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Tillage systems affect soil nitrogen availability and interact growth parameters of different faba bean cultivars

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Abstract. *Al-Enezy AFM, Zaidan BA, Almehemdi AF, Hussein AA, Salih MAA. 2023. Tillage systems affect soil nitrogen availability and interact growth parameters of different faba bean cultivars. Biodiversitas 24: 5558-5564.* A field trial was conducted during the winter season of 2021-2022 in one of the agricultural lands of Hamid Shaban village, which belongs to Abu Ghraib District of Baghdad Province (33°17'51.3"N, 44°04'55.0"E). The aim of the experiment was to investigate nitrogen availability in two different tillage systems and the growth characteristics of six broad bean varieties on clay-loamy soils. The field trial was triplicated using the Randomized Complete Block (RCBD) method. The first factor was the six broad bean varieties (Turkish, Dutch, Italian, Spanish, American and local), the second factor was the cultivation system Conservation Tiltage (no-till) and the traditional cultivation with a mouldboard plow. The results showed that the availability of nitrogen in the soil in the traditional tillage system corresponds to the superior to conservative tillage systems. Where this gives an average available nitrogen concentration of 23.3 mg kg^{-1}, an increase of 21 in relation to conservation tillage, which resulted in an average concentration of available nitrogen of 19.1 mg kg^{-1}. In addition, all the growth characteristics of the plants favored the traditional agricultural system. In the variety comparison, the Italian variety was characterized by the highest nitrogen content available in the soil of 26.10 mg kg^{-1} as well as the highest values of plant growth properties among the six varieties.

Keywords: Available nitrogen, conservation tillage, faba bean, traditional tillage

Abbreviations: C1: Turkish; C2: Dutch; C3: Italian; C4: Spanish; C5: American; C6: Local; C: LSD: Cultivars; T-LSD: Tillage system; T0: No tillage; T1: Tillage

INTRODUCTION

Faba bean has been cultivated for approximately 1000 years and is an important winter crop in warm temperate and semi-tropical regions. It serves as a vital source of protein-rich food in developing countries and can be used as a vegetable (Li et al. 2021). Although legumes like faba bean are considered secondary crops compared to grains, they play a crucial role in agricultural systems as a source of biological nitrogen and are significant in human nutrition as a protein source. They are also valuable for animals as a nutrient-rich feed (Multari et al. 2015). The majority of the world's faba bean production occurs in nine distinct agro-ecological areas, including Ethiopia, Central Asia, and East Asia. Ethiopia is second in terms of productivity behind China (Gebru and Mekonnen 2021). Faba bean is also one of the important vegetable crops in crop rotations, as it contributes to improving growth characters of other crops by enhancing soil properties (Li et al. 2021). Most Iraqi soils suffer from nitrogen deficiency, which is one of the major essential elements required by crops in general. Crop plants uptake nitrogen in the form of ammonium (NH_4) or nitrate (NO_3). Nitrogen is essential for chlorophyll synthesis, which is important for photosynthesis, as well as for energy compound formation, plant tissue growth, and development, with concentrations ranging from 2-5 mg kg^{-1} dry matter (Tajer 2016). Nitrogen is also crucial for plant cell growth, division, protein formation, and amino acid synthesis (Luo et al. 2020). Therefore, it is considered one of the most important elements required by plants, especially during tillering and elongation stages, to achieve good yield (Hashim et al. 2015).

Tillage is considered one of the most important field operations used to modify certain characteristics of the natural soil, such as its moisture holding capacity, nutrient retention capacity, root penetration resistance, soil drainage, and other properties (Mwiti 2022). Despite the importance of tillage, its repetition can have negative effects on soil properties. It causes soil particles to disperse, making them susceptible to water or wind erosion, as well as speeding up the decomposition of organic matter and decreasing its proportion in the soil. This leads to a reduction in nutrient availability during plant growth stages, soil deterioration, decreased productivity, and difficulty in reclamation (Farooq et al. 2011). To conserve natural resources (soil and water), a sustainable agricultural production system can be adopted, such as conservation agriculture, which originated as an idea proposed by Russian researchers Ovsinski and Malthus in the early 20th century in 1911. They advocated for the return to simple manual plowing to prepare the soil for cultivation, considering that moldboard plows disrupt the soil ecosystem, and the conservation

agriculture system aims to approach the natural development curve of the soil (Maehop 2018).

