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Soybean Production in Michigan

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ADAPTATION

Soybeans are adapted to a wide range of climatic and soil conditions. They are currently being grown most extensively in the southern half of the lower peninsula. However, recent experiences have shown that excellent yields, up to 40 bu./acre, are possible in northern Michigan using new short-season varieties. Soybeans can be grown on almost any soil, with the exception of some muck soils that are poorly drained or very susceptible to frost. Because of diseases, growing soybeans in fine-textured, poorly-drained soils can also cause problems. In some respects, soybeans are more drought tolerant than corn. Soybeans flower over a longer period of time, and if sufficient vegetative growth occurs, can produce good yields even after extended periods of dry weather.

ROTATION

Because of potential disease problems, soybeans should be rotated often. Do not grow soybeans in a rotation more than 2 years in a row unless disease resistant varieties are available. Corn or wheat are the preferred crops for rotation with soybeans. Soybeans should not follow dry beans or alfalfa in the rotation. Some diseases of dry beans, like white mold, can carry over to soybeans. With alfalfa, the extra nitrogen that is available for the following crop is utilized better by corn or wheat. Serious disease problems in soybeans may force a field out of soybeans for 4 or more years to reduce potential disease problems, especially when resistant varieties are not available.

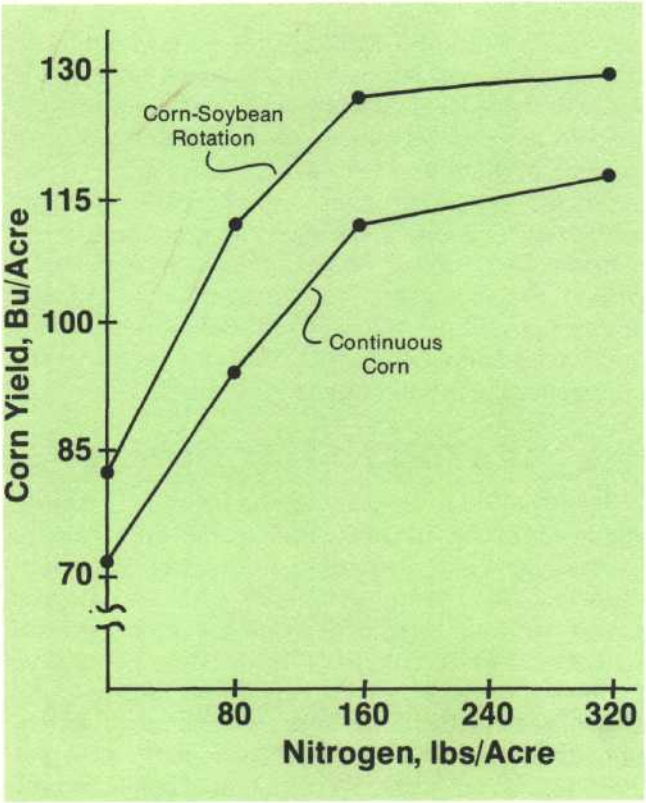

Figure 1. Effect of soybeans on corn in the rotation.

Source: Walsh, L. F. 1977. "Soybeans Good for Corn." Soybean News. 28(3).4.

A corn-soybean rotation is excellent for both soybeans and corn. Figure 1 shows that corn following soybeans out-yields corn following corn in a rotation. This is true at all nitrogen levels on corn. Soybean yields following corn are also higher than yields of soybeans following soybeans.

TILLAGE

Use only that tillage which is necessary to produce a firm seedbed. This can range from moldboard plowing and several secondary tillage operations to no-tillage and other conservation tillage systems. Primary tillage, where used, should be only deep enough to perform the functions required. Moldboard plowing as shallow as 5 or 6 inches will bury most weed seeds and trash and result in a fuel savings. Chisel plowing may be preferred if primary tillage is done in the fall following a low residue crop.

Secondary tillage should also be kept to a minimum. Restricting the number of secondary tillage passes reduces compaction, fuel use, time and labor. In most cases, do not perform secondary tillage at more than one-half the depth of primary tillage. When secondary tillage is conducted at the same depth as primary tillage, wet soil, weed seeds and other unwanted trash may be brought to the soil surface.

