EFFECT OF FOLIAR APPLICATION OF MORINGA LEAVES EXTRACT ON YIELD AND QUALITY OF BREAD WHEAT

Sura J. B **I. H. H. Al-Hilfy**
Lecturer **Prof.**
Dept. of Field Crops, Coll. of Agric. Engin. Sci., University of Baghdad, Iraq
E-mail:Sura.j@coagri.uobaghdad.edu.iq Entsar.hadi@coagri.uobaghdad.edu.iq

ABSTRACT

A field experiment was conducted at the experimental field, Dept. of Field Crops, Coll. of Agricultural Engineering Sciences, University of Baghdad, Al-Jadiriya, Iraq, during the winter seasons of 2018-2019 and 2019-2020, to study the effect of foliar application of moringa leaves extract at different stages of growth and its reflection on yield and quality of bread wheat (*Triticum aestivum L.*) var. Rasheed by determining best concentration and the spraying stage to raise the efficiency of production. A split plot arrangements was used according to RCBD design with three replicates, where the main plots contained three concentrations of moringa leaves extract (1/10, 1/20, 1/30), as well as control treatment (sprayed plants with water) While the sub plots contained three spraying stages (S1: tillering + elongation + booting stage , S2: elongation + booting + 100% anthesis stage, S3: booting + 100% anthesis + grain formation stage). The results showed that the concentration of 1/20 had a significant impact by giving the highest means of quality trails and grain yield 4.73 and 4.84 Mg ha^{-1} for both seasons. Spraying stage S1 recorded highest grain yield 4.45 and 4.56 Mg ha^{-1}for the both seasons while the spray stage S3 recorded the highest rate of quality trails. Therefore, we recommend spraying the moringa leaves extract with concentration of 1/20 in the S1 stage for the highest grain yield while spraying it during the S3 stage to obtaine the highest protein and wet gluten percentage.

Keywords: moringa, grain yield , protein, wet gluten .
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تأثير رش مستخلص اوراق المورينكا في حاصل ونوعية حنطة الخبز

سرى جاسم بندر انتصار هادي حميدي الحلفي
مدرس استاذ
قسم المحاصيل الحقلية– كلية علوم الهندسة الزراعية – جامعة بغداد، العراق

المستخلص

نفذت تجربة حقلية في حقل تجارب قسم المحاصيل الحقلية – كلية علوم الهندسة الزراعية / جامعة بغداد، الجادرية خلال الموسم الشتوي 2018 –2019 و 2019– 2020. بهدف معرفة تأثير رش مستخلص اوراق المورينكا بمراحل نمو مختلفة وانعكاسه على حاصل ونوعية حبة حنطة الخبز (*Triticum aestivum L.*) صنف الرشيد. استعمل تصميم القطاعات الكاملة المعشاة بترتيب الالواح المنشقة بثلاث مكررات. شملت الالواح الرئيسية ثلاثة تراكيز من مستخلص اوراق المورينكا (10/1 و20/1 و30/1) اضافة لمعاملة المقارنة (الرش بالماء فقط) في حين شملت الالواح الثانوية ثلاث مراحل للرش وهي (S1: الرش بمرحلة الاشطاء+ الاستطالة+ البطان ،S2 : الرش بمرحلة الاستطالة + البطان+ 100% تزهير، S3 : الرش بمرحلة البطان + 100% تزهير + تكوين الحبة). اظهرت النتائج ان تركيز 20/1 قد اثر معنويا بإعطاء اعلى متوسط في الصفات النوعية وحاصل الحبوب (4.73 و4.84 ميكاغرام هـ$^{-1}$)، كما تفوق الرش بمرحلة S1 واعطى اعلى متوسط في حاصل الحبوب بلغ 4.45 و4.56 ميكاغرام هـ$^{-1}$ لكلا الموسمين بالتتابع في حين سجل الرش بمرحلة S3 اعلى نسبة في الصفات النوعية. لذا نوصي برش مستخلص اوراق المورينكا بتركيز 20/1 بمرحلة S1 للحصول على اعلى حاصل من الحبوب في حين رشه بمرحلة S3 للحصول على اعلى حاصل من البروتين والكلوتين الرطب.

كلمات مفتاحية: مورينكا، حاصل الحبوب، بروتين، كلوتين رطب.