Conservation agriculture is based on three basic pillars: minimizing soil tillage, covering the soil surface with crop leftovers, and using the right crop rotation techniques. Additionally, because weed control sustainability in conservation agriculture represents the most crucial agroecological principle, it can be regarded as the fourth pillar of environmental conservation. (Cordeau 2022). It has spread to large areas worldwide, with the total cultivated area under this system estimated at about 157 million hectares worldwide, of which 76.6% in the Americas, 11.4% in Australia and New Zealand and 6.6% in Asia, 3.3% in Russia and Ukraine, 1.3% in Europe and 0.8% in Africa (Kassam et al. 2019; Kassam et al. 2022). The proper implementation of conservation agriculture offers environmental and economic advantages that ensure the sustainability of soil and natural resources. Among the benefits of this system are improvements in the chemical, physical, and biological properties of the soil, enhanced moisture retention capacity, and reduced wind and water erosion (Busari et al. 2015). The prevailing drought conditions, and the widespread practice of conventional tillage under drought conditions contribute to the negative effects of erosion, resulting in soil deterioration, decreased nutrient availability, and fertility depletion. Therefore, this study aims to compare the conventional moldboard plow tillage system with the conservation tillage system in terms of nitrogen availability and growth indicators for six cultivars of faba bean.

MATERIALS AND METHODS

Study area

This study was conducted in one of the agricultural fields in Hamid Shaban village, Abu Ghraib district, Baghdad Governorate (33°17'51.3"N, 44°04'55.0"E), during the winter season of 2021-2022. The soil in the study area was a silty clay loam and well drained which the drainage net is 100 m far from trial. Table 1 illustrates some of the chemical and physical properties of the study soil, determined using the methods described in (Sainju and Liptzin 2022). Crop management operations such as irrigation, fertilization, and weeding were applied as needed throughout the study.

Procedures

Experimental design

The field experiment was conducted using the Randomized Complete Block Design (RCBD) with three replications. The first factor consisted of six cultivars of faba beans (Turkish, Dutch, Italian, Spanish, American, and local) labeled as C1, C2, C3, C4, C5, and C6, respectively. The second factor was the tillage system, where two systems were used: the first system involved no tillage (T0), and the second system involved tillage to a depth of 25-30 cm (T1). The portion of land designated for conservation agriculture (without tillage) was prepared one season before the planting date. It was plowed, irrigated three times, and left until the faba bean planting season. The other portion of the land was plowed using a moldboard plow to the desired depth and then smoothed using a harrow. Since the availability of the studied elements in the soil was low, urea fertilizer was added at a rate of 40 kg ha^{-1} as a single stimulus dose after germination. Phosphorus and potassium were added using triple superphosphate and potassium sulfate, respectively, at a rate of 40 kg ha^{-1} during planting. Afterward, the field was divided into experimental units, each containing two furrows with a length of 2.5 m for each furrow, with a spacing of 50 cm between them, and a spacing of 75 cm between experimental units. The plants were cultivated on the two sides with plant density of 133333 plants per hectare.

Cultivation practice

After preparing the land and determining the experimental units, pre-irrigation was performed to determine the water level and the location of faba bean seed planting on the furrows. On October 18, 2021, faba bean seeds were planted at the upper third of the furrows at a depth of 4-5 cm, with a spacing of 25 cm between seeds. Immediately after planting, the experiment was irrigated, and upon completion of the experiment, soil samples were taken from the experimental units to estimate the nitrogen availability as nitrate, as well as the phosphorus and potassium levels under the influence of the experimental factors. Additionally, some growth indicators and characteristics of the cultivated faba bean cultivars were studied, including plant height, root length, number of branches, active root nodules, and vegetative dry weight.

Data analysis

The differences were tested at the least significant difference (LSD) at a significance level of 0.05. The correlation and ordination analysis using PCA were done using PAST4.12b (Hammer et al. 2001)

Table 1. Chemical and physical properties of the study soil

Parameter		Value
pH		7.7
Ec (dS m-1 (1-1)		2.3
Organic matter %		0.72
Bulk density g cm^{-3}		1.32
Avail. N mg kg^{-1}		15.6
Avail. P mg kg^{-1}		5.3
Avail. K mg kg^{-1}		213
Soil separates %	Sand	16
	Silt	55
	Clay	29
Soil texture		Silt clay loam

RESULTS AND DISCUSSION

Available nitrogen

It is evident from Table 2 that there is a significant difference in the amount of available nitrogen in the soil between the tillage systems used in this study. An increase in the average concentration of available nitrogen is observed when using the traditional farming system compared to the conservation agriculture system (no tillage) by 21.98%.

