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Effect of row spacing, tillage and herbicides on seed quality in rotated and continuous soybeans

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Summary

The effect of continuous soybeans (*Glycine max*) versus corn (*Zea mays*)-soybean rotation, conventional versus reduced tillage, 25 and 76 cm row spacings, and four methods of weed control: postemergence (POST), preplant-incorporated (PPI), hand weeded, and no weed control, on seed quality of cultivar 'Corsoy-79' was studied for three years. Seed quality parameters studied were weight, germination, fungal and bacterial microflora, and seedling-vigour. Crop rotation, tillage and row-spacing had some significant ($P = 0.05$) effects on seed quality parameters in individual years, but not in combined years. Plants in the POST herbicide treatment (sethoxydim + bentazon) had greater 1000-seed weight and yield than those in the PPI treatment (alachlor + metribuzin), but the level of seedborne microflora was not affected. Seeds from plants in the no weed control plots had lower 1000-seed weight and higher recovery of *Phomopsis* than those in the hand-weeded plots.

Résumé

Influence de la distance des rangs, du labour et des herbicides sur la qualité des graines de soja en culture continue ou alternée

Les effets d'une culture continue de soja (*Glycine max*) ou d'une rotation maïs (*Zea mays*)-soja, d'un labour conventionnel ou réduit, d'un espacement des rangs de 25 ou 76 cm et de quatre méthodes de désherbage (post-levée: POST, incorporation avant semis: PPI, désherbage manuel ou pas de désherbage) sur la qualité des graines du cultivar 'Corsoy-79' ont été étudiés pendant trois ans. Les paramètres de la qualité des graines étaient le poids, la germination, la microflore fongique et bactérienne et la vigueur des plantules. La rotation de la culture, le labour et l'espacement des rangs n'avaient pas d'effet significatif ($P = 0,05$) sur les paramètres de la qualité des semences pour chaque année prise individuellement, mais ce n'était pas le cas en combinant les années. Les plantes ayant subi un traitement herbicide POST (sethoxydium + bentazon) donnaient un plus grand poids de 1000 graines et une meilleure récolte que celles traitées PPI (alachlor + metribuzin), mais la microflore des graines n'était pas affectée. Les graines produites par les plantes des parcelles

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n'ayant pas subi de désherbage avaient un plus faible poids et une plus forte contamination *Phomopsis* que celles provenant des parcelles désherbées manuellement.

Zusammenfassung

Der Einfluß von Reihenabstand, Bodenbearbeitung und Herbiziden auf die Saatgutqualität von Sojabohnen bei Dauerkultur und Fruchtwechsel

Der Einfluß einer Dauerkultur von Sojabohne (*Glycine max*) gegenüber einem Fruchtwechsel Mais (*Zea mays*) – Sojabohne konventioneller gegenüber reduzierter Bodenbearbeitung, 25 cm gegenüber 76 cm Reihenabstand und 4 Arten der Unkrautbekämpfung, nämlich: Nachauflaufverfahren, Vorauflaufverfahren, Unkrautbekämpfung mit der Hand und ohne Unkrautbekämpfung, auf die Saatgutqualität der Sorte Corsoy-79 wurde drei Jahre lang untersucht. Die geprüften Qualitätsmerkmale waren Masse, Keimfähigkeit, Pilz- und Bakterienmikroflora und Keimlingstriebkraft. Fruchtwechsel, Bodenbearbeitung und Reihenabstand hatten in einzelnen Jahren fallweise signifikanten ($P = 0.05$) Einfluß auf Saatgutqualitätsmerkmale, aber nicht über die Jahre insgesamt. Bei der Nachauflaufunkrautbekämpfung (Sethoxydim + Bentazon) hatten die Pflanzen höheres Tausendkorngewicht und Ertrag als bei der Vorauflaufunkrautbekämpfung (Alachlor + Metribuzin), aber die Höhe der samenbürtigen Mikroflora blieb unbeeinflußt. Samen von Pflanzen der Kontrollparzellen ohne Unkrautbekämpfung hatten geringere Tausendkorngewichte und einen höheren Wiederbefall mit *Phomopsis* als jene mit Unkrautbekämpfung mit der Hand.

