

EFFECT OF CULTURAL PRACTICES AND FUNGICIDES
ON SOYBEANS (GLYCINE MAX (L.) MEER.)

BY

JOSEPH FEMBA

A thesis submitted in partial fulfillment
of the requirements for the degree of

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(Agronomy)

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Edward S. Oplinger

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ABSTRACT

Experiments were conducted from 1976 to 1978 at the Arlington Experimental Farm, Arlington, Wisconsin, to study the effect of planting dates, row widths and herbicide treatments on 'Hodgson' and 'Wells' soybeans. Additional studies were conducted at Janesville, Wisconsin, in 1976 and 1978 but one date of planting was used. Yield decreased with delayed planting. 'Hodgson' consistently outyielded 'Wells'. Soybeans planted in 10-inch rows yielded more than those in either the 7- or 30-inch rows. Except at Arlington in 1976, a postemergence application of bentazon did not increase yield significantly.

In 1978 a John Deere planter was compared with a Tye soybean drill and an IHC grain drill to study their effect on soybeans planted in 7-, 10-, 20- and 30-inch rows. For most soybean characteristics studied, the Tye soybean drill was not different from the John Deere planter but was superior to the IHC grain drill.

The effect of fungicides on seed quality was studied in 1978. 'Evans', 'Hodgson', 'Wells' and 'Beeson' soybeans were used in Experiment 1 where different rates of benomyl were compared and only 'Wells' was used in Experiments 2, 3 and 4 in which benomyl and thiabendazole were compared.

Also the effect of cultural practices mentioned above were studied. 'Evans' yielded highest but was the most susceptible to Diaporthe and Alternaria. Susceptibility decreased with lateness in maturity. The best disease control was obtained when 1/2+1/2 lb/a of benomyl was applied at R3 and R6 or 1+1 lb/a applied at the same times. Little response to fungicide treatments was found at Arlington. Seed infection decreased with delayed planting. Row width and herbicide treatments did not affect seed quality.

PART I

EFFECT OF DATE OF PLANTING, CULTIVARS, ROW WIDTH
AND HERBICIDES ON YIELD AND OTHER AGRONOMIC
CHARACTERISTICS OF SOYBEANS (GLYCINE MAX (L.) MERR.)

INTRODUCTION

Soybeans are the most important oil crop in the world and one of the cheapest sources of protein (32, 52). Uses of soybeans are many and expanding all the time. With the development of new products from soybeans, there is every indication that growth in demand will continue to increase.

The United States is the major world supplier of soybeans. The complexity of today's agriculture has greatly increased the cost of production per unit area and farmers are looking for ways that might help them maintain their profits as cost of farming inputs keep rising. The most logical way of combating this problem is increasing yield per harvested area.

For the past five years, soybean yield per acre in the United States has averaged 28 bu/a. University research and yield contest results have demonstrated that the yield potential of currently available cultivars is as high as 60 bu/a or more (40). However, yields of this magnitude are occasionally reported on larger production fields. Pendleton and Hartwig (47) reported that the difference in average soybean yields from a community, state, or region and yields from either research stations or outstanding growers therein is primarily due to management.

A number of factors are involved in sound soybean management. Selecting a cultivar that is adapted, high-yielding, lodging-resistant, nonshattering, disease-resistant and with seed of known high viability and quality is probably the first step (8, 47). Factors like planting date, row width, and weed control influence the choice of a cultivar (13, 31, 47, 52). Soybeans can successfully be planted in most areas of the United States over a broad range of time (19, 21). However, optimum yields are achieved from more precise planting time and it is important to determine that time in a given soybean growing region. In Wisconsin, yields of soybeans decrease particularly when planting is delayed until after June 1 (39). In the Corn Belt and northern states, narrow rows yield more than wide rows (12, 14, 34, 46, 49, 52, 65, 66). Until recently, the availability of adequate planting and cultivating equipment for narrow rows and inadequate weed control have been the major limitations in adopting narrow rows. Improved chemical weed control has greatly enhanced the use of narrow rows in soybean production (13, 47, 48).

In 1977, soybean seed produced in many regions of Wisconsin had low germination and low seedling vigor. Isolations revealed a high percentage of seed infection by Diaporthe phaseolorum (Cke. and Ell.) Sacc. var. sojiae and Phomopsis sp. associated with poorly germinating seed lots.

Diaporthe phaseolorum has been reported to cause severe losses of germinating seeds and young seedlings (62). Fungicide sprays on soybean plants in the field after mid-pod stage have been an effective control of seed infection by D. phaseolorum and Phomopsis sp. (18, 26, 50).

The research reported here was conducted at the University of Wisconsin Experimental Farm near Arlington, and at Janesville, Wisconsin, to evaluate the effect of four major aspects of soybean production: date of planting, cultivars, row width and herbicides. Studies were conducted from 1976 to 1978.

In 1978, an experiment was conducted at Arlington Experimental Farm to study the influence of the planting equipment on the performance of soybeans planted in 7, 10, 20, and 30 inch-row widths. The objective was to obtain information which might explain differences in seed yield that had been observed in previous years between narrow rows planted with a John Deere flexplanter and those planted with the IHC grain drill.

This report also includes results from experiments conducted in 1978 to evaluate the influence of soybean cultural practices and fungicide treatments on soybean seed yield, seed quality and other agronomic characteristics. The experiments were conducted on the Arlington Experimental Farm and at Vince Drendel's farm near Evansville, Wisconsin.

LITERATURE REVIEW

Effect of Planting Date

Soybeans are generally classified as short-day plants. This means that as long as the length of a day is shorter than the optimum daylength for the plants, they will flower and mature in a minimum number of days, assuming the temperatures are also optimal. Whenever soybeans experience a daylength greater than their optimum, the rate of development will be slowed and will take longer to reach flowering or maturity. The greater the daylength, the greater will be the delay. The response of soybean plants to planting date is related to this sensitivity to photoperiod (24). This is primarily because daylength changes with time of the year (8, 30).

Planting too early, when soil temperatures are low, usually results in poor emergence and plant stands. In the northern areas of the U.S., earliest planting dates in the spring coincides more nearly with dates of near maximum daylength and attainment of minimum soil temperatures required for good seed germination (24). The threshold temperature for germination is around 50°F (52). Emergence occurs very slowly at temperatures lower than 50°F. Van Schaik and Probst (61) found that soybeans plants grew faster and to greater heights as temperatures and photoperiod were increased.

In cold soils the seedling is subject to attack by soil organisms and it is a poor weed competitor under such conditions (52). Consequently, later plantings usually give better stands than early ones.

Since soybean seedling emergence in cold soils is slow, delayed emergence gives weeds a good start ahead of the soybeans, making the crop a poor weed competitor. Also, relatively late planting permits farmers to kill the early spring weed population before planting. Good stands obtained with later plantings help to shade-out weeds (13, 67).

In Wisconsin, plant height usually decreases with delayed planting. Torrie and Briggs (60) found that maximum plant height was obtained at the first planting date, May 10, with a progressive decrease with delay in planting. Scott and Aldrich (52) explained that the effect of planting date on the height of soybeans is one reason why mid- or full-season cultivars should be used for late plantings as long as there is a reasonable chance for them to mature before a killing frost. Mid-or full-season cultivars grow taller than early cultivars when all are planted late.

Torrie and Briggs (60) and Weiss et al., (69) found that date of planting had no effect on lodging. In central Illinois, Osler and Cartter (41) reported an increase in lodging with later plantings. Smith et al. (56) observed that during seasons with relatively low rainfall and low yields, late plantings lodged less than early plantings.

Similar results have been reported by Leffel (33). Scott and Aldrich (52) stated that the choice of cultivar has a much greater influence on lodging susceptibility than planting date.

Studies in Iowa, Illinois and Indiana have indicated that except for later maturing cultivars, seed size of soybeans is not influenced by date of planting (70). Osler and Cartter (41) reported that the seed size of two later cultivars decreased with delayed planting. Similar results were reported by Green et al. (22) and also by Torrie and Briggs (60). Scott and Aldrich (52) stated that seed size may or may not be affected by time of planting. It is influenced by the favorableness of the environment during the pod filling period. A change in planting date may or may not make this coincide with unfavorable moisture and temperature conditions.

Feaster (19) and Hartwig (24) stated that highest soybean seed yields in the U.S. are usually obtained from May plantings, but in the more northern latitudes, planting in late May may produce the highest yields. Cartter and Hartwig (8) wrote that recommendations for date of planting of soybeans in northern areas are usually based on the best date to plant full-season cultivars, those that utilize the full growing season and ripen before the average frost date. Feaster (19) reported that maximum grain yields result from

planting a full-season cultivar after the soil has become thoroughly warm in the spring. He explained that at this time conditions are most favorable for prompt germination and rapid growth. Torrie and Briggs (60) found that yield of late cultivars tended to decrease with plantings made after May 20 but the yield of early cultivars was not affected much by planting date.

Effect of Cultivars

Hartwig (25) reported that there is no other major crop for which photoperiodism is as important in determining area of adaptation, as for soybeans. Similar results were reported by Garner and Allard (21). This photoperiod sensitivity of soybeans limits their adaptability as a full-season crop to relatively narrow belts of latitudes, usually no wider than 100 to 150 miles. Based on this response to daylength, soybean cultivars have been divided into 12 maturity groups from 00 to X based on their north-south zone of adaptation. Groups 00, 0, I, and II are adapted to the longer days in the northern areas of adaptability, while succeeding groups are adapted farther south.

Response to daylength determines whether a cultivar is early or late in maturity (25, 52). The very early cultivars adapted to the northern production area where the days are long, will flower under almost continuous daylight. The very late cultivars adapted to the short day area of the

south, require at least 10 hours of darkness before flowering is initiated (52).

Wilcox (71) evaluated three soybean strains in 14 population densities from 10,000 to 236,000 plants/acre and found that strains differed in their response to population density when seed yield was expressed per unit area. At equidistant spacing, the three strains resulted in similar yields across a wide range of populations. Generally, the shorter, less branched and slightly earlier maturing cultivars respond best to solid seeding (12).

Cultivars of soybeans vary in their competitive ability against weeds, so much so that those which yield most when weed competition is severe may yield least under weed-free conditions. Wax and Pendleton (65) reported that considerably more grass was produced in 'Harosoy 63' plots than in 'Wayne' plots. They explained that that could have been due to increased competition for light in the 'Wayne' canopy. Scott and Aldrich (52) suggested that early cultivars be avoided in fields where weeds, especially the tall broad-leaves, are likely to get out of hand. They explained that harvest problems will be reduced if the soybeans and the weeds can dry up at about the same time.

A cultivar may vary considerably in height because of date of planting, spacing of plants in the row, spacing of rows, moisture supply, temperature, soil fertility, and

other factors of the environment (1, 8, 33, 69). Dougherty (17) reported that plant height differences between cultivars depended on the distances between nodes and, to a lesser extent, on the number of nodes. Early maturing cultivars are usually shorter than late maturing types (14).

Cooper (10) reported yield reductions of 21 to 23% when natural lodging occurred in the early pod filling stage of plant development. Weber and Fehr (67) found a 13% increase in soybean seed yield when early lodging was prevented. Weiss et al. (69) found lodging to increase with genetic lateness of the cultivar. Scott and Aldrich (52) stated that cultivars that stand well where lodging is known to be a problem may be the most profitable, even though they may show a slight yield disadvantage in variety performance tests.

Hartwig (25) reported that seed size for the more common commercial cultivars ranges from 12 to 18 grams per hundred seeds. Seasonal conditions however, play an important role in modifying the size of soybean seeds. One of the important factors is the stage of development of the plant in relation to weather conditions (8). Dougherty (17) found that there were differences in seed size between cultivars. 'Amsoy', which generally produced larger seed, also had fewer pods per plant and slightly more beans per pod. He also reported that 'Wayne' produced heavier seed when grown in 20-inch row spacing.

The gradual increase in the average yield of soybeans in the U.S. from 11 bu/a in 1924 to about 28 bu/a today is a unique example of differences between old and new cultivars (51, 54). This has been possible primarily through the development of cultivars that are adapted to local growing conditions (51). Generally, cultivars that take advantage of all or most of the growing season will yield more than those that mature earlier (8). Hanway and Weber (23) found that the weight increase in the seed fraction of several cultivars was similar, and the major differences in seed yield were attributed to length of the development period of the bean rather than rate of daily growth.

Effect of Row Width

Leffel and Barber (34) reported that production of soybeans within the United States has been accomplished with the use of machinery designed for other purposes. Utilization of corn planting and cultivating equipment has been extensive in the production of the soybean crop, and row spacings have often coincided with those for corn. Traditionally, soybeans have been planted in rows more than 30 inches apart (46, 65, 68). In the Corn Belt and northern states several studies have shown increases in seed yield with rows narrower than 30 inches (12, 14, 34, 46, 49, 65, 68).

Until recently, the unavailability of adequate planting equipment and effective weed control methods for narrow row soybeans have been the major problems in producing soybeans in narrow rows (3, 34, 38, 46). Pendleton et al. (46) reported that to grow soybeans in narrow rows, farmers will have to retool or gear up some of their machinery. For planting, they use a grain drill with certain holes stopped up, a regular bean or beet planter, or an altered corn planter. Leffel and Barber (34) also reported that in the early history of soybean production most of the acreage was planted with grain drills, in 7- or 8-inch rows. The only cultivations, if any, consisted of rotary hoeings or harrowings early in the growth of plants. It soon became apparent, however, that more efficient production could be achieved by the weed control obtained with row cultivation. For cultivation, farmers use regular cultivators available from implement dealers or they fashion their own (46).

The availability of modern and efficient herbicides has made it possible for farmers to grow soybeans in narrow rows with few if any cultivations (3, 38). This achievement has apparently encouraged the use of grain drills as narrow row planters. However, using grain drills to plant soybeans in narrow rows poses some problems. Grain drills generally cannot compensate for poorly prepared seedbeds as well as the conventional planters. A grain drill will plant 7-inch

rows, but seed spacing and placement is not always optimum. With limited surface moisture, it may be difficult to get seed down to moisture with some grain drills (3). Tractor-wheel tracks can make achieving uniform depth difficult when using a grain drill. However, the drill may be used in tandem behind a cultipacker to alleviate the problem. Newer grain drills with press-wheels and other improvements will help avoid most problems encountered when using older grain drills designed for seeding small grains (37). Parks et al. (43) reported that drilling 12 to 15 beans per foot of row in narrow rows may lead to lower yields as such plant densities produce small, spindly bean stalks that are susceptible to lodging. However, the data from seven experiments in which they compared drill with different hill drop treatments showed that in only one experiment was there a significant difference in yield.

Weed control, either chemical or mechanical, may be more effective in narrow rows than in wide rows because the herbicide needs to be effective for only a short time before the soybean canopy provides shade (4, 48, 65). Wax and Pendleton (65) concluded that the 20-inch rows would have an advantage over the 10-inch rows in that the 20-inch rows could be cultivated at least once if the herbicide failed to control all species of weeds present in significant numbers.

Agronomists in Tennessee (43) recommend that in narrow rows, seeding rate should be increased 20 to 25% over the ideal rate in conventional wide rows - 30 to 40 inches wide. They feel this is needed to compensate for potentially greater stand losses in narrow rows than in wide rows which may occur due to soil crusting, rotary hoeing and to some extent a less uniform planting depth in narrow than in wide rows. Cooper (11) noted that in 20-inch rows, early competition within the row effectively thins the population down to a population that will stand better. In contrast, the more uniform plant distribution in the 7-inch spacing results in more equally competitive plants which survive to maturity and set seed. This high population, however, results in increased lodging problems. Excess seeding rates may be more deleterious to yield in narrow rows because of less efficient natural thinning which occurs with more uniform plant distribution.

Experiments have shown that decreasing the inter- and intra-row spacing usually results in increasing plant height (29, 34, 68). Since late planted soybeans are usually not as tall as those planted in early May, the advantage for using narrow rows increases as planting is delayed past June (60).

Scott and Aldrich (52) reported that reducing row width from 38 to 40 inches to 20 or 30 inches has little

effect on lodging if the population is held at the optimum for the narrow rows. As rows are narrowed still more, some lodging can be expected (9, 29, 34, 68, 71). The detrimental effect of lodging on seed yield of soybeans is widely documented (9, 10, 11, 38, 44, 67).

Lehman and Lambert (35) found that seed weight and seeds per pod were not affected appreciably by spacing of rows or population change, whereas the number of seeds, pods, and branches per plant decreased with increased plant population. Costa (14) reported that more seeds per plant were set in 30-inch rows than in 10-inch rows. A larger number of seeds per plant in 30- than in 10-inch rows may result in a reduction of seed size because the increased number of seeds creates an additional demand on the available photosynthate (6).

Pendleton et al. (46) reported a consistent yield advantage of about 15% for 24- over 40-inch rows in Illinois. Yield advantages for even narrower row spacings have been reported (14, 35, 38, 59, 68). Narrow rows generally give more uniform plant distribution and increased yields (12). Fewer days are required to attain a leaf area index necessary to intercept 95% of solar radiation (53, 68). In narrow rows, there is more uniform plant competition for water, nutrients, and light than in wide rows (3, 68). Narrow rows have cooler soil temperatures than do wide rows, and as a

consequence, there is less evaporation from the soil surface due to shading by plants in narrow rows early in the growing season (44). Less soil erosion provided by solid seeding is, of course, most beneficial on sloping land. Mannering and Johnson (36) reported that soil loss was reduced by 35% from 20-inch rows. Harvesting losses are reduced in narrow rows (12, 38). Cooper (12) reported that with the more uniform plant distribution in solid seeding, the cutting area is spread over the entire length of the combine cutterbar, giving more uniform feeding of plants into the machine. Also, the absence of cultivator ridges allows a lower cutting height. Frequently the first 4 or 5 seed branches will abort on soybeans planted in the 20-inch row spacing. At wide row spacing, practically all of these low seeding branches would produce a sizeable number of beans. Beans produced on these lower seed branches have a high probability of being lost during harvest.

Effect of Herbicides

Many agronomists believe that improved weed control is the factor most responsible for recent state and regional yield increases (28, 47). Peters et al. (48) stated that the use of chemicals has reduced much of the hard labor as well as the cost of weed control.

Herbicides applied as a single application prior to or at planting usually fail to control broadleaf weeds

throughout the growing season (13, 28, 64). When combined with other techniques, herbicides are now indispensable to good agriculture. Measures that supplement preemergence weed control include rotary hoeing, cultivation, post-emergence herbicide, or any combination of these. Jacques and Harvey (27) obtained excellent weed control with pre-plant incorporated trifluralin followed by metribuzin applied preemergence at rates as low as $3/8$ lb/a. They found that tank mixtures of trifluralin and metribuzin deep incorporated tended to be more effective than shallow-incorporated mixtures when followed by bentazon applied postemergence.

Wax (63) wrote that although trifluralin is one of the most effective herbicides for control of annual grasses, it fails to control several of the troublesome broadleaf weeds such as velvetleaf, ragweed and wild mustard. Metribuzin is generally more effective on annual broadleaf weeds than on annual grasses. However, the margin of tolerance between weed control and crop injury is narrow, indicating potential for crop injury with this chemical. Thus, the most successful use of this herbicide might be realized by using a reduced rate in combination with other herbicides such as trifluralin. Such combinations could also provide wide-spectrum control of both annual grass and broadleaf weeds without soybean injury. Bentazon was recently evaluated as

a post emergence treatment in soybeans (66). Wax (63) reported that bentazon, applied at $3/4$ lb/a to 3 lb/a over the top of soybeans from the unifoliolate to the second trifoliolate stages of growth, selectively controlled many annual broadleaf weeds.

