AGRI UPDATE
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NO-TILL CROP PRODUCTION FOR KWAZULU-NATAL

AJ Arathoon

No-till is the ultimate conservation tillage system, because it conserves soil and moisture better than other tillage systems.

Weeds are controlled chemically and the seed is planted in a narrow slot, making mechanical cultivation unnecessary. Plant residues from the previous crop are left on the soil surface, creating an insulating and protective layer, which conserves the soil and the moisture in the soil (see Figure 1).

Figure 1: Soybeans planted into a no-till land previously grown to maize. Note the residue.

Advantages of no-till

No-till has many advantages and will be discussed briefly.

a) Reduced costs

Conservation tillage systems, of which no-till is a good example, are considerably cheaper than conventional (plough and disc) and reduced (chisel and disc) tillage systems (see Table 1). Despite possible higher herbicide costs incurred in no-till (weeds are killed with glyphosate/non-specific herbicides before planting), the total costs are very favourable.

It is clear from Table 1 that the capital outlay for no-till is approximately 60% of that required for conventional tillage. No-till planters are more expensive than conventional planters, but the greatest savings are made because a 2.3m offset disc harrow and a 4 furrow mouldboard plough are not required and therefore a 74 kW tractor and its driver are also not required. For all the tillage operation types mentioned in Table 1, a 60 kW tractor would be required to pull a 4-row planter with a 3m spray boom and a 400 litre chemical tank attached and a 48 kW tractor would be required to operate a fertilizer spreader.

With no-till, the number of operating hours spent in the field is reduced. Therefore less fuel is used and the wear and tear on the tractors is significantly reduced.

Table 1: Tillage and capital costs for maize production for various tillage systems (based on costs in the 2009/10 Guide to Machinery Costs)

Type of tillage operation	Total capital outlay costs (R)	Total variable tillage costs/ha (excl. all herbicide and insecticide costs) (R)	Total fixed costs/ha (e.g. license, insurance) (R)	Total costs/ha (variable + fixed costs) (R)
Conventional (plough & disc)	1 495 408	1056.31	830.09	1886.40
Chisel plough & disc	1 447 603	709.65	580.49	1290.14
Stubble mulch (chisel plough)	935 723	632.73	476.80	1109.53
Direct drill (no-till)	896 948	315.25	302.50	617.75

b) Reduced soil erosion by water and wind
Plant residues remaining from the previous crop should cover a minimum of 30% of the soil surface at planting. Commercial farmers generally aim for a 60% residue cover. The residues:
   a. reduce the pulverizing effect of raindrops on soil particles
   b. reduce the "sealing" and puddling of the top layer of the soil
   c. prevent the formation of a "crust" on the surface and so reduce runoff, soil movement and loss of soil fertility
   d. reduce soil loss from wind erosion.

c) Improved soil moisture conservation
Surface residues improve water infiltration into the soil and reduce evaporation. Therefore more moisture is available for the crop grown under no-till conditions, particularly during dry seasons and seasons with erratic rainfall.

d) Saving of time and labour
The number of land operations is drastically reduced in a no-till system. Land preparation by spraying herbicides is quicker than mechanical or cultural tillage operations.
Small-scale farmers do not have to wait for ploughing contractors, who can be expensive and unreliable. Consequently, small-scale no-till farmers can plant earlier, which can result in higher yields being obtained, because the crop is planted at the optimum time.

e) Sufficient mulch can reduce compaction and suppress weeds

f) Increased earthworm activity
With the minimum soil disturbance associated with no-till, earthworm populations will generally be higher than in other tillage systems. The advantages of earthworm activity can be exploited, especially in respect of soil aeration, soil drainage and the movement of plant nutrients in the soil.

g) A wide variety of agronomic and horticultural crops can be grown using no-till (see Figures 2 and 3)

Figure 2: Maize, soybeans, dry beans and cowpeas grown under no-till conditions.

Figure 3: No-till vegetable seedlings (cabbages, cauliflowers and broccoli) planted into soybean residue.