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INTRODUCATION

Wheat grains is a large and complex biological system as it grows and develops as a result of a complex series of vital processes that begin with taking sunlight and stabilizing carbon in the leaves and ending with the formation of energy and protein components in addition to various nutrients of minerals, vitamins and fibers. Protein is one of the most important components of wheat grain and its composition depends mainly on the effectiveness of the plant by dividing dry matter and nitrogen with grains, the percentage varies between 8-20% and its quality varies depending on the wheat production at different parts of the world in addition to the environmental factors including temperature during the filling period of the grain and fertilizer additives, especially nitrogen, in terms of the percentage, and time of application, as well as soil moisture (5,22).Wheat grain protein consists of two types of proteins, metabolic or structural proteins, which form mainly during the early stage of the grain development when the division of endosperm cells begins, The second type is the stored proteins or gluten which play a role in determining the quality of flour through its effect on water absorption, consistency, viscosity and elasticity when making bread as elastic mass that remains when washing wheat dough after the removal of starch granules and other soluble components in water, Its advantage among the flour grain crops is the ability to form a dough that retains gases and produces a good product of baked goods, especially bread, and these proteins are very complex and represent the main component of wheat protein and percentage 40% of the total protein, and it is formed when the cells of the grain begin to expand after the stopped of division (24,25). One of the challenges facing specialists in the agricultural field at present is to increase food production and improve its quality by use all that is natural and non-industrial to preserve the environment and not to cause any adverse side effects harmful to health, so increased interest in natural plant extracts, which have proven their positive effect in nutrients efficiency and improving vegetative growth and plant development. Leaves extract *Moringa olifera* L. one of the family plants Moringaceae and the most used part of the plant because it contains Zeatin, which is a natural source of cytokinins (growth regulator) and also contains proteins, minerals and vitamins, which play an important role in increasing the number of roots, accelerate the growth and the strength of plants. Delay the senescence of the leaves, lead to improved source capacity as a result a strong sink and increase the yield by 20-35%(11). researchers (2,16,17) have found that plant extractions increase the yield and improve the quality of different types of crops. The aim of this study is to find out the effect of spraying with moringa leaves extract to the grain yield and quality of the bread wheat var. Rasheed by determining the best concentration and the stage for spraying to raise the efficiency of production.

MATERIALS AND METHODS

An experiment was conducted at the experimental field, Department of Field Crops, College of Agricultural Engineering Sciences, University of Baghdad, Jadiriya, located at latitude of 33^{o} .32´N and longitude of 44^{o} .23´E. during the winter season of 2018-2019 and 2019-2020. Randomized Complete Block Design (RCBD) with in Split plot arrangement with three replicates was used, The moringa leaves extract with three concentrations 1/10,1/20,1/30 in addition to control treatment (spray tap water only) as a main plots, and the second factor was the spraying stages according to Zadoks scale (27) (S1: tillering + elongation + booting stage, S2: elongation + booting + 100% anthesis stage, S3: booting +100% anthesis + grain formation stage) and Control treatment spray tap water only were in sub plots. The net of sub plot area was $4m^2$, which contained 13 lines, 2m long, 15 cm apart, 5 cm depth, Al-Rasheed cv. seeds were planted on 28/11 and 11/11 for both seasons the seeding rate 160 kg ha^{-1} were sown manually with single row hand drilling. Before sowing, soil was analyzed for its physical and chemical properties (0-30) cm were show in Table 1. The compound fertilizer 15:15:15 was added at field preparing for planting, while the nitrogen 260 kg ha^{-1} was applied in a form of urea 46%N in two split 120 kg ha^{-1} at tillering

stage ZGS:20,second 140 kg ha^{-1} at booting stage ZGS:40 (10).

