

THE USE OF CROP SENSORS BEYOND NITROGEN AND IMPROVING THE RIGHT TO FARM

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ABSTRACT

Crop Sensors have been developed and used primarily for Nitrogen use in cropping systems but there are many more applications for crop sensors than this. They are now providing pastoral and cropping farmers with a more accurate way of managing an increasing variety of their field inputs. The improved field management that comes through the effective use of crop sensors increases the farmer's ability to retain the "Right to Farm" effectively.

With increased farming intensification and the expansion and amalgamation of farms, a variety of in-field issues are being identified. The variability that has been fenced off for soil type is now merged together as one. The use of crop sensors to locate and map this variability is extremely effective in enabling remediation to take place.

Some issues are man-made as with the poor application of in-field products such as lime. Poor application of lime can result in greatly fluctuating levels of pH across the application width, with it being either too high or too low for optimal plant growth. The use of the Trimble GreenSeeker® in discrete sensor mode is proving very useful in identifying these strips. As a result of poor applications micro-nutrients can often be a major issue and these are also now being effectively managed with crop sensors.

The use of Crop sensors in the dairy or pastoral industry is proving to have a huge advantage when improving the management of effluent spreading and variability that is associated with it. Effluent is a difficult product to apply and the inherent variability that is created due to uneven application fits very well with the use of crop sensors. Crop sensors can also now apply liquid nitrogen in-between every urine or dung patch.

Keywords: GreenSeeker pastoral pH effluent

Introduction

Since their development crop sensors they have been used primarily to measure biomass and chlorophyll content to calculate the amount of nitrogen a crop requires however there are many more applications for crop sensors than

this. They are now providing pastoral and cropping farmers with a more accurate way of managing an increasing variety of their field inputs.

With increased farming intensification and the expansion and amalgamation of farms, a variety of in-field issues are being identified. The natural variability that has been fenced off by soil type by previous generations of farmers is now merged together as one. Man-made variability through the poor application of farm inputs is also now able to be quantified. The use of crop sensors to locate and map both natural and man-made variability is extremely effective in enabling remediation to take place.

Issues with On-the-go Mapping and Application

Algorithms associated with crop sensors are in demand to make nitrogen application as simple and time efficient as possible. However these algorithms can prove to be problematic. More often than not, assumptions are being made regarding the crop variability, that the variability being detected is based around nitrogen levels when often this may not be the case.

Precision agriculture is just what it says, plain and simple. Precise. It's not "near enough" agriculture. It's about being precise and not making assumptions, by looking at crops that have assumed nitrogen deficiencies, and then applying more nitrogen, micro-nutrients imbalance can become a major issue. This in turn will have a negative impact on both the environment and the profitability of the farmer.

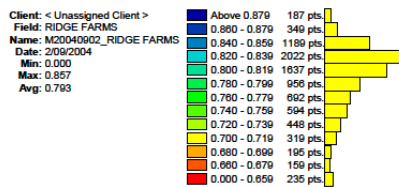
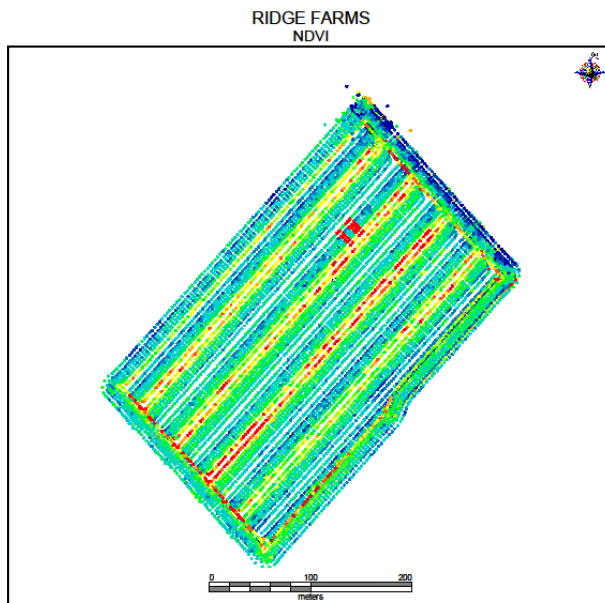
The successful use of crop sensors in New Zealand has to date primarily been based around field mapping for site identification with follow-up product application once the issue has been identified.

