Vol. 6, No. 2, pp. 149-163, (June 2025)
DOI: 10.21608/aujes.2025.363900.1332
Aswan University Journal of Environmental Studies (AUJES)
Online ISSN: 2735-4237, Print ISSN: 2735-4229
Journal homepage*:* https://aujes.journals.ekb.eg/ E-mail: AUJES@aswu.edu.eg
Original research

Evaluating the Effects of Foliar Application of persicaria senegalinsis Leaf Extract and Chitosan on yield parameters with Faba bean Cultivars

M. A. F. Habouh. [1], Awadalla. A.[1], M. A. Abdelfattah*. [1] , and Amal A. A. Mohamed.[2]

1-Department of Agronomy, Faculty of Agriculture & Natural Resources Aswan University, Aswan 815 Egypt.

2-Botany Department, Faculty of Science, Aswan University, Aswan, 81528, Egypt

Received:26 /2 /2025 Accepted: 9 / 4 /2025

Abstract:

The experiment was conducted at the farm of the faculty of agriculture and natural resources, Aswan university, during the 2022-2023 and 2023-2024 seasons to study the effect of spraying with Persicaria leaf extract, chitosan, and a mixed treatment, on the yield of three faba bean cultivars (Sakha 4, Nobaria 1, and Giza 716) when cultivated under Upper Egypt conditions.. The experiment was designed as a split-bloke arrangement (Randomized Complete Block Design) with three replicates in both seasons. Cultivar treatments were distributed on the main plots, while foliar spray treatments were distributed as sub-plots under the main plots. The obtained results showed a clear superiority of the treatment with Persicaria leaf extract spray over other spray treatments, as it significantly increased the number of branches, pods, seeds / plant, weight of 100 seeds, yield / plant, and yield / fed. The faba bean cultivars varied significantly in all the studied traits, with the Sakha 4 Cultivar showing clear superiority in the studied traits except for the number of branches and the weight of 100 seeds, where the Nubaria 1 Cultivar excelled. It can be recommended that planting the Sakha 4 faba bean Cultivar alongside treatment with Persicaria leaf extract spray in Upper Egypt to obtain the highest yield.

Keywords: *faba*, cultivar , *Persicaria, chitosan*.

1- Introduction

Faba bean *(Vicia faba L.)* is considered one of the most important pulse crops in Egypt in terms of production and consumption. Its green and dry seeds are widely consumed in human nutrition due to their rich content of proteins (26.1%), carbohydrates (58.3%), and dietary fiber (25.0%), according to the **USDA (2021).** In addition to its high nutritional value, faba bean contains bioactive compounds such as phenolics and flavonoids, which have antioxidant properties (Valente et al., 2018). Faba bean also contributes to improving soil properties and enhancing fertility, as the yield of crops grown after harvesting legumes

Corresponding author*: E-mail address: mohamed.abdelfatah@agr.aswu.edu.eg

often matches the effect of applying 30 to 80 kg of nitrogen fertilizer / hectare **(Leilah and El-Deeb, 1988).** The Food and Agriculture Organization **(FAO 2022)** reported that global faba bean production reached 6.1 million tons, with China, Ethiopia, and Australia being the leading producers. These countries play a crucial role in supplying faba beans, known for their high nutritional value and protein content. In Egypt, faba beans are a key staple crop and an essential part of the national diet. Locally, faba beans hold the distinction of being the most widely cultivated legume crop in terms of area. Data indicates that Egypt's domestic demand for faba beans ranges between 550,000 to 600,000 tons annually, while imports fall between 420,000 to 470,000 tons. In 2022, Egypt's faba bean production reached approximately 130,093 tons, spread across 90,770 fed (both intercropped and monocropped). Aswan Governorate alone cultivates 7,767 fed and produces 4,907 tons (both intercropped and monocropped) (**Economic Affairs Sector of the Ministry of Agriculture and Land Reclamation).** The average annual consumption / person of local faba beans is around 6 kg. Egypt is one of the largest faba bean producers in the Arab world, benefiting from favorable climate conditions and advanced farming practices. The local bean crop is a vital contributor to the country's agricultural economy. With increasing demand due to the health benefits of faba beans, including their high fiber content and essential amino acids, there are significant opportunities to improve production methods and boost yields. In recent years, agricultural production has advanced through the use of various growth-enhancing techniques. such as NPK fertilization, plant hormones, and organic/inorganic substances used for seed priming, soil applications, and foliar treatments **(Ibrahim *et. al.*, 2007).** Additionally, agricultural practices are shifting toward more sustainable management systems that reduce reliance on pesticides and synthetic fertilizers, enhance soil fertility, and reduce pests **(Van Loo et al.2017).** Exogenous application of plant growth-promoting substances influences plant growth by modulating metabolic, physiological, and biochemical responses, including cell division, differentiation, organogenesis, germination, and leaf senescence **(Mukhtar, 2008; Hayat et al., 2010).** One such substance is chitosan, a natural polysaccharide derived from the deacetylation of chitin found in crustacean shells **(Orgaz et al., 2011).** Chitosan improves crop yield, increases chlorophyll content, and enhances plant resistance to environmental stresses such as drought, salinity, and low temperatures, thereby reducing their negative impact on crops **(Kocięcka and Liberacki, 2021).** Chitosan and its derivatives are highly beneficial for agriculture due to their non-toxic, biodegradable, and environmentally friendly properties **(Chandrkrachang, 2002).** On the other hand, Persicaria senegalensis, a common and troublesome weed in the Nile system, is a tall plant (~1.5 m) with a thick, swollen stem and broad lanceolate leaves **(Midiwo et al., 2001).** It spreads rapidly by seeds and stem fragments and is found in shallow swamps where it can block small water bodies and restrict water flow near the banks **(Zahran and Willis, 2003).** This plant is known for its antioxidant properties. **(Payne and Lal, 2024).** Persicaria senegalensis is widely distributed along the Nile River and has been reported to contain high concentrations of phenolic compounds, flavonoids, saponins, tannins, steroids, anthocyanins, as well as carbohydrates, proteins, and essential mineral elements (Tabel 1) one of the most important active phenolic compounds found in the extract of Persicaria leaves (isoflavones and naringenin , coumarin , IAA oxidase enzyme) which proved to have an important role in various vital and physiological processes of the plant and vegetative qualities, as well as protection from vital and non-vital stresses **(Metwally et al., 2020) (Payne & Lall, 2024).** This study

