SUNFLOWER SEED PRODUCTION

TMENT OF AGRICULTURE PUBLICATION 1019 REVISED 1972

MERITS OF SUNFLOWERS

Because sunflowers are usually grown in rows, the crop can be a partial substitute for summerfallow and can extend the rotation by at least 1 year.

The plants are more resistant to frost and probably to drought than other plants grown in rows, such as corn and soybeans.

The plants compete well with annual weeds.

Sunflower seed is a cash crop. It is readily marketed and is usually sold immediately or within a few months after harvest.

Growing sunflowers helps to distribute farm activities uniformly throughout the season, especially at harvest.

Growing sunflowers helps to reduce the hazard of a one-crop, or wheat, economy.

When the stalks are left standing, they reduce the hazard of soil erosion in the winter and hold the snow well.

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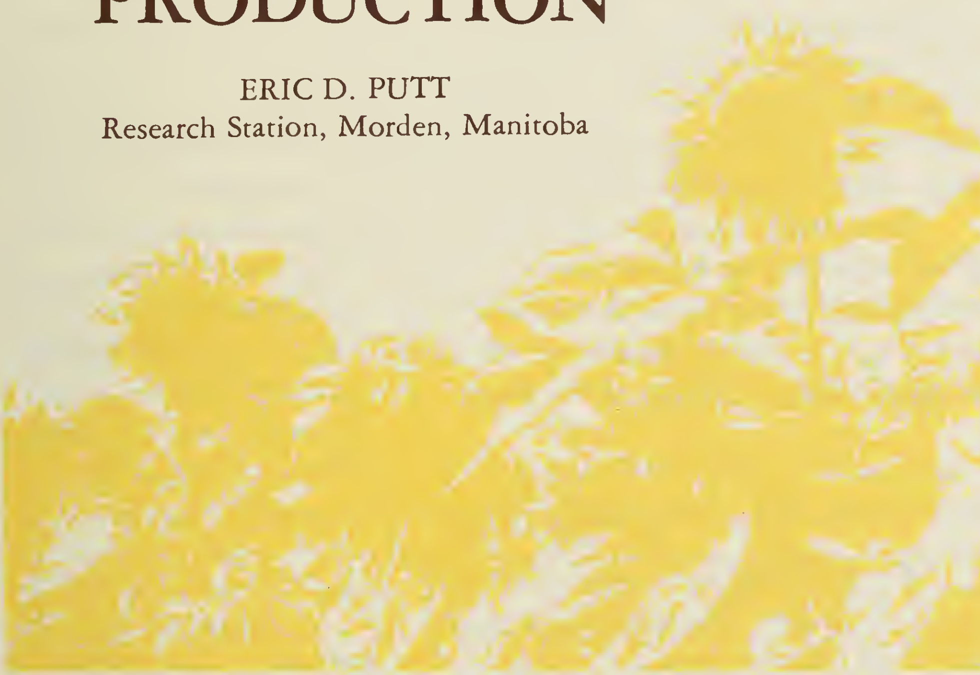

The sunflower crop is one of the most important annual oilseed crops in the world. The main market is as an oilseed for domestic or export crushing. It requires a seed of high oil content. There is also a fluctuating but, in general, an expanding market for two other types of seed: large seed for use as a confection or in gourmet foods, and seed of medium size with attractive black and white stripes for use in feeds for pet birds and animals.

When a farmer thinks of growing a new crop, his main interest is the cash return it offers. In this respect, sunflowers compare favorably with other crops grown in Western Canada. The average gross return in Manitoba for the 20 years 1951 to 1970 was $31.32 an acre. The figure for 1966 to 1970, or the period when the varieties of higher oil content were grown, was $38.21. The comparable returns for competing crops were as follows (the figures in brackets are the 1966 to 1970 average): oats $24.02 (28.90); barley $26.31 (30.53); flax $25.84 (26.84); wheat $34.32 (38.08); grain corn $38.76 (61.09); field peas $35.68 (34.77); buckwheat $18.28 (23.99); rapeseed (37.03).

The cost of producing sunflower seed is similar to the costs of growing grain crops. In studies in Manitoba and Alberta, the cost averaged 3.5 cents a pound, but varied from farm to farm depending on the yield per acre.

From 1966 to 1970 farmers in Manitoba seeded an average 34,000 acres annually to sunflowers. The crop is recommended for almost all arable land south of Township 14. In 1970, some acreage was also contracted in southern Saskatchewan and Alberta. The 1971 crop is reported to exceed 200,000 acres in the three Prairie Provinces, with approximately 65,000 in Saskatchewan and Alberta and about 150,000 acres in Manitoba. Oilseed crushing plants in all three provinces and an increased export demand from Japan assure growers of a ready market for their oilseed crop. In the adjoining states of Minnesota and North Dakota plantings are reported to exceed 400,000 acres.

Russia with 11 to 12 million acres annually and Argentina with about 3 million acres are the largest producers. Other countries in eastern Europe and Latin America produce significant amounts. There is also an increasing interest in the crop in other parts of Europe, including France, Germany, and Spain.

EQUIPMENT

Western Canadian farmers have most of the machinery needed to grow sunflowers. The crop can be sown with an ordinary grain drill. Although a finger weeder or rotary hoe is desirable, a drag harrow is an adequate substitute.

If sunflowers are grown as a conventional row crop in rows 36 to 42 inches apart, two pieces of special equipment are needed. The first is a row-crop cultivator. It must be equipped with hilling disks or other attachments that will keep the soil from covering the young plants during early cultivations. In later cultivations the disks throw the soil into the rows to smother small weeds. Attempts to modify the standard field cultivator for tillage in row crops have not been successful. The second piece of special equipment is a harvesting attachment. This attachment is almost essential to avoid severe loss of seed from shattering and heads dropping in front of the cutter bar. It costs about $500.

If the crop is grown in widely spaced rows or, at the opposite extreme, in rows spaced less than 18 inches apart, the harvesting attachment is the only piece of special equipment needed.

Place in the Rotation

As with most crops sunflowers usually give the best yields on summerfallow. But when they are grown as an intertilled crop, weed control is accomplished by the intertillage and the summerfallow could better be used for cereal grain.

When grown as a row crop seeding sunflowers as a third or fourth crop after summerfallow is common. In fact, it is common practice to seed them on land that normally would be used for summerfallow. Provided the correct procedure is used for weed control, the crop will produce satisfactorily on land heavily infested with annual weeds such as wild oats or mustard. But sunflowers cannot compete with heavy infestations of perennial weeds such as sowthistle or Canada thistle. These weeds cannot be controlled by row-crop cultivation.

Growing sunflowers on land that would normally be summerfallowed extends the rotation by at least 1 year. If you obtain a clean crop of sunflowers, the extension can be more than a single year, because after the sunflowers you can grow an additional crop or two before summerfallowing.

