HYBRIDS DIFFER IN RESPONSE TO COLDER SOIL TEMPERATURES

Farmer observations and research conducted under the TED component of SWEEP showed that those hybrids which performed best in conventional tillage were not necessarily the best under zero-tillage, at the same site. A corn hybrid rating system, based on corn hybrid cold tolerance was developed. The index developed requires confirmation with field testing in Ontario.

Although cold temperature tolerance in hybrids can play an important part in stand establishment, it is but one of the desirable characteristics of a hybrid for reduced tillage conditions. (Source: TED final report and pers. comm. Dr.H. Hope, Ag Can)

EFFECT OF CONSERVATION TILLAGE ON WATER QUALITY

Sandy Loam Upland Soils. Two years research compared the quantity and quality of surface runoff and tile drainage water in no-till and conventional tillage plots on upland soils in Huron County. Of 121 cm of rain that fell from October '89 to October '90, 19 cm left the site as tile flow and an estimated 49 cm moved below the tile lines. Surface runoff was negligible on both the conventional and no-till treatments at this site due to the high infiltration rate of the sandy loam soil. The remainder of the rainfall left the site through evaporation and crop transpiration.

The No-till site had higher average nitrate-nitrogen concentrations in the tile water in the early spring and fall compared to the mouldboard but the reverse was true in the late fall. Average nitrate concentration in the tile flow for both tillage systems was 10.7 mg/l (10.0 mg/l is the drinking water standard). The researchers concluded that the "no-till system did not result in an increased risk of chemical contamination of groundwater."

Rainfall simulation trials indicated that for very large rainfall events runoff would be expected to be higher from the no-till system compared to the mouldboard. However, the total phosphorus loss would still be 2-4 times lower than the mouldboard system. This increased runoff during large rainfall events on the no-till plots contrasts with the results of some American studies and the results of another SWEEP

study. Other factors in addition to tillage may play a role in water infiltration/runoff behaviour. Further research on various sites is required to solve this puzzle.

Lowland Clay Soils. Separate studies conducted on conventional, ridge and No Tillage plots on lowland poorly drained clay soils in Essex County paint a different picture. Here, conservation tillage (no-till and ridge till) effectively reduced soil erosion but not phosphorus transport. At the lowland site about 50% of phosphorous and sediment loss occurred in tile flow whereas at the upland site there was very little sediment or phosphorus in the tile flow. Measures in addition to conservation tillage such as optimizing phosphorous fertilizer use and controlling tile flow may be required to keep phosphorous in the fields on poorly drained clay soils.

The study on the poorly drained lowland Brookston soil also examined differences in herbicide losses between tillage treatments. The proportion of rainfall that run off the plots was independent of tillage but dependent on rainfall intensity, duration and initial soil moisture content. In both tillage systems, runoff producing events which occurred soon after herbicide application transported the largest amount of herbicide. The researchers concluded that "tillage and crop residue did not influence herbicide (metolachlor or atrazine) transport in surface or tile drainage runoff on poorly drained soil." (Source: TTC Summaries #37, 60; TED Final Report)

COVER CROPS FOR NITROGEN CYCLING

Concern over nitrogen leaching to groundwater under various agricultural cropping systems prompted research into the use of cover crops to "soak up" extra nitrogen leftover from manure or fertilizers after crop harvest.

A study (one year only) comparing various cover crops - ryegrass, oilseed radish and red clover - showed that they all initially scavenged nitrogen but that soil nitrate levels were often as high or higher under the cover crops during the late fall and winter. The scavenged nitrogen was released at different times from the various cover crops - oilseed radish released it too early for a succeeding corn crop while ryegrass immobilized it to the extent that the yield of the following corn crop was depressed.

Additional research is needed to better understand nutrient dynamics under various cover cropping systems. (Source: SWEEP Report #48, TED Final Report)

WEED CONTROL STRATEGIES FOR CONSERVATION TILLAGE

There were early concerns that reducing tillage would result in increased weed pressure and a resultant increased reliance on chemical weed control. However, following studies conducted under the SWEEP program from 1987-1990 researchers at the University of Guelph and Ridgetown College concluded that "the control of weeds in conservation tillage systems did not require higher dosages of herbicides."

One innovative no-till farmer was actually able to reduce herbicide use by 60% through a combination of banding and inter-row cultivation. A successful burndown treatment was essential to making the banding/inter-row cultivation work. One drawback to the system observed by the farmer was the dependence upon the weather for timely cultivation.

A weed survey conducted across southwestern Ontario indicated that the weed history of a field is an important factor in determining the changes in weed pressure which will occur after a transition to a conservation tillage system. This underlines the importance of weed scouting and understanding weed growth patterns.

Researchers also concluded that "currently recommended herbicides and herbicide combinations provide excellent broad-spectrum weed control in all tillage systems tested."

Jim Shaw of Ridgetown College gives the following advice on weed control strategies for reduced tillage: "A thorough and complete burndown is the backbone of a no-till weed control program. The second phase involves selecting the appropriate soil or foliar applied herbicide to control weeds which emerge following the burndown application. Reducing tillage may result in the invasion of "exotic weeds" so you must be prepared to identify these newcomers and develop a management strategy to deal with them.

Residual Effect of 2,4-D on Soybeans. Where 2,4-D was applied prior to planting soybeans there was no visible injury to the soybeans in either of the two years of the experiment. In the first year, there was no effect on yield but in the second year soybean yield was significantly reduced where the field was sprayed with 2,4-D L.V. ester or amine salts on planting day or sprayed with 2,4-D amine salts up to one week in advance of planting. (Source: SWEEP Report #32, TED Final Report, pers. comm. J.Shaw, RCAT)

THERE'S MORE TO SOIL THAN DIRT!

