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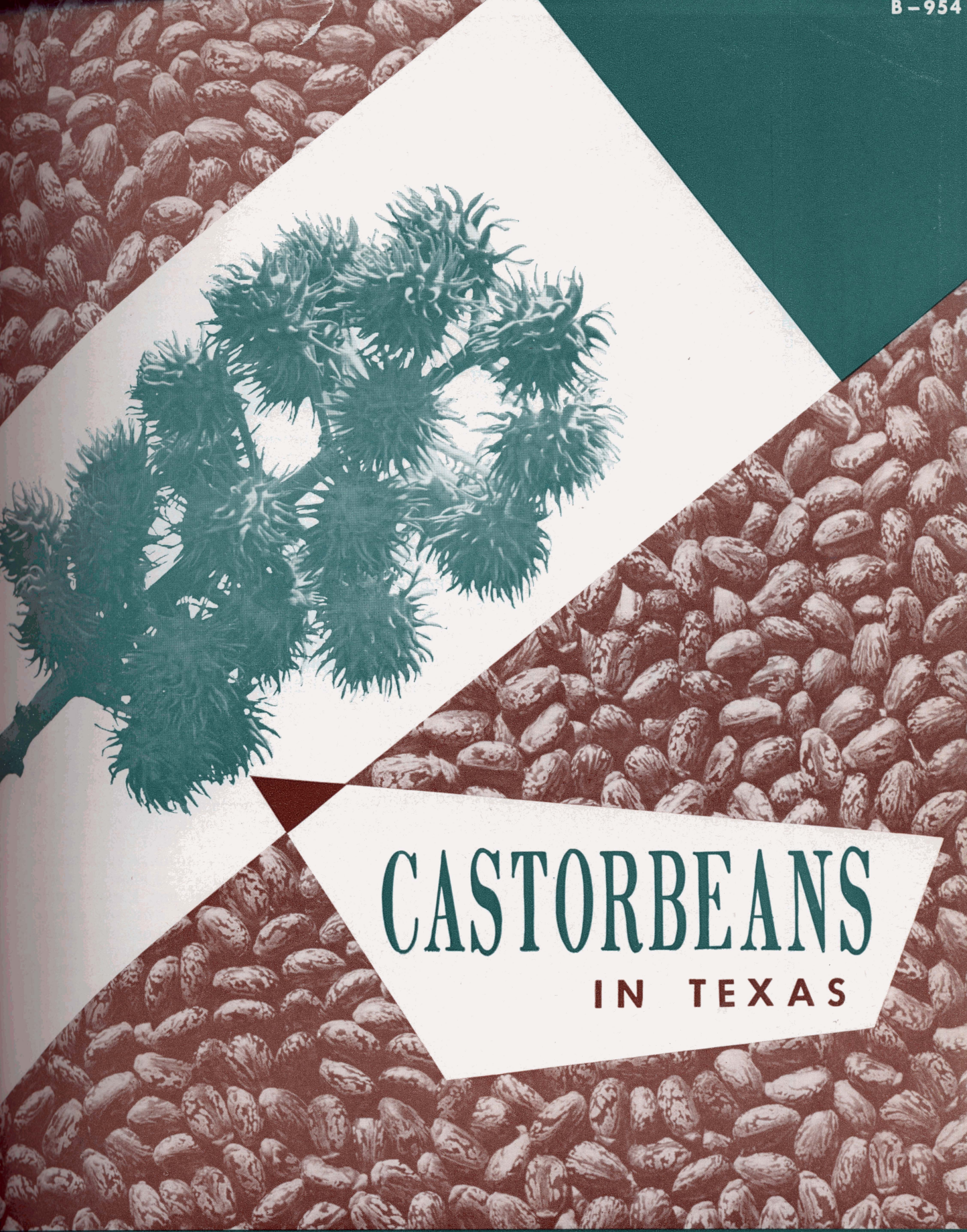

CASTORBEANS
IN TEXAS

TEXAS AGRICULTURAL EXPERIMENT STATION - - - TEXAS AGRICULTURAL EXTENSION SERVICE
College Station, Texas
IN COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE

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Castorbeans in Texas

Raymond D. Brigham and Ben R. Spears*

Castorbeans became established as a competitive cash crop for farmers of the Texas High Plains during the late 1950's, after development of high-yielding dwarf varieties and efficient harvester-hullers. Acreage expanded from a few hundred acres in 1957 to over 10,000 in 1959, with strong indications that the crop would be greatly expanded in this area in the immediate future.

There is a large and increasing demand for castor oil for industrial purposes; the United States is presently the largest importer and consumer of castor oil, taking 35 to 45 percent of the total world production. Domestic production supplied only 10 to 18 percent of the United States consumption during the 1950's. Texas became the leading state in castorbean production in 1959.

Castorbeans are produced in Texas for the seed, which contain approximately 50 percent oil. No mills or processing plants are located in the State, and all castorbeans produced are shipped by rail to a large plant in Bayonne, New Jersey, for crushing. Other plants are located in the Los Angeles and San Francisco areas; these plants currently crush castorbeans produced in New Mexico, Arizona and California.

Commercial production of castorbeans existed in the central part of the United States as early as 1850, but sporadic production caused mills eventually to locate on the east and west coasts to crush imported castorbeans. World Wars I and II stimulated attempts to produce our own domestic supply of castorbeans, since the oil was classed as critical material. During the Korean conflict, renewed efforts resulted in increased production, and Texas was one of the chief states producing castorbeans for the government-sponsored procurement program. Commercial production in Texas since 1955 has centered around Plainview, where a private company maintains a receiving point and personnel to assist farmers in producing castorbeans. Another company began contracting acreage in early 1960. All castorbean acreage in this area is irrigated.

