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# Determination of traits affecting the yield of Vicia Faba L. in two locations in the southern region under the influence of planting dates

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**Abstract:** A field research study was conducted in two different locations in the southern region (Misan and Basrah) during the winter of 2021-2022 to identify the traits that had the greatest effect on the yield of native varieties of broad beans through path coefficient analysis. The seedlings of the stock were planted on three different dates (10/15, 11/01, 11/15). Using a random block design with 3 replications in each study location, the composition of yield and the total plant yield were evaluated in addition to the height and number of branches per plant. The results demonstrated that: Maysan's site had a superior performance in all traits studied, this was reflected in the highest yield per plant. (385.29) g/plant, while Basrah site provided a yield per plant of (282.1) g. In terms of planting date, the first date had the highest yield of 389.6 g, while the second and third dates provided yields of (384.99) and (219.26) g, respectively. The interaction between Maysan site and different planting dates produced higher yield than the interaction between Basrah site and date, and the interaction between Maysan site and the first date was the highest with a yield of (394.4) g/plant, while the yield of Basrah site with the third interaction date was the lowest with (198.4) g. The results of path coefficient analysis showed that the number of seeds per pod and the average number of pods were the two factors with the greatest impact on the faba bean crop, while the number of seeds and the number of pods had the least impact on the yield trait as they had higher yield traits. The significant positive correlation values were (0.830 and 0.674), while the correlation of the number of seeds per pod was (0.395). The direct effects of the number of seeds per pod and the number of pods per plant on these two traits were (0.812 and 0.710) and the indirect effects were (0.299 and 0.105). Therefore, these two traits can be used as a guide for the selection of programs. Breeding for improving faba bean yield.

***Keywords:*** *Location effect, Path Coefficient, Path coefficient, Seasons dates, Selection Index, Selection index, Vicia faba L.*

## 1. Introduction

Vicia faba L. is an important winter legume crop for human consumption in the Middle East. They are of interest to many researchers for their dry seeds for human food and sometimes as animal feed, as they have a high seed protein content, ranging from 20% to 40%, which is influenced by genetic and environmental factors.

Legumes, especially faba beans, play an important role in soil improvement by fixing atmospheric nitrogen through root nodules (2). They are also used in crop rotations, especially after crops grown on polluted soils. Another characteristic of the plant is its high dry seed yield, which exceeds 2 tons/ha (20), (14), (4) and (5). Since seed yield is a major target of various breeding and improvement programs, it is a complex trait influenced by many genetic factors (10). There is no specific gene for yield, but rather genes for yield components. Direct selection does not produce encouraging improvement results, as weak genetics make plants susceptible to environmental conditions. Therefore, plant breeders try to improve related traits and achieve yield increases by targeting some of the yield-related components. Most yield


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components are less affected by environmental fluctuations. Therefore, the main factors affecting the yield of faba bean are the number of pods per plant, the number of seeds per pod and the average seed weight.

The correlation coefficients between yield and its components are divided into direct and indirect effects through path coefficient analysis, which helps to identify the main components affecting seed yield, so that the relative importance and direction of this effect in improving seed yield traits can be estimated. In this way, the components with direct and significant effects on yield can be identified and then selected in the desired direction. A study conducted in Basra Province found that the two most important characteristics determining the yield of faba bean crops are the number of seeds per pod and the average seed weight (Al-Sabahi, 2016).

The purpose of this study is to determine the traits that have the greatest impact on the yield of faba beans planted on different planting dates in two locations in the southern region through path coefficient analysis. These will be used as selection evidence in subsequent plans to cultivate and improve this crop to increase productivity.

## 2. Materials and Methods

Field studies were conducted in the winter of 2021-2022 at two locations in the southern region, the first in Missan Governorate (Al-Uzair District), approximately 110 km north of Basra city, and the second in Basra Governorate (Al-Dair District), approximately 80 km north of Basra city. Using local varieties used in the region, path coefficient analysis was used to determine the traits that had the greatest impact on broad bean yield as a guide for selection. Soil samples were collected and analyzed at both locations. The results of the analysis are shown in Table 1.

