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Between-Row Mowing + Banded Herbicide to Control Annual Weeds and Reduce Herbicide Use in No-till Soybean (*Glycine max*) and Corn (*Zea mays*)[1]

WILLIAM W. DONALD, NEWELL R. KITCHEN, and KENNETH A. SUDDUTH[2]

Abstract: Alternative methods are needed to control weeds in no-till corn and soybean which minimize herbicide contamination of surface or ground water. The objective of this research was to determine whether between-row (BR) mowing + band-applied herbicide could help reduce herbicide use, without sacrificing summer annual weed control or yield, in no-till soybean and field corn. Glyphosate was applied shortly before or at planting to control emerged winter annual weeds in all treatments. In the BR mowing weed management system, the band-applied soil residual herbicides imazaquin + alachlor in soybean or atrazine + alachlor in corn were applied shortly before or after planting followed by two or more between-row mowings to control summer annual weeds. Annual weeds were first mowed when they were about 8 cm tall and again just before crop canopy closure. Between-row mowing weeds very close to the soil surface two or three times killed or suppressed summer annual grass and broadleaf weeds, chiefly giant foxtail, common cocklebur, and horseweed, when timed properly. The BR mowing weed management system increased yield above a weedy check in these no-till crops. It also controlled weeds and yielded as well as or better than broadcast-applied herbicide at the same rates. Use of soil residual herbicides to control summer annual weeds was reduced 50% by banding because only 50% of the field area was sprayed.
Nomenclature: Alachlor, atrazine; glyphosate; imazaquin; common cocklebur, *Xanthium strumarium* L. # XANST; corn, *Zea mays* (L.) #[3] ZEAMX, 'Pioneer 3394'; giant foxtail, *Setaria faberii* (L.) Beauv. # SETFA; horseweed, *Conyza canadensis* (L.) Cronq # CONCA; soybean, *Glycine max* (L.) Merr. # GLYMA, 'Pioneer 9461'.
Additional index words: Band application, defoliation, mowing, mechanical weed control, no-till, no-tillage, tillage, topping.
Abbreviations: DAP, days after planting; BR, between row.

INTRODUCTION

Reduced and no-till farming systems minimize soil erosion on highly erodible farmland (Renard et al. 1994) and sediment contamination of surface water by reducing both primary tillage operations and field cultivation for weed management. Farmers chiefly rely on herbicides to manage weeds in reduced or no-till field corn and soybean in the Midwest (Anonymous 1999). Yet, herbicides contaminate surface water and can occasionally make it unfit for its intended uses (Baker and Johnson 1983: Brock 1982; Gaynor et al. 1995; Larson et al. 1997; Logan et al. 1987; Mutchler and Greer 1984). If herbicide contamination of surface and ground water is to be minimized, then best management practices must be used (Fawcett 1998) to reduce offsite herbicide movement (Logan et al. 1987; Logan 1993).

To reduce the chance of herbicide contamination of surface and ground water, alternative weed management systems are needed that either reduce the area treated with herbicides or herbicide application rates, or both. A modified between-row (BR) mowing weed management system (Donald 2000b, 2000c) has potential for doing this in no-tillage farming systems (Figure 1). The BR mowing weed management system reduced herbicide use 50% in soybean grown in 76-cm rows under "conventional" tillage because half of the land area was treated in strips with herbicide banded over rows alternating strips which were mowed twice between rows (Donald 2000a, 2000b). Two BR mowings close to the soil surface controlled summer annual weeds more consistently than mowing only once in 76-cm row soybeans (Donald 2000b). In one study, banding herbicides reduced herbicide applied per unit area as well as herbicide flux and

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[2] Res. Agronomist, Soil Scientist, Agric. Engr., U.S. Department of Agriculture, Agricultural Research Service, 269 Agric. Engr. Bldg., UMC, Columbia, MO 65211. Corresponding author's E-mail: donaldw@missouri.edu

[3] Letters following this symbol are a WSSA-approved computer code from *Composite List of Weeds,* Revised 1989. Available only on computer disk from WSSA, 810 East 10th Street, Lawrence, KS 66044–8897.

