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Effect of Spent Lubricating Oil on Some Growth Parameters of Two Varieties (TGx1485 – ID and TGx1448 – 2E) of Soybeans, (*Glycine max* L. merril)

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Abstract

The effects of spent lubricating oil on the growth of two varieties of soybean (TG x 1485-ID; (V_1)) and (TG x 1448-2E; (V_2)) were investigated in the laboratory and greenhouse experiments. In all the plants treated with spent lubricating oil, germination was delayed when compared with the controls. Also results from growth parameters such as stem height/plant, number of leaves/plants, number of nodes/plants and number of branches/plant indicated that spent lubricating oil had some adverse effects on the growth of soybeans. However, V_1 seems to be more tolerant to contamination by spent lubricating oil in terms of growth indices than V_2, which suffered most. Generally, while V_2 produced a net higher dry pod weight/plant, V_1 produced less dry weight/plant. It was generally observed in the study that with increasing level of oil contamination, the toxicity of the oil was more pronounced.

Key Words: Spent lubricating oil, growth parameters, soybeans, and pollution.

Introduction

In Nigeria and several other African countries, spent lubricating oil is discharged into the environment without due consideration for the toxic effects it has on the life of animals and plants (Nwankwo, 1983, Osuji, 1994). These spent lubricating oils contain aliphatic compounds, monocyclic aromatics and heavy metals that are potentially hazardous to both animals and plant life (Moore and Ramamoothy, 1984; Forth, 1990). It has been shown that petroleum products inhibit photosynthesis in plants (Dallyn, 1953; Baker, 1970; Shramm, 1972, Mason, 1991).

In an earlier paper, Fadina and Annih (2000) reported that the levels of the minerals Ca, Mg, K, Zn, Cu, Fe, N, Cd and Mn decreased before planting and at harvest of two varieties (TGX 1485-ID and TGX 1448-2E) of soybean Glycine max L. MERRIL. planted in soils contaminated with spent lubricating oil.

These minerals are essential to the growth of higher plants (Epstein, 1992). Fadina and Annih (2000) also observed that percentage germination of the two varieties of soybean was delayed when planted in soils contaminated with spent lubricating oils.

In continuation of this study, we have investigated the effects of spent lubricating oils on some growth parameters (Stem height, number of branches, leaves and nodes) of the varieties TGX 1485-ID and TGX 1448-2E of soybean Glycine max L. MERRIL.

Materials and Methods

Sixty plastic pots filled with soil collected from the experimental farm of the University of Dschang, Cameroon were used for this study. The pots were separated into two groups of 30 pots and labeled A and B. pots in-group A were next separated into 3 groups and labeled A-1, A-2, and A-3. Similarly, pots in group B were separated into 3 groups and labeled b-1, B-2 and B-3. Pots labeled A-1 and B-1 were used as the control and were thus not contaminated with spent lubricating oil. Pots labeled A-2 and B-2 were each contaminated with 50ml of spent lubricating oil, while those labeled A-3 and B-3 was each contaminated with 100ml of spent lubricating oil. The spent lubricating oil used for this study was collected from motor mechanic workshops in 3 different locations in Dschang town. The oil was collected in 21cm diameter plastic pots.

Two seeds of the TGx1485 – ID variety of soybean (V_1) were planted in each of the pots in group A while two seeds of the TGx1448- 2E variety of soy bean (V_2) were planted in each of the pots in group B. The seeds were obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

At two-week intervals until maturity at twelve weeks, each plant was observed for stem height, number of leaves, number of nodes and number of branches. At the end of the experiment, the number of surviving plants was recorded. The measurements of stem height were obtained using a transparent 2-meter long ruler. The data generated from this study were subjected to a 2-way analysis of variance (ANOVA) (SAS, 1997) and the Duncan's Multiple Range Test (DMRT) (Duncan, 1959) for separation of means at a significance level of 95% ($P<0.05$).

