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Original Article

Effect of using garlic and lemon peels extracts with selenium on *Vicia faba* productivity

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Abstract

Several agricultural practices produce wastes rich in some useful compounds. In this research, two types of wastes (i.e., garlic and lemon peelings) were chosen and used to prepare mixtures of these peels alcoholic extract with a certain concentration of selenium, either alone or in combinations treatments. Faba bean seeds (*Vicia faba L.* cv. Sakha 3) were cultivated in winter season of the year 2019 on a silty clay soil after soaking in these mixtures for 24 h. Some vegetative growth parameters such as fresh and dry weights, plant length, as well as N, K, phenols and flavonoids contents were determined during different physiological growth stages of *Vicia faba*, in addition to determine the leaf area and number of pods per plant at the flowering growth stage. Besides of pods and seeds weight, and seeds content of N, K, Se, protein, phenols and flavonoids were also determined after harvesting. Obtained results showed that soaking seeds in the studied extracts significantly increased the weight of pods and seeds as compared to the control treatment. Moreover, the soaking process increased the percentage of antioxidants in the produced seeds of *Vicia faba* as compared to the control treatment. This finding highlights the benefit of such soaking process to foods rich in antioxidants that increases immunity and resistance of human against widespread diseases.

Keywords: Garlic peel, Lemon peel, Reuse of agricultural wastes, Selenium, Antioxidants, *Vicia faba*

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Introduction

Faba bean (*Vicia faba* L.) is considered one of the most important economic crops, that contains about 26% protein, 58% carbohydrate, 2% fat, in addition to some minerals such as Ca, Mg, K, Na, Fe, Zn, Cu and Se, and some vitamins, e.g., B_1, B_2, B_3, B_6, B_9, C and K (Alghamdi, 2009).

Garlic extract is of a highly nutritive value since it contains large numbers of important enzymes and biochemical compounds such as antioxidants and vitamins that fight inflammation, decrease triglycerides, and reduce cholesterol levels which may lower heart disease risk (Mohamed and Akladious, 2014; El-

Saadony et al., 2017). Garlic peel can take part in manufacturing of organic fertilizers rich in nutrients necessary for growth of all plants. Using this peel will increase plant resistance for diseases, as well as increases plant growth and productivity (El-Saadony et al., 2017).

Lemon peels are containing plenty of bioactive compounds. They have nutritional value, with a fair amount of vitamin C, D-limonene, fiber, and many nutrients such as Ca, Mg and K (Satari and Karimi, 2018; Hou et al., 2019). Lemon peels are also a source of natural flavonoids (Cheigh et al., 2012). Citrus peel (lemon peel) contains phenolic compounds (phenolic acids and flavanones). Phenolic compounds show various bioactivities such as antimicrobial, antioxidant and anticancer (Ferreira et al., 2018; Nair et al., 2018). The polar fractions of grapefruit, lemon and sweet orange peels contain total flavonoid of 2.29, 15.96 and 3.97 mg g^{-1}, respectively (Ghasemi et al., 2009).

Selenium (Se) is one of the "essential" nutrients for human, being who intakes it through his food in trace amounts estimated by about 55 µg daily (Lauren, 2012). Generally, low concentrations of applied Se were shown to improve plant growth (Hartikainen et al., 2000 with ryegrass, Yang and Ding, 2000 with tobacco, Xu et al., 2003 with tea leaves, Turakainen et al., 2004 with potato, Abul-Soud and Abd-Elrahman, 2016 with eggplant under salt stress conditions, and Taha et al., 2019 with garlic under water stress conditions). At lower concentrations, Se stimulates plant growth, on the other hand, at high ones it acts as pro-oxidant, reducing yields and inducing metabolic disturbances (Saffaryazdi et al., 2012).

