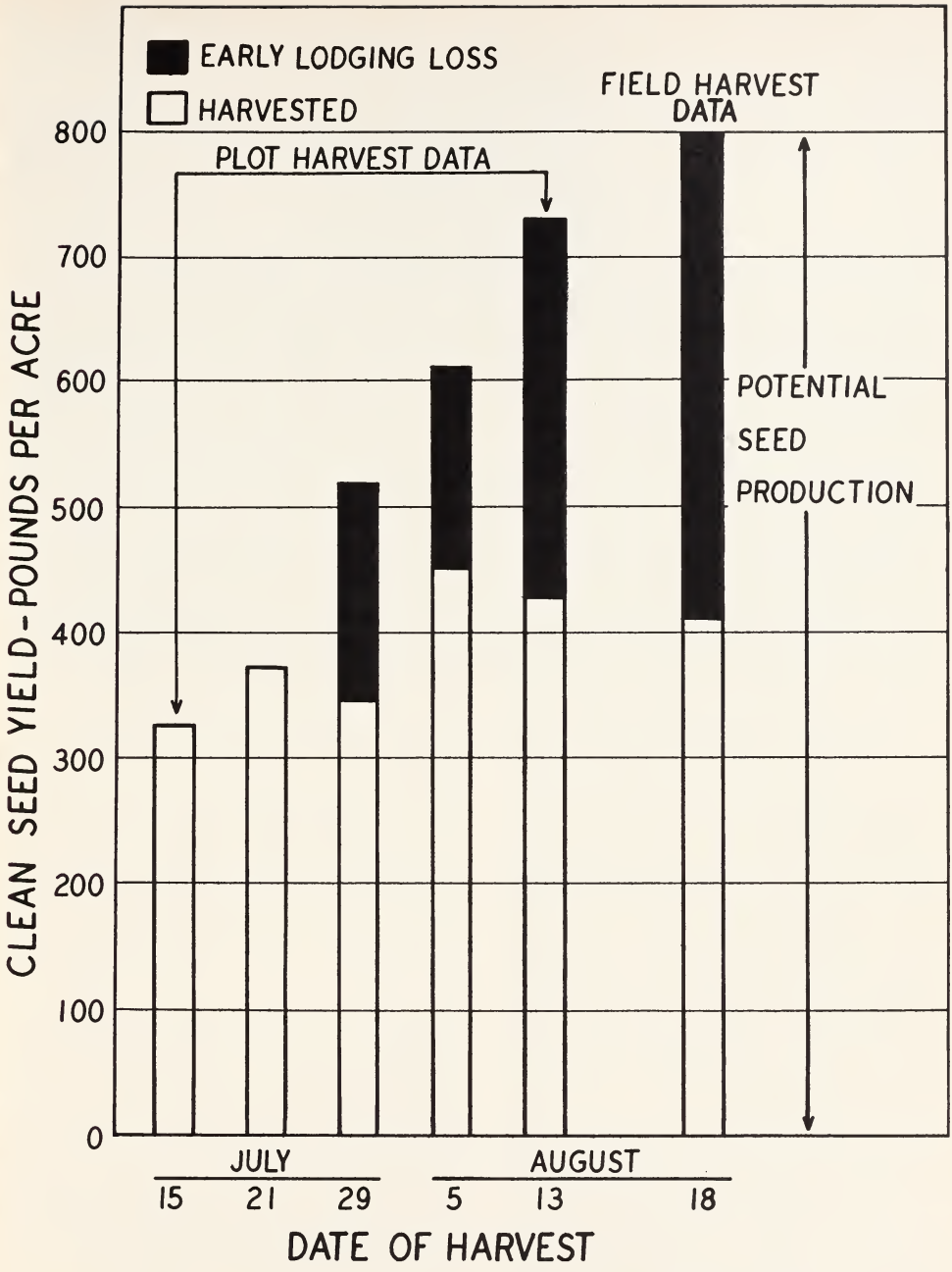

Fig. 30. Actual (harvested) and potential (harvested plus lost) seed yield at several harvest dates during last month of production showing seed lost by poor water and harvest management.

