

Data layers for soilborne disease

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Soilborne diseases continue to cause substantial losses in broadacre field crops. The spatial distribution of diseases such as take-all, rhizoctonia and crown rot is often variable within a paddock and is correlated with variation in soil attributes, topography and patterns of plant growth (eg yield, biomass).

Earlier research supported by SARDI/GRDC showed that disease inoculum levels frequently differed between Precision Agriculture (PA) zones. Knowledge of which zones are at risk from diseases is valuable for designing management strategies, so testing soil from different zones was encouraged. However, further work was required to identify which data sources provided the most valuable information on inoculum levels.

Many data layers (eg yield, elevation, biomass etc) can be mapped, using a range of proximally- and remotely-sensed data collection systems.

Our recent research assessed the usefulness of the many data layers available for mapping soilborne disease inoculum (Table 3).

root disease inoculum sampling zones can be derived from the cheapest available data

Spatial data layers (approximately 30 layers per paddock) were collected over five paddocks to determine which combinations of layers are most suitable for defining zones for disease inoculum measurement. We compared zone maps based on a single data layer through to maps based on combinations of many layers. The results suggest new guidelines for the best method to identify differences in inoculum level between PA zones.

Six zone models were generated, using different combinations of data layers (Table 3). Inoculum was measured for points on a grid over the whole paddock, and subsets of this grid were used to calculate the level within each zone. All zone models (except (f); Table 3) combined multiple data layers using a clustering technique in JMP ("Jump") computer software. Zone models a) and b) were also compared over an additional eight paddocks.

A "Partition Index" (PI) was devised to compare the relative ability of each zone model to partition paddocks into zones with different inoculum levels. This index takes into account differences between zone inoculum means and the whole paddock mean, as well as the size of each zone.

Averaged over the five paddocks proximal (a), satellite (b) and custom

Table 3 Six zone models were generated for each paddock, and inoculum levels were measured from points within each zone.

Model	Data layers used for zone map
a)	Proximally-sensed data (yield, ECa, elevation)
b)	Satellite NDVI biomass data.
c)	Custom disease zones (using correlation matrices and Forward Stepwise Multiple Linear Regression to choose layers - "Custom MLR" - selected from all available data layers).
d)	"Biological" layers (yield, NDVI biomass, aerial photography, N-Sensor).
e)	"Geological layers" (ECa, elevation, slope, gamma-radiometric and magnetic susceptibility).
f)	ECa (eg EM38) alone.

MLR (c) zone models were found to be equally robust, consistently producing zones with different levels of inoculum. "Biological" (d) and "Geological" (e) models were equal but less useful than a), b) and c), while ECa alone was least useful. Use of custom MLR zones (c) is probably unwarranted, because it is less practical for growers.

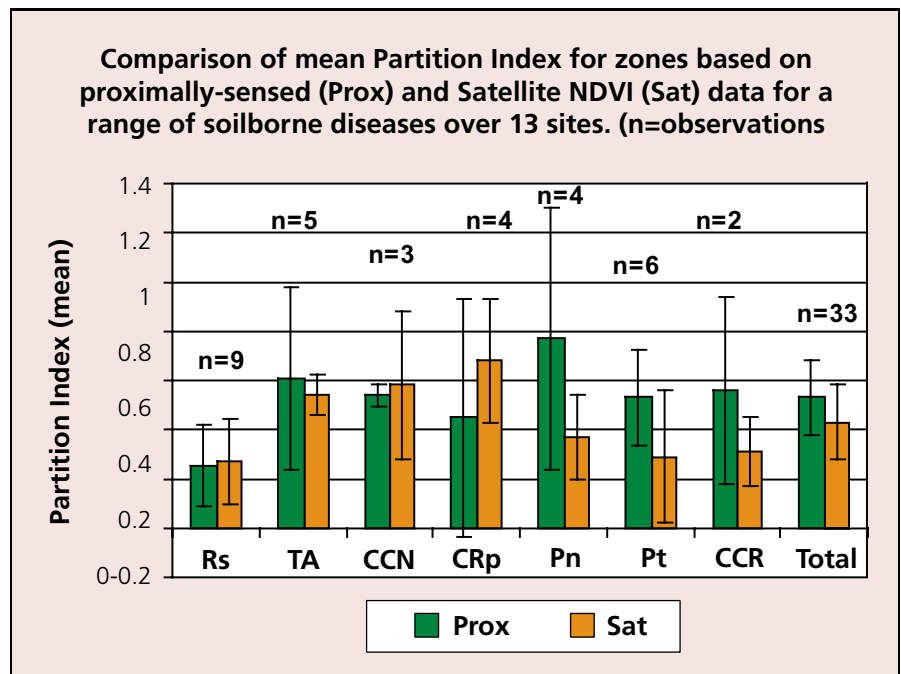
When proximal (a) and satellite (b) models were compared over 13 sites (Figure 1) the results suggested that they were equally useful in the identification of zones with different inoculum levels for the major diseases take-all, rhizoctonia and CCN.

Satellite NDVI data appeared to be better at predicting crown rot distribution, while the proximal model was better for common root rot, *Pratylenchus neglectus*, and *Pratylenchus thornei*.

Given the complexity of the interactions involved it appears difficult to predict in advance the usefulness of specific models for specific diseases. However, broad suggestions can be made.

Based on our work to date it is considered that proximal and satellite models are similarly useful when testing for the full range of diseases. Therefore, it is suggested that root disease inoculum sampling zones be derived from the cheapest available proximal or satellite data.

Figure 1. Comparison of usefulness (Partition Index) for zones based on proximally-sensed (Prox) and Satellite NDVI (Sat) data for a range of soilborne diseases over 13 sites. (n= observations)



Abbreviations for diseases:
 CCN = cereal cyst nematode;
 CRp = crownrot: *Fusarium psuedograminearum*;
 CRR = common root rot;
 Pn = *Pratylenchus neglectus*;
 Pt = *Pratylenchus thornei*;
 Rs = rhizoctonia;
 TA = take-all.

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Proximal data sources such as yield and ECa or remotely sensed satellite biomass data where all found to be useful data sources for identifying cereal root disease.