*Respectively, research agronomist, Crops Research Division, Agricultural Research Service, United States Department of Agriculture; and extension agronomist, Texas Agricultural Extension Service, The Texas A. & M. College System.

THE PLANT

The term "castorbean" is used commonly to refer to both the plant and seed of *Ricinus communis* L., a member of the Euphorbiaceae, or spurge, family. It is not a legume as the name implies. Castorbean also has been called "Palma Christi," or mole bean. Castor oil, one of the oldest commercial products, was used in lamps by the Egyptians more than 4,000 years ago, and castorbeans have been found in their ancient tombs. Castorbeans, considered by most authorities to be native to tropical Africa, may have originated in Abyssinia.

Castorbean plants are potential trees. They grow perennially in the tropics and sub-

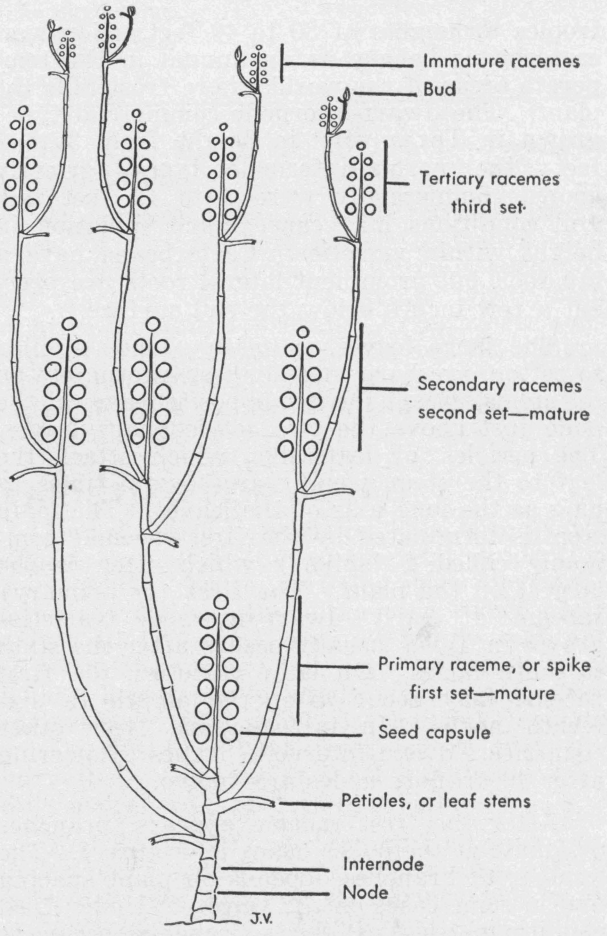

Fig. 1. Defoliated castorbean plant (schematic drawing).

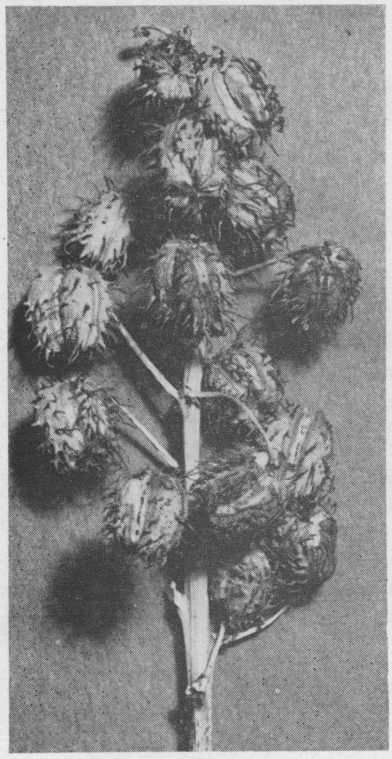

Fig. 2. Mature castorbean raceme (spike). Three seeds usually are contained in each capsule, but two to four may occur.

tropics to heights of 30 to 40 feet. However, castorbeans behave as an annual in the temperate areas of the world where frost kills the plant. The dwarf-internode commercial types grown in Texas vary in height from 3 to 5 feet; the normal-internode types formerly grown commercially were 6 to 12 feet tall. Soil conditions may cause much variation in height within varieties. Castorbeans have a tap root, but prominent lateral roots are present a few inches below the soil surface.

The large leaves, palmately lobed similar to cotton, are born more or less alternately on the stems, except for two opposite leaves at the node just above the two cotyledonary leaves. The petioles, or leafstalks, which attach the leaf to the stem, usually are several times as long as the long axis of the leaves. The main stem is terminated by the first raceme (commonly called a "spike") which often is the largest on the plant. The first (or primary) raceme of early dwarf-internode varieties grown in Texas usually occurs after the sixth to tenth nodes. On later varieties, the first raceme may occur after the eighth to sixteenth nodes. In introductions from other countries, dwarf-internode types flowering after 40 or more nodes are known.

After the first raceme appears, branches originate at the nodes below it, Figure 1. The number of branches depends on plant spacing and in some cases on the variety. Under field conditions, two or three branches occur at almost the same time, but generally in the following order: the first branch at the node immediately beneath the primary raceme; the second at the second node; and the third at the third node below the primary raceme. Each of these branches, usually after four or five nodes have formed, ends in a raceme. The first racemes formed on the branches are commonly called the "second set" of racemes. Subsequent branches arise from the nodes just beneath the racemes of the second set. This sequence of development continues as long as the plant remains alive and growing actively. Thus, the development of racemes along any one axis is sequential, making it possible for a plant to have racemes in all stages of development from bud stage to complete maturity. In a typical plant (and present varieties are of this type), the racemes usually bear female flowers on the upper 30 to 50 percent and male flowers on the lower 70 to 50 percent of the raceme. Commercial hybrid varieties, when available, may be of this type. Other promising hybrids may bear only female flowers along the entire raceme, but planting seed of these hybrids will contain a small percentage that will produce sufficient pollen-shedding plants to insure seed set of the pistillate plants in the commercial field.

