MEASUREMENT OF TRANSMITED VIBRATION TO TRACTOR SEAT

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ABSTRACT:

A field experiment was conducted at experimental field of Mechanization Agriculture , the College of Agriculture , Abu – Ghraib , University of Baghdad .To measure transmitted vibration to seat tractor during operation tillage , mold board plow with New Holland 66-S- 80 tractor as one machinery unit , Soil was treated at soil constant moisture (18 – 20 %) with two depths of plowing (15 and 20 cm) and three speed of tractor 2.0 , 3.5, 6.8 km / h . Three main dimensions in seat tractor measurement vertical, longitudinal and lateral acceleration. Split plot design under completes block design with three replicates .

قياس الاهتزازات المنقولة إلى مقعد جرار

الخلاصة :

التامة أجريت تجربة في حقل قسم المكننة الزراعية – كلية الزراعة – جامعة بغداد لقياس الاهتزازات المنقولة إلى مقعد الجرار أثناء عملية الحراثة ، تم استخدام محراث مطرحي ثلاثي قلاب معلق مع الجرار نيوهولند ليصبح وحدة مكنية واحدة . جرت معاملة التربة عند محتوى رطوبي ثابت 18 - 20 % وأستخدم الجرار نيو هولند ثنائي الدفع ذو قدرة حصانيه متوسطة ، عند عمقين للحراثة هي 15 و 20 سم وأستخدم ثلاث سرع عملية للجرار هي 2.0 و 3.5 و 6.8 كم / ساعة. تم قياس التسارع المنقول إلى مقعد الجرار بثلاث اتجاهات رئيسية هي العمودي والطولي والجانبي ، نفذت التجربة بتصميم الألواح المنشقة وتحت نظام القطاعات العشوائية الكاملة وبثلاث مكررات .

Key words: Ergonomics, Seat tractor, Vibration level, plow, Tillage.

INTRODUCTION

Recently, occupational health problems of agricultural workers have not received significant attention in developing countries. This is particularly important for tractor drivers who operate the tractor in unsuitable condition and high level of seat and tractor vibration .Tractors in high-income countries are very sophisticated and almost all have enclosed environment controlled suspended cabins and well design instrument and controls. These cabins are not likely to become common in countries like Iraq, because of economic reasons .Vehicle ride vibration is usually evaluated by acceleration value and its direction. In this regards, the acceleration can be divided into two groups, rotational and translational acceleration. Translational vibration is transmitted to a seat tractor along three perpendicular axes, longitudinal, lateral and vertical direction. Most of the tractor vibration occurs in the vertical plane, which is transmitted from wheels to the seat, whereas tractor drivers have more sensitivity to this type of vibration. On the other hand, vertical vibration level during field operation is usually exceeded from ISO standards levels (Maleki, 2008). Longitudinal and lateral vibrations occur due to tractor conditions. Vibration modes created by translational vibration on the human body caused discomfort, pain and injury. However rotational acceleration usually didn't cause any pain and injury (Griffin *et al*. 1982). The problems of tractor ride become more critical since the dominant natural frequency of the tractor (1-7 Hz) lies within most critical frequency range of human body (e.g. human trunk and lumbar vertebra have a natural frequency of 4-8 and 4-5 Hz, respectively) (Pop and Hansson, 1992 ; Troup, 1978; Klooster,2004) .
The vibration levels of tractors without cabins and suspensions have been extensively compared to the other road vehicles having suspension (Bovenzi and Betta, 1994). Moreover, many studies have been conducted on tractor seats in order to measure and compare the driver vibration with international health standards (ISO 2631-1:1997).
Many studies conducted to measurement levels vibration in seats tractor and the result was high levels combar with ISO 2631-1:1997 (Salakhe, 2007; Serudio, 2007; Muzammil, 2004). Vibration in tractor depends on many factors velocity of tractor, topography of field, tractor condition and design tractor and configuration which is by dynamic response (HSE, 2008).
The ride vibration of tractors with rear-mounted implements like mold board plow is frequently in excess of internationally accepted levels, especially during transport and plowing ,when the vibration level can be extremely high due to relatively high speed in combination with the roughness of the roads (Collins, 1991) .
The objective of this research is investigation of seat tractor vibration levels of common used tractor in Iraq and compared with ISO 2631- 1:1997.

