PEST INSECTS AS AFFECTED BY TILLAGE METHODS IN SOYBEANS, CORN AND SORGHUM

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INTRODUCTION

The no-tillage method of crop production has become more popular in Florida during recent years because of (a) the availability of planting equipment designed to operate under unplowed stubble and/or mulched conditions. (b) development of improved herbicides to control grass and broadleaf weeds, (c) our extension IFAS research efforts on no-tillage systems, and (d) our educational efforts with field days, demonstrations, conferences, and shortcourses through the IFAS Cooperative Extension Service. The double cropping succession of soybeans following small grain is probably the most practiced agronomic double cropping system all over the world. Soybeans succeeding corn in the warm season is another multicropping system that is also enjoying increased acreage in Florida and other parts of the southeastern United States.

Plant residues and the lack of soil disturbance associated with no-tillage systems provide favorable conditions for the build-up of pest populations. The multicropping practice that continueously provides food and/or suitable habitat for various pest organisms, also creates conditions that are conducive to pest activity. Our knowledge of insect biology and behavior as they are affected by the no-tillage practice is limited in spite of the increasing adoption of this practice for crop production. The objective of this study was to collect data on insect pests in multicropping, no-tillage soybean, corn and sorghum .systems.

EXPERIMENTAL PROCEDURE

Soybean systems

Observations on the effects of soil tillage methods on insect pest populations were made on the Robinson farm in Williston, and at Green Acres Agaonomy Farm, Gainesville. The following six tillage treatments were compared in two separate experiments in rye stubble and corn stalk at Williston: (1) no-tillage into rye stubble, (2) no-tillage plus in-row subsoil into rye stubble, *(3)* no-tillage into rye mulch, *(4)* no-tillage plus in-row subsoil into rye mulch, (5) conventional tillage into rye stubble, and **(6)** conventional tillage plus in-row subsoil into rye stubble.

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"Cobb" soybeans were planted in the rye stubble experiment on March 21, 1978 with a 2-row Brown-Harden Superseeder mounted on a 5600 Ford tractor. The entire field was fertilized with 600 pounds per acre 5-4.4-12.5 (N-P-K) applied at planting along with 1 pint (0.25 pound a.i. per acre) of paraquat plus 0.33 pint of Ortho XJ77 surfactant and 1 pound a.i. per acre of alachlor. A second crop of soybeans was grown at Williston from August to November, 1978. The same tillage treatments as above were evaluated in corn stalk. The agronomic practices were the same as in the rye stubble study above.

The Green Acres experiment was conducted in "Florida 501" oat stubble in which four tillage treatments, no-tillage and conventional tillage plus in-row subsoil for each, were compared. "Cobb" soybeans were planted on June 3, 1978. During the planting operation, 400 pounds per acre 5-4.4-12.5 (N-P-K) were applied along with 0.25 pound a.i. per acre metribuzin, 1 pound a.i. per acre linuron and 1.5 pints (0.375 pound a.i.) per acre of paraquat plus 0.33 pint Ortho X-77 surfactant. This study was repeated in 1979; soybeans were planted on June 12, 1979.

corn systems

No-tillage and conventional tillage treatments with in-row subsoil for each were compared in the vetch and wheat stubble. "DeKalb XL78A" corn was planted in both conventiona tillage and no-tillage plots on April 19, 1978 in the "Hairy" vetch stubble. In the "Holly" wheat stubble experiment, corn was planted on June 3, 1978. Planting was conducted with the same equipment as that used in the soybean systems.

All the plots in the vetch stubble experiment were fertilized at planting with 400 pounds per acre 0-7.92-29.88 (N-P-K), and additional applications of N (25 pounds per acre) were made on April 22, and June 10, 1978. The wheat stubble field was fertilized with 600 pounds per acre 5-4.4-12.5 (N-P-K) on June 3, 1978, with an additional application of 50 pounds per acre of N made on June 12. In both experiments, paraquat (0.38 pound a.i. per acre), plus Ortho X-77 surfactant (0.33 pint per acre), was used at planting, and 2, 4-D (.25 pounds a.i. per acre) and atrazine (2 pounds a.i. per acre) after emergence, for weed control. All the plots in the vetch stubble study and half of the rows in each replication in the wheat experiment were treated with carbofuran at the rate of 2 pounds a.i. per acre during the planting operation.

