

Effects of NPK Fertilizer on Growth and Yield Components in Certain Bean (*Vicia faba* L.) Cultivars

Media Nofel Mohammed Fawzi¹ and Zhala Muhammad Ameen²

¹Department of Field Crops, University of Salahaddin College of Agricultural Engineering Sciences, Erbil, Iraq.

²Department of Field Crops, University of Salahaddin College of Agricultural Engineering Sciences, Erbil, Iraq.

¹E-mail: media.mohammed@su.edu.krd

²E-mail: zhala.ameen@su.edu.krd

abstract

Three replicates were used in the factorial design of the randomized complete block design (RCBD) experiment. The initial element included two genotypes of broad beans (Turkish and Italian): Cultivar1, C1, Turkish (Biotech), and Cultivar2, C2, Italian (Zorzi). The second factor was three NPK levels (00:20:40), control treatment F0 (NPK: 00-00-00) (without fertilization). This study was carried out at the Gardarasha field, College of Agricultural Engineering Sciences, Salahaddin University, Erbil, during the growth season (2024–2025) with a GPS reading of (Latitude 36.10116 °N, longitude 44.00925 ° E, and elevation of 415.8) meters above sea level. The findings demonstrated the noteworthy impact of NPK fertilizer at a suitable rate on the growth features under study. The effect of NPK fertilizer on the plant height of faba bean which the plant heights of the varieties varied greatly, and the Italian cultivar was better (21.233 cm), but without adding NPK fertilizer, it gave the lowest average of the Turkish cultivar (16.167 cm), respectively. The leaf chlorophyll content was significantly impacted by these cultivars; the Turkish cultivar produced the lowest value (8.973 SPAD), while the Italian cultivar was superior (29.253 SPAD). Also, the cultivar from Italy produced the maximum average of (11.5pods), while the cultivar from Italy produced the lowest average of (5.833pods). It concludes that applying organic nutrients (NPK) fertilizer to plants produced both rapid growth and high-quality, high-yielding faba bean crops.

Keywords. Cultivars- NPK- Biotech- Zorzi.

1. Introduction

Faba bean (*Vicia faba* L.) is the primary vital legume crop, where it is utilized for human consumption as an excellent source of vegetarian protein, which contains (28-36%) [16]. It may be eaten raw or canned. Coming from America, it is because of its culinary and nutritional qualities that it is currently grown all over the world. It has calories, vitamins, fiber, minerals, and proteins. Vitamins, especially thiamine, riboflavin, niacin, vitamin B6, and folic acid, are abundant in beans. Increased nutrients in dry bean components, such as phenolics and antioxidants, were noted in dried

beans, in addition to micronutrients, including zinc and iron. Additionally, beans contain high vitamin and protein content. Enhancing rural livelihoods may be possible through the production and marketing. Moreover, due to rapid population expansion and a shortage of animal protein sources, there will likely be a greater demand for this crop's consumption, which calls for better intake in order to stay healthy. In some communes, beans are often an essential component of the cropping systems on small farms, despite all of the previously listed reasons. Furthermore, although potassium fertilizer is one of the necessary nutrients for plants, farmers on this hill used to grow beans

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without it, as is the case in many communes. Inorganic fertilizer such as NPK, when applied to the soil, adds nutrients, improve the soil chemical properties, and enhance crop growth, development, and yield [17]. The main components of NPK are crucial for plant nutrition, which is continuously required as the plant grows. During vegetative growth, flowering, and fruiting, the need for these components increases. Increasing the pollination

rate and decreasing flower dropping will undoubtedly enhance seed yield because the plant absorbs nutrients at a rate equivalent to its growth rate [3]. Consequently, the purpose of the study is to examine how NPK fertilizer affects the growth and yield characteristics of a few winter bean varieties in the Iraqi Kurdistan Region's Erbil Governorate during periods of rain.

