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On-Farm Mechanized Conservation Agriculture: Preliminary Agro-Economic Performance Difference between Disc Harrowing, Ripping and No-Till

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Abstract : Conservation agriculture (CA) as a climate-resilient and sustainable practice have been carried out for over three decades in Zambia. However, its continued promotion and adoption has been predominantly on a small-scale basis. Despite the plethora of scholarship pointing to the positive benefits of CA in regard to enhanced yield, profitability, carbon sequestration and minimal environmental degradation, these have not stimulated commensurate agricultural extensification desired for Zambia. The objective of this study was to investigate the potential differences between mechanized conventional and conservation tillage practices on operation time, fuel consumption, labor costs, soil moisture retention, soil temperature and crop yield. An on-farm mechanized conservation agriculture (MCA) experiment arranged in a randomized complete block design with four replications was used. The research was conducted on a 15 ha of sandy loam rainfed land: soybeans on 7ha with plot dimensions of 24 m by 210 m and maize on 8ha with plot dimensions of 24 m by 250 m. The three tillage treatments were: residue burning followed by disc harrowing, ripping tillage and no-till. The crops were rotated in two subsequent seasons. All operations were done using a 60hp 2-wheel tractor, a disc harrow, a two-tine ripper and a two-row planter. Soil measurements and the agro-economic factors were recorded for two farming seasons. The season results showed that the yield of maize and soybeans under no-till and ripping tillage practices were not significantly different from the conventional burning and discing. But, there was a significant difference in soil moisture content between no-till (25.31SFU±2.77) and disced (11.91SFU±0.59) plots at depths from 10-60 cm. Soil temperature in no-till plots (24.59°C±0.91) was significantly lower compared to the disced plots (26.20°C±1.75) at the depths 15 cm and 45 cm. For maize, there was a significant difference in operation time between disc-harrowed (3.68hr/ha±1.27) and no-till (1.85hr/ha±0.04) plots, and a significant difference in cost of labor between disc-harrowed (45.45$/ha±19.56) and no-till (21.76$/ha) plots. There was no significant difference in fuel consumption between ripping and disc-harrowing and direct seeding. For soybeans, there was a significant difference in operation time between no-tillage (1.96hr/ha±0.31) and ripping (3.34hr/ha±0.53) and disc harrowing (3.30hr/ha±0.16). Further, fuel consumption and labor on no-till plots were significantly different from both the ripped and disc-harrowed plots. The high seed emergence percentage on maize disc-harrowed plot (93.75%±5.87) was not significantly different from ripping and no-till plots. Again, the high seed emergence percentage for the soybean ripped plot (93.75%±13.03) had no significant difference with discing and ripping. The results show that it is economically sound and timesaving to practice MCA and get viable yields compared to conventional farming. This research fills the gap on the potential of MCA in the context of Zambia and its profitability in incentivizing policymakers to invest in appropriate and sustainable machinery and implements for extensive agricultural production.

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