Cooperative Extension
Washington State University
Department of Crop and Soil Sciences

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Management Considerations for Returning CRP Land to Crop Production

Preliminary Research Summary
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STEEP II
Solutions to Environmental & Economic Problems

Northwest Columbia Plateau Wind Erosion / Air Quality Project

Contributing agencies: Washington State University Cooperative Extension, Department of Crop and Soil Sciences and USDA programs and employment are available to all without descrimination.

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CRP Take-out Research Team

Growers: This large-scale on-farm test project has relied heavily on the active participation of growers who helped plan the field trials, provided the land and equipment, and conducted the field operations. The growers involved in large-scale field trials established in 1994 and 1995 include: GeorgeYoung and David Carlton in Columbia County, George O'Neal and Remie DeRuwe in Franklin County, Lenard Roth in Adams County, and Jim Richardson and Darrell Roberts in Lincoln County. Cooperating growers are also listed later in discussions of field trials on their respective farms. Growers cooperating on four spring CRP take-out trials for spring crops in 1996 include Dale and Gary Galbreath, and Ron Jirava in Adams County, Andy and John Rustemeyer in Lincoln County, and Toni Viebrock in Douglas County.

Project Leaders are Baird Miller, WSU Agronomist, Pullman, Roger Veseth, WSU/UI Conservation Tillage Specialist, Moscow, and Tim Fiez, WSU Soil Fertility Specialist, Pullman; with support from Tim Walters, WSU Crop Science Graduate Student, Pullman, and Harry Schafer, WSU Research Technician, Ritzville.

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CRP Background

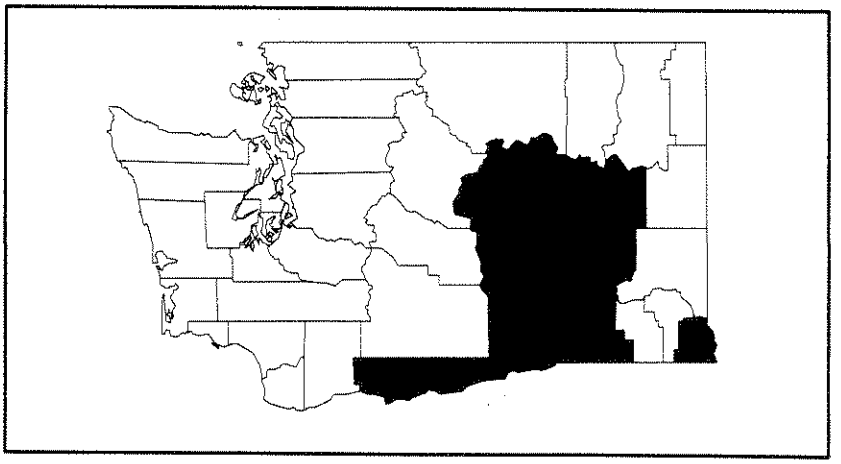

Figure 1. Washington State counties with significant CRP acres.

The Pacific Northwest has over 2.5 million acres of cropland in the Conservation Reserve Program (CRP). In Washington State there is over 1.045 million acres of CRP land. This represents nearly 14% of the 7.6 million acres in a 20 county area of eastern Washington. More than 50% of the CRP acres under contract are scheduled to expire in the fall of 1996, with CRP grass take-out operations authorized to begin July 1, 1996. In addition, an early release option has been approved beginning March, 1996.

A majority of the CRP land in Washington and the Northwest is in the low rainfall, winter wheat-summer fallow regions (Figure 1). This area typically receives from 7 to 14 inches annual precipitation and is particularly vulnerable to wind erosion. Serious soil erosion problems could result if intensive tillage and residue removal practices are used in returning CRP land to crop production. In this dry land region, limited research is available on converting perennial grass cover to crop production. Conservation tillage technologies have also changed dramatically over the last 20 years. To preserve the soil-building benefits gained during the CRP and to minimize soil erosion, a research knowledge base is needed to develop profitable management strategies for bringing CRP land back into crop production.

Overview of the Washington State CRP Take-out Research Project

In 1994, a Washington State research project was initiated to evaluate management strategies for returning CRP land to crop production. It is designed as an umbrella project for a comprehensive, "grass roots" effort to evaluate prospective, locally-identified management options for specific agronomic zones of the state. The research focus is on the low-rainfall, crop-fallow region because much of the CRP land is located in this cropping region. Crested wheatgrass is the predominant CRP grass in this area.

Washington State University Cooperative Extension is responsible for coordinating the statewide CRP take-out research project, as authorized by the Washington Farm Service Agency (FSA, formerly ASCS). As indicated in the CRP take-research team membership, the project relies on active involvement of growers, extension specialists and agents, researchers, and personnel from agricultural support agencies and industry.

The project goal is to identify management strategies that optimize agronomic performance and profitability of the first crops following CRP take-out, while providing effective soil erosion control, and preservation of soil improvements gained during CRP. There are two primary research thrusts in this statewide project: 1) evaluate management strategies for returning CRP land to winter wheat production following a summer fallow period; and 2) evaluate management strategies for returning CRP land to spring crop production. Additional research efforts focus on fertility management in CRP take-out, herbicide application rates and timings for killing CRP grass, and changes in soil quality under different take-out systems.

Criteria evaluated to determine the relative success of different CRP take-out systems include: soil water storage efficiency; seed zone soil water content in fallow systems; crop establishment and development; soil erosion potential based on surface residue, roughness and soil aggregation; pest incidence; crop yield and quality; and economics.

This research project is funded in part by two grant programs from the USDA Cooperative States Research, Education and Extension Service (CSREES): STEEP II (Solutions To Environmental and Economic Problems) and the Columbia Plateau Wind Erosion/Air Quality Project.

Research Approach

Before field experiments were initiated, a series of local planning meetings were conducted in six counties with high CRP acreage. Each meeting included four to six growers, county extension agents, researchers and personnel from USDA-NRCS, conservation districts and the agricultural service industry. This group

identified prospective tillage and residue management systems to be studied in the CRP take-out field research trials. The tillage systems in most 1994 and 1995 trials relied primarily on commonly available tillage equipment within the different cropping regions. Direct seeding was also evaluated in two 1995 field trials and is currently being studied in three 1996 field trials in Adams and Douglas Counties.