Similarly, the results showed a significant difference among the cultivars of faba bean in increasing the nitrogen concentration in the soil. The C3 cultivar outperformed by giving the highest nitrogen concentration rate in the soil, reaching 26.10 mg N kg^{-1} soil, while the C4 cultivar gave the lowest concentration among the cultivated cultivars, reaching 16.40 mg N kg-1 soil. Generally, all faba bean cultivars achieved an increase in the nitrogen concentration in the soil compared to the initial concentration present in the soil before cultivation Regarding the interaction between the study factors, the highest concentration of available nitrogen was observed in treatment C3T1, reaching 29.4 mg N kg^{-1} soil, which is an increase of 82.60% compared to the lowest nitrogen concentration in treatment C4T0, where the concentration of available nitrogen was 16.1 mg N kg^{-1} soil.

Plant height (cm)

The results presented in Table 3 illustrate the effect of plowing systems and plant cultivar on the plant height of the faba bean plant. It is observed that the traditional plowing system gave the highest average plant height of 119.99 cm, with a significant difference compared to the average plant height in the conservation plowing system (no plowing), which was 111.04 cm. The increase in plant height between the two plowing systems was 8.06%.

Furthermore, results reveal significant differences among the faba bean cultivars in terms of plant height. Cultivar C3 gave the highest average height of 127.32 cm, among all the cultivars, with an increase of 29.64% compared to cultivar C4, which had the lowest average plant height among the cultivated cultivars at 98.21 cm. Regarding the interaction between the study factors, Table 3 shows significant differences among the study treatments in terms of plant height. Treatment C3T1 yielded the highest average height for this trait among the study treatments, reaching 133.27 cm, while treatment C4S0 gave the lowest plant height at 94.03 cm. The reasons for these differences may be attributed to the factors mentioned above.

Root length

The results in Table 4 indicate the effect of the plowing system and plant cultivar on the characteristic of root length in the faba bean plant. It is observed that the traditional plowing system outperforms the conservation plowing system in terms of providing the highest average root length, which reached 16.96 cm compared to the average root length in the conservation plowing system, which was 13.65 cm. The percentage increase between the two plowing systems was 24.24%.

Similarly, the result demonstrates the significant differences among faba bean cultivars in terms of root length increase. Cultivar C3 outperformed the other cultivated cultivars by providing the highest average root length, reaching 17.86 cm. There was no significant difference between cultivar C3 and cultivar C6, but there was a significant difference between cultivar C3 and the remaining cultivars. Cultivar C4 had the lowest average root length among them, measuring 12.99 cm, with a percentage increase of 37.49% between cultivars C3 and C4. Regarding the interaction between the study factors, treatment C3T1 excelled in providing the highest average root length value, reaching 19.53cm, with a 64.5% increase compared to treatment C4T0, which had the lowest value among the study treatments at 11.87cm.

Table 2. Effect of tillage systems and faba bean on the available nitrogen concentration (mg kg^{-1}) in the soil after planting

Cultivar	Tillage systems		Mean
	T0	T1	
C1	19.8	26.3	23.05
C2	17.7	23.8	20.75
C3	22.8	29.4	26.10
C4	16.1	16.7	16.40
C5	17.4	21.0	19.20
C6	20.9	22.5	21.70
Mean tillage systems	19.1	23.3	23.3
LSD0.05	T=2.06	C=1.87	LSD0.05 C*T=2.54

Table 3. Effect of tillage system and plant on faba bean plant height (cm)

Cultivar	Tillage systems		Mean
	T0	T1	
C1	96.91	117.09	107.00
C2	122.45	128.53	125.49
C3	121.37	133.27	127.32
C4	94.03	102.40	98.21
C5	114.45	111.98	113.21
C6	117.04	126.67	121.85
Mean tillage systems	111.04	119.99	23.3
LSD0.05	T=6.74	C=2.91	LSD0.05 C*T =8.74

Table 4. Effect of tillage system and plant on faba bean root length (cm)

Cultivar	Tillage systems		Mean
	T0	T1	
C1	13.00	16.67	14.83
C2	12.33	17.61	14.97
C3	16.20	19.53	17.86
C4	11.87	14.12	12.99
C5	13.09	15.47	14.28
C6	15.41	18.37	16.89
Mean tillage systems	13.65	16.96	23.3
LSD0.05	T=3.24	C=1.86	LSD0.05 C*T =5.05

