

# No-Till On The Plains 2001 Speakers - Matt Hagny

## Southern Plains Cropping

**Topic Description: Crop rotation is the oldest and most effective method of weed and pest control which, if exploited, results in higher yields and lower production costs while spreading risk and workload. Good rotations are essential to a no-till production system, and will differ greatly from rotations commonly used in tillage-based systems for any particular location.**

I. Loss of crop diversity -- central KS & OK wasn't always monocrop wheat -- what changed?

A. Technology

B. Gov. Programs

C. Climate shift

D. Economics

E. Declining soil quality (OM, structure, erosion)

II. What did we lose along with crop rotations?

A. Crop health and pest control

1. Insects & diseases more effectively suppressed with crop rotation than with pesticides (breaks cycles: some years without a host crop)

2. Rotated crops recover nutrients better

3. Because of 1&2, rotated crops experience better health, which further suppresses weeds, insects & diseases -- a reinforcing loop

4. Weed control with rotation

a. Crops competitive at different times & in different ways

b. Herbicides applied at different times

c. Allows herbicide chemistry to be more varied

B. Diversity also spreads workload and risk

1. Different seeding/spraying/harvesting dates permits lower machine costs per acre (more acres per year with each machine)

2. Weather/pests/markets often favor a certain crop on any given year

3. Relieves boredom

C. Crop rotation beneficial to soil health (soil organisms, structure, etc.)

1. Different rooting patterns, root exudates, C/N ratios of residues, etc.

2. Studies of these interactions are in their infancy

3. Measurable effects (crop yields, profits, system resiliency, soil structure & OM) indicate better soil health with crop rotation

III. What did we gain from monocropping? Anything?

IV. No-till systems and crop rotation

A. No-till *permits* rotations not possible with tillage.

B. No-till *requires* rotations different from tillage-based systems

V. What is no-till?

A. Continuous

1. Benefits accrue w/ each additional year of no-till

2. Therefore, tillage no longer considered an option

B. Systems approach to crop rotation, pest control, crop establishment & care

C. Ultra-low soil disturbance: very narrow slot created by disc opener to place seed and/or fertilizer (no soil inversion, no residue destruction)

VI. What advantages does no-till offer?

A. Drastically improved moisture retention and availability

1. Better infiltration

a. Crop residue protects soil structure from damage by raindrops

b. Macropore preservation

c. Residue slows surface water movement

d. Soil structure allows deep storage of moisture reducing interference w/ field operations & plant growth

