CALIFORNIA AGRICULTURAL
EXTENSION SERVICE

CIRCULAR 155 · SEPTEMBER, 1949

GRASS SEED PRODUCTION

D. C. SUMNER
MILTON D. MILLER

THE COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA · BERKELEY

Why We Give You This Circular

- Interest in seeding California ranges and irrigated pastures is increasing.
- California imports nearly all of its grass seed for range and irrigated pasture seedings.
- There is a lack of grass seed of the species best suited to California conditions.
- California should start raising seeds adapted to its own conditions.
- There is an opportunity for the California specialty farmer to incorporate small grass seed acreages into his crop rotation.
- And here are the basic principles of grass seed production.

The Authors:

D. C. Sumner is Associate in the Experiment Station (Agronomy), Davis.

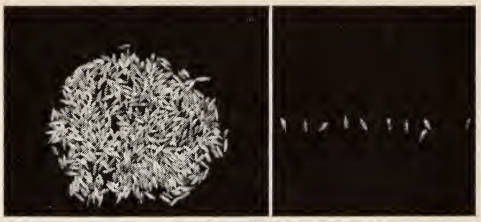
Milton D. Miller is Associate Agriculturist (Agronomy), Davis.

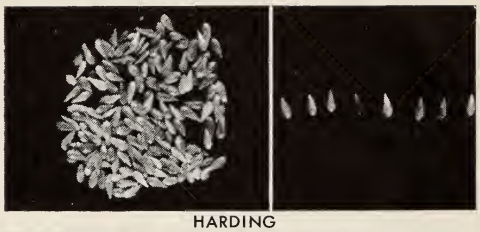
What We Are Talking About . . .

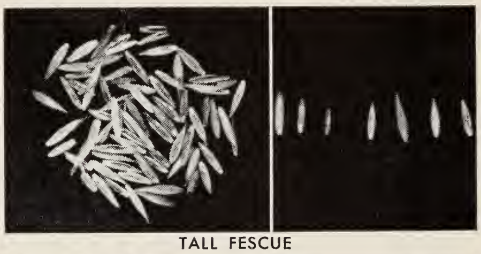
- The following discussion of grass seed production principles is primarily concerned with the six grasses appearing on this page. The seeds shown are about two-thirds actual size.
- These can now be grown successfully and economically in California.
- They will produce good seed yields.
- In California, seed yields **per acre** for these grasses averaged:

Smilo	600–800 lbs.
Hardinggrass	250–500 lbs.
Tall Fescue	400–850 lbs.
California Brome	450–700 lbs.
Harlan Brome	450–700 lbs.
Prairie Brome	450–700 lbs.

- Due to present scarcity and increasing demand, a grower may reasonably expect a modest premium for good quality seed.
- Other income. Straw, a by-product of seed production, is valuable stock roughage.
- These grasses will do best at elevations below 3,000 feet with a rainfall of 18 inches or more unless under irrigation. Areas having extreme summer heat or very cold winters should be avoided.
- The best soils available should be used.
- Harvesting. Standard grain farm equipment can be used but some modification is desirable.
- Threshing. The grower who understands the mechanics of a thresher or combine will have no difficulty in finding the proper thresher adjustments.
- Diseases and pests. So far, under California conditions, there have been no diseases in seed fields of these grasses.

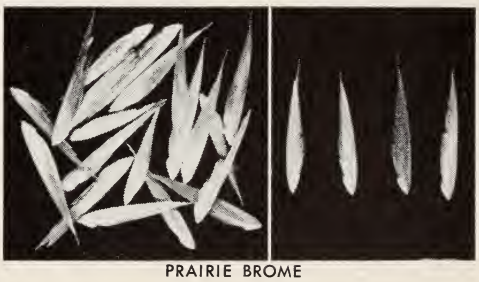

SMILO


HARDING


TALL FESCUE


CALIFORNIA BROME


HARLAN BROME


PRAIRIE BROME

This circular is a guide for potential grass seed producers. At this time, it is not possible to outline definite production methods for the varying conditions of each California locality because some grass species are quite new to cultivation. The information offered is based on workable practices from the authors' experiences, and from other sources such as the Nursery Division, Soil Conservation Service, United States Department of Agriculture. This agency coöperates with the University of California in producing Foundation seed of improved pasture species.

Can *YOU* Produce Good Grass Seed?

The successful grass seed producer **must** produce a high quality product. **He should be an experienced farmer in row crops, irrigation and seed production.** If he is to succeed he must become **a specialist** in seed production. He must give great attention to tedious detail. He must be meticulous and scrupulously careful. He cannot "think" a field is free of weeds or mixtures, or that a seeder and harvester are clean. **He must be absolutely certain** about such things. He must take every precaution to ensure the production of a top quality product.

Certified Seed

Progressive farmers and ranchers are insisting on pure strains of top quality pasture and range seeds.

Certified seed meets the exacting requirements (genetic purity and quality) of the California Crop Improvement Association. It is recognized as the highest quality seed available. Therefore, the grass seed producer should be a member of the Crop Improvement Association which has its headquarters at the University of California, Davis.

The local Farm Advisor has all information on how seed crops are certified.

The Potential Market

The potential California commercial demand is for:

1. Seeding irrigated pastures.
2. Seeding range land.

Future indications are that from 2 to 4 million pounds of grass and legume seed will be needed annually in California.

There are 585 thousand acres of irrigated pastures in California. When the various statewide irrigation projects are completed, this acreage may double. The demand for seed of grasses adapted to these seedings has been very active. It has increased steadily each year. If the maximum acreage is reached, about 2 million pounds of seed will be required annually for irrigated pastures alone.

There are 10 million acres of brushland in California. Most of this is potential grassland. Fifty to 100 thousand acres are being cleared each year.

The recent demand for grass seed species especially adapted for range use has been limited because:

1. Annual range acreage cleared has been low.
2. Prices of some grass seeds adapted for range use have been very high due to limited supply.

