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Abstract
This research studied the influence of row spacing on the competitiveness of soybeans with weeds. Late-emerging weeds were a greater problem in 30-in. than in 10-in. rows, and narrow-row soybeans competed successfully with weeds that emerged three weeks after planting, whereas wider-row soybeans needed four weeks to become competitive. The shading provided by narrow-row soybeans was as effective as a layby cultivation in controlling late-emerging weeds. Moreover, post-emergence herbicides controlled weeds effectively at rates lower than recommended by the manufacturer. Two one-quarter applications two weeks apart provided control equal to the full amount, with no yield losses. Narrow-row spacing offers potential for reducing herbicide costs, although success depends on appropriate selection and timely application of herbicide.

Keywords
Agronomy, Corn-soybean cropping systems, Weed control alternatives (not GMOs)

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences | Weed Science

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Abstract: This research studied the influence of row spacing on the competitiveness of soybeans with weeds. Late-emerging weeds were a greater problem in 30-in. than in 10-in. rows, and narrow-row soybeans competed successfully with weeds that emerged three weeks after planting, whereas wider-row soybeans needed four weeks to become competitive. The shading provided by narrow-row soybeans was as effective as a layby cultivation in controlling late-emerging weeds. Moreover, post-emergence herbicides controlled weeds effectively at rates lower than recommended by the manufacturer. Two one-quarter applications two weeks apart provided control equal to the full amount, with no yield losses. Narrow-row spacing offers potential for reducing herbicide costs, although success depends on appropriate selection and timely application of herbicide.

Background

The past five years have seen a tremendous increase in the number of no-till, narrow-row soybean acres planted in Iowa. This trend, which is expected to continue, has preceded the development of sound recommendations for optimizing crop production in this tillage system. No-tillage is aimed at reducing soil erosion by leaving the previous year’s residue on the soil surface to reduce soil loss with runoff water. Such conservation tillage practices are the least costly way to limit soil erosion, and many Iowa farmers would be unable to produce soybeans and still meet federal conservation compliance plans without them.

When grown under optimal conditions, narrow-row soybeans generally result in higher yields than wide rows. Average yield increases of approximately 7% and 12% were reported in Iowa for 20- and 10-inch row spacings respectively (compared to 30-in. row spacing). However, one of the production facets most affected in no-till planting of soybeans is weed management: the corresponding loss of cultivation as a weed management tool can pose a disadvantage. Because a large majority of Iowa farmers utilize cultivation as a management tool in soybeans, converting to no-till, narrow-row soybeans may increase herbicide use.

Narrow-row planting alters the competitive relationship between crop and weeds by influencing the rate at which the soybean canopy covers the soil surface. Research has shown that soybeans planted in 7-in. rows provided 80% soil cover five weeks after planting compared to 30% cover in 40-in. rows. The more rapid soil coverage in narrow rows reduces late-season weed problems when weeds are suppressed early with herbicides. Soybean populations within rows are another factor; stands with fewer than 10 plants per row foot allow increased weed growth.

The increased competitiveness of narrow-row soybeans can improve the efficiency of weed management programs. As postemergence herbicides replace soil-applied herbicides, proper application timing is critical for effective control. Post-emergence herbicides are usually applied approximately three to four weeks after planting, while weeds are less than four inches high. Growers typically delay applications as long as possible to insure control of later weed flushes. As a result, using full label rates is normally necessary. The more rapid canopy development of narrow-row spacings reduces problems with late-emerging weeds and may allow postemergence herbicides to be applied earlier in the season, therefore improving effectiveness and allowing reduced rates to control small weeds.
The objectives of this research were to
(1) determine the effect of row spacing and
seeding rates on weed management pro­
grams, in order to
(2) develop weed management strategies that
take advantage of the increased competi­
tiveness of soybeans planted in narrow
rows.

Weed emergence patterns in response to row
spacing and seeding rates were evaluated,
along with several timings of postemergence
applications, to determine whether the im­
proved competitiveness of narrow-row soy­
beans influences the optimum timing for her­
bicide application. This integration of cultural
practices with herbicides should provide weed
management strategies that offset the need for
an increase in herbicide use due to the loss of
tillage as a management tool.

Approach and methods

Experiments conducted at Atlantic, Ames,
and Nashua evaluated the effects of the soy­
bean canopy; a second set of studies evaluated
the effectiveness of reduced rates of post-
emergence herbicides in narrow-row soybeans.

