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UNIVERSITY OF CALIFORNIA

Red Clover Seed Production

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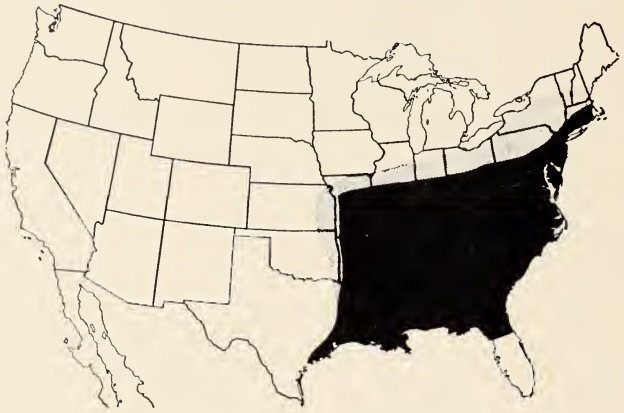
CIRCULAR 432

As a Cash Crop

for California legume-seed producers, red clover offers good possibilities. It can be grown for seed nearly anywhere in the state except in the coastal fog belt. New varieties are continually being developed to meet production needs.

Kenland Red Clover

is a recommended forage crop in 29 states, centering in Kentucky, Virginia, Maryland, Ohio, Indiana, and southern Illinois. A short-lived perennial, Kenland is usually used as a biennial for hay, pasture, soiling, and ensilage, and is recommended particularly where southern anthracnose and crown rot are prevalent and frequently destructive to susceptible red clover strains.



Shaded area shows where Kenland Red Clover is recommended as a forage crop.

Under California conditions, when grown for seed only, two years of production would normally be expected. In experimental plots at Davis 40 to 60 per cent of the old plants die by the end of the second year of production.

Estimated Needs of Kenland Red Clover* are

1953 ..... 6,691,000 pounds
1958 ..... 18,953,000 pounds

* From "Estimates of Use of Grass and Legume Seeds" 1951, 1953, and 1958, National Agricultural Mobilization Committee U.S.D.A. The map used above is from "Four New Forage Crops and Where They Will Grow," Crops and Soils, January, 1952.

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RED CLOVER SEED PRODUCTION

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To Grow The Seed . . .

the important things are: preparation of the seedbed . . proper seed . . inoculation and planting methods . . care of stands . . pest control

Preparation of seedbed

A FINE, FIRM SEEDBED is essential. The surface should be firmed by irrigation, rain settling, cultipacking, or ring rolling before seeding. A medium soil of the loam, sandy loam, and clay loam type is preferred. Alkaline and extremely sandy soils should be avoided.

Choice of seed

Seed source is important. For production of certified seed, registered or foundation seed must be used. Uncertified seed is difficult to market and brings a lower price.

Inoculation may be necessary

Red clover will thrive only if enough proper legume bacteria are present. These may be lacking in soils where true clovers (Trifolium sp.) have not been grown recently. The only way to be certain they are present is to inoculate the seed artificially with commercial cultures, available at most seed stores. Good sound advice is—inoculate in all cases of doubt and always on new land.

Planting methods

Broadcast seeding requires 10 to 12 pounds per acre, while 8 to 10 pounds are enough when seeded with a drill. In row plantings 1½ to 2 pounds make satisfactory stands. If row plantings are used, row spacings of from 24″ to 36″ result in maximum yields. The seed should be sown at a depth of about ½ inch.

Planting in rows is most common in those areas where row cropping is practiced normally. When planted in rows the crop requires less water, and cultivation for control of weeds is possible.

Row planting on the flat is satisfactory provided the flat surface is maintained. The hypocotyl (small stem) is very short and when planted in furrows or depressions is easily covered by soil movement. Seeding on raised beds may aid in establishing fall plantings. Broadcast and close-drill stands are satisfactory also.

