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The Effect Of Vehicular Traffic On The Yield Of Egusi-Melon (Collocynthus Citrillus L.)

Chiagorom, Victor Chukwudi

Imo State Polytechnic Umuagwo. Nigeria

***Abstract:** A 15x51m2 field was manually cleared with cutlass and divided into three blocks of four plots each. The soil was compacted using a 35.5KN wheel tractor. Treatment consisted of 0, 1, 5, and 10 passes (wheel-wheel) of the tractor and were replicated three times. After this seed beds were prepared where we planted the egusi-melon seeds, the seedling emergence was observed after 1 week, 3 weeks etc. This was noticed by taking into account the number of seeds planted and the number germinated per plot. This was determined by observing the total number of germinated seeds per plot after 1 week. This is normally expressed in percentage. For 20 seeds planted, if 18 germinated after 1 week for 5 passes; % seedling emergency =18/20 x 100 = 90%. At harvest, the yield was also measured plot by plot and the results recorded.*

***Keywords:** Compaction, vehicular traffic, yield, seedling emergence, egusi-melon (collocynthus citrillus L.).*

I. INTRODUCTION

Soil compaction is the process of applying pressure to the agricultural soil thereby disturbing the soil texture and structure and thereby compressing the soil.

The compaction of soil can also be defined as an increase in its dry density, and the closer packing of solid particles or reduction in porosity. Modern cropping systems are based on agricultural machinery and this machinery is responsible for most of the soil compaction.

The mechanization of crop production is increasing in most parts of the world. In many countries this trend is viewed with concern because of the compaction which results when wheels pass over soils used as a growing medium for crops (Soane, 1970; Barnes et al., 1971; Eriksson et al., 1974; Chancellor, 1976; Osuji 1988; Ohu et al., 1991).

Vehicular traffic on agricultural mechanization i.e. a process by which any or all of the usual operations involved in agricultural production are carried out with mechanical assistance using either manually operated machinery or motorized and/ or automated machine units.

Among the numerous studies carried out to determine the efforts of wheel traffic on soils, parameters such as bulk density, soil strength, total porosity and hydraulic conductivity have been used as indicators of soil compaction (Gameda et al., 1988), with bulk density being the most used (Raghavan et al., 1978; De knipe et al., 1981, Voorhess et al., 1986; Cupta and Almares, 1987).

The mutual interaction between these parameters are affected by soil moisture content. As soil moisture content increases, the soil strength (cone index) decreases and dry bulk density increases. (Taylor et al., 1981).

However, at a fixed moisture content a soil will have a higher strength at larger densities, which reflects the closer packing of solid particles. This compaction also alters the water content and movement in soils by modifying the void size distribution (Warkentin, 1971). This tends to reduce both the amount of water which is retained at low water suction pressure in the macro pores, and the saturated hydraulic conductivity of the soil. Ide et al. (1984) found that the reduction in total porosity resulting from compaction would lead to a shortage of oxygen for plant roots while the reduction in pore diameter would prevent the entrance of root tips and easy flow of gravitational water.

From the above review, it may be summarized that tractor passes on the soil result in the following:-

- ✓ Poor nutrient and water up take by plants
- ✓ Soil structure degradation which are reflected in changes in soil physical properties such as dry bulk density, soil strength, soil porosity, permeability etc. with soil structure

degradation, soil compaction due to traffic lowers the production potentials of the soil by exposing the soil to physio-chemical damages with a resultant poor nutrient uptake and poor growth and yield of crops.

Although compaction is detrimental to plant growth, but it can be ameliorated by any or all of the following:

- ✓ Avoid high machinery contact pressure especially during repeated passes in fields.
- ✓ Avoid moving on fields with machines when the top soil is moist, close to the "optimum" moisture content for compaction.
- ✓ Avoid excessive slipping of tractor lives during field operations, which could manage cultural programs that leave a healthy double soil density changes under the same weight.
- ✓ Manage cultural programs that leave healthy system of roots, and sufficient organic matter in the top soil (Mckyes, 1985).

So in this work, it is intended to assess the interactions of soil properties as they area affected by tractor wheel traffic.

PROBLEM STATEMENT

Soil compaction tends to reduce both the amount of water which is retained at low water suction pressure in the macro pores, and the saturated hydraulic conductivity of the soil. This can be controlled though by managing cultural programmes that leave healthy system of roots and enough organic matter in the top soil.

AIM AND OBJECTIVES

The aim of this work was to compare the seedling emergence, root development and the yield of egusi-melom based on the level of soil compaction.

The objectives of this research were to:-

- ✓ Evaluate the rate at which the growth responds to the tractor operation in the field.
- ✓ Determine the effect of different wheel passes of the tractor on the yield of egusi-melon (collocynthus citrillus L.).

JUSTIFICATION

Heavy tractor traffic on soils results in compaction which degrades soil structure and cause poor nutrient and water uptake by plants. This movement hampers the soil structural stability as well as soil production potential. These justify the research project.

