Response of Faba Bean to Foliar Spraying with Chelated Iron under different Nitrogen Fertilization Treatments in Sandy Soils

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Abstract: Two field experiments were conducted during 2019/2020 and 2020/2021 seasons at El-Qasasin district in Ismailia Governorate to study the effect of four nitrogen fertilization treatments namely 20, 40, 60 and 40 Kg N/fad plus spraying with 1% urea as well as three concentrations of chelated iron (12.5% Fe) as foliar spraying namely tap water (control), 750 and 1500 ppm on yield, its components and quality of faba bean (*Vicia faba* L.) Nubaria 3 variety in sandy soils of Ismailia Governorate. Plant height, number of branches and pods per plant, seeds number per pod, weight of pods and seeds per plant, hundred seed weight, seed and straw yields per fad as well as seed crude protein percentage of faba bean were significantly increased by raising nitrogen fertilization rate up to 60 Kg N/fad, which also exceeded significantly the treatment of 40 Kg N/fad plus spraying with 1% urea. Increasing chelated iron concentration as foliar spraying up to 1500 ppm statistically increased all aforementioned characters. The interaction between nitrogen fertilization treatments and foliar spraying with chelated iron affected significantly all aforementioned characters. The highest values of these characters produced from faba bean plants received 60 Kg N/fad and sprayed with 1500 ppm chelated iron.

Keywords: Faba bean, Nitrogen, Iron, Fertilization, Foliar spraying

INTRODUCTION

Faba bean (*Vicia faba* L.) is considered the most important seed leguminous crop grown in Egypt for human nutrition because of its rich seeds in protein which are consumed green (fresh) or dry. Whereas a great amount of faba bean seeds are consumed daily as human foods and animal feeds.

In Egypt, the consumption of faba bean is higher compared to the production, therefore Egypt import its from several countries.

Increasing the area devoted to faba bean in the Nile valley is very difficult due to great competition from other winter crops and its lower net income compared to these crops such as berseem and wheat. Therefore, expanding faba bean area should be taken in newly reclaimed sandy soils which facing many problems like low fertility especially in nitrogen and iron, poverty and high loss of nutrients by leaching.

Nitrogen is the most important essential nutrient in plant nutrition, it is a constituent of a large number of necessary organic compounds including amino acids, proteins, coenzymes, nucleic acids (DNA and RNA), ribosomes, chlorophyll, cytochrome and some vitamins (Marschner, 1986).

Although faba bean plants are legumes, a low rate of N fertilizer may be needed for early growth and during the entire growing season when symbiotic nitrogen fixation by root nodules bacteria is inhibited (Eaglesham *et.al.*, 1983).

Maximum yield of faba bean crop can not be obtained with symbiotically fixed N alone but nitrogen supply was required (Leng, 1973). Moreover, the sandy soils are suffering from nitrogen deficiency which in turn affect the yield potentiality negatively. Therefore, an adequate supply of N is essential to obtain maximum yield.

The positive effect of supplying faba bean with nitrogen fertilization on yield, its attributes and yield quality were emphasized by Fathy *et al.* (2007), El-Howeity *et al.* (2009), Osman *et al.* (2010), Sadek (2010), Gad *et al.* (2011), Abou-Elela and Gadallah (2012), Ghalwash *et al.* (2012), El-Tantawy and Nawar (2013), Mohamed *et al.* (2013), Abou-Amer *et al.* (2014), Ashoori (2014), Fouda *et al.* (2015), Sherif *et al.* (2017) and Abd El-Haleem *et al.* (2019).

Iron is considered one of the most important micronutrients for plants. It is a component of many enzymes such as catalase, peroxidase and cytochrome oxidase. Also, Iron is required for synthesis of chlorophyll, proteins and chloroplastides, beside it enhances several metabolic processes namely photosynthesis rate and nitrogen fixation by root nodules bacteria. Moreover, it regulates respiration (Marschner, 1986).

On the other hand, iron content in sandy soils is too low to face the plant requirements of this nutrient as well as iron fertilizers is high loss by fixation or leaching in sandy soils. Therefore, application of iron as foliar spraying is readily absorbed by the leaves and not lost through fixation, decomposition or leaching.