Methodology .1

:Location of Experiment 2.1

The experiment was carried out at the Gardarasha Agriculture Research Station, which is located in the Kurdistan area at Salahaddin University's College of Agricultural Engineering Sciences in Erbil

:Field Experiment 2.2

Three replicates were used in the factorial design of the randomized complete block design (RCBD) experiment. Among the first factors were included two genotypes of broad beans (Turkish and Italian), Cultivar1 C1: Turkish (Biotech) and Cultivar2 C2: Italian (Zorzi). The second factor was three NPK levels (00:20:40), control treatment F0 (NPK: 00-00-00) (without fertilization). At the site under investigation, the soil type is silty clay loam. The area of the experimental unit was 8.5 x 5.5

m. The plot measured one meter by one and a half with four rows per plot. The plots are laid out one meter apart; each replication consists of 6 plots with a 0.5-meter distance. Plants were 20 cm apart, and rows were 25 cm apart. The seeds were physically seeded on November 10, 2024. Before being planted, the seeds were soaked for a whole day

The seeds were sown in depth (5cm), which was also controlled by a special tool to achieve the accurate depth. Using either a spacing drill (placing 1–2 seeds per hole) or a seed drill. Both during the sowing and flowering stages, NPK fertilizer was combined with the soil and administered

Finally, five plant samples were selected from the center of each row and labeled; the boundary sections were not included. Plant height, chlorophyll content, pod length, and number of pods per plant were then measured for the labeled plant samples

cm and harrow-disked 48 hours before sowing, after the soil was plowable after a few days then the soil analyzed for some physical and chemical properties (Table 1).

Table 1. Some chemical and physical properties of the field soil of Gardarasha.

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2.3 Land preparation

Before starting the field experiment, an 8.5 × 5.5 m rectangular area was marked out on almost uniform soil. At the site under investigation, the soil texture is silty clay loam. Water was poured into the field and left to soak. The experimental field was chisel-plowed to 30

| Soil Sample | Particle size distribution | | | Texture Class | O.M | Total (N) | (P) | (K) |
|-------------|----------------------------|---------------------------|---------------------------|---------------|-------|-----------|-----|-----|
| | Sand gkg ⁻¹ | Silt gkg ⁻¹ | Clay gkg ⁻¹ | | | | | |
| Grderaska | 129.25 | 522.53 | 348.21 | Silty Clay | 10.14 | 8.61 | 6.3 | 19 |

2.5 Studied Qualities

Five plants were taken randomly from the middle grade of all experimental units for the purpose of studying plant traits.

2.5.1 Plant height (cm)

Plant height was measured using the unit of measurement for five plants and then averaged.

2.5.2 Chlorophyll content (SPAD)

Chlorophyll content was measured using the device SPAD Meter for five plants and then averaged.

2.5.3 Number of plant branches plant^{-1}

The number of plant branches for five plants was counted, divided by the number of plants, and recorded as an average.

2.5.4 No. of leaves plant^{-1}

The number of leaves for five plants was counted, divided by the number of plants, and recorded as an average.

2. Results and Discussion

For the majority of the qualities examined, the results showed a substantial difference between the treatments. The plants grew vigorously and produced a large number of high-quality faba bean seeds when fertilized with certain mineral nutrients (NPK) fertilizer. It was first noted by [14] that N plays a

2.4 Statistical Analysis

Using IBM SPSS, all of the data from this study were gathered and statistically examined using the analysis of variance (ANOVA) method for a randomized complete block design (RCBD). According to Duncan's multiple range test, the mean comparison was satisfied at the significance level (0.05) in the statistics program (20).

2.5.5 Leaf area ($\text{cm}^2 \text{plant}^{-1}$)

Leaf area for five plants was counted and recorded as an average.

2.5.6 Plant root-nodes number

Plant root-nodes number for five plants was counted, divided by the number of plants, and recorded as an average.

2.5.7 Pod length (cm)

Pod length was measured using the unit of measurement for five plants and then averaged.

2.5.8 Plant number of pods plant^{-1}

The number of pods for five plants was counted, divided by the number of plants, and recorded as an average.

2.5.9 No. of seeds. pod^{-1}

The number of seeds per pod for five plants was counted, divided by the number of plants, and recorded as an average.

significant function in protein, chlorophyll, enzymes, and energy transfer molecules (ADP and ATP).

3.1 Plant Height (cm)

The analysis of variance shows that the genotypes differ significantly from one another and the NPK fertilizer addition. Figure

(1) shows the impact of NPK fertilizer on the plant height of faba bean, where the cultivars differed significantly in plant height, and the Italian cultivar was superior (21.233 cm), while without adding NPK fertilizer, it gave the lowest average of the Turkish cultivar (16.167 cm), respectively. Genetic variations and cultivar reactions to the environment could be the cause of this [12]. This outcome was in line with [1]. When compared to the control (no fertilizer), the NPK fertilizer effect revealed a noticeably

