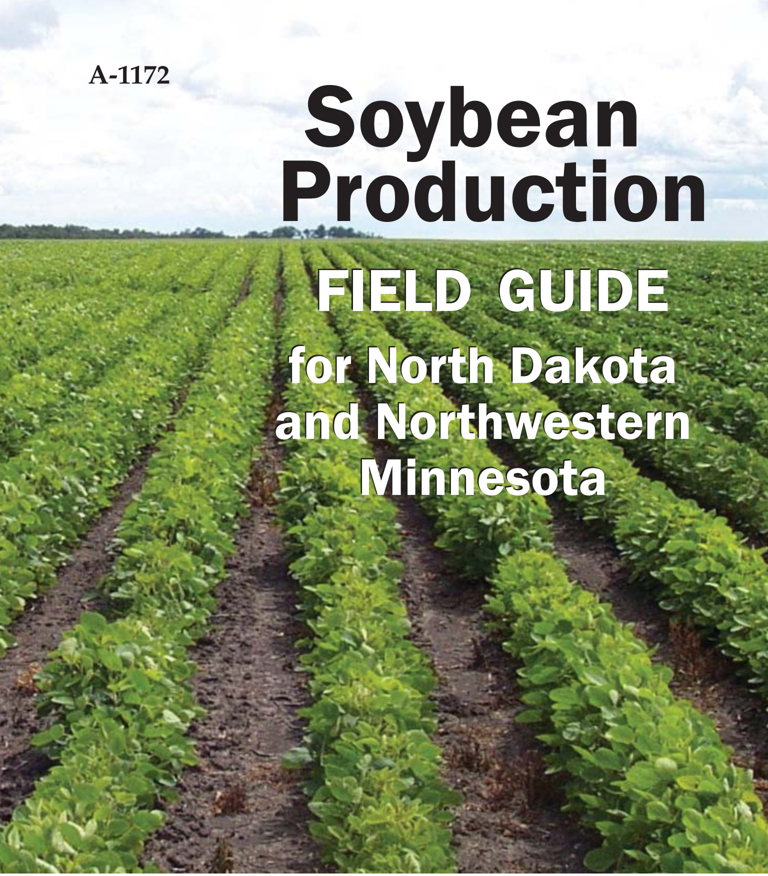
A-1172

Soybean Production

FIELD GUIDE for North Dakota and Northwestern Minnesota



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5M-7-10; 2.5M-8-10; 1.4M-1-13

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Introduction

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Changing weather conditions with varied rainfall amounts and stored soil water require soybean [*Glycine max* (L.) Merr.] growers to make careful decisions regarding tillage system, fertility management, variety selection, seedbed preparation, weed control strategies, crop rotations, water management and pest management practices.

This field guide has been developed to help you make timely management decisions. However, detailed and extensive information on any one area is not provided because of limited space. Complete discussions of soil fertility; weed, disease and insect control; variety performance; harvesting; and storage are available in other Extension publications listed in the back pages.

The pesticide use suggestions in this guide are based on federal label clearances and some state labels in North Dakota. Also, suggestions are based on research information collected in North Dakota State University experiments or trials in other states. All pesticides listed had a federal or state label at the time of publication of this guide. Check all pesticide labels at time of use for the most current label registration.

Modern technology, fluctuating export markets, changing USDA farm policies and environmental regulations all contribute to soybean growers' needs for careful planning and management to assure high yields and profitable production.

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Soybean Growth and Development

The soybean is a dicotyledonous plant that has epigeal emergence, meaning that during germination, the cotyledons are pulled through the soil surface by an elongating hypocotyl. The soil-penetrating structure is the hypocotyl arch. Once emerged (VE stage), the green cotyledons (seed halves) open and supply the new seedling with stored energy while capturing a small amount of light energy. The growing point is between the two cotyledons, and because it is above the ground, it could be killed by a spring frost or physical damage. This is in contrast with corn, in which the growing point is below the surface during the early development stages. The first true vegetative leaves formed are the unifoliolate leaves. These two single leaves form directly opposite one another above the cotyledonary node (VC stage). All other leaves are trifoliolates and consist of three leaflets (V1-n stages).