In tests for several years at Portage la Prairie, Man., wheat, barley, flax, soybeans, sugar beets, dry peas, and corn yielded as well after sunflowers as after many other crops. Farmers have found that oats also yield well after sunflowers. Because there is usually a heavy growth of volunteers after a sunflower crop, it is advisable to plant a crop that can be treated with a selective herbicide. The herbicide should be one that does not damage the crop but will destroy the volunteers. Sunflowers are highly susceptible to some herbicides, hence the volunteers are easily controlled.

Type of Soil

Most soils that will produce cereals or corn will produce sunflowers. Because the crop prefers warm temperatures, don't plant them in heavy low-lying soils that are poorly drained and warm up slowly in the spring. Sandy soils give good yields of sunflowers. Because the crop is more resistant to drought and frost than corn and soybeans are, sunflowers may be grown in Canada over a much larger area than that suitable for corn and soybeans.

Plant Populations and Seeding Rates

The amount of seed to sow per acre depends on the variety, the spacing between the rows, and the spacing of plants within the rows. Most commonly the crop is grown in rows 36 to 42 inches apart; but the crop has been grown successfully in row spacings ranging from as little as 6 to 7 inches up to wide spacings of 10 feet or more. When grown as a row crop the narrowest practical spacing between rows is 18 inches. In tests over a 3-year period this spacing has yielded as well as wider spacings of 36 or 42 inches. Accordingly, when you grow sunflowers as a row crop you should choose the spacing that best suits your equipment and is compatible with other row crops, such as sugar beets, that you may be growing. To some extent the narrower spacings aid in weed control because the spaces between the rows are completely shaded sooner than in the 36- to 42-inch width.

Another factor to consider when growing the crop as a conventional row crop is the intended market. For oilseed and bird feed types, plant spacings of 6 inches are desirable. This gives approximately 22,000 plants per acre. Such a population produces rather small heads that dry out quickly in the fall and are easier to harvest than large heads obtained in lower populations. For the oilseed varieties presently available a planting rate of 5 to 6 pounds per acre will provide the population indicated. However, you should consult your seed supplier for the recommended seeding rate for the seed you purchase because some offer seed of specific sizes and obviously larger seed must be planted at a heavier rate.

In producing the large type of seed, the spacing between the plants must be greater to assure a high percentage of large seed in the harvested crop. A spacing of 12 to 15 inches between plants or a population of 10,000 to 12,000 plants per acre, grown in rows, is recommended.

Much of the acreage planted in Saskatchewan and Alberta in the past 2 years has been in narrow rows of 12 inches or less. In 3 years of testing at the Research Station at Morden, plantings in 1-foot rows yielded 15 to 20 percent more than in rows spaced 3 feet apart. Various rates of seeding were used in the trial and the results indicate that a population ofapproximately 25,000 plants per acre gives the best yield in these narrow rows. A seeding rate of about 7 pounds per acre for the presently recommended oilseed varieties should achieve this population.

Another satisfactory method of growing the crop is the use of widely spaced rows. In this method single or double rows are planted 10 feet or more apart. The method allows tillage machinery normally found on a cereal grain farm to be used for cultivating between the rows. The exact distance between the rows will depend on the width of the tillage implement available. In three consecutive seasons of testing, using two varieties, rows 12 feet apart produced slightly more than half the amount of seed obtained from rows 3 feet apart. Various rates of seeding were used in the test. The results showed that a spacing of 3 to 4 inches between plants in the rows gave the best yields. This spacing gives a population of 11,000 to 14,000 plants per acre for 12-foot rows, and suggests a seeding rate of 3 to 4 pounds per acre.

Studies by the Research Station at Lethbridge, Alta.,[1] in one season, in a field where wide rows were used, showed that there was less moisture in the soil within the rows in the fall than in an adjacent summerfallow field. This deficiency was evident for 3 feet from the rows. During the winter, the sunflower stalks held snow well (Figure 1), but the adjacent summerfallow field remained bare. In the spring, the moisture level in the sunflower field was equal to or slightly higher than that in the summerfallow field. The level of nitrogen in the soil was lower in the sunflower rows than between the rows and also lower than in the summerfallow field. No experimental data are available on the yield of cereal crops following sunflowers in wide rows, but farmers' observations indicate that yields are equal or nearly equal to those obtained from summerfallow.

Figure 1 — Sunflower stalks in widely spaced rows hold snow well while summerfallow, in the foreground, is nearly bare.

This culture in wide rows offers the prospect of using sunflowers as a real summerfallow substitute. It is strongly recommended for continuing trial in the drier southerly areas of the prairies and, particularly, where there is a hazard of soil erosion in the winter or early spring on conventional fields of summerfallow. Providing the stalks are left standing, the snow that they will hold will substantially reduce the danger of soil drifting.

[1]Information provided by S. H. Pawlowski.

Treating the Seed

Seed treatment was previously recommended for sunflower seed on the basis that the treatment is good practice for any crop. Because of the current stigma attached to merçury, which is a common component of chemicals used for treating seed, the practice is no longer recommended. Furthermore, the field experiments that have been conducted under Western Canadian conditions do not show an advantage from treating sunflower seed.

Preparing the Seedbed

To ensure even germination the seedbed must be firm. A firm seedbed brings the moisture close to the surface and permits shallow seeding with rapid and even emergence. Because sunflowers are often grown in rows, they do not cover the soil surface as quickly as solid-seeded grain crops. For this reason, a lumpy surface or some trash cover is desirable in areas where there is a danger of soil drifting.

Date of Seeding

Seed sunflowers early; or as a general guide, seed at the same time as wheat. Temperatures down to 22°F do not damage newly emerged seedlings. The seedlings also retain good resistance to frost into the four-leaf stage. But plants with six to eight leaves are susceptible to light frosts. In Western Canada, particularly in Manitoba, the most suitable seeding time is May 1 to May 20, preferably the earlier part of this period. Yields and quality of seed decline rapidly with later seeding.

Seeding in April is not advisable. If warm weather follows an April seeding, the plants could be in the susceptible six- to eight-leaf stage by late May or early June and be injured by light frosts at this time. Injured plants branch profusely and give low yields.

Depth of Seeding

Sunflower seed has a thick hull and needs a good supply of moisture for germination. It is important to sow the seed into moist soil. Because the seed is large, it can be planted up to 4 inches deep with good results. But shallow seeding, provided the seed is in moist soil, gives quicker emergence than deep seeding.

Some growers who have tried the crop in wide rows described earlier have developed various pieces of homemade equipment or lister-type planters, which place the seed in a trench. This practice achieves the objective of placing the seed in moist soil. In addition if the planting is made on cereal stubble, the amount of volunteer grain within the row is reduced. Formation of the trench pushes the surface soil to the side of the row and at the same time moves the cereal seeds that can produce volunteer plants out of the immediate vicinity of the row.

The practice helps in the control of volunteer grain in the sunflower crop.