MATERIALS AND METHODS :

A field experiment was conducted at experimental field of Mechanization Department - College of Agriculture, Abu – Ghraib, University of Baghdad. Soil type was clay – silt and unused to agriculture , Soil was treated at soil constant moisture (18 – 20 %) with two depths of plowing (15 and 20 cm) and three speed of tractor 2.0 , 3.5, 6.8 km / h , with constant revolution of engine at 2000 rpm by hand lever fuel .
Field area was 180 m length and 80 m width. Condition of tractor rebated be recommended(ISO 5008 : 2002) , the tractor shall be in working order with full tank and radiator , but without optional front and rear weight , tire ballast, The tire used in test was stander size for tractor . mold board plow with New

Holland 66-S- 80 tractor as one machinery unit figures (1) and (2) and tables (1) and (2) .Used vibration meter type VB-8201HA figure (3) , location of the measurement figures (4), (5) and (6), the acceleration was measured along three mutually perpendicular axes , define as follows :
Z – Vertical direction: sensor put under the seat.
X – Longitudinal direction: sensor put back to chest seat.
Y- Lateral direction: sensor put right side or to left side of the seat.

Result

The mean values acceleration $(m/\sec^2)$ for along three mutually perpendicular axes show in Table (3). From the table it can be observed that there was noticeable change in acceleration value in the kind of task undertaken in the present study. The transit acceleration to seat tractor increased with the increase in the velocity of tractor.

The vertical acceleration decrease with the increase depth plowing, Because velocity of tractor decrease with the increase depth plowing and cutting soil area for shears increase, that happen because slippage in tires tractor and increase resistance soil against shears plow, figure (7) .

Longitudinal acceleration increased with the increase velocity of tractor , high speed 6.8 km / h and depth plowing 20 cm was transit high vibration to seat tractor , while velocity 2.0 km / h and the same depth was less transit vibration to seat tractor, because different velocity both of them, figure (8) .

Lateral acceleration was increased with the increase velocity of tractor , high vibration transit to seat tractor with speed 6.8 km /h and depth plowing , while low vibration at 2.0 km /h and depth 15 cm figure (9)

DISCUSSION

Results of the study showed that the levels of vibration transmitted to seat tractor during the experiment was high compare with ISO 2631-1:1997 . Velocity of tractor was a strong statistical significant effect on transmitting vibration to seat tractor all three perpendicular axes. Like these values acceleration especially in vertical direction effect on operator and caused discomfort, pain and injury, tired, less performance and not completely control operation to the tractor by operator.

Therefore, we must reduce effect high levels vibration on the operator by:
1- Making full and proper use of seat position and suspension adjustments – drivers should be able
to easily reach the pedals, know how to use any back support, adjust the seat so it provides support
for their thighs and adjust the suspension mechanism correctly for their weight.
2- Choosing a speed appropriate for the ground they are driving over – control of whole body vibra-tion should be used to reduce the risk of injury, NOT increase productivity.
3- Selecting a course to avoid potholes, ruts, bumps etc as much as possible.
4- When conducted conventional tillage must the working time be 4 hour not more, and take period rest between the works.
5- Good stile operation can be reducing levels transit vibration to seat tractor.

SUMMARY

Results can be summarized as follows:
1- Transmitted acceleration to seat tractor in three dimension vertical, longitudinal and lateral Increasing with increased speed tractor.
2- Transmitted vertical acceleration to seat tractor decreasing with increase depth of plowing from 15 to 20 cm. Tractor operator was uncomfortable and incompletely control driving on tractor with high speed of tractor 6.8 km / h.
3- Levels transmitted acceleration to seat tractor was high and across levels safety compare with ISO 2631-1-1997

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Figure. (1): Tractor new Holland and mold board plow as one machinery unit during measurement

