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High Residue Farming under Irrigation

Workshop Digest

This publication summarizes the presentations of speakers at the High Residue Farming under Irrigation workshop. For more information contact the WSU Extension office in Ephrata (509-754-2011 ext. 413, amcguire@wsu.edu).

Pesticides or uses of pesticides mentioned in this publication may not be labeled for use in Washington State.

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Why Consider High Residue Farming?

Andy McGuire, WSU Extension, Agricultural Systems Educator

1. Reasons to be interested in high residue farming
    a. To be the best farmers you can be
    b. To leave your farms in better shape than when you got them
2. What is high residue farming?
    a. It is farming while maintaining a high amount of residue on the soil
    b. It is a system
        i. Crop rotation
        ii. Cover crops
        iii. Soil fertility
            1. Soil management – this is often the main focus, but is just a part of the system. You cannot just stop tilling the soil and be successful with high residue farming
            2. Residue management - **the season starts with the harvest of the previous crop**
        iv. Pest management
        v. Equipment
        vi. Variety selection
    c. It includes reduced tillage, tined tillage, strip tillage and no-till or direct seeding. There is a continuum from conventional, clean tillage to direct seeding, of decreasing intensity and frequency of soil disturbance and increasing residues covering the soil.

Conventional tillage		**Non-Conservation tillage**	**High Residue Farming (Conservation tillage)**				
Moldboard plow	**Heavy Offset Disk**	**Reduced tillage <30% soil covered by residues**	**Reduced tillage >30% soil covered by residues**	**Ridge tillage**	**Tined tillage (chisel plow)**	**Strip tillage**	**No-till, direct seeding**
→ Decreasing intensity and frequency of soil disturbance →							
→ Increasing residues covering soil →							

    d. Reasons to consider changing
        i. Savings
            1. *"A penny saved is a penny earned"* Ben Franklin
                a. This is true in agriculture if quantity and quality of yields are maintained
            2. Fuel savings of 1.2 – 4 gallons/ac according to a local farmer's estimate, depending on the crop
            3. Machinery
                a. Fewer tractors and implements needed per acre farmed
                b. Less wear and tear on machinery used
            4. Time

a. Time savings of 7-24 minutes per acre according to a local estimate, depending on crop
b. This time can be used to farm more acres or for other pursuits
c. Direct savings if less hired labor is needed

5. Water saved (see later presentation). If power or water costs are high, as in the Odessa deep well area, a seasonal savings of $40 per acre is possible
6. While none of these savings are large by themselves, combined they are significant.
7. These savings must be considered in view of the increased costs for planter upgrades, no-till drills, and residue management equipment on combines.

ii. Soil benefits

1. Reduce or eliminate wind and water erosion
   a. Eliminates the need to irrigate in the spring to keep soil from blowing
   b. Saves pumping costs and can improves plant growth
2. Long term soil building, through different mechanisms
   a. Residue protects the soil
      i. reduces crusting
      ii. reduces/eliminates runoff
      iii. better chemigation and irrigation uniformity, without reservoir tillage
   b. Increased soil organic matter
      i. Increased aggregation
         1. Better structure
         2. Increased resistance to compaction
      ii. Increased beneficial organisms including earthworms
3. Breaks the tillage - compaction cycle:
   a. In intensive tillage systems
      i. Tillage is used to break up compaction
      ii. This creates loose soil
      iii. The tractor is operated on loose soil
      iv. This compacts the soil, necessitating more tillage
   b. In high residue farming systems
      i. Untilled soil, covered by crop residues builds soil structure
      ii. Tractor is operated on firm ground
      iii. Minimal compaction
      iv. No further tillage required

iii. Consider all the other farmers who have successfully adopted these systems.

