Evaluation of Faba Bean (*Vicia faba* L.) Performance under Various Micronutrients Foliar Applications and Plant Spacing

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Abstract: A pot and field experiments were carried out under Middle region of Saudi Arabia conditions to investigate the responses of two faba bean genotypes (local cultivar Hassawi 2 and new developed Population 4) to micronutrients foliar application and plant spacing. A field experiment was laid out in split-split plot design with three replications during 2012-2014 successive growing seasons. Faba bean genotypes placed in main plots, the sub-plots were devoted to micronutrient foliar application. Five foliar application treatments were applied (Control (Water), Fe, Zn, B, mixture Fe+ Zn+ B) and the three plant spacing treatments (10cm, 15cm and 20cm between hills) were applied as sub-sub plots. For better root characters assessment, pot experiment was arranged in factorial experiment design under cage where the two faba bean genotypes were sown and sprayed by the same micronutrient foliar application treatments. The results showed positive effect of foliar application on the performance of faba bean genotypes. The newly developed genotype Population 4 had higher estimates than the local cultivar Hassawi 2for most of the studied characters and surpassed it by 34.5% and 20.7% under spray by mixed foliar (Fe+Zn+B) in seed yield per plant and yield per hectare, respectively. Responses of Population 4 to fertilizer were higher than Hassawi 2, the more adapted genotype to poor environments. Comparing with control treatment, the mixed foliar treatment were higher 13.3% for seeds/pod to 25.7% for seed yield/plant. Zn and B treatments increased faba seed yield per plant and per hectare by 13.3 and 13.8% & 17.6 and 17.2%, respectively. The results showed that Boron was more crucial for enhancing seed yield while vegetative growth were improved under Zn application treatment, the highest number of leaves were recorded. Faba bean seed yield/ha were significantly affected by plant density treatments. The highest seed yield/plant was achieved by mid density (15cm between hills) treatment. Results of pot experiment proved that the better performance of population 4 were also due to its longer and better roots architecture under foliar application, while, Hassawi 2 was taller and had heavier shoots. Iron played visible role in root characters. Plants received Fe, Zn and mixed foliar treatments had better root characteristics.

[Abd El-azeem K. Salem, Ehab H El-Harty, Megahed H. Ammar and Salem S. Alghamdi. **Evaluation of Faba Bean (*Vicia faba* L.) Performance under Various Micronutrient Foliar Applications and Plant Spacing.** *Life Sci J*2014;11(10):1298-1304]. (ISSN:1097-8135). http://www.lifesciencesite.com. 191

Key Words: faba bean, micronutrients, foliar application, plant spacing

1. Introduction

Faba bean (*Vicia faba* L.) is one of the earliest domesticated field crop in the world; the earliest known archaeological remains are from the Neolithic period (6800 - 6500 B.C.) in the Mediterranean region. It is cultivated in more than 50 countries; with China accounting for a large fraction of world production. The total world production was 5.1 million tons in 2011. Faba bean seeds are rich in protein, vitamins and mineral salts and thus it is considered a daily meal for poor people in many parts in the world. A wide variability among faba bean genotypes are presented in publications Faba bean produce 6 t/ha seed under well managed environments (Saxena *et al.,* 1986). As a result of agriculture intensification and cropping systems, soil has become significantly poor in micronutrients content, also micronutrients are inadequately supplied to the soil for different reasons also, making it a critical factor for crop production and quality. Improving plant micronutrient status by foliar application would be very important for sustainable and economic crop production. Foliar application could restore the negative effect of nutrients uptake from soil (Fouly *et al*., 2010), and would be a key element of soil fertility sustainability. The application of fertilizer is very effective and useful to maintain sustainable agriculture (Dewal and Pareek, 2004). Most importantly, micronutrients are involved in the key physiological processes of photosynthesis and respiration (Mengel *et al.,* 2001) and their deficiency can impede these vital physiological processes and thus limiting yield gain. For example, iron (Fe) plays a crucial role, being a cofactor of enzymes of the reductive assimilatory pathway (Marschner 1997). Biochemical changes result in an increased ability to acquire Fe, and include the induction of a plasma-membrane Fe(III)-reductase and an Fe(II) transporter, an enhanced proton extrusion capacity, and the release of low molecular weight compounds such as carboxylates, flavins and phenolic compounds (Abadía *et al*., 2002). In some cases, however, Fe application might cause nutritional disorder due to the antagonistic effect of Fe with other cationic micronutrients (Ghasemi-Fasaei and Ronaghi, 2008).