The two experiments were repeated in 1979 with the same cultural practices, except that no insecticide was used in the 1979 season. "DeKalb XL78A" corn was planted on April 6 in the vetch study and June 12 in the wheat stubble experiment.

Sorghum systems

One experiment was conducted at Green Acres to determine the influence of no-tillage cropping and nitrogen fertilizer on time of grain sorghum flowering and sorghum midge infestation. The experimental site was in untilled and bahiagrass sod for five years before plowing and planting rye and lupine. The following treatments were compared in a latin plot layout: (1) no-tillage into rye mulch, (2) no-tillage into rye stubble, (3) no-tillage into lupine mulch, (4) no-tillage into lupine stubble, and (5) no winter crop conventional tillage for a check. Four levels (0, 50, 100, and 200 pounds per acre) af nitrogen fertilizer were tested as subtreatments.

Growers ML-135 grain sorghum hybrid was planted on April 17, 1978 in rows 30 inches apart using the Brown-Harden Superseeder. When sorghum was about 39 inches high, atrazine (2 pounds a.i. per acre) and paraquat (0.25 pounds a.i. per acre) plus Ortho X-77 surfactant were applied on the entire area as post application for weed suppression.

Estimation of insect populations and damage

Damage due to the lesser cornstalk borer, Elasmopalpus lignosellus (Zeller), and cutworms was assessed weekly by recording the number of damaged plants in two rows randomly selected in each replication. Fall armyworms, Spodoptera Frudiperda (J.E. Smith), and corn earworm, Heliothis zea (Boddie), damage levels were determined in corn by counting the number of plants with damaged foliage and the number of damaged ears in two rows and among 30 consecutive plants per replication. To assess stink bug damage to soybeans, pods were collected from 20 plants per treatment and the number of damaged seeds were recorded.

Populations of above-ground pest insects were monitored in soybeans using the plant shaking and sweep net methods. Non-baited pitfall traps (one trap/replication) were used to monitor populations of cutworms, Feltia subterranea (Fab.), and wireworms, Conoderus amplicollis (Gyll.) and C. falli Lane. The traps consisted of cottage cheese cups about one-third filled with ethylene glycol that killed and preserved the catches.

In the sorghum study, midge infestations were determined by counting adults of the sorghum midge, Contarinia sorghicola (Coquillett), that emerged from caged sorghum head samples. Twenty-five sorghum heads per replication were removed at random from the two middle rows of each plot at the milky stage of development and placed into 10 inch X 13.5 inch X 20 inch cardboard midge emergence cages. Emerging sorghum midges were collected in plastic vials inserted into the sides of each cage.

Ten sorghum heads per replication were examined and rated for grain damage on a scale of 0-10. Zero indicated no midge damage, and 1-10 indicated 10-100% grain loss. Days taken by the grain sorghum to reach mid-bloom (50% of the plants in each plot with 90-100% of the head emerged from the boot) were monitored 30-40 days after sorghum planting.

Yield determination

Dry matter yield of corn and soybeans was determined by harvesting two 20 foot rows in the middle of each plot. These samples were weighed and subsamples taken to determine dry matter. Soybean and corn yields are reported at 13% and 15.5% dry matter, respectively.

Sorghum yield was evaluated by hand harvesting sorghum from 16.4 feet/row in the two middle rows of each plot. Sorghum heads were dried in a greenhouse at 95–104 F €or about seven days to reduce grain moisture content to 10%. The heads were threshed in a Vogel[R] single head-thresher and the grain weighed.

RESULTS

Soybean systems

Two insects, the velvetbean caterpillar, Anticarsia gemmatilis Hubner, and the southern green stink bug, Nezara viridula (L.), were the most important pests observed during the two years. Early planted soybeans in the rye stubble study were not infested by the velvet-bean caterpillars. Populations of the southern green stink bug were significantly (P=0.05) higher in the no-tillage into rye mulch than in the conventional tillage (Table 1). The no-tillage into rye stubble was not significantly different from the conventional tillage for stink bug infestations.