Number and proportion of male to female flowers can vary greatly. The flowers, both male and female, are without petals. After the pollen is shed, the male flowers dry up and usually drop. The pollen, which is discharged forcibly from the anthers, is carried to the stigmas of the female flowers mainly by wind.

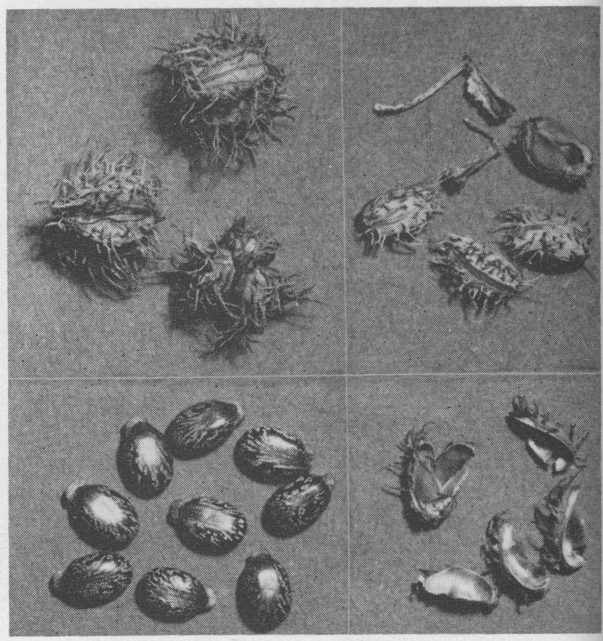

Fig. 3. Top left, dry filled capsules; top right, segments (carpels) of a capsule that contain the seed; bottom left, clean seed; bottom right, hulls from capsule.

After fertilization, the female flowers develop into spiny capsules, though spineless types are known. At maturity, the hull (pericarp) of the capsule may split along the outside seam (dorsal suture) of each of the three capsule segments (carpels). If the splitting is violent, as in wild types, the seed will be ejected and scattered on the ground around the plant. This type of splitting (dehiscence) is not present in the commercial varieties grown for mechanized production; seed of present varieties are held within the capsule for several weeks after frost with no appreciable loss.

Seed of current varieties grown in Texas vary in size from 1,400 to 1,600 per pound. Seed color ranges from light to dark brown, with various mottling patterns. The seed coat makes up about 25 percent of the weight of the seed. Oil content averages 50 percent, on a weight basis.

USES OF CASTORBEANS

Castor oil is used in ever-increasing quantities as a chemurgic raw material. Its largest single use is by the protective coatings industry, which produces paints, varnishes and lacquers. Very small quantities are used in the raw state; most castor oil undergoes one or more chemical processes to adapt it to a particular use, Table 1. More than 175 derivatives of castor oil are offered by one company.

The residue remaining after the oil has been extracted from the seed is known as castor pomace, and is used widely as organic fertilizer. Its use is restricted largely to areas of the east and west coasts. Because a poisonous constituent, ricin, remains in the pomace after extraction of the oil, the pomace cannot be used for livestock feed. Processes are known for destroying the toxic nature of ricin, but are not presently economical for commercial use.

ADAPTATION

The High Plains area appears to be well suited for growing castorbeans. Highest yields are produced under irrigation on fine or medium-textured soils. Most of the soils of the High Plains are in three general groups: the fine-textured soils (Pullman silty clay loams and related soils, commonly called "hard lands"), the medium-textured soils (mostly Amarillo and Portales sandy loams, commonly called "mixed lands") and the coarse-textured soils, (such as Brownfield sands, commonly called "sandy lands").

At least a 140-day growing season is required (from planting until first killing frost) to produce satisfactory yields in the High Plains area, and a 150 to 160-day season is more desirable.

Table 1. Uses of and products resulting from processing castorbeans and castor oil

Adhesives	Leather dressings & coatings
Alkyds	Lubricating oil additives
Artificial leather	Linoleum
Asphalt tile	Motor fuel additives
Bactericides	Nylon
Belt dressings	Oil cloth
Brake fluids	Packings
Brake linings	Paints
Candles	Paper coatings
Carbon paper	Perfume intermediates
Castor oil	Pharmaceuticals
Caulking compounds	Pigment grinding compounds
Coated fabrics	Pigment suspension compounds
Condenser oils	Plastisols
Corrosion inhibitors	Polishes
Cosmetics	Plasticizers
Crayons	Polyesters
Cutting oils	Potting compounds
Dielectric compounds	Putties
Drawing compounds	Rubber accelerators
Duplicating stencils	Rubber compounds
Emulsion paints	Rust inhibitors
Emulsion polishes	Shock absorber fluids
Enamels	Soap preparations
Fertilizers	Strippable coatings
Fertilizer fillers	Textile processing compounds
Fungicides	Urethane foams
Gasket pastes	Varnishes
Germicides	Vinyl compounds
Greases	Waxes
Hydraulic fluids	
Inks, duplicating	
Inks, printing	
Insecticides	
Lacquers	

Castorbeans are adapted to most other areas of Texas where cotton is grown, and where rainfall or irrigation water is adequate, but diseases are limiting factors where high relative humidities prevail. Areas where soils are infested with the cotton root-rot fungus should not be considered for growing castorbeans, because the plants are highly susceptible to this disease.

