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FARMER CASE STUDY THEME: VARIABLE RATE INPUTS ON VARIABLE SOIL TYPES BASED ON YIELD POTENTIAL

Case Study: using moisture probes to understand and manage soil variability across zones, paddocks and whole of farm, to mitigate risk.

Summary/Purpose

Bruce Heddle invested in a soil moisture probe for his paddock prior to his involvement in the Resilient Eyre Peninsula project. He understood its potential to add value and to inform decision making, but he was uncertain and lacked the expertise to fully appreciate the significance. He offered his probe to be included in the region's moisture probe network and became involved in the project as one of the focus paddocks. His move towards variable rate is happening concurrently with the Resilient Eyre Peninsula project trial and he hopes to further explore variable rate P application. While he appreciates the value of replacement-based systems, applying fertilizer in response to production, he would like to further investigate phosphate (P) responsiveness and how this might impact his inputs.

Context

Bruce Heddle's 1600-hectare farming operation, situated at Minnipa on central west Eyre Peninsula, includes a cropping focus as well as a livestock enterprise. Prior to his involvement in the Resilient Eyre Peninsula project, he had invested in a soil moisture probe because he believed it could support his operations: helping to inform management decisions, but he lacked the knowledge to convert findings into useable data. His involvement in the project evolved to include his property being chosen for one of the project's focus paddocks.

Bruce understands the benefits of stored moisture and using it to his advantage by maintaining adequate nutrition year to year across all zones. Variable rate technologies (VRT) have worked to his benefit as a result. On average, the soil type across the focus paddock has a high Plant Available Water Capacity (PAWC), compared to many other paddocks across the district. While parts of this paddock struggle in poor finishes, overall, yields are high and Bruce's 'zero summer weed' policy was considered by him to be beneficial because maximum summer rainfall is preserved in the soil profile for the coming season.

While this paddock has large variation in yield potential, the patterns in variation are consistent across different crops and years with variable rainfall yield patterns remaining the same. Bruce places a heavy weighting on the high yielding areas of the paddock when applying inputs (both N and P).

The clear-cut variation in PAWC and yield from one zone to the next across his paddocks makes yield and therefore input estimation simpler according to EPAG Research agronomist Jacob Giles. He explained, "the use of soil moisture probes can also be useful in this context. If we know how one zone will yield relative to another, then estimates at the probe can be related to the other zones within the paddock."

While being exposed to hot finishes, this paddock has a relatively low frost risk (yield predictions in season are more certain and the risk involved is less). Timely sowing is the best approach to mitigate heat damage and can be done so if there is adequate moisture. He said, "understanding soil moisture and the benefits of deeper sowing could be one way that soil moisture is exploited to mitigate the end of season heat risk in particular years." [1]

Approach and methodology

In terms of the commercial scale response to variability, this focus paddock is on a full variable rate for both phosphorus (P) inputs and nitrogen (N). In addition, post seeding N has been by zone. Bruce has driven decision making across the paddock and believes the replicated work that is being done on the focus paddock will be of significant value to growers in his area.

Bruce feels there is a lot more data yet to be used and the implications further investigated. For example, the most obvious variable to change by soil type and bucket size (yield potential), was N nutrition. Bruce currently has replicated trials sites on both the most productive area of his paddock and the most constrained area of the paddock for N responsiveness. He feels there ultimately needs to be P responsiveness included in that picture, as he suspects P responsiveness is driving some of the underlying issues.

He said the trial is delivering really useful work and that everybody is looking forward to the response, particularly in light of the fact this has been the "single most N responsive production season, in anybody's memory." According to Bruce, "production potential is so high that we should have hopefully stretched the boundaries to actually get some really clear messages about N response."

He also highlighted several layers of data coming out of the trial where he believes there is potential for further "scrutiny and external expertise". For example, there have been soil tests done to depth; a lot of grid sampling; as well as radio spectrometry (EM38) testing, which he said to date he has paid little attention to due to lack of understanding. He believes these additional layers of data offer potential scope for experts to explore further and determine whether there are correlations or potential commercial applications.

Impacts/Benefits

Bruce said his strategy going forward will remain reasonably stable, with some refinement of zoning, but generally "finessing," as the basic strategy is in place. The quantification of the variability between the zones

and the implementation of variable rate fertilizer application, where it is needed, with good data to back it up, has been a "significant step forward." He said targeting N inputs has been successful and had a lot of upsides on this paddock.

Understanding the variable PAWC across zones within his paddock has been beneficial with the use of VRT to optimise inputs. With the added knowledge of PAW and use of technology such as the soil moisture probe, yields can be optimised in season. This is especially true as the frost risk at this site is lower than many in the area. The hot finishes characteristic of the area however is frequent, and this can be mitigated by correct time of sowing matched with the correct variety of crop.

Bruce explained there is a P constraint on his soil type, and there needs to be a clearer idea of what the P responsiveness might be. He believes there may be scope to get more out of those constrained soil types with a change of mindset. Bruce discussed the phosphate application dynamic as being an area which is not yet fully understood and feels there is "significant learning to happen in this space. The whole business of variable rate phosphate is a work in progress for us. And it may be where the next attention goes on that paddock."

Bruce and others in similar situations on the upper EP which have higher yielding areas will have a lower water use efficiency in high decile years. Jacob (EPAG research) said the exact cause of this is unknown and while there are some who suggest insufficient N, he explained there are many other limiting factors that could potentially be the cause, "as well as N, calcareous soils can decrease P use efficiency. Lack of P and low sowing rates can limit tiller and therefore head counts per area." These are all significant drivers of yield and hence inadequate nutrients, and tillers may limit yield in good areas in high rainfall decile seasons. These may all be a cause of low WUE in high rainfall decile years.

Adoption and practice change

For Bruce, his involvement as a focus paddock in the Resilient EP project has served to validate his strategies. He appreciated the value gained from the soil test data that was collected. He said the EPAG Research team were thorough and disciplined in their process and Bruce places significant value on this data as a resource.

Value of moisture probes to farm decisions: Bruce highlighted the role of moisture probe data to his operations. He feels the region is gaining a better understanding of the role and limitations of soil moisture probes. While they provide useful information to go with all other data collected, he explained, "they are very spatially narrow." They represent a single point in a paddock or a farm. He noted that originally it was anticipated the soil moisture probes would provide really hard, quantifiable and precise information, however, he does not believe that is the case.

Instead, they provide trends and indicators and during certain times in a year they may provide critical information. For example, during a dry spring, moisture probes provide valuable information about the amount of moisture available and the general trajectory for the remainder of the year. Assessing through autumn, instead of accessing a precise reading, Bruce uses data to determine whether there is "a lot, a bit or not much at all. And that's about as precise as they are."

He believes this would be the sentiment amongst most of his peers using moisture probes: that their role is perhaps not what was originally anticipated.

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