1. 222 million acres under conservation tillage worldwide - growing fast in South America
2. 64 million acres in US is under conservation tillage
3. Local examples

a. Strip-tilled field and sweet corn into wheat stubble

b. Strip tilled sweet and field corn into various residues

c. Wheat into pea residues

d. Peas into wheat cover crop

e. Dry beans direct seeded into alfalfa and timothy

f. Alfalfa into barley residue

g. Onions into strip-tilled cover crop

h. Tomatoes in California's Central Valley

4. Farmers need more than soil benefits to make this kind of a change, they need an economic incentive. Ask yourself why other farmers are making this change?

iv. The time to change is now - things don't stay the same
   1. Fuel prices continue to increase
   2. Tillage equipment can still be sold at a good price. This will not be the case when everyone is making the change.
   3. Water issues
      a. Increased competition between agriculture and cities for water
      b. Hydropower and salmon issues
      c. Climate change effects on water supply
      d. Be proactive as farmers - use the best practices for saving water now
   4. If you do it now, it will be on your own terms at your own pace. We are behind our global competition.

e. Those who have an advantage in making the change
   i. Those who farm many acres
   ii. Farmers who pay a lot for water
   iii. Farmers with rocky ground where carrots, onions or potatoes are not grown
   iv. Custom farmers with high residue farming equipment

f. The first battle is made in the mind - you need to change your mind before you change your planter.

3. Why till the soil?
   a. In 1962, Kentucky farmer Harry Young Jr. planted the first successful no-till corn planting in US
      i. He used the tools available at the time
         1. A new herbicide called atrazine
         2. Barrels of water on his two row planter to force it into the sprayed out pasture.
   b. We now have planters that are designed for high amounts of residue. We have pre- and post-emergent herbicides, even herbicide resistant crops. We have high yielding varieties, seed treatments, and combines that can spread the residue uniformly. Why till the soil?

c. Ten years after his first no-till planting, Harry Young Jr. said "Coming generations of farmers will find it hard to understand why their forefathers found it necessary to turn, stir, sift, and comb every acre of soil every year"
d. There are still a few good reasons to till the soil; the question is whether there are still good reasons to till every acre of your soil every year? Consider high residue farming today.

Dr. Dwayne Beck is responsible for managing the Dakota Lakes Research Farm near Pierre in central South Dakota. He oversees several varied long-term applied research projects as well as day-to-day management of the facility. Since 1985, his emphasis has been on developing no-till systems for irrigated and dryland areas in central South Dakota. He works for South Dakota State University.

1. Their experience in South Dakota
    i. True low-disturbance, long term no-till systems, since 1983
    ii. No-till is a term he would like to get rid of - it's all about residue management.
    b. Dakota Lakes research farm
        i. Owned by farmers
        ii. The University does the research
            1. Short-terms studies are not accurate in evaluating treatments such as tillage or rotations which have long-term impacts
            2. On the Missouri river in Central South Dakota. They pump their water out of the river.
2. Tillage
    a. Tillage is a strange practice. Road builders disk and drive on the soil to make it harder, farmers do it "to make the soil softer"
    b. Tillage is trying to create macropores
        i. works the first time, but fills in after first rain/irrigation
    c. If you drive on a tilled field that has just been irrigated, how deep do you sink? As deep as the tillage went.
3. Why should irrigators no-till?
    a. To prevent runoff and save on pumping costs
        i. To lessen environmental effects of erosion off the farm
        ii. The research farm can now apply 2 inches of water in 9 minutes without runoff
        iii. Water drains through macropores formed by earthworms
    b. Better uniformity of water application
    c. Helps to make low pressure sprinklers work
4. Cultural practices to replace tillage.

    You cannot afford to replace tillage with technology, i.e. replacing tillage with herbicides. This is too expensive and can lead to resistance as it has in Australia and other areas.

    a. "*A change in cultural practice may not pay off in the first 1 or 2 years, but it will pay off over time*"
    b. Replace tillage with other cultural practices:
        i. Crop rotation – understanding the power of rotations is key
        ii. Sanitation
        iii. Competition.
    c. Crop rotation
        i. Crop rotation allows time (biological time) for natural enemies to destroy the pathogens of one crop…while unrelated crops are grown.

