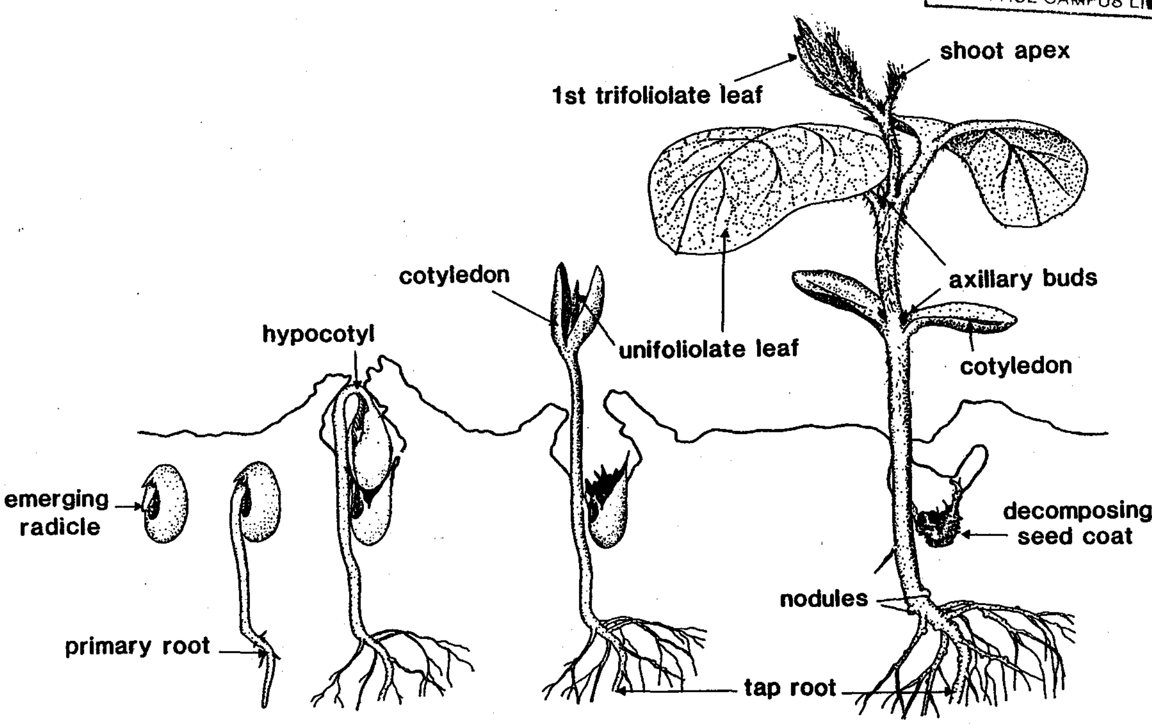
MINNESOTA EXTENSION SERVICE
UNIVERSITY OF MINNESOTA
AGRICULTURE

Soybean Growth and Development

&

Management Information for Replant Decisions



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SOYBEAN GROWTH AND DEVELOPMENT

An understanding of how a soybean plant develops can help you make important management decisions. This section discusses various seed and plant parts, explains how the soybean plant develops utilizing standardized vegetative and reproductive stage descriptions which are used by the National Crop Insurance Services (NCIS), and describes some of the important factors which affect growth and development of the soybean plant.

A soybean seed consists of a miniature plant attached to two nutrient storage reservoirs (cotyledons or seed halves) surrounded by a protective outer wrapper or seed coat called a testa (Figure 1). The cotyledons contain about 40% protein, 20% oil, and about 35% carbohydrate. These materials provide nutrients to the developing embryo during the germination process. The embryo axis (miniature plant) consists of an epicotyl-plumule (first leaves and the growing point for the new plant), a hypocotyl and the radicle or root.

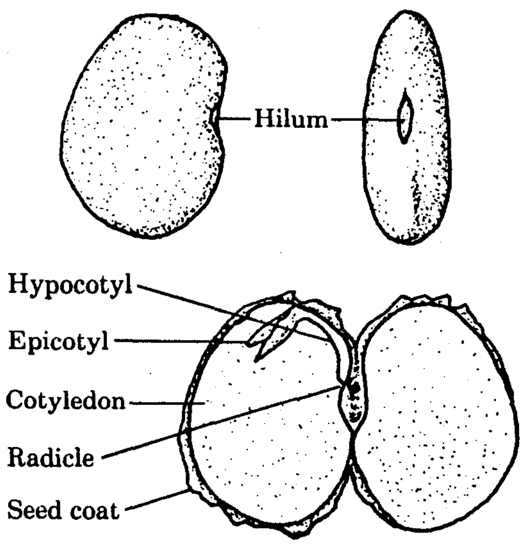


Figure 1. External and sectional view of a soybean seed.

When planted in moist soil the seed absorbs moisture and begins to germinate. When about 50% moisture content is achieved certain enzymes are activated to digest the stored food in the cotyledons which is then transported into other parts of the embryo. Figure 2 illustrates the early growth and development of a soybean plant. Growth begins with the emergence of the radicle from the seed coat within two to three days after planting. The radicle forms the primary root system of the seedling. This early root development firmly anchors the soybean plant in the soil. The hypocotyl also begins to elongate in a hook shape, raising the cotyledons and enclosed epicotyl above the soil surface. This process takes 5 to 15 days depending on moisture and temperature conditions. Once above the soil surface, the hypocotyl straightens. The epicotyl-plumule begins to grow and form the true stem and the true leaves of the plant. The cotyledons remain attached to the stem (at a point called the cotyledonary node) for a few days as their food reserves are utilized by the developing seedling. As stored food is removed the cotyledons turn yellow and shrivel before dropping off the plant. Loss of one or more of the cotyledons before the food reserves are fully utilized can slow early plant growth or result in death of the plant if photosynthetic leaf tissue is not formed quickly.