Fertilizers

Although only a few experiments have been carried out on the effect of fertilizers on the sunflower crop, there is little doubt that fertilizers do increase the yield and, equally important, hasten the maturity. In 16 tests conducted by the Manitoba Department of Agriculture in 2 years, 40 pounds of 11-48-0 per acre gave the best response, increasing the yield by 11 percent. The response was better on sandy loam than on clay soils. The fertilized strips also matured sooner and usually produced drier seed than unfertilized strips. In Alberta, tests by the Research Station at Lethbridge showed that 30 pounds of nitrogen and 30 pounds of phosphorus applied on an eroded fine sandy loam, and 30 pounds of nitrogen applied on a silt loam, gave good increases in yield. Rates of nitrogen above 30 pounds per acre gave no further increase in yield.

A recent trend in the Prairie Provinces is to fertilize according to recommendations based on soil tests in each field and for each crop. One year four farmers, cooperating with the Manitoba Department of Agriculture, got a return of $1.95 for each $1 invested in fertilizer when they followed the recommendations from soil tests. Heavier rates of nitrogen and phosphorus than recommended and the addition of potassium gave much lower rates of return. On the basis of these observations soil testing and following the resulting recommendations seems advisable.

It is obviously not feasible to make a general recommendation for rate of fertilizer application which will be applicable over the range of soil fertility found in the Prairie Provinces. The 1971 field crop recommendations for Manitoba are 40 to 60 pounds of nitrogen and 20 to 30 pounds of phosphate per acre. This is the rate recommended for cereal crops on stubble land in Manitoba. Because the crop is most commonly grown on stubble in Manitoba, it may be inferred that any general recommendation for cereals could also be applied to sunflowers in the absence of a specific soil test for the fields. When the crop is grown in rows 36 inches or more apart, the fertilizer should be applied as a side band application.

Weed Control by Tillage

Sunflowers will serve as a cleaning crop but, of course, only if weeds in them are well controlled. If possible, destroy one or two crops of weeds before seeding. Then seed immediately so that the crop will have an even start with the weed seeds remaining in the soil. Weed control after seeding depends first on cross-harrowing, and then by the correct use of the row-crop cultivator for inter-row tillage.

If there is any secret in successful sunflower production, it is the practice of cross-harrowing in the seedling stage. This practice gives unbelievably good control of weeds in the young crop. Because young sunflower plants are larger than many weeds and have a stronger root system, they are not as easily destroyed by harrowing as the competing weeds. Light diamond harrows should be used. Finger weeders, rotary hoes, and similar types of implements are also well suited for this work. Harrow once just before the crop emerges, or about 7 to 10 days after planting. This destroys weed seedlings that have germinated since the sunflowers were seeded. In very weedy fields harrowing twice before emergence may be beneficial.

After emergence it is best to wait until the plants are in the four- to six-leaf stage to avoid burying a large proportion of them during harrowing. *But the most important consideration is the infestation of weeds in the field.* If wet weather has prevented preemergence harrowing or *if the field is weedy, harrow regardless of the stage of the sunflowers.* In tests, seedlings that had just emerged withstood harrowing just as well as plants in the four- to six-leaf stage.

To kill the most weeds with the least damage to the sunflower plants, harrow on a warm, clear day. A firm seedbed also reduces damage to the sunflower stand in this operation. Timely harrowing when the crop is in the seedling stage can be a great help in controlling weeds. This practice will control extremely heavy infestations of wild oats fairly well. Some growers harrow their fields as many as five times after the crop emerges. *The success of this treatment depends on a uniform emergence, which in turn can be obtained only by preparing a firm seedbed and seeding deep enough to be sure that the seed is in moist soil.*

Growers who lack experience with the crop are often timid about harrowing. It is sometimes jokingly said that the best way to carry out this practice is for the owner of the field to send a hired hand into the crop with instructions not to look back. Meanwhile the owner should take the afternoon off. Some growers have reported that this approach is the best way to be sure the harrowing is carried to completion.

In the narrow row spacings of 18 inches or less cross-harrowing is the only tillage practice for weed control. Where the crop is grown in the conventional row spacings of 36 to 42 inches a row-crop cultivator equipped with hilling disks is essential. For the first cultivation set the disks to operate as close as possible to the rows and to throw the soil away from them. The cultivator shovel following behind should be set to push the soil into the groove left by the disk. Some operators prefer to leave the disk groove open and cross-harrow immediately to pull some weeds into it and bury them. But do not leave this groove open for an extended period because if you do, the soil near the plants will dry out. For the final cultivation set the disks to throw the soil into the rows to bury the small weeds in them. You will cover the weeds better if the disks working on either side of the row are set so that one works a foot or more behind the other rather than set opposite each other. Most growers cultivate three times, but the number varies. The main consideration is the weed condition of the field. Cultivate only deep enough to control weeds adequately. Deep cultivation may damage the roots and uses excessive fuel. Avoid late cultivations, which bend or break the plants or tear the leaves.

Weed Control with Chemicals

Practices in chemical weed control change rapidly— both in the available chemicals and their method of application. Chemicals are available for controlling some weeds in sunflowers. You should consult your agricultural representative or district agriculturist for the most recent information.

Sunflowers and 2,4-D

Be very careful when you use 2,4-D or MCPA herbicides near sunflowers. The sunflower plant is extremely susceptible to damage by these chemicals (Figure 2). In tests, mixed ester, low-volatile ester, and amine forms of 2,4-D were sprayed when a wind of 9 to 12 miles an hour was blowing toward sunflowers 110 yards away. The reductions in yield for the three forms were 42, 38, and 37 percent respectively. It is especially hazardous to use the more volatile forms of ester 2,4-D and MCPA near sunflower fields. These esters produce fumes that may blow over the sunflower field even several hours after the spray has been applied and cause serious damage. In a number of instances the volatile ester was applied near sunflowers while the wind was blowing away from them. Later in the day the wind direction changed and the fumes from the chemical caused heavy losses. Therefore, do not use the more volatile forms of 2,4-D and MCPA within ¼ mile of sunflowers, and preferably not within ½ mile.

The amine and sodium salt forms of 2,4-D and MCPA do not produce as many fumes as the more volatile esters. With proper precautions they can be used safely near sunflowers. Be careful not to let any spray droplets drift over the sunflower field. Keep at least 50 feet away from the field and spray when there is a definite breeze away from it. Also, do not use pressures higher than 30 to 40 pounds per square inch. The amine and the sodium salt of 2,4-D give adequate control of annual weeds, such as stinkweed and mustard. If an ester is required, use a low-volatile form.

Figure 2 — Sunflower plant injured by 2,4-D drift. The chemical was applied 55 yards from the plant.

