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HYDROCARBONS SPILLS AND THEIR EFFECTS ON GERMINATION AND GROWTH IN POLLUTED SOILS

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Abstract:-
The effects of hydrocarbons in plant germination and growth were investigated using specified plants (beans) and selected loamy soil from an area located nearby Tobruk city. A total of 12 pots having 2 viable. Beans seeds each; containing 10 kg of loamy soil were investigated. Pots were used as control experiment, 5 had hydrocarbons applied before planting seeds at levels of 100ml 150ml, 200ml, 250ml and 300ml and 5 had hydrocarbons applied in soil after germination of seeds. It was observed that seeds in the control pots had normal growth, where as in the hydrocarbons applied soil before planting, seeds had no germination and those in hydrocarbons applied soil after planting, the plants had stunted growth.

Keywords:-*Hydrocarbons, soil, pollution, concentration, beans, seeds, germination, growth.*

INTRODUCTION

Crude oil is usually transported to the refineries and this is the part that is of great disturbance because in the process of transportation a lot of spillage occurs - such as spillage from tankers, leakage from of shore wells, leakage from pipelines and trucks and even from underground storage tanks. After crude has being refined an amount of waste is produced and sometimes this waste is discharged into oceans which may flow to land, later causing pollution on farm lands. When pollution of land occurs (farmland) most times research is carried out on such land in other to know the level of damage caused so that compensation and treatment of the land can commence.

It is a complex and varied mixture of a number of hydrocarbons with small amounts of sulfur, nitrogen and oxygen. It is believed to be of organic origin, which occurs, naturally in the upper strata of the earth in various parts of the world. There are different types of crude oil and this is a function of the different amount of different hydrocarbons and other subolecules. Hydrocarbons especially from different field varies widely in physical and chemical properties. As mentioned, crude oils are essential mixtures of hydrocarbons, but not all hydrocarbons are present in every crude oil and in situations where the same hydrocarbons are present they are usually not present in the same proportion. This gives the basis for the formation of different types of crude. The character of crude oil is determined by the kind of hydrocarbons it contains and the proportions in which they are mixed. Nearly all crude are lighter (less dense) then water and flow quite readily, but some are heavy and do not flow freely. Crude from one field may be almost colorless; that form another black, but usually the color varies from light amber to light and dark green and brown. Small amounts of sulfur, nitrogen and oxygen are mixed with the hydrocarbons. Some crude have high sulfur content; those are called sour crude because of their odor. Those with low sulfur content are called sweet crude. The hydrocarbon molecules in petroleum vary in the number of hydrogen and carbon atoms and in the pattern in which the atoms are arranged. Those with a large number of carbon atom make up the thicker and heavier parts or fractions of crude oil such as asphalt. Other molecules with small number of atoms make up the lighter and more volatile fraction such as gasoline. With the knowledge that crude is found beneath the earth surface we may ask how one can access crude and this is done by drilling. After crude has been drilled, it has to be refined to suit human needs.

Pollution, whether it is acute (the result of one accidental spillage or intentional dumping) or chronic (arising from continuous or regular discharge) has deleterious effects upon the ecosphere. This is clearly borne out by the evidence accumulating from a number of previous work. [1] Demonstrated the penetration of crude oil through stomata into plants. Plants with heavy cuticles and few stomata permit little penetration of oils.[2] studied the penetration of refined petroleum into the tissues of plants and noted high penetration of emulsified oilsshowing that viscosity and surface tension influences the rate at which an oil will spread over and penetrate into a plant. After penetrating the surface of a leaf, the oil moves into the intercellular spaces. [3]; [4]; [5]; [6] and May then travel within the plant. This was later elaborated by [7] who classified injury into 3 categories:

1. Acute injury from volatile unsaturated compound.
2. Acute injury from volatile acidic compounds.
3. Chronic injury from high boiling unsaturated upon exposure to light and air.

This study is to determine the effect of oil pollution in plant growth of beans seeds in polluted soil.

Effect of Hydrocarbons on Soil

The effect of crude oil pollution in plant growth and germination seem to depend on the level of pollution and the period the oil has remained in the soil. If oil is sprayed on vegetation, it penetrates into the plant tissues, through the sensitive stomata, the thin cuticle and also through the epidermis. These penetrations are made possible by its transfer through the vascular system of the plant [8].According to [9], crude oil spillage on soil makes it unsatisfactory for plant growth. This is due to insufficient aeration of the soil because of displacement of air form the pore space between the soil particles by crude oil.

