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EFFECT SEED SOAKING OF MORINGA LEAF EXTRACT ON SOME GROWTH TRAITS AND BIOLOGICAL YIELD OF THREE BREAD WHEAT CULTIVARS

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Abstract

This study was carried out during the winter season of 2022-2023 at the Research Station of College of Agricultural Engineering Sciences, University of Baghdad /AL-Jadiriya, Iraq. In order to know the effect of seed soaking with Moringa leaf extract on some vegetative growth characteristics and biological yield of three bread wheat cultivars. Randomized Complete Block Design with the arrangement of split-plots with three replications was used. Bread wheat cultivars (Rasheed, Buhooth 22, Buhooth 10) occupied the main plots while treatments of soaking with Moringa leaf extract occupied the sub-plots, they included three concentrations (1% , 3% , 5% in addition to 0% tap water as control). The obtained results indicated that cultivar Rasheed was superior in plant height (100.23cm), flag leaf area (48.06cm^2), number of tillers (409.3m^{-2}), spike length (17.38cm), dry weight (1243.3 g m^{-2}) and biological yield (12.45 t ha^{-1}). The results showed that most of the treatments Moringa leaves extracted recorded significant differences from the control treatment which gave the lowest values, except for the number of tillers. The highest values were in the 3% concentration treatment and for all studied traits that were included plant height (105.11cm), leaf area (49.29cm^2), spike length (15.83cm), dry weight (1283.3g m^{-2}) and biological yield (12.24 t ha^{-1}). The effect of interaction for both factors was significant in most studied traits except for the number of tillers.

Keywords: Wheat Cultivars, Moringa, Vegetative Growth, Biological yield

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تأثير تنقيع البذور بمستخلص أوراق المورينكا في بعض صفات النمو والحاصل البايولوجي لثلاثة أصناف من حنطة الخبز

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المستخلص

أجريت هذه الدراسة خلال الموسم الشتوي 2022-2023 في محطة أبحاث كلية العلوم الهندسية الزراعية، جامعة بغداد / الجادرية، العراق. لمعرفة تأثير تنقيع البذور بمستخلص أوراق المورينكا في بعض صفات النمو الخضري والحاصل البايولوجي لثلاثة أصناف من حنطة الخبز. تم استخدام تصميم القطاعات العشوائية الكاملة بترتيب الألواح المنشقة بثلاثة مكررات. احتلت أصناف حنطة الخبز (رشيد، بحوث 22 وبحوث 10) الالواح الرئيسية بينما احتلت معاملات التنقيع بمستخلص أوراق المورينكا الالواح الثانوية وتضمنت ثلاث تراكيز (1%، 3%، 5% بالإضافة إلى 0% الماء الخام كمقارنة). أشارت النتائج تفوق الصنف رشيد في ارتفاع النبات (100.23 سم)، مساحة ورقة العلم (48.06 سم^2)، عدد الاشطاء (409.3 م$^{-2}$)، طول السنبلة (17.38 سم)، الوزن الجاف (1243.3 غم$^{-2}$) والحاصل البايولوجي (12.45 طن هـ$^{-1}$). أظهرت النتائج أن معظم المعاملات مستخلص أوراق المورينكا سجلت فروقاً معنوية عن معاملة المقارنة والتي أعطت أقل القيم باستثناء عدد الاشطاء، وكانت أعلى القيم لمعاملة تركيز 3% ولجميع الصفات المدروسة والتي شملت ارتفاع النبات (105.11 سم)، مساحة ورقة العلم (49.29 سم^2)، طول السنبلة (15.83 سم)، الوزن الجاف (1283.3 غم م$^{-2}$) والحاصل البايولوجي (12.24 طن هـ$^{-1}$). تأثير التداخل لكلا العاملين كان معنويا في معظم الصفات المدروسة باستثناء عدد الاشطاء.