Zinc (Zn) as a heavy metal in soil compounds with chloride phosphate, nitrate and sulphate anions. It can be critical in case of deficiency (Kacar and Katkat, 2007). Zinc has important functions in protein and carbohydrate metabolism and activates many enzymes; tryptophan synthetase, superoxide dismutase, and dehydrogenises. Therefore, low Zn reduces the plant protein content (Salardyny and Mojtahedi, 1998). Furthermore, zinc is an element that directly affect yield and quality because of its activity in biological membrane stability, enzyme activation ability and auxin synthesis (Marschner, 1997) and a key element for root and shoot growth during the growing season (Renjel, 2001).

Boron (B), is necessary for translocation of sugars, increased reproduction and germination of pollen grains. It tends to keep calcium in soluble form within the plant and also act as regulator of potassium ratios. Boron has significant role in cell wall formation (O'Neill *et al.,* 2004), cellular membrane functions (Goldbach *et al*., 2001), and anti-oxidative defense systems (Cakmak and Romheld, 1997). Boron deficiency is a worldwide problem for field crop production (Wei *et al.,* 1998) and availability of B to plants is affected by a variety of soil factors (Goldberg *et al*., 2000).

In agricultural systems, yield efficiency is affected by interaction between genetic, agriculture and environmental factors. Seed rate, fertilizers, time of irrigation and row spacing are among the main factors and are essential for higher yield potential (Shahin and Valiollah, 2009). The reflex of legume plants to different plant densities was studied by many researchers (Ayaz*et al.,* 2004; Tawaha and Turk, 2004; Dahmardeh *et al*., 2010). Talal (2006) and Ali *et al.* (2010), reported that the higher row spacing resulted a high seed yield, While the yield of faba beans was increased with decreased planting distances to 20cm between rows (Amer *et al.* 2012), and 15 cm between rows (Abou-Amer *et al.,* 2014). The objective of this study was to assess the effect of micronutrient foliar application and plant spacing on vegetative growth and yield performance of two selected faba bean genotypes.

2. Material and methods

This study was conducted to study the response of two faba bean genotypes to micronutrients foliar application and plant spacing under arid environment of the Middle region of Saudi Arabia during 2012-2014 successive seasons. Two independent experiments, field and pot experiments were carried out using two faba bean genotypes; local cultivar Hassawi 2 and new developed genotype Population 4.

The first experiment was conducted in open field of Dirab Agriculture Research and Experimental Station (South Riyadh (24o 43' 34" N, 46o 37' 15" E, Alt 600m), King Saud University. The soil texture was loam-sandy whose physiochemical attributes are shown in Table (1). Five foliar application treatments were applied; of micronutrients were Fe, Zn, B, combination (Fe + Zn + B) with 4g /L (12.5 %) as well as tap water were applied by spraying the two genotypes plants at 40 days and 55 days after sowing. Experiment was designed as Split- Split Plot trial with three replications where main plots were devoted to faba bean genotypes, foliar application of micronutrients was placed as subplots. Five foliar application treatments were used (Control (Water spray), Fe, Zn, B and combined micronutrient Fe+ Zn+ B). Three plant spacing treatments were located in sub-sub plots. Plant spacing treatments were; (10cm, 15cm and 20cm between hills with one plant per each). Seeds were sown in rows with one seed per hall in the first week of November in the two seasons. Each plot consisted of eight ridges, three meter length, and 50 cm apart. At physiological maturing stage, five plants per plot selected randomly to measure leaf area and no. of leaves per plant. To measure the yield components, five plants were randomly selected from the middle rows at the time of harvest then; their yield components including plant height, no. of branches, no. of pods, no. of seeds, seed yield per plant and no. of seeds per pod and seed yield /ha were measured. Super phosphate ammonium (15%) was add at the rate of 300 kg/ha during seed bed preparation. Simulative dose of urea (46%) (60 Kg ha^{-1}) was added before the first irrigation, while the second and third splits of urea were added before flowering and podding stages, respectively. Also Potassium sulphate (48% K_2O) were added at the rates of 100 kg/ha at flowering stage. Hand weed control was applied twice. To protect faba bean plant from aphid and pests, sprayed insecticide (Permethrin 10 EC) three and - four times was carried out on plants in first and second season, respectively**.** Pot experiment was carried out inLoam-sandy soil under cage. The seeds of Hassawi2 and Population 4 were grown in 15 x 15 x 50cm pots and same foliar application treatments were applied at 40 and 55 days from sowing. The pot experiment was laid out in factorial experiment with randomized complete block design with three replications. A pot was considered one replicate with single plant/pot.