Thus, this research aims at investigating the effects of soaking faba bean seeds (*Vicia faba L.*) in alcoholic extract of garlic and/ or lemon peels whether solely or in combination with Se on plant productivity and its seeds contents of antioxidants (i.e., phenols and flavonoids). Consolidating the idea of heading towards therapeutic agriculture because of its impact on maintaining human health and increasing the resistance to diseases, as most of the treatments used are mainly chemicals extracted from plants. Accordingly, this research has a second part (ongoing research work) is based on using the seeds with enhanced antioxidant activity produced from this research to ameliorate acetic acid induced colitis in experimental rats.

Material and Methods

A field experiment was conducted in winter season of the year 2019 to study the effect of soaking faba bean seeds in alcoholic extracts of garlic and/ or lemon peels either alone or in combination with Se on faba bean productivity represented by some vegetative growth parameters (fresh and dry weights as well as plant length, leaf area and number of pods per plant), in addition to N and K, phenols and flavonoids contents at the different physiological growth stages of plants. Assessing weight of pods and seeds as well as the produced seeds content of N, K, Se, protein, phenols and flavonoids after plant harvesting were also a matter of concern in this study.

Experimental site

The experimental site is the farm of The Faculty of Agriculture (30º11`N, 31º25`E), Ain Shams University, Qalubia Governorate, Egypt. The average temperature was 21.0±4.2ºC and the relative humidity was 63.5±7.3%. The soil of the research site was silty clay, *Vertic Torrifluvents* (Soil Survey Staff, 2010), and its physical and chemical properties were determined, before cultivation, by the standard methods described by Cottenie et al. (1982); Klute (1986) and the obtained results are shown in Table 1. The experimental soil was divided into seven agricultural lines (total plot area was 155.4 m^2), the net area of each line was 16.8 m^2, the distance between each two successive lines was 30 cm and the distance between plants on lines was 10 cm (Fig. 1).

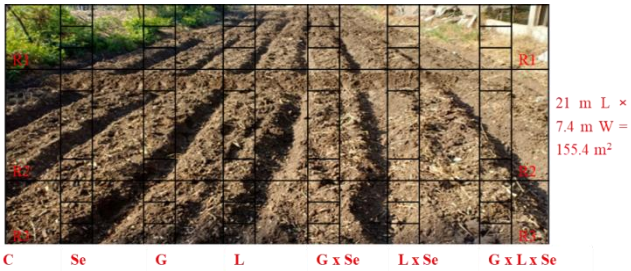

Figure-1: Soil preparation and the order of the applied treatments.

Note: C (Control), Se (Selenium solution), G (Garlic peel extract), L (Lemon peel extract) and their combinations treatments

Procedures

Seeds of faba bean (*Vicia faba L.* cv. Sakha 3) were obtained from the Legumes Crops Research Centre, Ministry of Agriculture, at Giza Governorate, Egypt. The obtained seeds were soaked in the extracts mentioned thereafter for 24 h, just before sowing. Phosphorus (P) fertilizer (ordinary superphosphate,

15.5% P_2O_5), at a rate of 360 kg ha^{-1}, was broadcasted during the soil preparation. Seeds (3 kg per total plot area) were sown (1-2 seeds per hill) on December 16th in 2019, and then sowing irrigation was applied. At 24 days after sowing (DAS), plants were thinned to secure one plant per hill followed by irrigation. Nitrogen (N) and potassium (K) fertilizers were not added to the soil depending on their sufficient content in the studied soil (see Table 1). Faba bean plants were sampled 4 times at: (i) the vegetative growth stage (24 DAS), (ii) the flowering growth stage (54 DAS), (iii) the fruiting growth stage (84 DAS), and (iv) at harvest (99 DAS). The harvesting was done every 14 days and continued for 3 times. Crop yield was weighed per plant and estimated for the total plot area.

Table-1: Some physical and chemical properties of the experimental soil, before cultivation, (0-15 cm layer).