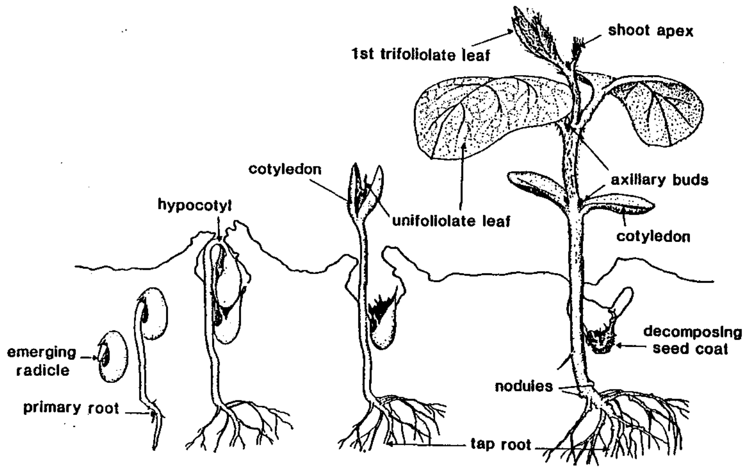


Figure 2. Early seedling development of soybean (adapted from original drawings by R. Kent Crookston).

The first true leaves are a pair of single leaflets (unifoliolate or primary leaves) attached opposite each other on the stem at the primary node just above the attachment of the cotyledons. Loss or damage to these leaves can result in reduced growth but is probably less damaging to continued plant development than early cotyledon loss.

All remaining leaves produced by the growing point of the new seedling are trifoliolate (three parts) and are attached to alternate sides of the stem at points called nodes. A new three-part leaf is produced every 3-10 days depending upon growing conditions. These leaves are the light capturing, food manufacturing organs of the plant.

Branches can develop from axillary buds, which are undeveloped growing points, located on both sides of the stem at the attachment points of the cotyledons (cotyledon node) and the primary leaves (primary node). These branches develop if the main growing point is damaged or destroyed, or if the soybeans are growing at low populations in the field. Each developing branch then elongates and produces leaves. Table 1 presents the standardized system developed by the National Crop Insurance Services (NCIS) for describing the early vegetative growth, as well as the average number of days between each growth stage.

Before the vegetative growth period has been completed, flowering or reproduction begins in soybeans grown in northern areas of the United States. The growth habit of soybean varieties grown in the north is indeterminate because the last vegetative growth is completed after the reproductive phase has begun. Flowering is triggered by changing daylengths and temperatures. Varieties are assigned maturity designations designated MG000 to MGX with each designation indicating adaption to north-south zones about 100 miles wide. When a variety is planted south of its zone of adaptation it flowers and matures earlier because the shorter day

Table 1. Vegetative growth staging terminology. (Adapted from Soybean Loss Instructions, National Crop Insurance Services (NCIS) #6302 Soybean/91).

Stage Abbrev.	Stage Title	Description
VE	Emergence	Plants emerge from the soil
VC	Cotyledon	Hypocotyl straightens and cotyledons unfold
V1	First Node	Fully developed leaves at unifoliolate node
V2	Second Node	Fully developed trifoliolate at second node above the cotyledonary node
V3	Third Node	Fully developed trifoliolate at third node above cotyledonary node
V6	Sixth Node	Fully developed trifoliolate at sixth node above cotyledonary node

Stage Abbreviation	Average Number of Days
Emergence of seedling from soil to V1	10
V1-V2 (First Node to Second Node)	5
V2-V3 (Second Node to Third Node)	5
V3-V4 (Third Node to Fourth Node)	5
V4-V5	5
V5-V6	3
Time interval between all V stages after V5	3

lengths induce flowering. When a variety is planted north of its zone of adaptation, flowering and maturity will be delayed because the proper daylength occurs at a later calendar date.

Flowers are produced in clusters at each node and generally progress from the bottom to the top of the plant. Soybean flowers are self-pollinated, so pods can begin to develop from some of the flowers shortly after they are produced. The number of pods per plant has a major effect on harvestable yield. As many as 75% of the flowers and/or developing pods can be shed from the plant. Water stress, leaf loss and high temperatures affect this shedding. Pods enlarge for a period of time before actual seed filling begins, and there are generally 2-3 seeds in each pod. Stress induced shedding during podding can be partially compensated for by late developing flowers. Table 2 provides a standardized description developed by National Crop Insurance Services for the various reproductive stages of the soybean plant as well as the average number of days for each stage.

A calendar indicating the "typical" progress of soybean development in Minnesota from planting to harvest is shown in Figure 3. The data for this calendar were provided by the Minnesota Agricultural Statistics Service (MASS) and shows the calendar dates at which various percentages of the soybean crop arrive at various growth and/or maturity stages.

Table 2. Reproductive stage terminology. (Adapted from Soybean Loss Instructions, National Crop Insurance Services (NCIS) #6302 Soybean/91).