Initial research at MSU suggests that no-till and minimum-till methods can produce soybean yields equal to those from conventional tillage. Two points need to be made about no-till and minimum tillage soybean production. First, weed control may require increased herbicide rates and increased sprayer pressures. The use of Paraquat as a contact herbicide may be required. Second, follow the same principles recommended for conventional tillage: uniform planting depth, adequate plant populations and good seed-to-soil contact. This may require some adjustments or modifications to planters.

Figure 2. Soybean maturity group zones in Michigan for full season varieties.

VARIETY SELECTION

Select soybean varieties on the following criteria: yield, maturity, lodging resistance and disease resistance. Yield is perhaps the most important criterion. Comparative yields of soybean varieties grown in Michigan are available from several sources, including on-farm trials. The Cooperative Extension Service of MSU annually publishes the "Michigan Soybean Performance Report," Extension Bulletin E-1206 (Free). This bulletin provides information on over 100 varieties commercially available in Michigan, and evaluates the varieties on yield, maturity, lodging, disease resistance and other characteristics. Using this information (available from several locations and for several years) combined with other available performance data, should result in the selection of top performing varieties.

Select a variety that will mature on time. Soybean varieties are classified in one of 10 "Maturity Groups" with a "Group 00" for planting in the very northern U.S. and "Group VIII" adapted to the far southern U.S. Figure 2 shows the different maturity groups adapted to Michigan. Soybeans can be rated on number of days to maturity but this is not a normal practice because planting the same variety of soybeans in different locations in Michigan will result in a different number of days to maturity. To determine the proper maturity for a new variety at a specific location, campare its maturity relative to established varieties which have matured on time in that location previously.

Most seed companies rate their varieties relative to the maturity of a commonly grown variety. Generally, that variety is Corsoy for Group II in Michigan. Varieties are listed as plus or minus so many days from Corsoy. For example, if variety "A" is listed as minus (−) 3 days from Corsoy, then it matures 3 days earlier than Corsoy. Or, if variety "B" is listed at +5 days it will mature 5 days later than Corsoy. This system eliminates location differences. Maturity ratings are provided in the "Michigan Soybean Performance Report" for all varieties tested. In general, experience is the best method for selecting

the proper maturity for soybeans. However a general rule of thumb to follow for selecting soybeans of proper maturity for your location: the variety should reach physiological maturity (evidenced by the pods changing from a green to a yellow color) before the average date for 25% chance of the first killing frost (28-30°F) in the fall (consult "Michigan Freeze Bulletin," MSU Agricultural Experiment Station Research Report No. 26 for these dates).

Lodging (lack of standability) is often a problem for farmers growing soybeans on high fertility soils and/or soils with high moisture availability. Lodging ratings are reported in the "Michigan Soybean Performance Report." If lodging has been a problem, choose varieties that yield well and have good lodging resistance. If standability is still a problem, then consider reducing seeding rates.

Disease resistance can be important. Phytophthora root rot is the most important disease of soybeans in Michigan. Many of the common varieties grown in Michigan are being converted into Phytophthora root rot resistant varieties. These new varieties have resistance to most of the "races" of root rot found in Michigan. If Phytophthora root rot or other diseases have been a problem, consult commercial companies or seed dealers to determine if resistant varieties are available.

Soybean varieties currently grown in Michigan are indeterminate types. Several new types of soybeans are being developed that are semi-determinate or semi-dwarf determinates. The new types, particularly the semi-dwarfs, are shorter, more lodging resistant, flower over a shorter period and are generally higher yielding in high yielding environments than the commonly grown indeterminate varieties. Because these new types have not been tested extensively, little is known about specific management practices. However, it is known that to obtain top yeilds of semi-determinate and semi-dwarf determinate varieties, they must be grown in high yield environments where water and fertility levels are good throughout the growing season. Planting in narrow rows at populations of 225,000 plants per acre or more is a requirement for these new varieties.