Particle size distribution, %	
C. Sand	14.5
F. Sand	19.5
Silt	33.7
Clay	32.3
Textural class	Silty clay
pH (1:2.5 soil: water suspension)	7.75
EC_e, dS m^{-1}	3.62
Soluble cations, $mmol_c$ L^{-1}	
Ca^{2+}	28.0
Mg^{2+}	25.4
Na^{+}	8.25
K^{+}	1.21
Soluble anions, $mmol_c$ L^{-1}	
CO_3^{2-}	n.d.*
HCO_3^{-}	3.85
Cl^{-}	7.01
SO_4^{2-}	50.6
Available macronutrient, µg g^{-1}	
N	165
P	6.58
K	671
*n.d. means not detected.	

Experimental treatments and design

The following seven treatments were used for soaking seeds of faba bean for 24 h before sowing:

(1) Distilled water as a control treatment (C),
(2) Selenium (Se) at a concentration of 5 µM Se in the form of sodium selenite solution,
(3) Garlic peel extract (G), 1.95 g L^{-1},
(4) Lemon peel extract (L), 8.31 g L^{-1},
(5) G × Se (by ratio of 1:1),
(6) L × Se (by ratio of 1:1), and
(7) G × L × Se (by ratio of 1:1:1).

Preparation of the garlic and lemon peels extracts: First, prepare an alcohol-water solution (80% alcohol) by diluting 833.3 mL ethanol (96%) with 166.7 mL distilled water, at an ambient temperature (22.3±3.4ºC). Second, weigh 50 g of garlic and lemon dried peels (dried at 65ºC till a constant weight), then add them to 300 mL of the diluted alcohol, then shake for 12 h and leave the mixture 48 h for equilibrium. The extract (Fig. 2) was obtained by filtering the mixture (either for garlic or lemon) through a Whatman #1.47 filter paper, then this filtrate was taken and placed in a Petri dish of known weight and the dishes were left overnight to permit volatilization of alcohol at an ambient temperature, then the plate was re-weighed, and the weight of the remaining portion was determined to express the weight of extracts (g). Finally, the obtained extracts (1.95 and 8.31 g for garlic and lemon, respectively) were diluted by one liter of distilled water for each treatment (weight of extract per volume of distilled water, g L^{-1}, *w:v*), according to the method described by Anwer et al. (2012).

The abovementioned seven treatments were allocated in a randomized complete block design with 3 replicates.

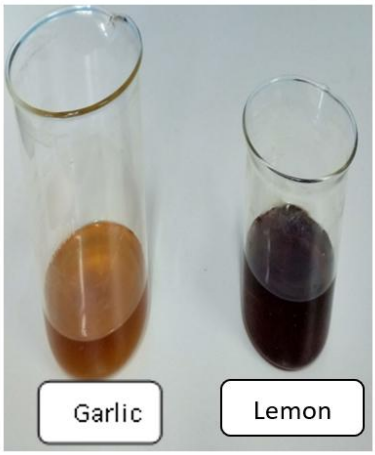

Figure-2: Extracts of garlic and lemon peels

Measurements

Morphological properties of faba bean

At the different physiological stages, three plants were collected for each treatment to estimate plant length (cm), fresh and dry weights (g $plant^{-1}$). At the flowering growth stage (54 DAS) number of pods

plant^{-1} was determined. Also, total leaf area (cm^2) was determined by multiplying the plant length (cm) ×maximum width (cm) × 0.583, using the disc method as described by Deriaux et al. (1973). At harvest (99 DAS), the weight of pods (Mg ha^{-1}), and weight of seeds (Mg ha^{-1}) were assessed.

