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Spray overlap reduction can deliver savings

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LEADING EDGE

Research from the University of Southern Queensland has shown spray overlap can be reduced by 20 per cent using global positioning systems (GPS).

The study also found that GPS guidance can provide a more reliable system for maintaining parallel swaths and eliminates the tendency of swaths to skew from operator error.

But in the study both GPS and conventional guidance operators had a tendency to overspray their runs to ensure they did not miss any areas.

In association with Trimble Navigation Australia the project assessed and compared the accuracy of differential global positioning system guidance equipment with a conventional guidance system for the application of agri-chemicals.

Responsible application of chemicals is not only environmentally sound, but makes good business sense. Technologies such as GPS provide scientific support for research into agricultural systems but now also provide tools to support improvements in farm management and efficiency.

The system being tested was a Trimble AgGPS 132 with a light bar to enable drivers to accurately follow a series of parallel tracks.

Tests were carried out at seven different sites using a variety of experienced and inexperienced operators. Data was collected to compare the GPS guidance against the conventional system of foam marking.

GPS and radio antennae on spray rig.

The results indicated that GPS guidance was superior to conventional guidance where conditions for foam marking, such as wind and crop height were not optimal.

Equipment tested

In 1997, Trimble released the AgGPS 132 as a differential GPS sensor with sub-metre accuracy. Then in early 1998, Trimble released a Parallel Swathing Option (PSO) for the AgGPS 132. The PSO is marketed as an add-on option to the AgGPS 132 and consists of a light bar connected to the AgGPS 132. This enables guidance to be displayed to the user through light emitting diodes (LEDs) on the light bar. Various patterns such as parallel straight lines, parallel curved lines, skip and headland patterns are available.

This tool is being mostly used for guidance of chemical sprays and fertiliser applications, planting operations and aircraft agricultural applications.

Project Objectives

The objective of the research project was to assess in-field accuracy of the AgGPS 132 under a variety of agricultural equipment, operator and environmental conditions. The research also aimed to assess the in-field accuracy of conventional guidance systems to compare both systems.

Dead reckoning

Dead reckoning is a locational technique that relies on the operator’s skill and experience to guide the machinery to a defined point at the end of a run. A number of devices including directional sensors and sights have been tested to improve the accuracy of this technique.

Foam marking

Foam marking guidance relies on dropping coloured foam blobs at the end of spray booms. These are used to assist in aligning the end of the boom to the next spray run. This technique is simple and works well in good spraying conditions, ie. little or no wind and clear

cropping. The system also relies on the ability of operators to align the end of a boom to a line of foam.

Differential GPS (DGPS)

Differential GPS or DGPS relies on transmission of a differential correction to improve the absolute or relative accuracy of the in-field GPS system. A number of commercial and free-to-air radio and satellite transmission systems for DGPS corrections are now available in Australia. DGPS systems will typically provide accuracies from one to five metres depending on the receiver and the distance from the nearest correction station. The reliability of DGPS systems has been questioned by a number of researchers. Some found that although DGPS provided acceptable accuracies for many applications, problems caused by loss of correction, poor satellite constellations and multi-pathing must be considered.

Others are more confident in the application of DGPS — one study contended that a well-engineered and installed DGPS system can achieve accuracies less than one metre.

Real time kinematic (RTK) GPS

Real-time kinematic (RTK) GPS provides centimetre accuracy in both static and moving applications. It relies on the use of a more sophisticated GPS receiver and a base station with a radio transmission facility within 10–15 km of the work area.

In recent years RTK GPS has been coupled to the machine's steering system to provide driverless or machine guidance for precision farming applications. These systems can achieve accuracies from two to 10 cm.

Data Collection

Field testing was undertaken on farms on the Darling Downs and in the Springsure area of central Queensland under typical farming conditions. The equipment for the project was provided by Trimble Navigation Limited and included:

• Trimble AgGPS 132 with the Parallel Swathing Option (PSO) with differential correction input and LED light bar guidance; and,

• Trimble 7400MSi high precision real-time kinematic GPS receiver and base station.

The AgGPS 132 can use either free-to-air or subscription-based private differential correction services to provide sub-metre positional data in real time.

The AgGPS 132 consists of a 12 channel, single frequency GPS receiver. The system uses atmospheric models and a virtual reference station to minimise degradation of accuracy from the fixed reference stations.

The 7400MSi is a high precision real-time GPS receiver. It is designed specifically for controlling moving applications The 7400MSi is a nine channel dual frequency GPS receiver with a stated horizontal accuracy of three cm.

Differential corrections for the AgGPS 132 were obtained from two sources during the study. A free-to-air correction was available from the Australian Maritime Safety Authority (AMSA) beacons that are situated along the east Australian coastline. The subscription-based OmniSTAR private service was also used for differential correction.

The AgGPS 132 PSO was used for navigational guidance only. The GPS antennae for both systems were mounted to a purpose-built bracket that was then attached to the roof of the spray vehicle. The bracket was positioned so that both of the GPS antennae were aligned to the direction of travel and centred across the vehicle.

Data was collected on board the vehicle on laptop computers and later downloaded for processing.

RESULTS

The results indicate that both GPS guided and foam-marking operators tend to err on the side of caution to ensure that missed areas are

minimised or eliminated. This results in increased overlap or over-application of chemicals. Both the area and linear comparisons indicate that the foam marker operators over-applied by about 20–25 per cent more than the GPS-guided operators.

This may account for up to 1.5 per cent of the total spray area and if the overlap was eliminated it could result in significant savings in chemical, fuel and time.

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