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EFFECT OF SPENT ENGINE OIL ON GERMINATION AND GROWTH PARAMETERS OF FLUTED PUMPKIN (*Telfairia occidentalis* Hook F.) IN MAKURDI, BENUE STATE, NIGERIA

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ABSTRACT

This study investigated the effects of spent engine oil on the germination and growth parameters of fluted pumpkin (Telfairia occidentalis). Fluted pumpkin was grown on soils contaminated with 20ml, 40ml, 60ml, 80ml and 100ml of spent engine oil to obtain 1, 2, 3, 4 and 5% contaminations respectively and monitored for eight (8) weeks after planting. The number of leaves, leaf area and plant height were determined weekly while the dry matter content was evaluated at the end of eighth week. Results showed that the mean leaf number, leaf area and plant heights of fluted pumpkin decreased with increasing level of contamination with spent engine oil. The highest mean leaf number which is 15.41 was recorded for the control. Plant height, number of leaves, leaf area and dry matter of T. occidentalis in the control plots (0%) differed significantly ($P \leq 0.05$) from those planted in 4 and 5% levels of the spent oil contaminated soils. The reductions in these growth characteristics measured were spent engine oil concentration dependent. Besides these quantitative parameters, growth retardation and yellowish leaf coloration were observed among the plants grown in the spent oil contaminated soils. Spent engine oil therefore had pronounced effects on the germination and growth of fluted pumpkin as revealed by this study. Therefore, fluted pumpkin should not be grown near or on soil contaminated with spent engine oil.

Keywords: Fluted pumpkin, Germination, Growth, Spent engine oil

INTRODUCTION

Spent engine oil refers to used motor oil collected from mechanical/automobile, workshops, garages, and industrial sources like hydraulics oil, turbine oils, process oil and metal working fluids (Olugboji and Ogunwole, 2008). Spent engine oil is a mixture of several different chemicals (Wang *et al*., 2000), including low and high molecular weight (C15-C20) aliphatic hydrocarbons, aromatic hydrocarbons, polychlorinated biphenyls, lubricative additives, chlorodibenzofurans, decomposition products, heavy metal contaminants such as aluminum, chromium, tin, lead, manganese, nickel, and silicon that come from engine parts as they wear down (ATSDR, 1997). It gets to the environment due to discharge by motor and generator mechanics (Odjegba and Sadiq, 2002) and from the exhaust system during engine use and due to engine leaks (Anoliefo and Edegai, 2000; Osubor and Anoliefo, 2003). The disposal of spent oil into open vacant plots and farms, gutters and water drains is an environmental risk (Odjegba and Sadiq, 2002) since it is liquid, it easily leaches into the environment and eventually pollutes either water or soil (Olugboji and Ogunwole, 2008).

Although some heavy metals at low concentrations are essential micronutrients for plants, but at high concentrations they may cause metabolic disorders and become growth inhibitors for most of the plant species (Fernandes and Henriques, 1991). Anoliefo and Vwioko (1995) reported that the contamination of soil with spent engine oil caused growth retardation in plants, with the effect more adverse for tomato (*Lycopersicom esculentum*) than pepper (*Capsicum annum* L.).

Fluted pumpkin (*Telfairia occidentalis* Hook F.), the test plant is a vegetative crop belonging to the family Cucurbitaceae, native to West Africa but occurs mostly in its cultivated form in various parts of southern Nigeria (Odoemena, 1991). It is obvious that plants are known to respond differently to their environment right from germination and at their different stages of growth, therefore it becomes necessary to study what the effect of disposal of spent oil into the environment will have on the growth and performance of crops with time. In view of the above, this research was therefore carried out to evaluate the effects of different levels of spent oil on growth parameters like height, number of leaves, leaf area and its effects on fresh weight, dry weight and leaf composition using Fluted pumpkin (*Telfairia occidentalis* Hook F.) as the test plant.