Stage Abbrev.	Stage Title	Description
R1-R2	Beginning bloom to full bloom	Flower at one of the four uppermost nodes
R3	Beginning pod	Pods just visible at one of the four uppermost nodes
R4	Full pod	Pod 3/4 inch long at one of the four uppermost nodes
R5	Beginning seed	Seed beginning to develop at one of the four uppermost nodes (Seed measures at least 1/8 inch in length)
R6	Full seed	Pod containing green seeds that fill the pod cavity at one of the four uppermost nodes
R7	Beginning maturity	One normal pod on the main stem that has reached its mature pod color. 50% or more of leaves are yellow
R8	Full maturity	95% of pods are their mature color

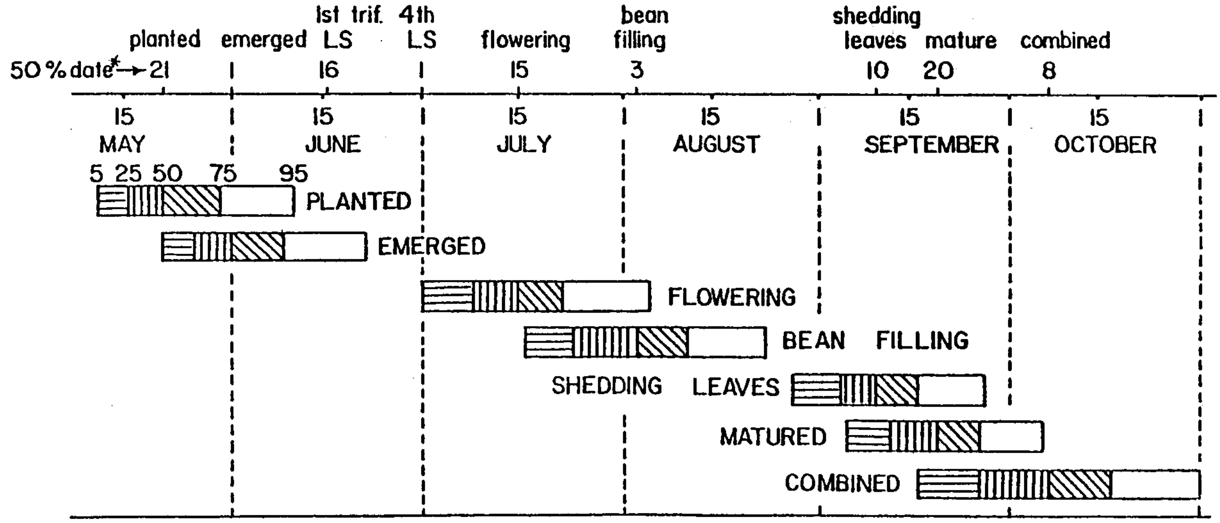
Stage Abbrev.	Stage Title	Average Number of Days
R1-R2 to R3	Begin bloom to begin pod	10
R3 to R4	Begin pod to full pod	9
R4 to R5	Full pod to begin seed	9
R5 to R6	Begin seed to full seed	15
R6 to R7	Full seed to being maturity	18
R7 to R8	Begin maturity to full maturity	9

MANAGEMENT INFORMATION FOR REPLANT DECISIONS

Don't make a hasty decision to replant soybeans when the plant population is not as good as you expected. When hail or wind has damaged soybeans early in the season, replanting is possible, but certain information needed to make a good decision must be obtained. Stage of plant growth, calendar date, extent of plant damage, remaining plant population, weed control effectiveness, seed availability as well as labor and cost of replanting need to be considered in making the decision.

This section will assist you in determining the extent of damage to the plants in your field and help you compare yield losses due to low plant populations with losses due to replanting at a late date. This section will also offer recommendations for varieties or alternate crops to use in replanting if it is deemed necessary and discusses how weed management decisions can affect your replant decision.

Figure 3. Minnesota soybean development calendar (adapted from Soybean Plant Development in Minnesota, Crop News #47 D.R. Hicks).



*Calendar date when 50% of soybean acreage has reached various developmental stages.

Bars for each stage show the dates when various percentage of acreage has arrived at that stage.

Determining the Yield Potential of Remaining Plants

Research in Minnesota has shown that the plant population can vary widely with little effect on yield. Soybean plants can produce good yields at low populations by setting more pods per plant and filling more of the seeds in each pod. Branch number also increases at low populations to provide more pod sites. At plant populations below 50,000 plants per acre, yield from the branches is significant. Some of these branches can break off the main stem prior to harvest and increase harvest loss, so extra care is necessary during combining.

Plants may not be uniformly distributed in lower plant populations. Uneven spacings or gaps between plants can result in lower yield (the amount depends on the size and number of gaps). A low population of uniformly spaced plants can yield equal to an evenly spaced normal stand, but yields can be lower if large gaps are present.

Stand reduction measurements are used to determine potential yield loss and assist in a replant decision. Extensive research in various areas of the United States has shown that yields are not affected by population reductions until they drop well below 125,000 plants per acre. Table 3 shows that stand reductions and gaps created at various times during the growing season have little effect on final soybean yield.

The first step in determining the number of remaining live plants is to carefully examine plants from various parts of the field. Determine the stage of growth now and at the time the damage occurred (use the previous material on growth and development to assist you in this task). Then carefully examine several plants to determine their potential to recover from the damage.

Plants which are cut off below the cotyledons, as shown in Figure 4, will never recover because there are no axillary buds to provide regrowth. In your plant population evaluation these should be considered as dead.

Table 3. Effect of various plant populations and gaps established at three calendar dates on final soybean yield.