**Table 1.**
Shows the results of soil analysis for two experimental sites.

| Location | E.C | PH | N Total kg1-\g | P ready kg1-\mg | K Ready kg1/ml | O.M | E.C irrigation water |
|---|---|---|---|---|---|---|---|
| Maysan | 5.3 | 7.3 | 1.45 | 22.1 | 68.2 | 1.4 | 2.2 |
| Basrah | 4.2 | 7.4 | 1.93 | 18.2 | 60.1 | 1.8 | 2.9 |

| +Location | Sand | Silt | Clay | Soil texture |
|---|---|---|---|---|
| Maysan | 16.8 | 43.3 | 39.7 | silty clay |
| Basrah | 46.3 | 48.2 | 5.13 | silty loam |

The land was vertically ploughed twice, and then the soil was leveled, and the field was divided into holes with a hole spacing of 75 cm. Each experimental unit had 5 holes with a hole length of 5 m and an area of 5 m. The experimental unit area was 18 square meters. The holes were determined, and after the land was properly dried, holes were dug in the upper third of the hole with a hole spacing of 25 cm. Two plants were left in each hole, making the plant density 106666 plants. 1-1 fraud. Tillage and irrigation works were carried out as recommended and required. The land was fertilized with nitrogen fertilizer of urea fertilizer 46%N, and the amount added at planting was 40 kg/dunam according to the recommended application rate, and the phosphorus fertilizer was tricalcium superphosphate, and the application rate was 180 kg. Phosphorus pentoxide. ha-1 was added during land preparation. A completely randomized block design was adopted with three replicates per site, and seeds were planted on three planting dates, namely 10/15, 11/1. and 15.11. during the above farming season. After maturity, ten plants from each experimental unit were tested to examine the following traits:

1. Plant height from base to top of plant (cm)
2. Number of branches/plant, calculated as the average of ten plants
3. Average sleeve length (cm)
4. Number of seeds/pods, calculated as the average of total number of seeds divided by number of pods
5. Average weight of 100 seeds (g), based on 15% moisture

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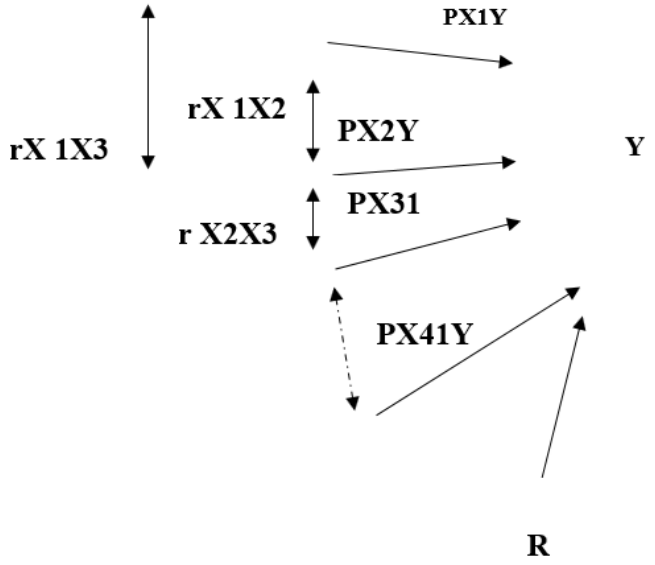
6. Yield per plant (g).

The data were analyzed according to the design used (3). Path coefficient analysis was also examined to determine the traits most affected by yield (11).

Path coefficient analysis was examined to determine the traits most affected by yield; this was determined by (AL-Rawi 1987):




**As:**

Xi: Causative factors (Three studied traits).

Y: Responsive factor (Grain yield).

