Response of two cultivars of broad bean to spraying with phosphorous and thiamine and their effect on some qualitative traits

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Abstract

Two field experiments were conducted in the Nile district (7 km northeast of Babylon province) during both seasons (2021) and (2022).In order to study the response of two cultivars of broad beans to phosphorous and thiamine broad beans, the split split plots experiment was applied according to the randomized complete block design (R.C.B.D) with three replicates. The main plots included the cultivars (Italian Franchi, Spanish Fito), while the sub- plots included fertilization with phosphorous at four levels (0 kg h^{-1}, 80 kg h^{-1}, 160 kg h^{-1}, 240 kg ha^{-1})While the plots were occupied under secondary spraying with thiamine at a concentration of (0 mg L^{-1}, 100 mg L^{-1}, 200 mg L^{-1}). The results were analyzed statistically using the Genestat program, and the averages were compared on the basis of the least significant difference LSD 0.05, and the results can be summarized as follows:

The studied cultivars differed significantly in the vegetative growth, yield and quality indicators for all of both study seasons, as the Franchi cultivar was significantly excelled on the Fito cultivar in the studied traits by registering the highest averages for the studied traits.The percentage of nitrogen was (3.36 and 3.37%), the percentage of phosphorus was (0.29 and 0.32%), the percentage of potassium was (4.87 and 4.52%), the weight of the seeds in the green pod was (16.38 and 17.93) grams, the weight of the seeds after drying was (9.52). and 10.44) g for both seasons, respectively.

The treatment of adding phosphorous (240 kg $^{-1}$) was significantly excelled on the rest of the treatments in terms of vegetative growth, yield, and quality indicators for all of them, and for both seasons.The highest averages were recorded for the studied traits, including the percentage of phosphorus (0.38 and 0.40%), the percentage of potassium (5.45 and 5.37%), the weight of the seeds in the green pod (22.43 and 22.93) g, the weight of the seeds after drying (11.09 and 11.69) g for both seasons. respectively.

The addition of thiamine caused a significant increase in all indicators of vegetative growth, yield and quality, especially the concentration (200 mg L^{-1}) by recording the highest averages for the studied traits, as the percentage of nitrogen reached (3.36 and 3.35)%,The percentage of phosphorus (0.41 and 0.44%), the percentage of potassium (4.81 and 4.69%), the weight of the seeds in the green pod (17.21 and 17.94) g, the weight of the seeds after drying (9.37 and 10.07) g for both seasons, respectively.

The triple interaction treatment (Franchi cultivar, 240 kg h^{-1} and 200 mg l^{-1}) was significantly excelled in all indicators of vegetative growth, yield and quality, where the studied traits gave the highest averages for the studied traits. The percentage of nitrogen was (3.57 and 3.62%), the percentage of phosphorus (0.43 and 0.48%), the percentage of potassium (5.25 and 5.98%), the weight of the seeds in the green pod was (27.33 and 28.97) g, the weight of the seeds after drying was (13.60). and 14.00) gm for both seasons, respectively.

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carbohydrate formation, such as starch, the formation of sugars, and the production of cellulose, is affected. It also contributes to the process of cell formation and division. Thiamine is one of the important vitamins for growth, and it is one of the water-soluble vitamins. Vitamin B1 is considered a growth hormone that moves from one part of the plant to other parts, that is, it is covered in the leaves and then transmitted to the root (Blokhina, etal 2003 It encourages the roots in its role in the root meristem sections and adding thiamine to the plant has an important role in increasing growth by its effect in increasing the cytokinins and gibberellins(Youssef et al,2004) Based on the foregoing, the study aimed to know the effect of phosphate fertilization and thiamine spraying on the vegetative growth traits of two cultivars of broad bean.

Materials and methods

Experiment location :

A field experiment was conducted during the two agricultural seasons (2020-2021) and (2120-2022) in Al-Nile sub-district (5 km) northeast of Babylon province to know the response of two cultivars of barley to phosphorous and thiamine.

Soil Analysis:

The soil of the experiment was analyzed before planting by taking random samples from the soil of the field to a depth of (0-30 cm) to conduct an analysis of the physical and chemical properties of soil in the laboratories of the Ministry of Agriculture, Department of Agriculture of Babylon province, shown in Table (1).