Number of branches

Table 5 illustrates the effect of the plowing system and plant cultivar on the characteristic of the number of main branches in faba bean plants. It is observed that the average number of branches in the traditional plowing system reached 8.56, slightly higher but not significantly different from the conservation plowing system, which had an average number of branches of 7.88. Similarly, result demonstrates the effect of the plant cultivar on the characteristic of the number of main branches. The cultivar C3 outperformed all the other cultivars (C1, C2, C4, C5, C6) by providing the highest average number of branches at 10.82. This difference was statistically significant, with percentage increases of 25.52%, 22.53%, 73.67%, 42.74%, and 49.24% respectively compared to the other cultivars. On the other hand, cultivar C4 had the lowest average number of branches at 6.23, among all the cultivars. These differences may be due to the ability of the genetic material that cultivar possessed to express itself to the highest as possible as could (Ziydan et al. 2021). The results indicate significant interaction between the treatments in terms of the number of branches. Treatment C3T1 excelled in providing the highest average number of branches among the study treatments, reaching 11.82, while treatment C4T0 had the lowest average number of branches, measuring 5.69, among the studied treatments.

Effective root nodules

Table 6 illustrates the impact of the tillage system and plant cultivar on the characteristic of the number of effective root nodules in faba bean plants. It is observed that the traditional tillage system outperforms the conservation tillage system in providing the highest average rate of effective root nodules at 21.49 nodules per plant compared to the conservation tillage system, which gave a lower average number of effective nodules at 18.13 nodules per plant. Similarly, the results indicate a significant difference among different plant cultivars in increasing the number of effective root nodules. Cultivar C3 was superior with the highest average number of effective nodules among the other cultivars (24.95 nodules per plant), while cultivar C5 had the lowest number of effective nodules at 17.33 nodules per plant.

The results also indicate a significant interaction between the study factors. Treatment C3T1 gave the highest value of effective nodules among all the treatments at 31.14 nodules per plant, while treatment C2T0 had the lowest number of effective nodules among all the treatments, with 14.22 nodules per plant.

Dry weight of vegetative biomass (g plant^{-1})

Table 7 illustrates the effect of tillage system and plant cultivar on the dry weight of vegetative biomass of the faba bean plant. It can be observed that the traditional tillage system outperformed the conservation tillage system in providing the highest average dry weight of vegetative biomass at 7.09 g plant^{-1} compared to 5.68 g plant^{-1} with the conservation tillage system. This means that the traditional tillage system achieved an increase in dry weight of vegetative biomass by 24.82% compared to the conservation tillage system. Additionally, the results show variation among faba bean cultivars in terms of significant increase in the trait of dry weight of vegetative biomass, where cultivar C3 outperformed all other cultivars by providing the highest average dry weight of vegetative biomass at 9.46 g plant^{-1}, with a significant increase. All cultivars achieved a significant increase compared to cultivar C4, which provided the lowest average dry weight of vegetative biomass, reaching 3.64 g plant^{-1}. The results also indicate a significant interaction between the study factors, significant differences can also be observed among the study treatments in terms of dry weight. Treatment C3T1 outperformed all other treatments by providing the highest dry weight of plants at 10.73 g plant^{-1}, while treatment C4T0 yielded the lowest dry weight of vegetative biomass at 3.20 g plant^{-1} among the study treatments.

Table 5. Effect of tillage system and plant on number of branches of faba bean

Cultivar	Tillage systems		Mean
	T0	T1	
C1	8.78	8.47	8.62
C2	8.21	9.46	8.83
C3	9.83	11.82	10.82
C4	5.69	6.78	6.23
C5	7.15	8.01	7.58
C6	7.65	6.85	7.25
Mean tillage systems	7.88	8.56	23.3
LSD0.05	T= N. S	C= 1.69	LSD0.05 C*T =2.28

Table 6. Effect of tillage system and plant on number of effective root nodules of faba bean

Cultivar	Tillage systems		Mean
	T0	T1	
C1	23.94	21.91	22.92
C2	14.22	21.36	17.79
C3	18.77	31.14	24.95
C4	16.52	18.83	17.67
C5	17.64	17.02	17.33
C6	17.70	18.69	18.19
Mean tillage systems	18.13	21.49	23.3
LSD0.05	T= 2.21	C= 3.95	LSD0.05 C*T =5.65

Table 7. Effect of tillage system and plant on number of effective root nodules of faba bean

