1998 WILKE RESEARCH DATA

Research Tasks Completed 1998

Soil testing
Canopy and Weed Densities
Disease evaluation
Insect evaluation
Water Infiltration
Yields
Residue

Research Tasks Planned for 1999

Soil testing (analyzation to completed by 3/15/99)
Canopy & Weed Densities
Disease evaluation
Insect evaluation
Water Infiltration
Yields
Residue
Photo points
Earth worm populations

1998 Overall Data Summary

Residue

Post harvest residue data results are presented in Table 1. These varied from farm to farm depending on the number of year's no-till methods had been used and the previous years yield.

Water Infiltration

First year baseline water infiltration tests were performed on all cooperator and control fields. This data is presented in Figure 1. The infiltration rates were generally high compared to expected rates, (see individual farms for soil types and specific results).

Weed, insects, and diseases

Each farm varied with the type and number of weeds present. In general these consisted of wild oats, lambsquarters, downy brome, Jim mustard, prickly lettuce, and cereal volunteers.

Insects were collected and evaluated for Dreger, Kupers, Johnson, Reinbold, Wilke, and Zwainz farms. Overall these showed a greater number of pest than beneficial insects. In the millet fields where the data was collected on a couple different dates, the total number of insects declined on the second collection. This was probably due to the crop drying. See Figures 4 & 5 for millet and safflower comparisons.

Disease evaluations were performed on all cooperator farms throughout the growing season. The only disease noted was stripe and leaf rust in spring wheat on the Wilke farm.

Yields

1998 crop yields are presented in Table 5. These values again varied from farm to farm. Spring barley ranged from 1.25 T – 1.94 T., spring wheat ranged from 19.95 bu – 50 bu./ac., winter wheat ranged from 54 bu – 90 bu/ac., safflower ranged from 100 lbs.-592.9 lbs./ac., canola ranged from 1001.3 lbs. – 1570 lbs./ac., millet ranged from 400 lbs.-800 lbs./ac., mustard ranged from 513.2 lbs. – 550 lbs./ac. Personal communication with Aaron Esser revealed the average area yields for mustard ranged between 800-1200 lbs./ac. (Esser, 1999). In general these did not yield as high as expected this year in the area due in part to a cool, wet spring and hot temperatures in July.

B. Dreger 98' Results and Discussion

Residue

Post harvest residue data results (Table 1), for field 1, spring barley, showed mean residue amounts that were high compared to the expected residue (2550-4500 lbs./ac) (Monsanto, 1992). However, the standard deviation showed an acceptable variance level for the number of samples collected. The difference is probably due to a high yield crop from 1997. This was the first year no-till methods were used on this field.

Data results for field 2, spring barley, showed mean residue amounts that were high compared to the expected residue (2550-4500 lbs./ac) (Monsanto, 1992). 1998 was the fourth year of using no-till methods on this field, causing an accumulation of 3 years of residue. The standard deviation showed an acceptable variance level for the number of samples collected.

Data results for field 3, winter wheat, showed mean residue amounts that fell within the expected residue (7200-9900 lbs./ac) (Monsanto, 1992). This was the first year of no-till methods were used on this field.

Water Infiltration

First year baseline water infiltration tests were performed on all three fields (see map) classified as Ritzville soil series. The soil survey lists the Ritzville series as a silt-loam with an average infiltration of .6-2.0 in/hr. (USDA, 1981). The data results (Table 2, & Figure 1) were similar between all three fields. However, the results obtained were higher than these expected amounts, but the standard deviation showed acceptable variance levels for the number of samples collected. 1998 was the fourth year no-till farming methods were used on field 2, spring barley, which would help account for the higher than normal rate for that field. 1998 was the first year no-till methods were used on fields 1, spring barley, and 2, winter wheat. The higher values on the other two fields could have been due to sampling locations. See Figure 2, for comparisons between farms.

Weeds, insects & diseases

Refer to Table 3, for canopy covers of each crop and type of weeds present in each field. Fields were only monitored once during the 1998 season for weed evaluations. However, the amount of Russian thistle, which germinated after the heavy rains the beginning of July, was noted.

See Table 4, for insects collected in each field. These numbers represent collection using the sweeping method. There were no insects found on the plants collected. Figure 3 graphically depicts beneficial insects vs. pests. Fields were only monitored once during the 1998-growing season for insects.

No signs of diseases were noted in the three research fields.

Yields

1998 crop yields (Table 5) for field 1, spring barley was average in relation to the Lincoln county spring barley yields (Office of Financial management, 1995). Field 2, spring barley was slightly below average, but this was probably due to the hail damage recorded by the owner. Field 3, winter wheat yielded 90 bu/ac., well above the county average of 66 bu/ac.

H. Johnson 1998 Results and Discussion

Residue

Post harvest residue data results are presented in Table 1. The results for field 1, canola, showed a mean residue amount of 9948 lbs./ac. There was no published expected residue amount found for canola to compare this to. However, comparing this to the other crops, this is probably higher than would be expected. The difference is probably due to the residue remaining from a high yield of spring wheat in 1997.
Results for field 2, spring barley, showed a mean residue amount within the expected residue amounts. This was the first year using no-till methods on this field.
Results from field 3, spring wheat, showed mean residue amounts above the expected residue amounts (3480.4-4972) (Monsanto, 1992). However, the standard deviation showed an acceptable variance level for the number of samples collected. The variation is more than likely due to residue remaining from a high yield of spring wheat in 1997.
There was no data collected on field 4, millet, at the time of this report.

Water Infiltration

First year baseline water infiltration tests were performed on all four fields (see map) classified as Broadx-Hanning soil series. These fields were divided in 1998 from two larger conventional fields. The soil survey lists Broadax-Hanning as a very deep silt-loam with an average infiltration of .2-2.0 ins./hr. (USDA, 1981). The data results (Table 2, & Figure 1) were higher than these expected amounts. The standard deviation showed acceptable variance levels for fields 1, 2, & 4, for the number of samples collected. Field 3 showed a higher than normal standard deviation possibly due to the location of sampling. More testing in this field would help to diminish variance levels. See Figure 2, for comparisons between farms.

Weeds, insects, and diseases

Refer to Table 3, for canopy density cover of each crop and type of weeds present in each field. All except field 4, millet, were monitored once during the 1998-growing season for weed evaluations.
Refer to Table 4, for insects collected in each field. These numbers represent collection using the sweeping method. See Figure 4 to compare beneficial insects versus pests found in other farms millet fields. There were no insects found on the plants collected. Figure 3 graphically depicts beneficial insects vs. pests. During the 1998-growing season fields 1-3, (canola, spring wheat, spring barley), were monitored once and field 4, (millet) was monitored twice.
No signs of diseases were noted in the four research fields.

Johnson Yields

1998 crop yields (Table 5) for field 2, spring barley, and field 3, spring wheat, were above average in relation to the Lincoln county spring barley yields (Office of Financial management, 1995). Field 1, canola had a yield of 1570 lbs./ac. There was no published data found to compare canola and millet yields to. However, personal communication with Aaron Esser revealed the average area yields for canola were 800-1200 lbs./ac. (Esser, 1999).

K. Kupers 1998 Results and Discussion

Residue

Post harvest residue data results (Table 1), for fields 1, spring wheat, and 2, oats, showed high mean residue amounts above the expected amounts (2170-3100 lbs./ac) (Monsanto, 1992). 1998 was the third year of using no-till methods on this field, causing an accumulation of 2 years of residue. The standard deviation for both fields had an acceptable variance level for the number of samples collected.
Data results for field 3, mustard, showed high mean residue of 6671 lbs./ac. 1998 was the third year of using no-till methods on this field, causing an accumulation of 2 years of residue from above average yielding crops.
There were no residue data results on field 4, millet, at the time of this report.

Water Infiltration

First year baseline water infiltration tests were performed on all four fields (see map) classified as a Renslow-Ritzville series. These fields were divided in 1998 from one larger no-till field the previous two years. The results were similar between all of the fields and this division would help to account for the similarity between them. The soil survey lists the Renslow-Ritzville series as a very deep silt loam with an average infiltration of .6-2.0 ins./hr. (USDA, 1981). However, the data results (Table 2, & Figure 1) were higher than these expected amounts, but the standard deviation showed acceptable variance levels for the number of samples collected. One would expect greater infiltration rates with each consecutive year of no-till methods. (Wuest, 1999). See Figure 2, for comparisons between farms.

Weed, insects, & diseases

Refer to Table 3, for canopy density cover of each crop and species of weeds present in each field. All fields had low weed populations. During the 1998-growing season fields 1-3, (spring wheat, oats, mustard), was monitored once, and field 4, (millet) was monitored twice for weed evaluations.
Refer to Table 4, for a list of insects collected in each field. These numbers represent collection using the sweeping method. See Figure 4, to compare beneficial insects versus pests found in other farms millet fields. There were no insects found on the plants collected. Figure 3 graphically depicts beneficial insects versus pests. During the 1998-growing season fields 1-3, (spring wheat, oats, mustard), was monitored once, and field 4, (millet) was monitored twice.
There were no signs of diseases noted in the four research fields.

Yields

1998 crop yields (Table 5) for field 1, spring wheat and field 2, oats were below average in relation to the Lincoln county yields (Office of Financial management, 1995). *Kupers.*

Kupers Yields continued

Mustard had a yield of 550 lbs./ac. There was no published data found for mustard and millet to compare the yields to. However, personal communication with Aaron Esser revealed the average area yields for mustard ranged between 800-1200 lbs./ac. (Esser, 1999). In general mustard did not yield as high as expected this year in the area due in part to a cool spring and hot temperatures in July. The high temperatures did not allow the heads to finish flowering before the termination of growth.

C. Laney 1998 Results and Discussion

Residue

Post harvest residue data results (Table 1), from field 1, spring barley, showed mean residue amounts above the expected values of 2346-4140 lbs./ac. (Monsanto, 1992). However, the standard deviation showed an acceptable variance level for the number of samples collected. The high residue amount is probably due in part to the 1997 residual residue. Field 3, spring wheat also showed a mean residue amount above the expected values of 2381-3401 lbs./ac. (Monsanto, 1992). The standard deviation fell within an acceptable variance level for the number of samples collected. This higher than expected value is again due in part to the 1997 residual residue. There was no published information found on canola mean residue weights. This weight may also be higher than expected due to the 1997 residual residue. This was the first year no-till methods were used on these fields.

Water Infiltration

First year baseline water infiltration tests were performed on all three fields (see map) classified as Bagdad soil series. Bagdad soils are a very deep silt-loam with an average infiltration of .6-2.0 ins./hr. (USDA, 1981). The data results (Table 2,& Figure 1) indicated a much higher infiltration rate than these expected rates. The standard deviations showed an acceptable variance level for the number of samples collected. The differences are possibly due to the location of sampling, or tillage used. 1998 was the first year no-till methods were used on these fields. See Figure 2, for comparisons between farms.

Weeds, insects, and diseases

Refer to Table 3, for canopy density cover of each crop and type of weeds present in each field. Fields were only monitored once during the 1998 season for weed evaluations. There was no data found for insects collected in 1998 for this farm.
No signs of diseases were noted in the three research fields.

Yields

1998 crop yields (Table 4) field 2, spring barley, and field 3, spring wheat had lower than average in relation to the Lincoln County yields (Office of Financial management, 1995). There was no published data found on the county's average canola yields. Personal communication with Arron Esser estimated average area yields for canola to be between 800-1200 lbs./ac. (Esser, 1999). In general this year canola did not yield as high as expected this year in the area due in part to a cool wet spring and hot temperatures in July. The high temperatures did not allow the heads to finish flowering before the termination of growth.

D. Reinbold 1998 Results and Discussion

Residue

Post harvest residue data results (Table 1), for field 1, spring barley, showed mean residue amounts that were high compared to the expected residue (2261-3990 lbs./ac) (Monsanto, 1992). Field 2, spring wheat, also showed mean residue amounts that were high compared to the expected residue (1397-1995 lbs./ac) (Monsanto, 1992). However, the standard deviations level fell within acceptable variance levels for the number of samples collected. The difference is probably due to a high yield from the 1997-barley crop. This was the first year no-till methods were used on these fields.
Data results for field 3, corn, showed a mean residue amount of 4215 lbs./ac, and field 4, Sudan grass had a mean residue of 5083.7 lbs./ac. There was no published residue data to compare corn and Sudan grass to. Both of these fields had a severe wild oat infestation, which would help to account for higher mean residue amounts. This was the first year no-till methods were used on these fields.

Water Infiltration

First year baseline water infiltration tests were performed on the same four fields soil tests were performed on in the spring, (see map). Each field is classified as Hanning series, silt-loam soil with an average infiltration of .6-2.0 in/hr. (USDA, 1981). The data results (Table 2 & Figure 1), obtained were higher than the expected amounts, but the standard deviation showed acceptable variance levels for the number of samples collected on fields 1,2 & 4. Field 3 showed a higher than normal standard deviation possibly due to the location of sampling. See Figure 2, for comparisons between farms. More testing would help to diminish variance levels. 1998 was the first year no-till methods were used on these four fields.

Weeds, insects, and diseases

Refer to Table 3, for canopy density covers of each crop and type of weeds present in each field. Fields were only monitored once during the 1998-growing season for weed evaluations. The early harvest of corn and Sudan grass was noted due to severe wild oat infestation.
Refer to Table 4, for insects collected in each field. These numbers represent collection using the sweeping method. There were no insects found on the plants collected. Figure 3 graphically depicts beneficial insects vs. pests. Fields were only monitored once during the 1998-growing season for insects.
No signs of diseases were noted in the four research fields.

Reinbold Yields

1998 crop yields (Table 5), field 1, spring barley, & field 3, spring wheat, averages were low in relation to the Lincoln County average yields (Office of Financial management, 1995). Field 2, spring wheat yielded 1.66 T/ac above the county average of 1.5 T (Office of Financial management, 1995). There was no published average yield data found for corn or Sudan grass in Lincoln County.

T. Zwainz 1998 Results and Discussion

Residue

Post harvest residue data results (Table 1), for field 2, spring barley/spring wheat, showed a mean residue amount slightly above the expected residue amounts, (2550-4500 lbs./ac.) (Monsanto, 1992). The standard deviation showed an acceptable variance level for the number of samples collected. The variance is probably due in part to the residue remaining from the previous crop. 1998 was the first year of using no-till methods on this field.
Results from field 1, winter wheat, mean residue amounts were within the expected residue amount (4258-8300 lbs./ac.) (Monsanto, 134-92-08R). 1998 was the first year of using no-till methods on this field.
There were no residue data results for field 3, safflower, available at the time of this report.

Water Infiltration

First year baseline water infiltration tests were performed on three fields (see map) classified as Hesseltine-Cheney-Uhlig series, a silt-loam soil with an average infiltration rate of .8-2.5 in/hr. (USDA, 1968). Data results obtained (Table 2 & Figure 1) were higher than the expected amounts, but the standard deviation showed acceptable variance levels for the number of samples collected on fields 1,winter wheat, & 3, safflower. Field 2 (spring barley/spring wheat), showed a higher than normal standard deviation possibly due to the location of sampling or tillage operations. More testing would help to diminish variance levels. 1998 was the first year no-till methods were used on these fields. 1998 was the third year no-till methods were used on the spring wheat portion of field 2. See Figure 2, for comparisons between farms.

Weeds, insects, a& diseases

Refer to Table 3, for canopy density cover of each crop and type of weeds present in each field. Fields were monitored once during the 1998-growing season for weed evaluations. Refer to Table 4, for insects collected in each field. These numbers represent collection using the sweeping method. There were no insects found on the plants collected. Figure 3 graphically depicts beneficial insects vs. pests. Fields 1-2 spring barley & winter wheat, were monitored once and field 3, safflower was monitored twice during the 1998-growing season for insects. See Figure 4, to compare numbers of beneficial insects versus pest in safflower with Wilke farm results.
No signs of diseases were noted in the three research fields.

Zwainz Yields

1998 crop yields (Table 5) for field 1, winter wheat, and field 2, spring barley were below the averages in relation to the Lincoln County average yields (Office of Financial management, 1995). There was no published county yield averages found for safflower. However, the safflower yield was well below the safflower yields for the Wilke farm. These three fields are located in Spokane county, but Lincoln county averages were used in order to compare directly with the other cooperators in Lincoln county.

Wilke 1998 Results & Discussion

Residue

Post harvest residue data results (Table 1) for spring wheat, fields 6,9,13,17, & 21, mean residue amounts ranged from 4709-7209 lbs./ac compared to the expected residue of 2107-3170 lbs./ac. (Monsanto, 1992). These results were high however; the standard deviation levels for 6, 17, & 21 fell within acceptable variance levels for the number of samples collected. More testing would need to be performed on fields 9 & 13 to help diminish the variance levels.
Results for spring barley, fields 7,8, 14, 16, & 19, mean residue amounts ranged from 3823-6144 lbs./ac compared to the expected residue of 2380-4620 lbs./ac. (Monsanto, 1992). These results were higher than expected but the standard deviation levels fell within acceptable variance levels for the number of samples collected. The higher than expected means are due in part to the remaining residue from high yielding winter wheat and spring barley crops in 1997.
Data for field 12, mustard, mean residue amounts were within the expected residue amount of 2000-2800 lbs./ac. (Monsanto, 1992). Field 15, mustard mean residue was higher than the expected amount, however the standard deviation level fell within acceptable variance levels for the number of samples collected. The difference in means is probably due in part to the remaining residue from high yielding winter wheat and spring barley crops in 1997.
There were no residue data results for millet and safflower fields at the time of this report. There was no published residue data to compare mustard, safflower and millet with.

Water Infiltration

First year baseline water infiltration tests were performed on all twenty-one fields. There are four different classifications of soils throughout the farm. (See map for locations.) The soils are classified as follows: Broadax, Broadax-Lance, Hanning silt-loam, and Mondovi silt-loam. Broadax, Broadax-Lance, and Hanning silt-loam are classified as deep soils and Mondovi silt-loam is classified as a very deep, well drained soil. All four have an average infiltration rate of .6-2.0 in/hr. (USDA, 1981). Data results (Table 2 & Figure 1) obtained were consistently higher than the expected amounts. Standard deviations showed acceptable variance levels for the number of samples collected on all fields except for 4,safflower, 5 & 10, millet, 13 & 21, spring wheat. More samples would help to diminish the variance level on those fields. The different soil classifications help to explain some of the greater infiltration rates obtained in the Mondovi silt-loam soils. The north end of fields 1-18 and middle of fields 14-18 fall into the Mondovi silt-loam soil classification. 1998 was the first year using no-till methods on these fields. See Figure 2, for comparisons between farms.

Wilke Weeds, insects, & diseases

Refer to Table 3a & b, for canopy density covers of each crop and type of weeds present in each field. During the 1998-growing season all spring wheat, spring barley, mustard, and safflower fields were evaluated once for weeds. The millet fields were evaluated three times. The severe weed infestations in all safflower fields (4, 11, & 18) were noted. There were innumerable wild oats, and multiple areas of prickly lettuce in these fields.
Refer to Table 4, for insects collected in each field. These numbers represent collection using the sweeping method. There were no insects found on the plants collected. Figure 3 graphically depicts beneficial insects versus pests. All fields except millet, (5, 10, & 20), and safflower (4,

11) was monitored once during the 1998-growing season for insect evaluations. See Figures 4 & 5 to compare insects found among other millet and safflower fields.
Leaf and stem rust were noted on all spring wheat plots, (6,9,13,17, & 21). No diseases were noted on any other fields.

Yields

1998 crop yields (Table 5) for spring barley & spring wheat were below average in relation to the Lincoln County average yields (Office of Financial management, 1995). The average yield for mustard was 513.2 lbs./ac. There was no published yield averages found for millet, safflower or mustard. However, personal communication with Aaron Esser estimated area average yields to be between 800-1200 lbs./ac. (Esser, 1999). In general this year mustard did not yield as high as expected this year in the area due in part to a cool wet spring and hot temperatures in July. The high temperatures did not allow the heads to finish flowering before the termination of growth.
See Table 6& Figure 6 for field stand counts. These were fairly consistent across the crop type.

Control I 98' Results and Discussion

Water Infiltration

First year baseline water infiltration tests were performed on three fields classified as Broadax-Hanning soil series (see map). These are deep silt-loam soils with an average infiltration of .6-2.0 ins./hr.(USDA, 1981). The data results Table 1, & Figure 1) indicated a much higher infiltration rate than these expected rates. However, the standard deviation showed an acceptable variance level for the number of samples collected.

Yields

1998 crop yields (Table 2) for field 1, spring barley was below average in relation to the Lincoln County average yields (Office of Financial management, 1995). Field 3, winter wheat yield was slightly below the county average of 66 bu/ac. (Office of Financial management, 1995).

No other research data was available for these fields for 1998.

Control II 98' Results and Discussion

Water Infiltration

First year baseline water infiltration tests were performed on three fields (see map) classified as Broadax-Hanning soil series. These are deep silt-loam soils with an average infiltration of .6-2.0 ins./hr.(USDA, 1981). The data results Table 1, & Figure 1 indicated a much higher infiltration rate than these expected rates. The standard deviation showed an acceptable variance level for the number of samples collected. The differences are possibly due to the location of sampling, or tillage used. Field 3, summer fallow was the only field measured in the results. Fields 1,2 were both chiseled and could not use enough water to properly measure the results.

Yields

1998 crop yields (Table 2) for field 1, winter wheat was below average in relation to the Lincoln County average yields (Office of Financial management, 1995). Field 2, spring wheat was above average in relation to the county average yields (Office of Financial management, 1995).

No other research data was available for these fields for 1998.

Control III 98' Results and Discussion

Water Infiltration

First year baseline water infiltration tests were performed on four fields (see map) classified as Broadax-Hanning soil series. These are deep silt-loam soils with an average infiltration of .6-2.0 ins./hr.(USDA, 1981). The data results Table 1, & Figure 1 indicated a much higher infiltration rate than these expected rates. However, the standard deviation showed an acceptable variance level for the number of samples collected on fields 1 & 4. Fields 2 & 3 had high standard deviations, which were probably due to the location of sampling, and tillage used.

Yields

1998 crop yields (Table 2) for field 3, winter wheat and field 2, spring wheat, were below the average in relation to the Lincoln county average yields (Office of Financial management, 1995). Field 4, spring wheat was above the average Lincoln county yields.

No other research data was available on these fields for 1998.

