Study the effects of salinity and crude oil on germination and seedling growth of barley and Green gram Seeds

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Abstract
The current study was conducted for determination the effect of salinity and oil pollution plants growth under Iraqi environmental conditions. Barley (Hordeum vulgare L.) chose as plant indicator for Grassy family and green gram(Vigna radiate L) as plant indicator for Leguminous family. Germination stage and seedlings growth considered as indicators for yield production. 5 different salinity levels (0, 100, 200, 300 and 400 meq/l of NaCl) were used. 10 seeds of each plant were placed on filter paper and placed inside Petri dish and 10 ml of saline solution was added, each treatment replicated 3 times and incubated at 25±2 °C. Germination rates, radical's length and gross weight were recorded daily during the experiments.

Salinity was significantly (p<0.01) reduced the germination rate up to 80% for barley and up to 87% for green gram. Seedlings grow under saline condition characterized by low ability to absorb water as a result of increasing osmotic pressure and reducing radical’s length.

Effect of crude oil pollution studied only on green gram by using three levels (0 ml (Oil, 0), 1ml (Oil,1) and 2ml (Oil, 2)) were added over the filter paper with same five levels of salinity. Crude oil pollution led to decrease the germination rate by (7.8%) and (63.4)% for (Oil,1) and (Oil, 2) respectively . On other hand, low level of crude oil pollution (Oil, 1) was able to increase the mean of gross weight by (40.8%) and high level (Oil, 2) by (2.6%) . While the radical length increased by (25.6%) at (Oil, 1) and decreased by (55.2%) by using (Oil, 2).

In spite of the low levels of crude pollution that ameliorate the stress of salinity on the germination and seedling growth at highest level of salinity (400 meq/l), we need more care about the affects of some carcinogenic hydrocarbon compounds which might be absorbed by roots and incorporated inside the plant materials. Such plants materials could cause cancers dieses as for consumers.

Introduction
The climate changes specially increasing temperatures and rise frequency of dust and sand storms and erratic rainfall in Iraq in addition to decreasing the amount of water for Iraqi rivers contributed to increasing areas of saline soils and increasing desertification.
In other direction the spread of oil extraction operations in different areas of Iraq as well as increase the numbers of power plants that use oil or one of its derivatives give more opportunity to soil oil pollution. Therefore, it is worthy to study the effects of salinity and oil pollution on the environment and especially on the agricultural production.

Soil salinity is one of the most important factors that limits crop production in arid and semi arid region (Neumann 1995). Plants have different responses to salinity depending on their stage of development (Kalaji and Pietkiewicz, 1993).

Salinity affected 7% of the world's land area, which amounts reached to 930 million ha (Szabolcs 1994, based on FAO 1989). The area of salinity is increasing at global scale and land use over 45 years found that 6% had become saline (Ghssemi et al. 1995). Irrigation systems are particularly prone to salinization, about half the existing irrigation systems of the world are under the influence of Stalinization, alkalization or water logging (Szabolcs 1994). Salinization can be managed by different ways such as changing irrigation systems to optimize use of water, and using of salt tolerance species.

Salt tolerance of plants is a complex trait that is controlled by a number of salt stress-responsive genes (Zhu 2000; Wang et al, 2004). The detrimental effects of salt on plants is consequences of both water deficit and interference with biochemical processes, which are brought about by high osmotic and excess sodium ion, respectively.

High salinity can rapidly inhibit root growth and hence water and essential mineral nutrients uptake capacity of the roots from the soil is decreased. At the same time, it can cause an increase in mortality of plants. The most common is that salt stress is caused by high Na+ and Cl- concentrations in the soil solution (Gulzar et al., 2003).

Salt tolerance is usually assessed as percent biomass production in saline versus control conditions. Dramatic differences are found between plant species. For example, after some time of growth in 200mm NaCl a salt-tolerant species such as sugar beet might have a reduction of only 20% in dry weight, a moderately tolerant such
as cotton might have a 60% reduction, and sensitive species such as soybean might be dead (Green & Munns 1980). Salt tolerance can also be assessed in terms of survival, which is quite appropriate for perennial species.