The beneficial effect of foliar spraying with iron on growth, yield, its components and yield quality of faba bean were recorded by El-Gizawy (2003), Abdo and Attia (2007), Nassar (2007), Knany *et al*. (2009), Fusial *et al*. (2012), Abd El-Razek *et al*. (2013), Al-Hiji (2014), Salem *et al.* (2014), El-Sobky and Yasin (2017), Abdel-Salam (2018), Attiya *et al*. (2019), El-Shafey *et al*. (2019), Fadhil and jader (2020), Nour El-Din *et al*. (2020) and El-Mansy *et al*. (2021).

Therefore, the objective of this study was to investigate the response of yield, its attributes and quality of faba bean Nubaria 3 variety to nitrogen fertilization and foliar spraying with chelated iron in sandy soils at Ismailia Governorate.

MATERIALS AND METHODS

Two field experiments were conducted during 2019/2020 and 2020/2021 seasons at EI-Qasasin district in Ismailia Governorate to study the effect of nitrogen fertilization and spraying with chelated iron on faba bean (*Vicia faba* L.) Nubaria 3 variety.

The soil of the experiments was sandy with pH values of 7.46 and 7.41 and contained 3.84 and 4.11 ppm available N, 1.72 and 1.76 ppm available P, 10.34 and 10.99 ppm available K and 0.10 % and 0.12 % organic matter in the two seasons, respectively.

Each experiment included 12 treatments, which were the combinations of four nitrogen fertilization treatments and three chelated iron concentrations as foliar spraying.

The experimental design was split plots with four replicates. Four nitrogen fertilization treatments arranged randomly in the main plots, while the three chelated iron treatments were allocated at random in the sub plots.

Each experimental sub plot consisted of six ridges, 4.5 meter in length and 50 cm in width (plot area was 13.5 m^2).

The preceding crop was sesame in both growing seasons.

Seeds of faba bean Nubaria 3 variety were sown on one side of the ridge in hills 10 cm apart on October 29 in the two seasons. After 24 days from sowing faba bean plants were thinned to two plants per hill.

Seeds were coated by Arab gum and inoculated with the specific Rhizobium strain immediately before sowing.

Four nitrogen fertilization treatments were 20, 40 and 60 kg N/fad as well as 40 kg N/fad plus spraying with 1% urea (46% N).

Nitrogen in the form of ammonium sulphate (20.5% N) was applied at three equal doses, after thinning, 65 and 78 days from sowing.

Foliar spraying with 1% urea was sprayed twice after 58 and 68 days from sowing with volume spray of 400 Liter/fad.

A basal dose of calcium superphosphate (15.5% P_2O_5) at rate of 200 kg /fad was applied at two equal doses. The first dose during soil preparing and the second one at 55 days from sowing

A basal dose of potassium sulphate (48% K_2O) at rate of 150 kg /fad was applied at three equal doses, after thinning, 55 and 78 days from sowing.

Chelated iron (12.5% Fe) at three concentrations namely tap water (control), 750 and 1500 ppm were conducted as foliar spraying.

Foliar spraying with chelated iron was done three times after 25, 45 and 66 days from sowing with volume spray of 400 Liter/fad.

The normal cultural practices for growing faba bean crop at Ismailia Governorate were followed.

At harvest time, after 173 days from sowing, samples of ten guarded plants were randomly taken from the two inner ridges in each sub plot to determine the following characters namely plant height (cm), number of branches/plant, number of pods per plant, number of seeds per pod, 100-seed weight (g), weight of pods per plant (g), weight of seeds per plant (g). Seed and straw yields (Kg/fad) were estimated from the plants of the three inner ridges in each sub plot and the yields per fad were calculated.

Seed crude protein percentage was determined as a total nitrogen (%) of faba bean seeds using the modified Micro-Kjeldahl Apparatus according to A.O.A.C. (1990), then the obtained values were multiplied by 6.25 (Tripathi *et al.* 1971).