Mapping For pH Management

One of the most easily remedied man-made issues is poor application of in-field products such as lime. The poor application of lime can result from a number of factors; varying product size, damp product, incorrectly calibrated spreader, or application in adverse weather conditions. These can all contribute to create an uneven spreading pattern which in turn can result in greatly fluctuating levels of pH across the application width, with the levels of pH being either too high or too low for optimal plant growth. The use of sensors that can record individual sensor information, such as Trimble GreenSeeker® in discrete sensor mode, is proving very useful in more accurately identifying these areas.



Fig. 1. Uneven growth in a ryegrass seed crop



Client: < Unassigned Client >
 Field: RIDGE FARMS
 Name: M20040902_RIDGE FARMS
 Date: 2/09/2004
 Min: 0.000
 Max: 0.857
 Avg: 0.793



Fig. 2. NDVI map created from GreenSeeker® in discrete sensor mode

Mapping issues as shown in Fig. 1. with the GreenSeeker® gives them a G.I.S. location. It is then possible to soil test in the specific areas as in Fig. 2. identifying the issue, allowing accurate treatment. Using the Crop sensor in this way the farmer has the ability to reduce the amount of product that is needed to treat the issue by reducing spreading width to match the identified areas. This also

saves a significant amount of money that would have been lost through reduced production or through over-application of product if the field was soil sampled using the traditional transect testing method.

Mapping For Plant Growth Regulators

The use of crop sensors has been very successful in the use of Moddus® plant growth regulator on ryegrass. Moddus® is a very expensive product. Studies have shown there is a direct correlation between the amount of Moddus® applied and an increase in seed yield (Chynoweth et al., 2010). GreenSeeker® is used to capture NDVI data (Fig. 3.) for the creation of a variable rate application map (Fig. 4.).

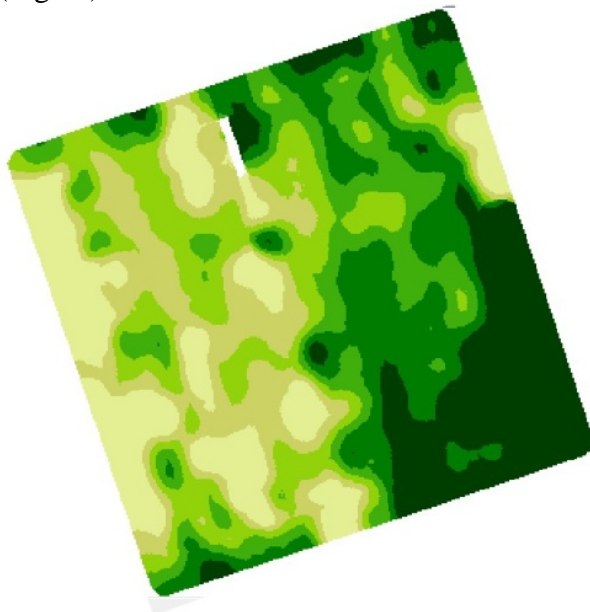
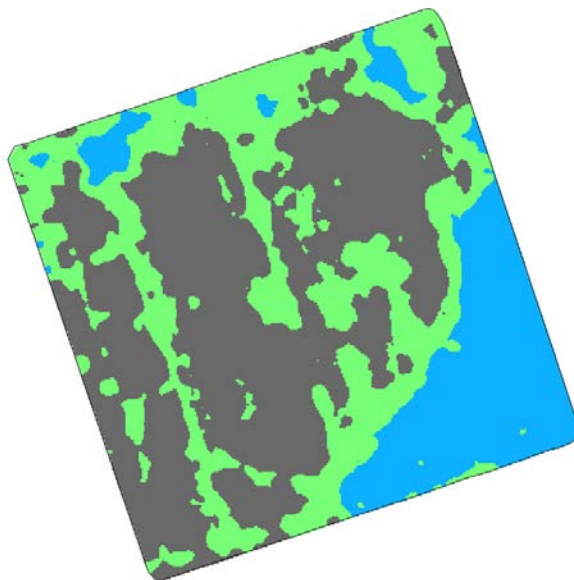


Fig. 3. GreenSeeker NDVI map of Ryegrass seed crop



Zone	Moddus L/Ha	Total Vol
1	1	125
2	1.4	175
3	1.6	200

Fig 4. Variable rate Moddus® application map.

