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RED CLOVER MANAGEMENT OPTIONS FOR NO-TILL CORN

No-till corn yields following underseeded red clover were never inferior to no-till yields after either winter wheat or barley that was not underseeded to red clover. Management alternatives such as earlier chemical kill and in-row residue clearing or coulter attachments were occasionally associated with higher corn yields. However, corn yields after moldboard plowing of underseeded red clover were superior to no-till yields in less than ideal growing seasons.

Introduction

Although the practice of underseeding red clover into cereals has expanded to over 50% of the cereal acreage in Ontario that was not seeded down to permanent hay crops, concerns have been expressed about no-till planting after red clover. Numerous no-till farmers have recently decided to stop underseeding red clover into winter wheat. In doing so they have decided to forgo the nitrogen, soil structure, and erosion protection benefits associated with red clover for a perceived advantage of more consistent no-till corn establishment after cereals alone.

A series of field trials were conducted from 1989-92 which attempted to outline red clover management strategies that would consistently maximize corn yields in no-till tillage systems. These field trials were located on either loam or silt loam soils on or near the Elora Research Station.

Methodology

Double-cut red clover was established by underseeding into either winter wheat or spring barley. Red clover was killed prior to corn planting. On some field trials, corn yield response to timing of red clover kill either 2 weeks (April 25) or 1 day (May 10) prior to corn planting was examined. Some trials also examined corn yield response to a fall kill date (October 10).

Corn was planted using a John-Deere 7000 Conservation-till corn planter that was equipped with a single unit mounted bubble coulter for each now. Starter fertilizer was applied in a band 5 cm to the side and 5 cm below the seed using a conservation-till fertilizer coulter. All corn was side dressed with sufficient nitrogen (as urea-ammonium nitrate) to ensure that N availability was not affecting the corn yields in these experiments.

Corn was usually planted in the no-till tillage system with minimal residue movement or soil loosening. Some trials examined a modified no- till tillage system where a 10-15 cm band of residue was cleared from the row area using unit mounted ACRA Plant Trash-Whippers or Dawn Trash Wheels (i.e. mounted in place of the unit mounted bubble coulter).Enhanced seed zone soil loosening using two 5-cm (2 in.) fluted coulters in conjunction with the unit mounted bubble coulter was also investigated.

Direct Seeded vs Underseeded Red clover

A series of field trials were conducted during 1990 and 1991 to assess corn yield response when planted no-till into red clover residue that had been established by either underseeding into winter wheat or that had been direct seeded. The direct seeded red clover was planted during early May and

was managed as a hay crop. No-till corn performance following red clover was also contrasted with corn following either winter wheat alone or grain corn. These field trials were conducted on a Fox Sandy Loam site near Ayr as well as on silt loam sites near Elora.

Corn yields when following itself were at least 20% lower than following red clover at Elora and 10% lower (1990 only) at Ayr (Fig. 1). Corn yields following wheat that was underseeded with red clover were never lower than following wheat alone. In fact, at Elora in 1990 corn yields were 8% higher following wheat that was underseeded with red clover compared to wheat alone. In 1990, corn yields following direct seeded red clover were at least 7% higher when compared to following red clover that was underseeded into wheat. Corn yields in 1991, however, were similar following underseeded and direct seeded red clover.

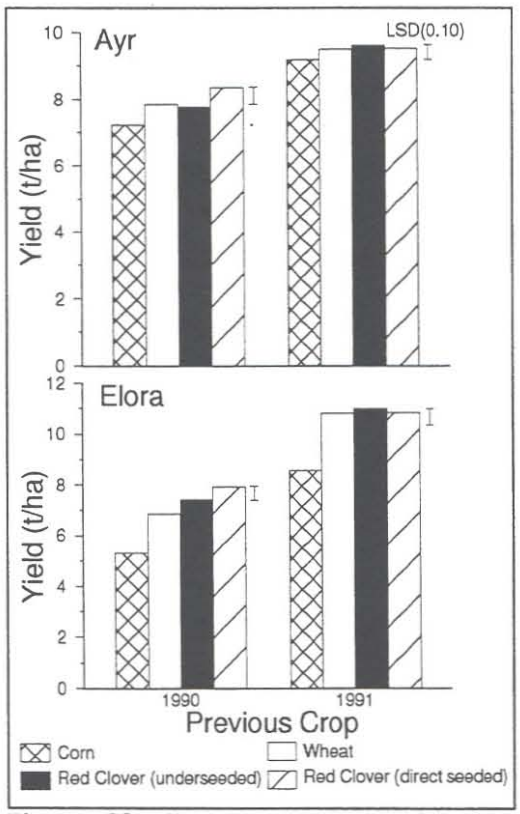

Figure 1 No-till corn yield response following corn, winter wheat alone, and underseeded vs. direct seeded red clover.