Results

Stem Height

The results of the stem heights of soybean are as shown in Fig 1. Stem heights of both varieties of soybean plant in the control soil increased progressively from 2 weeks on planting to 12 weeks (i.e. maturity). Similarly, stem height of the 2 varieties of soybean planted in oil-contaminated soil also increased progressively but at a reduced rate compared to those of the control. Stem heights in V_2 were significantly higher ($p=0.05$) than stem heights in V_1 after 6 weeks on planting. At harvest, mean stem heights in V_1 were 55.35 ± 4.74 cm. 36.66 ± 4.25 cm, and 32.11 ± 4.70 cm for the control, 50ml and 100ml oil-contaminated soils respectively. Mean stem heights in V_2 were 72.86 ± 5.41 cm, 62.27 ± 3.40 cm, and 37.02 ± 5.14 cm for the control, 50ml and 100ml oil-contaminated soils respectively (Table 1).

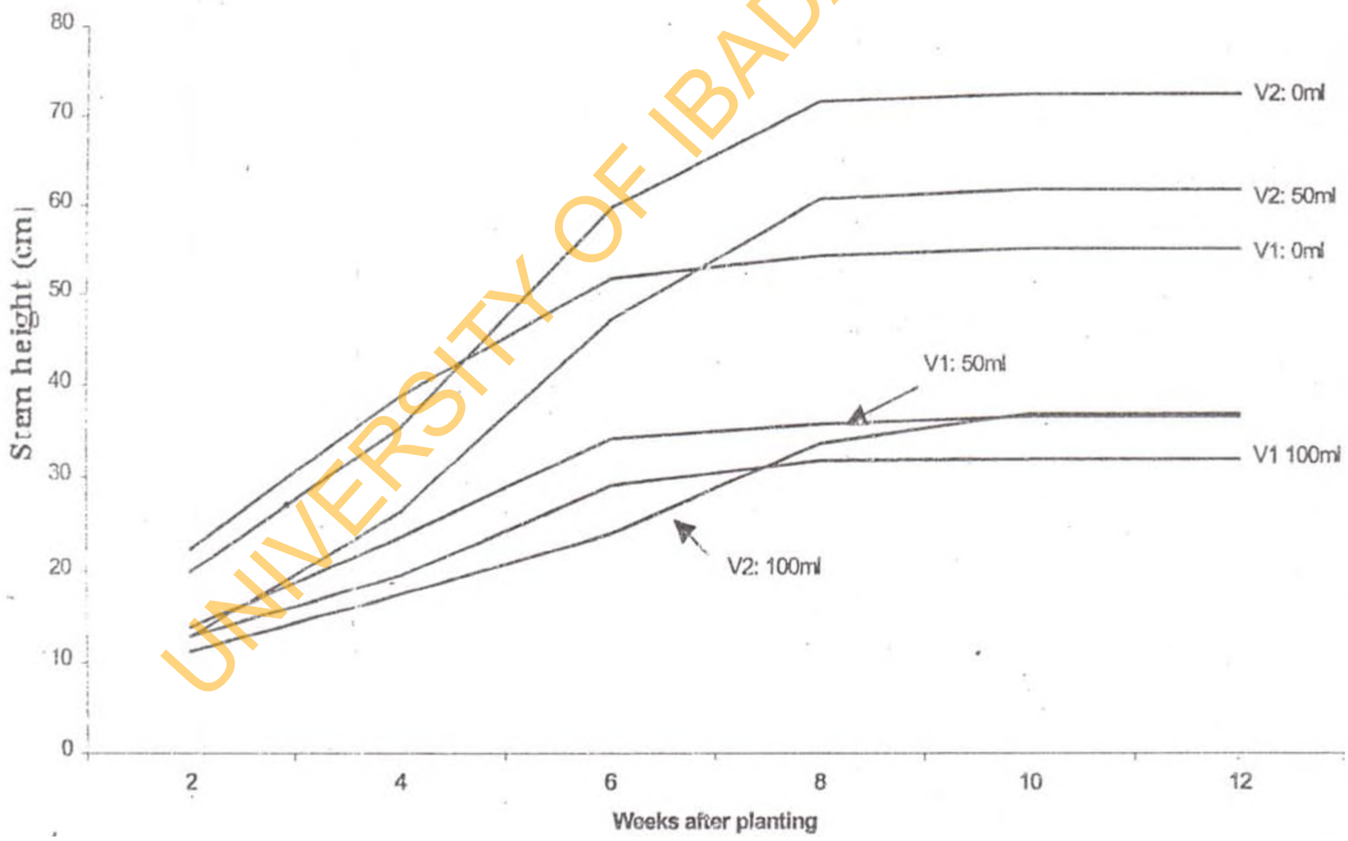

Figure 1: Stem height/plant (cm) of two varieties of soybean (V_1 & V_2) planted in control and oil - contaminated soils

