

## Response of barley and Broad bean to the efficiency of loading systems and productivity indicators by the effect of organic fertilization

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### Abstract

A field experiment was conducted during the winter season 2022-2023 to study the impact of the response of barley and broad bean to the efficiency of loading systems and productivity indicators by the effect of organic fertilization in the district of Al-Musayyib project / in Babylon province on 10/18/2022, according to the randomized complete block design (R.C.B.D) in the arrangement of split plot. And with three replications, where the main plot included fertilization (without fertilization, organic fertilization (with poultry), while the sub plot included loading systems. The following results were obtained: Fertilization was excelled on no fertilization in barley and broad bean for traits. The percentage of chlorophyll in barley and broad bean reached (45.48 and 55.91). Seed successively Trait number of grains/seeds barley and Broad bean amounted to (50.74 and 6.601) respectively traits weight of 100 grains/seeds Plant-1 barley and bean amounted to (7.76 and 93.03) g Plant<sup>-1</sup> . The yield of the plant barley and Broad bean leaf reached (7.76 and 93.03) g. (31.60 and 35.42) g.plant<sup>-1</sup>, respectively. The excelled of loading (1 barley: 2 broad bean) in traits of the number of grains and seeds for barley and Broad bean was (42.34 and 6.361), respectively. The excelled of loading (2 barley: 2 Broad bean) and (3 barley: 3 Broad bean) in traits of the percentage of chlorophyll for barley was (48.97 and 49.76) and (57.24 and 56.16) respectively .As for the combinations between fertilization and loading systems, the combination excelled between (fertilization and 1:2) in most of the studied traits in terms of number of grains/seeds, barley and Broad bean, were (57.35 and 7.799) respectively.

### introduction

*Vulgare hordeum* L. belongs to the Poaceae family. Barley ranks fourth in terms of cultivated areas and the amount of global production after wheat, rice and corn. It is known for its tolerance of harsh climatic conditions, and the crop is characterized by low nutritional requirements and rapid growth. In Iraq, barley ranks second in terms of cultivated areas and production, after wheat [6]The total global production of barley is about 144 million tons In Iraq, the annual production is estimated at 267 thousand tons, and the cultivated area is 3092 thousand dunums [19] The *Vicia faba* L. Broad bean is an important winter vegetable crop belonging to the Fabaceae family, which has a high percentage of protein in the seeds about 25-30% and its seeds contain carbohydrates up to

56% with the presence of mineral elements and up to 6% fiber and 1.5% fat [10]. Broad bean are one of the most important and oldest crops known to man, and they were cultivated and produced regularly [4] Due to its great importance in food and health, the importance of this plant comes because its green or dry seeds contain a large amount of protein and essential amino acids such as arginine and lysine, in addition to the seed's richness in carbohydrates, vitamins and minerals that are beneficial for health and bone building [17] Field crops of both types (grains and Broad bean) occupied a distinguished position in agricultural production due to their great importance in human and animal nutrition, where a complementary relationship arose between grain and legume crops from a

nutritional point of view, as the essential amino acids for building proteins are widely available in legume crops, while they are not available in grain crops Agricultural loading is defined as an agricultural system in which two or more crops are grown in one agricultural season in the same field and overlapping [12]. Possible utilization of resources and light, increasing production in quantity and quality diversifying crops grown in the same field, optimal utilization of cultivated areas and increasing their returns, in addition to making full use of fertilizers added during the crop's existence, in addition to the fact that agricultural loading systems have contributed significantly By reducing the incidence of insect pests and diseases compared to monoculture [3] . Organic fertilization is considered one of the poorest plant nutrients in most types of soils, and the greatest gain from cultivation with agricultural loading systems for plants is the use of organic fertilization in an integrated manner [6]. At present, emphasis is placed on the use of organic fertilization in modern agriculture, where it reduces the need To mineral fertilization and reduce its harm to the soil and human health in general [13]

The aim of this study is to estimate the growth and productivity of barley and bean plants under the influence of organic fertilization and to evaluate the growth and productivity of barley and Broad bean plants under the influence of the intercropping system.