This field research project uses large, replicated experiments with farm-scale equipment operated by the growers. This approach increases grower confidence in the research results and facilitates rapid grower adaptation of research results. Treatment area for each plot is generally 30 to 50 feet wide and 800 to 1,000 feet long, depending on the implements used. Each treatment is replicated four times. Most trials include 4 to 6 management systems (treatments), covering 15 to 35 acres in total.

The trials are designed to produce a wide range of surface residue levels and surface roughness. Primary tillage and residue management options being evaluated for preparation of summer fallow prior to planting winter wheat include: 1) fall disc-spring disc; 2) fall tine harrow-spring disc; 3) fall flail-spring sweep; 4) 2X spring disc; 5) spring burn-sweep; 6) spring flail-sweep; 7) fall harrow/chisel-spring cultivate; and 8) chemical fallow-direct seed. In spring take-out trials for spring cropping, the primary tillage and residue management treatments include: 1) spring sweep-disc; 2) 2X spring disc; 3) spring moldboard plow; 4) spring burn-sweep; 5) direct seed; 6) spring burn-direct seed; and 7) spring flail-direct seed.

Researchers involved in the trials take the lead in laying out the field experiment with the growers and collecting the data. The growers perform all of the crop production operations. Yield measurements are made using the grower's combine and portable truck scales or weigh wagons.

Data collection includes grass biomass, soil water content in the spring and at fall planting, soil fertility analysis for fertilizer application, surface residue and roughness, pest incidence, plant stands, and crop yield. Soil erosion potential is based on surface cover, surface roughness, soil aggregation under the different take-out systems. Comparative crop enterprise budgets are being generated to evaluate the profitability of the different systems. The trials are also being monitored beyond the crop harvest and through the next crop rotation, as time and resources permit, to evaluate the longer term effects of take-out treatments on soil erosion potential, pest incidence and soil quality.

In cooperation with other university and industry researchers, satellite experiments are also being conducted to evaluate alternative spring crop choices, fertilizer application options, nonselective herbicide rates and timings and other management questions.

Overview of Field Trials Established in 1994 and 1995

Seven large-scale on-farm trials for evaluating CRP take-out were established during 1994 and 1995. A preliminary summary of the results is presented in the following report.

Four trials in Adams, Franklin, Garfield and Lincoln Counties evaluating different tillage systems of CRP takeout followed by summer fallowing were planted to winter wheat in 1995. Spring take-out trials for spring wheat were completed in Columbia County in 1994 and 1995, along with a small plot satellite study on spring crop choice under high and low residue systems. A direct seeding trial with spring barley was conducted in Columbia County in 1995. Four small plot research trials on non-selective herbicide use for killing CRP grass were conducted in Franklin and Adams Counties in 1995 by Monsanto. Another study in 1995 on nonselective herbicide use in CRP take-out was conducted in Columbia County by the McGregor Company.

Preliminary Research Results From 1994 and 1995

CRP Take-out for Winter Wheat After Summer Fallow

Research Overview

Three large-scale trials were initiated in fall 1994 in Adams, Franklin, and Lincoln Counties to evaluate fall versus spring CRP take-out and management practices for summer fallow and winter wheat planting. A 1995 spring take-out trial on winter wheat after summer fallow was established in Garfield County. The trial also includes spring take-out treatments for spring wheat in 1996.

Fall Versus Spring CRP Take-out for Winter Wheat on Summer Fallow in Adams County

The trial site is north of Lind on the Lenard Roth farm. It is in a 10-inch annual rainfall zone and had been in crested wheatgrass for 8 years. Fall tillage and residue management treatments were established in 1994. Primary treatments compared for CRP take-out at the Adams County site are listed Table 1.

Table 1. Primary tillage treatments in the Adams County CRP take-out trial for winter wheat on summer fallow

Fall 1994	Spring 1995
Disc	Cultivate
2X Harrow and chisel	Skewtread - cultivator
Flail with combine in August	Sweep
—	Disc - cultivator
—	Sweep - disc

After the initial tillage operations, all treatments were managed as one field. Subsequent field operations included the following implements: skewtreader, rotary hoe, fertilizer injector, rodweeder three times during fallow and seeding soft white winter wheat with a John Deere HZ deep furrow drill.

Preliminary results from the trial are shown in Table 2. One of the most striking difference between treatments is in plant-available soil water to a 6-foot depth in March 1995 before spring tillage operations. Fall discing reduced overwinter water storage by about 2 inches compared the undisturbed grass cover in spring take-out treatments. The fall harrow-fall chiseling treatment caused a smaller but still significant water loss, but fall flailing did not.

The loss of soil water in the two fall tillage treatments was still evident at winter wheat seeding time in September, although the difference was not as great as in the spring. All of the treatments showed substantial water loss during the summer fallow.

Although differences in surface residue levels between treatments after seeding were not always significant, fall discing and fall harrowing/chiseling resulted in the lowest levels, about 12 percent cover. The fall combine flail-spring sweep resulted in the highest residue level of 15 percent. However, the surface residue level on all the treatments is relatively low, indicating that each of the primary tillage and residue management combinations or following secondary tillage operations could have been less intensive.

Roughness of the soil surface, which is also a factor in wind and water erosion potential, was measured several times during the fallow season and just after seeding. Surface random roughness (an average surface roughness measurement in inches) after seeding was similar in all the treatments. The secondary tillage operations with the skewtreader and rotary hoe effectively reduced soil cloddiness, consequently eliminated differences in soil roughness between treatments.

The lower soil water storage in the fall disc treatment may have caused the slightly lower plant stand, about 5.4 plants/square foot compared to 6.0 to 6.6 plants/square foot in the other treatments.