aimed to use Persicaria leaf extract and chitosan and evaluate their effect on the yield of three faba bean cultivars under the conditions of Upper Egypt.

2. Materials and methods

Two field experiment were conducted at Faculty of Agriculture and Natural Resources, Aswan University, Aswan governmente, Egypt during 2021-2022 and 2022-2023 seasons . The objective of this study was to investigate the effect of foliar spraying with Persicaria leaf extract and chitosan, as well as their combined application, on growth and yield and quality of faba bean (vicia faba) three genetically diversed faba bean genotypes (vicia faba) were used in agriculture, these cultivars were (Giza 716,Sakha 4 and Nubaria 1) Seeds were obtained from the agricultural research station to study the effect of foliar spraying of chitosan and extract of Persicaria sangalensis. Tow field experiment were laid-out in a split block design (strip plot deign) in randomized complete block design with three replications The study included spraying with one concentration of chitosan, spraying with persicarea extract at one level, a mixture treatment between persicarea extract and chitosan, and a control treatment. The crop was sprayed with Persicaria extract at one level, along with a control. The crop was grown in rows 70 cm apart, and the plot size was 9.45 m² (4.5 meters × 2.1 meters). Two to three seeds were planted / hole on one side of the row, with 25 cm spacing between each hole. The seeds were coated with the bacterial inoculant (Rhizobium), which was obtained from the Agricultural Research Center, Legumes Department, just before sowing. After germination, the plants were thinned to one plant / hill 15 days after planting. Phosphorus fertilizers in the form superphosphate (15.5% P_2O_5) and potassium sulfate(48% K_2O), respectively were added during the seedbed preparation , respectively, Adding to ammonium nitrate fertilizer (33.5% nitrogen) 20 days after planting as a booster dose. Spraying treatments were carried out every 20 days from planting, with a total of four sprays at (20, 40, 60, and 80) days. The three cultivars (Nubaria 1, Sakha 4, and Giza 716) were treated with four treatments: 20% Persicaria leaf extract, 3 cm³/L of chitosan, a mixture of 20% extract with 3 cm³/L of chitosan, and another control treatment using fresh water as a spray.

1. Treatments

1-Persicaria leaf extract .2-Chitosan .3-Mixture chitosan with Persicaria leaf extract

4-Control Without additions .

2-1-1.Preparation of extract

Fresh green leaves of Persicarea plants were harvested. The leaves were then dried in a shaded area. The dried leaves were finely ground using a grinder and then sieved to create Persicarea leaf powder. Persicarea leaf extract was made by grinding 50 g leaves mixed with 462 ml of 80% methanol every 6 hours after putting it in a shaker to get 1387 ml of extract. The extract was filtered through a cloth then Whatman filter paper and then diluted with fresh water to a concentration of 20% before spraying on the plant leaves. until they were completely wet.

2-1-2.Chitosan

"Chitosan solution (2-amino-2-deoxy-beta-D-glucosamine) was prepared by dissolving an appropriate amount of the Egyptian commercial chitosan product CHITOSAN EGYPT® in fresh water to obtain a concentration of 3 cm³/L."

2-1-3.chitosan with Persicaria leaf extract

A total of 1387 ml of Persicaria leaf extract was taken and mixed with fresh water to create a spray solution with a 20% concentration, with the addition of 3 cm³/L of chitosan. This mixture was sprayed on the plants until they were completely wet as a combined treatment.

2-2.data recorded:

Ten plants were taken from each experimental unit at harvest time, and the following measurements were recorded on them:

2-2-1.Number of pods / plant: total number of pods/plant was recorded at harvest time.

2-2-2.The number of branches : number of primary branches on the main stem at harvest time.

2-2-3.The number of seeds/plant: total number of seeds/plant was recorded at harvest time.

2-2-4.Seed yield/ plant(g): seed weight per plant at about 10-12 percent moisture content.