MATERIALS AND METHODS

Study Area with Geo-Reference

This study was carried out along J.S.Tarka way (Barracks Road) in Makurdi Local Government Area of Benue State, Nigeria on the elevation of 94m above sea level and located on latitude N 07^{o} 44′ 02.2″ of the equator and longitude E 008^{o} 31′ 21.9″ of the meridian using Garmin GPS map 76Cx geographical positioning device.

Sample Collection

The garden soil used in the study was collected from an open farm land opposite cabinet office, Barracks Road, Makurdi. The spent engine oil was obtained from a road side motor mechanic. Viable seeds of *Telfaira Occidentalis* were bought from Railway market located within Makurdi metropolis. The pulp containing the seeds was extracted from the fruit pods by hand and the seeds removed while the extracted seeds were air-dried for a day prior to planting.

Experimental Design and Planting of Seeds

The design of the experiment was a completely randomized design (CRD) with six replications for each treatment. The contamination of soil samples with the spent oil was done by thoroughly mixing the soil with different levels of spent engine oil in their respective plastic buckets. Soil of 2kg in each of the plastic buckets was treated with 20ml, 40ml, 60ml, 80ml and 100ml of spent oil to obtain 1, 2, 3, 4 and 5% spent oil contaminations respectively. Each treatment including the control (0%) was replicated six times and four (4) viable fluted pumpkin seeds were planted in each bucket, laid out in the field and watered. Seeds that germinated from each treatment were added cumulatively for fourteen days and the percentage germination in each treatment was calculated as:

$$\textit{Percentage}\ (\%) \textit{Germination} = \frac{No.\,of\ germinated\ seeds}{No.\,of\ seed\ sown} \times 100$$

Measurement of Growth Parameters

Growth parameters determined were plant height, number of leaves and leaf area, plant fresh weight and dry weight. A simple non-destructive technique adapted from Wood and Roper (2000) was employed to collect some growth parameters (Plant height and number of leaves). Plant height (Shoot length) was determined by measuring the plant from soil level up to the tip of the plant using meter rule. Leaf numbers were manually counted while leaf area was determined following the procedure of Agbogidi and Eshegbeyi (2006). The total leaf area per plant was then obtained by multiplying the averaged result by the number of leaves of the corresponding treatment. Fresh and dry weights were determined at eight (8) weeks after planting using a digital metaler balance. Dry weight was determined by oven drying at 150°C for five hours (5hrs) to a constant weight. The moisture content was determined by subtracting the dry weight from the fresh weight.

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) to analyze growth parameters assessed. The significant treatment means were separated using Least Significance Difference (LSD) at $\alpha \leq 0.05$ level.

RESULTS

Effect of Spent Engine Oil on Emergence / Germination

The emergence/germination of pumpkin seeds in soil treated with different levels of spent engine oil is presented in figure 1 as it was observed that the control had 100% germination while the 1% (20ml), 2 % (40ml), 3% (60ml), 4%(80ml) and 5%(100ml) had 83.33%, 75%, 62.5%, 41.67% and 8.33% germination, respectively. The control (0%), 1% and 2% treatments revealed that more that 50% of the seeds emerged within seven days. The 5% polluted soil had delayed emergence till the eighteenth day after planting. Significant reductions were observed in the germination percentage of *T. occidentalis* seeds sown in high spent oil level of contaminated soils when compared with seeds grown in the control (fig. 2). Days of germination were also delayed in groups with high level of contamination as it took seeds in the control pots eight (8) days to start germinating while seeds that were subjected to 5% of the spent oil took eighteen (18) days after planting for the first seed to sprout. Similarly, all the *T. occidentalis* seeds planted in the control germinated but the number significantly reduced with increasing oil level in the other contaminated groups. Only two of the seeds that were sown in 5% of spent oil contaminated soil germinated while the rest decayed. Germination count carried out for thirteen days revealed that percentage germination decreases with increased levels of contaminant. The control treatment had the highest percentage germination (100%).