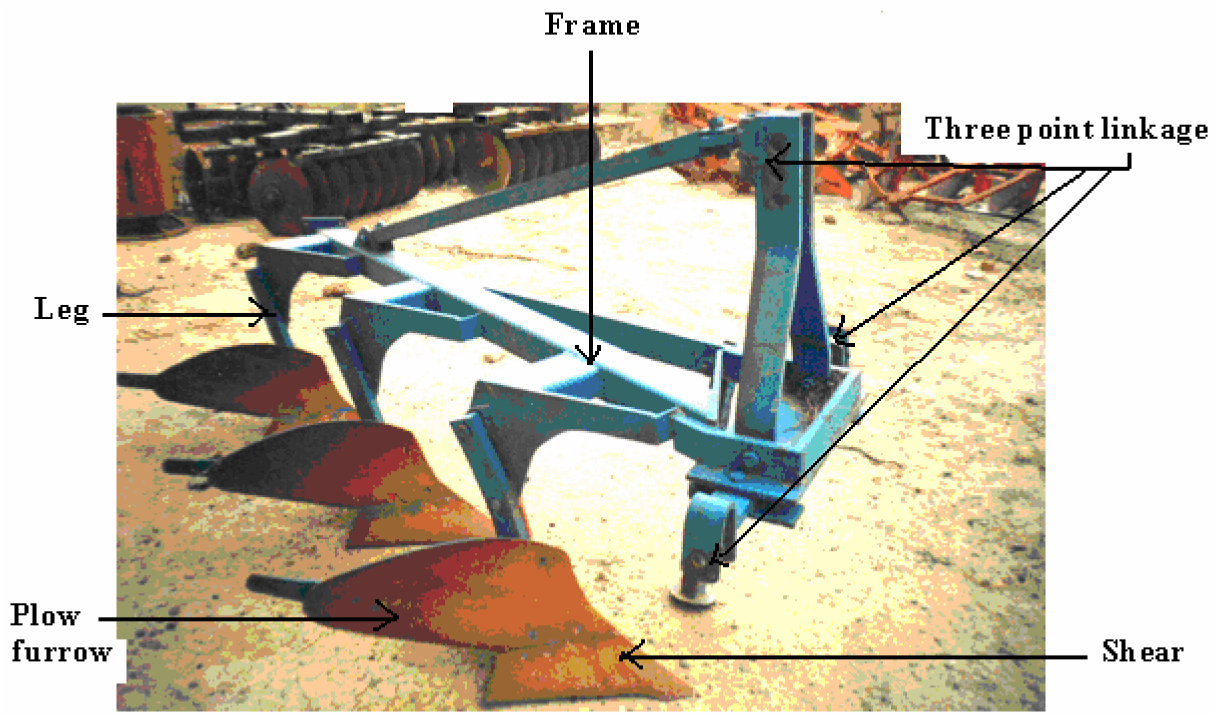

Figure. (2): Mold board plow

Table (1): Important specification of the tractor New Holland *

Model	New Holland 66 – S 80 2WD
Type engine	Iveco 4 stroke, direct injection, water cooled.
Number of cylinders	4
Diameter of cylinder (mm)	104
Long stroke (mm)	115
Engine power (horse mechanical)	80
Maximum revelation engine (rpm)	2600
Total weight (KN)	29.78
Tractor weight without ballast (KN)	25.80
Size rear tire	18.4 R 30
Pressure rear tire (Psi)	20 **
Size front tire	7.50 R16
Pressure front tire	30
Type suspension seat	Mechanical spring
Operator mass (kg)	65***
Made	Italy

*** Taken from NEW HOLLAND SERIES 66 SS**
*** * Pressures rear & front tire during experiment.**
***** Operator mass during experiment.**

Table (2): Specification of the mold board plow used in experiment.

Number shear	3
Type	Hanging by three linkage point
Working width (mm)	1050
Working depth (mm)	270
Total length (mm)	2880
Total width (mm)	1680
High (mm)	1155
Weight (kg)	280
Made	Iraq

.

Figure. (3) Vibration meter

Figure. (4) Measure transited acceleration to seat tractor in vertical direction.

Figure. (5) Measure transited acceleration to seat tractor in longitudinal direction.

Figure. (6) Measure transited acceleration to seat tractor in lateral direction.

Table 3. The mean values acceleration $(m/\sec^2)$ for along three mutually perpendicular axes.

Depth plowing (cm)	speed tractor (km / h)	Vertical Z $(m/\sec^2)$	Longitudinal X $(m/\sec^2)$	Lateral Y $(m/\sec^2)$
15	2.0	4.8	11.1	2.8
15	3.5	4.9	11.8	5.6
15	6.8	7.0	12.7	5.7
20	2.0	4.5	10.5	2.9
20	3.5	4.7	12.8	5.2
20	6.8	6.3	14.6	7.7

