Information Sheet

6.14 Subsoiling / Ripping

Subsoiling and ripping (sometimes also called deep tillage) refers to the practice of breaking up compacted sub surface soil layers, typically below the conventional tillage depth, using specialised tractor-drawn equipment aimed at lifting and cracking these layers. This is to improve water and airflow through the soil and alleviate any root limiting layers. Compaction at depth can lead to root growth limiting layers, impeded water flow and yield decline (see Information Sheet 6.9 for further information).

Nonetheless, soil disturbance should be avoided as far as possible. Frequent disturbance only provides short term gains that are not sustainable. However, where ripping is required, this can be a costly undertaking and all factors to ensure maximum benefit should be considered.

To ensure that the subsoiling operation will be effective, it is important to first eliminate confounding factors before embarking on the tillage operation. Examples include:

- Have your top and subsoil samples analysed for acidity or other chemical imbalance and use the opportunity to incorporate lime/gypsum to alleviate the problem.
- Check the depth of your soil. If your soils are shallow (i.e. hard rock less than 30 cm from the surface) and if your yields have been consistently low, you should consider returning the field to natural veld.
- Fields with a high water table should also be examined, as they could have been a wetland and if this is the case, the cane should be removed. As a last resort consider installing subsurface drains.

Identifying the need for ripping

To ensure that no unnecessary operations are undertaken, it is essential that the extent of any subsoil compaction problems be clearly identified and defined. This is best done by inspection:

- Check the surface for signs of a crust and runoff. If severe, this needs to be eliminated with a shallow cultivation (less than 10 cm). Soils prone to crusting should be protected with a mulch blanket to prevent the recurrence of a crust. This is a strong recommendation for coastal fields.
- Dig a pit and test the profile by chipping down the side for the presence of a compacted layer. Note the depth and root distribution to confirm the presence of compaction layers. If present, the compacted layer should be alleviated with a tine implement to a depth just below the restrictive layer (25 cm is usually sufficient for sugarcane fields).

Consider combining the ripping with other operations to reduce the number of passes. For example, consider combining rip, ridge for planting and fertiliser application all in one pass which will not only save land preparation costs but will also result in minimal soil disturbance.

Soil water content

For maximum effect, most soils should be dry at the time the fields are ripped. In moist soils the lateral disturbance is absent, and the ripped slot is smeared (sides are sealed) which reduces the rate of water movement into the bulk soil. In general, the best time to rip rainfed fields is during winter when conditions are normally dry. Summer should however be selected for irrigated areas as pre-harvest dry-off will normally yield drier soils. Certain grey soils (e.g. Westleigh, Glenrosa) and soils with high clay content (Clovelly, Hutton) might yield huge clods when ripped too dry, and this is also not desirable. Due to strong swell and shrink properties, it will seldom be necessary to rip soils with a Vertic topsoil (e.g. Arcadia, Rensburg).

Timing

In exceptional circumstances where compaction is evident, ripping should be practised within two weeks after harvesting to minimise damage to the new roots of the germinating crop. To maximise the ripping effect, soil water content as discussed above should be kept in mind when planning the operation.

Mulching

Cane leaves or any other organic residue on the surface will require additional preparation for ripping. The rip implement will have to be fitted with one or a combination of the following:

- A coulter to cut residue in front of the ripper tine (See Figures 1 and 2).
- Residue coulter wheels designed to continuously remove any debris that might build up in front of the ripper tine (Figure 3).

▲ Figure 1: An applicator fitted with a residue coulter and ripper for placing fertiliser in the soil.

▲ Figure 2: An applicator for chicken litter equipped with a residue coulter, ripper and compactor to level the area worked.

▲ Figure 3: A ripper fitted with residue coulter wheels.

▲ Figure 4: Ripper fitted with winged and straight tine tips.

Cultivation

The effect of ripping (subsoiling) on ratoon crop yields has been tested on the following 11 soil forms under rainfed conditions in the South African sugar industry: Glenrosa, Longlands, Westleigh, Arcadia, Cartref, Hutton, Milkwood, Wasbank, Shortlands, Inanda and Kroonstad.

The effect of ripping on ratoon cane yields has also been tested on the following five soils under irrigated conditions in Eswatini and the Eastern parts of Mpumalanga: Shortlands, Arcadia, Estcourt, Sterkspruit and Tambankulu.

Results indicated that subsoiling is a good alternative to ploughing when a minimum tillage system is considered. The benefits include:

- Minimum soil disturbance.
- Alleviation of surface and subsoil compacted layers.
- Improved water infiltration resulting in the efficient use of rainfall and irrigation.
- Interrow cultivation option with no or minimal effect on the current crop.
- Deep incorporation of ameliorants is possible (see Information sheet 6.12 Vertical Mulching and Figure 1).

Yield response

Field trials in South Africa showed a statistically significant response to subsoiling in only one field trial (Kroonstad soil). Three field trials showed statistically significant yield reductions (Glenrosa, Milkwood and Arcadia), whereas the rest showed no response to subsoiling under a range of conditions (i.e. dry or moist, rainfed or irrigated, mulched or bare surface). Eswatini experiments also showed no response to ripping under the conditions tested (these included 'moist' or 'dry' soils at the time of treatment). Delayed ripping (11 weeks after harvest) tended to affect yields adversely – probably due to excessive root damage.

The reason for no response cannot be determined from the trial reports. However, should stool damage have occurred the damage is permanent, and it was not yet shown that ripping will alleviate yield loss of the current crop. Nevertheless, a major benefit of ripping is improved water infiltration leading to reduced run-off and erosion. As a result, fertiliser loss through runoff is also reduced.

