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Contribution Of Tractor Model And Speed Of Operation During Tillage To The Emission Of Carbon Iv Oxide (Co_2) Gas Into The Environment

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ABSTRACT
Food demand increases with global population growth; agricultural mechanization has a role in equating these two variables if human life's existence is paramount. An average farmer in order to meet this food demand adopts agricultural mechanization that contributes to Green House Gases (GHG) emissions if sustainability is not a watchword. However, to prevent catastrophic climate change by meeting global food demand, the measurement and evaluation of CO_2 gas emissions on farms during tractor operation are important to finding solutions to reducing GHG emissions. A field operation study was conducted in the South-western state of Nigeria to determine the amount of CO_2 gas released into the environment by Nigerian farmers when comparing the use of two (2) different tractor models with two different ages (old and new), operating at various hand throttle speed of 15, 20 and 24km/h respectively. Analysis of the results shows that T_2, Massey Fergusson, (old) and T_1 Massey Fergusson, (new) always emit low CO_2 at hand throttle speed of 20 and 24km/hr respectively. At low speed of 15km/hr, the emission from the Massey Ferguson models is so high. Tractor models T_3 (NewHolland, new) and T_4 (NewHolland, old) emit higher CO_2 at speed of 20km/hr. The lowest emission of CO_2 is from the T_3 (NewHolland, new) model at the speed of 15km/hr. For tractor models T_4 (NewHolland, old) and T_3 (NewHolland, new), CO_2 emission increases with increasing speed at 20km/hr; the emission drops as the speed further increases to 24km/hr. It was observed that the highest values for CO_2 emission were recorded for tractor T_1 (Massey Ferguson, new) and T_2, Massey Fergusson, (old) at speed of 15km/hr and (T_3 (NewHolland, new) and T_4 (NewHolland, old)) at 20 and 24km/hr respectively. Both tractor models (T_3 (NewHolland, new) and T_4 (NewHolland, old))are best operated at 15km/hr, and (T_1 (Massey Ferguson, new) and T_2, Massey Fergusson, (old))at 20 and 24km/hr hand throttle speed for low emission of CO_2

KEYWORDS: CO_2 , Environment, Pollution, GH gas, Farming operation, Tractor model, Sustainability

I. INTRODUCTION

The atmospheric concentration of greenhouse gases (GHGs) has increased considerably in recent years due to human activities. Carbon dioxide (CO_2) is the most important anthropogenic GHG; its annual emissions increased by about 80% between 1970 and 2004 (Yue and Gao, 2018). Activities such as the burning of fossil fuels, the burning of forests and the loss of soil organic matter have been recognized as the main causes of that increase(Olivier and Peter, 2020). Investigation results show that CO_2 emission has a direct dependence on fuel consumption. An increase in fuel consumption equally increases emissions. The main worry is the amount of radiation which escapes depending on the concentration of greenhouse gases in the atmosphere - carbon emissions add to the concentration, which causes less radiation to escape. This will increase the surface temperature of the Earth. Eventually, the Earth's warming will increase with time; and might have disastrous consequences. From the ecological point of view, CO_2 is a dangerous gas because it

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creates a kind of a film which inhibits the warming of the Earth's surface. Because of the thermal effect, the Earth's temperature during the last century has increased on average by 0,3–0,7 °C (Šimatonis and Tikeviči 1994; Baltrėnas et al. 2004).

Although mechanization encourages large scale production and improves the quality of farm produce, on the other hand causes environmental pollution, deforestation and erosion (Jackson and Jackson, 1997). Farm mechanization is projected to have significant impacts on conditions affecting Global warming. This includes the use of machinery for the land preparation and processing of the harvested crop which involves the burning of the fossil fuel as the source of energy used and reduces the absolutions of the carbon dioxide by the deforestation of the farm trees(Cooke, 1970; Jackson and Jackson, 1997; Silver, 2008).

Increase of agricultural equipment and high performance of tractor stock influence pollution of the environment by exhaust gases. Poisonous exhaust substances, oil products and their vapour are disposed to the environment through engine breather and various wane products. The bigger concentration of equipment used the bigger noise level. Environmentally-unfriendly impact factors break ecological balance, decrease soil productivity and have a negative influence on human health (Šimatonis and Tiškevičius 1994). The processes involved in land forming are the primary and secondary tillage. These include first plough, secondary plough, harrowing and ridging. Since Agricultural mechanization is the application of mechanical technology and increased power to agriculture, largely as a means to enhance the productivity of human labour and often to achieve results well beyond the capacity of human labour with optimum yield and at minimal cost (Falaye, 2012). This includes the use of tractors of various types as well as animal-powered and human-powered implements and tools that are operated at different

II. MATERIALS AND METHODS

The study was conducted in Lagos State University of Science and Technology, Ikorodu, West central state of Nigeria under the western vegetation in sandy-loamy soil. The study area falls within the geographical location $16^0$37'0" North, $3^0$37'0" east of the western part of Nigeria.