Chemical components of plant

At the different physiological growth stages, the following determinations were conducted: N, K, phenols and flavonoids contents. At harvest (99 DAS), Se and protein content in seeds were also determined. The plant samples were oven dried at 65ºC, and then wet digested by a mixture of H_2SO_4 and H_2O_2 according to the method described by Cottenie et al. (1982). Total N content in plants was determined by micro Kjeldahl method using 5% boric acid and 40% NaOH as described by Chapman and Pratt (1961). Total K was determined using Flame photometer (Chapman and Pratt, 1961). Total Se was determined using ICP Mass Spectrometry (Benton, 2001). Total soluble protein concentration was quantified by the method of Bradford (1976) using bovine serum albumin (BSA) as a standard. Total phenols were determined according to the Folin-Ciocâlteu method outlined by Duca et al. (2019). Total flavonoids content was determined by the aluminum chloride colorimetric assay as described by Marinova et al. (2005).

Statistical analysis

The obtained data were statistically analyzed using SAS software package (SAS, 2006). The means that were significant were separated using Duncan's multiple range test (at $p \leq 0.05$ considered significant) ± standard error of the mean (SEM, n = 3).

Results

Morphological parameters of the grown plant

Fresh weight, dry weight, and plant length

Regarding the fresh and dry weights of faba bean plants, data in Table 2 show that at the vegetative growth stage, there were significant differences among the studied soaking treatments and the control one. At the flowering and fruiting growth stages, the treatment L× Se came next to the treatment G× L× Se in giving higher fresh and dry weight values.

Regarding the plant length, data illustrated in Table 2 and Fig. 3 show that at the vegetative and flowering growth stages, there were significant differences among the studied treatments where the treatments L× Se and G× L× Se were of the most pronounced effect, followed by the treatment of G× Se, while at the fruiting growth stage, the treatments G× Se, L× Se and G× L× Se were superior in giving high plant length, with no significant differences among them.

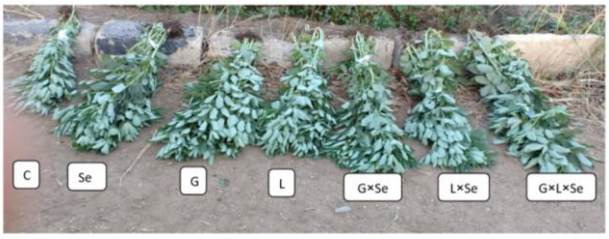

Figure-3: Faba bean length as affected by the studied treatments at plant harvest (99 DAS).

Note: C (Control), Se (Selenium solution), G (Garlic peel extract), L (Lemon peel extract) and their combinations treatments

Leaf area and number of pods per plant

Data illustrated in Figs. 4 and 5 showed that there was a clear significant difference in the leaf area of faba bean plants at the flowering growth stage (54 DAS) under the effect of the studied treatments more than the control. Also, a significant increase was observed in the number of pods per plant (Fig. 5) under the effect of the studied treatments as compared to the control. The treatment of G× L× Se was giving high values (25.2 cm ^{2} and 27.0) of leaf area and number of pods per plant, respectively, as compared to the other treatments.

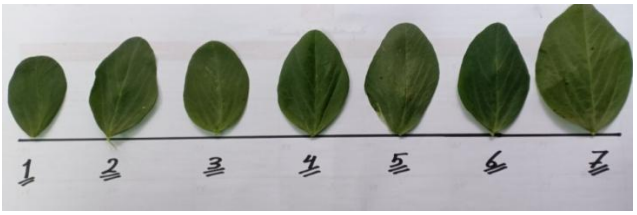

Figure-4: Leaf area of faba bean plants as affected by the studied treatments at the flowering growth stage (54 DAS).

Note: 1 (Control, C), 2 (Se solution, Se), 3 (Garlic peel extract, G), 4 (Lemon peel extract, L), 5 (G x Se), 6 (L x Se) and 7 (G x L x Se)

Table-2: Effects of the studied treatments on fresh and dry weights, and plant length of faba bean at different physiological growth stages.