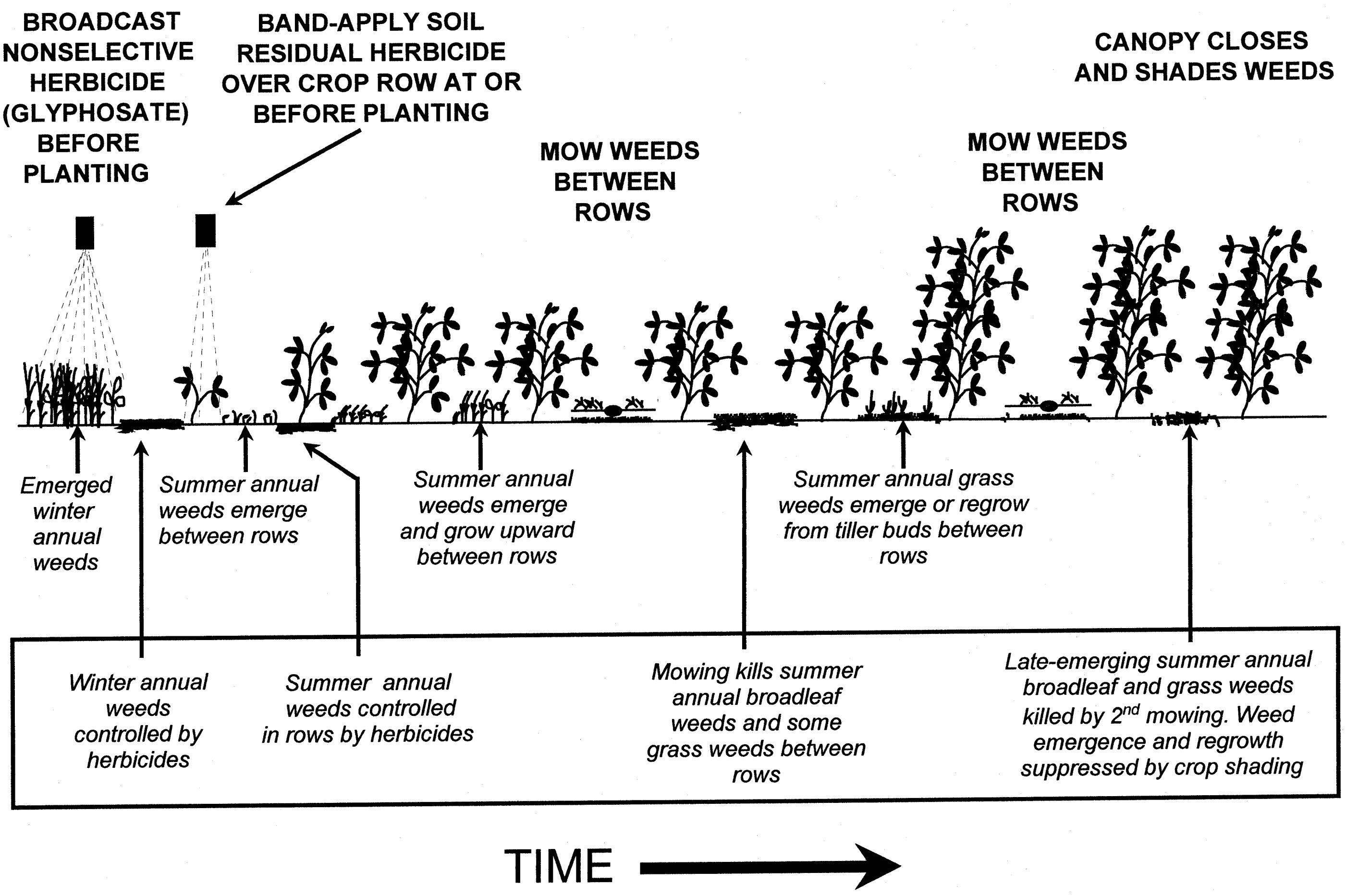

Figure 1. A diagram of the chief components of the between-row mowing weed management system for no-till row crops and how they contribute to weed management over time.

concentration in runoff from field margins (Gaynor and Van Wesenbeeck 1995).

The objective was to compare summer annual weed control and crop yield of the BR mowing weed management system (i.e., band-applied herbicide followed by BR mowing) with broadcast-applied soil-residual herbicide in no-till soybean and corn in north central Missouri.

MATERIALS AND METHODS

No-Till Agronomic Practices. The experiment was conducted at the Missouri Management Systems Evaluation Area (MSEA) research site near Centralia, MO, on large no-till plots with a 1 to 3% slope in which corn and soybean were rotated for two years before starting the experiment in 1993. The soil was a Mexico silty clay loam (fine, smectitic, Aeric Vertic Epiaqualfs) or Adco silt loam (fine, smectitic, mesic Vertic Albaqualfs) [at the summit]) (0 to 1% slope). Surface soil samples (N = 27; diam = 2.3 cm) from the summit, sideslope, and toeslope positions were characterized for the main plots (data not presented).