Seeding in early fall will help insure first-year crop production. The seeding should be made early enough to allow 4 to 6 true leaves of growth on the seedling plant before the onset of the excessively cold and rainy season. The seedlings are more susceptible to unfavorable growth conditions than either alfalfa or Ladino clover. Spring seedings must be done after the danger of severe frost is over but before hot weather begins. Spring seeding lessens first-year crop yields.

Care of stands

Water requirements of Kenland Red clover are about the same as for alfalfa except that more frequent applications are necessary. To get maximum seed yield keep the plants in a continued vigorous condition throughout the growing and seed-setting period.

The most satisfactory methods of irrigation are flooding by means of strip checks and furrow application. Sprinkler irrigation may have limited use only. Repeated wettings may promote deterioration of the heads and will result in shattering if used after the seed heads begin to mature. The growth and spread of mildew may be favored by sprinkler irrigation.

Clipping back. This is not generally recommended in red clover seed production. Except for control of weeds, disease, or insect pests, there is little to be gained. If necessary, it should be done at about the time the first bloom occurs.

Pollination

This is essential for a commercial seed crop since the red clover flower is practically self-sterile. Two hives of domestic bees per acre are usually sufficient. These should be placed in the field just as the plants begin to bloom.

Fertilization

This often increases yields. In many localities Kenland Red clover seedlings have responded to light applications of nitrogen. Where there is a known or suspected phosphorus or sulfur deficiency, these should be supplied. For specific fertilizer recommendations consult the local University of California Farm Advisor.

Pest control

If not properly controlled, pests can cause severe losses. Consult your Farm Advisor each year for specific control measures.

Before applying any insecticide, except sulfur, to a seed field the seed producer should notify his local Agricultural Commissioner and any beekeepers who may be operating in the immediate vicinity. Bees are essential for production of a commercial seed crop. Indiscriminate use of insecticides may kill pollinating insects. Inadequate control of the harmful insects may result through the use of the wrong materials or improper timing of applications.

Harmful insects. *Lygus bugs* are sucking insects that can do considerable damage to the flower parts and developing seed. The adults are small greenish to yellowish brown bugs that have a distinguishing raised "V" on their backs. The young lygus bugs are green-gray to yellow in color with red antennae. Both adults and young are very quick in their movements.

Lygus bug

When only lygus are involved, DDT sprays or dust at the rate of 1.5 pounds of actual DDT per acre are very effective. A 5 per cent DDT, 75 per cent sulfur dust application of 25 to 30 pounds per acre will control lygus bugs and retard likely mite infestations. The time to begin lygus control is when the lygus count reaches six per sweep with a standard insect net. Counts are determined by doubling the nymphal count and adding it to the adult count. For example, two adults and two nymphs per sweep equal a count of six; four adults and one nymph also equal a count of six, as do three nymphs or six adults.

Grasshoppers can move into seed fields and cause serious damage. When only grasshoppers are involved, toxaphene, chlordane, or aldrin are effective controls. The manufacturer's rate recom-

mendation should be followed. For fields in bloom toxaphene is recommended. Chlordane and aldrin are very toxic to bees, and so the necessary steps must be taken to protect the bee populations. If both grasshoppers and lygus bugs are present in troublesome numbers, toxaphene is recommended.

Armyworms at times could cause damage to a red clover seed field. To protect fields from advancing armyworms chemical barriers can be used around uninfested fields. Barriers of 5 to 10 per cent DDT dust 6 inches wide and 1/8 inch deep are successful. If the yellow-striped armyworm alone is in the field in damaging numbers or present with lygus bugs, treatments with DDT as for lygus bugs alone are effective.

Chalcid fly can be controlled only through preventing a build-up of their population. A thorough sanitation program including elimination of debris and any seed production of small-seeded legumes along near-by ditch banks, roadsides, and fence rows will tend to reduce and minimize likely damage from this pest.