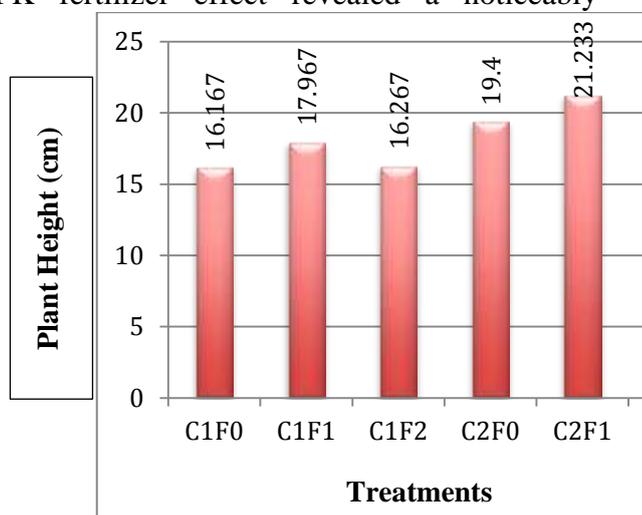


Figure 1 shows how NPK fertilizer affects the plant height (in centimeters) of *Vicia faba* L.

3.2 Chlorophyll content (SPAD):

The effects of NPK on the faba bean's chlorophyll content (SPAD) are depicted in Figure 2. The leaf chlorophyll content was

higher plant height. In *Vicia faba*, NPK fertilizers have a favorable effect on plant height. Numerous investigations have verified that variations in vegetative and culinary traits result from variations in genotypes and growth characteristics among varieties [26]. The findings demonstrated that some vegetative and yield features were positively impacted by all fertilization variables.

significantly impacted by these cultivars; the Turkish cultivar produced the lowest value (8.973 SPAD), while the Italian cultivar was superior (29.253 SPAD). This outcome was accepted [1]. Because nitrogen fertilizer enters chlorophyll, its addition during the vegetative development stage increases the amount of chlorophyll [24]. The vegetative development of plants fed with NPK fertilizer is noticeably higher. This suggests that one-third of the nitrogen in organic fertilizers is readily released, while the remaining portion stays in the soil for a considerable amount of time. Perhaps because nitrogen plays a beneficial role in chemical fertilizers and is a component of key biological components in plants, including proteins, nucleic acids, and chlorophyll, which aid in increasing cell division and number, thereby promoting vegetative growth [29].

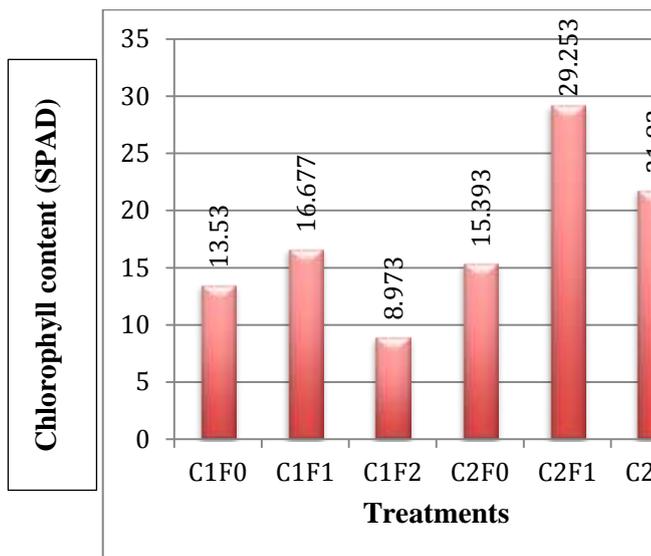


Figure 2 shows how NPK fertilizer affects the amount of chlorophyll (SPAD) in (*Vicia faba* L.).

The analysis of variance shows that the cultivars and the NPK fertilizer applications differ significantly from one another. With the Italian cultivar yielding the highest average of (4.833) branches and the Turkish cultivar yielding the lowest average of (3) branches, Figure (3) demonstrated that fertilizer had a significant increase in the number of branches per plant when compared to the control. Adding NPK fertilizer increased significantly plant branch number. This outcome resulted from variations in their internal hormone content, photosynthetic efficiency, susceptibility to environmental factors, and genotype [22]. This outcome was accepted [2]. When compared to the control treatment, the number of plant branches increased dramatically with the addition of NPK fertilizer.