ii. Nothing is happening biologically in a bare field, but residue and cover crops add "biological crops" to a rotation
iii. A decision must be made whether to optimize the system or make necessary adjustments to allow you to get by with a less diverse rotation
iv. Crop rotation is what controls diseases, not tillage. There are three factors to consider
    1. The sequence of crops
        a. Stacked rotations (two years of the same crop) with corn:
            i. Atrazine the first year, in fall after cover crop following wheat
            ii. Then a post emergent spray, or use RR or Liberty link corn in second year
        b. W-W-C-C-B-B (W=wheat, C=corn (105-120 day corn), B=soybeans first year, edible beans second year) is a good rotation for them in S. Dakota
    2. The intensity of cropping in time
        a. We should be able to intensify our rotations here under irrigation
        b. Cover crops
            i. Cover and forage crops provide the opportunity to increase both intensity and diversity.
                1. We do not have long enough seasons to grow two grain crops, so grow organic matter - gap fillers
                2. The goal under irrigation is to have something growing at all times
                3. When residues are covered with a canopy, many disease organisms on them emerge and try to infect but when the host is not present it dies and decreases pressure on following crops.
            ii. Examples
                1. Wheat into corn residue in late October before soybeans
                2. Cowpeas into wheat stubble?
                3. Vetch/sunnhemp mix
                    a. Vetch before corn is not a problem but it may become a weed in small grain crops
                4. They plant cover crops in their continuous corn
                5. Winter lentil as cover crop, or mix of spring/winter lentils
                6. Would like to plant cover crop before crop is harvested
                7. Cover crops should be cheap
                    a. Canola at 20#/ac
                    b. Mustard
            iii. Use a roller/crimper for killing cover crops
    3. The diversity of crops
v. Advantages of good rotations
    1. Allows more acres to be farmed because it spreads out time and machinery demands during spring planting

2. Allows the use of narrower equipment because of reduced time demands during the peak planting window for each crop
3. Allows a lengthened seeding-to-harvest window
4. Profitability
    a. better yields
        i. there are yield and cost penalties associated with short rotations
    b. lower variable costs
    c. efficient use of fixed assets

vi. Remember to separate your land enterprise from your farming enterprise. Innovations and high crop prices are only profitable until land prices adjust.
vii. See publications on crop rotation at www.dakotalakes.com

d. Mother nature is an opportunist
    i. *If you have a problem, you have provided an opportunity somewhere in your system.* An example is the overuse of specific herbicides which select for resistant weeds.
    ii. Strive to produce a crop which is healthy, not a crop which does not get sick. Healthy crops can handle stress better.

5. Weed control
    a. Lack of soil disturbance will result in less weeds
        i. Weed seeds remaining on soil surface will not survive as long as those that are buried by tillage. In the long-term, this will reduce the size of the weed seed bank. It will also allow you to know what weeds you will have to manage rather than turning up a random sample of seeds every year with tillage.
            1. Seed survival at 3 depths in the soil, 0", 2", 4"
                a. 55% survived at 4", 28% at 2", and only 11% survived at surface
    b. Research has shown that diversity in rotation can control weeds in the long term
        i. Tillage and poor rotation produced 225 weeds/m^2
        ii. No-till and GOOD Rotation produced 7 weeds/m^2
        iii. That is 97% weed control!
6. Equipment
    a. Residue managers: aim for a narrow bare strip. It should not move soil - if it does, weeds are being planted.
    b. Have a positive closing system, something designed to work with structured soils, not just loose soils.
    c. After harvest using a straight header, a cover crop can be seeded behind the header or before harvest.
    d. After harvest with a stripper header, cover crops can be drilled because the residue is not on the ground.
7. Residue management
    a. The goal is to spread the residue uniformly
    b. Residue from last year's crop competes with this year's weeds until this year's crop can compete with them. It is the canopy until a new canopy is grown.
    c. Start harvest on the downwind side of the field
    d. Crops residues keep the soil cooler in spring, which can delay emergence. They also keep the soil from getting too hot in the summer.
8. Soils
    a. Soil organic matter (SOM)
        i. If you could know only one thing about a soil, what parameter would you want to know?