## Materials and methods:

### 1. The location of the experiment

The field experiment was conducted in the sub-district of Al-Musayyib project / in Babylon provainc on 10/18/2022 for the purpose of studying the response of barley and broad bean to the efficiency of the loading and organic fertilization systems according to the randomized complete block design (R.C.B.D) in split-plot arrangement. And with three replications, where the main plot included fertilization (without fertilization, organic fertilization (with poultry)), while the sub plot included loading systems, according to Table (1).

**Table (1) shows the experiment scheme for loading systems**

Details	loading percentage (symbols)	Treatments
barley	Single cultivation	1
broad bean	Single cultivation	2
Barley line - broad bean line	1 - 1	3
Barley line - two lines broad bean	2 - 1	4
Barley line - three lines broad bean	3 - 1	5
Two lines of barley - two lines broad bean	2 - 2	6
Two lines of barley - three lines broad bean	3 - 2	7
Three lines of barley - three broad beans	3 - 3	8

## 2. Study factors

Experience factors consist of two factors:

- 1- The main plot that included the main plot is organic fertilization (without fertilization or fertilization).
- 2- The sub plot include the loading systems, as shown in Table (1) above.
3. testes of soil and crops

Samples were taken from the soil of the field before planting at a depth of (0-30) cm randomly and from different places of the experimental land, then they were mixed and the soil was air-dried, and after it was well homogenized, some chemical and physical tests were conducted according to the methods described by [15] The samples were analyzed in the laboratory of Al-Musayyib Technical College and Al-Musayyib Technical Institute, as shown in Table (2).

**Table (2) Chemical and physical properties of the soil under study**

unites	values	Measured chemical and physical properties
	7.4	pH
g.kg <sup>-1</sup>	1.9	organic matter
dsm <sup>-1</sup>	2	Electrical conductivity (EC)
mg.kg <sup>-1</sup>	0.9	nitrogen
	0.57	phosphorous
	1.17	potassium
Soil separator		
g.kg <sup>-1</sup>	520.00	sand
	280.00	silt
	200.00	clay
sandy loam		texture

## 4. Soil and crop processes

After selecting the land required for growing crops, the experimental land was prepared, and the soil service operations of plowing, smoothing and leveling were conducted on it. Leveling machine (two rates) [6]. Then the experimental field was divided

into three sectors, each sector includes 16 experimental units, to which the treatments are distributed randomly. A bowl of (3) grain or seeds to ensure full germination, at a depth of 2-3 cm for barley, and a depth of 3-5 cm for broad bean, on one side of the rice. The seeds were sown on 10/18/2022, and germination took place on the date of barley germination

on 10/23/2022, and the germination date of the broad bean on 10/28/2022. The thinning process took place two weeks after germination to keep the strongest plants in each jar, then the approved loading rate was determined. On the numbers of exchanged cultivars in cultivation at each experimental unit. Phosphate fertilizers were added in the form of triple superphosphate fertilizer ( $P_2O_5$  46%) at a rate of  $240 \text{ kg ha}^{-1}$  as a single batch before planting, with the addition of an amount of urea fertilizer (46% N) and in two batches, one at planting and the other batch after 45 days of planting, at a rate of  $320 \text{ kg ha}^{-1}$  after hoeing the experiment [9] with the experiment being watered and performing all service operations such as hoeing, weeding and control as needed during the growing season. A distance was left between one experimental unit and another 1 m within the one repeater, as well as a distance between one repeater and another 1 m, as the total experimental units for three replications were 48 experimental units for the whole experiment. The crops of barley and broad bean were grown in the field, where the barley crop (ABA 99) of the rank kernel was obtained from the Agricultural Research Department of Abu Ghraib, as well as the French bean variety (LUZ DE OTONO) commercially.