VARIETIES FOR TEXAS

Dwarf-internode varieties have been grown almost exclusively for commercial production since 1957. These varieties were developed especially for mechanical harvest. They grow only 3 to 4 feet tall and are highly resistant to seed shattering and capsule losses from wind. Resistance to wind is important, since castorbeans may stand in the field several weeks after a killing frost before they are harvested. Oil content of the available varieties averages 50 percent by weight.

BAKER 296 is early maturing and produces many small to medium racemes. It is extremely resistant to shattering, and moderately resistant to bacterial leaf spot. However, it is very susceptible to Alternaria leaf

Fig. 4. Dwarf castorbean varieties are similar in height to grain sorghum, and are well adapted to mechanical harvesting.

spot, and is difficult to hull because of a thick capsule wall. Baker 296 comprised most of the acreage in 1958 and 1959. It yielded more than 3,000 pounds per acre in 1958 where moisture and fertilizer were optimum; yields over 2,000 pounds per acre were common.

DAWN is a late-maturing variety that produces a few large racemes. It is highly resistant to shattering, hulls easily, has resistance to Alternaria leaf spot and is moderately resistant to bacterial leaf spot. Yields of more than 2,700 pounds per acre have been produced under favorable conditions. Baker 296 is favored over Dawn in the Plainview area because of its earlier maturity and less likelihood of frost damage before the seed mature. Several hundred acres of Dawn were grown in 1957 but an early frost seriously reduced yields; only small acreages of the variety were planted the following 2 years. Further field testing of the variety may show it has desirable characteristics under more favorable conditions.

Plant breeders of commercial companies, the United States Department of Agriculture and state agricultural experiment stations strive cooperatively to develop improved varieties. Dwarf-internode hybrids appear promising, but the only hybrids presently available in quantity are tall-growing types (normal-internode) which are grown commercially in California and Arizona. A commercially produced dwarf-internode hybrid was planted on a small acreage in 1960.

Table 2. Yields per acre of two dwarf-internode castorbean varieties grown for 3 years in replicated yield trials at Plainview

Variety	Pounds per acre[1]		
	1957	1958	1959
Baker 296	2064	2438	1829
Dawn	1757	2376	2231

[1]Average of four replications

CULTURAL PRACTICES

Seedbed Preparation. Seedbed preparation is much the same as for cotton. Deep tillage, such as chiseling 8 to 12 inches deep, encourages development and deeper penetration of the tap root. Castorbeans usually are planted in a furrow by opening a bed with a lister-type planter. Beds usually are irrigated before planting by running water down the furrows. Castorbean land should be prepared for 40-inch rows, since most harvesters used in Texas are made for that row spacing.

Planting. Castorbeans should be planted when the soil is warm—a 10-day average of 60 degrees Fahrenheit at 8-inch depth at 8 a.m. This usually coincides with cotton planting time on the High Plains. Cool nights in late April and early May tend to keep soil temperatures too low for satisfactory germination, but May 5 to 25 usually is satisfactory for planting in the Plainview area. Castorbeans should not be planted after June 10 in that area.

Only seed of high germination and of good quality should be planted, since poor seed often produce poor stands or weak seedlings. Test weight, color, plumpness and lack of cracks in the seed coat are evidence of seed quality. Arasan or Captan, at the rate of 1 to 2 ounces per bushel, is satisfactory for seed treatment.

A planting furrow 3 to 4 inches deep normally permits the seed to be in contact with moist, firm soil when planting after a preplanting irrigation. Deeper planting furrows may delay emergence and increase the probability of replanting after hard, washing rainstorms. Early varieties tend to set the first spike low, and this spike may not be harvested with the present mechanical harvesters if a deep planting furrow is used. Castorbean seed are large and slow to germinate; emergence of the seedlings may take 7 to 14 days, but more often it takes 10 days. For uniform germination and emergence, the seed require moist soil over a longer period than do corn or cotton seed. Castorbean seed should be planted 2½ to 3 inches deep, depending on the texture and condition of the soil. If press wheels are used in contact with the seed, care should be taken that they do not crush the seed.

Castorbeans should be planted in 40-inch rows, with a seeding rate of 12 to 14 pounds per acre. A plant spacing of 8 to 10 inches within the row is considered satisfactory.

With careful planting, thinning is not necessary.

Special care should be taken to prevent crushing the fragile castorbean seed in the planter box. An inclined-plate planter is ideal, but a cotton planter box can be used if properly modified. The seed pawl or leveler should be replaced by a wire or brush-type leveler, and the plate should have enough holes so that it will turn at a slow speed and still plant at the desired rate. Plates for current varieties should be 5/16-inch thick, with 9/16-inch round holes in the center-drop plates, or 9/16 by 1/4-inch cells in the edge-drop type. Oil and crushed seed may clog the plates and prevent the seed from dropping evenly. If this occurs, empty the the planting box and wash it with kerosene. A handful of corn meal or coarsely ground grain sorghum mixed with each hopper of seed will help prevent this problem.

Fertilizer Requirements. Adequate amounts of nitrogen and phosphorus must be available to produce high yields of castorbeans. Most soils in the High Plains area are low in nitrogen, and nitrogen fertilizer usually must be applied to produce good yields. To fertilize castorbeans properly, first determine the need for nitrogen and phosphorus by having the soil tested; then apply the kind and amount of fertilizer recommended in the soil test report. When a soil test and past cropping history show a field is deficient in nitrogen, 60 to 120 pounds of nitrogen usually are needed for maximum yields of castorbeans. It is possible to overfertilize with nitrogen, producing rank vegetative growth and weak root systems. For that reason, split applications of nitrogen are recommended. The second application can be made by sidedressing nitrogen between the rows at about the last cultivation, while avoiding root damage as much as possible.

