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Seed soaking effects on the emergence and early growth of Pea (*Pisum sativum*) and Okra ((*Abelmoschus esculentus*)

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Abstract A petri dish experiment and pot experiment were conducted to investigate the effect of seed soaking on the germination of Pea and Okra and the early growth of Okra. There were four soaking times, 0h, 5h, 10h, and 24h. The results showed positive effects of seed soaking on the emergence and growth of the two crops. Results showed that the germination percentage did not correlate linearly with the increase in Pea seed soaking time, while in Okra, the germination percentage increased with the increase in soaking time. Both crops had the highest germination percentage at 24h soaking time which was 96% for Pea, and 76% for Okra. Pea seeds soaked for 24h had the longest radicle followed by the control treatment (0h). For Okra, there was a steady increase in the radicle and plumule length along with the increase in soaking period. For Okra, the height of the plant in the fourth week in the treatment of soaking for 24 hours was about twice the height of the plant in the same week in the treatment of the control. These results could be used in improving the growth of the crops.
Keywords: Seeds, Soaking, Crops, Leaf number, Plant height.

تأثير نقع البذور على الإنبات ومراحل النمو المبكرة في نباتي الباميا والبازلاء

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الملخص أجريت تجربة اطباق وتجربة أكياس بلاستيكية لتقصي تأثير نقع البذور على إنبات نباتي الباميا والبازلاء وتأثير النقع على مراحل النمو المبكرة في الباميا. كان هناك أربع فترات للنقع وهي الكنترول (بدون نقع)، النقع لخمس ساعات، النقع لعشر ساعات والنقع لأربع وعشرين ساعة. أظهرت النتائج تأثيراً إيجابياً لنقع البذور على الإنبات والنمو لكلا المحصولين. بالنسبة للبازلاء أظهرت النتائج أن العلاقة لم تكن خطية بين زمن النقع ونسبة الانبات، بينما في الباميا كانت نسبة الإنبات متدرجة في الزيادة مع الزيادة في زمن النقع. في كلا المحصولين كانت أعلى نسبة انبات في زمن النقع لمدة 24 ساعة والتي كانت 96% و76% في البازلاء والباميا على التوالي. بذور البازلاء المنقوعة لمدة 24 ساعة كانت الأطول رويشة تليها البذور في معاملة الشاهد. بينما في الباميا كان طول الجذير والرويشة مرتبطاً طردياً بزيادة زمن النقع. أفضل ارتفاع لنبات الباميا كان في النباتات التي نقعت بذورها لمدة 24 ساعة. هذه النتائج يمكن استغلالها في تحسين النمو والانتاجية في كلا المحصولين.

الكلمات المفتاحية: بذور، نقع، محاصيل، ارتفاع النبات، عدد الاوراق.

Introduction

Generally, it would be difficult for man to change soil properties or climatic conditions in a certain piece of land to get the suitable conditions for crop production, but using the knowledge and skills of farmers can help to improve crop growth and production from sowing to harvesting. That can be achieved by good agricultural practices like the implementation of crop rotations and the accurate use of fertilisers [1]. Among good agricultural practices, Man can improve germination and seedlings growth. [2] pointed out that for the annual crops, the growth stage from germination until seedlings appearance is essential for the cycle of crop production because the germination percentage and the survival of seedlings has a great impact on crop productivity and the quality of yield. The main aim of crop planting is to get the higher possible yield with the best possible quality, and to achieve that, there must be a good start of the crop growth cycle to get enough density for a good yield. In many cases, the environment does not provide the required conditions to achieve this, especially in dry and semi-arid regions [3].

Drought usually causes stress on the germination of seeds and seedlings in the areas that depend on rain for agriculture, consequently, the crop will have poor germination and scattered plants with big gaps between them. As a result, the crop will produce poor yield [4].