Range owners will do more seeding as brush clearance increases and seed supplies become plentiful at reasonable prices. This should create a more active demand for seed for California ranges.

An out-of-state market may also develop as seed production increases. The U. S. is rapidly incorporating seeded pastures into the various crop rotation systems.

The Pacific Northwest has found it highly profitable to produce forage grass seed. California has a similar opportunity. Its climate is especially well suited for seed production.

Grasses and Legumes in Greatest California Demand

Most of the grass seed used in California is imported from other states and countries.

The following is the supply situation.

Seed in fairly adequate supply:

Tall Fescue
Orchardgrass
Ryegrass (Annual and Perennial)
Ladino Clover
Alfalfa
Subterranean Clover

Seed in limited supply:

Hardinggrass
California Brome
Bur Clover
Burnet (a member of the rose family; not a grass or a legume).

Seed in very limited supply:

Smilo
Prairie Brome
Harlan Brome
Rose Clover

Seed not in commercial production until economical harvesting methods are developed:

Stipas (Nodding and Purple)
Veldtgrass
California Oatgrass

The following discussion of grass seed production principles is concerned primarily with **Harding, Fescue, Smilo, California Brome, Prairie Brome,** and **Harlan Brome.** These can now be grown successfully and economically. They will produce good seed yields.

The production principles outlined here can be applied, with modification, to the growing of most varieties of grass seed.

Yields and Prices

Yield per acre influences cash returns.

Seed yields depend upon management, and uncontrollable conditions such as weather and soil. Naturally, there is a wide variation from district to district and farm to farm.

In California, seed yields per acre for the following grasses have averaged:

Hardinggrass . . . . . 250–500 lbs.
Tall Fescue . . . . . 400–850 lbs.
Smilo . . . . . 600–800 lbs.
California Brome . . . . 450–700 lbs.
Prairie Brome . . . . . 450–700 lbs.
Harlan Brome . . . . . 450–700 lbs.

If these adapted species are to have wide usage, the farmer must be encouraged to use them. Price is an important factor.

Due to present scarcity and increasing demand, a grower may reasonably expect a modest premium for good quality seed. This may be especially true during these initial years.

Production for use only in California seedings should gradually expand as demand increases. If production increases faster than demand, abnormally low prices may result in any one season until demand catches up with supply.

Initially, farmers producing some of the species not now in good supply may expect an exceptionally good price. However, as supplies increase, prices are expected to level off; then only a modest premium can be expected over prices of commonly produced seed such as Orchardgrass and Tall Fescue.

No doubt, prices for hard-to-produce species such as Veldt and the Stipas will remain quite favorable.

Other Income

Straw, a by-product of seed production, is valuable stock roughage when correctly handled to preserve the green color and properties of good hay. In some areas, it is especially valued as feed for horses.

Pasturing seed fields for additional income has distinct disadvantages.

In the past, and even today, in the older seed producing areas of the U. S. where much of the seed is produced in solid

stands, some fields are often used as pastures in the spring or fall, or both. Under such treatment, the stands are weakened by trampling, heavy grazing and introduced weeds. Consequently, seed yields and quality are lowered, and the seed crop rapidly becomes incidental to pasturage.

Under California conditions, pasturing grass seed fields cannot be recommended.

Under irrigation, considerable damage to the stand results from grazing while wet.

Stock becomes an important factor in introducing and maintaining a weed problem unless their digestive tracts have been thoroughly cleaned out prior to their grazing in a seed field.

If pasturing is practiced, however, it must be done very carefully and be incidental to seed production. In areas of sufficient soil moisture, or where irrigation is possible, a light pasturing after seed harvest to remove crop aftermath is possible if stock is removed early enough in the fall to allow the grass plants to regain considerable growth and root reserves before winter.

A Balanced Production Program

It is inadvisable to set up new farming projects based solely on grass seed production because of the economic hazards of a developing industry. Grass seed production should be incorporated in a sound crop rotation system.

Farmers already producing alfalfa, ladino clover, sudangrass, or vegetable seeds should find it profitable to add grass seed production to their programs.

Managers of established diversified row and grain crop enterprises might well consider grass seed as a profitable addition to their rotation systems.

It would be best to select ladino clover, red clover or one of the new alfalfa varieties such as Ranger, Buffalo or Atlantic as the basic seed crop. To the basic seed crop can be added a modest initial acreage of one of the six grass seed crops under discussion (Harding, Tall Fescue, Smilo, California Brome, Prairie Brome and Harlan Brome). The reasons for this are twofold:

1. The know-how of legume seed production is widespread in the key areas of the state.

2. The market for these legume species is nationwide.

As production experience is gained and the market develops, the production program can be altered to meet demand.

Climate and Soils

Good seed crops can be grown throughout most of California.

It is believed that for seed production the grasses under discussion will do best at elevations below 3,000 feet with a rainfall of 18 inches or more unless under irrigation.

Areas having extreme summer heat or very cold winters should be avoided.

Areas of relatively moderate humidity and free of prevailing strong winds have a decided advantage. As a seed crop approaches maturity it becomes increasingly susceptible to shattering. Strong winds, at or near harvest time, can cause large losses of seed.

The best soils available should be used. A deep, well drained, near neutral, fertile soil of high-water-holding capacity is preferred.

Grasses Improve Soil

The production and maintenance of good vigorous stands of bunch grasses in a crop rotation system contribute immeasurably to a sound farm management program.

Perennial bunch grasses are excellent soil improvers for heavy land. Due to their deep, extensive, fibrous root systems the soil is opened up below plow depth. Organic matter is added to the soil

each year by the partial renewal of the root system. Within four years a decided change in the friability of the poorest soil is usually noticed.

In addition to the above, the clean cultivation necessary for seed production leaves the land in much better condition for other crops.

GROWING THE CROP

The Time to Plant

Planting in the early fall insures larger and more productive plants in the first crop year (fig. 1). Planting at this time is preferred even if pre-irrigation is necessary to prepare a seedbed. Perennial grasses are slow in becoming established and do not reach their maximum growth the first year.