Some SWEEP-TED studies attempted to characterize the soil life and the impact of agriculture on it. Soil microorganisms and insects are involved in residue decomposition, nutrient cycling, soil structure and other soil properties.

One study examined the effect of ploughing on the populations of soil organisms in a pasture and zero-till field. The infiltration rate and pore continuity were higher in the zero-tilled soil than in soil that had been ploughed two months previously. Water infiltration was directly related to the earthworm population and very much lower in the ploughed soil where there was a lack of sufficient continuous burrows for water transmission. Earthworm populations did not fully recover in the ploughed plots in the six months following disturbance by ploughing. (Source: SWEEP Report #30, infoSource #14)

YIELD REDUCTION EFFECTS OF CROP RESIDUES

Early no-till pioneers in Ontario had observed that certain crop residues (e.g. rye, canola) could result in stunted corn under cool, wet spring weather conditions. Research at the University of Guelph attempted to determine if the cause was at least, in part, due to the release of chemicals from the decaying crop residue inhibiting the growth of the newly planted crop (allelopathy).

The study concluded that the presence of crop residues on the soil surface in conservation tillage increased soil water content and decreased soil temperature and subsequently suppressed corn plant growth. However, increased soil moisture and reduced soil temperatures could not totally explain the reduction in corn plant development, particularly that found with red clover and canola crop residue.

Chemicals known to be inhibitory to plant growth were produced in soils in the lab under wet and high temperature conditions. Fresh, green, or easily decomposable material was most likely to produce these compounds. However, these compounds could not be detected at concentrations considered phytotoxic in field soil samples, although they were detected in some plots after certain June rainfall events. Moving residues away from the row area generally increased corn yield.

Allelopathic symptoms may be the result of a combination of factors such as increased soil moisture and decreased soil temperature, release of inhibitory chemicals from decaying crop residues or a tie-up of

nitrogen by soil microorganisms breaking down the crop residue. (Source: SWEEP Report #56, TED Final Report, TTC Summary #56)

FARM LEVEL ECONOMIC ANALYSIS

The mandate of the Farm Level Economic Analysis Component of the SWEEP Program was to assess the economic implications of adopting soil conserving technologies both to farmers and to society. Data from the Tillage 2000 Program and the three Pilot Watersheds was used in the economic evaluation. Here are some of the study results:

* It pays to use conservation tillage because it's profitable for the farm enterprise.

* Conservation tillage is good for the environment from a watershed perspective.

* Yield variability with conservation tillage is equal to or less that the variability associated with conventional tillage.

* Financial risk of conservation tillage is no more and sometimes less compared to conventional tillage.

* Overall economic impact on farm input suppliers and processors from a shift to soil conservation tillage practices is likely slight.

(Source: An Economic Evaluation of Soil Conserving Technologies-Summary Report)

$13.55/AC MORE WITH NO-TILL CORN SYSTEM

That's just one of the significant findings from a program designed to develop a management strategy to control erosion and to improve soil productivity.

Tillage 2000 was a long-term, on-farm, field-scale research and demonstration project conducted for five years on 40 farms across Ontario. Each site included a carefully controlled and laid out research plot on which conventional and conservation farming systems

were compared to each other through the use of a number of permanent benchmarks occupying the same soil type and slope position.

Impact of Conservation Tillage on Yield

Based on Tillage 2000 results, for fields with percent sand contents greater than 36% in the plough layer (surface soil, top 15-30 cm), the no-till yield on average would be higher than the conventional tillage system. The no-till yield for the finer textured soils (more clay) would, on average, be lower than conventional tillage systems.

Conservation tillage systems may be more buffered against adverse climatic growing conditions than conventional tillage systems. High yielding areas under conservation tillage dropped on average 13.8% in yield during a stress year compared to 16.5% decrease in the conventional tillage system. Low yielding areas in the conservation system decreased 24% in yield in the stress year, compared to 31.1% decrease in the conventional system. With paired field yield data, the ratio of conservation yield/conventional yield was highest in 1988, a drought stress year.

T2000 Economics of Conservation Tillage System

Average net returns were $0.05/acre and $13.55/acre higher in the no-till corn system compared to the minimum and mouldboard systems respectively. The higher profits were primarily the result of a significant decrease in the cost of field operations while maintaining equal yields.

The average net returns of no-till soybeans were $3.61/acre and $13.38/acre lower when compared to the mouldboard and minimum till systems respectively. The lower net returns for conservation tillage soybeans were primarily due to a combination of substantially higher herbicide costs and slightly decreased yields. (Reduced soybean yields and increased herbicide costs may have been a result of farmers having little previous conservation tillage experience.)

Winter wheat net returns were, on average $8.94 and $12.86 per acre higher for the minimum till and no-till when compared to the mouldboard system.

The highest net returns per labour hour were observed for no-till corn.

The data in the Tillage 2000 project indicate that it should be possible to implement a conservation tillage system with no loss in yield productivity or economic return, in all but the heavier textured soils. This is especially true for sandy soils where increases in yield are likely under conservation tillage.

Tillage 2000 was a co-operative effort by the Ontario Ministry of Agriculture and Food (OMAF), Dept. of Land Resource Science (U of Guelph), and the Ontario Soil and Crop Improvement Association (OSCIA). In addition, several conservation authorities were involved. In Southwestern Ontario, Tillage 2000 was part of the federal-provincial Soil and Water Environmental Enhancement Program (SWEEP). (Source: Tillage 2000 Final Report, TED Final Report)