2-2-5.100-seed weight(g): calculated from seed yield per plant divided by number of seeds / plant x 100

2-2-6.Seed yield(ardab/feddan): estimated as the total seed yield for each sub plot, then converted into ardab/fed (155 kg)

Table 1: Secondary metabolites, Total antioxidant capacity (TAC), Radical scavenging activity (IC50),Content of nutrient minerals in the different parts of the hydrophytes in the selected sites during different seasons. **(Metwally, 2020)**

	Summer		Spring	
	Saluga and ghazal	**Near Isis hotel**	**Saluga and ghazal**	**Near Isis hotel**
Steroids	57.26±0.93	42.51±1.07	29.25±0.68	29.00±0.78
Flavonoid	92.26±0.74	76.15±2.60	25.41±0.13	21.92±0.47
Flavonols	30.03±1.02	27.55±0.75	7.80±0.07	5.70±0.04
Saponins	4.57±0.02	2.76±0.14	23.38±2.23	16.45±0.54
Phinolics	9.76±0.57	6.68±0.78	18.68±0.79	16.46±0.59
Anthocyanin	0.51±0.02	0.11±0.01	0.89±0.1	0.18±0.1
TAC	436.6±1.44	273.73±2.13	657.31±1.76	274.74±1.87
IC50	33.62±2.89	31.25±1.15	40.90±4.10	39.10±2.66
Ca+2	1.23±0.09	1.03±0.06	1.21±0.03	1.10±0.1
Mg+2	0.74±0.04	0.70±0.09	0.77±0.02	0.70±0.01
So4-2	0.31±0.00	5.28±0.30	3.33±0.81	1.15±0.13
No3-1	0.03±0.00	0.04±0.00	0.02±0.00	0.03±0.00
Po4-3	0.001±0.00	0.092±0.03	0.02±0.00	0.043±0.00
Mn+2	2.37±0.43	7.40±0.43	2.53±0.20	8.43±0.50
Fe+2	2.65±0.54	7.61±0.34	5.11±0.05	6.05±0.05
Cu+2	0.02±0.00	0.07±0.00	0.10±0.00	0.28±0.01
	Autumn		Winter	

	Saluga and ghazal	Near Isis hotel	Saluga and ghazal	Near Isis hotel
Steroids	24.39±0.52	30.41±0.19	20.36±0.44	10.16±0.24
Flavonoid	16.22±2.48	16.83±0.89	14.70±1.11	16.33±0.44
Flavonols	6.82±0.22	6.23±0.65	5.10±0.04	9.63±0.05
Saponins	7.50±0.08	11.78±0.23	28.30±0.04	21.53±0.08
Phinolics	6.61±0.38	6.15±1.05	3.55±0.45	5.85±0.05
Anthocyanin	1.03±0.08	0.81±0.03	0.24±0.02	0.09±0.00
TAC	421.05±1.7	460.71±3.62	244.76±2.54	312.85±2.10
IC50	28.78±3.99	35.00±1.73	22.94±1.48	23.73±1.02
Ca+2	1.63±0.07	1.36±0.04	1.14±0.02	1.11±0.01
Mg+2	0.67±0.03	0.55±0.04	0.74±0.04	0.68±0.01
So4-2	0.21±0.07	0.25±0.04	0.01±0.00	4.44±0.18
No3-1	0.07±0.00	0.08±0.00	0.03±0.00	0.04±0.00
Po4-3	0.001±0.00	0.008±0.00	0.001±0.00	0.002±0.00
Mn+2	1.53±0.14	2.79±0.14	2.22±0.07	4.24±0.24
Fe+2	2.65±0.1	5.93±0.18	5.42±0.24	8.60±0.17
Cu+2	0.1±0.00	0.13±0.00	0.09±0.00	0.12±0.00

2.3.Statistical analysis:

All collected data composition were analyzed with analysis of variance **(ANOVA)** Procedures, using the **Costat Statistical Software Package v.9.2 (Costat).** Differences between means were compared by revised least significant difference (R LSD) at 5% level significant **(Gomez and Gomez, 1984).** Variance of the two seasons was not homogenous (**Bartlett's Test),** consequently the combined analysis not performed.

3. Results and discussion

3.1.Number of branch / plant

The number of branch enhances The Photosynthetic area, and Thus its increase is a Fundamental Factor in improving and increasing Productivity

Table 2 Presents The obtained result

3.1.1.Effect of spray treatments:

We conclude from the results presented in Table 2 that there are highly significant differences in the first and second seasons between the spray treatments, as the spray treatment with the extract of the leaves of the persicarea plant recorded the highest values for the number of branches for bean plants with values of 3.66-4.09 in both seasons, respectively compared to the rest of the spray treatments, and the lowest values were recorded in the control with values of 2.92-3.15 in both the first and second seasons,

respectively This is done by improving the photosynthesis process and chlorophyll pigments by protecting them from UV damage and free radicals and maintaining the vital processes of the plant when exposed to thermal or water stress conditions due to the presence of flavonoids (Tabel 1) **(Albergaria *et al* 2020) (Saini *et al* 2024),** in addition to stimulating the growth of an increase in the number of bacterial nodes that supply plants with nitrogen. Due to the presence of phenolic compounds such as isoflavones **(Garg et al 2016) (Hussein et al., 2017) (P.L. Whitten, 2020) (Sharma et al. 2021) (Payne and Lal, 2024)** All of this in turn leads to improving the branching of plants.