#### 5. traits studied

For barley: average percentage of chlorophyll in leaves, number of grains/spike, plant yield ( $\text{kg/ha}^{-1}$ )

For broad bean: average percentage of chlorophyll in leaves, number of seeds.  $\text{Pod}^{-1}$ , seed yield per plant ( $\text{g. plant}^{-1}$ )

#### 6. Statistical analysis

The data were analyzed statistically using the analysis of variance and according to the randomized complete block design (RCBD) in a split-plot arrangement, and the comparison was made for the arithmetic means of the treatments using the Least Significant

Difference (L.S.D) test at the level of probability 0.05, using the Genstat statistical analysis program to distinguish differences between the treatments [5]

### Results and discussion

#### Average percentage of chlorophyll in the leaves of barley:

The results in Table (3) showed that there were significant differences between the arithmetic averages in the average traits of the percentage of chlorophyll of the barley plant for fertilization, loading, and the interactions for the agricultural season 2022-2023. The results of Table (3) showed that there were significant differences in traits of the percentage of plant chlorophyll for the added fertilization, where the treatment excelled Organic fertilization compared to non-fertilization and gave the highest rate of (45.48) spat for the season, while the non-fertilization treatment gave the lowest rate of (36.24) for the season. This is due to its ability to improve the physical, chemical and biological properties of the soil because of the nutrients it contains. When it decomposes, it produces many organic acids with an acidic action that may reduce the pH of the soil, in addition to its content of nutrients that may increase the readiness and absorption of nutrients in the soil. By plants and increasing its concentration in the leaves, as well as increasing the content of leaves of chlorophyll and the concentration of carbohydrates in them and improving the vegetative growth of trees (Ibrahim, 2018). These results are consistent with ([16]. It is noted from Table (3) that there are significant differences in loading between barley and broad bean in this traits, as loading excelled (3:3) and gave the highest rate for this trait compared to the rest of the other loads, which amounted to (49.76) spad, and this did not differ significantly from loading (2:2.) which gave the highest rate of (48.97) SPAD, and the monoculture gave the lowest rate of (27.00) SPAD. As for the intercropping patterns, the same table shows

that there are no significant differences loading in this trait. between the combination of fertilization and

**Table (3) Response of barley and broad beans to the efficiency of loading systems and productive indicators by the effect of organic fertilization of trait of % chlorophyll in barley**

season2023 - 2022									
average	3-3	3-2	2-2	3-1	2-1	1-1	Single	loading fertilization	
45.48	55.26	44.65	55.35	44.02	46.18	44.55	28.37	fertilization	
36.24	44.27	34.37	42.60	36.11	36.03	34.69	25.63	without fertilization	
	49.76	39.51	48.97	40.07	41.11	39.62	27.00	average	
interaction N. S					loading 2.997		fertilization 3.075	L.S.D	

The number of grains per spike. plant<sup>-1</sup> in barley

The results shown in Table (4) indicate that there are significant differences in the trait of the number of grains in the barley plant for the added fertilization, as the organic fertilization treatment excelled on the non-fertilization and gave the highest rate of (50.74) grains for the season, while the non-fertilization treatment gave the lowest rate of (26.59) grains for the season. This means that the barley plant benefited from the nitrogen that is biologically fixed by the broad bean crop, as nitrogen is considered one of the most important elements in the growth processes, and on the other hand there is a lack of competition between cultivated plants. It is noted from Table (4) that there are significant differences in loading between barley and broad beans in this characteristic, as loading exceeded (2:1) and gave the highest average for this characteristic compared to the rest of the other suppositories

. The reason for the excelled of the intercropping treatment is due to the role of the broad bean crop in fixing atmospheric nitrogen, and the barley crop benefited from it, which led to an increase in the leaf area of barley, which in turn led to an increase in the photosynthesis process, which was reflected in the increase of carbohydrates transported from the source to the sink, which led to an increase in trait of Fertilization for this treatment compared to other treatments, which reflected positively in increasing the number of grains in the plant. It appears from the same table that there is a significant effect of the combination between fertilization and loading in the number of grain trait. The combination between (fertilization and cultivation 2:1) gave the highest mean for the number of grains, reaching (57.35) for the season, and the combination between (without fertilization and monoculture) gave the lowest rate for this trait. It reached (23.52.)