Table 2. Preliminary results from the 1994-96 Adams County trial on fall versus spring CRP take-out for winter wheat on summer fallow

Treatments	Available Soil Water Spring 1995 (inches/6 ft)	Available Soil Water Fall 1995 (inches/6 ft)	% Surface Residue Cover (6/1/95)	% Surface Residue Cover (after seeding)	Inches Surface Random Roughness (after seeding)	Plant Stand (plants/ft^2)
Fall disc	2.9 d	1.9 bc	24 c	11.5 c	2.3 ab	5.4 b
Fall 2X harrow	4.2 c	1.8 c	25 bc	12.0 bc	2.2 b	6.3 a
Fall flail	4.8 ab	2.6 ab	27 ab	15.0 a	2.6 ab	6.0 ab
Spring disc	4.7 b	3.3 a	21 d	13.3 abc	2.4 ab	6.6 a
Spring sweep	5.2 a	2.3 bc	28 a	14.3 ab	2.8 a	6.0 ab
LSD (10%)	0.4	0.7	2.0	2.4	0.5	0.9

Fall Versus Spring CRP Take-out for Winter Wheat on Summer Fallow in Franklin County

A second fall versus spring CRP take-out trial for summer fallow and winter wheat was on the George O'Neal and Remie DeRuwe farm north of Connell on the edge of Franklin County. It is in a 9-inch rainfall zone and the field had been in crested wheatgrass for 8 years. Fall tillage and residue management treatments were established in 1994. Table 3 describes the primary treatments included in the trial. Roundup RT was applied at a 1-pint per acre rate to all the plots before spring field operations. After the initial spring tillage operations were established, the trial was managed as one field. Subsequent field operations included fertilizing with a shank applicator, rodweeding three times during the summer fallow and seeding hard red winter wheat with an International Harvester deep furrow drill.

Table 3. Treatments in the Franklin County CRP take-out trial for winter wheat on summer fallow

Fall 1994	Spring 1995
Disc	Disc
2X Harrow	Disc
Flail	Sweep
—	Burn - Sweep
—	Disc - Disc

Table 4 summarized the preliminary results from the Franklin County trial. Soil samples were taken to a 6-foot depth before spring tillage operations. All of the tillage and residue management in the fall resulted in

significantly lower overwinter water storage because of greater evaporation. Where the grass residue was left undisturbed over winter for the spring burn and spring disc treatments, there was just over 4 inches of plant-available soil water to a 6-foot depth. Both of the fall residue treatments of harrowing and flailing resulted in slightly lower soil water contents of 3.6 inches. The fall disc treatment resulted in the greatest loss of water over winter. It contained only 2.2 inches of available water, which was 2 inches lower that under undisturbed grass cover over winter. This was similar to the soil water loss with fall discing in the Adams County trial.

Six-foot soil samples were again taken just after winter wheat seeding. All of the treatments lost about half of the water content present in the spring. As in the spring sampling, however, the fall discing still had the lowest water content at 0.9 inch, which was just over 1 inch less than the spring take-out treatments.

Surface residue cover was measured through the fallow season and after seeding. Although surface residue levels in all the treatments were low, the fall flail - spring sweep treatment resulted in the highest surface residue level of about 9 percent. This was one of the least intensive tillage systems. The lowest residue treatment was the spring burn - sweep with about 2 percent. The other three treatments with one or two disc operations had surface residue levels of 5 to 6 percent.

The two treatments with the highest surface roughness in July 1995 of the fallow season were the two lowest intensity tillage treatments...the fall flail - spring sweep and the spring burn - spring sweep. All the other treatments included one or more disc operations. This illustrates the well know fact that the disc can reduce soil structure and aggregation, particularly in these light textured soils. There were no real differences in surface roughness after seeding.

There were no significant differences in plant stands between the treatments, except for the fall disc treatment, which contained about half the population of the other treatments. This was probably the result of a lower soil water content in the seedzone, which reduced germination and establishment.

Table 4. Preliminary results from the 1994-96 Franklin County trial on fall versus spring CRP take-out for winter wheat on summer fallow.

Treatments	Available Soil Water Spring 1995 (inches/6 feet)	Available Soil Water Fall 1995 (inches/6 ft)	% Surface Residue Cover (after seeding)	Inches of Surface Random Roughness (July 1995)	Inches of Surface Random Roughness (after seeding)	Plant Stand (plants/ft^2)
Fall disc	2.2 c	0.9 c	5.8 b	3.0 c	3.0 a	3.9 b
Fall harrow	3.6 b	1.9 b	6.5 b	3.3 b	3.2 a	7.7 a
Fall flail	3.6 b	2.0 ab	8.8 a	3.7 a	3.2 a	6.9 a
Spring burn	4.1 a	2.1 ab	1.9 c	3.9 a	3.3 a	6.9 a
Spring disc	4.2 a	2.2 a	5.8 b	3.1 bc	2.7 b	7.1 a
LSD (10%)	0.3	0.2	1.1	0.3	0.2	0.9

Fall Versus Spring CRP Take-out for Winter Wheat on Summer Fallow in Lincoln County

The trial is located north of Ritzville near the town of Lamona. Grower cooperators are Jim Richardson and Darrell Roberts. The site is in a 10-inch annual rainfall zone and had been in crested wheatgrass for 8 years. Fall tillage and residue management treatments were established in 1994. Roundup RT was applied at 1-pint per acre to all the plots before spring field operations.

CRP take-out treatments compared at the Lincoln County trial are listed in Table 5. Both the disc and sweep

had a 3-bar tine harrow attached. After the initial tillage operations, the plots were managed as one field. Subsequent field operations included fertilizer injector, three rodweeder operations during fallow, and seeding soft white winter wheat with a John Deere deep furrow drill.

Table 5. Treatments in the Lincoln County CRP take-out trial for winter wheat on summer fallow

Fall 1994	Spring 1995
Disc*	Sweep*
2X Harrow	Disc*
—	Flail - Disc*
—	Burn - Sweep*
—	Disc*

* 3-bar tine harrow attachment

Table 6 shows part of the preliminary results of the Lincoln County trial. There were no significant differences in overwinter soil water storage between fall and spring take-out treatments in the early spring, in contrast to results at the Adams and Franklin County trials. There was also no differences in soil water content at seeding time, but early fall rains before sampling probably overshadowed treatment differences.

Surface residue measurements in July 1995 of the fallow season showed the spring burn to have the lowest percent cover -- about 14 percent. Fall or spring discing resulted in about 49 to 51 percent surface cover. Harrowing or flailing ahead of spring discing further reduced the surface cover to about 40 to 44 percent. In a spring planting system, surface residue levels and soil roughness would have been adequate for effective erosion control prior to crop canopy cover with the spring crop.