Introduction

Extensive research has been done on the effect of cultural and weed control practices on soybean (*Glycine max* (L.) Merr.) yield, but little has been reported on the effect of cultural practices or herbicide selection on soybean seed quality. Seed quality is important to farmers and certified seed producers interested in producing weed seed-free and pathogen-free seeds with high test weight, germination potential, and vigour. Several reviews (Altman and Campbell, 1971; Katan and Eshel, 1973; Rodriguez-Kabana and Curl, 1980) on pesticide/plant disease interactions indicated that herbicides may affect disease development in many crops but little work has been reported on seedborne pathogens. Desiccant-type herbicides used at soybean maturity affect disease development of seedborne pathogens in soybeans (Cerkauskas, Dhingra and Sinclair, 1983; Cerkauskas, Dhingra, Sinclair and Foor, 1982) therefore, conventional herbicides used for weed control at planting or shortly after may also exert some effect. Herbicides may exert fungitoxic effects when applied to soil and crop debris where the overwintering structures and primary inocula of many seedborne soybean pathogens reside (Rodriguez-Kabana and Curl, 1980). Also, certain combinations of herbicides result in lower amounts of soybean phytotoxicity than others (Espinoza, Adams and Behrens, 1968). Different levels of herbicide-induced phytotoxicity represent differences in plant stress which may in turn affect infection by seedborne or other pathogens (Katan and Eshel, 1973).

Disease development in soybeans can be affected by cropping sequence (Summer Doupnik and Boosalis, 1981; Weber, Shibles and Byth, 1966), tillage (Cook, Boosalis and Doupnik, 1978; Sumner *et al.*, 1981; Unger and McCalla, 1983), row width (Grau and Radke, 1984; Mmbaga, Grau and Arny, 1979) as well as weed control (Dhingra

nd de Silva, 1979). It is important to know whether or not these soybean cultural ractices affect the recovery of seedborne microflora, which in turn affect seed weight, ermination, or vigour. The objective of this three year study (1981–1983) was to examne the effect of crop rotation, tillage, row-width, and herbicides on soybean seed quali-y. A portion of this study was summarised in an abstract (Bowman, Hartman, McClary, Sinc Hummel and Wax, 1984). Another study (Bowman, Hartman, McClary, Sin r, Hummel and Wax, 1986) compared the effects of cultural practices on seed quality in tillage and no-tillage soybeans. This is the first study to compare such cultural practices in rotated and continuously-cropped soybeans.

Materials and methods

Experimental design

The study was conducted during the cropping seasons of 1981, 1982 and 1983 on the Cruse Tr University of Illinois at Urbana-Champaign with the following soil types prese the experimental area: Catlin silt loam, Drummer silty clay loam, and Flanagan si loam. The treatments included a factorial combination of two cropping sequences: continuous soybean (cultivar 'Corsoy-79') or annual rotation with maize (*Zea mays* L. cultivar 'B73 × Pa91'); two tillage systems: conventional (disking and mouldboard in the fall, then disking, incorporating herbicides, disking, and field cultivation in the spring); and reduced (same as conventional minus mouldboard ploughing); two row spacings: 25 and 76 cm; and four methods of weed control (described in the next section). The experiment was analysed as a split-plot with the treatment combination of cropping sequence × tillage × row-spacing forming the main-plots (12 m m). Experimental units consisted of the four subplots (9 m × 8 m), each represen ng one of the four herbicide treatments described below. There were three replications for each treatment in the split-plot design. The centre 8 m of row of each experimental unit was harvested with a commercial combine with a 4.6 m header and yield recorded at 13% moisture. Seeds were obtained from the Illinois Foundation Seeds, Inc., Tolono, IL. The target populations for 25 and 76 cm spaced soybeans were 419,000 and 330,000 plants/hectare, respectively. Seeding rates were adjusted based on seed germination tests and an assumed field emergence of 85%. Fertiliser an me applications were made according to soil analyses.

Herbicide t ents

Four weed control methods were used: POST, a post-emergence application of sethoxydim (Poast) and bentazon (Basagran) at 0.3 and 0.8 kg ai/ha, respectively; PPI, a preplant-incorporated application of alachlor (Lasso EC) and metribuzin (Lexone 4L) at 3.4 and 0.6 kg ai/ha, respectively; a hand-weeded control; and a nonweeded control. In 1981, sethoxydim was not available and alachlor (3.4 kg ai/ha, PPI) was substituted. Since the 1981 PPI treatment was unique, combined analysis for the herbicide means was only pe med on data from 1982 and 1983. Weed control was measured using a 0–100 s sed on the percentage control of weeds in each plot (100% control

= no weeds found in the plot).