Faba bean plants at 85 days after sowing (at pod filling stage) were harvested and root rinsed to study the effect of foliar application on root parameters.

Table 1: Physical and chemical analysis of Dirab soil.

Sample depth	Saturated soil pH	E.C. ($ds.m^{-1}$)	Total N%	Absorbable P(ppm)	Absorbable K (ppm)	O.M %	Sand	Silt	Clay	Caco3 %
0-30 cm	7.5	0.9	13.1	20.6	86.6	0.3	76.1	12	11.9	18.0

Statistical analysis was done for each season separately and after confirmation of errors homogeneity for the two seasons, thus combined analysis of the two seasons was applied.. Statistical analysis was performed with *MSTATC* software.

3. Results and Discussion

The field experiment results indicated that genotype, fertilizer and plant spacing significantly affected the growth and seed yield parameters of faba bean plants. Season affected significantly most of faba bean characters except no. of seeds/plant, no. of seeds/pod and seed yield/plant (Table 2).The new genotype (Population 4) had better performance for most studied characters than the local variety (Hassawi 2). Insignificant differences for plant height and number of branches were detected between the two genotypes (Table 3). Population 4 had more no. of leaves/plant (130.4) and leaf area (85.2) ansd subsequently increase of photosynthesis and accumulation of dry matter leading to increase seed yield. The differences between newly developed population 4 and Hassawi 2 were clear and wide under foliar application treatment with combined micronutrients (Fe+Zn+B, T5). Population 4 exceeded the local cultivar by 34.5% and 20.7% under spray by mixed micronutrient treatment (Fe+Zn+B) for seed yield per plant and per hectare, respectively. Population 4 surpass of Hassawi 2 values were decreased under other foliar treatments, mean differences were only 27.5% and 10.7%, for seed yield per plant and per hectare, respectively. This indicated that the response of Pop. 4 to foliar fertilizer application were higher than that of Hassawi 2, while the later was more adapted to poor environments (Table 3).

Table 2: Mean square estimates for combined analysis of variance among the two seasons.

S O V	df	Plant height	No. of branches	No. of pods/ plant	No. of seeds/ plant	No. of seeds/ pod	Seed yield/ plant	Leaf area	No. of leaves/ plant	Seed yield /ha
Replication	2	55.51	1.4	17.61	1.9	0.286	11.2	164.4	886.0	0.082
Year (Y)	1	984.7**	24.2**	0.6**	0.1ns	0.001ns	1.6ns	1284.8**	6336.8**	0.14*
Error	2	1.44	0.1	0.01	0.7	0.014	1.1	0.2	1.2	0.001
Genotype G	1	3.47ns	1.01ns	125.0**	3845.7**	0.10*	3301.6**	7112.7**	7321.7*	0.15**
G Y	1	0.01ns	0.4ns	0.36ns	8.9ns	0.044ns	2.3ns	7.8ns	17.4*	0.001ns
Error	4	20.3	0.09	5.03	25.2	0.069	15.1	50.9	399.2	0.17
Spray (S)	4	1527.9**	2.2**	48.1**	330.3**	0.4*	212.3**	1344.8**	1790.4**	0.18**
S Y	4	87.3**	1.5*	0.06ns	1.2ns	0.164ns	2.0ns	1.5ns	4.7ns	0.001ns
S G	4	62.6**	5.1**	35.9**	189.2**	0.5*	183.0**	758.3**	294.4**	0.062ns
S G Y	4	9.27ns	0.3ns	0.19ns	2.3ns	0.078ns	1.0ns	0.9ns	0.8ns	0.002ns
Density (D)	2	3653.3**	17.9**	161.1**	814.9**	1.5**	819.1**	222.5ns	27019.0**	1.91**
D Y	2	61.0**	0.1ns	42.9**	391.5**	0.122ns	205.2**	0.3ns	57.8ns	0.001ns
G D	2	61.8**	9.6**	142.0**	1474.2**	0.56*	1135.2**	308.6*	1466.7**	0.091*
G D Y	2	2.77ns	1.0ns	0.51ns	2.2ns	0.158ns	12.1ns	0.3ns	2.8ns	0.001ns
D S	8	124.7**	3.0**	32.2**	333.9**	0.7**	137.8**	281.5**	759.3**	0.12**
D S Y	8	2.52ns	0.4ns	0.12ns	1.5ns	0.105ns	4.1ns	0.3ns	2.3ns	0.002ns
G S D	8	196.9**	2.5**	24.7**	87.7*	0.8**	60.8**	396.2**	302.1**	0.24**
G S D Y	8	1.43ns	0.9ns	0.13ns	0.7ns	0.139ns	4.1ns	0.5ns	0.7ns	0.002ns
Error	112	11.5	0.5	5.73	42.2	0.133	11.5	104.2	42.2	0.032