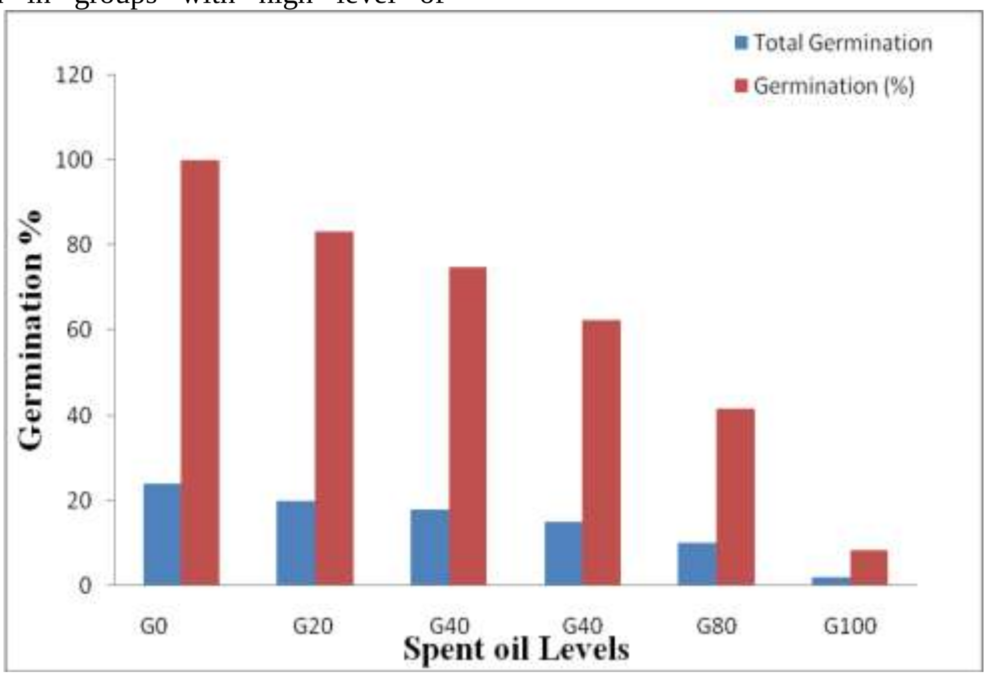

Fig.1. Emergence of pumpkin seeds in soil treated with different levels of spent oil.

Effect of Spent Engine Oil on Seedling Growth of *T. occidentalis*

Effect on Number of Leaves

The highest mean number of leaves of *T. occidentalis* was obtained from the control treatment (15.41) and this was statistically ($p \leq 0.05$) different from that obtained in soil polluted with 80ml and 100ml of spent engine oil (5.89 and 0.83) (Table 1). Significant marked reduction in leaves production was observed in *T. occidentalis* grown in soil polluted with 100 ml compared to other treatments.

Table 1: Mean Number of leaves of *Telfaira occidentalis* grown in spent oil contaminated soil.

Spent oil Levels (%)	Average Number of leaves Weeks after Planting (wap)						Mean
	2	3	4	5	6	7	
G_0	5.50^a	11.80^a	14.50^a	17.50^a	20.00^a	23.17^a	15.41
G_{20}	5.00^a	10.67^a	13.67^a	15.17^a	17.17^a	18.00^a	13.28
G_{40}	3.33^a	10.33^a	13.67^a	15.50^a	17.33^a	19.83^a	13.33
G_{60}	3.50^b	10.67^b	13.00^b	15.00^b	17.83^b	18.00^b	13.33
G_{80}	1.00^c	3.50^c	7.17^c	7.83^c	7.17^c	8.67^c	5.89
G_{100}	0^d	0^d	0.33^d	1.83^d	1.17^d	1.67^d	0.83

Means with different alphabets within the same column are significantly different at $P \leq 0.05$ using the Least Significance different tests (LSD).