INTRODUCTION

The Fabaceae family is one of the largest and most diverse families and includes soybeans, chickpeas and lentils, which are examples of legumes commonly consumed by humans and used as animal feed. The broad bean (Vicia faba), commonly known as the field broad bean, is one of the oldest and most popular cultivated plants on the planet and has the highest productive potential of all leguminous crops (Mekky et al (2020).broad bean seeds contain a high percentage of protein ranging between 26-33% and also contain amino acids, 0.55-1.06% dietary fibre, iron, zinc, in addition to antioxidants, saponins and some phenolic compounds (Labba, et al, 2021). Foliar Nutrition is an effective method to supply plants with nutrients and vitamins through the vegetative parts to contribute to the growth and development of the plant. This method is economical by reducing the need for large quantities of nutrients, especially large ones, compared to other methods. It is necessary to emphasize that nutrition through the shoots is a supplement to nutrition through the soil and not a substitute for it (El-naggar et al, 2009) Phosphorous is one of the basic and necessary nutrients for plant growth and development. It has been called the Key of Life because of its main and direct role in most of the processes that take place within plant cells, as these processes cannot occur without phosphorous. When the plant absorbs phosphorous, the phosphorus is distributed within all living cells within the plant tissues to participate in the vital processes of the plant. In the absence of phosphorous, the average of

Table (1) Some physical and chemical traits of the experimental field before planting

units	values	Traits
_____	**7.8**	**pH**
Ds.m^{1-}	**4.5**	**ECe**
%	**1.13**	Organic matter
ppm	**52**	nitrogen
ppm	**7**	phosphorous
ppm	**188**	potassium
)Centimol. Kg^{-1} soil(	**21.08**	**CEC**

g.cm^3	**1.13**	bulk density
%	60.0	sand
%	**24.5**	silt
%	**15.5**	clay
Sandy loam	**Sandy loam**	texture

1. control
2. 100 (mg. L^{-1})
3. 200 (mg. L^{-1})

3 - 6: The studied traits

Estimate the percentage of nitrogen, phosphorus and potassium in the leaf

A random sample was taken from the leaves of plants taken from the midlines of each experimental unit and used in measuring the characteristic of leaf area. Potassium (Al-Hassani, 2018).

Seed weight per green pod

The weight of the seeds in the green pod was calculated using the electronic scale at the maturity stage, where (10) pods were taken for each experimental unit.

Seed weight after drying

The fresh seeds were taken and dried in the open air, and their weight was measured after drying by means of an electronic balance

Results and discussion :

1 . The percentage of nitrogen in the leaves

The results in tables (2 and 3) showed that there was a significant effect of the cultivars on the nitrogen content of the leaves, where the Italian cultivar Franchi gave the highest rate for this trait, amounting to (3.36 and 3.37%) for the two seasons, respectively, compared with the French variety Fito, which gave (3.29%) for the first season (3.26%) for the second season.The reason for the addition of phosphate fertilizer had a significant effect on the percentage of nitrogen in the leaves, as the treatment (240 kg.ha^{-1}) was significantly excelled and gave the highest value of (3.47 and 3.46%) for both seasons, respectively, compared to the treatment without fertilizer, which gave (3.19 and 3.18% for the both seasons.The addition of thiamine has an effect on the nitrogen content of the leaves, where the treatment (200 mg L^{-1}) excelled by giving it the highest rate for this trait, which reached (3.36%) for the first season and (3.35%)

The tillage operations were conducted using the Moldboard plows, after which the levelling and smoothing operations were conducted, and the land was divided according to the design used.The planting was conducted on lines, with a distance between one line and another 50 cm, and the experimental unit was a board (2 * 3 m) with six lines, a length of 2 m for one line. One plant in pit after reaching the height of the plant (10-15) cm(Aady, 2012). so the total of the experimental units is (72) experimental units. The process of nitrogen fertilization was conducted with an amount of 80 kg N H-1 in the form of urea fertilizer (46% N) and at one batch (15) days after planting. The form of triple superphosphate fertilizer (21%P) in one batch before planting (Al-Hassani, 2018). .

Experiment design:

The experiment (the split plots experiment) was conducted according to the randomized complete block design (R.C.B.D) with three replications.

