COULTER DISCS

To best understand discs you first need to understand the different types of discs and what terms are used to describe them and how each of these effect the cutting ability and the type of cut.

Centre Hole, Radial Holes and Pitch Circle Diameter (PCD). These have no effect on the cutting ability or type of cut. They relate only to the hub mechanism used to carry the disc. The most common patterns used in Australia are 4 stud and 5 stud on Discs large than 16" in diameter and six stud on discs less than 16" in diameter. Also starting to gain in popularity in Australia are the Agrihub patterns.

Diameter. This refers to the outer diameter of the disc, generally the larger the diameter the larger the thickness. The most common sizes and their thickness are; 15" (3mm and 4mm), 16" (4mm), 18" (4mm), 20" (5mm) and 24" (6mm). Manutec carry 16", 18" and 20" for use on our coulters. Generally 18" is used as the standard.

The larger the diameter and the thicker the disc the more cutting force that is required to cut and the greater the surface area of the disc that is in contact with the material to be cut. Therefore, the larger discs will require greater spring pressure to cut. Thicker discs are also more prone to going blunt than thinner discs. The larger discs will however give a deeper cut and have less wear and tear. The deeper cut in some soils and trash types will be necessary to get an effective cut. When checking the diameter of used discs, it is not unusual to have 1" to 2" of reduced diameter due to wear. One disadvantage of larger disc sizes is in having enough space to breakout over obstacles, so when retrofitting discs or changing disc sizes this is an important consideration.

Bevel. This refers to the angular cut on the leading edge of the disc that creates the cutting surface. Discs will either be single bevel or double bevel and the depth or angle of the bevel can also be different. The bevel will determine how the soil opens. The most common bevel is 10mm deep. For trash coulters a double bevel is always the best option. For Disc openers a single bevel is the most commonly used option.

Flat/Dish. This refers to the curvature of the disc. The majority of coulter discs and discs used in disc openers are flat. Conversely the majority of cultivator discs are a dish shape. The dish shape is designed to maximise soil disturbance.

Style/Shape/Pattern. There are many different styles or shapes of discs and it is this that will most effect the type of cut. The most common styles are;

Plain – Plain discs have good penetration and cutting in heavier soils. Minimal soil disturbance and are less prone to plugging in wet clay soils. Plain discs are widely available in Australia and are very commonly used. Plain discs are not as good at maintaining high velocity as some other discs particularly in lighter soils. Often a tow in angle will help plain discs to maintain a higher cutting velocity.

Fluted – Fluted discs also have good penetration and good cutting ability. They are also reported to have a degree of self-sharpening capability. Fluted discs will produce a moderate level of soil disturbance. Fluted discs have a fine ripple around the outside of the disc, on average the cutting ripple is around 6mm wide. Fluted discs work better in sandy, loamy soils, they are more prone to plugging in heavier clay soils. Fluted discs also are better at maintaining a higher disc velocity in lighter soils. Fluted discs are readily available in Australia and are one of the most commonly used discs.

Cross-Wave discs are a hybrid disc that take the best features of other disc types to produce very good performance across mixed soil types. This disc was originally designed by Manutec as we were looking for a disc that could maintain a high disc velocity across a range of soil types, operate effectively in heavy soils and keep soil disturbance to a minimum.

Wavey – Wavey discs have moderate penetration and cutting and high soil disturbance. The number of waves and the width of wave will determine the soil disturbance. The most common waves are 7, 13 and 26 waves. On average the cutting wave is between 20 and 30mm wide. This type of disc is readily available in Australia, but are not widely used, compared to other disc types.

Knotched/Scalloped – These discs have good penetration and cutting especially in coarse residue. Minimal soil disturbance. The knotched disc is a variation of the plain disc with semi-circular knotches cut into the cutting edge. This knotched effect can help in heavier trash loads of coarse residue and can also help to reduce the amount of spring pressure required to cut and achieve cutting depth. These type of discs are not commonly used on coulters in Australia, they are used in some single and double disc openers, where users report that the scalloped disc assists with maintaining disc drive in heavier trash loads. However, there is some concern that residue between the knotches may not be cut.

Turbo – This term refers to the changed angle in the waves/flutes on the disc, rather than being symmetrical the waves cross the line of symmetry, these are referred to as asymmetrical waves. This has the effect of making the wave more vertical when it enters the soil and makes contact with the trash. These discs tend to have higher rates of soil disturbance. These type of discs are not yet very common in Australia and are not that widely available, their use is however on the increase.

Bubble – This type of disc appears to have bubbles if the face of the disc. The bubbles assist the disc to maintain traction with the soil and this helps to keep the disc velocity high. This type of disc is more effective in lighter and sandy soils. It will be prone to plugging in heavier clay soils.

Residue Wheel – Residue wheels normally run in conjunction with discs and coulters. The function of the residue wheel is to reduce the amount of trash/residue to make it easier for the coulter/disc to cut.

