# SNS COLLEGE OF TECHNOLOGY

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## DEPARTMENT OF AGRICULTURE ENGINEERING

## 19AGB301-FARM TRACTORS

### III YEAR V SEM

UNIT 5- ERGONOMICS AND ENVIRONMENTAL PROTECTION

TOPIC – ERGONOMIC ASPECTS OF POWER TILLER

## Abstract

*The operation of a power tiller is fatiguing work for the operators. Because of walking behind the machine on a tilled land for hours and environment conditions which make the work harder (air temperature, dust, field conditions etc.), the operators spend high physical efforts during the operation. Also operator exposes vibration during working. All of these factors cause fatigue on the operators. In this study, operator's fatigue were assessed for two power tillers at different forward speeds. To determine the discomfort level two different methods were used. These are overall discomfort rating method (ODR) and body part discomfort score (BPDS). Obtained data were analyzed statistically. The results of the experiment showed that discomfort level increases as increasing in forward speed. The high discomfort level has been achieved at the high power tiller. Results were shown that the most discomfort rating was obtained from the working with more powerful tiller at high forward speed.*



***Keywords:*** *Ergonomics, Postural discomfort, Power tiller, Human strain*

## Introduction

Power tiller is an essential machine especially during seedbed preparation and hoeing season. Working with a power tiller is fatiguing work for operators. A power tiller operator walks behind the machine during the working period. Also the operator has to control forward movement and guide the machine while turning at headlands [8]. Additionally environment conditions make the work harder. All of these factors cause fatigue on the operators. Farmers operate for tillers for more than 8 h a day depends on the working conditions. For these reasons, operators' fatigue during working with power tiller must be considered in terms of ergonomics.

Human are able to perceive the strain generated in their bodies by a given work task and to make relative judgments about this perceived effort. Thus, the relationship between the physical stimulus and its perceived sensation can be calculated. This correlation between the work and its psychologically perceived intensity probably has been used as long as people have sought to express their preference for one type of work over another [3]. The perceived discomfort during the working usually has been assessed with questionnaires. These questionnaires have been used especially determining human performance in agricultural tasks. Meyer and Radwin [4] used body part discomfort score (BPDS) to find difference in body strain at stoop and prone postures for a simulated agricultural harvesting task. They

found that body part discomfort score of working stoop posture is higher than working in prone posture. Tewari, Dewangan and Karmakar [7] mounted a seat arrangement to detect physiological responses of the new seated position were compared with the effects of the standard design where the operator must walk behind the machine. They found that work related body pain was reduced on an average 27% by incorporating a seat in the hand tractor. The appreciable reduction in pain was observed in the foot, thigh and back of the operator. Müller and Coetsee [5] used the rating of perceived exertions scale to investigate differences in burnt and unburnt sugar cane harvesting. Rating of perceived exertion values recorded during harvesting burnt and unburnt cane. It has not been found any difference statistically.

In this study, perceived exertion by operators was determined with overall discomfort rating (ODR) and body part discomfort score (BPDS).

## Materials and Methods

This study was carried out in orchards which belong to Ankara University Faculty of Agriculture. The soil surface condition was dry and undulating. The weather during the experiment period was clear with the mean temperature and relative humidity varying between 21.0–30.0°C and 18.3–47.7%, respectively.

Five male operators who had good experience at the controls and operating power tiller were selected. They were healthy and had no physical ailment. Basic anthropometric data of the subjects is presented in Table 1.

Table 1. Physical and physiological characteristics of the subjects

| Subject No | Age (years) | Height (cm) | Weight (kg) |
|---|---|---|---|
| 1 | 44 | 175 | 90 |
| 2 | 36 | 175 | 65 |
| 3 | 27 | 179 | 86 |
| 4 | 37 | 173 | 80 |
| 5 | 33 | 177 | 85 |

Operating depth was about 10 cm. Two power tillers were selected; one has 8hp engine power, the other one has 12hp engine power. The trials were conducted at selected three forward speed levels; 1.6 km/h, 2.2 km/h, 2.8 km/h.