Disadvantages of no-till

No-till has disadvantages such as:

a) A higher degree of management is required.
b) A good weed control programme is required. For the herbicides to work effectively, crop residues must be uniformly distributed over the field.

c) Germination and initial plant development can be slower due to cooler soil temperatures resulting from the residue cover. Some planters remove the residue close to the row in order to increase soil temperatures within the row. This action also prevents hairpinning of the residue, which can hinder the planting operation.
d) If the soil is too wet at planting, the seed slot may not close sufficiently, resulting in poor seed-soil contact and germination.
e) Soil compaction needs to be monitored. It can increase with time and cause poor plant growth and production. Compaction can be reduced if machines and animals are not put into the lands when the soil is wet. Vehicles should always use the same tracks in the land. The combine harvester should discharge off the lands.
f) High levels of residue can become a fire hazard.

Planters and methods of planting

Various no-till planters are available to suit both small-scale and commercial farmers (see examples in Figures 4, 5 and 6). Small-scale farmers who cannot afford or do not have access to a no-till planter, may use a v-shaped hoe to open a furrow in the soil in which to place the fertilizer and seed.

No-till planters must have adequate weight in order to provide sufficient penetration into the soil to get the fertilizer and seed placed at the required depth. Coulters are fitted at the front of the planter to slice through the plant residues and a tine is attached to open up a narrow furrow in the soil.

Figure 4: A knapsack sprayer for spraying agro-chemicals and a v-shaped hoe for drawing a furrow in which the fertilizer and seed can be placed.

Figure 5: A tractor mounted no-till planter.

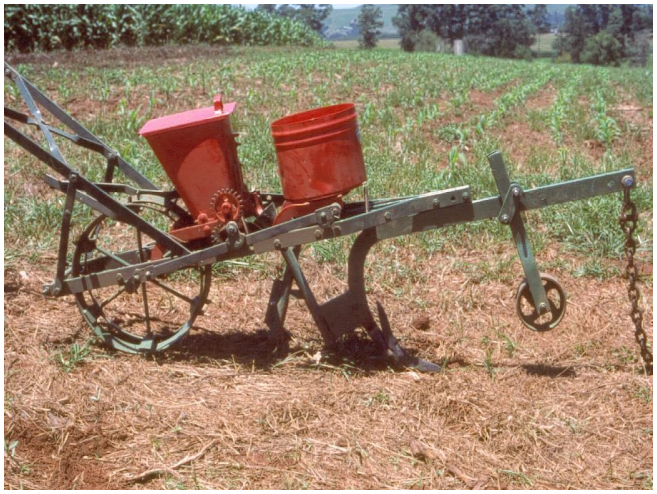

Figure 6: An animal-drawn single-row no-till planter without coulter attached.

Considerations

Before embarking on a no-till crop production system, any nutrient deficiencies (especially soil acidity) or compacted layers in the soil must be rectified if the plants are to produce optimally.

Thereafter, the number of years that a soil can be utilized under no-till will depend on the soil clay content, compaction and acidity levels. Generally, the higher the clay content, the longer the soil can be under no-till. Picture 7 indicates the number of seasons soils can be under no-till in KwaZulu-Natal before soil loosening is required.

It is advised that lime be applied every two to three years to the soil surface in areas where acidity is a problem. However, this should be confirmed by having soil samples analyzed regularly.

Crops utilized for silage production leave insufficient residues on the surface. It is therefore recommended that cover-crops (e.g. stooling rye and oats) be established using a no-till planter within three days of

removing the silage crop. They will then protect the soil surface and provide sufficient residue by planting time. Depending on the growth of the cover-crops, they could be grazed at least once, which would offset some of the seed costs incurred.

A no-till programme starts during the harvesting of the previous crop. The harvester needs to be adapted to create usable residue otherwise, if it is chopped too finely, most of it could be blown away in the August/September winds. The residues also need to be evenly distributed in the field.

The amount of residue left on the soil surface will depend on the erodibility of the soil, the type of residue and the slope of the land. The steeper the slope and the more fragile the residue the greater the quantity of residue required. For example, soybean residue is more fragile and decomposes quicker than maize residue and therefore more of it will be required.

Conclusion

The financial (yield, capital and working costs and reduced risk) and environmental benefits (less erosion and more balanced eco-systems) obtained by growing crops under no-till conditions far exceed those of other tillage systems. Consequently, the number of farmers growing crops under no-till is increasing annually.