1. The answer is soil organic matter, because high organic matter means high productivity

ii. SOM consists mostly of C, some N, S, and other nutrients
    1. SOM = soil carbon

iii. Soil carbon is critical to soil health. It affects:
    1. Infiltration rate
    2. Water holding capacity
        a. 100 lbs of dry soil with 4-5% OM can hold 165-195 lbs of water, but with 1.5-2% OM, it can hold only 35-45 lbs of water. However, the amount of SOM does not tell you anything about its quality, nor if the amount is increasing or decreasing over time.
    3. Nutrient exchange
    4. Oxygen exchange
    5. Soil life

iv. When oxygen is present, SOM "burns" slowly producing CO_2, water, ammonia, and other nutrients. This is decomposition.
    1. This process is slowed in no-till because the soil is cooler and the material is exposed to less oxygen. The SOM in untilled soils is also more protected within soil aggregates.
    2. In untilled soils, the decomposition process occurs later in the year, when plants need the N released. With tillage, the N is released early, when plant cannot use it, and so is prone to leaching.

v. Tillage accelerates carbon cycle by adding oxygen and "burning" up carbon (residues)
    1. Immobilization is the process of making organic matter. This is not a bad thing if it is managed. It is only a problem if it occurs when the crop is growing and needs N.
    2. When plants immobilize N they also immobilize C from CO_2.
    3. With tillage-based farming, there is increased breakdown (mobilization) of SOM while at the same time its rate of formation is reduced.
    4. Nutrients lost by burning straw-Australia
        a. 75 bu./ac crop
            i. 50 lbs N/ac, 82% lost
            ii. 5 lbs P/ac, 44% lost
            iii. 100 lbs K/ac, 40% lost
            iv. 3000 lbs C/ac, 80% lost

vi. Think of C as a nutrient
    1. Only growing plants capture C
        a. C comes from the roots left behind and residues
    2. Sequestering C means
        a. growing more plants = cropping diversity
        b. growing plants longer (cover crops, perennial) = cropping intensity
        c. Managing plant growth (grazing management)
        d. reducing erosion (carbon is on top)
        e. reducing tillage (injects oxygen)
        f. keeping soil cool
        g. adding nitrogen (legumes, fertilizer, manure)

3. Because carbon levels decrease naturally, the soil needs regular additions of carbon (organic matter) to maintain its quality. Manure and compost add C
4. "*You can buy nitrogen, but it is harder to buy carbon"*

vii. Beck's hypothesis is that the attainable yield of crops may be limited by the supply of CO_2 to the plant.
1. This was thought to be an environmental constraint, the fixed concentration of CO_2 in the air, but Beck thinks it could be changed by decomposition of residue under the crop canopy during the summer.
a. The release of CO_2 from decomposing residues occurs when the crop actually needs the CO_2.in untilled soils.
b. With tillage, this release occurs just after the tillage operation which is too early because the plant is not yet established.
c. Residues that decompose after crop canopy is established could enhance canopy CO_2 concentrations
d. Plants may then respond to having more CO_2 by increasing stomatal resistance. This reduces water loss through leaves and improves water efficiency.
2. This has not yet been proven.

b. Soil microorganisms
i. Think of the microorganisms in your soil as livestock (cattle) in the field. They are the equivalent of 6-8 cows liveweight per ac.
ii. They do not do well on a diet that is not balanced - continuous cropping will reduce their diversity
iii. *"Don't bring them home unless you can feed them."* This is what happens when you get them going but then remove the residue

c. Soil fertility
i. <u>Tillage comparisons that do not use starter fertilizer are biased against no-till</u>
ii. Phosphorus
1. Soil fertility depends on having the available nutrient, moisture, and roots together at the same time.
2. With corn, the seed is the dominant P source through stage V1. Up to this point, no fertilizer nutrients are needed.
3. At stage V2, the soil becomes the dominant P source. Plant demand on the soil for P approaches a maximum – at this point the roots need to be in starter band for maximum effectiveness.
4. Put some P and K in starter, but remember that high N and K levels near the seed can be detrimental

iii. Put on fertilizer so that it does not feed the weeds.
1. Some starter P with seed
2. other nutrients placed near row at seeding or on soil surface after crop canopy closes
a. if broadcasted before canopy closes, it encourages weeds

iv. There is a problem with sampling long term no-till fields because, unlike tilled soils, they become heterogeneous.
v. *"Listen to the South Americans, not corn belt no-tillers"*
vi. Put fertilizer on with the planter to save a trip through the field

9. Water savings
a. *"Take the E out of ET"* (evaporation out of evapotranspiration)
i. Evaporation does you no good. To be productive, water must go through the plant.

ii. Residue takes E out of ET
iii. Due to water savings, they pump about 2/3 of what they did before with tillage but without runoff, half as much as tillage with runoff.