Mites. *Spider mites or red spiders* can cause widespread damage. Control measures should be started when mites are first noticed. Several different species may be involved. These include Atlantic mite, Brown Almond mite, Pacific mite, and the two-spotted mite. Your Farm Advisor can identify these or have them identified.

Mites are sometimes active on red clover in early February (at Davis) and may by May or June cause serious damage. DN 289 or Elgetol 318 are good clean-up sprays, which may be used before the clover comes into full bloom.

Dusting sulfur at the rate of 30 to 40 pounds per acre will control the Atlantic mite. Daytime temperatures must be 80° F. or above for sulfur to be fully effective. Sulfur may cause severe burning of red clover flowers if applied when temperatures are above 85° F.

Aramite and Ovotran sprays and dusts are very effective against mites. Both are safe to use since they are practically nontoxic to bees. Two TEPP sprays applied 5 to 7 days apart result in good mite control. TEPP must not be applied during the day when the field force of bees is working, or serious injury will result. Because parathion is so deadly to bees, it cannot be recommended for pest control while the clover is in bloom.

Weeds. Weed control is essential. Planting the crop on land relatively free of weeds is the first requirement for successful red clover seed production. Where cultivation is possible, as in row plantings, this method is generally most economical. Hand weeding may be needed to clean up a serious weed pest or remove weeds from the rows. In excessively weedy close-drilled or broadcasted stands it may be necessary to mow, to use herbicides, or to rogue in order to eliminate weeds.

Kenland Red clover seedlings are somewhat more sensitive than alfalfa seedlings to dinitro selectives, and greater caution must be employed when they are used.

Once the red clover stand is established, general-contact weed killers can be used. Formulations using 20 to 45 gallons of Diesel oil plus 1 quart of general dinitro in 40 to 70 gallons of water per acre will kill seedling grasses and small broadleaf weeds. Do not let grasses get beyond 1¼ to 1½ inches tall and broadleafed weeds beyond the 2 to 4 true-leaf stage of growth before treatment. Other proprietary contact weed oils can also be used.

Where only winter-growing grasses such as ryegrass, annual bluegrass, foxtail, etc. are present, I.P.C. (O. isopropyl, N phenyl, carbamate) may be used. It may be applied in the early fall (October 15 through November) and irrigated in, or it can be applied in late February. As a spray the recommended rates are 3 to 5 pounds of active ma-

terial in 60 to 100 gallons of water per acre. To be effective I.P.C. must be retained in the root zone. Excessive water leaches it below this depth, and insufficient amounts may not carry the material deep enough. The best results are obtained when it is applied just before emergence of the grass seedlings.

In Harvesting . . .

check these points: time of harvest . . method of curing . . use of suitable pickup . . adjustment of threshing mechanism . . ground speed . . special attachments for your machinery

Harvesting should start . . .

. . . when seed-heads are brown and 90 per cent or more of the seed are past the hard-dough stage of maturity. Harvesting must be done before an appreciable amount of seed-head deterioration begins. On fall plantings (at Davis) the first-year crop normally matures during the months of August and September. Seed from second-year stands, if not cut back, will mature somewhat earlier.

The harvesting of red clover is divided into two distinct operations: (1) the curing or preparation and (2) the hulling and separation of the seed. The curing is by windrowing and contact spraying.

Curing methods

Windrow curing is the most commonly used method. For windrowing the standard mower with "curler" attachment or the windrow swather can be used. The curler, a series of curved bars attached to the rear of the mower cutter bar, leaves a tightly rolled windrow which cures more slowly and is more susceptible to wind and rain damage. When used in row-planted fields or where the stand is sparse, the curler also tends to leave the windrow somewhat bunchy and often noncontinuous.

The windrow swather has a cutter bar on the front edge of a cross conveyor very much like the header of a combine. It is usually equipped with a pickup reel. The cut material is conveyed either to the center or to one side and deposited as a loose, open windrow. Though more expensive, the windrow-swather can be used successfully on all types of stands.