Field operation dates for treatments and measurements are summarized (Table 1). Soybean fertilization (phosphorous-potassium) for a yield goal of 2,690 kg/ha was based on soil tests and recommendations of the University of Missouri soil testing laboratory. Pioneer 9461 soybean seeds were planted at 395,000 seeds/ha in 76-cm rows 3 to 5 cm deep with a four-row planter[4] having a single disk coulter with gauge wheels, a slot opener, seed firming wheel, and disk covers.

Corn hybrid Pioneer 3394 was planted at 54,340 and 59,280 seeds/ha in 76-cm rows 3 to 5 cm deep in 1993 and 1994, respectively, and was fertilized for a yield goal of 9,500 kg/ha (Table 1). In 1993, nitrogen as 28% UAN solution was applied at 20 kg/ha as starter fertilizer + 105 kg/ha side dressed (knifed in between rows) at planting. In 1994, nitrogen was applied at 11 kg/ha as starter

[4] Buffalo All-Flex Planter (model 4500-H), Fleischer Manufacturing, Inc., Box 848, Columbus, NE 68601.

Table 1. Dates of field operations or measurements for no-till soybean and corn in 1993 and 1994.

Field operation or measurement	Soybean 1993		Soybean 1994		Corn 1993		Corn 1994	
		DAP[a]		DAP		DAP		DAP
Nitrogen application	—		—		May 17	0	May 19	0
Glyphosate application	June 2	−1	May 27	3	May 20	3	May 22	3
Plant crop	June 3	0	May 24	0	May 17	0	May 19	0
Herbicides band- or broadcast applied	June 2	−1	May 27	3	May 24	7	May 22	3
Hoe and hand weed check plots	June 11	8	May 31	7	May 17	0	May 31	12
	14–16	11	June 1	8	June 11	25	June 1	13
	July 19–20,	46	June 30–	37	June 13–	27	June 30–	42
	26–27	47	July 1	38	18	32	July 1	43
		53	July 17,	54	July 19–20	33	July 19	61
		54	19	56	July 26–29	40		
Measure crop stand	July 27	54	July 7	64	July 27	71	July 27	69
Mow between rows	June 18	15	July 1	38	June 18	32	July 1	43
	July 13	40	July 14	51	July 13	57	July 18	60
					July 28	72		
Visually rate weed control	July 27	54	Aug 9	77	July 27	71	Aug 9	82
Photograph weed cover	July 28	55	Aug 11	79	July 28	72	Aug 25	98
Harvest yield	Oct 13–14	132	Sept 30	129	Oct 5–7	141	—	—
			Oct 3–4					

[a] Abbreviation: DAP, days after planting.

fertilizer + 140 kg/ha side dressed at planting. Weather data (daily air minimum and maximum temperature and precipitation) were collected at the site.

Treatments. The no-till BR mowing weed management system consisted of four components: (1) a competitive crop, soybean or corn, (2) glyphosate broadcast-applied shortly before or at planting to control emerged winter annual weeds, (3) band-applied soil-residual herbicide over crop rows at or soon after planting in which the band width was 50% of the row width, and (4) two or more BR mowings close to the soil surface to control summer annual weeds (Figure 1). Glyphosate at the same rate was applied shortly before or at planting to the following four no-till treatments: (1) a weedy check, (2) a hand hoed, weed-free check, (3) broadcast-applied soil residual herbicides alone, shortly before or after planting, and (4) the no-till BR mowing weed management system. Individual plots measured 3 by 7 m. Broadleaf weeds, other than horseweed and common cocklebur, were generally sparse, whereas giant foxtail, the major grass weed, was dense. Within each year and crop, the total, grass, and broadleaf weed cover between rows in late summer was independent of slope position in weedy check plots (data not presented).

Between-Row Mowing. Close mowing summer annual broadleaf and grass weeds was simulated using an "XL" PRO model DR Trimmer/ mower (Country Home Products, Charlotte, Vermont)[5] operated about 2.5 cm above the soil surface (Figure 1 and Table 1). The BR mowing width was 60 cm, leaving about 8 cm unmowed on each side of 76-cm wide crop rows. Between-row mowing was first imposed when weeds were about 8 cm tall. A second mowing controlled grass regrowth and late emerging broadleaf and grass summer annual weeds after they became 8 and 15 cm tall.

Herbicide Treatment. Glyphosate + imazaquin + alachlor + 0.5% (by vol) nonionic surfactant were applied to soybean plots before or soon after planting to control emerged winter annual weeds and subsequent flushes of summer annual weeds (Table 2). Imazaquin + alachlor were broadcast-applied to herbicide-only treatments or were band-applied over crop rows in the BR mowing system. Alachlor and imazaquin were applied to 6 to 12% and 34 to 40% of Missouri soybeans, respectively, in 1993 and 1994 (Mills et al. 1995).