The application of phosphorus to soils low in this element will produce more vigorous plants, hasten maturity and generally increase seed set. On deficient soils, 20 to 60 pounds of available phosphoric acid (P_2O_5) may be needed, and can be applied before or at planting time. Soils of the High Plains generally are well supplied with potassium.

Irrigation. Preplanting furrow irrigation should wet the soil profile to caliche on shallow soils or to a depth of 5 or 6 feet on deep soils to supply subsoil moisture for castorbean plants throughout the growing season. Except on sandy soils, wetting the soil more than 3 feet during the growing season is not practical. Adequate preplanting irrigation insures sufficient subsoil moisture during peak periods of water use. Excessive irrigation of heavy soils during the growing season results in damage from "water-logging" or poor soil aeration.

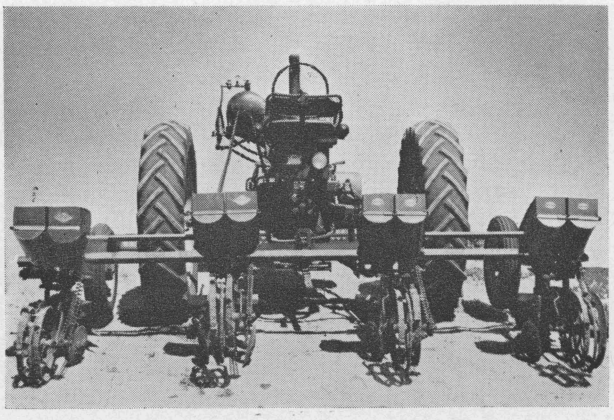

Fig. 5. Inclined-plate planters, such as shown above, are ideal for planting castorbeans. However, modified cotton planters can be used.

In years of normal rainfall, the first irrigation water usually is applied in late June or early July, just before the first raceme appears on the plant. The peak water requirement period usually is during late July and through August, when the plants are fruiting heavily. The top 2 feet of soil should be watched closely to determine the amount of useful soil moisture remaining. Irrigation is needed when approximately half the total available soil moisture has been used. A chart for estimating soil moisture is available from county agricultural agents. Irrigation should begin early enough that the last plants to be irrigated will not reach a moisture stress. The capacity of the well or delivery from other sources should be known to plan the watering schedule properly. Castorbeans have a high water requirement during critical periods, and the acreage grown should be limited to the amount that can be irrigated adequately. If low rainfall, high temperatures and high winds occur during the peak growing and fruiting period, irrigation may be required each 7 to 10 days to maintain high yield potentials. Under more normal conditions, 12 to 14 days between irrigations may be sufficient. If the leaves are allowed to wilt at any time during the morning, blasted or poorly filled seed capsules will result and some leaves will be lost as a result of the moisture stress.

Castorbeans require approximately 20 to 24 acre-inches of water annually to produce high yields, depending on climatic variations. The time of last irrigation usually is from September 1 to 10, according to the growing season.

Weed Control. Castorbean seedlings emerge slowly, and annual weeds and grasses often are a problem until the plants make some growth and begin to shade the area between the rows. Cultivation is much the same as for controlling weeds in cotton. Rotary hoes often are used before or after the plants emerge to

control small annual weeds and grasses. Proper timing of this operation often can eliminate or reduce hand hoeing.

Castorbean plants are tap-rooted, but they also have a shallow, wide-spread fibrous root system that appears to be much more important than the tap root in obtaining moisture and nutrients from the soil. For this reason, cultivations should be as shallow as possible, and only as often as necessary to control weed growth. During the last cultivation, front cultivator sweeps should not be set close to the plants in the row or the shallow lateral roots may be damaged.

INSECTS AND DISEASES

The castorbean plant is not toxic to most insects. Infestations of thrips, corn earworms, armyworms, spider mites, leaf miners, lygus bugs, green stink bugs and false chinch bugs sometimes appear in castorbean fields. Only infestations of the false chinch bug have become serious enough to warrant control measures on the High Plains, and then only in scattered fields. Webworms, caterpillars, grasshoppers and leafhoppers also have been observed in castorbean fields. To date, insects have not been a serious problem on the High Plains. However, as the acreage increases and production extends over several years, populations of certain insects may build up and make control measures necessary.

Diseases usually are present on castorbeans in the High Plains area, but often do little damage, because the low relative humidity, together with sparse rainfall during a normal growing season, is generally unfavorable for their development. However, there are several diseases that can cause serious economic loss when conditions are optimum for their development. Proper cultural practices should be followed to produce vigorous plants, because they are more resistant to disease than weak plants.

Various soil and seedborne fungi can cause damping-off of young seedlings, but they can be controlled largely by fungicidal seed treatment. A seedling disease similar to sore shin of cotton occurred in 1960 when early planted castorbeans germinated and emerged in cold, wet soils. Later plantings in warmer soils were not affected. This appears to be a satisfactory control for this seedling disease.

