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EXPLORATION OF MORINGA LEAVES EXTRACT AS SEED SOAKING AND FOLIAR TREATMENT FOR FABA BEAN

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ABSTRACT: Laboratory and field experiments were designed to investigate the influence of moringa leaves extract concentrations as seed soaking and foliar treatments on seed germination characters, field emergence, growth and yield as well as its attributes of faba bean (cv Sakha 1). Moringa leaves extract concentrations under study for both seed soaking and foliar treatments were (0, 5, 10 and 15 g/l). The results could be summarized as follows: Soaking faba bean seed in moringa leaves extract, generally recorded significant effect on all germination and seedling characters except germination (%). Soaking faba bean seed in moringa leaves extract (10 g/l) gave the highest values of field emergence (%), emergence index and seedling characters compared with soaking in distilled water. Moringa leaves extract as a seed soaking treatment had significant effect only on branch/m² and seed yield (kg/fad). No significant differences of all characters under study were obtained between soaking seed in distilled water and soaking in moringa leaves extract concentration (5g/l). Application moringa leaves extract (10 g/l) as a foliar in the field, recorded the highest values of growth and yield characters compared with control. It could be concluded that seed soaking and foliar application of moringa leaves extract concentration (10 g/l) was a successful way to improve field emergence and seed yield of faba bean (cv. Sakha 1).

Key words: Faba bean, moringa, leaves, extract, germination.

INTRODUCTION

Faba bean (*Vicia faba* L.) is a primary source of vegetable protein and carbohydrates in human food and animal feed. However, the total production of this crop is still insufficient to cover the local consumption. There is a great need to overcome this gap between local production and consumption demand. *Moringa oleifera* leaves extract (MLE) is considered one of the plant biostimulants, which are substances when applied as seed soaking and/or foliar spray positively modify plant growth (Rady *et al.*, 2015). Moringa leaves extract can be recommended to be used effectively by farmers as a bio-organic fertilizer for various crops due to its high productivity, high nutritive value, antioxidant effect, easy preparation, low cost and environmentally friendly nature (Mona, 2013).

Basra *et al.* (2011) reported that priming maize seed with moringa leaves extract (MLE) diluted to 30 times with distilled water, enhanced seedlings traits and speed germination. Safi-naz and Rady (2015) demonstrated that moringa leaves extract application used as seed soaking or foliar spray, significantly increased growth characteristics (*i.e.*, shoot length, number and area of leaves per plant, and plant dry weight), physio-chemical attributes (*i.e.*, total chlorophylls, total carotenoids, total soluble sugars, free proline and ascorbic acid, contents of N, P, K and Ca, and ratios of K/Na and Ca/Na). According to Mehboob (2011) osmopriming of maize seed with moringa leaves extract reduced mean emergence time (MET) (8.967 *vs.* 9.097 days) and increased final emergence percentage (FEP) (83.33 *vs.* 86.333) under optimum compared to control.

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A plant growth spray made from moringa leaves increased crop production as such as 20-35%, moringa extract spray improves the crops by heavier roots, stems and leaves, increasing in yield as much as 20-35% (Foidle *et al.*, 2001). Using MLE priming in wheat under normal conditions was found to be effective and improved the seedling emergence rate, speed, early growth, level of antioxidants, leaves total soluble protein and chlorophyll contents as compared to control (Yasmeen, 2011). The present study aimed to evaluate extract of moringa leaves as a seed soaking treatment and foliar spray treatment for improving emergence, growth and yield of faba bean.

MATERIALS AND METHODS

Laboratory and field experiments were carried out during 2014/2015 and 2015/2016 seasons at the Laboratory of Seed Technology

Research Unit, Mansoura and Experimental Farm of Tag Al-Ezz, Agric. Res. Station, ARC, Dakahlia Governorate, Egypt, to study the effect of moringa leaves extract with four concentrations (0, 5, 10, 15 g/l) as either seed soaking treatment or foliar application on field emergence, growth and yield of faba bean (cv Sakha 1). Seeds were obtained from Central Administration of Seed Production (CASP).

Preparation of Moringa Leaves Extract

Moringa leaves (*Moringa oleifera*) were cleaned thoroughly, dried in room temperature and then crushed into coarse powder and 5, 10 and 15 g of the powder were weighted and soaked separately in 1 liter of distilled water. All preparations were kept on a Shaker for 3 days. Then filtered through cheese cloth. Chemical composition of Moringa leaves extract according to US Department of Agriculture (2013) is shown in Table 1.