Overall discomfort rating (ODR) had been defined by using a 10-point psychophsical rating scale. There was a movable pointer on it. After each experience subjects indicated the comfort level on this scale (Fig 1). At the end of the each trial averages of overall discomfort rating values had been calculated.

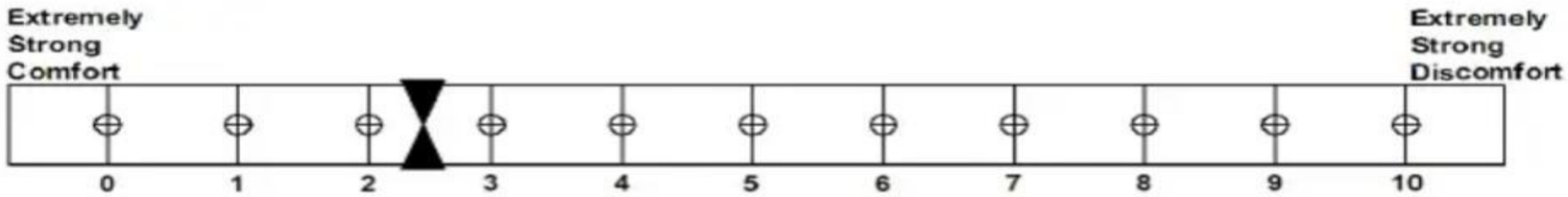


Figure 1. Overall Discomfort Rating Scale

Overall discomfort rating (ODR) was used which was developed by Corlett and Bishop [2] for the assessment of it. It consisted of a 70 cm long graduated scale with its left marked as 0 and it's and right ends 10 which are representing 'no discomfort' and 'extreme discomfort', respectively. A sliding pointer was provided on the scale to mark the level of discomfort. At the ends of each trial subjects were asked to mark their overall discomfort rating on the scale. The overall discomfort ratings given by each of the five subjects were averaged to get the mean rating [6].

For identifying the body part this comfort scored (BPDS) human body is divided into 12 regions (Fig 2). Each subject was asked to explain to discomfort of all body parts [6]

The number of different groups of body parts which are identified from extreme discomfort (10) to no discomfort (0) represented the number of intensity levels of pain experienced [1]. The total score for a subject was the sum of all individual scores of the body parts assigned by the operator. The body discomfort score of all the operators was averaged to get the mean score.

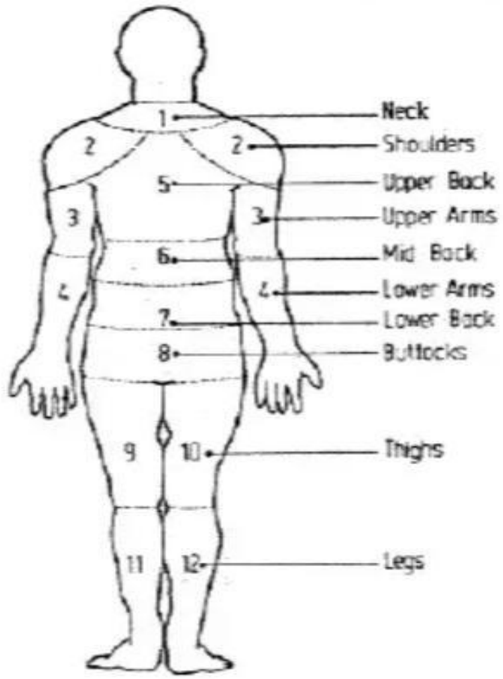


Figure 2. Body map for Body Part Discomfort Score (BPDS)

## Results and discussion

The mean value of overall discomfort scores and body parts discomfort scores after working with power tillers for selected levels of forward speed are presented in Table 2. Overall discomfort rating varied from 4.3 to 5.8 for the 8hp power tiller and 4.8 to 7.3 for the other power tiller (12hp). The mean value of body part discomfort score was increased from 31.2 to 42.7 for the power tiller which has 8hp engine power and 37.3 to 49.8 for the other power tiller (12hp). Each method indicated the similar tendency. It is clear from the Table 2 that raising of forward speed causes the higher discomfort level.