While phosphorous fertilization was placed in the subplots, while spraying with thiamine occupied the subplots.Experimental factors: The experiment of the split plot to study included three factors, which are:

The first factor:

Two cultivar of broad beans and occupied the main

1- Franchi . cultivar
2- Fito cultivar

The second factor:

Fertilization with phosphorous at four levels and occupied the sub plot

1.0 (kg.ha^{-1})
2. 80 (kg. ha^{-1})
3. 160 (kg. ha^{-1})
4. 240 (kg. ha^{-1})

The third factor:

The sub-sub plot included three concentrations of thiamine

thiamine and phosphorus, where the combination (200 mg L $^{-1}$ thiamine + 240 kg ha $^{-1}$ phosphorus) achieved the highest results (3.53 and 3.55%) for both seasons, respectively, while the combination gave (0 mg L $^{-1}$ Thiamine + 0 kg h^{-1} phosphorous) the lowest rates for this trait were (3.15 and 3.15%) for both seasons, respectively. The triple interaction between the cultivars, phosphate fertilization and spraying with thiamine achieved a significantly excelled for the leaf nitrogen content % in the combination (Franchi cultivar + 240 kg ha $^{-1}$ + 100 mg L $^{-1}$) as it gave the highest rate of (3.57 %) for the first season and (3.62 %) for the second season, compared with the control treatment, Fito, 0 phosphorous, and water spraying reached (3.13 and 3.12 %) for the two seasons, respectively.

for the second season compared to the control treatment without spraying, which gave the lowest The rate for this trait was (3.29%) for the first season and (3.28%) for the second season.The interaction between cultivars and phosphate fertilization resulted in significant differences for this trait, where the combination (Franchi cultivar + 240 kg ha^{-1} phosphorous) gave the highest rate for this trait, reaching (3.50%) for the first season and (3.52%) for the second season, while the combination gave (Fito cultivar + 0 kg ha^{-1} phosphorus) the lowest rate for this trait was (3.17 and 3.13%) for the two seasons, respectively. It is also noted from the two tables that there is no significant interaction between the cultivars and thiamine. The results showed a significantly excelled of the interaction between

Table (2) Effect of cultivars, phosphorus and thiamine on the percentage of nitrogen in the leaves (%) for the 2021 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
3.21	3.25	3.22	3.16	0kg.ha-1	Franchi
3.32	3.35	3.33	3.28	80kg.ha-1	
3.39	3.42	3.39	3.37	160kg.ha-1	
3.50	3.57	3.48	3.46	240kg.ha-1	
3.17	3.19	3.17	3.13	0kg.ha-1	Fito
3.25	3.26	3.26	3.22	80kg.ha-1	
3.33	3.36	3.34	3.29	160kg.ha-1	
3.43	3.50	3.41	3.38	240kg.ha-1	
0.013	**0.018**			**LSD 0.05**	
cultivars× Thiamine concentration					
3.36	3.40	3.35	3.32	Franchi	
3.29	3.33	3.30	3.25	Fito	
0.003	**N.S**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
3.19	3.22	3.20	3.15	0kg.ha-1	
3.28	3.31	3.30	3.25	80kg.ha-1	
3.36	3.39	3.37	3.33	160kg.ha-1	
3.47	3.53	3.45	3.42	240kg.ha-1	
0.009	**0.013**			**LSD 0.05**	
	3.36	3.33	3.29	average	
	0.006			**LSD 0.05**	

Table (3) The effect of cultivars, phosphorus and thiamine on the percentage of nitrogen in the leaves (%) for the 2022 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
3.23	3.26	3.23	3.19	0kg.ha-1	Franchi
3.33	3.35	3.33	3.29	80kg.ha-1	
3.39	3.42	3.39	3.37	160kg.ha-1	
3.52	3.62	3.48	3.46	240kg.ha-1	
3.13	3.15	3.13	3.12	0kg.ha-1	Fito
3.20	3.22	3.22	3.16	80kg.ha-1	
3.29	3.33	3.28	3.26	160kg.ha-1	
3.41	3.48	3.38	3.36	240kg.ha-1	
0.008	**0.018**			**LSD 0.05**	
cultivars× Thiamine concentration					
3.37	3.41	3.36	3.33	Franchi	
3.26	3.29	3.25	3.22	Fito	
0.014	**N.S**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
3.18	3.20	3.18	3.15	0kg.ha-1	
3.26	3.29	3.27	3.23	80kg.ha-1	
3.34	3.38	3.33	3.32	160kg.ha-1	
3.46	3.55	3.43	3.41	240kg.ha-1	
0.006	**0.013**			**LSD 0.05**	
	3.35	3.30	3.28	average	
	0.006			**LSD 0.05**	

respectively, compared to the treatment of no addition (0 kg ha^{-1}), which was recorded The lowest average was (0.14 and 0.18%) for both seasons, respectively.