**Table (4) The response of barley and broad beans to the efficiency of loading regimes and productivity indicators by the effect of organic fertilization on the number of grains per grain. plant - 1 in barley**

season2023 - 2022								
average	3-3	3-2	2-2	3-1	2-1	1-1	Single	loading fertilizat ion
50.74	52.69	52.86	53.08	56.60	57.35	53.83	28.78	fertilizat ion
26.59	27.20	27.66	27.54	25.87	27.34	26.99	23.52	without fertilizat ion
	39.95	40.26	40.31	41.24	42.34	40.41	26.15	average
interaction 2.527					loading 1.874		fertilizati on 1.344	L.S.D

#### Plant yield (kg/ha ) in barley

The results of Table (5) showed that there were significant differences for the plant yield in barley for the added organic fertilization, where the organic fertilization treatment was excelled on the non-fertilization treatment and gave the highest rate of (31.60) g.plant<sup>-1</sup> for the season, while the treatment of no fertilization gave the lowest rate of (20.20) g. Plant<sup>-1</sup> for the season. The results are similar to what was reached by [14] and the reason for the superiority of this trait is due to the increase in the number of spikes in the plant and the increase in the percentage of chlorophyll, which was reflected in the yield of the individual plant, and this is consistent with what he mentioned .It is noted from

Table (5) that there are significant differences in loading between barley and broad bean in this traits, as loading (2:1) excelled and gave the highest average for this trait compared to the rest of the other loads, which amounted to (29.42) g. plant<sup>-1</sup>, while the monoculture gave the lowest rate of (16.30) g. This-1 plant is consistent with the results [7]. It appears from the same table that there is a significant effect of the combination between fertilization and loading in the same traits for barley for the 2022-2023 season, as the combination between (fertilization and cultivation 2:1) gave the highest rate of (36.23) g. plant<sup>-1</sup> for the season and the combination between (without fertilization and monoculture) gave the lowest mean for this trait amounted to (14.00) g. Plant<sup>-1</sup> for the same season.

**Table (5) The response of barley and broad bean to the efficiency of loading systems and productivity indicators by the effect of organic fertilization on traits of plant yield (g. plant - 1 in barley**

season2023 - 2022								
average	3-3	3-2	2-2	3-1	2-1	1-1	Single	loading fertilization
31.60	34.07	33.07	33.40	33.13	36.23	32.67	18.60	fertilization
20.20	21.00	21.80	20.47	20.53	22.60	21.00	14.00	without fertilization
	27.53	27.43	26.93	26.83	29.42	26.83	16.30	average
interaction 2.788					loading 1.258		fertilization 3.660	L.S.D

#### The average percentage of chlorophyll in the leaves of broad bean

The results of table (6) showed that there were significant differences in traits of the percentage of chlorophyll in the broad bean for the added organic fertilization, where the organic fertilization treatment excelled on the non-fertilization treatment and gave the highest rate of (55.91)% for the season, while the non-fertilization treatment gave the lowest rate of (41.79%). This is consistent with [2].

It is noted from Table (6) that there are significant differences in loading between barley and broad bean in this traits, where the loading (2:1) excelled and gave the highest rate for this traits compared to the rest of the other suppositories, which amounted to (48.89)%, and the single culture gave the lowest rate, amounting to (39.11)%.As for intercropping patterns, the same table shows that there is no significant effect of the combination of fertilization and loading on the chlorophyll percentage.

**Table (6) Response of barley and broad bean to the efficiency of loading systems and productive indicators to the effect of organic fertilization on traits of chlorophyll% in the broad bean**

season2023 - 2022									
average	3-3	3-2	2-2	3-1	2-1	1-1	Single	loading fertilization	
55.91	62.99	53.85	65.95	53.58	56.28	51.86	46.84	fertilization	
41.79	49.33	40.94	48.53	39.85	41.51	40.95	31.39	without fertilization	
	56.16	47.40	57.24	46.71	48.89	46.41	39.11	average	
interaction N . S					loading 5.375		fertilization 18.114	L.S.D	

number of seeds. (pod.plant<sup>-1</sup>)