R: The remaining factors

: A vector representing a path parameter from the Causative to the effector

: A vector representing the coefficient of correlation between the two traits rxixi

From the above chart, the grain yield y is the result of the causative factors x1, x2, x3, and x4

rx1y = px1y + px2yr12+ ……..+ px4yr14

rx2y = px1yr21 + px2y+ ……..+ px4yr24

rx4y = px1yr1 4+ px2yr24 +……..+ px4y

$rRy = PRY = (1-\sum PxiYrxiy)^{1/2}$

These simultaneous equations are put into a matrix as follows:

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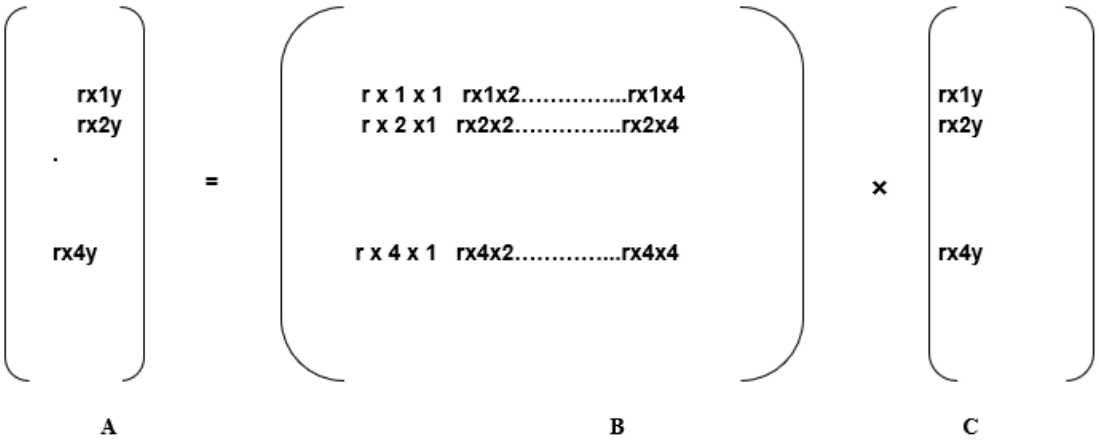
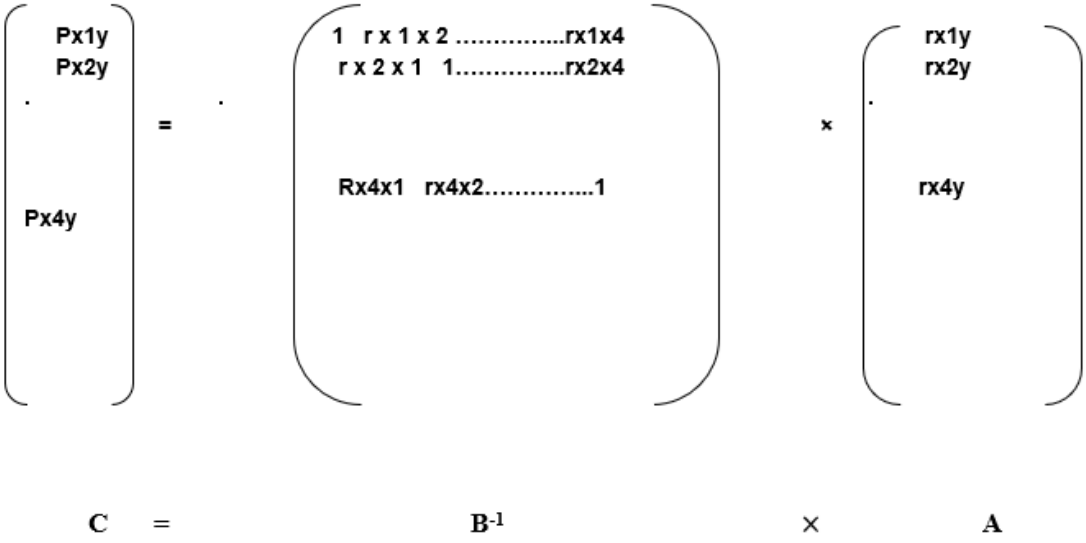



To calculate the values of matrix C (the values of the path coefficient), we compute the inverse of matrix B.




