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The selection of best tillage implements in terms of energy use efficiency using simple additive weighting methodology

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Introduction

Main part of energy consumption in agricultural mechanization is tillage operations therefore optimization of energy consumption in tillage operation is very important. A management method for system to optimize in agriculture is Simple Additive Weighting (SAW) methodology that this method can operate according to criteria of the systems. This method states that, which system has better performance? (for example the system for agricultural tractors, type of implements, methods of tillage, planting and harvesting, and etc). Fuel consumption is the most important factor in terms of energy consumption in tractor because the fuel energy contributes to help tractor to work . Specific draught is important force that measured for investigation of energy consumption of tillage implements, it can show the amount of drawbar force that optimized (for work width 1 meter implements tillage) by using this method. The multiplication of the drawbar force in forward speed factor resulted drawbar power. The most common method is using of tractors drawbar power in mechanized agriculture. Important factor for assessment and determination performance of tractor is drawbar power. Several studies have been showed that about 20 to 55%of available drawbar power was wasting by implements tillage. Another important parameters that affect on traction efficiency pull's machine is slip. A simple additive weighting two-step procedure involving basic weighted as follows: (1) scale the values of all attributes to make them comparable; (2) sum up the values of the all attributes for each alternative.

Materials and Methods

In this study, three implements tillage were studied including moldboard plow, disk plow and disk harrow and they called A, B and C , respectively. Three different forward speeds of 3, 4, 5, 6 Km/h for each implements were selected according to the type of work at various depths. In this study fuel consumption factor was measured by means of micro-oval flow meter, forward speed was measured by a Doppler radar, Slip was measured by Proxy Sensor, and drawbar force was measured by a three point auto hitch dynamometer. Depth tillage was maintained by depth-knob control system. tillage implements for comparison proper class was rated tables (1), (2) and (3) that includes low depth (12.4 cm moldboard plow, disk plow 12.3 cm and 12.4 cm disk harrow), middle depth (18 cm moldboard plow, disk plow 17.4 cm and 15.2 cm disk harrow) and the high depth (23.5 cm moldboard plow, disk plow 23.4 cm and 17.2 cm disk harrow).

Results and Discussion

The results of Table 5 shows a higher combined ratio of the amount of energy that is optimum performance in the form of (1), (2) and (3). Also Combined ratio is a way that the whole system will be valued according to their criteria that objective criteria according to the study, we classified as positive and negative criteria and all its problems the system had a higher combined ratio than the rest of the system is the optimal system performance. Kheiralla *et al*, (2004) in their research used statistical methods and indicated that energy efficiency disk harrow, disk plow and moldboard plow was better than the other devices but Simple Additive Weight way of energy efficiency in different conditions partially expressed.

Conclusions

The results showed that disk plow in different depth tillage and forward speed, has higher energy efficiency.

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Disk harrow compared with other tillage implements recommended for the high depth. Disc harrow is not optimal in the low depth because it compared to other implements has lower slip and tractive efficiency. Moldboard plow is optimum use energy in depth and average speeds (4 and 5 km h^{-1}).

Keywords: Energy, Implements tillage, Systems, SAW