	Time of Stand Establishment or Reduction		
Plant Population	At Planting	June 15	July 5
(X 1000)	Yield (bushels/acre)		
150	50.0	49.6	50.6
125	49.6	50.2	50.9
100	50.6	53.0	48.8
75	49.7	50.3	46.8
75 (1 ft gaps)	47.5	48.4	45.4
75 (2 ft gaps)	43.9	46.7	43.5
50	47.8	43.4	39.7

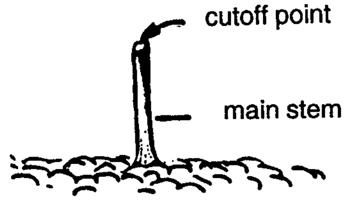


Figure 4. Soybean stem cut off below cotyledons.

While some of the plants damaged as shown in Figure 5 eventually die, most can regrow from one or both of the axillary buds located at the cotyledon attachment point to the main stem. The rate and intensity of regrowth is influenced by the amount of remaining cotyledon tissue which supplies energy for this process. Three situations are shown. In order of probability of regrowth A > B > C because of the relative amounts of cotyledon tissues present to supply the energy required for regrowth.

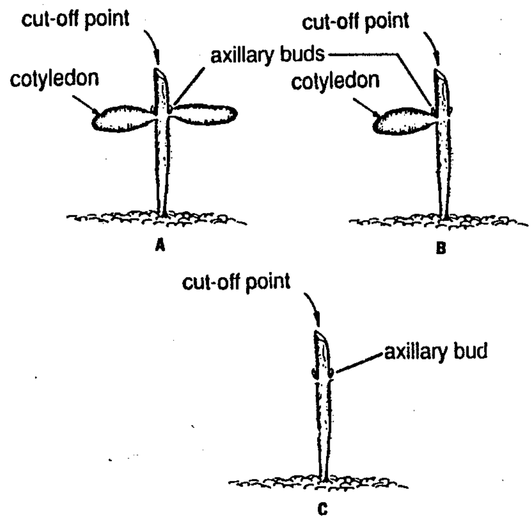


Figure 5. Soybean stems cut off immediately above the cotyledons, with various amounts of cotyledon tissue remaining.

Plants cut off above the unifoliolate leaf node can recover by growth from any of the four axillary buds present on the main stem. Functional green leaf tissue and cotyledons are important in generating energy to drive regrowth. Even though the leaves are shredded and torn they can still supply energy to the developing growing points. Axillary buds usually develop rapidly after the main stem is cut off. Usually one new stem becomes dominant and can be mistaken later for an original stem unless you examine the base of the plant carefully. This initial regrowth can be visible within 3 or 4 days if conditions are favorable. Figure 6b shows a typical regrowth pattern 10 to 14 days after cutoff damage similar to that shown in Figure 6a.

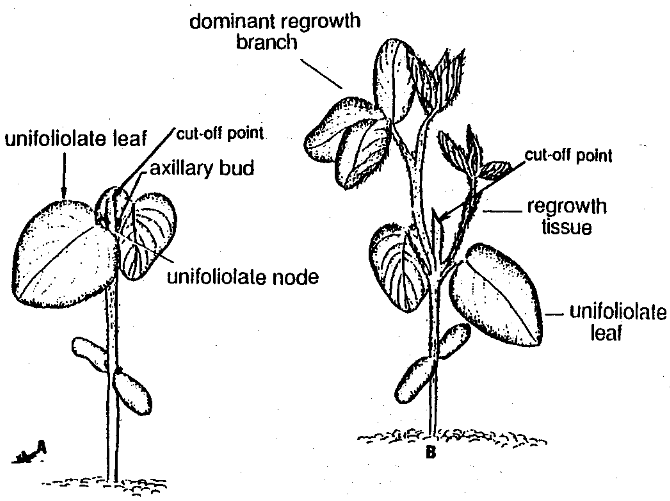


Figure 6. Soybean plant with a main stem cut off immediately above the unifoliolate node and a typical regrowth pattern.

Regrowth of damaged plants is sometimes very slow and often is slower than replanted soybeans, especially if large amounts of leaf tissue have been removed and hot, dry conditions prevail. This can result in a slight delay in maturity of a hail damaged field because of the time spent in the recovery period.

In some previous publications, leaf loss and amount of damaged leaf tissue was a part of the yield loss determination process, but extensive research has indicated that leaf damage during the early vegetative (V) stages has an insignificant effect on final yield because of the soybean plant's ability to compensate for early season damage.

Using all this information, carefully reexamine plants in several areas of the field and count the number of live plants per foot of row (make several of these counts in various areas of the field) then use Table 4 to determine the plant populations per acre for your row width. Then determine the expected yield for this population using Table 3.

Table 4. Relationship between plants/ft of row and plants/acre for various row spacings.

Plant pop./acre	Row Width 36-40"	30"	20"	10"	Drill
(X 1000)			**Plants/foot of row**		
150	10.9	8.6	5.7	2.8	2.0
125	9.1	7.2	4.8	2.4	1.7
100	7.3	5.7	3.8	1.9	1.3
75	5.4	4.3	2.9	1.4	1.0

Determining Yield Loss Due to Replanting

Now we will determine the yield if you were to replant today and compare it to the expected yield of the remaining population. Normal dates of planting for soybean in Minnesota are typically after corn. In recent years, increased yields due to early planting have advanced the recommended planting date for both crops. Data from the Minnesota Agricultural Statistics Service indicate that about 5% of the soybeans are now planted by May 10th increasing to about 95% planted by June 15th. Nearly half of Minnesota soybean acreage is planted on or before May 20th of each year (Figure 3).