A number of reports have shown that 10-inch rows have an advantage over the 40-inch rows in that narrow rows help control weeds by providing earlier shading than wide rows (3, 13, 35, 53, 68). Burnside (3) reported that a lower herbicide rate was required for weed control in 10-inch rows than in 40-inch rows. He also stated that because of the lower herbicide rate in narrow rows than in wide rows, little or no soybean injury was expected in narrow rows.

Johnson (28) reported that where weeds remained in untreated plots, or in plots where herbicides did not control the weeds within seven weeks after planting, the growth of soybean plants was retarded and stands reduced. Herbicides may sometimes cause a reduction in plant stand (4, 28, 42, 64, 66). Wax et al. (66) stated that several herbicides have been shown to affect soybean cultivars differentially. They reported that the response to soil incorporated metribuzin of most of the commercially important cultivars and some non-commercial ones varied due to factors such as soil texture, organic matter, planting depth, and perhaps soil

moisture and rainfall differences. Burnside and Moomaw (4) found that average soybean stands were similar regardless of the herbicide treatment. They reported that stand reductions occurred in plots receiving metribuzin preemergence at 1/2 lb/a plus bentazon postemergence at 3/4 lb/a with one rotary hoeing. However, this reduction was not statistically different from the other treatments. They concluded that a number of herbicide treatments will selectively control weeds in soybeans without affecting soybean stand.

Burnside and Colville (4) reported that soybean plants on plots receiving no weed control treatment were significantly shorter than other plants. They explained that this could have been due to increased weed competition. Johnson (28) reported that soybean plant height was not influenced by sequential treatments of trifluralin or vernolate when applied with any postemergence treatment.

Burnside and Colville (4) reported that there was a reduction in soybean lodging with increased weed control. Similar results were reported by Johnson (28). He found that no lodging occurred when trifluralin was applied in sequence with any postemergence treatment.

Johnson's (28) results obtained over a period of three years showed that the effect of herbicides on seed size of soybeans varied with season and herbicide treatment. Burnside and Colville (4) reported that weight of 100 seeds was

the plant character least affected by mechanical, cultural and chemical practices studied.

Weeds bring about yield reductions by competing with crops for moisture, nutrients, and light (63). The effect of weed competition on crop yield varies greatly with location, species, duration of infestation, moisture, weed density, and other factors. In experiments conducted over several years, Staniforth and Weber (58) found that annual weeds such as foxtails, pigweeds, smartweeds, and velvet-leaf reduced soybean yield 10% on the average. Uncontrolled weeds may prevent or hamper harvest of soybeans (63). Tall, broadleaf weeds which may be succulent at harvest, often decrease harvesting efficiency.

Several herbicides are widely used for selective control of annual weeds in soybeans. Burnside and Moomaw (4) tested six herbicides for weed control in soybeans and found that, with the exception of one, all preemergence herbicide treatments produced average soybean yields that were equivalent to those of the handweed plots, and higher than those from weedy check plots. They also reported that main plots receiving bentazon at $3/4$ lb/a plus one rotary hoeing produced higher average soybean yields than plots receiving no bentazon with or without rotary hoeing.

MATERIALS AND METHODS

Studies were conducted at the University of Wisconsin Arlington Experimental Farm, from 1976 to 1978 on a Plano silt loam soil (Typic Argiudoll fine-silty mixed mesic). Additional studies were conducted on the Rock County Farm near Janesville in 1976 and 1978.

Arlington Tests:

Soil test results indicated: pH 6.4, 35 tons/a organic matter, 125 lb/a phosphorus (P) and 275 lb/a potassium (K). Each year, 400 lb/a of 6-24-24 fertilizer was applied before planting. Corn was grown prior to the 1976 study, soybeans prior to 1977 and winter wheat prior to the 1978 study.

Dates of planting were set at two-week intervals, as indicated in Table 1. Cultivars planted were 'Hodgson' and 'Wells' of maturity groups I and II, respectively. Wisconsin Foundation Seed was used each year. Row widths compared were 7-, 10- and 30-inch at populations of 298,700, 209,100 and 139,400 plants/a, respectively. A John Deere Model 71 flex-planter (JD) was used to plant the 10- and 30-inch row widths. The 7-inch rows were planted with a McCormick International Harvester Company (IHC) single disk grain drill in 1976 and 1977 and a Tye soybean drill in 1978. In 1976 and 1977, 3/4 lb/a active ingredient (a.i.) trifluralin (a,a,a-Trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine tank mixed with

Table 1. Conditions at time of bentazon application.

Location	Year	Planting date	Spraying date	Time of day	Temp. °F	RH %	Wind mph	Plant ht. (in)	Growth ^{1/} stage
Arlington:	1976	May 11	June 28	9:00 am	85	75	S5	8	V4
		May 23	June 28	9:00 am	85	75	S5	6	V3
		June 8	June 28	9:00 am	85	75	S5	4	V2
	1977	May 9	June 3	1:00 pm	75	65	SE15	4	V3
		May 23	July 5	10:00 am	90	45	SE15	13	V5
		June 7	July 5	10:00 am	90	45	SE15	4	V3
Janesville	1978	May 11	June 8	12:30 pm	72	75	SE10	5	V2
		May 25	June 26	3:30 pm	78	75	SE20	8	V3
		June 8	July 5	1:30 pm	76	70	SE20	5	V2
Janesville	1976	May 26	June 28	2:00 pm	85	75	S10	6	V4
		May 18	June 14	2:30 pm	82	95	SE15	8	V3

^{1/} Stages of soybean development as described by Fehr et al.

3/4 lb/a a.i. metribuzin (4-Amino-6-(1,1-dimethylethyl)-3-(methylthio)-1,2,4-triazin-5(4H)-one) was applied and incorporated prior to planting. In 1978, glyphosate (isopropylamine salt of N-(phosphonomethyl) glycine) was used to kill the winter wheat crop before 3/4 lb/a a.i. trifluralin was applied and incorporated. The conditions and stages of soybean growth at the time bentazon (3-(1-methylethyl)-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide) was sprayed as a postemergence herbicide are shown in Table 1. Bentazon was applied at 1 lb/a a.i. All applications of bentazon were done in a volume of 30 gallons/a at a pressure of 32 psi. The 30-inch rows were cultivated once early in the season.

A split-split-split plot design with four replications was used. Main plots were dates of planting, cultivars were subplots, row widths were sub-subplots. In 1976 and 1977 there were twelve rows in 7-inch plots and the middle eight were harvested. In 1978 ten rows were planted and six were harvested. The 10-inch plots consisted of six rows and the middle four were harvested. Four rows were planted in the 30-inch plots and the middle two were harvested. Plots were 33, 34 and 25 ft. long in 1976, 1977 and 1978, respectively. Herbicide treatments were sub-sub-subplots.

Janesville Tests

Additional studies were conducted at the Rock County Experimental Farm near Janesville. One date of planting was used, otherwise the experiments were treated in the same

manner as those at Arlington. In 1978 row widths compared were the 7- and 30-inch and $3/4$ lb/a a.i. trifluralin was applied prior to planting. Weather conditions and soybean stages of growth at the times 1 lb/a a.i. bentazon was sprayed postemergence were as shown in Table 1.

A split-split plot design with three replications in 1976 and two in 1978 was used with cultivars as main plots, row widths as subplots and herbicide treatments as sub-subplots. Plots were 56 ft. long in 1976 and 46 ft. in 1978.

Planting Equipment Test

The study was conducted at the Arlington Experimental Farm in 1978. Equipment compared consisted of the John Deere flex-planter, the Tye soybean drill and the IHC grain drill. The equipment were compared in 7-, 10-, 20- and 30-inch rows and the treatments were as shown in Table 2. The cultivar 'Hodgson' was used and was planted on June 6. Plots were 34 ft. long with numbers of rows per plot indicated in Table 2.

Harvesting of all experiments described above was done with a Hege 125 plot combine. Seed harvested from individual plots was weighed in the field and a small sample was saved for determination of moisture and seed size. Yield (bu/a) was adjusted to a constant 13% moisture. Percent moisture was determined by oven drying a seed sample at 132°F for 7 days. Seed size (grams/100 seeds) was determined by

Table 2. Treatments evaluated and plot sizes in the planting equipment study. Arlington, Wis., 1978.

Treatment	Planting equipment	Row width (in)	No. of rows	
			planted	harvested
1	JD	30	4	2
2	JD	20	6	4
3	JD	10	6	4
4	Tye	30	3	1
5	Tye	20	6	4
6	Tye	10	8	6
7	Tye	7	10	6
8	IHC	7	12	8

weighing 100 seeds per sample. Plant stands (plants/a) were measured in 1977 and 1978 at emergence and harvest by counting the plants within 8 ft. of the two middle rows of each plot. Plant height (inches) was measured as the average height of five plants chosen at random in each plot. It was measured from the soil surface to the tip of the stem at maturity. Maturity was defined as the time when leaves had dropped and 95% of the pods were ripe (brown or gray in color). Lodging was recorded using a scale of 1 to 5 where 1 indicated almost all plants were erect and 5 almost horizontal. Weed control was recorded in 1976 and 1978. A scale of 1 to 5 was used where 1 meant excellent control and 5 indicated poor weed control.

All data were subjected to the analysis of variance (ANOVA) and computation of appropriate means and least significant differences (LSD) at the 5% level of significance according to the procedure described by Steel and Torrie (57).

RESULTS

Arlington Tests:

In 1977, soybeans that were planted early in May yielded more than those planted late in May or early June but in 1978 yield at the first date of planting was lower than that at the second date. No difference in yield was observed between the first and second dates in 1976 (Tables A2, A3). The third date of planting consistently resulted in the lowest yield (Tables 3, A10, A11, Figure 1). Lower yields with later planting corresponded to reduced seed size as measured by weight of 100 seeds (Table 3). Significant differences in lodging were found in 1976 when more lodging occurred in the June planting than in either of the May plantings. In 1976 height increased with delayed planting but in 1978 the tallest plants were at the first date of planting. No significant differences were found in 1977. The effect of date of planting on plant population varied with years but there was a tendency for the second date to have a lower population at emergence than either the first or third dates of planting. When averaged over years, the final populations were higher with the first planting date than either the second or third date. Weed control was progressively better with delay in planting although no significant differences were found in 1976 (Tables 3, A2, A3).

Table 3. Effect of dates of planting on yield, seed weight, lodging, plant height, plant population and weed control averaged over cultivars, row width and herbicides. Arlington, Wis., 1976-1978.

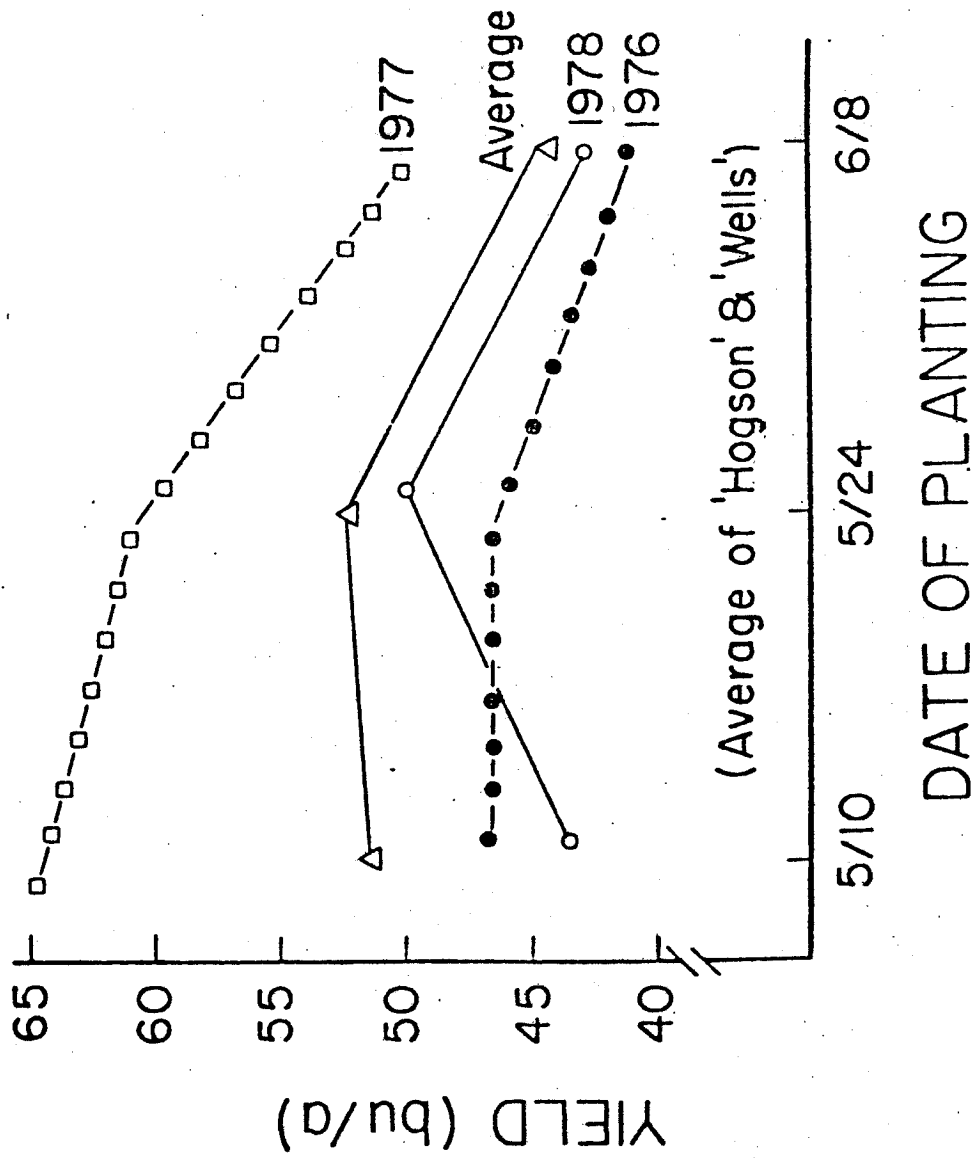
Year	Dates of planting			Mean	LSD .05
	1	2	3		
- Yield (bu/a) -					
1976	46.90	46.70	41.20	44.90	3.20
1977	64.80	61.20	50.50	58.80	2.50
1978	43.50	50.10	43.10	45.60	3.80
Mean	51.70	52.70	44.90	49.80	1.80
- Seed weight (g/100)					
1976	15.14	14.46	12.80	14.13	0.22
1977	17.39	16.36	15.85	16.53	0.34
1978	16.12	14.88	14.15	15.05	1.49
Mean	16.22	15.23	14.27	15.24	0.39
- Lodging -					
1976	1.00	1.20	2.30	1.50	0.30
1977	1.00	1.00	1.10	1.00	0.10 ⁿ
1978	1.10	1.10	1.10	1.10	0.30 ⁿ
Mean	1.00	1.10	1.50	1.20	0.10 ⁿ
- Plant height (in) -					
1976	31.40	34.20	36.40	34.00	1.90
1977	39.60	39.90	39.30	39.60	0.70 ⁿ
1978	35.10	34.90	31.20	33.70	3.10
Mean	35.40	36.30	35.60	35.80	1.10

Table 3. (continued)

Year	Dates of planting			Mean	LSD .05
	1	2	3		
- Emergence population x 10 ³ -					
1977	194.10	172.30	177.60	181.30	6.30
1978	99.60	92.30	106.00	99.30	12.30
Mean	146.80	132.30	141.80	140.30	6.60
- Harvested population x 10 ³ -					
1977	165.30	156.40	143.30	155.00	5.30
1978	96.00	91.10	104.60	97.20	12.60
Mean	130.60	123.70	123.90	126.10	6.30
- Weed control -					
1976	2.10	2.20	1.80	2.00	0.40 ⁿ
1978	3.30	1.70	1.20	2.10	0.60
Mean	2.70	1.90	1.50	2.00	0.40

n = LSD calculated but not significant at the 5% level of significance.

Figure 1. Effect of dates of planting on soybean yield averaged over cultivars, row widths and herbicides. Arlington, Wis., 1976-78.



The 'Hodgson' cultivar consistently had higher yields and larger seeds than 'Wells', however, the differences in yield were not significant in 1978 (Tables 4, A9, A10, A11, Figures 2, 3, 4). 'Hodgson' lodged more than 'Wells' in 1976 but not in 1977 and 1978 (Table 4). 'Wells' was taller than 'Hodgson' except in 1978 when the opposite was observed. In 1978 'Hodgson' had more plants/a than 'Wells'. The two cultivars did not differ in their ability to compete with weeds. The effect of cultivars on plant height, seed size and lodging in 1976 and plant population in 1978 was different at different dates of planting (Tables A3, A9).

Yields were greater in the 7- and 10-inch row widths than in the 30-inch row widths (Tables 5, A11, Figure 5). In 1976 the difference between the 7- and 10-inch rows was not significant but in 1977 and 1978 higher yields were found in 10-inch rows than in 7-inch rows (Tables 5, A2, A3, A5, A6, A8, A9). In 1976 and 1978, seed size decreased as row width was reduced but the opposite was observed in 1977 (Table 5). Plants in the 7- and 10-inch row widths lodged slightly more than those in the 30-inch row widths. Plants in the 30-inch rows tended to be shorter than plants in the 7- and 10-inch rows although in 1978 plants in the 7-inch rows were shorter than plants in either the 10- or 30-inch row widths. In 1977, the 30-inch row widths had the lowest plant population/a and there were more plants/a

Table 4. Effect of cultivars on yield, seed weight, lodging, plant height, plant population and weed control over dates of planting, row widths and herbicides. Arlington, Wis., 1976-1978.