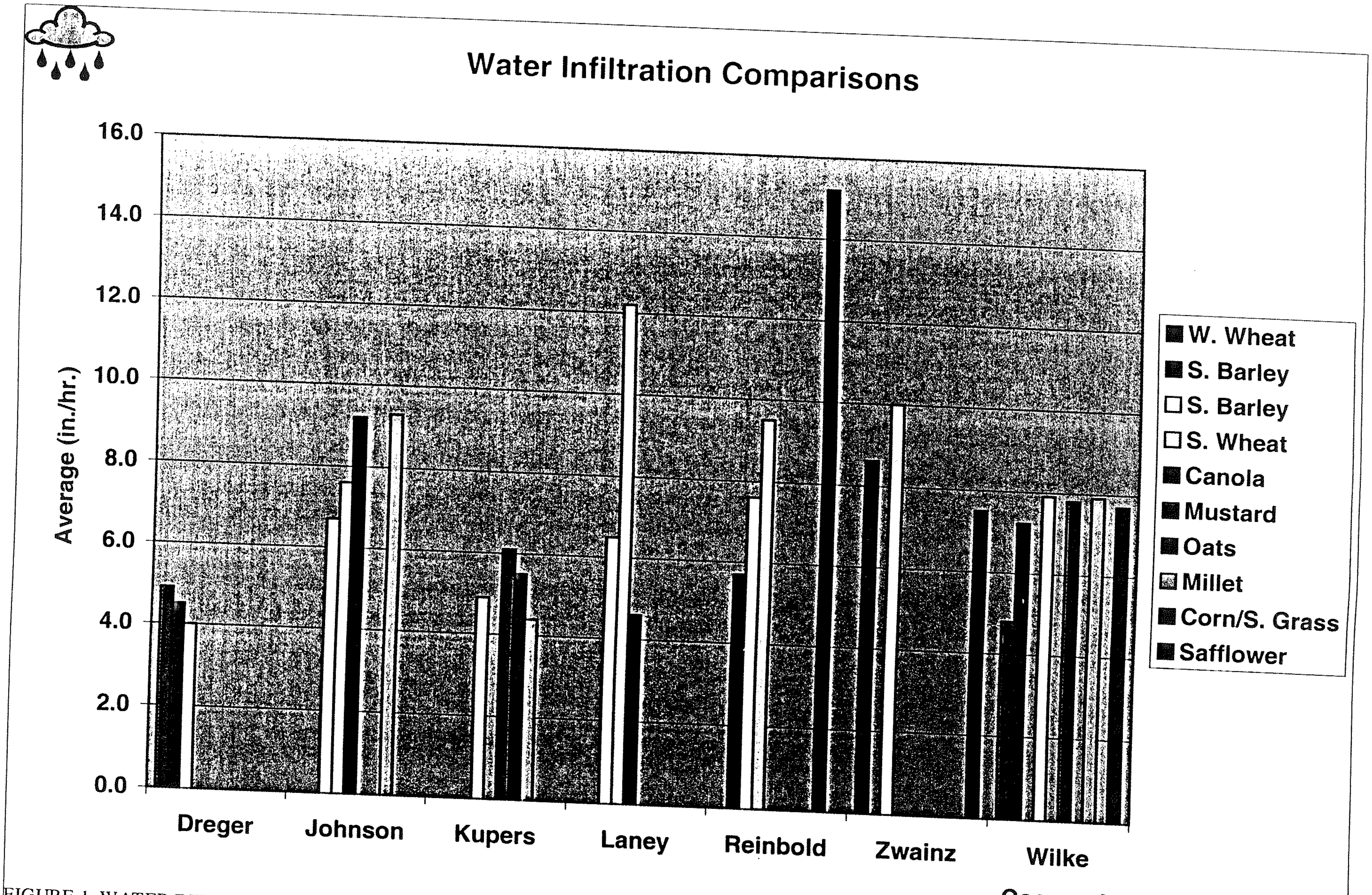

FIGURE 1. WATER INFILTRATION RATES 1998

Mean Post Harvest Residue Data (lbs/ac) 1998										
Cooperator	S. Barley	S. Wheat	W. Wheat	Millet	Canola	Mustard	Safflower	Oats	Corn	Sudan Grass
B. Dregger	5025.3 6767.0		8886.3							
H. Johnson	4382.3	5975.0			9947.6					
K. Kupers		8430.3				6671.3		8539.0		
C. Laney	8020.0	4232.0			4511.3					
D. Reinbold	5498.0	5330.3							4215.0	5083.7
T. Zwainz	5724.0		8215.7							
Wilke (ave.)	4916.9	5199.6				3063.3				

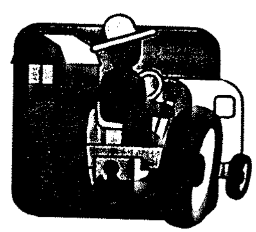

TABLE 1. MEAN POST HARVEST RESIDUE 1998

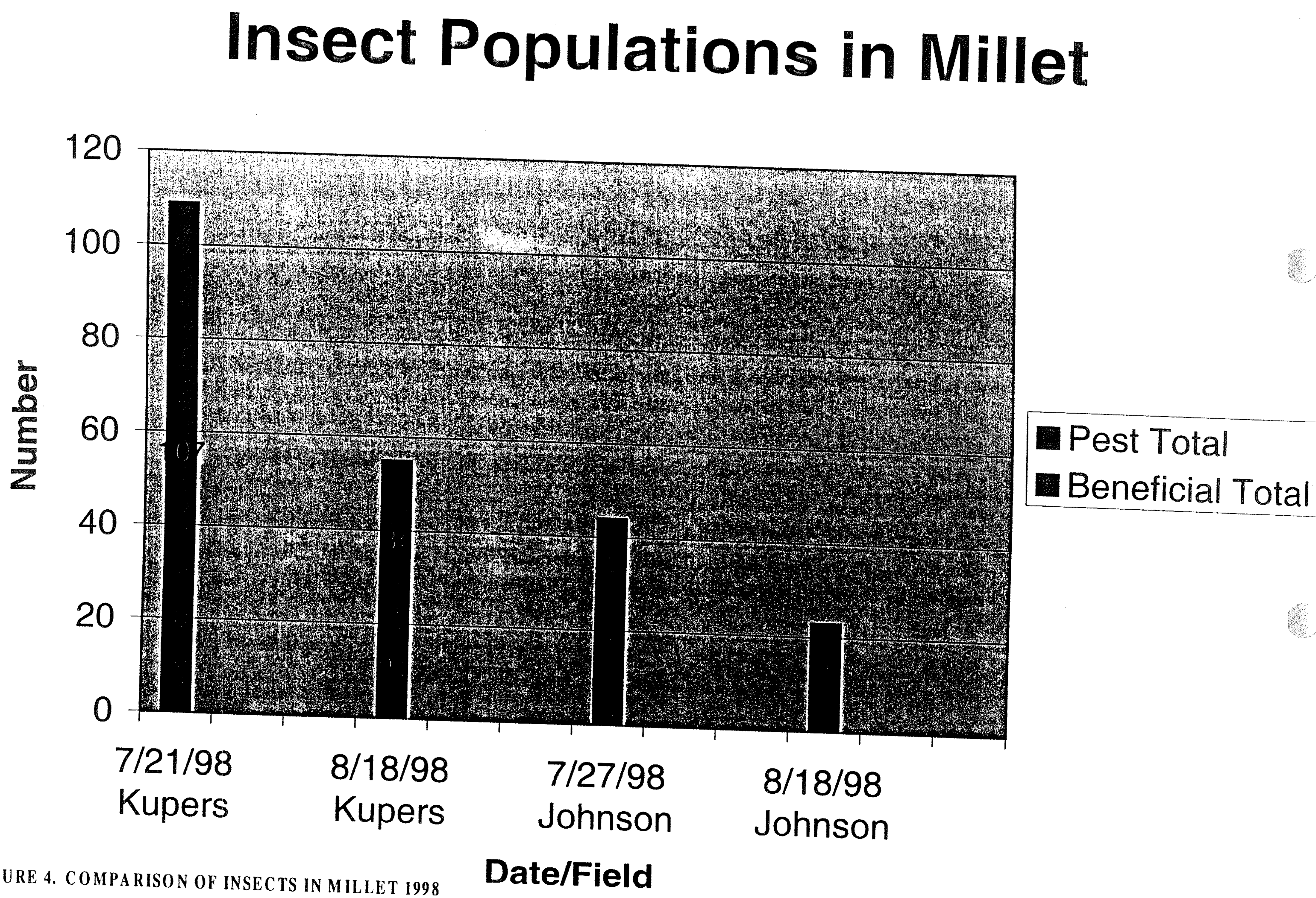

FIGURE 4. COMPARISON OF INSECTS IN MILLET 1998

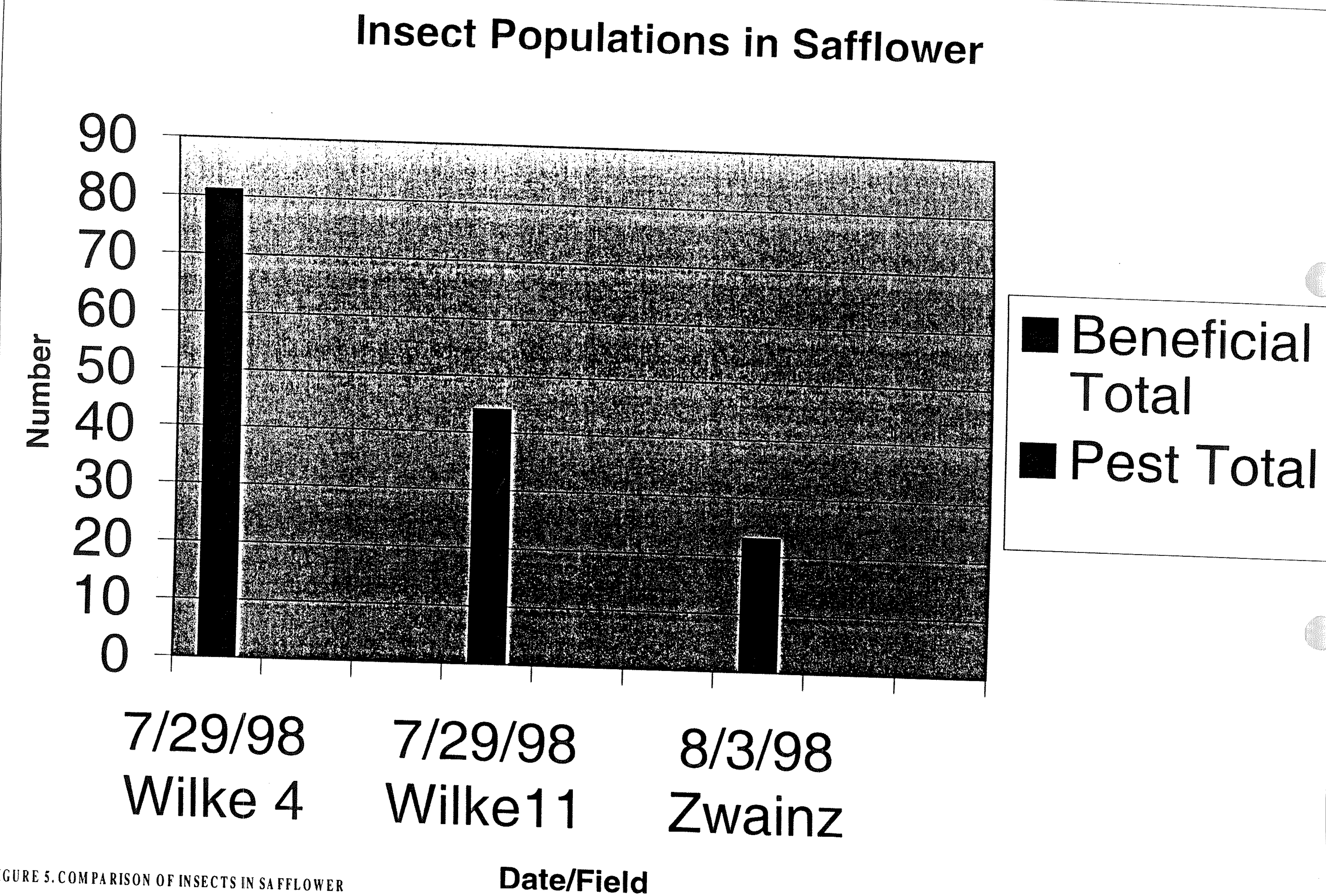

FIGURE 5. COMPARISON OF INSECTS IN SAFFLOWER

Yield Data Summary 1998

Crop	Dreger ac.	Dreger Yield/ac	Johnson ac.	Johnson Yield/ac	Kupers ac.	Kupers Yield/ac	Laney ac.	Laney Yield/ac	Reinbold ac.	Reinbold Yield/ac	Zwainz ac.	Zwainz Yield/ac	Wilke ac.	Wilke Yield/ac
S. Barley	636	1.5T	22.2	1.94T			30.1	1.38T	25.0	1.66T	200.6	1.36T	44.9	1.44T
S. Barley	148	1.25T							25.0	1.33T				
S. Wheat			23.8	49.72bu	10.0	31.0 bu	294	34.01bu	25.0	19.95bu			45.4	31.22bu
W. Wheat	535	90bu									148.4	60.6bu		
Safflower											30.0	100#	29.0	592.9#
Canola			24.7	1570#			139.8	1001.3#						
Millet			24.2	800#	9.0	400#							27.1	596.0#
Oats					10.0	1650#								
Mustard					10.0	550#							18.2	513.2#
Corn									25.0	45 bu				
Sudan grass									25.0	3000#				

*Note-Reinbold Sudan Grass 3000 #/ac + forage

Crop	Control II ac.	Control II Yield/ac	Control III ac.	Control III Yield/ac	Control I ac.	Control I Yield/ac
W. Wheat	600	69 bu	87	54 bu	103	62 bu
S. Wheat	200	50 bu	152.9	42 bu		
S. Wheat			11.9	47 bu		
Barley					104	1.2 T

Crop	Lincoln County Average Yields
W. Wheat	66 bu/ac
S. Wheat	43 bu/ac
S. Barley	1.5 T/ac
Oats	60 bu/ac

* Lincoln County, Washington 1995 Data Book

TABLE 5. 1998 CROP YIELDS

Literature Cited

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Wilke Direct Seeding Project: 1998 Crop Yields

CROP	UNIT	1	2	3	1	2	3	Wilke*	Check 1	Check 2	Check 3
S. Barley	T/A	1.5	1.4	1.4	1.9		1.7	1.4			1.2
S. Barley	T/A	1.3					1.3				
S. Wheat	bu/A		34	38	50	31	20	31	50	42	
S. Wheat	bu/A									47	
W. Wheat	bu/A	90		60					69	54	62
Safflower	lb/A			100				593			
Canola	lb/A		1001		1570						
Millet	lb/A				800	400		596			
Oats	lb/A					1650					
Mustard	lb/A					550		513			
Corn	bu/A						45				
Sudan grass	lb/A						3000**				

* Wilke yields average over 3 reps

** Sudan grass 3000 #/ac + forage

Yield Data Summary 1999

Yield / Acre

		3-Year Cooperators				4-Year Cooperators		
98 Crop	99 Crop	1	2	3	Wilke	1	2	Wilke
Spring Barley	SW Alpowa	44 bu						
Spring Barley	SW Alpowa	45 bu						
Winter Wheat	SC Hyola 308	0		1078 lbs				
Spring Barley	SC Reward		517 lbs					
Spring Canola	SW Alpowa		30 bu			48.5 bu Wa		
Spring Wheat	SB Baronesse		1.2 T		1.2 T Mel	1.7 T		1.2 T
Spring Barley	WW Eltan			54 bu				
Safflower	SW Wawawai			43 bu				28 bu
Spring Barley	Millet Ebird					1050 lbs		472 lbs
Spring Barley	Millet Dawn							515 lbs
Millet	SC Hyola 308					1000 lbs		1011 lbs
Spring Wheat	Millet Dawn						1080 lbs	
Oats	SW Wawawai						27 bu	
Mustard	SW Wawawai				35 bu		33 bu	
Millet	Buckwheat						1051 lbs	
Spring Barley	Mustard				757 lbs			

Post Harvest Residue Data Summary 1999

lbs/acre

Crop	Control I lbs./ac	Control II lbs./ac	Control III lbs./ac
Winter W	4193	4002	
Spring Wheat (Pene		2914	
Spring Wheat ()			
Spring Ba	2414		
Spring Barley ()			

98 Crop	99 Crop	3-Year Cooperators 1	3-Year Cooperators 2	3-Year Cooperators 3	3-Year Cooperators Wilke	4-Year Cooperators 1	4-Year Cooperators 2	4-Year Cooperators Wilke
Spring Barley	Spring Wheat	5821						
Spring Barley	Spring Wheat	2853						
Winter Wheat	Spring Canola			4744				
Spring Barley	Spring Canola							
Spring Canola	Spring Wheat		3896			7488		
Spring Wheat	Spring Barley		5941		4710	6142		5435
Spring Barley	Winter Wheat			6971				
Safflower	Spring Wheat			4732				6086
Spring Barley	Millet							6016
Spring Barley	Millet							5526
Millet	Canola					5720		7809
Spring Wheat	Millet							
Oats	Spring Wheat						5554	
Mustard	Spring Wheat				4118		6565	
Millet	Buckwheat						7246	
Spring Barley	Mustard				4897			

(shaded) no data available at time of report

Stand Counts 1999
Ave. plants / sq. ft.

		3-Year Cooperators				4-Year Cooperators		
98 Crop	99 Crop	1	2	3	Wilke	1	2	Wilke
Spring Barley	Spring Wheat	19						
Spring Barley	Spring Wheat	14						
Winter Wheat	Spring Canola	3		5				
Spring Barley	Spring Canola		4					
Spring Canola	Spring Wheat		10			13		
Spring Wheat	Spring Barley		8		16	14		18
Spring Barley	Winter Wheat			13				
Safflower	Spring Wheat			14				16
Spring Barley	Millet					7		5
Millet	Canola					6		4
Spring Wheat	Millet						8	
Oats	Spring Wheat						25	
Mustard	Spring Wheat				14		20	
Millet	Buckwheat						15	
Winter Wheat	Spring Wheat				19			
Winter Wheat	Spring Barley				11			
Winter Wheat	Mustard				4			
Spring Barley	Mustard				8			

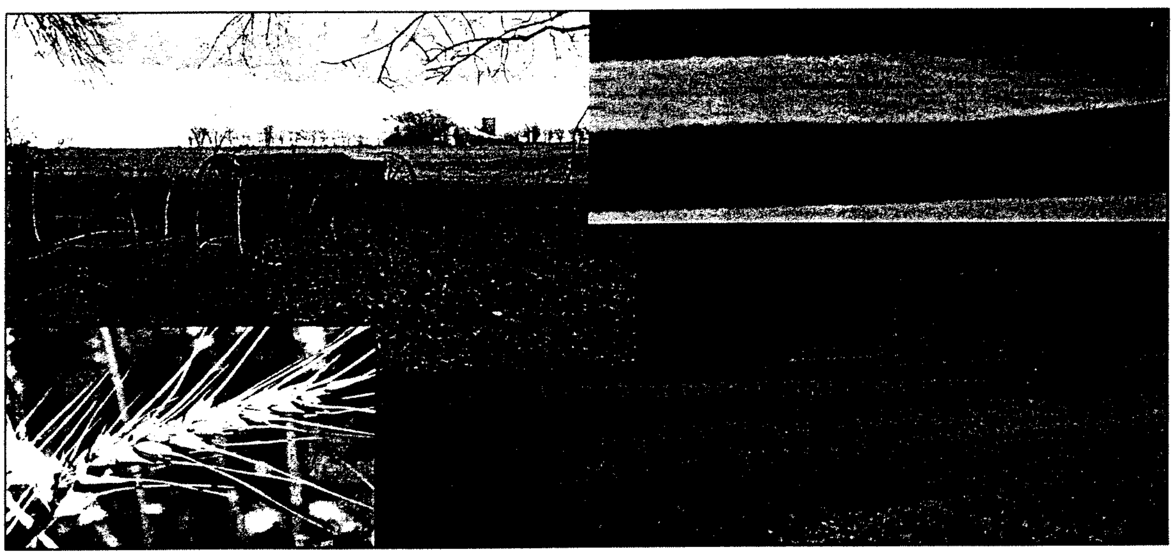
Yield Data Summary 1999

Yield / Acre

98 Crop	99 Crop	Control I Yield/ac	Control II Yield/ac	Control III Yield/ac
Fallow	Winter Wheat	58 bu	64 bu	
Winter Wheat	Spring Wheat		52 bu	
Spring Barley	Fallow			
Spring Wheat	Fallow			
Winter Wheat	Spring Barley	1.7 T		
	Spring Barley			

Wilke Project

2000 Progress Report



WSU Cooperative Extension

Ag Horizons Team

WASHINGTON STATE UNIVERSITY

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Introduction - Diana Roberts

The Wilke Project, centered at Davenport in Lincoln County, Washington, is a community driven, public-private venture for enhancing the environmental sustainability, social resiliency, and economic viability of agricultural communities of eastern Washington's upper Columbia Plateau. A group of farmers, wanting to improve their farm economics and soil conservation by using direct seeding (no-till) cropping systems, instigated the project in 1997. The Ag Horizons Team of Washington State University Cooperative Extension facilitated development of the Project with funding from the EPA, the WA Department of Ecology, and other sources. The Wilke Team that has developed the vision and holistic goal for the project comprises

Lincoln and Spokane County growers
WSU Cooperative Extension Ag Horizons Team
EPA – CPAI (Columbia Plateau Agricultural Initiative)
Lincoln Conservation District
The McGregor Company
McKay Seed
Monsanto
NRCS
WA Fish and Wildlife

> ***Currently the Wilke Project is focused on adapting, demonstrating, and researching direct seed systems with annual cropping and diverse crop rotations.***

Our goals for using these systems follow:

- Reduce soil erosion by wind and water

  With direct seeding systems the farmer uses a specialized grain drill to apply seed and fertilizer in one pass over the ground without prior tillage or cultivation. Crop residue remains on the soil surface after harvest and reduces soil erosion by wind and water. Thus direct seeding improves airshed quality for human health and improves watershed quality for fish and wildlife habitat.

- Improve the efficiency and net return of farming operations

  Direct seeding has the potential to enable producers cut input costs from tillage operations and to use their equipment more efficiently. Crop and marketing diversity provide risk spreading in a global economy

- Enhance soil quality

  Direct seeding systems with diverse, long-term crop rotations increase the levels and diversity of soil microbial and macrobial (earthworm) populations. Crop residue retained on the soil surface reduces water loss and increases water available for crop use. Plant photosynthesis sequesters (stores) carbon dioxide in the soil as organic matter carbon that is not re-oxidized by tillage. This reduces greenhouse gases in the atmosphere.