The results of the two tables showed that thiamine had a significant effect on the trait of the phosphorus content of the leaves, as spraying the broad bean plants with (200 mg L^{-1}) gave the highest mean for the trait and amounted to (0.41 and 0.44%) compared to the no-spray treatment that gave (0.24 and 0.27%)) for both seasons.

The results of the same table show that the bi-interaction with phosphorus had a significant effect on this trait, as the plants within the combination (Franchi cultivar and 240 kg ha $^{-1}$) achieved the highest average of (0.40 and 0.43%)

phosphorus content in leaves (%)

Statistical results in tables (4 and 5) indicated that there were significant differences in the phosphorous content of leaves of bean plant, where the Franchi cultivar was significantly excelled on the Fito cultivar by giving it the highest average phosphorus content of leaves of (0.29 and 0.32%) for both seasons, respectively, while it gave The class Fito has the lowest average value (0.24%) for the first season and (0.28%) for the second season.

The addition of phosphorous also affected significantly the phosphorous content of the leaves (%), as the treatment of addition (240 kg ha^{-1}) was distinguished by giving it the highest average value (0.38 and 0.40%) for both seasons,

of (0.41 and 0.44%) for both seasons, respectively. While the combination (0 kg e^{-1} phosphorus + 0 mg l^{-1} thiamine) recorded the lowest average (0.14 and 0.18%) for both seasons, respectively.The results of the same table indicate that there are significant differences in the phosphorous content of the leaves of broad bean plant as a result of the interaction between the study factors combined, as the combination (Franchi + 240 kg h^{-1} + 200 mg l^{-1} thiamine) was significantly superior to the other combinations by recording the highest average of (0.43 and 0.48 %), respectively, for both seasons, compared to the combination (Fito + 0 kg e^{-1} phosphorus + 0 mg L^{-1} thiamine), which recorded the lowest average of (0.13 and 0.16 %) for both seasons, respectively.

for both seasons, respectively, while the (Fito and Fito cultivar) 0 kg ha $^{-1}$) the lowest average with a value of (0.14 and 0.18%) for both seasons, respectively.As for the bi-interaction between the cultivar and thiamine, significant differences appeared between the combinations, with (Franchi + 200 mg L^{-1}) significantly excelled on the rest of the other combinations and achieved the highest mean for the trait (0.32 and 0.35) for the two consecutive seasons, while the combination (Fito) was recorded. + 0 thiamine) the lowest mean (0.21 and 0.29%) for the two seasons, respectively.The bi- interaction between phosphorus and thiamine led to a significant increase in this trait, where the combination (240 kg h^{-1} phosphorus + 100 mg l^{-1} thiamine) was significantly excelled on the rest of the other combinations and recorded the highest average

Table (4) Effect of cultivars, phosphorus and thiamine on the percentage of phosphorous in leaves (%) for the 2021 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
0.17	0.19	0.17	0.15	0kg.ha-1	Franchi
0.25	0.28	0.25	0.23	80kg.ha-1	
0.33	0.35	0.32	0.30	160kg.ha-1	
0.40	0.43	0.39	0.37	240kg.ha-1	
0.14	0.15	0.14	0.13	0kg.ha-1	Fito
0.19	0.20	0.20	0.17	80kg.ha-1	
0.26	0.30	0.25	0.23	160kg.ha-1	
0.36	0.39	0.36	0.33	240kg.ha-1	
0.005	**0.009**			**LSD 0.05**	
cultivars× Thiamine concentration					
0.29	0.32	0.28	0.26	Franchi	
0.24	0.26	0.24	0.21	Fito	
0.005	**N.S**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
0.16	0.17	0.15	0.14	0kg.ha-1	
0.22	0.24	0.23	0.20	80kg.ha-1	
0.29	0.33	0.29	0.26	160kg.ha-1	
0.38	0.41	0.38	0.35	240kg.ha-1	
0.004	**0.006**			**LSD 0.05**	
	0.29	0.26	0.24	average	