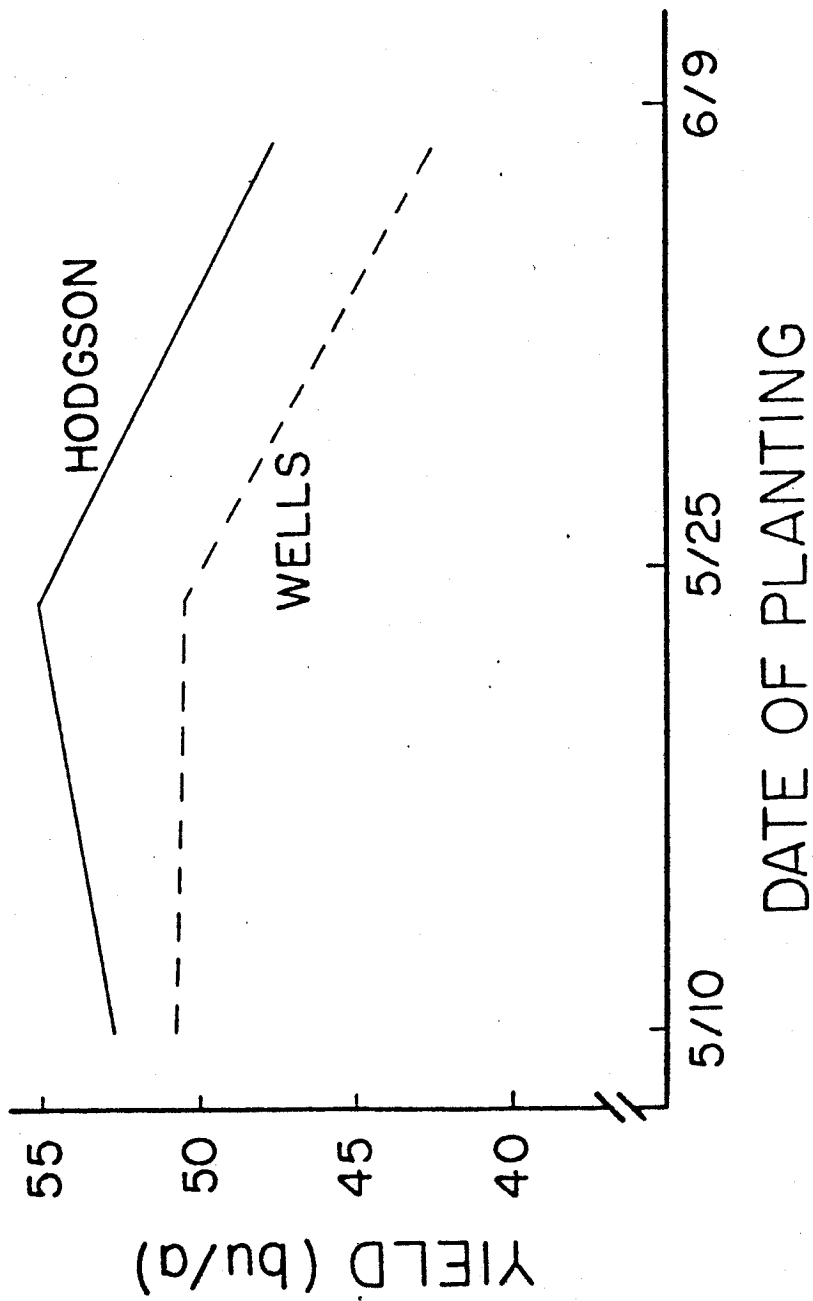
Year	Cultivars		Mean	LSD .05
	Hodgson	Wells		
- Yield (bu/a) -				
1976	46.30	43.60	44.90	2.20
1977	59.70	58.00	58.80	1.40
1978	49.60	41.50	45.50	9.40 ⁿ
Mean	51.90	47.70	49.70	2.50
- Seed weight (g/100) -				
1976	15.27	12.99	14.13	0.36
1977	17.08	15.99	16.53	0.32
1978	15.06	15.04	15.05	0.61 ⁿ
Mean	15.80	14.67	15.23	0.25
- Lodging -				
1976	1.70	1.30	1.50	0.10
1977	1.10	1.00	1.00	0.10 ⁿ
1978	1.20	1.00	1.10	0.20 ⁿ
Mean	1.30	1.10	1.20	0.10
- Plant height (in.) -				
1976	31.40	36.60	34.00	0.90
1977	38.40	40.80	39.60	1.10
1978	34.90	32.60	33.70	1.70
Mean	34.90	36.70	35.80	0.70

Table 4. (continued)

Year	Cultivars		Mean	LSD .05
	Hodgson	Wells		
- Emergence population x 10 ³ -				
1977	177.70	184.90	181.30	9.00 ⁿ
1978	116.10	82.50	99.30	11.80
Mean	146.90	133.70	140.30	7.40
- Harvested population x 10 ³ -				
1977	151.80	158.20	155.00	7.30 ⁿ
1978	110.10	84.30	97.20	10.10
Mean	130.90	121.20	126.00	6.20
- Weed control -				
1976	2.20	1.90	2.00	0.30 ⁿ
1978	1.90	2.20	2.00	0.60 ⁿ
Mean	2.00	2.00	2.00	0.40 ⁿ

n = LSD calculated but not significant at the 5% level of significance.

Figure 2. Effect of dates of planting and cultivars on soybean yield averaged over row widths and herbicides. Arlington, Wis., 1976-78.



Effect of dates of planting on yield of 'Hodgson' and 'Wells' soybeans averaged over row widths and herbicides. Arlington, Wis., 1976-78.

Figure 3.

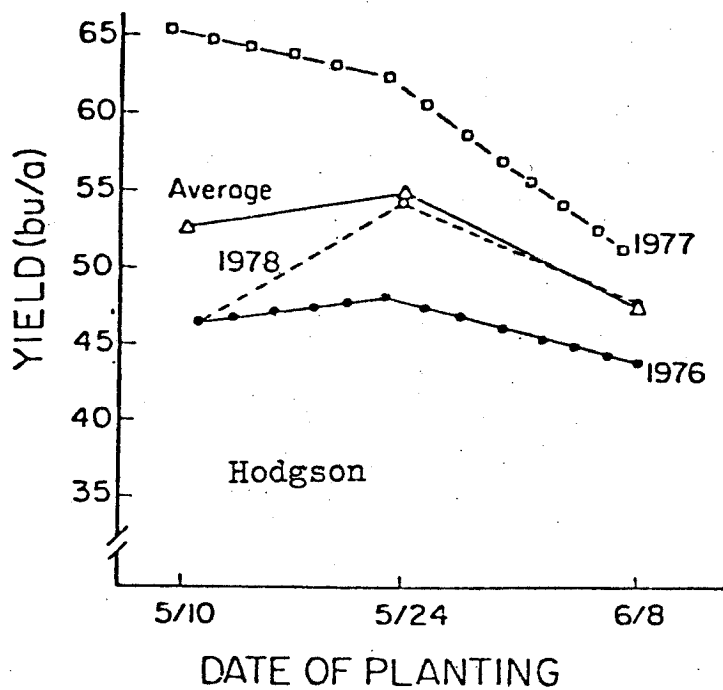


Figure 4.

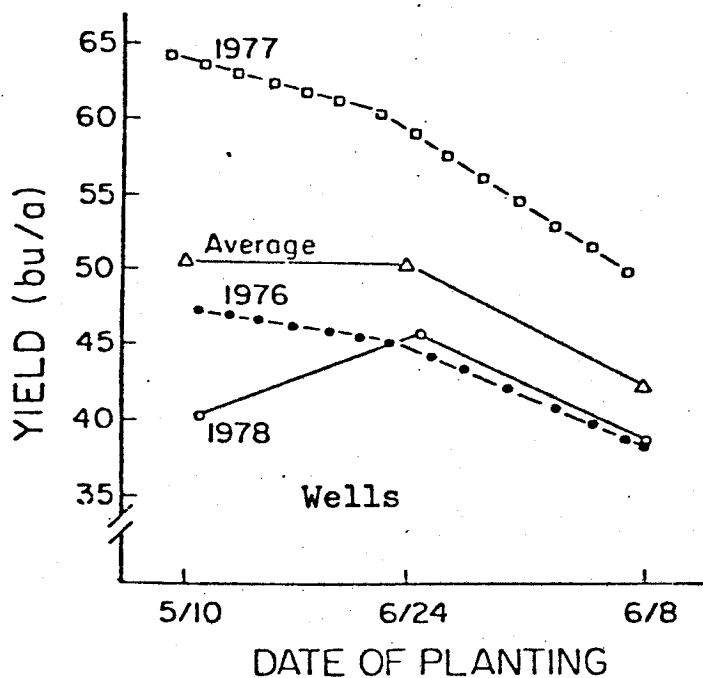


Table 5. Effect of row widths on yield, seed weight, lodging, height, plant population and weed control averaged over dates of planting, cultivars and herbicides. Arlington, Wis., 1976-1978.

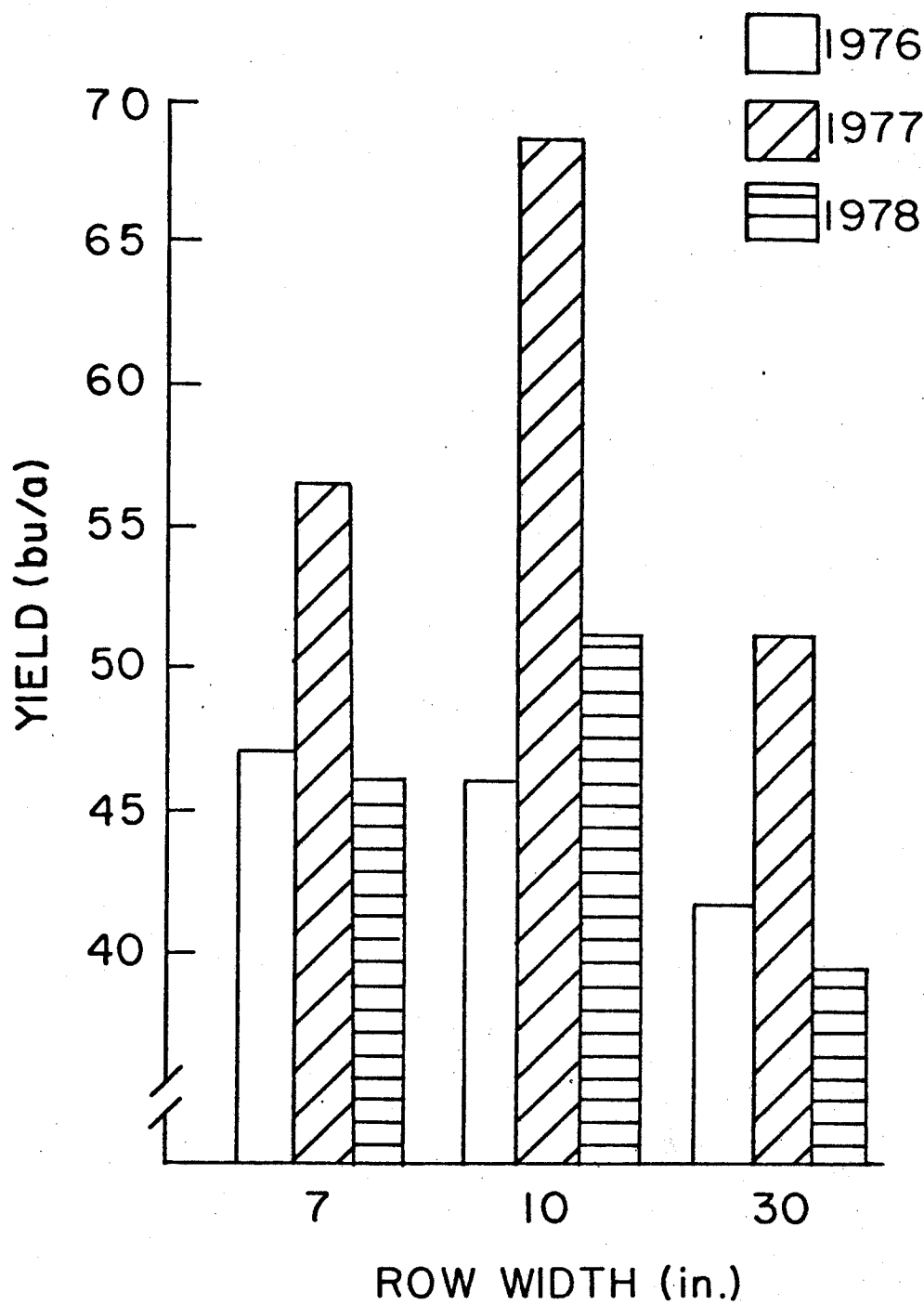
Year	Row widths (in.)			Mean	LSD .05
	30	10	7		
- Yield (bu/a) -					
1976	41.80	46.00	47.10	45.00	2.20
1977	51.30	68.70	56.50	58.80	1.50
1978	39.40	51.20	46.10	45.60	2.80
Mean	44.20	55.30	49.90	49.80	1.30
- Seed weight (g/100) -					
1976	14.40	14.09	13.91	14.13	0.20
1977	16.32	16.52	16.76	16.53	0.19
1978	15.46	14.85	14.83	15.05	0.37
Mean	15.39	15.15	15.17	15.24	0.15
- Lodging -					
1976	1.30	1.70	1.50	1.50	0.20
1977	1.00	1.00	1.10	1.00	0.10 ⁿ
1978	1.10	1.10	1.20	1.10	0.10 ⁿ
Mean	1.10	1.30	1.30	1.20	0.10
- Plant height (in.) -					
1976	32.70	34.70	34.60	34.00	0.70
1977	38.80	39.80	40.10	39.60	0.60
1978	34.20	34.50	32.50	33.70	1.00
Mean	35.20	36.30	35.70	35.80	0.40

Table 5. (continued)

Year	Row widths (in.)			Mean	LSD .05
	30	10	70		
- Emergence population x 10 ³ -					
1977	115.90	195.10	233.00	181.30	13.70
1978	72.60	129.40	95.80	99.30	8.50
Mean	94.20	162.20	164.40	140.30	7.80
- Harvested population x 10 ³ -					
1977	97.90	174.80	192.30	155.00	8.90
1978	69.90	123.60	98.20	97.20	7.80
Mean	83.90	149.20	145.20	126.10	5.90
- Weed control -					
1976	1.80	2.50	1.80	2.00	0.20
1978	1.70	1.90	2.70	2.10	0.40
Mean	1.70	2.20	2.20	2.00	0.20

n = LSD was calculated but not significant at the 5% level of significance.

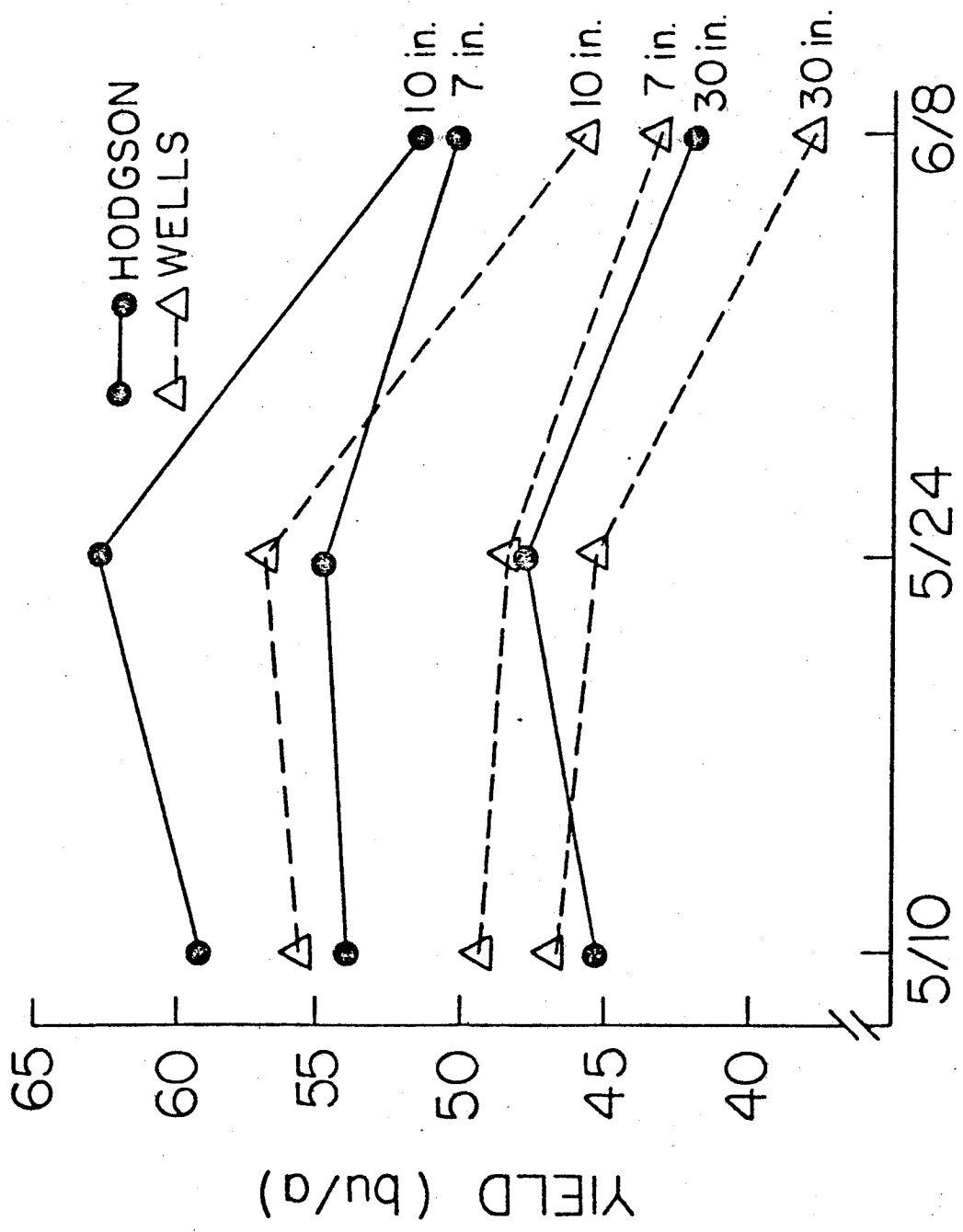
Figure 5. Effect of row widths on soybean yield, averaged over dates of planting, cultivars and herbicides. Arlington, Wis., 1976-78.



in 7-inch than in 10-inch rows. The opposite was observed in 1978. Weed control was best in the 30-inch row widths. In 1976 weed control in 7- and 30-inch rows was the same and superior to that in 10-inch rows. The effect of row widths on yield in 1976, seed size in 1976 and 1977, weed control, plant population/a and plant height in 1978, was not the same at all three dates of planting (Tables A1, A3, A4, A6, A7, A9, Figure 6). Similarly, the effect of row widths on yield in 1976 and 1977, and seed size in 1976 and 1978 varied with the cultivar used (Tables A1, A4, A7, Figure 6).

In 1976, the herbicide treatment that included both a preplanting and a postemergence herbicide yielded more than the other treatment which consisted of only the preplanting herbicide (Tables 6, A1, A2, A3). No significant difference in yield was found in 1977 and 1978 (Tables A6, A9). Applications of bentazon reduced size of seed and lodging in 1976 but no difference in lodging was found in 1977 and 1978. Herbicide treatments did not differ in their effects on plant height and plant population/a. Better weed control was obtained in plots that were sprayed with bentazon than in those that were not sprayed but the difference between the two herbicide treatments was not significant in 1978. The effect of herbicide treatments on yield in 1976 and 1978, and on weed control in 1976 was significantly modified by date of planting (Tables A3, A9).

1976-78.



DATE OF PLANTING

Table 6. Effect of herbicides on yield, seed weight, lodging, plant population and weed control averaged over dates of planting, cultivars and row widths. Arlington, Wis., 1976-1978.

Year	Herbicides		Mean	LSD .05
	1	2		
- Yield (bu/a) -				
1976	43.60	46.30	44.90	1.40
1977	59.10	58.60	58.80	0.80 ⁿ
1978	45.90	45.20	45.50	1.40 ⁿ
Mean	49.50	50.00	49.70	0.70 ⁿ
- Seed weight (g/100) -				
1976	14.28	13.98	14.13	0.17
1977	16.62	16.45	16.53	0.17 ⁿ
1978	15.14	14.96	15.05	0.25 ⁿ
Mean	15.35	15.13	15.24	0.11
- Lodging -				
1976	1.60	1.40	1.50	0.20 ⁿ
1977	1.00	1.00	1.00	0.00 ⁿ
1978	1.10	1.10	1.10	0.10 ⁿ
Mean	1.20	1.20	1.20	0.10 ⁿ
- Plant height (in.) -				
1976	34.40	33.60	34.00	0.70
1977	39.70	39.40	39.50	0.30 ⁿ
1978	33.90	33.60	33.70	0.80 ⁿ
Mean	36.00	35.50	35.70	0.30

Table 6. (continued)

Year	Herbicides		Mean	LSD .05
	1	2		
- Emergence population x 10 ³ -				
1977	183.20	179.40	181.30	4.40 ⁿ
1978	98.00	100.60	99.30	7.00 ⁿ
Mean	140.60	140.00	140.30	4.00 ⁿ
- Harvested population x 10 ³ -				
1977	155.20	154.90	155.00	4.90 ⁿ
1978	96.90	97.50	97.20	6.50 ⁿ
Mean	126.00	126.20	126.10	4.00 ⁿ
- Weed control -				
1976	2.60	1.50	2.00	0.20
1978	2.20	2.00	2.10	0.40 ⁿ
Mean	2.40	1.70	2.00	0.20

n = LSD calculated but not significant at 5% level of significance.

Better weed control was associated with delay in planting (Tables A10, A11). The application of bentazon increased yield in the 10-inch rows but not in the 7-inch rows. Yield was increased in 30-inch rows when 'Wells' was planted (Figure 7).

Janesville Tests:

'Hodgson' yielded more than 'Wells' in 1978 but no difference was found in 1976 (Tables 7, A12, A13, A14). In 1976, 'Hodgson' had larger seeds than 'Wells' but again the difference was not significant in 1978. Although the difference in height was significant in 1978 only, 'Wells' was consistently taller than 'Hodgson'.