The analysis of variance of split plots design was used according to Snedecor and Cochran (1982). Differences between treatments means were compared using Duncan's Multiple Range Test (Duncan, 1955). Means followed by the same alphabetical letters are not statistically different according to Duncan's Multiple Range Test at the 5% level of significance (Duncan, 1955).

RESULTS AND DISCUSSION

A-Effect of nitrogen fertilization treatments:-

Data in Table (1) reveal that increasing nitrogen fertilization rate from 20 to 40 and 60 Kg N/fad significantly increased plant height, number of branches and pods per plant as well as number of seeds/pod and that held true in the two seasons.

The high rate of nitrogen fertilization 60 Kg N/fad significantly exceeded 40 Kg N/fad plus spraying with 1% urea in aforementioned characters during both seasons (Table 1).

Applying 40 Kg N /fad plus spraying with 1% urea induced increases in aforementioned characters significant compared to 20 Kg N/fad, insignificant compared to 40 Kg N/fad alone except number of seed/pod where the increase was significant and that was true in the two seasons (Table 1).

These results were expected since nitrogen enhances cell division and elongation in turn increases number and length of internodes resulting taller plants. Also, N favours meristematic tissues, photosynthesis rate which resulted more branches per plant. The increase in number of pods per plant may be due to favorable effect of N on pods setting.

The positive effect of nitrogen on number of seeds per pod might be due to that N increases photosynthesis rate and the amount of metabolites synthesized by the leaves in turn furnished enough food to face the requirements of greater number of seeds per pod.

These results are in accordance with those recorded by Shaaban *et al.* (2006), Fathy *et al*. (2007), Bozorgi *et al.* (2011), Abou-Elela and Gadallah (2012), Abou-Amer *et al.* (2014), Fouda *et al.* (2015), Abd EL-Haleem *et al.* (2019), Basdemir *et al*. (2020).

Table (1): Effect of nitrogen fertilization treatments and foliar spraying with chelated iron on plant height, number of branches per plant, number of pods per plant and number of seeds per pod of faba bean during the two seasons of 2019/2020 and 2020/2021

Treatments	Plant height (cm)		Number of branches per plant		Number of pods per plant		Number of seeds per pod	
	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021
Nitrogen fertilization (Kg N /fad)								
20	116.66 C	119.66 C	2.63 C	2.67 C	9.59 C	10.08 C	1.99 D	2.02 D
40	144.77 B	150.11 B	3.10 B	3.18 B	10.6. B	11.14 B	2.16 C	2.19 C
60	173.66 A	182.66 A	3.66 A	3.77 A	12.56 A	13.16 A	2.55 A	2.58 A
40 + spray urea	151.44 B	157.66 B	3.21 B	3.28 B	11.13 B	11.65 B	2.35 B	2.38 B
F. test	*	*	*	*	*	*	*	*
Foliar spraying with chelated iron (ppm)								
Tap water	132.50 C	137.00 C	2.86 C	2.92 C	10.09 C	10.55 C	2.11 C	2.14 C
750	146.66 B	152.41 B	3.15 B	3.23 B	10.85 B	11.37 B	2.25 B	2.28 B
1500	160.75 A	168.16 A	3.44 A	3.52 A	11.99 A	12.60 A	2.43 A	2.46 A
F. test	*	*	*	*	*	*	*	*
Interaction effect								
N x Fe	*	*	*	*	*	*	*	*

Data presented in Table (2) illustrate that hundred seed weight was increased gradually by increasing nitrogen fertilization rate up to 60 Kg N /fad, which also exceeded the treatment of 40 Kg N /fad plus spraying with 1% urea, however the differences among the four nitrogen treatments were not great enough to reach the 5% level of significance except between the high nitrogen rate of 60 Kg N /fad and low level of 20 Kg N /fad where the increase was significant and that held true in the two seasons.

The positive effect of applying nitrogen fertilization on hundred seed weight might be attributed to that N encourages plant growth, total chlorophyll content, metabolic processes, several enzymes and photosynthesis rate in turn increases the amount of metabolites synthesized in the leaves and partitioned to fruiting organs i.e. seeds.