Besides the physical stress on seed germination processes in the dry lands, the biotic stress like insects and fungus will also have a negative impact on seed germination and seedlings growth. As it was pointed out in [2], these problems are usually associated with the increase of plant weakness as a result of different types of stress during the germination and seedling growth period, therefore, shortening the time that a crop requires between sowing and germination and, between the first seed and the last seed

germination in a certain crop, has a great agricultural benefit. Therefore, it is unsurprising that there are many attempts to treat seeds before sowing to improve seed germination in the field to get the required density of plants in a certain area, and as a result the best yield will be obtained. This is leading us to the objective of this study (seed soaking)

Seed soaking:

The establishment of a good and uniform stand, which is the base of the success of germination and emergence of seeds, is one of the most important management practices in crop production, especially where once-over harvesting is performed. This can be enhanced by pre-germination seed treatments such as soaking seed.

Fast germination and emergence of healthy seedlings is an essential step for the successful establishment of plants, while water deficit during the germination stage leads to a decrease or complete inhibition of seed germination and seedling establishment [5]. Under drought conditions, the performance of seed germination, and healthy seedling establishment discouraged due to the decrease of water potential, which leads to a decline in water uptake by plants [6]. Issam et al. [7] indicated that seed soaking can increase antioxidant activities as well as decrease lipid peroxidation in the course of seed germination.

Soaking effects are also associated with a wide range of metabolic events [8]. Unequal or poor germination and subsequently uneven seedling growth can cause great financial losses by decreasing crop yield, though seed soaking can multiply speed and uniformity of germination [9].

Pea (*Pisum sativum*) is an important edible leguminous seed crop for human nutrition. Its seeds contain 18-20% dry matter whose 10-12% is carbohydrate and 5-8% is protein [10]. Pea is used as a fresh vegetable, frozen or canned. About 12.2 million tons of pea production were achieved in 6.3 million ha agricultural lands of the world with an average yield of 1.930 kg ha^{-1} [10]. In 2007, 213 tons of Pea were produced in Libya [11]. Pearce [12] noticed that seed soaking in water has enormous importance in the acceleration of germination despite the seedling growth might be influenced by the climatic conditions later. The same reference reported that the seeds of Pea had a great benefit from seed soaking in the acceleration of seedling growth.

Furthermore, soaking pea seed with distilled water improved the final germination, and reduced the mean germination time and the frequency of chromosomal aberrations [13]. This helped develop a protocol for soaking pea seeds.

The improvements in seed yield, number of leaves per plant and leaf area were also observed in seed soaking study with rainfed upland cotton-Gossypium hirsutum [14].

Although it appears, therefore, that certain pre-germination treatments applied to seeds of certain species may result in beneficial effects, It is equally clear that the response to a treatment may vary not only between species but also between seed lots within a species [12].

Okra (*Abelmoschus esculentus* L.) is one of the most widely known dicotyledonous plants and utilized species of the family Malvaceae [15]. Okra is a popular summer crop and very nutritious but might have poor seedling emergence and vigor. Okra seeds do not germinate below 20C. The slow and uneven germination of okra seed is the main barrier in the early spring planting [16].

Okra seeds are very nutritious; contain proteins, vitamin B6, folic acid, fibre and relatively low amount of copper, iron, manganese and zinc. Per 100 gm of okra contain 7.03 g carbohydrates, 1.20 g sugars, 3.2 g dietary fiber, 0.10 g fat, 2 g protein, 90.17 g water and 129 KJ energy. The main problem in okra is slow growth and unsynchronized flowering and maturity [17]

Objectives

- To determine the effectiveness of seed soaking in enhancing seedling emergence in Pea and Okra
- To determine the effect of seed soakingon early growth and development of Okra

Materials and Methods

Location and samples collection

The soil was collected from Ashati District. Seeds were obtained from local shops In Brack. The experiment was carried out in the Environmental Sciences Department, Faculty of Engineering and Technology, 2017

Seed Preparation

All the seeds were immersed in water so the weak and rotten seeds would float and would be excluded. [18].