10. *"The devil is in the details"*
    a. Somebody says they had trouble with no-till, ask what they have trouble with. Factors such as equipment, nutrient management, variety selection, rotation, timeliness, etc. can have more impact on results than the factor being tested.
11. No-till websites
    a. www.no-till.com
    b. www.sdnotill.com
    c. www.dakotalakes.com
    d. www.aapresid.org.ar/english/

How does this work on the farm?

Mark Watson, with his brother Bruce, operates a family farm which has been in his family for 113 years. They implemented a complete no-till farming system on their farm in 1995, and did a variety of reduced tillage and chem-fallow farming prior to that. They farm approximately 3000 acres of dryland and irrigated crops near Alliance Nebraska, growing wheat, corn, edible beans, chickpeas, and proso millet.

1. Why switch to a no-till farming system?
    a. Profitability: better utilize resources, fuel, labor, machinery, soil and moisture to become more profitable
    a. Water savings: he pumps water from Ogallala aquifer where groundwater levels are dropping and restrictions are being implemented.
    b. Soil
        i. Crop residues improve the soil. *"Utilize crop residue; you can't have too much residue."*
        Crop residues:
            1. Act as a weed barrier
            2. Improve water infiltration
                a. prevents crusting
                b. decreases runoff
            3. Protect the soil surface
                a. breaks up rain drops
            4. Improve soil structure
                a. Aggregation, sponginess
                    i. Improved seedling emergence, and improved stands, never has had to replant a no-till crop
            5. Decrease evaporation
                a. compared to bare soil, with no crop canopy, saved about 3" of water over season
            6. Decrease or eliminate water and wind erosion
        ii. Watson has increased his organic matter from 0.8% to 2.4% over 11 years
    c. Additional benefits
        i. Diverse rotation breaks up weed and disease cycles

ii. Limits work to spraying, planting and harvesting

d. Savings from no-till farming
    i. Less machinery is required: planter sprayer drill combine and grain cart, one tractor for grain cart, leased tractor for drill
    ii. Significant savings in fuel and labor – They use only 1.4 gallons/ac over their entire rotation.
    iii. Reduced irrigation pumping costs and depreciation of irrigation equipment
    iv. Herbicide costs are similar to conventional systems
    v. Tillage costs eliminated

e. Water use
    i. Cost is $4.64 per ac-in
    ii. Conventional tillage, 5-6 operations
        1. Savings from reduced tillage passes
        2. Increased storage of winter moisture
        3. Reduction of evaporation from residues
        4. 6-8” of water saved, $37 per ac

f. More N fertilizer may be needed because the SOM is increasing. This soil building this may account for any yield drag in the first few years.

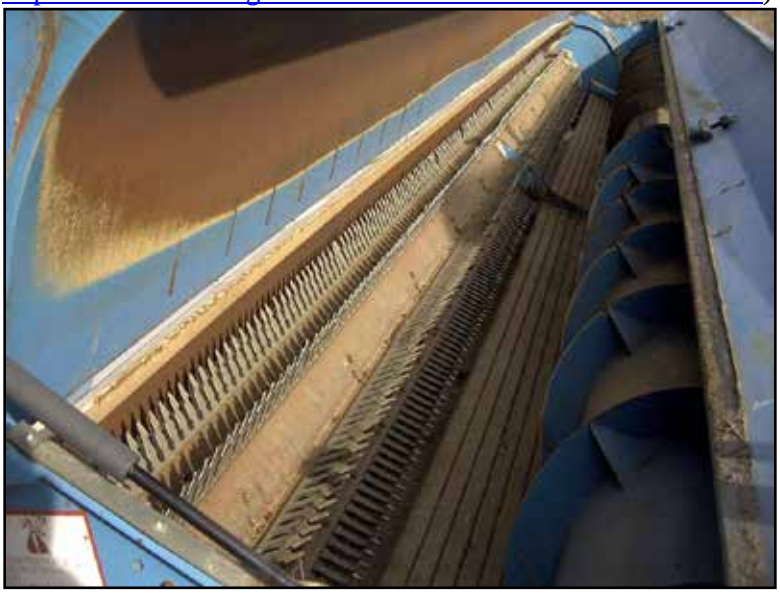
2. Watson farm details
    a. Sandy clay loam soil
    b. Irrigated rotation: wheat-dry beans-corn-chick peas-wheat
        i. Chickpeas into irrigated corn stalks