Confirming results were emphasized by Sadek (2010), Gad *et al*. (2011), Abou-Elela and Gadallah (2012), Mohamed *et al*. (2013), Fouda *et al.* (2015), Sherif *et al.* (2017) and Abd El-Haleem *et al.* (2019).

Table (2): Effect of nitrogen fertilization treatments and foliar spraying with chelated iron on hundred seed weight, weight of pods per plant and weight of seeds per plant of faba bean during the two seasons of 2019/2020 and 2020/2021

Treatments	Hundred seed weight (g)		Weight of pods per plant (g)		Weight of seeds per plant (g)	
	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021
Nitrogen fertilization (Kg N /fad)						
20	81.01 B	82.59 B	18.76 D	19.76 D	14.95 D	15.88 D
40	83.96 AB	85.60 AB	22.26 C	23.88 C	17.98 C	19.10 C
60	89.14 A	90.88 A	29.03 A	32.48 A	23.86 A	25.64 A
40+spray urea	85.67 AB	87.64 AB	25.57 B	26.72 B	20.87 B	21.93 B
F. test	*	*	*	*	*	*
Foliar spraying with chelated iron (ppm)						
Tap water	82.84 B	84.50 B	21.31 C	22.15 C	17.10 C	17.92 C
750	85.01 AB	86.75 AB	24.27 B	26.17 B	19.68 B	20.90 B
1500	86.98 A	88.79 A	26.14 A	28.84 A	21.47 A	23.10 A
F. test	*	*	*	*	*	*
Interaction effect						
N x Fe	*	*	*	*	*	*

It is clearly evident from Table (2) that weight of pods and seeds per plant were significantly increased by raising nitrogen fertilization level up to 60 Kg N/fad in the two seasons.

Faba bean plants received 60 Kg N/fad outweighed significantly those treated by 40 Kg N /fad plus spraying with 1% urea in weight of pods and seeds per plant, the last treatment deviated in this respect significantly with 40 and 20 Kg N /fad and that was true in the two seasons (Table 2).

These results were expected since nitrogen increases pods number/plant, seeds number per pod and hundred seed weight.

These results are in a good line with those noticed by Fathy *et al*. (2007), Sadek (2010), Gad *et al*. (2011), Ghalwash *et al*. (2012), El-Tantawy and Nawar (2013), Abou-Amer *et al*. (2014) and Abd El-Haleem *et al.* (2019).

It is obvious from Table (3) that seed and straw yields per fad were significantly increased by raising nitrogen fertilization rate up to 60 Kg N/fad, which also exceeded statistically the treatment of 40 Kg N /fad plus spraying with 1% urea and that was true in the two seasons.

Faba bean plants received 40 Kg N/fad plus spraying with 1% urea out yielded significantly both 40 and 20 Kg N/fad in seed and straw yields per fad in the two seasons (Table 3).

The relative increases in seed yield per fad by applying 60 Kg N/fad compared to 40 Kg N/fad plus spraying with 1% urea, 40 and 20 Kg N/fad were 7.68%, 26.46% and 45.61%, respectively in the first season and 10.66%, 25.77% and 48.11%, respectively in the second season (Table 3).

The positive effect of applying nitrogen fertilization on seed yield per fad of faba bean might be due to that nitrogen is a constituent of a large number of necessary organic compounds such as amino acids, proteins, coenzymes, nucleic acids, ribosomes, chlorophyll and cytochrome (Marschner, 1986). Also N stimulates plant growth, metabolic processes and photosynthesis rate in turn increases the amount of metabolites synthesized in the leaves and partitioned to fruiting organs which reflected favorably on number of pods/plant, seeds number per pod, weight of pods/plant, hundred seed weight and seeds weight per plant consequently increases seed yield per fad.

Several investigators recorded that applying nitrogen fertilization increased seed yield per fad of faba bean, Shaaban *et al.* (2006), El-Howeity *et al*. (2009), Sadek (2010), Gad *et al*. (2011), Abou-Elela and Gadallah (2012), Mohamed *et al*. (2013), Abou-Amer *et al*. (2014), Fouda *et al.* (2015) and Abd El-Haleem *et al.* (2019).