Similar reports have been made by [10] and [11]. [12] Reported that waste oil causes a breakdown of soil texture, followed by soil dispersion. It is obvious that a soil already contaminated with crude oil has deleterious effects as: killing of plant on contact, or retard the growth as well as inhibit germination and this is already established. This is due to the fact that it enhances the inhibition of activities of the soil micro-organisms by delimiting free water supply and aeration. Though crude oil may be toxic, [12] reported that crop growth could be stimulated by soil contaminated of the order of one percent. Similar results were also obtained in a simulated pollution study by [13] using different levels of crude oil.

Effect of Hydrocarbons on Plant

Seed germinations seem to be affected by oil at least in two ways. At high level of crude oil pollution, seed germination is prevented probably by oil soaking through the outer integument of the seeds. At low level of crude oil pollution, seed germination is retarded by the presence of oil [13]. This seems to be varied between different plant species in their ability to germinate in the presence of crude oil. The effect of crude oil on plant is one that is of great concern as it causes damage to different parts of the plant that are vital for its wellbeing and survival and hence obstructs development and growth.[14]showed that the leaves of plants affected by oil tended to dehydrate and show a general sign of chlorosis, indicating water deficiency.[12]observed that the volatile fraction of oil had a high wetting capacity and penetrating power and when in contact with seed, the oil would enter the seed coat and kill the embryo readily, which will in turn, cause reduction in percent germination.

From various experiments, it has been elucidated that crude oil spillage would affect plants in the following ways: Inhibit the germination of plants. Delay germination by inducing stress, which prolongs lag phase. Inhibit the uptake of water and nutrients by the root of the plant, hence causing deficiency to other parts as the leaves. Affects regeneration of stumps. Affects anatomical features of leaves. Causes cellular and stomatal abnormalities. Disruption of the plant water balance, which indirectly influences plant metabolism. Causes root stress, which reduces leaf growth via stomata conductance. Causes ‘chlorosis of leaves. And enlargement of cells in various tissues due to oxygen starvation were cells coalesce forming large cells in tissues.

Material and Methods

Soil Preparation

Sandy loam soil was collected from an area nearby Tobruk city, and weighed. Twelve (12) planting pots were used. Other materials were hydrocarbons, which was gotten from oil refinery, a cylinder and beaker for measurements. Soil samples were dried and broken into small particles. It was then sieved to remove stones and sand. An amount of soil weighed out into each planting pot.

Treatment

The experiment involved (3) different groups, each group containing loam soil. *Group* A was the control and contained absolutely no amount of hydrocarbons and consists of 2 planting pots. It was left under normal conditions of temperature, sunlight and water. *Group* B: a test group that contained (5) different planting pots, but with the soil treated with crude oil before planting, in increasing amounts of hydrocarbons in the different pots as follows:

1st Bucket: l00 ml of hydrocarbons
2nd Bucket: 150ml of hydrocarbons
3rd Bucket: 200ml of hydrocarbons
4th Bucket: 250ml of hydrocarbons
5th Bucket: 300ml of hydrocarbons

The third group. That is *Group* C had (5) buckets in which the soil was not treated before planting rather. Hydrocarbons were introduced into the bucket containing soil after planting and seeds had germinated. The hydrocarbons were introduced 2 weeks after planting in the manner described below:

1st Bucket: l00 ml of hydrocarbons
2nd Bucket: 150ml of hydrocarbons
3rd Bucket: 200ml of hydrocarbons
4th Bucket: 250ml of hydrocarbons
5th Bucket: 300ml of hydrocarbons

Hydrocarbons Application

Hydrocarbons application were done on separate days for the (2) different test groups. *Group* (B), which is treatment before planting, was done to commence the experiment. *Group*(C) which is treatment after germination was done 2 weeks after.

Effect on Plant Characteristics

Plant Height

Plant heights were measured weekly starting from a week after planting. For collection of height data, the plants were randomly tagged in each experiment until their heights were measured from ground level to tip of the terminal, bud, using a meter rule on the 1st and 2nd week after planting. The data that was collected (obtained) from the measurement were computed and the height of plant for each treatment was determined and recorded.

Leaf Area

Leaf length and leaf area index was taken on the 1st and 2nd week after planting.

