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Big Bend Community College, Moses Lake, Washington

Reduced Tillage under Irrigation

Workshop Digest

This publication summarizes the presentations of speakers at the Reduced Tillage under Irrigation workshop. For more information, or to purchase a DVD of the workshop, contact the WSU Extension office in Ephrata (509-754-2011 ext. 413, amcguire@wsu.edu).

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Workshop agenda

Why consider reduced tillage now?, *Andy McGuire, WSU Extension*

Has anybody tried this here?, Producer panel:

Tim Melville, Enterprise, Oregon

Eric Williamson, George, Washington

What is Possible? Experience with Irrigated Systems in Nebraska, *Paul Jasa, University of Nebraska-Lincoln (UNL)*

How are these systems managed?, *Paul Jasa, UNL*

How do soils respond to reduced tillage?, *Stewart Wuest, USDA-ARS, Pendleton, Oregon*

How does reduced tillage affect fertilizer application?, *Guy Swanson, Exactrix Global Systems*

What kind of equipment do I need?, *Paul Jasa, UNL*

Where do I start?, *Justin Mount, NRCS, Ephrata,* *Paul Jasa, UNL*

Why consider reduced tillage now?

Andy McGuire, WSU Extension, Agricultural Systems Educator

Reasons to consider reducing your tillage:

1. Decreased costs:
    a. High fuel costs and high probability of increased fuel costs in future
    b. Equipment
        i. Higher start-up costs, but lower in long-term
        ii. Reduced need for tillage equipment
        iii. Less wear and tear on tractors per acre farmed
    c. Labor, less time in the field or potential to farm more acres
2. Improves soil (see Stewart Wuest presentation below)
3. Reduced wind erosion
4. Increasing pressure to cut other costs; fuel, equipment, labor, because of increasing N fertilizer costs
5. Potential with reduced tillage to use some legume cover crops for N
6. The competition is cutting costs by reducing tillage
    a. Overseas; Brazil, Argentina
    b. California

Why reduce tillage?

1. Often not needed
2. Reasons we till the soil:
    a. Control weeds
    b. Move soil for seed insertion
    c. Modify soil surface
    d. Manage crop residue
    e. Add soil amendments
    f. Control insects and diseases
    g. Loosen soil
3. What is needed for good crop growth?
    c. Firm soil for seed and seed-soil contact
    d. Low strength soil for root development. Soil structure, pores from earthworms, and old root channels become important in untilled soils.
    e. Permeable soil surface. This is not generally an issue with surface residues, built up soil structure, and aggregation in untilled soils, unless compacted.

The tillage - compaction cycle:

1. Tillage used to break up compaction
2. This creates loose soil
3. The tractor is operated on loose soil
4. This compacts the soil, necessitating more tillage

High residue farming systems can break this cycle:

1. Untilled soil, covered by crop residues builds soil structure
2. Tractor is operated on firm ground
3. Minimal compaction
4. Reduced costs

Farmers are making rational decisions about what tillage is needed based on the needs of the plant, not based on tradition or appearance of the fields, and those who have made the change find that they can get away with much less tillage than is normally done.

There are farmers successfully reducing tillage under irrigation in this region:

- Peas near Walla Walla
- Strip-tilled sweet corn near George and near Tri-Cities
- Add-on chaff spreader being used South of Moses Lake
- Tim Melville and Eric Williamson will speak about their experiences

High residue farming systems require management

- Reduced tillage, whether you are doing no-till, strip till or something else, is a system. It is not just planting through residue…

Places to go for help

- Justin Mount, with NRCS will talk about their programs.
- Other speakers will give advice on how to get started.

Has anybody tried this here?

Tim Melville farms near Enterprise, Oregon, and has over 20 years of direct seeding experience. He and his sons farm 2000 acres, growing spring and winter wheat, barley, peas, canola, alfalfa, and white Dutch clover, all under irrigation. Tim is currently on the board of the Pacific Northwest Direct Seed Association. For a case study of the Melville farm, see http://pnwsteep.wsu.edu/dscases/ext_pubs/pnw0526.pdf.