In 1976 the highest yield was obtained in 10-inch rows and the lowest in 7-inch rows. Yields in 10- and 30-inch rows were not significantly different. In 1978, the 7-inch rows out-yielded 30-inch rows by 4.6 bu/a, but again the difference was not statistically different (Table 7). No differences in seed size and plant population were observed, however, plant stands were not as uniform in 7-inch rows as those in 30-inch rows. In 1976 plant height was decreased as spacing between rows was reduced but the difference in 1978 was not significant. No significant difference in lodging was found among row widths although the 7-inch row widths showed a tendency to lodge more than the 30-inch row widths. The best weed control was found in the 30-inch

Figure 7. Effect of cultivars, row widths and herbicides on soybean yield averaged over dates of planting. Arlington, Wis., 1976-78.

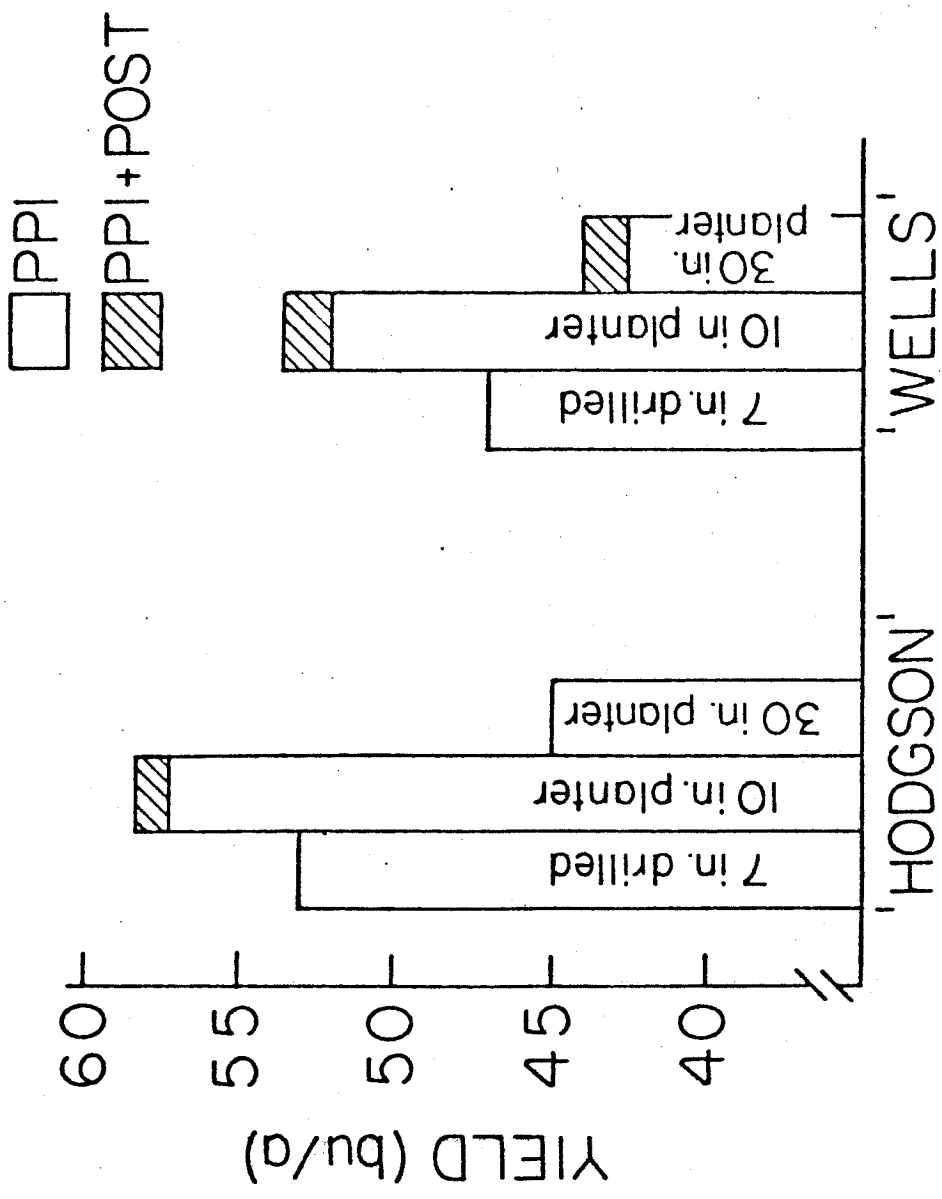


Table 7. Summary of the effect of cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Janesville, Wis., 1976 and 1978.

	Yield (bu/a)		% Moisture		Seed wt. (g/100)		Plant ₃ pop. ^{2/} x 10 ³		Plant ht. (in.)		Lodging score		Weed control							
	1976	1978	1976	1978	1976	1978	1976	1978	1976	1978	1976	1978	1976	1978	Mean					
Cultivars																				
Hodgson	44.4	60.8	52.6	12.4	19.0	15.7	17.25	18.30	17.77	57.3	46.7	32.1	39.2	35.6	1.1	1.6	1.3	2.1	3.0	2.5
Wells	44.7	57.6	51.1	12.5	18.2	15.3	15.21	19.40	17.30	68.5	54.1	34.7	42.7	38.7	1.1	1.5	1.3	2.3	1.6	1.9
LSD .05	10.5 ⁿ	0.6	3.9 ⁿ	1.5 ⁿ	34.9 ⁿ	12.9 ⁿ	0.72	1.42 ⁿ	0.76 ⁿ	107.7 ⁿ	35.6 ⁿ	3.6 ⁿ	3.2	2.4	0.0 ⁿ	4.8 ⁿ	1.7 ⁿ	0.8 ⁿ	1.6 ⁿ	0.8 ⁿ
Row widths (in.)																				
30	45.3	51.9	48.6	12.4	18.4	15.4	16.43	18.68	17.55	117.2	92.4	34.7	41.9	38.3	1.2	1.4	1.3	1.8	1.6	1.7
10	46.3	-	46.3	12.4	-	12.4	16.38	-	16.38	-	-	33.2	-	33.2	1.0	-	1.0	2.3	-	2.3
7	41.9	66.5	54.2	12.7	18.8	15.7	15.88	19.03	17.45	85.8	83.5	32.3	40.1	36.2	1.0	1.7	1.3	2.5	3.0	2.7
LSD .05	3.3	21.3 ⁿ	8.7 ⁿ	0.6 ⁿ	2.5 ⁿ	1.1	0.82 ⁿ	1.61 ⁿ	1.21	15.8	14.5 ⁿ	1.2	2.2 ⁿ	1.2	0.2 ⁿ	1.9 ⁿ	0.7 ⁿ	0.5	3.4 ⁿ	1.4 ⁿ
Herbicides^{1/}																				
1	43.9	58.1	51.0	12.5	18.9	15.2	16.29	18.80	17.54	64.2	49.7	33.6	41.1	37.3	1.0	1.6	1.3	2.4	2.6	2.5
2	45.1	60.3	52.7	12.4	18.2	15.3	16.17	18.90	17.53	61.6	51.1	33.2	40.9	37.0	1.1	1.5	1.3	2.0	2.0	2.0
LSD .05	2.4 ⁿ	4.1 ⁿ	2.3 ⁿ	0.3 ⁿ	3.3 ⁿ	1.3 ⁿ	0.44	1.56 ⁿ	8.5 ⁿ	8.5 ⁿ	9.8 ⁿ	1.9 ⁿ	1.9 ⁿ	1.3 ⁿ	0.5 ⁿ	0.8 ⁿ	0.5 ⁿ	0.6 ⁿ	2.1 ⁿ	1.0 ⁿ

^{1/} 1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI).
 2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI) + 1 lb/a bentazon.

^{2/} EPOP = emerged population, HPOP = harvested population, plants/a.

rows and weed population increased with decrease in row width. Yield was slightly increased by bentazon but the increase was not statistically significant. The herbicide treatment that included bentazon controlled weeds better than that without it, but again the difference was not significant. Plant populations at emergence were lower with 'Hodgson' and higher with 'Wells' when bentazon was applied, however, no significant difference was found at harvest.

Planting Equipment Test:

Although the difference was not significant, average yields were higher in plots planted with the Tye soybean drill than in plots planted with the John Deere planter (Tables 8, 9, A15). There were more plants/a in plots planted with the John Deere planter than in those planted with the Tye soybean drill, however, the differences were significant only at harvest time in 30-inch rows. No differences in seed size, plant height or lodging were found.

With both the John Deere planter and the Tye soybean drill, yields were increased when row width was reduced from 30 or 20 inches to 10 inches (Tables 9, A15). However, yields in 20- and 30-inch row widths were not different. Larger seeds were found in 30-inch rows than in either 10- or 20-inch rows. There were more plants/a as row width was reduced from 30 to 10 inches. No differences in plant height were observed. Plants in 10- and 30-inch

Table 8. Effect of planting equipment and row width on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1978.

Planting equipment	Row width (in.)	Yield bu/a	Moisture %	Seed wt. g/100	Plant pop. x 10 ³		Height (in.)	Lodging score
					EPOP ^{1/}	HPOP ^{1/}		
JD	10	72.3	15.0	15.53	176.5	178.9	32.5	2.0
JD	20	59.7	14.9	15.01	113.1	110.7	32.5	1.0
JD	30	57.3	15.6	16.59	97.7	102.6	34.0	1.7
TYE	7	67.6	15.4	15.64	337.3	323.3	34.0	2.2
TYE	10	67.8	15.3	15.69	134.8	137.2	33.5	1.7
TYE	20	61.9	15.4	15.62	127.0	118.8	33.5	1.2
TYE	30	66.5	15.3	16.25	68.1	57.2	32.7	1.7
IHC	7	62.9	15.4	15.23	217.1	205.4	32.0	2.0
LSD .05		10.6	1.0 ⁿ	1.27 ⁿ	46.7	45.2	3.6 ⁿ	0.6

^{1/} EPOP = Emerged population, HPOP = Harvested population, plants/a.
n = LSD calculated but not significant at 5% level of significance.

Table 9. Summary of the comparison between JD planter and Tye drill in the 10-inch, 20-inch and 30-inch rows. Arlington, Wis., 1978.

	Yield (bu/a)	% Moisture	Seed wt. g/100	$\frac{\text{Plant pop.} \times 10^3}{\text{EPOP}^{1/2}}$	Height (in.)	Lodging score
JD	63.1	15.2	15.71	129.1	33.0	1.6
Tye	65.4	15.3	15.85	110.0	33.2	1.6
LSD .05	2.9 ⁿ	0.8 ⁿ	1.07 ⁿ	67.4 ⁿ	4.2 ⁿ	0.4 ⁿ
Row width (in.)						
10	70.1	15.2	15.61	155.6	33.0	1.9
20	60.8	15.2	15.32	120.0	33.0	1.1
30	61.9	15.4	16.42	82.9	33.4	1.7
LSD .05	8.5	0.8 ⁿ	0.79	56.5	2.4 ⁿ	0.4

^{1/}EPOP = Emerged population, HPOP = Harvested population, plants/a
n = LSD calculated but not significant at 5% level of significance.

lodged more than plants in 20-inch rows. Although no significant difference was found, yields from plots planted with the Tye soybean drill were 9.4 bu/a more than yield from plots planted with the IHC grain drill when the two equipments were compared in 7-inch row widths (Tables 8, A15). There were no differences in seed size, plant height and lodging. Plots planted with the IHC drill had more plants/a than plots planted with the Tye drill. The effect of row widths on both emerged and final plant populations differed with the type of equipment used to plant soybeans (Tables 8, 9, A15).

DISCUSSION

Arlington

Soybean performance may vary from year to year because of variations in rainfall, temperature and other environmental factors. In these experiments, moisture supply should be considered the major environmental factor that affected soybean growth. Tables A20 to A25 show the annual rainfall and temperature conditions during the three growing seasons. The 1976 growing season was one of the driest on record in Wisconsin. The combination of above normal temperatures and the lack of rainfall caused severe stress in soybeans which was further accentuated by several days of hot, drying winds. The 1977 crop season was exceptionally productive due to timely rainfalls. The most significant weather feature of the 1978 growing season was the heavy rainfall early in the season. Total rainfall from April to September averaged 28.7 inches compared with 22.8 inches in 1977, 13.1 inches in 1976 and a normal of 21.4 inches.

The differences in rainfall from year to year may partly explain the varying effect of date of planting in each of the three years. Plants grew under droughty conditions in 1976, under ideal conditions in 1977 and under too wet conditions resulting in severe soil crusting in 1978. In 1977, the highest yield was obtained with the earliest planting date and yields were reduced as planting was delayed. The unusually warm spring and ideal growing

conditions in 1977 contributed to high yields obtained at the first date of planting. Feaster (19) and Hartwig (24) reported that in the more northern latitudes of the United States, planting in late May generally produce the highest yields. The main reason for that is that late May planting ensures that soybeans are planted at a time when soils are warm enough to promote good seed germination and fast emergence. In 1977, soils warmed up much earlier than usual. In 1976, a combination of drought and cold temperatures early in spring was likely responsible for the non-significant difference between the first and second dates of planting. In 1978, the heavy rains that occurred early in the season caused serious soil crusting and reduced not only yield but also plant populations/a at the first date of planting. In all three years, the lowest yield was found at the third date of planting. Similar results were reported by Torrie and Briggs (60). They reported that yield tended to decrease with plantings made after May 20. This is due largely to the effect of the shortening photoperiod.

Seed size also decreased with delay in planting. Similar results were reported by Weiss et al. (69). Soybeans planted early have a longer growing season and more time for pod filling before the first killing frost than do those planted later in the season. Hanway and Weber (23)

concluded that late cultivars yielded more than early cultivars because they spend more time filling pods than do early cultivars.

Lodging was significant in 1976 only and it increased with an increase in plant height. Weiss et al. (69) and Torrie and Briggs (60) found that lodging of soybean plants was not affected consistently by delay in planting and that may explain the non-significance in 1977 and 1978. In 1976, the increased plant height that occurred at later dates of planting was due probably to the warm soil temperatures that prevailed after May 23. The early part of May was cold and dry with several nights of below freezing temperatures followed by warmer June temperatures. A report by van Schaik and Probst (61) showed an increase in plant height as temperature increased. In 1977, there was no difference in plant height. Warm temperatures accompanied by adequate soil moisture and an unusually long growing season, made it possible, even for late planted plants to grow to greater heights than would be expected during an average growing season. In 1978, plants at the third date of planting were significantly shorter than those at either the first or second date of planting. The reduction in plant height observed when planting is delayed has been attributed to the effect of shortening photoperiod (21, 41, 60, 69).

In 1977 and 1978 the lowest plant populations were found at the second date of planting. The low soil

moisture experienced at this date might have caused the lower plant populations observed.

Weed control improved with a delay in planting. This was because later plantings allowed for killing an extra crop of weeds during seed bed preparation. Also, warm soil temperatures associated with later plantings aid in attaining rapid germination, emergence and canopy development which help in shading out weeds.

'Hodgson' cultivar yielded more and had larger seeds than 'Wells'. Seed yield is dependent not only upon the number of pods produced but also on seeds per pod and seed size (4, 61). Burnside and Colville (4) have previously reported a positive correlation between greater weight of 100 seeds (seed size) and yield. The two cultivars are adapted to southern Wisconsin, however, 'Hodgson' is usually 5 to 7 days earlier in maturity. Scott and Aldrich (52) stressed the importance of environmental conditions at pod filling as the major determinants of final seed size. Usually a cultivar whose pod filling period coincides with favorable environmental conditions, especially soil moisture, has larger seeds than a cultivar whose pod filling stage occurs during unfavorable conditions.

'Wells' was taller but more resistant to lodging than 'Hodgson'. Usually lodging is positively correlated with plant height, yield and weight of 100 seeds (seed size);

which indicates that tall, high-yielding soybean plants generally lodge more (4). Morphologically the cultivar 'Wells' has thicker stems than 'Hodgson' and generally has better lodging resistance. Height of a cultivar is influenced by several factors such as date of planting, spacing between and within rows, moisture supply, temperature, etc. (1, 8, 33, 69). Another important factor affecting plant height is the maturity of the cultivar. Early cultivars are usually shorter than later maturing ones. In 1978, the trend was reversed as a result of reduced plant stands in 'Wells'. The reduction in plant height associated with low plant stands was reported by Weber et al. (68). 'Hodgson' emerged 2 to 3 days ahead of 'Wells' and the soil crusting which occurred during the second and third week of May could have reduced stands of 'Wells' more than it did for 'Hodgson'. The cultivars were not different in their ability to compete with weeds. The effect of cultivars on lodging in 1976, seed size in 1976 and 1978, plant height in 1976 and 1978 and plant population in 1978 was significantly influenced by the date of planting indicating that the performance of each cultivar depended on the time when the planting was done.

In all three years the 7- and 10-inch rows yielded more than the 30-inch rows. Similar results have been reported by other workers (38, 46, 59). In 1978, competition

from weeds and poor plant stands could have contributed to low yields found in 7-inch rows.

In 1976 and 1978 seed size decreased with decrease in row width. Such results were in agreement with those reported by Costa (14). He reasoned that this was due to greater intra-plant competition in narrow rows. Lehman and Lambert (35) reported that row spacing did not affect seed weight appreciably. This may explain the different results obtained from year to year.

Row width resulted in significantly different lodging in 1976 only. The 7- and 10-inch rows lodged more than the 30-inch rows. In 1976 and 1977 plants were taller in 7- and 10-inch rows than in 30-inch rows. This behavior of soybean plants to increase height with decreasing inter-row spacing has been reported by a number of workers (30, 34, 68). In 1978, the poor plant stands in the 7-inch rows were responsible for the reduced plant height and might have allowed more weed competition. The one inter-row cultivation in 30-inch row plots combined with herbicide applications provided the best weed control. Similar results were reported by Peters et al. (48). The significant interactions between row widths and date of planting and that between row width and cultivars indicate that the effect of row widths on soybean characteristics is dependent on the time soybeans are planted and the cultivar used.

In 1976, better weed control provided by the combination of a preplanting and a postemergence herbicide resulted in higher yields than in the herbicide treatment that did not include a postemergence application. A number of writers have reported that herbicide combinations can markedly increase the spectrum and dependability of weed control in soybeans (27, 28, 64). Herbicide treatments had no effect on plant populations and plant height. Similar results were reported by Burnside and Moomaw (5). They found that average soybean stands were similar regardless of the herbicide treatment. Johnson (28) reported that plant height and lodging were not influenced by sequential treatments of trifluralin when applied with any postemergence treatment. Burnside and Colville (4) reported that seed weight was the plant character least affected by mechanical, cultural and chemical practices they studied.

Better weed control was found in plots that received both the preplanting and postemergence herbicide applications. Johnson (28) reported that herbicides applied as a single application to soybeans prior to or at planting, failed to control broadleaf weeds throughout the growing season. He stated that either cultivation or additional herbicides are required to control weeds for the remainder of the season.

It should be noted, however, that the non-significant difference between herbicide treatments could have been due to lack of adequate weed pressure. Weed stands were highest in the first date of planting and even then weed competition was minimized by cultivating the 30-inch row widths. Wax and Pendleton (65) reported that weed population increased with increase in row width. As a consequence, the beneficial effect of herbicide treatments would be expected to be more pronounced in uncultivated wide rows than in narrow rows. Seedbed preparation practices before planting the second and third dates were performed after most weed seed had germinated and emerged. Since extra crop of weeds was killed before soybeans were planted, weed competition was reduced. This is supported by the significant interaction between dates of planting and herbicide treatments which indicates that the effect of herbicide treatments was not the same at all three dates of planting.