2. Reduced evaporation

a. Sunlight reflectance

b. Reduced air movement across soil surface

c. Moisture stored deep in profile

3. Increased OM stores more water

4. Better root & mycorrhizal exploration & extraction

B. Elimination of stand-establishment problems (if well managed)

1. Crusting can be avoided entirely

2. More likely to have adequate moisture in seed zone for germination

C. Other micro-climate changes

1. Greatly reduced winterkill (in fall-established wht or canola)

2. Temperature moderation

D. Builds populations of beneficial organisms

E. Nutrient recovery often improved

F. Soil erosion & nutrient runoff eliminated

VII. Disadvantages of no-till adoption

A. Requires some changes in equipment

1. Machinery investment can be lower with no-till than conventional

2. Machinery must be designed or modified for no-till system

B. Initial unfamiliarity with no-till techniques

1. Information is available: conferences, consultants, other farmers, researchers

2. Be discerning: why is that working/not working in that location/operation & will the same hold true for me?

C. Initial unfamiliarity with crops added to rotation

D. More intensive management

VIII. No-till compatible with livestock?

A. Grazing of crop residues, covercrops, or growing wheat acceptable/beneficial IF:

1. Severe rutting is avoided (it's next year's seedbed)

2. Value gained exceeds TOTAL costs:

a. Nutrients removed by grazing must be replaced

b. Residue loss = less water storage for next crop

c. Compaction

d. Increased weed seed germination w/ hoof traffic

e. Managing wheat for grazing precludes management for high yields

f. Hoof traffic worsens denitrification on some soils/climates

## IX. No-till equipment

### A. Seeding

1. Low disturbance

a. Improves residue flow thru implement

b. Lowers horsepower requirement

c. Functions in wet soils

d. Reduces weed seed germination

e. Temperature moderation, moisture storage, reduces crusting

2. Depth gauging separate from firming/closing

3. Seed/soil firming separate from closing (more structured soils in no-till)

4. Closing by slicing/crumbling, not squeezing

5. Row width & seed singulation choices

6. Some fertilizer placement

7. Residue moving vs. delay planting

8. Variable downpressure

9. Parallel linkage

10. Cost, durability, user-friendliness

### B. Harvesting

1. Straw AND chaff distributed evenly across width of header

2. Don't create ruts (really only a problem the first year or two of no-till)

### C. Spraying

1. Flotation + convenience = timeliness

## X. Rotation Concepts

### A. Intensity of rotation

1. Water is money if you're a farmer.
2. No-till stores and makes available considerably more water.
3. Making use of the extra water is desirable (harvesting more water)
  - a. Yield stability, higher value crops, fewer fallow periods
  - b. Prevents overly saturated soils that interfere with field work and crop growth
  - c. Requires increasing rotational intensity:
    1. More high water-use crops
    2. Shorten fallow periods
    3. Double-cropping or relay-cropping
    4. Cover crops
    5. Later maturing varieties

### B. Diversity required

1. Broadleaf vs. grass
2. Cool-season vs. warm-season habits
3. Crops in major groups share similar water/heat needs and weed/pest vulnerability

### C. Planting into Diverse Seedbeds (eg., corn after corn vs. corn after wheat)

1. Reduces risk
2. Bigger seeding window due to different soil temps & soil moisture
3. This does not mean that any crop sequence is acceptable; sometimes, however, a crop will work reasonably well in more than one sequence
4. Prevents selecting for pest biotypes w/ unusual habits (eg., corn rootworm beetles laying eggs in soybean fields in the Corn Belt) -- D. Beck: "We don't want to be consistent in either sequence or interval."

### D. Stacking Concept (a.k.a. "Short-break, long-break")

1. Allows longer break between crops (log. reduction in weeds/insects/diseases)
2. Allows more diverse seedbeds & rotations

### 3. Better usage of N fertilizers and legume fixation

4. Prevents selecting for pest biotypes w/ very long dormancies (only a concern for pests w/ low mobility & life cycles approx. tracking the life cycle of a crop)

### E. Myth of the Perfect Rotation vs. Reality

1. Differences in growers' ability & willingness to accept the risk level

2. Differences in machinery, livestock, grain handling & capital available

3. Beyond 1 & 2, even if we could identify the perfect rotation for a certain soil & the average climate for that area, *it would be impossible to implement that rotation every year across large acreages due to weather disruptions*. The best we can do is identify desirable sequences and implement them as often as possible. Even so, there are huge differences in sequences and great advantages to discovering and using the very best sequences whenever possible.

### XI. Components of rotation

#### A. Warm-season grasses

1. Corn & milo & forage sorghums

a. Short-season corn was only a recent fad, but

full-season corn is destined to increase on the Southern Plains

b. Corn currently requires special equipment for planting & harvesting

c. Corn and narrow-row milo are excellent for anchoring soil and building surface residue levels (large amount of durable residues) -- corn is the most durable of crop residues due to high lignin content & coarseness

d. In warm, high rainfall areas, milo & corn & fs can be a double-crop

e. Rotate to:

BEST: beans/cotton/flowers/greenfallow

\*watch carryover from sulfonylureas (Permit, Peak, Beacon, etc) & atrazine

GOOD: corn/milo (if only 2d year), millet

POOR: wheat (poor seedling growth & headscab)

