



Agricultural University
of Athens

1-4 July 2024
Athens-Greece

ageng2024.com

ABSTRACT BOOK

OP23-2 | Sustainability assessment of hydraulic and PTO driven inter-row tillage implements

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Agricultural machinery manufacturers are looking for innovative solutions to improve the sustainability of their products in terms of environmental, economic and social issues. Regarding specialized tractors, in recent decades a large increase in the available oil flow rate at the hydraulic remotes was observed, which resulted in the possibility of providing high values of hydraulic power to the implements. Thus, many implement manufacturers started to develop Hydraulic-Driven Implements (HDI) to replace traditional PTO-Driven Implements (PDI). HDI could apport many benefits mainly due to the absence of the cardan shaft connection, such as improved comfort and safety during implement connection, less noisiness and an improved implement rotational speed control in active implements. Moreover, generally HDI have lower purchase prices and maintenance costs than the equivalent PDI, since the latter are composed of a greater number of components. However, HDI suffer from lower power delivery efficiency compared to PDI, leading to higher fuel consumption and consequently higher CO² emissions. The main purpose of this study was the comparison analysis between HDI and PDI concerning fuel consumption, economic aspects and environmental impacts. The study involved a four-wheel drive specialized tractor with a nominal engine power of 87 kW and a maximum oil flow rate at the hydraulic remotes of 80 L/min. The implements chosen to perform the field trials were an inter-row Rotary Disk and an inter-row Power Harrow, since both were commercially available in their Hydraulic and PTO driven versions. In addition, the chosen implements were produced by the same manufacturer, thus the number of uncontrolled variables due to different design layouts was reduced since many components are shared between the two versions. Implements hitching time were measured, then field tests were performed in an orchard acquiring essential parameters such as tractor engine speed and power, traveling speed, fuel consumption, oil pressure and flow rate at the hydraulic remotes with all the considered implements. Results show that on the HDI the absence of the cardan shaft shortened the implements hitching time and improved comfort and safety during the operation. In addition, the PDI showed lower values of fuel consumption per hectare, with reductions of up to 50% compared with the equivalent HDI performing the same agricultural operation. However, HDI have considerably lower ownership costs compared to PDI, so the economic break-even point using the PDI is reachable only with an intensive usage of the machinery

KW: Farming sustainability; Hydraulic-Driven Implement, Inter-Row Tillage