Janesville:

Of the characteristics studied, cultivars were significantly different in seed size in 1976, in yield and plant height in 1978. When soil moisture was limiting in 1976, no difference in yield was found between 'Hodgson' and 'Wells' but with adequate moisture in 1978, 'Hodgson' yielded more than 'Wells'. When averaged over the years, 'Hodgson' had larger seeds than 'Wells' but the latter was

taller than the former. These results are in agreement with those obtained from the Arlington studies.

In 1976 the 30- and 10-inch row widths yielded about the same and both were superior to the 7-inch row width. Better weed control in 30-inch rows was again a result of the combination of herbicides and one interrow cultivation. Plants were shorter in 7- and 10-inch rows than in 30-inch rows. Costa (14) reported similar results and he reasoned that this could have been due to increased intra-plant competition as the space between the rows is reduced. In 1978, no significant differences were found between the 7-inch and the 30-inch rows, probably because of the poor plant stands in the 7-inch rows. Herbicide treatments were not different. Similar results were found at Arlington in 1977 and 1978.

Planting Equipment

Drills are commonly used to plant soybeans in narrow rows but generally they cannot compensate for poorly prepared seedbeds as well as the conventional planters. As a general rule of thumb, seeding rates are increased over the ideal in conventional wide rows when drills are used, to ensure a good plant stand. Equipment manufacturers have developed several new planters and many new or improved options designed specifically for soybeans.

Experimental results obtained at the Arlington Experimental Farm showed that the Tye soybean drill differed from the John Deere planter only in plant population at maturity

when soybeans were planted in 30-inch row widths. The Tye drill was also compared with the IHC grain drill in the 7-inch row width. Plots planted with the Tye drill had more plants/a than those planted with the IHC grain drill.

The Tye soybean drill possesses certain features that make it more suitable for planting soybeans than most grain drills. The following are some of those features. The Tye drill has a seed dispensing unit that meters soybean seed accurately and gently without cracking or grinding. Other drills do not have the same mechanism. The Tye drill has a double disc opener that places the seed uniformly at a constant depth with minimum soil disturbance and moisture loss. The other major difference between the Tye and the IHC drills is the use of press wheels on the Tye drill. Press wheels firm the seed in the seedbed for uniform and quick germination.

Difficulties were encountered in establishing good plant stands in the cultural practices study when the Tye drill was used to plant soybeans in 7-inch row widths. Such problems were not found in the planting equipment study because the seeding rate was increased over that used in the cultural practices study. The seeding rate was increased from 3 to 4 seeds/ft of row to 5 to 6 seeds/ft of row. With proper adjustment of the Tye soybean drill and ideal field conditions, such high rates might not be necessary.

Results at Arlington showed that the Tye soybean drill could perform as well as the John Deere planter and better than the IHC grain drill.

SUMMARY

Field experiments were conducted from 1976 to 1978 at the University of Wisconsin Arlington Experimental Farm and at Janesville in 1976 and 1978, to evaluate the effect of dates of planting on 'Hodgson' and 'Wells' soybean cultivars planted in 7-, 10- and 30-inch row widths except at Janesville in 1978 when the 10-inch rows were not included. Herbicide treatments consisted of a preplanting application of trifluralin with metribuzin and with or without a post-emergence application of bentazon. Metribuzin was not used in 1978 and only one date was used at Janesville in 1976 and 1978. At Arlington in 1978, a study was conducted to study the effect of planting equipment on soybeans.

Yield, seed size and weed population decreased with delay in planting except in 1978 when the second date yielded highest. Lodging increased with delay in planting in 1976 but no differences were found in 1977 and 1978. Plant stands/a were lowest at the second date. 'Hodgson' consistently out-yielded 'Wells' except at Janesville in 1976 and the difference increased with delay in planting. Averaged over years 'Hodgson' was shorter but had larger seeds and lodged more than 'Wells'. 'Wells' had more plants/a than 'Hodgson' in 1977 but the opposite was found in 1978 because of soil crusting. The 7- and 10-inch rows yielded

more than the 30-inch rows except at Janesville in 1976 when the 10- and 30-inch rows yielded the same but more than the 7-inch rows. Also at the same location in 1978, no difference was found between the 10- and 30-inch rows. On the average the 30-inch rows had the best weed control, the largest seeds and at Janesville, the tallest plants. Plant height tended to increase with decrease in row width at Arlington. Plants in the 30-inch rows lodged the least. Better weed control was found in plots sprayed with bentazon and at Arlington in 1976, yield was significantly increased by the herbicide. *The Tye soybean drill performed as well as the John Deere planter and better than the IHC grain drill.*

PART II

EFFECT OF CULTURAL PRACTICES AND FUNGICIDES
ON CONTROL OF SOYBEAN DISEASES

INTRODUCTION

In 1977, soybean seed produced in many regions of Wisconsin had low germination and low seedling vigor. Isolations revealed a high percentage of seed infected by Diaporthe phaseolorum (Cke & Ell.) var. sojaj Wehm (Syn. D. sojaj Leh.) and the imperfect stage Phomopsis sojaj Leh. associated with poor germinating seed lots (Grau and Oplinger, unpublished data). Preliminary studies conducted in 1977 (Grau and Oplinger, unpublished data) indicated that seed quality was lower in narrow than in wide rows, however, more work is needed to confirm the results. Also more information is needed to evaluate the effectiveness of various fungicides and cultural practices for the production of good quality seed.

These experiments were conducted to evaluate the effectiveness of foliar application of the fungicides benomyl (Methyl 1-(butyrcarbamoyl)-2 benzimidazolecarbamate) and thiazobenzodiazol (2-(4'-Thiazolyl)-benzimidazole)(Mertect 20 S and Mertect 340 F) for control of D. phaseolorum var. sojaj and Alternaria sp. In addition to this, the effect of dates of planting, cultivars, row widths and herbicide treatments on seed quality were studied.

LITERATURE REVIEW

Pod and stem blight, caused by D. phaseolorum var. sojae, usually appears on plants at maturity and normally losses in yield do not occur (2, 62). The fungus has been reported to be seed-borne (55, 62). Detrimental effects of seed-borne diseases on quality of soybean seed have been reported by Sinclair and Shurtleff (55).

Infected plants are recognized by linear rows of black pycnidia on the stems and petioles. Infected seeds appear shriveled or moldy or may not show symptoms. Most infected seeds do not germinate (50) or if they do they may produce weak seedlings. The fungus does not penetrate uninjured pods but may enter through abrasions, cracks, or other injuries (2). Seed infection is much greater with delayed harvest, particularly when accompanied by alternate wetting and drying, which is conducive to pod deterioration (2, 15, 55).

Great emphasis is put on cultural practices as the primary means of control of the fungus (15, 16). These include planting high-quality, pathogen-free seed. Crop rotation and a deep incorporation of crop residues after harvest may be beneficial. Green et al. (22) reported that as date of planting was delayed, there was an improvement in the quality of seed produced. Seed infection by D. phaseolorum var. sojae increases as temperatures and precipitation increase.

This may be a partial explanation for the lower seed germination which is more frequent in early than in late maturing cultivars because seeds of late maturing cultivars mature under cooler temperatures than do seeds of early cultivars (15). There are reports that state that soybean cultivars differ in susceptibility to pod and stem blight (2, 55) but caution should be exercised as not to confuse resistance with the effects of maturity of a cultivar. Pendleton et al. (46) reported that differences in row spacings did not noticeably affect seed quality.

Foliar application of fungicides from mid-flowering to the late-pod stage lowers the incidence of pod and stem blight as well as seed infection (2, 18, 26, 50, 55). Split applications of benomyl at early and late pod stages have proven to be very effective for controlling seed infection by D. phaseolorum var. sojae (18, 50). Currently, thiabendazole is also registered for control of pod and stem blight in soybeans (16). However, benomyl has been more effective in Wisconsin evaluations than thiabendazole (Grau, unpublished data). Prasartsee et al. (50) reported that thiabendazole was the least effective fungicide tested and they explained that this could have been due to the rate used (6 oz/a of 98.5 WP) or inadequate formulation.

MATERIALS AND METHODS

Four field experiments were conducted in 1978, Experiment 1 was at Vince Drendel's Farm near Evansville, and Experiments 2, 3 and 4 were conducted at the Arlington Experimental Farm, Arlington, Wisconsin. Soybeans had been grown the previous year on all fields used. Rates of application are expressed as formulated product.

Experiment 1

The cultivars 'Evans', 'Hodgson', 'Wells' and 'Beeson' belonging to maturity groups 0, I, II and III, respectively, were planted in row widths of 10 and 30 inches. The 10-inch plots were discarded because of poor plant stands and fungicide treatments were made only to 30-inch plots. Fungicide treatments and time of application were as shown in Table 11. Table 10 shows conditions at the time when the fungicide was applied. Treatments were arranged in a split-plot design with cultivars as main plots and fungicide treatments as subplots. Four replications were used.

Experiments 2, 3 and 4

The cultivar 'Wells' was used in these experiments. The fungicides compared were benomyl (Benlate 50W) and two formulations of thiabendazol (Mertect 20-S and Mertect 340-F). Treatment rates and times are shown in Table 12. Nonsprayed plants were the control treatments. Conditions

Table 10. Conditions at time of fungicide applications.

Experiment 1.

Date	7/24	8/22
Time	11:00 a.m.	11:00 a.m.
Temperature (F°)	72	78
Relative Humidity (%)	50	50
Wind	5-SE	10-SE
% Interception	90	95
Plant Height	39	44
No. of Leaves	14	20
Stage of Growth	R3	R6
Method	Foliar	Foliar
Equipment	CO ₂	CO ₂
Volumn (g/a)	30	30
Pressure (psi)	34	34
Tips	730154	730154

Experiments 2, 3 and 4.

Date	8/2	8/27	9/25
Time	3:00 p.m.	3:00 p.m.	3:00 p.m.
Temperature (F°)	75	72	65
Relative Humidity (%)	75	50	52
Wind	5-S	10-SE	5-SE
% Interception	90	98	90
Plant Height	36	44	40
No. of Leaves	11	18	20
Stage of Growth	R ₃	R ₆	R ₈
Method	Foliar	Foliar	Foliar
Equipment	CO ₂	CO ₂	CO ₂
Volumn (g/a)	30	30	30
Pressure (psi)	34	34	34
Tips	730154	730154	730154

Table 11. Effect of cultivars, fungicide rates (benomyl) and time of application on seed yield, seed quality and other agronomic characteristics of soybeans. Evansville, Wis., 1978.

	Fungicide treatment		Yield (bu/a)	% Moisture	Seed wt. (g/100)	Plant ₃ pop. x 10 ³	Height (in.)	Lodging score	Diartho	Alter-naria	% Germination
	Rate lb/a	Time 1/									
Evans	Control		44.8	15.2	14.42	83.9	36.2	1.5	51	85	25
	1/2+1/2	R3 + R6	48.9	14.3	14.72	93.7	35.0	1.7	24	30	44
	1+1	R3 + R6	52.3	15.9	15.86	76.2	34.2	1.5	31	33	38
Hodgson	Control		46.0	13.4	15.44	90.4	34.7	2.7	17	10	22
	1/2+1/2	R3 + R6	44.3	13.7	15.26	100.2	35.5	2.0	17	12	63
	1+1	R3 + R6	50.3	13.8	16.99	94.7	35.5	2.2	10	13	57
Wells	Control		42.3	13.3	15.65	79.5	34.5	2.7	20	12	61
	1/2+1/2	R3 + R6	41.5	15.0	15.80	105.6	39.0	1.0	14	10	43
	1+1	R3 + R6	49.0	17.1	18.12	107.8	43.0	1.0	9	8	50
Beeson	Control		47.1	15.9	16.38	107.8	41.0	1.0	10	12	55
	1/2+1/2	R3 + R6	47.7	15.9	18.14	111.1	38.0	1.0	18	13	45
	1+1	R3 + R6	44.1	17.6	19.26	82.8	40.0	1.0	20	11	56
	Control		50.6	16.7	19.96	86.0	40.0	1.2	10	16	49
	1/2+1/2	R3 + R6	49.3	14.9	17.56	74.1	38.0	1.5	9	14	53
	1+1	R3 + R6				83.9	37.0	1.2	23	10	51

Table 11. (continued)

Cultivar mean	Fungicide treatment		Yield (bu/a)	% Moisture	Seed wt. (g/100)	Plant pop. x 10 ³	Height (in.)	Lodging score	Dia- porthe maria	% Germina- tion
	Rate lb/a	Time ^{1/}								
Evans			49.1	15.0	14.90	88.2	35.0	1.7	38	33
Hodgson			45.7	13.5	15.84	91.2	35.0	2.4	16	62
Wells			45.4	15.9	17.11	108.1	41.0	1.0	13	48
Beeson			47.9	16.3	19.01	81.7	39.0	1.2	10	52
LSD .05			6.3 ⁿ	0.9	1.16	9.3	3.0	0.4	6	6
<u>Fungicide mean</u>										
Control			45.2	14.9	16.23	90.7	37.0	1.6	26	47
1/2+1/2	R3 + R6		46.6	15.7	17.02	96.9	38.0	1.5	15	50
1+1	R3 + R6		49.3	15.4	17.13	88.2	37.0	1.6	15	53
2	R6		47.2	14.7	16.49	93.4	37.0	1.7	26	45
LSD .05			3.7	1.0 ⁿ	0.99 ⁿ	9.5 ⁿ	2.0 ⁿ	0.3 ⁿ	6	6

^{1/}R3 = beginning of pod development, R6 = full seed as per Fehr et al.
n = LSD calculated but not significant at the .05 level.

Table 12. Effect of fungicide treatments on seed yield, seed quality, and other agronomic characteristics of Wells soybeans. Arlington, Wis., 1978.

Time	Fungicide treatment		Yield bu/a	Moisture %	Seed wt. g/100	Plant ht. (in.)	Lodging score	Dia- porthe %	Alter- naria %
	Kind	Rate/a							
<u>Experiment 2</u>									
R ₃ +R ₈	Mertect 20-S	12 oz	43.1	19.1	15.60	36	1.0	10.0	27
	Mertect 340-F	6 oz	42.3	19.1	15.55	36	1.2	2.5	24
	Benlate 50W	1/2 lb	43.4	19.3	15.71	36	1.0	7.5	23
	Control		44.1	19.1	15.56	37	1.0	6.5	20
	ISD		3.6 ⁿ	0.1	0.66 ⁿ	2 ⁿ	0.4 ⁿ	5.5 ⁿ	12 ⁿ
<u>Experiment 3</u>									
R ₃ +R ₆ +R ₈	Mertect 20-S	12 oz	41.6	15.6	15.76	36	1.0	1.5	39
	Mertect 340-F	6 oz	40.8	15.6	14.86	36	1.5	2.5	40
	Benlate 50W	1/2 lb	42.8	15.7	16.06	36	1.7	1.5	32
	Control		42.5	15.6	15.62	37	1.2	2.0	35
	ISD		5.0 ⁿ	0.4 ⁿ	.67	1.1 ⁿ	0.7 ⁿ	3.5 ⁿ	10 ⁿ

Table 12. (continued)

Time ^{1/}	Fungicide treatment		Yield Rate/a bu/a	Moisture %	Seed wt. g/100	Plant ht. (in.)	Lodging score	Dia- porth ^e %	Alter- naria %	
	Kind	Rate/a bu/a								
Experiment 4										
R ₃ +R ₆										
	Mertect	20-S	6 oz	44.8	15.6	16.03	37	1.2	2.5	31
	Mertect	20-S	12 oz	47.1	15.6	16.38	39	1.0	0.5	29
	Mertect	20-S	16 oz	44.0	15.6	15.48	38	1.2	1.0	38
	Mertect	20-S	32 oz	44.4	15.6	16.06	37	1.2	3.5	38
	Mertect	20-S	64 oz	43.2	15.6	15.46	37	1.2	0.5	30
	Mertect	340-F	6 oz	47.1	15.6	15.64	37	1.2	6.0	29
	Mertect	340-F	8 oz	48.1	15.6	16.07	37	1.2	1.5	32
	Mertect	340-F	10 oz	47.5	15.6	16.06	37	1.5	2.5	29
	Benlate	50W	1/2 lb	45.7	15.7	15.46	38	1.5	4.0	37
	Control			45.8	15.6	15.94	37	1.2	4.0	21
	LSD	.05		5.3 ⁿ	0.1 ⁿ	0.72 ⁿ	2.3 ⁿ	0.7 ⁿ	3.5	11 ⁿ

^{1/}R₃ = initial flowering, R₆ = beginning of pod development, R₈ = physiological maturity.
n = LSD calculated but not significant at the 5% level.

at the times of spraying are shown in Table 10. A randomized complete block with four replications was used in each of the three experiments. Each plot had four rows 30 inches apart.

All fungicide applications were made with a carbon dioxide powered sprayer at 32 psi and a spray volume of 30 gallons/a. All plots were harvested with a Hege 125 plot combine and only the middle two rows were harvested for determinations of yield, weight of 100 seeds and percentages of D. phaseolorum var. sojiae and Alternaria sp. Other data collected were plant height at maturity and plant population at harvest (in Experiment 1 only). Seed from Experiment 1 was analyzed for percent germination by the Seed Testing Laboratory of the Wisconsin Crop Improvement Association. Seed from the cultural practices study, previously reported in Part I of this thesis, was assayed for Diaporthe and Alternaria sp. to evaluate the effect of date of planting, cultivars, row widths and herbicides on seed quality.

Determination of Seed Infection

Fifty seeds from each plot were surface disinfected in 1% sodium hypochlorite for 3 minutes, blotted dry and aseptically plated in groups of 10 on potato dextrose agar acidified to pH 4.0. Seeds were incubated at room temperature (72-78°F) for 7 days after which counts of seeds having the fungi growing on them were made. The number of infected seeds per plot was then recorded as a percentage of the total

number of seeds used (50 seeds). All data collected were subjected to an analysis of variance (ANOVA) and computation of appropriate means and least significant difference (LSD) at the 5% level of probability according to procedures described by Steel and Torrie (57).

RESULTS

Experiment 1

Although not significant, there were differences in yield among cultivars (Tables 11, A16). The highest yield was obtained with 'Evans' followed by 'Beeson'. 'Hodgson' and 'Wells' yielded about the same. Seed size as measured by the weight of 100 seeds increased with lateness in maturity of cultivars.

The highest number of infected seeds by D. phaseolorum var. sojae and Alternaria sp. was found in 'Evans'. The other three cultivars were not significantly different from each other. Results also indicated that seed infection by Diaporthe phaseolorum var. sojae decreased with lateness in maturity of cultivars. Percentage of seed germination was lowest in 'Evans' and that corresponded with the highest fungal seed infection.

Yield was highest at the 1+1 lb/a rate and that at the 1/2+1/2 lb/a rate was second (Table 11). The smallest seeds were found in plots that were not sprayed with the fungicide but differences were not statistically significant.

Except for the 2 lb/a rate applied at R6, fungicide treatments were superior to the control in reducing seed infection by D. phaseolorum var. sojae. The 1/2+1/2 lb/a sprayed at R3 and R6 was equally effective in reducing seed infection as was the 1+1 lb/a rate. The 2 lb/a rate together

with the control had lower percentages of seed infected with Alternaria than the other two treatments. Alternaria percentages were low where Diaporthe was high and vice versa.

The highest percent germination was obtained with the rate of 1+1 lb/a followed by that at the 1/2+1/2 lb/a rate. The 2 lb/a rate had a lower percent germination than the control. Yield was higher in treatments that had high percent germination and with low Diaporthe infection.

Experiments 2, 3, 4 and Cultural Practices

Treatments were not significantly different in Experiment 2 (Table A17). In Experiment 3, the treatment of Benlate 50 W resulted in significantly higher seeds than treatments with Mertect 20-S or Mertect 340-F which were not different from each other. In Experiment 4 Mertect 340-F at the rate of 6 oz/a had a significantly higher percentage of Diaporthe than the rest of the treatments which did not differ significantly from one another.