Table 1. Chemical composition of moringa leaves extract (100 g)

Nutrient	Amount in 100 grams
Energy (Kcal, MJ)	64
Protein (g)	9.4
Carbohydrates (g)	8.3
Fiber, crude (g)	2
Ca (mg)	185
P (mg)	112
Na (mg)	9
K (mg)	337
Fe (mg)	4
Zn (mg)	0.6
Cu (mg)	0.15
Thiamin (mg)	0.26
Riboflavin (mg)	0.66
Vitamin B-6 (mg)	1.2
Vitamin A (µg RAE)	378
Vitamin C (mg)	52
Vitamin E (mg)	25

Laboratory Experiment

Faba bean seeds were soaked in moringa leaves extract with concentrations (5, 10 and 15 g/l) and distilled water as a control for 6 hours before incubation in growth chamber at 20°C for 14 days and germination was observed daily to study the following characters:

1. Germination percentage (G%): It was calculated by counting only normal seedlings 14 days after planting according to (ISTA Rules, 1999).
2. Speed germination index (SGI): It was calculated as described in the Association of Official Seed Analysis (AOSA, 1983).
3. Seedling length (cm): It was measured from ten normal seedlings, 14 days after planting.
4. Seedling dry weight (g): Ten seedlings were dried in hot-air oven at 85°C for 12 hours and weighted 14 days after planting.

Field Experiment

Two field experiments were conducted at Tag Al-Ezz, Agric. Res. Station. The preceding summer crop was rice (*Oryza sativa* L.) in both seasons. The soil of trial field was analyzed as shown in Table 2.

The experimental design was strip plot design with four replicates. The horizontal plots included the four seed soaking treatments with different concentrations of moringa leaves extract for 6 hr., as follows (Distilled water, 5 g/l, 10 g/l and 15 g/l).

The vertical plots were allocated to four moringa leaves extract foliar treatments as follows (Without foliar application, 5 g/l, 10 g/l and 15 g/l).

The area of each experimental plot was 10.5 m², including five ridges each of 3.5 meters long and 60 cm width. Calcium super phosphate (15.5% P₂O₅) was applied at a rate of 150 kg/faddan during the appropriate soil preparation and before sowing. Nitrogen fertilizer (in the form of urea 46.5%) was applied at the rate of 15 kg N/fad., before the first irrigation. Seeds were sown on Nov. 10th and 20th at the first and second seasons, respectively in hills of 20 cm apart on one side of the ridge. Seeding rate was 2 seeds for hill, with approximate 70000

plant/fed and without replanting absent hills. Foliar application treatments applied twice, the first was at 20 days after sowing and the second was at 30 days after sowing using 1.5 liter of solution for each experimental plot.

Field Measurements

1. Field emergence (%): It was determined after 14 days from planting 400 seeds at area of 1.0 m².
2. Field emergence Index (FEI): In this index, the higher the value, the better the field conditions until FEI=1.0, so that FE=G (ideal). The field emergence index for each experiment was calculated based on the procedure used by Egli and Tekrony (1996) according to the following equation:

$$FEI = \frac{FE}{G}$$

Where:

FEI = Field emergence index; FE = Mean seedling field emergence of all seed lots; G = Mean standard germination of all seed lots.

Growth and Yield Characters

Ten plants were randomly chosen from the central ridges of each plot at harvest to estimate plant height (cm), branch number /plant, pod number /plant and seed weight/plant. Branch number/ m² were estimated by counting number of branch in 8 hills and seed yield (kg/fad.) was harvested from plot (10.5 m²) for each treatment.

All obtained data were subjected to the statistical analysis according to the technique of analysis of variance (ANOVA) of completely randomized design for laboratory experiment and strip plot design for the field experiment, as described by Gomez and Gomez (1984).