SEED QUALITY

Always use top quality seed of a good performing variety. Michigan Certified Seed insures genetic or varietal purity, good warm germination, and freedom from noxious weed seeds and foreign material. When planting in cool soils or under other stress conditions, use vigor-tested seed. Because the soybean is a self-pollinated crop, seed can be saved from one year to another for planting. However, this seed should be checked for germination, vigor and pass the same rigorous standards used for certifying seed.

Seed germination and vigor are often reduced by diseases. Pod and stem blight, caused by *Phomopsis* sp., is an example of a seed disease which can significantly reduce soybean germination. If shriveled seeds are noticed in a soybean lot or if the autumn was wet, germination and vigor testing is a must to determine the quality of seed for planting next year. Do not use seed that falls below the certification requirements, before fungicide seed treatment. Chemical seed treatment has not been shown to increase germination in field trials conducted in Michigan. Trials at Michigan State University indicate that good quality seed will perform up to its potential, even under stress conditions, without the use of seed treatment.

FERTILITY

Soil fertility is an important component of the overall management system for producing high yielding soybeans. A bushel of soybeans contains about 3.8 pounds of nitrogen, 0.9 pounds of phosphate and about 1.4 pounds of potash. Thus, in a 40 bu./acre crop there are about 152 pounds of nitrogen (N), 36 pounds of phosphate (P_2O_5) and 56 pounds of potash (K_2O). These nutrients, therefore, need to be available to soybean plants for top production.

A good fertility program begins with a good soil pH. A pH of 6.5 is recommended for soybean fields. Acid soils should be limed to this pH to allow for good production and for good nodulation on the soybean roots to fix nitrogen. Soybeans grown on soil pH's higher than 6.8 may show a manganese deficiency.

Most of the nitrogen in harvested soybean seed is obtained from nitrogen fixing nodules on the root. It is not necessary to add bacterial inoculum or nitrogen to the soil at planting if soybeans have been grown recently (within the last 4 years) and nodulation was good. However, 25 lbs./acre of starter nitrogen may be beneficial when planting early into cold soils.

If soybeans have not been grown recently in a field or never before, apply bacterial inoculum to the seed. This bacterial inoculum, when applied to the seed prior to planting, will result in the formation of nitrogen fixing nodules on the roots. The nodules convert atmospheric nitrogen to a form usable by the soybean plant. This inoculum is often mixed with peat or humus and sold in a near-dry form. Purchase inoculum from a reputable dealer to assure good

quality and check for the expiration date to assure that the inoculum will be viable at planting.

Always store inoculum (both dealer and grower) in a cool, dry place prior to application at planting. To insure a viable inoculum, apply within a few hours of planting, especially where inoculum is being placed over fungicide-treated seed. Apply the inoculum as directed by the manufacturer. With air planters, and in some other cases, a "sticker" compound may be necessary to hold the inoculum on the seed during planting. Granular and liquid inoculums are available for in-furrow application, however these products are normally more costly and have not shown improvements over seed-applied dry products, except at higher rates.

Occasionally, the nitrogen fixing activity of the bacteria in the nodules on the roots do not provide sufficient nitrogen to the soybean plant. When nitrogen deficiency symptoms (pale green to yellow leaves) appear before the pod-fill stage and persist for more than a few days, apply 45-60 pounds of nitrogen by sidedressing or aerially to correct the deficiency.

Apply phosphate and potash as recommended by a soil test. Applying large amounts of P_2O_5 and K_2O to the soil prior to growing a corn crop will result in the excess of these nutrients carrying over for the following year's soybean crop. This is especially true on medium and fine-textured soils where high levels of P_2O_5 and K_2O not only provide the potential for increasing corn yields, but also the carry over reduces the need for application of fertilizer on all acreage every year. Time, labor and fuel costs are also reduced. Fertilize sandy or low fertility soils often, since the above practice may not be practical.

Row fertilization in a band 2 inches to the side and 2 inches below the seed is suggested when planting on low fertility soils and/or when planting early into cool soils. Row fertilization is not recommended when soybeans are planted in narrow rows with a grain drill because of the potential salt or acid injury.