Table 1: Mean plant characteristics at harvest of two varieties of soybeans (V_1 & V_2) grown on control and oil contaminated soils

Plant characteristics	Soybean variety	Oil contamination 0ml	50ml	100ml	Variety Grand mean
	V_1	55.35 ± 4.74	36.66 ± 4.25	32.11 ± 4.70	41.37±12.31$^{b@}$
Stem height (cm)	V_2	72.86 ± 5.41	62.27 ± 3.40	37.02 ± 5.14	57.38±18.41^{a}
	CL ** Grand mean	64.10 ± 12.38$^{a@}$	49.46 ± 18.10^{b}	34.56 ± 3.47^{c}	
	V_1	11.60 ± 3.04	10.40 ± 1.67	4.00 ± 1.58	8.66 ± 4.08
Number of leaves	V_2	18.40 ± 6.18	9.80 ± 3.49	7.40 ± 2.07	11.86 ± 5.78^{a}
	CL ** Grand mean	15.00 ± 4.80^{a}	10.10 ± 0.42^{b}	5.70 ± 2.40^{c}	
	V_1	33.20 ± 2.68	23.00 ± 2.54	11.80 ± 1.48	22.66 ± 10.70^{b}
Number of nodes	V_2	50.00 ± 3.74	33.20 ± 6.14	16.60 ± 3.71	33.26± 16.70^{a}
	CL ** Grand mean	41.60 ± 11.87^{a}	28.10 ± 7.21^{b}	14.20 ± 3.39^{c}	

- Oil contamination level (0ml = control; 50ml in soil; 100ml in soil)

** CL = Oil contamination level grand mean

@ Grand means on the same row or column with different superscripts are significantly different ($P<0.05$)

Number of Leaves

The results of the number of leaves per plant of soybean are as shown in Fig. 2. Leaf umber per plant of both varieties of soybean planted in the control soil increased progressively from 2 weeks to 10 weeks on planting but dropped at harvest. Similarly, leaf number per plant dropped at maturity on planting for both varieties in the 50ml and 100ml oil-contaminated soils. At 10 weeks on planting, the V_2 variety had a higher mean (29.0 ± 4.36) leaf number per plant in the 50ml oil-contaminated soil than the V_1 variety (20.0 ± 3.23). However, the mean number of leaves in 100ml oil-contaminated soil was higher in V_2 than in V_1 for the same period. Similarly, the V_2 variety of soybean had a higher mean number of leaves per plant than the V_1 variety during the same period. At harvest, the mean values for leaf number per plant for V_1 were: 11.00 ± 3.04, 10.40 ± 1.67 and 4.00 ± 1.58 in the control, 50ml and 100ml oil contaminated soils respectively. The mean values for V_2 were 18.40 ± 6.18, 9.80 ± 3.49 and 7.40 ± 2.07 in the control, 50ml and 100ml oil contaminated soils respectively (Table 1).