Table 2: Effect of chitosan, persecaria extract and their interaction on number of branch of faba bean cultivars in 2022/2023 and 2023/2024 seasons

Season	**2022-2023**				**2023-2024**			
Spray Treatment	Cultivars			Mean	Cultivars			Mean
	Nubaria1	**Giza716**	**Sakha4**		**Nubaria1**	**Giza716**	**Sakha4**	
Control	2.97	2.90	2.87	2.92	3.20	3.17	3.09	3.15
Chitosan	3.98	3.30	3.34	3.55	4.10	3.97	3.93	4.00
Persicaria	3.81	3.59	3.57	3.66	4.30	4.13	3.83	4.09
Chitosan & persicaria	3.27	3.07	3.03	3.10	3.70	3.63	3.50	3.61
Mean	3.51	3.21	3.20		3.83	3.72	3.59	
F Test and R.LSD 0.05	**F Test**		**Rev LSD 0.05**		**F Test**		**Rev LSD 0.05**	
Cultivars	**		0.15		*		0.16	
Spray Treatment	**		0.11		**		0.07	
Interaction	*		0.45		N. S			

3.1.2.Faba bean cultivars effects:

The results presented in Table 2 show that there are very significant differences between the cultivars in both seasons in terms of the number of branches of plants, where the Nubaria1 Cultivar recorded the highest values for the number of branches with values of (3.51-3.83) in both the first and second seasons, respectively and the Sakha4 Cultivar was the Cultivar that recorded the lowest number of branches with values of (3.20-3.59) in both seasons. This is due to the fact that the genetic structure of the Nubaria1 Cultivar is a characteristic structure in the branching trait, which distinguishes it from the rest of the cultivars**. (Ghareeb et al., 2023)**

3.1.3.Effect of the interaction:

From the results shown in Table 2 it is clear that there are significant differences in the interaction in the first season, as the highest value for the number of branches was when treating chitosan with the Nubaria 1 Cultivar (3.98), while the lowest value was recorded in the control with the Sakha 4 Cultivar (2.87). The cultivars may vary in their response to foliar spray treatments. Therefore, Nubaria 1 cultivar might show a higher response in terms of the number of branches when treated with chitosan compared to other treatments.

3-2 Number of pods / plant

The number of pods in plants affects productivity, and the more pods there are with their appropriate distribution on the plant, the more this contributes to increasing the yield.

3.2.1.Effect of spray treatments:

Table No. 3 shows that there are highly significant differences between the spray treatments in both seasons, as spraying with the extract of Persicarea leaves showed a clear superiority in the number of pods/plant compared to the other spray treatments with values of (24.49 - 27.16), and the lowest values for the number of pods / plant were in the control treatment with values of(19.26 - 24.70) These results are due to the presence of flavonoids (Tabel 1), as many studies have shown that plants use flavonoids to produce the distinctive yellow color of pollen grains, as well as to help pollen tube germination, and it has also been found that they protect pollen grains from sterility if the plant is exposed to frost conditions**(Pourcel and Grotewold 2009; ;Mohammadrezakhani et al. 2018; Wang et al 2020;Postiglione et al 2024).** Flavonoids, including anthocyanins, are also involved in making flowers appear bright in color and enhancing the scent of flowers, which works to attract pollinators **(Ghasemzadeh et al 2011),** resulting in increased pollination and flower setting, which explains the increase in the number of plant pods.

Table 3: Effect of chitosan, persecaria extract and their interaction on number of pods of faba bean cultivars in 2022/2023 and 2023/2024 seasons

Season	**2022-2023**				**2023-2024**			
Spray Treatment	Cultivars			Mean	Cultivars			Mean
	Nubaria1	**Giza716**	**Sakha4**		**Nubaria1**	**Giza716**	**Sakha4**	
Control	15.40	18.67	23.70	19.26	19.57	23.83	30.70	24.70
Chitosan	17.83	21.17	27.83	22.27	19.43	25.30	31.93	25.57
Persicaria	18.97	23.30	31.20	24.49	19.97	28.10	33.40	27.16
Chitosan & persicaria	16.60	19.43	25.80	20.61	19.60	24.67	30.80	25.02
Mean	17.20	20.64	27.13		19.64	25.48	31.71	
F Test and R.LSD 0.05	**F Test**		**Rev LSD 0.05**		**F Test**		**Rev LSD 0.05**	
Cultivars	**		1.839		**		0.869	
Spray Treatment	**		1.17		**		1.1	
Interaction	N. S				N. S			

3.2.2.Faba bean cultivars effects:

The results in Table 3 indicate that there are significant differences between the cultivars in the number of pods / plant, as the cultivar Sakha 4 recorded the highest values for the number of pods / plant in both seasons compared to the other cultivars at values of (27.13-31.71) and the cultivar Nubaria 1 recorded the lowest values for the number of pods / plant in both seasons at values of (17.20–19.64) Based on the compatibility of the

characteristic genetic traits of the Sakha 4 Cultivar with environmental conditions, this led to an increase in the number of pods of plants. **(Abdel-Baky et al 2019) (Samah A. Sabry, 2022) (Abdelaal, 2023) .**

3.2.3.Effect of the interaction:

Table 3 indicates that there is no significant interaction between cultivars and spray treatments in the number of pods / plant for the bean crop in both seasons.

3-3 number of seeds / plant

The researcher aims to increase productivity, which is one of the most important factors in increasing the unit area. One of the factors that helps achieve this is the number of seeds, as they play an important role in increasing the productivity of the fed. Table No. (3) shows the results that were obtained.