1. The Melville farm has been 100% no-till since mid-80s
2. Management
    a. Requires intense management
    b. Starts with managing the crop residue with the combine. The chaff must be spread properly, not just the straw. Straw is managed mostly with a heavy harrow and time – it deteriorates over winter if it is touching the soil.
    c. Management also required for water, fertility, and pests. Slugs are the only new pest he has noticed.
    d. Crop rotation is the heart of a good system for weed and disease control
    e. Weed control-less herbicides
    f. Disease control- less fungicides
3. Equipment
    a. He uses a Concord drill, 10" spacing, and also a Yielder disk drill
    b. Spray rig. He sprays more often, but only uses glyphosate once a year.
    c. Heavy harrow. This is used for residue management after harvest when straw is very dry.
    d. Combine. This must be set up to distribute straw and chaff evenly
4. Crops
    a. Wheat and peas are the cash crops
    b. Barley
    c. RR canola for weed control
    d. Alfalfa for setting up wheat crops and to control wild oats
    e. Timothy hay
    f. Pacific gold mustard - good for next wheat crop
5. Rotation
    a. Wheat into peas is simple and his favorite direct seeding situation
    b. Alfalfa into barley residue; a challenge to seed at right depth with small seeds
6. Why he direct seeds:
    a. Saves time: 7 min/ac planting and spraying with roundup, vs. 24 min/ac with conventional system, without accounting for rock picking
    b. Fuel savings: 1.2 gal/ac vs. 4 gal/ac for conventional system
    c. Water savings: 0.5" of water loss per tillage operation. Pumping costs him $4 per acre-inch.
    d. Environmental reasons
        i. Cleaner air, less dust, less CO_2 released. PNDSA is involved in carbon sequestration work.

ii. Not burning fuel and not burning carbon (C) in soil
iii. Wind and water erosion controlled
iv. Increases soil organic matter

e. Soil quality=organic matter
i. Seed+H2O+C+NPKS+sunlight=organic matter
ii. Organic matter + plow=H2O+C+NPKS
iii. Organic matter is a savings account in the soil, but it does cost money to build OM levels
iv. Benefits of increased soil organic matter:
1. Water infiltration. He runs his pivots in a 4-day rotation, applying 1" of water with no runoff.
2. More earthworms. He has imported nightcrawlers into his fields.

7. He recommends membership in the Pacific Northwest Direct Seed Association, http://www.directseed.org/. This tri-state organization, started in 2000, has over 300 members.

Eric Williamson is part of a family farming operation near George, Washington. They have been strip-tilling corn for five years and have planted over 8000 acres total of sweet corn and field corn for themselves and others.

Their first question when they started was how much yield would be sacrificed to do this? They discovered that they did not have to sacrifice any yield, *if* they managed it well. Their sweet corn yields beat the yearly average for their processor.

1. Equipment
a. Tracked tractor
b. John Deere planter behind a custom built strip tiller
c. Strip tiller setup:
i. Yetter residue managers
ii. 24" DMI coulter
iii. DMI minimum disturbance shank, set 14-18" deep
iv. DMI berm builders
v. A rolling basket to pack berm
vi. On the planter: residue movers, Nutri-mate fertilizer injection, True-Slot opener, and angled closing disks.
d. All of this is attached to the tractor with two point connection and lift assist wheels
e. Autosteer guidance is almost required for this setup. They use JD's Greenstar system.
2. Planting conditions encountered:
f. Corn stalks
g. Grazed stalks
h. Volunteer wheat
i. Cover crop wheat up to 16" tall when sprayed, with excellent yields
j. Triticale, grazed
k. Pea vines

    l. Mint stubble
    m. Alfalfa, sprayed before cutting or regrowth sprayed after cutting
    n. Timothy stubble (killing the timothy is challenging)
    o. The key to handling all of these conditions is where you put the seed
3. Why they strip-till:
    a. To control wind erosion and reduce the irrigation needed for erosion control which has led to over-irrigation of crops
    b. Preemergent herbicides work better without extra irrigations for wind control
    c. Saving 2-4 passes or $20-$30 per acre. They do no tillage before strip tilling in the spring.
    d. Reduced the number of tractors they needed
    e. Better utilization of their tractors
    f. Reduced labor during corn
    g. Equal yields
    h. No need for further operations on field
    i. Increase of soil organic matter over time - now up to 1.5-1.6 % after several years
4. Challenges
    a. Adjustment of equipment takes time
    b. More skill required to drive the tractor because there is more to watch
    c. Their setup requires 30-35 hp per row to pull
    d. Eliminates cultivation as an option
    e. Makes them dependent on herbicides
    f. Must have fertility good before planting, esp. P and K - put P on the year before.
    g. Some additional tillage is required at times to get it right
5. Plans for the future
    a. Fine tune the planter
    b. Working on no-till for small grains

What is possible?