Harvesting

A sunflower crop that was seeded in early May is usually ready to harvest about mid-October. Specialists say that the safe moisture level

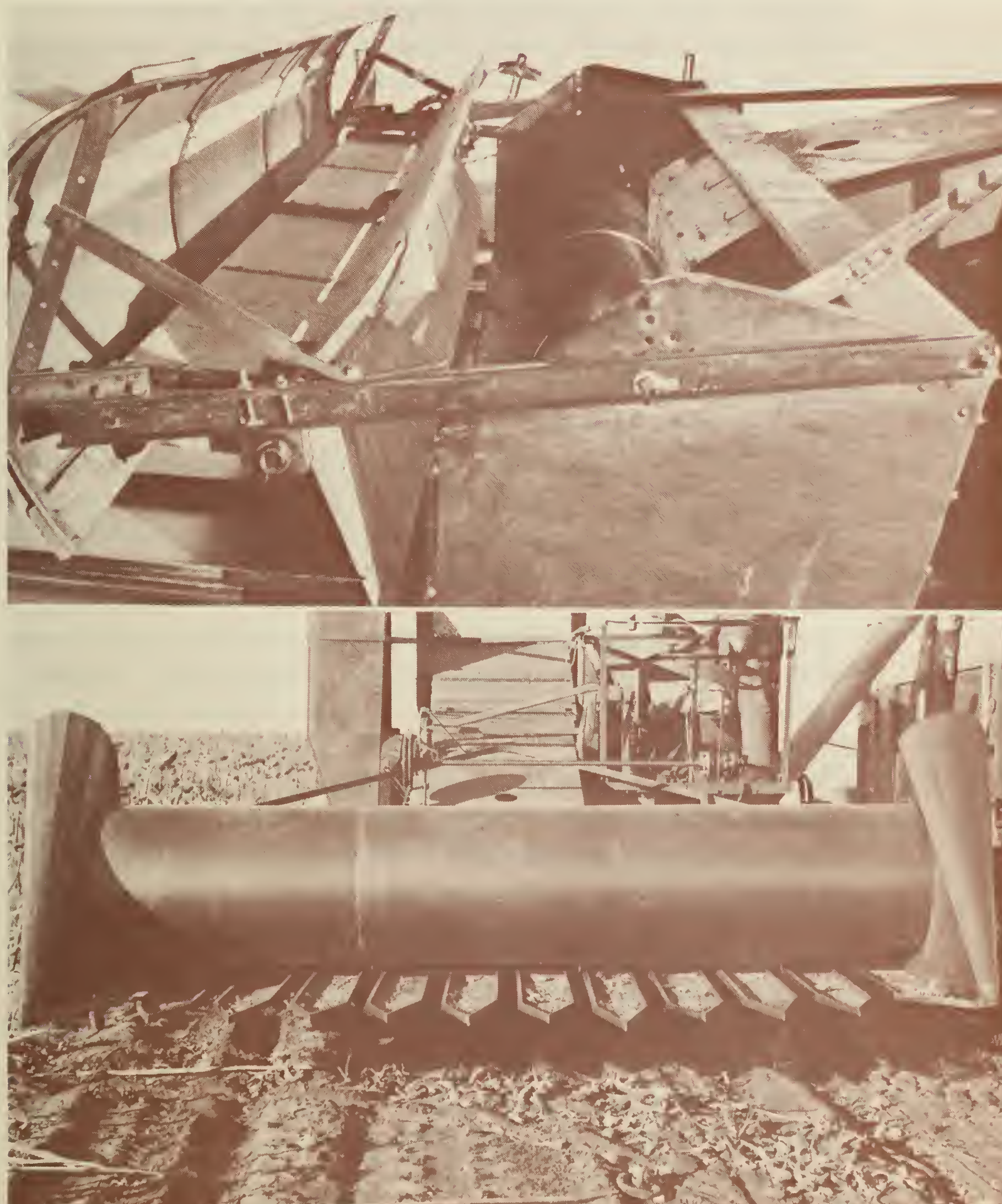

Figure 3 — *Top*: side view of sunflower harvesting attachment showing sheet-metal shield and small, three-armed reel that replaces the conventional reel. *Bottom*: front view of a similar type of attachment.

for storing seed under all weather conditions is 9.5 percent. In practice, growers often store seed with a moisture content of 12 percent for a few months. It is possible to store seed containing 14 to 15 percent moisture during cold weather but the practice is not recommended. Some shattering and bird damage may occur after maturity, but the loss is usually small and the crop can be left standing until the moisture content is low enough for safe storage. Have a grain elevator operator test your seed rather than run the risk of losing or damaging the entire crop through heating in the bin.

A combine fitted with a special sunflower attachment is the only practical equipment for harvesting the crop. A machine on which the cylinder speed can be reduced without lowering the speed of the decks and shoe is essential.

Sunflower seed threshes from the head easily. Reduce the cylinder speed to about half that used for cereal grains and open the concaves wide. Excessive cylinder speed and close concave setting break up the heads so that the sieves in the shoe become overloaded. This prevents free flow of the wind blast through them and interferes with good cleaning and separation. High cylinder speed may also cause serious dehulling of seed and lead to lower grades when marketing. If the combine is properly operated, there is almost no hulling and the dockage is low. Most samples have dockage of 2 or 3 percent and a few have none.

The main changes in a combine for sunflower harvesting are in the reel and cutter bar. The conventional reel is removed. Two modifications may replace it. The more common one consists of a reel of three short arms working behind a large convex sheet-metal shield, as illustrated in Figures 3 and 4. The second type is a rotating drum, illustrated in Figure 5. Besides the modification for the reel, long metal pans spaced 3 inches apart are attached to the cutter bar. In operation, this equipment acts somewhat like a stripper. The stems are pushed forward by the shield and slide between the pans. As the heads pass under the lower edge of the shield, they are drawn to the knife by the reel, cut off, and thrown into the feeding auger. The pans guide the stems and catch most of the seed that is shattered from the heads as they move to the feeding auger.

Several farmers or local machine shops and some smaller manufacturing firms in Manitoba and Alberta have built harvesting equipment. The main parts are usually similar in shape and function, but the size and method for adjustment may vary. Figure 3 shows two views, and the drawing, Figure 4, gives the measurements and details of construction of one type of attachment that worked well.

The upper left of Figure 4 shows that the pans are 9 inches wide and 52 inches long, tapering to a point, the taper starting 37 inches from the back of the pan. They are 1 inch deep. They are spaced 12 inches center to center, the slot between them being 3 inches wide. Material is No. 16 gauge sheet iron. Guard clips (A) of sheet iron, almost triangular in shape, 6 inches long and 4¼ inches deep are welded to the sides of the pan, 4 inches from the back end. These clip over the standard guards when the pans are attached. The side pans are also 9 inches wide but are 3 inches longer and taper only to one side. They have a curved dividing bar (B) of ½-inch iron rod welded to the outer side.

The lower left of Figure 4 shows the method of attaching the pans to the cutter bar. They are bolted directly over the regular guards, two of the regular bolts being replaced by slightly longer ones. The rest of the support is given by a 1-inch by ¼-inch strap iron brace (L) 39 inches long, attached to the front end of the pan and below the cutter bar at the rear.