Alternaria leaf spot, caused by *Alternaria ricini* (Yoshii) Hansford, has resulted in varying degrees of defoliation of castorbeans on the High Plains. The leaf spot usually is visible first on the lower, older leaves of the plant as light-brown spots made up of concentric rings around the point of infection. Diseased leaves dry and curl and drop prematurely. Losses in yield have ranged from negligible to serious. Damage from Alternaria leaf spot in 1958-59 was moderate to heavy in fields of Baker 296, and the incidence of the disease appeared to be connected with disease-damaged roots, which weakened the plants and made them more susceptible to leaf infection. A capsule mold, caused by the same fungus, occurs on the High Plains but usually is not a problem; however, it is very serious in areas of high rainfall and high humidity. Capsules are attacked when half to full size, and light or unfilled seed often result when infection occurs early in the development of the capsules. Capsules attacked early usually wilt and turn bluish-purple; those attacked later may turn brown. After periods of high humidity, the fungus produces spores abundantly on the surface of the infected capsules, and a black, smutty appearance results. Pedicels of the capsules also are attacked, and capsules often drop from the plant. Some varieties appear to be affected less severely than others, but no immune or highly resistant varieties are yet available. In years of normal rainfall on the High Plains, Alternaria capsule mold likely will present no difficulties with castorbean production.

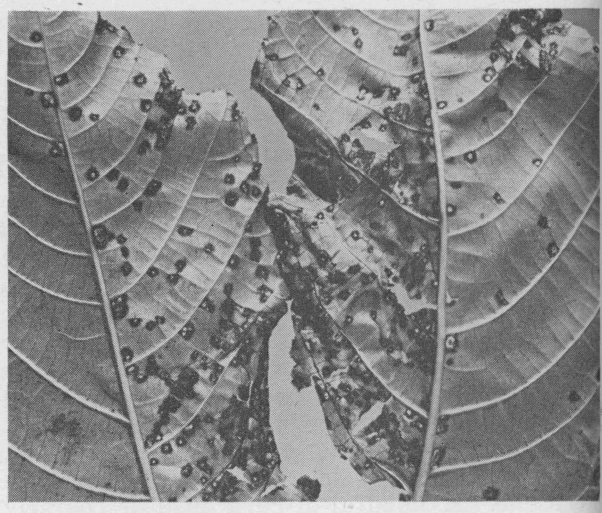

Fig. 6. Bacterial leaf spot of castorbeans can cause defoliation and lower yields.

Bacterial leaf spot, caused by *Xanthomonas ricinicola* (Elliott) Dowson, occasionally has caused serious damage to castorbeans in Texas. The last serious outbreaks were during 1950-54 when highly susceptible normal-internode varieties were grown. The disease was most severe in northeastern Texas, but was present on the High Plains, with serious economic loss occurring in some fields. The disease often is evident on cotyledonary leaves of emerging seedlings; water-soaked spots (lesions) appear and gradually turn black upon drying of the cotyledons. Water-soaked spots of the same

type appear on young leaves and frequently enlarge and form large, blackened areas. Heavy leaf infection results in yellowing and premature leaf drop. Blasting of immature capsules and breaking over of girdled racemes and stems also occur in very severe cases. The bacterium is seedborne but also may overwinter in diseased plant material. It is spread chiefly by hard, blowing rains. Hot, dry weather following infection often prevents further spread of the disease; the infected leaves drop and new leaves are produced by the plant. The present dwarf-internode varieties have moderate resistance to bacterial leaf spot.

Several other castorbean diseases have been observed in Texas, but are not problems in the present production area. Gray mold, caused by *Sclerotinia ricini* Godfrey, is a serious problem when castorbeans are grown on the Gulf Coast, since it destroys the racemes in all stages of development. The disease may occur in other areas during periods of high rainfall. There is no effective control. Although varieties differ markedly in tolerance, no immune or highly resistant varieties are yet available.

Cotton root rot, caused by *Phymatotrichum omnivorum* (Shear) Duggar, attacks castorbeans, and the plants should not be grown on infested soils. There has been no indication of varietal resistance to the disease.

Southern blight, caused by *Sclerotium rolfsii* Sacc., and Cercospora leaf spot, caused by *Cercospora ricinella* Sacc. & Berl., have been observed in isolated spots in Texas. Charcoal rot, caused by *Macrophomina phaseoli* (Maubl.) Ashby, has been reported on castorbeans at College Station, but can occur in other areas.

HARVESTING

Dwarf-internode castorbeans usually are ready to harvest about 10 days after a killing frost, if normal drying weather prevails. Capsules should be dry enough for the seed to hull when rubbed between the hands. One two-row harvester-huller can harvest 300 to 500 acres per season, if favorable weather prevails.

The present harvesters shake the dry capsules from the standing plants, hull the seed and elevate the clean seed to a holding bin. Rotating beaters hit the plants about 6 to 8 inches above the ground and induce low-frequency vibrations that knock the capsules from the racemes. Hullers are of two types: the USDA-designed huller has a horizontal rubber-covered disc and the other, a rubber-covered cylinder. The seed are emptied from the holding bin into a truck and hauled to the receiving point.

Harvesters used during the 1958-59 harvest were manufactured largely in Plainview by a local machine shop. They were mainly two-row, tractor-mounted machines patterned after the USDA-designed castorbean harvester. Two four-row machines (one tractor-mounted and one combine-mounted) also were made in Plainview in 1958. Both operated satisfactorily with cylinder-type hullers. One commercial firm operated a combine-mounted experimental two-row castorbean harvester in 1957-58. In 1959, this company manufactured three two-row attachments for one of its self-propelled combines, and these were sold to growers in the Plainview area. Five four-row attachments also were made by the local machine shop for the same type of combine. These combine attachments for harvesting castorbeans can be taken off and replaced with the original grain header and threshing cylinder for harvesting small grain or grain sorghum. Cost of a two-row machine shop manufactured combine attachment in 1960 was approximately $3,200; cost of the four-row attachment was about $5,800.