Windrowing must be done only when the humidity is high or when dew is present on the plants. To minimize shattering losses, windrowing is generally done in conjunction with the mowing.

Spray-curing. Preharvest spraying and direct combining have been very successful in areas where strong winds and low humidity are a hazard to seed production. The spray, a dinitro general (Dow or Sinox), applied by airplane at from 1 to 3 pints in 10 to 15 gallons of Diesel oil per acre, is used to condition the crop. Ground-rig application is satisfactory but requires 50 to 100 per cent more oil and sufficient water to make an emulsion that can be applied at rates ranging from 25 to 60 gallons per acre. Spraying is most effective when stands are uniformly mature, open, and erect. Under certain conditions two applications of spray may be desirable. The first will kill the external growth; and the second, a day or two later, will kill the lower and previously protected foliage. When two applications are used, 1 quart of dinitro in 8 gallons of oil per application is adequate.

Combining should follow spraying as soon as the leaves are dry—usually about 3 to 5 days after treatment. It should be completed within 8 to 10 days or before regrowth, head shatter, pod drop, or popping open of the pods occurs to any

great extent. The practice of withholding water to dry out stands as a means of curing for direct combining has limited use only.

Combining. When properly adjusted all commercial harvesters will thresh red clover satisfactorily. The main functions of a combine are concerned with the header in cutting, lifting or feeding the material into the machine, the cylinder in hulling or threshing the seed out of the pods, and the walkers, shoe, and return system, in separating the seed from the straw and chaff.

Header

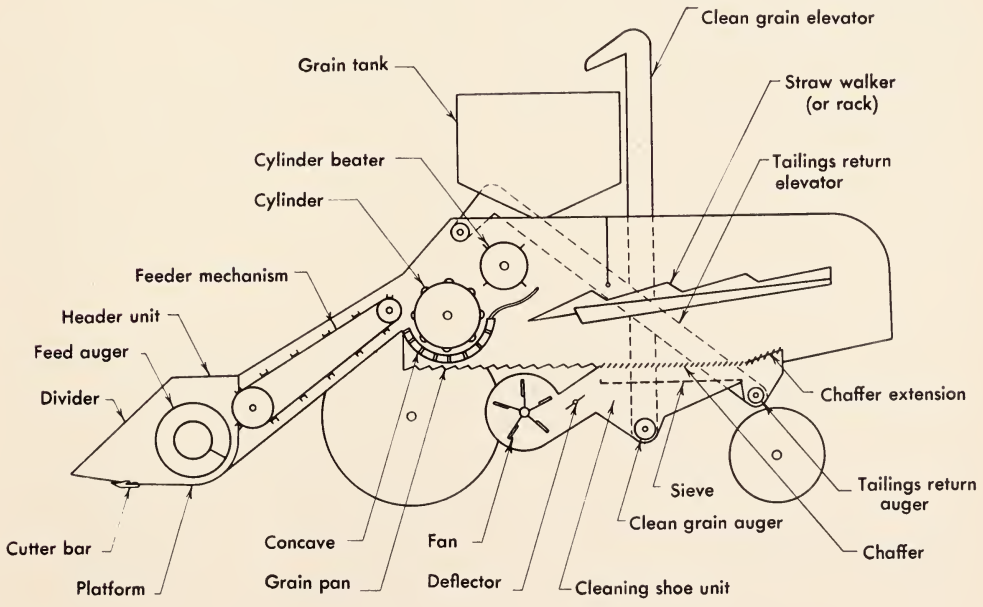
A pickup attachment is used to lift and feed the windrowed material into the harvester. The pickup should be ground-powered, with a peripheral speed 10 to 15 per cent faster than the forward speed. This provides a steady tension on the windrow without pulling it apart. The mounting on the header should be such as to prevent back-feeding to the ground. The conventional cutter bar equipped with lifter guards can also be used as a windrow pickup device, but it will clip off green stubble that may overload the tailings-return system.