This system is endorsed by the KwaZulu-Natal Department of Agriculture, Environmental Affairs and Rural Development. Further information can be obtained from J. Arathoon (033-3559495/100 or e-mail James.Arathoon@kzndae.gov.za), or the No-Till Club (Sandra Findlay 033-3443535), which has a comprehensive publication entitled “A guide to no-till crop production in KwaZulu-Natal”.

Reference:

Guide to Machinery Costs 2009/10. Compiled by the Department of Agriculture, Forestry and Fisheries, Republic of South Africa, October 2009. ISBN 978-1-86871-301-1.

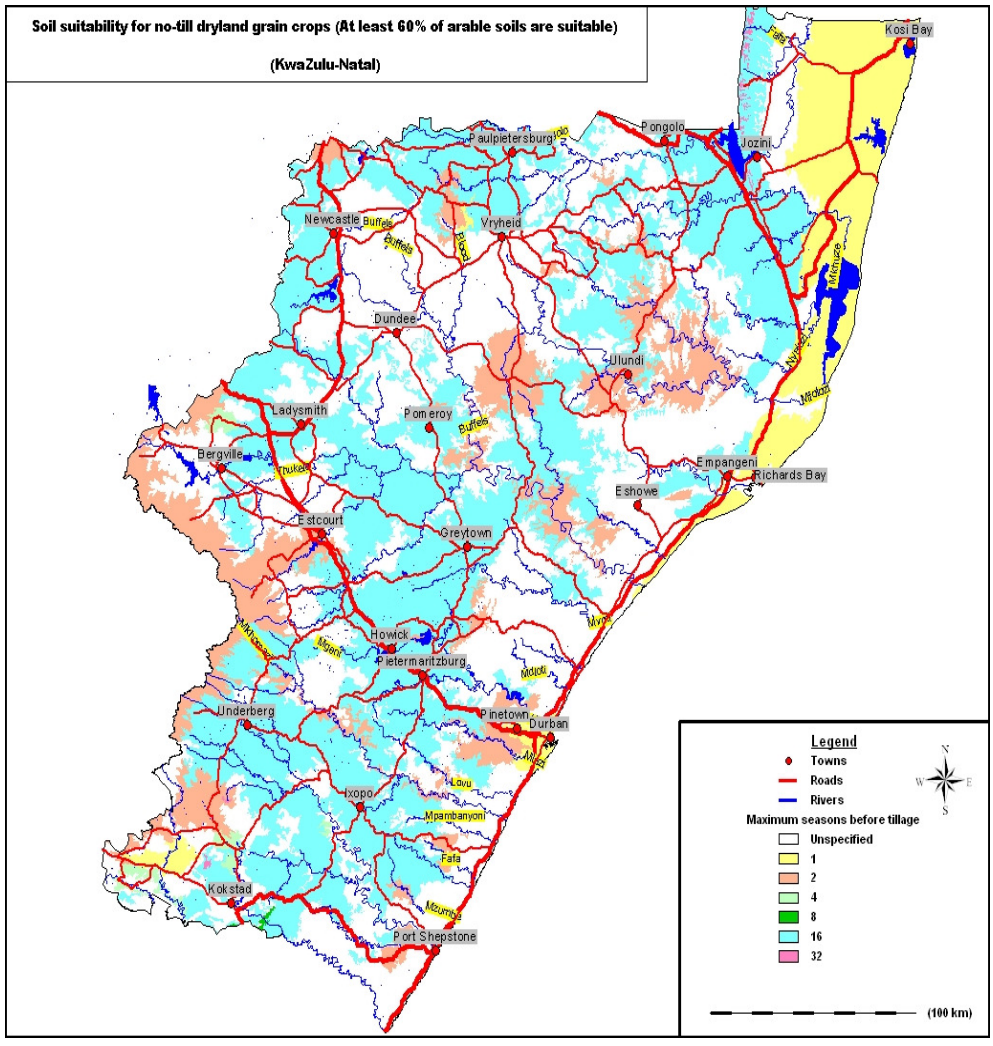

Figure 7: Map of KwaZulu-Natal, indicating the number of seasons soils can be under no-till before soil loosening is required.