Table 1. Some physical and chemical characteristics of the study soil for both seasons 2018-2019 and 2019-2020

character	O. M %	Fe ppm	Zn ppm	Cu ppm	Mn ppm	B ppm	Mg ppm	Ca ppm	K ppm	P Ppm	N ppm	EC ds.m^{-1}	pH	Silt %	Clay %	Sand %
2018-2019	0.94	3.66	1.58	0.073	0.15	0.28	6.25	8.11	83.56	14.90	101.5	1.6	7.20	298	288	414
2019-2020	0.73	6.22	3.04	0.43	0.30	0.41	8.41	9.22	462.5	2.13	9.45	3.95	7.28	410	80	510

Preparation of moringa leaves extract. Collecting fresh leaves at flowering stage and dried in the shade at room temperature and then milled in the electric mill to get the leaf powder, the weight 100g of powder added the 500 ml of warm distilled water at a temperature of 40 mº and left for drip for 24 hours after which the solution was filtered with the wet cloth and re-filtered again with filter paper and then placed in glass dishes in Oven at a temperature of 40 Cº to get the concentrated extract (9). leaves sample was analyzed before use to determine the proportions of the macro and micro elements and the percentage of protein contained in the leaves of moringa and took the same amount of soft leaves to determine the proportions of anti and non- enzymatic antioxidants (Table 2)

Table 2. Biochemical compounds per 1g of moringa leaves extract

macro elements						micro elements				Anti and non-enzymatic antioxidants		
N%	P%	K%	Ca %	Mg %	Zn %	Cu %	Fe%	Mn %	B%	SOD	POD	CAT
2.01	0.29	0.56	1.44	0.44	0.83	1.01	2.19	0.33	1.40	0.010	0.004	6.128
Total content of phenols						Ascorbic acid					Protein	
5.18						1.33					13%	

• Analysis of major and minor elements and non-enzymatic antioxidants of moringa leaves in graduate laboratories - Central Nutrition Laboratory / College of Agricultural Engineering Sciences - University of Baghdad.

• Protein and enzymatic antioxidants were analyzed for moringa leaves in graduate laboratories - tissue culture laboratory / College of Agricultural Engineering Sciences - University of Baghdad. Data were analysed with analysis of variance and means were compared using the least significant difference at 5% level (23). The studied traits are:

Content of chlorophyll : Determined in the fresh leaves and calculated according to the formulae Total Chlorophyll = 20.2 D (645) + 8.02 D (663) (7) then it was converted into a 100g^{-1} wet weight according to the following formulae: mlg liter^{-1}× final size of extract (liter) x 100/ sample weight (g).

Grain yield (Mg ha^{-1}): At maturity, 0.30 m^2 was harvested manually from each plot and based on moisture 13%.

Protein content %: Total nitrogen content in grains was estimated using Microkjeldhal and the protein ratio was calculated by multiplying nitrogen ×5.7 (4).

Wet gluten content %: Weight of 10 g of flour per sample, plus 6 ml of water until it became dough, and washed the dough of saline solution with concentration 2% Gradually for the purpose of removal of the starch, the gluten were then weighed directly and was calculated from the following equation: (1).

Total wet gluten ratio = wet gluten weight / flour sample weight ×100

RESUITS AND DISCUSSION

Content of chlorophyll: Results in Table 3. indicate a significant effect concentrations of moringa leaves extract on content of chlorophyll. The highest value for this trait (555.8 and 566.3 Mg) was obtained from concentration 1/20, and the lowest value was obtained from control treatment (453.7 and 471.6 Mg per 100 g wet weight) for both seasons, respectively . The increase in this trait could be due to the macro and micro elements contained in the moringa leaves extract such as nitrogen its known role in the synthesis of the molecule chlorophyll or the important role of magnesium, which enters its composition the center of its molecule (3,8). Regarding the spraying stage, results in Table 3. show a significant differences among spraying stage, the highest spraying stage in content of chlorophyll was S1 which had (570.1 and 555.3 Mg per 100 g wet weight), It did not significantly different with the spraying stage S2 while they differ with the stage S3, which gave the lowest value 485.6 and 492.9 mg^{-1} per 100g wet weight for the two seasons respectively. Spraying stage S1 and S2 provide

elements that positively affect the increase of the content of the leaves of chlorophyll until the stage of 100% anthesis, which reaches at this stage to the maximum content (18). The effect of interaction between concentrations of moringa leaves extract and spraying stage was significant for both seasons (Table 3), concentration 1/20 produced the highest content of chlorophyll (594.1 and 606.5 mg^{-1} per 100g wet weight), when spraying at (tillering + elongation + booting stages), whereas control treatment had the lowest content of chlorophyll at all stages of spraying for both seasons.