For direct combining, the standard cutter bar is used. On lodged or row-planted stands lifters arranged on both sides of the rows or evenly spaced along the cutter bar aid in lifting and properly guiding the material.

Cylinder and concave

The hulling is the biggest problem in threshing, and the type of cylinder will affect the efficiency to varying degrees. The rasp-bar cylinder and spike-toothed cylinder do a similarly good job of threshing, except that the latter chops the straw somewhat finer. In limited tests the V-bar has shown a more positive hulling action, and it does a little better job of threshing—but causes slightly more seed damage.

Avoid seed damage. Excessive seed damage will occur if the peripheral speed of the cylinder (speed of tips of teeth or bars) is too high. The seed from stands conditioned by spraying contains more moisture than windrowed material and is less subject to threshing damage.



Cross section of a typical combine.

Under these conditions the cylinder can be run faster, but in no case should it exceed the upper range of the recommended speeds (Table 1). Uniform and proper machine load is very important. Even at the proper cylinder speed, increasing damage will occur as the cylinder load is reduced.

Cylinder clearance. The clearance between the cylinder and the concave should be from $\frac{3}{32}$ to $\frac{3}{16}$ of an inch. Openings in the concave should be blanked off so that the seed pods will travel the entire length of the concave.

Separation

Straw carriers (walker, rack, or slatted conveyor) in windrowed red clover normally handle about one third of the total material passing through the machine. When less than this amount is handled, it is either because the cylinder is chopping up the straw excessively or because the openings in the carriers are too large. These openings should then be reduced but not to the point where there is an appreciable loss of free seed over the carriers.

Cleaning shoe. Chaffers and the air blast in the cleaning shoe must be carefully adjusted and properly operated to function satisfactorily. An improperly adjusted shoe can cause large amounts of seed to be lost.

For best performance the chaffer should be well opened. A minimum clearance through the openings of about $\frac{1}{2}$ inch has been found satisfactory under usual conditions. If the openings are too small, separation is inadequate, and excessive amounts of seed may be lost over the rear of the shoe. Openings that are too large result in overloading the lower sieve and the tailings-return system.

Wind adjustments should be made by starting out with too much air and then gradually reducing it until the adjustment for minimum seed loss over the rear of the shoe is found. Too much air causes free seed to be blown out in the air stream above the chaff. Insufficient wind causes seed to be carried out in the main body of the chaff stream and also results in overloading of the lower sieve and the tailings return. In addition, the seed in the bin or sack will have more dirt in it.

For the best performance the chaffer extension should be raised to slightly above horizontal, and the openings should have a little more clearance than is required for those on the main chaffer.

A $\frac{1}{10}$-inch round-hole sieve under the chaffer is recommended in place of the adjustable sieve with which the machine is normally equipped for grain.

Ground speed

Operating ground speed is important in regulating machine load. An insufficient load promotes increasing seed damage, especially with V-bar cylinders. An excessive load may cause feeding difficulties and increased seed losses over the rear of the machine. Correct ground

Table 1. Recommended Peripheral Cylinder Speeds for Different Types of Cylinders Operating in Windrowed or Spray-cured Red Clover.

Type of cylinder	Peripheral cylinder-speed FPM	
	Windrowed crop	Spray-cured crop
Rasp-bar or spike-tooth	5,000–5,500	5,500–6,000
V-bar	4,800–5,300	5,300–5,700

Table 2. Revolutions per Minute for Various Peripheral Speeds and Cylinder Diameters.