- Reduce stubble burning

  With diverse crop ecosystems that break disease cycles and allow different times for seeding and weed management, there is less need for stubble burning, which will reduce air pollution associated with field burning.

- Reduce agri-chemical and fossil fuel use

  Direct seeding, which eliminates up to five passes across a field in a crop rotation, immediately reduces farm use of petrochemical fuels. In the short term agri-chemical use may increase as the farmer uses herbicides instead of tillage to manage weeds. However, in the long term, diverse crop rotations that sanitize the soil should reduce agri-chemical use

We are taking a holistic approach to studying the agro-ecology of these cropping systems. We want to understand the complex yet fascinating interactions among various components of the systems and then use these factors to conserve the environment and optimize production efficiency. Components we are considering include crop type (grass or broadleaf, warm or cool season), crop species, cultivar, weeds, insects, diseases, residue amount and color, seeding and harvest dates, soil microbial relations, and market criteria.

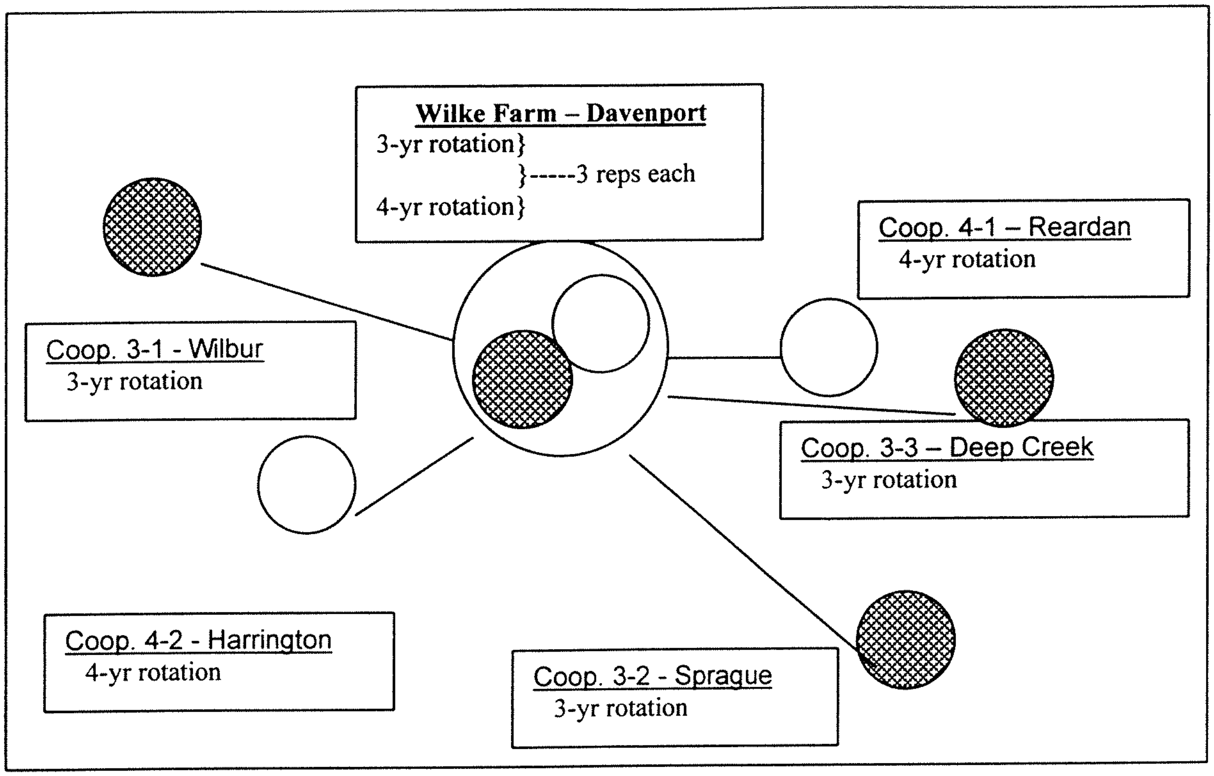
We also want to broaden our current work to address other goals of the Wilke Project:

- Extend the findings of the project to area producers: Due to previous failures in the 1980's, adoption of direct seeding in the PNW lags behind U.S. and world trends. There is a steep learning curve for growers to overcome in the transition. We need to provide growers with demonstrated answers to their questions and enable them to learn from the successes of their innovator peers.
- Expand the geographic scope of the Project: Interest in direct seeding has increased across the PNW and attendance at the annual PNW Direct Seeding Conference has been 800-1,100 the past three years. Challenges with the system vary with regional climates. We need to assist all growing regions in the transition.
- Develop long term, soil building rotations with perennial forages: Perennial grasses and legumes, included in direct seeding systems, have additional benefits for erosion controls, weed management, and soil building along with reduced agri-chemical usage.
- Include livestock finished for market on stubble and standing grain: Reducing the number of feedlots in Washington beef production would diminish their accompanying environmental issues of odor and waste management. We want to demonstrate the feasibility of finishing animals for market on standing grain crops and stubble.
- Enhance wildlife habitat: We want to improve the species diversity and natural pest control in farm ecosystems by establishing wildlife habitat along field borders and waterways.
- Strengthen rural communities: Sustainable rural communities and agribusinesses are essential to economic viability of the agricultural region. We want to strengthen local enterprise across the area by adding value to agricultural products through innovative marketing and processing.

Project Design

The 320-acre Wilke Farm at Davenport is the "hub" of the Project. Although the farm is WSU-owned, it is operated as a commercial farm by a local producer, Dale Dietrich. A major premise of the Project is to conduct experiments on a farm-size scale using farm-size equipment. Currently the Team is testing direct seeding systems with a three- and a four-year crop rotation, each replicated three times on the Wilke Farm. The rotations are under annual cropping so we are eliminating summer fallow and aiming to conserve soil and moisture by developing a mat of crop residue on the soil surface. The plots are 9 -10 acre strips, and surrounding farms in a conventional tillage rotation are used as checks. In addition, area growers on a 5 – 30 mile radius (Figure 1) replicate a rotation on their farms (25 acres per crop) so we gain a broad picture of the performance of the system across the region. There were six cooperators in 1998 and five in 1999 & 2000.

Figure 1. Diagrammatic representation of the 2000 Wilke Project layout



The rotations are as follows and are based on crop type, not on specific crops.

> ***Four-year rotation**: spring cereal – winter cereal – warm season grass – broadleaf*
> ***Three-year rotation**: winter cereal – spring cereal – broadleaf*

The four-year rotation is one that Dwayne Beck of SDSU has proven successful at Pierre, South Dakota. The sequence of crop types in this rotation has specific advantages for weed and residue management, seeding date, etc. However, while warm season grasses are highly beneficial to a no-till system, we do not have native warm season grasses in our area (though some weedy species have naturalized here). So the three-year rotation includes all cool season crops, making it a lower-risk rotation. Also, acknowledging the suitability of the PNW climate to producing cool season cereals (e.g. wheat and barley), we have maintained these crops as 50% of the four-year rotation and as 66% of the three-year rotation. Other crops we are trying in the region include canola, mustard, safflower, peas, garbanzos, buckwheat, flax, sunflower, millet, corn, and sudangrass. Ultimately the economics of a rotation will determine its success. Within the principles of the system the grower cooperators are free to choose individual crops they believe will suit their microclimate and market opportunities in a given year. Trying to combine real-life farming decisions with statistically sound experiments presents us with some unique challenges

Parameters
In 1997 one third of the Wilke Farm was direct-seeded and we established the current strips and cooperator plots in 1998. The Wilke Project finished its third season in 2000.

We collect agronomic and economic data from the Wilke Farm and from all the cooperators. Parameters include stand establishment, weeds, insects, diseases, yield residue, soil organic matter, water infiltration, and earthworm populations. Economics are of primary importance and ultimately will determine the success of the rotations. Due to the whole systems perspective of the Project, we do not draw conclusions from individual crop yields in a single year. Also, some crops have rotational benefits, such as weed control, that are not directly reflected in their individual financial return. We also obtain economic information from conventional cropping systems from two farms adjoining the Wilke Farm.

Agronomic Results and Summary – Darla Rugel and Diana Roberts

In 2000, we completed the third year of the 3-year and 4-year rotations. *These results are preliminary and are presented for observational purposes only. They are not statistical comparisons, nor do we intend to draw conclusions on crops or rotations at this point in the project.*

Stand Establishment

Table 5 includes the stand counts for each project site for 2000.

Weeds

Tables 1-3 show the total number of weeds by species taken within four 100 x 2 ft transects per field for the 3-year and 4-year rotations (we also collected this data in 1998, & 1999). Weed management is a major issue in transitioning to direct seeding. We expect to see changes in weed species and numbers during the transition to direct seeding. We choose our rotations and crops to try to optimize weed management.

Wild oat infestations have long been a problem along the whole Highway 2 corridor and on the Wilke Farm. Our data shows that this weed continues to be a major problem on the Wilke Farm. In 2000 there were up to six flushes of wild oats, that continued to germinate after the crops. We attempted to remove the immature oats from the millet strips by setting the combine header above the millet. Wild oats have not been such a problem on the cooperator farms. Cone catchfly appears to becoming more numerous within the 4-year rotation at the Wilke Farm.

Insects

All three years of the project 1998, 1999, and 2000 we monitored insect populations in the 3-year and 4-year rotations. We collected the both insect pests (aphids, leafhoppers, thrips) and beneficial insects (lady beetles, parasitic wasps, damsel bugs, soft winged flour beetles). The following comments are based on visual inspection of the data, not on statistical results.

1999 In the 3-year rotation, aphid populations in canola and mustard increased noticeably the first part of July and soon their numbers were great enough to become an economic concern. Two cooperators had treated their seed with *Gaucho*, but it was no longer effective by the time the aphids arrived. These cooperators sprayed the canola with *Capture* to help suppress aphid populations. The aphid population at the third cooperator's field became too severe and he did not spray, resulting in an aborted crop. By mid to late July, aphids began moving into the cereal grains and beneficial predators began slowly increasing in numbers.

In the 4-year rotation, aphids also increased noticeably in mid to late July, particularly in canola. Aphids were sprayed with *Capture* on all the canola fields in the 4-year rotation. At Cooperator Site 1 for the 4-year rotation, the 1999 spring wheat field that had been in canola in 1998 had nearly as many aphids as the 1999 canola field, suggesting a carryover. The other 4-year cooperator showed a similar trend on his field that had been in mustard in 1998. However, this did not appear to be the case at the Wilke farm. The barley fields (6, 9, 21) that were adjacent to the canola fields (5, 10, 20) showed a higher incidence of aphids and pest insects than wheat, or millet farther away. This suggests canola is attracting aphids and they spread to adjacent fields. By late July and early August, beneficial insects such as lady beetles, and parasitic wasp numbers began increasing.

Table 1. Occurance of weed species (no./800 ft^2) at beginning (Beg) and end (End) of 2000 crop season.

	Coop. 3-1						*Coop. 3-2*						*Coop. 3-3*					
	s. wheat		peas		s. wheat		s. wheat		s. barley		buckwheat		s. barley		flax		w. wheat	
weed name	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End
cone catchfly							36	0			0	2						
cudweed															0	2		
domestic mustard											0	4						
Jim Hill mustard							15	0	5	0	0	4	13	0				
kocia									1	0	0	1						
knotweed	0	1							8	0					0	3		
lambsquarters							82	0			0	5	31	0	0	17		
mayweed chamomile							24	0							0	7		
prickly lettuce	0	4	0	2	3	2	24	0	28	0	22	10	2	0	1	5		
panicle willow weed											0	1						
pineapple weed													2	0				
Russian thistle	0	290	9	101	1	101	253	0	330	150	11	50						
tansy mustard	1	0							2	0	6	1						
tumble pig weed									2	0	233	44						
cheat grass	23	640			156	0											154	176
goat grass															18	0		
volunteer canola							121	0	11	0	1	2	1	0	1	1		
volunteer cereals									3	3	9	0			7	0		
wild oats							2	104	0	4			0	3			300	162

Table 2. Occurance of weed species (no./800 ft^2) at beginning (Beg) and end (End) of 2000 crop season.

	Wilke 3-year					
	s. barley		peas		w. wheat	
weed name	Beg	End	Beg	End	Beg	End
cone catchfly	10	0	28			
Canadian thistle			1	0		
cudweed			4	0		
domestic mustard					0	1
Jim Hill mustard			3		1	0
knotweed			2			
lambsquarters			2		5	0
prickly lettuce	1		8		1	4
Russian thistle	15	0	16	0		
shepherds purse			1		154	0
tansy mustard					1	0
tumble pig weed			2		8	0
cheat grass			41		729	528
cereal rye					0	14
volunteer cereals			30			
volunteer peas	4	0				
wind grass					0	208
wild oats	0	220	776		60	56

Table 3. Occurance of weed species (no./800 ft^2) at beginning (Beg) and end (End) of 2000 crop season.

	Coop. 4-1								*Coop. 4-2*							
	s. barley		canola		millet		s. wheat		sunflowers		millet		s. wheat		s. wheat	
weed name	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End	Beg	End
cone catchfly	1	0			80	63	453	473								
corn gromwell													0	11		
Canadian thistle			2	0					0	1						
cudweed			0	4			5	1	3	2			3	0	2	0
domestic mustard			0	1												
henbit			300	0												
horseweed			10	3												
Jim Hill mustard			5	0			4	0					3	0	5	0
kocia					2	2										
knotweed									0	1					66	0
lambsquarters	9	0	234	300	3	3	1	0								
marestail									11	7	3	2	0	1		
mayweed chamomile							3	0								
prickly lettuce	23	1	12	11	1	1	0	2	13	0			11	0	8	0
Russian thistle	374	0	136	2	1	0			10	10			24	39	40	176
shepherds purse			0	2			8	2								
small seed false flax			5	0												
tumble pig weed	20	0	450	3	11	5	151	0								
white cap			0	2												
cheat grass	7	4	6	0	35	0	6	11							18	44
volunteer canola	60	0			19	18	335	0	61	0			0	1		
volunteer cereals	3	0	467	0												
volunteer millet									17	55						
wild oats	0	26			0	49	150	0								

	Wilke 4-year							
	w. wheat		s. wheat		millet		sunflower	
weed name	Beg	End	Beg	End	Beg	End	Beg	End
cone catchfly	3	0	243	2	26	29	495	225
Canadian thistle			24	10			1	0
cudweed			10	4	2	0		
domestic mustard					1	0		
Jim Hill mustard			1	0	3	0	34	0
kocia							1	0
knotweed					6	4	1	13
lambsquarters			87	0	5	8	22	24
mayweed chamomile			13	0				
morning glory	0	2					16	0
prickly lettuce	2	3	51	38	10	27	45	10
panicle willow weed					0	8		
Russian thistle			15	0	1	6	7	8
shepherds purse			239	0			1	0
small seed false flax					1	0		
tansy mustard			1	0				
tumble pig weed			33	0	183	89	243	10
volunteer sunflower					5	4		
cheat grass	199	157					21	0
cereal rye	0	1						
goat grass	0	7						
volunteer canola			549	0				
volunteer cereals			24	23	1135	?*	1157	?*
volunteer millet							62	0
wind grass	0	30						
wild oats	30	7	0	26		1135	?*	1280

*Note Numbers for (Beg) volunteer cereals can include wheat, barley, & wild oats.

Insects continued

2000 In the 3-year rotation, aphid populations increased noticeably in early to mid July, especially in Coop. 3-1 pea field. Beneficial insects particularly lady beetle populations increased and peaked in mid-July. Many lady beetles and larva were observed in Coop. 3-1 pea field on peas and Russian Thistle at this time. The beginning of August, the three cooperators farms showed beneficial insect populations greater than or equal to pest populations. However at the Wilke farm there remained less beneficial insects than pests. This may possible be due to spraying the pea fields for aphids with *Dimethalate-4* on July 18, 2000. It was observed that both pests and beneficial insects were killed at that time in those fields.

In the 4-year rotation, aphids also increased noticeably in early to mid July. At Coop. 4-1, the 2000 spring wheat field that had been in canola in 1999 had a greater aphid population than the 2000 canola field, suggesting a carry over. In the 2000 canola field, the aphid population dropped after being sprayed with *Capture* on July 7, 2000 but there was no decrease in the population in the 2000 spring wheat field (1999 canola) until late July as the crop began ripening. This was a similar to the scenario observed in 1999. The Wilke farm showed a similar trend in spring wheat fields (5, 10, 20) that had been in canola in 1999. However, this wasn't the case in 1999, rather a higher incidence of aphids in the fields adjacent to canola. The difference may be due to different adjacent crops in 2000(see Wilke map), which were more mature or possibly less palletable. Overall there were lower aphid populations observed in 2000 compared to 1999. In late July and early August, two of the 4-year cooperators and the Wilke Farm showed increased beneficial insect numbers (lady beetle, parasitic wasp, soft winged flower beetle) but not as great as the numbers observed in the 3-year rotation.

Disease

The only incidence of disease we observed in 2000 was take all in a winter wheat for Coop. 3-3. A portion of that field had been planted with safflower in 1998. This portion shows less disease than that which had been in continuous cereals.

Yields

Appendix A shows crop yields for 1998 and 1999.

In 1998, cereal yields from the direct seed fields were similar (statistical tests not made) to those cereals in nearby conventionally tilled fields. Yields of alternative crops were sub-optimal in some cases. We attribute this in part to the learning curve with growing these crops and partly to the weather.

July 1998 saw record high temperatures, which appeared to curtail flowering and seed set in alternative crops. Mustard plants at the Wilke Farm showed reduced branch development so the top of the plant appeared pointed instead of rounded. While mustard is reputedly more heat tolerant than canola, a field of canola about three miles away had three times the yield of the Wilke Farm mustard. The canola was an early maturing variety so possibly finished most of its flowering before the onset of heat. Also, soils at the Wilke Farm are typically shallow and hold less moisture than much of the surrounding land.

We attribute low safflower yields at the Wilke Farm to stand establishment problems, especially in chaff rows, and also to wild oat pressure. There are no post-emergent herbicides labeled for use in safflower, so although the crop has potential for the area we will not grow it currently on the Wilke Farm. Safflower in a cooperator's field did not yield well in a shallow, extremely clay soil. Other fields of safflower around the region have had superior yields.

Millet yields were low across all the fields in the Project. We chose a red proso millet from Colorado in order to get a price premium offered for red versus white seeded types in the birdseed market. However, this red variety did not have the yield potential of white types.

The cooperator who grew corn and Sudangrass baled these crops for hay prior to maturity to deal with a wild oat infestation. As he has a cattle operation he was able to use the forage – demonstrating the benefit of having an alternative market for the crops.

In 1999, cereal yields appeared similar in direct seeded and conventional fields. Once again we experienced "abnormal" weather conditions that contributed to low yields with alternative crops.

The spring of 1999 was cold and dry. Weeds emerged late, and on the Wilke Farm we had to use an additional post-seeding pre-emergent *Roundup* application. Late frosts damaged canola stands at several locations. Herbicides appeared to be less effective in the cold conditions. Continuing flushes of wild oats and Russian thistles reduced yields in one cooperator's fields. Wild oats also continued to germinate in the millet plots on the Wilke Farm, and we sprayed out some of the stand as a rescue treatment.

In 2000, cereal yields appeared similar in the direct seeded fields. Again the alternative crops had variable yields across the farms. Tables 4 and 5 show 2000 yields.

Several of the alternative crops were not harvested due to a variety of conditions. At Coop. 3-1, peas were not harvested due to shattering. At Coop. 3-2, buckwheat was not harvested due to a frost in early September causing the plants to lose seeds. At the Wilke farm, the millet fields were evaluated and discovered that there was more than likely not a significant enough stand to harvest for grain, and also not enough to harvest for forage. A portion of the sunflowers were harvested in early November, but an untimely early snow storm prevented harvesting the remainder.

We felt in the pea fields at the Wilke farm that there was significant enough insect damage to cause lower than expected yields.

Residue

We continued to measure post harvest residue in all fields in the Project and on control farms adjacent to the Wilke Farm. Results are shown in Tables 4 and 5 for 2000.

Ecological Results

We believe it is important to include observations about ecological shifts resulting from direct seeding system because there is an interconnection between farming practices, soil, and air quality. In 1999, we began looking at different field observations to provide evidence of any of theses ecological shifts or trends among the Wilke farm and cooperators' farms. Again, it is still to soon to draw a conclusion of how the rotations and system affect ecology. We know from previous research that, "tillage directly affects soil porosity and the placement of residues. Tillage collapses soil pores, changing the water holding, gas, and nutrient exchange capacities of the soil. Direct-seed systems reduce soil disturbance, increase organic matter, improve soil structure, buffer soil temperatures, and allow soil to catch and hold more water" (Clapperton, 1999).

Organic Matter

Organic matter is a key component in improving soil physical properties, and contributes to increased water holding capacity, increases available plant nutrients, and holds soil particles together. A couple of the keys to maintaining organic matter are through crop rotation and incorporation of crop residues (Kennedy 1999). Increased organic matter should reduce wind and water erosion by holding the soils together tighter. This will allow less available soil to be blown away by the wind, and water to be captured in the soil, rather than running off and robbing soils.

In 1998 we took baseline data for soil organic matter at 0 to 2", 2 to 4", and 4 to 12" depths. We will repeat these measurements after one cycle through each of the 3 year- and 4 year rotations.

Water infiltration

Organic matter is a key component in improving soil physical properties, and contributes to increased water holding capacity, increases available plant nutrients, and holds soil particles together. A couple of the keys to maintaining organic matter are through crop rotation and incorporation of crop residues (Kennedy 1999). Increased organic matter should reduce wind and water erosion by holding the soils together tighter. This will allow less available soil to be blown away by the wind, and water to be captured in the soil, rather than running off and robbing soils.

In 1998 we took baseline data for soil organic matter at 0 to 2", 2 to 4", and 4 to 12" depths. We will repeat these measurements after one cycle through each of the 3 year- and 4 year rotations.

We did not finish collection of the water infiltration measurements in the fall of 2000, due to an early snow. They will be taken over in the spring of 2001.

Table 4. 3-Year rotation stand counts, yield and residue for 2000.