انتساب الباحث

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معلومات البحث

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الكلمات المفتاحية : اصناف الحنطة، المورينكا، النمو الخضري ، الحاصل البايولوجي

Introduction

Bread wheat (Triticum aestivum L.) is one of the most important cereal crops grown globally, as more than a third of the world's population depends on it [1], and as a result of the increasing demand for food day after day and with the high population growth, a large gap has formed between wheat consumption and its productivity [2] and [3]. The interest in reducing this gap and increasing productivity with environmentally safe agricultural methods has become one of the most important goals of agricultural policy. Several techniques have been developed for the growth and development of field crops, the most important of which is the seed soaking technique, as it is a simple and inexpensive physiological process that occurs pre-sowing [4], through which the seed absorb water to an extent that allows it to undergo the necessary metabolic processes (metabolism) before germination without root emergence from seed coat [5], leading to early DNA replication, increasing RNA and ATP, stimulating the biosynthesis of proteins and repairing cellular bio membranes [6], as well as improving the efficiency of nutrient utilization, which allows for higher growth, regulates the water state of the plant, and reduces the accumulation of toxic elements, flowering, early maturity, and high yield for various types of crops [7] and [8]. In recent years, the world has focused its attention on reducing environmental pollution by reducing the use of chemicals in crop production. Therefore, many researchers tend to use environmentally safe and inexpensive organic growth materials (bio-stimulants) to encourage plant productivity [9] and [10]. Plant extracts are among the most widely used bio stimulants in agriculture [11] and [12], including the leaf extract of Moringa olifera L. one of the plants of the Moringaceae family and the most used part of the plant, as it is a natural plant growth regulator because it is a source of zeatin derived from cytokinins in addition to containing nutrients, vitamins and amino acids, which are involved in many physiological processes in the plant [13] and [14]. MLE has proven its positive effect in improving the vegetative growth of the plant, and as a result, the yield of various agricultural crops increased by 20-35% [15], depending on the concentration used, which varies according to the plant [16]. Khan et al [17] found when they studied different soaking treatments to improve the growth and productivity of wheat that MLE at a concentration of 3% gave the highest results in the number of tillers, plant height, and spike length (350 m-2), (93.77cm), and (10.69cm) respectively, superior to all treatments included in the study and agreed with Rehman et al [13] findings that use of MLE at a concentration of 3.3% whether by soaking wheat seeds only or in combination with foliar spraying, had a significant effect on many characteristics of vegetative growth, such as which led to the improvement of biological yield. The aim of the study is the effect of seed soaking with different concentrations of Moringa leaf extract on the growth characteristics and biological yield of three bread wheat cultivars, and to determine the best concentration to raise the efficiency of production.

MATERIALS AND METHODS

This research was conducted at the Research Station College of Agricultural Engineering

Sciences, University of Baghdad (Jadiriya) at latitude of 33o .32´N and longitude of 44o .23´E. during the winter Season of 2022-2023. Soil at the site was sandy - loam (clay, 6.8%; silt, 40%; sand, 53.2%) with the pH of 7.14 and EC of 2.4 dsm^{-1}. Other soil properties as shown in Table (1).

Table (1): soil physical and chemical properties

Dept.	OM	$CaCo_3$	N	P	K	Ca^{++}	Mg^{++}	Na^{+}	HCO_3	Cl^{-}	K^{+}
cm	g kg^{-1}		mg kg^{-1}			mmolc l^{-1}					
0-30	6.51	282.1	23.01	8.31	120.09	16.09	8.88	1.83	1.24	17.39	1.16