Cultivar	Tillage systems		Mean
	T0	T1	
C1	5.74	7.85	6.29
C2	5.12	6.86	5.99
C3	8.19	10.73	9.46
C4	3.20	4.09	3.64
C5	5.61	5.75	5.68
C6	6.24	7.31	6.77
Mean tillage systems	5.68	7.09	23.3
LSD0.05	T= 0.68	C= 1.20	LSD0.05 C*T =1.58

Discussion

The reason for this increase may be attributed to the fact that in the case of traditional tillage, the soil permeability increases as mentioned by Maehop (2018), and it reduces the soil's resistance to root penetration into the soil up to the depth of tillage. Consequently, the root mass of the plant increases, leading to increased enzymatic and nitrogenous secretions, as well as an increase in the nitrogen-fixing bacterial nodules attached to the root surface. Furthermore, these nodules may detach during different stages of plant growth and decompose in the soil into nitrogenous compounds.

Additionally, organic matter is considered an important reservoir of nutrients in the soil. The tillage process causes an increase in the rate of organic matter decomposition due to improved aeration and increased contact between the soil and organic matter. On the other hand, the organic matter content tends to increase with the use of conservation agriculture system, as a result of its accumulation in the surface layer from the residues of previous seasons' crops grown in the same soil (Maehop 2018; Al-Bayati et al. 2021). The reason for this increase may be attributed to the role of faba bean in improving soil properties through the fixation of atmospheric nitrogen by the root nodules bacteria, which symbiotically interact with the plant (Siczek and Lipiec 2016). The rhizobium nodules present on the root surface of faba bean increase the nitrogen concentration in the soil, as well as the availability of phosphorus, potassium, and some trace elements by reducing the soil's reaction degree (pH) over a period of time after faba bean cultivation. This improvement enhances soil fertility (Rashid et al 2016), that faba bean roots secrete enzymatic and nitrogenous products that enhance soil biotic activity, by decomposing and releasing nitrogen into the soil in the form of ammonium, which is converted by Nitrobacter bacteria. These complex transformations maintain a good level of nitrogen in the soil.

For plant height, its own results are attributed to the role of the plowing system in improving soil properties, as well as increasing the concentration of plant-available nitrogen in the soil, as indicated in Table 2. Nitrogen is essential for increasing meristematic tissue activity and serving as a building block for the amino acids that make up plant proteins, including the amino acid tryptophan, which is considered the basis for the formation of the natural auxin IAA, the most important indicator of internal plant development. Additionally, tryptophan acts as a stimulant for increasing the number of plant cells and regulating their division, thereby promoting plant growth and height (Loddo and Gooding 2012). Furthermore, The reason for this difference is due to genetic, environmental, or phenotypic variations among the cultivated cultivars (Girma and Hail 2014; Ziydan et al. 2021). Plant height possesses a very low effect on other traits (Figures 1 and 2). Where, this trait vector has abtuse angle with other trait vectors.

For root length, this may be attributed to the role of traditional plowing in turning and loosening the soil to a greater depth, thus creating suitable intermediate pores that facilitate root penetration. This is due to the provision of favorable physical conditions, resulting in increased root length and depth. Reducing the depth of plowing hampers the deepening of faba bean roots and tends to make them superficial, leading to weak growth, small size, decreased weight, and reduced proportion to the aboveground biomass. The variation in root length among different plant cultivars may be attributed to genetic and environmental differences in their ability to fix atmospheric nitrogen and increase its concentration in the soil and plants. This is supported by Table 2. Additionally, this variation may be explained by genetic differences in the cultivars' responsiveness to different nutrient concentrations, which manifests in various growth and yield traits. This finding is consistent with previous studies by Girma and Hail (2014); Ziydan et al. (2018). Moreover, PCA analysis interprets 88.53% of the total variance among cultivars and traits. Where, Italian and Turkish are most superior in root length, branches, biomass, soil nitrogen and active nodules (Figure 1). These results are also supported by colored correlation (Pearson) (Figure 2).