3.3 No. of branches plant⁻¹:

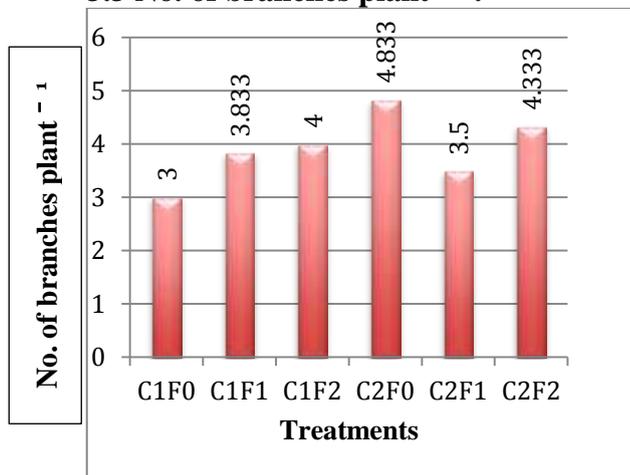


Figure 3 NPK fertilizer's impact on the number of branches of *Vicia faba* L.

cultivar produced the highest average number of leaves per plant (56.333), while the Turkish cultivar produced the lowest average number of leaves per plant (42.833), as shown in Figure (4). The availability of nutrients such as nitrogen and phosphate greatly influences leaf formation. Nitrogen and phosphate nutrients absorbed by the roots will be distributed to all plant organs, such as the apical shoot part, which will later be used to form new leaves. This is consistent with the findings of [15], [9], and [30], who discovered that the plant produced more leaves when fertilized organisms were added. The number of plant leaves rose when organic fertilizer was added. There was a notable impact from the interplay between NPK fertilizer and cultivars.

3.4 No. of leaves plant⁻¹:

The NPK fertilizer results in fig (4) chemical treatment demonstrated a markedly higher number of leaves per plant¹. The Italian

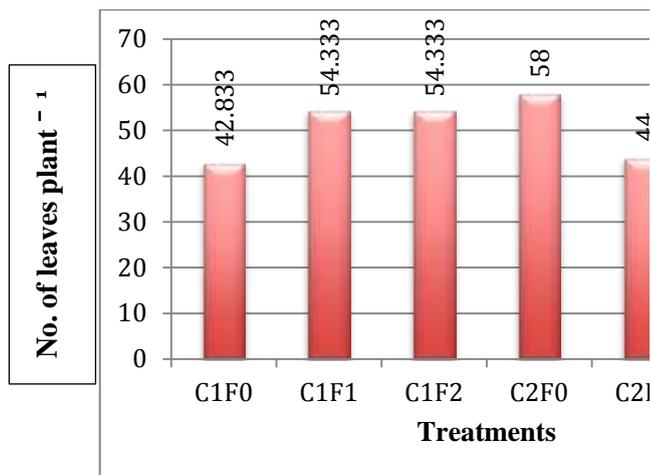


Figure 4 shows how the number of leaves on the plant ⁻¹ of (*Vicia faba* L.) is affected by NPK fertilizer.

3.5 Leaf area (cm² plant⁻¹):

The analysis of variance shows that the cultivars and the NPK fertilizer applications differ significantly from one another. According to Figure (5), the Turkish cultivar produced the lowest average of 16.577) cm² plant⁻¹, while the Italian cultivar produced the highest average of 22.04 cm² plant⁻¹. Due to the interplay between genetics and environment, the variations were caused by variations in genotype

composition and its reaction to the environment [1]; [12]. This could be because nitrogen and plant growth regulators were processed as a result of the addition of fertilized organisms [30].

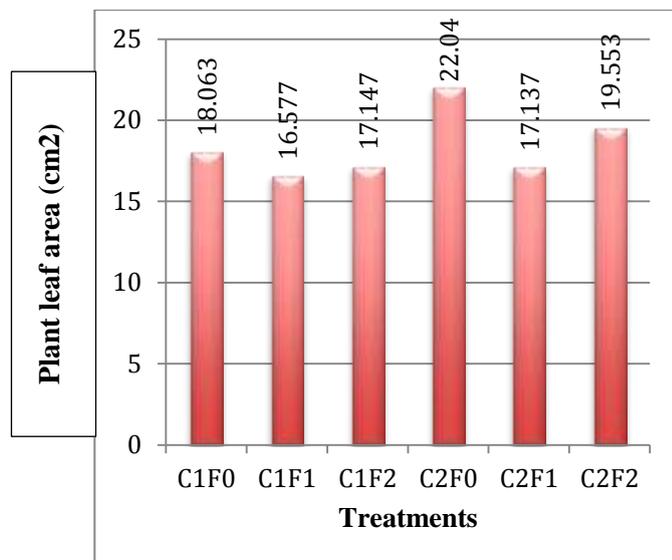


Figure 5 NPK fertilizer's impact on (*Vicia faba* L.) LAI.

