



## Comparative Analysis of Autonomous Agricultural Robots and Traditional Tractors in Mechanical Weed Control Efficiency

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Mechanical weed control, as an alternative to pesticide use, offers dual benefits in terms of environmental and economic sustainability. However, the labour and resource intensity of conventional methods can be mitigated through innovative technologies, such as agricultural robots. This study assesses the performance of an agricultural robot 'Robotti 150 D' (Agrointelli, Aarhus, Denmark), in comparison to a traditional tractor, focusing on its efficiency in mechanical weed control in a maize field at the experimental farm of the University of Padova in northeastern Italy. The precision weeder employed for this assessment was Rotosark (OliverAgro s.r.l., Verona, Italy).

A 1.1-ha field was divided into 8 blocks worked halves by the robot and tractor, each further divided into sections with weeding operations conducted at 3 km/h and 5 km/h. Twenty-four randomly positioned 1 m<sup>2</sup> experimental plots were assessed for weed species presence via images analysed using ArcGIS Pro (v3.2.1. ESRI ArcGIS Pro©). Weed control efficiency was calculated by comparing weed presence and density before and after weeding operations. Long-term effects were evaluated by comparing weed biomass collected before harvest between plots managed by robot and tractor.

Both the robot and the tractor exhibited a weed control efficiency of approximately 95%, with no statistical differences observed between methods or velocities. Even at the species level, no significant differences were identified. Moreover, final weed biomass showed no significant distinctions between plots managed by robot and tractor.

These results suggest the autonomous robot demonstrates comparable efficacy in weeding to the traditional tractor. While further experiments are required to assess performance in diverse conditions, the study concludes that autonomous robots for mechanical weeding present a promising solution for precision agriculture. Despite their current availability on the market, these systems are in a developmental phase, requiring further refinement to meet user needs and preferences.

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