Surface cover at planting was still lowest in the burn-sweep with 4 percent. The other four disc treatments ranges from 13 to 16 percent cover, with harrowing and flailing treatments still being slightly lower.

Surface random roughness after seeding was significantly higher with the spring burn - sweep treatment. The other four treatments with the disc as primary tillage had similar levels of surface roughness.

There was no differences in winter wheat plant stands between the treatments. Early fall rains provided uniform seed zone water and seed-soil contact appeared to be good under all the treatments.

Table 6. Preliminary results from the 1994-96 Adams County trial on fall versus spring CRP take-out for winter wheat on summer fallow.

Treatments	Available Soil Water Spring 1995 (inches/6 ft)	Available Soil Water Fall 1995 (inches/6 ft)	% Surface Residue Cover (7/95)	% Surface Residue Cover (postplant)	Inches Surface Random Roughness (postplant)	Plant Stand (plants/ft^2)
Fall disc	5.5 b	5.2 a	50.8 a	16.0 a	2.8 b	9.0 a
Fall harrow	5.7 b	5.3 a	44.1 bc	13.5 b	3.0 b	9.6 a
Spring disc	5.6 b	5.3 a	48.5 ab	14.6 ab	3.0 b	9.1 a
Spring flail	6.0 ab	5.4 a	40.4 c	13.0 b	2.9 b	9.3 a
Spring burn	6.8 a	4.9 a	14.4 d	4.1 c	3.6 a	9.2 a
LSD (10%)	0.9	0.6	5.5	2.1	0.4	1.1

1995 Spring CRP Take-out for Winter Wheat on Summer Fallow and 1996 Spring Take-out for Spring Wheat in Garfield County

A spring take-out trial was established in Garfield County in 1995 for winter wheat after fallow and for spring wheat in 1996. The trial is located northwest of Pomeroy. The site is in a 12-inch annual rainfall zone and had been in crested wheatgrass for 8 years. Clay Barr is the grower cooperator. Trial leadership and coordination is provided by Jeff Harlow, NRCS District Conservationist, and David Bragg, Area Extension Agent, both at Pomeroy.

There were four primary treatments in the spring take-out trial for winter wheat on summer fallow (Table 7). The first was a 1-pint Roundup RT application ahead of 2X disc operations in March, followed by field cultivation, fertilizer injection, 3 rodweedings during fallow. The second treatment was the same combination of operations only beginning in July. The reason for the two take-out timings was to compare the normal July 1 take-out authorization time with an early release take-out in March. The third treatments began in March with a spray, flail and then chemical fallow with Roundup RT and direct seeding with a Agrow drill. This drill is an Australian direct seeding drill owned by the Pomeroy Conservation District. The fourth treatments began in March with a burn and then chemical fallow with Roundup RT and direct seeding with the Agrow drill. Conventionally-tilled plots were seeded with an International Harvester double disc drill. The Agrow drill does not have deep fertilizer placement capability so the nitrogen fertilizer requirement was split between surface broadcasting and starter fertilizer with the seed.

Two spring wheat treatments are being established in 1996. One treatment was flailed in the fall of 1995 and will be sprayed in the spring before a conventional tillage planting which tentatively includes 2 disc operations, field cultivation, fertilizer injection, and seeding with the IH double disk drill. The other spring wheat treatment will be a spring spray, burn and direct seeding with the Agrow drill.

Table 7. Treatments in the Garfield County trial on 1995 spring take-out - winter wheat on summer fallow and 1996 spring take-out for spring wheat.

March to July 1995	July to October 1995	October 1995	Spring 1996
Spray - 2X disc - cultivate - fertilize - rodweed	Rodweed	Conventional seed	———
———	Spray - 2X disc - cultivate - fertilize - rodweed	Conventional seed	———
Spray - flail - chemical fallow	Chemical fallow	Direct seed	———
Burn - chemical fallow	Chemical fallow	Direct seed	———
———	———	Flail	Spray - 2X disc - cultivate - fertilize - conventional seed
———	———	———	Spray - burn - direct seed

There were marked differences in surface residue cover between treatments after winter wheat seeding. Disc treatments retained 12 to 16 percent surface residue. A 91 percent residue cover was retained with the flailing - chemical fallowing and direct seeding. A 38 percent residue cover was present on the burn treatment after chemical fallowing and direct seeding. This is higher than normal following a burn because spring rains delayed herbicide application after burning and the CRP grass made considerable regrowth before it was sprayed.

Spring Take-out for Spring Cereals

Research Overview

Spring take-out trials with soft white spring wheat were completed in 1994 and 1995 in Columbia County. A smaller satellite trial near the large trial in 1995 also compared soft white spring wheat, hard red spring wheat, spring barley and spring oats under plow and 2X disc treatments. A no-till spring barley study was conducted with two rates of preplant Roundup at a separate but similar location in Columbia County.

The 1994 spring crop trial site was summer fallowed in 1995 and seeded to winter wheat. In the spring before establishment of the summer fallow, large differences in downy brome populations were documented among tillage treatments. These weed populations were evaluated again in the winter wheat crop during the 1995-96 crop year. Soil erodibility potential as affected by the 1994 spring tillage and residue management treatments will be evaluated during the subsequent fallow - winter wheat rotation.

In Garfield County, a 1996 spring take-out trial with spring wheat will be included as treatments in the trial currently underway for fallow-winter wheat (see the Garfield County fallow trial for details).

1994 and 1995 Spring CRP take-out for Spring Wheat in Columbia County

Two years of a trial on spring CRP take-out for soft white spring wheat using four different tillage and residue management systems were conducted in Columbia County 1994 and 1995. The trials were south of Starbuck in a 14-inch annual rainfall area on the George Young farm and conducted in cooperation with Roland Schirman, WSU Columbia County Extension Agent. After the tillage and residue management treatments (Table 8) were established, the trial was treated as one field with fertilizer injection using with a shank applicator, followed by skewtreading and seeding soft white spring wheat with a conventional John Deere double disc drill.

Table 8. Primary Treatments in the 1994 and 1995 Columbia County Trials on Spring CRP Take-out for Spring Wheat

Tillage System
Moldboard plow (with trashboards) - disc
Burn - sweep
Sweep - disc
Disc - disc

Table 9 summarizes part of the trial data for 1994. Plow and burn-sweep treatments averaged 10 and 15% surface residue, respectively, while 2X disc and disc-sweep treatments were significantly higher, averaging 55 and 58%, respectively.