RESULTS

Seed germination percentage, field emergence (%), field emergence index, speed germination index, seedling length (cm) and seedling dry weight (g) of faba bean during two seasons are shown in Tables 3 and 4. Pre-sowing soaking of faba bean seeds with moringa extract at concentration (10 g/l) was superior in field emergence (%) and emergence index compared

Table 2. Chemical analysis of soil at experimental site in 2014/15 and 2015/16 seasons

	Organic matter (%)	Salinity dS/m	PH	Available N (ppm)	Available P (ppm)	Exchangeable K (ppm)
Season 2014/15	1.8	1.9	7.7	31.6	5.4	223
Season 2015/16	1.7	2.2	8.2	30.5	3.8	217

Table 3. Germination (%), field emergence (%) and field emergence index of Sakha 1 faba bean cultivar as affected by seed soaking in moringa leaves extract concentrations in both seasons (2014-15, 2015-16)

Moringa leaves extract concentration	Germination (%)		Field emergence (%)		Field emergence index	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Soaking						
Distilled water	92	90	87	85	0.95	0.94
5 g / l	92	91	88	86	0.96	0.95
10 g/l	92	91	90	88	0.98	0.97
15 g/l	89	89	83	82	0.93	0.92
F. test	NS	NS	**	**	**	**
LSD at 5 %	-	-	3	2	0.02	0.02

Table 4. Speed germination index, seedling length (cm) and seedling dry weight (g) of Sakha 1 faba bean cultivar as affected by seed soaking in moringa leaves extract concentrations in both seasons (2014-15, 2015-16)

Moringa leaves extract concentration	Speed germination index		Seedling length (cm)		Seedling dry weight (g)	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Soaking						
Distilled water	20.8	20.2	23.0	22.6	0.298	0.294
5 g/l	21.5	20.7	23.5	23.0	0.307	0.302
10 g/l	23.5	23.0	25.2	24.3	0.319	0.316
15 g/l	19.8	19.2	21.9	21.0	0.284	0.282
F. test	**	**	**	**	**	**
LSD at 5%	0.8	0.6	0.7	0.6	0.011	0.010

with other concentrations. Also, 10 g/l concentration recorded the fastest speed germination index, tallest seedling length and heaviest seedling dry weight. On contrast, (15 g/l) moringa leaves extract concentration gave the lowest values of mentioned parameters in Table 3. Germination (%) didn't affect by moringa leaves extracts as a seed soaking treatment. No significant differences of characters in Tables 3 and 4 were obtained between soaking faba bean seed with (5 g/l) moringa leaves extract and distilled water.

Tables 5 and 6 shows plant height (cm), branch number/plant, branch number/m², seed weight (g)/plant, pod number/plant and seed yield (kg/fad.) characters of Sakha 1 faba bean cultivar as affected by moringa extract solution as seed soaking and foliar application. Moringa extract concentrations as a seed soaking treatment gave insignificant effect on all characters in Tables 5 and 6 except branch number/m² and seed yield (kg/fad.) characters. Soaking faba bean seeds in moringa leaves extract at (10 g/l) significantly exceeded the other seed treatments in branch number/ m² and seed yield (kg/fad.) but, lowest values of all characters in Tables 5 and 6 were obtained by concentration (15 g/l) of moringa leaves extract as a seed treatment. Also, in branch number/m² and seed yield (kg/fad.) characters no significant differences were obtained between soaking faba bean seed with concentration (5 g/l) moringa leaves extract and distilled water treatment. With respect to moringa leaves extract as a foliar treatment, all characters in Tables 5 and 6 were significantly affected and concentration (10 g/l) of foliar moringa gave the similar behavior of the same concentration as a seed soaking treatment, which was superior compared with other foliar treatments.

Results in Table 7 clearly shows that the interaction between moringa extract solution as a seed treatment and foliar treatment recorded significant effect on branch number/m² and seed yield (kg/fad.) in both seasons under study. Both soaking and foliar faba bean with moringa extract solution at concentration (10g/l) gave the highest values of branch number/m² and seed yield (kg/fad.) in both seasons under study. While, soaking and foliar faba bean with moringa extract solution at concentration (15g/l) produce the lowest values of previous mentioned characters.

DISCUSSION

Soaking faba bean seed in moringa leaves extract in concentration (10 g/l) as a pre-sowing treatment succeeded to promote germination index, field emergence (%), field emergence index and seedling characters as shown in Tables 3 and 4 and these results agreed with those of Noman (2008) who used moringa leaves extract as priming agent in hybrid maize and recorded increasing in germination speed and seedling vigor. Also, Phiri (2010) found that priming with moringa extract solution increased germination of sorghum, length of maize radicals and hypocotyls of wheat