Manganese is the only micronutrient applied to soybean fields that has resulted in a yield increase in Michigan. Manganese is often deficient on soils with a pH above 6.8, and on muck soils. Manganese deficiency symptoms are similar to those on dry beans and are characterized by interveinal yellowing of leaf tissue with veins remaining dark green. This problem can be corrected by soil testing and fertilizing in the row with recommended applications of manganese or by using foliar fertilization at the proper time and rate. Additional details on manganese deficiency and corrective practices can be found in MSU Extension Bulletin E-1031 "Essential Micronutrients: Manganese" (Free) or E-486 "Secondary and Micronutrients for Vegetables and Field Crops". The latter bulletin may be consulted for information on the other possible nutrient deficiencies.

PLANTING PRACTICES

Planting Date

Early planting results in top yields. Figure 3 presents the yield performance of four varieties of different maturity planted at three planting dates in central Michigan. Medium and full season varieties benefited from early planting whereas the very short-season variety, Evans yielded less when planted early. Although medium and full-season varieties decrease in yield after early May planting, this decrease is not substantial until after mid-May in southern Michigan and late May in central Michigan. After these dates, yields decrease at about one-half bu./acre/day. Maturity date and harvest are also delayed by late planting. However, a 5-day delay in planting results in only a 2-day delay in maturity.

There is a general misconception in Michigan that soybeans are very susceptible to frost. Actually, soybean leaf tissue tolerates temperatures 2°F to 3°F lower than corn leaf tissue. For short periods, soybeans can withstand a temperature of about 27°F to 29°F whereas corn can only withstand a temperature of 29°F to 31°F. However, unlike corn, soybeans will not regenerate new plant tissue once frozen. Corn will regenerate new plant tissue after being frozen as long as the growing point below the soil surface does not freeze. Nevertheless, soybean tolerance to low temperature means that soybeans can be planted in early May, if soils are warm (50-55°F), without a large risk from frost. Planting in northern Michigan can often begin as early as the last of May or as early as the soil warms up and can be worked.

Do not plant short season varieties early (Figure 3) because yields will decrease.

When soil conditions or other problems dictate late planting, consider using narrow rows and increasing the population by 10%. Do not change to short season varieties unless planting is delayed past late June or an early harvest is necessary.

Row Width

Most soybeans in Michigan are planted in 28 or 30 inch rows or wider. About 10% of the soybean acres are planted in row widths of less than 20 inches. Research at MSU indicates that, on the long-term average, soybeans planted in row widths of 20 inches or less will yield about 5 bu./acre more than soybeans planted in rows 28 inches or wider. This

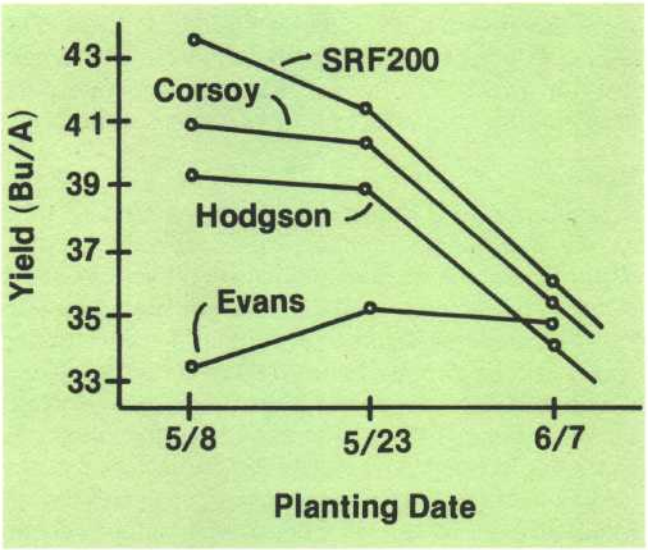

Figure 3. Effect of planting date and variety maturity on soybean yield, central Michigan, 1978. (Corsoy and SRF200 - Full season, Hodgson - mid-season, Evans - short season variety).

yield increase varies from 1 or 2 bushels in some years to as much as 20 bu./acre in other years. Other advantages of narrow row soybean production: slightly less lodging, higher podding height, suppression of late germinating weeds, decreased branching, easier harvesting and increased erosion control. Disadvantages of narrow rows include: no possibility for cultivation in the very narrow rows, required equipment changes and the need for greater inputs of fertilizers, seed and possibly herbicides.