Table 4: Effect of chitosan, persecaria extract and their interaction on number of seeds of faba bean cultivars in 2022/2023 and 2023/2024 seasons

Season	**2022-2023**				**2023-2024**			
Spray Treatment	Cultivars			Mean	Cultivars			Mean
	Nubaria1	**Giza716**	**Sakha4**		**Nubaria1**	**Giza716**	**Sakha4**	
Control	55.50	67.73	88.07	70.43	68.10	82.07	103.4	84.51
Chitosan	60.83	80.83	94.00	78.56	67.07	87.07	104.6	86.26
Persicaria	66.53	91.77	98.93	85.74	70.53	100.1	111.9	94.19
Chitosan & persicaria	57.73	74.17	89.57	73.82	62.57	84.53	109.4	85.51
Mean	60.15	78.63	92.64		67.07	88.44	107.3	
F Test and R.LSD 0.05	**F Test**		**Rev LSD 0.05**		**F Test**		**Rev LSD 0.05**	
Cultivars	**		2.57		**		3.85	
Spray Treatment	**		4.24		**		3.78	
Interaction	**		9.93		*		13.28	

3.3.1.Effect of spray treatments:

It is clear from Table 4 that there are significant differences between the spray treatments in both the first and second seasons, as the extract of persicarea leaves achieved the highest values (85.74-94.19) compared to the rest of the spray treatments, and the control achieved the lowest results in both seasons with values (70.43-84.51). This is due to flavonoids (Tabel 1), which help in the growth and germination of the pollen tube and maintain the vitality of pollen

grains**(Pourcel and Grotewold 2009) (Wang et al 2020) (Postiglione et al 2024).** As a result, fertilization and seed formation increase, leading to a higher number of seeds. Additionally, the enhancement of flower color, making them more vibrant and shiny, attracts pollinators, which increases pollination**(Van der Meer et al 1992).** Consequently, more pods are formed, and this also leads to an increase in the number of seeds / plant.

3.3.2.Faba bean cultivars effects:

Table 4 shows that there are highly significant differences between the different cultivars in both the first and second seasons. The highest values for the number of seeds / plant were (92.64-107.3) with the Sakha 4 Cultivar, while the Nubaria 1 Cultivar recorded the lowest values compared to the Sakha 4 and Giza 716 cultivars (60.15-107.3) This is due to the genetic makeup of the cultivars.

3.3.3.Effect of the interaction:

Table 4 also shows significant differences between the interactions, as the highest values of the number of seeds / plant were recorded when treating chitosan with the Sakha4 Cultivar in both seasons, where their values reached (98.93-111.9), while the lowest value was when treating the control with Nubaria 1. The best foliar spray treatment that resulted in the highest number of seeds / plant was the application of Persicaria leaf extract. The Sakha 4 cultivar produced the highest number of seeds / plant. The outcome showed that the greatest number of seeds was achieved with the treatment of Persicaria leaf extract combined with the Sakha 4 cultivar.

3-4 Weight 100 seeds (g)

The weight of 100 seeds is on of The Factors of Production, and an increase in weight Leads to higher Production. Table 5 shows The obtained Values.

Table 5: Effect of chitosan, persecaria extract and their interaction on Weight 100 seeds of faba bean cultivars in 2022/2023 and 2023/2024 seasons.

Season	**2022-2023**				**2023-2024**			
Spray Treatment	Cultivars			Mean	Cultivars			Mean
	Nubaria1	**Giza716**	**Sakha4**		**Nubaria1**	**Giza716**	**Sakha4**	
Control	98.67	82.27	89.43	90.12	110.8	85.43	93.80	96.69
Chitosan	105.3	90.23	98.97	98.18	105.7	93.13	101.7	100.2
Persicaria	111.9	94.40	103.3	103.2	118.1	93.13	104.4	105.3
Chitosan & persicaria	102.2	88.57	93.20	94.66	111.2	90.47	97.27	99.64
Mean	104.5	88.87	96.22		111.5	90.54	99.29	
F Test and R.LSD 0.05	**F Test**		**Rev LSD 0.05**		**F Test**		**Rev LSD 0.05**	
Cultivars	**		2.41		**		5.53	
Spray Treatment	**		3.02		**		2.53	

Interaction	N. S	**	10.43

3.4.1.Effect of spray treatments:

It is evident from Table 5. that there are highly significant differences between the spray treatments, as the spray treatment with the extract of the leaves of the persicarea plant achieved the highest rates of weights from 100 seeds, which were at values of (103.2-105.3), while the lowest values were at the control in both seasons at values of (89.43-96.69). The increase in chlorophyll pigment resulted in an increase in the products of the photosynthesis process. The presence of flavonoid compounds also played a role in protecting chlorophyll pigments and the photosynthesis process from free radicals and the harmful effects of ultraviolet radiation **(S. Zafari et al 2016) (S. Kumar et al 2020) (Dehghanian et al., 2022) (Kumar et al., 2023)** . As a result, the products of photosynthesis increased and were used for storage in the seeds in the form of starchy endosperm. Additionally, the presence of flavonoid compounds in the extract (Tabel 1) may have contributed to an increase in the number of bacterial nodules in the roots, leading to greater nitrogen fixation **(Sharma et al. 2021) (Payne and Lal, 2024).** This nitrogen is used in protein synthesis, which also increases the protein content in the seeds, resulting in an increase in seed weight .

