A No-Till Rice Mindset And What No-Till Rice Can Do To Enhance Your Natural Resource Base

Presented by Dr. Merle Anders
Rice Systems Agronomist, University of Arkansas

Many of us grew up singing:
Sons of the soil are we, Lads of the field and flock,
Turning our sods, asking no odds. Where is life so free?
Facing the dawn, brain ruling brawn, Lord's of our lands we'll be.
R. Buchanan in *The Ploughing Song:* used in 4-H and FFA meetings.
This and many other songs, poems, and social norms helped form a 'plow culture' that is underpinned by five basic beliefs (C.M. Coughenour, S Chamala, 2000).

1. *Plowing is necessary to clear the field of surface residue, aerate the soil, and improve soil structure*.
2. *Burying surface residue suppresses plant diseases, insects, and weeds*.
3. *A clean plowed surface facilitates cultivation to level the ground, destroy weeds, and break up clods for a finely tilled seedbed*.
4. *Plowing and cultivation are the most cost-effective methods of controlling weeds and of preparing a proper plant bed for the tiller or row planter.*
5. *As a central activity of farming, plowing symbolizes and validates the farmer's role in society; one who performs his craft well gains prestige and enjoys feelings of self-worth*.

Successful no-till rice production requires a producer develop a mindset that will question, if not destroy, each of these basic beliefs. This makes the art of no-till production conceptually difficult and has hampered its wider adoption; particularly in rice. To overcome this barrier each 'plow culture' belief needs to be looked at in a framework of current production practices and possibilities. Here they are:

1. *Plowing is necessary to clear the field of surface residue, aerate the soil, and improve soil structure*. Planting through surface residue is not a problem given the equipment currently available. We have found that replacing standard closing wheels with spike closing wheels generally eliminates many of the problems encountered when planting into a wet seedbed. Yes; it is true that plowing aerates the soil BUT only in the layer that is disturbed. A better question is 'does the soil need aeration?' Aeration of the soil results in increased microbial activity. This leads to faster decomposition of organic matter; not a benefit. Soil structure is improved with organic matter which is reduced by plowing therefore soil structure is damaged by plowing not improved.
2. *Burying surface residue suppresses plant diseases, insects, and weeds*. I know of no body of research that has proven that burying surface residue suppresses plant diseases. Weeds and insects are temporarily 'out of site' but are not dead. Generally, burying weed seeds ensures they will be present in the future while stimulating germination in existing seeds. Is this a case of "out of site, out of mind." Residue remaining on the surface protects the soil surface from the impact of rainfall thus reduces erosion. Decaying residue contributes to soil health and nutrient levels. Good residue management is necessary in no-till production and is possible with the proper use of existing machinery and water. Combines should be equipped with

'shredder-spreaders' that shred residues and distribute them across an area equal to the width of the combine header. Care needs to be taken in not leaving a field with areas of high residue concentrations at the end of the season. These areas will impact the effectiveness of herbicides in the following season. We have found that the effectiveness of Command (Clomazone) is significantly reduced when crop residues remain on the field; this was not the case with Facet (quinclorac) or Newpath (imazethapyr). In our studies we use Command at high rates plus Facet and have been able to get acceptable weed control. We also capture winter rainfall whenever possible to both conserve water and enhance the decomposition of existing residue.

3. *A clean plowed surface facilitates cultivation to level the ground, destroy weeds, and break up clods for a finely tilled seedbed*. Yes, a clean plowed surface does facilitate cultivation BUT is cultivation necessary give the herbicides available today and the costs involved with plowing and cultivation? Our findings indicate that once labor is included in costs that plowing and cultivation are not cost effective. If you do not plow you do not have clods. Why spend money to create a problem that requires you to spend more money? A finely tilled seedbed is not necessary with today's equipment; in many rice producing soils a finely tilled seedbed results in crusting and a need to flush. We never flush no-till rice; it is not necessary. Once again you spend money to guarantee you will spend more money.

4. *Plowing and cultivation are the most cost-effective methods of controlling weeds and of preparing a proper plant bed for the tiller or row planter.* Not in our current agriculture setting. While you might kill the weeds that have germinated plowing results in more weed germinating and buries any weed seeds that are on the soil surface thus guaranteeing their survival. The costs of controlling weeds via chemicals and using a proper no-till planter to establish a crop are somewhat cheaper than conventional methods. There are additional savings from being able to get into a field sooner using no-till and thus planting a larger area within the same time frame. Additional labor costs are associated with conventional-till farming.

5. *As a central activity of farming, plowing symbolizes and validates the farmer's role in society; one who performs his craft well gains prestige and enjoys feelings of self-worth*. This is probably the biggest obstacle no-till farmers need to overcome when they change from conventional to no-till production. 'Trash Farming' as it is often referred to by those clinging to the 'plow culture' can cause neighbors to laugh and no-tillers to become outcasts. Consider yourself as a leader and others will follow. In the not-too distant future they will not have a choice. Focus on the bottom line and it will be easier.