	0.003	**LSD 0.05**

Table (5) Effect of cultivars, phosphorus and thiamine on the percentage of phosphorous in leaves (%) for the 2022 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
0.22	0.25	0.23	0.19	0kg.ha-1	Franchi
0.29	0.31	0.29	0.27	80kg.ha-1	
0.35	0.37	0.35	0.33	160kg.ha-1	
0.43	0.48	0.42	0.39	240kg.ha-1	
0.18	0.20	0.18	0.16	0kg.ha-1	Fito
0.25	0.26	0.26	0.23	80kg.ha-1	
0.31	0.34	0.31	0.28	160kg.ha-1	
0.37	0.40	0.37	0.35	240kg.ha-1	
0.007	**0.011**			**LSD 0.05**	
cultivars× Thiamine concentration					
0.32	0.35	0.32	0.29	Franchi	
0.28	0.30	0.28	0.25	Fito	
0.004	**0.005**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
0.20	0.23	0.20	0.18	0kg.ha-1	
0.27	0.29	0.28	0.25	80kg.ha-1	
0.33	0.35	0.33	0.31	160kg.ha-1	
0.40	0.44	0.40	0.37	240kg.ha-1	
0.005	**0.008**			**LSD 0.05**	
	0.33	0.30	0.27	average	
	0.004			**LSD 0.05**	

an effect on the potassium content of the leaves, where the treatment (200 mg.L^{-1}) excelled by giving it the highest rate of (4.81%) for the first season and (4.69%) for the second season, compared to the control treatment without spraying, which gave the lowest rate for this. The trait was (4.41%) for the first season and (4.21%) for the second season. The bi- interaction between the cultivar and phosphorous fertilization achieved a significant effect, as the combination (Franchi + 240 kg ha^{-1}) excelled by registering the highest rate (5.62 and 5.56) for both seasons, respectively, compared to the combination (Fito + 80 kg ha^{-1} phosphorous), which gave A value of (3.44 and 4.36%) for both seasons, respectively.The results of the two tables indicated that there was a significant

Potassium content in leaves (%)

The results in tables (6 and 7) showed that there was a significant effect of the cultivars on trait of the potassium content of the leaves, where the Italian variety Franchi gave the highest average for this trait amounting to (4.87 and 4.52%) for the two seasons, respectively, compared with the French variety Fito, which gave (4.35%) for the season. the first and (4.43%) for the second season.The addition of phosphate fertilizer had a significant effect on the potassium content in the leaves, where the treatment (240 kg ha^{-1}) was significantly excelled and gave the highest value of (5.45 and 5.37%) for both seasons, respectively, compared to the treatment without fertilizer, which gave (3.78 and 3.42%) for both seasons. The addition of thiamine has

for the second season in When the combination (0 kg h^{-1} phosphorous + spraying with water only) gave the lowest rate for this trait, it reached (3.57 and 3.19%) for the two seasons, respectively.

The triple interaction between cultivars, phosphate fertilization and thiamine spraying achieved a significantly excelled for this trait in the combination (Franchi cultivar + 240 kg hectare $^{-1}$ + 100 mg liter $^{-1}$), as it gave the highest rates of (5.25%) for the first season and (5.98%) for the first season. The second is a comparison with the control treatment, Fito class, 0 phosphorus, and water spraying reached (3.24 and 3.06%) for both seasons, respectively.

interaction between the cultivar and thiamine, where the bi-interaction between (Franchi cultivar + spraying with thiamine 200 mg L^{-1}) gave the highest mean for the trait, which reached (5.04) for the first season and for the second season (4.77%), while the interaction gave (4.77%) for the cultivar. Fito + comparison treatment without spraying (the lowest rate was (4.13 and 4.24%) for the two seasons, respectively.The interaction between phosphate and thiamine fertilization led to significant differences for this trait, as the combination spraying with thiamine (200 mg L $^{-1}$ + 240 kg ha $^{-1}$) gave the highest rate for this trait which reached (5.63%) for the first season and (5.65%)

