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Response Times of Electronic Spray Controllers as a Function of Speed Changes

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Extended Abstract

Agricultural production is associated to the expansion of agribusiness, and the continuous increase in agricultural production is associated with new technologies. One of the factors that has contributed to this increase is the use of phytosanitary products, which have proven to be fundamental for protecting and preserving the productive potential of agricultural crops.

The applications of phytosanitary products have many variable factors, which are subject to a large number of errors in the operation. Such operational errors are extremely important in the agricultural production process, making it essential to adopt new technologies, such as the use of electronic spray controllers. These controllers minimize environmental contamination as much as possible and reduce production costs [1]. The use of this technology guarantees the control of such inaccuracies, as electronic control systems act by controlling the application rate, through mechanisms that simultaneously correct the application rate depending on variations occurring in the operation, such as variations in speed, providing greater efficiency in the application of phytosanitary products. In cases where the application rate is fixed, that is, without the use of electronic controllers, the average application error is 46.96% of the total area [1].

This survey aimed to evaluate the spray system flow control response times (application rate) as a function of tractor speed variation. The speed change intervals analysed were every 6 km/h, being: 6-12, 12-18, 18-12 and 12-6km/h. For each change, four repetitions were carried out, and the collection was carried out at 8 Hz, totalling 4300 observations, containing information on time and pressure from the applicator. Speed changes every 4 km/h were also considered, being: 4-8, 8-12, 12-16, 16-12, 12-8 and 8-4 km/h. For this case, the total number of observations collected was 5990.

To calculate the response time to each speed change, a sample was selected in which the application rate remained stable. With this sample, a confidence interval was constructed using Chebyshev's inequality. This procedure was performed for each speed change. Thus, the response times of the controllers, based on speed changes, were calculated as the difference in time between the first point outside the confidence interval to the last point outside the next confidence interval. After calculating the response times for the ten speed changes, obtaining a total sample of 40 times (four for each change), the log-rank test was applied to verify the existence of significant differences in the median times. As a result, it was possible to group the speed changes into two homogeneous groups: Group 1 consisting of 6-12, 12-18 and 12-6 km/h; Group 2 consisting of 18-12,4-8, 8-12,12-16,16-12,12-8 and 8-4km/h.

Finally, the time changes that make up group 2 were those that presented the shortest time for the stabilization of phytosanitary application, and the speed changes that make up this group are the most suitable for reducing application errors.

References

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