Depending upon local conditions, seeding should be done between October 1 and December 1, or during the period when cereal crops are usually sown.

In most areas of California, seeding before the first fall rains is rather hazardous. An unusually early rain may provide sufficient moisture at or near the surface to germinate the seed; then the surface soil may dry out before the normal rainy season sets in. This might cause loss of the stand.

In areas subject to severe frosts, seeding should be done early enough to ensure seedling plants being well established and in the third or fourth leaf stage before the first frost.

Stands may be secured if seeding is done in late winter or early spring, but yields for the first year are usually very much lower than when seeding is done in the fall. Spring seedings are only recommended for those areas where fall seedings will not survive the winters.

Seedbed Preparation

A fine, firm seedbed, as used in alfalfa production, is essential.

For fall planting, the land should be spring plowed and summer fallowed; allowing no weeds to set seed.

Spring planted seedbeds should be on land fallowed the previous year, plowed early, and worked into a fine, firm, weed-free condition.

Before planting, the land should be harrowed lightly to eliminate all germi-

Fig. 1—Hardinggrass seed field. This field was fall planted and is producing its first seed crop. Furrow irrigation is accomplished by the use of siphons from a main ditch.

TABLE 1—Possible Genetic and Mechanical Contaminants of Grass Seeds

Seed Crop	California grasses which may cross pollinate with seed crop	Some seeds difficult or impossible to remove from harvested crop
Harding	None	Reed canarygrass, all annual canarygrasses, Fescue, Ryegrass, Watergrass
Smilo	None	Pigweed
Fescue	Other varieties of Fescue (Meadow, Tall and Alta, and K–31) may be found as escapes in ditch banks, roadsides, etc., adjacent to irrigated pastures	Ryegrass Other Fescues Watergrass Wild Oats
California Brome	Native stands of same species; found in foothill areas, uncultivated fields, etc.	All other bromes, native or cultivated. Wild Oats, Watergrass
Prairie Brome	Rescue grass; variety of same species. Irrigated pastures, uncultivated fields and agricultural areas	Same as California Brome
Harlan Brome	None	Same as California Brome

nating weeds. Care should be taken to prevent turning up deeper weed seeds.

Land should be cultipacked before and after seeding.

Good seedbed preparation reduces weed problems. In certain areas, it may be advisable to irrigate up the weeds after the seedbed is prepared and to spray them out with a fortified oil spray before seeding. Consult local Farm Advisors for information on spray formulas and techniques.

Land selected for grass seed production should be as free as possible from weeds. Seedling perennial grasses grow slowly. Weeds can soon weaken a good stand of young grass.

Beginning with seedbed preparation, never compromise with weeds. Weed seeds and seeds of other grasses are difficult, costly, and sometimes impossible to remove from a harvested seed crop.

Plant Quality Seed Only

Only Certified or Foundation seed should be used for grass seed production. It is important for the seed to meet the demands of commercial seed users. This can be done by using only the very best seed of the highest quality. Foundation and Certified seed, the best available, can be obtained through the California Crop Improvement Association.

Seed is the least expensive item in the total cost of production. Use only the best.

Plant in Rows

The best yields are obtained from planting in rows.

The choice of row widths depends upon the cultivation equipment at hand.

Row widths for perennial grasses should be between 3 and 3½ feet.

Extensive tillering and crown growth after the first year will almost close over the inter-row spacing (fig. 2).

In almost all cases, too close a row spacing will result in lower yields.

Rows should be placed on the contour to reduce erosion problems.

Seed fields have been planted to solid stands, but the stands were short lived and weed control was difficult.

Cross Pollination

Table 1 deals with cross pollination.

Grasses of different genera, such as Bromes and Fescues, do not cross pollinate. Occasionally, grasses of the same genus, but different species, have produced hybrids. These hybrids occur so infrequently that they do not interfere with seed quality as related to commercial seed production. The growing of several unrelated grasses for seed in adjacent fields does not produce a problem except that mechanical mixtures are possible.

Cross pollination occurs between varieties of a species. For example, in the Fescues we have Kentucky 31, Alta Fescue and Tall Fescue derived from Meadow Fescue. All of these are of the same genus and species. To avoid cross pollination,

Fig. 2—Tall Fescue seed field in its second year of production. The three-foot row spacing is almost closed over by the heavy growth. Crop is ready for binding.

TABLE 2—Average Seeding Rates of Live-Pure Seed per Acre Based on 3-foot Rows

Variety of Grass	Number Seeds per lb.	Minimum Germination for Cert. Seed	Pounds Seeded per Acre	Seeds per Linear Foot of Row
Harding.....	350,000	70	3	50
Fescue.....	225,000	85	4	52
Smilo.....	1,221,000	70	3	76
Bromes				
California	142,000	85	5	41
Prairie	68,000	85	5	20
Harlan.....	72,000	85	5	20

the Crop Improvement Association has adopted the following field standard:

"All fields or portions of fields used for the production of certified seed must be at least 40 rods (660 ft.) distant from fields or areas containing plants with which cross pollination is apt to occur."

Rates of Seeding

We must first understand the term "Live-pure seed," or its abbreviation "lps."

The important factors in seed quality are purity and germination.

Purity is the percentage by weight of pure seed present in any given lot.

Germination is the percentage of pure seed of any given lot that will begin to grow in laboratory tests.

"Live-pure seed," or its abbreviation "lps," means quality of the seed and includes purity and germination.

How do we know what the purity and germination percentages are in the seed we buy?

The law requires that each container of commercially sold seed be properly labeled. The label **must** show the name of the variety of seed, percentages of purity, germination, seeds of weeds and other crops, and inert material such as dirt and chaff.

In established seed producing areas, a general practice of many years standing is to use the lowest possible seeding rate of live-pure seed and still assure an even stand within the row.