Also, moringa extract solution as a field treatment in concentration (10 g/l) recorded good results. Several workers reported that using moringa extract solution as a field treatment is effective, it may be due to that moringa extract is a natural source of cytokinin, moringa leaves is also rich in ascorbates, carotenoids, potassium and have plant growth promoting capabilities and often applied as exogenous plant growth enhancers (Foidle *et al.*, 2001). Siddhuraju and Becker (2003) studied the antioxidants properties of moringa leaves extract and demonstrated that it: reduced potassium ferricyanide, scavenged superoxide radicals, prevented the peroxidation of lipid membrane in liposomes, could donate hydrogen and scavenge radicals. The effectiveness of moringa is because its leaves are rich source of PGR hormone, zeatin, ascorbic acid, Ca and K. Moringa leaves are potential source of vitamin A and C, iron, calcium, riboflavin, beta-carotene and phenolic acid (Nambiar *et al.*, 2005). some assessments in moringa leaves as follow, 40139 µg/100g total carotenoides on fresh weight basis in moringa leaves , 19210 µg/100g was β-carotene. Ascorbic acid at 6.6 mg/g on dry weight basis, 0.26 mg/g Fe, 22.4 mg/g calcium, 6.3 mg/g P, 11.2 mg/g oxallic acid and 0.9 g/100 g fiber (Yasmeen, 2011). It was noted that increasing concentration of moringa extract to 15 g / l recorded negative effect on germination characters, it may be due to allelochemicals released from moringa, which inhibited the rate of germination (Moktar Hossain *et al.*, 2012). It could be concluded that seed soaking and foliar application with moringa leaves extract concentration (10 g/l) is effective in improving emergence, growth and yield characters of faba bean.

Table 5. Plant height (cm), branch number/plant and branch number/m² of Sakha 1 faba bean cultivar as affected by moringa leaves extract concentrations as a seed soaking and foliar in both seasons(2014-15, 2015-16)

Moringa leaves extract concentration	Plant height (cm)		Branch number/plant		Branch number/m ²	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Seed soaking						
Distilled water	86.9	86.5	3.6	3.5	44.9	44.1
5 g/l	87.0	86.6	3.6	3.5	45.8	44.6
10 g/l	87.0	86.8	3.6	3.5	47.4	46.5
15 g/l	86.3	85.9	3.5	3.4	40.4	38.9
F. test	NS	NS	NS	NS	**	**
LSD at 5%	-	-	-	-	1.0	0.9
Foliar application						
Without	86.6	86.2	3.5	3.4	43.7	43.7
5 g/l	87.1	86.7	3.6	3.5	44.7	43.7
10 g/l	88.1	87.6	3.8	3.6	47.8	45.5
15 g/l	85.6	85.1	3.5	3.3	42.2	41.1
F. test	**	**	*	*	*	*
LSD at 5%	0.8	0.6	0.2	0.1	1.8	1.5

Table 6. Seed weight (g)/plant, pod number/plant and seed yield (kg/fad.) of Sakha 1 faba bean cultivar as affected by moringa leaves extract concentrations as a seed soaking and foliar in both seasons(2014-15, 2015-16)

Moringa leaves extract concentration	Seed weight (g)/plant		Pod number/plant		Seed yield (kg/fad.)	
	2014/2015	2015/2016	2014/2015	2015/2016	2014/2015	2015/2016
Seed soaking						
Distilled water	22.4	21.7	18.5	18.0	1242	1177
5 g/l	22.5	21.9	18.5	18.0	1255	1196
10 g/l	22.5	22.0	18.6	18.1	1315	1270
15 g/l	21.8	21.7	18.3	17.9	1116	1061
F. test	NS	NS	NS	NS	**	**
LSD at 5%	-	-	-	-	28	25
Foliar application						
Without	22.1	21.5	18.2	17.5	1220	1165
5 g/l	22.5	22.1	18.5	17.9	1241	1182
10 g/l	23.1	22.6	19.5	18.9	1273	1212
15 g/l	21.7	21.2	17.7	17.3	1195	1146
F. test	**	**	**	**	**	**
LSD at 5%	0.5	0.4	0.8	0.8	29	27

Table 7. Branch number/m² and seed yield (kg/fad.) of Sakha 1 faba bean cultivar as affected by interaction between moringa extract solution as a seed soaking and foliar in both seasons