All varieties respond in yield to narrow row widths, but some respond more than others. Growers should select the top yielding varieties as indicated from narrow row trials. If information is not available on varietal performance in narrow rows, select varieties that are top yielding in wide rows. In general, these varieties will be the top performing varieties in narrow rows.

Theoretically, the narrower the row width, the higher the yield. However, research at MSU has shown the largest increases in yield result when going from 28 inch rows or wider to 20 inch row widths or less. Lesser increases result when going from 20 inch rows to narrower row widths. Select a system of narrow row planting that fits individual conditions no matter what the row width less than 20 inches. Row widths of 15 to 20 inches allow tractors and cultivators to be adapted for cultivation. These row widths also permit the use of row unit planters which tend to produce, on the average, slightly better stands than when soybeans are planted with a grain drill. New grain drills adapted to planting soybeans, however, have generally produced acceptable stands.

When planting narrow row soybeans with a grain drill, prepare a firm seedbed to insure uniform planting depth. Remove wheel tracks by a harrow, cultipacker or other implement in front of the planter. Equip grain drills with depth bands or depth controls to regulate seeding depth to the recommended 1½ inches. Use press wheels or a cultipacker to achieve good seed-to-soil contact following planting. Press wheels are preferred because a cultipacker may increase weed seed germination between rows and may increase soil crusting, thereby limiting water infiltration.

Narrow rows are recommended for soybean growers who have weed problems under control and who have the equipment and the managerial ability to produce soybeans using this method. More information on narrow row soybean production is available in Extension Bulletin E-1433, "Seeding Soybeans in Narrow Rows" (Free).

The relationship of row width to planting date and varietal maturity is seen in the results (Table 2) of a 3-year planting systems study conducted in central and southeastern Michigan. This study was supported by a grant from the soybean grower check-off program. The top five ranked yields resulted from planting in early-mid May in 10-20 inch rows using medium-full season varieties. The best yield for a short season variety was not achieved until the 12th ranking and the top yield in wide rows (30 inches) was not realized until the 15th ranking. The lowest yields resulted from varieties planted late (early-mid June) in wide rows. The results of this planting system study suggest that growers using the common practices of growing full season varieties in wide rows and planting in late May (22nd ranked system, as an example) could improve yields by more than 10 bu./acre using the same variety planted 1 to 2 weeks earlier in narrow rows (1st ranked system).

Population

Because seed size of soybean varieties varies, current seeding rate recommendations are based on plants per acre or seeds per foot of row and not pounds per acre. Recommended plant populations and seeding rates for the various row widths are listed in Table 1. These recommendations are based on 85% germination seed and allow for good podding height, average lodging resistance and one rotary hoeing.

The rates can be adjusted for various planting practices or other conditions. For high germination seed and ideal planting conditions, use the lower rates. Use the lower rates if lodging is a problem. Seeding rates may need to be reduced on irrigated fields, particularly where lodging susceptible

TABLE 1. Recommended seeding rates.

Row width (inches)	Desired final stand (plants/ft.)	Seeds/ft. of row*	Approx. lbs./acre*
7-10	2-3	2.8-4.0	70-100
14-15	4	5.0-5.5	65-85
18-20	5	6.0-7.0	60-80
28-30	7	7.5-9.0	55-65

*Based on 85% germination seed.