Effect of soybean canopy on weed manage­
ment: Experiments were conducted during
two years to evaluate the effects of soybean
row spacing, cultivation, and timing of herbi­
cide application on weed control and soybean
yield. Soybeans were planted no-till into
approximately 70% corn residue. Plots were
sprayed with Roundup (a broad spectrum her­
bicide) prior to planting to control emerged
weeds. Three treatments were evaluated: 10­
in. rows, 30-in. rows, and 30-in. rows with a
layby cultivation. Soybeans were planted at a
rate of 200,000 seeds/acre in 10-in. rows and
160,000 in 30-in. rows. Three postemergence
herbicide treatments were evaluated: a mix­
ture of Poast Plus, Galaxy, and an adjuvant
applied either as an early-post (two weeks
after planting), mid-post (three weeks after
planting), or late-post (four weeks after plant­
ing). Poast Plus provides control of most
grasses, whereas Galaxy is effective on broad-
leaf species. Rates were selected to provide
effective control of all emerged weeds. An
untreated control was also included. Neither
Galaxy nor Poast Plus has significant residual
activity, which allowed evaluation of how well
the different row-spacing treatments s
tothered weeds emerging after application.
In year two, a weed-free treatment was also
included.

Weed control was evaluated visually through­
out the growing season. A swath through the
middle of the plot was harvested to evaluate
soybean yields.

A second experiment in 1995 evaluated the
influence of the soybean canopy on the perfor­
mance of Pursuit for giant foxtail and smart­
weed control. Soybeans were planted into
untillled corn residue. Two canopy treatments
were studied: soybeans planted in 10-in. rows
and no soybeans. Four herbicide treatments
were evaluated: Pursuit 2SC applied at 1, 2,
and 4 ounces per acre and a tank mix of 1.5
pints Poast Plus + 2 pints Galaxy + adjuvant.
All Pursuit treatments included a crop oil con­
centrate and 28% N as additives. An untreated
control was also used.

These treatments were conducted to evaluate
the importance of residual activity from
postemergence herbicides for maintaining full-
season weed control. Pursuit has significant
soil activity at full rates but not at lower rates.
Neither Poast nor Galaxy has soil activity. These
herbicide treatments, paired with the
two soybean canopy treatments, allowed eval­
uation of the interaction between the soybean
 canopy and herbicide residual. Weed control
was visually evaluated six and 12 weeks after
planting.

Reduced rate herbicide studies: The perfor­
mance of postemergence herbicides in no-till
drilled soybeans was also evaluated. All ex­
periments were conducted in soybeans fol­
lowing corn. Roundup was applied at planting
to control emerged weeds. Soybeans were
planted at populations of 200,000 seeds/acre.
Herbicides were applied at the recommended
label rate (IX), one-half the label rate (0.5X),
and one-quarter (0.25X). The 0.25X rate was
applied as an early-post (EP) treatment 2 to 2.5
weeks after planting (WAP); the 0.5X rate was
applied as a mid-post (MP) application (3 to 3.5 WAP); and the 1.0X rate was applied as a late post (LP) application (3.5 to 4 WAP). Weed size typically was 1 to 2 in. at the EP application, 2 to 3 in. at MP, and 3 to 4 in. at LP. Sequential (S) applications of the 0.25X and 0.5X were also evaluated. The 0.25XS treatment consisted of an EP and LP application of the 0.25S rate, and the 0.5XS treatment included a MP and LP application of the 0.5X rate.

Herbicides evaluated included Pursuit and a combination of Assure II + Concert. Weed control was visually evaluated throughout the growing season, and soybean yields were mechanically harvested.

Findings

Effect of soybean canopy on weed management: All application timings provided excellent control of weeds present at application. Weed control ratings were taken in August for giant foxtail, velvetleaf, pigweed, and smartweed.

Results in year one at one location (Table 1) were typical. The early-post application provided poor control regardless of row spacing. At the time of the EP application, giant foxtail plants were approximately one inch in height. All emerged foxtail plants were controlled, but foxtail that emerged after the application were not affected significantly by the soybean canopy. The advantage of narrow-row spacing is most evident at the MP application. As with the EP application, all emerged foxtail were controlled by the Poast Plus. Late-emerging foxtail competed successfully in soybeans planted in 30-in. rows, resulting in a late-season control rating of 50%. However, shading by the soybean canopy in 10-in. rows reduced survival of late-emerging foxtail and improved late-season control ratings to 84%. A layby cultivation in 30-in. rows with a MP application resulted in 86% control. The early canopy development in narrow rows provided similar weed control benefits as a layby cultivation in 30-in. rows at three of four locations. At another site in year one, giant foxtail control was similar between MP and LP applications in the drill and 30-in. row spacings. Cultivation improved foxtail control over that in the two row-spacing treatments without cultivation.

More rapid canopy development in narrow rows appears to increase soybean yield potential by shading weeds. Averaged over herbicide treatments, drilled soybeans outyielded 30-in. rows without cultivation in three out of five experiments. However, there was no yield advantage in the drilled treatment compared to 30-inch rows with cultivation. Yields in the cultivated treatment were greater than in drilled beans at one first-year site, probably because of uneven stands in the drill treatment caused by dry conditions after planting. Stand establishment was more uniform with the planter.