Glyphosate was applied to corn plots, as described for soybean plots. Atrazine + alachlor were substituted for the imazaquin + alachlor (Table 2). In 1993 and 1994, alachlor and atrazine were applied to 18 to 36% and 83 to 84% of Missouri corn, respectively (Mills et al. 1995).

Glyphosate controlled winter annual weeds in all treatments. In weed-free checks, summer annual weeds emerging after planting in crop rows were hand-pulled and hoed, and weeds between crop rows were hoed several times during the growing season in a timely fashion (Table 1). Yields of the weed-free check plots represent the maximum for the site-year.

Measurements. Crop stand was determined by counting plants in two 1.8-m lengths in each four-row plot after

[5] Names are necessary to report factually on available data; however, the USDA neither guarantees nor warrants the standard of the product, and the use of the name by the USDA implies no approval of the product to the exclusion of others that may also be suitable.

Table 2. Sprayer and application description for herbicide treatments.

				1993		1994	
Crop	Treatment	Variable	Units	Broadcast Application	Band Application	Broadcast Application	Band Application
Corn	Glyphosate +	Rate	kg ai/ha	1.1	—	1.7	—
	nonionic surfactant		+ % (v/v)	+0.5%		+0.5%	
	Date applied	Date		May 20	—	May 22	—
	Atrazine + alachlor	Rate	kg ai/ha	2.2 + 2.3	2.2 + 2.2	2.2 + 2.2	2.2 + 2.2
	Date applied preemergence	Date		May 24	May 24	May 22	May 22
	Sprayer			Tractor	Bicycle	Bicycle	Bicycle
				Hydraulic	Compressed air	Compressed air	Compressed air
	Ground speed	Speed	km/h	6.4	4	4.8	4.8
	Spray volume	Volume	L/ha	170	60	76	76
	Nozzle type			Teejet flat fan (XR 8003)	Teejet even (8001 EVS)	Teejet flat fan (8001)	Teejet even (8001 EVS)
	Spray pressure	Pressure	kPa	207	207	276	276
Soybean	Glyphosate	Rate	kg ai/ha	1.1	—	1.7	1.7
	Nonionic surfactant	Rate	% (v/v)	0.5%	—	0.5%	0.5%
	Date applied	Date		June 2	June 2	May 24	May 24
	Imazaquin + alachlor	Rate	kg ai/ha	0.1 + 2.5	0.1 + 2.2	0.1 + 2.5	0.1 + 2.5
	Date applied	Date		June 2	June 2	May 24	May 24
	Sprayer			Tractor	Bicycle	Bicycle	Bicycle
				Hydraulic	Compressed air	Compressed air	Compressed air
	Ground speed	Speed	km/h	6.4	4	4.8	4.8
	Spray volume	Volume	L/ha	185	60	76	72
	Nozzle type			Teejet flat fan (XR 8003)	Teejet even (8001 EVS)	Teejet flat fan (8001)	Teejet even (8001 EVS)
	Spray pressure	Pressure	kPa	207	207	276	276

emergence ended. Weed control in rows and between rows was evaluated visually in late summer and before harvest (data not presented) based on a scale of 0% (no control) to 100% (complete kill). Seeds were harvested with a plot combine from the two center rows in a 1.4- by 7-m area in each plot. After seed cleaning, yields and moisture contents were measured, and net yields were adjusted to 13% moisture for soybean or 15.5% for corn.

Projected percent ground cover (Bonham 1989) of grass and broadleaf weeds growing between rows was photographed about the same time weed control was visually rated (Table 1). Soybean foliage was pulled back from between rows with 1-m^2 black cloth-covered wooden frame panels and four between-row photographs per plot were taken with a video camera (RC-570 still video camera, Cannon U.S.A., Inc., Lake Success, New York) at a height of 140 cm. Weed height was also measured when photographs were taken. Each photograph corresponded to 0.8 m^2 at the soil surface based on photographs of a 30- by 30-cm orange calibration plate. Photographs were digitized (SV-PC SV Digitzer Still Video Board, Cannon U.S.A. Inc., Lake Success, New York) and saved as TARGA files for image analysis (Sigma Scan Pro ver. 5 Jandel Scientific, San Rafael, California). The image analysis software was used to automatically superimpose a 20 x 20 pixel grid over each photograph. To measure projected weed ground cover in the photographs, the intersections of this grid over either grass or broadleaf weed foliage were counted, and total, grass, and broadleaf weed percent cover were expressed as a percent of the total number of grid intersections per picture.

Statistical Analysis. The experiment had a randomized complete block design. Soybean had six and nine blocks in 1993 and 1994, respectively, whereas corn had nine and six blocks in 1993 and 1994, respectively (i.e., corn and soybean were rotated). Blocks were located at three slope positions [i.e., starting at 24 m (summit), 91 m (side slope) and 146 m (toe slope) downslope from the east end at the summit].