Excessive crowding of plants within the row decreases yields.

Table 2 gives the average recommended seeding rate of Live-pure seed (lps) per acre based on 3-foot rows. These rates have produced excellent stands in California when seeded on well-worked, firm, weed-free seed beds.

Seed lots are rarely 100 per cent live and pure, and to follow table 2 **we must make an allowance for this** and plant an additional amount of seed in order to plant at the recommended rate of live-pure seed. Table 3 is handy for calculating the amount of seed to sow per acre to ensure planting the required full poundage of live-pure seeds per acre called for in Table 2. This is how to find the amount of seed per acre to sow to get the recommended rate of live-pure seed.

Find the "lps" by multiplying the per cent germination by per cent purity and dividing by 100. Remember that these percentages appear on the seed container.

Opposite the "lps" in Table 3 is the conversion factor by which the recommended seeding rate is multiplied to find the actual amount of seed which must be planted to get the live-pure seed per acre called for in the recommended rates of seeding. For example, the recommended

TABLE 3—Lps Factors for Determining Seeding Rates

% lps	Factor	% lps	Factor
1	100.00	51	1.96
2	50.00	52	1.92
3	33.30	53	1.89
4	25.00	54	1.85
5	20.00	55	1.82
6	16.66	56	1.79
7	14.29	57	1.76
8	12.50	58	1.73
9	11.11	59	1.70
10	10.00	60	1.67
11	9.09	61	1.64
12	8.33	62	1.62
13	7.69	63	1.59
14	7.14	64	1.56
15	6.66	65	1.54
16	6.25	66	1.52
17	5.88	67	1.49
18	5.56	68	1.47
19	5.27	69	1.45
20	5.00	70	1.43
21	4.77	71	1.41
22	4.55	72	1.39
23	4.35	73	1.37
24	4.17	74	1.35
25	4.00	75	1.34
26	3.85	76	1.32
27	3.71	77	1.30
28	3.53	78	1.28
29	3.45	79	1.27
30	3.33	80	1.25
31	3.23	81	1.24
32	3.13	82	1.22
33	3.03	83	1.20
34	2.94	84	1.19
35	2.86	85	1.18
36	2.78	86	1.16
37	2.70	87	1.15
38	2.63	88	1.14
39	2.57	89	1.12
40	2.50	90	1.11
41	2.44	91	1.10
42	2.38	92	1.09
43	2.33	93	1.08
44	2.28	94	1.06
45	2.21	95	1.05
46	2.18	96	1.04
47	2.13	97	1.03
48	2.08	98	1.02
49	2.04	99	1.01
50	2.00	100	1.00

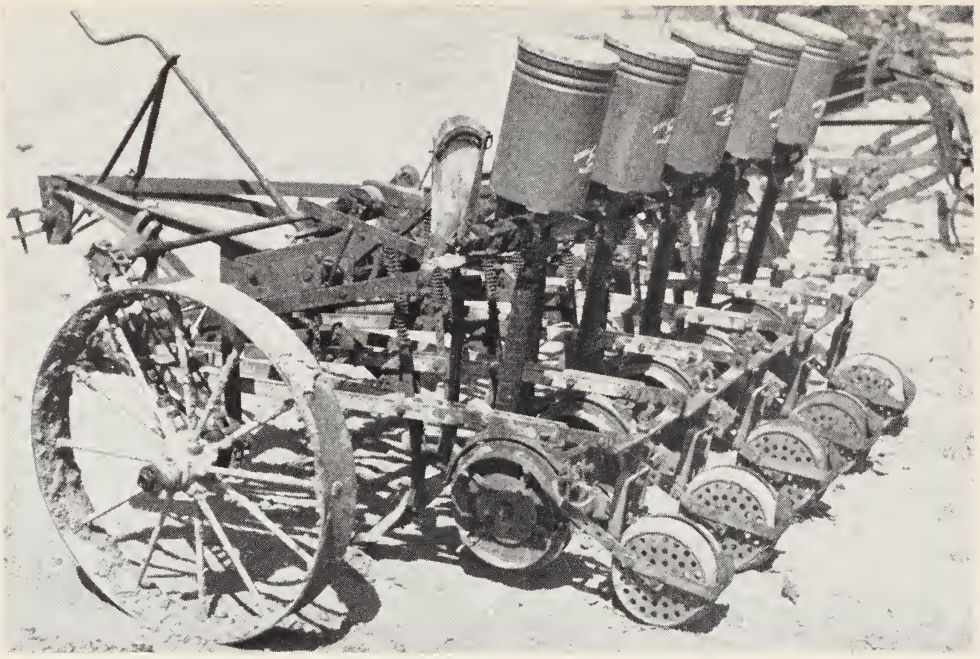


Fig. 3—Fluted feed type drill with double-disk furrow openers provided with depth bands. The above drill was custom built by the Soil Conservation Service. Note the furrowing shoes mounted in front of each furrow opener. This permits drilling seed into a listed furrow well into the moisture without planting too deep. Smilo and other small-seeded varieties are especially benefited by this procedure.

seeding rate of Smilo is 3 pounds per acre (table 2). The label on the seed container shows the Smilo to have a "germination" of 70 per cent, and a "purity" of 99 per cent. We multiply 70 (germination) by 99 (purity) and divide by 100. Our answer is 69.3 which is the per cent lps or:

$$\frac{70\ (\text{germ.}) \times 99\ (\text{purity})}{100} = 69.3\%\ \text{lps}$$

Having found the lps we now use Table 3. The conversion factor opposite "69" is 1.45. We multiply 1.45×3 (the recommended seeding rate) and the result is 4.35, therefore, 4.35 pounds of this particular lot of Smilo seed must be planted to assure seeding 3 full pounds of live-pure seed per acre.

Depth of Seeding

The depth of seeding must be shallow and carefully controlled.

Depth bands attached to double disc furrow openers (fig. 3), or any other positive depth regulator, are satisfactory. Shoe-type openers as used on sugar beet and vegetable seed planters can be used.