Plant Girth

Stem and plant circumference were taken at the 1st and 2nd week after planting and this was done using a thread and meter rule.

Results and Discussion

Tables 1 and 2 present the procedure of experiments for the three Groups A, B and C. The germination period has been affected by the degree of pollution, whereas the control Group A and Group C germinated after 7 days of planting (Table 1), while the treated soil before planting for Group B exhibits different periods of germination as shown in Table 2. The plant in the high polluted soil (300ml) shows germination after 34 days while at 100ml the plant germinated after 9 days.

Table 1 Results of Group A and B

	Group A Control	Group B				
		100ml	150ml	200ml	250ml	300ml
Planting Date	1/2/2018	1/2/2018	1/2/2018	1/2/2018	1/2/2018	1/2/2018
Germination Date	8/2/2018	10/2/2018	18/2/2018	22/2/2018	26/2/2018	4/3/2018
Germination Period	7 days	9 days	17 days	21 days	27 days	34 days

Table 2 Results of Group A and C

	Group A Control	Group C				
		100ml	150ml	200ml	250ml	300ml
Planting Date	1/2/2018	1/2/2018	1/2/2018	1/2/2018	1/2/2018	1/2/2018
Germination Date	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018	8/2/2018
Period of germination	7 days	7 days	7 days	7 days	7 days	7 days

Effect on Germination

Group a - Control

All seeds germinated. Plant showed luxuriant leaves, sterns and growth was normal as shown in figures1 and 2.

Group B –

No seed germinated, the entire experiment had been concluded.

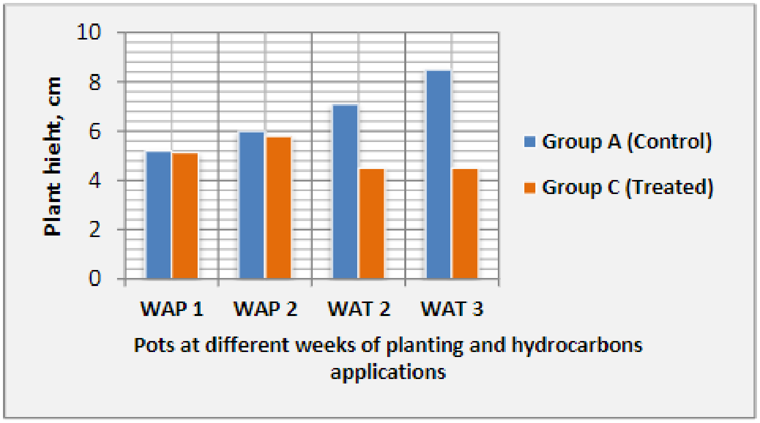

Figure 1: Comparison of plant height between control (Group A) and treated pots (Group C)

WAP = week after planting, WAT = week after treatment

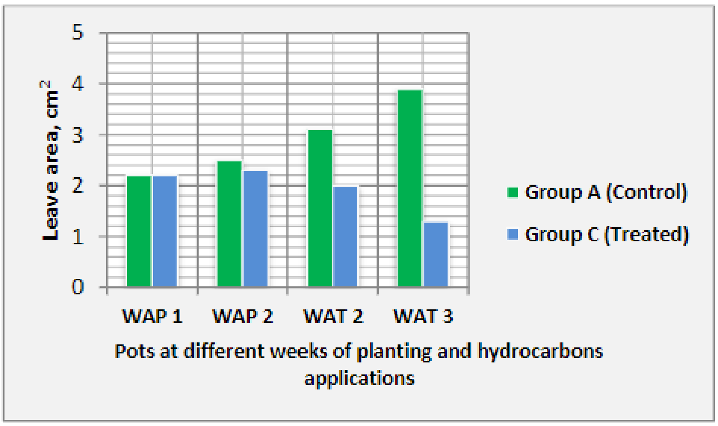

Figure 2: Comparison of leaf area between control (Group A) and treated pots (Group C)

WAP = week after planting, WAT = week after treatment

Group C

All seeds germinated but progressively deteriorated after application of crude oil showing signs of stress, wilting de-coloration and stunting as shown in figure 3 through 7.

Effect on Plant Characteristics

Plant Height:

There was a significant difference between the control (group A) and the treated plants in group C as shown in figure 1. This phenomenon was more visible during the 3rd and 4th weeks after planting, during which periods; crude oil had been introduced in the pots.