Randomized Complete Block Design (RCBD) with the arrangement of split-plots with three replicates was used. The main plots included three cultivars (Rasheed, Buhooth 22, Buhooth 10),while the sub plots included three concentrations of MLE (1%, 3% and 5% in addition to the control treatment of soaking in tap water) all of which were soaked for 12h. The area of the experimental unit was $4m^2$, and it included 10 lines of 2m length, with a distance of 20cm between one line and another, with a seed quantity of 120 kg ha^{-1} and sowing date on 26th November. During land preparation the full dose of NPK fertilizer (15:15:15) were applied at a rate of 500 kg ha^{-1},while nitrogen was applied from urea (46%N) at a rate of 260 kg ha^{-1} in two split dose, 120 kg ha^{-1} at beginning of the tillers stage ZGS:20 and 140 kg ha^{-1} at the beginning of the booting stage ZGS:40 according to the fertilizer recommendation [18]. At 100% anthesis a sample of ten main stems was collected randomly from each plot for measurement: Plant height (cm), flag leaf area (cm^2) was calculated according to the formulae of Thomas [19]: length× maximum width ×0.95, spike length, and from m^{-2} area No. of tillers (m^{-2}) was counted and dry weight of plant (g m^{-2}) was recorded by an electric balance, For the determination of biological yield, an area of m^{-2} was harvested from each plot at the fully mature stage. The differences among the treatment means were compared using the least significant difference (L.S.D) test at the level of 0.05 probabilities [20].

Preparation of Moringa Leaf Extract (MLE).

The extract was prepared by collecting fresh leaves at the time of flowering, dried in the shade at room temperature, and then ground in an electric mill to obtain leaf powder 100 gm, powder was weighed and 500 ml of warm distilled water at a temperature of 40ºC was added to it and left to soak for 24h, after that the solution was filter paper [21]. The extract was concentrated by evaporation at a temperature of 45ºC then the concentrations were prepared by taking 10, 30, 50 ml from extract and completed the volume to 1000 ml from distilled water respectively to reach the concentrations of 1%, 3% and 5%.

RESULTS AND DISCUSSION

Plant height (cm)

Results in Table 2. indicates that the effect of cultivars, MLE soaking concentrations and their interaction had a significant effect on the plant height. Cultivar Rasheed gave the tallest plants (100.23 cm) while the shortest plants were recorded by Buhooth 10 (90.19cm) which did not differ significantly from Buhooth 22, Differences

in plant height may be due to the genetic makeup of the varieties. Data in Table 2. showed that the superior results were achieved by soaking seeds in MLE solution at a concentration of 3% which recorded (105.11cm) followed by both of 1% and 5% concentrates respectively. On the other hand, soaking seeds in tap water was insufficient to enhance the plant height which registerated lowest values (83.54 cm). This increase may be attributed to soaking with Moringa extract in the activity of meristematic cells and the increase in the length of the internodes [22] and [23]. This result agreed with his findings by Rehman et al.[13] and Khan et al. [17]. Regarding the interaction, the highest value was obtained when Rasheed seeds were soaked with MLE 3% concentrate (110.46cm), whereas the lowest value was recorded with Buhooth 10 seeds soaked with tap water (88.54 cm). as shown in Table (2).

Table(2): Effect of cultivars, MLE concentrations and their interaction on Plant height (cm).

Cultivars	MLE Concentrations				means
	0	%1	%3	%5	
Rasheed	88.54	106.05	110.46	95.88	100.23
Buhooth 22	82.38	97.38	104.58	87.92	93.06
Buhooth 10	80.95	93.45	100.28	86.08	90.19
L.S.D	4.22				3.67
Mean	83.54	98.96	105.11	89.96	
L.S.D	2.07				

Flag Leaf area (cm^2)

The leaf area is related to the productive capacity of the cultivar, but its effect on the grain yield varies according to the genotype and the available growth factors [24] and [25]. Results in Table 3. clearly indicated that cultivars had a significant effect on leaf area. Rasheed had the highest flag leaf area (48.06 cm^2) followed by Buhooth 10 (45.18 cm^2), while the lowest flag leaf area (40.77 cm^2) was produced with Buhooth 22. Table 3. showed that, plants produced from seed soaking with MLE solution by different concentrations had significant positive effect in flag leaf area, especially those were produced from soaked seed in MLE 3% (49.29cm^2) Meanwhile, the lowest values were detected with those plants grown with soaking in tap water (38.35cm^2). The reason for this increase is may be due to the effect soaking of growth hormones such as cytokinin, as well as the macro and micro elements present in MLE [16], which encouraged the plant to absorb water and nutrients leading to increased efficiency of the photosynthesis process and an increase in its products necessary for leaf cell division and elongation, Similar results were obtained Nasralla et al [26] that the flag leaf area increases when wheat crops are treated with extracts. The highest flag leaf area was reported when seed of the cultivar Rasheed soaked at concentration 3% (52.84cm^2), while the lowest number for the same character was obtained with seed of cultivar Buhooth 22 when soaked at tap water (35.13cm^2). as shown in Table (3).