The study included two separate experiments

Experiment1: Seed Germination in Petri Dishes

Seeds were washed under running water, and then washed by sodium hypochlorite (5%). Immediately the seeds were washed with running water several times. Soaking treatments were; seeds with no soaking (0h), seeds soaked for five hours (5h), seeds soaked for 10 hours (10h) and seeds soaked for 24 hours (24h).

12 Petri dishes (sterilized with 5% sodium hypochlorite) were prepared for each plant and these were in three replicates per soaked time-each replicate having ten seeds. Two lyres of filter paper were put inside each dish and 10 seeds of each replicate were distributed regularly on the filter papers ensuring that enough space is available among the seeds. The Pea experiment was started in December 2017 and Okra experiment was started in May 2018. Seeds were moisturised with enough water ensuring that the seeds stay moist all the time.

Measurements

- Seed germination percentage
  Seed germination percentage was calculated as
  $GP = Ni / N \times 100$
  Ni = number of germinated seeds
  N = total number of seeds

- radical length and plumule were measured daily for seven days

Experiment2

This experiment was carried out for Okra only. Twelve polybags were filled with agricultural soil collected from a farm in Brack and these were in three replicates per soaking time- each replicate having three seeds thinned to one plant per bag after emergence. Soil pH and electrical conductivity were measured before sowing the seeds. Soil pH was measured directly in soil abstract 1:1 by pH meter model (3310 JENWAY). Soil conductivity (EC; ms/cm 0.25Cº) was measured directly in soil abstract 1:1 by Conductivity meter model (4310) JENWAY. Soaking treatments were; seeds with no soaking (0h), seeds soaked for five hours (5h), seeds soakingfor 10 hours (10h) and seeds soaked for 24 hours (24h). Plant height and leaf number were measured weekly

Statistical analysis

Statistical analysis was run using SPSS v16

Results and discussions

Experiment1

Seed germination percentage

Table1 shows that the germination percentage did not correlate linearly with the increase in Pea seed soaking time, while in Okra, the germination percentage increased with the increase in soaking time. This can be used to improve Okra seed germination. Studies indicated that although okra is a drought- tolerant crop, farmers still suffer to obtain good germination [16].

Despite irregular response of the Pea seeds to soaking treatments, seeds soaked for 24h germinated better than the seeds that were not soaked (0h). The statistical analysis showed significant differences ($p<0.05$) between the two plants, while these differences did not exist between the soaking times within the same plant. These results are in consistency with a study of [19]. who pointed out that the germination percentage of Pea seeds soaked for 12h reached 86%. In a similar study on *Gundeiia tournefortii*, soaking the seeds for 24h improved the germination percentage by 27% [20].

Table1. The effect of soaking time on the seed germination percentage

soaking period/plant	24h	10h	5h	0h
Okra	%76	%66	%63	%46
Pea	%96	%80	%86	%86

Results showed a positive effect of the soaking on the radicle and the plumule appearance as hydroprimed seeds could achieve earlier and more uniform germination (Figure1). Pea seeds soaked for 24h had the longest radicle followed by the control treatment (0h). Although the effect of soakingon the radicle length did not differ significantly ($p>0.05$), the results still considered important. There was a steady increase in the plumule length with the increase of soaking period (Figure1). 5h treatment had the longest plumule compared with the other treatments ($p=0.03$)

For Okra, As Figure2 shows, there was a steady increase in the radicle and plumule length along with the increase in the soakingperiod. 24h treatment surpassed the other treatments in both of plumule and radicle length. These results are consistent with [21]. who indicated that Okra seed soaking has a positive effect on germination and growth

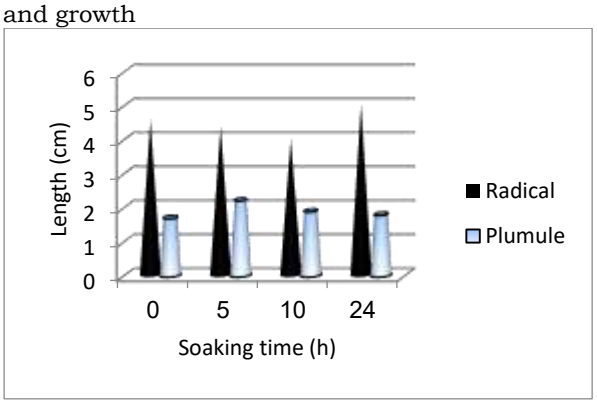

Figure1. The effect of soaking time on plumule and radicle length in the Pea plant