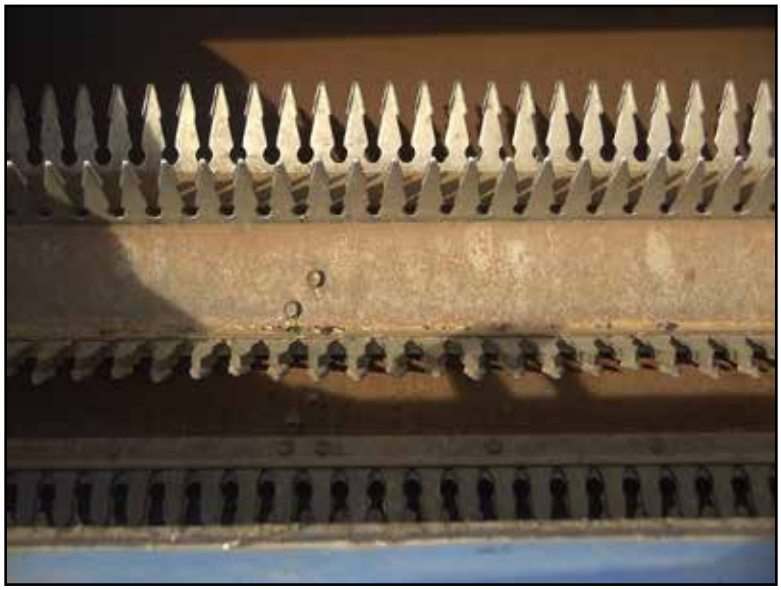
        1. Spartan is the main herbicide, with Pursuit used sometimes
        2. 15” rows, planted twice with 30” planter
        3. Harvested with flex head with air reel

    c. Compaction has not been a problem
        ii. Every 3-4 years he has to close the wheel track under the pivots

3. Equipment
    a. Managing high amounts of residue

Shelbourne stripper header for grains and beans (See http://www.ars.usda.gov/is/AR/archive/feb95/harvester0295.htm)





1. Takes the grain/beans out of the head. The rest of the residue is left standing and attached.
2. Uses less fuel because it does not handle the straw and only some of the chaff
3. Don't need to worry about distributing residue
4. Can run faster than a normal header
5. 24' wide

6. In bean harvest

   a. Watson sets the skid plates so the teeth are running about 1" above ground
   b. Upright bean varieties do not work as well with stripper header as the vine-types
   c. Beans were lost only in the row, in the area where trash managers had cleared residue out
   d. Picked up some dirt in the wheel tracks

ii. Chaff spreaders are on combine (slide)

b. Planting equipment
   i. 7200 JD vacuum planter
      1. Single disk fertilizer opener
      2. Graff trash wheels
      3. Keeton seed firmers
      4. May Wes closing wheels
      5. Able to plant into high residue and corn stalks

6. Recommends getting the hoses out of way of the residue

ii. Residue managers should not be set too aggressively. Level the planter before beginning (See Paul Jasa presentation, 2005 workshop digest).

iii. He plants at an angle to the old rows

iv. Drill

1. Single disk opener
2. Press wheel for seed
3. Closing wheel

c. Sprayer

i. Important to have your own sprayer because of improved timeliness

4. Herbicides
   a. Plan ahead at least one year.
   b. Avoid long duration residual herbicides to remain flexible in rotation.
   c. Herbicide costs are very similar to conventional farming, esp. with a good rotation
   d. One herbicide application may replace 3-4 tillage operations

Pinto beans direct seeded into stripper headed wheat stubble

e. Planted into irrigated wheat stubble, 30" rows, the first week of June. In the future, Watson wants to try planting in 7.5" rows.

f. Good stand established
g. Exceptional weed control
    i. Burndown in early spring to kill wheat
    ii. Raptor and pursuit or Raptor/Result
h. Harvested the 15-20th of September

i. See online publication with full budgets, fixed and variable costs for Watson's irrigated no-till crops compared to an intensively tilled production system.