Stink bugs were in trace numbers in the corn stalk (late planted soybeans) experiment at Williston, but velvetbean caterpillars populations reached such a high level that an application of Lannate[R] was made on September 27, 1978. However, the differences between treatments for the caterpillar populations were not significant (P=0.05). An average of 10.00, 10.13, and 10.79 velvetbean caterpillars per shake was recorded in the no-tillage into corn stalk in rye stubble, no-tillage into corn stalk in rye mulch and the conventional tillage into corn stalk, respectively. In-row subsoil did not affect significantly caterpillar populations in either main tillage treatments.

Damage to soybean seedlings caused by the lesser conrstalk borer at Williston was generally low and was not affected significantly by the tillage methods. On the average, 1.92, 1.92, and 2.04 damaged plants per row were observed respectively in no-tillage into corn stalk in rye stubble, rye mulch, and conventional tillage.

Tables two and three show data collected on stink bug infestations and damage in the oat stubble at Green Acres. Stink bug populations in 1979 were about double those in the 1978 season, but the statistical analysis of the data failed to reveal any significant (P=0.05) differences between the tillage methods for stink bug populations and damage to seeds in either year.

In 1978, numbers of velvetbean caterpillars collected from no-tillage were statistically the same as those collected from the conventional tillage soybeans (Table 4). The 1979 results indicated that significant differences were found between treatments only for small (up to 0.59 inch) larvae; populations of small larvae were significantly higher in no-tillage than in all other treatments (Table 4). Medium (0.62–0.98 inch) and larger (over 0.98 inch) larvae were not affected.

The lesser corn stalk borer caused significantly more damage to no-tillage soybeans than to conventionally tilled soybeans in 1979 (Table 5). Other insects observed on soybeans in more or less high populations included the three-cornered alfalfa hopper, <u>Spissistilus festinus</u> (Say), and the soybean looper, <u>Pseudoplusia includens</u> (Walker). No significant differences were found in numbers of these insects between the untilled and conventionally tilled soybeans.

Table 6 contains yield data collected from 1977 to 1979. During the first year, soybean yields were significantly higher under no-tillage as compared to the conventional tillage systems. No significant differences were detected among treatments the second year, but the no-tillage non-subsoiled treatment was lower than yield for other treatments in 1970.

The trend for yield of no-tillage soybeans to go down after the second year is apparent. In-row subsoiling may prolong this trend as reflected by the yield for this treatment being the same as for con? ventional tillage soybeans. The yield response to no-tillage in 1977 is likely due to extra soil moisture and the extreme droughty conditions experienced that year.

<u>Corn systems</u>

Tables 7-15 show the results obtained on insect pests from both the vetch stubble and the wheat stubble experiments. Infestations due to the fall armyworms and corn earworms were more severe in the late plant ed (wheat stubble) than in the early planted field corn, but were not affected by the tillage methods (Tables 7-10). These pests did not, according to the results, cause more damage in no-tillage corn than in conventionally tilled corn.

Wireworm populations were not affected by the no-tillage practice as compared to the conventional tillage (Table 11). Although no-tillage greatly increased cutworm populations (Table 12), no apparent damage was done to corn seedlings by these insects. Cutworms, however, may be expected to cause more damage to non tilled than to conventionally tilled corn because of their higher population levels in no-tillage corn systems. Therefore, a good program for weed control and insecticidal treatments of the soil must be an important part of the cropping procedure when no-tillage is adopted for corn production.

No-tillage significantly reduced lesser cornstalk borer damage to corn (Tables 13-15). This practice may be used in an integrated control program along with early planting, irrigation (lesser cornstalk borer damage is more severe on late planted and waterstressed crops) and applications of a good soil insecticide in order to regulate lesser cornstalk borer infestations.

Yield data are shown in Tables 16 and 17, respectively for the vetch and wheat experiments. Yield of corn was either not affected by tillage method or tended to be greater in no-tillage treatments. The mulching benefits of vetch are reflected in the higher yields under no-tillage.

Sorghum systems

The results of the study are shown in Table 18. Sorghum planted in lupine stubble and lupine mulch plots attained mid-bloom earlier than that planted in the conventional tillage and rye mulchfstubble treatments. Percent grain loss was lowest in the lupine plots and highest in the conventional tillage plots. Yield of the grain sorghum was higher in no-tillage into lupine mulch than in all other treatments.