Very small seeds (Smilo) should be placed just below the soil surface.

Small seeds (Harding and Fescue) should not be placed deeper than ¼ inch.

Larger seeds (Bromes) should not be drilled to a depth greater than ½ inch.

Deeper plantings than these delay germination and emergence, and develop poor stands.

It is sometimes difficult to establish a stand of Smilo. This is due to the very shallow seeding depth necessary; also the seedlings are so small that it is hard to get them through a crusted surface.

Roughly, 25% of the viable Smilo seed will germinate within the first 10 days. The remainder may germinate over a period of 40 days. If the surface moisture dries out during this period a poor stand may result. Very shallow seeding in the

bottom of a listed furrow where the surface moisture is retained for a long time tends to overcome this.

Seeding Equipment

Several types of seeders are commonly used. Nearly all give good results if they are used properly (fig. 4).

The ordinary grass seeders and fluted feed grain drills will handle most grass seeds when all drill runs, except those necessary for the desired row spacing, are covered.

Multiple-row bean and beet planters with fluted feed type cans instead of the knock-out plate type feed have proved very successful. An interesting example is that of two seed cans feeding into one furrow opener. It is claimed that this system makes more certain an even distribution of seed and fewer skips in the row when using low seeding rates.

The Planet Jr. seeder units are used quite successfully, but they work best for small, smooth, free flowing seeds.

Using rice hulls as a dilutent greatly facilitates drilling light, fluffy, awned, or other seeds which tend to mat or bridge over the metering devices of planting equipment.

The seed drill should be set to deliver at its maximum rate, and the weight of the rice hulls delivered per acre should be determined.

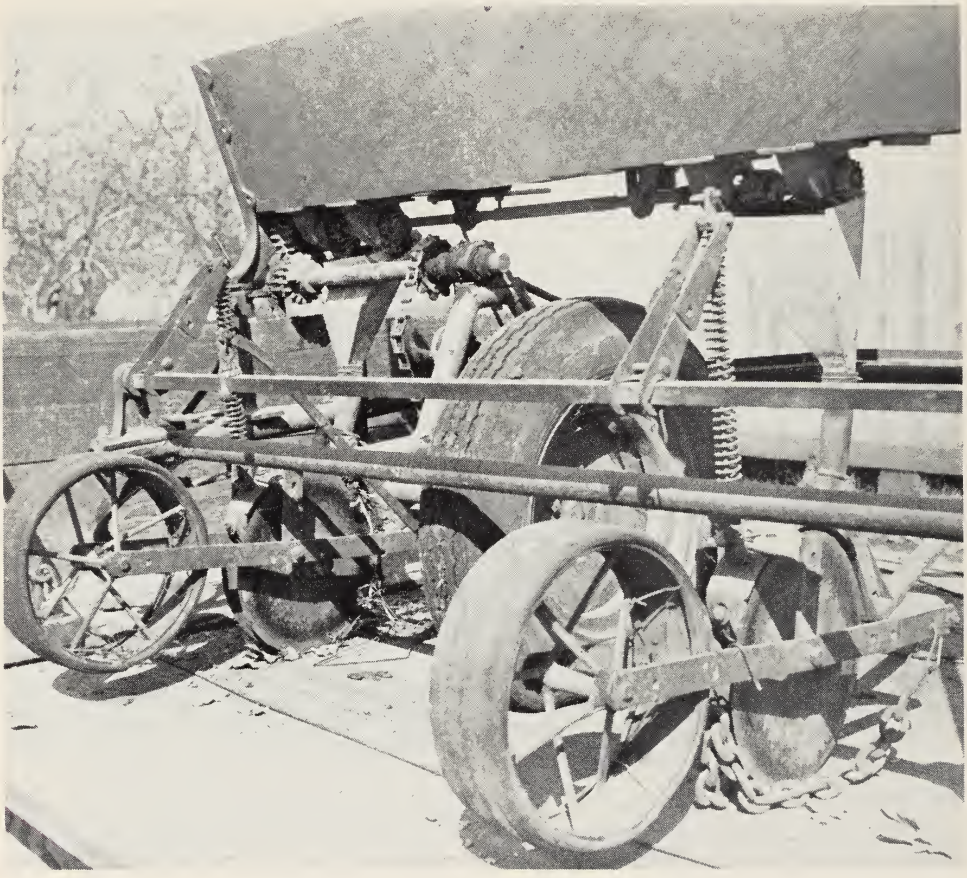


Fig. 4—Two runs of a home-made four-row planter. Fluted metering devices are used in this machine. The seed box has alternating compartments for seed and fertilizer so that a supply of each is metered into a single furrow. Some growers use all compartments for seed to ensure an even seeding. In this case, the fertilizer is applied later as a side dressing.

Before seeding, the desired number of pounds of seed per acre are mixed thoroughly with the amount of rice hulls that the drill will deliver on a per acre basis. It is advisable to limit each batch of mix to the amount required for three acres because a better mixing is obtained and maintained.

When the seed is added to the hulls there will be a small error in the delivery rate per acre. When seeding at high rates per acre, or with large seeded grasses, this error may be corrected by removing enough hulls to equal one-half the volume of seed to be added. For small seeding rates, the error is small enough to be disregarded.

The seed and rice hulls must be thoroughly mixed to ensure an even distribution of seed.

MANAGEMENT

Cultivation is the key to weed control. It may be supplemented by proper use of chemical sprays. Row culture makes cultivation possible.

Continual care and proper management to ensure a weed-free stand is of primary importance in seed production. A good grass seed producer will never let weeds mature. The best and cheapest time to remove contaminating seeds from the crop is before harvest. Early and complete weed elimination is essential.

Cultivation should be discontinued when the crop plants reach a size where they may be injured by machinery moving through the field.