Table 2. Mean value of overall discomfort rating (ODR) and body parts discomfort scores (BPDS)

| Forward Speed (km/h) | Mean Value of ODR | | Mean Value of BPDS | |
|---|---|---|---|---|
| | Power Tiller (8hp) | Power Tiller (12hp) | Power Tiller (8hp) | Power Tiller (12hp) |
| 1.6 | 4.3 | 4.8 | 31.2 | 37.3 |
| 2.2 | 5.1 | 6.1 | 38.5 | 43.4 |
| 2.8 | 5.8 | 7.3 | 42.7 | 49.8 |

Body parts to be forced during the operation with power tiller are presented in Figure 3.

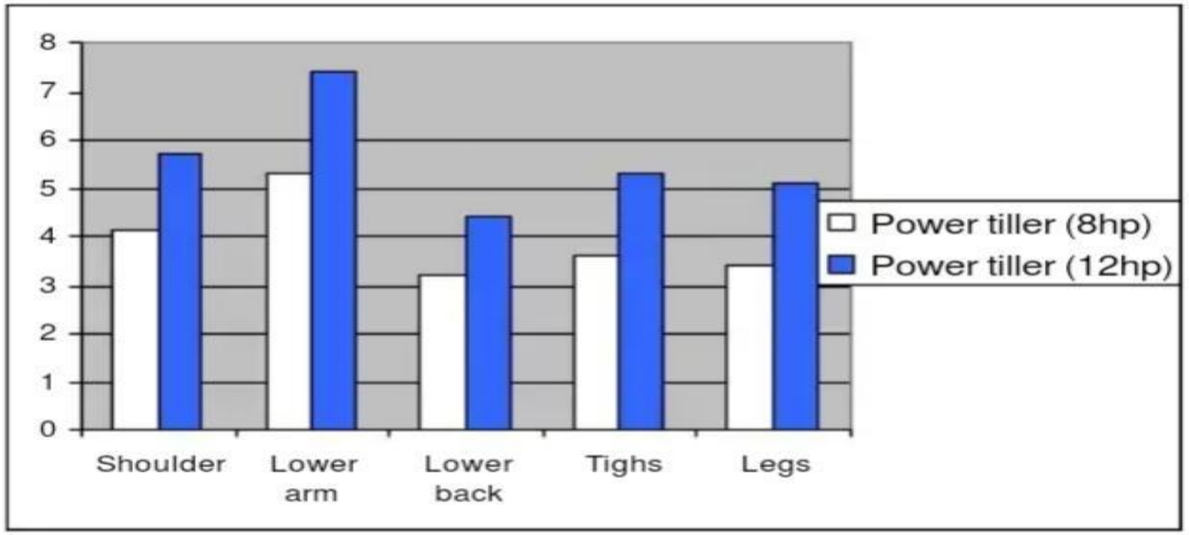


Figure 3. The mean values of body parts discomfort score for the power tillers

## Conclusions

According the results, the conclusions were given as follows:

- Ergonomic precautions must be taken to prevent the effects of environmental conditions such as temperature, humidity, dust and vibration of machine.
- The overall discomfort scores and body parts discomfort scores increased while increasing in forward speed for working with each tillers.
- Working with more powerful tiller causes the rising at ODR and BPDS values.
- The most exertion was perceived at lower arms, shoulders for each of two power tiller. To prevent this, control of power tillers should be analyzed in terms of ergonomics.
- The type of handling angle and the height of it might be adjustable for users who have different anthropometric features.
- Power tiller should be designed with respect to ergonomic criteria.

## References


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# Youtube links

*https://youtu.be/R90lMgloYnc*

***Similar to this ergonomics we can learn the ergonomics of power tiller***

Thank You