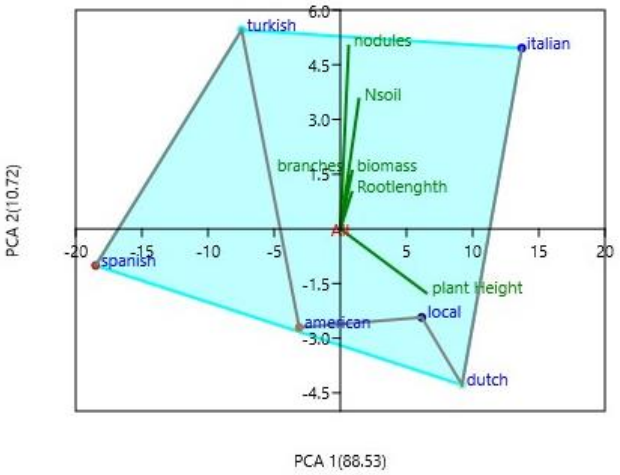

Figure 1. PCA analysis of cultivars by traits for different faba bean cultivars

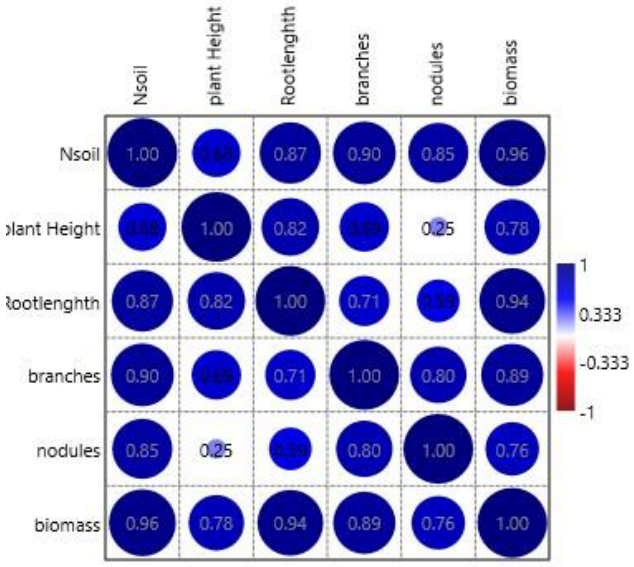

Figure 2. The colored correlation (pearson) among six traits of faba bean

Regarding the number of branches, this finding is consistent with the results reported by Ziydan et al. (2021), where the traditional plowing system outperformed the conservation plowing system in increasing the number of branches in wheat. This finding is consistent with the results of a previous study by Ribeiro et al. (2014), which stated that the characteristic of the number of main branches in a single plant is a specific genetic trait for each cultivar within the same species. This trait may sometimes be influenced by the plowing process or other plant-related services. The variation in the number of branches among the cultivars may also be attributed to the increased nitrogen concentration in the soil and plants resulting from the genetic differences between plant cultivars in their ability to fix atmospheric nitrogen and the enzymatic and nitrogenous secretions of faba bean roots. Additionally, it could be due to the genetic composition and plant behavior in response to the cultivated environment, as well as the different cultivars' responsiveness to different nutrient availability, which aligns with the findings of Girma and Hail (2014); Ziydan et al. (2018). On effective root nodules, this could be attributed to the role of traditional tillage in soil disintegration and increased soil porosity. In the case of traditional tillage, soil porosity increases, as mentioned by Maehop (2018), and soil resistance to root penetration decreases, allowing roots to spread and form more nodules. This finding is consistent with the results of Li et al. (2021), who found that the ridge tillage system increased the number of effective root nodules compared to the conservation tillage system. Ridge tillage improves root growth, lateral root proliferation, and increases root length and surface area, thus increasing the number of root nodules in the ridge system, the soil and are mobilized as found by Cheţan (2020) and Şimon et al. (2019). Whereas, Singh et al. (2022) found that applied crop residues with no tillage and reduced tillage led to improve root nodules because of improving soil properties. Furthermore, a lower concentration of available nitrogen in the soil serves as a driving force that stimulates plants to form root nodules in order to fix atmospheric nitrogen after receiving an initial nitrogen boost at the beginning of cultivation to meet the plant and microbial nitrogen requirements before nodule formation. This aligns with the findings of Buetow et al. (2017) and Zoffoli et al. (2021), who observed that nitrogen fertilization reduces the number of effective bacterial nodules on plant roots. Depending on genetic material, this difference may be attributed to the genetic composition of the cultivars in their response to available nitrogen and the plant's biochemical processes that supply the root nodules with the necessary food and energy for their formation (Etemadi et al. 2019). Futhermore, the soil nitrogen positively correlated with root length(cm), branches number, active nodules and dry matter (biomass) (Figure 1, Figure 2).