3-year Cooperator	Field	2000 crop	stand counts no./ ft^2	yield lbs. (bu)	Ave. residue (lbs./ac)
3-1	1	s. wheat Alpowa	11	2280 (38)	4688
	2	peas Columbia	6	*not harvested	3603
	3	s. wheat Alpowa	8	1200 (20)	2177

3-year Cooperator	Field	2000 crop	stand counts no./ ft^2	yield lbs. (bu)	Ave. residue (lbs./ac)
3-2	1	s. wheat Alpowa	14	2568 (43)	2642
	2	s. barley Baronesse	9	2520 (42)	2402
	3	buckwheat Common	14	* not harvested	not collected

3-year Cooperator	Field	2000 crop	stand counts no./ ft^2	yield lbs. (bu)	Ave. residue (lbs./ac)
3-3	1	s. barley Harrington	11	2900	5845
	2	flax McDuff	27	960	7503
	3	w. wheat Eltan	13	2760 (46)	10,270

Cooperator	Field	2000 crop	stand counts no./ ft^2	yield lbs. (bu)	Ave. residue (lbs./ac)
Wilke 3 yr	1	s. barley Meltan	14	3000	4013
	12	s. barley Meltan	13	2800	
	15	s. barley Meltan	13	2600	
	Averages		*13*	*2800*	
	2	peas Toledo	5	754	4607
	13	peas Toledo	6	820	
	17	peas Toledo	8	800	
	Averages		*6*	*792*	
	3	w. wheat rely	18	3018 (50)	4767
	14	w. wheat rely	16	2898 (50)	
	16	w. wheat rely	16	3696 (62)	
	Averages		*17*	*3204 (54)*	

* Cooperator 3-2 00' Buckwheat froze out Sept. 10, 2000, not harvested

* Cooperator 3-1 00' fields 1 & 2 different from 98', 99' fields 1 & 2

Table 5. 4-Year rotation stand counts, yield, and residue for 2000.

4-year Cooperator	Field	crop (2000)	stand counts no./ft^2	yield lbs. (bu)	Ave. residue (lbs./ac)
4-1	1	s. barley Baronesse	22	4720	4740
	2	canola Intermtn. 105	11	1529	5547
	3	millet Dawn	6	850	4136
	4	s. wheat Penewawa	19	2940 (49)	2852

4-year Cooperator	Field	crop (2000)	stand counts no./ft^2	yield lbs. (bu)	Ave. residue (lbs./ac)
4-2	1	sunflowers Integra 626	1	1000	not collected fall 2000
	2	millet Dawn	9	500	not collected fall 2000
	3	s. wheat Alpowa	11	2700 (45)	5371
	4	s. wheat Alpowa	14	3180 (53)	6695

Cooperator	Field	crop (2000)	stand counts no./ft^2	yield lbs. (bu)	Ave. residue (lbs./ac)
Wilke 4 yr	4	w. wheat Madson	21	3348 (56)	
	11	w. wheat Madson	16	3240 (54)	
	18	w. wheat Madson	16	3162 (53)	
		Averages	*18*	*3250 (54)*	*5865*
	5	s. wheat Alpowa	13	3552 (59)	
	10	s. wheat Alpowa	17	2796 (47)	
	20	s. wheat Alpowa	16	2892 (48)	
		Averages	*15*	*3080 (51)*	*7642*
Wilke 4 year	6	millet Dawn	3	*not harvested	not collected fall 2000
	9	millet Dawn	3	*not harvested	
	21	millet Dawn	4	not harvested	
		Averages	*3*		
	7	sunflowers Big Foot	1	not harvested	not collected fall 2000
	8	sunflowers Big Foot	1	not harvested	
	19	sunflowers Big Foot	1	not harvested	
		Averages	*1*		

Erosion

We observed only slight water erosion at the Wilke farm in the spring of 2000 after several rains on frozen soils.

We did not observe wind erosion on any direct-seeded fields during field equipment operations. However, it was observed during tillage operations on three different conventional fields adjacent to cooperators' fields.

Earthworms

Earthworms can be tremendously beneficial in a direct-seeding system. In direct-seeding systems they become primary agents for recycling nutrients by ingesting and recycling soil organic matter. As the surface residue builds up in these systems it triggers growth in earthworm populations. However, populations decrease with soil disturbance, such as tillage, and with application of harmful chemicals (NRCS 1999). Canadian research has shown increases in earthworm populations after broadleaf crops in the rotation, such as canola, and mustard (Bezdicek, 1999).

We sampled for earthworms in the spring of 1999, but did not find any. However, we did find evidence of an earthworm channel in a 4-year cooperator's field that had been in the direct-seeding system for four years.

We did not sample for earthworms in the spring of 2000, but will sample again in the spring of 2001 at the Wilke Farm. If earthworms are found there, we will sample for them at Coop. 4-2's farm which has been in a direct seed system for five years.

Bulk Density

We sampled for bulk density in the spring of 1999 and will do so again in the spring of 2000 to determine if there are any changes.

Practical Observations

Following are some of the empirical observations we have made so far (a.k.a. *Mistakes we have made that you can learn from...*)

- The folks who say you should begin any direct seeding system with adequate chaff spreaders on your combine the season <u>before</u> you start direct seeding are absolutely right. Do this – it's cheaper than a new combine is. Chaff spreading reduces problems with seed germination and nutrient tie-up that may be associated with chaff rows.
- Getting good seed to soil contact is crucial to obtaining a good stand. Do the work in setting up your drill to achieve this. Seeding depth control and fertilizer placement are important criteria in drill choice.
- Watch nature (soil temperature and moisture) more than traditional dates to determine optimum seeding time. In 1999, the Wilke Farm was sprayed with *Roundup* prior to seeding in mid-April. However, this cold, dry spring very few weeds had emerged. A second, post-seeding pre-emergence *Roundup* application was necessary, as there was a sudden flush of weeds.
- If you are choosing a crop variety to obtain a premium in a niche market, especially an alternative crop with limited yield data from our area, be sure you know its yield potential. In 1998, red proso millet had a higher price than white proso millet on the bird seed market. It may have been possible to harvest it direct, without swathing. However, the yield potential was lower than for the white millet so the price premium was not advantageous.
- Make sure that a new crop has pesticides registered for weeds and other potential problems. Safflower in 1998 had one of the better returns of alternative crops on the Wilke Farm. However, lack of registered herbicides for grassy weed control makes it a risky rotational crop.
- Weather affects crops. This statement is too obvious. However, it underscores the value we have obtained from a hundred years of breeding cereals (wheat and barley) that are well adapted and stable in our Pacific Northwest environment. Alternative crops that have not benefited from this research investment are far more susceptible to weather fluctuations. Unseasonably hot weather in July of 1998 reduced yields of most of the alternative crops. Mustard at the Wilke Farm was affected more than an early maturing canola variety grown three miles away, even though mustard is supposedly less heat sensitive than canola. In 1999, frost after emergence damaged mustard and canola stands. Seedlings emerging through heavy residue were actually more susceptible to frost than in areas where the ground was clear of residue and heated up more quickly.

- If a crop has a rotational benefit in the system, don't cancel this out with other management decisions (e.g. losing patience). One of the Wilke crop rotations includes a warm season grass to allow a wider window in the spring for managing weeds prior to seeding. In 1998 we seeded millet on June 6, which allowed for three*Roundup* applications beforehand and greatly reduced wild oat populations. In 1999, we followed a recommendation from the Midwest and seeded the millet earlier (May 24). The spring was unusually cool, and although there were two *Roundup* applications, a lot of wild oats germinated after seeding. Consequently we missed a major rotational benefit of this crop. We seeded millet later this year

Economics - Jon Newkirk and Annie Smart

We are using a combination of economic engineering and enterprise analysis with an "expert" panel for the economic analysis of the Wilke Project. We engineer equipment costs using the direct seed equipment complement on each farm, and include annual use, age, purchase prices, useful life, diesel and lube costs, and repair experience for that equipment on the farms. While the plots are not whole-farm, we make the assumption that equipment would be used on the whole farm in order to establish annual use for each piece of equipment. We develop an enterprise budget for each cooperator by combining equipment costs with the following factors;
actual plot input costs per acre, labor per acre, and revenue per acre based on yield and prevailing market prices at harvest.

At the end of the rotation, we will develop a rotation budget based on actual input costs and yields for the entire rotation. At the end of the project, we will engineer an "assumed" rotation budget based on project experience and on focus group discussions with the cooperators. We will include the cooperators' judgement as to how they will proceed in the future, i.e. what will be their preferred equipment complement, rotations, inputs, etc. based on their experience during the Wilke Project.

We will present the information in a format that will enable area producers to make comparisons with their own operations. Tables 6 and 7 show 1998 and 1999 economic data from the Wilke Farm and cooperators, while Table 8 summarizes 1999 Wilke Farm economics for the 3-year and 4-year rotations.

2000 Table 9 summarizes the 2000 Wilke Farm Project economic data for the 3-year and 4-year rotations of the Wilke farm and cooperators. Table 10 shows the preliminary economic data from the Wilke farm. The average cost analysis for 2000 by crop is shown in Table 11.

Table 6. 1998 Wilke Project Rotation Economics.

Variable Input Costs	Average for 4 year Rotation	Average for 3 year Rotation
Seed	$ 10.49	$ 11.62
Fert	$ 23.39	$ 22.96
Herbicide	$ 7.89	$ 12.67
Insecticide		
Custom	$ 0.96	$ 1.54
Fuel/Lube	$ 2.71	$ 2.49
Total Variable Input Costs	$ 45.44	$ 51.28
*Labor	$ 4.33	$ 3.99
**Trucking	$ 4.88	$ 4.88
Equipment Costs (Tractor, drill, harrow, sprayer, combine)		
Replacement Cost	$ 17.66	$ 17.13
Repairs/Maintenance	$ 6.21	$ 6.55
Total Equip Costs	$ 23.87	$ 23.68
Taxes/Housing	$ 2.70	$ 2.99
Revenue/acre	$ 90.04	$ 101.12
Revenue Less variable input	$ 44.60	$ 49.84
Revenue less variable cost + labor + Equipment + Trucking (Harvest Hauling)	$ 8.82	$ 14.30

Table 7. 1999 Wilke Project Rotation Economics.

Variable Input Costs	Average for 4 year Rotation	Average for 3 year Rotation
Seed	$ 11.93	$ 11.31
Fert	$ 14.68	$ 19.82
Herbicide	$ 13.74	$ 18.11
Insecticide	$ 1.41	$ 0.31
Custom		$ 0.13
Fuel/Lube	$ 4.83	$ 3.66
Total Variable Input Costs	$ 46.59	$ 53.34
*Labor	$ 3.45	$ 2.63
**Trucking	$ 4.88	$ 4.88
Equipment Costs (Tractor, drill, harrow, sprayer, combine)		
Replacement Cost	$ 19.74	$ 15.95
Repairs/Maintenance	$ 7.51	$ 11.67
Total Equip Costs	$ 27.25	$ 27.62
Taxes and Housing	$ 3.02	$ 2.30
Revenue/acre	$ 83.99	$ 91.55
Revenue Less variable input	$ 37.40	$ 38.21
Revenue less variable cost + labor + Equipment + Trucking (Harvest Hauling)	-$1.20	$ 0.78

Table 8. 1999 Wilke Farm rotation economics

	Wilke Farm 3-year rotation			Wilke Farm 4-year rotation			
Variable Input and Labor Costs	Sp Wheat Calorwa	Sg Barley Meltan	Mustard Yellow	Spg Wht Wawawai	Canola Hyola	Sg Barley Baronesse	Millet Early bird/Dawn
Seed	$ 9.80	$ 9.80	$ 16.25	9.8	25	10.95	4
Fert	$ 14.88	$ 14.88	$ 8.52	14.88	18.29	14.88	8.52
Herbicide	$ 36.61	$ 36.61	$ 11.20	36.34	23.97	36.34	11.2
Insecticide							
Fuel/Lube	$ 6.46	$ 6.46	$ 5.77	6.46	6.46	6.46	5.77
Total Variable Cost:	$ 67.75	$ 67.75	$ 41.74	67.48	73.72	68.63	29.49
Labor	$ 3.91	$ 3.91	$ 3.56	3.91	3.91	3.91	3.56
*Trucking	$ 4.88	$ 4.88	$ 4.88	4.88	4.88	4.88	4.88
Equipment costs (Tractor, drill, harrow, sprayer, combine, fertilizer)							
Replacement Cost	$ 19.22	$ 19.22	$ 18.57	19.22	19.22	19.22	18.57
Repairs/Maintenance	$ 8.60	$ 8.60	$ 7.88	8.6	8.6	8.6	7.88
Total Equip Cost	$ 27.82	$ 27.82	$ 26.45	27.82	27.82	27.82	26.45
Tax/Housing	$ 3.04	$ 3.04	$ 2.97	$ 3.04	$ 3.04	$ 3.04	$ 2.97
Yield	34.5Bu	1.22 T	757#	29.8bu	1011#	1.21 T	486#
Price	$ 2.77	70/T	.1/#	2.77	.075/#	70/T	.055/#
Revenue/acre	$ 95.56	$ 85.40	$ 75.70	$ 82.55	$ 75.82	$ 84.70	$ 26.73
Revenue less Variable Cost	$ 27.81	$ 17.65	$ 33.96	$ 15.07	$ 2.10	$ 16.07	-$2.76
Revnue less Variable cost + Equipment + Trucking (Harvest Haul)	-11.84	-22.00	-3.90	-$24.58	-$37.55	-$23.58	-$40.62

List of Operations:	Sp Wheat Calorwa	Sg Barley Meltan	Mustard Yellow	Spg Wht Wawawai	Canola Hyola	Sg Barley Baronesse	Millet Early bird/Dawn
	Herb Spray	Herb Spray	Herb Spray	Herb Spray	Herb Spray	Herb Spray	Herb Spray
	Seed/Fert	Seed/Fert	Seed/Fert	Seed/Fert	Seed/Fert	Seed/Fert	Seed/Fert
	Herb Spray	Herb Spray	Herb Spray	Herb Spray	Herb Spray	Herb Spray	Herb Spray
	Herb Spray	Herb Spray	Harvest	Herb Spray	Herb Spray	Herb Spray	Harvest
	Harvest	Harvest	Trucking	Harvest	Harvest	Harvest	Trucking
	Trucking	Trucking		Trucking	Trucking	Trucking	

*Estimate developed from previous Wilke farm data

Table 9. 2000 Wilke Project Rotation Economics.

Average of 3 & 4 Year Rotations **2000**

PRELIMINARY

Variable Input Costs	Average for 4 year Rotation	Average for 3 Year Rotation
Seed	$ 10.77	$ 11.43
Fert	$ 16.43	$ 17.32
Herbicide	$ 16.68	$ 17.52
Insecticide	$ 1.39	$ 0.31
Custom	$ 3.23	$ 2.07
Fuel/Lube	$ 6.11	$ 3.41
Total Variable Input Costs	$ 54.09	$ 52.02
*Labor	$ 3.94	$ 2.66
**Trucking	$ 4.88	$ 4.88

Equipment Costs (Tractor, drill, harrow, sprayer,combine)	Average for 4 year Rotation	Average for 3 Year Rotation
Replacement Cost	$ 23.19	$ 14.90
Repairs/Maintenance	$ 4.46	$ 5.55
Total Equip Costs	$ 27.65	$ 20.44
Taxes/Housing	$ 3.24	$ 2.21
Revenue/acre	$ 130.15	$ 82.76
Revenue less variable cost+labor+ Equipment+Trucking (Harvest Haul)	$34.21	$9.66

**Trucking cost "engineered"/ estimated from area enterprise budgets.

1998 Revenue less variable cost+ labor+equipment + trucking (harvest haul)

4 year Rotation	**3 year Rotation**
$ 8.82	$ 14.30

The 2000 results are PRELIMINARY. Some yields have not been calculated, therefore, the revenue/acre, revenue less variable cost & revenue less variable cost + equipment are not the true value. They are based on the yields that were present in the locations, not including the missing yields.

Table 10. 2000 Wilke Farm rotation economics

Grower Name	**Wilke 3 year Rotation Wilke Farm**			**Wilke 4 Year Rotation Wilke Farm**			
Crop	**Spg Barley Meltan**	**Wtr Wheat Rely**	**Peas Toledo**	**Wtr Wheat Madson**	**Spg Wheat Alpowa**	**Millet Dawn**	**Sunflower Bigfoot**
Variable Input and Labor Costs							
Seed	$ 12.00	$ 10.00	$ 30.00	$ 10.00	$ 10.00	$ 7.00	$ 25.00
Fert	$ 17.86	$ 18.37	$ 8.38	$ 18.37	$ 17.86	$ 13.99	13.99
Herbicide	$ 44.88	$ 35.16	$ 18.22	$ 35.16	$ 44.88	$ 12.96	$ 30.46
Insecticide			$ 3.68				
Custom/Rent/Plane	$ 3.00	$ 14.00	$ 7.75	$ 14.00	$ 3.00	$ 3.00	$ 3.00
Fuel/Lube	$ 7.76	$ 1.42	$ 7.76	$ 1.42	$ 7.76	$ 7.76	$ 8.92
Total Variable Cost	$ 85.50	$ 78.95	$ 75.79	$ 78.95	$ 83.50	$ 44.71	$ 81.37
Labor	$ 4.21	$ 1.21	$ 4.21	$ 1.21	$ 4.21	$ 4.21	$ 5.16
*Trucking	$ 4.88	$ 4.88	$ 4.88	$ 4.88	$ 4.88	$ 4.88	$ 4.88
Equipment Costs (Tractor, drill, harrow, sprayer, combine, fertilizer)							
Replacement Cost	$ 25.19	$ 11.18	$ 25.19	$ 11.18	$ 25.19	$ 25.24	$ 33.57
Repairs /Maintenance	$ 7.49	$ 3.85	$ 7.49	$ 3.85	$ 7.49	$ 7.49	$ 10.21
Total Equip Cost	$ 32.68	$ 15.03	$ 32.68	$ 15.03	$ 32.68	$ 32.73	$ 43.78
Tax/Housing	$ 3.68	$ 1.82	$ 1.65	$ 1.82	$ 3.68	$ 1.65	$ 5.03
Yield	1.4T	53.40 bu	791.64#	$ 54.17	$ 51.34		
Price	$ 73.33	$ 2.84	$ 0.055	$ 2.84	$ 2.84		
Revenue/Acre	$ 102.66	$ 151.66	$ 43.54	$ 153.85	$ 145.81		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Revenue less variable cost + equipment + trucking(harvest haul)	-$28.29	$ 49.77	-$64.93	$ 51.96	$ 16.86		
	Fall Fert Spray Spray Seed/Fert Spray Harvest	Seed/Fert Spray Harvest	Fall Fert Spray Spray Spray Seed Spray Plane Harvest	Seed/Fert Spray Harvest	Fall Fert Spray Spray Seed/Fert Spray Harvest	Fall Fert Spray Spray Spray Seed/Fert Harvest	Fall Fert Spray Spray Spray Seed/Fert Spray Harvest

*Estimate developed from previous Wilke farm data

Table 11. Average Cost Analysis for 2000 by crop

$$$ Per Acre

Variable Input Costs	Spg Wheat	Range of Input Cost	Spg Barley	Range of Input Cost	Canola	Range of Input Cost	Millet	Range of Input Cost	Winter Wheat
Seed	$ 7.93	4.46-10.80	$ 9.80	7.44-12	$ 13.38		$ 4.09	2.40-7	$ 9.48
Fert	$ 21.60	16-23.97	$ 21.04	17.86-28.95	$ 20.02		$ 11.51	6.97-13.99	$ 19.84
Herbicide	$ 14.81	7.40-44.88	$ 22.46	8.45-44.88	$ 19.65		$ 9.42	5.28-12.96	$ 27.37
Insecticide					$ 8.46				
Custom	$ 0.43	$ 3.00	$ 0.75	$ 3.00	$ 15.75		$ 1.00	$ 3.00	$ 9.34
Fuel/Lube	$ 5.12	1.62-8.39	$ 4.55	3.92-4.45	$ 3.30		$ 5.51	3.07-7.76	$ 1.94
[illegible]	$ 47.75		$ 58.58		$ 80.56		$ 29.86		$ 68.60
*Labor	$ 3.24	1.82-4.37	$ 4.13	3.92-4.45	$ 4.45		$ 3.77	3.02-4.21	$ 2.00
**Trucking	$ 4.88		$ 4.88		$ 4.88		$ 4.88		$ 4.88

Equipment Costs (Tractor, drill, harrow, sprayer,combine)

	Spg Wheat	Range of Input Cost	Spg Barley	Range of Input Cost	Canola	Range of Input Cost	Millet	Range of Input Cost	Winter Wheat
Replacement Cost	$ 21.65	14.86-26.24	$ 19.71	15.24-25.19	$ 23.11		$ 22.33	18.79-25.24	$ 12.11
Repairs/Maintenance	$ 5.27	2.30-10.79	$ 6.61	4.09-9.66	$ 4.09		$ 4.38	1.65-7.49	$ 4.20
[illegible]	[illegible]		$ 26.39		[illegible]		[illegible]		[illegible]
Taxes/Housing	$ 3.24	2.61-3.76	$ 3.02	2.20-3.68	$ 3.35		$ 2.60	1.65-3.33	$ 1.91
Yield	42.7 bu	20-53 bu	1.62 T	1.26-2.36T	1528#		678#	500-850#	51.19 bu
Price	$ 2.84		73.33/T		$ 0.075				$ 2.84
Revenue/acre	$ 121.25		$ 118.80		$ 114.60				$ 145.39
Revenue less Variable cost+labor+ Equipment + Trucking (Harvest Haul)	$35.69		$21.88		-$5.53				$52.34

Table 11 continued. Average Cost Analysis for 2000 by crop

Variable Input Costs			Peas	Range of Input Cost	Sunflower	Range of Input Cost	Flax	Range of Input Cost	Buckwheat
Seed			$ 27.60	25.20-30.00	$ 25.00	$ 25.00	$ 3.97	8.43-10.00	$ 8.32
Fert			$ 8.19	8-8.38	$ 10.75	7.50-13.99	$ 23.00	18.37-22.78	$ 9.40
Herbicide			$ 8.19	3.50-18.22	$ 23.99	6.76-30.46	$ 23.01	11.79-35.16	$ 4.76
Insecticide			$ 1.84	$ 3.68	$ 4.05	$ 8.10			
Custom			$ 3.38	$ 7.75	$ 1.50	$ 3.00		$ 14.00	
Fuel/Lube			$ 5.33	1.05-7.76	$ 7.52	6.11-8.92	$ 3.20	1.42-2.96	$ 1.57
Total Variable Input Costs			$ 56.77	[illegible]	$ 67.42	[illegible]	$ 53.18	[illegible]	$ 24.05
*Labor			$ 2.54	.86-4.21	$ 4.19	3.21-5.16	$ 3.81	1.21-3.57	$ 0.83
**Trucking			$ 4.88		$ 4.88		$ 4.88		$ 4.88

Equipment Costs (Tractor, drill, harrow, sprayer,combine)

		Peas	Range of Input Cost	Sunflower	Range of Input Cost	Flax	Range of Input Cost	Buckwheat
Replacement Cost		$ 16.22	7.24-25.19	$ 26.59	19.60-33.57	$ 14.92	11.18-13.97	$ 3.03
Repairs/Maintenance		$ 4.09	.68-7.49	$ 6.04	1.86-10.24	$ 5.23	3.85-4.90	$ 1.28
Total Equip Costs		$ 26.40	[illegible]	$ 36.62	[illegible]	$ 20.15	[illegible]	$ 4.31
Taxes/Housing		$ 1.52	1.41-1.63	$ 3.98	2.93-5.03	$ 2.17	1.82-2.07	$ 0.52
Yield		791.64#		1000#		960#	46-54.17 bu	Not Harvested
Price		.055/#		$ 0.08		.083/#		
Revenue/acre		$ 43.54		$ 80.00		$ 79.68		
Revenue less Variable cost + labor + Equipment + Trucking (Harvest Haul)		$64.93		$ 5.07		$ 6.35		
		*only one grower harvested peas		*one grower sold sf				

Wilke Project Successes and Related Work – Diana Roberts

In 1998 the Ag Horizons Team also initiated an on-farm testing (OFT) program in Lincoln and Adams Counties, which is coordinated by Aaron Esser. This program, which enables growers to put out large-scale plots on their own farms to answer questions they have about farming practices, has proven most successful. Many of the questions they have pertain to the transition to direct seeding, and reflect the interest in the system that the Wilke Project has generated.