The highest percentage of D. phaseolorum and Alternaria was found at the May 11 planting (Tables 13, A18). Seed infection decreased with delay in planting. Cultivars, row widths and herbicide treatments had no effect on Diaporthe or Alternaria in this study.

Table 13. Effect of date of planting, cultivars, row widths and herbicides on seed quality.
Arlington, Wis., 1978.

Dates of planting	Row widths (in.)	Herbicides ^{1/}	Cultivars			
			Hodgson		Wells	
			% <u>Dia-</u> <u>porthe</u>	% <u>Alter-</u> <u>naria</u>	% <u>Dia-</u> <u>porthe</u>	% <u>Alter-</u> <u>naria</u>
May 11	30	1	0.0	15.2	2.2	17.5
		2	0.7	13.7	1.2	20.0
	10	1	0.2	10.5	1.5	18.2
		2	0.7	8.0	2.7	21.7
	7	1	0.2	12.5	1.5	17.5
		2	1.0	12.7	3.5	14.5
May 25	30	1	0.7	14.7	0.2	14.5
		2	0.7	12.7	0.5	12.2
	10	1	0.7	16.0	1.2	9.7
		2	0.0	18.0	1.5	11.0
	7	1	1.0	15.7	1.0	8.2
		2	0.7	16.5	1.0	5.0
June 8	30	1	0.5	12.2	1.0	3.5
		2	0.7	4.5	0.5	5.7
	10	1	2.2	11.7	0.5	1.5
		2	1.2	9.5	0.2	3.7
	7	1	0.7	7.0	0.0	4.2
		2	1.5	4.7	0.7	4.2

Table 13. (continued)

	% <u>Diaporthe</u>	% <u>Alternaria</u>
<u>Dates of planting mean</u>		
May 11	1.3	15.2
May 25	0.8	12.9
June 8	0.8	6.1
LSD .05	0.3	1.8
<u>Cultivars mean</u>		
Hodgson	0.8	12.0
Wells	1.2	10.7
LSD .05	0.5 ⁿ	2.3 ⁿ
<u>Row widths</u>		
30	0.8	12.2
10	1.1	11.6
7	1.1	10.3
LSD .05	0.4 ⁿ	1.7 ⁿ
<u>Herbicides</u>		
1	0.9	11.7
2	1.1	11.0
LSD .05	0.5 ⁿ	1.2 ⁿ

^{1/}1 = 3/4 lb/a trifluralin (PPI).

2 = 3/4 lb/a trifluralin (PPI) + 1 lb/a bentazon (Post).

n = LSD calculated but not significant at the 5% level of significance.

DISCUSSION

Although the differences were not statistically significant, results showed that 'Evans' outyielded 'Hodgson', 'Wells' and 'Beeson'. It was also evident that 'Evans' was the most susceptible to D. phaseolorum var. sojae. Cultivars were sprayed on the same day even though 'Evans' was slightly beyond the R3 and R6 stages of growth and 'Beeson' was slightly less than the R3 and R6 stages. Also, all four cultivars were not harvested until September 26 when 'Beeson' was ready for harvesting. Such delayed harvesting could have contributed to the high seed infection by Diaporthe in earlier than in later cultivars. However, several workers (2, 15, 55, 62) have reported that cultivars differ in their susceptibility to Diaporthe. Early cultivars in a given region are usually more susceptible than full season cultivars. Results obtained in Experiment 1 showed similar results. The poor response to fungicide treatments observed in the Arlington tests might have been due to the cultivars used. 'Hodgson', a medium maturity cultivar, and 'Wells', a full maturity cultivar, are not as susceptible as 'Evans' to D. phaseolorum var. sojae. Seed germination increased with the decrease in seed infection by Diaporthe. Similar results were reported by Ellis et al. (18).

In Experiment 1, yield was increased when benomyl was sprayed on soybeans at R3 and R6 growth stages but the only significant difference in yield was that between the control and the 1+1 lb/a rate. Previous work has indicated that the main advantage of using fungicides to control Diaporthe is improving seed quality and not necessarily increasing yield (2, 16, 62). Results obtained in Experiment 1 showed a lower number of infected seed in plots sprayed with benomyl than in plots not sprayed. Also, percent germination increased as seed infection was reduced. Such findings are supported by those found by Ellis et al. (18) who found that germination percentages were inversely related to percentages of seed infected by D. phaseolorum var. sojae.

Although seed infection by Diaporthe was very low in the cultural practices study when compared to results in Experiment 1, results indicated that seeds at the May 11 planting had a significantly higher number of infected seed than seeds at either the May 25 or June 8 plantings. Green et al. (22) reported that as date of planting was delayed, there was an improvement in the quality of seed produced. Cultivars, row widths and herbicide treatments showed no effect on seed quality. Pendleton et al. (46) reported that differences in row spacing did not noticeably affect seed quality. Their report supports the results in the cultural practices study. However, with a high incidence of the

disease, the results might have been different from those observed in this study.

SUMMARY

Studies were conducted in 1978 at Vince Drendel's Farm near Evansville (Experiment 1) and at the Arlington Experimental Farm, in Wisconsin (Experiments 1, 3 and 4) to evaluate the effect of fungicides and cultural practices on seed quality. Treatments in Experiment 1 consisted of four cultivars: 'Evans', 'Hodgson', 'Wells' and 'Beeson' belonging to maturity groups of 0, I, II and III, respectively; three rates of benomyl applied at R3 and R6 stages of growth with the non-sprayed plants serving as controls. In Experiments 2, 3 and 4 benomyl was compared with different rates of thiazobenzazole sprayed at R3, R6 and R8. Again, non-sprayed plots were the control treatments. The cultivar 'Wells' was used. Seed from the cultural practices study was assayed for D. phaseolorum var. sojae and Alternaria sp.

'Evans' outyielded the other three cultivars but it was also the most susceptible to D. phaseolorum var. sojae and Alternaria sp. Susceptibility decreased with lateness in maturity of cultivars. Fungicide treatments increased yield although the only significant difference was that between the control and the 1+1 lb/a rate. High percent germination was associated with low Diaporthe percentages. The rates 1/2+1/2 lb/a and 1+1 lb/a were equally effective in reducing Diaporthe seed infection but the 2 lb/a rate applied at the

R6 stage was not better than the control. The cultivar 'Wells' used in Experiments 2, 3 and 4 and also used together with 'Hodgson' in the cultural practices study, showed little response to fungicide treatments. May 11 planting had significantly more seed infection than either the May 25 or June 8 plantings. Row widths and herbicide treatments had no effect on seed quality.

Although 'Evans' yielded more than full season cultivars, it would be necessary to control the disease in order to obtain seed of good quality. Good disease control was achieved by using benomyl at rates as low as 1/2 lb/a applied at the R3 stage and then followed by another 1/2 lb/a at the R6 stage or by planting full-season cultivars. Planting too early may reduce seed quality.

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APPENDIX

Table A1. Effect of date of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1976.

Date of planting	Cultivar	Row width (in.)	Herbi- cide ^{1/}	Yield (bu/a)	% Moisture	Seed wt. (g/100)	Plant ht. (in.)	Lodging score	Weed control
May 11	Hodgson	30	1	41.0	12.2	16.90	28.0	1.0	2.5
			2	41.5	12.2	16.50	27.2	1.0	2.3
		10	1	45.0	12.0	16.90	28.0	1.0	2.8
			2	46.9	12.2	16.40	28.2	1.0	2.0
		7	1	53.1	11.4	16.50	27.5	1.0	2.0
			2	53.3	12.5	16.20	27.5	1.0	1.8
	Wells	30	1	46.8	14.4	14.90	33.2	1.0	2.3
			2	47.5	13.2	14.30	34.2	1.0	1.0
		10	1	48.4	13.7	13.50	35.5	1.0	3.0
			2	45.7	13.3	13.00	35.5	1.0	2.3
		7	1	48.5	15.1	13.60	36.5	1.0	2.3
			2	45.5	15.6	13.00	35.7	1.0	1.3
May 23	Hodgson	30	1	41.3	11.7	16.00	30.7	1.0	2.5
			2	42.0	12.1	16.10	30.7	1.0	1.5
		10	1	44.9	13.8	16.20	33.7	1.0	4.0
			2	57.7	13.6	15.70	30.2	1.5	3.0
		7	1	49.9	15.6	15.60	34.0	1.0	2.3
			2	53.8	13.2	15.20	31.7	1.3	1.5

Table A1. (continued)

Date of planting	Cultivar	Row width (in.)	Herbicide ^{1/}	Yield (bu/a)	% Moisture	Seed wt. (g/100)	Plant ht. (in.)	Lodging score	Weed control
May 23	Wells	30	1	39.7	13.3	13.40	35.5	1.0	1.8
			2	46.2	13.7	13.70	35.7	1.0	1.0
		10	1	46.6	13.6	13.30	38.7	1.3	3.5
			2	57.7	13.5	13.00	37.2	1.3	2.3
June 8	Hodgson	7	1	39.5	12.8	12.70	36.0	1.8	2.0
			2	41.5	13.9	12.60	35.5	1.3	1.8
		30	1	39.6	13.6	13.30	33.5	2.8	2.3
			2	39.8	14.8	13.20	32.5	2.3	1.0
Wells	Wells	10	1	41.0	13.8	13.60	37.0	3.8	3.3
			2	46.2	14.4	13.20	33.2	3.0	1.0
		7	1	45.6	13.9	13.50	35.0	3.0	2.5
			2	51.2	13.9	13.80	37.0	3.0	1.0
June 8	Wells	30	1	37.3	14.2	12.40	36.2	1.3	2.3
			2	38.7	14.4	12.30	35.0	1.3	1.0
		10	1	34.9	15.2	12.40	40.5	2.8	2.5
			2	37.2	14.8	11.80	38.5	1.8	1.0
7	1	40.9	14.2	12.30	39.5	1.5	2.5		
	2	41.8	13.9	11.70	38.7	1.5	1.0		

^{1/}1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI).
 2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI) + 1 lb/a bentazon (Post).

Table A2. Summary of the effect of dates of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1976.

	Yield bu/a	% Moisture	Seed wt. (g/100)	Height (in.)	Lodging score	Weed control
<u>Dates of planting</u>						
May 11	46.9	13.1	15.14	31.4	1.0	2.1
May 23	46.7	13.2	14.46	34.2	1.2	2.2
June 8	41.2	14.3	12.80	36.4	2.3	1.8
LSD .05	3.2	0.6	0.22	1.9	0.3	0.4 ⁿ
<u>Cultivars</u>						
Hodgson	46.3	13.0	15.27	31.4	1.7	2.2
Wells	43.6	14.0	12.99	36.6	1.3	1.9
LSD .05	2.2	0.3	0.36	0.9	0.1	0.3 ⁿ
<u>Row widths (in.)</u>						
30	41.8	13.3	14.40	32.7	1.3	1.8
10	46.0	13.7	14.09	34.7	1.7	2.5
7	47.1	13.61	13.91	34.6	1.5	1.8
LSD .05	2.2	0.3 ⁿ	0.20	0.7	0.2	0.2
<u>Herbicides^{1/}</u>						
1	43.6	13.5	14.28	34.4	1.6	2.6
2	46.3	13.6	13.98	33.6	1.4	1.5
LSD .05	1.4	0.3 ⁿ	0.17	0.7	0.2 ⁿ	0.2

^{1/} 1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI)
 2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI) +
 1 lb/a bentazon (Post).

n = LSD calculated but not significant at the .05 level of significance.

Table A3. ANOVA Summary of the effect of dates of planting, cultivars, row width, and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1976.

Source of variation	df	Yield		Moisture		Seed wt.		Plant height		Lodging		Weed control	
		MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS
Reps	3	33.23ns	1.31ns	0.85ns	9.72ns	0.69ns	2.55ns						
Dates (D)	2	508.50**	18.98**	69.68**	296.02**	24.19**	2.90ns						
Error A	6	41.26	1.66	0.20	14.13	0.46	0.66						
Cultivars (C)	1	270.07*	37.50**	186.67**	940.44**	5.44**	2.25ns						
D x C	2	97.53ns	11.95**	9.33**	50.51**	7.38**	0.27ns						
Error B	9	33.36	0.82	0.67	6.13	0.07	0.73						
Row width (R)	2	375.32**	1.88ns	3.05**	58.40**	1.90**	9.02**						
D x R	4	145.99**	3.12**	1.26**	7.04ns	1.05**	2.04**						
C x R	2	309.13**	0.75ns	1.83**	6.17ns	0.01ns	0.52ns						
D x C x R	4	44.25ns	3.85**	0.36ns	6.67ns	0.16ns	0.60ns						
Error C	36	28.86	0.68	0.24	3.17	0.15	0.29						
Herbicide (H)	1	280.63**	0.80ns	3.24**	23.36*	0.44ns	38.03**						
D x H	2	128.79**	0.13ns	0.30ns	5.30ns	0.63ns	2.42**						
C x H	1	14.83ns	1.19ns	0.09ns	1.36ns	0.11ns	0.03ns						
R x H	2	48.27ns	0.47ns	0.26ns	8.05ns	0.09ns	0.47ns						
D x C x H	2	9.67ns	1.46ns	0.29ns	2.34ns	0.22ns	0.63ns						
D x R x H	4	33.71ns	1.35ns	0.13ns	5.74ns	0.43ns	0.17ns						
C x R x H	2	31.67ns	0.62ns	0.12ns	2.38ns	0.17ns	0.13ns						
D x C x R x H	4	1.94ns	0.12ns	0.07ns	2.76ns	0.06ns	0.24ns						
Error D	54	16.76	0.65	0.26	4.27	0.21	0.41						
Total	143												

$\frac{1}{2}$ ns = not significant; *, ** = significant at .05 and .01 level, respectively.

Table A4. Effect of dates of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1977.

Date of planting	Cultivar	Row width (in.)	Herbicide ^{1/}	Yield (bu/a)	% Moisture	Seed wt. (g/100)	Plant pop. x 10 ³		Plant ht. (in.)	Lodging score
							EPOP ^{2/}	HPOP ^{2/}		
May 9	Hodgson	30	1	58.3	12.7	17.54	125.8	107.8	38.5	1.0
			2	54.4	12.9	17.82	124.7	100.7	37.5	1.0
	10	1	76.7	12.7	18.23	176.4	151.9	39.0	1.0	
		2	75.8	12.6	17.52	163.4	158.4	37.7	1.0	
	7	1	62.3	13.0	17.52	287.0	226.3	39.2	1.0	
		2	64.5	12.8	17.65	263.7	228.7	38.2	1.0	
May 23	Wells	30	1	56.2	13.5	16.91	125.2	107.8	39.5	1.0
			2	57.9	13.4	16.69	127.4	100.7	41.0	1.0
	10	1	74.6	13.3	18.10	209.1	179.7	40.5	1.0	
		2	76.5	13.3	16.99	194.4	178.1	41.2	1.0	
	7	1	60.2	13.2	17.57	268.4	219.3	41.2	1.0	
		2	59.9	13.7	17.10	263.7	224.0	41.0	1.0	
May 23	Hodgson	30	1	52.5	17.9	16.36	117.6	102.9	38.0	1.0
			2	56.0	18.6	16.58	115.4	98.6	37.7	1.0
	10	1	77.6	18.7	17.08	207.5	197.7	39.7	1.0	
		2	70.5	18.9	16.86	204.2	191.1	38.5	1.0	
	7	1	61.5	18.8	17.02	175.0	151.7	37.5	1.0	
		2	56.3	18.7	17.24	172.7	154.0	37.7	1.0	

Table A4. (continued)

Date of planting	Cultivar	Row width (in.)	Herbicide ^{1/}	Yield (bu/a)	% Moisture	Seed wt. (g/100)	Plant pop. x 10 ³ EPOP ^{2/} /HPOP ^{2/}	Plant ht. (in.)	Lodging score
May 23	Wells	30	1	53.6	19.7	16.06	126.9	41.2	1.0
			2	52.6	19.8	15.67	129.6	40.0	1.0
		10	1	69.8	20.0	16.31	232.0	41.7	1.0
			2	66.2	20.0	15.62	236.9	41.0	1.0
June 7	Hodgson	7	1	58.2	19.5	16.22	172.7	42.0	1.0
			2	60.0	19.7	16.32	177.3	43.0	1.0
		30	1	43.3	12.8	16.31	101.8	38.2	1.2
			2	41.5	13.0	16.44	87.1	37.2	1.2
Wells	Hodgson	10	1	62.1	12.9	16.44	183.0	38.5	1.0
			2	61.5	12.8	16.88	194.4	38.5	1.0
		7	1	49.5	13.1	17.16	259.0	40.0	1.2
			2	49.9	12.7	16.77	240.4	38.5	1.2
Wells	Hodgson	30	1	44.3	13.3	14.55	103.5	38.0	1.0
			2	45.1	13.2	14.88	106.2	38.2	1.0
		10	1	54.6	13.7	14.82	173.2	40.5	1.0
			2	58.1	13.5	14.38	166.6	40.7	1.0
7	Hodgson	1	48.9	13.6	15.89	254.4	41.5	1.2	
		2	47.1	13.6	15.67	261.4	41.2	1.5	

^{1/} 1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI).
 2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI) + 1 lb/a bentazon (Post).

^{2/} EPOP = Emerged population, HPOP = Harvested population, plants/a.

Table A5. Summary of the effect of dates of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1977.

	Yield (bu/a)	% Moisture	Seed wt. g/100	Plant pop. x 10 ³ ^{2/}		Height (in.)	Lodging score
				EPOP	HPOP		
<u>Dates of planting</u>							
May 9	64.8	13.1	17.39	194.1	165.3	39.6	1.0
May 23	61.2	19.2	16.36	172.3	156.4	39.9	1.0
June 7	50.5	13.2	15.85	177.6	143.3	39.3 ⁿ	1.1 ⁿ
LSD .05	2.5	0.3	0.34	6.3	5.3	0.7	0.1 ⁿ
<u>Cultivars</u>							
Hodgson	59.7	14.8	17.08	177.7	151.8	38.4	1.1
Wells	58.0	15.5	15.99	184.9 ⁿ	158.2 ⁿ	40.8	1.0
LSD .05	1.4	0.2	0.32	9.0	7.3 ⁿ	1.1	ns
<u>Row width (in.)</u>							
30	51.3	15.1	16.32	115.9	97.9	38.8	1.0
10	68.7	15.2	16.53	195.1	174.8	39.8	1.0
7	56.5	15.2 ⁿ	16.76	233.0	192.3	40.1	1.1 ⁿ
LSD .05	1.5	0.3 ⁿ	0.19	13.7	8.9	0.6	0.1 ⁿ
<u>Herbicides ^{1/}</u>							
1	59.1	15.1	16.62	183.2	155.2	39.7	1.0
2	58.6 ⁿ	15.2 ⁿ	16.45 ⁿ	179.4 ⁿ	154.9 ⁿ	39.4 ⁿ	1.0
LSD .05	0.8 ⁿ	0.1 ⁿ	0.17 ⁿ	4.4 ⁿ	4.9 ⁿ	0.3 ⁿ	ns

^{1/} 1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI).
 2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI) + 1 lb/a bentazon (Post).

^{2/} EPOP = Emerged population, HPOP = Harvested population.

n = LSD calculated but not significant at the .05 level.

Table A6. ANOVA Summary of the effect of dates of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Arlington. Wis., 1977.