Seed quality

Cleaned seed lots were moisture tested electronically and weighed to determine seed yield and 1000-seed weight at 13% moisture. One-hundred seeds from each experimental unit were surface sterilised in 0.5% NaOCl solution (Clorox) for four minutes and rinsed three times (two minutes per rinse) in sterile deionised water. All seeds were plated on potato-dextrose agar (PDA; Difco) with five seeds per 9 cm culture plate. The following parameters in percentage were recorded after one week at 25 °C: germinated (combined hypocotyl and root length ⩾ twice the cotyledon length), germinated 'clean' (germinated with no bacteria or fungi present), recovery of seedborne bacteria or individual fungal species (number of discrete colonies on a germinated, nongerminated and total seed basis), and total fungi. Seed germination was recorded by placing 100 seeds per experimental unit on moistened, cellulose blotter pads (Kimpac). The number of seeds that were germinated, germinated/vigorous (hypocotyl length ⩾ 12 cm), and germinated/nonvigorous (hypocotyl length ⩾ 2.5 cm, but < 12 cm) were recorded after one week at 90% relative humidity and 28 °C.

Data were analysed within years and over three years by combined analysis. Fisher's protected, least significant difference method (FLSD) was used to separate means ($P = 0.05$).

Results

Seedborne microflora prevalent throughout the three growing seasons consisted of *Alternaria* spp. (causal agent of Alternaria pod and seed decay), *Bacillus*-like colonies identified earlier in this laboratory (Tenne, Foor and Sinclair, 1977) as *B. subtilis* (Ehrenberg) Cohn (causal agent of Bacillus seed decay), *Cercospora kikuchii* (T. Matsu. & Tomoyasu) Gardner (causal agent of Cercospora leafspot and purple seed stain), *Fusarium* spp. (causal agent of Fusarium blight, wilt, pod and collar rot), and *Phomopsis* spp. complex (causal agents of Phomopsis seed decay, pod and stem blight). All can be detrimental to soybean seed quality (Sinclair, 1982). The means for the principal seed quality variables averaged over all plots during the three year period were: germination on PDA, 90%; germination on Kimpac, 90%; germinated-clean on PDA, 58%; 1000-seed weight, 149 g; vigour, 47%; *Alternaria* spp., 6%; *Bacillus* spp., 13%; *C. kikuchii*, 1%; *Fusarium* spp., 1%; and *Phomopsis* spp., 3%. The average yield and weed control were 2744 kg/ha and 65%, respectively.

Analysis by year

Cropping year had a significant effect on some variables (table 1). Both seed vigour and germination were significantly higher in 1982, significantly lower in 1983, and intermediate in 1981. In spite of the better vigour and seed germination in 1982, the highest recovery of *Phomopsis* spp. (7%) (table 2) was recorded in that year. Recovery of *Alternaria* spp. and *C. kikuchii* was significantly greater in 1983 than in any other

Table 1. Effect of year on yield and seed quality variables on Corsoy-79 soybeans in rotated and continuously grown soybean plots at Urbana, Illinois, 1981–1983.

Year	Yield (kg/ha)	Mean percentage			
		Germination[x]	Vigorous seedlings[x,y]	*Alternaria* spp.	*Cercospora kikuchii*
[illegible]	2506a[z]	84b	43b	1c	0b
[illegible]	3148a	97a	82a	6b	1b
[illegible]	2577a	81c	14c	12a	3a

[x] Means based on 96 observations from triplicated plots with two cropping sequences, two tillage levels, two row-spacing levels, and four herbicide levels in a factorial design. Observations in the mean percentage categories were each derived from a subsample of 100 seeds incubated for one week.

[y] Seeds incubated on moistened, cellulose pads. All other mean percentages derived from surface-sterilised seed incubated on potato-dextrose agar.

[x] Vigorous = hypocotyl length ≥ 12 cm.

[z] Means followed by the same letter in a column are not significantly different (FLSD, P = 0.05).

year (table 1). All other variables examined, including yield, were not significantly affected by year.