How much water will high residue farming save under irrigation?

Andy McGuire, WSU Extension, Agricultural Systems Educator

1. Unlike some long-term benefits of high residue farming, water savings starts as soon as the soil is covered by residue.
2. Residue reduces evaporation
    a. Factors that affect evaporation
        i. Solar radiation
        ii. Air temperature
        iii. Relative humidity
        iv. Wind speed
    b. Residue affects everything but air temperature
        i. It blocks some solar radiation, especially early in the season before the canopy closes
        ii. It slows the wind
        iii. It creates a layer of higher relative humidity air by reducing air movement
            1. this reduces the difference of humidity between the soil and the air, which reduces evaporation
        iv. Residue reduces evaporation more in irrigated conditions than in dryland soils

Average daily evaporation (mm) from under a corn canopy during the growing season		
	Dryland	Full Irrigation
Bare soil	0.045	0.067
Soil covered with wheat straw	0.045	0.037

Todd et al., 1991

            1. This is because soil in irrigated fields is wet more often than in dryland fields. When the soil is wet, evaporation is only limited by the energy reaching it.
            2. In dryland, the evaporation is limited by the water movement to the surface, which not affected by residue
        v. ~4" of water saved over the cropping season due to residue cover, in Nebraska research
            1. During the winter, more water is stored under residue because of increased snow catch and infiltration, and reduced runoff
    c. Water is also saved with each tillage pass that is eliminated: 1/3-1" per pass, depending on the operation
    d. Total water saved: 3.3-6.5 inches per year

	Water savings, inches
Elimination of tillage	0.3 — 0.7 per pass
Reduced evaporation	2 — 3.8
Increased storage	1 — 2
Total:	**3.3 — 6.5**

    e. Savings depends on power costs
        i. Cost of water
            1. Deep wells: $3.60-6.25 ac-in
            2. Project water: $2.80-3.60/ac-in
        ii. Savings from high residue systems
            1. Deep well areas: $11.90-40.60 per acre

2. Project water: $9.20-23.40 per acre

	Water and power $ per ac	$ per in	Value of saved water $ per ac
Deep well water	80–150	3.60–6.25	11.90–40.60
Canal water	70–80	2.80–3.60	9.20–23.40

f. Williamson farm strip-till vs. direct seed sweetcorn study: Link to report

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What is the PNDSA and what can it do for you?

Russ Evans comes to Washington State from the short grass prairie region of East Central Alberta. He has been involved in conservation agriculture and direct seeding his entire life. Trained as an Agriculture Engineering Technologist, he designed conservation related equipment for a short line manufacturer for several years before taking on a management role for the Alberta Conservation Tillage Society. Between 1990 and 2000 Russ fostered the development of the multi-partner Farm Tech Conference and the Alberta Reduced Tillage Initiative. Both of these programs have helped Alberta achieve a 70 to 80% adoption rate of direct seed practices. He has recently taken the Executive Director position with Pacific Northwest Direct Seed Association (PNDSA).

1. PNDSA
    a. www.directseed.org
    b. Organized in 2000, PNDSA is a grower directed, non-profit, non-commodity specific, member supported organization.
    c. PNDSA's goal is to increase direct seeded acres in the Pacific Northwest. They do this by promoting direct seed cropping systems through input to research, research interpretation and information exchange. Although their main focus has been in dryland agriculture they want to begin working in irrigated areas.
    d. They are the first grower organization in U.S. to aggregate their members for a soil-carbon lease agreement
    e. PNDSA has strong relationships with environmental organizations
    f. Activities
        i. Newsletter
        ii. Website
        iii. Annual direct seed conference
        iv. Peer support when moving to and developing a direct seed system
    g. What can PNDSA do for you?
        i. Direct input to shape government policy and programs
        ii. Carbon market establishment
        iii. Aggregate farmers for carbon sequestration payments
        iv. Provide direct input to research community on grower's needs