Source of variation	df	Yield MS	Moisture MS	Seed wt. MS	Plant pop. x 10 ⁶		Plant ht. MS	Lodging score MS
					EPOP MS	HPOP MS		
Reps	3	70.4ns	1.8ns	.51ns	2226.1*	473.4ns	0.7ns	0.1ns
Dates (D)	2	2655.3**	589.6**	29.45**	6203.6**	5868.2**	4.1ns	0.3ns
Error A	6	40.1	0.7	0.72	249.9	179.8	3.2	0.1
Cultivar (C)	1	103.5*	22.1**	42.98**	1866.0ns	1440.9ns	207.9ns	0.0ns
D x C	2	4.7ns	1.4*	3.00ns	584.5ns	704.5ns	9.2ns	0.0ns
Error B	9	14.8	0.2	0.74	576.8	378.0	8.3	0.0
Row width (R)	2	3798.7**	0.3ns	2.39**	171149.5**	121016.8**	23.6**	0.1ns
D x R	4	19.7ns	0.3ns	0.83**	231191.3**	14894.7**	3.6ns	0.1ns
C x R	2	65.6*	0.1ns	0.41ns	580.7ns	655.7ns	5.4ns	0.0ns
D x C x R	4	27.8ns	0.3ns	0.71*	1536.0ns	415.7ns	3.2ns	0.5ns
Error C	36	13.8	0.4	0.20	1100.2	465.3	2.1	0.1
Herbicide (H)	1	12.2ns	0.1ns	1.02ns	527.8ns	3.3ns	3.7ns	0.0ns
D x H	2	16.6ns	0.3ns	0.21ns	296.4ns	207.2ns	0.1ns	0.0ns
C x H	1	29.3ns	0.0ns	1.14*	476.6ns	8.5ns	7.6*	0.0ns
D x H	2	2.9ns	0.1ns	0.45ns	61.4ns	244.0ns	0.0ns	0.0ns
D x C x H	2	0.3ns	0.1ns	0.32ns	2.7ns	169.1ns	2.1ns	0.0ns
D x R x H	4	25.1*	0.0ns	0.09ns	15.6ns	271.2ns	2.4ns	0.0ns
C x R x H	2	6.4ns	0.6ns	0.07ns	331.9ns	168.1ns	0.0ns	0.0ns
D x C x R x H	4	28.6**	0.0ns	0.44ns	160.2ns	250.0ns	1.0ns	0.0ns
Error D	54	8.3	0.3	0.26	246.7	308.8	1.5	0.0
Total	143							

1/ ns = not significant at .05 level; *, ** = significant at .05 and .01 levels.

2/ EPOP = Emerged population, HPOP = Harvested population, plants/a average over 1976 and 1978.
n = LSD calculated but not significant at the .05 level.

Table A7. Effect of date of planting, cultivar, row width, and herbicides on the yield and other agronomic characteristics of soybeans. Arlington, Wis., 1978.

Date of planting	Cultivar	Row width (in.)	Herbi- cide ^{1/}	Yield (bu/a)	% Mois- ture	Seed wt. (g/100)	$\frac{\text{Plant pop.} \times 10^3}{\text{FPOP}_2/\text{HPOP}_2}$	Plant ht. (in.)	Lodging score	Weed control	
May 11	Hodgson	30	1	40.4	17.2	16.36	64.8	59.3	36.5	1.2	2.5
			2	37.5	17.4	16.18	65.3	59.9	32.0	1.0	2.2
		10	1	54.4	16.7	14.77	136.1	134.5	37.5	1.2	2.0
			2	56.5	17.1	14.19	152.5	134.5	34.2	1.2	2.0
		7	1	46.6	18.5	15.91	98.6	86.8	35.0	1.2	4.7
			2	44.4	17.9	15.70	82.1	68.1	33.0	1.2	3.7
	Wells	30	1	34.5	21.0	17.19	74.6	66.2	34.5	1.0	3.0
			2	37.2	18.0	16.25	74.6	68.1	35.5	1.0	2.5
		10	1	42.6	19.5	17.46	124.6	138.6	36.7	1.0	4.5
			2	46.3	18.5	16.94	146.0	142.7	37.7	1.0	2.7
		7	1	37.2	19.2	16.32	84.5	91.5	33.5	1.2	4.5
			2	44.8	18.6	16.13	91.5	102.1	35.0	1.2	4.2
May 25	Hodgson	30	1	47.9	16.9	15.65	77.3	79.5	38.5	1.2	1.2
			2	46.5	16.7	15.70	80.6	68.9	36.7	1.0	1.0
		10	1	65.4	16.5	14.89	157.4	151.7	38.7	1.2	1.0
			2	59.8	16.5	14.87	142.7	141.9	36.7	1.2	1.0
		7	1	57.2	16.5	14.53	86.8	97.4	34.0	1.2	3.0
			2	50.5	16.3	14.14	93.9	97.4	32.0	1.2	1.7

Table A7. (continued)

Date of planting	Cultivar	Row width (in.)	Herbicide ^{1/}	Yield (bu/a)	% Moisture	Seed wt. (g/100)	$\frac{\text{Plant pop} \times 10^3}{\text{EPOP}^2}$	$\frac{\text{Plant pop} \times 10^3}{\text{HPOP}^2}$	Plant ht. (in.)	Lodging score	Weed control
May 25	Wells	30	1	40.9	16.8	15.11	53.4	56.4	35.2	1.0	1.7
			2	39.9	16.8	14.88	60.4	63.7	35.5	1.0	2.0
		10	1	50.5	16.5	14.42	100.0	101.7	32.5	1.0	1.2
			2	50.7	16.9	14.66	121.4	115.6	35.0	1.0	1.7
		7	1	47.5	17.3	14.52	56.3	77.5	31.7	1.0	2.7
			2	44.6	17.0	15.12	77.5	41.1	31.7	1.2	2.2
June 8	Hodgson	30	1	41.0	16.7	15.42	114.9	114.3	35.0	1.0	1.0
			2	45.9	16.7	15.10	119.2	115.7	35.2	1.2	1.0
		10	1	48.7	16.9	14.55	164.0	124.6	32.5	1.0	1.0
			2	49.6	16.9	14.11	152.5	136.9	33.0	1.2	2.2
		7	1	51.7	17.7	14.28	157.2	157.2	31.2	1.5	1.0
			2	49.1	17.1	14.64	143.2	153.7	36.0	1.5	1.2
Wells	Wells	30	1	29.7	20.0	13.83	44.1	45.7	27.7	1.0	1.0
			2	31.2	21.1	13.87	42.5	40.8	27.7	1.0	1.0
		10	1	46.3	17.8	14.00	82.0	82.0	30.0	1.0	1.0
			2	43.5	19.0	13.38	73.8	87.7	29.2	1.0	1.0
		7	1	44.0	20.1	13.21	86.8	79.8	29.0	1.0	1.2
			2	36.0	21.7	13.43	91.5	125.6	27.7	1.0	1.7

^{1/} 1 = 3/4 lb/a trifluralin (PFI), 2 = 3/4 lb/a trifluralin (PFI) + 1 lb/a bentazon (Post).

^{2/} EPOP = Emerged population, HPOP = Harvested population, plants/a.

Table A8. Summary of the effect of dates of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1978.

	Yield (bu/a)	% Moisture	Seed wt. g/100	Plant pop. x 10 ³ ^{2/} EPOP	HPOP	Height (in.)	Lodging score	Weed control
<u>Dates of planting</u>								
May 11	43.5	18.3	16.12	99.6	96.0	35.1	1.1	3.3
May 25	50.1	16.7	14.88	92.3	91.1	34.9	1.1	1.7
June 8	43.1	18.5	14.15	106.0	104.6	31.2	1.1 ⁿ	1.2
LSD .05	3.8	1.3	1.49	12.6	12.6	3.1	0.3 ⁿ	0.6
<u>Cultivars</u>								
Hodgson	49.6	17.0	15.06	116.1	110.1	34.9	1.2	1.9
Wells	41.5 ⁿ	18.7	15.04 ⁿ	82.5	84.3	32.6	1.0 ⁿ	2.2 ⁿ
LSD .05	9.4 ⁿ	1.0	0.61 ⁿ	11.8	10.1	1.7	0.2 ⁿ	0.6 ⁿ
<u>Row widths (in.)</u>								
30	39.4	17.9	15.46	72.6	69.9	34.2	1.1	1.7
10	51.2	17.4	14.85	129.4	123.6	34.5	1.1	1.9
7	46.1	18.2	14.83	95.8	98.2	32.5	1.2 ⁿ	2.7
LSD .05	2.8	0.4	0.37	8.5	7.8	1.0	0.1 ⁿ	0.4
<u>Herbicides</u> ^{1/}								
1	45.9	17.9	15.14	98.0	96.9	33.9	1.1	2.2
2	45.2 ⁿ	17.8 ⁿ	14.96 ⁿ	100.6 ⁿ	97.5 ⁿ	33.6 ⁿ	1.1 ⁿ	2.0 ⁿ
LSD .05	1.4 ⁿ	0.3 ⁿ	0.25 ⁿ	7.0 ⁿ	6.5 ⁿ	0.8 ⁿ	0.1 ⁿ	0.4 ⁿ

^{1/} 1 = 3/4 lb/a trifluralin (PPI). 2 = 3/4 lb/a trifluralin (PPI) + 1 lb/a bentazon (post).

^{2/} EPOP = Emerged population, HPOP = Harvested population, plants/a.

n = LSD calculated but not significant at the .05 level.

Table A9. ANOVA Summary of the effect of dates of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1978.

Source of variation	df	Yield $\frac{1}{MS}$	Moisture MS	Seed wt. MS	Plant pop. x 10 ⁶ $\frac{2}{MS}$		Plant ht. MS	Lodging score MS	Weed control MS
					EPOP MS	HPOP MS			
Reps	3	43.97ns	3.04ns	12.87ns	355.6ns	1181.9ns	95.25ns	0.77ns	2.40ns
Date (D)	2	744.8**	44.32*	47.36*	2247.3ns	2256.8ns	229.40*	0.77ns	56.42**
Error A	6	56.57	6.99	8.91	605.50	637.90	37.66	0.29	1.34
Cultivars (C)	1	2357.57ns	98.15**	0.01ns	40504.2**	24005.2**	193.67*	1.17*	3.67ns
D x C	2	32.57ns	20.59ns	15.51*	15417.2**	14586.0**	109.80*	0.05ns	1.51ns
Error B	9	617.35	6.95	2.63	978.18	723.47	20.02	0.18	2.25
Row width (R)	2	1682.55**	7.41**	6.20**	39122.9**	34690.4**	55.56**	0.36*	13.78**
D x R	4	32.23ns	1.88ns	.14ns	3813.2**	7447.3**	24.49*	0.02ns	3.14*
C x R	2	9.25ns	1.66ns	3.84*	790.6ns	40.0ns	3.76ns	0.03ns	0.11ns
D x C x R	4	87.75ns	4.02*	2.57ns	159.4ns	741.8ns	11.66ns	0.12ns	1.35ns
Error C	36	46.91	1.05	00.80	422.12	352.70	6.10	0.10	1.06
Herbicide (H)	1	16.95ns	0.30ns	1.08ns	251.8ns	12.3ns	3.67ns	0.10ns	1.56ns
D x H	2	68.69*	5.32**	0.71ns	467.3ns	584.5ns	8.22ns	0.05ns	3.52ns
C x H	1	23.93ns	0.03ns	0.01ns	1064.6ns	508.0ns	22.56*	0.01ns	0.01ns
R x H	2	30.91ns	.78ns	0.53ns	20.6ns	47.4ns	2.76ns	0.03ns	0.25ns
D x C x H	2	77.89*	7.01**	0.23ns	125.5ns	78.2ns	39.40**	0.09ns	0.72ns
D x R x H	4	32.58ns	0.46ns	0.19ns	137.3ns	326.1ns	2.70ns	0.04ns	1.18ns
C x R x H	2	2.97ns	1.36ns	0.21ns	324.5ns	97.1ns	6.90ns	0.03ns	1.03ns
D x C x R x H	4	11.39ns	0.87ns	0.26ns	516.0ns	1785.6**	2.82ns	0.02ns	0.20ns
Error D	54	17.90	1.04	0.56	446.50	376.10	5.34	0.07	1.14
Total	143								

$\frac{1}{ns}$ = not significant at .05 level, *, ** = significant at .05 and .01 level, respectively.

$\frac{2}{EPOP}$ = Emerged population, HPOP = Harvested population, plants/a average over 1976 and 1978.
N = LSD calculated but not significant at the .05 level.

Table A10. Effect of dates of planting, cultivars, row width and herbicides on yield and other agronomic characteristics of soybeans. Arlington, Wis. Averages of 1976-78.

Date of planting (Average)	Cultivar	Row width (in.)	Herbicide ^{1/}	Yield (bu/a)	% Moisture	Seed wt. (g/100)	$\frac{\text{EPOP}_2}{\text{HPOP}_2}$	Plant pop. x 10 ³ $\frac{\text{EPOP}_2}{\text{HPOP}_2}$	Plant ht. (in.)	Lodging score	Weed control ^{2/}
May 10	Hodgson	30	1	46.2	14.0	16.93	95.8	83.5	34.3	1.1	2.5
			2	44.5	14.2	16.83	95.0	80.3	32.2	1.0	2.2
		10	1	58.7	13.8	16.63	156.2	143.2	34.8	1.1	2.7
			2	59.7	14.0	16.04	157.9	146.4	33.3	1.1	1.0
		7	1	54.0	14.3	16.64	192.8	156.5	34.1	1.1	3.3
			2	54.1	14.4	16.52	172.9	148.4	33.1	1.1	2.7
	Wells	30	1	45.8	16.3	16.33	99.9	87.0	35.7	1.0	2.6
			2	47.5	14.9	15.75	101.0	84.4	36.8	1.0	1.7
		10	1	55.2	15.5	16.02	166.8	159.1	37.7	1.0	3.7
			2	56.2	15.0	15.64	170.2	160.4	38.3	1.0	2.5
		7	1	48.6	15.8	15.83	176.4	155.4	37.2	1.1	3.4
			2	50.1	16.0	15.41	177.6	163.0	37.3	1.1	2.7
May 24	Hodgson	30	1	47.2	15.5	16.00	97.4	91.2	35.8	1.1	1.9
			2	48.2	15.8	16.13	98.0	83.7	35.1	1.0	1.2
		10	1	62.6	16.3	16.06	182.4	174.7	37.5	1.1	2.5
			2	62.7	16.3	15.81	173.4	166.5	35.1	1.2	2.0
		7	1	56.2	17.0	15.72	130.9	124.5	35.2	1.1	2.6
			2	53.5	16.1	15.53	133.3	125.7	33.9	1.2	1.6

Table A10. (continued)

Date of planting (Average)	Cultivar	Row width (in.)	Herbicide ^{1/}	Yield (bu/a)	% Moisture	Seed wt. (g/100)	$\frac{\text{Plant pop.} \times 10^3}{\text{HPOP}^2}$	$\frac{\text{Plant pop.} \times 10^3}{\text{HPOP}^2}$	Plant ht. (in.)	Lodging score	Weed control ^{2/}
May 24	Wells	30	1	44.7	16.6	14.86	90.1	84.8	37.5	1.0	1.7
			2	46.2	16.8	14.75	95.0	90.1	37.2	1.0	1.5
June 8	Hodgson	10	1	55.6	16.7	14.68	166.0	161.1	37.7	1.1	2.3
			2	58.2	16.8	14.43	179.1	165.6	37.7	1.1	2.0
		7	1	48.4	16.5	14.48	114.5	121.6	36.6	1.3	2.3
			2	48.7	16.9	14.35	127.4	95.2	36.9	1.2	2.0
June 8	Hodgson	30	1	41.3	14.4	15.01	108.3	99.1	35.7	1.7	1.6
			2	42.4	14.8	14.91	103.1	94.9	35.1	1.6	1.0
		10	1	50.6	14.5	14.86	173.5	133.3	36.0	1.9	2.1
			2	52.4	14.7	14.73	173.4	151.7	34.8	1.7	1.6
		7	1	48.9	14.9	14.98	208.1	182.4	35.4	1.9	1.7
			2	50.1	14.6	15.07	191.8	171.3	37.2	1.9	1.1
June 8	Wells	30	1	37.1	15.8	13.59	73.8	63.4	33.9	1.3	1.6
			2	38.4	16.2	13.68	74.3	64.2	33.6	1.3	1.0
		10	1	45.3	15.6	13.74	127.6	112.0	37.2	1.6	1.7
			2	46.3	15.8	13.19	120.2	116.1	36.3	1.3	1.0
		7	1	44.6	16.0	13.80	170.6	135.5	36.8	1.2	1.8
			2	41.6	16.4	13.60	176.4	163.1	36.0	1.3	1.3

^{1/} 1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI); 2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI) + 1 lb/a bentazon (Post).

^{2/} HPOP = Emerged population, HPOP = Harvested population, plants/a; average of 1977 and 1978.

^{3/} Average of 1976 and 1978.

Table A11. Effect of dates of planting, cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans averaged over 3 years. Arlington, Wis., 1976-1978.

Dates of planting	Yield (bu/a)	Seed wt. (g/100)	Plant pop. x 10 ³		Height (in.)	Lodging score	Weed control
			EPOP	HPOP			
1	51.7	16.22	146.8	130.6	35.4	1.0	2.7
2	52.7	15.23	132.3	123.8	36.3	1.1	1.9
3	44.9	14.27	141.8	123.9	35.6	1.5	1.5
LSD .05	1.8	0.39	6.6	6.3	1.1 ⁿ	0.1	0.4
<u>Cultivars</u>							
Hodgson	51.9	15.80	146.9	130.9	34.9	1.3	2.0
Wells	47.7	14.67	133.7	121.2	36.7	1.1	2.0
LSD .05	2.5	0.25	7.4	6.2	0.7	0.1	0.4 ⁿ
<u>Row widths (in.)</u>							
30	44.2	15.39	94.2	83.9	35.2	1.1	1.7
10	55.3	15.15	162.2	149.2	36.3	1.3	2.2
7	49.9	15.17	164.4	145.2	35.7	1.3	2.2
LSD .05	1.3	0.15	7.8	5.9	0.4	0.1	0.2
<u>Herbicides</u> ^{1/}							
1	49.5	15.35	140.6	126.0	36.0	1.2	2.4
2	50.0	15.13	140.0	126.2	35.5	1.2	1.7
LSD .05	0.7 ⁿ	0.11	4.0 ⁿ	4.0 ⁿ	0.3	0.1 ⁿ	0.2

^{1/} 1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI). 2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PPI) + 1 lb/a bentazon (Post).
^{2/} EPOP = Emerged population, HPOP = Harvested population, plants/a average over 1976 and 1978. n = LSD calculated but not significant at the .05 level.
^{3/} Averaged over 1976 and 1978.

Table A12. Effect of cultivars, row widths and herbicides on yield and other agronomic characteristics of soybeans. Janesville, Wis., 1976 and 1978.

Cultivars	Row width (in.)	Herbicides ^{1/}	Yield (bu/a)		% Moisture		Seed wt. g/100		Plant pop. x 10 ³		Plant ht. (in.)		Lodging score		Weed control							
			1976	1978	1976	1978	1976	1978	1976	1978	1976	1978	1976	1978	1976	1978	1976	1978				
Hodgson	30	1	45.6	52.4	49.0	12.5	17.8	15.1	17.36	17.95	17.65	118.2	87.7	33.7	40.5	37.1	1.0	1.5	1.7	2.5	2.1	
		2	43.7	50.2	46.9	12.5	19.9	16.2	17.46	18.72	18.09	94.2	82.8	31.7	40.0	35.8	1.3	1.0	1.1	2.0	2.0	
	10	1	46.7	-	46.7	12.7	-	12.7	17.56	-	17.56	-	-	32.7	-	32.7	1.0	-	1.0	2.0	-	2.0
		2	46.3	-	46.3	12.2	-	12.2	17.92	-	17.92	-	-	31.0	-	31.0	1.0	-	1.0	1.7	-	1.7
	7	1	41.2	66.6	53.7	12.4	20.2	16.3	16.90	18.51	17.70	90.5	88.2	32.3	37.5	34.9	1.0	1.5	1.2	2.7	4.0	3.7
		2	42.7	74.0	58.3	12.2	18.0	20.1	16.31	18.03	17.17	76.6	76.6	31.0	39.0	35.0	1.0	2.5	1.7	1.7	3.5	2.6
Wells	30	1	45.7	48.2	46.9	12.4	18.2	20.3	15.62	19.23	17.42	120.9	94.2	35.7	44.0	39.8	1.0	2.0	1.5	2.0	1.0	1.5
		2	46.4	56.6	51.5	12.3	17.6	19.9	15.28	18.82	17.05	135.6	105.1	37.7	43.0	40.3	1.3	1.0	1.1	1.7	1.0	1.3
	10	1	44.6	-	44.6	12.2	-	12.2	15.18	-	15.18	-	-	32.7	-	32.7	1.0	-	1.0	3.0	-	3.0
		2	47.8	-	47.8	12.4	-	12.4	14.85	-	14.85	-	-	36.3	-	36.3	1.0	-	1.0	2.3	-	2.3
	7	1	39.6	65.1	52.3	13.1	19.5	16.3	15.11	19.69	17.40	88.2	81.2	34.7	42.5	38.6	1.0	1.5	1.2	3.0	3.0	3.0
		2	43.9	60.5	52.2	13.1	17.4	15.2	15.22	19.86	17.54	88.2	88.2	31.3	41.5	36.4	1.0	1.5	1.2	2.7	1.5	2.1

^{1/}1 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PFI).