The equipment and materials used for the study includes: measuring tape, New Holland tractor (old and new), Massey Fergusson tractor (old and new), 14.4 hectares of land, 2 Hand held gas collector (multiRAE Pro), Disc plough, disc harrow and Ridger.

Tractor below the age of ten years are referred to as **NEW** and above ten years are referred to as **OLD.**

The major tillage operations were conducted first plough; second plough; harrowing and ridging at 13days, 5days,and 3 days time intervals respectively . The CO_2 gas emission were monitored before, during and after the tillage operation.

Before the first plough, the CO_2 in the environment was measured. During the first plough, the four tractors were allowed to run at various hand throttle speeds of 15km/hr. 20km/hr and 24km/hr. The CO_2 emission was monitored after 1-3 days. After 13 days, the second plough was carried out using the four tractors at the operating hand throttle speeds of 15km/hr, 20km/hr and 24km/hr. The depth of the operation also varied. After the fifth day, the harrowing operation was carried out using the four tractors at various operating hand throttle speeds of 15km/hr, 20km/hr and 24km/hr. Finally, after the third day, the ridging operation was carried out with the four tractors at the operation hand throttle speeds of 15km/hr, 20km/hr and 24km/hr

III. RESULTS AND DISCUSSION

RESULTS

Gaseous levels before the 1st ploughing 2.66 ± 0.29.

TABLE 1: Tractor model with speed of operation on CO_2gas emission during the 1st plough

	T1	T2	T3	T4
15km/h	3006.67 ± 114.49^h	5466.67 ± 208.17^j	557.25 ± 7.29^a	595.00 ± 13.23^b
20km/h	898.33 ± 42.01^c	1633.33 ± 76.38^e	1787.50 ± 72.76^f	3250.00 ± 132.29^i
24km/h	1127.50 ± 27.50^d	2050.00 ± 50.00^g	1173.33 ± 42.01^d	2133.33 ± 76.38^g

T_1 = (McFergusson, new) , T_2 = (McFergusson, old) , T_3 = (NewHolland, new) T_4 = (NewHolland, old)

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TABLE 2 : Tractor model with speed of operation on CO_2 gas emission during the 2nd plough

	T1	T2	T3	T4
15km/h	231.13±88.16^{h}	4209.33±160.29^{j}	567.28±5.60^{a}	576.15±10.19^{b}
20km/h	691.72±32.34^{c}	1257.67±58.81^{e}	1376.38±56.02^{f}	2502.50±101.86^{i}
24km/h	868.18±21.18^{d}	1578.50±38.50^{g}	903.47±32.34^{d}	1642.67±58.81^{g}

T_1 = (McFergusson, new) , T_2 = (McFergusson, old) , T_3 = (NewHolland, new) T_4 = (NewHolland, old

TABLE 3 : Tractor model with speed of operation on CO_2 gas emission during the soil harrowing

	T1	T2	T3	T4
15km/h	2104.67±80.14^{b}	3826.08±145.72^{j}	552.08±5.09^{a}	576.50±9.26^{b}
20km/h	628.83±29.41^{c}	1143.33±53.46^{e}	1251.25±50.93^{r}	2275.00±92.60^{i}
24km/h	789.25±19.25^{d}	1453.00±35.00^{g}	821.33±29.41^{d}	1493.33±53.46^{g}

T_1 = (McFergusson, new) , T_2 = (McFergusson, old) , T_3 = (NewHolland, new) T_4 = (NewHolland, old

Table 4:Tractor model with speed of operation on CO_2 gas emission during the soil ridging

	T1	T2	T3	T4
15km/h	3006.67±114.49^{h}	5466.67±208.17^{j}	557.25±7.29^{9}	595.00±13.23^{b}
20km/h	898.33±42.01^{c}	1633.33±76.38^{e}	1787.50±72.76^{f}	3250.00±132.29^{i}
24km/h	1127.50±27.50^{d}	2050.00±50.00^{g}	1173.33±42.01^{d}	2133.33±76.38^{g}

T_1 = (McFergusson, new) , T_2 = (McFergusson, old) , T_3 = (NewHolland, new) T_4 = (NewHolland, old)

Table 5: Interaction of operation speed and tractor model on carbon (IV) oxide gas emission

	T_1	T_2	T_3	T_4
15km/h	2330.168	4236.668	558.37	576.625
20km/h	696.2075	1265.833	1385.315	2518.75
24km/h	873.815	1588.75	909.3325	1653.333

T_1 = (McFergusson, new) , T_2 = (McFergusson, old) , T_3 = (NewHolland, new) T_4 = (NewHolland, old)