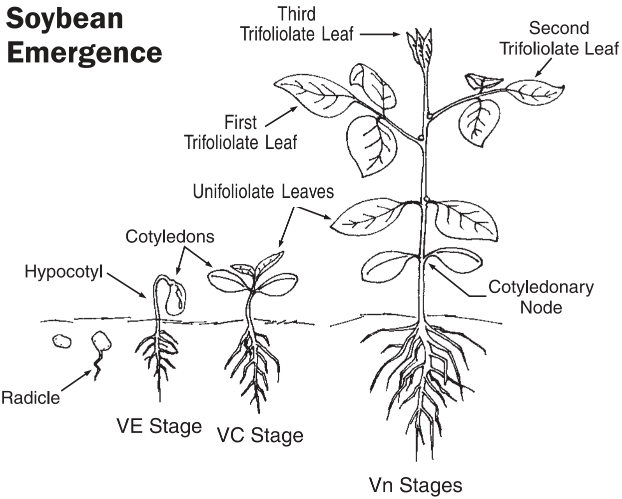

Figure 1. Soybean Emergence.

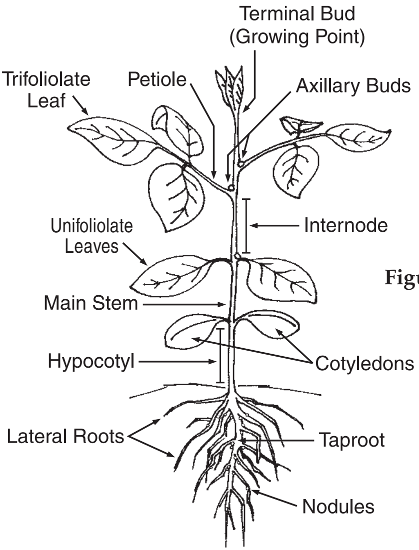

Figure 2. The soybean plant in V2 stage of development.

Growth Stages

Soybean development is characterized by two distinct growth phases. The first is the vegetative (V) stages that cover growth from emergence to flowering. The reproductive (R) stages cover growth from flowering through maturation.

Plant stages are determined by classifying leaf, flower, pod and seed development. Staging also requires node identification. A node is the part of the stem where a leaf is (or has been) attached. A leaf is considered fully developed when the leaf at the node directly above it (the next younger leaf) has expanded enough so that the two lateral edges on each of the leaflets have partially unrolled and are no longer touching.

Vegetative stages (V)

Stage	Description
VE	**<u>Emergence</u>** – Cotyledons above the soil surface.
VC	**<u>Cotyledon</u>** – Unifoliolate leaves unrolled sufficiently so that the leaf edges are not touching.
V1	**<u>First-node</u>** – Fully developed leaves at unifoliolate node.
V(n)	**<u>nth-node</u>** – The "n" represents the number of nodes on the main stem with fully developed leaves beginning with the unifoliolate leaves.

From *Fehr and Caviness*[1]

Reproductive stages (R)

Stage	Description
R1	**<u>Beginning bloom</u>** – One open flower at any node on the main stem.
R2	**<u>Full bloom</u>** – Open flower at one of the two uppermost nodes on the main stem with a fully developed leaf.
R3	**<u>Beginning pod</u>** – Pod 3/16 inch long at one of the four uppermost nodes on the main stem with a fully developed leaf.
R4	**<u>Full pod</u>** – Pod 3/4 inch long at one of the four uppermost nodes on the main stem with a fully developed leaf.
R5	**<u>Beginning seed</u>** – Seed 1/8 inch long in a pod at one of the four uppermost nodes on the main stem with a fully developed leaf.

R6 **<u>Full seed</u>** – Pod containing a green seed that fills the pod cavity at one of the four uppermost nodes on the main stem with a fully developed leaf.

R7 **<u>Beginning maturity</u>** – One normal pod on the main stem that has reached its mature pod color.

R8 **<u>Full maturity</u>** – Ninety-five percent of the pods have reached their mature pod color. Five to 10 days of drying weather are required after R8 for the soybean moisture levels to be reduced to less than 15 percent.

From *Fehr and Caviness*[1]

Number of days between stages.