Plow and burn-sweep treatments had higher plant stands than the 2X disc and sweep-disc. Very dry conditions after seeding and poorer seed-soil contact probably reduced stand establishment in the high residue treatments. There was only about 5 inches of plant available soil water to 4 feet depth at planting and almost no effective precipitation occurred after seeding during the growing season.

Plow and burn-sweep treatments had a higher incidence of dryland foot rot largely because the thicker, more advanced stand of wheat resulted in increased drought stress under the dry spring conditions, which is a major contributor to the disease. The crop was also fertilized for a 35 bushel/acre yield (not possible under the

drought conditions), adding to the drought stress conditions favored by the disease.

Yields of all treatments were low due to the very dry spring conditions, but were very close to recrop spring wheat yields in the area that year. Although yield difference between high and low residue treatments were statistically significant, the differences were only about 3.5 bushels/acre.

Table 9. Partial results of the 1994 Columbia County spring take-out trial with spring wheat.

Treatments	Residue Cover after seeding (%)	Plant Stand (plants/ft²)	Dryland Foot rot (% infected stems)	Yield (bu/acre)
Plow - disc	15.2 b	7.4 b	16.1 b	18.1 b
Burn - sweep	10.2 a	7.7 b	15.5 b	17.9 b
Disc - disc	54.7 c	5.5 a	2.9 a	14.5 a
Sweep - disc	57.9 c	5.5 a	3.1 a	14.4 a
LSD (10%)	3.3	0.7	4.1	2.0

In the 1995 trial (Table 10), surface residue differences were similar to 1994, but all residue levels were slightly lower in 1995, possibly because of higher soil moisture conditions.

Plant stands were not significantly different. Two reasons for similar plant stands among treatments in 1995 (in contrast to 1994) include better seedzone soil moisture conditions at and after seeding, and slightly lower surface residue levels than in 1994 (~34% compared to ~57%). Although original plant populations were very similar shortly after emergence, there was some evidence of loss of stand and a "patchy stand appearance" in both of the higher residue treatments. Rhizoctonia root rot was identified on roots of plants in the affected areas and is believed to be at least part of the reason for the loss of stand and reduced yields. The disease was also present on plant roots in the low residue treatments, but did not appear to be having as much impact on the plants.

There were significantly higher yields in the low residue treatments (as in 1994), but again the yield differences between low and high residue systems were still small...2-5 bu/A. Northwest research has shown that using conservation tillage drills with deep fertilizer placement below seeding depth and near the seed row, and with better residue handling capability in the high residue treatments would probably have improved yield potential under these higher residue conditions compared to seeding and fertilizing with conventional tillage equipment.

Table 10. Partial results of the 1995 Columbia County spring take-out trial with spring wheat.

Treatments	% Surface Residue Cover	Plant Stand (plants/ft²)	Yield (bu/acre)
Plow - disc	9.4 a	10.2 a	43.0 a
Burn - sweep	9.7 a	9.7 a	41.6 a
Disc - disc	34.9 b	9.4 a	39.3 b
Sweep - disc	33.9 b	9.4 a	37.8 b
LSD (10%)	7.6	0.9	1.8

Downy Brome Populations in Fallow and Winter Wheat Following the 1994 Columbia Trial on Spring CRP Take-out for Spring Wheat

Continued data collection on the 1994 trial site on spring CRP take-out for spring wheat provided an opportunity to evaluate the effects of the different tillage and residue management systems in a spring wheat - fallow - winter wheat rotation on down brome populations in winter wheat. The trial site was chiseled in the fall of 1994, summer fallowed in 1995 and seeded to winter wheat. Summer fallow operations included a April application of Roundup RT, initial spring tillage in late-May with a Caulkins Chisel-Chopper, followed by two rodweedings. Winter wheat was seeded in September with a JD HZ deep furrow drill.

Before the initial spring tillage operations for fallow, downy brome seedling populations were determined on each 1994 treatment plot (Table 11). The plow and burn treatments had relatively low downy brome populations compared to the sweep - disc and 2X disc treatments, confirming the effectiveness of these practices in destroying the downy brome seed, reducing germination or reducing emergence. However, the 3-year crop rotation of spring wheat - fallow - winter wheat was also very effective in reducing downy brome seed carryover in the soil. Downy brome populations in the winter wheat crop in January 1996 were very uniform and averaged less than 0.5 plant/square foot, with no significant differences between treatments.

Table 11. Downy brome population in April 1995 of the fallow year on the 1994 Columbia County trial area on spring take-out trial with spring wheat and in winter wheat in January 1996.

Treatments	Downy brome population in April 1995 in fallow before spring tillage (plants/ft^2)	Downy brome population in January 1996 in winter wheat after fallow (plants/ft^2)
Plow - disc	3.7 c	< .5
Burn - sweep	5.1 c	< .5
Disc - disc	25.5 a	< .5
Sweep - disc	23.3 b	< .5
LSD (10%)	1.5	NS

1995 Spring Crop Choice Trial with Spring CRP Take-out in Columbia County

Four spring cereals were compared under high and low residue take-out systems at a satellite trial near the 1995 Columbia County trial mentioned above. The primary tillage treatments were moldboard plow-disc and 2X disc, followed by skewtreading, fertilizer injection and seeding with a small plot research drill. Percent surface residue cover after seeding averaged 9% after the plow and 34% after the 2X disc. Spring cereal crops included soft white common wheat, hard red wheat, oats and spring barley. Yields of all crops under the high-residue 2X disc system were equal to or greater than yields under the low-residue plow system (Table 12). Yield ranking of crops from highest to lowest on a pounds/acre basis was: barley > white wheat > red wheat > oats.

Table 12. Yield of four spring cereal crops in the 1995 Columbia County spring crop choice trial with spring CRP take-out.