Effect on Plant Height

Mean plant height decreased significantly with an increase in the levels of spent engine oil (Table 2). The mean height of the control of *T. occidentalis* (48.75 cm) at eight weeks after planting (8WAP) was significantly greater than that of plants grown in soil polluted with 60ml (3%), 80ml (4%) and 100 ml (5%) of spent engine oil (44.33.12.71 and 0.96 cm. respectively) at $p \leq 0.05$. However, no significant mean plant height difference was found between the control and soil polluted with 20ml and 40ml (44.77 and 47.67 cm) (Table 2).Within the polluted soil, significant differences in plant height were not found with respect to *T. occidentalis* grown in soil polluted with 20 and 40ml of spent engine oil but was noticed in 60, 80 and 100ml contaminated soils. As observed in this study plant height of *T. occidentalis* in soil polluted with 80 and100 ml of spent engine oil was highly affected when compared to other treatments studied.

Table 2: Mean Plant height of *Telfaira occidentalis* grown in spent oil contaminated soil

Spent Oil Levels (%)	Average Plant height (cm)Weeks after Planting (wap)						Means
	2	3	4	5	6	7	
G_0	10.17^a	42.25^a	57.42^a	59.67^a	61.54^a	61.50^a	48.75
G_{20}	8.33^a	33.70^a	54.67^a	57.08^a	57.33^a	57.50^a	44.77
G_{40}	3.67^a	31.42^a	52.75^a	65.67^a	66.17^a	66.33^a	47.67
G_{60}	4.00^b	32.37^b	52.50^b	58.75^b	59.17^b	59.17^b	44.33
G_{80}	1.17^c	7.58^c	14.33^c	17.67^c	18.00^c	18.00^c	12.71
G_{100}	0^d	0^d	0.17^d	1.75^d	1.33^d	2.50^d	0.96

Means with different alphabets within the same column are significantly different at $P \leq 0.05$ using the Least Significance different tests (LSD).

Effect on Leaf Area

The mean leaf areas analyzed showed clear decline with increase in level of spent engine oil applied (Table 3). The mean leaf area of the control plants (46.31 cm^2) was greater than that of plants grown in 20ml (1%), 40ml (2%), 60ml (3%), 80ml (4%) and 100 ml (5%) of spent engine oil (43.87, 39.93, 35.30, 12.00 and 1.47 cm^2, respectively) though there was no significant difference in the leaf area of 20ml (1%) and 40ml (2%). Among the polluted soil, mean leaf area of plants grown in 60ml, 80ml and 100ml of spent engine oil differed significantly compared to other treatment studied (Table 3) . When compared with other polluted plants assessed, plants with the highest level (100ml) of spent engine showed the least mean leaf area development. It was also observed that the leaves of the plants grown in 80ml (4%) and 100ml (5%) polluted soil had smooth and shiny surfaces when compared with plants grown on the other polluted soils (0ml, 20ml 40ml and 60ml).

Table 3: Mean Leaf area of *Telfaira occidentalis* grown in spent oil contaminated soil

Spent oil Levels (%)	Average Leaf Area (cm^2) Weeks after Planting (wap)						Means
	2	3	4	5	6	7	
G_{0}	11.04^{a}	38.60^{a}	45.70^{a}	65.13^{a}	57.81^{a}	59.56^{a}	46.31
G_{20}	10.62^{a}	30.29^{a}	49.94^{a}	63.40^{a}	51.54^{a}	57.43^{a}	43.87
G_{40}	3.72^{a}	28.56^{a}	53.12^{a}	55.03^{a}	46.94^{a}	52.19^{a}	39.93
G_{60}	6.23^{b}	24.46^{b}	44.31^{b}	47.05^{b}	45.94^{b}	43.82^{b}	35.30
G_{80}	4.61^{c}	6.74^{c}	14.88^{c}	12.36^{c}	16.72^{c}	16.69^{c}	12.00
G_{100}	0^{d}	0^{d}	0.13^{d}	2.25^{d}	2.06^{d}	4.38^{d}	1.47

Means with different alphabets within the same column are significantly different at $P \leq 0.05$ using the Least Significance different tests (LSD).