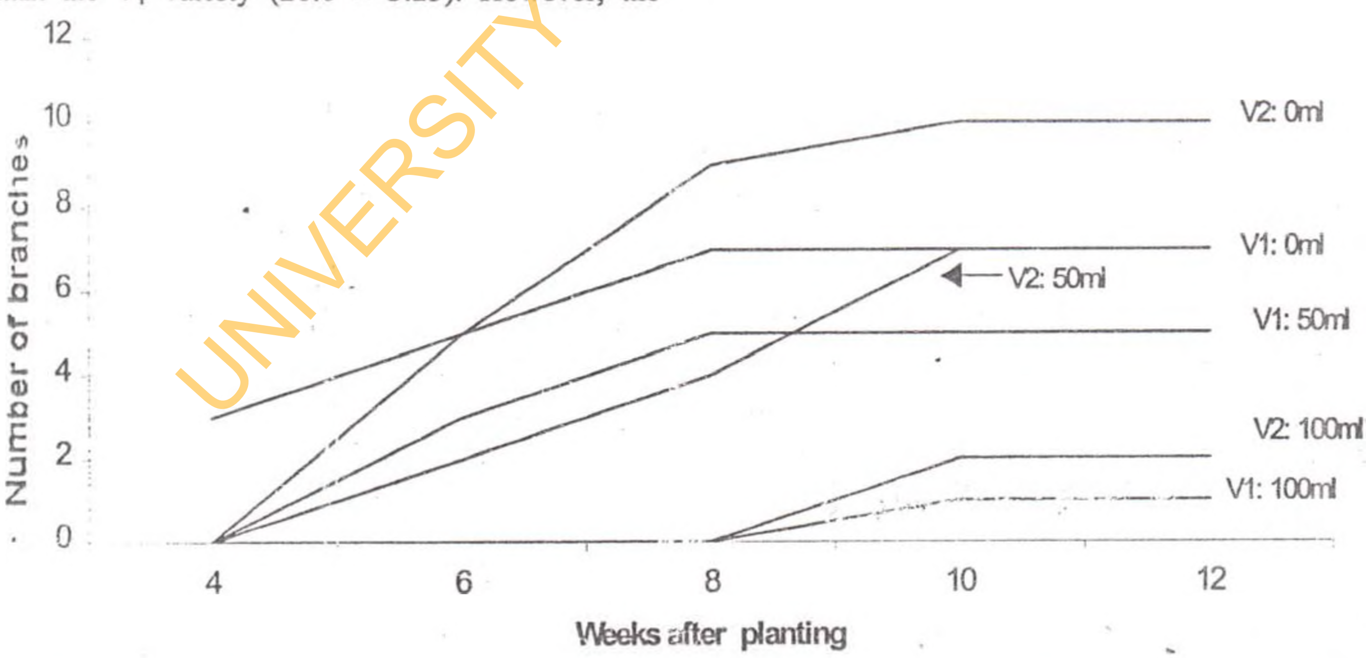

Figure 2: Number of branches/plant of two varieties of soybean (V_1 &V_2) planted in control and oil - contaminated soils

Number of Nodes

The results of the number of nodes per plant of soybean are as shown in Fig. 3. The number of nodes per plant of both varieties of soybean planted inn the control soil increased progressively from two weeks to maturity at 12 weeks on planting. Similarly, the number of nodes per plant of the two varieties of soybean planted in oil contaminated soils increased progressively but at a reduced rate compared to the control. At maturity, V_2 had a significantly higher mean number of nodes per plant (36.00 ± 1.58) in 50ml oil contaminated soil as compared to the corresponding value for V_1 (23.00 ± 2.83). The same trend was observed for the two varieties of soybean planted in 100ml oil contaminated soil. The mean values were 17.00 ± 2.13 and 12.00 ±0.33 for V_2 and V_1 respectively. The mean number of nodes obtained for V_1 were 33.20 ± 2.68, 23.00 ± 2.54 and 11.80 ± 1.48 for the control, 50ml and 100ml oil contaminated soils respectively. The values for V_2 were 50.00 ± 3.74, 33.20 ± 6.14 and 16.60 ± 3.71 for the control, 50ml and 100ml oil contaminated soils respectively (Table 1).