Another measure of community support for the Wilke Project was the successful funding of a Researcher and a Technician position for the Project through WSU's Safe Food Initiative to the Washington State legislature. Many area farmers and commodity groups lobbied for the initiative. We are currently in the process of hiring a researcher to fill this position.

The USDA Western Region SARE (Sustainable Agriculture Research and Education) program recently awarded the Ag Horizons Team a three-year grant of $177,000. This grant allows us to coordinate data collection on a related direct seeding project in Whitman County and to expand on-farm testing of direct seeding issues in the high rainfall region of Spokane County.

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WILKE FARM PLOT MAP FOR 1998, 1999, 2000

Boundary Road (west side, plots 1–17) · Grass Strip (east side) · Drainage Ditch (beside plots 19–21)

1. '98 w. wht. (Eltan-Rod)	'99 s. wht. (Calorwa)	'00 s. barley (Meltan)
2. '98 w. wht. (Eltan-Rod)	'99 s. barley (Meltan)	'00 peas (Toledo)
3. '98 w. wht. (Eltan-Rod)	'99 mustard (Yellow)	'00 w. wht. (Rely)
4. '98 safflower	'99 s. wht. (Wawawai)	'00 w. wht. (Madson)
5. '98 millet (CO Red)	'99 canola	'00 s. wht. (Alpowa)
6. '98 s. wht. (Alpowa)	'99 s. barley (Baronesse)	'00 millet (Dawn)
7. '98 s. barley (Meltan)	'99 millet (Early Bird)	'00 sunflowers (Big Foot, Confection)
8. '98 s. barley (Meltan)	'99 millet (Early Bird)	'00 sunflowers (Big Foot)
9. '98s wht. (Alpowa)	'99 s. barley (Barnesse)	'00 millet (Dawn)
10. '98 millet (CO Red)	'99 canola (Hyola 308)	'00 s. wht. (Alpowa)
11. '98 safflower	'99 s. wht. (Wawawai)	'00 w. wht. (Madson)
12. '98 mustard (Yellow)	'99 s. wht. (Calorwa)	'00 s. barley (Meltan)
13. '98 s. wht. (Alpowa)	'99 s. barley (Meltan)	'00 peas (Toledo)
14. '98 s. barley (Meltan)	'99 mustard	'00 w. wht. (Rely)
15. '98 mustard (Yellow)	'99 s. wht. (Calorwa)	'00 s. barley (Meltan)
16. '98 s. barley (Meltan)	'99 mustard	'00 w. wht (Rely)
17. '98 s. wht. (Alpowa)	'99 s. barley (Meltan)	'00 peas (Toledo)
18. '98 safflower	'99 s. wht. (Wawawai)	'00 w. wht. (Madson
19. '98 s. barley (Meltan)	'99 millet (Dawn)	'00 sunflowers (Big Foot)
20.'98 millet (CO Red)	'99 canola (Hyola 308)	'00 s. wht. (Alpowa)
21. '98 s wht. (Alpowa)	'99 s. barley (Baronesse)	'00 millet (Dawn)

3 year rotation (shaded plots)

4 year rotation (unshaded plots)

Appendix A Field Data History Cooperators & Wilke Farm

3-year Cooperators	Field	1998 crop	1998 stand no./ft²	1998 yield lbs.(bu)	1998 Ave. residue (lbs./ac)	1999 crop	1999 stand counts no./ft²	1999 yield lbs. (bu)	1999 Ave residue (lbs./ac)	2000 crop	2000 stand counts no./ft²	2000 yield lbs. (bu)	2000 Ave. residue (lbs./ac)
3-1	1	s. barley Baronesse		3000	6767	s. wheat Alpowa	19	2640	5821	s. wheat Alpowa	11	2280 (38)	4688
	2	s. barley Baronesse		2500	5025	s. wheat Alpowa	14	2700	2853	peas Columbia	6	not harvested	3603
	3	w. wheat Eltan		5400 (90)	8886	s. canola Hyola 308	3	0	not collected	s. wheat Alpowa	8	1200 (20)	2177

3-year Cooperators	Field	1998 crop	1998 stand no./ft²	1998 yield lbs.(bu)	1998 Ave. residue (lbs./ac)	1999 crop	1999 stand counts no./ft²	1999 yield lbs. (bu)	1999 Ave. residue (lbs./ac)	2000 crop	2000 stand counts no./ft²	2000 yield lbs. (bu)	2000 Ave. residue (lbs./ac)
3-2	1	s. barley Camelot		2760	8020	s. canola Reward	4	517	4520	s. wheat Alpowa	14	2568 (43)	2642
	2	s. canola		1001	4511	s. wheat Alpowa	10	1800 (30)	3896	s. barley Baronesse	9	2520 (42)	2402
	3	s. wheat Edwall		2040 (34)	4232	s. barley Baronesse	8	2400	5941	buckwheat Common	14	* not harvested	not collected

3-year Cooperators	Field	1998 crop	1998 stand no./ft²	1998 yield lbs.(bu)	1998 Ave. residue (lbs./ac)	1999 crop	1999 stand counts no./ft²	1999 yield lbs. (bu)	1999 Ave. residue (lbs./ac)	2000 crop	2000 stand counts no./ft²	2000 yield lbs.	2000 Ave. residue (lbs./ac)
3-3	1	w. wheat Madson		3650	8216	s. canola Hyola 308	5	1078	4744	s. barley Harrington	11	2900	5845
	2	s. barley Harrington		3000	5724	w. wheat Eltan	13	3240 (54)	6971	flax McDuff	27	960	7503
	3	safflower		100	4050	s. wheat Wawawai	14	2580 (43)	4732	w. wheat Eltan	13	2760 (46)	10,270

* Cooperator 3-2 00' Buckwheat froze out Sept. 10, 2000, not harvested
* Cooperator 3-1 00' fields 1 & 2 different from 98', 99' fields 1 & 2
■ No data available

Cooperator	Field	1998 crop	1998 stand no./ft²	1998 yield lbs.(bu)	1998 Ave. residue (lbs./ac)	1999 crop	1999 stand counts no./ ft²	1999 yield lbs.	1999 Ave. residue (lbs./ac)	2000 crop	2000 stand counts no./ ft²	2000 yield lbs.	2000 Ave. residue (lbs./ac)
Wilke 3 yr	1	w. wheat Eltan/Rod	no dat	no data	7954	s. wheat Calorwa	19	2286 (38)	4118	s. barley Meltan	14	3000 #	4013
	12	mustard Yellow	16	523	3063	s. wheat Calorwa	15	1950 (33)		s. barley Meltan	13	2800 #	
	15	mustard Yellow	17	503		s. wheat Calorwa	13	1980 (33)		s. barley Meltan	13	2600 #	
	Averages		*17*	*513*		*Averages*	*16*	*2072 (35)*		*Averages*	*13*	*2800 #*	
	2	w. wheat Eltan/Rod	no dat	no data	7954	s. barley Meltan	11	2480	4710	peas Toledo	5	754 #	4607
	13	s. wheat Alpowa	13	1920 (32)	4581	s. barley Meltan	17	2540		peas Toledo	6	820 #	
	17	s. wheat Alpowa	21	1842 (31)		s. barley Meltan	15	2300		peas Toledo	8	800 #	
	Averages		*17*	*1881 (32)*		*Averages*	*14*	2440		*Averages*	6	792 #	
	3	w. wheat Eltan/Rod	no data		7954	mustard Yellow	4	737	4897	w. wheat rely	18	3018 #	4767
	14	s. barley Meltan	14	2740	5040	mustard Yellow	7	737		w. wheat rely	16	2898 #	
	16	s. barley Meltan	15	2800		mustard Yellow	9	797		w. wheat rely	16	3696 #	
	Averages		*15*	*2770*		*Averages*	*7*	*757*		*Averages*	*17*	*3204 #*	

4-year Cooperators	Field	1998 crop	1998 stand no./ft²	1998 yield lbs.(bu)	1998 Ave. residue (lbs./ac)	1999 crop	1999 stand counts no./ ft^2	1999 yield lbs.	1999 Ave. residue (lbs./ac)	2000 crop	2000 stand counts no./ ft^2	2000 yield lbs.	2000 Ave. residue (lbs./ac)
4-1	1	s. canola Hyola 308		1570	9948	s. wheat Wawawai	13	2910 (49)	7488	s. barley Baronesse	22	4720 #	4740
	2	s. barley Baronesse		3880	4382	millet Early Bird	7	1050	5632	canola Intermtn. 10	11	1529 #	5547
	3	s. wheat Penawawa		2983 (50)	5975	s. barley Baronesse	14	3440	6142	millet Dawn	6	850 #	4136
	4	millet CO. Red		800	4963	s. canola Hyola 308	6	1000	5720	s. wheat Penewawa	19	2940 #	2852

4-year Cooperators	Field	1998 crop	1998 stand no./ft²	1998 yield lbs.(bu)	1998 Ave. residue (lbs./ac)	1999 crop	1999 stand counts no./ ft^2	1999 yield lbs.(bu)	1999 Ave. residue (lbs./ac)	2000 crop	2000 stand counts no./ ft^2	2000 yield lbs.	2000 Ave. residue (lbs./ac)
4-2	1	s. wheat Alpowa		1860 (31)	8430	millet Dawn	8	1080	7368	sunflowers Integra 626	1	1000 #	not collected fall 2000
	2	oats Celsia		1650	8539	s. wheat Wawawai	25	1650 (28)	5554	millet Dawn	9	500 #	not collected fall 2000
	3	mustard Yellow		550	6671	s. wheat Wawawai	20	1980 (33)	6565	s. wheat Alpowa	11	2700 #	5371
	4	millet CO. Red		400	6484	buckwheat	15	1051	7246	s. wheat Alpowa	14	3180 #	6695

Cooperator	Field	1998 crop	1998 stand no./ft²	1998 yield lbs.(bu)	1998 Ave. residue (lbs./ac)	1999 crop	1999 stand counts no./ft²	1999 yield lbs.(bu)	1999 Ave. residue (lbs./ac)	2000 crop	2000 stand counts no./ft²	2000 yield lbs.	2000 Ave. residue (lbs./ac)
Wilke 4 yr	4	safflower	6	681		s. wheat Wawawai	25	1572 (26)		w. wheat Madson	21	3348 #	
	11	safflower	4	553		s. wheat Wawawai	13	1506 (25)		w. wheat Madson	16	3240 #	
	18	safflower	6	546		s. wheat Wawawai	11	2274 (38)		w. wheat Madson	16	3162 #	
	Averages		*5*	*593*	*6181*	*Averages*	*16*	*1784 (30)*	*6086*	*Averages*	*18*	*3250 #*	*5865*
	5	millet CO. Red	18	591		s. canola Hyola 308	3	992		s. wheat Alpowa	13	3552 #	
	10	millet CO. Red	25	572		s. canola Hyola 308	3	912		s. wheat Alpowa	17	2796 #	
	20	millet CO. Red	17	625		s. canola Hyola 308	5	1130		s. wheat Alpowa	16	2892 #	
	Averages		*20*	*596.0*	*6466*	*Averages*	*4*	*1011*	*7809*	*Averages*	*15*	*3080 #*	*7642*
Wilke 4 year	6	s. wheat Alpowa	20	1902 (32)		s. barley Baronesse	17	2280		millet Dawn	3	*not harvested	not collected fall 2000
	9	s. wheat Alpowa	14	1806 (30)		s. barley Baronesse	18	2380		millet Dawn	3	*not harveste	
	21	s. wheat Alpowa	14	1890 (32)		s. barley Baronesse	20	2640		millet Dawn	4	*not harvested	
	Averages		*16*	*1866 (31)*	*5612*	*Averages*	*18*	*2433*	*5435*	*Averages*	*3*		
	7	s. barley Meltan	14	2940		millet Early Bird	3	474	6016	sunflowers Big Foot	1	*not harvested	not collected fall 2000
	8	s. barley Meltan	13	3080		millet Early Bird	5	469		sunflowers Big Foot	1	*not harveste	
	19	s. barley Meltan	19	2800		millet Dawn	7	515	5526	sunflowers Big Foot	1	*not harvested	
	Averages		*15*	*2940*	*4835*	*Averages*	*5*	*486*	*5771*	*Averages*	*1*		

Coop. 3--1 **3 year Rotation** **2000**

Crop	Spg Wheat		Spg Wheat		Peas
	Alpowa		Alpowa		Columbian
Variable Input and Labor Costs					
Seed	$ 4.96		$ 4.96		$ 25.20
Fert	$ 16.00		$ 16.00		$ 8.00
Herbicide	$ 9.50		$ 9.50		$ 3.50
Insecticide					
Fuel/lube	$ 1.62		$ 1.62		$ 1.05
Total Variable Cost	**$ 32.08**		**$ 32.08**		**$ 37.75**
Labor	$ 1.82		$ 1.82		$ 0.86
*Trucking	$ 4.88		$ 4.88		
Equipment Costs (Tractor, drill, harrow, sprayer, combine)					
Replacement Cost	$ 14.86		$ 14.86		$ 7.24
Repairs/Maintenance	$ 4.96		$ 4.96		$ 0.68
Total Equip Cost	$ 19.82		$ 19.82		$ 7.92
Tax/Housing	$ 2.76		$ 2.76		$ 1.41
Yield	38 bu		20 bu		Not Harvested
Price	$ 2.84		$ 2.84		
Revenue/Acre	$ 107.92		$ 56.80		
Revenue Less Variable cost	**$ 75.84**		**$ 24.72**		
Revenue less variable cost + equipment + trucking(harvest haul)	$ 46.56		-$4.56		

*Estimate developed from previous Wilke Farm Data

Spg Wheat	Spg Wheat	Peas
Harrow	Harrow	Harrow
Spray	Spray	Spray
Seed	Seed	Seed
Spray	Spray	
Harvest	Harvest	

Grower Name | **Coop.3--2** | **3 Year Rotation** | **2000**

Crop		Spg Wht Alpowa		Sp Barley Baronesse		Buckwheat		*Canola
VARIABLE INPUT AND LABOR COSTS								
Seed		$ 10.80		$ 10.98		$ 8.32		$ 22.75
Fert		$ 20.04		$ 18.93		$ 9.40		$ 21.60
Herbicide		$ 13.36		$ 13.10		$ 4.76		$ 15.77
Custom								$ 2.00
Fuel/Lube		$ 4.74		$ 3.23		$ 1.57		$ 4.99
Total Variable Costs		**$ 48.94**		**$ 46.24**		**$ 24.05**		**$ 67.11**
Labor		$ 1.62		$ 3.92		$ 0.83		$ 5.24
*Trucking		$ 4.88		$ 4.88		$ 4.88		$ 4.88
EQUIPMENT COSTS (Tractor, drill, harrow, spayer, fert applicator, combine)								
Replacement Cost		$ 17.77		$ 15.29		$ 3.03		$ 23.08
Repairs/Maintenance		$ 10.79		$ 9.66		$ 1.28		$ 14.18
Total Equipment Costs		$ 28.56		$ 24.95		$ 4.31		$ 37.26
Tax/Housing		$ 2.61		$ 2.84		$ 0.52		$ 4.30
Yield		42.5 bu		1.26 T		Not Harvested		870
Price		$ 2.84		$ 73.33				$ 0.075
Revenue/Acre		$ 120.70		$ 92.40				$ 65.25
[redacted]								
Revenue Less variable cost+ equipment+Trucking (harvest haul)		$ 34.09		$ 9.57				-$53.54

*Estimate developed from Wilke Farm Data

	Spg Wht		Sp Barley		Buckwheat		*Canola	
	Fall Fert	Spray	Harrow	Harvest	Harrow		Fall Fert	Harvest
	Harrow	Harvest	Spray		Spray		Harrow	
	Spray		Spray		Seed/Fert		Spray	
	Seed/Fert		Seed/Fert				Seed/fert	
	Spray		Spray				Spray	

Grower Name	**Coop.3--3**	**3 year Rotation**	**2000**
Crop	Winter Wheat Eltan	Spring Barley Harrington	Flax McDuff

Variable Input and Labor Costs

Seed	$ 8.43	$ 7.44	$ 3.97
Fert	$ 22.78	$ 28.95	$ 23.00
Herbicide	$ 11.79	$ 23.41	$ 23.01
Insecticide			
Fuel/Lube	$ 2.96	$ 3.88	$ 3.20
Custom			
Total Variable Cost	$ 45.96	$ 63.68	$ 53.18

Labor	$ 3.57	$ 3.92	$ 3.81

Trucking	$ 4.88	$ 4.88	$ 4.88

Equipment Costs (Tractor, drill, harrow, sprayer, combine, fertilizer)

Replacement Cost	$ 13.97	$ 15.24	$ 14.92
Repairs/Maintence	$ 4.90	$ 5.19	$ 5.23
Total Equipment Cost	$ 18.87	$ 20.43	$ 20.15

Tax/Housing	$ 2.07	$ 2.20	$ 2.17

Yield	46bu	1.46 T	960#
Price	$ 2.84	$ 73.33	.083/#
Revenue/Acre	$ 130.64	$ 107.07	$ 79.68

Revenue less Variable Cost	$ 84.68	$ 43.39	$ 26.50
Revenue less Variable cost + Equipment + Trucking (Harvest Haul)	$ 55.29	$ 11.96	$ 6.35

	Fall Spray Seed/Fert Spray Harvest	Harrow Spray Seed/Fert Spray Harvest	Spray Seed/Fert Spray Spray Harvest

4 Year Rotation **2000**

Grower Name **Coop. 4-1**
Crop

Variable Input & Labor Costs	Spg Wheat Pennewawa	Spg Barley Baroness	Canola	Millet
Seed	$ 8.40	$ 8.75	$ 13.38	$ 2.40
Fert	$ 18.49	$ 18.40	$ 20.02	$ 13.56
Herbicide	$ 11.57	$ 8.45	$ 19.65	$ 5.28
Insecticide			$ 8.46	
Custom (swath + Application)			$ 15.75	
Fuel/Lube	$ 3.30	$ 3.30	$ 3.30	$ 3.07
Total Variable Costs	**$ 41.76**	**$ 38.90**	**$ 80.56**	**$ 24.31**
Labor	$ 4.45	$ 4.45	$ 4.45	$ 4.06
*Trucking	$ 4.88	$ 4.88	$ 4.88	$ 4.88
Equipment costs (Tractor, Drill, Harrow, Sprayer, Combine)				
Replacement Cost	$ 23.11	$ 23.11	$ 23.11	$ 22.94
Repairs/Maintenance	$ 4.09	$ 4.09	$ 4.09	$ 3.99
Total Equip Costs	$ 27.20	$ 27.20	$ 27.20	$ 26.93
Tax/Housing	$ 3.35	$ 3.35	$ 3.35	$ 3.33
Yield	49 bu	2.36 T	1528#	850#
Price	$ 2.84	$ 73.33	$ 0.075	
Revenue/Acre	**$ 139.16**	**$ 173.06**	**$ 114.60**	
[redacted]				
Revenue less Variable cost + Equipment + trucking(harvest haul)	$ 57.52	$ 94.28	-$5.53	

*Estimate developed from Wilke farm Data

	Spg Wheat		Spg Barley		Canola		Millet
	Fall Fert	Spray	Harrow	Harvest	Harrow	Cust Spra	Harrow
	Harrow	Harvest	Spray		Spray	Swath	Spray
	Spray		Seed/Fert		Seed/Fert	Harvest	Seed/Fert
	Seed/Fert		Spray		Spray		Harvest

4 Year Rotation **2000**

Grower Name	**Coop. 4-2**				
Crop	Spg Wheat Alpowa	Spg Wheat Alpowa	Millet Dawn	Sunflower Integra	
Variable Input & Labor Costs					
Seed	$ 8.17	$ 8.17	$ 2.86	$ 25.00	
Fert	$ 23.97	$ 23.97	$ 6.97	$ 7.50	
Herbicide	$ 7.40	$ 7.40	$ 10.01	$ 6.76	
Insecticide				$ 8.10	
Custom					
Fuel/Lube	$ 8.39	$ 8.39	$ 5.70	$ 6.11	
Total Variable Costs	$ 47.93	$ 47.93	$ 25.54	$ 53.47	
Labor	$ 4.37	$ 4.37	$ 3.02	$ 3.21	
*Trucking	$ 4.88	$ 4.88	$ 4.88	$ 4.88	
Equipment costs (Tractor, Drill, Harrow, Sprayer, Combine)					
Replacement Cost	$ 26.24	$ 26.24	$ 18.79	$ 19.60	
Repairs/Maintenance	$ 2.30	$ 2.30	$ 1.65	$ 1.86	
Total Equip Costs	$ 28.54	$ 28.54	$ 20.44	$ 21.46	
Tax/Housing	$ 3.76	$ 3.76	$ 2.82	$ 2.93	
Yield	45 bu	53 bu	500#	1000#	
Price	$ 2.84	$ 2.84	$ 0.070	.08/lb	(includes .04/cleaning)
Revenue/Acre	$ 127.80	$ 150.52	$ 35.00	$ 80.00	
	[illegible]	$ 102.59	$ 4.46	[illegible]	
Revenue less Variable cost + Equipment + trucking(harvest haul)	$ 38.32	$ 61.04	-$26.70	$ 5.07	

*Estimate developed from Wilke farm Data

Spg Wheat		Spg Wheat		Millet		Sunflower	
Fall Fert	Fert	Fall Fert	Fert	Spray	Harvest	Spray	Spray
Spray	Harvest	Spray	Harvest	Fert		Fert	Harvest
Seed/Fert		Seed/Fert		Seed/Fert		Seed/Fert	
Spray		Spray		Spray		Spray	

Wilke Project - Selected Economic Data
2001 Crop Year
Presented at the Wilke Field Day, June 26, 2002

Collected and Prepared by Annie Smart and Jon Newkirk

Notes:

a. Unless otherwise noted, all costs and returns are on a per acre basis.
b. Input costs include, seed, fertilizer, chemicals, custom application, fuel/lube.
c. Equipment costs ranged from $21.67/acre to $31.01 per acre depending on the number of operations. All equipment costs include depreciation and interest on the full replacement value of the equipment.
d. Full costs, less land ownership or rental costs, include input costs, labor, equipment including harvest, taxes and housing. They do not include a return to management.