The variable rate application has increased evenness of crop maturity, reducing seed loss potential and increasing profitability. Because it is known that the more Moddus® is applied the greater the yield, farmers now have the confidence to increase the levels of applied product to the optimum in the areas that require it and reduce it where it is not necessary. If there is over-application where the biomass is reduced then there is a high potential to lose seed due to climatic conditions while the majority of the crop is still maturing.

Mapping for Weed Management

NDVI mapping to identify areas of significant weed pressure is proving to be a very useful tool in locating these areas, allowing targeted treatment in the current crop or in a future crop when there may be limited herbicide options.

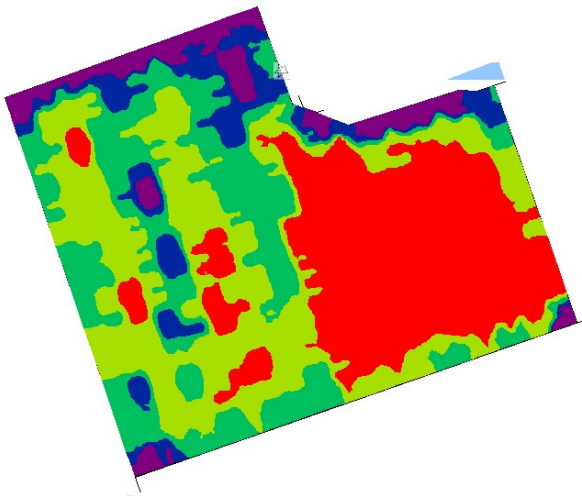


Fig. 5. Herbicide application map for site-specific weed control.

Vulpia bromoides, commonly known as hairgrass, is difficult to control in many crops but with the above map the farmer was able to use site specific application of herbicides which may have been considered risky if applied across the whole crop. Fig. 5. seen above, showing areas of significant weed pressure in purple to blue, demonstrates the patchiness of some weeds and the issues associated with their control.

Grass weeds are emerging as a problem around the world in cropping systems and the reliance on broad acre application is increasing (Heap, 1997). This has the increasing risk of herbicide resistance.

Mapping for Pest Management

Native to New Zealand the Grass Grub, '*Costelytra zealandica*' has proliferated since we became a predominantly pastoral country. It is the natural enemy of the common grass and has a significant impact on both the pastoral and arable sectors (Fenimore, P.G. 1984). In its grub form it has the ability to eat off plant roots causing them to die or be extensively damaged resulting in a significant impact on grass production and having a huge associated cost to the farmer. Grass-grubs occur in aggregations and cause damage in patches of pasture

making it possible to monitor and treat the affected area on a regular basis once these areas have been identified by crop sensors. Other pests also operate in this fashion and a similar approach can be taken.