How are these systems managed?

What kind of equipment do I need?

Residue, Soil Structure and Water Infiltration
Residue, No-till and System Management and
No-till Planting Equipment, Adjustments, and Operation

Paul Jasa works at the University of Nebraska at Lincoln as an agricultural engineer. He has more than two decades of experience in research and development no-till cropping techniques. A winner of the 1999 no-till innovator award, Paul shares his no-till experience around the country and internationally.

1. Tillage
    a. Tillage is used to create uniform conditions from the wet spots, dry spots, and residues in the field. However, tillage destroys soil structure and destroys the good seedbed provided in untilled soils.
    b. Using tillage to dry out wet areas compacts the soil and makes it wetter in the next year
    c. Tillage fluffs soils temporarily
    d. Tillage plants weed seeds. Long term no-till reduces weed pressure allowing use of lower herbicide rates
    e. Tillage destroys soil structure. If there is a compacted layer, then ripping may be necessary, but then leave it alone after ripping.
2. Reduced tillage
    a. In Nebraska, reduced tillage is worse than full width tillage because while full width tillage destroys soil structure, it does makes things uniform. Reduced tillage reduces uniformity.
        i. Saves some money but continuous no-till is better
        ii. Soil structure will never build in full width tillage, which is never uniform nor consistent in reduced tillage because any portion of the field may be tilled the next year, unless you practice controlled traffic
3. Strip till
    a. With strip-till, keep P applications close to rows
    b. Cut through compaction zone (root-restricting layers) from years of tillage
    c. In strip tilled conditions, bare soil gets colder at night than residue covered soil, radiates heat out faster, temperature at 6 am is lower than the temp under residue, wider temp swings, more stress on seedling

d. Fall strip tilling better than spring, soil reconsolidates over winter and problems are not as severe
e. Requires lots of horsepower

4. Compaction
    a. There can be full width compaction from tillage or wheel track compaction. Both involve loss of pore space in the soil.
    b. With firm soil (no-till conditions), compaction is less in wheel tracks
    c. If you do not leave a track on firm soil, you are not compacting the soil, the pore space is not leaving
    d. To manage the wheel track, use wider tires or tracked tractors, which apply less pressure on soil and have more axles carrying the load
    e. "If you are concerned about compaction, you don't own a disk"
5. Deep tillage, ripping
    a. What to do if you have a plow pan:
        i. Fracture it with tillage below the plow pan
        ii. Disrupts the soil structure
        iii. Tillage afterwards - disking, smoothing, and packing - will recompact the soil, effectively moving your moldboard plow pan at 8" to a chisel plow pan at 12" deep
    b. If you have to do deep tillage:
        i. Shank spacing = operating depth of rippers/chisel plows
        ii. Ripping in fall is best, then plant over slots
        iii. Must get below compacted layer
6. No-till system
    a. No-till is a system to be managed. There is no recipe for no-till.
    b. The key is to strive for uniformity in the field. Uniformity of residue distribution, of crop stand, of application of water, fertilizer, and pesticides. Problems occur when conditions are not uniform.
    c. Residue management
        i. Residue makes the system work
        ii. The key is to spread residue uniformly. When seeds are under the same amount of residue, they all emerge at the same time
        iii. Residue absorbs water impact from pivots, especially large drops from drop nozzles
        iv. Without residue, you get crusting because the soil is not protected. Residue on the soil is the most cost-effective erosion control
        v. Vertical tillage with Aerway, rotary harrows, etc. is not needed if you have good soil structure
        vi. Residue is easiest to handle if it is anchored, attached, and standing upright. This speeds soil drying and warming and you do not have to cut the residue at planting. Loose residue can move with water, wind or with your planter.
        vii. With long term no-till residue disappears faster
        viii. Combine considerations
            1. Spread residue at harvest with the combine
                a. The new style choppers are not good enough for wide heads
                b. Spread chaff - do not have chaff windrow