4 Year Rotations

1. SprWht, Corn, Sunflowers, SprWht

Positive returns over input costs for entire rotation.
Losses with corn drag down the entire rotation.
Net loss for full costs less land costs for entire rotation.

2. WtrWht, Canola, SprWht, Millet

Positive returns over input costs for entire rotation.
Millet unsold, value estimated based on market price.
Returns on wheat carries rotation into positive.
Canola has positive returns over input costs but has net loss of returns over full costs less land costs.
Net gain over full costs less land costs for entire rotation.

3. WtrWht, SprWht, Peas, Millet

Negative returns over input costs for full rotation.
Larger than average spray/herbicide bill cuts wheat margin.
Net loss for full costs less land costs for full rotation.

3 Year Rotations

1. Canola, SprWht, WtrWht

Positive returns over input costs for entire rotation.
Net gain of returns over full costs less land costs for full rotation.
Winter wheat and spring wheat have net gains over full costs less land costs.

2. WtrWht, SprBar, Peas

Positive returns over input costs for entire rotation.
Returns from Peas, 541 lbs./acre did not cover input costs.
Net loss of returns over full costs less land costs for entire rotation.

Selected Crops
Wilke Project - 2001 Crop Year

Winter Wheat

Winter Wheat Yields	3 or 4 Year Rotation	Variety	Input Costs	Returns over Input Costs
32.7	4	Madson/Eltan	$102.78	$ 5.37
46.5	3	Madson/Eltan	102.78	$50.64
34.7	4	Coda	$45.90	$68.61
42.0	3	Coda	$56.84	$79.66

Spring Wheat

Spring Wheat Yields	3 or 4 Year Rotation	Variety	Input Costs	Returns over Input Costs
31.26	4	926	53.17	48.12
32.0	4	Winsome	46.94	61.86
55.9	4	Penawawa	65.89	118.58
30.9	4	Alpowa	81.33	20.78
39.3	3	Winsome	78.56	56.89

Canola

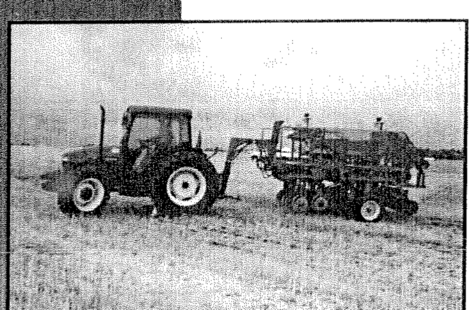
Canola Yields	3 or 4 Year Rotation	Variety	Input Costs	Returns over Input Costs
755#	3	IMC 105	50.79	20.93
925#	4	IMC 105	69.77	68.61

Sunflowers showed promise with positive returns over input costs and a very small net gain on returns over full costs less land costs. Gains in wheat yields after sunflowers makes this a crop worth further research.

Returns to millet, corn and peas did not cover input costs in 2001.

Wilke Farm

Wilke Project 4-Year Wrap up



AGRICULTURAL HORIZONS
contemporary issues for agriculture

COOPERATIVE EXTENSION
WASHINGTON STATE UNIVERSITY

1998-2002

Forward

Research results described in this report are based on findings of the 4-year Wilke Project conducted by the Agriculture Horizons Team of Washington State University in cooperation with local growers and private and public entities. Results described are not intended to be a recipe for transition to direct seeding, but as a description of results, and insights, and mistakes made along the way. Although our best efforts were made to make this report error free, the authors, Washington State University, and WSU Cooperative Extension shall not be held liable for content or implementation of results.

Introduction

Diana Roberts

Since Beulah Wilke deeded 320 acres of her land at Davenport, WA, to WSU for research in 1981, the Wilke Farm has been the site of several individual research efforts. *Currently the Wilke Project is focused on adapting and demonstrating direct seed cropping systems, with annual cropping and diverse rotations, for the intermediate rainfall area (12 to 17 inches annually) of eastern Washington.*

Project goals

Our goals for these systems are to enhance soil quality, reduce soil erosion by wind and water, and improve the efficiency and net return of farming operations. We are taking a holistic approach to studying the cropping systems. We want to understand the complex, interactions among various components of the biological system and then use these factors to optimize production efficiency. Factors we are considering include crop type (grass or broadleaf, warm or cool season), species, cultivar, weeds, insects, diseases, residue amount and color, seeding and harvest dates, soil microbial relations, and market criteria.

The Project is a public-private cooperative effort that is facilitated and led by the Ag Horizons team of WSU Cooperative Extension. Other goals for the Wilke Project include:

- Extend the findings of the project to area producers,
- Develop long term rotations with perennial forages,
- Include livestock that are finished for market on stubble and standing grain,
- Establish wildlife habitat on the Wilke Farm,
- Enhance community sustainability through commodity marketing and processing.

Some of the goals involving livestock and forages have not come to fruition because of the lack of funding for capital improvements to make this work possible.

Cooperators

The Wilke Team that developed this holistic goal includes the following collaborators and cooperators.

- ACIRDS (Annual Cropping, Intense Rotation, Direct Seed) group of Lincoln and Spokane County producers
- Ag Horizons team of WSU Cooperative Extension,
- Environmental Protection Agency Region10; Columbia Plateau Agricultural Initiative (CPAI)
- Lincoln Conservation District
- McKay Seed Company (Almira)
- Monsanto
- NRCS
- The McGregor Company
- Washington State Department of Fish and Wildlife
- Western Farm Services

The initiative for the Project came, however, from area growers. In 1997 a group of farmers, who were intent on transitioning their farms to direct seeding systems, asked the Ag Horizons team to support their efforts. These two groups approached the WSU-appointed committee that has responsibility for the Wilke Farm and obtained permission to convert it to direct seeding systems. As the Wilke Farm is not financially supported by WSU, the Project has to be self-sustaining through crop revenue and grants.

Objectives

Since 1998 we have evaluated two crop rotations on the Wilke Farm:

- A four-year rotation that includes two cool season cereals (spring and winter), one warm season grass, and one broadleaf crop.
- A three-year rotation including crops all adapted to the region; two cool season cereals (spring and winter) and one cool season broadleaf.

Project Design

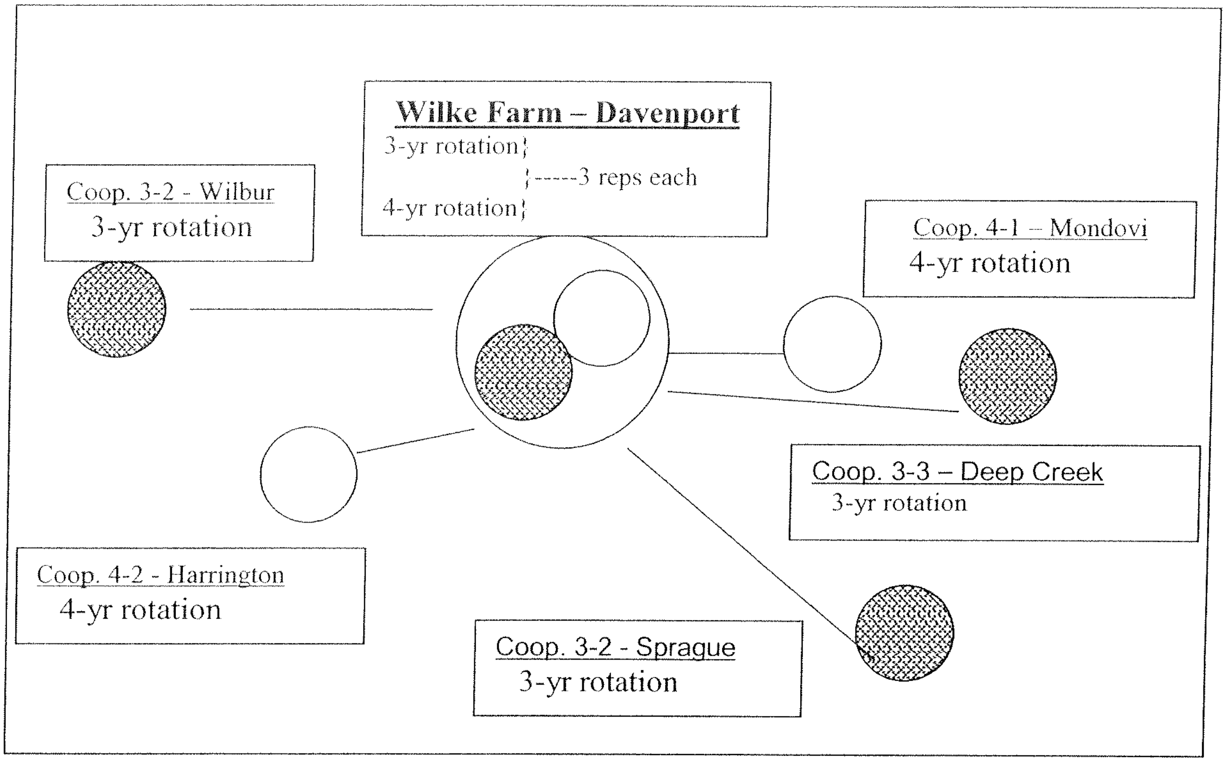
The main field design on the Wilke Farm includes two crop rotations grown in three replications of 8-10 acre strips. This design is a compromise between the research need for multiple replications and the growers' desire for large, wide, field scale plots that have short borders (i.e. square) to facilitate spraying and turning equipment. An important premise of the Project is to use farm-size equipment for all management operations. Growers like to see the performance of a crop or a management system over a range of landscape types. There is also room for some trials laid out in small plots.

In addition to the Wilke Farm, five area grower cooperators replicated a rotation (in 10 – 25 acre plots) on their farms. These plots provide information on the system's performance in a variety of microclimates. The cooperators were

- Tom Zwainz (Deep Creek)
- Hal Johnson (Mondovi)
- Karl Kupers (Harrington)
- Chris Laney (Sprague)
- Bill Dreger (Wilbur)

Parameters

We collected agronomic and financial data from the Wilke Farm and from all the cooperators. Parameters include yield, weeds, insects, diseases, residue, soil organic matter, water infiltration, and earthworm populations. Economics are of primary importance and ultimately will determine the success of the rotations. Due to the whole systems perspective of the Project, we have not drawn conclusions from individual crop yields in a single year. Also, some crops have rotational benefits, such as weed control, that are not directly reflected in their individual financial return. We also obtained economic information from conventional cropping systems from two farms adjoining the Wilke Farm.



Project Design

Two crop rotations were initiated in the spring of 1998 at the WSU Wilke Research and Extension Farm near Davenport, WA and on five cooperator's fields within a 30-mile radius of Davenport. A large portion of the Wilke farm was placed into replicated strips or plots representing a 3- or 4- year rotation. The 3-year rotation is an extension of the traditional winter wheat/spring grain/fallow rotation commonly practiced in Lincoln County. This rotation is winter wheat/spring cereal/broadleaf. The 4-year rotation was modeled after a rotation found to be successful in the Northern Great Plains. This rotation is spring wheat/winter wheat/warm season grass/broadleaf. As mentioned above, the plots at the Wilke farm were replicated three times to allow statistical analysis of the data. Cooperator plots were not replicated but multiple samples were collected in each field. Plot size ranged from 8 to 10 acres at Wilke to 10 to 100+ acres on cooperator farms. Each part of the rotation was present each year in all locations. Each cooperator chose either a 3- or 4-year rotation to establish on their farm while the Wilke farm had both rotations present. Within a rotation, cooperators were allowed to choose individual crops and varieties within a crop-type they believed would suit their farm operations and market opportunities. All field operations were performed using grower equipment.

Materials Methods

Sampling

Weed populations: From the field sampling position, a 100-ft transect was laid out at a forty-five degree angle to the crop rows. A marker, two feet in length was placed across the transect, one feet on either side. The number and species of each weed within this belt was tallied and recorded. Weed populations were evaluated once in the spring four weeks after planting and once prior to harvest. If a weed was unable to be identified in the field it was recorded as an unknown with a number and taken back to the WSU Lincoln County Extension Office and identified according to a standard taxonomic guide to the species level. Unidentified weeds were sent to the Extension Weed Specialist at WSU identification.

Soils: Soil samples were collected and analyzed by a commercial firm, Soiltest Farm Consultants, Inc. Three locations were sampled within each field to create a field composite. Samples were collected to a depth of six feet using a sub-soil probe. Samples from each foot were collected and labeled separately. Each sample was analyzed for the following parameters: Nitrate, and moisture (1-6 ft.), sulfates (1-3 ft.), ammonium nitrate, phosphorus, pH, and organic matter (0-1 ft.). At the end of a complete 3-year or 4-year rotation, the pH & organic matter were measured in the top 1-foot (0-2", 2-4", and 4-12"), to determine any changes over the period of the project.

Stand counts: A marker, three feet in length, was placed at three of the established random positions. The total number of crop plants on either side of the marker within the furrow was tallied and recorded for each field. These numbers were compared to standards for each crop.

Insect populations: Insect monitoring occurred four weeks after planting and every two weeks during the growing season. At five pre-determined random locations, five sweeps were taken at a forty-five degree angle to the crop rows using an insect sweep net. All insects collected in the net were placed in plastic bags, labeled, placed in a cooler. There they were frozen for later identification. A standard insect taxonomic guide was used in determining insects to the genus level. Unidentifiable insects were sent to WSU Insect Diagnostic Laboratory in Processor, WA. Following insect identification and verification the collected samples are disposed of.

Post harvest residue was evaluated in the fall at three locations in each field. A hoop 42 inches in diameter, (1 m^2) was placed on the ground over the residue. All residue within the hoop was clipped to the ground level, raking small pieces and old residue into a pile.

The collected residue was placed into a 5-gallon bucket with a sieve screen on the bottom to sieve out the unwanted soil. The residue was placed in a brown paper bag and weighed. The amount of residue in pounds per acre for each field plot was determined by multiplying the sample's net gram weight by 10. Post harvest residue was evaluated immediately following harvest prior to any fall seeding. Residue from late harvested crops can be collected and evaluated in the spring prior to any other tillage operations if weather conditions are not favorable immediately following harvest.

Water Infiltration was conducted at previously established random locations, within each of the 48 fields. The method is a standard developed by the USDA and can be found in the USDA Soil Quality Test Kit Guide (USDA 1999). The sampling area should be cleared of surface residue to the soil. A 6-inch diameter hard plastic ring was driven into the ground to a depth of 3 inches. The soil was firmed around the inside edges of the ring to prevent seepage and minimize disturbance to the rest of the soil surface inside the ring. The soil surface inside of the ring was lined with a sheet of plastic wrap to completely cover the soil and ring. The ring was filled with 444mL or (1") of distilled water. The plastic wrap was removed gently by pulling it out, and leaving the water in the ring. The time it takes for the 1" of water to infiltrate the soil until the surface is glistening was recorded and later calculated into inches per hour it takes for the soil to absorb the water.

Economics: A schedule of field operations performed for the year by each cooperator and at the Wilke Farm operator was collected by team members. Based on farm prices and schedule of field operations a set of Enterprise budgets was engineered for each operation estimating costs and returns. This is a commonly accepted practice in the Farm Management profession.

Earthworms: Sampling methods used were National Sampling Protocols developed by Jill Clapperton for Worm Watch (Clapperton, 1998). Modified hand sorting was used to determine the number and species diversity of earthworm. This method was used to study what species of earthworms live and work at different depths in the soil.

A location was chosen that occurred in a moist area, not on a dry hilltop. A plastic sheet was placed on ground near digging area to set containers on. If there was a lot of surface residue it was sorted through to find any surface or litter dwelling earthworms. If any worms were found they were placed in a container, counted, and recorded on a data sheet.

A shovel was used to dig down and scoop out the soil carefully and placed on a plastic sheet to the side. The modified hand-sort method was used to gently break up the soil clumps and search for worms or cocoons. If worms would have been found they would have been placed in containers, labeled, numbered, and later identified. Following identification all earthworms would be returned to the soil and soil surface residue returned back to place (Clapperton 1998). Sampling was repeated at six locations in eleven different fields at the Wilke farm and three locations in each field at Kupers farm.

Results and Summary

Dennis Tonks and Darla Rugel

In this summary, we are attempting to pool data from the four years of the project together and do statistical analysis where possible. Because of the robust nature of the project, some statistical analysis is not acceptable. In these cases averages and non-statistical data are presented and should be recognized as such. Because each cooperator only had one rotation on their farm no comparisons among farms can be made, only within a farm. In some cases, data from cooperator farms are pooled together. Where statistical inferences are made, fields or multiple sampling data were used as replications.

Weeds

Weed management is a major concern in transition to direct seeding and one of the most costly operations to consider. One of the theories behind intensive cropping is that with a mixture of winter and spring crops certain weed species are selected against and should be less of a problem. For example, winter annual grasses such as jointed goatgrass or downy brome (cheat grass) should be less of a problem in a spring cropping system. Likewise, wild oats should be less of an issue during winter cropping. Also adding warm season crops that can be planted later should aid in management of early germinating weeds and multiple weed flushes. In this project, we have observed at least a portion of this theory with some weed species decreasing in number while direct seeding or management used has favored other species.

On the Wilke farm, when comparing the 3- and 4-year rotations, wild oats were the only weed species that showed a difference between the two rotations. Averaged over years, wild oat populations were on average 8.9 and 0.25 plants/yd^2 in the 3- and 4-year rotations, respectively. This indicates that when other crops besides spring cereals are grown, wild oat populations can be reduced. Averaged over rotations, prickly lettuce, knotweed, and wild oat populations decreased over time, while cone catchfly and downy brome populations increased (table 1). Weeds, in particular wild oats, contributed to lower than expected yields for many crops and was one of the most expensive crop inputs (see section on economics for further details). The method of recording weed populations when dealing with a 'native' population may not accurately describe these populations because of the special variability of weeds in a field. Some sampling points or field areas had high weed populations while others had very few weeds, thus possibly skewing the results. One such case is the observation of Russian thistle moving into the plot area but not in the area sampled.

Cooperator fields have also had changes in weed populations. Downy brome populations generally decreased but populations of kochia, prickly lettuce, Russian thistle increased in several cases. Other shifts in weed populations based on observations are a reduction in field bindweed (morning glory), which does well in tilled systems. Based on ours and other grower observations, other perennial weeds such as Canada thistle, dalmation toadflax, and mullein have increased in area.

Weed management is critical in crop selection also. Growing a crop with limited weed control options needs to be considered. If weeds are allowed to grow and not controlled because there are no registered herbicides, not only can yield be reduced because of competition but it can cause a setback in reducing weed populations. See also the section at the end of the agronomic results that describe some of the practical observations not shown in the data.

Table 1. Change in cone catchfly, prickly lettuce Shepard's purse, knotweed, wild oat, and downy brome populations over time in direct seeded rotations at the WSU Wilke farm.

Year	Cone catchfly	Prickly lettuce	Shepard's purse	Knot weed	Wild oat	Downy brome
	------------	------------	plants/yd^2	------------	------------	------------
1999	0.6	9.2	0.8	2.0	136.9	0.8
2000	8.4	3.0	4.8	0.4	41.0	9.0
2001	20.9	0.9	0.7	0.1	13.0	11.7
LSD (0.05)	4.0	3.5	3.5	0.5	16.0	7.8

Insects

All four years of the project we monitored insect populations in the 3-year and 4-year rotations. We collected both pest (aphids, leafhoppers, thrips) and beneficial insects (lady beetles, parasitic wasps, damsel bugs, soft winged flower beetles). The following comments are based on visual inspection of the data, not on statistical results.

Insect populations varied from year to year of the study period but have shown a general trend of pest insects peaking in early July and out numbering beneficial predators that increased soon afterwards.

In small grain fields that had been in canola the previous year demonstrated higher aphid populations than fields of small grains following small grains. This was noted in two out of the four years of the study, at two different cooperators, suggesting a carry over in populations.

Disease

The only incidence of disease we observed was take-all in 2000 in a winter wheat field following safflower planted in 1998. Otherwise, fields have been disease free.

Crop Yield and Residue

First an explanation about the sequence of crops in each rotation and how these are reported in the yield tables and follow the sequence of the rotation in the field. For details about crop sequence, crop varieties and study layout, a detailed map of the Wilke farm is included in back of this report. In the 3-year rotation, the first small grain in the rotation was designated as a spring or winter cereal, the choice made by individual cooperators. The second small grain was to be a spring cereal followed by a broadleaf crop. In the 4-year rotation, the first small grain crop was a spring cereal, while the second cereal in the rotation was to be a winter or spring cereal followed by a warm season grass, then a broadleaf crop.

Crop yield is generally reported as pounds of crops produced per acre (lb/a) in order to average and add together cereals and broadleaf crops for comparison of yields between rotations. Crop yield varied from year to year averaged over rotations and crops. In most cases, crop yield was greatest in 2000 while lowest average yield was in 2001, due to dry growing conditions (table 2). Averaged over rotations and crops, crop yield ranged from 1441 to 1638 lbs/a at the Wilke farm. Cooperator crop yield ranged from 1115 to 2544 lb/a during the study period. During the same period, the conventional cooperator yield was 2311 lb/a, averaged over years, crops and fallow. On the Wilke farm, the 3-year rotation produced 22% more crop than the 4-year rotation, averaged over crops (table 2). This is mainly due to the poor performance of the warm season grass (proso millet) in the 4-year rotation (table 3).

