AGRICULTURAL
GUIDE
Published by the University of Missouri-Columbia Extension Division

MAY 1 4 1987

Determinate semi-dwarf and semi-determinate soybean varieties

Zane R. Helsel and Harry C. Minor
Department of Agronomy, College of Agriculture

Archive version - check for updates

Several environmental factors affect the productivity of soybeans. Among them are water, nutrients and light. When water and nutrients are deficient, they can be supplied artificially by using irrigation and fertilization. Plants don't always intercept and use all of the available light. The efficiency with which the plant intercepts light is influenced by such features as leaf area and how the leaves are displayed. Lodging is one factor influencing efficient light interception and use. It can be controlled by genetic manipulation.

Lodging reduces yield from 10 to 20 percent when it occurs before maturity, even though plants can be harvested. The loss from poor light use depends on when lodging occurs during the plant's life cycle and on the potential productivity of the environment. Yield losses are most severe when lodging occurs during the pod-filling stage or when soybeans are grown in high-yield environments.

Two new types of soybeans have been developed to combat the problem of lodging in soybeans. They are the **determinate semi-dwarfs** (often referred to as semi-dwarf determinates, dwarfs or semi-dwarfs) and **semi-determinates**. These new types are shorter and more lodging resistant than indeterminate varieties commonly grown in central and northern Missouri. Under high-yield conditions where lodging is a problem, they have shown an ability to produce from 5 to 10 percent more than common varieties. However, they are specifically adapted for potentially high-yield conditions. Under low-yielding conditions, the new types often produce lower yields than the common soybean types. Figure 1 compares yields of *Ripley*, a new semi-dwarf, and *Williams 82* in several yield environments. *Ripley* produced a progressively higher yield than *Williams 82*, as conditions were suitable for production of 50 or more bushels per acre.

Several varieties of the two new types have been developed and are currently being grown on a limited basis in Missouri. However, the varieties developed to date are in the II, III, and IV maturity groups and adapted only to conditions in central and northern Missouri.

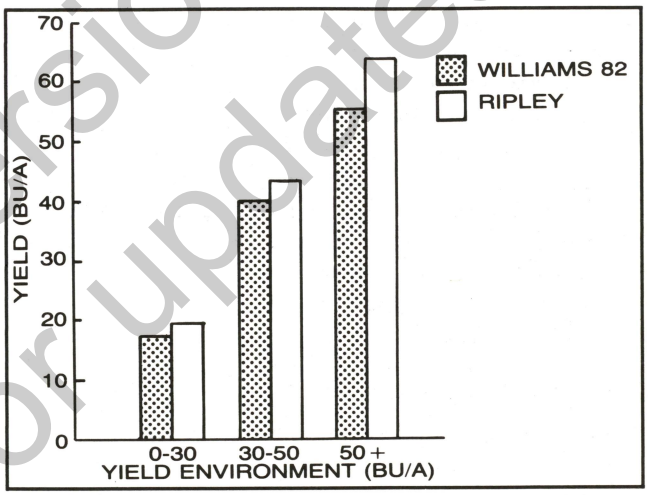

Figure 1. Yield of indeterminate (Williams 82) and determinate semi-dwarf variety (Ripley) in three yield environments.

This guide describes the characteristics of the new determinate semi-dwarf and semi-determinate varieties and suggests production practices for these new soybean types which should result in top productivity.

Definitions and characteristics

These two new types of soybeans differ in growth habit. Varieties commonly grown in central and northern Missouri are referred to as indeterminate soybeans. *Williams* is an example. **Indeterminate soybeans** continue terminal vegetative growth after flowering has begun, and growth continues until flowers form at

Table 1. Characteristics of three soybean plant types.

Characteristics	*Plant Type*		
	Indeterminates	*Determinate Semi-Dwarfs*	*Semi-determinates*
Flowering time (Days)	21-28	16-21	18-21
Stress Tolerance ("problem stage")	Very Good	Fair	Good
Internode Length	Long	Short	Intermediate
Plant Height	Tall	Short	Intermediate
Pod Height	High	Low-Medium	High
Pod Set	Scattered	Concentrated	Concentrated
Standability	Good	Excellent	Very Good

Adapted from V. R. Seeds Inc. Plymouth, IN.

the growing point of the stem. Plant height may double before this occurs.

Varieties like *Forrest*, grown in Southeast Missouri, are referred to as **determinate soybeans**. These varieties develop a cluster of pods at the terminal bud and cease terminal vegetative growth soon after flowering begins. After this stage, plant height increases very little, although some vegetative growth continues in the form of branching.

The new **determinate semi-dwarf** varieties and **semi-determinate** varieties combine some of the characteristics of both the northern indeterminate varieties and southern determinate varieties. Determinate semi-dwarf varieties are true determinate varieties. They stop terminal vegetative growth once flowering and podding begin. Semi-determinate varieties fall somewhere between determinate and indeterminate varieties. They continue to add a small amount of terminal vegetative growth after flowering and podding begin, but before a distinct set of terminal pods is formed. The determinate semi-dwarfs are about one-half the height of common varieties (see Figure 2), while the semi-determinate varieties are about 6 to 10 inches shorter than the indeterminate varieties.

Largely as a result of the shorter heights, both of these new types of varieties have greater lodging resistance than commonly grown varieties. The shorter determinate semi-dwarfs have the greatest resistance.

Because determinate semi-dwarfs reach maximum height by the onset of flowering, drought stress during the pre-bloom vegetative period can result in even shorter plants and a lower yield. Indeterminate varieties are less susceptible because they can add terminal vegetative growth during periods of late season moisture. Thus, there is potential for yield compensation.