2 = 3/4 lb/a trifluralin + 3/4 lb/a metribuzin (PFI) + 1 lb/a bentazon (Post).

^{2/}EFOP = Emerged population, HPOP = Harvested population, plants/a.

Table A14. ANOVA Summary of the effect of cultivar, row width and herbicides on yield and other agronomic characteristics of soybeans. Janesville, Wis., 1978.

Source of variation	df	Yield MS ^{1/}	Moisture		Seed		Plant pop.		Plant ht. MS	Lodging score MS	Weed control MS
			MS	wt. MS	EPOP ^{2/} MS	HPOP ^{2/} MS					
Reps	1	45.73**	1.87ns	1.29ns	85.89ns	167.38ns	12.25ns	3.06ns	7.56ns		
Cultivar (C)	1	40.76**	2.63ns	4.82ns	712.46ns	280.53ns	49.00*	0.06ns	7.56ns		
Error A	1	0.01	30.21	0.05	574.53	62.70	0.25	0.56	0.06		
Row width (R)	1	863.78ns	0.69ns	0.48ns	3936.10*	317.86ns	12.25ns	0.56ns	7.56ns		
C x R	1	72.46ns	0.11ns	0.66ns	303.20ns	146.64ns	0.25ns	0.56ns	0.06ns		
Error B	2	98.10	1.39	0.56	107.90	91.04	1.00	0.81	2.56		
Herbicide (H)	1	20.40ns	2.01ns	0.00ns	134.28ns	45.55ns	0.25ns	0.06ns	1.56ns		
C x H	1	0.50ns	1.65ns	0.07ns	691.13*	294.97ns	2.25ns	0.56ns	0.06ns		
R x H	1	2.79ns	7.91ns	0.11ns	5.43ns	28.24ns	1.00ns	1.56ns	0.56ns		
C x R x H	1	128.07*	1.94ns	0.85ns	153.02ns	1.92ns	1.00ns	0.06ns	0.56ns		
Error C	4	8.74	5.69	1.27	75.31	99.37	1.87	0.31	2.19		
Total	15										

^{1/} ns = not significant at .05 level, * and ** = significant at .05 and .01 levels.

^{2/} EPOP = Emerged population, HPOP = Harvested population.

Table A15. ANOVA Summary of the effect of planting equipment and row widths on yield and other agronomic characteristics of soybeans. Arlington, Wis., 1978.

Source of variation	df	Yield		Moisture		Seed wt.		Plant pop. x 10 ⁶ ^{2/}		Height		Lodging	
		MS ^{1/}	MS	MS	MS	MS	MS	EPOP	HPOP	MS	MS	MS	MS
Reps	3	232.49**	0.07ns	2.47*	461.20ns	1624.93ns	4.70ns	0.28ns					
Treatments	7	96.41ns	0.22ns	1.05ns	29267.72**	27053.07**	2.28ns	0.67**					
Error	21	40.10	0.37	0.58	780.09	731.51	4.60	0.14					
Total	31												
ANOVA Summary of the comparison between JD planter and Tye grain drill. in 10-inch, 20-inch and 30-inch rows. Arlington, Wis., 1978.													
Reps	3	156.32**	0.20ns	1.81ns	220.62ns	260.21ns	5.15ns	0.28ns					
Equipment (E)	1	30.92ns	0.13ns	0.12ns	2200.86ns	4156.87**	0.37ns	0.00ns					
Error A	3	4.87	0.39	0.68	268.94	120.37	10.26	0.11					
Row width (R)	2	203.59ns	0.22ns	2.62*	10580.84**	12271.00**	0.37ns	1.29**					
E x R	2	93.99ns	0.39ns	0.46ns	1708.87*	1791.34**	3.37ns	0.12ns					
Error B	12	61.59	0.48	0.53	268.64	227.52	4.71	0.15					
Total	23												

^{1/} ns = not significant at .05 level; *, ** = significant at .05 and .01 levels.

^{2/} EPOP = Emerged population; HPOP = Harvested population.

Table A16. ANOVA Summary of the effect of cultivars, fungicide rates (benomyl) and time of application on seed yield, seed quality and other agronomic characteristics of soybeans. Evansville, Wis., 1978.

Source of variation	df	Yield	Mois-	Seed	Plant	Plant	Lodging	Dia-	Alter-	Germina-
		MS ¹	ture	wt.	pop. x 10 ³	ht.	MS	porthe	na-ria	tion
		MS	MS	MS	MS	MS	MS	MS	MS	MS
Reps	3	85.15ns	6.30*	13.77*	209.51ns	71.10*	0.10ns	115.73ns	290.50*	125.83ns
Cultivars (C)	3	50.05ns	23.58**	50.67**	2024.34**	117.02**	6.35**	2142.06**	344.33*	2393.17**
Error A	9	62.25	1.16	2.12	136.51	11.40	0.28	56.40	58.94	52.00
Fungicide (F)	3	49.96ns	3.39ns	2.89ns	223.74ns	8.94ns	0.19	653.06**	235.50**	211.00**
V x F	9	37.23ns	2.28ns	3.74ns	209.78ns	7.78ns	0.26	103.28ns	155.72ns	143.39ns
Error B	36	27.28	2.13	1.92	175.32	5.78	0.18	79.34	77.56	69.40
Total	63									

¹/ns = not significant at .05 level; *, ** = significant at .05 and .01 level, respectively.

Table A17. ANOVA Summary of the effect of fungicide treatments on seed yield, seed quality and other agronomic characteristics of 'Wells' soybeans. Arlington, Wis., 1978.

Source of variation	df	Yield		Moisture		Seed wt.		Plant ht.		Lodging		Diarthoria		Alter-naria	
		MS ^{1/}	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	MS	
<u>Experiment 2</u> Time: R3 and R8															
Reps	3	2.87**	0.14**	0.45ns	1.08ns	0.06ns	16.33ns	60.67ns							
Treatments	3	2.15ns	0.06**	0.02ns	1.08ns	0.06ns	43.67ns	33.33ns							
Error	9	5.18	0.01	0.17	1.47	0.06	11.89	55.33							
Total	15														
<u>Experiment 3</u> Time: R3, R6 and R8															
Reps	3	12.16ns	0.01ns	0.39ns	4.17**	0.25ns	2.25ns	6.33ns							
Treatments	3	3.32ns	0.01ns	1.03*	0.83ns	0.42ns	0.92ns	56.33ns							
Error	9	11.26	0.06	0.17	0.44	0.19	4.69	42.11							
Total	15														
<u>Experiment 4</u> Time: R3 and R6															
Reps	3	11.40ns	0.00ns	0.72*	3.37ns	0.36ns	6.67ns	306.27**							
Treatments	9	10.97ns	0.00ns	0.42ns	1.06ns	0.08ns	12.84*	112.44ns							
Error	27	13.33	0.00	0.25	2.44	0.23	5.70	62.34							
Total	39														

^{1/} ns = not significant at .05 level; *, ** = significant at .05 and .01 level, respectively.

Table A18. ANOVA Summary of the effect of dates of planting, cultivars, row widths and herbicides on seed quality. Arlington, Wis., 1978.

Source of variation	df	<u>Diaporthe</u> MS ^{1/}	<u>Alternaria</u> MS
Reps	3	1.21ns	12.23ns
Dates (D)	2	4.02*	1080.19**
Error A	6	0.47	12.50
Cultivar (C)	1	5.84ns	58.78ns
D x C	2	15.97**	496.47**
Error B	9	1.43	38.14
Row width (R)	2	1.56ns	49.65ns
D x R	4	0.36ns	7.33ns
C x R	2	0.01ns	20.67ns
D x C x R	4	2.23ns	86.74**
Error C	36	1.10	15.88
Herbicides (H)	1	1.56ns	16.00ns
D x H	2	2.27ns	4.15ns
C x H	1	0.34ns	38.03ns
R x H	2	1.90ns	17.15ns
D x C x H	2	0.22ns	39.51ns
D x R x H	4	1.26ns	5.29ns
C x R x H	2	2.09ns	32.51ns
D x C x R x H	4	0.62ns	5.61ns
Error	54	1.85	13.62
Total	143		

Table A. 19. Infection of soybean seed by Diaporthe phaseolorum var. sojae, 1977.

Cultivar	Janesville	Kenosha	Lancaster	Arlington	Durand	Hancock Dryland	Hancock Irrigated	Galesville
SRF 150P	48	12	14	20	2	--	--	10
Evans	62	44	16	40	2	4	2	2
Grande	--	--	--	--	0	--	--	--
Swift	74	--	14	--	0	--	2	16
Chippewa 64	40	42	46	20	2	2	0	2
Steele	44	36	32	38	6	0	0	6
Hodgson	66	52	40	20	0	4	0	8
Hodgson 78	48	50	22	12	--	--	--	--
Coles	38	22	46	--	--	4	0	22
Marion	--	--	12	--	--	--	--	--
Corsoy	58	10	32	12	00	0	0	2
Vickery	60	14	40	--	0	2	0	6
Wells	44	18	24	12	2	0	0	10
Amsoy 71	32	8	14	8	--	--	--	--
SRF-200	32	6	6	--	--	--	--	--
Beeson	28	4	22	6	--	--	--	--
Wayne	4	6	2	6	--	--	--	--
Hark	26	14	24	6	0	0	0	8

Table A20. Summary of rainfall received at the Arlington Experimental Farm (Agronomy) during the 1976 growing season.

Day	April	May	June	July	August	September
1	.01					.02
2						
3						
4						
5		.13			.19	
6		.03			.01	
7						
8						
9					.07	
10						
11	.37					
12						
13		.04	.07		.81	
14			.32			.14
15	.78	.26		1.21		
16		.67				
17	.17	.13				
18	.11					
19				.10		.35
20	.23	.02		.29		.06
21	1.45			.19		
22	.08					
23	.02					
24	1.00		.17	.49		
25	.02		.10			
26				.04	1.59	
27						
28			.09	.93	.64	
29			.07	.01		
30	.14					
31				1.35		
Total	4.35	1.28	.82	4.64	3.31	.95
Departure from mean	+1.68	-1.74	-3.48	+ .97	- .95	-3.12

Table A21. Summary of air temperatures ($^{\circ}\text{F}$) at the Arlington Experimental Farm (Agronomy) during the 1976 growing season.

Day	April		May		June		July		August		September	
	max	min	max	min	max	min	max	min	max	min	max	min
1	43	30	60	37	75	57	79	50	75	50	82	53
2	62	30	54	36	74	46	82	51	73	51	71	41
3	60	39	47	31	77	45	82	53	79	50	85	55
4	51	30	65	29	80	50	87	55	82	50	83	48
5	61	31	71	53	80	52	90	55	80	61	74	44
6	63	36	62	33	85	54	91	60	72	50	79	46
7	62	34	52	31	87	57	88	64	73	48	87	61
8	57	27	67	31	88	58	86	57	79	50	87	53
9	60	28	79	51	88	61	83	61	82	52	83	52
10	67	39	78	44	86	64	99	76	83	59	70	41
11	52	24	73	43	91	63	97	76	90	62	82	43
12	53	24	63	33	92	64	86	50	86	64	83	50
13	67	30	67	41	94	59	88	54	85	61	83	55
14	73	46	73	42	88	61	94	69	73	54	79	61
15	70	55	72	48	82	68	92	65	69	45	66	51
16	78	58	61	54	73	54	80	56	75	47	64	49
17	78	59	61	47	83	49	78	51	76	48	73	42
18	76	60	66	35	82	62	88	55	84	57	75	47
19	64	39	73	36	74	46	84	64	87	65	78	48
20	58	40	84	59	84	49	83	68	86	58	67	45
21	55	43	82	50	83	52	83	60	88	57	61	42
22	60	38	70	43	83	59	81	57	91	61	68	31
23	59	39	63	42	78	55	91	66	85	61	65	40
24	47	40	64	39	69	56	84	61	84	56	65	30
25	50	35	67	39	79	53	89	58	86	59	65	39
26	52	29	71	42	90	62	86	63	84	61	68	42
27	51	27	75	46	86	63	87	62	90	69	60	40
28	59	33	74	50	85	62	87	67	87	53	62	33
29	63	37	67	53	85	54	79	62	73	45	68	40
30	61	43	68	55	78	55	86	60	77	50	76	41
31	--	--	73	56	--	--	85	55	86	57	--	--

Table A22. Summary of rainfall received at the Arlington Experimental Farm (Agronomy) during the 1977 growing season.

Day	April	May	June	July	August	September
1			.09	.12		
2	.37		.01			.03
3	.01			.81		
4	.73				.19	.07
5		.14	1.12		.02	
6						
7		.04	.13	.02		
8			.21		.50	
9			.02		.34	
10					.02	
11			.36		.01	
12				.10		.45
13					.37	.10
14	.04					
15		.31		.01		.02
16			.02	.16	.69	.06
17		.02		.71		.18
18			.23			.14
19	.23					
20	.15	.08		2.52		.02
21	1.01	.55			.25	
22		.02			.01	.19
23			.03	.34	.04	.04
24						.89
25						.04
26						
27						
28	.04		.35		.19	
29		.03				.07
30		.13	.25			.29
31		1.08		.47	.09	
Total	2.58	2.36	2.73	5.37	2.74	2.59
Departure from mean	- .09	- .66	-1.57	+1.70	-1.52	-1.48

Table A23. Summary of air temperatures ($^{\circ}\text{F}$) at Arlington Experimental Farm (Agronomy) during the 1977 growing season.

Day	April		May		June		July		August		September	
	max	min	max	min	max	min	max	min	max	min	max	min
1	47	33	73	45	70	54	77	53	79	52	82	63
2	45	35	73	48	67	48	84	54	78	60	75	59
3	46	29	68	37	75	42	83	63	79	59	70	53
4	43	31	69	47	88	53	96	74	75	59	80	56
5	34	26	76	55	84	59	94	70	80	62	80	59
6	38	13	74	46	80	54	94	75	78	56	78	53
7	52	30	73	36	68	43	92	70	84	66	76	63
8	50	25	74	38	64	42	86	68	82	66	79	41
9	59	27	63	28	66	37	81	57	80	58	79	61
10	80	43	68	32	72	45	80	55	78	63	72	49
11	79	51	80	47	68	51	88	65	78	46	75	53
13	73	56	85	54	68	49	88	54	77	56	68	55
14	58	44	85	56	74	46	98	70	74	48	72	43
15	80	42	85	56	75	51	96	70	74	49	70	49
16	79	54	84	61	84	55	89	67	73	59	62	53
17	83	50	82	60	84	61	87	65	69	52	70	58
18	84	51	88	63	82	62	86	66	69	44	76	59
19	80	57	88	62	79	54	94	70	67	49	75	56
20	74	58	87	61	79	53	93	72	70	46	61	42
21	72	53	83	61	75	50	90	67	72	58	56	49
22	62	45	79	62	77	55	81	52	75	50	60	51
23	69	40	81	56	77	52	81	55	71	55	62	54
24	69	40	87	57	89	60	79	66	69	46	69	61
25	58	37	87	58	85	62	80	63	72	41	70	52
26	67	34	86	56	89	58	73	49	80	61	67	47
27	80	40	86	53	90	65	75	53	88	73	65	49
28	80	34	89	53	88	68	80	56	83	68	69	45
29	63	29	89	60	80	56	83	65	75	54	69	52
30	80	38	80	55	80	60	85	61	77	51	64	49
31	--	--	77	52	--	--	85	56	83	60	--	--

Table A24. Summary of rainfall received at the Arlington Experimental Farm (Agronomy) during the 1978 growing season.

Day	April	May	June	July	August	September
1			.02	2.46		
2	.29			.05		.04
3	.05		.01			
4	.04					
5						
6	1.10					
7				.05		
8		.25	.32			
9	.05	.01				
10	.34					
11	.03					
12		1.60				.94
13		3.70		.08		1.01
14		.22	.03			.36
15						
16			1.08		.06	
17			1.34			.25
18	.44		.56	.02	.07	1.77
19	.30				.16	
20	.02		.19	.64		.66
21				.35		.21
22				.12	.07	
23	.31	.09	.07			
24	.01				.38	
25			3.40			
26				.18		
27					.38	
28		.78				
29		.13		.06		
30			1.01			.04
31		.28		.09		
Total	2.98	7.08	8.03	4.10	1.02	5.28
Departure from mean	-.31	+4.06	+3.73	+ .43	-3.24	+1.21

Table A25. Summary of air temperatures ($^{\circ}\text{F}$) at Arlington Experimental Farm (Agronomy) during the 1978 growing season.

Day	April		May		June		July		August		September	
	max	min	max	min	max	min	max	min	max	min	max	min
1	71	35	56	23	79	57	77	65	78	50	82	57
2	35	27	60	26	70	48	77	61	79	64	84	62
3	50	30	66	32	72	46	74	58	70	51	85	60
4	53	39	62	37	77	50	77	63	73	48	82	48
5	54	32	58	40	77	49	81	59	78	48	85	56
6	54	39	65	32	82	54	86	65	84	50	87	57
7	62	40	64	40	83	59	83	68	83	54	94	59
8	55	32	67	42	77	45	80	56	86	62	96	69
9	53	34	61	43	77	48	79	62	82	58	94	62
10	51	40	71	38	83	45	74	51	79	52	90	65
11	49	34	72	40	87	60	74	48	81	56	89	64
12	63	26	73	57	88	62	73	50	85	60	87	61
13	59	30	73	41	72	42	79	64	88	63	63	56
14	55	31	47	39	69	46	81	56	88	64	73	61
15	53	30	61	44	78	52	85	63	90	68	77	51
16	51	28	61	47	78	59	84	56	81	61	74	49
17	50	28	70	43	72	63	85	62	85	56	67	55
18	45	35	78	50	75	57	84	70	88	68	76	51
19	43	38	78	53	78	50	86	71	87	59	86	61
20	42	34	77	61	77	59	85	69	80	47	83	57
21	50	28	67	41	73	48	71	60	78	52	62	49
22	56	28	69	38	77	50	83	66	84	61	67	40
23	59	38	68	53	76	56	79	55	89	66	68	39
24	57	36	75	55	80	55	78	57	87	66	75	47
25	58	35	82	54	79	64	83	57	82	63	70	41
26	62	33	87	62	90	66	82	67	77	67	72	47
27	68	37	89	66	89	67	79	60	76	68	71	54
28	72	40	87	56	84	61	76	55	77	64	63	36
29	68	51	83	64	87	59	73	66	78	54	68	46
30	54	29	78	59	87	68	70	46	8-	52	62	48
31	--	--	83	54	--	--	78	52	79	51	--	--