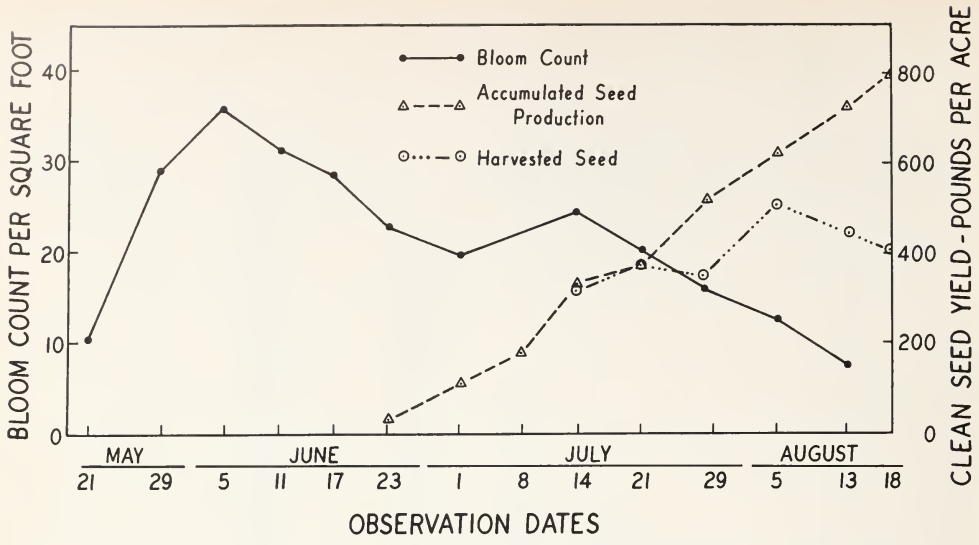

Fig. 31. Ladino clover bloom and seed production curves showing yield potential.

90 per cent of their total potential yield in 90 to 100 days following cut-back. Irrigation cut-off and harvest must be timed correctly in order for harvestable seed yields to approach the potential production. Where considerable lodging is evident, its is advisable to stop irrigation in preparation for harvest when 60 to 70 per cent of the seed heads are mature. In stands where plants are upright and 80 to 90 per cent of the heads are mature, light, rapid irrigations may be continued 10 to 20 days to permit late-blooming heads to mature. Thus, vigorously-growing fields may be irrigated longer and harvested later because seed heads usually have not lodged and germination in them has not begun.

For maximum yields, irrigation must be stopped before germination of seed in heads becomes extensive. The harvest should be scheduled accordingly, usually within 90 to 110 days following cut-back. The top 2 feet of soil should be checked to ascertain how long soil moisture will support the crop after final irrigation, in order that harvesting can be completed and irrigation resumed to prevent stand loss from moisture-stress.

Harvesting methods. In California, harvesting is done by one of two methods: spray-curing followed by direct combining and no subsequent harvesting operation, or combining from the windrow, with straw and chaff from the combine blown into vans. Collected material is rethreshed at a central location, and the field is vacuumed after the first combining operation. The second method requires much specialized equipment which established seed growers have built up over the years, so new seed-growers are encouraged to spray-cure and direct-combine the seed crop. If the combine is equipped with a specially-built cutter bar mounting to permit harvesting across irrigation borders, and the field surface is very smooth, 90 to 95 per cent of the potential seed yield can be harvested. Large-scale field tests for the second method under ideal conditions indicated that approximately 85 per cent of the potential yield was harvested.

Spray curing. If soil is shallow and uniform and the amount of water in the soil can be controlled, drying the stand to cure for direct combining is sometimes done. However, fields must dry uniformly before direct combining after field drying can be accomplished with any suc-

Fig. 32. A modified cutter-bar mounting permits cutting across irrigation borders within 1½ inches of soil surface. With such a mounting, up to 95 per cent of the crop can be harvested.

cess. The most successful method of conditioning for direct combining is application of pre-harvest sprays. (See your local Farm Advisor for information about chemicals registered for use as pre-harvest sprays.)

Mowing and windrowing. Most Ladino clover cut for seed is windrowed with a self-propelled windrower; if a mower is used it should have a bunching attachment. In either case, clover should be cut as close to the ground as possible; occasionally a side-delivery rake is used for windrowing immediately after mowing. Enough space should be left between swaths or windrows to provide room for harvesting machinery.