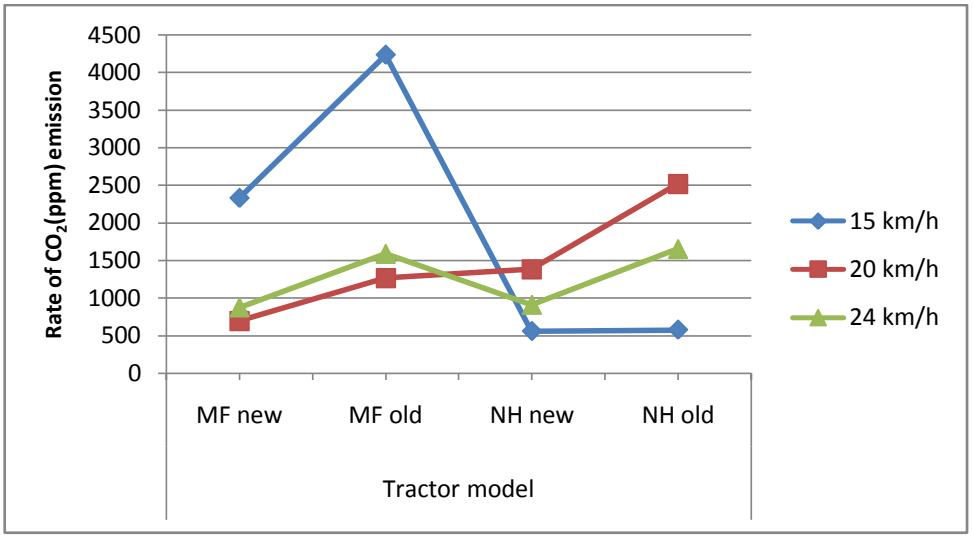

Fig1: Effect of speed of operation and tractor model on carbon (IV) oxide gas emission

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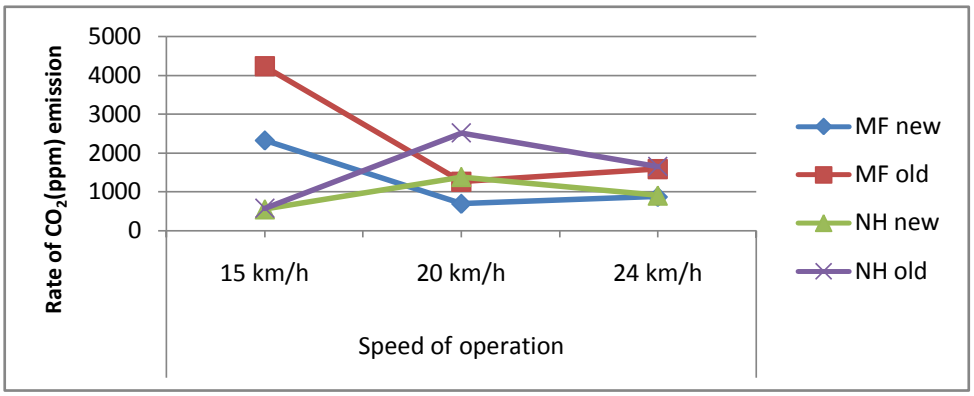

Figure 2: Effect of speed of operation and tractor model on carbon (IV) oxide gas emission

Effect of Tractor Model and speed of operation on emission Carbon (iv) oxide (CO_2) gas

There was an indication of 2.66 ± 0.29 ppm level of CO_2 before the 1st ploughing activity. Operating the tractors at the speed of 15 km/ hr T_3 (NewHolland, new) was observed to release the least concentrations: 557.25 ± 7.29 ppm of CO_2 while T_2 (McFergusson, old) released the highest concentrations: 5466.67 ± 208.17 ppm. At the speed of 20 km/ hr, T_1 (McFergusson, new) was observed to release the least concentrations: 898.33 ± 42.01 ppm of CO_2 while T_4 (NewHolland, old) released the highest concentrations: 3250.00 ± 132.29 ppm. At the speed of 24 km/ hr T_1 (McFergusson, new) was observed to release the least concentrations: 1127.50 ± 27.50 ppm of CO_2 while T_4 (NewHolland, old) released the highest concentrations: 2133.33 ± 76.38 ppm. The T_2 (McFergusson, old) at the speed of 15 km/ hr had the highest release ($p < 0.05$) of CO_2 (Table 1).