Indeterminate varieties flower over a longer period of time than do determinate semi-dwarfs or semi-determinate varieties. The new varieties have flowering periods about one week shorter than indeterminates of the same maturity. These shorter flowering periods may affect the ability of these plant types to withstand drought stress during flowering.

Figure 2. Author Zane Helsel points out the size of an indeterminate variety (left) and a determinate semi-dwarf variety.

Table 2. Maturity classifications of new varieties.

Variety	Type[1]	Maturity Group	Days + or - [2] Williams	Phytophthora Root Rot Rating[3]
Gnome 85	DSD	II	-9	R
Elf	DSD	III	+1	S
Sprite	DSD	III	-3	S
Hobbit	DSD	III	-2	S
Pixie	DSD	IV	+4	S
Ripley[4]	DSD	IV	+4	T
Will	SD	III	-3	S

[1]DSD Determinate Semi-dwarf.
SD Semi-Determinate.
[2]Plus (+) means later than Williams
Minus (-) means earlier than Williams
[3]S = Susceptible; T = Tolerant; R = Resistant
[4]Taller than other DSD types

Table 1 compares characteristics of determinate semi-dwarf varieties and semi-determinate varieties to common indeterminate varieties. (See Table 1 and Figure 2.)

Several new determinate semi-dwarf and semi-determinate varieties have been released by the USDA, universities, and commercial companies. See Table 2 for maturity classifications of varieties released by public institutions.

Production practices

The determinate semi-dwarf and semi-determinate varieties are designed to perform well under production practices and conditions conducive to high yield. Attempt to grow these varieties only if your land has produced 50 bushels or more soybeans frequently over the past 10 years. In other words, there's a high risk involved in growing these varieties where high yields are not common. The following production practices are recommended to achieve high yields of determinate semi-dwarf and semi-determinate varieties.

- **Deep, fertile, productive soil.** These new types should be grown on soils with good fertility, good moisture-holding capacity and a history of high productivity.
- **Early planting.** To achieve maximum plant height and production with these new variety types, you must plant them during May in central and northern Missouri. Early planting is necessary to produce sufficient plant height for high yields. They are not recommended for planting in mid to late June or July. If planted late, these varieties will be too short with many of their pods too low for efficient combining.
- **Narrow rows.** Narrow rows 10 inches or less, are recommended to produce maximum yields with determinate semi-dwarf and semi-determinate varieties. The lodging resistance in these varieties gives them the ability to stand well in narrow rows with high populations. The crowding effect also increases plant and podding heights, which aids combining efficiency.
- **High seeding rates.** A final plant population of 225,000 or more per acre is recommended for top yields. Based on 90 percent germination of seed, a seeding rate of three-and-one-half to four seeds per foot of row in 7-inch rows is required (90-120 pounds of good quality seed). The lower rate of this range would be appropriate for the semi-determinates and *Ripley* because they are slightly more susceptible to lodging than the other determinate semi-dwarfs.
- **High fertility.** Soils should be high in fertility for the potentially greater yields from these new variety types. Research has shown that these varieties require slightly higher nutrient levels per bushel of production than common varieties. In developing a fertility plan, estimate or request fertility recommendations from a soil test for a yield goal approximately 20 percent higher than current yields.
- **Good moisture supply.** For top yields, some adequate source of moisture, whether from the soil, rainfall or from irrigation, must be available during the entire growing season. So far in Missouri, these new varieties have produced best on river bottom soils, under irrigated conditions or in wet years. Early season moisture stress can result in incomplete canopy formation, very low pods and low yields. To take advantage of the high-yield potential of new varieties, they should be irrigated at a full rate during the vegetative (prebloom) growth just like corn, as well as during pod fill. (Conversely, water should be limited during the vegetative growth period of indeterminate varieties.)
- **Control Pests.** Because these varieties are short they do not compete well against weeds. Disease and insect infestations can reduce yields more with these varieties than normal varieties because vegetative growth is limited and grow back after flowering is minimal. Fields grown to these varieties should be monitored closely and receive treatment before other fields.
- **Floating or flexible combine cutter bar.** Because

these new varieties develop pods close to the soil surface, a floating or flexible cutter bar, or some other mechanism on the combine, is necessary for the combine header to pick up low pods. A smooth seedbed at planting time can reduce harvest losses due to uneven cutting. Also, proper reel adjustment ensures that plants flow smoothly into the combine head.

Summary

The new determinate semi-dwarf and semi-determinate varieties are designed to be more lodging resistant. They can produce significantly higher yields *under conditions conducive to high yields*. For excellent yields, 1) plant early, 2) seed in narrow rows (preferably 10 inches or less), 3) plant at higher seeding rates (three-and-one-half to four seeds per foot of 7-inch rows), 4) apply adequate fertilizer and water, and 5) harvest carefully.

Acknowledgement: The authors acknowledge the suggestions made by Dr. Richard Cooper, USDA, OARDC, Ohio State University, during preparation of this Guide.

The new determinate semi-dwarf and semi-determinate varieties should not be grown in low-yield environments: in wide rows, at low seeding rates, on low moisture-holding soils, on low-fertility soils or in late plantings.

■ Issued in furtherance of Cooperative Extension Work Acts of May 8 and June 30, 1914 in cooperation with the United States Department of Agriculture. John W. Oren, Director, Cooperative Extension Service, University of Missouri and Lincoln University, Columbia, Missouri 65211. ■ An equal opportunity institution.