Cropping Sequence

Cropping sequence affected several agronomic and seed quality variables in individual years but not when combined over three years (table 2). Yield, weed control, and seed weight were significantly higher in rotated soybeans versus continuous plots in individual years but were not significant over the three year period. Soybeans in rotation had larger seeds and out yielded continuous soybeans in each year, but the yield increase was not significant in 1981 and the increase in seed weight was significant only in 1982 (table 2). Seeds from rotated plots had higher test weights, germination, vigour and lower recovery of *Phomopsis* spp. than seeds from continuous soybean plots in certain individual years. However, there were no significant differences between the two cropping sequences for any seed quality parameter when analysis was made over the three year period (table 2).

Tillage

Weed control was significantly higher in conventional tillage compared to reduced tillage averaged over the three years (table 3). Yield of conventional plots was not significantly different from that of the reduced tillage plots in any year. In 1981, there was significantly higher recovery of *Alternaria* spp. from seeds of the reduced tillage treatments, but the magnitude of this difference was so small as to render the finding unimportant. In general, recovery of these fungi was similar in seeds from either of the two tillage treatments in individual years or for the three years combined (table

Row Spacing

Narrow- and wide-spacing gave similar results for all variables except weed [illegible] which was significantly lower, in wide-spaced rows in 1981, 1982, and for the three-year average (table 4). In 1981, the narrow-spaced rows had a significantly lower recovery of *Phomopsis* spp. and in 1982 significantly fewer germinated-clean seeds. There was a statistically nonsignificant trend for more germinated-clean seed to be recovered from plots with the wider rows. There were no major differences in yield between the two row spacings over the three years (table 4).

Herbicide applications

A comparison of the untreated and hand-weeded controls allowed for an as[illegible]

Table 2. Effect of tillage on agronomic and seed-quality variables on Corsoy-79 soybeans in [illegible] continuously grown soybean plots at Urbana, Illinois, 1981–1983.

Year/Cropping sequence	Yield (kg/ha)	Weed control (%)	Seed quality variables				
			1000-seed weight (g)	Germinated	Germinated clean[u]	Vigorous seedlings[v]	*Phomopsis* spp.
				Mean percentage			
1981[w]							
Rotated[x]	2586a[y]	81a	147a	92a	68a	46a	3b
Continuous	2426a	68b	144a	92a	68a	40b	4a
1982[w]							
Rotated	3579a	73a	154a	94a	66a	85a	4b
Continuous	2717b	41b	146b	92b	65a	81b	7a
1983[w]							
Rotated	2994a	71a	152a	88a	48a	9a	1a
Continuous	2159b	58b	149a	81b	35b	9b	1a
1981–1983[z]							
Rotated	3053a	75a	151a	91a	61a	50a	2a
Continuous	2434a	55a	146a	88a	56a	43a	4a

[u] Clean = no recovery of seedborne fungi or bacteria.

[v] Vigorous = hypocotyl length ≥ 12 cm.

[w] Means based on 48 observations for triplicated plots with two tillage levels, two row-spacing levels and four herbicide levels in a factorial design. Observations in the mean percentage categories were each derived from a subsample of 100 seeds incubated for one week.

[x] Rotated = soybeans grown in a corn-soybean rotation, continuous = continuously grown soybeans

[y] Means followed by the same letter in a column are not significantly different (LSD, P = 0.05).

[z] Means based on 144 observations from three years of triplicated plots arranged as in footnote [w].

Table 3. Effect of tillage on agronomic and seed-quality variables on Corsoy-79 soybeans in rotated and continuously grown soybean plots at Urbana, Illinois 1981–1983.

Year tillage[1]	Weed control (%)	Yield (kg/ha)	*Alternaria* spp. (%)[w]
[illegible]			
Conventional	76[x]	2578a	1b
Reduced	71	2433a	2a
[illegible]			
Conventional	59a	3169a	6a
Reduced	59a	3127a	6a
[illegible]			
Conventional	69a	2490a	12a
Reduced	60a	2663a	11a
[illegible] 1983			
Conventional	68a	2746a	7a
Reduced	62[y]	2741a	6a

[1] Conventional = disking and moldboard plow in the Fall followed by disking, herbicide incorporation, disking and field cultivation in the Spring. Reduced = same as conventional but with elimination of the moldboard plow operation.

[w] Mean percentage recovery. Each observation derived from a subsample of 100 surface sterilised seed incubated on potato-dextrose agar for one week.

[x] Means based on 48 observations from triplicated plots with two cropping sequences, two row-spacing levels and four herbicide levels in a factorial design.