*, ** significant at 5 and 1%, ns: not significant

The results of foliar spray with micronutrient reveled high differences with superior effect of mixed dose treatment (Fe+Zn+B). Comparing with control treatment, insignificant differences were recorded among faba bean genotypes treated by separate elements Fe, Zn, B and control (no fertilizer) for no. of branches and number of seeds/pod. Faba bean plants received iron had insignificant differences in number of seeds/plant with slight significant differences for other parameters compared with control treatment. However, iron spray enhanced seed yield per plant and per hectare treatments by 7.9 and 10.3%, respectively compared with control.

Zinc application significantly increased faba bean seed yield and yield components except no. of branches, seeds/pod and leaf area. Compared with control treatment, Zn and B treatments increased faba seed yield per plant and yield per hectare by 13.3 and 13.8% & 17.6 and 17.2%, respectively. This result indicates the importance of boron for seed yield production and importance of Zn for vegetative growth where leaves number increased substantially after zinc application (Table 3).

Table 3: Effect of foliar application on the two faba bean genotypes seed yield parameters.

Trait	Genotype	Foliar application					LSD $_{0.05}$	
		Fe+Zn+B	Fe	Zn	B	control	Spray	S x G
Plant height (cm)	Hassawi 2	119.4	107.0	109.1	111.3	97.7	1.5	2.2
	Population 4	116.9	102.8	109.7	110.1	100.4		
	Mean	118.2	104.9	109.4	110.7	99.1		
Total No. of branches/plant	Hassawi 2	5.6	5.2	5.4	5.3	5.0	3.3	0.5
	Population 4	5.7	5.3	5.7	5.3	4.9		
	Mean	5.7	5.3	5.6	5.3	4.9		
No. of pods/plant	Hassawi 2	13.4	11.9	12.3	12.9	11.6	1.1	1.6
	Population 4	17.2	14.8	15.8	15.4	12.5		
	Mean	15.3	13.4	14.0	14.2	12.1		
No. of seeds/plant	Hassawi 2	38.0	31.0	34.3	35.8	30.7	3.3	4.3
	Population 4	53.2	43.2	43.0	45.2	38.3		
	Mean	45.6	37.1	38.7	40.5	34.5		
No. of seeds/pod	Hassawi 2	2.7	2.6	2.6	2.6	2.2	0.17	0.24
	Population 4	3.3	3.0	2.8	2.9	3.0		
	Mean	3.0	2.8	2.7	2.8	2.6		
Seed yield/plant (g)	Hassawi 2	31.9	26.4	28.6	29.2	24.4	1.58	2.24
	Population 4	42.9	33.7	34.4	36.2	31.1		
	Mean	37.4	30.0	31.5	32.7	27.8		
No. of leaves/plant	Hassawi 2	129.3	117.6	119.1	114.8	111.6	3.0	4.3
	Population 4	142.4	129.3	131.5	126.2	122.9		
	Mean	135.8	123.4	125.3	120.5	117.2		
Leaf area (cm)	Hassawi 2	83.6	82.8	70.3	77.9	73.8	4.8	6.7
	Population 4	94.1	87.6	83.3	88.0	73.2		
	Mean	88.8	85.2	76.8	82.9	73.5		
Seed yield/ha (t)	Hassawi 2	3.4	2.9	3.1	3.2	2.8	0.2	ns
	Population 4	4.1	3.5	3.5	3.5	3.1		
	Mean	3.7	3.2	3.3	3.4	2.9		