Analysis of variance was conducted using SPSS statistical software[6] (SPSS 1998). Means were separated using LSD at $P < 0.05$. Results are presented separately by year because rainfall patterns and amounts differed greatly between years (Figure 2).

Yield potential and weed populations varied across slope position at the site (Kitchen et al. 1995; Sudduth et al. 1995). Depth to claypan was not uniform within a slope position across the entire experiment and varied greatly even at the small plot scale. Depth to claypan was less at the sideslope than at the summit or toeslope positions. Claypan depth and A horizon thickness varied with slope position and likely influenced yield potential by modifying soil water holding capacity.

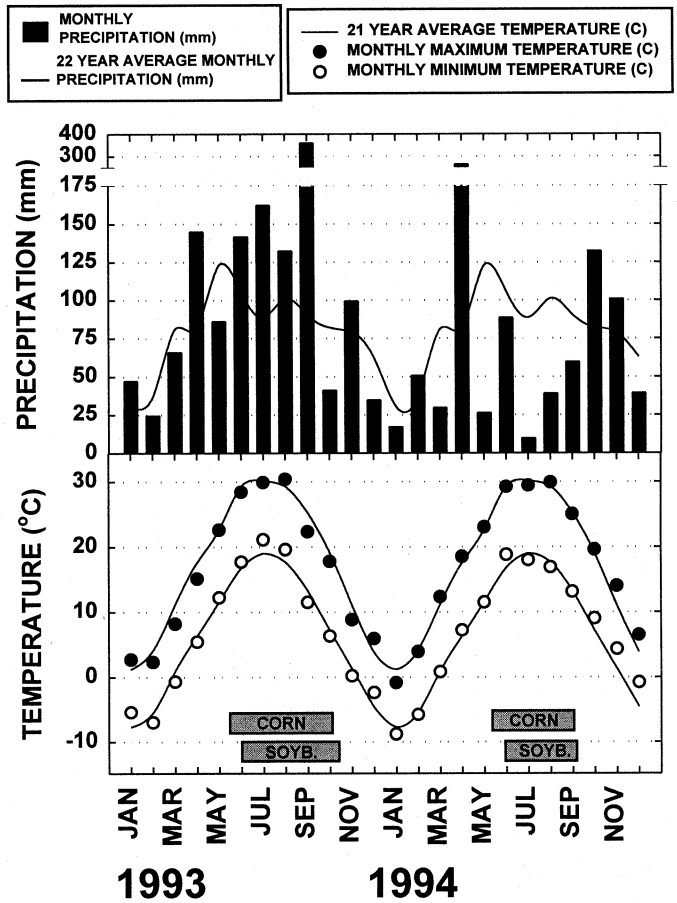

Figure 2. Monthly rainfall and daily maximum and minimum air temperatures compared with long-term monthly average rainfall (22-year) and long-term daily average maximum and minimum air temperature (21-year) at the MSEA experimental site near Centralia, MO, in 1993 and 1994. Gray bars represent the growing season length for corn or soybean (soyb) in either year.

RESULTS AND DISCUSSION

Average daily maximum and minimum air temperatures for each month were similar in both growing seasons and were similar to the long term average daily maximum and minimum air temperatures (Figure 2). Monthly average rainfall was well above and below average throughout the growing season in 1993 and 1994, respectively (205% and 45% of the long term average of 500 mm accumulated between May 1 and September 30, respectively) (see Table 1 for specific dates of planting and harvest).

[6] SPSS for Windows, version 6.0, 1993, SPSS Inc., 444 N. Michigan Ave., Chicago, IL 60611.

