Comparing the Performance of Traditional and Autonomous Tractors in Maize Sowing: An Overall Evaluation of Agricultural Robot Adoption

Bettucci Francesco[1], Sozzi Marco[1], Gasparini Franco[1], Sartori Luigi[1], Marinello Francesco[1]
[1] *Department of Land Environment Resources and Health University of Padova*
Viale dell'Università, 16. – 35020, Legnaro, Italy.
Corresponding author: francesco.bettucci@phd.unipd.it

Keywords: Agricultural Robots, UGV, Machine operating efficiency, Precision Farming

Objectives

Over the past few decades, robots have increasingly been used in agriculture to automate various tasks, from planting and harvesting crops to monitoring crop health. These robots are designed to increase efficiency, reduce labour costs, and improve crop yields while minimising environmental impact. Some examples of agricultural robots include autonomous tractors, drones equipped with sensors and cameras, and robotic arms for precision planting and harvesting. The use of robots in agriculture is a rapidly growing field. It is expected to continue to expand in the coming years as the demand for sustainable and efficient farming practices increases.
This research aims to compare the performance of a traditional tractor with an autonomous tractor in terms of time needed to perform the same task, evaluating machine operating performance using effective working times and accessory times (turns and downtime).
Moreover, focuses on the overall evaluation of the adoption of this new technology, considering every aspect, from the knowledge required to operate the robot to the final working operation, considering pros, cons and all the obstacles encountered in the robot setup.

Methods

The comparison was performed between maise sowing, using a traditional tractor (Lamborghini R4.95) equipped with Monosem NG Plus 4 rows planter (working width 3m) and an autonomous tractor (Robotti 150d) equipped with Mascar three rows planter (working width 2.10). The operating speed was 7 km/h for the tractor and 5 km/h for the robot. The operations were executed in the same field, divided into eight blocks, four for the tractor and four for the robot. The times were collected by an operator supervising all the operations. For this specific case, due to the small field size, the seeds refill was not counted in the analysis of the accessory time.
The results were then analysed and compared using statistical analysis.

Results

The results showed a big difference in the machine operating efficiency, 83% for the traditional tractor and 68% for the autonomous one, this is due to the different operating speeds, working width and the higher time required by the robot to perform the turns, on average 51 seconds compared to 14 seconds of the tractor.

Considering the effective working capacity for this operation, the tractor worked at 2.1 ha/h compared to the 1.05 ha/h of the robot, and for the operational working capacity, 1.75 ha/h for the tractor and 0.71 for the robot.
These findings will be more clearly explained in the final version of the paper.