It is important to know how annual crops established in the field from seeds respond to salinity, as weak plants with slow growth compete poorly with weeds and plant pathogens, etc.

Crude oil pollution is one of most important pollutants especially at oil producing country such as Iraq. Some works reported that crude oil has direct herbicidal and phytotoxic effects to some seedlings Asuquo, et al., 2002; Bamiddele J.F and Agbogidi, O.M., 2000.

Seedling emergence probably is the single most important phonological event that influences the success of an annual plant. Emergence represents the point in time when a seedling is weaned by from dependence upon nonrenewable seed reserves originally produced by its parent, and when photosynthetic autotrophies’ begins. Timing of emergence often determines whether a plant competes successfully with others plants grown in the same place. Grassy and Leguminous are important plant families for humanity and consider important sources for foods. Barley (Hordeum vulgare L.) represent for grassy family and green gram (Vigna radiate L.) represent for Leguminous family were used in current study to illustrate the effects of salinity and crude oil pollution on the yield production depending on the effects on seeds germination and early seedlings growth.

Material and Methods

This research was conducted in the laboratory of plant and Environment department, Research Center and Natural History Museum, Baghdad University.

Plant materials: seeds of barely (Hordeum vulgare L.) and green gram (Vigna radiate L.) local varieties.

Experiment 1:

To evaluate the salt tolerance of plants during seeds germination and early seedlings growth, 10 seeds of each species were placed on Whatman No.1 filter paper placed in Petri dishes containing NaCl Solution 1 M with different dilution (0, 100, 200, 300 and 400
meq/L and represented as S0, S1, S2, S3 and S4 respectively. Seeds for of barely (Hordeum vulgare L.) and green gram (Vigna radiate L.) local varieties were incubated at 25 ± 2°C using complete randomized design in factorial experiment with 3 replications. Each Petri was weighted daily and replacing the water loss by distilled water to maintain salt concentrations as planned. Germination counts, gross weight and radical's length were recorded daily. Germination rates were determined with the following formula: Germination rate (%) = (Number of germinated seeds / Number of total seeds) × 100. The determinations continued till 8 days after germination. For determination the gross weight of germinated seeds contents of each Petri were removed from the Petri dishes daily, quickly as possible and surface-dried with a tissue paper and weighed and determined the length of radicals for each germinated seed then returned to the original dishes. The average of gross weight and radicals length calculated for each dishes using the

Experiment 2:
Effects of five different salt concentrations (0, 100, 200, 300 and 400 meq/l of Nacl) and three levels of crude oil pollution (0, 1 and 2 ml of light Basra crude oil obtained from Dorra refinery) represented as (Oil,0, Oil,1 and Oil,2 respectively) were studied. Salt solutions and crude 0il were distributed evenly on Whatman No.1 filter paper placed in Petri dishes and then put 10 of the green gram (Vigna radiate L.) seeds in each Petri using a complete randomized design in factorial experiment with 3 replications. Technical and determination of germination rates, gross weight and radicals length were carried out as in the experiment 1.

Statistical analysis: studied characters were statistically analyzed by using the Statistica program (versions 5.5, 1999). The statistical significance of differences among the mean values was determined by least significant difference (LSD) test at 1% and 5% probability.

Results and Discussion

Experiment 1
Effect of salinity on seed germination:
Analysis of variance showed significant difference among salinity levels (P<0.01) in both barley and green gram seeds (Fig1)

Fig 1  Effect of Salinity levels on germination rate of Seeds

Germination rate of barley was strongly affected by all levels of salinity. Germination rate was inversely proportional with increasing salinity. On other hand in green gram seeds there was no affected on germination rate till 200 meq/l but decreased sharply at 300 and 400 meq/l (Fig 1).