The differences among plant spacing treatments and their interactions with genotypes were highly significant for all studied parameters except leaf area, indicating that faba bean plants are sensitive to plant density per unit area and that each genotype requires a specific plant spacing for maximum yield potential (Table 4). Plants grown under higher density (10 cm between hills) were taller with lower number of productive branches, leaves and leaf area and produced high seed yield/ha (3.7t) due to high number of plants per plot area, rather than yield per plant per se. However, seed yield/plant was highest (35.9g) under lower plant density (15cm between hills). However, plants grown under the lowest density (20 cm between hills) recorded the lowest estimates in all characters except no of branches, leaves and leaf area. This could be due to plants exposed to high and low temperature during day and night and strong winds among flowering and pod filling stages. The interaction between micronutrient foliar application and plant spacing are presented in Table (5). The mixed application of micronutrient combined with wide plant spacing improved most studied traits.

To study the effect of micronutrients on shoot and root parameters during vegetative growth stage, the two faba bean genotypes grown in pots and sprayed by the five micronutrient treatments. Highly significant differences among foliar application treatments and genotypes and their interaction were detected (Table 6) as revealed from mean square estimates. Population 4 roots were longer and heavier but the old cultivar Hassawi 2 was taller and had heavier shoots (Table 7). The micronutrients significantly affected the root and shoot characters except shoot fresh weight. Iron play the most important role in root characters, which plants received Fe, Zn and Mixed ranked first in estimates of root length and weights. Increase on root length was more than water treatment by 60.1, 59.1 and

51.7%, respectively. This increase played role in root weights and the three treatments ranked first in dry weight but Zn ranked second in fresh weight. The shoot length and dry weight had significant differences between micronutrient treatments however these differences were wide and clear on roots characters. Comparing with water treatment, micronutrient treatments increased shoot height and dry weight except dry weight of Zn treatment. The highest plants (88.5cm) were found in mixed treatment but the heaviest shoots (9.2g) were in Fe treatment.

Table 4: Effect of spaces between plants on the two faba bean genotypes characters.

Trait	**Genotype**	**Plant spacing**				**LSD $_{0.05}$**	
		10 cm	15 cm	20 cm	Mean	**Space**	**S x G**
Plant height (cm)	**Hassawi 2**	111.0	108.6	101.2	106.9	1.2	2.1
	Population 4	117.1	107.1	99.7	108.0		
	Mean	114.1	107.9	100.5	107.5		
Total No. of branches/plant	**Hassawi 2**	4.1	5.5	6.3	5.3	0.3	0.4
	Population 4	4.9	5.2	6.0	5.4		
	Mean	4.5	5.4	6.1	5.3		
No. of pods/plant	**Hassawi 2**	12.0	15.0	10.3	12.4	0.9	1.5
	Population 4	15.6	17.1	12.7	15.1		
	Mean	13.8	16.1	11.5	13.8		
No. of seeds/plant	**Hassawi 2**	31.8	39.0	31.2	34.0	2.4	0.13
	Population 4	45.2	49.9	38.7	44.6		
	Mean	38.5	44.4	34.9	39.3		
No. of seeds/pod	**Hassawi 2**	2.3	2.5	2.8	2.6	4.1	0.23
	Population 4	3.0	3.0	3.0	3.0		
	Mean	2.7	2.7	2.9	2.8		
Seed yield/plant (g)	**Hassawi 2**	26.5	32.3	25.4	28.1	1.2	2.1
	Population 4	36.4	39.6	31.0	35.7		
	Mean	31.5	35.9	28.2	31.9		
No. of leaves/plant	**Hassawi 2**	95.2	124.8	135.4	118.5	2.4	3.3
	Population 4	104.8	137.5	149.0	130.4		
	Mean	100.0	131.2	142.2	124.5		
Leaf area (cm)	**Hassawi 2**	73.2	76.8	83.0	77.7	ns	6.4
	Population 4	81.3	85.8	88.6	85.2		
	Mean	77.2	81.3	85.8	81.5		
Seed yield/ha (t)	**Hassawi 2**	3.4	3.0	2.9	3.1	0.2	0.3
	Population 4	3.9	3.5	3.1	3.5		
	Mean	3.7	3.3	3.0	3.3		

Table (5): Effect of interaction between foliar application and distance of plants.