Soil compaction had been a very sensitive problem to agricultural production because it involves poor soil and water conservation and thus reduced crop growth and yield. In developing countries like Nigeria, mechanization is increasing and, although the vehicles used may be light, the low structural stability of many tropical soils combined with the high erosivity of rainfall together increase the chances of serious soil degradation by field traffic. Compaction from field traffic may occur in virtually all types of crop production (Soane and Van Ouiverkerk, 1981).

It modifies the pore volume and pore structure of the soil with changes in void ratio, total porosity, specific volume and dry bulk density. Changes in bulk volumetric properties may not be as important to plant growth as the associated increased strength and reduction of conductivity, permeability and diffusivity of water and air through the soil pore system (Soane 1985; Boone et al., 1987; Guerif, 1988).

The soil properties to measure in compaction studies must be chosen by the researcher. The properties must strongly influence the way in which the soil responds to applied loads and the likely importance of the measured changes in subsequent crop growth. Bulk density had found application for comparing growth of different varieties of crops (Hakansson, 1973, Raghavan et al., 1976) and for the comparison of the compacting effects of different wheel treatments over a range of soil types (Ljungara, 1977; Lamers, et al., 1986). Changes in pore size distribution during compaction are important particularly with respect to large air-filled pores. Porosity and void ratio changes in a wide range of agricultural soils resulting from an applied mechanical stress have been reported by Larson et al. (1980) and Voinvail and Flocker (1991). Compaction reduces the diameter and continuity of pores and thus reduces the permeability and diffusion of gases and liquids in the soil (Grable, 1971; Ball, 1979). The cone resistance that measures soil strength is an important parameter affected by compaction. Compaction increases soil strength which not only increases soil cutting forces and energy required but will also impede the growth of plant roots. (Mckyes, 1985; Taylor et al., 1981).

All these soil properties mentioned above are usually affected by both soil type and soil moisture content (Mulqueen, et al., 1980).

It is widely though that second subsequent passes of a wheel produce less compaction than that caused by the first pass. This depends on the initial soil strength and its distribution with depth (Soane et al., 1981).

Modern systems of crop production are tending to increase both the number of passes and the loads carried on the wheels of agricultural vehicles especially in seed bed preparation, spraying and harvesting operations (Soane et al., 1982). During fertilizer distribution, secondary cultivation and sowing, soil strength is generally low as a result of the loosening during primary cultivation and the soil is usually moist making tractor to cause appreciable compaction Ljungars (1977) found that the soil moisture content and the number of wheel passes were the factors primarily responsible for the compaction resulting from seedbed traffic.

Compaction by wheel traffic was found by Raghavan et al. (1979) to delay germination and early growth of maize silage. Root distribution of maize has been found to be closely associated with both the number of passes and the contact pressure of types running over the soil either before or after seedling (Raghavan and Mckyes, 1978).

II. LITERATURE REVIEW

There has been conflicting records of yield response to vehicular traffic. Chancellor (1976; Jaggard (1975) found a decrease in yield of wheat, sorghum, and maize when heavy traffic was used prior to or during seedbed operations. While Eriksson et al. (1974) and Dvortear, Polyak (1979) reported increase and decrease in yield respectively due to wheel traffic, most research depend to a considerable extent on the soil water status at the time of the traffic. Recent work on grains have shown exponential decrease in yield with increase number of tractor wheel passes (Canarache et al., 1988; Osuji 1988; Ohu, 1991). In non-cereal crops, the passage of tractor wheel in ridges, as with potatoes, carrots and sugar beat may cause reduction in root and tuber growth (Campbell, 1980). These non-cereal crops are generally more sensitive to compaction than those of cereals. However, as with cereals soil water status influence their response. Wheel traffic effects on vegetable crops (Vomocil, Flocker, 1965), ornamental bulbs (De Faan and Vender Valk, 1970) and fore species (Greacen and Sands 1980) have been reported with yield reduction. The effects of wheel traffic upon soil properties are predictable but the crop response is variable. However, despite the large amount of reported work on the effect of wheel traffic on cereal and non cereal crops, none has been reported on egusi-melon except for those of tillage induced compaction on the crop (Asoegwu, 1987).

Many researches have used several numbers of wheel passes in their works. Bonsu (1991) used 0,2,8 and 14 passes, Osuji (1988) used 0, 2,5, 10 and 15 passes and Ragharan et al. (1976) used 1, 5, 10 and 15 passes, Canarache et al. (1988) used 0,1,3,5, 10 , 20 and 30 passes and Daniel et al. (1988) used 0, 1,3,5 and 10 passes. In view of the fact that mechanization sequence is different in South Eastern Nigeria, 0, 1,5 and 10 passes of the tractor wheel were used in this work.

