NO-TILLAGE, PAST AND PRESENT

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INTRODUCTION

No-tillage may be defined as the introduction of seed into untilled soil by opening a narrow slot$, trench or band of sufficient width and depth to obtain seed coverage and soil contact. This system of planting eliminates plowing, discing, harrowing and other conventional methods of seedbed preparation.

Cultivation of row crops is eliminated with the use of herbicides to control unwanted plants or to restrict growth and competition of desirable plants in pasture renovation during the establishment period of the newly seeded crop.

Several terms are commonly used to describe this planting technique: zero till, no-till, zero tillage, direct seeding, direct drilling, sod planting, mulch tillage, stubble planting, ecological systems, and many others. These usually encompass the same basic principles referred to in this publication as no-tillage. Other innovations included in the no-tillage systems include aerial seeding and incorporating seed into fertilizer for broadcast distribution as the fertilizer is applied.

NO-TILLAGE DEVELOPMENT AND ADOPTION

Centuries elapsed between the use of crude, wooden tillage implements and Thomas Jefferson's development of a mathematical formula for the mold-board plow. Charles Newbold, in 1796, received a patent for a cast iron plow and in the early 1830's a steel mold-board plow was introduced. Continued refinement of primary and secondary tillage implements evolved to highly sophisticated, large units which annually disturb the equivalent amount of soil that would be required to build a super highway from New York to California.

Attention turned to no-tillage in the late 1940's with the introduction of plant growth regulators developed during World War 11. Klingman, at North Carolina, reported no-tillage work. Barron, Davidson and Fitzgerald, in 1951, reported successful application of no-tillage techniques. Sprague, in the 1960's, reported pasture renovation using chemicals as a substitute for tillage. Porter, New Zealand, reported on strawberry production followed by Hood and Jeater at Jealott's Hill on small grain. Scharbau of West Germany, in 1968, reported on rape and small grain no-tillage. Hence, worldwide interest in no-tillage and research to provide

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the theory for application was well underway.

Refinement of the system can be traced to McKibben, Illinois; Shear and Moschler, Virginia; Triplett and VanDoren, Ohio; Freeman, Kentucky; Lewis and Worsham, North Carolina; and many others in the midwest and southeast.

Speight, North Carolina, reported on double cropping using winter small grains and soybeans using the no-tillage approach.

It would be remiss not to give full credit to innovative farmers for application and further sophistication of the systems and adoption on a commercial scale.

Other crops which have been grown using no-tillage include horticultural crops, tobacco, cotton, grain sorghum, sweet sorghum, sugar cane, sugar beets, popcorn and sweet corn. With continued research it is probable that all crops can be grown using no-tillage methods. Only economics or a lack of imagination will prevent a wide adaptation of this method to all major cultivated species.

It is paradoxical that no-tillage combines the use of modern chemicals with the oldest method of introducing seed into soil, similar to that used by the American Indian in planting maize seed with minimum soil disturbance using crude hand tools.

The no-tillage system was not a sudden development during the 1950-60's, but is a product of continual change in production technology and methods. Researchers and farmers were moving toward less soil preparation, and many concepts were considered.

Wheel track planting is a method where soil is turned or plowed, followed with the planter aligned to plant directly behind and in the tractor tire track. The tire action firmed the soil and eliminated the need for discing and other soil preparation. At the same time a major equipment manufacturer was developing a "plow-plant" system. This system, like wheel track planting, involved plowing of the land and planting without additional seedbed preparation. Farmers did not accept these systems because of a major timing conflict resulting from plowing being delayed until the planting period. Weather risk and peak labor requirements negated the benefits gained by these systems. It should be noted that these systems were part of the technical evolution that made no-tillage more acceptable to producers when the concept was introduced.

The acceptance and adoption of no-tillage by farmers in Kentucky and the southeast in the late 1960's was influenced by four major factors. If all four factors had not been present, large scale commercial use of no-tillage systems would have been delayed. These four factors were:

1. Late, wet springs which delayed corn and soybean growers planting beyond normal planting dates;

2. Extremely limited available farm labor supply;

3. Introduction of a commercially available no-tillage planter;

4. Labeling and availability of a contact herbicide, Paraquat, which made no-tillage crop production more consistent and successful with the improved control of competing vegetation.