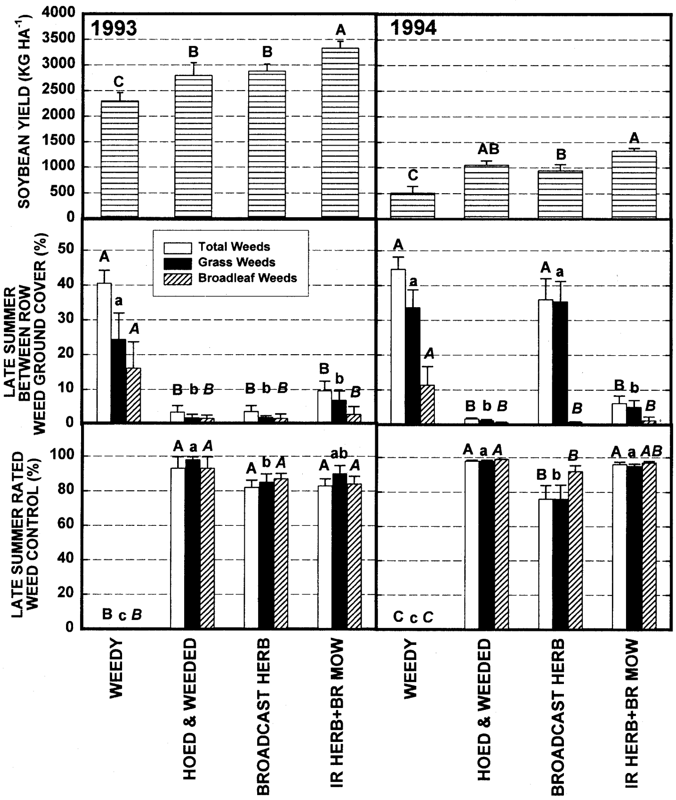

Figure 3. Soybean yield (top panel), late summer between-row total, grass, and broadleaf weed ground cover (middle panel), and visually evaluated late summer total, grass, and broadleaf weed control (bottom panel) versus treatment. Means (bar) ± standard errors (capped whisker) are presented. Means for a variable with the same letter were not different by Fisher's protected LSD test (P = 0.05). Total weeds, grass weeds, and broadleaf weeds were analyzed separately for ground cover and rated control each year. Abbreviations: herb, herbicide; IR, in row; and BR, between row.

Soybean Weed Control Based on Ground Cover and Rating. Glyphosate controlled winter annual weeds in all treatments in both years (data not presented). In the weedy checks, late summer total summer annual weed cover between rows was 41 and 45% in 1993 and 1994, respectively (Figure 3). In the weedy checks, grass weeds, chiefly giant foxtail, accounted for 62% and 76% of this total weed cover, respectively, but only 24% and 34% of total ground cover between rows, respectively, in 1993 and 1994. Perhaps, delayed, incomplete soybean canopy closure because of low rainfall (Figure 2) encouraged growth of grass over broadleaf weed cover between rows in 1994, even though soybean was planted 10 d earlier in 1994 than in 1993 (Table 1).

In 1993, the three weed control treatments reduced late summer total, grass, and broadleaf weed cover between rows to 10% or less, well below the weedy check (41%) (Figure 3). Total, grass, and broadleaf weed cover between rows could not be distinguished among the three treatments. In-row weed control was excellent for all three treatments in 1993, as well (data not presented). Above normal rainfall in 1993 (Figure 2) apparently activated imazaquin and alachlor whether they were band-applied or broadcast. Early, complete canopy closure due to favorable moisture conditions for soybean growth also likely contributed to excellent weed control in all three weed control treatments. Because late summer canopy closure was complete, only two BR mowings were required for the BR mowing weed management system in 1993, as observed in "conventional" tillage systems (Donald 2000b, 2000c). Other sparsely distributed weeds were well controlled by mowing and included: barnyardgrass [*Echinochloa crus-galli* (L.) Beauv. # ECHCG], common lambsquarters (*Chenopodium album* L. # CHEAL), common milkweed (*Asclepias syriaca* L. # ASCSY), fall panicum (*Panicum dichotomiflorum* Michx. # PANDI), horsenettle (*Solanum carolinense* L. # SOLCA), ivyleaf morningglory [*Ipomoea hederaceae* (L.) Jacq. # IPOHE], ladysthumb smartweed (*Polygonum persicaria* L. POLPE), Pennsylvania smartweed (*Polygonum pensylvanicum* L. # POLPY), waterhemp sp. (*Amaranthus* sp.), prickly lettuce (*Lactuca serriola* L. # LACSE), tall morningglory [*Ipomoea purpurea* (L.) Roth. # PHBPU], and velvetleaf (*Abutilon theophrasti* Medik. # ABUTH).

In 1994, late summer total, grass, and broadleaf weed cover between rows was 6% or less in the BR mowing weed management system and weed-free checks, again, well below the weedy check (45%) (Figure 3). But, in the broadcast herbicide treatment, late summer total and grass weed cover between rows was indistinguishable from the weedy check, although imazaquin severely reduced broadleaf weed cover between rows compared to the weedy check. Weed control in crop rows was excellent following band- and broadcast herbicide treatments (data not presented) even though drought delayed soybean canopy closure. Because of lack of rainfall, alachlor was probably not activated adequately to control grass weeds between rows and the open soybean canopy failed to shade and suppress late summer weed growth in the broadcast herbicide treatment. Weed control with some broadcast-applied soil residual herbicides, such as alachlor, can vary dramatically due to year to year fluctuations in rainfall which is needed for activation.

