

## ABSTRACT

An investigation has been carried out with powertiller operated Rotary and Combined Machines for tilling of unsaturated soils, from mechanical and ergonomic considerations.

Theoretical analysis has been done to evaluate the coefficients representing the fraction of total Specific Energy for active and passive tools. Octagonal ring transducers are designed and used to measure horizontal and vertical soil reaction forces in laboratory tests.

Laboratory tests are carried out under controlled conditions in a soil bin using one Rotary Machine and four Combined Machines. These are operated at different levels of rotor speed, linear speed and depth of working. Results obtained are evaluated in terms of Specific Energy, Mean Weight Diameter of soil aggregates and Inverse Performance Index. Based on the results another detailed study has been made with one of the more promising Combined Machines comprising of two fixed shovels spaced at 10 cm apart followed by the Rotary Unit. The performance of this unit too has been evaluated in terms of Specific Energy, Mean Weight Diameter and Inverse Performance Index.

Ergonomic studies have also been conducted in the laboratory as well as in the field. Initially three subjects are selected to represent 5th, 50th and 95th percentile of powertiller operator population based on their body

measurements. Then a detailed study is carried out to find the effect of Temperature, Relative Humidity and imposed Work Load on Energy Expenditure Rate with three selected subjects under controlled conditions in a Psychrometric Chamber.

From the results of the laboratory experiments Regression Models are developed for Inverse Performance Index, Specific Energy, Mean Weight Diameter as well as Heart Rate and Energy Expenditure Rate.

On the basis of laboratory studies, a new tool bar has been designed to incorporate the selected Fixed Machine in the power tiller in addition to the Rotary Unit. The Rotary as well as the Combined Machine are then tested in the field from mechanical and ergonomic considerations.

Field results indicate that the selected Combined Machine gives better performance in terms of quality of work done and comparable performance from all other mechanical considerations, for a single pass of the Powertiller. The operations of the Rotary as well as the Combined Machine are observed to be " Moderately Heavy ", according to standard classification.

KEY WORDS :

Powertiller; Rotary Machine; Combined Machine; Specific Energy; Mean Weight Diameter; Inverse Performance Index; Horizontal soil reaction force; Vertical soil reaction force; Rotor Speed; Linear Speed; Depth of Working; Ergonomics; Subjects; Heart Rate; Oxygen Consumption Rate; Energy Expenditure Rate; Regression Models.