c. With chopper and chaff spreaders, the need for harrowing is eliminated or minimized
d. If the residue is left standing upright, anchored, and attached, you do not have to cut it with planter
e. Example of an irrigated no-tiller who has a 7-pivot average corn yield of 265 bu/ac, and no-tills back into that level of residue in the spring. He can do this because he is practicing continuous no-till and his Cat combine spreads residue and processes the stalks well.
f. It is easier on equipment to plant in same direction as the combine. To do this you must match combine and planter width, or multiples of widths.
g. John Deere (JD) combines have to run high to reduce ear toss, due to intermeshing stalk rollers. The old tapered stalk rollers are better.
h. The Cat and Case-IH combines run knife-to-knife stalk rollers which minimize ear toss so that the head can be set lower. Knife-to-knife stalk rollers crimp and crush stalks, but do not break them, so that breakdown is faster.
i. One solution is to put lean bars on front of planters to push stalks over so they do not touch equipment

ix. Cover crops
1. Harvest excess water
2. Help break down residues after harvest. The microclimate under the cover crop canopy helps decomposition.
3. Add organic matter to soil

d. Weed management
i. Never let weeds get started. He uses residual herbicides early, before planting. He never used burndowns for many years when roundup was expensive.
ii. Apply residual herbicide in early April at 2/3 rate, then 1/3 rate at planting and skip the burndown
iii. Only uses Roundup for volunteer wheat control after wheat
iv. Rotate herbicide products between four modes of action
v. No product is used two years in a row
1. RR soybeans
2. Post emergent in corn, typically buctril, banvil or atrazine if needed
3. Pre-emergent in corn is Dual, with atrazine, Bicep
4. Pre-emergent in beans is Prowl
vi. Do not use flood jet nozzles for herbicides - they are for fertilizers. Use flat fan nozzles with 100% overlap
vii. Know your weeds
viii. 2,4-D in fall to kill winter annuals and perennials

e. Soil structure
i. When you park the tillage tools and go no-till, for the first and second year there is not much soil structure

1. After year 3+ years of no-till, the soil begins to behave differently
2. Continuous no-till builds soil structure. A tillage rotation will not build soil structure.

ii. Do some digging in your fields
1. Cone penetrometers do not tell us much unless used carefully. The results are heavily influenced by water content. They do not tell us about pores in soil structure, cracks, etc. Look at the roots - how deep do they go?
2. If you cannot identify a root-restricting layer, you do not need tillage

iii. With good soil structure, excess water is not a problem

iv. Tillage rotation does not work - the soil structure does not build

v. When beginning to no-till it was necessary to fill pivot tracks, but as soil structure built up this practice was eliminated

f. Irrigation
i. Every time the pivot goes around, the first 0.1" of water is lost to evaporation off the canopy and residue. The more often you have to irrigate, the more of these losses you have. Under no-till with residues you can irrigate less often and save water.
1. Residue vs. no residue; 3-5" more needed with no residue because of increased evaporation
2. Residue reduces evaporation from soil, particularly under irrigation

ii. Use a more intensive cropping to make use of the water saved in no-till

g. Planting
i. A no-till planter must perform these four steps:
1. Cut residue
2. Penetrate soil to desired seeding depth
3. Get seed-to-soil contact
4. Close seed slot

ii. **Step 1**, Cutting the residue
1. Look at the angle of contact between the disk blade and the residue/soil. If it is 30-40°, you can cut residue without a coulter.
2. Bigger planting disks are better, 15"+
3. Coulters
a. Best to have a planter that does not need the coulter
b. Hairpinning goes away by taking off the coulter and adjusting the disk opener for proper cutting edge contact angle with residue
c. Disk openers are much sharper than coulters
d. Coulters can be used in abrasive sandy soils to take wear instead of the opening disks
e. Wavy coulters can bring up mud in wet sticky conditions making it difficult to get seed-to-soil contact and to close the planting slot
f. If you run coulters, set them at seeding depth and not below, and use as narrow a coulter as possible to minimize soil disturbance

g. If there is long residue in field, and you have a less vigorous crop like sweet corn, then a coulter in front of residue movers can help cut the residue so the movers can part it. In this case, the coulter is placed off to side of seed location just to cut residue not to cut soil.