Table (3): Effect of cultivars, MLE concentrations and their interaction on flag leaf area (cm^2)

Cultivars	MLE Concentrations				means
	0	%1	%3	%5	
Rasheed	41.63	51.16	52.84	46.62	48.06
Buhooth 22	35.13	43.09	44.24	40.62	40.77
Buhooth 10	38.30	47.04	50.79	44.57	45.18
L.S.D	3.19				1.46
Mean	38.35	47.10	49.29	43.94	
L.S.D	2.02				

Number of tillers m^{-2}

In this study the effect of cultivars was significant , whereas the effect of MLE soaking concentrations and the interaction between the two factors was non-significant on this trait (Table 4). Cultivars responded differently

regarding the number of tillers m^{-2}. The highest mean for number of tillers m^{-2} was shown with Rasheed cultivar plants (409.3 m^{-2}), while the lowest value for the same character was recorded with plants of Buhooth 22 (373.2 m^{-2}). The differences among Rasheed and the two other cultivars were significant, whereas the difference between Buhooth 22 and Buhooth 10 was not significant. This difference between varieties may be due to the genetic nature. as shown in Table (4).

Table (4): Effect of cultivars, MLE concentrations and their interaction on number of tillers (m^{-2})

Cultivars	MLE Concentrations				means
	0	%1	%3	%5	
Rasheed	400.0	413.0	408.6	415.7	409.3
Buhooth 22	365.0	371.3	369.3	387.4	373.2
Buhooth 10	372.3	395.3	382.3	401.0	387.7
L.S.D	N.S				17.93
Mean	379.3	393.2	386.7	401.3	
L.S.D	N.S				

Spike length (cm)

It is evident from the results shown in Table 5. that cultivars, MLE concentrations and their interaction affected significantly to the spike length. Rasheed cultivar produced the tallest spikes (17.38 cm) followed by Buhooth 10 (13.28 cm), whereas shortest spikes were obtained from plants of Buhooth 22 cultivar (13.28 cm), differences in spike length may be attributed to the nature of the genetic makeup. Concerning the effect of different Moringa extract concentrations on spike length data in Table 5. showed that all concentrations of MLE 3% (15.83cm) followed by both 1% (15.18cm) and 5% (14.34cm) lead to significant increases in spike length compared to the tap water (13.94cm). These significant results may be attributed to containing MLE extract on various nutrients that have a role in encouraging plant cells

to grow, divide, Hence the elongation of the axis of the spike. Similar results were shown by Khan et al [17] who found that soaking with Moringa extract increased the length of the spike. Results presented in Table 5. indicated that the studied interaction cultivars and MLE concentrations had a significant effect on spike length. Generally, the highest spike length was given by soaking Rasheed at MLE concentration of 3% (18.60cm), whereas the lowest spike length was produced by planting Buhooth 22 at tap water (12.50cm). as shown in Table (5).

Table (5): Effect of cultivars, MLE concentrations and their interaction on spike length (cm)

Cultivars	MLE Concentrations				means
	0	%1	%3	%5	
Rasheed	16.12	18.46	18.60	16.34	17.38
Buhooth 22	12.50	13.45	13.88	13.27	13.28
Buhooth 10	13.21	13.64	15.02	13.41	13.82
L.S.D	0.57				0.41
Mean	13.94	15.18	15.83	14.34	
L.S.D	0.32				

Dry weight (g m^{-2})

Results in Table 6. clearly indicated that cultivars had a significant effect on dry weight per unit area. Rasheed had the highest dry weight (1243.3 g m^{-2}) followed by Buhooth 22 (1191.0 g m^{-2}), while the lowest dry weight