No-tillage evolved into many unforeseen systems. What started as corn grown into killed sod moved into various crops grown in all types of residues and rotations. Perhaps the greatest development will be the multi-cropping systems using no-tillage methods. Double cropped small grains and soybeans, previously practiced only in the south, moved north into Kentucky, Ohio, Indiana and Illinois, and west to Iowa and Nebraska, with the advent of no-till systems.

An agronomic evaluation of no-tillage by researchers, Extension specialists and farmers would list the following major advantages and disadvantages:

Advantages -

Reduction of soil erosion. Wind and water erosion potential dictates land use. Lloyd, Ohio, shows soil erosion can be reduced from 242,000 kg/ha under conventional tillage, to 330 kg/ha under no-tillage on sloping land with high intensity rainfall.

Increased land use. Class II and III land can be used as intensively as Class I land because of reduced water erosion. Individual farmers can increase row crop acreage on land subject to erosion without soil degradation.

Energy conservation. Energy requirements in the production of corn and soybeans can be reduced from 50-75% as compared with conventional planting (Griffith, Purdue).

Less soil compaction. Fewer trips over field and reduction of soil preparation lessen the risk of soil compaction.

Improved timing of crop establishment and planting. Crops may be planted and harvested under a wider range of soil moisture conditions with no-tillage than with conventional methods.

Reduction in irrigation water usage. From 1" to 2" less irrigation water per hectare is required with no-tillage due to reduced evaporation associated with the system. This is an important factor from an economic standpoint and in areas with a depleting soil water supply (Wiese, Texas).

Reduced machinery investment. The need for high horsepower tractors is eliminated with no-tillage; much of that power is required for plowing and discing.

Improved moisture regime. No-tillage generally increases water infiltration rate and reduces erosion. Approximately 20% more soil moisture is available for crop use under no-tillage planting which is sufficient to reduce plant stress during short drought periods.

Disadvantages – -

Soil temperature. Soil temperature tends to run 2-3° lower in no-tillage which is a disadvantage in northern areas because it delays spring planting. Soils have less day-to-night temperature fluctuation under no-tillage, but late spring freezes will injure no-tillage crops to a greater extent than conventional crops due to mulch cover and reduced soil radiation.

Insect activity. Insect numbers and crop damage can be higher than in conventional tillage, and the need for insecticides is greater.

Higher producer-managerial level required. More management ability is needed or must be developed in the no-tillage system than with conventional methods. There are fewer alternatives to correct errors than in conventional systems.

GROTJTH AND POTENTIAL OF NO-TILLAGE

The rapid growth of no-tillage from research plots and a few rows for observation on farms to present acreage was not expected. Farmers tried a few acres and gradually changed to total no-tillage. Others started using no-tillage in double cropping while growing a large part of row crop acreage in conventional tillage. Producers in the middle Atlantic states and the upper southeast now grow 20-30% of all corn acreage **no-**tillage, and 30-50% of soybeans no-tillage.

It is improbable that no-tillage or any single system of production will be used by growers to the exclusion of all other methods. A conservative estimate is that 60-80% of crop acreage will be planted no-tillage within the next 25 years. The ability to control emerging perennial weed problems, regulation and availability of chemicals, changing economics of crop production, increasing environmental concern for sediment control, cost and availability of energy and world need for food and fiber will dictate the percentage of crops grown no-tillage and the rate of change from traditional methods.

No-tillage is off the drawing boards and is a highly desirable method of crop production with a predictable, steady growth in acreage and numbers of producers world-wide.

Wide interest and adoption of no-tillage has been recorded world-wide, and the potential growth and use of no-tillage is unlimited. It should be recognized that the no-tillage system as it is known today is less than

20 years old, while conventional systems are at least 200 years old. It is impossible to forecast the changes and opportunities that will develop with this important concept of crop production.

No-tillage has application for both the large commercial operator and the small subsistence farmer in developing countries. A farmer without equipment can grow only the acres he has the energy to till, but with no-tillage more food can be produced. R. Lal, International Institute for Tropical Agriculture, 1975, reports similar data on no-tillage maize and grain legumes on tropical soils in Ibadan, Nigeria, and sees widespread adoption in the shifting agricultural systems of West Africa.

Argentine reports from J. Cazenave and others, 1977, support growth potential for South America in no-tillage crop production systems involving maize, soybeans, sunflower and wheat.

No-tillage crop production will be limited only by the imagination of researchers such as those of you in attendance at this conference.