Spray	**Distance between**	**Plant height (cm)**	**No. of branches /plant**	**No. of pods/ plant**	**No. of seeds/ plant**	**No. of seeds/ pod**	**Seed yield/ plant(g)**	**No. of leaves/ plant**	**Leaf area (cm)**	**Seed yield/ ha (t)**
Fe + Zn + B	10m	123.7	5.4	15.6	46.1	2.9	38.0	110.0	86.1	2.8
	15cm	119.3	5.1	18.2	51.4	2.9	42.4	153.6	85.5	2.8
	20cm	106.5	7.0	12.1	39.4	3.3	31.8	144.0	94.9	3.2
Fe	10m	120.4	6.0	13.8	35.1	2.7	30.2	105.8	76.1	2.6
	15cm	105.6	5.3	15.1	44.2	2.9	34.1	122.1	88.2	2.8
	20cm	102.2	6.0	11.2	31.9	2.9	25.8	142.4	81.3	2.8
Zn	10m	110.6	4.4	14.2	38.1	2.5	31.2	95.3	74.6	2.4
	15cm	105.9	5.5	16.5	42.1	2.5	34.4	144.5	81.2	2.4
	20cm	98.3	6.1	11.4	35.9	3.2	29.0	136.3	74.2	3.1
B	10m	117.4	4.8	13.8	39.7	2.8	32.0	92.8	78.8	2.7
	15cm	113.5	5.5	15.6	44.9	2.8	36.2	129.1	77.4	2.7
	20cm	101.1	5.7	13.2	37.0	2.8	29.9	139.7	71.5	2.7
Control	10m	108.1	4.8	11.6	33.5	2.6	26.0	96.2	70.4	2.5
	15cm	95.0	5.4	15.0	39.6	2.7	32.6	130.8	72.1	2.6
	20cm	94.2	5.9	9.7	30.5	2.6	24.7	124.9	78.0	2.5
LSD $_{0.05}$%		2.7	0.6	1.9	5.3	0.3	2.7	8.3	5.3	0.14

Table 6. Analysis of variance for the two faba bean genotypes and five foliar applications in factorial design.

S. O. V.	df	Root length	Root fresh weight	Root dry weight	Shoot length	Shoot fresh weight	Shoot dry weight
Replication	2	24.0	11.1	0.20	14.2	7.5	0.01
Spray (S)	4	154.0**	18.8**	1.5**	71.5**	62.5ns	4.65**
Genotype (G)	1	1.9ns	78.4**	0.80**	97.2*	2.64ns	3.33*
G x S	4	42.9**	3.0*	0.09ns	3.9ns	113.3*	0.20ns
Error	18	7.9	1.1	0.10	13.4	31.2	0.52

*, ** significant at 5 and 1%, ns :not significant

Table 7. Effect of foliar application on shoot and root characters of the two faba bean genotypes

Trait	Genotype	Foliar application						$LSD_{0.05}$	
		Fe+Zn+B	Fe	Zn	B	Control	Mean	Spray	S x G
Root length (cm)	**Hassawi 2**	30.5	28.5	31.5	26.0	20.5	27.4	3.4	4.8
	Population 4	31.0	36.5	33.0	33.0	20.0	30.7		
	Mean	30.8	32.5	32.3	29.5	20.3	29.1		
Root fresh weight (g)	**Hassawi 2**	8.7	7.2	6.1	6.2	5.8	6.8	1.3	1.8
	Population 4	12.9	12.4	8.2	8.7	8.0	10.0		
	Mean	10.8	9.8	7.1	7.4	6.9	8.4		
Root dry weight (g)	**Hassawi 2**	3.4	3.3	3.0	2.8	2.7	3.0	0.4	ns
	Population 4	3.9	4.0	3.6	2.9	3.3	3.5		
	Mean	3.7	3.7	3.3	2.8	3.0	3.4		
Shoot length (cm)	**Hassawi 2**	90.0	86.0	87.3	88.7	80.3	86.5	6.3	ns
	Population 4	87.0	82.3	84.7	82.3	78.0	82.9		
	Mean	88.5	84.2	86.0	85.5	79.2	84.7		
Shoot fresh weight (g)	**Hassawi 2**	30.9	33.5	43.5	30.8	27.2	33.2	ns	9.6
	Population 4	28.2	39.0	28.6	34.5	32.6	32.6		
	Mean	29.5	36.3	36.0	32.6	29.9	32.9		
Shoot dry weight (g)	**Hassawi 2**	8.7	8.8	9.0	8.6	7.6	8.5	0.9	ns
	Population 4	8.9	9.5	7.2	8.7	8.0	8.5		
	Mean	8.8	9.2	8.1	8.7	7.8	8.5		

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