The potential yield advantage of narrow rows is believed to be due to more efficient utilization of available sunlight. While most yield studies are done under weed-free conditions, these studies indicate that under conditions with escaped weeds, as encountered in growers’ fields, soybeans planted in narrow rows are able to minimize the impact of interspecific competition with weeds.

Two experiments in year two to further evaluate the contribution of the soybean canopy to weed management indicated that the presence of soybeans had little effect on weed control at the early evaluation date. The 0.25X Pursuit treatment provided lower levels of foxtail and smartweed control than the higher rates. The Galaxy/Poast Plus treatment was similar to the 0.5X and 1.0X Pursuit rates at the early evaluation date.

The large differences in late control ratings between the two canopy regimes demonstrated the importance of weed suppression by the crop canopy. For example, the 0.25X Pursuit treatment provided 83% foxtail control seven WAP at Ames in both canopy regimes. At the late evaluation, foxtail control dropped to 61% with soybeans present versus 35% control with no canopy. The results also demonstrate the advantage of postemergence herbicides that have residual activity in addition to foliar
activity. Pursuit has both, whereas Galaxy and Poast are primarily foliar-active products. Galaxy and Poast performed similarly to the 1.0X Pursuit treatment in early season evaluations. Reduced rates of Pursuit had declines in late-season weed control similar to the Galaxy/Poast treatment. Reducing herbicide rates will influence residual activity more than foliar activity. The soybean canopy greatly diminished this drop-off in Pursuit’s late-season performance but did not eliminate it. The row spacing studies illustrated that narrow-row soybeans minimized the yield impact of late-emerging weeds.

Because rapid development of the soybean canopy in narrow rows reduces the survival and competitiveness of late-emerging weeds, post-emergence herbicide applications can be made earlier in the season while weeds are small and easier to kill.

Reduced rate herbicide studies: The reduced rate studies show promise for lowering weed management costs by reducing herbicide use. Each weed control observation for the reduced rate treatments was compared to the standard treatment and grouped as to whether control was significantly less than, equal to, or greater than the standard. Only the 0.25X treatment increased risk less than the 1.0X treatment, resulting in lower weed control in six of twelve situations. The 0.5X treatment resulted in poorer control than the recommended rate in one of twelve situations.

The sequential application strategy is promising for reducing the risks associated with reduced rates. While reduced-rate applications will increase the likelihood of reduced weed control, a second reduced-rate application one to two weeks after the first will bring the control up to the level of the recommended rate. The drawback is the need for a second trip over the field at a time when the grower may be busy with other critical cropping operations. Cost for a second application will range from $5 to $8 per acre—which can be recouped if the 0.25X strategy is used (weed management costs would increase with use of the sequential 0.5X application). The 0.25X treatment would need a second application in more situations to maintain weed control equivalent to that achieved with the recommended rate.

No yield losses were associated with the reduced rate treatments in any experiment. The lack of yield losses even with reduced weed control observed with some of the single reduced-rate applications supports results of experiments evaluating the effect of row spacing on weed management. The increased competitiveness provided by rapid canopy development in narrow rows reduces the risk of significant yield losses to escaped weeds.

Implications
This research has documented the advantages of row spacings of 10 inches or less for managing weeds in soybeans. The earlier shading of the soil surface with narrow rows provided benefits similar to that of a layby cultivation in wide rows. The soybean canopy’s ability to smother late-emerging weeds provides the opportunity to apply herbicides closer to planting while weeds are small and easier to control. The smothering effect of the canopy reduces problems with late-emerging weeds that are a problem with early applications in wide rows. Any grower equipped with a drill may use this strategy.
Postemergence herbicides applied at rates lower than recommended provided control equivalent to the label rate. Although the quarter-rate treatment was inconsistent, resulting in reduced control compared to the label rate in 50% of observations, two one-quarter rate applications provided control equal to or better than the standard. The sequential application strategy has potential to reduce herbicide use, but growers must carefully evaluate the cost of the second application and their ability to complete the application in a timely fashion.

This work demonstrated the potential for integrated management strategies to reduce weed management costs. The competition provided by soybeans can replace a portion of the herbicide. While reduced rates will increase risk, it can be minimized by monitoring fields after application to determine the need for a sequential application. Where sequential applications are required, the amount of herbicide would not exceed (and may still be less than) the amount of the recommended label rate.

These research results were disseminated through field days and conferences, and through revisions in two ISU Extension bulletins on herbicide use and crop-weed interactions.

Narrow-row soybeans (shown at left) are on the increase in Iowa, due in part to their potential for increased yields and reduced soil erosion. Rapid development of a canopy that helps to control weeds can be another important advantage.