2. Millet

a. Late-season water user

b. Extremely drought tolerant

c. Rotate to any crop

### 3. Rice

- a. Can be grown under pivot irrigation
- b. Dryland not yet practical

#### B. Warm-season broadleaf

##### 1. Soybeans & dry beans (navy, pinto, garbanzo, mung)

- a. Adapted to broad range of soils & climates
  - 1. variety selection for high-pH, drought tolerance
  - 2. inoculation of legume crops
  - 3. control grassy weeds which outcompete soybeans for nutrients
- b. Soybeans are low-input
- c. Can be a doublecrop or relay-crop
- d. Rotate to:

BEST: small grains (spring or winter)

FAIR/GOOD: corn/milo (for cooler, higher rainfall areas -- lack of residue causes problems w/ too much heat in central KS)

\*watch Pursuit and Classic carryover

POOR/GOOD: broadleaf crops (if only 2d year & erosion potential low & crop is one that tolerates certain diseases)

##### 2. Cotton

- a. Tolerates thin soils & hot/dry weather but performs best (if managed) on good soils with adequate rainfall
- b. Mod.-high management, moderate input costs
- c. Requires special harvest equipment (stripper)
- d. Can be planted with no-till drill
- e. Rotate to:

BEST: small grains

\*watch Staple & Zorial carryover

FAIR: corn/milo (higher rainfall areas only -- lack of residue causes problems w/ too much heat)

\*watch Staple & Zorial carryover

GOOD: cotton (if only 2d year & erosion potential low or covercrops used)

POOR: most other broadleaf crops

### 3. Sunflower

a. Drought tolerant

b. Can be high-input

1. Fertilize like corn/milo

2. Insect problems can be controlled, but are potentially devastating if neglected

c. Blackbird problems in some locations

d. Special planting & harvesting equipment necessary

e. Not well adapted to high humidity & rainfall

f. Can be double-crop/relay-crop; more drought tolerant & earlier maturity than beans & milo

g. Rotate to:

BEST: small grains & millet

GOOD: corn/milo (higher rainfall areas)

POOR: broadleaf crops

### 4. Cowpeas

a. Well adapted to heat

5. Sesame, others

C. Cool-season grasses (small grains)

1. Wheat (spring & winter), oats, barley, triticale, rye

a. heavy residue, but doesn't last long & poorly anchored

b. spring wheat shows potential following cotton

c. Rotate to:

BEST: any double-crop or relay-crop or cover crop in high rainfall areas

\*don't apply long-residual sulfonylureas (Glean, Amber, Finesse, Peak)

BEST: corn/milo

\*watch sulfonyleurea carryover

FAIR: beans (carryover w/ht stubble often wetter than desired)

\*use STS beans if suspect sulfonyleurea carryover from wheat

POOR: flowers/cotton (carryover w/ht stubble often too wet)

\*sensitive to carryover of some SU's

FAIR/GOOD: small grains (if only 2d year & low-rainfall area)

D. Cool-season broadleaf

1. Field peas

a. Can be harvested for grain or silage or hay

b. Fixes nitrogen

c. Rotate to:

BEST: double-crop/relay-crop milo or millet

GOOD: corn/milo or small grains

FAIR: other broadleaf crops

2. Canola

a. Spring-seeded may fit our workload & rotations best

b. Needs to be "pushed" (artificially lodged) to reduce shattering in hot & windy KS)

3. Lupines, lentils, others

E. Cover crops (greenfallow)

1. Legumes (clover, vetch, peas, trefoil, Sunn hemp)

a. fixes N

b. uses excess water (improves seeder performance & stand establishment)

c. alleviates compaction

d. builds OM & surface residue to store more water late-season

e. keeps mycorrhizae levels high

f. can influence insect & disease pressure

2. Grasses (wheat, rye, ryegrass, black oats)

F. Perennials -- hay or harvest on the hoof

1. Alfalfa -- excellent N source and OM builder

2. Orchardgrass, fescue, etc.

## XII. Planning your rotations

A. High water-use and drought-sensitive crops:

1. Will the soil profile generally be full by the time the high water-use crop starts using a lot of moisture?

2. Will residue levels be adequate?

3. Is the crop one which will make use of extra water?

4. Arid regions may use two or more years of low water-use crops to build moisture deep in the soil profile thereby reducing risk on the high water-use crop