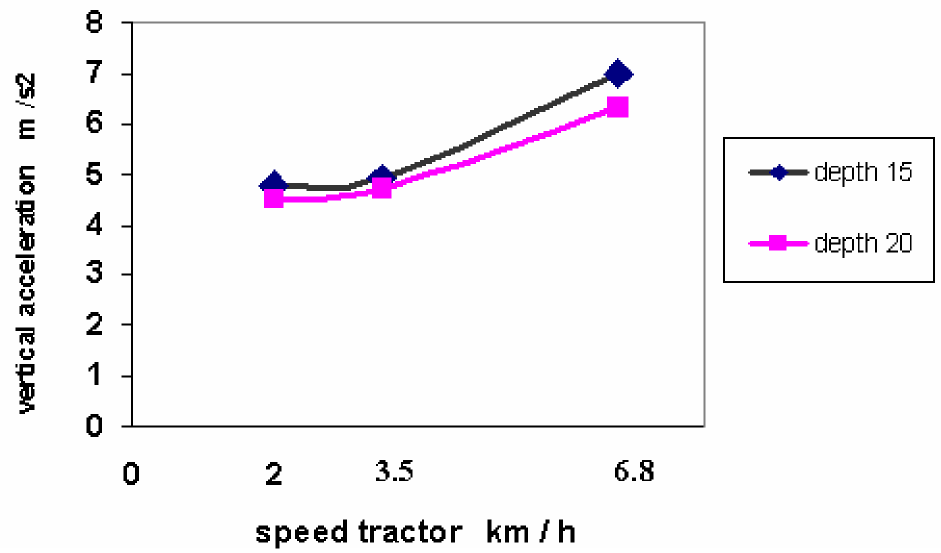

Figure 7. Relation transit vertical acceleration to seat tractor with speed and depth plowing

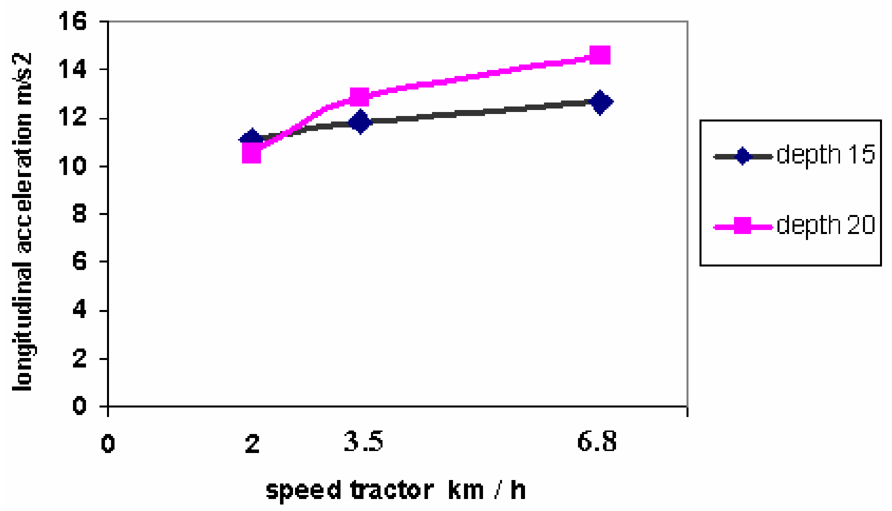

Figure 8. Relation transit longitudinal acceleration to seat tractor with speed and depth plowing

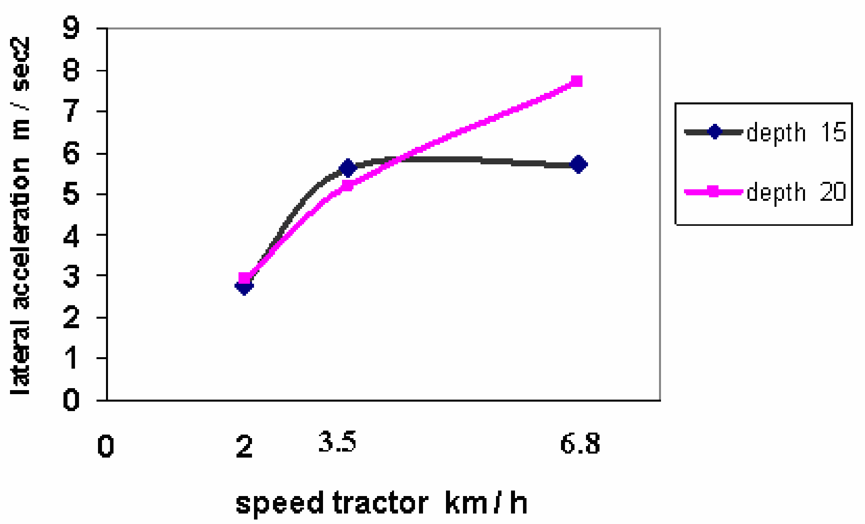

Figure 9. Relation transit lateral acceleration to seat tractor with speed and depth plowing