Red Clover vs Barley, Corn and Soybeans

During the 1989 and 1990 growing seasons no-till corn response to crop rotation and in-row residue clearing was assessed. The preceding year crop treatments were corn, soybeans, barley, and red clover that was underseeded into barley. The red clover was sprayed on either April 25 or May 10.

Relative to soybeans, lower plant weights 5 weeks after planting following red clover indicated that early season rates of growth were retarded (Fig. 2). Clearing crop residues out of the row area generally increased early season rates of growth. This trend was especially noticeable following red clover, but not evident after soybeans. Where residue was not cleared from the row area, early season corn growth after red clover (sprayed on May 10) was significantly slower than following either soybeans, corn or barley.

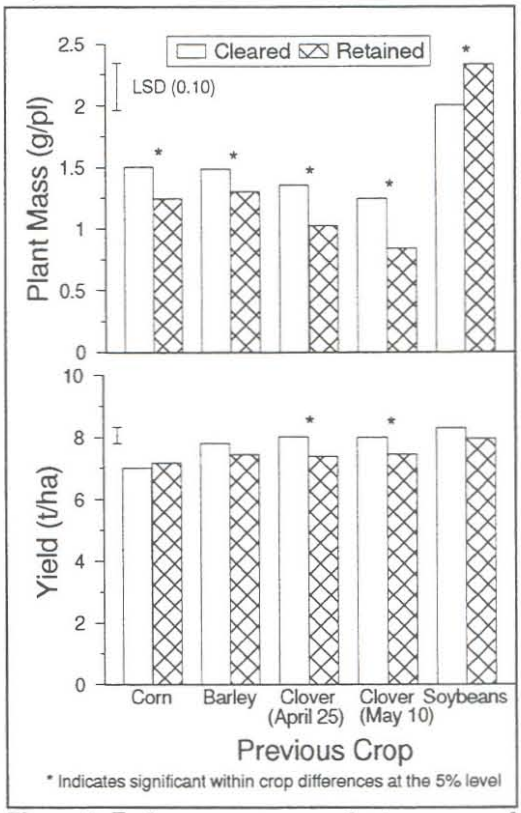

Figure 2 Early season corn plant mass and grain yield response to moldboard plowing and various no-till planting systems after underseeded red clover.

Clearing crop residue out of the row area increased grain yields by more than 0.55 t/ha

following red clover, regardless of the spray date (Fig. 2). When residue was cleared from the row area, grain corn yields following red clover were greater than following corn and were less than 0.30 t/ha lower than after soybeans. Corn yields were similar following barley or barley that was underseeded with red clover, regardless of the spray date.

Harvest grain moisture averaged 2% higher following red clover compared to barley alone when residue was not cleared from the row area. When residue was cleared from the row area, grain moisture after under-seeded red clover was reduced by 2% and was similar to that following barley alone. Relative to soybeans or corn, grain moisture following red clover was at least 2% higher when in-row residue was cleared from the row area and 4% higher when residue was retained in the row area.

Timing of Red Clover Kill

Field trials were conducted from 1989-91 to assess no-till corn performance following winter wheat, and wheat plus red clover. No-till corn yield response to timing of red clover kill was also examined.

In 1989 and 1990, grain yields were higher when corn was planted following red clover that had been sprayed at least 2 weeks prior to planting (i.e. April 25) compared to after wheat with no red clover (Fig. 3). However, in 1991 corn yields were not higher following red clover that was sprayed on April 25. Delaying spraying until May 10 and planting corn the following day reduced corn yields (p=0.11) only in 1990. Killing red clover in the fall did not increase corn yields relative to a spring kill date in either 1990 or 1991. Harvest grain moisture following red clover relative to wheat alone was increased by more than 2 % only in 1991.