Since lupine is a legume and therefore fixes nitrogen in the soil, it can be argued that sorghum grown after the lupine benefited from the "fixed nitrogen". Accelerated growth resulted in early sorghum flowering; thus facilitating escape of the crop from damaging midge populations.

Table 1. Effect of tillage on southern green stink bug populations estimated by the shake cloth method in "Cobb" soybeans at Williston, FL., 1978.

Treatment	Stink bug population[1]	
	Total Number	Average/Shake*
No-tillage into rye stubble	74	1.3ab
No-tillage plus in-row subsoil into rye stubble	86	1.5b
No-tillage into rye mulch	97	1.7b
No-tillage plus in-row subsoil into rye mulch	106	1.9b
Conventional tillage into rye stubble	54	1.0a
Conventional tillage plus in-row subsoil into rye stubble	61	1.1ab

[1]Numbers are totals and averages of eight weekly shakes/treatment for seven weeks.
*Values followed by the same letter are not significantly different at 0.05 level by Duncan's new multiple range test.

Table 2. Number of southern green stink bugs collected from "Cobb" soybeans by the plant shaking method[1] at Green Acres, Gainesville, FL.

Treatment	Average/Shake* Nymph 1978	Nymph 1979	Adult 1978	Adult 1979
No-tillage into oat stubble	1.2	2.3	2.1	4.9
No-tillage plus in-row subsoil into oat stubble	0.6	1.3	1.6	4.7
Conventional tillage	0.8	1.3	1.8	4.9
Conventional tillage plus in-row subsoil	0.5	1.9	2.1	3.9

1/Eight weekly shakes per treatment for nine weeks for 1978 and four shakes for four weeks for 1979.
*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 3. Stink bug damaged to seeds in no-tillage and conventional tillage "Cobb" soybeans at Green Acres, Gainesville, FL.

Treatment	1978 Percent Damage*	1979 Percent Damage*	1979 Percent Small Seeds*
No-tillage into oat stubble	7.5	16.3	38.9
No-tillage plus in-row subsoil into oat stubble	3.9	14.3	28.9
Conventional tillage	8.4	15.0	19.3
Conventional tillage plus in-row subsoil	7.5	17.0	20.7

1/ Damage: seeds with at least one feeding puncture.
Small seeds: small, wrinkled and fungus infected seeds.
*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 4. Number of Velvetbean caterpillars collected from no-tillage and conventional tillage soybeans at Green Acres, Gainesville, FL.

Treatment	Average No. Larvae/Shake1				
	1978*		1979**		
	Small	Large	Small	Med.	Large
No-tillage into oat stubble	7.9	2.9	11.4	1.9e	1.8x
No-tillage pus in-row subsoil into oat stubble	8.4	2.2	16.lb	2.8e	2.1x
Conventional tillage into oat stubble	8.6	1.8	17.1b	2.7e	1.1x
Conventional tillage plus in-row subsoil	8.5	3.5	16.4b	2.9e	1.7x

1/ 1978, Small: up to 0.98 in.; Large: over 0.98 in.
1979, Small: up to 0.59 in.; Medium: 0.62-0.98 in.; Large: over 0.98 in.
*In the analysis of variance no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.
**Means in each column not followed by the same letters are significantly different at the 0.05 level by Duncan's new multiple range test.

Table 5. Lesser cornstalk borer infestations in no-tillage and conventional tillage "Cobb" soybeans at Green Acres, Gainesville, FL., 1979.

Treatment	Infested Plants[1]	
	Total number	Average/row*
No-tillage into oat stubble	103	4.3a
No-tillage plus in-row subsoil into oat stubble	46	1.9b
Conventional tillage into oat stubble	34	1.4b
Conventional tillage plus in-row subsoil into oat stubble	20	0.8c

1/ Estimations based on two different rows/replications observed weekly for three weeks.
*Values not followed by the same letter are significantly different at the 0.05 level by Duncan's new multiple range test.