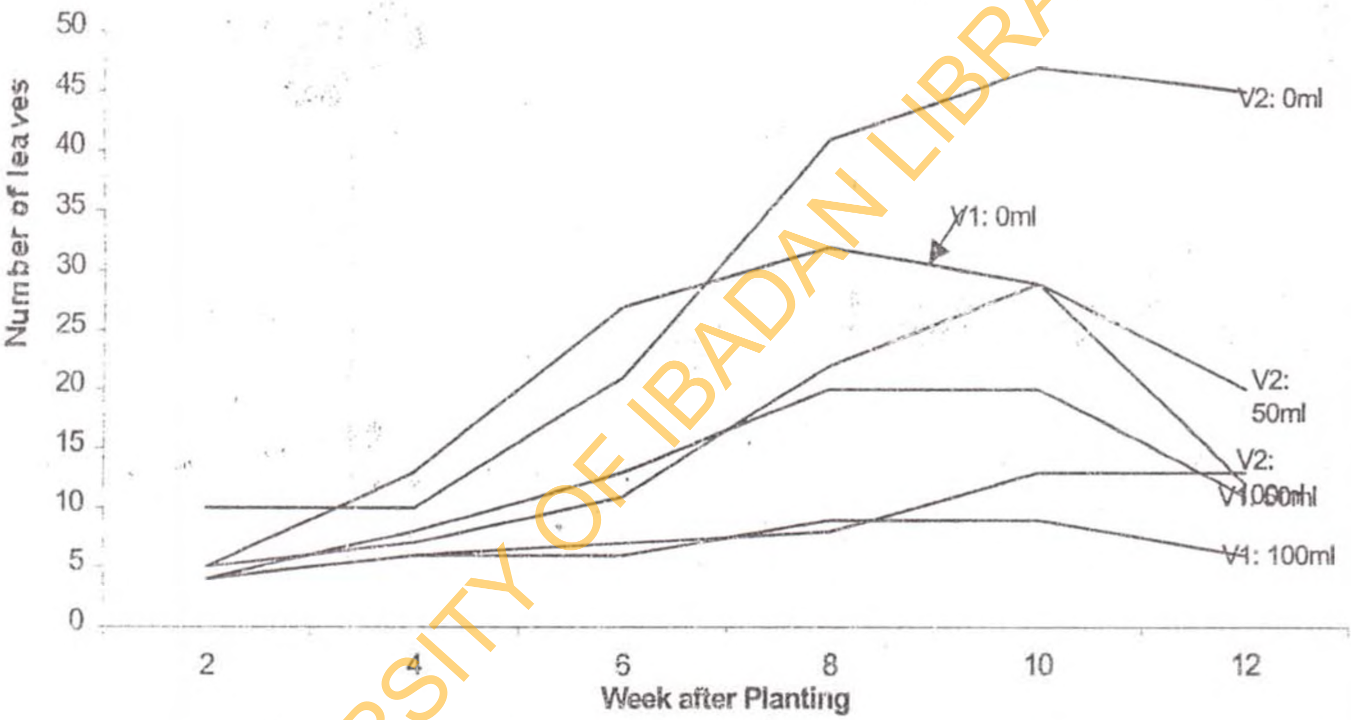

Figure 3: Number of leaves/plant of two varieties of soybean (V_1 &V_2) planted in control and oil - contaminated soils

Number of Branches

The results of the number of branches per plant of soybean are as shown in Fig. 4. While V_1 grown on control soil brought forth 3 branches per plant at 4 weeks after planting, no branches were produced in both 50ml and 100ml oil-contaminated soils. V_2 did not gives rise to any branch until 6 weeks after planting, even then 2 branches and nil branch were produced with 50ml and 100ml oil-contaminated soils respectively. Thereafter, more branches were produced with a peak of 7 and 10 and 5 and 7 at 10weeks with control and 50ml oil-contaminated soils in V_1 and V_2 respectively. Very few (maximum 2) branches were produced by the two varieties of soybean planted in 100ml oil-contaminated soils. In general, V_2 produced significantly more branches ($p<0.05$) than V_1 in both control and 50ml oil-contaminated soils, while V_2 appeared more affected than V_1 in respect of poor branching in 100ml oil-contaminated soils.