For the rear attachment a piece of 1½-inch by ¼-inch angle iron (K) the full width of the machine is fastened under the cutter bar. It is attached to the original angle iron (H), which carried the guards, by five short pieces of 2-inch by ¼-inch strap iron (J) welded at equal intervals along the new piece (K) and then each fastened by a single 7/16-inch bolt to the vertical part of the original iron (H). The holes that must be drilled in the original angle iron (H) for this purpose are the only ones required for the changeover. It is important that this piece of angle iron be mounted as close to the cutter bar as possible. The attaching pieces of strap iron (J) must not be any longer than necessary. After this angle iron (K) has been fastened in place, the rear of the strap iron brace (L), which has a half twist, is bolted to it.

The front attachment for the pan consists of a 3-inch piece of 1¼-inch by ⅛-inch angle iron (C) welded to its center bottom surface. The strap iron brace (L) is fastened to this short piece of angle iron with a single bolt (D), 34 inches from the back of the pan. A piece of light rod (E) is welded to the front end of the strap iron (L) to form a slot 4 inches long, for adjusting the pan height.

The other important part is the large sheet-metal guard, or shield, mounted in front of the small three-armed reel. The supports for the shield are mounted on the original channel irons (W), which carry the reel. The base of the supports, which is bolted to the channel iron, is made of 1½-inch by ¼-inch angle iron, 12 inches long (U) with a small plate (T) welded to the upper front edge. This small plate (T) has a number of holes (S) in an arc, which allow the slope of the shield to be adjusted; the single bolt 3 inches below in the angle iron serves as a pivot (V). The part forming the frame of the shield is made of a piece of 1-inch by ¼-inch strap iron, 36 inches long and shaped in an arc so that the ends are 30 inches apart (O). To this arc of strap iron is welded a 20-inch length of 1-inch by ¼-inch angle iron (P). It, in turn, is bolted

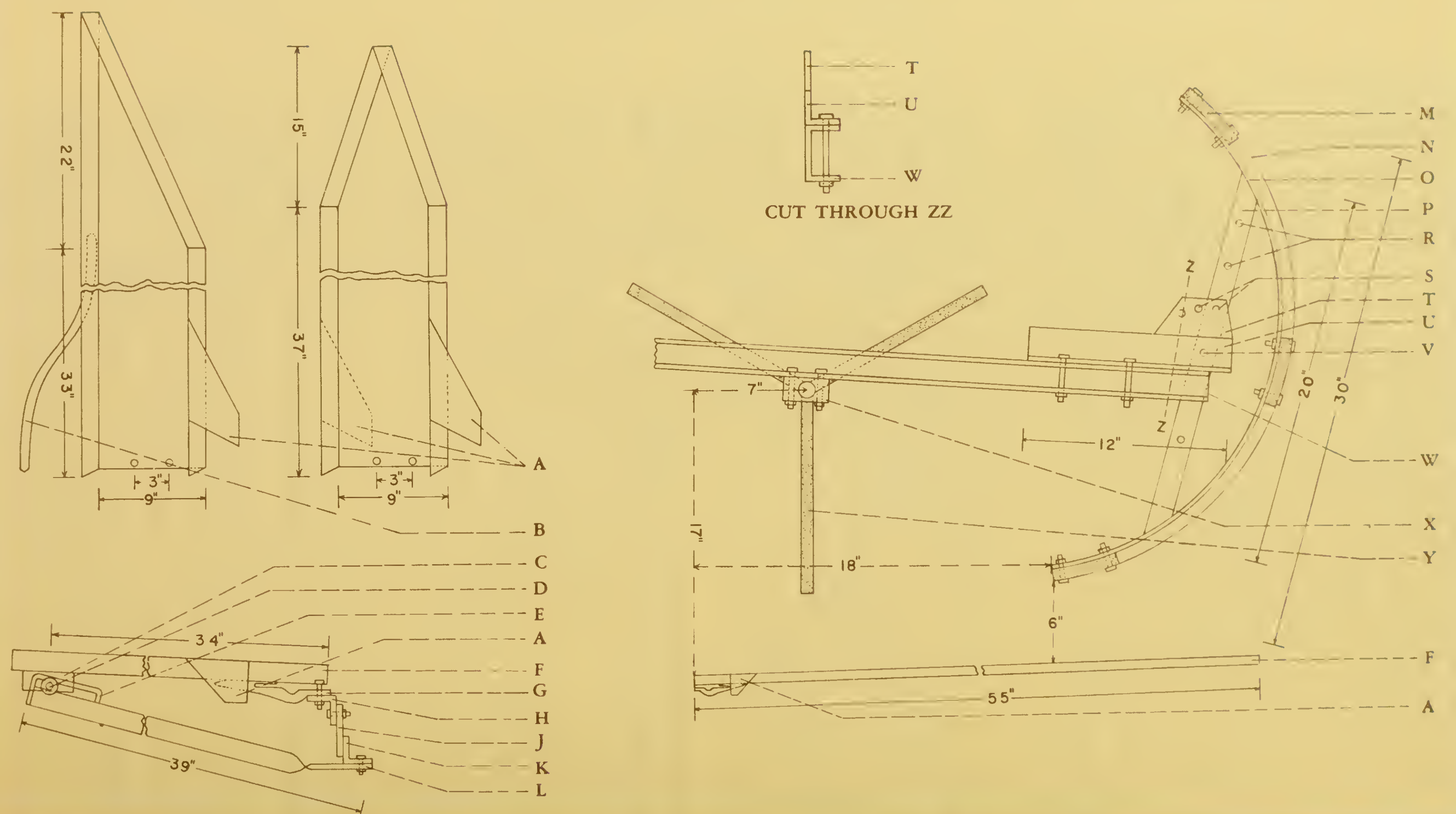

Figure 4 — Sketch of details for constructing the harvesting attachment shown in Figure 3. Not drawn to scale.

to the base (U) attached to the channel iron (W). A number of holes (R) spaced 3 inches apart in the angle iron (P) allow the height of the shield to be adjusted. This assembly at each end of the combine is joined together by three 1-inch by 4-inch boards (M) fastened to the arc with ¼-inch bolts. Usually on machines 8 feet or more wide, a third metal arc of strap iron is bolted to the boards in the center of the machine for added strength and rigidity. The face of the shield (N), which is usually made of 20-gauge galvanized iron or similar material, is then fastened to the boards with screws.