TABLE 2. Soybean planting systems.*

Rank	Planting date**	Row width (inches)	Variety	Yield (bu/acre)
1	1	20	SRF 200	57.4
2	1	10	Corsoy	56.8
3	1	20	Corsoy	55.0
4	1	10	SRF 200	55.0
5	1	10	Hodgson (78)	54.9
6	2	10	Corsoy	53.0
7	1	20	Hodgson (78)	52.8
8	2	20	Corsoy	51.7
9	2	10	Hodgson (78)	51.7
10	2	20	Hodgson (78)	51.2
11	2	20	SRF 200	50.4
12	1	10	Evans	49.2
13	2	10	SRF 200	48.8
14	1	20	Evans	48.2
15	1	30	Corsoy	47.9
16	2	10	Evans	46.7
17	2	20	Evans	46.0
18	1	30	SRF 200	45.2
19	1	30	Hodgson (78)	44.8
20	2	30	Corsoy	44.3
21	3	10	Corsoy	44.0
22	2	30	SRF 200	43.7
23	3	10	Hodgson (78)	43.6
24	2	30	Hodgson (78)	42.6
25	3	20	Evans	42.5
26	3	10	Evans	42.3
27	3	20	Hodgson (78)	42.1
28	1	30	Evans	42.0
29	3	10	SRF 200	40.8
30	2	30	Evans	40.8
31	3	20	Corsoy	40.1
32	3	20	SRF 200	39.4
33	3	30	Hodgson (78)	35.5
34	3	30	Corsoy	35.4
35	3	30	Evans	34.9
36	3	30	SRF 200	34.8

*Average of 1978-80 in central and southeastern Michigan.

**1 = Early-mid May
2 = Late May
3 = Early-mid June

varieties have too much water applied to them. The higher rates are necessary where low quality seed is used or when planting (a) into poor seedbeds, (b) very early or very late, or (c) a short season variety.

Depth

Ideal planting depth for soybeans is 1½ to 2 inches. When seeding early into cool soils, seeding depth can be 1 inch deep if good seed-to-soil contact is made. Never plant soybeans deeper than 2 inches. Planting some varieties deeper than 2 inches under warm soil conditions causes a physiological effect which restricts germination and emergence. Until all varieties are tested for this characteristic, it is safer not to plant soybeans deep. When emergence is slow as a result of deep planting, poor stands can result and weeds can get a head start on the soybean plants. If a seedbed is dry, wait to plant into moisture at the recommended depth.

Weed Control

Weed control efforts should be based on the entire rotation that includes soybeans. Weeds must be identified to determine exactly how to control them. With other crops in the rotation, herbicides or cultivation may be used to greatly decrease the population of many weeds. Many herbicides, cultivation and other practices exist to reduce weed infestation, particularly with corn. However, certain chemicals, such as atrazine, can result in carryover injury to soybeans. Extension Bulletin E-1215 "A Quick Test for Atrazine Carryover" (Free) provides information on how to test for potential injury.

Base weed control for soybeans on cultural and chemical practices. Proper tillage can be used effectively to reduce weed populations. Seedbed preparation 1 week before planting followed by reworking the soil just prior to planting can be an effective cultural practice to kill the first flush of germinating weeds. In wide rows, cultivation can be used as the only weed control method, although, control may not be adequate. Herbicides are normally needed, particularly in narrow rows and no-till fields where cultivation is not practical.

Preplant incorporated, pre-emergence and post-emergence herbicides are available to control most annual broadleaf and grassy weeds in soybeans. Chemical weed control should start with a soil program and follow with a postemergence program, if necessary. Detailed information on recommended herbicides for Michigan growers is presented in Extension Bulletin E-434, "Weed Control Guide for Field Crops (Price 40 cents)". This bulletin also provides information on cultural control, determining the potential of herbicide carryover and other factors related to weed control.

Consider several factors when using cultivation to control weeds. Use cultivation only to break up a very hard crust or to kill weeds. Several types of cultivators are available. A rotary hoe used shortly after planting will control the first flush of very small germinating weed seedlings just as they are emerging from the soil and are in the "white stage." Use rotary hoes in the afternoon and when the soil and plants are not wet. Since each rotary hoeing results in about a 5% loss in soybean stand, plan and adjust seeding rates accordingly. Various other cultivators can be used after soybeans have developed several leaves. Cultivators with shovels should be set up to move through the soil with the bottom of the shovels on a plane level with the soil. It is important not to cultivate more than 2 inches deep, as this can injure soybean roots and cause ridges which may create problems at harvest.