III. FIELD PREPARATION/ METHODOLOGY

A piece of land at Umunahu, Uratta in Owerri was manually cleared using cutlass and piled. The soil was leveled by the use of rake and measured in three blocks of four plots each. The field measured 15x 51m^2. The field was divided into three blocks, leaving a head land of 3m wide between blocks. Each plot measured 1x10m^2. A4 – cylinder Steyr 768 tractor having two rear tires inflation pressure of 40 Psi with a weight of 35.5KN and tire size of 16.9/14-30 (6 ply rating) and this very tractor was to make passes on the field leaving a portion as control. The number of passes were 0, 1,5 and 10 replicated three times and the mean value recorded.

CULTURAL OPERATION OF THE SOIL

Seed beds were prepared and egusi-melon (colocynthus citrullus L.) seeds were planted three per hole of about 2cm diameter and 3cm deep. These holes were dug using ordinary sticks. The displaced soil was used to cover the seeds. These seeds were planted at different passes of 0,1,5, and 10 and were observed after 1, 3,6 and 9 weeks for seedling emergence. At harvest the fruits were weighed and after a week the fruits were broken and the seeds washed and dried and weighed and result recorded.

SEEDLING EMERGENCE

After planting the egusi-melon seeds, the seedling emergence was observed after 1 week, 3 weeks. This was noticed by taking into account the number of seeds planted and the number germinated per plot. This is normally expressed in percentages.

This was determined by observing the total number of germinated per plot after 1 week.

For 20 seeds planted, if 18 germinated after 1 week for 5 passes;

$$\% \text{ seedling emergency} = \frac{18}{20} \times \frac{100}{1} = 90\%$$

IV. RESULTS AND DISCUSSION

B11	100%	B21	100%	B31	0%	
B12	100%	B22	0%	B32	80%	51m
B13	80%	B23	90%	B33	90%	
B14	5%	B24	80%	B34	90%	

Table 1: Seedling emergence (After 1 week)

The results obtained from this experiment were represented in tables as shown above.

RELATIONSHIPS BETWEEN SEEDLING EMERGENCE AND WHEEL TRAFFIC

- ✓ *SEEDLING EMERGENCE:* The percentage seedling emergence was calculated after one week of planting the egusi-melon seeds on the treated plots.

From Table 2, the percentage seedling emergence decreased with increased traffic intensity. This is because compaction increases the soil strength and the cutting force therefore impending seedling emergence. The percentage seedling emergence was maximum(93.33%) in the 0 pass treatment and lowest (1.67%) in the 10 passes treatment. This result is similar to those of Dvorster and Polyak (1979) and Asoegwu (1987) and deviated slightly from those of Chancellor (1976) and Jagagrd (1975). The deviation is attributable to the extent of soil water status at the time of the traffic.

TRACTOR DENSITY

Number of tractor passes	0	1	5	10
Seedling Emergence	93.33%	96.67%	80%	1.67%

Table 2: Effect of traffic density on seedling emergence (after 1 week)

The conflicting records were mainly on cereals which are not so sensitive to compaction as against non-cereals (egusi-melon). Soil water status at the time of compaction must have been responsible for these differences.

Tractor Passes	No of Fruits Per Plot	Average No of Fruits per Plot	Weight of Fruits Per Plot (kg)	Weight of dry Seeds (kg)	Average Wt of Dry Seeds Per Plot (kg)
0	20,18,18	19	10.20	0.16	0.16

	(56)		0.3 (9) 8.50	0.16 0.17	
1	17,20, 16 (53)	18	8.82 9.90 (9.10) 8.56	0.15 0.15 0.12	0.14
5	10,10,9	10	5.35 5.90 (5.60) 5.40	0.10 0.10 0.11	0.10
10	3,5,7 (15)	5	3.02 3.83 2.94 (3.30)	0.10 0.10 0.10	0.10

Table 3: Yield

SIZES OF FRUITS AND YIELD

We found out that fruit sizes control seed yield and both are governed by compaction. Deviation observed in 5 and 10 passes treatment could be as a result of soil water status at the time of compaction.

m 2.4m | 2m

0 Pass	1 Pass	10 Pass	
1 Pass	10 Pass	5 Pass	
5 Pass	0 Pass	1 Pass	
10 Pass	5 Pass	0 Pass	
10.3m			

51m

Table 4: Layout of the experimental plots

	0	1	5	10
SIZE A	27	28	13	1
SIZE B	25	16	12	6
SIZE C	10	9	8	8
TOTAL	62	53	33	15

Key:
Size A=S1 greater than 14
Size B=11 less than S2 greater than 14
Size C= S3 less than11cm

Table 5: Effect of traffic intensity on sizes of fruits

V. CONCLUSION

From the results so far got, it is found out that soil compaction as a result of farm vehicular traffic affects soil physical properties, seedling emergence, root development and yield of egusi-melon (Collocynthus citrilus L.)

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