[y] Means followed by the same letter in a column are not significantly different (FLSD, P = 0.05).

[z] Means based on 144 observations from three years of triplicated plots arranged as in footnote 'x'.

relative weed pressure on seed quality, whereas a comparison of POST and PPI treatments allowed for a comparison of two chemical application methods.

In the combined year analysis, significantly higher yield, weed control, and seed weight and significantly lower recovery of *Phomopsis* spp. were recorded in the hand-weeded plots as compared to untreated control plots. Seed vigour and germination were significantly higher in seeds from the untreated control plots as compared to seeds from hand-weeded plots. POST outperformed the PPI treatment in that yield and seed weights were significantly higher. No significant differences were recorded in weed control, seed germination, vigour, or any of the seedborne microflora between POST and PPI in the combined year analysis.

Discussion

Over a three year period neither cropping sequence, tillage, or row spacing had a significant effect upon any seed quality parameter or yield. Certain cultural practices affected soybean seed quality on a year to year basis, but differences were small and would not economically affect seed quality. Weed control was affected by row spacing and herbicide treatment between and among years. Herbicide treatment also resulted

in yield differences. These results were similar to those obtained in another study where the effects of three tillage systems upon soybean seed quality were [illegible] in a maize-soybean rotation (Bowman, *et al.*, 1986).

Crop rotation is used to maintain high soybean yields through reduction of disease build-up (Sinclair, 1982). For example, the incidence of *Septoria* brown spot was reduced in rotated soybeans as compared to continuous soybeans (Williams, 1981). In our study, seed from rotated plots had similar yield and quality as seed from continuous soybean plots over the three year period. Mouldboard ploughing is a widely used tillage procedure which leaves little crop residue on the soil surface and thereby contributes highly to soil erosion. In this study, the elimination of the mouldboard ploughing operation in a traditional tillage sequence did not appreciably affect yield or seed quality in any of the three years. Generally, tillage [illegible]ion results in lowered crop yields. However, under drought stress, soybean quality [illegible] be improved with reduced tillage (Tyler and Overton, 1982). A frequent criticism of reduced tillage is that any savings made by reducing land preparation procedures are offset by the cost of desiccant-type herbicides required for postemergence weed control.

In our study, row spacing affected weed control, had little effect upon seed quality,

Table 4. Effect of row spacing on agronomic and seed quality variables on Corsoy-9 soybeans in rotated and continuously grown soybean plots at Urbana, Illinois, 1981-1983.

Year/row spacing (cm)	Yield (kg/ha)	Weed control (%)	Seed quality		
			Alternaria spp.	*Phomopsis* spp.	Germinated clean[w]
			Mean percentage		
1981[x]					
25	2429a[y]	67b	2a	3b	69a
76	2583a	81a	1b	4a	68a
1982[x]					
25	3112a	48b	7a	6a	62b
76	3184a	65a	5b	5a	69a
1983[x]					
25	2642a	60a	14a	1a	39a
76	2511a	68a	10a	1a	43a
1981–1983[z]					
25	2642a	59b	7a	3a	57a
76	2511a	72a	6b	3a	60a

[x] Means based on 48 observations from triplicated plots with two cropping sequences, two tillage levels and four herbicide levels in a factorial design. Observations in the mean percentage [illegible]ories were each derived from a subsample of surface sterilised seeds incubated on potato-dextrose agar [illegible]ne week.

[w] Clean = no recovery of seedborne fungi or bacteria.

[y] Means followed by the same letter in a column are not significantly different (FLSD, $P = 0.05$).

[z] Means based on 144 observations from three years of triplicated plots arranged as in footnote 'x'.

Table 5. Effect of herbicides on agronomic and seed quality variables on Corsoy-79 soybeans in rotated and continuously grown soybean plots at Urbana, Illinois, 1982-1983.

	Yield (kg/ha)	Weed control (%)	Mean percentage			
			1000-seed weight (g)	Germinated (blotter)[w,x]	Vigorous seedlings[w,y]	*Phomopsis* spp.
POST	3257a[z]	73b	152a	89b	48b	2b
Untreated check	2081c	11c	148c	90a	50a	4a
PPI	3051b	75b	150b	88b	48b	3ab
Hand-weeded	3081ab	83a	151ab	88b	47b	3b

[v] POST = sethoxydim + bentazon (0.3 and 0.8 kg ai/ha) applied post-emergence, PPI = alachlor + metribuzin (3.4 + 0.6 kg ai/ha). Sethoxydim replaced by alachlor (PPI, 3.4 kg ai/ha) in 1981.