Leaf Area: There was a significant difference between the control (group A) and the treated plants in group C as shown in figure 2. Mean leaf area decreased during the period the plants were treated with hydrocarbons.

Plant Girth: The largest stem girth was in the control during the 3rd week of planting. There was a decline in girth size in the treated plants as the weeks increased.

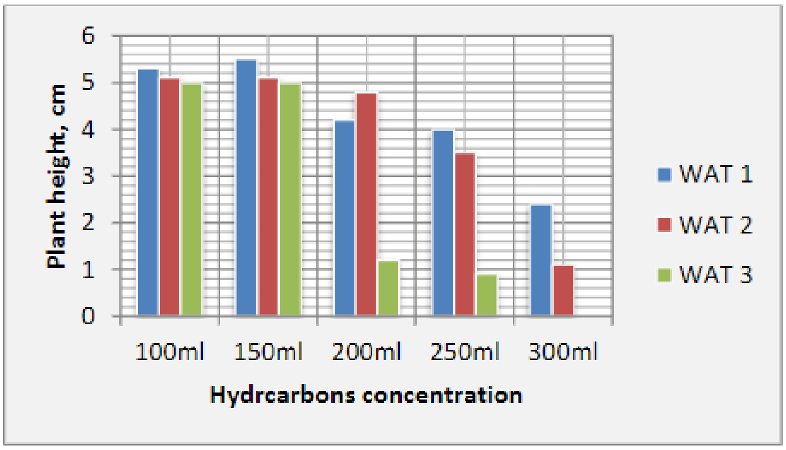

Figure 3: Comparison of plant height between different treated pots of Group C

WAT = week after treatment, PL = plant death

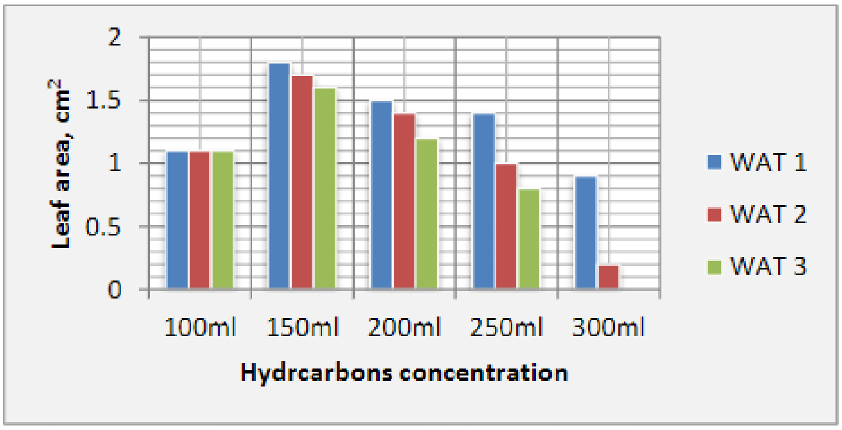

Figure 4: Comparison of leaf area between different treated pots of Group C

WAT = week after treatment, PL = plant death

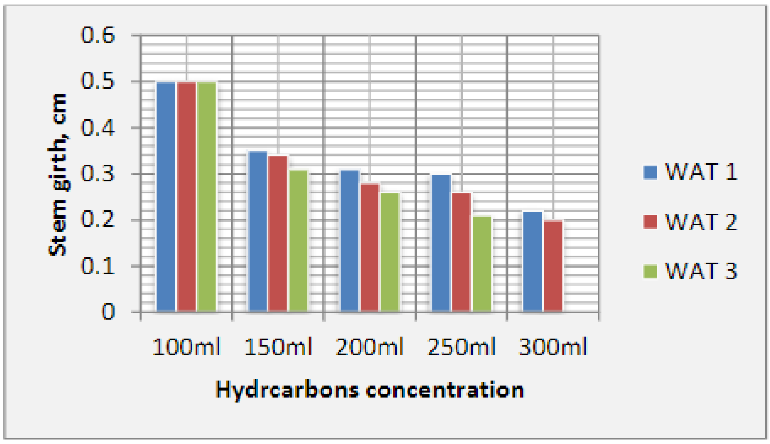

Figure 5: Comparison of stem girth between different treated pots of Group C

WAT = week after treatment, PL = plant death

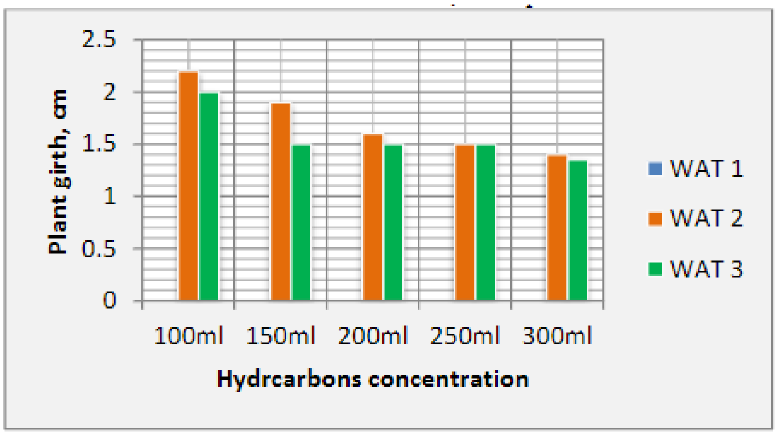

Figure 6: Comparison of plant girth between different treated pots of Group B

WAT = week after treatment, PL = plant death

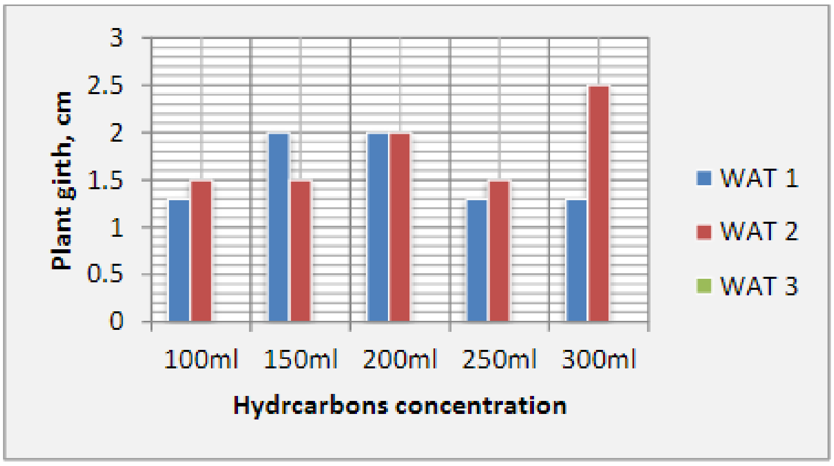

Figure 7: Comparison of plant girth between different treated pots of Group C

WAT = week after treatment, PL = plant death

The fact that germination is a process related to living cells and requires an expenditure of energy is well known. Energy expenditure in germinating seeds as in all living systems depends on the process of oxidation, which may require gaseous exchange. The taking in of oxygen and the release of carbon dioxide [14]. It is therefore, possible that the inhibition of germination of soil treated with crude oil (now containing oiled seeds) is partly due to the preclusion of this vital gaseous exchange by the oil film covering the