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Challenges and opportunities in high residue farming - Panel session

Dwayne Beck, Will Reed (Basin City farmer), Mark Watson, Alan Williamson (George farmer)

1. Backgrounds
    a. Beck and Watson (see earlier presentation summaries)
2. Williamson
    a. Since starting to strip-till in 2001, they have used the practice on 4600 ac of sweetcorn and peas.
    b. Experience/Lessons learned:
        i. Has planted into mint, alfalfa, bean straw, wheat, corn, timothy, and bluegrass.
        ii. They did not use the strip-till shanks in the bluegrass, but the coulter and disks alone worked well in the firm sod and produced a very even stand of sweetcorn.
3. Reed
    a. Started direct seeding some corn in 2004 with his brother. Later they bought a planter that could band fertilizer.
    b. Does some custom no-till work
    c. Experience/Lessons learned:
        i. Has direct seeded into an old hay field
        ii. Found that when cattle were left to graze a corn field for a long time, they knock everything down making planting difficult.
        iii. He agrees that "upright and attached" residues are easier to plant through than those loose on the soil.
4. Questions
    a. *What can you do about problems with establishing direct seeded peas in the tractor wheel tracks after a wheat cover crop that was minimally tilled in th*e *fall?*
        i. Over several years, the soil will firm up if tillage is eliminated, then this will not be a problem
        ii. More cover crops will help this process along, while also reducing compaction risks
            1. Oats would have better root system in the fall than wheat
    b. *What is needed to plant through corn stalks?*
        i. Do not plant wheat into corn stubble, because of fusarium head scab
            1. Wheat after corn for cover crop is OK
        ii. Beck has used a Corn-Corn-broadleaf (like peas) rotation, then cover crop and winter wheat
            1. The large seed of the broadleaf helps it to emerge through all the stubble and allows it to be planted deep, through heavy residues.
            2. Peas like cool temperatures under heavy residues
        iii. Residues which are upright and attached will help. Watson does not graze his fields for this reason.
            1. Upright and attached residues will not decompose as fast which is fine if that is what you want
        iv. Use a cover crop to get a canopy over the top of residue going into winter. This raises the humidity in the residue and it decomposes more quickly.
        v. Bt corn stalks are tougher to slice through than non-Bt stalks
    c. *Is it necessary to fertilize plants with starter?*
        i. Until the crop emerges all the plants nutrients are coming from the seed
            1. In Australia, the seed is tested for N-P-K and micronutrients
        ii. Starter P should be placed right in seed trench, about 1/3 of total, NOT under seed because the plant will not reach it there when it needs it
        iii. Put other fertilizer 2" to the side of the seed trench
    d. *What about earthworms*?

i. Beck: nightcrawlers and field worms should be there, but nightcrawlers will not be stay around if there is any disturbance because they have burrows.
ii. They seeded earthworms at Dakota Lakes research farm. They must have the right habitat for them to survive which means a good residue cover. Horizontal burrowers are valuable and will take some disturbance.
iii. Worms do not do as well in sandy soils

e. *What is the drill of choice?*
   i. Watson: 750 JD drill or other single disk drills
      1. Goes through residue well - the only thing that he has found that will handle it
   ii. Beck: Any modern corn planter will do but drills are not there yet. The South Americans all use double disk drills, but the difference is that they are offset with two different size disks.

f. *How do I get started?*
   i. Watson
      1. Don't be afraid of the change - it is not that hard. Make the decision to try it.
      2. Look at it as a learning experience
   ii. Williamson
      1. Get over the visual impact of a residue covered field – they are not pretty according to past standards
   iii. Reed
      1. Take small steps, a small field or portion of a field
   iv. Beck
      1. Look at Beck's publication on how to make the transition
      2. Economically, the best way to switch it to change it all at once. Or do it on one field for several years.
      3. Do it on a field big enough so that it will hurt if you mess it up, so that you will pay attention to it. Don't put it on the back 40; put it out in front of everyone.
      4. Talk to people who are doing it - look to South America.