Factsheet:

Technology to Improve Business Performance and Resilience Part 2:

Arable

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In this series of three fact sheets an arable, beef and sheep farmer have been interviewed to find out what key pieces of farm technology they cannot do without.

With a farming history dating back to 1927, McGregor Farms continues to farm its own ground and operates and manages land under various contract farming agreements within a 15-mile radius of the home farm, Coldstream Mains in the Scottish Borders. Such has been the partnership success of the contractual farming arrangements the total area farmed currently sits at just over 3,400 ha.

Cereals predominate (winter wheat, winter and spring barley and spring oats) with break crops of oilseed rape and beans. Potatoes, and vining peas are grown 1 year in 8. Oilseed rape has latterly been the most profitable combinable crop and about 70% of the rape acreage follows wheat.

The business invests readily in infrastructure, staff, and equipment. It has, over time, moved to a 12-metre controlled traffic farming (CTF) system for cultivations, drilling and combining, setting tramlines at 36 metres for spraying and fertilising with the aim to reduce compaction and improve crop establishment. The bulk of the nitrogen fertiliser is applied in liquid form through fitted dribble bars. Three 8700 Lexion combines equipped with 12.3m headers and extra-long folding unloading augers (7XL) bring in the harvest. There are however exceptions to the CTF approach, oilseed rape for example, is still established with a Simba SL and seeder unit and land is rotationally ploughed every 4-5 years.

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Investment in technology has been at the forefront of business strategy allowing the business to operate several precision farming technologies to improve efficiency covering:

- Variable Application of Phosphate, Potash & Lime
- Variable Rate Seed Drilling
- Variable Targeted Application of Nitrogen (N Sensor)
- RTK Steering System (Greenstar)
- Auto Shut Off-sprayers, drills, spreaders
- Sprayer Boom Levelling & Pulse Width Modulation (PWM)
- Yield Mapping
- Machinery Telematics
- Office to Machine Connectivity

Central to all the above is RTK satellite guidance and positioning systems accurate to +/-2cm. All fields are mapped with electronic field boundaries, headland, and in-field tramlines, enabling auto shut-off for the sprayers, drills, and spreaders. The auto-headland steering enables headlands to be drilled inside to outside so reducing unwanted travel over already seeded ground.

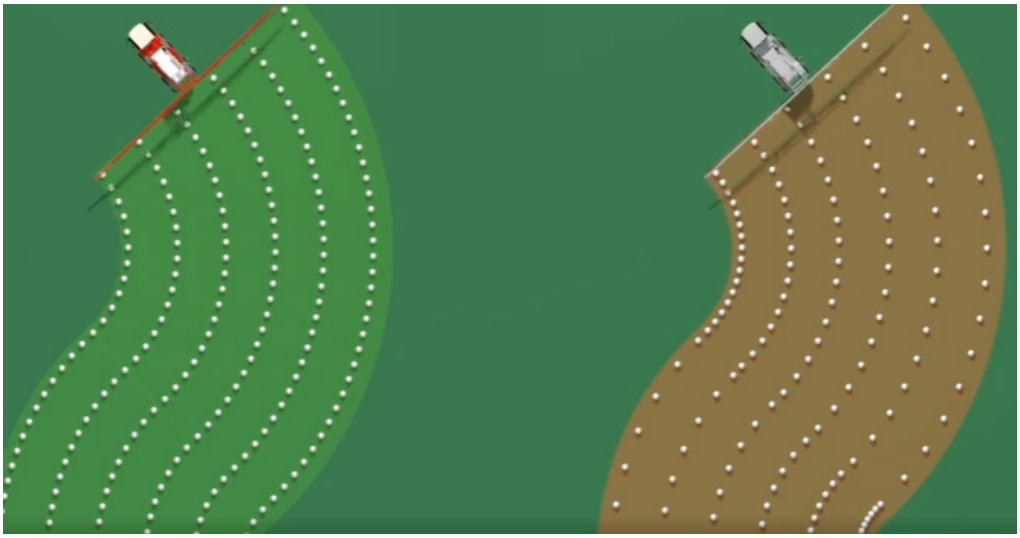
Assistant Arable Manager Tom Hoggen three most valued technology applications at McGregor Farms are:

1. Spraying operations: Auto boom height control with Pulse Width Modulation (PWM)

With multiple crop passes required each season there is an enormous workload to keep on top of for the farm's sprayer operators. Having an auto levelling system for the spray boom height not only optimises application efficacy but also takes away, what can be, the huge operator distraction of a manual height control system.

With this element taken care of, the PWM system comes into its own. It allows the spray pressure to remain constant irrespective of changes in forward speed; speed up and the pulse rate increases, slow down and the pulse rate drops correspondingly to facilitate a consistent application rate and spray quality across the field. Because there is individual nozzle control, overlapping is avoided and fields spray out smaller than they would otherwise, with the corresponding saving on fertiliser and chemicals.

The system also allows turn and speed compensation as demonstrated in the diagram below (left side: with and right side: without). When making a turn while spraying, each nozzle is travelling at a different speed. To spray consistently at the same rate, faster moving nozzles pulse more, and slower moving nozzles pulse less. The system compensates for this, enabling 100% coverage across all areas of the field.