Variable	Fresh weight (g plant^{-1})	Dry weight (g plant^{-1})	Plant length (cm)
At the vegetative growth stage (24 DAS)			
Control	13.5±2.07d	1.47±0.28e	16.0±0.18d
Selenium solution (Se)	16.1±1.93c	1.82±0.34c	16.4±0.12cd
Garlic peel extract (G)	16.7±3.32c	1.68±0.24d	17.0±0.09c
Lemon peel extract (L)	17.8±1.76bc	1.85±0.17bc	18.6±0.08b
G × Se	20.1±2.48a	2.11±0.13a	18.4±0.07b
L × Se	17.4±3.38c	1.73±0.34d	18.7± 0.08ab
G × L × Se	18.3±0.67b	1.89±0.10b	19.5±0.06a
At the flowering growth stage (54 DAS)			
Control	45.0±7.82e	4.93±0.29d	30.0±0.58e
Selenium solution (Se)	112±9.13cd	11.4±1.22c	43.3±1.57d
Garlic peel extract (G)	108±6.67d	11.8±1.19c	51.7±1.67c
Lemon peel extract (L)	120±14.6c	11.8±1.58c	47.3±1.45cd
G × Se	151±12.9ab	13.7±1.67b	57.7±1.45b
L × Se	144±15.4b	14.0±2.31ab	63.3±3.33a
G × L × Se	154±14.1a	14.4±0.87a	60.0±0.59ab
At the fruiting growth stage (84 DAS)			
Control	166±13.4f	31.6±2.76e	70.0±0.58d
Selenium solution (Se)	301±14.7e	55.7±1.43cd	90.5±0.50c
Garlic peel extract (G)	347±8.67c	50.9±1.80d	100±0.58b
Lemon peel extract (L)	312±17.1d	60.9±3.52c	90.0±0.58c
G × Se	334±16.5cd	52.9±4.09d	120±0.33a
L × Se	659±17.6b	107±1.79b	120±1.15a
G × L × Se	742±12.2a	127±1.22a	120±0.58a

Note: Means within columns followed by different letters are significantly different at $p \leq 0.05$.

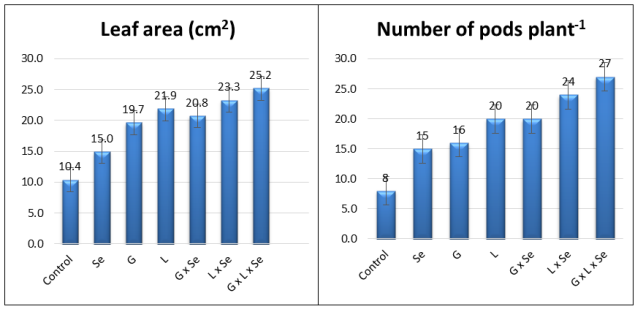

Figure-5: Effect of the studied treatments on leaf area and number of pods per plant of faba bean at the flowering growth stage (54 DAS).

Note: Se (Selenium solution), G (Garlic peel extract), L (Lemon peel extract) and their combinations treatments

Chemical properties

Nitrogen content

A significant increase was observed for N concentration (Table 3) in faba bean shoots owing to the studied soaking treatments as compared to the control, at the different physiological growth stages. The treatment of Se followed by the treatment of L× Se at the vegetative growth stage, and lemon peel extract followed by garlic at the flowering growth stage, in addition to the treatment of L× Se followed by the treatment of G× L× Se at the fruiting growth stage, were superior in giving high concentrations of N as compared to the other treatments.

Potassium content

It was noticeable that there were no significant differences among some of the studied soaking treatments beside of the control treatment in K concentration (Table 3) of faba bean shoots at the vegetative growth stage, except for the treatment of G× L× Se which gave the highest values, while the treatments of G× Se, L× Se and G× L× Se gave the highest concentrations of K at the flowering and fruiting growth stages, with no significant differences among them.

Table-3: Effects of the studied treatments on N, K, phenols, and flavonoids contents of faba bean at different physiological growth stages.