4. Residue movers
    a. You will not get reduced evaporation from residues if you move them
    b. Residue movers can push soil as well. They disturb your uniform conditions of temperature and moisture.
    c. After 3-5 years of no-till, you build up a residue mat and residue movers will not be needed
    d. If you are going to use them, use the spoked finger type
        i. They move residue without moving the soil
        ii. If they are turning more than half the time, they are set too deep. Set them so that they only move piles of residue, or deep areas. If there is no residue, they should not be moving soil.
        iii. They will pay during the first few years of no-till, until a residue mat builds up
    e. Spiked residue movers do not work well into corn stumps and stalks. They are not designed to handle corn root balls and are better for wheat and bean residues.

iii. **Step 2**, Penetrate soil to desired seeding depth

1. Openers
    a. Think about the four steps with hoe openers on drills. Look for narrow, minimal soil disturbance - disk openers are better.
    b. Disk opener drills need extra weight because of the number of rows and down pressure required
    c. Shank openers require more horsepower than disk openers
2. Row down-pressure
    a. Set down-pressure springs for seeding depth. 300 lbs or more per row should be available from down-pressure springs
    b. As springs are added, weight may need to be added to the planter. Use suitcase weights if possible. The more you have going into the ground, the more weight is necessary to keep it in the ground, e.g. fertilizer openers.
    c. Folding wings on planters should be pinned if possible to transfer weight to rows

iv. **Step 3**, Get seed-to-soil contact

1. Keeton seed firmers, perhaps better for dry conditions
2. Rebounders, perhaps better for wet conditions
3. Both good for corn, where depth is important

4. Spiked closing wheels can leave holes that dry out the seed zone - follow with a drag chain to fill in the holes
5. In dry conditions, try a high camber on angled spiked wheels. HCS system (http://www.exapta.com/)
6. Other devices can also be used to press the seed into the soil

v. **Step 4**, Close seed slot
   1. Closing devices
      a. Cast iron press wheels can cause problems in higher clay or moisture conditions. They are too aggressive in these conditions.
      b. Stick with standard rubber tires and angled press wheels
   2. Steps 3 and 4 are separate - think about them that way and do it separately on the planter
   3. Look at where angle of press wheels intersect in the soil. Is it at the seed or below it? In no-till soils, the press wheels may not close the seed slot, but they should give seed-to-soil contact.
   4. Even if the slot sidewall is compacted or smeared, you can fracture this if the press wheels are setup to close seed slot properly
   5. If seed-to-soil contact is there, do not tighten down press wheels. Let some other tool close the slot.
   6. If you are having problems closing the seed slot, check to see that the planter is properly leveled to slightly tail down?
   7. Use a furrow slot closer for shrink-swell clays
   8. Wide press wheels do not fracture sidewall very well
   9. Notched disks with depth control can be used to close the seed slot
   10. If you replace angled closing wheels with spiked wheels, they will close seed slot, but they do not give seed-to-soil contact – think of steps 3 and 4 separately

vi. Row location
   1. He plants down old rows in a corn-soybean rotation
      a. Do not plant in wheel tracks from previous year, use controlled traffic if you can and match up your equipment widths
      b. Keep all traffic off the rows
      c. In corn after corn, move a couple inches to the side but stay out of wheel track
   2. He plants corn, beans, sorghum, and wheat at 2” depth

vii. Planter adjustment
   1. In early spring, test your planter to see how much down pressure you need, check it when it is empty as that is the hardest time to penetrate the soil
   2. Make sure that toolbar is the right height so that parallel links are running parallel to the ground. If toolbar is too high, the springs do not work. If too low, you break springs.

3. Once it is leveled, set it slightly tail down in back. This raises the residue cutting point of the openers and improves seed-to-soil contact
4. Try blind planting (without seed)
5. Stop with the planter still in ground
    a. Check the gage wheels to see if they are firmly in contact with the ground, you should be able to barely turn them
        i. If it spins freely, something is holding you out of the ground. Try tightening springs or adding weight.
        ii. If you cannot move the gage wheel and it is leaving tracks, loosen the springs
    b. You may need to change spring pressure in dry vs. wet conditions
6. Add seed and plant; check depth, spacing, seed-to-soil contact, and closing of seed slot
7. Do all this a couple weeks before planting so you have time to fix it

viii. A 1970's John Deere MaxEmerge is all that is need to do no-till planting if it has the required weight and springs for down pressure