Percentage Dry Matter

The dry matter of *T. occidentalis* in soil treated with different levels of spent engine oil is shown in figure 2. There was no difference between the dry matter and moisture content of the control, 1% (20ml), 2% (40ml) and 3% (60ml) spent oil treated soils though 40ml (2%) has the highest moisture content. However with the 4% (80ml) and 5% (100ml) treated soil, there was a significant reduction of the leaf dry matter and moisture content. Also observed in seedlings of *T. occidentalis* grown in oil treated soils mostly on those subjected to higher levels of spent oil contaminant were retardation in growth, leaf defoliation and yellowness of leaves.

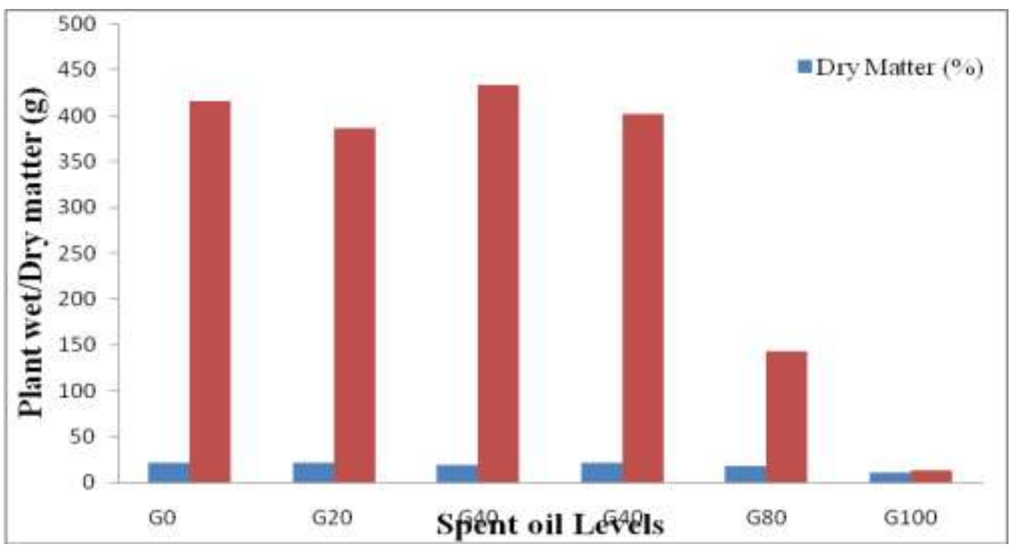

Fig. 2: The percentage dry matter and moisture content of *T. occidentalis* on soil treated with different level of spent engine oil.

DISCUSSION

The observed reduction in the germination percentage, days to emergency/germination, rate of germination as well as, the growth parameters (plant height, number of leaves and leaf area) measured could be attributed to the numerous hydrocarbons, related compounds and chemical additives present in spent engine oil which are toxic to soil environment and biological organisms that affected emergence and growth performance of *T. occidentalis*. The herbicidal and phytotoxic properties of spent engine oil to organisms have been reported by Vwioko and Fashemi (2005). Due to the toxic nature of spent engine oil, the embryo of fluted pumpkin seeds could have been injured or killed as it gets in contact with the oil and this finding is in line with reports presented by Anoliefo and Vwioko (2001), Siddiqui and Adams (2002) and Sharafi *et al.* (2007). Equally, these findings were in line with the result of the research conducted by Anoliefo and Vwioko (1995) that contamination of soil with 4 and 5% spent oil consistently inhibited germination of hot pepper and tomatoes. The death and non-germination of *T. occidentalis* seeds planted in 4 and 5% level of oil agrees with the findings of Agbogidi and Ofuoku (2005) that the level of oil seemed to exert significant influences on plant species and agricultural lands.

