Aerial Video for Crop Monitoring

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The benefits of using aeroplanes for monitoring purposes has been known for many years, particularly by the military who were able to set up their own planes and equipment. Over the years the use of aerial photography has become more widespread, but the cost of getting the plane and equipment to take the photos at the most appropriate time has limited its use for cropping. Taking photos out of the window of the plane does not show up the differences in a paddock as well, mainly because you are looking across the crop rather than vertically down through it.

For some years, the Postlethwaite family took still photos through a hole in the floor of a Cessna. This produced excellent results, gut the risk of missing part of the paddock because there is only a narrow field of view, and having an airsick cameraman as a result of looking down through the floor meant a better method was needed.

In 1992, the Donald Farm Vision 2000 Discussion Group visited Neville Sharpe's property in South Australia and saw his first attempts at videoing crops. At that time the quality of the images was not good, but since then dramatic improvements in video camera and computer technology have made video a viable option. In 1996, a reasonably priced digital recorder was released onto the market, and Donald Landcare Group purchased one so that it could be used for crop monitoring.

The camera is attached to the door of a high winged aircraft such as a Cessna 172 and set so that it is pointing straight down. A remote viewer is used so that everyone in the plane, including the pilot can see what the camera is recording.

As soon as the plane has landed, the tape can be viewed and individual frames selected by using a video capture card in a computer. Once the image is in the computer, it can be printed off as is, or changed so that differences are highlighted if required. With a wide angle lens on the camera. And the plane flying at 2500 ft. the camera covers a 600m wide strip, which is wide enough for many paddocks, At this scale, each pixel covers about 1 metre squared. To cover a larger area with the one image, the plane needs to foy higher, remembering that there will be a correspondingly larger area covered by each pixel. If more detail is needed in any particular area, then the zoom lens on the camera can be used.

The system has now been developed to the stage where it gives us good results and is suited to our needs. By this we mean that it must be -

a) affordable
b) user friendly
c) versatile

What can be seen on the ground?

As a general rule, if it is a straight line, it is man made, and if it has uneven edges then it is natural. In wet years features such as creek lines and crabholes show up clearly. Variations in crop density over an apparently even paddock are very common. While we cannot tell what causes these differences from the picture, it does show us where to look on the ground to determine the cause. Different soil type, weed growth, soil compaction, insect attack, poor urea spreading, and uneven aerial spraying have been identified so far, as well as others that have not yet been explained.

How can it help with management?
It helps people assess their paddocks more realistically, even to the stage of; should this paddock be cropped regularly? Or if small areas show up as being poor, what can be done to bring those parts up to the rest of the paddock. Because those areas can be identified separately from the rest of the paddock, soil tests can also be taken separately from the rest of the paddock, soil tests can also be taken separately rather than lumped in with the rest of the paddock. Similarly, any treatments can be varied to suit. By taking images over a number of years, the response of different crops to the treatments can be traced. A permanent reminder of mistakes like driving too wide with the spray unit can only help reduce such occurrences in the future, even if it is only because of the treat of the pictures being pulled out to show others.

Looking to the future :
In the short term there are 2 objectives for us, to be able to use the images as a predictor of the yield map , as well as complementary to the yield map, and using different shades of colour to identify weed species.

As was clearly demonstrated by the results of the MEYCheck program, the potential yield of a crop is set early in the season. Variations in crop health at that stage, as shown in the video images will relate to the potential yield of each pixel in the image. By using this in combination with the yield map we can see where the yield was limited by low potential, and where subsequent events which reduce the potential yield have been more important, This helps us identify the correct cause of the lower yield. As and example, a paddock with 2 soil types, one well structured, and the other prone to crusting and waterlogging in wet conditions. Emergence of the crop on the poorer soil is less, so its potential is lower from the start. However, heavy rain in August causes waterlogging on this soil, so lowering yield even more. The video image helps us determine what was the main cause of the low yield, ie, is increasing the sowing rate to give adequate plant numbers sufficient, or do we need to solve a soil structure problem?

A second aspect which shows up on the video images is the variations in shades of colour over the paddock. Some of these differences are easy to see, others not. We are looking at the minor differences, and to make them easier to see, we will pick up patches of weed infestation and may even be able to identify the weed.

In the longer term, the video image is a map of the paddock. Currently the images we are using have some distortion, particularly at the edges, but there is computer software now available that can remove this distortion, so making the image an accurate map, with differences across the paddock identified. Currently global positioning systems (GPS) in use on agricultural machines is accurate to about 1 metre. Once a system is available that is accurate to about 5 cm and is affordable then why not have the tractor drive itself? By combining the video image with the GPS, a computer can steer the equipment around the tree, change the spray to kill the patch of radish on nozzles 3 and 4 and stop as soon as the tank is empty to allow you to fill up again. Sounds futuristic, but the technology is already available, only it's currently too expensive to justify, just like the computer a few years ago.