Variable	N (%)	K (%)	Phenols (µg g^{-1} DW)	Flavonoids (µg g^{-1} DW)
At the vegetative growth stage (24 DAS)				
Control	1.44±0.02e	1.50±0.03c	7266±12.6e	3192±57.0e
Selenium solution (Se)	2.17±0.27a	1.52±0.04c	8147±6.98b	4528±2.74b
Garlic peel extract (G)	1.91±0.28bc	1.49±0.16c	6868±18.9g	2508±2.99f
Lemon peel extract (L)	1.61±0.09de	1.63±0.13b	7823±3.34c	3287±17.7e
G × Se	1.43±0.04e	1.59±0.03b	7035±16.5f	3600±3.77d
L × Se	2.11±0.14b	1.62±0.04b	7320±16.5d	4089±64.2c
G × L × Se	1.82±0.35cd	1.71±0.04a	10147±29.2a	5648±69.2a
At the flowering growth stage (54 DAS)				
Control	2.76±0.34e	1.49±0.02bc	7292±8.33g	2901±62.8d
Selenium solution (Se)	4.61±0.26b	1.34±0.03c	9482±3.04c	3978±37.3c
Garlic peel extract (G)	4.73±0.08ab	1.33±0.04c	8047±8.58f	2188±3.14e
Lemon peel extract (L)	4.95±0.41a	1.58±0.04b	8954±7.68e	3873±6.89c
G × Se	3.79±0.47c	1.86±0.17a	9069±9.16d	3961±7.73c
L × Se	3.34±0.22d	1.88±0.12a	10125±10.8b	4612±68.9b
G × L × Se	4.67±0.12b	1.92±0.16a	11128±4.19a	5608±1.19a
At the fruiting growth stage (84 DAS)				
Control	4.20±0.21c	1.73±0.01ab	4431±1.73bc	570.3±25.7bc
Selenium solution (Se)	5.07±0.07b	1.34±0.03c	3732±69.0c	446.1±4.41c
Garlic peel extract (G)	3.80±0.20d	1.31±0.09c	4773±18.2abc	581.8±10.5bc
Lemon peel extract (L)	3.87±0.16d	1.43±0.04b	5315±20.5abc	779.0±1.70ab
G × Se	4.09±0.07cd	1.80±0.10a	4934±3.04abc	628.8±1.22bc
L × Se	5.48±0.25a	1.77±0.09a	6472±33.0ab	829.5±1.87ab
G × L × Se	5.38±0.14a	1.78±0.06a	6794±7.11a	984.9±3.18a

Note: Means within columns followed by different letters are significantly different at $p \leq 0.05$.

Content of phenols

It was noticed that the treatment of G× L× Se gave the highest value of phenols content (Table 3) in faba bean plants at their different physiological growth stages, followed by the mixture of lemon peel extract and Se by ratio of 1:1 at the flowering and fruiting growth stages, while the treatment of Se at 5 µM came in the second order at the vegetative growth stage.

Content of flavonoids

There was a significant increase in flavonoids content (Table 3) in faba bean plants at their different physiological growth stages in the case of using the treatment of G× L× Se, followed by the treatment of L× Se at the flowering and fruiting growth stages, while the treatment of soaking seeds before cultivation by 5 µM of Se solution came in the second order at the vegetative growth stage.

Yield and its components

Data presented in Table 4 show the effect of soaking faba bean seeds, before cultivation, in Se (5 µM), and garlic and lemon peels extracts, and their combinations on yield and its components as compared to the control treatment. Results indicated that there were significant increases in the weight of pods and seeds, with higher values due to application of G× L× Se treatment, followed by the treatment of L× Se. It was also observed that there was a significant increase in the contents of faba bean seeds of N, K and Se, as well as increases in their content of the antioxidants, i.e., phenols and flavonoids, also, high content of protein especially when the treatment of G× L× Se was applied, followed by the treatment of L× Se.