Table 3. Effect of moringa leaves extract concentrations, spraying stages and their interaction on content of chlorophyll (mg^{-1}) of wheat for 2018-2019 and 2019-2020

Concentrations	2018-2019 Spraying stages				2019-2020 Spraying stages			
	S1	S2	S3	Mean	S1	S2	S3	Mean
Spraying with water only	454.6	446.9	459.6	453.7	471.2	468.2	475.5	471.6
1/10	570.1	533.2	485.6	529.6	595.5	551.8	494.3	547.2
1/20	594.1	550.4	522.8	555.8	606.5	573.4	519.1	566.3
1/30	520.8	509.5	462.2	497.5	548.1	526.5	482.9	519.2
LSD 0.05		38.20		31.99		35.28		19.78
Mean	570.1	533.2	485.6		555.3	530.0	492.9	
LSD 0.05		19.10				17.64		

Grain yield: Grain yield is an important trait which represents the amount of dry matter accumulation over time (6). Data in Table 4. shows that grain yield was significantly influenced by concentrations of moringa leaves extract. The highest value for this trait (4.73 and 4.84 Mg ha^{-1}) was obtained from concentration 1/20, and the lowest value was obtained from control treatment (3.71 and 3.79 Mg ha^{-1}) for both season, respectively. It should be noted that the concentrations of the three extracts was more effect in the grain yield due to the role of the hormone zeatin contained in the extract of the leaves of moringa, known for its increase of the product and by 25-30% through its participation in the movement of carbohydrates and distribution, as zeatin unites with glucose to produce a compound called Zeatin-o- glucoside known as GOS and this compound is characterized by being more active in strengthening plant growth 100 times more than the activity of zeatin and zeatin riboside and plays a vital role in the survival of the plants remains green for long time (12). Similar results were reported by some other authors (14,26).The effect of spraying stage on grain yield was significant as shows in Table 4. The spraying S1 (tillering + elongation + booting stage) gave the highest yield (4.45 and 4.56 Mg ha^{-1}) followed by S2 (elongation +booting+ 100% anthesis stage) (4.34 and 4.45 t ha^{-1}) and S3 (booting +100% anthesis + grain formation stage) (4.12 and 4.21 t ha^{-1}) for both seasons, respectively. This result in agreement with other researchers (11,26) they refers to increase grain yield with spraying the moringa leaves extract in the stage of (tillering+ elongation + booting). The effect of interaction between concentrations of moringa leaves extract and spraying stage was significant for both seasons (Table 4). This differences due to differences among concentrations to spraying stages. Concentration 1/20 produced the highest grain yield (4.86 and 4.98 Mg ha^{-1}) when spraying at (tillering + elongation + booting stages) , whereas control treatment produced the lowest grain yield at all stages of spraying for both seasons.

Table 4. Effect of moringa leaves extract concentrations, spraying stages and their interaction on grain yield (Mg ha^{-1}) of wheat for 2018-2019 and 2019-2020

Concentrations	2018-2019 Spraying stages				2019-2020 Spraying stages			
	S1	S2	S3	Mean	S1	S2	S3	Mean
Spraying with water only	3.71	3.70	3.72	3.71	3.80	3.77	3.79	3.79
1/10	4.79	4.64	4.31	4.58	4.90	4.85	4.39	4.71
1/20	4.86	4.82	4.51	4.73	4.98	4.92	4.63	4.84
1/30	4.45	4.19	3.96	4.20	4.57	4.26	4.02	4.28
LSD 0.05		0.21		0.12		0.20		0.13
Mean	4.45	4.34	4.12		4.56	4.45	4.21	
LSD 0.05		0.12				0.11		