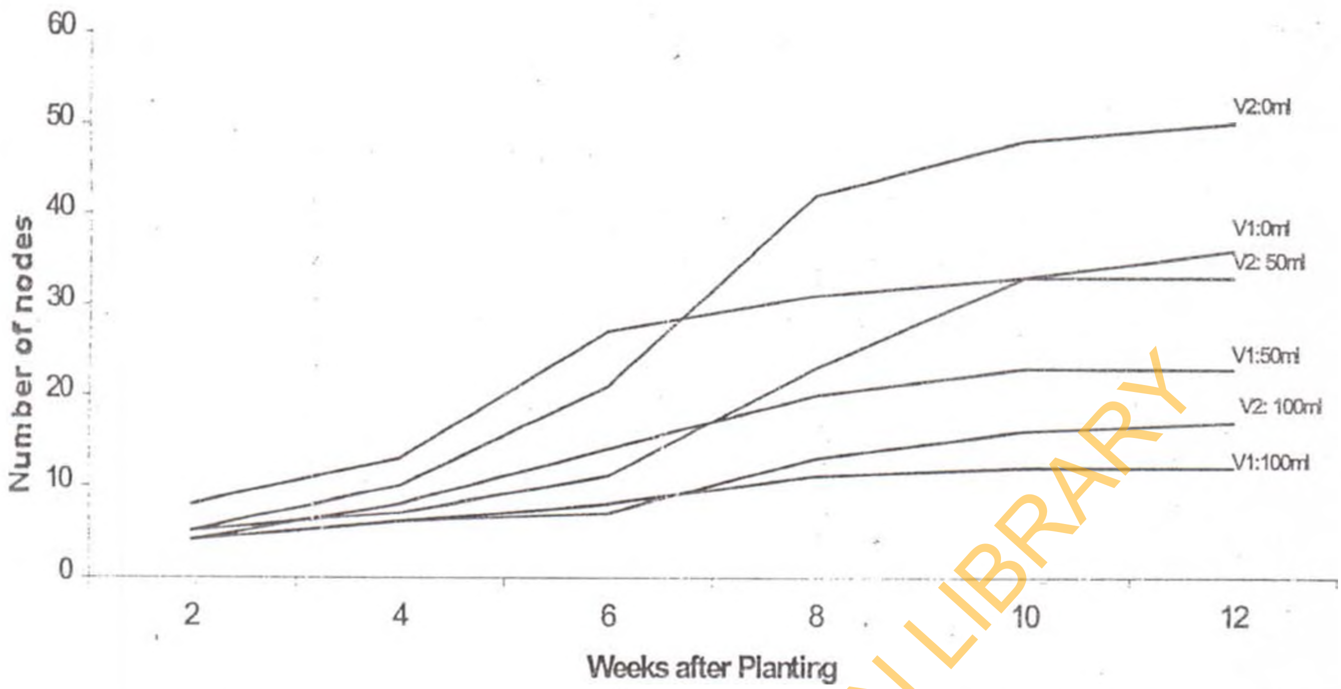

Figure 4: Number of nodes/plant of two varieties of soybean (V_1 &V_2) planted in control and oil - contaminated soils

Discussion

The results of this study revealed that all the growth parameters (stem height, number of leaves, number of nodes and number of branches) studied were higher in V_2 than V_1 when grown on uncontaminated soil. This may be due to genetic factors which were endowed on V_2 either by selection or by natural means as an advantage over V_1 which produced plants that were shorter in term of stem height gave rise to less number of leaves, nodes and branches.

Oil contamination of experimental soils, on the other hand caused variable decreases in these growth parameters in both varieties of soybean. Daniel (2002) reported that oil spill, has an impact on plant growth probably due to insufficient aeration of the soil. This agrees with the findings of Odjegba (2002) and Anoliefo(1995) who observed that spent engine (lubricating) oil had inhibitory effects on the growth parameters of *Amaranthus hybridus* L.,*Capsicum annum* and *Lycopersicom esculentum* respectively. The changes were more severely felt with increase in oil contamination levels in the experimental soils. However, V2 appeared to suffer more drastic reduction in the growth parameters than V1. This implies that V1 is more resistant to adverse effects of oil contamination than V2, which is a faster growing soybean variety than V1. Odu (1991, 1981) observed that light oil pollution caused leaves to become yellow and drop soon after thereby causing a reduction in leave number.

Oil contamination of experimental soils reduces drastically the percolation/retention of water. This is manifested as reduced miscibility of water in the soil hence availability to plants and enhanced loss through leaching (Annih, 1997). The net effect of these is the availability of water and dissolved nutrients to plants grown in oil-contaminated soils. Melachlan and Harty (1981) reported that reduced infiltration of water through sand (in beaches) containing oil may be caused by retardation of interstitial water flow owing to a decrease in pore spaces. Also Moore and Ramamoorthy (198/4) reported that the magnitude of effect depend on the volume of oil spilled, state of weathering, location of the soil of beach and the degree of admixture with soil. This study confirms the observation of Raymond (1977) that oil pollution has an effect on agriculture, especially on loss of national environmental quality by causing a yield loss of up to 100%

macro- and micro-flora and fauna, total elimination of animal life as well as benthic and littoral species. Results from the study indicated that indiscriminate dumping of spent lubricating oil has significant effects on the growth and yield of plants.

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