Some growers prefer swath drying, in which case windrowing is done a night or two before combining. To prevent shattering, raking should be done slowly and when the material is tough from high humidity or dew. Because Ladino is usually difficult to cut, cutter bars should be sharp, adequately powered, and kept in top-notch operating condition. Normally, clover plants are dry and ready for combining 4 or 5 days after mowing.

Curing may be hastened by turning the windrows; this should be done at night when losses from shattering will be at a minimum. Turning should be done slowly, with only enough acreage turned each night to keep ahead of combine operations. Some growers do not turn swaths or windrows if curing conditions have been particularly favorable.

Threshing. Ladino clover-seed threshing requires skill, experience, and patience. However, new growers should be able to spray-cure and direct-combine seed crops under most conditions. To reduce the possible spread of weed seeds, all machines should be cleaned thoroughly before entering a field.

There are wide variations in methods

Fig. 33. Weedy grass rows resulting from moving combine into the field without first thoroughly cleaning it of straw and chaff containing weed seeds.

of threshing the Ladino seed crop. If the crop is not spray-cured and direct-combined, most methods can be fitted into the following pattern:

- Mowing and partially raking or windrowing seed crop with self-propelled windrowers.
- Combining windrows and collecting straw from rear of the combine.
- Rethreshing of straw and chaff from the first threshing, usually with a stationary thresher. (Equipment to mechanize feeding of stationary threshing unit is available.)
- Vacuuming the field and threshing material picked up by the vacuum machine with a stationary thresher. (An alternate method is to vacuum and thresh with a self-propelled vacuum-combine unit.)

Self-propelled combines are equipped with regular or locally adapted forage pickups and straw blowers; the latter facilitate moving straw into tightly covered and screened vans behind the combine. Material accumulated from the combine is usually rethreshed by a stationary thresher located at one corner of the field. The combine shoe is usually equipped with a $\frac{1}{12}$-inch round hole screen, and cyclinder speeds of about 6,000 feet per minute are used. To calculate the cylinder seed in feet per minute, multiply the cylinder diameter in feet by 3.14 and the cylinder (revolutions per minute).

When the windrowed clover has been picked up, the field is vacuumed with a custom-made locally-adapted machine; seed recovered from material picked up in vacuuming ranges from 10 to 40 per cent of total seed harvested per acre. Many vacuum machines simply blow the suctioned material into a covered van, and the material is threshed by stationary threshers.

Recently, custom-made suction machines have been built into self-propelled combines in which the suction unit replaces the entire header assembly. In most such machines, material from the cyclone of the suction unit feeds directly into the cylinder of the threshing unit. After threshing, debris from the rear of the machine is discharged back onto the field. This feature is considered to be a distinct advantage over the system in which the suctioned material is hauled off the field for threshing.

Some California farmers have built their own clover combines and threshers

Fig. 34. Combining from windrows with a self-propelled harvester (top), and collecting straw and chaff for rethreshing (bottom) with a stationary thresher.

with greatly increased screening capacity. In a few instances, seed cleaners have been mounted on field threshers.

Because of the smallness and smoothness of Ladino clover seeds, they can easily escape from inside the combines—so combines should be equipped with a seed-collecting pan under the main harvester body. A large collecting pan suspended under the machine can return as much as 50 to 100 pounds of clean seed per day; pans are particularly important in the direct combining operation, but should also be used when the field is going to be vacuum harvested (free seed on the ground is difficult to pick up even when brushes are used at the entrance of the vacuum nozzle).

Seed damage. Ladino clover seed can be damaged by excessive threshing cylinder or vacuum-fan speeds, protruding sharp edges in the ducting to the cyclone, or by the cyclone itself. Holes in the ducting or cyclone wall must be immediately patched with a flush patch—failure to do so has resulted in sufficient seed damage to lower the germination well below the minimum of 85 per cent for certified seed. If the crop is being direct-combined without rethreshing, the cylinder speed should be between 6,000 and 6,500 feet per min-

Fig. 35. Left: vacuuming seed. Below: unloading vacuumed seed and trash from seed-tight van with automatic cable-pulley rig. Seed will be recovered with a stationary thresher.