[w] Means based on 48 observations from two years of triplicated plots with two cropping sequences, two tillage levels and two row spacing levels arranged in a factorial design. Observations in the mean percentage categories were derived from a subsample of 100 seeds incubated for one week.

[x] Seeds incubated on moistened cellulose pads. All other mean percentage data derived from surface sterilized seed incubated on potato-dextrose agar.

[y] Vigorous = hypocotyl length ≥ 12 cm.

[z] Means followed by the same letter in a column are not significantly different (FLSD, P = 0.05).

and none on yield. Wide rows resulted in significantly better weed control and lower recovery of *Alternaria* spp. but this may be due to the narrow rows not being mechanically cultivated 20 days after emergence as were the wide rows. In general, the literature is mixed on the effect of row width on soybeans. Some authors report that narrow rows increase yields (Cooper, 1977; Lehman and Lambert, 1960; Weber *et al.*, 1966), while others report that row width may not have a significant effect on yield (Gebhardt and Minor, 1981; Hicks, Pendleton, Bernard and Johnston, 1969). Row spacing can affect pod number, canopy architecture, leaf area index, microclimate, light interception, etc., but such factors may be dependent upon cultivar and planting date (Cooper, 1977), two factors which were not compared in this study. Narrow rows are thought to provide a more favorable microclimate for soybean fungal pathogens (Grau and [illegible] 1984; Mmbaga *et al.*, 1979) and result in higher disease incidence; in our study, [illegible] differences were noted in the recovery of seedborne pathogens based on row-[illegible] Similarly, narrower rows did not significantly affect the incidence of *Septoria* [illegible] in soybeans (Pataky and Lim, 1981).

[illegible] demonstrated that weed control procedures can affect both yield and [illegible] in the long term. The postemergence (POST) combination provided the [illegible] of weed control as the PPI combination but significantly out yielded and [illegible] higher seed weights than the PPI combination. There were no major differences, however, between POST and PPI as to the recovery of seedborne fungi. These [illegible] similar to those of another study (Bowman, Yorinori and Sinclair, 1986) [illegible] bramben, metolachlor, metribuzin, trifluralin and vernolate were found to [illegible] affect upon soybean seed weight or microflora.

[illegible] found that we[illegible] infested plots had significantly lower yields and seed weights

and a higher recovery of seedborne pathogens than the relatively weed[illegible]e plots. T higher recovery of seedborne *Phomopsis* spp. in weed infested plot[illegible]mpared weed free plots was consistent with other reports which cite the role of [illegible]s as alternative hosts of seedborne soybean pathogens (Cerkauskas, Dhingra, Si[illegible]and Asm 1983; Dhingra and de Silva, 1978). Weed control and seed quality may be close related since weeds can (i) serve as alternative hosts for soybean pathogens, (ii) affe microclimate conditions which in turn may affect the viability of pathogen inocula and (iii) compete for nutrients and moisture resulting in a stressed crop that may predisposed to pathogen attack.

On the other hand, we found that seeds from the untreated plots produced seedlings with marginally more vigour than seeds from the hand-weeded plots. Why seeds fr weed infested plots with a higher recovery of *Phomopsis* spp. would[illegible]ve this marginally higher vigour cannot be explained. Many reports (Bowman *et al.*, 1986; Cerkauskas *et al.*, 1983; Dhingra and de Silva, 1978; Hepperly *et al.*, 1980) indicated that increased weed infestation is detrimental to soybean seed quantity, especially where there is evidence of higher infection by seedborne pathogens, such as *Phomopsis* sp Therefore, we feel that this particular finding although statistically significant, may not be real.

Soybean seed quality can be affected by cultural practices and weed control procedures. However, most of the differences detected in this study were small and would not be of economic significance to a soybean grower interested in seed quality. Therefore, cultural practices in rotated or continuously-cropped soybeans had few important effects on soybean seed quality in this three year study. Elimination of moldboard ploughing may serve to minimise soil erosion while maintaining high yield and seed quality. Continuous-cropping of soybeans or planting in narrow rows at high density did not significantly compromise yield or seed quality. Weed control emerged as the variable most likely to be affected by cultural practices.

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