The increase in straw yield per fad of faba bean by application of nitrogen fertilization may be due to that nitrogen increases plant height, number of branches /plant and weight of roots, stems and leaves /plant.

These results are in a same trend with those recorded by Sadek (2010), Bozorgi *et al.* (2011), Mohamed *et al.* (2013), Abou-Amer *et al.* (2014) and Sherif *et al.* (2017).

Table (3): Effect of nitrogen fertilization treatments and foliar spraying with chelated iron on seed yield per fad, straw yield per fad and seed crude protein percentage of faba bean during the two seasons of 2019/2020 and 2020/2021

Treatments	Seed yield per fad (kg)		Straw yield per fad (kg)		Seed crude protein percentage	
	2019/2020	2020/2021	2019/2020	2020/2021	2019/2020	2020/2021
Nitrogen fertilization (Kg N /fad)						
20	1762.00 D	1895.11 D	2470.33 D	2696.00 D	26.93 C	26.68 C
40	2028.77 C	2231.66 C	3195.33 C	3560.00 C	30.38 B	30.03 B
60	2565.66 A	2806.77 A	4317.00 A	4779.33 A	33.30 A	32.77 A
40+spray urea	2382.66 B	2536.33 B	3841.00 B	4140.00 B	31.32 B	30.89 B
F. test	*	*	*	*	*	*
Foliar spraying with chelated iron (ppm)						
Tap water	1960.25 C	2128.16 C	3139.91 C	3451.91 C	27.87 C	27.56 C
750	2222.91 B	2403.50 B	3509.66 B	3844.66 B	30.48 B	30.09 B
1500	2371.16 A	2570.75 A	3718.16 A	4084.91 A	33.11 A	32.63 A
F. test	*	*	*	*	*	*
Interaction effect						
N x Fe	*	*	*	*	*	*

Data in Table (3) demonstrate that fertilizing faba bean plants with 60 Kg N/fad produced the highest seed crude protein percentage followed by 40 and 20 Kg N/fad, respectively with significant variations among them in the two seasons.

Faba bean plants received 60 Kg N/fad surpassed significantly those treated by 40 Kg N/fad plus spraying with 1% urea in seed crude protein percentage during both seasons (Table 3).

Seed crude protein percentage tended to increase significantly by applying 40 Kg N/fad plus spraying with 1% urea compared to 20 Kg N/fad, similar trend was observed with 40 Kg N /fad but the increase was not high enough to reach the 5% level of significance and that held true in the two seasons (Table 3).

The favorable effect of applying nitrogen fertilization on seed crude protein percentage of faba bean might be attributed to that nitrogen is a constituent of amino acids, proteins and coenzymes as well as it enhances metabolic processes (Marschner, 1986). Confirming results were illustrated by Osman *et al.* (2010), Sadek (2010)**,** El-Khateeb *et al.* (2012)**,** Abou-Amer *et al.* (2014)**,** Ashoori (2014)**,** Fouda *et al.* (2015) and Adak and Kibritci (2016)**.**

B-Effect of foliar spraying with chelated iron:-

Data in Table (1) show that increasing chelated iron concentration as foliar spraying from zero to 750 and 1500 ppm significantly increased plant height, number of branches and pods per plant as well as number of seeds /pod and that was true during both seasons.

The increase in plant height and number of branches per plant by spraying faba bean plants with chelated iron may be due to that iron encourages several enzymes, metabolic processes and photosynthesis rate in turn increases plant growth characters. The increase in number of pods per plant might be attributed to favorable effect of iron on pods setting percentage. While the increase in seeds number per pod may be due to that iron reduces seeds abortion and incomplete fertilization. These results are in harmony with those recorded by El-Gizawy (2003), Abdo and Attia (2007), Fusial *et al.* (2012), Abd El-Razek *et al*. (2013), Al-Hiji (2014), El-Sobky and Yasin (2017), Fadhil and jader (2020), Nour El- Din *et al*. (2020) and El-Mansy *et al*. (2021).