Cylinder diameter in inches	RPM to give 4,500 ft. per min.	RPM to give 5,000 ft. per min.	RPM to give 5,500 ft. per min.	RPM to give 6,000 ft. per min.
14	1,230	1,360	1,510	1,645
16	1,075	1,190	1,315	1,435
18	955	1,060	1,165	1,270
20	860	955	1,050	1,145
22	780	870	950	1,040
24	715	795	875	955

$$\text{Peripheral speed, feet per minute} = 3.1416 \times \frac{\text{cylinder diameter in inches}}{12} \times \text{rpm.}$$

speed is determined by the free seed losses over the cleaning shoe. It is usually not economically practical to try to reduce seed losses below 5 to 10 pounds per acre because of reduced machine capacities. Ground speeds will vary from 0.5 mph in heavy growth to 1 mph or more in medium to light stands.

Special attachments

Certain special attachments are optional. A pan or canvas suspended under the machine will catch seed that might leak from around the cleaning shoe, elevator doors, joints between header and combine, and elsewhere.

A reel is necessary only when direct-combining very thin stands. It should be ground-powered and driven slightly faster than ground speed.

A reverse gear, or at least a clutch, on the feeder mechanism drive is desirable.

Flax rolls, though not essential in red clover, do retard the incoming material and hold it so that the cylinder has more of a combing action.

Care of seed. Threshed seed is moved from the field directly to seed warehouses either in sacks or in bulk. Bulk handling reduces labor requirements and eliminates the use of sacks. Seed harvested from spray-cured fields should be cleaned or dried immediately to prevent heating.

Production Costs . . .

check yours against the examples given here

Cost of production for Kenland Red clover seed will naturally vary with location, soil type, and other conditions. The example given in the tables on the following pages is representative of conditions in most of the areas where production is feasible. The costs are such as should be achieved under good management practices.

The data on cost per pound with various yields show the importance of getting maximum yields during both production seasons. A low yield either year can run the cost above the market price.

Sample Inputs and Costs for Kenland Red Clover

			Cost per acre
Costs to establish stand			
Seed bed preparation—plow, disc, check, roll—1 man, medium tractor 3.5 hours at $3.50		$ 12.25	
Preirrigate—1 man-hour at $1.00	$ 1.00		
Water—¼ acre-foot at $4.00	1.00		
		2.00	
Plant—1 man, small tractor ⅓ hour at $2.40	.80		
Seed—8 lb. at $.80	6.40		
		7.20	
Miscellaneous—Taxes ½ year	2.00		
Interest $400 at 5% for ½ year	10.00		
		12.00	
Total cost to establish stand			$ 33.45
Cultural costs—two years			
Irrigate*—16 times per year—16 man-hours at $1.00	16.00		
Water—8 acre-feet at $4.00	32.00		
		48.00	
Bees—2 hives per acre per year		18.00	
Fertilize—once each year			
Two men and small tractor 0.4 hour at $3.10	1.24		
Fertilizer, if needed (300–600 pounds single superphosphate)	9.60		
		10.84	
Spray—2 times per year			
Man and small tractor 0.4 hour at $2.10	.84		
Spray material	10.00		
		10.84	
Miscellaneous—Taxes 2 years	8.00		
Interest $433.45 at 5% for 2 years	43.34		
Seed certification	.20		
		51.54	
Total cost			139.22
Harvest costs—two years			
Mow and rake—3 times—1 hay crop and 2 seed crops			
Man and light tractor 3.5 hours at $2.10		7.35	
Bale—1 ton at $5.00		5.00	
Combine—2 times			
One man and combine—2 hours at $4.00	8.00		
Sacks	.50		
		8.50	
Total harvest cost			20.85
Less credit for one ton hay			20.00
Total cost per acre for uncleaned seed			$173.52
Cleaning seed—6 cents per pound clean seed			

* The number of irrigations will depend on soil type and locality and may vary from 4 to 16 applications per season.

Cost per pound cleaned seed based on two years production

Pounds clean seed per acre	Cultural and harvest costs, cents	Cleaning, cents	Per pound total cost, cents
300	57.8	6.0	63.8
600	28.9	6.0	34.9
900	19.3	6.0	25.3
1,200	14.5	6.0	20.5
1,500	11.6	6.0	17.6

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