Stages	Average Days Fehr	Range in Days Fehr
Planting to VE	10	5-15
VE to VC	5	3-10
VC to V1	5	3-10
V1 to V2	5	3-10
V2 to V3	5	3-10
V3 to V4	5	3-8
V4 to V5	5	3-8
beyond V5	3	2-5
R1 to R2	3	0-7
R2 to R3	10	5-15
R3 to R4	9	5-15
R4 to R5	9	4-26
R5 to R6	15	11-20
R6 to R7	18	9-30
R7 to R8	9	7-18

From *Fehr and Caviness*[1]

[1] Fehr, W.R., and C.E. Caviness. 1977. Stages of soybean development. Spec. Rep. 80. Iowa State Univ. Coop. Ext. Serv., Ames.

Number of days between stages (0.0-0.5 relative maturity; 2004-07).

Stages	Average Days Carrington	Range in Days Carrington
Planting to VE	18	11-26
VE to V1	13	11-15
V1 to V3	10	8-12
V3-R1	13	8-16
R1 to R3	16	12-20
R3 to R5	11	6-14
R5 to R7	36	32-44
R7 to R8	6	5-10

From *Endres et al.* Carrington Research Extension Center Annual Reports.

Extremes in growing conditions, such as temperature, rainfall and soils, can greatly alter the development of soybean. Many post-applied herbicides are labeled for application at certain soybean growth stages. To avoid herbicide injury (some herbicides), we highly recommend you identify development by growth stage and not use plant height, planting dates or row closure as a basis for application timing.

Variety Selection and Adaptation

Soybean variety selection should be based on maturity, yield, seed quality, lodging resistance, iron-deficiency chlorosis tolerance and disease reaction. Comparative maturity and yield of public and private soybean varieties can be obtained from a current copy of Extension publication A-843, "North Dakota Soybean Variety Performance Testing."

Later-maturing varieties tend to yield more than early maturing varieties when evaluated at the same location. After determining a suitable maturity for the field, comparing yields of varieties that are of similar maturity is important. Although late maturity increases yield potential, later-maturing varieties are more risky to grow than earlier-maturing varieties because an early fall frost may kill a late-maturing variety before the beans have completely filled in the pods, which impacts yield and quality.

Soybean Maturity

Soybean respond to both day length and heat units, so the actual calendar date a variety will mature is highly influenced by latitude; each variety has a narrow range of north to south adaptation. Soybean yield and quality are affected if a season-ending freeze occurs before a variety reaches physiological maturity. Dates of maturity are listed in performance tables and indicate when varieties were physiologically mature. Usually harvest can commence approximately seven to 14 days after the soybean crop is physiologically mature. Relative maturity ratings also are provided for many of the varieties entered in the trials at various locations. Relative maturity ratings for private varieties were provided by the companies entering the variety in the trial.

Varieties of maturity groups 00 (double zero), 0 (zero) and 1 are suitable for eastern North Dakota and northwestern Minnesota. These maturity groups are further subdivided. For example, a 0.1 maturity group is an early group 0 variety and a 0.9 is a late maturity group 0 variety.

Generalized areas of adaptation in North Dakota are indicated by zones in Figure 3. Minnesota maturity zones are indicated in Figure 4.

The best way to select a high-yielding variety is to use data averaged across several locations and years. Because weather conditions are unknown in advance, averaging across several years' data will identify a variety that likely will yield well across different weather conditions. Selecting a variety that has performed relatively well in both dry and moist conditions is the best way to pinpoint a variety that does well, regardless of weather fluctuations.

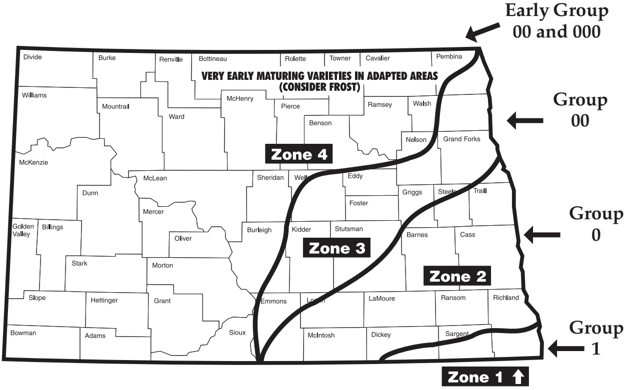

Figure 3. North Dakota soybean maturity zones.