Moldboard Plow vs No-till

During the 1989 and 1992 growing seasons, field trials were conducted to contrast corn performance in moldboard plow and no-till tillage systems. The effect of timing of spring plow and chemical burn down operations (either 2 weeks or 1 day prior to planting) on corn performance was also assessed.

In 1989, corn yields in the fall moldboard plow, spring moldboard plow and no-till tillage systems were similar (Fig. 4). However, in 1992 no-till yields were reduced by at least 20% compared to moldboard plowing. In both years, the timing of moldboard plowing or red clover kill had no effect on grain yields.

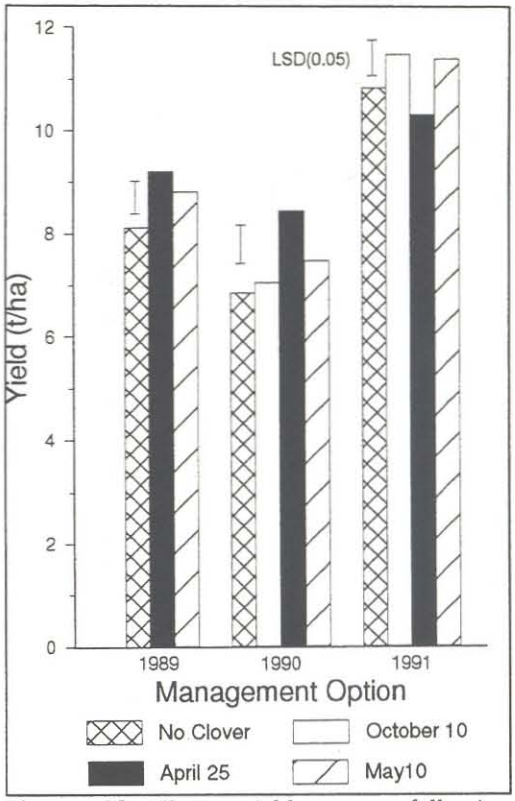

Figure 3 No-till corn yield response following red clover that had been underseeded into winter wheat and killed on various dates.

Grain moisture at harvest did not vary among the various plow and no-till tillage systems in 1989. In 1992, however, no-till planting corn was associated with grain moisture that was at least 3% higher than in the spring moldboard plow tillage systems. Yield reductions associated with no-till in 1992 might have been less severe if sufficient heat units had been received to allow for normal maturing.

Modified No-till

A series of field trials were conducted from 1990-92 to assess corn performance in various no- till tillage systems relative to spring moldboard plowing. Red clover was killed at least 2 weeks prior to corn planting.

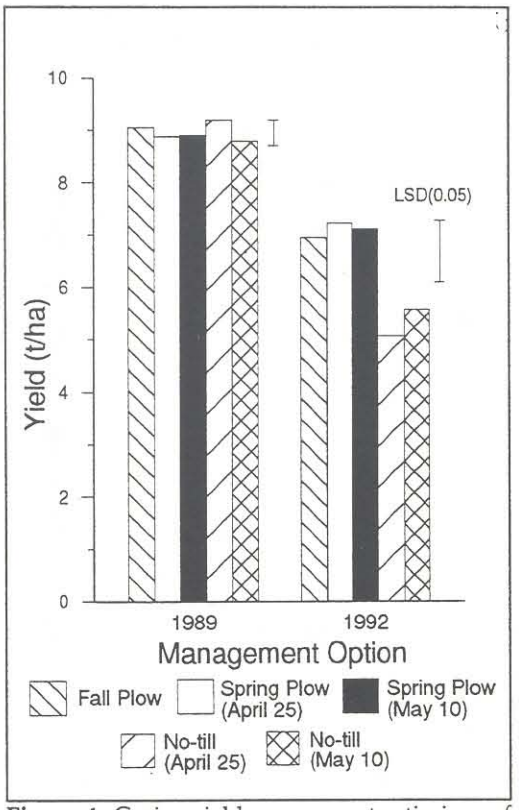

Figure 4 Grain yield response to timing of moldboard plowing and herbicide application for no-till corn following underseeded red clover.