(1115.0 g m^{-2}) was produced with Buhooth 10. These results might be attributed to the Increasing the vegetative growth represented by plant height and leaf area (Table 2,3) of Rasheed cultivar led to an increase in the dry matter production and then the dry weight. Also, this difference between the cultivars is attributed to the genetic nature and the extent of utilization of growth factors. The highest dry weight (1283.3 g m^{-2}) was produced from seed soaked at MLE concentration of 3% followed concentration of 1% (1215.9g m^{-2}) than concentration of 5% (1145.5g m^{-2}), while the lowest number of the trait was recorded at soaking seed of tap water (1087.8 g m^{-2}). The reason behind the highest dry weight obtained at MLE concentrations This may be attributed to the effect of soaking with Moringa extract in activation of meristematic tissues, division and elongation of cells, leading to an increase in dry weight. Results presented in Table 6. indicated that the studied interaction i.e. cultivars and concentrations of the extract had a significant effect on dry weight. Generally, the highest value was obtained when Rasheed was soaking at MLE concentration of 3% (1340.7g m^{-2}), whereas the lowest value was recorded with Buhooth 10 at soaking of tap water (984.8g m^{-2}). as shown in Table (6).

Table (6): Effect of cultivars, MLE concentrations and their interaction on dry weight (g m^{-2})

Cultivars	MLE Concentrations				means
	0	%1	%3	%5	
Rasheed	1159.0	1260.7	1340.7	1212.7	1243.3
Buhooth 22	1119.5	1205.4	1279.1	1160.1	1191.0
Buhooth 10	984.8	1181.5	1230.0	1063.8	1115.0
L.S.D	62.26				49.69
Mean	1087.8	1215.9	1283.3	1145.5	
L.S.D	33.07				

Biological yield (t ha^{-1})

The biological yield is defined as the dry weight of the vegetative part plus the grain yield. It expresses the net process of photosynthesis during the life cycle of the crop and is affected by genetic and environmental factors [27] and [28]. It is obvious from Table 7. that the effect of cultivars on biological yield per unit area was significant. Mean biological yield comparisons indicated that the highest biological yield belonged to Rasheed (12.45tha^{-1}), whereas the lowest biological yield was obtained from Buhooth 10 (11.39 tha^{-1}). The superiority of Rasheed cultivar in biological yield is due to its superiority in all growth traits. Extract concentrations showed significant differences among treatments for biological yield (Table 7). The biological yield increased with increasing concentrations from 1% till 3%, then followed with a decrease at the concentration of 5% has inhibitor effect. Maximum biological yield (12.24 tha^{-1}) was recorded with concentration of 3% while the minimum biological yield (11.34 tha^{-1}) was obtained with control tap water. The reason for the increase in biological yield may be attributed to the effect of soaking with MLE in increasing cytokinin, which leads to delaying the senescence of leaves and the move of metabolites from the source to the apex of the developing meristematic tissues leading to an increase in the vegetative parts of the plant and an increase in dry matter [29], Similar results were shown by Rehman et al. [13]. Regarding the interaction, The highest number of biological yield (t ha^{-1}) was reported when plants of the cultivar Rasheed seed soaked at concentration of 3% (12.75 tha^{-1}), while the lowest number for the same character were obtained with plants of cultivar Buhooth 10 when seed soaked at tap water (10.87 tha^{-1}). as shown in Table (7).

Table (7): Effect of cultivars, MLE concentrations and their interaction on Biological yield (t ha^{-1})

Cultivars	MLE Concentrations				means
	0	%1	%3	%5	
Rasheed	12.15	12.51	12.75	12.40	12.45
Buhooth 22	11.01	11.74	12.07	11.41	11.56
Buhooth 10	10.87	11.56	11.88	11.23	11.39
L.S.D	0.30				0.16
Mean	11.34	11.94	12.24	11.68	
L.S.D	0.19				

Conclusions

As a general from this study, it can be said that, soaking bread wheat seeds with Moringa leaf extract at concentration of 3% for 12h was the superior treatment to obtain the maximum values of vegetative growth and biological yield to increase efficiency of production.

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