It is obvious from Table (2) that faba bean plants sprayed with 1500 ppm chelated iron outweighed insignificantly those received 750 ppm and significantly unsprayed control in hundred seed weight during the two seasons. Moreover, plants sprayed with 750 ppm chelated iron was statistically in par with those unsprayed control and that held true in the two seasons.

The positive effect of chelated iron on hundred seed weight of faba bean was expected since iron enhances metabolic processes, photosynthesis rate, total chlorophyll content and several enzymes as well as increases plant growth and leaves area per plant which resulted in raising the amount of metabolites synthesized by the leaves and partitioned for seeds filling thereby hundred seed weight increased. Confirming results were emphasized by El-Gizawy (2003), Abdo and Attia (2007), Fusial *et al*. (2012), Abd El-Razek *et al*. (2013), Al-Hiji (2014), Al-Zubaidy and Alwan (2015), El-Sobky and Yasin (2017), Fadhil and jader (2020) and Nour El- Din *et al*. (2020).

The results in Table (2) indicate that faba bean plants sprayed with 1500 ppm chelated iron produced the heaviest weight of pods and seeds per plant followed by those received 750 ppm and unsprayed control, respectively with significant differences among the three concentrations in the two seasons.

The favorable effect of chelated iron on weight of pods per plant may be due to that iron increases number of pods per plant, seeds number per pod and hundred seed weight. While the positive effect of iron on weight of seeds per plant might be attributed to the increasing in pods weight per plant, shelling percentage, number of seeds per pod and the average of seed weight. These results are in accordance with those stated by Abdo and Attia (2007), Al-Hiji (2014), Salem *et al.* (2014), Al-Zubaidy and Al-Bawee (2018), El-Shafey *et al*. (2019), Fadhil and jader (2020) and Nour El- Din *et al*. (2020).

It is clearly evident from Table (3) that increasing chelated iron concentration as foliar spraying up to 1500 ppm significantly increased seed and straw yields per fad and that held true during both seasons.

The positive effect of chelated iron on seed yield per fad of faba bean might be due to that iron is a constituent of several enzymes such as catalase, peroxidase and cytochrome oxidase. It is required for synthesis of chlorophyll, proteins and chloroplastides, beside iron enhances metabolic processes such as photosynthesis rate and nitrogen fixation by root nodules bacteria which reflected on increasing leaves area per plant and leaf area index in turn increases the amount of light energy intercepted by plants, consequently increments amount of metabolites synthesized in the leaves and partitioned to fruiting organs which reflected favorable on raising number of pods per plant, seeds number per pod, hundred seed weight and seeds weight per plant ultimately increases seed yield per fad.

The relative increases in seed yield per fad by spraying faba bean plants with 1500 ppm chelated iron compared to 750 ppm and unsprayed control were 6.67% and 20.96%, respectively in the first season and 6.96% and 20.80%, respectively in the second season (Table 3).

These results agree with those illustrated by El-Gizawy (2003), Abdo and Attia (2007), Nassar (2007), Knany *et al*. (2009), Abd El-Razek *et al*. (2013), Al-Hiji (2014), Salem *et al.* (2014), El-Sobky and Yasin (2017), El-Shafey *et al.* (2019), and Nour El- Din *et al*. (2020).

The increase in straw yield per fad by foliar spraying with chelated iron was expected since iron increases plant height, number of branches per plant and weight of leaves, stems and roots per plant.

Similar results were emphasized by Abdo and Attia (2007), Nassar (2007), El-Sobky and Yasin (2017) and Nour El-Din *et al*. (2020).

It is clearly evident from Table (3) that there were consistent and remarkable increases in seed crude protein percentage as chelated iron concentration increased from zero to 750 and 1500 ppm with significant differences among the three concentrations and that was true in the two seasons.

The favorable effect of foliar spraying with chelated iron on seed crude protein percentage might be attributed to that iron enhances metabolic processes, various enzymes and nitrogen fixation by root nodules bacteria as well as stimulates synthesis of protein (Marschner, 1986). Similar results were detected by El-Gizawy (2003), Abdo and Attia (2007), El-Shafey *et al*. (2019) and Nour El-Din *et al*. (2020).