seeds. Thus a delay in the inhibition of the required volume of water and an uneasy gaseous exchange together with an inadequate amount of the essentials reaching the seed may have caused the seeds not germinating. The total preclusion of water and oxygen from the seeds with thick oil coat would result in no germination (remaining dormant until the seed rot away). Another factor that may have contributed to the inhibitory effects of crude oil on germination is the increased microbial activity in treated soil, which may have further depleted available oxygen.

Conclusion

Application of l00ml and above amount of hydrocarbons soil inhibited germination. In plants that have already germinated the exposure of plants to crude oil at levels of l00ml and above had adverse effects on growth and development as it reduces stem circumferences, leaf length, leaf width and leaf area of the plant. The stem became thinner in size and most of the leaf became yellowish in colour compared with the control, which had no level of crude oil in it. Environmental pollution has been shown to have adverse effects on plant growth, especially hydrocarbons spillage. The effect of hydrocarbons will be determined by the concentration to which the particular plant is exposed to it, its persistence in the environment as well as the tolerance of the plant to hydrocarbons and its constituent. It is therefore recommended that concentration of hydrocarbons at levels of l00ml and above be avoided to have contact with farm lands and where this fails, immediate cleanup of affected areas be made, to avoid contamination of soil, as well as penetration and uptake of hydrocarbons into already growing plants.

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