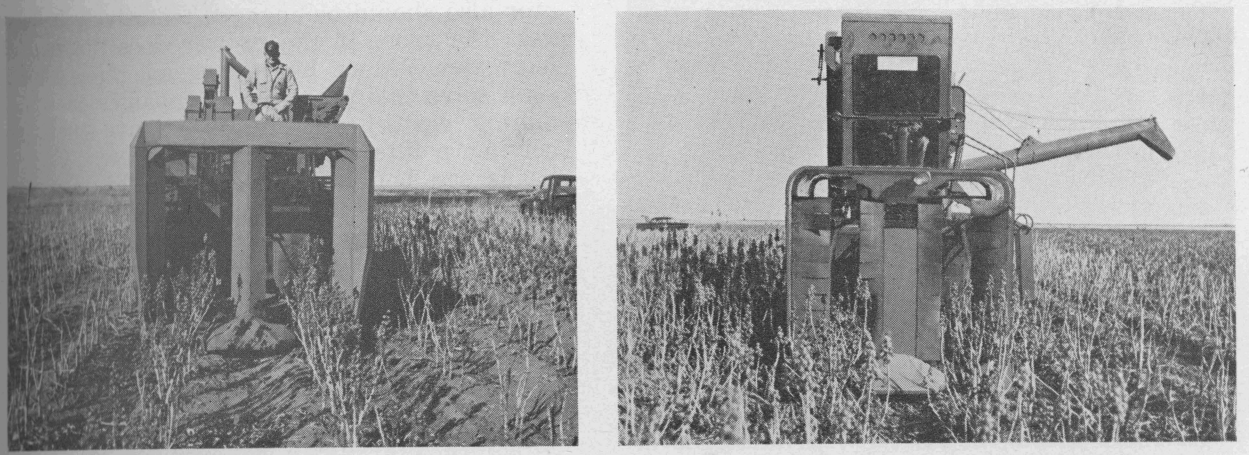

Fig. 7. Left, USDA-type harvester, tractor-mounted; right, a harvester (factory-built) mounted on a self-propelled combine.

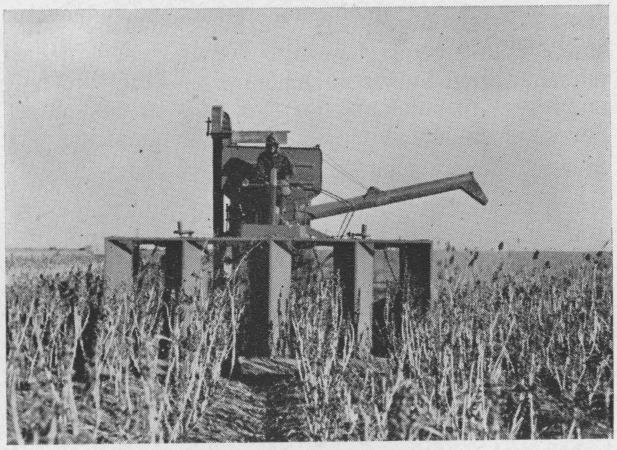

Fig. 8. Four-row harvester (machine shop built) mounted on a self-propelled combine.

Combines and trucks used to harvest and haul castorbeans must be cleaned thoroughly before being used for other agricultural products. Since castorbeans are poisonous to humans and livestock, contaminated grain cannot be sold.

Castorbeans store well. Castorbeans in storage for 2 years have yielded oil that met national stockpile specifications for No. 1 castor oil. The oil from cracked and broken seed was slightly lower in free fatty acid than that from sound whole seed. Freshly hulled seed with not more than 6 percent moisture and 5 percent cracked and broken seed should not deteriorate significantly in storage for at least 2 years.

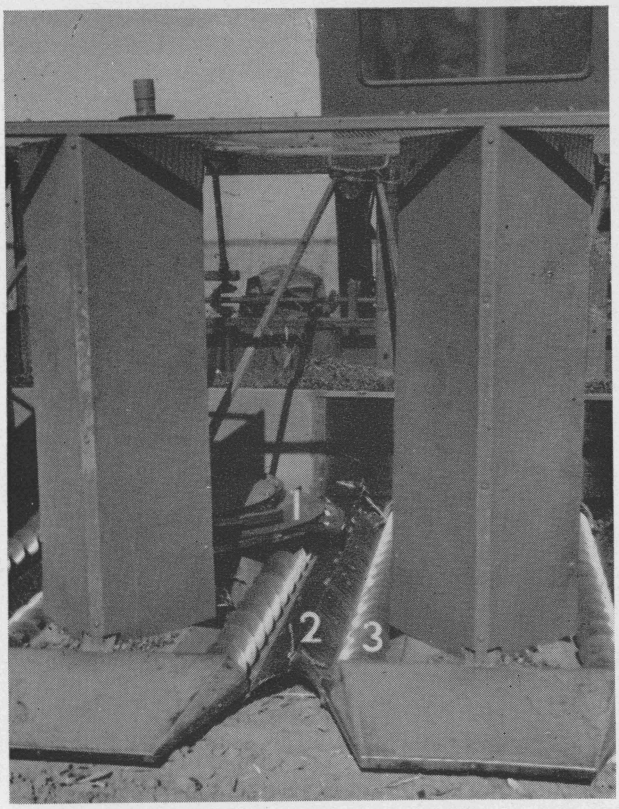

Fig. 9. Close view of harvesting mechanism. A rotary beater (1) shakes the capsules from the plant. Brushes (2) seal around the base of the plants and augers (3) move the capsules to a series of vertical augers for delivery to the huller.—Courtesy L. D. Schoenleber, USDA.

COSTS AND RETURNS

The cost of producing an acre of high-yielding, dwarf-internode castorbeans under irrigation on the High Plains is $45 to $60 per acre. This estimate includes cost of land preparation, planting, irrigation, fertilizer, cultivation, insect control, mechanical harvesting and hauling. It does not include a cost for land use.