3.4.2.Faba bean cultivars effects:

The data in Table 5 indicate that there are highly significant differences between the cultivars in both seasons. The Cultivar Nubaria 1 achieved the highest weight of 100 seeds compared to the rest of the cultivars in both seasons at values of (104.5-111.5) and the Cultivar Giza 716 achieved the lowest values at (88.87-90.54) This is due to the genetic composition of the cultivars, which led to a reduction in the number of seeds and pods, which results in an increase in the amount of nutrients and seed contents of various components, which increases the weight of the seeds. **(Abou-El-Seba et al 2016).**

3.4.3.Effect of the interaction:

The data in Table 5 indicate that there are highly significant differences between the interactions in the second season, as the highest values of 100-seed weight were recorded when treating the extract of Persicarea leaves with Nubaria 1 with a value of (118.1), and the lowest value was when treating the control with Giza 716 with a value of (85.43) The best foliar spray treatment, which resulted in the highest weight for 100 seeds, was the treatment with the extract of Persicaria plant leaves. The Nubaria 1 cultivar gave the highest weight for 100 seeds. The result showed that the highest weight for 100 seeds was achieved with the treatment of Persicaria plant leaf extract in combination with the Nubaria 1 cultivar.

3-5 yield / plant (g)

The plant's yield is The results Yield/plant of the Previous Traits, including The weight of loo seeds, the number of Pods, and the number of seeds, Therefore, improving any of these, traits Leads to an increase in the Plants yield, Table 6 Shows these values.

Table 6: Effect of chitosan, persecaria extract and their interaction on yield / plant of faba bean cultivars in 2022/2023 and 2023/2024 seasons

Season	**2022-2023**				**2023-2024**			
Spray Treatment	Cultivars			Mean	Cultivars			Mean
	Nubaria1	**Giza716**	**Sakha4**		**Nubaria1**	**Giza716**	**Sakh 4**	
Control	65.80	63.90	96.17	75.29	74.20	65.90	97.3	79.14
Chitosan	72.70	78.93	105.0	85.56	70.47	81.60	109.0	87.03
Persicaria	80.10	86.57	111.9	92.88	84.43	88.90	116.6	96.66
Chitosan & persicaria	68.50	75.87	99.30	81.22	76.23	78.87	102.9	86.02
Mean	71.78	76.32	103.1		76.33	78.82	106.5	
F Test and R.LSD 0.05	**F Test**		**Rev LSD 0.05**		**F Test**		**Rev LSD 0.05**	
Cultivars	**		7.08		**		7.28	
Spray Treatment	**		1.73		**		3.03	
Interaction	*		8.07		*		15.1	

3.5.1.Effect of spray treatments:

Table 6 shows that there are significant differences between the spray treatments, as spraying with extract of the leaves of the persicarea plant showed a clear superiority in both seasons in terms of the yield of each plant with values of (92.88-96.66), and the control treatment recorded the lowest values of (75.29-79.14) in both seasons, With the increase in crop components on the plant, the yield of each plant increased, leading to an increase in the weight of 100 seeds due to the increase in chlorophyll **(Saini et al 2024).** This resulted in more photosynthesis products being stored in the seeds as carbohydrates. Additionally, both the number of pods and the number of seeds increased due to enhanced pollination and fertilization processes,**(Postiglione et al 2024)** thanks to the presence of flavonoid compounds.

3.5.2.Faba bean cultivars effects:

Table 6 shows that there are significant differences between the cultivars, as the Sakha 4 Cultivar achieved the highest values in terms of crop quantity / plant at values of (103.1-106.5) in both seasons, while the Nubaria 1 Cultivar recorded the lowest values (71.78-76.33) Based on the distinctive genetic composition of the cultivars, which led to an increase in the characteristics of the crop, this was the reason for increasing the yield of each plant. **(Abdel-Baky et al 2019; Samah A. Sabry, 2022; Abdelaal, 2023)** .

3.5.3.Effect of the interaction

Table 6 shows that there are clear significant differences between the interaction in both seasons, as the highest values were achieved when spraying with the extract of the leaves of the persicarea plant with the Sakha 4 Cultivar in both seasons with values of (111.9-116.6), while

the lowest values were achieved when treating the control with the Giza 716 Cultivar with values of (63.90-65.90) in both seasons. The foliar spray treatment that achieved the highest yield / plant was the application of Persicaria leaf extract. The Sakha 4 cultivar showed the best performance, producing the highest yield / plant. This demonstrates that the combination of Persicaria leaf extract with the Sakha 4 cultivar resulted in the greatest yield / plant.

3-6 Seed yield (ardab /feddan)

3.6.1.Effect of spray treatments:

The results of Table 7 showed that there were highly significant differences between the spray treatments in both seasons, as the spray treatments achieved the highest values of spraying with the extract of the leaves of the persicarea plant at a value of (8.26-8.52) ardebs / fed, and the control treatment recorded the lowest results at values of (7.22-7.40) ardebs / fed. This difference may be attributed to Due to the presence of phenolic compounds in the extract (Tabel 1), which positively influenced the plant's biological processes and crop characteristics such as the number of seeds, number of pods, and seed weight, all of the above resulted in an increase in the plant yield, leading to an overall increase in the yield / fed.