Early planting dates allow use of full season varieties which are usually higher yielding than earlier maturing types. Yield performance and other characteristics of the major public varieties for various planting dates in Minnesota are reported in the current edition of Varietal Trials of Selected Farm Crops (Item number AD-MR-5615-E) published by the Agricultural Experiment Station of the University of Minnesota.

Table 5 shows the approximate percentage yield loss resulting from various planting dates. Note that dates earlier than May 20 produce the best yields, while later planting dates result in large yield decreases. Full season varieties planted before June 10 will mature in southern Minnesota before the fall frost date in early October, but will, of course, have lower yields.

Use Table 5 to determine the yield reduction for replanted soybeans and compare it to the yield potential of the remaining population.

Table 5. Percent yield loss for various planting dates.

Planting Date	Percent Yield Loss
April 28	0
May 12	-1.5%
May 26	-12.7%
June 9	-23.7%
June 23	-43.2%

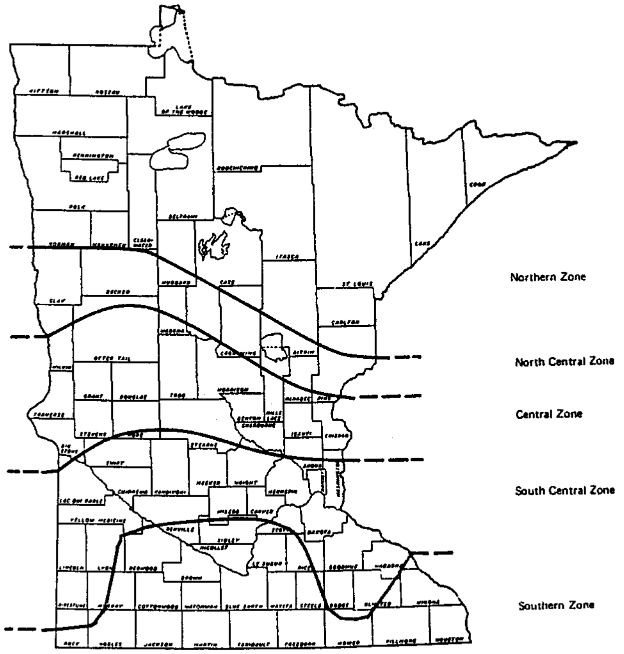


Figure 7. Crop maturity zones in Minnesota (based on climatological data) (adapted from Minnesota Relative Maturity Ratings of Corn Hybrids, Agronomy Fact Sheet #27, R.H. Peterson and D.R. Hicks).

Variety and Alternate Crop Choices for Replanting

Table 6 shows the recommended public varieties for various maturity areas and planting dates in Minnesota. The map of Minnesota shown as Figure 7 shows these maturity zone boundaries. Following these recommendations should ensure a harvestable grain of good yield and quality. Note that as planting is delayed, earlier varieties are recommended. This table can help you in selecting varieties for late planting following an early crop of peas or for replanting following a natural hazard such as hail or flood damage or replanting after poor emergence due to drought or poor quality seed. Some of these events may happen so late into the growing season that replanting soybeans may not be economical so you might have to switch to another crop. See Figure 8 for information on planting date guidelines for some of these alternate crops.

Weed Management Decisions

Even if enough healthy plants (with good distribution in the row) remain after a hail storm to warrant leaving the stand, the weed status of the field is an important consideration in determining whether or not to replant. Soybeans will grow slowly for a period of time after damage occurs, depending on the amount of leaf loss and the weather. The rate at which soybeans recover will influence their competitive ability with weeds and their sensitivity to various weed control practices.

In relatively weed-free fields, soybeans so that are not too severely injured will probably recover and grow fast enough that combinations of cultivation and application of postemergence herbicides will be effective. Effective cultivation requires weeds to be small (1-3 inches) and the crop tall to prevent it from being buried by soil. It is not necessary to cultivate deeper than 1 to 2 inches for most weeds. A shallow cultivation will effectively control annual weeds with little additional crop stress or soil moisture loss.

Early in the growing season, if a field to be replanted is very weedy, a soil-applied herbicide may be needed prior to the second planting. To reduce the chance of crop injury to the replanted crop, select an herbicide that is suited to the soil and weed situation (see the current edition of Cultural and Chemical Weed Control in Field Crops, Minnesota Extension Service, AG-BU-3157), but which is not in the same chemical family as the first herbicide (Table 7). For example, if the first crop of soybeans was treated with trifluralin (Treflan), replanted soybeans should not be treated with Treflan or chemicals similar to Treflan, such as

Table 6. Public soybean variety recommendations for various planting dates and crop maturity zones in Minnesota.

Planting Date	North	North Central	Central	South Central	South
	------------	------------	Variety	------------	------------
May 15	McCall	Ozzie	Glenwood	Hodgson 78	Hardin, Corsoy 79
June 1	McCall	Ozzie	Glenwood	Hodgson 78	Hardin, Corsoy 79
June 15	---	McCall	Ozzie	Glenwood	Hardin
July 1	---	---	McCall	Ozzie	Glenwood
July 15	---	----	---	---	McCall

ethalfluralin (Sonalan) or pendimethalin (Prowl). Use the Cultural and Chemical Weed Control in Field Crops bulletin (AG-BU-3157) to choose an herbicide from another chemical family that will control the weed species in the field. Care must also be taken to choose a herbicide that, when applied this late in the growing season, will not present a carryover to next year's crop. See the individual herbicide labels for crop rotation restrictions. If you do retreat the crop with the herbicide that was previously used, remember to check the label for the maximum registered amount of herbicide that can be **legally** applied and act accordingly.