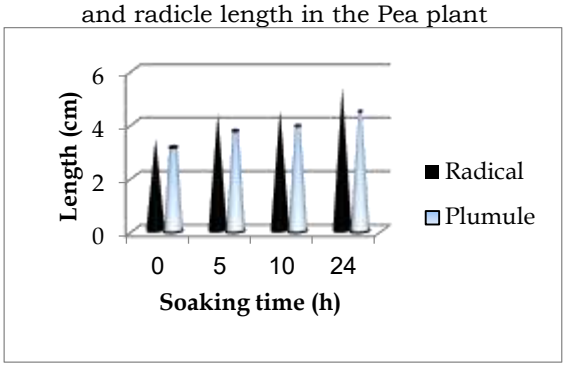

Figure2. The effect of soaking time on plumule and radicle length in the Okra plant

Experiment2

Soil properties

The results showed that the soil pH value was 8.25, EC was 2.07 ms/cm and the TDS was 13

Plant growth

In okra plant, the soaking of seeds did not show regular effects on plant growth (Figure 3), but the effect of soaking shows that the height of the plant in the fourth week in the treatment of soaking for 24 hours was about twice the height of the plant in the same week in the treatment of the control. The number of leaves increased in soaking treatments compared with the control (Figure 4). The results of soaking the seeds in okra are consistent with the [22]. study in which it was found that soaking for 24 hours had a positive effect on the number of leaves in both peanuts and Bambara.

Kaur, et al. [21]. indicated that unsoaked seeds produce plants that took more days to 50% flowering than plants grown from soaked seeds. This is in consistency with the results of this study

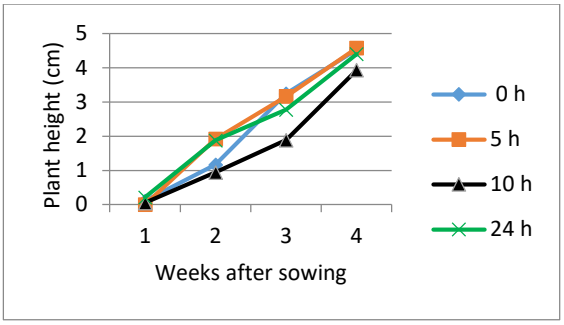

Figure3. The effect of soaking time on the plant height in the Okra plant

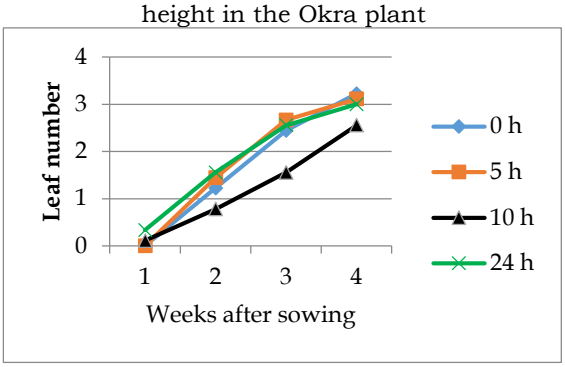

Figure4. The effect of soaking time on the leaf number in the Okra plant.

Conclusion

Generally, there was a positive effect of seed soaking on the germination of the seeds and the appearance of radicle and plumule in both Okra and Pea with differences between the two plants in terms of responding to the soaking treatments. Seed soaking also improved the growth of plants in terms of plant height and leaf number. These results could be used in improving the cropgrowth. It should be taken into consideration that seed soaking is a good practice in improving germination and subsequent crop development. It is also recommended to carry out more studies on the effect of soaking on crop productivity as this study was terminated before yield stage

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