Table 7: Effect of chitosan, persecaria extract, and their interaction on yield (ard/fed) of faba bean cultivars in 2022/2023 and 2023/2024 seasons

Season	**2022-2023**				**2023-2024**			
Spray Treatment	Cultivars			Mean	Cultivars			Mean
	Nubaria1	**Giza716**	**Sakha4**		**Nubaria1**	**Giza716**	**Sakha4**	
Control	7.82	5.48	8.37	7.22	7.87	5.76	8.58	7.40
Chitosan	8.03	6.10	9.71	7.94	8.14	6.25	9.74	8.04
Persicaria	8.47	6.41	9.91	8.26	8.74	6.69	10.1	8.52
Chitosan & persicaria	7.73	5.59	8.87	7.40	8.29	5.82	8.93	7.68
Mean	8.01	5.89	9.22		8.26	6.13	9.34	
F Test and R.LSD 0.05	**F Test**		**Rev LSD 0.05**		**F Test**		**Rev LSD 0.05**	
Cultivars	**		0.22		**		0.15	
Spray Treatment	**		0.26		**		0.11	
Interaction	*		0.84		**		0.79	

3.6.2.Faba bean cultivars effects:

Table 7 shows that there are significant differences between different cultivars in yield / fed in both seasons. The table showed that the Sakha 4 Cultivar showed a clear superiority with a yield of (9.22 - 9.34) ardeb / fed, while the yield of the Giza 716 Cultivar was very low compared to the rest of the cultivars and achieved a yield of (5.89-6.13) ardeb / fed in both the first and

second seasons. These results are due to the fact that cultivars have a distinctive genetic composition of crop qualities and the more the environm ent is compatible with the genetic composition of the Cultivar, this leads to an increase in the yield of the Cultivar **(Abdel-Baky et al 2019) (Abdelaal, 2023).**

3.6.3.Effect of the interaction

We conclude from Table 7 that there are significant differences in the interaction in both the first and second seasons, as the Sakha Cultivar achieved the highest yield values with spraying treatment with extract of the leaves of the persicaria plant at (9.91 - 10.1) ardebs / fed in both the first and second seasons, while the lowest values were (5.48 - 5.76) ardebs / fed in the control treatment with the Giza 716 Cultivar. The highest foliar spray treatment, which resulted in the maximum yield / fed, was the application of Persicaria leaf extract. The Sakha 4 cultivar produced the highest yield / fed. The result showed that the greatest yield / fed was achieved with the foliar spray of Persicaria leaf extract combined with the Sakha 4 cultivar.

Conclusion

This experiment confirmed that foliar spraying of Persicaria leaf extract has shown promising results in improving the growth and productivity of faba beans, therefore it is recommended as a possible sustainable agricultural practice to enhance plant health and productivity, it is also strongly recommended to use Sakha 4 cultivars of faba beans, as they have shown superior performance in terms of growth and yield when grown under climatic conditions in Upper Egypt and under experimental conditions, according to the promising results of Persicaria leaf extract, it is strongly recommended to expand the study of the effects of Persicaria leaf extract on faba beans. additional research should focus on improving the concentration, timing and frequency of application of spraying to determine best practices for different growing conditions where no research is available And sufficient studies on the use of Persicaria leaf extract as a nutrient for field crops as an alternative to chemical fertilizers with high cost and environmental damage .

References

Abou-El-Seba, S. E., Abou-Salama, A. M., El-Nagar, G. R., & El-Mohsen, M. A. (2016). Physiological responses for growth and yield of some faba bean varieties under different plant densities. Assiut J. Agric. Sci, 47(6-1), 18-33.

Abdelaal, M. S. M. (2023). Response of Growth, Productivity and Quality For Some Faba Bean (Vicia faba L.) Cultivars to Different Irrigation Regimes. Egyptian Journal of Agronomy, 45(3), 231–247.

Abdel-Baky, Y. R., Abouziena, H. F., Amin, A. A., Rashad El-Sh, M., & Abd El-Sttar, A. M. (2019). Improve quality and productivity of some faba bean cultivars with foliar application of fulvic acid. Bulletin of the National Research Centre, 43, 1-11.

Albergaria, E. T., Oliveira, A. F. M., & Albuquerque, U. P. (2020). The effect of water deficit stress on the composition of phenolic compounds in medicinal plants. South African Journal of Botany, 131, 12-17.

Chandrkrachang S. (2002). The application of chitin and chitosan in agriculture in Thailand.Advances in Chitin and Chitosan Science, 5: 458–462.

Dehghanian, Z., Habibi, K., Dehghanian, M., Aliyar, S., Lajayer, B. A., Astatkie, T., Minkina, T., & Keswani, C. (2022). Reinforcing the bulwark: unravelling the efficient applications of plant phenolics and tannins against environmental stresses. Heliyon, 8(3).

Ghareeb, R. Y., El-Latif, A., Hany, S. A., & Kandil, E. E. (2023). Productivity of Some Faba Bean (Vica faba L.) Cultivars Under Different Planting Times. Egyptian Academic Journal of Biological Sciences, H. Botany, 14(1), 105-111.

Ghasemzadeh, A., & Ghasemzadeh, N. (2011). Flavonoids and phenolic acids: Role and biochemical activity in plants and human. J. Med. Plants Res, 5(31), 6697-6703.

Gomaz, K. A and A. A. Gomez (1984). Statistical procedures for agricultural research. Johan wily & sons

Hayat, Q., S. Hayat, M. Irfan, A. Ahmad. (2010). Effect of exogenous salicylic acid under changing environment: A review. Environmental and Experimental Botany. 68: 14-25.

Hussein, S., Usama, E.-M., Tantawy, M., Kawashty, S., & Saleh, N. (2017). Phenolics of selected species of Persicaria and Polygonum (Polygonaceae) in Egypt. Arabian Journal of Chemistry, 10(1), 76–81.

Ibrahim, J. A., I. Muazzam, I. A. Jegede, O. F. Kunle and J. I. Okogun. (2007). Ethnomedicinal plants and methods used by Gwandara tribe of Sabo Wuse in Niger state, Nigeria to treat mental illness. African Journal of Traditional Complementary and Alternative Medicines. 4: 211-218.