Spring Cereal Crop	Crop Variety	Yield in moldboard plow take-out bu/acre (pounds/acre)	Yield in 2x disc take-out bu/acre (pounds/acre)
Barley	Baronnesse	75.9 a (3,643)	75.8 a (3,638)
Oats	Otana	54.2 b (1,738)	62.1 b (1,987)
Soft white common wheat	Penawawa	48.7 c (2,922)	48.3 c (2,718)
Hard red wheat	Butte 86	39.4 d (2,364)	40.0 d (2,400)

1995 Direct-seeded Spring Barley into Herbicide-killed CRP in Columbia County

A CRP take-out trial with direct seeding spring barley into CRP sprayed with Roundup RT was conducted in 1995 in Columbia County by David Carlton (grower) and Roland Schirman, WSU Extension Agricultural Agent. The trial site was in a 14-inch annual rainfall zone. The CRP field had been in crested wheatgrass for 9 years.

Two treatments were 1 pint/acre (16 oz/acre) and 1 quart/acre of Roundup RT rates applied on February 27 1995. The trial was then direct-seeded to Baronesse spring barley on March 4 with a Yielder drill without any prior tillage or residue management.

Percent kill of the CRP grass at planting time (4/4/95) were 58% and 78% for the 1 pint and 1 quart/acre rates, respectively. Yields of direct-seeded spring barley following the two herbicide rates were not significant different -- 3345 and 3520 lb/acre, respectively.

A small-plot satellite study on Roundup RT application rates for control of crested wheatgrass without tillage was conducted near the direct seeding trial in 1995. It was established on March 1 by Stephen Reinertsen, McGregor Co. Research Agronomist. Application rates of 8, 16, 24, 32, and 48 oz/acre gave 10, 39, 53, 59 and 80 percent grass control, respectively, in May.

Overview of New CRP Take-out Trials in 1996

Four new trials on CRP spring take-out into spring wheat are underway in 1996 in Adams, Lincoln and Douglas Counties. The following is a brief description of the field experiments and trial locations.

Direct Seeding Strategies for CRP Take-out with Hard Red Spring Wheat in Adams County

The trial is located east of Ritzville on the Dale and Gary Galbreath farm in a 10- to 12-inch annual rainfall zone. The field has been in crested wheatgrass for 9 years. Several direct seeding systems with a Yielder drill are being compared with a "conventional" tillage system using a John Deere double disc drill. All treatments were sprayed with 3 pints/acre of Roundup RT. Five treatments are included in the trial: 1) direct seed in undisturbed grass; 2) direct seeding with a fertilizer/starch blend in undisturbed grass; 3) spring flail - direct seed; 4) spring burn - direct seed; and 5) a conventional take-out system tentatively including disc, fertilizer injector, coil-packer and seeding with convention drill.

Direct Seeding Drill Comparison for CRP Take-out with Hard Red Spring Wheat in Douglas County

This trial is being conducted in collaboration with the 1996 "Fields of Tomorrow" program sponsored by Monsanto and a number of area grower and Ag support agencies and industries. The trial is located east of Waterville near Farmer on the Tony Viebrock farm in a 14-inch annual rainfall zone. The field is in its 9th year of crested wheatgrass. The grass residue was cut and chopped with a combine in fall 1995. Hard red spring wheat will be planted with a number of direct seeding drills and air seeders, and under a conventional tillage system. Direct seeding implements tentatively include: Concord airseeder; two Flexicoil airseeders; John Deere 750 drill; and standard John Deere HZ deep furrow drill. The conventional tillage comparison tentatively includes a disc, sweep, fertilizer injector, field cultivator/harrow, and seeding with a John Deere double disc drill. The trial will also be repeated in undisturbed CRP grass and in winter wheat stubble. A field day will be held at this site on June 18, 1996.

Direct Seeding Drill Comparison for CRP Take-out with Hard Red Spring Wheat in Adams County

This trial is being conducted in collaboration with the 1996 "Fields of Tomorrow" program sponsored by Monsanto and a number of area grower and Ag support agencies and industries. The trial is located west of Ritzville on the Ron Jirava farm in a 10- to 12-inch annual rainfall zone. The field is in its 10th year of crested wheatgrass. Hard red spring wheat will be planted with a number of direct seeding drills and air seeders, and under a conventional tillage system. Direct seeding implements tentatively include: Concord airseeder; two Flexicoil airseeders; John Deere 750 drill; John Deere 9450 drill; John Deere HZ deep furrow drill modified for deep fertilizer banding; and Agpro drill. The reduced tillage system comparison tentatively includes a light disc operation, undercutter, skewtreader, fertilizer injector, coil-packer and seeding with a John Deere double disc drill. A field day will be held at this site on June 20, 1996.

Spring Take-out of Tall Wheatgrass CRP for Hard Red Spring Wheat in Lincoln County

The trial is north of Sprague on the Andy and John Rustemeyer farm in a 13-inch annual rainfall zone. The field is in its 10th year of CRP and is predominantly tall wheatgrass. Four different tillage and residue management combinations will be compared. Prior to the initial field operations, half of each treatment area will be sprayed with Roundup RT and the other half left untreated. Primary treatments tentatively include: 1) flail-disc-sweep-cultivator/harrow; 2) 2X disc-cultivator/harrow; 3) burn-sweep or cultivator; and 4) disc-burn-cultivator/harrow. After the above primary tillage and residue management treatments have been established, the trial will be managed as one field with fertilizer application using a conventional fertilizer injector and seeding with a conventional International Harvester hoe drill.

Cooperative Research on CRP Take-out

Herbicide Kill of CRP Grass

Sheldon Blank, Monsanto research agronomist in Pasco, conducted four cooperative field trials on Roundup RT rates and timings on crested wheatgrass beginning in the fall of 1994. A rate study in Columbia County by Stephen Reinertsen, McGregor Co. research agronomist in Colfax, was discussed in the previous section. The Monsanto studies and highlights of the results of these small plot experiments are described below.

Fall Versus Spring Timing, Rate and Fall Residue Removal

This study by Blank was conducted in a 9-inch annual rainfall zone in 9-year old crested wheatgrass fields near Connell and Kahlotus in Franklin County. The trials were established in August 1994 with two residue

treatments: mowing and removal of the residue versus undisturbed. Roundup RT was the sprayed at 1, 2, or 3 pints/acre rates on November 28, 1994 or March 7, 1995. The crested wheatgrass had 2-3 inches new growth at both the fall and spring application times.