Implements used

The most common implement used to alleviate subsoil compaction is a straight tip subsoiler (in some cases with wings – Figure 5). Various spring tine rippers (in some cases with wings) and a paraplough (Figure 6) are also used. When used in ratoon cane the tine of rippers are pulled through the middle of the interrow to depths that range from 150 to 600 mm. The purpose of the rip operation, and depth of the restricted soil layer, will determine the ripping depth.

▲ Figure 5: A straight tip subsoiler.

▲ Figure 6: A paraplough.

Soil compaction

Soil compaction should be distinguished from stool damage (driving over the stools) which is potentially far more costly compared to soil compaction. Soil compaction in the sugar industry occurs mainly at the soil surface to a depth of between 15 to 25 cm depending on the soil type, clay content and water content at the time of compaction. Wet sandier soils with little organic matter will compact to greater depths compared to dry clayey soils with much organic matter. Grey soils are the most susceptible to compaction, with black soils being the least and red soils being intermediate. Subsurface compaction (between depths of 20 to 45 cm) in the form of a plough layer is less common in the sugarcane industry but has a severe rooting depth and water infiltration limitation. Both types of compaction (surface and subsurface) can be alleviated with ripping, while taking the soil water content into account for maximum effect.

Surface capping

Capping (or crusting) is mainly caused by water droplets hitting the surface causing structural collapse and blocked pores creating a thin, but very dense, sealed layer. Grey soils are in general very susceptible to capping followed by red soils. Alleviation is very easy via light cultivation with a scarifier (Figure 7). Deep ripping is not required unless a compacted layer is present at depth. Leaving tops scattered (following burning at harvest) or a mulch blanket (no burning at harvest) are excellent alternatives to protect the soil surface from capping (Figure 1).

▲ Figure 7: Two types of scarifiers.

Compaction prevention

In general, there is no evidence to recommend the repeated use of ripping in ratoon cane to improve cane yields. However, where soil compaction is present, loosening of the soil surface will be beneficial for several reasons. Interrow ripping to a shallow depth will alleviate the problem by improving fertiliser and water use efficiency, water infiltration and thereby reducing run-off and erosion. A policy of 'prevention is better than cure' should always be followed to minimise the effects of compaction.

The following practices can be employed to prevent the occurrence of compaction:

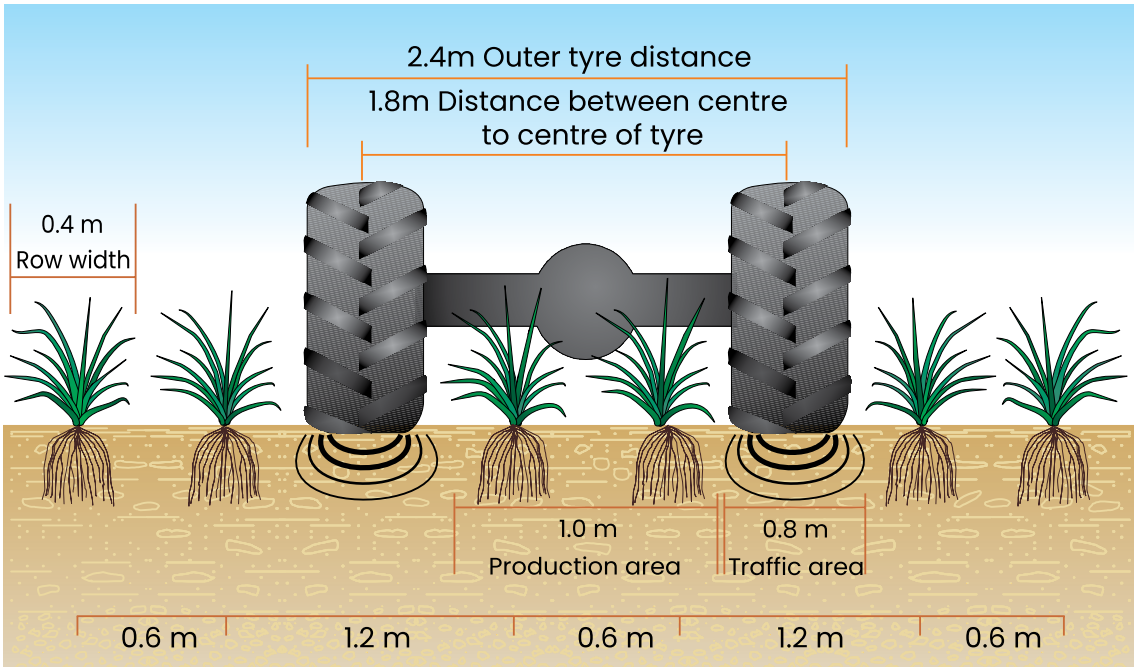
• Wheels should not run over the cane rows. Make use of permanent control traffic zones to prevent wheels from driving over cane stools (i.e. tramline system – see Figure 8 and Information Sheet 6.10). In a manually harvested system, the tramlines need only be in every six or seventh row depending on your specific loader operation.

• Restrict large haulage trucks to loading zones.

• Avoid using infield transport when soils are wet. In addition, ensure that high flotation tyres are fitted to reduce the compaction effort.

• Use soil form information to plan a harvesting schedule. Harvest crops on poorly drained soils during dry periods (usually in the winter) and if need be, harvest fields on well-drained soils during wetter periods (see Table "Suggested harvest programme based on soil groups" in Information Sheet 6.2).

• The reasons for reduced yields after ripping treatments may, in many trials, be ascribed either to the disturbance of the soil-root-interface while the crop is still reliant on the old root system, or to stool pruning.



▲ Figure 8. Field layout managed with a controlled traffic system. Distances are determined by factors such as the available equipment, the crop and water regime (rainfed vs irrigation).

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