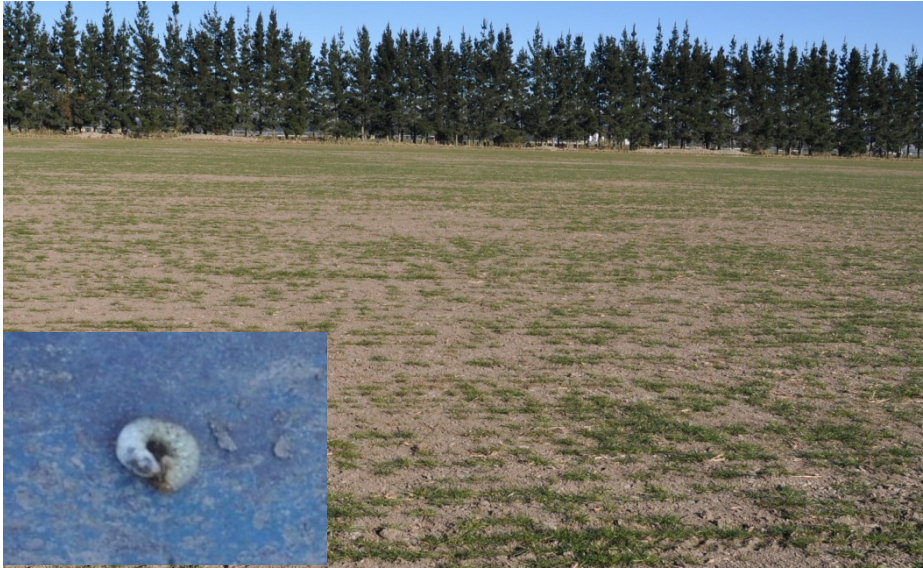
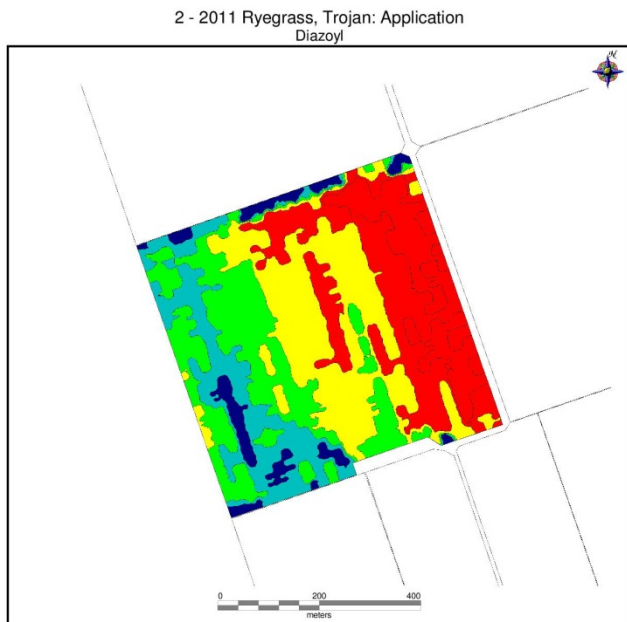


Fig. 6. Pasture damage cause by Grass Grub with close-up of Grub



Client: < Unassigned Client >	3.00 l/ha 1.53 ha
Farm: Greenvale	2.00 l/ha 4.63 ha
Field: 2	1.00 l/ha 7.31 ha
Crop: 2011 Ryegrass, Trojan	0.75 l/ha 8.46 ha
Name: 2 - Application - Diazoyl	0.50 l/ha 9.80 ha
Type: Application	
Area: 31.87 ha	
Date: 23/04/2012	
Diazoyl: 32,392 litres	
Unit Cost: \$19.44/l	
Product Cost: \$629.70	
Cost Per Area: \$19.76/ha	



Fig. 7. Variable rate Pesticide chemical application map

GreenSeeker® has been used to identify the areas. Prescription maps are made to variably apply products to the affected areas with an appropriate plan. This has the ability to significantly reduce the amount of product needed. By using the variable rate application map shown in Fig. 7, a 30% reduction was achieved in the amount of product typically applied to control the pest.

The same map allows the farmer to undertake variable rate seed application for pasture renovation. This may be with a new technique that allows a grass plant that includes a specific plant endophyte containing an insect repellent. These technologies combine to form an economic approach with a long term view to being responsible for ensuring a sustainable environment.

Agriculture is coming under increasing pressure to reduce the use of organophosphate chemicals and it is highly likely the sector will lose the right to use these products. A review is being undertaken by New Zealand's Environmental Risk Management Agency seeking submissions on the banning of the diazinon and three other organophosphates. Currently diazinon is the one of the few options for control of the New Zealand Grass Grub.

Now however, through the use of GreenSeeker® it is possible to locate and site-specifically apply products to only the affected areas. This method significantly reduces the amount of inputs needed, reducing environmental impact.

Mapping for Effluent Management

The use of Crop sensors in the dairy or pastoral industry is proving to have a huge advantage when improving the management of effluent spreading and variability that is associated with it. Effluent is a difficult product to apply and the inherent variability that is created due to uneven application fits very well with the use of crop sensors.

Fig. 8. shows the NDVI changes across a field where dairy effluent is dispersed under a centre pivot. By using this data it was possible to avoid all the areas in green with a subsequent nitrogen and potassium application, applying only to the red and orange areas that had a low NDVI reading and low nitrogen content.

