

## Ergonomic assessment of some commonly used tractors in Iran

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**Introduction:** Different models of tractors have been imported from foreign countries or assembled in Iran for many years. Consistency of foreign manufactured products with native specifications and the improvement of locally manufactured tractors are important problems that must be considered. Moreover, tractor dimensions, sitting space and some other important factors such as the ability of Iranian users to operate them must be taken into consideration. In this study, we surveyed the proper proportion of tractors dimension, location of control tools and driver's work space, with Iranian users' anthropometric data of drivers from five provinces. Human factors are of paramount importance in developing farm machinery given that these machines will often be operated by persons with minimum skills. Therefore, farm machinery should be made simple to operate and as free from hazards as possible.

**Materials and methods:** Firstly, the anthropometric data for 250 users 20-60 years old was calculated. The drivers were selected randomly. Then the specifications of 4 tractors including: Ferguson 285, Ferguson 399, Valtra and New Holland were compared with the anthropometric data of user in 5th and 95th percentile value and their adaptation was studied. Anthropometric Data of subjects consisted of: standing height, full hand length, popliteal length, seat pan width, seat pan depth, elbow height, seat back support height, hand pan width, hand grip and full-leg length. Getting on the tractor is the first contact of an operator with a tractor. In assessing the suitability of the provision made for getting on the tractor, an experiment was arranged in which operators tried to get on 3 tractors. The mode of getting on the tractors, the agony on the operator's face, the muscular reactions and individual opinion on the difficulties or comfort while undertaking the task were observed and recorded. The specifications of tractors compared with Anthropometric Data were measured, while the tractors were positioned on a level ground for measurements after the tires had been ganged. These specifications were tractor height, steering wheel height, footrest height, foot set height; tractor seat geometry as seat pan width, seat pan depth and seat pan support height; steering geometry as distance of steering wheel from seat reference point, steering wheel radius, steering wheel thickness, steering wheel inclination to the horizontal and seat reach adjustment; levers and pedals distance from seat reference point as gear lever, parking brake lever, hydraulic control lever, clutch pedal, accelerator pedal, brake pedal, front panel, workspace width and workspace length.

**Results and Discussion:** The experiment that was conducted with operators attempting to get on the tractors indicated that tractor steps heights were higher than the desirable limit. Therefore, based on the ideas of the researcher and tractors drivers, getting on all tractors is difficult. With an increase in the number of steps or a decrease in their heights, the desirable condition can be created. Seat depth of new Holland and Valtra tractors were great for drivers in the 5th percentile value. A variable thickness pad can solve this problem. Results of studies indicated that Seat depth of Massey Ferguson 285 and 399 was shorter than driver's leg length of 95th percentile value. To solve the problem an increase of 10 centimeters to pad height of these tractors was suggested. Seat pad of tractors were short for drivers in the 95th percentile value. Distance of steering wheel from seat reference point (SRP) in Massey Ferguson 285 and Valtra was further than drivers hand length in the 5th percentile value. Therefore, the drivers hand is short for driver's good operation. Surveys indicated that drivers had problems for gear lever access in Massey Ferguson 399. Therefore, for good access on gear lever we must increase seat stroke range by 5-10 centimeters. The record available from

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Meteorological Organization indicated that air temperature and rain throughout the year in the study area is between 20 to 40degrees Celsius and 100to 300mm change. Valtra and New Holland tractors having a driver cabs with heating and cooling equipment have the ideal space for the performance of their driver. Massey Ferguson 285 tractor does not have any driver cab and Roll Over Protection Structure (ROPS).

**Conclusions:** This research was conducted in five provinces of Iran to assess ergonomics of some commonly and new used tractors in Iran containing Ferguson 285, Ferguson 399, Valtra and New Holland. As there was no data base with required details, data was collected directly by personal contact with tractor users. A questionnaire was filled out for each person and anthropometric data was calculated in all provinces for 250 users 20-60 year old that were selected at random. Then relevant specifications of 4 tractors were measured and compared with the relevant anthropometric data of users in the 5th and 95th percentile value and their adaptation was studied. The results indicated that tractor steps, Seat depth, distance of steering wheel and distance of some levers and pedals from seat reference point should be amended.

**Keywords:** Anthropometry, Ergonomics, Tractor