In general the increasing the salinity reducing the seeds germination could be due to increasing the osmotic pressure and / or to specific toxicity which may reduce or retard germination process. These result were in agreement with Basalah, 1991; Waisel, 1972.

The salt tolerance of green gram was higher for low levels of salinity (S1 and S2) than barley, while at higher levels (S3 and S4) the tolerance was less.

Effect of salinity on radical’s length
As might be expected the radicals growth which expressed by length were decreased as a result of increasing the salinity for both barley and green gram seeds (Fig 2).This result could be due to biological toxicity by salt which reduce the elongation of radicals.

Fig 2 Effect Salinity levels on length of radicals of Seedlings
Effect of salinity on gross weight of germinated seeds
The gross weight of germinated seeds which mainly refer to the total uptake of water by seed as preparing process to germination process were highly affected by salinity in both barley and green gram. The highest gross weight observed at control treatment and decreased gradually with increasing the salinity (Fig 3). Increasing water salinity led to increasing osmotic pressure in water and would reduce the water diffusion from outside cell membrane to inside cells of radicals and could be due to reduce the length of radicals as shown in fig2. The lowest water absorption happened at highest salinity in S4 in both seeds type.

Fig 3 Effect of Salinity on Gross Weight of Seedling
These findings were reinforced the result of germination rate above and in fever with increasing the osmotic pressure as a result of increasing salinity.

Experiment 2:
Effect of salinity levels and crude oil pollution on green gram seeds
Analysis of variance showed significant affect for salinity and crude oil pollution. Both factors were reduced the germination rate. The highest germination rate was at control treatment (S0). The means of germination rates were reduced gradually with increasing both salinity and crude oil pollution levels (table 1).

Table (1) Effect of Salinity and Crude Oils on Germination % of Green gram Seeds

<table>
<thead>
<tr>
<th>Treatments</th>
<th>(Oil, 0)</th>
<th>(Oil, 1)</th>
<th>(Oil, 2)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>100</td>
<td>95.3</td>
<td>57.3</td>
<td>78.65</td>
</tr>
<tr>
<td>S1</td>
<td>100</td>
<td>98.7</td>
<td>40.7</td>
<td>79.80</td>
</tr>
<tr>
<td>S2</td>
<td>100</td>
<td>96.7</td>
<td>41.3</td>
<td>79.33</td>
</tr>
<tr>
<td>S3</td>
<td>78.7</td>
<td>37.3</td>
<td>4.0</td>
<td>40.00</td>
</tr>
<tr>
<td>S4</td>
<td>13.3</td>
<td>33.3</td>
<td>0.0</td>
<td>15.53</td>
</tr>
<tr>
<td>Mean</td>
<td>78.4</td>
<td>72.3</td>
<td>28.7</td>
<td></td>
</tr>
</tbody>
</table>

Oil pollution decreased the germination rates from 78.4 % to 72.3% and 28.7% for (Oil, 0), (Oil, 1) and (Oil, 2) respectively (table 1). The interaction between salinity and crude oil was significantly
affected and it was clear that increasing the salinity levels led to more decreasing in germination with increasing oil levels. S4 was exceptional where low level of oil (Oil, 1) led to increased the germination rate from 13.3% to 33.3% and increasing the level of pollution to (Oil, 2) prevent any germination process (Table, 1).

Effect of crude oil on gross weight of seedlings was clearly depended on level of salinity (Table 2). Low level of oil (Oil, 1) was led to increased the mean of gross weight from 1.15 at (Oil, 0) to 1.62 at (Oil, 1) while increased the oil to (Oil, 2) led to decreased the mean weight to 1.18 and the same trend were for all levels of salinity except for S4 where low level of oil (Oil, 1) led to increase the gross weight from 0.89 to 1.37 and to 1.12 at high level (Oil, 2) (Table 2). Increasing the gross weight of seedling of at crude oil pollution not necessarily belong to more water absorption but could be due to absorb hydro carbonic molecules which characterized by high molecular weight. Therefore, the gross weight of seeds at treatment of S4 received oil (Oil, 2) increased to 1.12 even there was no germination happened at all.