Table 6. Yield of soybeans from conventional and no-tillage systems in oat stubble at Green Acres, Gainesville, Florida.

Treatment	1977	1978	1979	Average
	Average yield*			
		bu/A		
No-tillage into oat stubble	36.0a	29.0a	15.0b	26.6
No-tillage plus in-row subsoil into oat stubble	36.0a	34.0a	21.0ab	30.3
Conventional tillage	21.0b	34.0a	26.0a	27.0
Conventional tillage plus in-row subsoil	21.0b	30.0a	24.0a	25.0
Average	28.5	31.7	21.5	

*Data among tillage treatments followed by the same letter within each year are not significantly different at the 0.05 level of probability. Data among years with a common underline within each tillage treatment are not significantly different at the 0.05 level of probability, by Duncan's new multiple range test.

Table 7. Foliage ear damage caused by the fall armyworm, and the corn earworm, in no-tillage and conventional tillage corn at Green Acres, Gainesville, FL., 1978[1].

Treatment	% infestation* Foliage	Ears
No-tillage into vetch stubble	24.6	44.3
No-tillage plus in-row subsoil into vetch stubble	37.5	38.4
Conventional tillage	30.8	43.2
Conventional tillage plus in-row subsoil	22.7	50.8

laumbers are averages of 120 plants per treatment (each week) for four weeks for foliage and three weeks for ears.
*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 8. Damage caused by the fall armyworm, and corn earworm, to no-tillage and conventional tillage field corn at Green Acres, Gainesville, FL., 1979[1].

Treatment	Corn infestation*			
	Avg. No./row		%infestation	
	plants	ears	plants	ears
No-tillage into vetch stubble	0.4	2.8	1.5	10.6
No-tillage plus in-row subsoil into vetch stubble	0.5	3.6	2.0	14.6
Conventional tillage	0.6	2.0	1.5	5.4
Conventional tillage plus in-row subsoil	0.4	3.4	0.8	9.9

[1]Numbers are averages of 120 plants per treatment (each week) for five weeks for foliage and four weeks for ears.
*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 9. Infestations of the fall armyworm, and corn earworm, in no-tillage and oonventional tillage field corn at Green Acres, Gainesville, FL., 1978[1].

Treatment	% infestation*			
		Plants with destroyed		
	plants	whorl	tassel	ears
No-tillage into wheat stubble	77.5	94.6	74.2	86.9
No-tillage plus in-row subsoil into wheat stubble	77.8	90.8	70.9	78.5
Conventional tillage	74.8	93.3	84.3	82.3
Conventional tillage plus in-row subsoil	76.2	94.6	83.2	72.1

[1]Average based on 120 plants per treatment per week.
*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 10. Infestations of the fall armyworm, and corn earworm, in no-tillage and conventional tillage field corn at Green Acres, Gainesville, FL., 1979.

Treatment	Infested plants*		
		%	
	Average No./row	(on row basis)	(on 120 plant basis)
No-tillage into wheat stubble	31.4	68.9	91.7
No-tillage plus in-row subsoil	35.2	71.8	92.1
Conventional tillage	27.0	60.3	87.5
Conventional tillage plus in-row subsoil	30.7	64.5	88.7

*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 11. Number of wireworms, collected in pitfall traps from conventional tillage and no-tillage corn at Green Acres, Gainesville, FL., 1979[1].

Treatment	Total Number		Average/Trap*	
	Vetch stubble	Wheat stubble	Vetch stubble	Wheat stubble
No-tillage	466	150	12.94	6.25
No-tillage plus in-row subsoil	368	207	10.22	8.62
Conventional tillage	389	265	10.80	11.04
Conventional tillage plus in-row subsoil	280	173	7.78	7.21

[1]Numbers are totals and averages of nine weeks for vetch and six weeks for wheat with four traps per treatment.
*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 12. Activity of the granulated cutworm, monitored by nonbaited pitfall traps in no-tillage and conventional tillage corn at Green Acres, Gainesville, FL., 1979[1].

Treatment	Cutworm population	
	Total No.	Avg. /Trap
No-tillage into vetch stubble	160	10.0a*
No-tillage plus in-row subsoil	345	21.6a
Conventional tillage	34	2.1b
Conventional tillage plus in-row subsoil	5	0.3b

[1]Numbers are totals and averages of four traps per treatment for four weeks.
*Values not followed by the same letter are significantly different by Duncan's new multiple range test at the 0.05 level.