Studies on dry weight of vegetative biomass have differed. This increase can be attributed to the role of the traditional tillage system in enhancing the availability of nitrogen, which in turn affects plant height and the number of branches, as indicated in Tables 2, 3, and 5 above, resulting in an increase in the dry weight of vegetative biomass. This variation among cultivars can be attributed to differences in the number of branches, which depend on the genetic composition of each cultivar and its behavior in the cultivated environment. Additionally, cultivars may differ genetically in their response to nitrogen availability, which reflects on the growth of the plant's vegetative biomass. This is consistent with the findings of Xuan et al. (2017).

In conclusion, the advantage of the traditional tillage system in increasing nitrogen availability does not diminish the importance of conservative tillage in improving the physical properties of the soil and increasing its resistance to erosion and runoff. The advantage of the traditional tillage system lies in the importance of the tillage process in creating a favorable environment for the propagation and growth of roots in the soil. This in turn increases root nodule potential, nitrogen availability and nutrient utilization, which is reflected in the plant's growth characteristics. The superiority of the Italian variety may reflect its genetic sensitivity to nutrient availability and the suitability of the soil environment for its optimal growth. Therefore, it will take time to continue the optimal implementation of conservation agriculture before confirmed and convincing results are achieved. However, future study is very necessary to make precise decisions.

REFERENCES

Al-Bayati AH, Ziydan BA, Al-Enzy AFM. 2021. The effect of some nitrogen fertilization practices and tillage systems on growth and yield of wheat crop within the conditions of the sedimentary plain in Iraq. IOP Conf Ser Earth Environ Sci 761 (1): 012006. DOI: 10.1088/1755-1315/761/1/012006.

Buetow R, Mehring GH, Kandel H, Johnson B, Osorno JM. 2017. Nitrogen fertilization and inoculation effects on dry bean. Agric Sci 8: 1065-1081. DOI: 10.4236/as.2017.810077.

Busari MA, Kukal SS, Kaur A, Bhatt R, Dulazi AA. 2015. Conservation tillage impacts on soil, crop and the environment. Intl Soil Water Conserv Res 3 (2): 119-129. DOI: 10.1016/j.iswcr.2015.05.002.

Cheţan F. 2020. Influence of different tillage systems on soybean nodulation and yield in the transylvanian plain conditions. Bull UASVM Ser Agric 77 (2): 1-8. DOI:10.15835/buasvmcn-agr: 2020.0039.

Cordeau S. 2022. Conservation agriculture and agroecological weed management. Agronomy 12: 867. DOI: 10.3390/agronomy12040867.

Etemadi F, Hashemi M, Barker AV, Zandvakili OR, Liu X. 2019. Agronomy, nutritional value, and medicinal application of faba bean (*Vicia faba* L.). Hortic Plant J 5 (4): 170-182. DOI: 10.1080/00103624.2018.1495729.

Farooq M, Flower KC, Jabran K, Wahid A, Siddique KHM. 2011. Crop yield and weed management in rain-fed conservation agriculture. Soil Till Res 117: 172- 183. DOI: 10.1016/j.still.2011.10.001.

Gebru A, Mesganaw M. 2021. Improving faba bean production and productivity through the integrated management of Orobanche Crenatae at Kutaber, Amhara Region, Ethiopia. J Agric Sci Food Technol 7 (1): 114-117. DOI: 10.17352/2455-815X.000097.

Girma F, Haile D. 2014. Effects of supplemental irrigation on physiological parameters and yield of faba bean (*Vicia faba* L.) cultivars in the Highlands of Bale, Ethiopia. J Agron 13 (1): 29-34. DOI: 10.3923/ja.2014.29.34.

Hammer Ø, Harper DAT, Ryan PD. 2001. PAST: Paleontological Statistics Software Package for education and data analysis. Palaeontologia Electronica 4 (1): 1-9.

Hashim MM, Yusop MK, Othman R, Wahid SA. 2015. Characterization of nitrogen uptake pattern in Malaysian rice MR219 at different growth stages using 15N isotope. Rice Sci 22 (5): 250-254. DOI: 10.1016/j.rsci.2015.09.005.

Kassam A, Friedrich T, Derpsch R. 2019. Global spread of conservation agriculture. Intl J Environ Sci Stud 76 (1): 29-51. DOI: 10.1080/00207233.2018.1494927.

Kassam A, Friedrich T, Derpsch R. 2022. Successful experiences and lessons from conservation agriculture worldwide. Agronomy 12 (4): 769. DOI: 10.3390/agronomy12040769.