Table (6) Effect of cultivars, phosphorus and thiamine on the percentage of potassium in leaves (%) for the 2021 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
4.11	4.33	4.10	3.91	0kg.ha-1	Franchi
4.67	4.85	4.70	4.48	80kg.ha-1	
5.07	5.25	5.03	4.93	160kg.ha-1	
5.62	5.72	5.65	5.48	240kg.ha-1	
3.44	3.67	3.42	3.24	0kg.ha-1	Fito
4.09	4.22	4.22	3.85	80kg.ha-1	
4.57	4.90	4.47	4.33	160kg.ha-1	
5.29	5.55	5.21	5.10	240kg.ha-1	
0.030	**0.074**			**LSD 0.05**	
cultivars× Thiamine concentration					
4.87	5.04	4.87	4.70	Franchi	
4.35	4.58	4.33	4.13	Fito	
0.056	**0.037**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
3.78	4.00	3.76	3.57	0kg.ha-1	
4.38	4.53	4.46	4.16	80kg.ha-1	
4.82	5.08	4.75	4.63	160kg.ha-1	
5.45	5.63	5.43	5.29	240kg.ha-1	
0.021	**0.052**			**LSD 0.05**	
	4.81	4.60	4.41	average	
	0.026			**LSD 0.05**	

Table (7) Effect of cultivars, phosphorus and thiamine on the percentage of potassium in leaves (%) for the 2022 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
3.47	3.69	3.41	3.32	0kg.ha-1	Franchi
4.24	4.43	4.28	4.02	80kg.ha-1	
4.80	4.98	4.82	4.60	160kg.ha-1	
5.56	5.98	5.42	5.28	240kg.ha-1	
3.36	3.68	3.33	3.06	0kg.ha-1	Fito
4.39	4.49	4.49	4.18	80kg.ha-1	
4.79	4.91	4.81	4.66	160kg.ha-1	
5.18	5.31	5.17	5.05	240kg.ha-1	
0.049	**0.063**			**LSD 0.05**	
cultivars× Thiamine concentration					
4.52	4.77	4.48	4.31	Franchi	
4.43	4.60	4.45	4.24	Fito	
0.026	**0.031**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
3.42	3.69	3.37	3.19	0kg.ha-1	
4.32	4.46	4.38	4.10	80kg.ha-1	
4.80	4.95	4.82	4.63	160kg.ha-1	
5.37	5.65	5.30	5.17	240kg.ha-1	
0.035	**0.044**			**LSD 0.05**	
	4.69	4.47	4.27	average	
	0.022			**LSD 0.05**	

excelled by giving it the highest rate in this trait, which amounted to (17.21) gm for the first season and (17.94) gm for the second season, compared to the control treatment without spraying, which It gave the lowest rate for this trait, which was (14.92) gm for the first season and (15.28) gm for the second season.The bi-interaction between the cultivar and phosphorus fertilization achieved a significant effect on the seed weight in Green pod, where the combination Franchi 240 kg ha^{-1} excelled by recording the highest rate of (24.23 and 25.77) gm for both seasons, respectively, compared to the combination Fito 0 kg ha^{-1}, which It gave a value of (11.11 and 11.79) grams for both seasons, respectively. The results of the two tables (21 and 22) showed that there was a significant interaction between the cultivar and thiamine, where the bi-interaction between the

Seed weight in green pod (gm)

The results in tables (8 and 9) showed that there was a significant effect of the cultivars on the trait of seed weight in green pod, where the Italian variety Franchi gave the highest average for the trait amounted to (16.38 and 17.93) gm for both seasons, respectively, compared with the French variety Fito, which gave (15.71) gm for the first season and (15.19) grams for the second season.The addition of phosphate fertilizer had a significant effect on seed weight in green pod, as the treatment (240 kg ha^{-1}) was significantly excelled and gave the highest value of (22.43 and 22.93) gm for both seasons, respectively, compared to the treatment without fertilizer, which gave (11.59 and 12.44) grams for both seasons, respectively. The addition of thiamine has an effect on the characteristic of seed weight in the green pod, as the treatment (200 mg L^{-1})

combination gave Fito with and without The lowest rate of spraying for this trait was (11.20 and 11.77) g for the two seasons, respectively.The triple interaction between cultivars, phosphate fertilization and thiamine spraying achieved a significant superiority for seed weight in the green pod in the combination (Franchi cultivar + 240 kg ha $^{-1}$ + 100 mg liter $^{-1}$) as it gave the highest rate of (27.33) gm for the first season and (28.97) gm for the second season compared to the comparison treatment (Fito variety + 0 kg h^{-1} phosphorus + 0 mg l^{-1}) amounted to (11.53 and 12.17) gm for both seasons, respectively.

