LAND PREPARATION: deciding how best to keep costs down

Ian Daniells

Department of Agriculture, NSW

Agricultural Research Station, Narrabri

Introduction

Throughout this article I will be encouraging less tillage. There are three reasons for this. Firstly, tillage is costly. Secondly, soil structure often is sufficiently good for farming without tillage. Thirdly, soil moisture conditions are seldom right for effective tillage: there is always the danger that tillage will be harmful to soil structure.

Decisions on land preparation

(1) Economics

The first consideration is the cost of the various operations in relation to returns. Reducing seed bed preparation costs will play a big part in economic production. The question to ask is: how much tillage can I afford to do? Some of the major operations such as deep ripping or chisel ploughing may have to be rejected. This is discussed further by McKenzie and Hulme elsewhere in these proceedings.

(2) Physical need for tillage

The second consideration is the need for tillage: how much working does a particular field need? Some tillage operations dispose of <u>weeds or stubble</u>. Other operations are concerned with <u>shaping the soil surface</u> into ridge and furrow for water flow.

Other tillage operations are aimed at producing the right conditions for plant growth by changing the soil's structure.

However, soil structure changes constantly in response to many factors, not just tillage. The interplay of these various factors determines whether the soil structure is good or bad.

Take account of the cropping history (continuous cotton or rotation). Look at the yield history: if a field is yielding less than it used to or less than other fields, could it be that the soil structure is becoming degraded? What were the soil moisture conditions during the previous season's land preparation? Was the topsoil wet? How about the subsoil? What did the seed bed look like: fine and fluffy or coarse and cloddy? Answers to questions such as these will help you decide whether the soil structure was good or bad at the start of the previous season.

The weather over the previous season will control the drying of the soil profile and any effect this may have on restoring soil structure. An early last irrigation followed by a dry finish to the season can allow the crop to dry the soil to depth. This drying has a double benefit: cracking may partly restore soil structure and the dry soil is in a fit state for the following land preparation.

(3) Structural condition of the soil

A useful way of determining the need for tillage is to examine the soil profile in a backhoe pit. There are 3 zones in the soil profile to examine. The first is the tilled layer (the plough layer of a flat field or the ridges of a furrowed field). The second zone is the upper subsoil (just below the tilled layer). The third zone is the deeper subsoil.

If the tilled layer of a cracking clay is in good condition, it will consist of porous, crumbly clods perhaps embedded in loose, fine soil. A poor soil will contain dense clods with dull surfaces and rounded faces. The clods can sometimes be broken into smaller pieces along cup-shaped cracks, suggesting that one lump of soil has been pressed into another.

A poor seed bed will affect the early growth of a crop and reduce yield. However, degradation in the tilled layer can be dealt with, given time. This layer is the most affected by wetting and drying; it receives the loosening action of frost and can be stirred (when dry!) by normal tillage. Early land preparation allows the mellowing effects of time and the weather to improve matters.

The upper subsoil, extending for perhaps 20 cm below the tilled layer, should be examined most carefully. A good cracking clay will contain many fine cracks between small blocky aggregates which can be easily prised out with a knife. With depth, these aggregates become larger and they become more wedge-shaped. Each piece will have many almost-flat, shiny faces and can be broken into smaller pieces revealing more shiny faces.

A cracking clay in poor condition will have a different structure in the upper subsoil. Cracks will be further apart and shiny faces fewer. If clods can be distinguished, they will have dull, rounded faces and may "cup" into one another. In the extreme, the whole upper subsoil will appear to be one mass with no separate clods. When dry it will have large vertical cracks with hard, dense blocks of soil between. When wet it will be plastic with no evidence of fractures. A clod prised from the profile will simply be a lump broken off a larger piece revealing a dull, rough face.

Degradation in the upper subsoil is difficult to deal with. This zone is protected from the loosening action of frost, is less affected by wetting and drying and is out of reach of normal tillage implements.

The structure of the upper subsoil may be partly restored by thorough, deep drying by a crop. Following this, deep ripping may or may not further improve the soil.

The deeper subsoil is often better structured than the upper subsoil. This is because it is below the depth of tillage and away from the compacting influence of wheels. A good structure in the deeper subsoil will consist of large wedge-shaped aggregates with shiny faces. Thus, by examining the soil profile we can decide how much and what type of tillage is needed.

Other approaches can be used to deduce the structural state of the soil. Cotton roots can be examined for signs of branching or bending. This can be done by pulling up several plants. A better way is to examine the roots in a backhoe pit: the shape of the roots can then be related to signs of poor structure in the soil profile.

Neutron probe readings during the cotton season may point to a possible problem, for example poor moisture extraction at depth.

Other methods of assessing soil structure include measurements of penetration resistance, gas diffusion rate, bulk density of intact clods and the use of dyes in water to show pores.

Another consideration influencing decisions on land preparation is the risk that tillage may be detrimental. There is always the danger that tillage will make matters worse. The question to ask is: how much tillage dare I do? To decide whether tillage would be a risk, we need to assess the soil moisture status.

(4) Soil water content

The moisture state of the soil profile can be assessed by feel. If the soil can be moulded then it is too wet for tillage. A soil which is dry enough for tillage will be impossible to mould into a ball: the loose material will not stick together and the larger lumps will either be too hard to mould, or will crumble.

While surface soil can be dried by sun and wind, a wet subsoil will not approach a satisfactory dryness without an actively growing crop. The subsoil moisture content may be assessed by digging or augering to obtain a sample of soil to feel. If neutron probe access tubes are in place, the probe may be used to predict when the soil is dry enough for tillage - it will need to be a lot drier than your normal refill point! The soil should not be wetter than permanent wilting point: the point where plants would fail to recover from wilting even if watered. In practice, this is the driest state to which a crop can bring a soil.

The risk of tillage may be immediate or long term. An immediate risk arises if the soil is not dry to depth. Tillage should be kept to the bare minimum. A long-term risk may arise if, for example, existing ridges are ploughed out. The risk then is that rain may occur before land preparation can be completed with the ridges reformed.

The risk of land preparation under the wrong conditions is very real. One experiment has shown a loss of lint yield of 33% due to land preparation on originally good soil which was not dry to depth. This loss in yield is serious enough. When added to the cost of the land preparation which caused that loss, it is a tragedy.

Conclusions

Keeping land preparation costs down? My advice is to examine the soil profile to assess the need for and risk of tillage.

If the need is high (say there is a badly degraded layer that should be broken by deep ripping, or a lot of work is required to produce a seed bed) but the risk of further degrading the soil is low (soil dry to depth) then the decision rests on the cost of the operations involved.

If the need and risk are both high, it may be uneconomic to grow cotton in that field until the soil can be improved by dryland cropping.

If the need for tillage is low, leave the existing ridges in place, adopt minimum tillage and save some money.