Discussion

Obtained results showed the effectiveness of soaking faba bean seeds, before cultivation, in the studied treatments for 24 h, on increasing the fresh and dry weights, and plant length, as well as their content of N and K, in addition to the high content of phenols and flavonoids during the different growth stages and which reflected on the final productivity. Also, it gave higher weights of pods and seeds and increased their content of N, K, Se, and protein, as well as the higher

content of antioxidants components. It is interesting to note that the treatment of G× L× Se was superior in giving high results, as compared to the other treatments including the control treatment.

Of course, soaking seeds before cultivation in any of these treatments that are rich in nutrients and chemical compounds will benefit the crop. This is confirmed by Nossier et al. (2017) who studied the response of wheat plants to application of Se and humic acid by soaking grains before cultivation in these solutions which helped in increasing the rate of growth and weights of fresh and dry, the length of both the shoot and the root system and increasing the final crop. Also, they emphasized that the soaking process before planting increased the rate of Se absorption and thus increased its quantity in the final crop. Perhaps the reason of soaking seeds in Se before cultivation led to increased seeds content of Se, because of the element movement from the high concentration (external solution) to the low concentration (inside seeds), Nossier et al. (2017). Selenium supplementation to plants enhances the production and quality of edible plant products, by increasing antioxidant activity of plants, as found by Xu et al. (2003) in tea leaves and Xu and Hu (2004) in rice.

As for the role of garlic peels extract, garlic is a source of antioxidants, i.e., phenols and flavonoids, also, some minerals especially P, K and Se, and a source of vitamins especially vitamin B complex and vitamin C (Pekowska and Skupień, 2009).

Table-4: Effects of the studied treatments on weights of pods and seeds, and chemical components of faba bean seeds at harvest (99 DAS).

Variable	Value	Variable	Value
Weight of pods (Mg ha^{-1})		**Se (mg kg^{-1})**	
Control	12.33±1.71c	Control	0.05±0.001c
Selenium solution (Se)	18.47±1.70ab	Selenium solution (Se)	0.50±0.001b
Garlic peel extract (G)	17.53±1.06ab	Garlic peel extract (G)	1.01±0.002ab
Lemon peel extract (L)	18.53±1.75ab	Lemon peel extract (L)	1.01±0.003ab
G × Se	15.25±1.31bc	G × Se	1.05±0.002ab
L × Se	18.78±1.56ab	L × Se	1.04±0.001ab
G × L × Se	20.77±1.14a	G × L × Se	1.13±0.004a
Weight of seeds (Mg ha^{-1})		**Protein (mg 100g^{-1})**	
Control	4.22±1.89b	Control	237±1.47f
Selenium solution (Se)	6.29±1.09a	Selenium solution (Se)	306±3.40c
Garlic peel extract (G)	6.29±1.79a	Garlic peel extract (G)	263±0.84e
Lemon peel extract (L)	6.46±1.70a	Lemon peel extract (L)	286±0.34d
G × Se	4.51±1.83b	G × Se	291±0.96d
L × Se	6.65±1.30a	L × Se	369±1.37b
G × L × Se	6.96±1.82a	G × L × Se	399±1.03a
N (%)		**Phenols (µg g^{-1} DW)**	
Control	1.03±0.06f	Control	1372±10.9d
Selenium solution (Se)	1.30±0.05e	Selenium solution (Se)	2039±5.06b
Garlic peel extract (G)	1.50±0.05d	Garlic peel extract (G)	1776±14.4c
Lemon peel extract (L)	1.60±0.06cd	Lemon peel extract (L)	1239±8.99e
G × Se	1.70±0.02bc	G × Se	1758±1.49c
L × Se	1.80±0.006b	L × Se	3026±41.6a
G × L × Se	1.90±0.009a	G × L × Se	3068±40.4a
K (%)		**Flavonoids (µg g^{-1} DW)**	
Control	0.88±0.006e	Control	175.5±3.28f
Selenium solution (Se)	1.18±0.008bc	Selenium solution (Se)	415.8±1.91c
Garlic peel extract (G)	1.15±0.060d	Garlic peel extract (G)	232.8±1.30e
Lemon peel extract (L)	1.17±0.006cd	Lemon peel extract (L)	230.3±1.23e
G × Se	1.18±0.006bc	G × Se	275.4±0.58d
L × Se	1.20±0.006b	L × Se	461.3±2.77b
G × L × Se	1.30±0.014a	G × L × Se	539.6±1.01a

Note: Means within columns followed by different letters are significantly different at $p \leq 0.05$.