Key to Letters in Figure 4

A, guard clip, 6″ long, 4½″ deep.
B, dividing rod of ½″ iron.
C, piece of 1″ × ⅛″ angle iron, 3″ long, welded to F.
D, front support bolt and washer.
E, ¼″ iron rod welded to L to permit adjustment of pan height.
F, pan.
G, guard.
H, original angle iron, carrying guard.
J, short plate of 2″ × ¼″ strap iron welded to K and bolted to H.
K, new piece of 1½″ × ¼″ angle iron full width of combine.
L, 1″ × ¼″ strap iron brace of supporting pan.
M, 1″ × 4″ board full width of combine.
N, 28-gauge sheet-metal shield.
O, 1″ × ¼″ strap iron, 36 inches long, shaped to an arc 30 inches across.
P, 1″ × ¼″ angle iron, 20 inches long, welded to O.
R, holes 3″ apart, allowing the shield height to be adjusted.
S, holes in an arc, which, with pivot hole V, allow the slope of the shield to be adjusted.
T, small ¼″ iron plate, welded to U.
U, 1½″ × ¼″ angle iron, 12 inches long.
V, pivot hole which, with S, allows the slope of the shield to be adjusted.
W, channel iron support for original reel.
X, reel boxing.
Y, reel arm of 1″ × 12″ board.

The reel is of simple construction consisting only of three arms, 12 inches long, mounted on the standard reel shaft, and 1-inch by 12-inch boards (Y) attached to them. Most operators mount the reel boxing (X) below the original channel iron (W), rather than above it, which is the standard position.

The information on the position of this equipment as shown in Figure 4 is not definite or fixed. The measurements shown were taken from a machine in operation, but many adjustments are possible. Different field conditions will likely require different adjustments.

Minor variations in construction and improvements in this equipment are being added as further experience is gained. A recently built attachment is illustrated in Figure 3, bottom. Note that the pans in this unit have a lip about ¾-inch wide, which gives them added strength and is reputed to retain shattered seed better. Large dividers have been constructed of heavy sheet metal in place of the dividing bar (B) shown in Figure 4. Also, one ⅜-inch iron rod for each space, or slot, between the pans has been fastened to the reel arms in a position to just clear the sickle as the reel revolves. In the figure, these are just visible in the second, fifth, and eighth slots from the right. These rods aid considerably in preventing the slots from clogging with stalks and heads when the machine is operating in tough or damp crops.

Figure 5 — Another type of harvesting attachment using a rotating drum to replace the conventional reel. This type of replacement is gaining popular acceptance. Other parts are similar to those shown in Figures 3 and 4.

Figure 5 illustrates the most recent development in harvesting equipment. In this attachment the conventional reel is replaced by a rotating drum instead of by the three-armed reel and stationary shield. The drive for the reel rotates the drum. Triangular-shaped pieces of strap iron are welded to the drum. As it rotates these pass through the slots between the pans and dislodge any stalks that may cause clogging.

The equipment described here has removed the difficulties that farmers had in harvesting sunflower seed in the early years of its production in Canada. Equipment of the same design is used in Russia and Argentina. When the crop is reasonably dry, or yielding seed with about 12 percent moisture, it harvests as easily as cereal grains.

DISEASES

Sunflowers, like most other crops, are subject to several diseases. In Canada, the two most serious ones are leaf mottle, or verticillium wilt, and sunflower rust. Fungi cause both. Downy mildew and sclerotinia wilt, or stem rot, also due to fungi, have caused economic losses in some fields. In addition, a disease due to the virus causing aster yellows appears in sunflowers and led to observable losses in one year.

The fungi causing these diseases overwinter in the soil or on dead sunflower stalks and leaves. Those responsible for verticillium wilt and sclerotinia wilt may live in the soil for several years. In addition both, especially sclerotinia wilt, occur on several other broad-leaved crops including sugar beets, rapeseed, peas, alfalfa, and sweet clover as well as a variety of fleshy weeds like thistles and pigweed. The virus causing aster yellows may overwinter in the live tissue of perennials or winter annuals such as thistles and stinkweed and be transferred to sunflowers by insects.

Crop rotation is one means of minimizing sunflower diseases. Do not grow sunflowers more than once in 4 years on the same land and if possible extend the period even further. Do not follow sunflowers with other crops that may be attacked by verticillium wilt or sclerotinia wilt. Preferably sunflowers should follow and be followed by a cereal such as wheat, oats, barley, or corn. Maintaining this type of sequence in the rotation will help to prevent buildup in the soil of the fungi causing the diseases.

You can also combat disease by growing disease-resistant varieties. Fortunately, there are licensed varieties available with resistance to the most serious diseases, verticillium wilt and rust. Resistance to the other diseases is present in the breeding material at research stations and can be added to commercial varieties if an increase in the diseases becomes evident.

Detailed descriptions of the various diseases and further information on their control may be found in *Diseases of Field Crops in the Prairie Provinces*, Canada Department of Agriculture Publication 1302, available from Information Canada, Ottawa.

INSECTS

Wireworms, cutworms, beet webworms, and grasshoppers attack sunflowers as well as other crops. Publications are available outlining standard procedures for their control. Because there is considerable anxiety about the use of some types of insecticides and their effect on the environment, control measures for insects change rapidly. Consult your agricultural representative or district agriculturist for the latest information.

The larvae of a number of insects attack only sunflowers. The larvae of the sunflower moth[2] and the banded sunflower moth[3] bore or tunnel in the seed and head. The sunflower maggot[4] tunnels in the pith of the stem. These three insects have never caused serious damage in the Canadian sunflower crop. Populations and their damage fluctuate from year to year but natural parasites have kept them from becoming a serious deterrent to sunflower seed production. The larvae of an unidentified midge appeared in the buds and flowering heads in west-central Minnesota in 1971. Serious damage was feared but losses appear to have been much less than first expected.

The sunflower leaf beetle[5] has seriously damaged a few fields. This insect looks like the potato beetle but is only two-thirds as large. The adults are characterized by an exclamation type of mark on the outer edges of the wing cover, and the larvae are green instead of brick red in color. The overwintering adults cause damage by invading seedling stands of sunflower. The larvae do damage by eating the upper leaves of the plants in late bud or blossom. The larvae are usually found resting between the bracts of the buds or heads. Another leaf feeder is the thistle caterpillar,[6] or larva of the painted lady butterfly. Although heavy populations of it defoliate large sunflower plants in a few days, it has caused economic injury in only one season since sunflowers have been grown for seed in Western Canada.

BLACKBIRDS AND OTHER PESTS

Generally, damage from birds has never been serious. But blackbirds may destroy entire isolated fields that are near areas of still water bordered with a rank growth of weeds. These areas are natural breeding and roosting grounds for blackbirds. Very large flocks gather in them before migrating in the fall, especially if a sunflower field is nearby.

[2]*Homoeosoma electellum* (Hulst).
[3]*Phalonia hospes* (Walsingham).
[4]*Strauzia longipennis* (Wiedemann).
[5]*Zygospila exclamationis* (Fabricius).
[6]*Vanessa cardui* (Linnaeus).

Avoid planting sunflowers near these areas.