2,4-D and selective di-nitro sprays (e.g., Dow and Sinox selectives) can be used to eliminate broad-leaved weeds such as mustard, wild radish, yellow star thistle, knotweed and fiddle neck.

At present, no chemical herbicides can be recommended for selectively killing out contaminating grass weeds such as rip gut and wild oats. These must be controlled by cultivation and roguing.

Before using sprays, grass plants should be at least 2 to 3 inches high or past the third or fourth leaf stage.

There has been no apparent damage to grass plants when 2,4-D has been applied at a rate of 1½ pounds of acid equivalent per acre. Very effective and much safer weed control has been obtained with as little as ½ to ¾ pounds of 2,4-D acid equivalent per acre while the weeds were in the two- to five-leaf stage.

Many crop plants are very susceptible to 2,4-D if it reaches their roots, even though the aerial portions are tolerant or resistant. As a precaution, 2,4-D should not be applied to a seedling grass stand just before a rain. An entire stand of healthy Hardinggrass seedlings was killed under these circumstances. A spraying just before a light rain resulted in the rain washing the 2,4-D from the plants into the root zone.

Di-nitro selective herbicides have been used with no damage to the grass plants.

Manufacturers' recommendations as to amounts of 2,4-D and Di-nitro selectives to apply per acre should be followed. Caution should be taken at all times in using weed sprays. It is advisable to first observe the effect of a spray on a small section of row before applying it to the entire field.

Hand Roguing

Weeds will occur in fields, particularly within the rows, despite careful cultivation and spraying.

The stand should be gone over very carefully and all weeds and off-type plants removed. This should be done at least once before and again soon after the grass plants produce seed heads.

Water Requirements

Irrigation will be necessary in most areas of California.

Good yields of grass seed can be produced without irrigation in the north

coastal counties having high rainfall. In the other parts of California, irrigation will usually produce higher yields than dry land culture.

Seed producing stands require ¼ to ⅓ as much water as a good stand of alfalfa.

Root systems of established perennial grasses penetrate the soil to a depth of 5 to 6 feet. It is essential to maintain sufficient moisture in the root zone up to harvest time if continuous plant growth and highest seed yields are to be obtained.

After harvest, less water will probably be required because growth rate will be greatly reduced. But in most areas of California, one or two irrigations after harvest are necessary to prevent injury from late summer drought, and to speed early fall recovery.

Fertilization

Grasses are heavy users of nitrogen. In most cases, they will respond to its application.

It is impossible to make definite fertilization recommendations for **all** California conditions because of wide soil variations. Each grower must determine his needs by field tests and experiences in his area.

On some soils, particularly after the first year, fertilization is necessary to continuously produce profitable seed crops.

Barnyard manure should not be used. It usually contains many weed seeds.

In California and Oregon, fertilization has increased and maintained yields. Thirty to 60 pounds of elemental nitrogen per acre and the same amount of phosphoric acid have been added to seed fields as a side dressing.

In Oregon, it is found that in most cases a combination of nitrogen and phosphorus is better than nitrogen alone. Some growers use ammonium nitrate and treble superphosphate; others use 11–48–0 or 16–20–0.

Sometimes, a split application is used; one half in the fall and the rest in the spring.

The use of too much nitrogen in seed fields has caused extensive lodging.

Expected Life of a Stand

The number of years a stand will be profitable depends upon:

1. Management
2. Productivity of the soil
3. Freeness of the stand from weeds.

The highest production from grass seed fields is generally secured from the second and third years' harvest. Yields in succeeding years may steadily decline. There are known seed producing grass stands seven and eight years old still producing good seed crops.

HARVESTING

When to Harvest

The actual date of harvesting is determined by carefully observing the maturing stand.

As grasses mature, the seeds go through these stages in the following order:

1. Milky
2. Soft dough
3. Medium dough
4. Hard dough.

Grasses are progressively more subject to shattering as they approach maturity.

The crop should not be harvested until the majority of maturing heads throughout the field are entering the hard dough stage; usually about the time the top seeds in the head are just about starting to shatter. This can be determined by gently tapping the grass head in the palm of the hand.

If the crop is harvested much before the hard dough stage, a large percentage of the seeds will be light, shriveled and of low germination.

It is imperative that all harvesting equipment be ready for use. Under hot,

Fig. 5—Binding, shocking to cure and threshing with a mobile machine is the most widely used grass seed harvesting method. The shattered seed on the left of the machine sifts into the metal pan shown dragging beneath and extending to the rear of the binder. Shattered seed from the right side of the machine slides into the tray beneath the bundle carrier. Note short pieces of hose fastened to reel slats. These are centered on the rows and help to keep the cutter-bar free. (Union Pacific Railroad photo.)

dry conditions the change from medium to hard dough can be very rapid. A few days of very hot weather during this critical period can carry the crop past the best harvesting stage and result in excessive shattering.

Smilo does not shatter as readily as the other grasses under discussion and can be left to mature longer before harvesting.

Apart from the difficulty in establishing a stand, Smilo is one of the least difficult grasses to handle.

Although it is recommended that initial plantings be kept small, the size of a seed field must be considered when determining harvest time. In a large field, for example, several days might be required to complete harvesting, and if harvesting started when the seed was well into the hard dough stage it might result in the loss of a large quantity of over-ripe seed before the field was finished. In such a case, it would be necessary to start harvesting a little early and average out the loss of some immature or light seed against the recovery of a greater amount of the mature seed.

Methods of Harvesting

Standard grain farm equipment can be used in harvesting grass seed. Although special equipment is unnecessary, some modification is desirable (fig. 5).

The most universally accepted practice is binding, shocking, and delivery to a stationary thresher.

The cutter bar of the binder should have pea pick-up guards mounted to run along each side of the grass rows. Some guards are extended with snub-nosed shoes (fig. 6).

Some modification of the binder must be made to salvage shattered seeds, otherwise seed loss is great. The outside end of the sheet metal pan under the horizontal draper is extended out, up and around the outside draper roll to prevent shattered seed from being carried out and onto the ground.