It works as a catalyst in improving the growth and yield of faba bean plants. Puvača et al. (2014) and Martins et al. (2016) reported that the growth improvement in faba bean cultivars can be established by the fact that garlic extracts contain various growth-promoting compounds as organo-sulphur compounds such as allicin and di-allyl di-sulphide, starch, and vitamins. Hayat et al. (2018) reported that garlic extract treatment increased growth parameters of pepper plant. Similar trend was obtained by Osman et al. (2014) on sunflower plants and Mohamed et al. (2020) on faba bean.

Several researchers have confirmed the increase of antioxidants, i.e., phenols and flavonoids, in the peels of some fruits more than the fruits themselves. Ghasemi et al. (2009) reported that flavonoids are one of the major bioactive substances present in citrus fruits and their peels like lemon. Citrus peels represent nearly about 40-50% of the fruit mass and is a rich source of flavonoids (Singh et al., 2020). Total flavonoid content was found higher in peels (5.2-23.3 mg g^{-1}) when compared with fruit tissues (0.3-3.3 mg g^{-1}) of different citrus species. Flavonoids present in citrus are the powerful antioxidants and potent free radical scavengers that help in preventing from diseases that caused by the reactive oxygen species (Ashraf et al., 2017). Phenolic compounds are present in edible parts of citrus fruit and non-edible parts, especially citrus peels (Gorinstein et al., 2001). Antioxidants content, i.e., phenols and flavonoids in garlic and lemon peels, had a role in increasing the efficiency of the photosynthesis process and increasing the plant resistance to any environmental changes, such as temperature imbalance, water shortage, or exposure to insect infection (Mohamed et al., 2020; Hayat et al., 2018).

As a result of increasing the efficiency of the photosynthesis process, increasing in plant growth occurs during the stage of cell division by increasing the number of cells, where the protoplasmic proteins were built from amino acids, amides, or similar compounds, as well. Synthesis of cellulose, pectin and other wall-forming substances occurs from dissolving simple carbohydrate molecules (Hayat et al., 2018). Also, playing an important role in the processes of nutritional transformation and in maintaining cell osmosis. Besides, increasing nutrient uptake and giving vigor plant growth which is reflected on increasing the crop productivity (Gupta and Huang, 2014). This is what the obtained results showed, as there was a clear increase in the amount of final crop in case of using the studied extracts as compared to the control. There was an increase in the weight of faba bean pods and seeds when applying the treatment of G× L× Se by about 50% compared to the control treatment.

Conclusion

As a result of the agricultural practices, many wastes are produced and considered rich in several useful compounds. In this research alcoholic extracts of garlic and/ or lemon peelings were used individually or with Se in soaking seeds of faba bean. The quality of produced seeds was rich in protein and antioxidants; thus, they play a role in preventing certain diseases when human eats them. The treatment of G× L× Se was superior in giving higher amounts of the aforementioned nutritional components as compared to the other treatments.

Recommendations

So, we can recommend the treatment of G × L × Se to increase faba bean productivity, and its contents of antioxidants and nutrients that increase the ability to adapt with bad conditions and maximize resistance against widespread diseases.

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Contribution of Authors

Nossier MI: Designed research methodology, collected and analyzed data and wrote the first draft.
Abd-Elrahman SH: Data analysis and interpretation, literature review, manuscript writing and approval.
El-Sayed SM: Designed research methodology, data analysis and interpretation and critical review.