Does no-till rice production enhance the farmers' natural resource base? Here are some of our results:

1. *Aggregate stability:* Soil aggregates refer to small soil particles that are a combination of minerals, carbon, organic matter, and a host of organic and inorganic chemicals. The abundance of soil water stable aggregates is considered a measurement of soil quality as well as a physical property of the soil that can affect water absorption, aeration, and root penetration. Soils containing a higher percentage of water stable aggregates; particularly larger aggregates, are considered to be of better quality. A wealth of information exists on the impact of tillage on the abundance of water stable aggregates in crop production systems that do not contain rice while little or no similar information exists on rice production systems. Measurements on the abundance of water stable aggregates in conventional-and no-till rice systems were carried out at the University of Arkansas Rice Research and Extension Center. Comparisons were made on seven rotations that have been managed as conventional-and no-till for 5 years. Samples were collected at 0-4in and 4-8in depths and processed to determine the percentage of water stable aggregates > 4.0mm, 2.0-4.0mm, 1.0-2.0mm, 0.50-1.0mm, 0.25-0.50mm respectively. When the percentages of each aggregate size were pooled and compared across treatments it was found that there were no differences in the upper (0-4"0) and lower (4-8") soil depth percentages in the conventional-till treatments while there was a significant difference in the upper and lower soil depths in the no-till rotations. Total water stable aggregates in the lower soil depth of no-till plots were similar to the conventional-till values while those in the upper soil depth (0-4") were twice the value of the lower depth. This indicates that total percent water stable aggregates increased in the top 4" of the soil profile in the no-till plots while there were no changes in the 4-8" depth of the no-till and at any depth in the conventional-till plots. Percentage of water stable aggregates in any soil will not increase rapidly thus we did not expect to see changes in the lower soil depth after only 5 years. All values in the conventional-till plots were approximately half those from no-till plots. We did not expect differences in the soil depth measurements in the conventionaltill plots because the soil layers are mixed each year with tillage operations. In all cases soil quality, as measured by percentage water stable aggregates, was improved in the no-till plots when compared to the conventional-till plots.

The rotations we compared had rice every year, every second year, and every third year. Highest water stable aggregate values were in the rotations that had rice every year while the lowest values were from rotations that contained rice every third year. These results suggest that rice, grown in a no-till setting and where stubble is left on the field, has the potential to significantly increase the percentage of soil water stable aggregates and thus soil quality.

The carbon and nitrogen content (%) of each aggregate class was determined. This adds a 'quality' measurement to our 'quantity' measurement of the abundance of water stable aggregates. We found that, regardless of tillage treatment, the highest percent of carbon or nitrogen was in the 1.0-2.0mm aggregate size class. Differences between tillage treatments in percent carbon and nitrogen were greatest for the larger aggregates and nearly the same for the smaller aggregates. These results indicate that quality as measured by carbon and nitrogen content will be significantly improved with higher percentages of larger aggregates. Of the seven rotations we measured, continuous rice had the highest carbon and nitrogen values for the largest aggregate class. While much smaller in terms of abundance the larger aggregates appear to be of better quality; particularly in the no-till systems. This, combined with a relatively high percentage of larger sized aggregates in the rotations where rice appears more frequently, suggest rice is a good crop to increase soil quality and that the more frequent it is found in rotations that are no-till the better soil quality will be.

2. *Soil resistance:* Soil resistance is a physical measurement that can give an indication of how easily it will be for a plant to penetrate the soil. We compared soil profiles in no-till and conventional-till rotations to a depth of 16" at 2" intervals. For all rotations there was a decrease in resistance in the 4-14" depths in the no-till plots compared to the conventional-till plots. This decrease in soil resistance was associated with increased soil moisture. Some of the lowest resistance recordings were with the continuous rice, corn-rice, and soybean-rice rotations. The relationship of increased soil moisture with decreased soil resistance support our finding that notill rice does not require flushing and that fields can be drained earlier because of additional water being held in the soil.

In the last two years our no-till rice grain yields have been greater than the conventional till yields. This is due, in part, to improved soil physical and chemical properties in the no-till systems and a better understanding of how to manage no-till rice production. We are well past the 'plow' mind set and can show the benefits of making the change to no-till.

First Comes The Seed - Then The Stand

Presented by Dan Bradshaw

Certified Professional Crop Consultant-Independent, Certified Professional Agronomist

Planting the seed is the first and most important step in producing a profitable rice crop. This goes without saying but the importance is sometimes not fully appreciated in the heat of making planting decisions. In a no till or reduced till situation, there are numerous factors which can, and at times do, reduce or make more difficult the obtaining of an optimum stand. A few of these factors are:

excessive soil moisture
soil too dry
excessive residue
soil borne diseases
insufficient seed/soil contact
soil plasticity

These and other situations and possible solutions will be discussed from the points of view of producers and consultants.