Protein content (%): Concentrations of moringa leaves extract had significant effect on protein content for both seasons (Table 5). Highest protein content (13.01 and 13.13 %) was recorded from the concentration 1/20, while the lowest protein content (11.34 and 11.38%) were obtained from control in both seasons, respectively. These results may be due to the nitrogen content found in the moringa leaves extract, which is the main component of enzymes and nuclear acids, as the nitrogen absorbed by the plant is mainly in the form of nitrate and ammonium, ammonium combined with carbon to form Glutamic acids and builds protein from different associations of amino acids, or the sulfur effect that is include in the formation of amino acids to synthesis protein (13). Regarding spraying stage, S3(booting +100% anthesis + grain formation stage) produced highest protein content (12.95 and 13.01%), followed by S2 (elongation + booting + 100% anthesis stage) (12.62 and 12.45 %) and S1 (tillering + elongation + booting stage) (12.01 and 12.02 %) for both seasons, respectively. These results might be due to that the quality of the grain depends directly on the efficient utilization of the photosynthesis process during the anthesis stage (20), and the late-stage S3 and S2 stage increased the duration of the leaves to be more active and delay the senescence, These results are in harmony with those obtained by Seilsepour (21) who found that the spraying of moringa leaves extract after the anthesis increase protein rate. Table 4 shows that the effect of interaction the similarity of all the concentrations of moringa leaves extract at the different spraying stages, shows that these concentrations were effective by increasing the protein percentage at the spraying stages after the anthesis, the highest mean gave at the concentration 1/20 with spray stage S3 (13.01% and 13.76%) for both seasons respectively while the lowest mean for this trail was from control treatment for both seasons.

Table 5. Effect of moringa leaves extract concentrations, spraying stages and their interaction on the protein content of wheat (%) for 2018-2019 and 2019-2020

Concentrations	2018-2019 Spraying stages				2019-2020 Spraying stages			
	S1	S2	S3	Mean	S1	S2	S3	Mean
Spraying with water only	11.41	11.26	11.34	11.34	11.45	11.21	11.47	11.38
1/10	12.20	13.08	13.45	12.91	12.10	12.85	13.55	12.83
1/20	12.34	13.13	13.56	13.01	12.48	13.15	13.76	13.13
1/30	12.08	13.01	13.43	12.84	12.06	12.75	13.27	12.69
LSD 0.05		0.31		0.26		0.52		0.44
Mean	12.01	12.62	12.95		12.02	12.45	13.01	
LSD 0.05		0.15				0.26		

Wet gluten content %: It is reved from Table 5. that the effect of moringa leaves extract conc., spraying stages and the interaction between the two factors were significant on this trait for both seasons. Highest wet gluten content was recorded (33.04 and 33.68%) when wheat plants sprayed with the concentration 1/20, while the control

treatment, which recorded lowest mean of this trait (30.26% and 30.39%) for both seasons, respectively. This increases with concentration of moringa leaves extract could be due to the effect of nitrogen in the extract enters into the synthesis of gluten by affecting the increase of gliadins and thus affecting the percentage of proteins that make up gliadin/glutenin (15, 19). Regarding the spraying stages. results in Table 5. the highest wet gluten content was in S3 (booting +100% anthesis + grain formation stage) (33.09 and 33.58%) followed by S2 (elongation + booting + 100% anthesis stage) (32.48 and 32.85%) and S1 (tillering + elongation + booting stage) which produced (31.11 and 31.56%) during both seasons, respectively. The reason is that gluten are the main component of protein and the increase in protein content leads to an increase in gluten (19). Table 5 shows the similarity of the effect of all the concentrations of moringa leaves extract at the different spraying stages and shows that these concentrations were effective by increasing the percentage of gluten at the spraying stages after the anthesis and that the highest value obtained from use of 1/20 at the spraying stage S3 (33.04 and 34.88%) while the control treatment with all spraying stages gave the lowest mean for both seasons.

Table 5. Effect of moringa leaves extract concentrations, spraying stages and their interaction on the wet gluten content of wheat (%) for 2018-2019 and 2019-2020

Concentrations	2018-2019 Spraying stages				2019-2020 Spraying stages			
	S1	S2	S3	Mean	S1	S2	S3	Mean
Spraying with water only	30.38	30.15	30.24	30.26	30.48	30.28	30.42	30.39
1/10	31.41	33.29	34.05	32.91	32.18	33.62	34.57	33.46
1/20	31.67	33.35	34.09	33.04	32.26	33.89	34.88	33.68
1/30	30.98	33.13	33.98	32.70	31.34	33.60	34.46	33.13
LSD 0.05		0.49		0.36		0.79		0.58
Mean	31.11	32.48	33.09		31.56	32.85	33.58	
LSD 0.05		0.24				0.40		

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