Sheet metal is fastened over the "Bull" wheel, extending down beneath the elevator draper on the one side and the tying platform on the other, keeping clear of the bunching and tying fingers, and twine run.

A heavy, tapered pan is hung under the inside roller of the horizontal draper and the edge of the sheet metal beneath the elevator draper to catch all seeds from these two drapers.

A box mounted on the bundle carrier, or a heavy pan dragged on the ground under the tying platform, will catch the seed from the tying platform and also save the shattered seed when the bundle is kicked out.

The bundles should be forked off and placed gently on the ground.

Growers maintain that the value of the seed saved by these pans on a binder often is enough to pay for harvesting costs.

The cutter bar of the binder should be set just low enough to get all the seed heads and make a bundle that will hold together and shock well.

The bundles should be of medium size and placed in loose shocks to facilitate drying (fig. 7). Rough or unnecessary handling should be avoided.

Shatter losses are greatly reduced by binding and shocking in the early morning when the plants are damp.

The time required for curing in the shock varies according to location and weather. In most parts of California, threshing may begin in 1 to 3 weeks after binding and shocking.

A vehicle with a tight bed or canvas bottom cover is used to move cured bundles to a stationary thresher. This prevents loss of seed.

A large amount of seed can also be saved by placing canvas under and around the thresher.

In some areas, the thresher is moved about the field to reduce handling of the bundles.

Normally, under California conditions, seed threshed from cured shocks can be safely bagged and promptly moved into warehouses. However, if the moisture content of the threshed seed is high the bags should be only partially filled and then left in the field to dry. Until dry, they should be turned often enough to prevent heating and molding.

Threshing

The grower who understands the mechanics of a thresher or a combine will have no difficulty in finding the proper

Fig. 6—Guards placed on the binder cutter-bar to run on each side of the grass row raise the grass plants and facilitate cutting. Guard shoes prevent the point from running into the ground. (Union Pacific Railroad photo.)

Fig. 7—Tall Fescue bound and shocked. Rough or unnecessary handling during binding and shocking operations will cause much loss from shattering. (Union Pacific Railroad photo.)

thresher adjustments for handling grass seeds.

Grass seeds are light. They vary in size. Each species requires different adjustments of concaves, riddles, screens and air blast to prevent injury and excessive loss of seed. Adjustments will also vary with different seasonal conditions.

The best adjustments for any particular grass are only learned by experience.

The following suggestions come from experienced grass seed producers and were gathered over a wide area of the West.

A thresher or combine with a rasp or rub-bar is preferred. However, the toothed cylinder machine is satisfactory.

Most grass seeds separate rather slowly from the straw, therefore the machine must be fed slowly enough to handle the

material without forcing the seed through the machine with the tailings.

Grass seeds are light. Compared with barley only 10–15 per cent as much air is needed for separation. Use as little air as possible. This may mean removing some of the fan blades.

Cylinder speed will vary between 1150 and 1600 rpm. Use the highest possible speed that will not damage the seed or cause excessive chopping of the straw.

Cylinder or rub-bar settings will vary between $\frac{1}{8}$ and $\frac{1}{4}$ inch. Take the same precautions as in the preceding paragraph.

Chaff should ride across the riddles on an air cushion. This is done by properly adjusting the wind boards and fan.

Take frequent samples from the return auger. If there is too much straw, there is not enough air being used. If there is too much heavy seed, there may be too much air. Either reduce the air and/or open the sieve. If there are too many unthreshed heads, either adjust the clearance or speed of the cylinder.

The use of the perforated sieve, if one is present, is believed by many to be unnecessary and the cause of much trouble. Using the sieve does not do away with the need to re-clean the seed. It may be desirable to remove the sieve because it is almost sure to clog and cause trouble from time to time.

Limit the operation to threshing. Cleaning can best be done later with machines for that purpose.

Regular checking of the straw, tailings, seed and chaffer is necessary for a good threshing job.

When using a combine (fig. 8) as a mobile thresher, remove the cutter bar and fasten a 2″ × 12″ plank above the draper. Bundles can be placed on this plank for cutting. A slow, even, uniform feed is necessary for best results.

Other Harvesting Methods

The procedure already outlined is most generally used, but some growers use direct harvesting methods regardless of heavier seed losses.

Harvesting costs per pound of seed are lower when fields are large, and headers and combines are used.

In using the combine, the seed crop should be left to mature a little longer before harvesting.

The sickle bar should be kept high to avoid as much as possible the cutting of the more succulent basal portions of the grass plants. This, coupled with a slow

Fig. 8—Standard combines can be used as mobile threshers moving from one group of shocks to the next. The cut bundles should be evenly spread over the draper to provide an even flow of material into the thresher.

Fig. 9—Prairie brome in second growing season. Note height and large amount of green plant material.

forward movement of the combine, gives better threshing and smaller loss. It also helps to prevent clogging of the elevators and return augers with green plant material (fig. 9).

Another important disadvantage to combining is the high moisture content of the harvested material. If this material is not properly handled to hasten drying, the threshed material will heat and mold. To prevent this, sacks from the combine should be partially filled and left in the field to dry. They must be turned daily.

Combined seed may also be spread on a tight floor and turned daily to facilitate proper drying.

Threshing from windrow does not work well in row plantings. Weeds, clods and rocks are picked up. This adds greatly to threshing and cleaning problems.

Preparing Thresher-run Seed for Planting or Marketing

Thresher-run grass seed usually contains various amounts of straw, dirt, weed seeds and seeds of other crops.

If seed fields have been kept free of weeds and other crops, cleaning will usually be simple and not require special equipment.

It is good for a grower to clean his own seed because he is able to see the quality of seed he has produced.

In general, commercial seed processing firms are well equipped for cleaning seed, and some growers may find it an advantage to have their seed cleaned commercially. But the grower should take an active interest in cleaning operations wherever they are done.