C- Interaction effect:-

There was significant interaction between nitrogen fertilization treatments and spraying with chelated iron on plant height, number of branches /plant, number of pods /plant, number of seeds /pod, weight of pods /plant, weight of seeds /plant, hundred seed weight, seed yield /fad, straw yield /fad and seed crude protein percentage in the two seasons (Tables 1, 2 and 3).

The highest values of all aforementioned characters were produced by applying 60 Kg N /fad and spraying with 1500 ppm chelated iron. While the lowest values were achieved by adding 20 Kg N /fad and unsprayed control in the two seasons (Table 4). These results are in harmony with those recorded by Caliskan *et al.* (2008), El-Tantawy and Nawar (2013)**,** Doklega (2015) and Pal *et al.* (2019)**.**

Table (4): Yield, its attributes and quality of faba bean as significantly affected by the interaction between nitrogen fertilization treatments and foliar spraying with chelated iron during the two seasons of 2019/2020 and 2020/2021

Character	Highest value		Lowest value	
	2019/2020	2020/2021	2019/2020	2020/2021
Plant height (cm)	190.66	201.66	105.66	107.66
Number of branches per plant	4.00	4.12	2.38	2.41
Number of pods per plant	13.90	14.60	9.19	9.64
Number of seeds per pod	2.79	2.82	1.87	1.89
Hundred seed weight (g)	91.10	92.92	78.98	80.49
Weight of pods per plant (g)	31.17	36.89	16.63	17.78
Weight of seeds per plant (g)	26.00	29.00	13.14	14.19
Seed yield per fad (kg)	2729.66	3013.00	1577.66	1703.66
Straw yield per fad (kg)	4558.66	5094.66	2239.66	2452.66
Seed crude protein percentage	36.49	35.83	24.57	24.37

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استجابة الفول البلدي للرش الورقى بالحديد المخلبى تحت معاملات مختلفة للتسميد الآزوتي في الأراضي الرملية

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أجريت تجربتان حقليتان في موسمي ٢٠١٩/٢٠٢٠ و٢٠٢٠/٢٠٢١ بمنطقة القصاصين بمحافظة الإسماعيلية لدراسة تأثير أربع معاملات من التسميد الآزوتى هي ٢٠، ٤٠، ٦٠ كجم أزوت /فدان بالإضافة إلى ٤٠ كجم أزوت/فدان مع الرش الورقى باليوريا بتركيز ١% وكذلك ثلاث معاملات من الرش الورقى بالحديد المخلبي (١٢,٥% حديد) هي الرش بالماء(كنترول) , ٧٥٠ , ١٥٠٠ جزء في المليون على محصول الفول البلدي صنف نوبارية ٣ في الأراضي الرملية بمحافظة الإسماعيلية.

ويمكن تلخيص النتائج كما يلى:-

١- أدى زيادة معدل التسميد الآزوتى حتى ٦٠ كجم أزوت /فدان إلى زيادة معنوية في ارتفاع النبات وعدد الأفرع / نبات وعدد القرون /نبات وعدد بذور القرن ووزن المائة بذرة ووزن القرون /نبات ووزن البذور /نبات ومحصول البذور /فدان ومحصول القش /فدان والنسبة المئوية للبروتين بالبذور.

٢- تفوقت معاملة ٦٠ كجم أزوت /فدان معنويا على معاملة ٤٠ كجم أزوت /فدان مع الرش الورقى باليوريا بتركيز ١% في كل الصفات السابقة.

٣- أدى زيادة تركيز الحديد المخلبى في الرش الورقى حتى ١٥٠٠ جزء في المليون إلى زيادة معنوية في كل الصفات السابقة.

٤- يوجد تأثير معنوي للتفاعل بين التسميد الآزوتى والرش الورقى بالحديد المخلبى على كل الصفات السابقة. وقد أمكن الحصول على أعلى القيم لجميع الصفات السابقة بالتسميد بمعدل ٦٠ كجم أزوت /فدان والرش الورقى بالحديد المخلبى بتركيز ١٥٠٠ جزء في المليون.

الكلمات الدالة: الفول البلدي، التسميد الآزوتى، الرش بالحديد