It is obvious that oil in soil could have affected the biological oxygen demand (BOD) level, thereby interfering with normal gaseous exchange which is required for germination and growth performance of *T. occidentalis*. The failure of some of the seeds to germinate may be attributed to increase in soil temperature due to dark nature of contaminated soil. As visually observed in this study, polluted soils were darker than the control and dark soils are good absorbers of heat as light soil as stated by Olayinka and Arinde (2012). Also, Anoliefo and Edegbai (2000) observed that polluted soil with spent engine oil experienced what can be described as physiological drought in terms of disruption of plant water relation and root respiration that are necessary for growth and development. This is applicable to groups with higher level of spent oil contamination as observed.

The observed increase in the plants grown in the control soils could be seen as the unadulterated nature of the soil structure which allowed normal metabolic activities of the test plant. The reduction of the plant growth as observed in this study could be due to reduction of mineral element with increasing oil concentration in the soil as reported by Odjegba and Sadiq (2002). Reduction in growth might be interpreted as being due to general effects of the spent oil which may have shown up either in the distortion or reduction in the number of stomata per unit area of the leaf. This might have affected photosynthetic process and subsequently, the amount of photosynthetic products synthesized. Such growth reductions due to soil oil pollution have been reported by Anoliefo and Vwioko (2001).

Interference with the soil-water-relation as well as, nutrient immobilization and the presence of heavy metals could also be responsible for the observed reduction in plant parameters as seen in this study. The significant percentage differences observed in the fresh and dry weight accumulation of *T. occidentalis* could be attributed to the high oil level in soil and hence uptake of ions (water and salts) is carried out by the roots. The plants in control soils with their roots undisturbed could have absorbed enough nutrients when compared to the seedlings exposed to higher spent engine oil treatment. Agbogidi (2010) reported that a reduction in shoot growth is a direct resultant effect of engine oil pollution in the root growths as roots are input organs for the absorption and translocation of water and mineral nutrients. Reduced dry mass accumulation following spent oil application on garden soil had been reported by Agbogidi and Ejemeta (2005) and Agbogidi and Eshegbeyi (2006) where they noted that hydrocarbons from oil contaminated soils accumulate in the chloroplast of plant leaves. This makes the photosynthetic ability of the leaves become reduced, thereby affecting translocation in affected plants which might be due to obstruction of the xylem and phloem vessels consequently causing reduction in photosynthetic products and dry matter content of the entire plants. The observed leaf defoliation, yellowness of leaves, stunted growth was in line with the findings of Agbogidi and Illondu (2013) who researched on the effects of engine oil on the germination and seedling growth of *Moringa oleifera* where it was shown that soil contamination by spent engine oil has a highly significant effect of reducing the germination responses and subsequent performance including biomass production of *Moringa oleifera* seedlings.

Spent engine oil is inhibitory to plant growth and this could be attributed to large amount of hydrocarbons in used oil, including the highly toxic poly aromatic hydrocarbon (PAHs) as reported by Wang *et al*. (2000). These findings showed that spent engine oil inhibited plant growth as evidenced by reduction in plant height and the effect was oil level dependents. Also, they are in congruent with the data presented for *Glycine max*, *Vigna unguiculata* and *Zea mays* (Kayode *et al*., 2009). Equally, findings from this research work supported the data presented for *Chromolaena odorata* and *Arachis hypogaea* (Osubor and Anoliefor, 2003), where they reported an obvious reduction in leaf area at higher concentration of crude oil and spent lubricating oil, respectively.

In consideration of the above results, it is rational to state that spent engine oil at lower levels (1% and 2%) do not have much effects on *T. occidentalis*. However, above these levels, it was noted that the effect became paramount both on germination and performance of growth parameters. At 4 and 5% pollution level, there was reduction or delay in seed germination with some premature deaths of plants recorded.

CONCLUSION

Conclusively, this study has demonstrated that spent engine oil has a significant effect on germination and growth parameters of *T. occidentalis*. It should therefore be the concern of all and sundry to guard against spent oil pollution of our arable agricultural land in order to maintain our quest for sustainable agricultural productivity.

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