Scaring devices help to control blackbirds. Acetylene exploders using gas from acetylene tanks are the most effective. One of these units costs about $100 and will protect up to 10 acres for about a dollar an acre. Start the exploders as soon as the blackbirds begin to feed in the field and change their location often so that the birds do not become accustomed to them. Large firecrackers are another noisemaker. They are ignited by inserting the fuses at intervals in a slow-burning rope. No capital cost is involved with firecrackers but they require more protection from wet weather than the acetylene exploders. *Blackbirds in Field Crops*, Canada Department of Agriculture Publication 1184, provides additional information.

A practice that some growers in Minnesota have found effective in repelling blackbirds is to apply not more than 2 quarts of waste lubricating oil for each acre of water surface at the roosting grounds. Some of these same growers who are avid hunters report no adverse effects on ducks and other aquatic wildlife. Subject to provincial wildlife regulations, the practice is recommended for trial.

Gophers and rabbits, particularly gophers, can cause serious damage to young stands of sunflowers. The damage is worse in drier areas because the rather large, tender, moisture-laden seedlings are attractive not only as food but also for their moisture content. Control gophers with any poison bait that regulations may allow. Also, foster their control by preventing destruction of their natural enemies including weasels, badgers, and coyotes.

VARIETIES

The varieties Peredovik and Krasnodarets are recommended for production of oilseed, Valley for bird feed, and Commander for large seed (Figure 6). Other varieties no longer recommended for seed production are Advance, Advent, Admiral, Armavirec, Beacon, Mennonite, and Sunrise. Brief descriptions of the recommended varieties follow.

Peredovik, which was the most widely grown variety, was introduced from Russia. It yields well and matures moderately early. Depending on moisture and fertility it is 4 to 6½ feet high. It is resistant to leaf mottle, or verticillium wilt, but susceptible to rust. The seed is of medium size and black with narrow, dark gray stripes. It contains 44 percent oil.

Krasnodarets, also an introduction from Russia, was licensed in 1969. It yields 10 to 15 percent less than Peredovik and is about 10 inches shorter; its seed is similar to Peredovik. Like Peredovik it is susceptible to rust, but it does have fair tolerance for verticillium wilt.

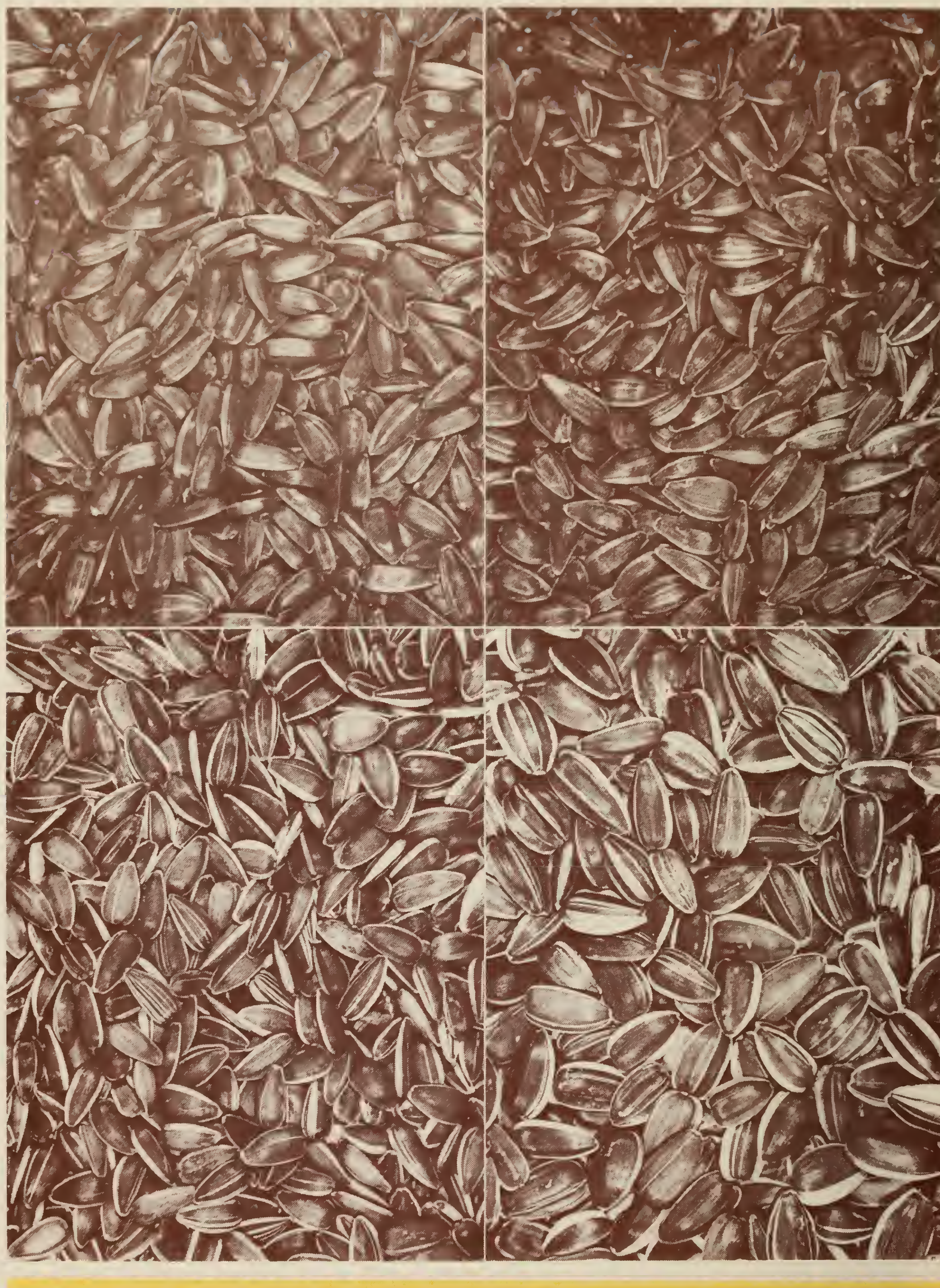

Figure 6 — Seed of recommended varieties of sunflowers. *Upper left,* Peredovik; *upper right,* Krasnodarets; *lower left,* Valley; *lower right,* Commander. Peredovik and Krasnodarets are oilseed varieties. Valley is grown for bird and pet feed and Commander for large seed.

It flowers 5 to 10 days earlier than Peredovik and because of this important advantage in maturity it is popular in areas with frost-free periods that are shorter than that in the Red River Valley of Manitoba, where most of the sunflower crop has been grown until recent years.

Valley is now recommended for production of bird feed. The seed is about the same size as that of Peredovik but because it is plump and prominently striped black and white it is more attractive than Peredovik and Krasnodarets to bird fanciers. Valley yields about 20 percent more than Peredovik and is about the same height. Oil content in the seed is 36 percent. It is slightly later maturing than Peredovik and for this reason should not be grown outside the Red River Valley of Manitoba. It is resistant to rust, which is a distinct advantage for production in this area. It is susceptible to verticillium wilt. Because Valley is a first-generation hybrid new seed must be obtained each year.