Replanting

Periodically soil insects, crusting, herbicide injury or diseases cause a loss of stand. Because soybeans have the ability to branch they tend to compensate better than other crops when the number of plants is reduced. However, when stand loss does occur, a decision must be made on whether or not to replant.

If plants in sizable parts of a field are totally killed, you may want to replant just those areas. If plants have been injured throughout the field at random, then the average number of living plants remaining should be determined. Plants are living if the terminal bud or any axial buds remain green and send out new leaves within a couple of days after injury. Where 40% or more of the recommended stand remains (see Table 1), replanting is probably not economically justified. Replanting may be beneficial if less than 40% of the stand remains and it has been less than 3 weeks since the original planting date. But remember, there is no assurance that the second planting will not be injured or incur some other problem.

When replanting following herbicide injury, rework the soil with a secondary tillage tool. Do not apply another soil herbicide. Do not rework the soil if metribuzin (Sencor/Lexone) was used. Follow recommendations for late planting as outlined in the last paragraph of the section on "Planting Date."

Double Cropping

Double cropping in Michigan has met with varying degrees of success. The most successful systems have involved the early harvest of a first crop with subsequent early planting of the soybean crop. Double cropping is still a questionable practice in Michigan and is only recommended when growers are willing to accept greater risks for greater economic success.

The following suggestions may prove beneficial in reducing the risks associated with double cropping:

- For every week's delay in planting in late June and early July, expect a 5 bu./acre decrease in yield. Therefore, plant soybeans early by removing the first crop early. Consider following early maturing varieties of winter rye, barley or wheat harvested for forage or high moisture grain.
- Planting soybeans after July 7 is not recommended.
- If planting after the third week in June, use a short season variety.
- Increase plant population by 10% and plant in narrow rows.
- Use no-till if topsoil moisture is good. Plowing may be beneficial if only the top few inches are dry. If the entire topsoil profile is dry, abandon double cropping unless irrigation is available.
- When planting no-till soybeans after a crop harvested for grain, chop or remove the straw to improve weed control and planter operation.
- Use an herbicide to kill existing vegetation. Postemergence herbicides may provide better weed control than preemergence herbicides if irrigation is not available or rainfall is not imminent.

IRRIGATION

Only a few acres of soybeans in Michigan are irrigated. Studies at MSU suggest that irrigation will increase soybean yield when applied in small amounts. However, the yield increases have not been of the magnitude of those experienced by corn growers. Do not irrigate soybeans like corn, because varieties of the indeterminate type continue to grow vegetatively while flowering. Applying large amounts of water in the early growing stages tends to make soybeans grow very tall, lodge and not form pods until late. As a very general recommendation, irrigate soybeans with limited applications of water prior to full flower (about one half the rate used on corn). From full flower to pod set and pod fill, irrigate at levels similar to those applied to corn. Specific information on soybean irrigation can be obtained from Extension Bulletin E-1110, "Irrigation Scheduling for Field Crops and Vegetables" (Free) and in the chapter on "Soybean Irrigation" in the MSU *Irrigation Guide*.

HARVESTING

The key to harvesting is to minimize losses. Soybeans can be harvested at any moisture below 18%.