3.6 Plant root-nodes number:

We see from the analysis of variance that there are significant differences between the cultivars and the NPK fertilizer additions. Figure (6) shows that the Turkish cultivar gave the highest average of (102.333) root-nodes number, while Italy cultivar gave the lowest average of (54.667) root-nodes number. This result is that chemical fertilizer led to an increase in root growth and proliferation, as well as the activity of fertilized organisms, and therefore increases root-nodes. Number and size of root-nodes are affected by Rhizobium type and characters [20]. The presence of fertilized organisms leads to an increased production of growth regulators

and thus promotes growth and the formation of more root nodes that contribute to nitrogen stabilization and to improved root growth and proliferation [4]. The interaction between the cultivars and NPK fertilizer had a significant effect. This outcome was in line with both [28] and [10].

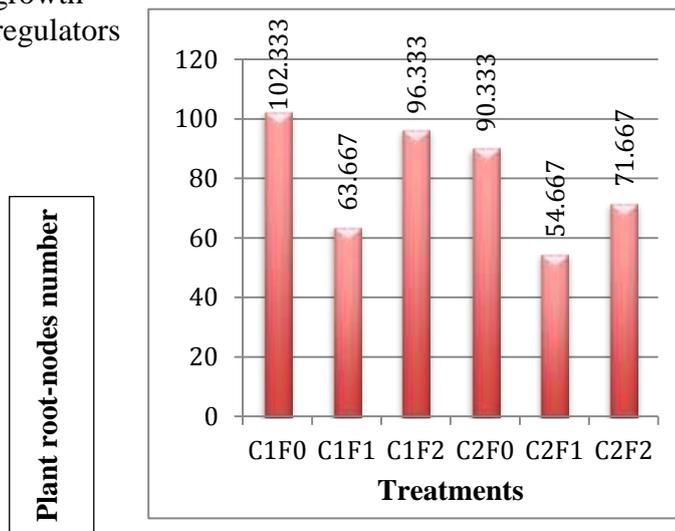


Figure 6 shows how the number of bacterial nodes of (*Vicia faba* L.) is affected

by NPK fertilizer.

3.7 Pod length (cm):

Pod length was significantly ($P \leq 0.05$) influenced due to the application of organic NPK fertilizer. Figure (7) makes it evident that the Italian cultivar had the highest value, measuring (26.233 cm), while the Turkish cultivar had the lowest value, measuring (20.933 cm). Perhaps the reason for this difference is due to the effect of the response to organic fertilizer on the traits of the length of the pod. The elements that lead to plant activity and thus increased length of the horn and this trait is affected by many factors, including the surrounding environmental conditions [13].

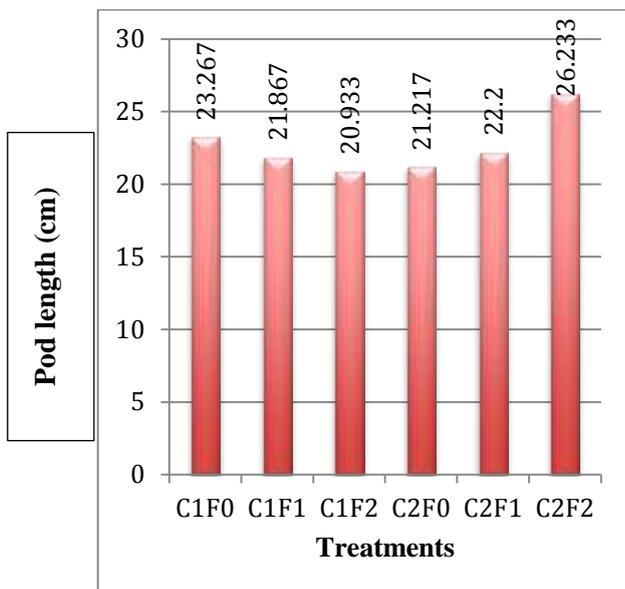


Figure 7 shows how the NPK fertilizer affects the (*Vicia faba* L.) pod length (cm).