In 2000, winter wheat replaced spring wheat following the broadleaf crop in the 3-year rotation. While in the 4-year rotation winter wheat was planted as the second small grain in the rotation. During the last two years of the study, winter wheat out-produced spring wheat by an average of 18 bu/a (data not shown). During this period, winter wheat yield ranged from 2580 to 3660 lbs/a (43 to 61 bu/a) while spring wheat yielded from 1800 to 3060 lb/a (30 to 51 bu/a). In the 3-year rotation, barley followed wheat in the rotation and averaged 2489 lb/a (1.25 T/a) and ranged from 1500 to 3000 lb/a (0.75 T/a to 1.5 T/a) (tables 4 and 5).

Alternative crops grown in the project included yellow mustard, canola, safflower, sunflowers, peas, buckwheat, flax for broadleaf crops and proso millet and corn for warm season grasses. One cooperator grew corn and sudangrass that was harvested for forage. These crops were grown with varying degrees of success. Some of the alternative crops were sensitive to frost, heat, and generally not well adapted to the climate. For example, sunflowers or corn may require too long of a growing season or require more summer rainfall than is customary in the area. More work is required to select varieties that may be suitable for the climate. Cool season broadleaf crops may be better suited to the area.

A detailed discussion of the effect of yield on profitability is discussed in the section on economics.

Crop residue ranged from 5400 to 7635 lb/a during the study period. On the Wilke farm, the greatest amount of residue was produced during the year with the lowest yields (table 2). While the 3-year rotation produced greatest yields overall, the 4-year rotation produced slightly greater residue levels (table 3). This is likely due to inclusion of proso millet in the rotation that produced residue amounts nearly equal to small grains and may decay at a slower rate. Overall, residue levels did not increase over the study period indicating residue is breaking down at a rate nearly equal to what is being produced.

Because of the poor yield of the warm season grass, it has been eliminated from the 4-year rotation on the Wilke farm and replaced with barley in an attempt to make the rotation more profitable. We are also attempting to make the rotations more rigid, planting the same broadleaf crop and wheat varieties in both rotations to allow streamlining of operations and to allow more accurate analysis of the data.

Table 2. Average crop yield and residue levels for the Wilke Farm from 1998 to 2001 averaged over rotations and crops.

Year	Yield	Residue
	lb/a	lb/a
1998	1638	5400
1999	1569	5401
2000	2069	5186
2001	1441	7635
LSD (0.05)	84	663

Table 3. Wilke farm crop yield and residue averaged over crops and years.

Rotation	Yield	Crop Residue
	lb/a	lb/a
3-year	1926	5787
4-year	1507	5902
	*[a]	*

[a]Asterisk indicates significant F-test at the 0.05 level of probability.

Table 4. Crop type yield in Wilke 3- and 4-year rotations averaged over years[a].

	Yield		Crop residue	
Crop type	3-year	4-year	3-year	4-year
	--------lb/a--------		--------lb/a--------	
Sm. grain 1	2567	2143	6394	5942
Sm. grain 2	2489	2656	6150	6319
Warm season grass	--	403	--	5816
Broadleaf	663	824	4760	5510
LSD (0.05)	174	134	1195	834

[a]Crop type within a rotation - 3-year: Sm. grain, 1 (winter or spring cereal); Sm. grain2 (spring cereal); 4-year: Sm. grain 1, (spring cereal); Sm. grain 2, (winter or spring cereal).

Table 5. Wilke Project cooperator yields and crop residues averaged over years.

Cooperator (rotation)	Crop type	Yield	Crop Residue
		lb/a	lb/a
3-1 (3 yr)	Sm grain	2977	8677
	Sm grain	2812	5858
	Broadleaf	455	5225
	LSD	1769	NS
3-2 (3 yr)	Sm grain	1977	4303
	Sm grain	2370	5489
	Broadleaf	759	4516
	LSD	121	NS
4-1 (4 yr)	Sm grain	3048	5588
	Sm grain	3535	5669
	Warm season grass	875	4910
	Broadleaf	906	7413
	LSD	1010	NS
4-2 (4 yr)	Sm grain	2183	7244
	Sm grain	2018	7481
	Warm season grass	620	6580
	Broadleaf	865	6412
	LSD	610	NS

[a]Crop type within a rotation: 3-year Sm. grain 1 (winter or spring cereal), Sm grain 2 (spring cereal): 4-year Sm. grain 1 (spring cereal), Sm grain 2 (winter or spring cereal)

Soil Quality

Organic matter Organic matter is a key component in improving soil physical properties, and contributes to increased water holding capacity, increases available plant nutrients, and holds soil particles together. A couple of the keys to maintaining organic matter are through crop rotation and incorporation of crop residues (Kennedy 1999). Increased organic matter should reduce wind and water erosion by holding the soils together. This will allow less available soil to be blown away by the wind, and water to be captured in the soil, rather than running off soils.

In 1998 we took baseline data for soil organic matter at 0 to 2", 2 to 4", and 4 to 12" depths and in the spring of 2002 these measurements were repeated in approximately the same locations in each field. There was a trend for increased soil organic matter (carbon) in the top foot of soil especially in the to 0 - 2 inch range (Tables 6 and 7). The only statistical difference in organic matter was at the 0 – 2 inch range on the Wilke farm although in some cases, cooperator organic matter increased by as much as 1%. Greater depths also showed a trend for increase but these were more moderate. The conventional cooperators fields also showed a trend for increased organic matter probably due to adopted conservation practices.

Table 6. Soil pH and organic carbon in 1998 and 2002 in the top foot of soil after four years of direct seeding on the Wilke farm, averaged over 3- and 4-year rotations.

	Organic carbon		pH	
Soil depth	1998	2002	1998	2002
(in)	--------(%)-------			
0 – 2	3.1	3.9*	6.0	6.1
2 – 4	2.8	2.9	5.7	5.7
4 – 12	2.1	2.1	6.3	6.1

Pairs within a depth range followed by an asterisk are significantly different at the 5% level of probability.

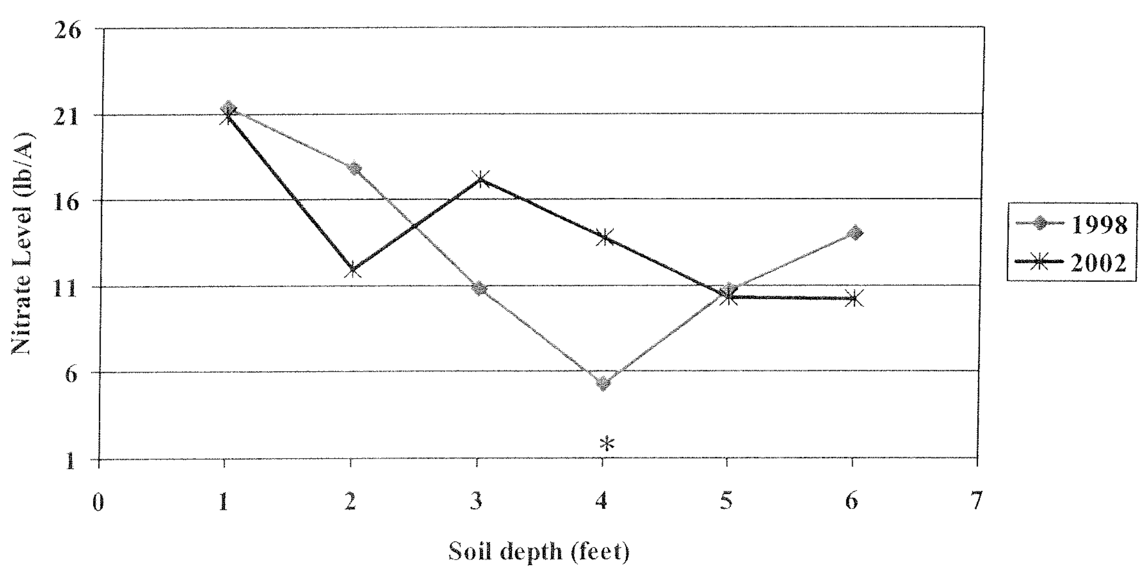
Table 7. Comparison of Wilke cooperator soil organic matter content and pH measured at 0-2, 2-4, and 4-12 inches in 1998 and in 2002.

		Organic carbon			pH		
Cooperator	year	0-2	2-4	4-12	0-2	2-4	4-12
		(depth in inches)					
		-------%-------					
Conv. 1	1998	2.6	2.5	1.9	6.1	5.8	6.2
	2002	2.9	2.7	2.2	6.3	5.9	5.9
Conv. 2	1998	3.1	2.5	1.9	5.7	5.4	6.0
	2002	3.8	3.1	2.3	6.2	5.3	5.9
3-year	1998	3.3	3.1	2.1	6.1	5.7	6.4
	2002	4.3	3.3	2.3	6.2	5.4	6.0
4-year 1	1998	3.7	3.2	2.4	6.1	5.7	6.6
	2002	4.4	3.8	2.7	6.5	5.9	6.4
4-year 2	1998	3.0	2.3	1.9	5.4	5.3	6.0
	2002	3.9	2.3	1.7	6.2	5.5	6.1

Soil pH The acidification of direct seeded soils has been a concern in the higher rainfall areas of the Palouse. Data collected in 1998 and again in 2002 indicate that soil pH is not increasing under direct seeded systems (tables 6 and 7).

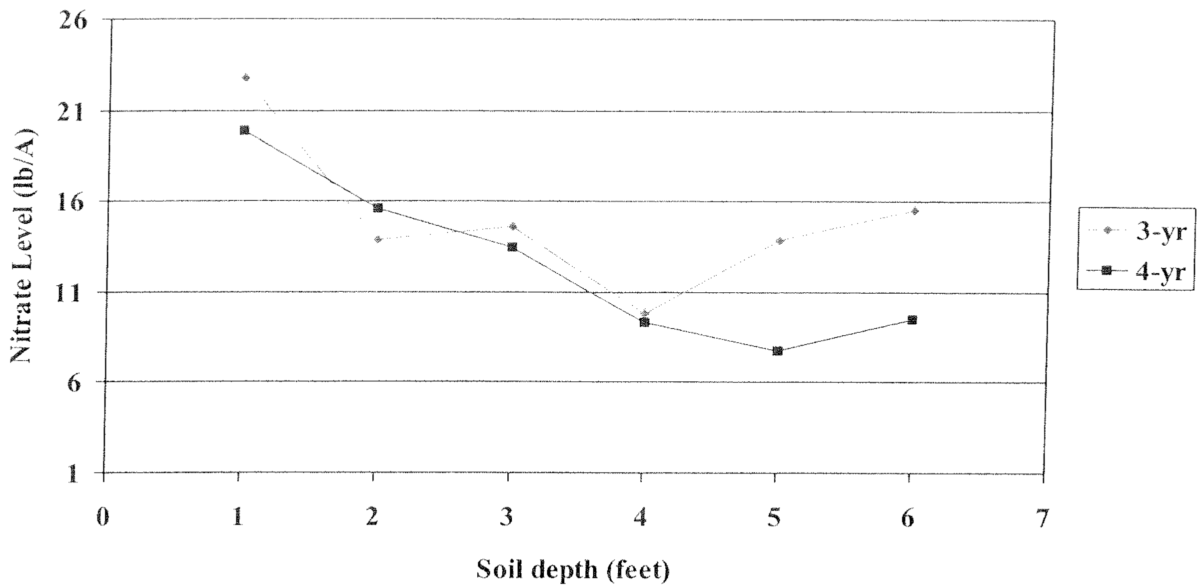
Nitrate movement Baseline information for nitrate levels were obtained in 1998 to monitor the movement of nitrogen fertilizer in the soil in a more intensively cropped system. Results indicate that there was a slight increase in nitrate levels in the 3 and 4-foot levels in 2002 compared to 1998 (figure 1). This indicates that care needs to be taken to ensure that nitrate movement is minimized in the profile. There was no statistical difference between nitrate levels in the soil profile, although there is a trend for less nitrate in the 5th and 6th foot compared to the 3-year rotation possibly due to growing deep-rooted crops in the rotation like sunflowers (figure 2). Cooperator fields did not show a significant increase in nitrate levels in the soil profile. In fact two farms showed a decrease in nitrate levels over all (data not shown).

Figure 1. Soil nitrate levels in 1998 and 2002 for direct seeded fields on the Wilke farm averaged over 3- and 4-year crop rotations.



*Indicates statistical differnce in means within a depth at the 0.05 level of probability

Figure 2. Nitrate concentration in the soil profile comparing 3- and 4-year rotations on the Wilke farm in spring 2002.



Means within a depth are not statistically different at the 0.05 level of probability

Water infiltration Water infiltration is the rate at which water enters the soil. It is dependent on soil type, soil structure, or amount of aggregation, and water content (USDA 1999). Tillage affects water infiltration rate by temporally loosening the soil, causing rapid water infiltration. However, tillage also disrupts aggregation and soil structure, creating compaction. Soils that are not disturbed will enhance water infiltration because of larger pore size and soil aggregation. Root and earthworm channels can create continuous pores into the profile. Compacted or disrupted soils have less pore space and resulting in lower infiltration rates. The infiltration rates in inches per hour that have historically been used in soil survey classes are as follows: 0.6 to 2 inches/hour (moderate), 2 to 6 inches/hour (moderately rapid), and 6 to 20 inches/hour (rapid).

Infiltration rates have increased from 1.1 to 6.3 up to 3.6 to 20.2 inches per hour from 2000 to 2001, respectively. Infiltration rates in the cooperator fields have also increased from 3.0 to 4.8 to 3.2 to 11.4 inches per hour from 2000 to 2001, respectively. This dramatic increase helps avoid runoff from rainfall and rapid snowmelt.

- Another cooperator, who had not direct seeded as long, applied 40-50 lb N in the fall of 1999. He was encouraged to seed it evenly distributed in the top 2-3 feet in the spring of 2000.
- A third cooperator used all Solution 32 in the spring of 2000 – and his malt barley was too high in protein.

Crops. Rotation, diversity, and crop selection continue to be an issue.

- The warm season grass is questionable in the 4-year rotation, but the group decided to grow millet again in 2001 to facilitate proper statistical analysis of the rotation.
- With consistent direct seeding, one grower cooperator has noticed that crops can germinate quicker and from greater depths than normally recommended for that seed size.
- Seed can emerge quite easily through the duff layer, so small seeds can still emerge when placed deeper to make good contact with soil and moisture.
    - There are some pros and cons to this phenomenon and it takes close observation to use it to one's advantage. (1) For example, if you are planning to apply Roundup post-seeding and prior to crop emergence, you may have a shorter spray window than anticipated. (2) frost sensitive crops that germinate quicker than normal may need to be seeded later so that the danger of frost is less as they emerge. Warm season broadleaves, such as safflower and buckwheat are very frost tolerant until they start to flower.
- If you are choosing a crop variety to obtain a premium in a niche market, especially an alternative crop with limited yield data from our area, be sure you know its yield potential. In 1998, red proso millet had a higher price than white proso millet on the birdseed market. It may have been possible to harvest it direct, without swathing. However, the yield potential was lower than for the white millet so the price premium was not advantageous.
- Weather affects crops. This statement is too obvious. However, it underscores the value we have obtained from a hundred years of breeding cereals (wheat and barley) that are well adapted and stable in our Pacific Northwest environment. Alternative crops that have not benefited from this research investment are far more susceptible to weather fluctuations. Unseasonably hot weather in July of 1998 reduced yields of most of the alternative crops. Mustard at the Wilke Farm was affected more than an early maturing canola variety grown three miles away, even though mustard is supposedly less heat sensitive than canola. In 1999, frost after emergence damaged mustard and canola stands. Seedlings emerging through heavy residue were actually more susceptible to frost than in areas where the ground was clear of residue and heated up more quickly.
- If a crop has a rotational benefit in the system, don't cancel this out with other management decisions (e.g. losing patience). One of the Wilke crop rotations includes a warm season grass to allow a wider window in the spring for managing weeds prior to seeding. In 1998 we seeded millet on June 6, which allowed for three *Roundup* applications beforehand and greatly reduced wild oat populations. In 1999, we followed a recommendation from the Midwest and seeded the millet

earlier (May 24). The spring was unusually cool, and although there were two *Roundup* applications, a lot of wild oats germinated after seeding. Consequently we missed a major rotational benefit of this crop.

- Watch nature (soil temperature and moisture) more than traditional dates to determine optimum seeding time. In 1999, the Wilke Farm was sprayed with *Roundup* prior to seeding in mid-April. However, this cold, dry spring very few weeds had emerged. A second, post-seeding pre-emergence *Roundup* application was necessary, as there was a sudden flush of weeds.
- Make sure that a new crop has pesticides registered for weeds and other potential problems. Safflower in 1998 had one of the better returns of alternative crops on the Wilke Farm. However, lack of registered herbicides for grassy weed control makes it a risky rotational crop.
- Pick rotational crops based on potential for marketability, pest and weed management, and rotational benefits.

Misc.

- The folks who say you should begin any direct seeding system with adequate chaff spreaders on your combine the season before you start direct seeding are absolutely right. Do this – it's cheaper than a new combine is. Chaff spreading reduces problems with seed germination and nutrient tie-up that may be associated with chaff rows.
- Getting good seed to soil contact is crucial to obtaining a good stand. Do the work in setting up your drill to achieve this.
- Seeding depth control and fertilizer placement are important criteria in drill choice.

Acknowledgments

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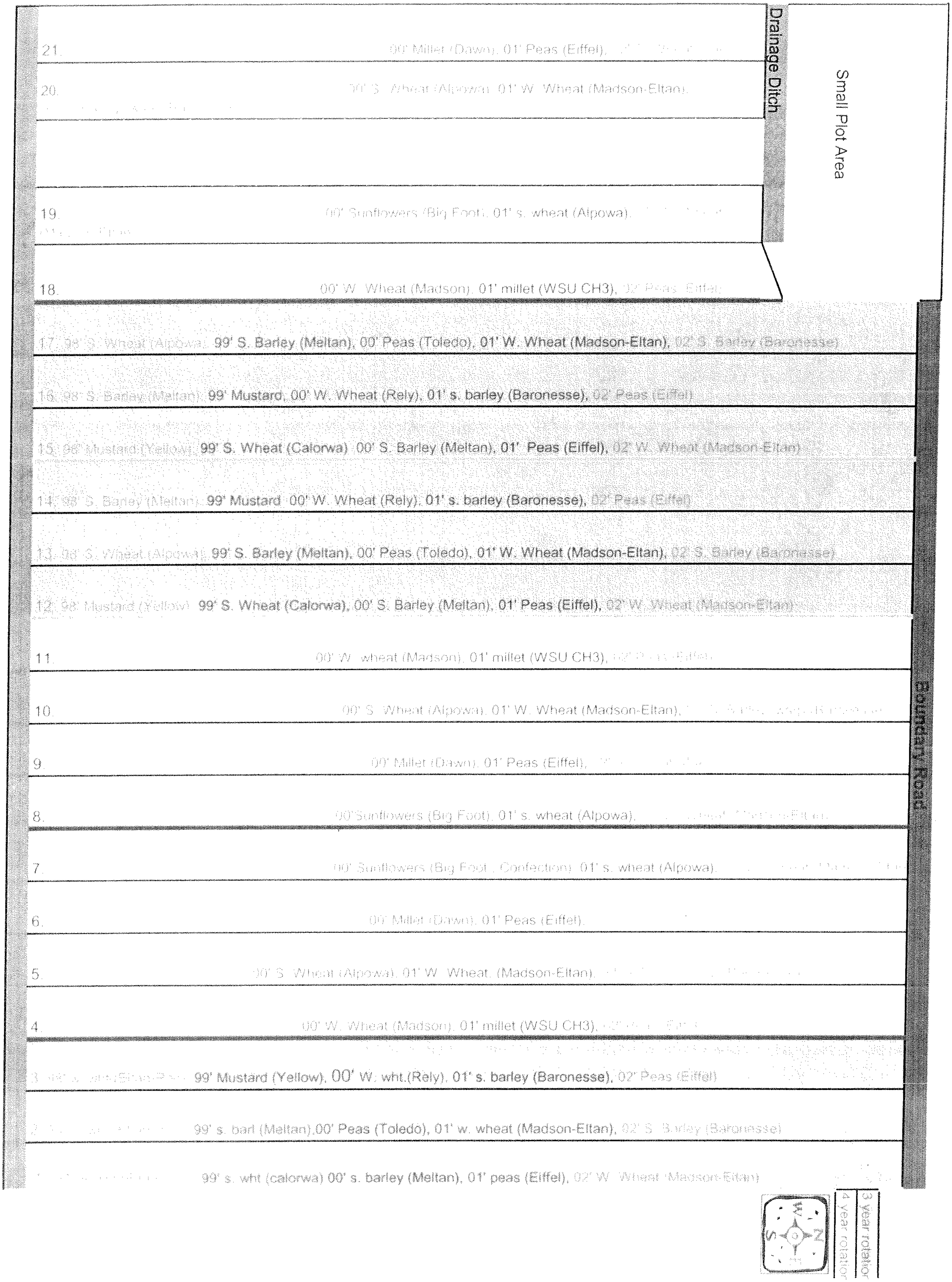

Drainage Ditch
Small Plot Area
21. 00' Millet (Dawn), 01' Peas (Eiffel),
20. 00' S. Wheat (Alpowa), 01' W. Wheat (Madson-Eltan),
19. 00' Sunflowers (Big Foot), 01' s. wheat (Alpowa),
18. 00' W. Wheat (Madson), 01' millet (WSU CH3), 02' Peas, Eiffel
17. 98' S. Wheat (Alpowa), 99' S. Barley (Meltan), 00' Peas (Toledo), 01' W. Wheat (Madson-Eltan), 02' S. Barley (Baronesse)
16. 98' S. Barley (Meltan), 99' Mustard, 00' W. Wheat (Rely), 01' s. barley (Baronesse), 02' Peas (Eiffel)
15. 98' Mustard (Yellow), 99' S. Wheat (Calorwa) 00' S. Barley (Meltan), 01' Peas (Eiffel), 02' W. Wheat (Madson-Eltan)
14. 98' S. Barley (Meltan), 99' Mustard 00' W. Wheat (Rely), 01' s. barley (Baronesse), 02' Peas (Eiffel)
13. 98' S. Wheat (Alpowa), 99' S. Barley (Meltan), 00' Peas (Toledo), 01' W. Wheat (Madson-Eltan), 02' S. Barley (Baronesse)
12. 98' Mustard (Yellow) 99' S. Wheat (Calorwa), 00' S. Barley (Meltan), 01' Peas (Eiffel), 02' W. Wheat (Madson-Eltan)
11. 00' W. wheat (Madson), 01' millet (WSU CH3),
10. 00' S. Wheat (Alpowa), 01' W. Wheat (Madson-Eltan),
9. 00' Millet (Dawn), 01' Peas (Eiffel),
8. 00'Sunflowers (Big Foot), 01' s. wheat (Alpowa),
7. 00' Sunflowers (Big Foot , Confection), 01' s. wheat (Alpowa),
6. 00' Millet (Dawn), 01' Peas (Eiffel),
5. 00' S. Wheat (Alpowa), 01' W. Wheat. (Madson-Eltan),
4. 00' W. Wheat (Madson), 01' millet (WSU CH3),
3. 99' Mustard (Yellow), 00' W. wht.(Rely), 01' s. barley (Baronesse), 02' Peas (Eiffel)
2. 99' s. barl (Meltan),00' Peas (Toledo), 01' w. wheat (Madson-Eltan), 02' S. Barley (Baronesse)
1. 99' s. wht (calorwa) 00' s. barley (Meltan), 01' peas (Eiffel), 02' W. Wheat (Madson-Eltan)
Boundary Road
N
W
S
3 year rotation
4 year rotation

COOPERATIVE EXTENSION
Washington State University
SPOKANE COUNTY

222 N. Havana
Spokane, WA 99202-4799
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February 5, 2002

Agricultural Burning Practices and Research Task Force
c/o Karen Wood
Air Quality Program
Department of Ecology
4601 N Monroe Ste 202
Spokane WA 99205-1295

FEB - 2002

Dear Task Force Members:

Fourth year funding for contract #0000035; *Evaluating pest populations under high residue, direct seeding cropping systems for the Inland Northwest*

On behalf of the Lincoln County Conservation District and the Ag Horizons team of WSU Cooperative Extension, I am writing to inform you of the progress made on the Wilke Direct Seeding Project in 2002 and 2001, and to request fourth and final year funding **($23,350)** for our grant.