Table 13. Lesser cornstalk borer, infestations in no-tillage and conventional tillage field corn at Green Acres, Gainesville, FL., 1978-1979.

Treatment	Damaged Plants[1]			
	Total No.		Average No./row*	
	1978	1979	1978	1979
No-tillage into vetch stubble	3	15	0.1a	0.9c
No-tillage plus in-row subsoil into vetch stubble	2	13	0.1a	0.8c
Conventional tillage	32	3	1.3b	0.2c
Conventional tillage plus in-row subsoil	32	2	1.3b	0.1c

[1]Estimation is based on eight rows per treatment examined each week for three weeks.
*Means in each column not followed by the same letter are significantly different at the 0.05 level by Duncan's new mutiple range test.

Table 14. Infestations of the lesser cornstalk borer, in no-tillage and conventional tillage field corn at Green Acres, Gainesville, FL., 1978.

Treatment	No. plants observed	infested	Infestations* %	Infestations* Plants/ row
No-tillage into wheat stubble	1987	31	1.6a	100c
No-tillage plus in-row subsoil into wheat stubble	2751	104	3.8b	3.2d
Conventional tillage	2507	88	3.5b	2.7d
Conventional tillage plus in-row subsoil	2966	80	2.7b	2.5d

*Values in each column not followed by the same letter are significantly different at the 0.05 level by Duncan's new multiple range test.

Table 15. Infestations of the lesser cornstalk borer, in no-tillage and conventional tillage field corn at Green Acres, Gainesville, FL., 1979.

Treatment	No. Plants Total observed	No. Plants Number infested	Infestation* %	Infestation* Avg./row
No-tillage into wheat stubble	1138	90	7.9	3.7
No-tillage plus in-row subsoil into wheat stubble	1171	89	7.6	3.7
Conventional tillage	1160	109	9.4	4.5
Conventional tillage plus in-row subsoil	1140	90	7.9	3.7

*In the analysis of variance, no significant differences were detected among the means. Therefore, Duncan's comparisons were not made.

Table 16. Yield of corn from Conventional tillage and no-tillage in vetch stubble at Green Acres, Gainesville. FL.,

Treatment	Average Yield* (Ton/A-Dry Matter) 1978	1979	2-year average
No-tillage into vetch stubble	3.8a	3.6ab	3.7a
No-tillage plus in-row subsoil into vetch stubble	3.7a	3.9a	3.8a
Conventional tillage	2.7b	2.3b	2.5c
Conventional tillage plus in-row subsoil	3.2ab	2.6ab	2.9b

*Values in each column not followed by the same letter are significantly different at the 0.05 level by Duncan's new multiple range test.

Table 17. Yield of Corn from conventional tillage and no-tillage in wheat stubble at Green Acres, Gainesville, FL.

Treatment	Average Yield* (Ton/A Dry Matter) 1978	1979	2-year average
No-tillage into wheat stubble	3.lb	3.2ab	3.la
No-tillage plus in-row subsoil into wheat stubble	3.3ab	3.5a	3.4a
Conventional tillage into wheat stubble	3.3ab	2.7b	3.0s
Conventional tillage plus in-row subsoil into wheat stubble	3.6a	3.0ab	3.3a

*Values in each column not followed by the same letter are significantly different at the 0.05 level by Duncan's new multiple range teat.

Table 18. Days to mid-bloom, percent grain loss and yield of the grain sorghum at Gainesville, FL., 1978.

Treatment	Days to mid-bloom $\bar{X} \pm SD$	%grain loss $\bar{X} \pm SD$	Yield (Ton/A)
No-tillage into rye mulch	70.2±5.7	9.4±12.7	3.6
No-tillage into rye stubble	71.0±5.3	10.0f13.3	3.3
No-tillage into lupine mulch	65.3±7.2	4.8±4.0	4.1
No-tillage into lupine stubble	64.5±5.1	4.3±3.4	3.5
Conventional tillage	68.3±6.9	12.lf19.2	3.3