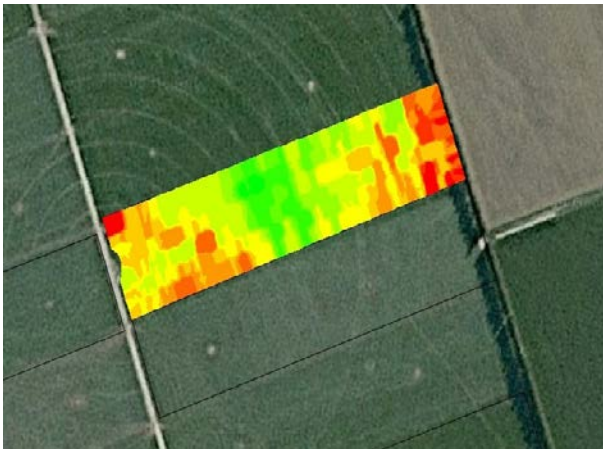


Fig. 8. GreenSeeker® map of paddock effluent area

Nitrogen exclusion zones were also formed in the gateways and around the water troughs as shown in Fig. 9.

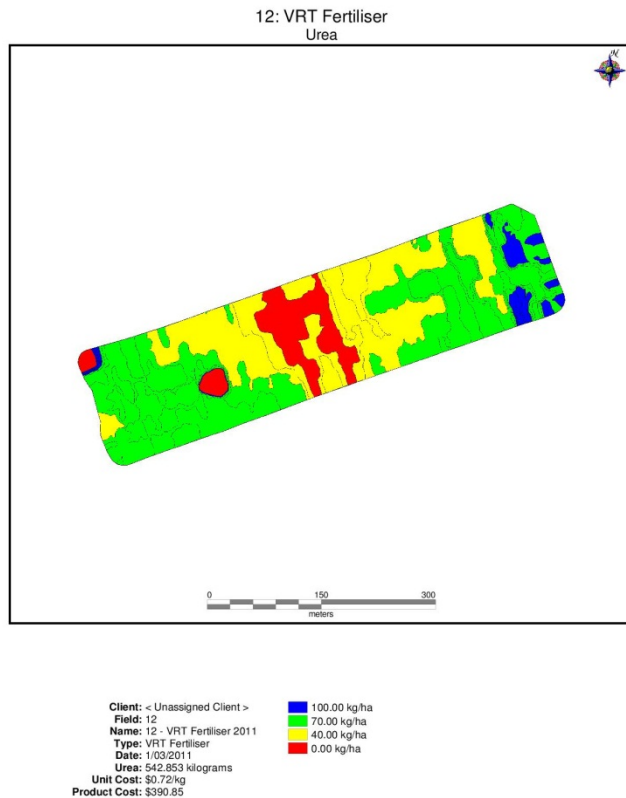


Fig. 9. Variable rate fertilizer application map

The map in Fig. 8. highlights the inaccuracy of the effluent dispersal system previously installed. As a consequence of this information changes were made to the dispersal system. Further changes are now being made to this system, with variable rate irrigation and variable rate effluent dispersal being installed to add to the efficient use of the effluent resource.

Crop sensors are now being utilised in increasingly innovative ways. With the use of crop sensors it is now possible to apply liquid nitrogen in-between every urine or dung patch. Through our company we have developed a new use for the WeedSeeker® sensor. With this further development it is now possible to apply nitrogen or other products to the areas between urine or dung patches. When applying nitrogen it has proven to be able to reduce the application amount by up to 30% on a single pass.

The Future of Precision Agriculture for Improving the Right to Farm

Many factors are now challenging the ability of farmers to maintain their existing “Right to Farm”. This pressure is increasing throughout the world. Increasing urban sprawl, growing disconnect between urban and rural areas,

mounting environmental pressures and subsequent increases in government regulation, such as annual nutrient allocations and increasing chemical application regulations all threaten the ability of the farmer to maintain a profitable, productive and sustainable business.

The improved field management that comes through the effective use of crop sensors and site-specific application technology is now improving the farmer's "Right to Farm".

Crop sensors are now proving to be highly effective in managing a variety of inputs at farm level. From nutrient and pest mapping through to weed and effluent mapping, farm inputs are now able to be placed in the right place, in the right amount.

With this increased accuracy and better acceptance of the technology, farmers have the ability to reduce inputs and create traceability while ensuring that production levels are maintained. To farm with the knowledge that they are putting the right input, in the right place, while adding to profitability. With this approach Regulators will allow the farmer to continue using products that may have otherwise been banned and the public will see that farmers are doing their utmost to protect the shared environment. Truly sustainable farming.

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