Castorbeans are bought at a price related directly to the world market for castor oil and castorbeans, with a freight deduction for moving them from the production area to the processing plant. There are now no acreage controls and no price-support programs. Disregarding abnormally high wartime markets, prices fluctuated from 4.5 to 6.5 cents per pound from 1947 to 1959, but are expected to fluctuate less as domestic production is stabilized. Yields were approximately 1,000 to 2,500 pounds per acre during the first 3 years of commercial dwarf-internode castorbean production. An overall average of 1,800 pounds per acre was produced in 1958. Lower yields were produced in 1957 and 1959. Gross income from an acre of castorbeans which produced 1,800 pounds per acre, marketed at 5 cents per pound, would be approximately $90, with an adjusted return after deducting production costs, but not land costs, of approximately $30 to $45 per acre.

Before growing castorbeans, arrangements should be made for seed of an adapted variety, and for marketing the crop. A custom operator also should be engaged tentatively to harvest the crop, if the grower does not own a harvester. More harvesting machines should soon solve this problem. Companies currently buying castorbeans in Texas have their receiving points located at Plainview. Castorbeans are bought by weight on a clean-bean basis. Grower contracts currently specify that the grower will receive a minimum price or the market price at delivery, whichever is higher.

CROPPING SEQUENCES

Present mechanical harvesters leave 5 to 10 percent of the castorbean seed in the field. This loss presents a problem for crops that follow. Since castorbean seed germinate and

volunteer the following spring, a pasture or hay crop should not be planted after castorbeans. Castorbean plants are unpalatable to livestock, but some might be consumed with the forage and could be toxic if taken in sufficient quantities. Although castorbeans sometimes are planted after castorbeans to escape the volunteer problem, this practice is not recommended, because losses from disease usually increase.

Grain sorghum and cotton most commonly follow castorbeans in the Plainview area. Grain sorghum is probably the most suitable crop if proper precautions are taken. Grain sorghum should not be planted earlier than mid-June so that a high percentage of the volunteer castorbean plants can be destroyed by cultivation before and at planting. Any castorbean plants that emerge after planting and escape cultivation should be removed by hand or destroyed by herbicidal sprays, such as 2,4-D, before the grain sorghum reaches the boot stage. One castorbean plant in a grain sorghum field at harvest time could result in serious consequences. A lot of grain sorghum that contains only a few fragments of the castorbean plant will be classed as sample grade by the Grain Division of the Agricultural Marketing Service, USDA. Such contamination could result in losses where the grain is fed to livestock.

Cotton may follow castorbeans, but more problems may be encountered in controlling volunteer castorbean seedlings early in the season than with grain sorghum. Since cotton normally is planted earlier than grain sorghum, there is little opportunity to destroy volunteer castorbean seedlings prior to planting. Hand hoeing or replanting may be necessary where a large number of volunteer castorbean seedlings emerge with the cotton. Once the cotton crop is established, volunteer castorbean seedlings usually are eliminated in normal cotton production operations.

After harvesting castorbeans, care should be taken in preparing the land for the succeeding crop in order to control volunteer castorbean plants more easily. The shattered seed should remain near the soil surface; plowing with moldboard or disc plows to depths of 6 to 8 inches should be avoided. Chisels can be used for deep tillage without turning the soil, and a disc harrow will put the top few inches of soil in good condition. Seedbed preparation for the following row crop then can be completed by listing the land. In this way, germination of shattered castorbean seed will occur in a relatively short period the next spring, and the seedlings can be destroyed more quickly than where seed were turned under several inches deep and emergence extended over a prolonged period.

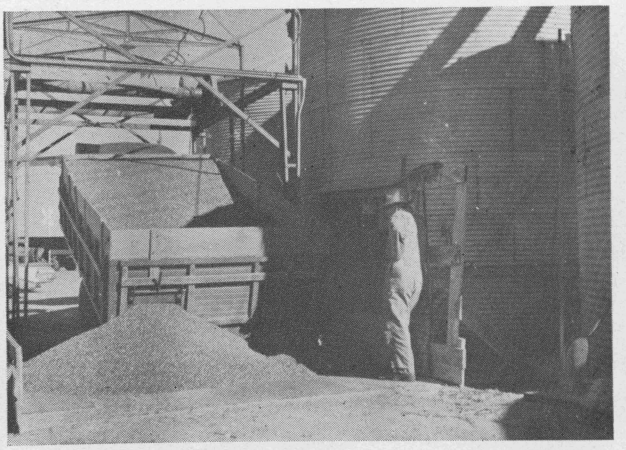

Fig. 10. After castorbeans are unloaded at a receiving point, they are graded and bought by weight on a clean-bean basis.

Castorbean crop residues are valuable sources of organic matter and plant nutrients when returned to the soil. The stalks are broken easily by mechanical stalk cutters or stalk shredders, and the plant residues decompose readily when incorporated into the soil. The hulls have proved slightly better than dairy manure in fertilizer value, and they are scattered over the field during harvest.

CAUTION

Castorbean seed are poisonous to man and animals. The toxic substance is called ricin. Results of feeding experiments with leaves and stems are conflicting as to the presence of a poisonous substance, but contamination of grain and forage with these plant parts should be avoided. The plant is unpalatable to livestock, and most animals avoid eating it unless deprived of desirable feed.

Allergens also are contained in the seed. These substances, separate and distinct from the toxic constituents, can cause strong allergic reactions in some people.

Texas Agricultural Experiment Station, R. D. Lewis, Director, College Station, Texas