Data collection continued as before. Each spring we took soil fertility tests on the Wilke Farm and the 5 cooperator farms. Subsequently we collected information on plant stands and cover development, weed species and incidence, insects, and diseases. After harvest we determined residue levels and water infiltration rates. We also obtained economic information from the Wilke Farm operator and from the off-site cooperators, and from two "check" farms in a conventional rotation.

In 2001 the Wilke Direct Seeding Project completed the fourth year of the project. We are currently conducting a thorough analysis of the data so we can determine the next steps. Attached is a summary of the analysis thus far.

We held the annual Wilke Field Day in July 2000 and 2001. These events were attended by 65-80 growers, and by a number of EPA Region 10 staff and several WA legislators. In 2000 growers toured local farmer-cooperator sites. In March 2001 we also held a research review of the project, to which we invited all the cooperating farmers, researchers, and agribusiness's, and other WSU researchers. It provided us with affirmation of the work done, and input on aspects to emphasize or change.

In June 2001, several of the project team toured direct seeding research at Lethbridge, Alberta. A written report of the trip is attached.

In December 2000, we hired Dr. Dennis Tonks as the Dryland Farming Systems agronomist, who now leads the research aspect of the project. His position and a technician position are funded by the WA legislature as a result of WSU's Safe Food Initiative. We have other small grants from STEEP but these funds do not cover the whole cost of the project, so our need for continued funding from the Ag Burning Task Force is real. Attached is our proposed budget for this grant.

Like last year, we propose using the final year funds for risk-sharing for our farmer cooperators and for the Wilke Farm operator for the 2001 season. (The Wilke Farm is managed as a commercial farm and must remain in the black.) At the beginning of the project we committed to helping these cooperators bear the risk of experimenting with a completely different production system and growing alternative crops on their farms. In 1998-2000 we did this by paying them custom seeding and harvest rates ($38 acre) on their experimental acres.

In 2001 we had a total of 575 acres in the project, including the Wilke Farm. We propose paying for risk sharing on these acres with Ag Burning funds (total $21,850). The indirect costs ($1,500) are for grant management, so the **total request is $23,350.**

Thank you for your previous assistance and for your consideration of this proposal. We hope to hear from you in the near future so we can inform our grower cooperators whether we can fulfill our commitment to them. Please let me know if you need any further information.

Sincerely,

Diana Roberts

Diana Roberts
Area Extension Agronomist

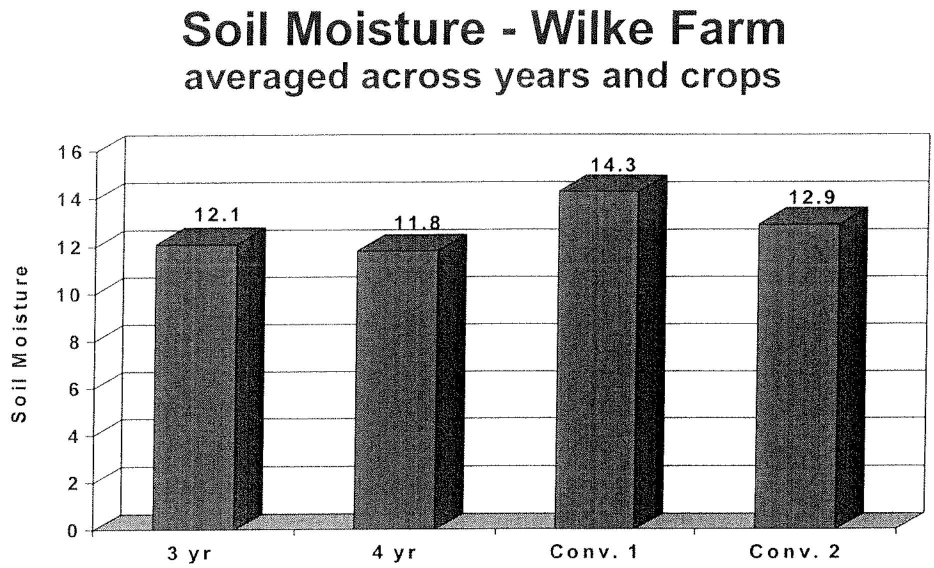
pc. Jon Jones, David Lundgren, Dennis Tonks

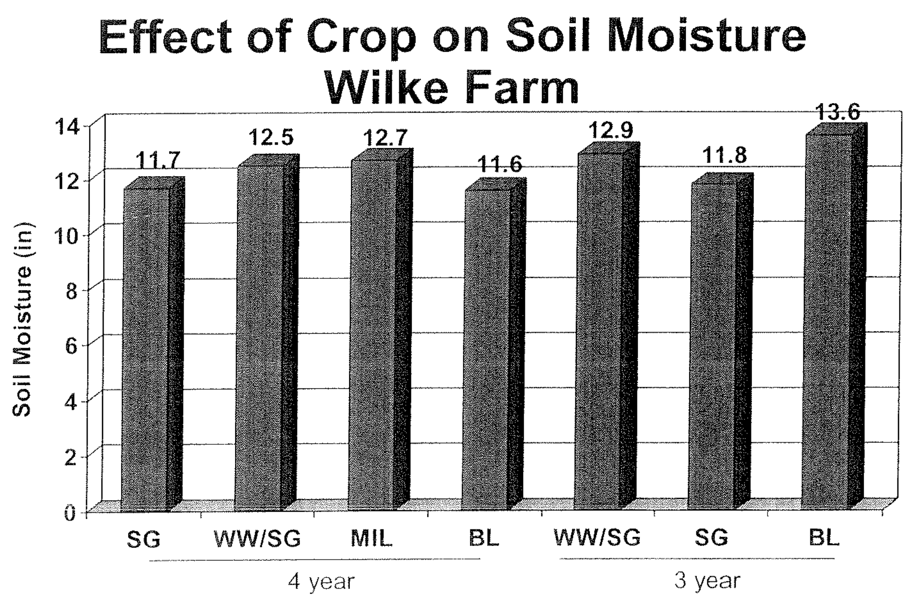
encl.Wilke Farm charts, Combine residue management and the American Farm Bill

2001/2 Agricultural Burning Practices and Research Task Force Proposed Budget:

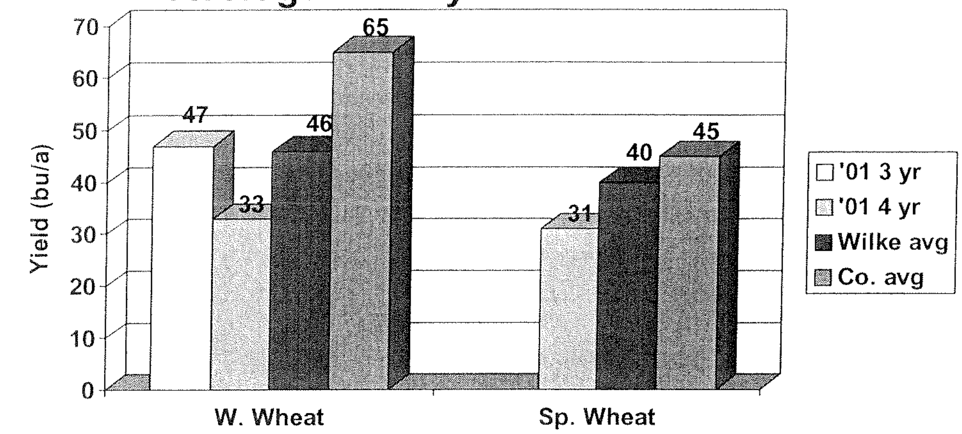
Evaluating pest populations under high residue, direct seeding cropping systems for the Inland Northwest

Item	Units	Unit Cost	Subtotal
No-till seeding	575 acres	$19/A	$10,925
Harvesting	575 acres	$19/A	$10,925
Indirect costs			$1,500
		TOTAL	**$23,350**


Soil Moisture - Wilke Farm
averaged across years and crops
Soil Moisture
0
2
4
6
8
10
12
14
16
12.1
11.8
14.3
12.9
3 yr
4 yr
Conv. 1
Conv. 2

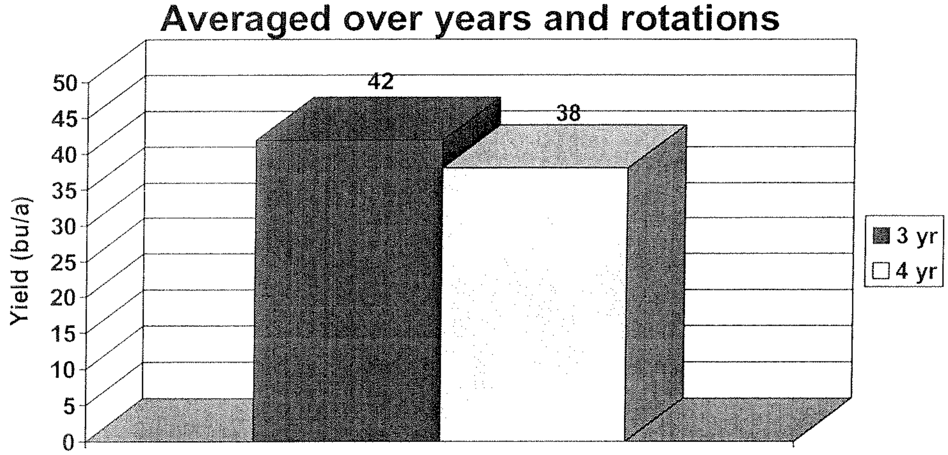

Effect of Crop on Soil Moisture
Wilke Farm
Soil Moisture (in)
0
2
4
6
8
10
12
14
11.7
12.5
12.7
11.6
12.9
11.8
13.6
SG
WW/SG
MIL
BL
WW/SG
SG
BL
4 year
3 year

Wheat Yields- Wilke
Averaged over years and rotations

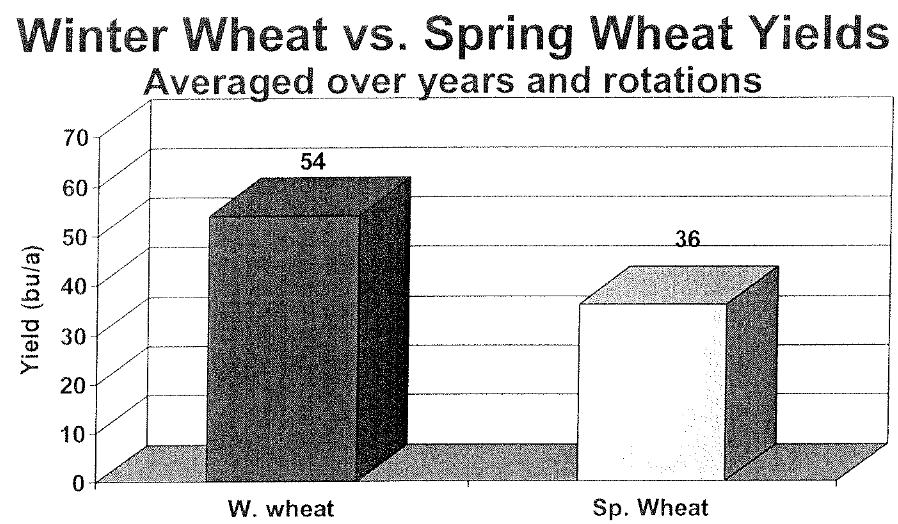


Range: WW, 33-61 bu/a;
SW, 30-51 bu/a

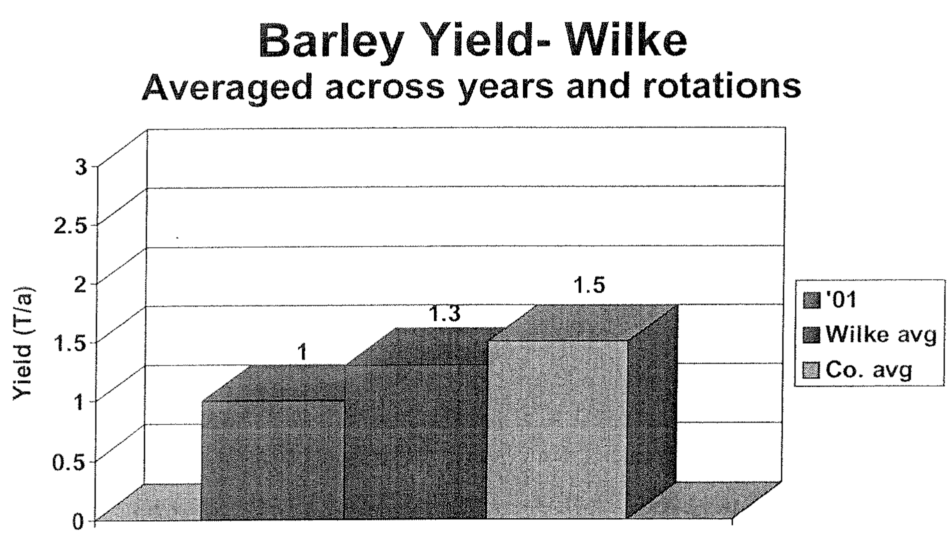
Wheat Yields- Wilke 3 yr vs. 4 yr
Averaged over years and rotations



Range: WW, 43-61 bu/a;
SW, 30-51 bu/a



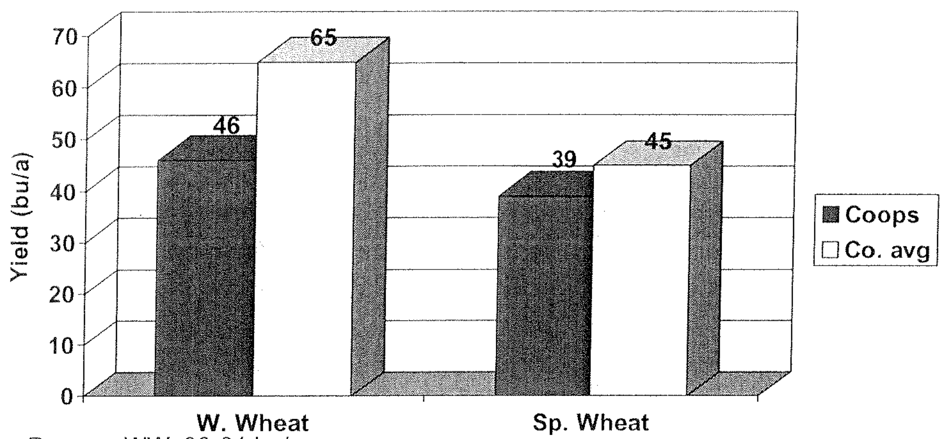
Range: WW, 43-61 bu/a;
SW, 30-51 bu/a



Range: 0.75-1.05 T/a
'01 = 1 T/a

Wheat Yields- Cooperator Fields

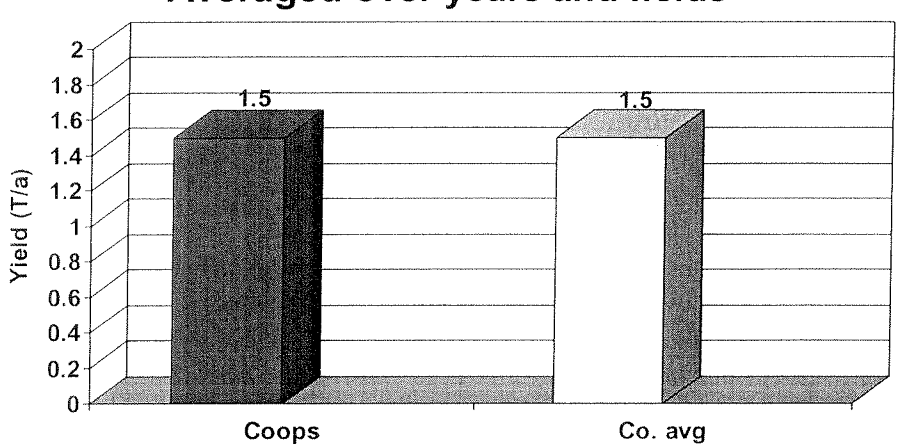
Averaged over years and fields



Range: WW, 30-61 bu/a
SW, 30-53 bu/a

Barley Yields- Cooperator Fields

Averaged over years and fields



Range: 0.75-2.4 T/a

Combine Residue Management and the American Farm Bill

by Aaron Esser and Dennis Tonks

This past summer we toured the Agriculture and Agri-Food Canada Lethbridge Research Station and four surrounding direct seed farms with some Lincoln County grain growers and other extension personnel. Two things that really stuck with us were how emphatic each of the growers talked about needing to spread and manage the residue behind the combine, and how much knowledge and understanding they had about the "American Farm Bill" and United States agricultural policy in general. It was clear both of these issues were important for their livelihood.

Some interesting facts and figures about western Canada are that 80% of the total dryland acres are direct seeded, and 60% of the total farmland in western Canada is direct seeded. Ninety percent of the summer fallow is chemical, and overall fallow has been reduced over 50% in the past 20 years.

The first farm we visited was NeverIdle Farms LTD, owned and operated by Ike and Rob Lanier. They have been direct seeding for 20 years, and have a diverse crop rotation of wheat, barley, triticale, canola, peas and sunflowers. They do not incorporate a specific rotation but are very aggressive in planting and marketing. One example of this was some oilseed sunflowers for the dairy industry they were monitoring closely for stand establishment and the price of mustard. The Laniers were going to spray the sunflowers out and seed mustard if the sunflowers had low stand establishment and/or the price of mustard reached $0.30/lb. Three points they felt were important for the success of direct seeding on their farm were managing residue, fall weed control, and fall fertilization.

The second farm we visited was owned and operated by Lloyd, Connie and Ryan Mercer. Unlike NeverIdle Farms LTD, the Mercers used a more set crop rotation of canola, winter wheat, pea/garbanzo beans, and spring grain. As far as openers, they use a high disturbance double shoot shovel "paired-row" openers when moisture levels in the spring are adequate and a low disturbance single shoot shovel "single-row" openers under dry spring conditions.

Tony Brummelhuis direct seeds his irrigated farm with a modified John Deere 750 drill. Like three previous farmers, Tony felt very strongly about needing to manage the residue with the combine and not removing the straw. He stated he didn't have the time, money or resources to bale the straw and burning was not an option. Tony felt rotation was more important than individual crop profit, up to a point, but always consider a crop that can both help control weeds, disease and residue as well as profitability.

Mark Lindstedt was the last and driest (roughly 10-12 inches) farm we visited. Mark, who had been considered a direct seed "Doubting Tom", has only been direct seeding for 3 years, and was convinced it was the only to way to go after a complete crop disaster in 2000. He stated he has had crop disasters in the past and will continue to have crop disasters in the future, but this was the first disaster on his farm that was contained only to the crop and not the ground. Mark uses a flexible rotation that includes wheat, perennial rye, canola, grains, peas and 2000 acres of chemical fallow. Mark traditionally seeds over 4,000 acres/year with 1 drill and tractor. Two benefits Mark has had with direct seeding is the reduction of crusting and fuel savings. He seeds over 400 acres with one tank of fuel.

The Lethbridge Research Center is the largest agricultural research center in Canada with 1,200-acres for research and about 350 employees. We met with Drs. Henry Janzen, Frank Larney, Bob Blackshaw, and Jill Clapperton. Henry Janzen and Frank Larney (Soil Scientists) talked about several long-term crop rotation studies (one since 1910) farmed using best management practices. Another study since 1967 has compared chemical fallow and conventional tilled fallow. The chemical fallow plots have greater water infiltration, organic matter, and earthworms. Wheat yield is comparable between the two systems.

Bob Blackshaw (Weed Scientist) talked about an integrated weed management study looking at banded compared to broadcast nitrogen fertilizer. What he is finding is that fertilizer seems to stimulate germination in some weed species (such as wild oats). Therefore, applying some broadcast nitrogen fertilizer in the fall and harrowing may stimulate weed germination and increase control in the spring. He also talked about the need for fertilizer placement, banding fertilizer limits weed access and they are not as competitive.

Jill Clapperton (Rhizoshere Ecologist) talked about soil quality aspects. She stressed the need of looking at whole rotation effects and the need for legumes in a rotation. She also stressed the need for mycorrhizal relationships with plants.

Some general comments and observations from the trip. Because of diverse crop rotations wild oats have become less of a problem and dandelions and some other annual weeds such as sheperdspurse have become more of a problem. Lethbridge is home to a lot of feedlots and gives growers the opportunity for local markets. Overall the trip was very educational. Grower feedback from the trip was very positive about both the on-farm visits and the research center.