Results - Fall herbicide application at all rates was ineffective (0-5% control) because of grass dormancy even though grass regrowth was present and spraying conditions were good. Mowing and residue removal had no significant effect on grass kill. Spring applications rates of 2 -3 pints/acre gave 96.5 to 100% control by June and 94.5 to 99% control by October. Spring application of 1 pint/acre gave significantly lower control than the 3 pint/acre rate -- 85 to 90% control by June and 87.5% control by October.

Spring Herbicide Timing and Rate Trials Near Connell and Lind

Blank established this experiment adjacent to the large-scale CRP take-out trials near Connell in Franklin County and Lind in Adams County. Both sites were in 9- to 10-inch annual rainfall areas on 9-year stands of crested wheatgrass. Roundup RT was applied at 8, 16, 24, 32 and 48 oz/acre in March, April and May 1995. Heights of new growth at spraying times at the Connell site were 3-5 in March, 5-7 inches in April and 9-12 in May. At the Lind site, new growth heights were 3-4 inches in March, 3-6 inches in April and 6-9 inches in May.

Results - There was little difference in grass control between March, April and May applications. An early application time would conserve more soil water for a spring crop following CRP take-out. The 24 - 32 oz/acre rates gave 70+% control by June. The 48 oz/acre rate gave 80 - 99% control by June.

Nitrogen Fertility Management in CRP Take-out

Tim Fiez, WSU soil fertility specialist, is cooperating on nitrogen fertilizer trials established across the large-scale trials with winter wheat after sumer fallow in Franklin and Adams Counties. These studies are designed to help address questions on potential nitrogen tie-up and fertilizer recommendations under the different tillage and residue management systems in the field trials. Nitrogen fertilizer was applied in June at 0, 20, 40, and 60 lb N/acre rates, with the large trials fertilized at recommended rates of 40-45 lbN/A based on soil test levels. The fertilizer trial was seeded with the deep furrow drill in the same direction as the fertilizer application (across the tillage plots) and will be harvested with a small-plot combine.

Economic Analyses of the CRP Take-out Systems in the Large-Scale Trials

Doug Young, WSU agricultural economist, and Kate Painter, WSU economics research associate, are conducting the economic analyses of the CRP take-out systems for this project. The economic comparisons are getting underway and will be completed after harvest of the trials in 1996.

Soil Quality Changes with Different CRP Take-out Systems

Ann Kennedy, ARS soil microbiologist in Pullman, is cooperating in the evaluation of soil quality and microbial changes as the CRP land is returned to crop production. Samples continue to be collected and analyzed from the large-scale trials. Preliminary results show that changes in soil pH, electrical conductivity, microbial carbon mineralization, and other soil chemical and microbial parameters are taking place in the take-out treatments as compared with the undisturbed CRP soil.

Preliminary Research Conclusions and Management Strategy Considerations

Weed Management Prior to CRP Contract Expiration

Consider applying nonselective or selective herbicides at low labeled rates to begin controlling winter annual grasses and other problem weeds in the CRP grass one or two years ahead of contract expiration. Spot spraying of perennial weeds should also done as needed.

Choice of Spring Planting Versus Fall Planting

As the planning process begins for returning CRP acreage to crop production, consider the farm program provisions, economics and agronomic limitations. Depending on the farm program, base acreage restrictions may not allow complete conversion of the contracted acreage to crop production in the first year following contract expiration, so a mix of spring and fall planting may be best. Farm program changes in 1996 may also remove some crop acreage restrictions, allowing more flexible crop rotations based on crop profitability and available soil water. The following are some agronomic considerations:

Spring planting could be considered under the following scenarios:

1) Adequate soil water for a profitable spring crop
2) Shallow soils where the soil profile fills completely each winter
3) Areas where spring crops generally have a high degree of success
4) High potential for crop infestations with winter annual grass weeds, such as downy brome and jointed goatgrass

Fall planting after summer fallow period could be considered under the following scenarios:

1) Enough time and rainfall to maintain adequate seed zone soil water for winter wheat establishment
2) Areas where spring crops have not been profitable and/or the soil water content is low in the spring

Fall planting after summer fallow starting at a July CRP take-out ("current" authorized take-out time for contracts expiring in October) is not considered an acceptable option for most of the low-rainfall crop-fallow region in the Inland Northwest. Extensive soil water use by the CRP grass would probably not leave adequate seed zone water for timely winter wheat establishment, requiring later seeding after fall rains or seeding into dry soil. This CRP take-out approach could result in serious weed problems in fields with a high soil seedbank of downy brome and other winter annual grasses. This take-out timing may work in higher precipitation areas and in years with summer rains.

Fall Versus Spring CRP Take-out and Related Management Options

The results of CRP take-out research trials in Franklin and Adams Counties for winter wheat after summer fallow illustrate the potential disadvantage of fall tillage and residue removal. Compared to leaving the grass undisturbed over winter, there was approximately 2 inches lower soil water storage in the spring with fall discing. This reaffirms years of Northwest research on increased overwinter evaporative water loss from soils if much of the soil surface is exposed. The difference in water storage would have the greatest impact on spring crop yield potential in the region, although some reduction in winter wheat stand establishment was noted at the two trials.

Other fall tillage practices that remove much of the residue and bare the surface soil, such plowing or burning, would result in similar evaporative water losses over winter. Less intensive tillage and residue removal practices in the fall, such as chiseling, harrowing, and flailing caused slight reductions in overwinter water

storage. This may provide an effective trade-off by allowing less intensive tillage or direct seeding options the following spring. For example, the fall flail - spring sweep combination for fallow establishment at the Franklin County trial was the least intensive tillage system and resulted in one of the highest levels of surface residue and roughness without affecting winter wheat establishment.

Frozen Soil Runoff Areas

In areas with a high frequency of overwinter runoff on frozen soil, practices such fall subsoiling or wide-spaced chiseling (24" to 72") could be considered in the fall before CRP take-out. These tillage operations can improve water infiltration with minimal surface residue and soil surface disturbance, consequently increasing overwinter water storage potential.