B. Are rotations intense enough to prevent oversaturation?

C. At least 2 years/crops out of wheat/rye/triticale/oats/barley

D. At least 2 years/crops out of broadleaf crops

E. At least 2 years/crops out of corn/milo group

F. Stacking 2 years of same crop type to lengthen breaks

G. Diverse seedbed environments (planting into different residues)

H. Will soil warm up? cotton, spring small grains, corn

I. Corn/milo often enough to prevent erosion?

J. Weed & pest potentiality (including volunteer of previous crop)

K. Allelopathy

L. Usage of N available from legume crops or cover crops

M. Will special equipment be needed? Can it be rented/hired?

N. Timeliness of planting/spraying/harvesting

O. Capital outlay, profit & risk

### XIII. Examples:

#### A. Eastern KS & OK

1. wht/DC soy-corn-corn-soy-soy
2. wht/DC soy-corn-corn-canola/DC soy-soy
3. wht/DC corn-corn-soy-corn-canola/DC soy-soy
4. wht/DC milo-soy-corn-corn-cotton-covercrop/cotton
5. wht/DC corn-corn-soy-soy-milo-cotton
6. wht/DC soy-pea/DC corn-corn-cotton-covercrop/cotton

#### B. Central KS & OK

1. wht/covercrop-corn-corn-soy-milo-soy
2. wht/DC forage-wht/covercrop-corn-corn-soy-soy
3. wht/DC sunfl-corn-corn-soy-soy
4. wht/DC milo-milo-soy-corn-corn-soy-soy
5. wht/cowpea-corn-cotton-covercrop/cotton
6. wht/covercrop-corn-cotton-cotton

#### B. Western KS & panhandle OK

1. wht-wht-corn-corn-sunflower
2. wht/covercrop-corn-milo-peas
3. wht-wht-corn-corn-peas-wht-corn-soy

### XIV. How to make high water-use & drought-sensitive crops work in more arid climates

A. Decrease row width for quick canopy

B. Plant early

C. Adequate fertility

D. Variety selection (generally long maturities & good stress tolerance)

E. Ultra-low-disturbance (no soil inversion and no residue destruction)

F. Maximize residue production & preservation (prior years)

G. Proper rotation

H. Weed control

I. Good soil structure & high OM (these will be inevitable if no-till is done properly, however, these benefits are not immediate but will gradually accumulate over many years of well-managed low-disturbance no-till)

XV. Experimentation, observation & analysis

A. Top-notch managers won't arbitrarily limit their thoughts or possibilities

B. Recognize the assumptions you make when you seed a crop

C. Causation of observed phenomena is seldom a simple matter

1. Rotations are highly interactive

2. Crop responses often nonlinear

3. Soil organisms play an important role, where the web of causation is especially tangled

Oklahoma Crop Acreage (Harvested)

1909 1997

Corn 5,900,000 200,000

Cotton 2,000,000 200,000

Alfalfa 400,000\* 400,000

Soybeans 0 300,000

Sorghum/kafir 500,000 500,000

Oats 600,000 0

Wheat 1,200,000 5,400,000

-

Source: Okla. Ag. Stats. Service

all acreages rounded to nearest hundred thousand

\*from 1919 (first year alfalfa data recorded)

Kansas Crop Acreage

1910 1998

Corn 8,600,000 3,000,000

Alfalfa 900,000 1,000,000

Soybeans 0 2,500,000

Sorghum/kafir 1,200,000 3,400,000

Oats 1,700,000 100,000

Barley 300,000 0

Flax 100,000 0

Spring Wheat 100,000 0

Winter Wheat 4,800,000 10,100,000

-

Source: Ks. Ag. Stats. Service

all acreages rounded to nearest hundred thousand

[Return to No-Till On The Plains 2001 Page](#)