Table (2) Effect of Salinity and Crude Oils on Gross Weight of Green gram of Seedlings

<table>
<thead>
<tr>
<th>Treatment</th>
<th>(Oil,0)</th>
<th>(Oil,1)</th>
<th>(Oil,2)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>1.33</td>
<td>1.81</td>
<td>1.51</td>
<td>1.55</td>
</tr>
<tr>
<td>S1</td>
<td>1.16</td>
<td>1.66</td>
<td>1.01</td>
<td>1.28</td>
</tr>
<tr>
<td>S2</td>
<td>1.30</td>
<td>2.15</td>
<td>1.08</td>
<td>1.51</td>
</tr>
<tr>
<td>S3</td>
<td>1.05</td>
<td>1.10</td>
<td>1.17</td>
<td>1.11</td>
</tr>
<tr>
<td>S4</td>
<td>0.89</td>
<td>1.37</td>
<td>1.12</td>
<td>1.13</td>
</tr>
<tr>
<td>Mean</td>
<td>1.15</td>
<td>1.62</td>
<td>1.18</td>
<td></td>
</tr>
</tbody>
</table>

The effects of crude oil on length of radicals of seedlings was also depend on the levels of pollution were (Oil, 1) led in general to increasing the length of radicals while (Oil, 2) led to decrease the length except for S4 where low levels was able to eliminate the effects of salinity. The radical's length S4 at (Oil, 1) increased from 0.27 to 7.44 and for (Oil, 2) led to prevent any germination for seeds.
Table (3) Effect of Salinity and Crude Oils on Length of Radicals of Green gram Seedlings

<table>
<thead>
<tr>
<th>Treatment</th>
<th>(Oil,0)</th>
<th>(Oil,1)</th>
<th>(Oil,2)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>20.4</td>
<td>21.1</td>
<td>15.15</td>
<td>18.88</td>
</tr>
<tr>
<td>S1</td>
<td>21.40</td>
<td>20.39</td>
<td>5.61</td>
<td>15.80</td>
</tr>
<tr>
<td>S2</td>
<td>11.8</td>
<td>13.59</td>
<td>3.48</td>
<td>9.62</td>
</tr>
<tr>
<td>S3</td>
<td>1.96</td>
<td>7.60</td>
<td>0.73</td>
<td>3.43</td>
</tr>
<tr>
<td>S4</td>
<td>0.27</td>
<td>7.44</td>
<td>0.0</td>
<td>2.57</td>
</tr>
<tr>
<td>Mean</td>
<td>11.16</td>
<td>14.02</td>
<td>4.99</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

Effects of salt on both barley and green gram was led to reducing the percentage of germination rates ranged between 3% and 80% for barley and between 0% and 87% for green gram depended on levels of salinity used. The decline in percentage of germination will reflect its impact on the final production if we suppose that the others production factors remain constant without change. According the current results will lose up to 80% of yield for barley and up to 87% for green gram as a result of salinity within used levels. Salinity reflects the same trend of reduction on both gross weight and length of radicals.

In Iraq as a result of increasing the salinity of many soils and poor quality of water irrigation need to be more attention in choosing plant species in agriculture. We should be choose the plants that tolerant to salinity and use suitable irrigation systems which able to reduce the water consumptions to prevent any salt accumulations in soil. The reduction in gross weight and radicals length of seedlings refer to decreasing the ability of plants for water absorption which negatively affect the germination process. The reduction the ability of absorbing soil water consequently reduces the nutrients uptake by seedlings and would reflect their affects on plant nutrition and depress the final yield.

Oil pollution reduced the mean of germination rate of green gram by 8.4% at oil1 and by 173% at Oil2 while oil1 was able to increase the germination rate at high levels of salinity S4 from 13.3% at oil0
to 33.3% at oil1 but increasing the dose to oil2 prevent any seeds germination (table 1). Low level of crude oil pollution (oil1) was able to increase the mean of gross weight by 30% and high level (oil2) by 2.5%. While the radical length increased by 20.4% at oil1 and decreased by 123% by using oil2.