The results shown in Table (7) indicate that there are significant differences in the number of seeds in the barley plant for added fertilization, where the organic fertilization treatment was excelled on the non-fertilization treatment and gave the highest rate of (6.601) seeds for the season, while the non-fertilization treatment gave the lowest rate of (4.281). Seeds for the season. This is consistent with [8] . It could be related to the ability of microorganisms in compost to produce plant hormones such as indole acetic acid. Such microorganisms can dissolve and mobilize phosphorous and potassium, fix N, and increase the availability of these nutrients

to plants; Hence, it can enhance the growth and productivity of crops [17]. It is noted from Table (7) that there are significant differences in loading between barley and broad bean in this traits, where loading excelled (2:1) and gave the highest average for this traits compared to the rest of the other suppositories, amounting to (6.361) seeds, and the single cultivation gave the lowest rate for this traits amounting to (4.498). ) It appears from the same table that there is a significant effect of the combination between fertilization and loading on the number of grains, where the combination between (fertilization and cultivation 2:1) gave the highest mean of the number of grains, reaching (7.799) seeds. This is consistent with the findings of [1, 11].



**Table (7) The response of barley and broad bean to the efficiency of loading systems and productivity indicators by the effect of organic fertilization on the number of seeds per seed. plant-1 in broad bean**

season2023 - 2022								
average	3-3	3-2	2-2	3-1	2-1	1-1	Single	loading fertilizat ion
6.601	6.799	6.721	6.557	6.902	7.799	6.720	4.707	fertilizat ion
4.281	4.014	4.013	4.080	4.532	4.924	4.112	4.289	without fertilizat ion
	5.406	5.367	5.318	5.717	6.361	5.416	4.498	average
interaction 0.7092					loading 0.4741		fertilizati on 0.6846	L.S.D

The results of Table (8) showed that there were significant differences for the plant yield in the **Seed yield per plant (g. plant<sup>-1</sup>) for broad bean**

broad bean for the added organic fertilization, as the organic fertilization treatment was excelled on the non-fertilization treatment and gave the highest rate of (35.42) g. plant<sup>-1</sup>, while the treatment of no fertilization gave the lowest rate of (20.98) g. Plant<sup>-1</sup>. The results are similar to [4]. The reason for the superiority of this traits is due to the increase in the number of spikes in the plant and the increase in the percentage of chlorophyll, which is reflected in the yield of the individual plant. Organic fertilizers improve soil structure, provide a wide range of plant nutrients, and add beneficial microorganisms of [1]

to the soil [4] It is noted from Table (8) that there are significant differences in loading between barley and broad bean in this trait, as loading exceeded (2:1) and gave the highest rate for this trait compared to the rest of the other loads, which amounted to (37.09) g. plant<sup>-1</sup>, while monoculture gave the lowest rate for this trait amounted to (19.50) g. Plant<sup>-1</sup>. It appears from the same table that there is a significant effect of the combination between fertilization and loading in the same trait, where the combination between (fertilization and cultivation 2:1) gave the highest rate of (47.09) g. plant<sup>-1</sup> for the season and the combination between (without fertilization and monoculture) gave the lowest mean for this trait amounted to (16.52) g. Plant<sup>-1</sup>. This is consistent with the results

**Table (18) The response of barley and broad bean to the efficiency of loading systems and productivity indicators by the effect of organic fertilization on the trait of plant yield. plant-1 in broad bean**

season2023 - 2022								
average	3-3	3-2	2-2	3-1	2-1	1-1	Single	loading fertilization
35.42	36.39	34.54	35.00	37.26	47.09	35.19	22.48	fertilization
20.98	20.20	20.34	20.20	22.41	27.08	20.11	16.52	without fertilization
	28.30	27.44	27.60	29.84	37.09	27.65	19.50	average
interaction 3.917					loading 2.515		fertilization 4.111	L.S.D

### Conclusions and recommendations

It is concluded from this that the organic fertilization gave rates for all growth and yield characteristics and for the two plants (barley and legumes) compared to cultivation without fertilization, and the interaction between fertilization and cultivation (2:1) gave the highest rate for all studied characteristics for the season 2022-2023 except for the characteristic of the chlorophyll ratio of barley, where it exceeded loading (2). Barley: 2 Peas) and (3 Barley: 3 Peas). The interaction between (without fertilization and monoculture) gave the lowest mean for all traits in barley and bean plants. The loading, fertilizing and intercropping systems were superior to the studied characteristics.

Thus, we recommend the use of organic fertilization with the loading system, a barley line with two legume lines.

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