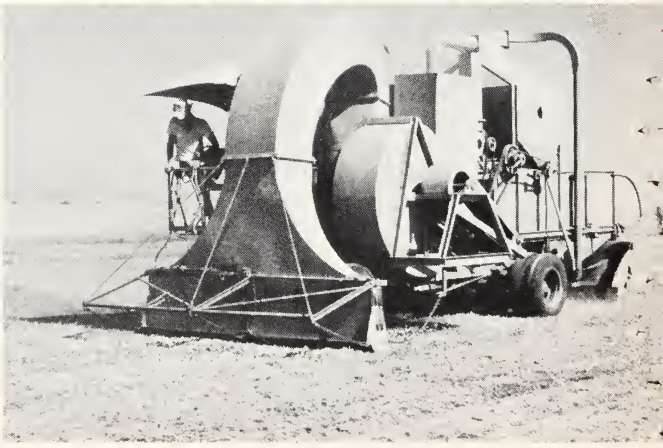

Fig. 36. Right: a custom-made, self-propelled vacuum-combine.

ute (1040 to 1130 for a 22-inch cylinder). Cylinder speeds as low as 5,450 feet per minute (950) can be used if the straw is rethreshed.

Importance of post-harvesting management. To revive drought-stricken clover fields, they should be irrigated immediately after harvesting is completed (in fact, irrigators and harvestermen will often be seen together in the same field). If this is done, damage to the stand because of harvest drying-out will be minimized and growers will get greatly increased fall pasturage. Irrigations should be frequent in autumn until regular rains begin.

When a seed field is directed-combined without collecting the straw and chaff from the combine, all debris should be removed from the field.

Where severe frosts occur, clover-seed fields should enter the cold season with not less than 6 to 8 inches of growth—good clover protects against excessive frost and reduces weed competition. In milder areas, seed fields can be successfully grazed well into the winter without serious damage to the stands, provided that animals are moved out of the fields when soil is wet and over-grazing is not allowed.

Processing and selling seed. Threshed seed is sent directly to seed warehouses, where it is cleaned and prepared for marketing. California Ladino seed-producing districts are fortunate in having efficient, well-staffed, commercial seed-processing facilities available. Processed seed is sold by growers under two systems: California seed-growers associations, which are recognized as farmer-cooperatives market Ladino seed for grower members; or reputable seed firms with national outlets who annually contract with local growers for their crops.

Production costs. Production costs for Ladino clover seed are quite variable, depending in large part on yield and the method of harvest. Your local Farm Advisor can supply you with current information on these topics.

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.

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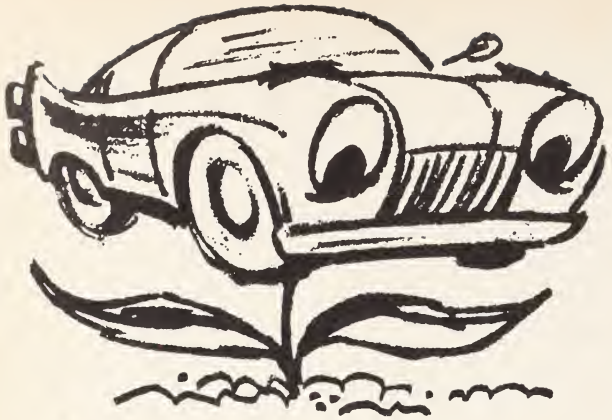

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. . . . . 900,000 bushels of corn
736,000 bushels of flaxseed
74,000 bales of cotton

or, *in terms of approximate acreage:*

. . . . . 15,000 acres of corn
80,000 acres of flax
78,000 acres of cotton

During the same period this company used products derived from 364,000 sheep and 36,000 cattle—plus many other items such as hog bristles and beeswax. In all, produce equivalent to the output of 1,000 good-sized farms is needed yearly. No wonder a top executive in the automotive industry has said: "Our plants, here and throughout the world, would have to close their doors in a few days if their flow of agricultural materials were to stop."

Supplying America's countless industries—and feeding the nation bountifully—makes agriculture America's biggest and perhaps most important business. That is one reason why anything which affects agriculture affects everybody.