Commander was selected from the old variety Mennonite and is similar in all respects to Mennonite except that it produces a greater proportion of large seed. Its total yield of seed is similar to Peredovik but the oil content is only 28 percent. It matures in the same time as Peredovik and is about the same height. It is moderately susceptible to leaf mottle and susceptible to rust. Mingren is an American variety with large seed and is not licensed in Canada. Tests in Manitoba show that its performance is similar to Commander.

The varieties no longer recommended have been discontinued for one or more of a number of reasons including late maturity, low yield, low oil content, susceptibility to disease, and lack of uniformity. New varieties are continually being introduced from other countries or developed in the sunflower breeding programs of the Research Branch in Canada. Significant breeding programs are also being conducted by companies and the Department of Agriculture in the United States. Keep informed on new varieties by consulting your agricultural representative, district agriculturist, or nearest agricultural research establishment.

ARE SUNFLOWERS HARD ON THE LAND?

A belief that sunflowers are hard on the land is probably a carryover from the time when the variety Mammoth Russian was grown in Western Canada as a silage crop. Because the plants were 8 to 10 feet high, they removed more moisture and nutrients from the soil than the shorter types now grown for seed. Studies comparing the nutrients used by silage corn and sunflowers show that sunflowers use more potassium and calcium but less of the important elements, nitrogen and phosphorus. As there are good quantities of potassium and calcium in most of the soils in Western Canada, the requirements of the sunflower crop for these elements are not important in the area. Some farmers have reported that land after sunflowers is just as productive as summerfallow.

In tests in Idaho on the silage type of sunflowers, the yield of spring wheat was almost normal after sunflowers. At Scott, Sask., in rotation experiments, the yield of wheat after sunflowers for a 12-year average was the same as or slightly higher than the yield after wheat, flax, sweet clover, or crested wheatgrass, indicating that sunflowers are no harder on the land than other common crops. Results were similar in studies at Portage la Prairie, Man., where nine crops were grown after sunflowers and after summerfallow, wheat, flax, peas, corn, and sugar beets. Six of the nine crops, wheat, barley, flax, rapeseed, sugar beets, and dry peas, yielded more after sunflowers than after any other treatment except summerfallow. These results are based on averages of 2 years for corn and up to 6 years for barley. Although the yields for most crops were higher after summerfallow, they were not high enough to warrant the outlay for fallowing.

The high stubble of the sunflower crop is another desirable feature. If the stalks are left standing over the winter, they hold snow well. The reduction of the winter soil erosion hazard as well as the benefits of moisture from the snow that is held are tangible assets.

THE FUTURE OF THE SUNFLOWER CROP

The future for any edible vegetable oil crop is good. Applying to all crops is the increasing demand for food that is being created by the rapid increases in human population. Applying specifically to the oilseed crops is the observation by nutritionists that edible oil consumption per capita is the first item in the diet to increase as the nutritional standard of a developing country improves. Further, as the technology of processing vegetable protein improves, it is expected that reconstituted proteins, or "synthetic foods," will be made in forms acceptable to the local food habits of the protein-deficient areas of the world. Thus there is an outlook for increasing worldwide demand for protein, and oilseed crops are an important source of this item.

On the North American continent two factors keep the outlook for edible oil crops strong. The first is the increasing use of vegetable rather than animal fats, and prominent in this trend is the use of polyunsaturated vegetable oils, of which sunflower oil is a prime example. Per capita annual use of food fats and oils in the United States in 1961 was 44.8 pounds; by 1969 it had risen to 52.8 pounds. In spite of this increase the use of butter and lard declined and the increase occurred mainly in salad and cooking oils, baking and frying fats, and margarine.

Secondly, the increasing demand for red meats on the continent, and in the more affluent nations generally, is contributing to an increased demand for protein for livestock feed, a fact shown by soybean meal prices rising almost $20 a ton in the last decade.

More locally, in Manitoba the strong position of oilseed versus other crops can be seen in the changes in prices in the last 10 years. For six crops out of ten examined, their mean prices over the two seasons 1969 and 1970 were lower than the mean prices in 1961 and 1962. Rapeseed and sunflowers, both oilseed crops, both showed higher prices in 1969 and 1970 than in 1961 and 1962.

An increasing number of farmers over an enlarging area are recognizing sunflowers as a desirable crop in their operations. Until recently most of the crop in Manitoba was produced in four or five municipalities in the Red River Valley. There have been pockets of production elsewhere, which have spread gradually to 1,000 acres or more in each of 21 municipalities in 1971.

It was earlier stated that the gross return of sunflowers compares favorably with other crops. It is also noticeable that, except for corn, the improvement in the last 5 years has been better than for any other crop. These improvements reflect recent introduction of early-maturing varieties of high oil content from Russia. Peredovik with one-third higher oil content than the older varieties was the first. Krasnodarets, coming later, produces about the same amount of oil per acre as the older varieties and matures 1 week earlier. The choice of varieties increases the flexibility of the crop in the growers' operations and the high oil content lets the crusher pay better prices for seed because he can operate his plant more efficiently.

An announcement of the discovery of a fertility-restoring gene in December 1970 by the Agricultural Research Service of the United States Department of Agriculture is an important development in sunflower breeding. This gene, in combination with a character called cytoplasmic male sterility, discovered earlier in France, provides the means to produce commercially hybrid sunflower seed equivalent to the high-yielding and widely used hybrid corn seed. Estimates of the benefit from it vary from 15 to 50 percent increase in yield; even at 15 percent the improvement in yield will be substantial. This improvement, by increasing the value of the crop, indirectly helps it in other ways by encouraging more use of fertilizer and more input into weed control. Some optimistic persons predict that the use of hybrid seed and the added care it will bring to the crop could double its yield. One firm in the United States has an extensive program to develop hybrid seed. It expects to release the first seed from the program to the public in 1972 or 1973. Canadian use of hybrid seed will soon follow.

Thus the future for the sunflower crop is encouraging. The basic reason is that it is an oilseed crop and produces fat and protein, both of which are in increasing demand as human and livestock food. Moreover, the rate of increasing demand is greater than for components of cereal crops. The other main and more specific reason is the major increase in yield on the near horizon, resulting from the research discovery of the mechanism to produce hybrid seed. Until recently only two or three scientists worked on the crop in North America. Now seven or eight are engaged in research with sunflowers and the budgets for it are increasing. These trends augur well for further discoveries that will improve the competitive position of the crop.

Copies of this publication may be obtained from
INFORMATION DIVISION
CANADA DEPARTMENT OF AGRICULTURE
OTTAWA
K1A 0C7

15M-35952-4:72 Cat. No. A53-1019

PRINTED............................1957
REPRINTED....................1962, 1965
REVISED......................1967, 1972