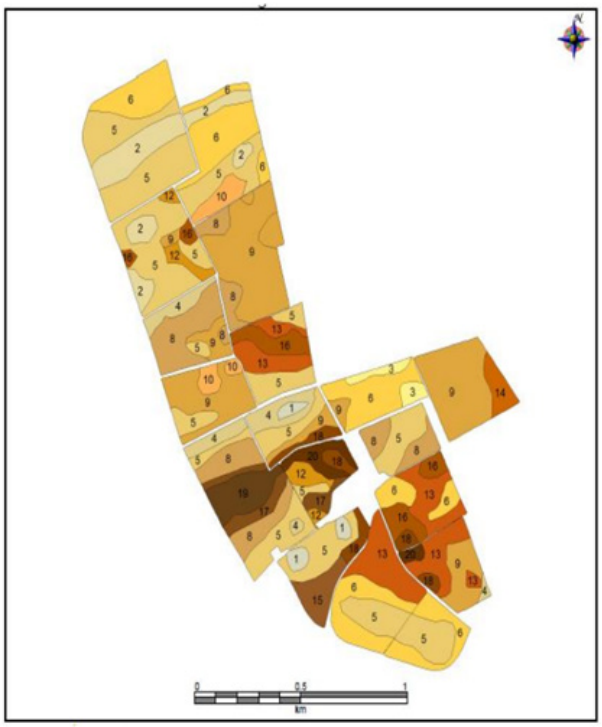


2. Variable-rate drilling

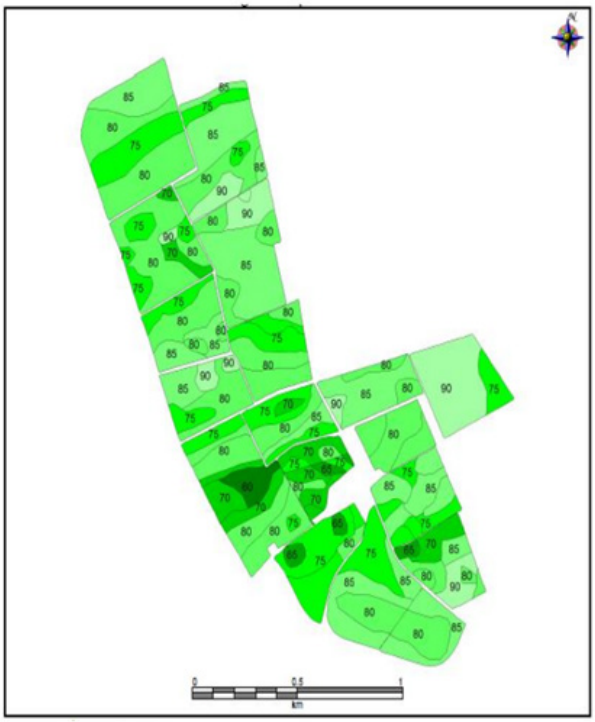
Mapping the fields for soil conductivity enables zoning by both soil type and percentage (%) crop establishment which can then be used as the basis for variable rate drilling maps; heavier soils receiving a higher seed rate and lighter soils, a reduced seed rate.

Smaller fields that have, over time, been merged into a single larger field often leads to more soil type variation within that larger field. Although the total amount of seed used is the same, varying drilling rates in this way across the field achieves a more even plant stand, reduces the risk of lodging and potentially increases output from poorer performing areas. In the example below expected establishment rates vary between 60% and 90% of seeds sown and is zoned according to soil conductivity results.

Soil conductivity zones



Expected establishment % zones



Variable rate maps are created in cropping software and issued with office-to-machine connectivity. Gaining knowledge of fields soil variability in this way is especially useful when land is taken on under new contractual farming arrangements.

3. Variable Targeted Application of Nitrogen (N Sensor)

McGregor Farms have been variably applying fertiliser for over a decade. Today Tom is using real-time N sensors; to variably apply liquid nitrogen through dribble bars to the crop. Preference is to rent the equipment to allow more regular upgrades as technology improves.

The two sprayer mounted N-Sensor measure light reflectance at specific wavebands related to the crops chlorophyll content and biomass and ensure that the optimal rate of fertiliser is applied to each individual part of the field.

Rather than using satellite imagery, the whole process of determining the crop's nitrogen requirement and application of the correct fertiliser rate, happens instantaneously.

Advances in technology now mean that the N Sensor can also work at night and when the crop is damp or has a heavy dew.

For cereals Tom opts for the Target Rate Programme where the average application rate is pre-set before entry into the field and the sensor varies around this average depending on measurements from the crop. In OSR the Absolute Programme is used; here the N sensor makes the recommendation at the point of application. The N-Sensor measures the N picked up in the crop for the given growth stage and knows the expected amount of N required by the crop at that timing and then applies or cuts back the difference. From experience Tom notes that the system usually applies close to 200kgN/ha to the rape.

Manufacturers trials will claim cereal yields increase by 3.5%, OSR by 3.9% and Nitrogen savings of 14%. While perhaps difficult to exactly verify, Tom does see additional benefits from less lodging and a more even canopy and improved nitrogen use efficiency.

The table below summaries this factsheet. General in-field GPS guidance can be upgraded to provide the necessary platform on which to operate the latest variable rate application technology and so derive best management of data and greatest efficiency from input use. The star ratings build as technology applications are added to the basic system.

Precision Technology Investment				Benefits & Star Rating (1-5)
Basic Field Guidance 				Accuracy ★★ Data Management ★ Efficiency of input use ★ Cost ★
Field guidance to +/-2cm  RTK	Variable rate drilling 			Accuracy ★★★ Data Management ★★★ Efficiency of input use ★★★ Cost ★★★
Field guidance to +/-2cm  RTK	Variable rate drilling 	Variable rate fertiliser 		Accuracy ★★★★ Data Management ★★★★ Efficiency of input use ★★★★ Cost ★★★★
Field guidance to +/-2cm  RTK	Variable rate drilling 	Variable rate fertiliser 	Pulse Width Modulation 	Accuracy ★★★★★ Data Management ★★★★★ Efficiency of input use ★★★★★ Cost ★★★★★

For more information on Technology and Business Performance please visit: [Technology to Improve Business Performance | Helping farmers in Scotland | Farm Advisory Service (fas.scot)]

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