Operating the tractors during the second plough at the speed of 15 km/ hr , T_3 (NewHolland, new) was observed to emit the least concentrations: 567.28 ± 5.60 ppm of CO_2 while T_2 (McFergusson, old) emitted the highest concentrations: 4209.33 ± 160.29 ppm. At the speed of 20 km/ hr, T_1 (McFergusson, new) was observed to emit the least concentrations: 691.72 ± 32.34 ppm of CO_2 while T_4 (NewHolland, old) emitted the highest concentrations: 2502.50 ± 101.86 ppm. At the speed of 24 km/ hr, T_1 (McFergusson, new) was observed to emit the least concentrations: 868.18 ± 21.18 ppm of CO_2 while T_4 (NewHolland, old) released the highest concentrations: 1642.67 ± 58.81 ppm. The T_2 (McFergusson, old) at the speed of 15 km/ hr emitted the highest ($p < 0.05$) emission of CO_2 (Table 2).

Operating the tractors for harrowing at the speed of 15 km/ hr , T_3 (NewHolland, new) was observed to release the least concentrations: 552.08 ±5.09 ppm of CO_2 while T_2(McFergusson, old) released the highest concentrations: 3826.67 ± 145.72 ppm. At the speed of 20 km/ hr, T_1 (McFergusson, new) was observed to release the least concentrations: 628.83 ±29.41 ppm of CO_2 while T_4 (NewHolland, old) released the highest concentrations: 2275.00 ± 92.60 ppm. At the speed of 24 km/ hr , T_1 (McFergusson, new) was observed to release the least concentrations: 789.25 ±19.25 ppm of CO_2 while T_4 (NewHolland, old) released the highest concentrations: 1493.33 ± 53.46 ppm. The T_2 (McFergusson, old) at the speed of 15 km/ hr had the highest release ($p < 0.05$) of CO_2 (Table 3).

Operating the studied tractors during ridging at the speed of 15 km/ hr, T_3 (NewHolland, new) was observed to emit the least concentrations: 556.87 ±4.58 ppm of CO_2 while T_2 (McFergusson, old) emitted the highest concentrations: 3444.00 ± 131.14 ppm. At the speed of 20 km/ hr, T_1 (McFergusson, new) was observed to emit the least concentrations: 565.95 ±26.46 ppm of CO_2 while T_4 (NewHolland, old) emitted the highest concentrations: 2047.50 ± 83.34 ppm. At the speed of 24 km/ hr, T_1 (McFergusson, new) was observed to emit the least concentrations: 710.33 ±17.33 ppm of CO_2 while T_4 (NewHolland, old) released the highest concentrations: 1344.00 ± 48.12 ppm. The T_2 (McFergusson, old) at the speed of 15 km/ hr significantly ($p < 0.05$) emitted the highest CO_2 (Table 4). The CO_2 emissions were highly ($p > 0.05$) significant.

There are no significant differences in CO_2 emission for the following combinations of speeds of operation and models of tractor: T_1 (McFergusson, new) at15km/hr. and T_4 (NewHolland, old) at 20km/hr.; T_3 (NewHolland, new) at 12km/hr T_4 (NewHolland, old) at 15km/hr. and T_1 (McFergusson, new) at20km/hr.; T_4 (NewHolland, old) at 15km/hr T_1 (McFergusson, new) at 20km/hr. and T_1 (McFergusson, new) at 24km/hr.; T_1 (McFergusson, new) at 20km/hr T_1

(McFergusson, new) at 24km/hr. and T_3 (NewHolland, new) at 24km/hr.; T_4 (NewHolland, old) at 20km/hr. and T_3 (NewHolland, new) at 20km/hr.; T_3 (NewHolland, new) at 20km/hr T_2 (McFergusson, old) at 24km/hr. and T_4 (NewHolland, old) at 24km/hr.. However, T_2 (McFergusson, old) at 15km/hr. Is significantly different from every other combination of tractor model and speed for CO_2 emission.

From figure 1 and 2, T_2 (McFergusson, old) and T_1 (McFergusson, new) emits low CO_2 gas at 20km/hr but when the tractor speed is low, the emission of the Mercy Fergusions models are so high. Tractor models T_3 (NewHolland, new), T_4 (NewHolland, old) emits higher CO_2 at speed of 20km/hr. Lowest emission of CO_2 for the T_3 (NewHolland, new) and T_4 (NewHolland, old) model are at 15km/hr speed. For tractor model T_4 (NewHolland, old) and T_3 (NewHolland, new), CO_2 emission increases with increasing speed to 20km/hr and later the CO_2 emission drops as speed further increases. It was observed that highest values for CO_2 were recorded for tractor T_2 (McFergusson, old) at speed of 20km/hr. which was 4236.67. From the result table 1, it was however noted that T_3 (NewHolland, new) at speed of 15km/hr had the least recorded value of 558.37.

IV. CONCLUSION

It was observed that high emissions of CO_2 are recorded at high speed for new model tractors for both MC Fergusson new Holland and the old model CO_2 values were high irrespective of the speed. When the new and old models are compared the new model is best used for low emissions of CO_2.

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