## 3. Results and Discussion

*3.1. Plant Height (cm)*

The results of statistical analysis showed that site, planting date and the interaction between them had a significant effect on plant height (cm), with Maysan site having the highest mean plant height (115.3cm) and Basra site having the lowest mean plant height (105.2) cm. The results of the table showed that the first planting date (October 15) had the highest plant height (118.4 cm) while the first planting date (November 15) had the lowest plant height (95.2 cm). The reason for this is that early planting provides a longer growing season, resulting in an increase in plant height, as broad beans are indeterminate plants. This is consistent with the results of (7). As for the interaction between the two factors, the combination of Maysan site with the first date gave the highest mean value (127.1) cm, which was significantly different from all other interactions. The reason for the difference between the two sites is that the irrigation water and soil in Maysan had lower salinity, and in addition, the soil in the Maysan site had higher N, P, and K concentrations. (Table 1).

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*3.2. Number of Branches/Plant*

The number of branches in the plant is considered to be one of the most important traits of the plant as it leads to an increase in the number of pods in the plant, thereby increasing the yield. This is shown in the correlation table (Table 5) when the correlation coefficient value between height and seed yield was (0.720). The location, planting date and the interaction between them had a significant effect on this trait as the Maysan location produced the best results with an average of (6.8) branches/plant, while the Basra location provided (5.9) branches. This could be due to the suitability of the soil conditions in the location, which is characterized by low electrical conductivity. It is characterized by high soil nitrogen and organic matter content (Table 1), which gave the crop a better chance to grow, thereby increasing the number of branches, while the first planting date had the highest average number of branches of 8.17, while the third appointment produced the least number of branches, with an average of 6.12 branches per plant. This is consistent with the results of (19). In terms of overlap, the highest average number of branches was found on the first day of Maysan (9.2) and the lowest average number of branches was found on the third day of Basra (6.12)..

*3.3. Average Pod Length (cm)*

The results showed that the study site, planting date and their interaction had a significant effect on the mean pod length. The mean height of the Maysan site exceeded expectations, being 22.1 cm, while the mean height of the Basra site was 18.4 cm. As for the planting date, the first planting date had a mean height of 23.1 cm, which was significantly different from the second and third dates, as the third date had the lowest mean height (18.4) cm, which is consistent with (19). The treatment, the first appointment, the Maysan site produced the highest mean value (26.3), which was significantly different from all other interactions, and the lowest combination was the third appointment, the Basra site, with a mean of 16.3.

*3.4. Number of Pods/Plant*

It's one of the most important components of the harvest of faba beans. From the data in Tables (2 and 3), it is evident that the location, date and their interaction had a significant impact on this trait; the Maysan location had a higher average of 18.2 pods per plant than the Qurna location. The cause of this is that the location had a beneficial number of branches per plant. In regards to the planting date, the first had an average of 22.3 pods per plant, this was greater than the other dates, and the third had the lowest average of 15.1 pods. per plant. The reason why the first appointment was superior in this trait was due to its advantage in the number of branches. This was due to the fact that the environmental conditions during flowering, fertilization and fruit setting could be more suitable than the other dates, resulting in an increase in fruit setting and therefore a higher number of pods/plant. As for the interaction, the first appointment in Maysan gave the highest pods per plant with an average of 19.7 pods/plant and there were no significant differences in some combinations. As for the third date treatment in Basra, it had the lowest pods per plant with 1.42 pods/plant.