Li B, Chen X, Shi X, Liu J, Wei Y, Xiong F. 2021. Effects of ridge tillage and straw mulching on cultivation the fresh faba beans. Agronomy 11 (6): 1054. DOI: 10.3390/agronomy11061054.

Loddo S, Gooding MJ. 2012. Semi-dwarfing (Rht-B1b) improves nitrogen-use efficiency in wheat, but not at economically optimal levels of nitrogen availability. Cereal Res Commun 40 (1): 116-121. DOI: 10.1556/CRC.40.2012.1.13.

Luo L, Zhang Y, Xu G. 2020. How does nitrogen shape plant architecture?. J Exp Bot 71: 4415-4427. DOI: 10.1093/jxb/eraa187.

Maehop EJ. 2018. Effect of Conservation Agriculture on Some Soil Hydrophysical Properties and The Yield of Some Forage Crops Salamia Research Center. [Thesis]. Faculty of Agriculture. Damascus University, Damascus.

Mwiti FM, Gitau AN, Mbuge DO. 2022. Edaphic response and behavior of agricultural soils to mechanical perturbation in tillage. Agric Eng 4 (2): 335-355. DOI: 10.3390/agriengineering4020023.

Multari S, Stewart D, Russell WR. 2015. Potential of faba bean as future protein supply to partially replace meat intake in the human diet. Compr Rev Food Sci Food Saf 14 (5): 511-522. DOI: 10.1111/1541-4337.12146.

Rashid MI, Mujawar LH, Shahzad T, Almeelbi T, Ismail IM, Oves M. 2016. Bacteria and fungi can contribute to nutrients bioavailability and aggregate formation in degraded soils. Microbiol Res 183: 26-41. DOI: 10.1016/j.micres.2015.11.007.

Ribeiro HLC, Boiteux LS, Santos CAF. 2014. Genetic parameters of earliness and plant architecture traits suitable for mechanical harvesting of cowpea (*Vigna unguiculata*). Aust J Crop Sci 8 (8): 1232-1238.

Siczek A, Lipiec J. 2016. Impact of aba bean-seed rhizobial inoculation on microbial activity in the rhizosphere soil during growing season. Intl J Mol Sci 17 (5): 784. DOI: 10.3390/ijms17050784.

Sainju UM, Liptzin D. 2022. Relating soil chemical properties to other soil properties and dryland crop production. Front Environ Sci 10: 1005114. DOI: 10.3389/fenvs.2022.1005114.

Şimon A, Cheţan F, Cheţan C, Bărdaş M, Deac V. 2019. The influence of the tillage system and fertilization on soybean yield at ARDS Turda, 2015-2017. Bull UASVM Ser Agric 76 (2): 93-98. DOI: 10.15835/buasvmcn-agr: 2018.0030.

Singh KP, Meena V, Somasundaram J, Singh S, Dotaniya ML, Das H, Singh O, Srivastava A. 2022. Interactive effect of tillage and crop residue management on weed dynamics, root characteristics, crop productivity, profitability and nutrient uptake in chickpea (*Cicer arietinum* L.) under vertisol of Central India. PLoS ONE 17 (12): e0279831. DOI: 10.1371/journal.pone.0279831.

Tajer A. 2016. What's the Function of Nitrogen (N) In Plants? https://www.greenwaybiotech.com/blogs/gardening-articles/whats-the-function-of-nitrogen-n-in-plants

Xuan W, Beeckman, T, Xu G. 2017. Plant nitrogen nutrition: Sensing and signaling. Curr Opin Plant Biol 39: 57-65. DOI: 10.1016/j.pbi.2017.05.010.

Zoffoli BC, Brito LF, Straliotto R, de Araújo AP. 2021. Early nitrogen supplementation stimulates the nodulation and growth of common bean plants inoculated with rhizobium. Acta Sci Agron 43: 1-13. DOI: 10.4025/actasciagron.v43i1.55105.

Ziydan BA, Al-Enzy AF, Almehemdi AF. 2018. Effect of tillage systems on the growth and yield of five cultivars of bread Wheat. Iraqi J Des Stud 8 (1): 10-15.

Ziydan BA, Al-Enzy AF, Almehemdi AF. 2021. Effect of tillage systems on the growth and productivity of eight wheat cultivars. 3rd Scientific & 1st International Conference of Desert Studies-2021. (ICDS 2021). IOP Conf Ser Earth Environ Sci 904: 012044. DOI: 10.1088/1755-1315/904/1/012044.