In 1994, a third mowing was required for the BR mowing system to suppress weed cover between rows because soybean canopy closure and shading were incomplete. This verified the importance of crop canopy closure for suppressing weed cover in the BR mowing system (Donald 2000c). The BR mowing weed management system allowed flexibility in managing mid-season weed escapes when environmental conditions limited crop competition and favored mid-season weed growth between rows.

Weed control treatments were easily distinguished from the weedy check in both years based on visually rated control (Figure 3). Although the relative relationships between treatments were similar to weed ground cover results, rating was relatively insensitive, subjective, and did not adequately differentiate results between years. Subjective visual rating suffers from a lack of an absolute standard of comparison so that results across years may represent different amounts of weed growth (Donald 2000a).

Soybean Yields. When averaged over slope position, soybean yields of the three weed control treatments were greater than the weedy check in both years (Figure 3). Yields of the BR mowing weed management system were greater than or equaled the weed-free check in 1993 and 1994, respectively, and were greater than the broadcast-applied herbicide in both years (Figure 3). Yields for these three treatments were expected to be equal, as observed previously in conventional tillage soybean (Donald 2000b, 2000c) and other unpublished no-till research. Yields of the weed-free check could not be distinguished from the broadcast-applied herbicide in either year (Figure 3). Care was taken in weeding the weed-free check plots to avoid damaging the crop, eliminating one possible cause for these unexpected results. The most likely explanation is that the experiment was conducted on a farmer's field and both weed populations and yield potential differed between blocks, leading to greater variability and reducing the statistical ability to distinguish between treatments that is customary in research station experiments.

The yield goal for which weed-free soybean was fertilized was achieved in 1993 (104% of a 2,690 kg/ha goal), but not in 1994 (39% of the goal) (Figure 3). As noted, growing season rainfall was above normal in 1993 (Figure 2) and favored soybean seed formation at the site. In 1994, prolonged below normal monthly rainfall during critical soybean flowering, seed forming, and seed filling stages limited yield. Yields of the weedy checks were 85 and 19% of the yield goal in 1993 and 1994, respectively. Weeds reduced soybean yield in the weedy checks relatively more when soil moisture also limited yield, as others reported (Jackson et al. 1985; McWhorter and Patterson 1980; Mortensen and Coble 1989). Nevertheless, the BR mowing weed management system performed similarly in soybeans both years despite drastic differences in rainfall amounts and seasonal distribution between years (Figure 2).

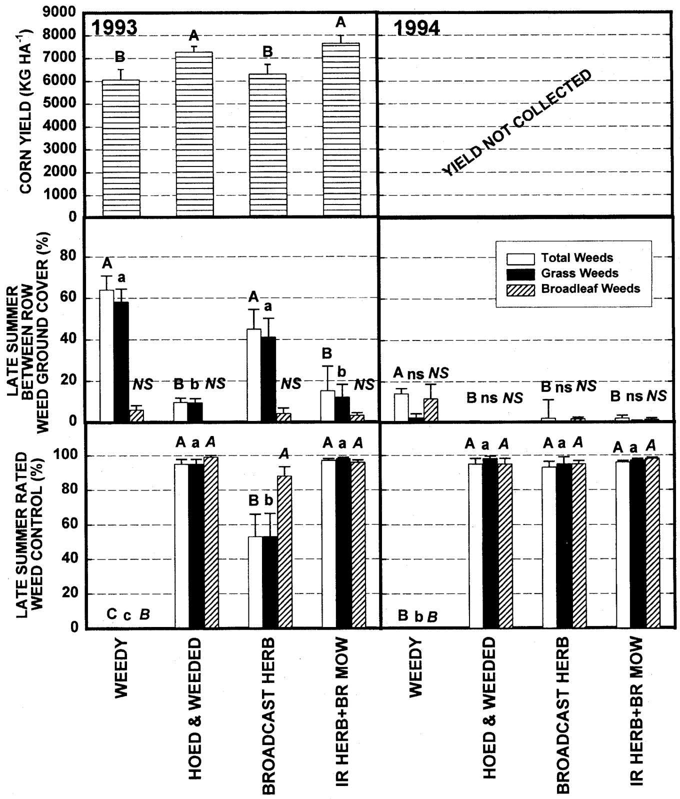

Figure 4. Bar charts of corn yield (top panel), late summer between-row total, grass, and broadleaf weed ground cover (middle panel), and visually evaluated late summer total, grass, and broadleaf weed control (bottom panel) versus treatment. Means (bar) ± standard errors (capped whisker) are presented. Means for a variable with the same letter were not different by Fisher's protected LSD test ($P = 0.05$). Total weeds, grass weeds, and broadleaf weeds were analyzed separately for ground cover and rated control each year. Abbreviations: herb, herbicide, IR, in row; and BR, between row.

