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Guest Column

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Production of many crops has doubled and even tripled during the past 40 years due to technological advances in the areas of tillage and planting equipment, fertilizers, pesticides and crop varieties or hybrids. Along with these advances have come challenges to protect our environment and conserve our natural resources including water, soil and fuel energy. Many of the concerns have surfaced because some current "conventional" agricultural management practices are degrading these resources.

Reduced tillage, also known as minimum or conservation tillage, was introduced as one of the more economical methods to reduce the problems associated with pollution, loss in productivity from soil erosion, and high energy use. Reduced tillage is still in its infancy compared to the time spent developing "conventional" tillage practices and requires additional research and time to realize its full potential. Reduced tillage, as with any management practice, has limitations which can only be solved by treating reduced tillage as a system. The lack of a systems approach, a point so often ignored in past research evaluations of many "conventional" management practices, often will leave many inconsistent and unexplainable results.

A systems approach is often avoided since the approach requires more effort and planning, especially when a large number of variables that includes such items as soil type, crop rotation, stored soil moisture, soil test levels, tillage methods and number, surface residue conditions, chemical and physical condition of the soil, fertilizer rates and placement method, seed selection and treatment, equipment row spacing, seeding rates, weed population, specie and control methods, disease or insect incidence and control measures, planting-harvest dates and both micro and macro climatic conditions need to be considered or integrated into the system.

Although the systems approach is very complex, the producer deals with the approach each cropping season. Researchers, in the interest of scientific advancement, must also use the systems approach and take a more holistic approach to agricultural research. Researchers can no longer effectively evaluate a single variable without some thought or consideration given to the soil-plant-climatic interactions associated with a multitude of variables. A true systems approach will require multidisciplinary action to identify and fine tune those management variables that will minimize input and/or maximize yields for the producer. The multidisciplinary systems approach will also provide the greatest return for our research effort by eliminating excess duplication.

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In This Issue

On the Cover: Conservation tillage is becoming more popular in North Dakota. In this issue, researchers address several topics involved with conservation tillage. Photo by James Berg

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Table 4. Nutrient content of sunflower seed as influenced by conventional and reduced tillage systems. Fargo, ND[1]

Primary Fall Tillage System[2]	Weed Control Method[3]	Nutrient Concentration			Total Nutrient Uptake		
		N	P	K	N	P	K
		——%——			——lb/acre——		
Plow	H	2.84	.60	.84	41	8.8	12
	H + C	2.85	.61	.86	43	9.6	13
	Ave	2.85	.60	.85	42	9.2	13
Sweep	H	2.60	.56	.82	49	10.4	15
	H + C	2.93	.61	.86	47	9.7	14
	Ave	2.76	.59	.84	48	10.1	15
Intertill	H	2.82	.70	.92	54	13.2	17
	H + C	2.93	.67	.86	56	12.9	16
	Ave	2.87	.69	.89	55	13.0	17
No-till	H	2.69	.62	.81	45	10.4	14
	H + C	2.72	.62	.83	49	11.3	15
	Ave	2.71	.62	.82	47	10.9	14
Average	H	2.74	.62	.85	47	10.7	15
	H + C	2.86	.63	.86	49	10.9	15

[1]Data are the average of three years (1980, 1982, 1983). Low seed yields (less than 200 lb/acre) were obtained in 1981 due to Midge damage and data not included.

[2]Tillage system: Plow = plow, disk twice, field cultivate twice in the fall, field cultivate and plant in spring; Sweep = one fall tillage with chisel plow with sweeps and plant in sprining; Intertill = one pass in fall with Woods intertiller that tills an 8-inch row and plant in spring; No-till = no tillage and plant directly from standing stubble.

[3]Weed control: H = a fall application (October) of trifluralin at 20 lb/acre as 5G. Complete or partial incorporation of granular herbicide on all tillage systems except no-till; C = one early cultivation for additional weed control with rear mounted cultivator.

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Recent advances in technology, coupled with our current crop surpluses, have switched our thinking away from applied research with more emphasis being placed on basic or specific single variable research. Basic research has a purpose and may serve as a guide for further advances in applied research. However, the advances in basic resarch can only be considered successful when the results are evaluated against all possible interactions within the system. This evaluation or applied research phase is the necessary link with the producer.

Biotechnology and computerized plant growth models are being proposed as a means to achieve further gains in production efficiency. Initial advances in biotechnology in areas like gene splicing and the transfer of symbiotic nitrogen-fixation to major crops may only require a relatively short time. However, evaluation and transfer of the advances into the system may require considerably longer. The modeling approach has the potential for more rapid influx into the system, but still requires both basic and applied research to develop and test the capability of the model in the production system. The trend toward more reduced tillage in current cropping systems suggests the need for model development in this area. Models that show merit for specific tillage or cropping systems will provide a new management or decision-making tool for the producer.

Researchers need to concentrate on the systems approach when developing future research goals or projects in modeling or biotechnology. Rapid advances in agricultural research will depend on a willingness to accept the multidisciplinary systems approach that places emphasis on some advanced form of reduced tillage. The systems approach must also be supported by a strong research (basic and applied) and education program capable of attracting and inspiring scientists in all areas of agricultural crop production.

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