3.8 No. of pods plant⁻¹:

The analysis of variance shows that the cultivars and the NPK fertilizer applications differ significantly from one another. The cultivar from Italy produced the maximum average of 11.5 pods, while the cultivar from Italy produced the lowest average of 5.833 pods, as shown in Figure (8). From this point on, the genotype's influence on the trait of the number of pods in the plant and the cause of the notable variations among the cultivars may be attributed to variations in the percentage of fruit setting and formation that result from environmental influences on the fertilization process and,

3.9 No. of seeds. pod⁻¹:

The use of organic NPK fertilizer had a substantial ($P < 0.05$) impact on number of seeds per pod¹. Figure (9) makes it evident that the kinds' seed counts varied. Pod⁻¹ and the Turkish variety produced the most seeds (5.667), whereas the Turkish variety produced the fewest (3.75). Adding chemical fertilizer caused an increase in number of seeds per pod¹.

consequently, pod formation. [13] suggested similar outcomes.

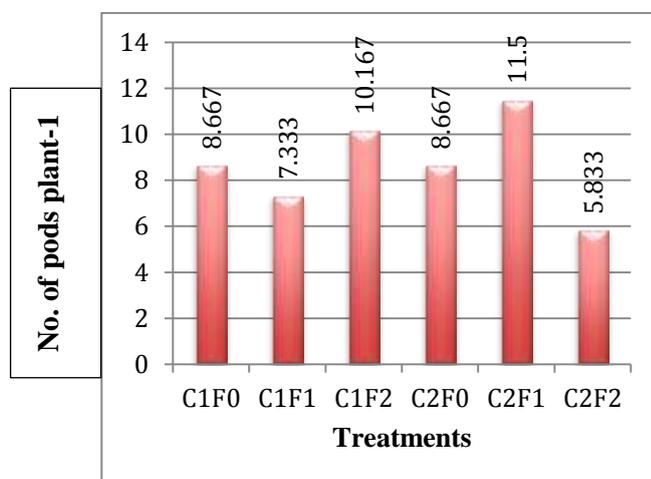


Figure 8 shows how NPK fertilizer affects the number of pods produced by the plant (*Vicia faba* L.).

This may be due to the role of chemical fertilizer in improving the growth and nutritional status of the plant, as well as the role of phosphorus in increasing root spread and development, which was reflected in increasing pod seed number. Because of the interplay between genetics and the environment, this distinction resulted from genetic variations and how they responded to their surroundings. This outcome was accepted [1].

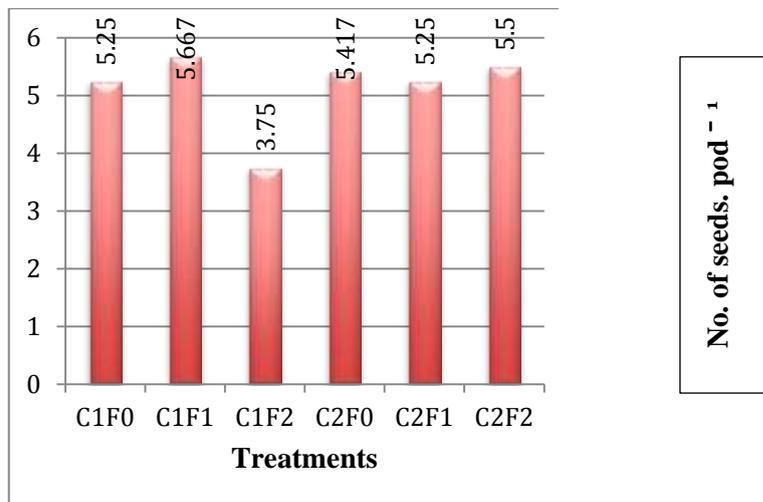


Figure 9 shows how the number of seeds of (*Vicia faba* L.) is affected by NPK fertilizer.

4. Conclusion

The addition of NPK fertilizer to the faba bean cultivars showed a significant increase in the production of seeds. Italian cultivar was the best in growth, yield components and seeds yield compared to the other cultivar. Therefore, the production and productivity of faba beans could be enhanced by using cultivars with better yields as Turkish cultivar. Additionally, applying NPK fertilizer helps to increase faba bean yield components, greater seed production, and vegetative development. The findings showed that, as compared to the control treatment, the application of the organic fertilizer NPK obviously significantly enhanced the plant height, chlorophyll content, pod length, and number of pods per plant¹. NPK fertilizer also improves the growth and yields of broad beans. Therefore, it is advised to produce field crops using the organic fertilizer NPK. However, it could be concluded that under the conditions of

the experiment, planting Italian faba bean and Turkish cultivar under NPK levels (00:20:40) is recommended.

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