Our experience with discs and how they perform has been very similar to our experience with press wheels, that is that every situation is different and that there is no one solution fits all. There are two groups of factors that affect a disc's ability to cut. Group 1 are related to the discs physical characteristics, these are as follows:

Disc Diameter – A larger disc diameter will cut deeper which may give the disc a greater opportunity of cutting the trash. However, a larger diameter disc has a larger disc edge in contact with the trash and hence will require greater force to cut through. Large discs can have a lower radial velocity which may also impact on cutting ability. Larger diameter discs are also thicker. (see below). So, to operate larger disc and maximise their potential to cut an assembly capable of greater down pressure is required. The larger disc will also affect breakout and rock/obstacle clearance.

Disc Thickness – The thicker the disc, then more force that will be required to achieve the same cut as a thinner disc. Thicker discs will wear longer however they may also go blunt. Generally, the larger the diameter of the disc the thicker the disc will be and as per above the greater

pressure that will be required for the disc to operate at maximum potential. To assist we recommend larger bevels in thicker discs.

Disc Sharpness – One of the most important factors is disc sharpness. Discs will start off sharp and it is important that in the design of the disc assembly that discs are allowed to self-sharpen. The blunter the disc the more force that will be required to cut. Some plain discs can be resharpened but this is not an easy or quick process.

Disc Material - there are two main materials used for discs these are Boron Steel and Manganese Steel. Some farmers in the more highly abrasive soils of WA have also had discs made from hardox. The hardness of the steel will affect the wear rate. Wear is literally a double-edged sword because wear also helps to keep your disc sharp. Very hard steels also do not cope well with rock impact and are more prone to cracking. The ideal material wears enough to stay sharp but not so much that it wears out too quick.

Disc Angle – Disc angle not only will determine the shape and width of cut, but the disc angle will also help to keep discs sharp. A lead in angle will help to maintain higher disc velocity and an off vertical angle will help to keep the disc at cutting depth.

Disc shape – Disc shape will not only determine the degree of soil disturbance, but the greater the soil disturbance the more force that will be required to achieve the same level of cut. The disc shape is very important with regard to maintaining a high disc velocity. High disc velocity is an important factor as per the next point.

Disc Velocity – The higher the disc velocity the greater the cutting ability and the better the chance of reaching the sheer force required to cut trash. Disc velocity is not a physical attribute that can be seen looking at a disc, rather it is a variable that is affected by a range of different factors including, shape, soil type, diameter and operating angle.

Group 2 are the environmental factors, these are as follows:

Type of Trash – different trash has different levels of sheer force required to cut. It is quite common for discs to cut well in one type of trash and then struggle against another.

Age of Trash – the characteristics of trash at different stages of decomposition will result in different levels of sheer force required to cut the trash. The worst stage of decomposition is when the outside of the trash goes slimy and the inside is still quite fibrous. Which generally happens around seeding time. An increasing number of farmers are setting up coulters on separate bars and then running around the paddocks before seeding at a time when the trash is most easily cut. Even if the trash hair pins it is likely to have rotted out by the time seeding starts.

Distribution of Trash – This is how the trash is distributed across the cutting surface. Ie standing stubble, fallen stubble, chaff, random weeds.

Line of trash – This is the relative angle between the existing trash and current seeding line. Many farmers have reported to me that by adjusting the sewing angle to cross existing trash lines by as little as 5 degrees greatly improves coulter performance and reduces both hair pinning and blockages.

Time of Day – Coulter performance will be reduced during the time of day when heavy dew is present and enhanced during the hotter periods.

Soil Type – the soil provides the disc with its cutting resistance and drive which effects the velocity of the disc. Some soils are also very abrasive and so will keep discs sharper (they will also wear the discs out quicker). Heavier soils will plug some disc types making it harder for them to penetrate to a good cutting depth and this will also slow down the disc velocity.

Soil Surface Hardness – the harder the surface the better the chance of cutting however, the harder it will be to achieve optimal cutting depth. Very hard soils may also make discs blunt. Softer soils that give no cutting resistance will make cutting trash very difficult and in these types of soils a trash holding wheel or a residue wheel may be required.

Moisture Level - The moisture level in trash is an important factor. Moisture can be as a result of residual moisture as part of the decomposition process, moisture from rainfall, moisture from morning/evening dew. Moisture can also reinvigorate the outer slimy layer. Hence the timing of seeding is very important, areas with high trash loads are better seeded when trash moisture levels are low.

Thickness of Trash – This is where multiple layers of trash are requiring to be cut. Often this can result in retention of moisture in the lower level of the trash. Making cutting even more difficult. We tend to find this is major problem after storms when a lot of standing stubble lies over.

The Perfect Disc

Sorry to be misleading but there isn't one ? Yet ? No disc will cut through thick wet fallen trash in light soils. Clever farming practices or the use of non-disc techniques need to be applied such as:

- Crop the worst trash infected areas when the trash has lost some of its moisture.
- Pre-Coulter your paddocks when the trash is at its most cuttable.
- Use a trash reduction wheel in front of the coulter to move some of the trash and make the coulter more affective.
- Change the line of seeding.
- Use an anti-hair pinning wheel in conjunction with the disc
- Keep your discs sharp
- Better weed management
- Better stubble management

Also remember that discs are not just for trash, discs also have the following side benefits;

- Reduced Pulling HP for tractor
- Reduced soil through
- Reduced clod size
- Reduced wear on your points.

If you have anything to add to this document that may help other farmers or that may help us to develop more effective products contact us at Manutec.