In fields that require replanting but still have good weed control or in fields planted after mid-June, another application of a soil-applied herbicide is probably not necessary. The more persistent soil-applied herbicides used on the first planting should remain in sufficient quantity to give some weed control in the replanted crop because most weed seeds near the soil surface should have already germinated. In weed-free fields the crop should be planted without any soil tillage or tilled no more than 1.5 to 2 inches deep to avoid bringing weed seeds and untreated soil to the surface. Soil and air temperatures should be favorable for fast germination, emergence, and growth of the crop, giving the crop a competitive advantage over weeds. Germinating weeds can be controlled by rotary hoeing, cultivation, postemergence herbicides, or combinations of these practices. Rotary hoeing is effective on newly germinated weeds before they emerge from the soil (weeds in the white stage). After weeds emerge, the effectiveness of the rotary

Table 7. Soil-applied herbicides by chemical families[1].

Chemical Family	Herbicides
Acetanilides	Alachlor (Lasso) Metolachlor (Dual) Propachlor (Ramrod)
Benzoic Acids	Dicamba (Banvel)
Dinitroanalines	Ethalfluralin (Sonalan) Pendimethalin (Prowl) Trifluralin (Treflan)
Imidazolinones	Imazethapyr (Pursuit)
Isoxazolidinones	Clomazone (Command)
Sulfonylureas	Chlorimuron-ethyl (Classic)
Thiocarbamates	Butylate (Sutan+) EPTC (Eradicane, Eradicane Extra)
Triazines	Atrazine Cyanazine (Bladex) Metribuzin (Sencor, Lexone) Simazine (Princep)
Ureas	Linuron (Lorox)

[1]This table does not include package mixtures. Package mixtures contain two of the herbicides listed above and are often referred to by trade names that differ from those listed in the table. See the current edition of AG-BU-3157, Cultural and Chemical Weed Control in Field Crops for a list of package mixture contents.

Table 8. Maximum weed sizes controlled by label rates of postemergence soybean herbicides.[a]

Herbicide[b]	Product Rate	Pigweed	Lambs-quarters	Velvetleaf	Cocklebur	Eastern black nightshade	Foxtail
	-----	-----	leaf stage[c]/weed height (inches)	-----	-----	-----	-----
Acifluorfen 2S (Blazer)	2 pt/A	6 / 3	3 / <1	4 / 3-4	4 / 4	4 / 2	NL[d]
Bentazon 4S (Basagran)	2 pt/A	NL	4-8 / 2	4-6 / 5	6-10 / 10	NL	NL
Chlorimuron-ethyl 25 DF (Classic)	0.75 oz/A	6 / 4	NL	8 / 6	10 / 12	NL	NL
Fenoxaprop 1EC (Option/Whip)	1.2 pt/A	NL	NL	NL	NL	NL	-[e] / 3-6
Fluazifop 1EC (Fusilade 2000)	1.5 pt/A	NL	NL	NL	NL	NL	4 / 2-6
Fomesafen 2LC (Reflex)	1 pt/A	4 / -	NL	NL	NL	4 / -	NL
Imazaquin 70DG (Scepter)	1.4 oz/A	- / 4	NL	NL	- / 8	NL	NL
Imazethapyr 2AS (Pursuit)	0.25 pt/A	8 / 8	2 / 1-2	4 / 3	8 / 8	4 / 3	3 / 3
Lactofen 2EC (Cobra)	12.5 oz/A	6 / -	NL	4 / -	6 / -	6 / -	NL
Quizalofop 0.8EC (Assure II)	7.0 oz/A	NL	NL	NL	NL	NL	- / 2-8[f]
Sethoxydim 1.5EC (Poast)	1 pt/A	NL	NL	NL	NL	NL	- / ≤8
Sethoxydim 1.0 EC (Poast Plus)	1.5 pt/A	NL	NL	NL	NL	NL	- / ≤8
Thifensulfuron 25DF (Pinnacle)	0.25 oz/A	- / 12	- / 4	- / 6	NL	NL	NL

[a] Maximum weed sizes were taken from the label, where possible. The labeled maximum weed sizes would reflect control under ideal conditions. Hail stress may decrease the weed size at which satisfactory control is achieved.
[b] Please see the label for the proper addititive to use with each herbicide.
[c] When dealing with the leaf stage of hail damaged weeds, be sure to count leaf scars to determine the weeds' real size.
[d] NL = Not labeled.
[e] Leaf stage or weed height not given on label.
[f] Giant foxtail is 2 to 8 inches, Green and Yellow foxtail is 2 to 4 inches

hoe rapidly diminishes. Soybeans up to the second trifoliolate (V2) leaf stage can be rotary hoed. Do not rotary hoe soybeans when the hook-shaped hypocotyl has just emerged from the soil (the "crook stage"). Also, be aware that rotary hoeing may compound injury to hail-stressed soybeans.

Postemergence herbicide applications can control many annual weeds in soybeans, provided the weeds are small (Table 8). **Postemergence herbicides should not be applied until the soybeans have recovered from the hail damage and resumed growth.** This is particularly true of the postemergence broadleaf herbicides. Most postemergence broadleaf herbicide labels require a delay in application until the stress period passes, generally when the crop and weeds resume growth. Postemergence grass herbicides for soybeans are not as restrictive and can be applied to hail-stressed beans; however, the stress may reduce herbicide effectiveness on both the broadleaf and grass weeds.