*3.5. Number of Seeds/Pod*

One of the most important components of the harvested seed volume of a broad bean is the time of year. The outcomes in Table (2) demonstrate the significant influence of the studied site, planting date and their combination on the trait of the number of seeds per pod. The Maysan site produced an average of 5.8 seeds per plant, while the Basra site produced 4.8 seeds per pod. About the planting date, the first date was planted with 5.53 pods per plant, the second date was not different from 5.14 pods per plant, and the third date had the lowest average number of pods with 4.62 pods per plant. Regarding the interaction, the first date at the Maysan site produced the greatest number of seeds with a mean of 5.9, in contrast, the third date at the Basra site had the lowest number of seeds with an average of 4.2 seeds per pod.

*3.6. Weight of 100 Seeds*

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The third component of faba bean cultivation was dependent on the different environmental conditions caused by the different locations and different dates of planting. This slows the progression of nutrients towards the accumulation phase in high temperatures, this is especially true of the late portion of the sowing period, and increases the loss of nutrients during the respiration process. When scrutinizing the results, a significant difference in the effects of each planting date is apparent as well as the interaction between them. The Maysan site had the highest average yield (365) g-1, while the Basra site had the highest yield per 100 seeds (338.1) g, this was caused by the different nutrient treatments in the two locations. About the date of sowing, the first sowing date had the highest yield (374.8) g, which was not significantly different from the second sowing date (360.1) g, while the third sowing date had a yield of (314.3) g. This is due to the temperature fluctuations during the period of grain filling, with low temperatures in the early stage and higher temperatures in the late stage. About the interaction, the combination produced the Maysan's location, the first date had the highest average (382.6) g, and there was no significant difference between the Maysan combination and the second date (375.1). The lowest average weight of 100 seeds was located at the Basra site, this combined with the third date had an average weight of (332.7) grams...

*3.7. Individual Plant Yield (G)*

The yield is the final composition of the plant, which is influenced by the number of pods on the plant, the number of seeds in the pods, and the average weight of each seed. This trait was highly variable among the plantation sites and dates. The first site had the greatest yield, with a value of 385.2 g/plant, while the second site had the lowest yield, with a value of282.1 g/plant. This was caused by the first site's superiority in terms of the yield components (the number of pods per plant, the number of seeds per pod, and the average weight of the seeds). From the date of sowing, the first and second dates had the greatest seed yields, each having a value of 389.6 g, while the third date had the lowest yield, with a value of 219.4 g/plant. The superiority of the first and second dates was attributed to their superiority in terms of the yield components (the number of pods per plant, the number of seeds per pod, and the average weight of the seeds). The treatment had the greatest yield on the first date at the Maysan location, with an average of 394.4 g/plant, this was not significantly different from the treatment that followed the second planting date at the same location, and was different than the other treatments. This is caused by the absence of two treatments in the agricultural composition. The increase in the first position compared to the second position is 36.7%..

*3.8. Path Analysis and Correlation Values Between the Yield and the Studied Traits*

The results in Table 5 demonstrate the degree to which various plant traits are associated with seed yield, it can be seen that there is a significant positive association (0.01 level) between the number of branches and yield (0.720), the average pod length and yield (0.811), the number of pods and yield (0.674), and the number of pods and yield (0.830), while the traits associated with the height and average weight of the seed and the yield are not significant (0.411 and 0.395, respectively). It's apparent that the traits associated with the number of pods in the plant and the number of seeds in the pods are crucial to the composition of broad bean crop yields. This can be employed as a means of selection to increase the yield of this crop, the results of the path coefficient analysis in Table 4 indicate that this is true, as the indirect effects of (0.710 and 0.812) and the direct effects of (0.185 and 0.22) were achieved for both traits. These findings are similar to those of others.. (12, 9, 15, 1).

