



8. DISCUSSION AND CONCLUSIONS

The performance and productive outcome of the crops cultivated over the two pivots showed noticeable differences from one another over the period of the experiment (1998 - 1999). These differences were relative to the uniformity of crop development between the two pivots and, within the same pivot, from one season to the other. Tweefontein showed a more marked variability over the planted surface. Yield levels also differed between the two fields, with Major achieving better results.

The main hypothesis being investigated is that the performance of the crops through the seasons differs due to the fact that Pivot Tweefontein is set up over a rehabilitated site and because of the characteristics of this rehabilitation, whilst Major is set on virgin land. The various hypotheses that were explored in the data analysis can be summarised as follows:

- Better performance and less variability should be experienced on the pivot on virgin land (Major) as compared to the one on rehabilitated land (Tweefontein). The causes of this are problems with sub-soil/soil preparation practices in the rehabilitation process. The location of areas with different levels of soil compaction may affect the drainage and should be identified by the soil profile to spoil/impermeable layer and reflected on the surface by the variability in the crop canopy.
- Better performance and less variability should be experienced for winter crops (wheat) with respect to summer crops (maize and beans), especially on rehabilitated profiles under irrigated conditions where there is control over the water balance. The possible conclusion is that rehabilitated pivots can be irrigated successfully in winter while they can take only supplemental irrigation in summer, otherwise there could be water logging. Alternatively, in summer, crops that can take 'wet feet' should be used, or else crops should be produced under dry land conditions, in some areas.
- Rehabilitation should be appropriate and a slight slope given to the surface to allow drainage. Alternatively a drainage system should be built.



For Pivot Tweefontein, the variability of the crop canopy can be attributed to the non-uniform preparation of the soil when the land was reclaimed from open cast mining. For Pivot Major, on the other hand, the internal variability may also be due to the soil substratum. In this case it is not ascribed to any human activity, but rather to the presence of a shallow impermeable layer in certain areas.

The limited duration of the experiment made it impossible to return to the site and verify the assumptions. This means that the comparison of the two pivots does not authorise any definitive conclusion or recommendation of 'best practices' for either soil preparation or cultivation.

However, the foremost achievement of this study was the design and implementation of a system for the analysis of spatial variability over cultivated fields, and such a system has the potential of evolving into an innovative crop management tool.

The whole technological approach relies on the use of remote sensing and GIS and this requires a certain level of evolution and revision in the way the data is acquired, stored and even analysed. The use of imagery as a source of information guarantees timeliness of data availability and a synoptical and thus complete view of the fields. This guides and sets the standard for all the other data gathering actions. On the analysis side, the amount of data made available by remote sensing and processed by a GIS is such that traditional and interactive analysis and interpretation is somewhat limiting. The system requires a high level of automation of the analysis procedure and this drives toward the rationalisation of such procedures. The basis of the whole philosophy is that the data that are run through the system are the most objective and synoptic as technically possible and the evaluation of the data itself is conducted through strictly analytical and statistically consistent procedures.