Once soybean plants have resumed active growth, many weeds may be too big to control with herbicides. Therefore, if soybean fields are severely hail-stressed and weedy and the grass and broadleaf weeds exceed the weed sizes listed in Table 8, a difficult decision needs to be made. If the weed population is large and it isn't too late to replant, then replanting is advisable even though the crop plants would probably recover. If it is too late to replant a crop then cultivation is the only option.

The use of postemergence herbicides to control later weed flushes poses several unique problems. A grower should be aware of applicable forage, feed, and grazing restrictions imposed by the Environmental Protection Agency (EPA) (Table 9). These restrictions are included on the herbicide label and are imposed by the EPA to prevent unacceptable levels of herbicides from entering grain and livestock food sources. A large number of soybean herbicides have grazing and forage restrictions on their labels

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Table 9. Forage, feed and grazing restrictions for soybean herbicides.[1]

Herbicide	Restrictions
Acifluorfen (Blazer)	Do NOT use for feed or forage. Do NOT apply within 50 days of harvest.
Alachlor (Lasso 4EC)	Do NOT feed or forage for hay, alachlor treated soybeans.
Alachlor (Lasso MT)	Do NOT feed or forage for hay, alachlor treated soybeans.
Bentazon (Basagran)	No restrictions.
Chlorimuron (Classic)	Do NOT graze or harvest for forage or hay. Do NOT apply within 60 days of harvest.
Clomozone (Command)	Do NOT graze or harvest for forage or hay.
Ethalfluralin (Sonalan)	Do NOT graze, feed for forage, or cut for hay or silage.
Fenoxaprop (Option)	Do NOT graze or feed forage, hay, or straw. Do NOT apply within 90 days of harvest.
Fenoxaprop (Whip)	Do NOT graze or feed forage, hay, or straw. Do NOT apply within 90 days of harvest.
Fluazifop (Fusilade 2000)	Do NOT use for feed or forage. Do NOT apply after soybeans bloom.
Fomesafen (Reflex)	Do NOT graze or harvest for forage or hay. Do NOT graze rotated small grain crops or harvest for forage or straw. Do NOT apply beyond 3 weeks after soybean emergence.
Glyphosate (Roundup)	Do NOT harvest or feed forage for 8 weeks after application. Allow 14 days following spot treatment before grazing livestock.
Imazaquin (Scepter)	Do NOT graze or feed forage, hay, or straw. Do NOT apply within 90 days of harvest.
Imazethapyr (Pursuit)	Do NOT graze or feed forage, hay, or straw. Do NOT apply within 85 days of harvest.
Lactofen (Cobra)	Do NOT graze on forage or stubble. Do NOT use hay or straw for feed or bedding. Do NOT apply within 90 days of harvest.
Linuron (Lorox)	Do NOT use for feed or forage.
Metolachlor (Dual)	No restrictions.
Metribuzin (Lexone)	May be grazed or fed to livestock 40 days after application unless specified on companion product (eg., Lorox, or Sonalan mixtures).
Metribuzin (Sencor)	May be grazed or fed to livestock 40 days after application unless specified on companion product (eg., Lorox, or Sonalan mixtures).
Naptalam + 2,4-DB (Rescue)	Do NOT graze or feed forage to livestock. Do NOT apply within 60 days of harvest.
Pendimethalin (Prowl)	No restrictions.
Quizalofop (Assure II)	Do NOT graze or harvest for forage or hay. Do NOT apply within 80 days of harvest.
Sethoxydim (Poast, Poast Plus)	Do NOT graze or feed forage or ensile. Hay can be fed to livestock. Do NOT apply within 90 days of harvest.
Thifensulfuron (Pinnacle)	Do NOT graze or feed forage, hay or straw. Do NOT apply within 60 days of harvest.
Trifluralin (Treflan)	No restrictions.

(Continued in next column)

[1]Restrictions for package mixtures are generally taken from the most restrictive product in the mixture. See the label for more details. See the current edition of AG-BU-3157, Cultural and Chemical Weed Control in Field Crops for a list of package mixture contents.

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(Table 9). This does not necessarily mean that herbicide residues exist at unacceptable levels in soybean plants. Often, there is a restriction because soybeans are not usually used for grazing or forage. It is more cost-effective for a herbicide manufacturer to restrict grazing and forage rather than conduct expensive research to document herbicide residue levels in the crop residue. It is important to note, however, that postemergence soybean herbicides do have minimum time intervals between time of herbicide application and soybean harvest to prevent herbicide residues from entering the soybean seed. Table 9 lists these minimum time intervals as well as forage, feed, and grazing restrictions for soybean herbicides. **It is very important that the applicator stay within label restrictions.**

Because of the reduced competitiveness of hail-damaged soybeans, weeds that are normally shaded out are able to grow and become a major problem. Eastern black nightshade is an excellent example of this situation. Eastern black nightshade is not a very competitive plant in a normal soybean stand because its growth and development is reduced by the soybean canopy. Watch for the development of this weed in hail-damaged fields. Timely applications of Blazer, Cobra, Pursuit, Reflex, (Table 8) or a cultivation will reduce this problem in soybeans.

In some situations, it may be too late to replant soybeans, necessitating a change to another crop (see Figure 8). The herbicide used on soybeans may limit the choice of crops that can be replanted. Most preplant incorporated or preemergence herbicides will persist in the soil at least 4 to 12 weeks and could injure a newly planted crop. In addition, labelled crop rotation restrictions may also limit crops that can be planted. Any crop for which the chemical is labeled may be planted. Label information regarding replanting should be followed carefully because some labels suggest tilling the soil before replanting, others do not. See the individual herbicide label for specific details. Alternative crops which can be planted when various herbicides were used on the first crop are given in Table 10.

