Advantages of Reduced Tillage:

A Literature Review

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  Increased crop yields  
  Improved longer-term productivity  
  Faster, earlier planting and less labour required  
  Less fuel, tractor power, maintenance  
  Gradually decreasing inputs  
  Cropping more profitable  
  Beter reduced tillage planters and other equipment available  
  Beter herbicides and herbicide resistant crops  
  Crop residue cover benefits  
  Quantity of crop residue  
  Cover crops  
  Reduces water and wind erosion  
  Conserves more water in the soil  
  Improves soil organic matter content and soil health  
  Reduces soil fertility loss  
  Recycles nutrients  
  Improves availability of nutrients  
  Reduces soil temperature  
  Crop residue based biofuel  

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ABBREVIATIONS  
CA    Conservation agriculture  
CRC  Crop residue cover  
CT    Conservation tillage  
CVT   Conventional tillage  
DD    Direct drill  
MNT   Minimum tillage  
MT    Mulch-tillage  
KZN   KwaZulu-Natal  
OM    Organic matter  
NT    No-till  
RT    Reduced tillage  
SOM  Soil organic matter  
ST    Strip-tillage  
VT    Vertical tillage
ABSTRACT

Tillage affects crop yields, establishment costs and speed, crop profitability, soil health, erosion, organic matter and nutrient cycling. In many areas of the world including South Africa crop production has changed or is changing from plough-based tillage to cheaper, more profitable and sustainable reduced tillage systems such as minimum, mulch, strip and no-till or conservation agriculture. In South Africa the transition was usually initially to chisel-based reduced tillage systems. A range of more sustainable no-till systems are used on more than 70% of the cropping area in Brazil, Argentina, Australia, Canada and the Western Cape as well as in KwaZulu-Natal. Reduced tillage is used widely in other provinces while no-till is being practiced on an increasing scale. The main reasons for the change to no-till-based systems are the lower tillage costs while maintaining or increasing crop yields and profitability. They also facilitate faster more timeous planting and require less labour, fuel, tractor power and maintenance. A wide range of modern no-till planters and associated equipment have been developed internationally and many are marketed locally. Better herbicides and herbicide resistant crops have made weed control easier. The retention of various levels of crop residue on the soil surface until after planting the following crop, the two major factors contributing to successful conservation tillage or no-till. Adequate crop residue on the soil surface conserves more water in the soil as it improves infiltration, reduces runoff and wind and water erosion as well as evaporation. It also improves soil health, soil organic matter in the surface soil, soil structure, productivity, soil fertility, nutrient cycling and reduces soil compaction. Many farmers using appropriate, knowledge intensive, conservation tillage systems, are consistently producing top yields and profits. These systems, with crop residue retention on the soil surface, have many important off-farm benefits.

Keywords:
Conservation agriculture, conservation tillage, crop residue soil cover benefits, no-till, strip-till, tillage definitions, tillage practices.

INTRODUCTION

The rapid increase in fuel costs has again caused farmers to consider cheaper tillage systems in order to contain rising production costs. Less intensive reduced/conservation tillage systems are cheaper and are often more profitable as they facilitate more timely crop establishment, involve less work and labour and control soil erosion better as well as retarding soil degeneration. This is especially important in the more marginal cropping areas but is also important in humid areas. Weeds have traditionally been one of the prime reasons for tillage. However, the availability of new herbicides and the development of cultivars resistant to certain herbicides has done much to reduce the need for tillage. Improved chisel implements, modern planters, better fertilization, production practices, crop protection etc. have contributed to mechanized farmers gradually changing to more sustainable crop production systems over the past decades and gradually increasing total farm yields. Initially the change was from intensive inversion tillage with mouldboard ploughs to non-inversion tillage with chisels, discs and rippers. Some areas have adopted even more sustainable tillage systems using no-till and direct drilling and the retention of varying levels of crop residue on the soil surface until after planting the following crop.

In a number of countries there has been a marked change from more expensive slow plough-based conventional tillage systems to cheaper, faster, more sustainable systems and this is ongoing. This change is well illustrated by the area under NT world-wide increasing from 45 M ha in 1999 to 116 M ha in 2009 (Derpsch et al., 2010). Reduced tillage is practiced on an even greater scale. The USA, Brazil, Argentina, Uruguay, Paraguay, Australia and Canada use no-till on 40 to 80% of their arable land while Africa and Asia have less than 1% under no-till (Derpsch & Friedrich, 2009). No-till is done on over 65% of land under annual crops in KwaZulu-Natal and in the Western Cape. European countries only have 15% of their arable land under reduced tillage, including 1% under no-till (Basch, 2008).

Sustainable crop production is based on farming methods that are economically competitive and environmentally friendly. This farming technology not only benefits production but also benefits the long-term maintenance of the soil and water resources upon which it is based. This requires a delicate balance between the economic implications of cropping practices and the environmental consequences of using the wrong practices. Production must be in harmony with nature for improved soil, water and air quality and biological diversity (Reicosky & Saxton, 2006).

Globally many articles, leaflets and books on tillage systems including ploughing, reduced, minimum and conservation tillage as well as no-till, strip-till and conservation agriculture include sections on the advantages of these systems. In many cases the on-farm advantages are listed concisely in between three and eleven points (Buchholz et al. 1993; OMAFRA, undated; Univ. Nebraska, 2009). Some list no-till advantages for specific crops and areas (Herbek, 1983). Others are presented in a paragraph to about two pages in length (Buchholz et al., 1993; Derpsch, 1999; Kindig, 2009; Phillips & Phillips, 1984; Venter, undated). Relatively few are comprehensive (Baeumer & Bakermans, 1974; FAO, 2004; Derpsch et al., 2010). Most promote one tillage system very strongly indicating that it is much better than other systems and gloss over or omit important constraints. Some are not appropriate for South Africa due to great difference in production conditions. A few are very relevant. A very comprehensive 104 page “book” on advantages and benefits of no-till was compiled in point form mainly from South African literature under the auspices of the No-Till Club: KwaZulu-Natal (2005). In Europe, where good tillage research has been done for more than 70 years, the disadvantages of NT are also presented (Basch et al., 2009; Derpsch et al., 2010).

This review of reduced tillage in all its forms from chisel tillage to conservation agriculture was undertaken to supply crop farmers and advisors in South Africa with comprehensive information on the many factors influencing the effectiveness of tillage systems as well as the variation