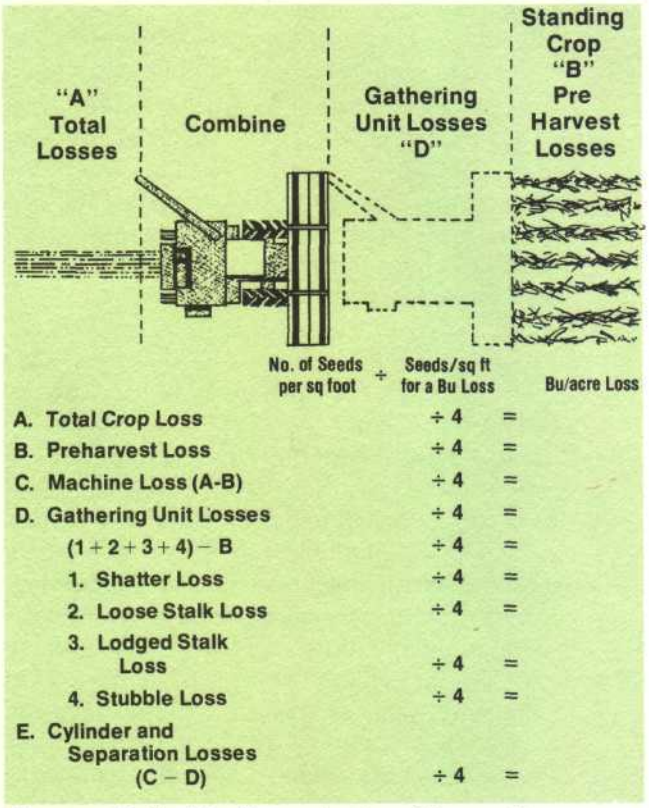

Figure 4. Method for determination of harvest loss.

Adapted from: Bashford, L. L. 1977. "Measuring Soybean Harvesting Losses." Neb Guide G77-375. Cooperative Extension Service, University of Nebraska, Lincoln, NE.

If artificial drying is not planned, harvesting at about 14% is ideal. Storing soybeans for more than a short period, requires a moisture of 13% or less. Check frequently for soybean harvest losses and seed damage during the harvest period. Leaving four beans per square foot on the soil surface or on the remaining plants equals the loss of one bushel of soybeans per acre. Even a few plants with a couple of pods remaining, due to high cutting height, can result in the loss of several bushels per acre. Poor combine adjustment at the gathering unit or in the machine itself can result in excessive losses or seed damage from those plants harvested.

Figure 4 illustrates a method of calculating harvest losses. To reduce losses due to the machine and the gathering unit, consult the owners manual and make adjustments accordingly during the harvest. Try to combine low enough to pick up all pods on the plant. New flexible or floating cutter bar heads on combines have helped growers combine closer to the soil. When harvesting soybeans planted in 10 inch rows or less, dividers on the ends of the head are necessary to separate plants, particularly if lodging has occurred.

Weeds often cause harvesting losses, particularly if harvesting before weeds are killed by frost. Paraquat can be used as a harvest aid where heavy weed infestations occur and where scheduling of early harvesting before frost is beneficial. Dry down rate of soybeans may also be improved with paraquat use. Consult the paraquat label for information on timing, rate, and application method.

PESTS

Insects and nematodes rarely produce economic losses in soybeans in Michigan. Insects that cause defoliation of plants are normally not a problem. If insects become a serious problem, see Extension Bulletin E-499 "Protecting Soybeans and Dry Beans from Insects and Nematodes" (Price 30 cents). This bulletin can also help you determine when nematodes are a problem.

DISEASES

Diseases are the most common and most serious pest problem of soybeans in Michigan. The most prevalent disease is Phytophthora root rot, of which races 1, 3, and 7 are predominant in Michigan. Many new commercial, USDA and university varieties are available now or are being developed that have resistance to this disease. Crop rotation and good drainage on heavy, low lying land helps reduce this disease. There are many leaf diseases of soybeans, but they cause little economic loss. Other diseases of soybean seed and plants are periodically a problem in Michigan. Greater detail on these diseases can be found in Extension Bulletins NCR-57 "Soybean Diseases" (Price 35 cents), leaflets E-1418 and E-1419 "Soybean Diseases I and II" (Free) and E-1511 "Phytophthora Root and Stem Rot of Soybeans." Descriptions and photographs of the various diseases and general methods of control can be found in these bulletins.

Crop rotation is recommended to help prevent soybean diseases from becoming a problem and to keep disease levels to a minimum. Using high quality, disease free seed, planting on well-drained soils, plowing under crop residue, preventing weed growth in and around fields, and not cultivating when plants are wet will also help to minimize the severity of the various diseases. Chemical control of diseases has not been found to be economically feasible for Michigan soybean growers.

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