Note: Herbicide names, and application and use restrictions were based on information available for use in 1991. **Always refer to current herbicide labels for the latest information.** This publication is for your information. The University of Minnesota or its officers or employees make no claims or representations that the chemicals discussed will or will not result in residues on agricultural commodities and assume no responsibility for results from using herbicides.

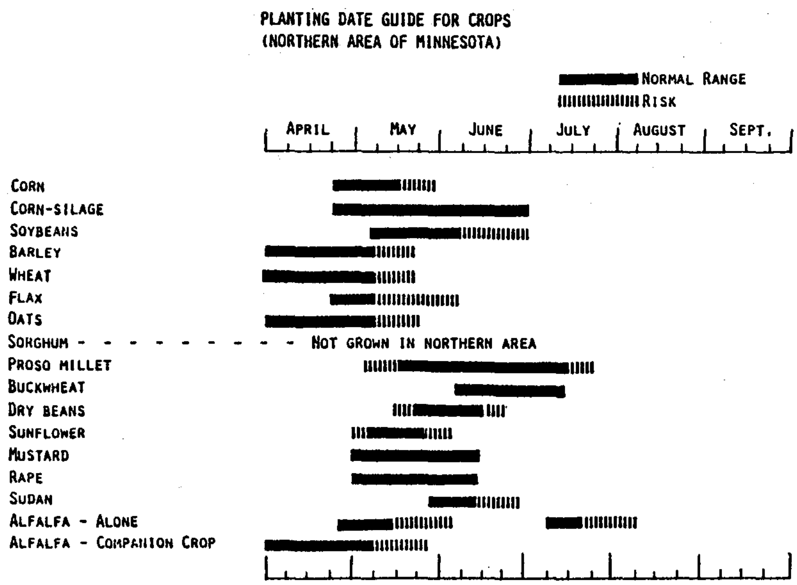
Table 10. Alternative crops for second planting when the first planting was treated with various soybean herbicides.

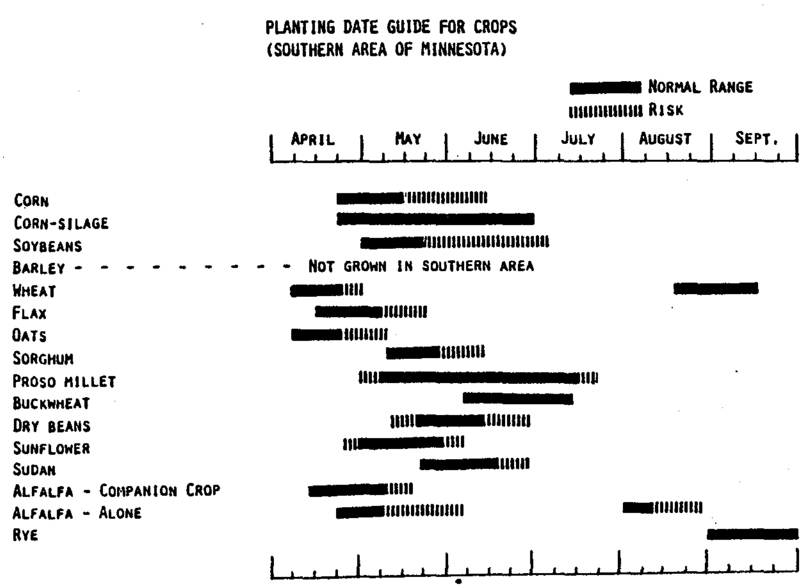
First Chemical Used	Crops That Can Be Planted[1]
Acifluorfen (Blazer)	Soybeans
Alachlor (Lasso)	Corn, soybeans, dry beans, grain sorghum (use seed protectant), sunflowers
Bentazon (Basagran)	No restrictions
Chlorimuron-ethyl (Classic)	Soybeans
Clomazone (Command)	Soybeans
Ethalfluralin (Sonalan)	Soybeans, dry beans, sunflowers
Fenoxaprop (Option/Whip)	Soybeans; all other crops, except small grains, in 30 days
Fluazifop (Fusilade 2000)	Soybeans; all other crops in 60 days
Fomesafen (Reflex)	Soybeans
Imazaquin (Scepter)	Soybeans
Imazethapyr (Pursuit)	Soybeans
Lactofen (Cobra)	Soybeans, pumpkins
Linuron (Lorox)	Corn, soybeans, grain sorghum
Metolachlor (Dual)	Corn, soybeans, dry beans, grain sorghum (use seed protectant)
Metribuzin (Lexone, Sencor)	Soybeans
Pendimethalin (Prowl)	Soybeans, dry beans, alfalfa, sunflowers
Quizalofop (Assure II)	Soybeans
Sethoxydim (Poast)	Do not apply prior to corn, milo, millet, or sorghum
Sethoxydim (Poast Plus)	Do not apply prior to corn, milo, millet, or sorghum
Thifensulfuron (Pinnacle)	Soybeans; all other crops in 45 days
Trifluralin (Treflan)	Soybeans, dry beans, flax, sunflowers, alfalfa

[1]Restrictions for package mixtures are generally taken from the most restrictive product in the mixture. See the label for more details. See the current edition of AG-BU-3157, Cultural and Chemical Weed Control in Field Crops for a list of package mixture contents.

[2]See appropriate label for any additional restrictions or precautions.

FIGURE 8. NORMAL AND RISK RANGES OF PLANTING DATES FOR VARIOUS CROPS IN NORTHERN AND SOUTHERN AREAS OF MINNESOTA.





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