From the current study we could conclude that low levels of crude oil could be able to ameliorate the affects of high salinity levels for green gram and need further studies to get more details on this finding.

The results also referred to significant interaction between salinity and pollution. Increasing the salinity and crude oil pollution together led to more reduction in germination rate (Table 1).

Finally the low levels of crude pollution that ameliorate the stress of salinity on the germination and seedling growth, more care about the affects of some carcinogenic hydrocarbon compounds which might be absorbed by roots and stay inside the yield and cause cancer after consumption.

However, such results need further studies to throw the more light on the side affects of crude oil pollution on safety of using food grown at polluted soils.

References

دراسة تأثير الملوحة والنفط الخام على نباتات
نمو بادارات نباتي الشعير والماش
أ.م. د. حسن علي
أ. د. باسم عباس عبد علي
مركز بحوث و متحف التاريخ الطبيعي / جامعة بغداد
الخلاصة

ُأجريت الدراسة الحالية لتحقيق تأثير كل من الملوحة والنفط النقفي تحت ظروف البيئة العراقية على نمو النباتات. تم اختيار الشعير كدليل نباتي من العائلة النجيلية و الماشي دليل نباتي من العائلة البҚولية. اعتمدت مرحلة الابتاث ونمو البادرات كمؤشر للالتئام النباتي . استخدمت 5 مستويات من الملوحة (0 , 100, 200, 300 و 400 مل مكاني / لتر من كلودي الصوديوم ) تم دراسة الابتاث ونمو البادرات في ظروف مستقر عليها. 10 بذور من كل نبتة وضعت على وقاية ترشيح موضعية في طبق بتي و أضيف لها 10 مل من كل مستوى ملحي وحظيت تحت درجة 25 ± 2 درجة مئوية.
وكل معايير كرر تصام مرات. نسبة الابتاث وطول الجذور والوزن الكلي للبادرات تم حسابها يوميا.
النتائج حلت احصائياً لتحقيق الفروقات الاحصائية. أشارت النتائج إلى الملوحة أدت إلى خفض كل من
تاثير التلوث الترطيبي تم دراسته على نبات اللحم باستعمال 3 مستويات للثنوتي (0 مل و 1 مل و 2 مل) من النقط الخام لكل طبق أضيفت على ورق الترشيح تم بعد إضافة 10 مل من كل مستوى ملحي من المستويات المستخدمة أعلاه للملوحة. ووضعت 10 بذور من اللحم في كل طبق وكل معاملة كرت عشر مرات. وحلت الطرق بنفس الطرق أعلاه وتم احتساب كل من نسب القربات وطول الجذور والوزن الكلي للبذورات. وانشأت النتائج من التلوث الترطيبي ساهم في خفض معدل نسبة الآفات بمقدار 7.8% لمستوى ثلوتي (1مل) ونسبة 63.4% بالنتيجة لمستوى (2مل) من النقط الخام. ولكن من جهة أخرى أدت التلوث الترطيبي إلى ارتفاع الوزن الكلي بمقدار 40.8% و26.2% لكل من مستوي ثلوتي (1مل و 2مل) على التوالي. ونسبة في زيادة اطوال الجذر بمقدار 25.6% في المستوى (1مل) وانخفاض بمقدار 55.2% في مستوى (2مل). ونسبة على الرغم من أن التلوث الترطيبي بمقدار (1مل) أدت إلى تحسن أطوال الجذر والوزن الكلي في جميع مستويات الملوحة وارتفاع نسبة الآفات في المستوى العالي من الملوحة (400 ملي مكافي) فإن هناك حاجة لدراسات لاحقة لتحديد فيما إذا كان هناك مركبات هيدروكاربتونية مرطبة يتم احتسابها من قبل النباتات النامية مثل هذه التربة لاحتمال تسببها في أمراض سرطانية للمستهلك عند استخدامها.