h. Soil fertility
    i. Manure
        1. For incorporation, use Aerway
        2. Inject it (hog manure)
        3. Put it on top if incorporation is not required by law
    ii. Fertilizer
        1. Recommends fertilizer placement indexed to the plant row
        2. They apply anhydrous in March. Reasoning: How many days do you have to plant? Maybe two weeks. How many days do you have to put on fertilizer? Many more. Putting it on early will not slow down planting.
        3. They apply a starter and popup at planting
        4. The starter attachment for JD, a single disk with single depth wheel, is well suited for no-till. 2 x 2 placement for tilled soil, 2" below, 2" beside, but the roots in no-till are more spread out. Therefore, for no-till conditions he places it 4" to side.
        5. Put down P with planter, in furrow or broadcast
            a. In tilled soils, plant roots do not get to broadcasted fertilizer
            b. In no-till soils, broadcast fertilizers are available because the surface stays wetter and roots penetrate it. It is similar to broadcast applications in pasture, rangeland, alfalfa, and lawn situations where P does not have to be incorporated.
            c. In-furrow popup is OK
        6. Broadcast N can be lost to the air. UAN solution can have losses if not incorporated by water or injected
    iii. Air spreaders can broadcast P and K in no-till, but not N

iv. Look for minimal soil disturbance when applying fertilizer. To apply anhydrous-N in no-till, use a C shank with coulter in front to cut the soil. Coil shanks are for tilled ground.
v. Use your no-till planter to apply fertilizer even when not planting, as custom work
vi. Popup fertilizer
    1. Needed for early plantings because roots are growing slower
    2. Place right with the seed
    3. Low rate; 5 gal 10-34-0
    4. Can be placed with Keeton seed firmer
vii. Lime, put on top, moves 0.5-1" per year in no-till, a long term investment

How do soils respond to reduced tillage?

Stewart Wuest is a soil scientist with the Agricultural Research Service in Pendleton, Oregon. He has done research on the effects of reducing tillage on soils, water infiltration, and seed germination.

1. The effects of tillage:
    a. Rearranges soil structure that may have formed
    b. Mixes surface residues into soil
    c. Provides a *temporary* increase in water infiltration, usually for only the first half inch of precipitation. The infiltration of further applications of water is slower
    d. It either requires further tillage to maintain condition or ending tillage to let soil structure build for long-term improvement of infiltration and other soil properties
2. Description of research:
    a. Measurements made in spring, late winter
    b. In dryland area, with loess soils
    c. Measured ponded infiltration
3. Results:
    a. Infiltration
        i. Infiltration was always greater in stubble than in growing wheat
        ii. In long-term studies, no-till soils have higher infiltration rates than conventional tilled, up to 10 in./hour
        iii. Infiltration rates by primary tillage practice: minimum-till > disk, chisel > spring plow > fall plow
        iv. Infiltration differences exist even with disturbed soil samples, so tilling will not necessarily help, except in the very short term
        v. The longer a soil remains untilled, the more pathways are formed for water movement
        vi. Intensive tillage tends to decrease water infiltration capacity, soil organic matter, and soil aggregation
    b. Soil carbon/organic matter
        i. Infiltration rates correlate with the levels of water stable aggregates which correlate with the total carbon (organic matter) in soils. Small additions of organic matter can really help infiltration.

ii. The potential to increase organic matter limited by precipitation and temperature. [With irrigation, water is not limiting and so there is the potential to increase organic matter levels]

c. If residue is buried at 6-8", moisture and oxygen levels are optimal for decomposition

d. We have very weakly aggregated soils due to low levels of organic matter and clay. Therefore, they are extremely fragile with the soil particles free to move and form crusts.

4. Seeds can germinate without contact with liquid water; seed-to-soil contact is not needed. What is needed is a humid environment, with relative humidity near 100%.

Where do I start?

Justin Mount, Agronomist, NRCS, Ephrata Field Office.

1. Relevant NRCS programs: Environmental Quality Incentives Program (EQIP), Conservation Security Program (CSP)
   a. Programs are administered through the Big Bend Local Working Group
   b. EQIP funds direct seed, strip till, no-till (329 standard),
      i. Competitively ranked and funded projects
      ii. $2 million available for this region in 2006
      iii. deadline for applications, 1/13/06
2. Contact NRCS, 509-754-2011 Ext. 3.

Tim Melville:

- Do as much research as you can
- Attend workshops like this
- Watch other farmers who are making it work
- Start small, hire neighbor to do planting for a few years, pick best soil to try this on
- Have to make the plunge, commit to making it work

Paul Jasa:

- Use crop roots as report card: dig them up with a shovel, look at roots, black spots in soil are decaying roots. Then ask, do you have a soil structure problem? If not, park the tillage tools that destroy soil structure.
- Residue comes first, soil structure comes later
- If you think no-till will work or no-till will fail, you are right. It requires management.

Assembled and edited by Andy McGuire, WSU Extension, WSU Center for Sustaining Agriculture and Natural Resources.