The following steps may be involved in preparing grass seed for planting or marketing. These include scalping, cleaning, and processing.

Scalping. This is the first step. It removes coarse trash from thresher-run material. A scalper is an inclined screen held in a rack. It is made to shake back and forth by hand or by an eccentric drive connected to a small motor.

The screen may be made of hardware cloth or standard fanning-mill screen stock. Eight-mesh and 4-mesh hardware cloth is satisfactory for rough cleaning.

The scalper, when used with fanning mills or other seed cleaning equipment, will quickly prepare grass seed that is suitable for farm seeding.

Cleaning. The ordinary 2-screen fanning mill can be used for cleaning if the proper screen sizes are used. Openings in the top screen should be just large enough to let the largest seeds drop through. Openings in the bottom screen should be small enough to retain the smaller seeds and let the impurities and small weed seeds get through.

The air should be adjusted to remove the chaff and light immature seeds.

Correct screens for each type of seed are essential. Screens come in standard sizes and are readily available from seed processing equipment manufacturers.

Processing. Smooth grass seed (Harding, Smilo and Tall Fescue) needs no processing.

Some grass seeds, such as the Bromes and Stipas, have hairs, awns and other appendages. These make them hard to clean and to plant. The Nursery Division of the Soil Conservation Service reports that ordinary farm hammer mills, operating at speeds of 600 to 1400 rpm, have been successfully used to trim such seeds.

The procedure recommended by D. A. Savage and James E. Smith in the 1948 U.S.D.A. Yearbook, "Grass", is as follows: Place in the mill a screen having openings slightly larger than the seed to be processed. Start the mill at slow speed. Fill the cylinder with seed material and keep it full. After a short run carefully examine the seed that has passed through the mill. If few or no cracked or hulled seeds are found, but many of the seeds retain the appendages to be removed, advance the cylinder speed by about 100 rpm. Be careful to prevent cracking or damaging the seed. Over-processing will damage the seeds. Repeat this process

until the greatest amount of trimmed material is obtained with the least breakage of seed. This will be the correct speed at which to process the particular lot of seed.

After running a seed lot through the hammer mill and cleaning it in a fanning mill, it is necessary to re-run that part of the seed lot still untrimmed through the hammer mill and a finer screen.

The hammer mill should be fed to its full capacity; then the hammers will roll the material around repeatedly and squeeze out through the screen, seeds which have been trimmed enough to pass readily through it. If the volume of material in the mill decreases but the speed remains the same, the cushioning effect of seed on the hammers is greatly reduced and the hammers begin to grind.

Seed growers without experience in this processing method should carefully experiment with it before treating large amount of seed. **Over-processing reduces germination.** It might be safer to leave the processing of the seed to commercial concerns if the seed is to be marketed.

Diseases and Pests

So far, under California conditions, there have been no diseases in seed fields of Harding, Tall Fescue, Smilo, California Brome, Prairie Brome and Harlan Brome.

Insect damage may become troublesome but only two isolated cases have occurred to date.

In 1947, grass thrips wiped out the entire seed yield in a stand of Tall Fescue. The thrips fed on the tender floral parts of the plant and sucked them dry. The stand gave all appearances of producing a record seed crop but on close examination of the heads it was apparent that no seeds would form.

Grass thrips can be controlled by dusting with 5 per cent DDT at 30 pounds per acre prior to the emergence of the seed heads from the boot. This should be repeated often enough to hold the thrips in check.

In 1948, and in the same field as the Tall Fescue referred to above, red spiders infested nearly all grass species. Some grasses were so weakened that the seed yield was drastically reduced and germination of the harvested seed was only about 50 per cent.

Red spider may be checked by dusting with sulfur at a rate of 20 pounds per acre, and keeping the plants in a vigorous vegetative condition by nitrogen applications and frequent irrigations.

The insect damage outlined above occurred in a field surrounded on all sides by many acres of annual grasses and weeds. It is believed that as the native cover dried up, the insects moved from this area and into the lush succulent green growth of the seed field. This situation is not typical of most farming lands; insect pests are not likely to be found where there are no natural annual host plants. But it is well to be constantly on the lookout for pests so that early control measures can be taken.

In some areas of Oregon, wireworms have caused considerable damage to seedling grasses, and it is believed that the greatest damage from this pest is caused during the seedling stage. Since wireworms are widely distributed in California it is likely that in some areas they could interfere with securing stands.

Acknowledgment

California and Oregon seed producers, Oregon State College research and Extension workers, and members of the Southern California Unit, Nursery Division, Soil Conservation Service are thanked for their assistance in compiling some of the information contained in this circular.

In order that the information in our publications may be more intelligible, it is sometimes necessary to use trade names of products or equipment rather than complicated descriptive or chemical identifications. In so doing it is unavoidable in some cases that similar products which are on the market under other trade names may not be cited. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Coöperative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture coöperating.
Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914.
J. Earl Coke, Director, California Agricultural Extension Service.

141

12½*m*-9,'49(B5145)

48 Ways to solve a problem
Farm Advisors...

located in 48 California counties and in these towns:

Alturas
Auburn
Bakersfield
Colusa
Cowell
Eureka
El Centro
Fresno
Fairfield
Grass Valley
Hayward
Hanford
Hollister
Half Moon Bay
Kelseyville
Los Angeles
Madera
Merced
Modesto
Marysville
Napa
Oroville
Placerville
Quincy
Riverside
Redding
Red Bluff
Susanville
San Rafael
Salinas
Santa Ana
Sacramento
San Bernardino
San Diego
Stockton
San Luis Obispo
Santa Barbara
San Jose
Santa Cruz
Santa Rosa
Sonora
Ukiah
Visalia
Ventura
Yreka
Yuba City
Weaverville
Woodland

AGRICULTURAL EXTENSION SERVICE
U.S. DEPARTMENT OF AGRICULTURE AND UNIVERSITY OF CALIFORNIA

CALIFORNIA AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF CALIFORNIA • BERKELEY