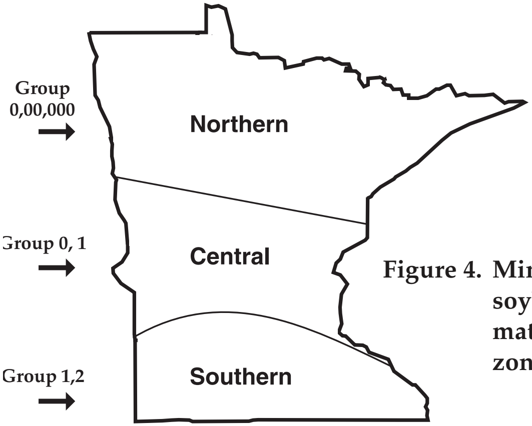

Figure 4. Minnesota soybean maturity zones.

Phytophthora

Phytophthora root rot caused by the soilborne-fungus *Phytophthora sojae* is the No. 1 disease problem of soybean in North Dakota. Phytophthora root rot tends to be more of a problem in the Red River Valley and on poorly drained, heavy-textured soils, but the disease can cause significant stand reduction and yield loss in other areas when conditions are favorable. Most varieties have phytophthora root rot-resistance genes. Each gene for resistance confers resistance to a different race (or races) of phytophthora. For example, a gene that may confer resistance to Race 3 may not confer resistance to Race 4 and vice versa. According to a survey of phytophthora races done by NDSU's soybean pathologist, Berlin Nelson, Races 3 and 4 are most common in North Dakota. However, numerous other races are found in the state. Based on these findings, resistance genes *Rps6* and *Rps1k* (commonly called the k gene) are the most likely genes to provide resistance against the races common in North Dakota. Although use of a soybean variety with the genes *Rps6* or *Rps1k* does not guarantee control, deploying one of these two resistance genes will maximize the likelihood of some protection against phytophthora root rot.

Iron-deficiency Chlorosis

Iron-deficiency chlorosis (IDC) is a major problem in the eastern part of North Dakota and western Minnesota and is caused by iron being less available as soil pH increases. Iron-chlorosis symptoms are most common during the two- to seven-trifoliolate leaf stages. Plants tend to recover and start to turn green again during the flowering and pod-filling stages. However, IDC during the early vegetative stages can reduce yield severely. Some varieties are more tolerant to IDC than others. For high pH soils with known IDC problems, select an IDC-tolerant variety of suitable maturity that is high yielding. Variety IDC sores are posted on Jay Goos' website at *www.yellowsoybeans.com*. Data on genetic differences for IDC tolerance are available in publication A-843.

Soybean Cyst Nematode

The soybean cyst nematode (SCN), *Heterodera glycines*, is a small parasitic roundworm that attacks the roots of soybean plants. Soybean cyst nematode has been found and verified in Cass and Richland counties of North Dakota and up to Red Lake County in northwestern Minnesota. Unverified reports indicate SCN also has been found in fields in adjacent counties. Soybean cyst nematode causes yield losses in infested fields. Crop rotation and resistance are the most important management practices growers can use to control nematodes. Growers may want to consider testing their soils for SCN. If a nematode problem is in the field, only resistant soybean varieties should be planted.

Specialty Soybean

Food soybean

Some soybean varieties have been developed for human consumption and have special food-processing characteristics. Tofu is a white curd that primarily is consumed in Asian countries. Special varieties have been developed that are high in protein and make smooth-textured tofu. These high-protein tofu types are lower yielding than the oilseed varieties sold to the elevator. Natto is another human food product made from soybean. Natto is a fermented product made from whole soybeans that are cooked. Natto cultivars are very small seeded and tend to yield even less than the specialty cultivars developed for the tofu market.

Growers should consult university publications on soybean variety performance to determine how much less these specialty varieties yield compared with oilseed soybean. Based on the lower yield, a higher price per bushel needs to be obtained to economically justify growing these specialty soybean types. A contract should be arranged prior to growing these special types so a market will be available.

Oil modified

Soybean cultivars with modified oil content are being developed. Different fatty acid compositions modify the type of oil the soybean plant produces in the seed. Low saturated fats are desirable because this type of oil is better for human health. High oleic, low palmitic, low stearic and low linolenic acid content are all genetic modifications that produce healthier oil for human consumption. We have not seen any indication that these modifications reduce yield. However, yield of specific cultivars with modified oil content should be evaluated to determine whether high yield has been incorporated with the modified oil content. These specialty cultivars are commercially available and will be produced using identity-preserved (IP) marketing.