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**Table 2.**
Effect of locations on the studied traits under the influence of different planting date.

| Location | Plant height (cm) | Number of branches/ Plant | Average pod length (cm) | Number of pods in the plant | Number of seeds/Pod | Average weight of 100 seeds (g) | Single plant yield (g) |
|---|---|---|---|---|---|---|---|
| Maysan | 115.3 | 6.8 | 22.1 | 18.2 | 5.8 | 365.0 | 385.29 |
| Basrah | 105.2 | 5.9 | 18.4 | 14.8 | 4.7 | 338.1 | 282.1 |
| L.S.D | 6.5 | 0.79 | 1.14 | 1.51 | 0.8 | 24.02 | 51.2 |
| Planting dates | Plant height (cm) | Number of branches/plant | Average pod length (cm) | Number of pods in the plant | Number of seeds/Pod | Average weight of 100 seeds (g) | Single plant yield (g) |
| First date | 118.4 | 8.17 | 23.1 | 22.3 | 5.53 | 374.8 | 389.6 |
| Second date | 109.5 | 7.3 | 22.5 | 20.8 | 5.14 | 360.1 | 374.99 |
| Third date | 95.2 | 6.12 | 18.4 | 15.1 | 4.62 | 314.3 | 219.26 |
| L.S.D | 3.98 | 1.03 | 1.29 | 1.98 | 0.61 | 29.28 | 65.299 |

**Table 3.**
Effect of interaction between planting dates and study sites on the studied traits.

| Location | Dates | Plant height | Number of branches/ Plant | Average pod length (cm) | Number of pods in the plant | Number of seeds/Pod | Average weight of 100 seeds (g) | Single plant yield (g) |
|---|---|---|---|---|---|---|---|---|
| Maysan | First | 127.1 | 9.2 | 26.3 | 19.7 | 5.9 | 382.6 | 394.4 |
| | Second | 119.3 | 8.3 | 24.8 | 17.9 | 5.3 | 375.1 | 355.85 |
| | Third | 110.66 | 5.98 | 19.5 | 17.5 | 4.80 | 342.3 | 287.3 |
| Basrah | First | 113.8 | 8.6 | 18.9 | 17.2 | 5.1 | 376.4 | 330.18 |
| | Second | 103.2 | 7.96 | 17.5 | 15.8 | 4.79 | 352.3 | 266.6 |
| | Third | 90.4 | 4.89 | 16.3 | 14.2 | 4.2 | 332.7 | 198.4 |
| L.S.D | | 5.13 | 1.48 | 1.86 | 2.76 | 0.93 | 31.9 | 90.5 |

**Table 4.**
Direct and indirect effects of different traits on the yield trait.

| Attribute | Indirect effect of traits on yield | Direct effect |
|---|---|---|
| (A1) Plant height | 0.521 | -0.116 |
| (A2) Number of branches/Plant | 0.652 | 0.118 |
| (A3) Average pod length (cm) | 0.0698 | 0.129 |
| (A4) Number of pods and plant | 0.710 | 0.185 |
| (A5) Number of seeds in the pod | 0.812 | 0.299 |
| (A6) Average weight of 100 seeds (g) | 0.511 | 0.08 |
| (A7) Plant yield (g) | 0.941 | 0.360 |

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**Table 5.**
Correlation values between the outcome and the studied traits and the path relationship between the outcome and the studied traits (Correlations*)

| | Plant height | Number of branches in the plant | Average pod length | Number of pods in a plant | Number of seeds in a pod | Average weight of 100 seeds | yield* |
|---|---|---|---|---|---|---|---|
| Plant height | | .324 | .593(**) | .439(*) | 0.215 | 0.477(*) | 0.411 |
| Number of branches in the plant | | | 0.415 | 0.709(**) | 0.198 | 0.616 | 0.720 |
| Average pod length | | | | 0.686(**) | 0.245 | 0.798 | 0.811 |
| Number of pods in a plant | | | | 0.553(*) | 0.081 | 0.69(**) | 0.674(**) |
| Number of seeds in a pod | | | | | | 0.799(**) | 0.830(**) |
| Average weight of 100 seeds | | | | | | | 0.395 |
| Yield | | | | | | | 0.941 |

**Note:** *Significant at 0.05 level **Significant at 0.01 level.



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