Franchi cultivar and spraying with thiamine 200 mg L^{-1} gave the highest mean for the trait which reached (17.83) gm for the first season and (19.33) gm for the second season, while (19.33) gm for the second season. The overlapping of the French cultivar and the control treatment without spraying gave the lowest rate of (14.65 and 14.03) gm for both seasons, respectively.The interaction between phosphate and thiamine fertilization led to significant differences for this trait, as the Franchi combination gave spraying with thiamine 200 mg L^{-1} the highest rate for this trait was (24.72) gm for the first season and (26.32) gm for the second season, while the

Table (8) Effect of cultivars, phosphorus and thiamine on seed weight in Green pod (gm) for the 2021 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
12.08	12.87	11.83	11.53	0kg.ha-1	Franchi
13.69	14.37	13.60	13.10	80kg.ha-1	
15.52	16.73	15.20	14.63	160kg.ha-1	
24.23	27.33	23.90	21.47	240kg.ha-1	
11.11	11.47	11.00	10.87	0kg.ha-1	Fito
13.50	14.40	14.40	11.70	80kg.ha-1	
17.60	18.43	17.73	16.63	160kg.ha-1	
20.62	22.10	20.37	19.40	240kg.ha-1	
0.347	**0.757**			**LSD 0.05**	
cultivars× Thiamine concentration					
16.38	17.83	16.13	15.18	Franchi	
15.71	16.60	15.88	14.65	Fito	
0.216	**0.378**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
11.59	12.17	11.42	11.20	0kg.ha-1	
13.59	14.38	14.00	12.40	80kg.ha-1	
16.56	17.58	16.47	15.63	160kg.ha-1	
22.43	24.72	22.13	20.43	240kg.ha-1	
0.245	**0.535**			**LSD 0.05**	
	17.21	16.00	14.92	average	
	0.268			**LSD 0.05**	

Table (9) Effect of cultivars, phosphorus and thiamine on seed weight in green pods(gm) for the 2022 season

Cultivars ×phosphate	Thiamine spray concentrations	phosphate fertilization	Cultivars

fertilization	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
13.09	14.00	13.10	12.17	0kg.ha-1	Franchi
14.79	15.23	14.83	14.30	80kg.ha-1	
18.09	19.13	18.50	16.63	160kg.ha-1	
25.77	28.97	25.33	23.00	240kg.ha-1	
11.79	12.17	11.83	11.37	0kg.ha-1	Fito
13.46	13.87	13.87	12.63	80kg.ha-1	
15.41	16.47	15.40	14.37	160kg.ha-1	
20.10	23.67	18.87	17.77	240kg.ha-1	
0.363	**0.571**			**LSD 0.05**	
cultivars× Thiamine concentration					
17.93	19.33	17.94	16.53	Franchi	
15.19	16.54	14.99	14.03	Fito	
0.516	**0.285**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
12.44	13.08	12.47	11.77	0kg.ha-1	
14.12	14.55	14.35	13.47	80kg.ha-1	
16.75	17.80	16.95	15.50	160kg.ha-1	
22.93	26.32	22.10	20.38	240kg.ha-1	
0.257	**0.403**			**LSD 0.05**	
	17.94	16.47	15.28	average	
	0.202			**LSD 0.05**	

of (9.37 and 10.07) grams for the two seasons, respectively, compared to the no-spray treatment, which gave (8.29 and 9.03).) Cloud for both seasons.The results of the same table show that the bi-interaction with phosphorus had a significant effect on the weight of the seeds after drying, as the plants within the combination (Franchi cultivar and 240 kg h^{-1} phosphorus) achieved the highest average of (11.59 and 12.64) gm, respectively, for both seasons, while (The class Fito and 0 kg h^{-1} phosphorous) had the lowest average value of (5.82 and 6.47) gm for both seasons, respectively. As for the bi-interaction between the cultivar and thiamine, significant differences appeared between the combinations, with (Franchi + 200 mg L^{-1}) significantly excelled on the rest of the other combinations and achieved the highest mean for the trait amounted to (10.30 and 11.05) g for for both seasons, respectively, while the combination recorded (Fito + 0 thiamine) was the lowest average of (7.58 and 8.14) gm for both seasons, respectively.The bi- interaction between

: Weight of seeds after drying (gm)