		2014/2015				2015/2016			
		(Moringa extract) foliar				(Moringa extract) Foliar			
		Without foliar	5 g/l	10 g/l	15 g/l	Without foliar	5 g/l	10 g/l	15 g/l
		Branch number/m²							
Soaking (Moringa leaves extract)	Distilled water	44.0	45.1	47.8	42.5	43.8	45	46.3	41.3
	5 g/l	44.7	46.0	48.9	43.4	46.3	43.7	46.2	42.2
	10 g/l	46.0	47.5	51.3	44.7	46.5	46.6	49.6	43.1
	15 g/l	40.1	40.2	43.2	38.2	38.3	39.4	40.1	38
	F. test	**				**			
	LSD at 5%	1.4				1.2			
		Seed yield (kg/fad.)							
Soaking (Moringa leaves extract)	Distilled water	1242	1248	1270	1209	1172	1178	1209	1151
	5 g/l	1240	1268	1301	1212	1175	1209	1246	1154
	10 g/l	1303	1320	1372	1268	1272	1273	1299	1239
	15 g/l	1097	1128	1149	1092	1042	1068	1093	1041
	F. test	**				**			
	LSD at 5%	32				28			

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استكشاف مستخلص أوراق المورينجا كمعاملة نقع تقاوي ورش لل فول البلدي

فيصل إبراهيم يوسف - مجدي سعد الدين أبو الذهب

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قسم بحوث تكنولوجيا البذور - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية - مصر

أجريت تجربتان أحدهما معملية والأخرى حقلية بمعمل قسم بحوث تكنولوجيا البذور بالمنصورة ومحطة بحوث تاج العز الزراعية على الترتيب خلال عامي ٢٠١٤ / ٢٠١٥ و ٢٠١٥ / ٢٠١٦م في تصميم الشرائح المتعامدة في أربع مكررات بهدف دراسة تأثير مستخلص أوراق المورينجا كمعاملة نقع تقاوي قبل الزراعة ومعاملة رش حقلية على صفات النباتات، التكشف الحقلي، النمو والمحصول للفول البلدي صنف سخا ١ وكانت معاملات نقع التقاوي بمستخلص أوراق المورينجا بتركيزات (ماء مقطر، ٥، ١٠، ١٥ جم/لتر) في الشرائح الأفقية، ومعاملات الرش بمستخلص أوراق المورينجا (بدون رش، ٥، ١٠، ١٥ جم/لتر) في الشرائح الرأسية ويمكن تلخيص أهم النتائج فيما يلي: أظهرت النتائج أن النقع بمستخلص أوراق المورينجا كان له تأثير معنوي على صفات قوة البذور والبادرات والتي تم قياسها بواسطة (دليل الإنبات، نسبة الانبثاق، دليل الانبثاق، طول البادرات والوزن الجاف للبادرات) وقد سجلت معاملة النقع بمستخلص أوراق المورينجا بتركيز (١٠ جم/لتر) أعلى القراءات مقارنة بالكونترول (نقع التقاوي في ماء مقطر) في كل الصفات السالف ذكرها، بينما لم يكن النقع بمستخلص أوراق المورينجا له تأثير معنوي على النسبة المئوية للإنبات، لم يظهر مستخلص أوراق المورينجا كمعاملة تقاوي تأثيراً معنوياً على الصفات الحقلية (طول النبات، عدد الفروع/نبات، وزن البذور/نبات وعدد القرون/نبات)، بينما كان له تأثير معنوي على صفتي عدد الفروع/متر^٢ ومحصول البذور (كجم/فدان)، أشارت النتائج أن الرش بمستخلص المورينجا كان له تأثير معنوياً على كل الصفات الحقلية تحت الدراسة، وسجلت المعاملة (رش بمستخلص أوراق مورينجا بتركيز ١٠ جم/لتر) أعلى القيم للصفات الحقلية تحت الدراسة مقارنة بمعاملة الكونترول (بدون رش)، كان للتفاعل بين النقع بمستخلص أوراق المورينجا والرش به تأثيراً معنوياً على عدد الفروع/م^٢ ومحصول البذور (كجم للفدان) وقد سجلت معاملة النقع في مستخلص أوراق المورينجا (١٠ جم/لتر) + الرش بمستخلص أوراق المورينجا (١٠ جم/لتر) أعلى القيم لصفة محصول البذور (كجم/ فدان)، توصي هذه الدراسة بنقع تقاوي الفول البلدي (صنف سخا ١) قبل الزراعة في مستخلص أوراق المورينجا (١٠ جم/لتر) مع الرش الحقلي بمستخلص أوراق المورينجا بنفس التركيز لتحقيق أفضل تكشف حقلي وأعلى إنتاجية لمحصول الفول البلدي تحت ظروف محافظة الدقهلية.

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