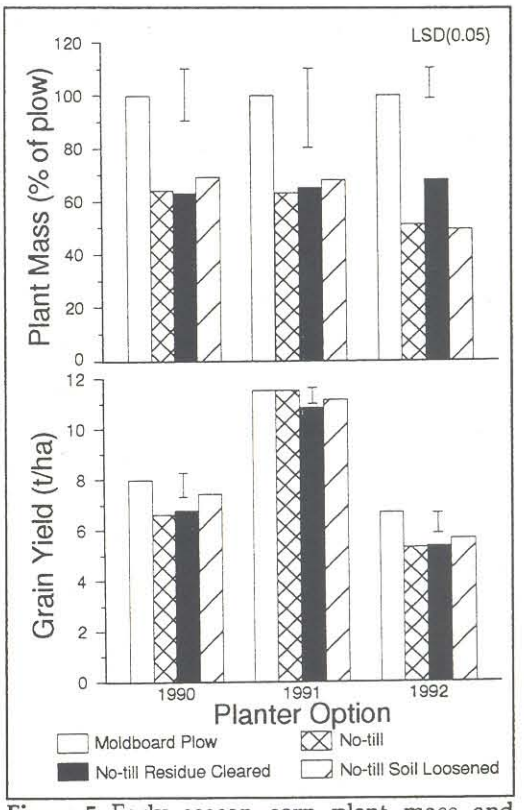

Figure 5 Early season corn plant mass and grain yield response to in-row residue management when planted no-till following various crops.

Early season growth was slower in the no-till tillage systems. Corn plant mass 5 weeks after planting range from 30 to 50% lower with no-till than moldboard plowing (Fig. 5). Only in 1992 was there a difference in early season growth rates among the no-till tillage systems, with faster rates of growth occurring where residue was cleared from the row area.

In 1990 and 1992, planting corn with minimal soil or residue disturbance reduced corn yields by at least 20% when compared to moldboard plowing (Fig. 5). In 1991, however, grain yields where corn was planted no-till with minimal in-row residue or soil disturbance were similar to moldboard plowing. Seed zone soil loosening increased ($p=0.07$) yields relative to where soil was minimally disturbed only in 1990. When seed zone soil was loosened, no-till yield reductions relative to moldboard plowing were less than 10% in 2 out of 3 years. Clearing residue out of the row area did not increase corn yields relative to where soil and residue was minimally disturbed.

No-till grain moisture was about 1.5 to 4.0 % higher than in the moldboard plow tillage system.

Synopsis

The following general comments can be made at this stage in our research:

1. No-till planting corn following red clover was associated with slower rates of early season growth than was apparent following other crops (eg. soybeans and cereals which were not underseeded). Slower rates of early season growth, however, were not always associated with reduced yield potential.
2. No-till corn yields following underseeded red clover were similar to or higher than after barley or wheat crops which were not underseeded. No-till corn yields were occasionally higher following direct-seeded red clover (harvested as hay) than following either wheat or wheat that had been underseeded with red clover. In

addition, no-till corn yields following red clover were often higher than those achieved following grain corn.

3. Early season corn growth was consistently slower in no-till compared to moldboard plow tillage systems. Despite these slower early season growth rates, no-till and moldboard plow corn yields were similar during growing seasons with ideal weather conditions (i.e. 1989 and 1991) . However, when the growing season was less than ideal (i.e. 1990 and 1992) corn yields planted no- till were less than in the moldboard plow tillage system. Therefore corn yields following red clover can be expected to be more variable over years in no-till tillage systems.
4. Spraying to kill red clover 2 weeks prior to corn planting or during the previous fall did not consistently increase corn yields relative to spraying the day prior to planting. Nevertheless, early kill of red clover prior to no-till planting is still recommended to minimize risk associated with insect pests, excessive moisture loss and seed placement problems.
5. Modifying the no-till tillage system to clear residue out of the row area did not consistently increase yields. On one site, grain yields were increased. On another site, however, yields were either unaffected or reduced relative to where residue was not moved. Using coulters to loosen seed zone soil occasionally was associated with higher yields.
6. Harvest grain moisture was usually 2 to 4% higher following red clover compared to following either wheat or barley that had not been underseeded. Also, grain moisture was 2 to 4% higher when corn was planted no-till, rather than with moldboard plowing, after underseeded red clover. In years with sufficient heat unit accumulation, this delay in maturity would not be expected to affect final yields.
7. Although no-till corn yield response to the various red clover management strategies examined was not consistent, these field trials did indicate that the practice of underseeding red clover into wheat can still be recommended on no-till farms with coarse to medium-textured soils. It should be noted that in none of these trials were pest problems severe enough to affect plant population or reduce yields.

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