Corn Weed Control Based on Ground Cover and Rating. Glyphosate controlled winter annual weeds in corn in both years (data not presented). The BR mowing system greatly reduced total and grass ground cover between rows, compared with the weedy check in both years (Figure 4). Total and grass weed cover of the BR mowing system was also indistinguishable from the weed-free check. Broadleaf weed cover was the same for all three weed control treatments.

In 1993, late summer total weed cover between rows in weedy checks was greater in corn (64%) (Figure 4) than in soybean (41%) (Figure 3). Nitrogen fertilization and above normal rainfall likely favored early weed ground cover growth in corn compared with soybean, which was not fertilized with nitrogen. In 1994, the late summer total weed cover between rows in weedy checks was lower in corn (14%) (Figure 4) than in soybean (45%) (Figure 3). Although corn stands had gaps, corn canopy closed both years, in contrast to soybean, which never completely closed canopy in 1994 due to lack of rainfall (Figure 2) and competition for soil moisture by weeds. Incomplete shading between soybean rows likely favored late summer weed ground cover growth in 1994.

In weedy checks, total weed ground cover (58%) between corn rows consisted primarily of grass weeds, chiefly giant foxtail, in late summer of 1993 (Figure 4). However, in 1994 total weed ground cover between rows was greatly reduced (12%) and consisted chiefly of broadleaf weeds. Below average rainfall in 1994 (Figure 2) likely suppressed both grass and broadleaf weed cover, but broadleaf weeds were relatively less influenced than grass weeds. Corn planting date (Table 1) and air temperatures were similar both years (Figure 2) and do not explain these differences. In a year of below normal growing seasonal rainfall (Figure 2), corn was better able to suppress total weed ground cover between rows (Figure 4) than was soybean (Figure 3), presumably because of earlier, more complete canopy closure, shading, and competition for soil moisture.

In 1993, the total and grass weed cover between rows in the broadcast herbicide treatment could not be distinguished from the weedy check in corn (Figure 4), in contrast to low total and grass weed cover in the same treatments in soybean (Figure 3). While above normal moisture conditions in 1993 likely favored rapid microbial degradation of alachlor, the differences in total and grass weed cover between rows in corn versus soybean are hard to explain. Nitrogen fertilization in corn, but not soybean, combined with above normal rainfall likely favored earlier grass weed cover development in corn than in soybean. As noted above, between row total and grass weed cover were greater in the weedy checks in corn than in soybean in 1993.

In 1994, the three weed control treatments decreased total weed ground cover below the weedy check plots (Figure 4). But, these three weed control treatments could not be distinguished from one another. As noted for soybean, the weed control for these treatments was greater than the weedy check in both years when visually rated in no-till corn (Figure 4). Again, the relative relationships between treatments corresponded to that measured with weed ground cover. But, control rating is insensitive and subjective, lacking an absolute standard of comparison between years, as noted above (Donald 2000a).

Corn Yield. Corn yield of the BR mowing weed management system equaled the weed-free check and was greater than either the broadcast-applied herbicide or weedy check in 1993 (Figure 4). Yields of the broadcast-applied herbicide treatment were indistinguishable from the weedy check.

In 1993, yields of the weed-free and weedy checks were only 77% and 64% of the goal for which corn was fertilized (Figure 4), despite favorable rainfall for corn growth (Figure 2). Above normal rainfall probably either leached nitrogen below the crop rooting zone and/or encouraged early denitrification, limiting mid- and late-season nitrogen availability for subsequent corn growth. Nitrogen fertilizer limitation would not likely limit soybean growth because soybean plants fix atmospheric nitrogen (Figure 3). Percent corn emergence averaged 92% and 72% in 1993 and 1994, respectively. In 1994, corn was not harvested for yield because stands were poor with erratic gaps due to a planter malfunction. Weed cover in each plot was measured where corn stands were free of gaps.

Implications of the Research. The BR mowing weed management system controlled weeds in two years with widely contrasting rainfall patterns (Figure 2), without sacrificing yield in no-till corn in one year in which yield was measured (Figure 4) and in soybean in two years (Figure 3). It also controlled weeds and yielded as well as or better than broadcast-applied herbicide at the same rates and the weed-free check plots. In one study, banding herbicides reduced herbicide flux and concentration in runoff from field margins (Gaynor and Van Wesenbeeck 1995). Soil residual herbicide use was reduced 50% by banding because only 50% of the field area was sprayed. Additional reductions in herbicide use could be achieved by reducing both band width and herbicide rate using computerized weed control decision aides.

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