Kocięcka J, Liberacki D (2021) The potential of using chitosan on cereal crops in the face of climate change. Plants 10(1160):1–27.

Kumar, K., Debnath, P., Singh, S., & Kumar, N. (2023). An overview of plant phenolics and their involvement in abiotic stress tolerance. Stresses, 3(3), 570–585.

Kumar, S., Abedin, M. M., Singh, A. K., & Das, S. (2020). Role of phenolic compounds in plant-defensive mechanisms. Plant phenolics in sustainable agriculture: volume 1, 517-532.

Kwon, S. and J. Torrie (1964). Hertability and Interrelationship among Traits of two soybean population. Crop science, 4:196-198

Leilah, A. A., & El Deeb, A. A. (1988). Effect of plant density, Rhizobium inoculation and nitrogen rates on Faba bean (Vicia Faba, l.)[Egypt]. Journal of Agricultural Sciences, Mansoura Univ., 13.

M. A. Zahran and A. J. Willis, (2003). ―Plant life in the River Nile in Egypt,‖ Riyadh Mars Publ. House viii, 531p.-. ISBN, vol. 1370310765, pp. 50–53

Metwally, F. E., Mohamed, A. A. A., Mahalel, U. A., & Sheded, M. G. (2020). Evaluation Of Certain Cosmopolitan Hydrophytes In The Nile River, Aswan District For Their Ecological And Bioactivity Potentials: A Review. INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH, 9, 1.

Midiwo, J. O., Yenesew, A., Juma, B. F., Omosa, K. L., Omosa, I. L., & Mutisya, D. (2001). Phytochemical evaluation of some Kenyan medicinal plants. In Proceedings of the Phytochemical evaluation of some Kenyan medicinal plants. 11th NAPRECA Symposium Book of Proceedings.

Mohammadrezakhani, S., Hajilou, J., & Rezanejad, F. (2018). Evaluation of phenolic and flavonoid compounds in pollen grains of three Citrus species in response to low temperature. Grana, 57(3), 214-222.

Mukhtar, F. B. (2008). Effect of some plant growth regulators on the growth and nutritional value of Hibiscus sabdariffa L. (Red Sorrel). International Journal of Pure and Applied Sciences. 2(3):70-75.

Orgaz B. Lobete M.M. Puga C.H. San Jose C. (2011). Effectiveness of chitosan against mature biofilms formed by food related bacteria. International of Molecular Sciences, 12: 817–828.

Payne, B., & Lall, N. (2024). Persicaria senegalensis (Meisn.) Sojak: A review on identifying features, traditional uses, and biological activities. South African Journal of Botany, 170, 205-219.

Postiglione, A. E., Delange, A. M., Ali, M. F., Wang, E. Y., Houben, M., Hahn, S. L., Khoury, M. G., Roark, C. M., Davis, M., & Reid, R. W. (2024). Flavonols improve tomato pollen thermotolerance during germination and tube elongation by maintaining reactive oxygen species homeostasis. The Plant Cell, 36(10), 4511–4534.

Pourcel, L., & Grotewold, E. (2009). Participation of phytochemicals in plant development and growth. In Plant-derived Natural Products: Synthesis, Function, and Application (pp. 269-279). New York, NY: Springer US.

Saini, N., Anmol, A., Kumar, S., Bakshi, M., & Dhiman, Z. (2024). Exploring phenolic compounds as natural stress alleviators in plants-a comprehensive review. Physiological and Molecular Plant Pathology, 102383.

Samah A. Sabry, A. M. A. E.-M. S. A. (2022). Assessing Drought Tolerance of some Faba Bean (Vicia faba L.) Cultivars Using Genetic Variability, Tolerance Indices and ISSR Markers. Journal of Plant Production Sciences, 11(1), 111–121.

Sharma, P., Kumar, V., & Guleria, P. (2021). Naringenin alleviates lead-induced changes in mungbean morphology with improvement in protein digestibility and solubility. South African Journal of Botany, 140, 419-427.

Valente, I. M., Maia, M. R., Malushi, N., Oliveira, H. M., Papa, L., Rodrigues, J. A., ... & Cabrita, A. R. (2018). Profiling of phenolic compounds and antioxidant properties of European varieties and cultivars of Vicia faba L. pods. Phytochemistry, 152, 223-229.

Van Der Meer, I. M., Stam, M. E., van Tunen, A. J., Mol, J. N., & Stuitje, A. R. (1992). Antisense inhibition of flavonoid biosynthesis in petunia anthers results in male sterility. The Plant Cell, 4(3), 253-262.

Van Loo, E. J., Hoefkens, C., & Verbeke, W. (2017). Healthy, sustainable and plant-based eating: Perceived (mis) match and involvement-based consumer segments as targets for future policy. Food policy, 69, 46-57.

Wang , L., Ying Lam, L. P., Lui, A. C., Zhu, F. Y., Chen, M. X., Liu, H., ... & Lo, C. (2020). Flavonoids are indispensable for complete male fertility in rice. Journal of Experimental Botany, 71(16), 4715-4728.

Whitten, P. L., Kudo, S., & Okubo, K. K. (2020). Isoflavonoids. In Handbook of plant and fungal toxicants (pp. 117-137). CRC Press.

Zafari, S., Sharifi, M., Chashmi, N. A., & Mur, L. A. (2016). Modulation of Pb-induced stress in Prosopis shoots through an interconnected network of signaling molecules, phenolic compounds and amino acids. Plant physiology and biochemistry, 99, 11-20