Spring CRP Take-out Systems with of Spring Crops

Direct Seeding - Direct seeding systems have the potential of retaining more of the soil quality improvements gained under grass cover for the longest time compared to tillage take-out systems. Soil water conservation would also be greater under direct seeding, allowing higher yield potential if the crop can effectively utilize the increased water availability. The one direct seeding CRP take-out trial in Columbia in 1995 resulted in exceptional spring barley yields (3,300 - 3,500) with about 55 to 80 % grass control, respectively. There was no comparison with other tillage systems or with complete grass control in the study. The 1995 cooperative research trials by Monsanto on Roundup RT kill of CRP grass without tillage indicate that a 48 oz/acre (3 pints) rate may be needed to kill a high percentage (90%+) of the crested wheatgrass.

Northwest research on direct seeding spring crops after cereals in crop rotations would indicate that the nonselective herbicide should be applied to volunteer grain and weeds at least 14 to 21 days (longer if possible) before direct spring seeding to effectively **break the "green bridge"** of root diseases hosted on the roots of those plants. It is assumed that the same principle would apply to crested wheatgrass CRP take-out, although that has not been specifically researched.

An important part of the success of direct seeding would depend on having a drill that could effectively penetrate the grass residue and soil for good seed-to-soil contact and accurate seeding depth. Northwest research on direct seeding of spring cereals after cereals also shows that deep banding of fertilizer below seed depth and below or near the seed row can reduce the impacts of root diseases and increase yield potential. This management practice will likely improve yield of direct-seeded spring crops in CRP take-out.

Some residue management practices, such as flailing, may help improve drill performance in direct seeding. Using a combine to cut and chop the grass residue when it is dry in the fall worked very effectively in the Adams County trial near Lind and in preparation for a 1996 direct seeding spring trial planned near Waterville in Douglas County. It is not know how effective spring flailing would be for spring direct seeding. Spring burning before direct spring seeding would provide good seedbed conditions but would also increase soil water loss by evaporation. Another consideration with burning is the loss of grass residue contribution to the soil organic matter.

Spring Take-out with Tillage - Consider an early application of a nonselective herbicide for control of winter annual weeds and for improved kill of CRP grass. Herbicide kill would be particularly important under wet spring conditions when grass plants roots would tend to reestablish after tillage operations. Allow the recommended time between spraying and tillage to permit effective translocation into the plant roots.

More intensive tillage and residue removal systems could be warranted for seedbed preparation if growers did not have drills available for direct seeding. There is only a narrow time window between grass cover and crop establishment when the soil would be susceptible to soil erosion and water loss by evaporation and runoff. If the grass residue is burned, use a minimum tillage system with non-inversion tillage implements, such as undercutters, sweeps or cultivators, to preserve soil structure and roughness, and the limited surface residue

remaining. If the moldboard plow is used, do not use trash boards in order to retain more of the grass residue on the surface.

Plow - disc and burn - sweep treatments for seeding with a conventional double disc drill resulted in the highest spring wheat yield at the 1994 and 1995 Columbia County trials. Although the higher residue treatments of sweep - disc and 2X disc resulted in lower yields both years, the yield differences were relatively small, generally 2-5 bushels/acre. With some additional seedbed preparation or with drills that provided better residue penetration and seed-soil contact, yields would probably have been higher on the sweep - disc or 2X disc treatments.

CRP Take-out Systems for Winter Wheat after Summer Fallow

All four of the CRP take-out research trials for winter wheat after summer fallow indicate that most tillage and residue management practices used were overly intensive, resulting in excessive removal of surface residue and reduction of surface roughness. The disc, in particular, should be used with caution in very low rainfall, wind erosive areas that have light textured soils with weak soil structure, such as the Shano series. If the disc is used in CRP take-out, minimize the depth and speed of operation. The moldboard was not used in the CRP take-out trials with summer fallow, but would be even less desirable than the disc under these light soil and residue conditions.

Burning is not recommended in the crested wheatgrass CRP take-out with summer fallow because very low surface residue levels remain for erosion control. The moderate to low residue levels with crested wheatgrass generally would not warrant the use of burning to achieve manageable residue levels at seeding time after fallow. Burning does however allow the use of less intensive, sub-surface tillage implements which can maintain higher levels of soil roughness.

When tillage is used in CRP take-out for summer fallow, start primary tillage operations when there is still good surface soil moisture (not wet) on light textured soils in order to maintain adequate soil structure. Use a minimum tillage summer fallow system to retain adequate surface residue, and roughness for erosion control.

Chemical fallow and direct fall seeding of winter wheat was only included in the 1995 Garfield County trial, which will be harvested in 1996. The ability to maintain seed zone water for winter wheat establishment with chemical fallow can be a concern in low rainfall areas of the Northwest. This was not a limitation at the Garfield County trial because of early fall rains. A fallow combination of subsurface tillage, such as with an undercutter or sweep, and partial chemical fallow could provide effective grass kill with lower herbicide rates than under chemical fallow, and still effectively retain seedzone water, and surface residue and roughness for erosion control.

Fertility Management

Plant nutrient availability may vary under different tillage and residue management systems for CRP take-out. Take soil samples to appropriate crop rooting depths to determine soil fertility levels and available soil water. Growers should plan to fertilize conservatively, taking into account the soil test results, and a realistic yield goal based on the available soil moisture and expected effective rainfall. Preliminary research results indicate that fields that have been in CRP grass can have relatively high residual nitrogen levels. Excess nitrogen can lead to excessive crop growth and water stress, thus increasing the potential for dryland foot rot. Research efforts lead by Tim Fiez, WSU soil fertility specialist, should provide increased understanding of nitrogen fertility management in CRP take-out.

Other Agronomic Considerations

Choose the best adapted and disease resistant crop varieties. Use seed treatments for protection against wire worms, seed rots and smuts.

Additional Report Copies and More Information on CRP Take-out

Additional copies of this report are available at Washington State county offices of WSU Cooperative Extension, Conservation Districts, USDA Natural Resources Conservation Service and USDA Farm Service Agency. Copies can also be requested from the WSU Crop and Soil Sciences Dept. Cooperative Extension office at 509-335-2915.

For more information on the WSU CRP take-out research project contact the project leaders:

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For herbicide application recommendations, refer to product labels and the Pacific Northwest Weed Control Handbook, an annually revised extension publication available from the extension offices of the University of Idaho, Oregon State University and Washington State University. To simplify information, chemical and equipment trade names have been used. Neither endorsement of named products is intended, nor criticism implied of similar products not mentioned.

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