The statistical results in tables (10 and 11) indicate that there are significant differences in the weight of the seeds after drying of the broad bean plant, where the Franchi cultivar was significantly superior to the Fito cultivar by giving it the highest mean for the trait, which reached (9.52 and 10.44) gm for both seasons, respectively, while the Fito cultivar gave the lowest. Average of (8.04 and 8.65) gm for both seasons, respectively.The addition of phosphorous also significantly affected the weight of the seeds after drying, where the addition treatment (240 kg h^{-1}) was distinguished by giving it the highest average of (11.09 and 11.69) gm for both seasons, respectively, compared to the no-addition treatment, which recorded the lowest average of (6.79 and 7.52) gm for both seasons. sequentially.The results of the two tables showed that thiamine had a significant effect on the weight of the seeds after drying, where spraying the broad bean plants with (200 mg L^{-1}) gave the highest average value

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differences in the weight of the seeds after drying of broad bean plant as a result of the interaction between the factors of the study combined, as the combination (Franchi + 240 kg e^{-1} + 200 mg l^{-1} thiamine) was significantly superior to the other combinations by recording the highest average of (13.60 and 14.00) gm for the two seasons, respectively, compared to the combination (Fito + 0 kg h^{-1} phosphorus + 0 mg ltr^{-1} thiamine), which recorded the lowest average of (5.33 and 6.13) gm for both seasons, respectively.

phosphorus and thiamine led to a significant increase in this trait, Where the combination (240 kg h^{-1} phosphorus + 100 mg l^{-1} thiamine) was significantly excelled on the rest of the other combinations and recorded the highest average of (12.23 and 12.67) gm for both seasons, respectively. While the combination (0 kg h^{-1} phosphorus + 0 mg l^{-1} thiamine) recorded the lowest average of (6.33 and 7.20) g for both seasons, respectively.The results of the same table indicate that there are significant

Table (10) Effect of cultivars, phosphorus and thiamine on seed weight after drying (g) for the 2021 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
7.77	8.23	7.73	7.33	0kg.ha-1	Franchi
8.92	9.14	8.87	8.77	80kg.ha-1	
9.81	10.23	9.80	9.40	160kg.ha-1	
11.59	13.60	10.67	10.50	240kg.ha-1	
5.82	6.33	5.80	5.33	0kg.ha-1	Fito
7.30	7.57	7.57	6.77	80kg.ha-1	
8.44	9.00	8.47	7.87	160kg.ha-1	
10.60	10.87	10.60	10.33	240kg.ha-1	
0.191	**0.190**			**LSD 0.05**	
cultivars× Thiamine concentration					
9.52	10.30	9.27	9.00	Franchi	
8.04	8.44	8.11	7.58	Fito	
0.093	**0.095**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
6.79	7.28	6.77	6.33	0kg.ha-1	
8.11	8.35	8.22	7.77	80kg.ha-1	
9.13	9.62	9.13	8.63	160kg.ha-1	
11.09	12.23	10.63	10.42	240kg.ha-1	
0.135	**0.135**			**LSD 0.05**	
	9.37	8.69	8.29	average	
	0.067			**LSD 0.05**	

Table (11) Effect of cultivars, phosphorus and thiamine on seed weight after drying (gm) for the 2022 season

Cultivars ×phosphate fertilization	Thiamine spray concentrations			phosphate fertilization	Cultivars
	200 mg.kg-1	100 mg.kg-1	0 mg.kg-1		
8.58	8.87	8.60	8.27	0kg.ha-1	Franchi
9.72	10.13	9.73	9.30	80kg.ha-1	

10.80	11.20	10.73	10.47	160kg.ha-1	
12.64	14.00	12.30	11.63	240kg.ha-1	
6.47	6.83	6.43	6.13	0kg.ha-1	Fito
8.03	8.37	8.37	7.37	80kg.ha-1	
9.37	9.80	9.43	8.87	160kg.ha-1	
10.73	11.33	10.67	10.20	240kg.ha-1	
0.107	**0.157**			**LSD 0.05**	
cultivars× Thiamine concentration					
10.44	11.05	10.34	9.92	Franchi	
8.65	9.08	8.73	8.14	Fito	
0.095	**0.078**			**LSD 0.05**	
phosphate fertilization x thiamine concentration					
7.52	7.85	7.52	7.20	0kg.ha-1	
8.88	9.25	9.05	8.33	80kg.ha-1	
10.08	10.50	10.08	9.67	160kg.ha-1	
11.69	12.67	11.48	10.92	240kg.ha-1	
0.075	**0.111**			**LSD 0.05**	
	10.07	9.53	9.03	average	
	0.055			**LSD 0.05**	

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