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The effect of plant density on the growth and seed yield of fenugreek *(Trigonella foenum graecum L.)*

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Abstract

This study was conducted to determine the effects of different plant and row spacing (20*20 as T1, 30*30 as T2 and 40*40 as T3 cm) on the growth and yield of fenugreek (*Trigonella foenum graecum L.*) in Bakrajo – Sulaimani in the autumn season of (2013-2014).This simple field experiment was arranged in RCBD within three replication at the experimental fields of Bakrajo Technical Agricultural Institute– Sulaimani Polytechnic University. As a result of the research, while all the growth and yield parameters except dry root weight were significantly affected by plant and row spacing applications, significant increased in plant height (68.067) cm seed yield (1407.267) kg/ha was resulted from (20) cm plant and row spacing. While number of branches per plant (13.233), the dry weight of vegetative (57.867) gm, number of pod per plant (70.133), number of seeds per pod (17.13) and thousand-seed weight (14.6) gm, was resulted from (40) cm plant and row spacing.

Introduction

Fenugreek (*Trigonella foenum graecum L.*), belonging to the family Fabaceae is a self-pollinated , annual, herbaceous plant growing up to 10-40cm height. It's believed to have been originated in western Asia and south- Eastern Europe. It has long been cultivated in Asia, Africa and Mediterranean countries for both edible purposes and Medicinal values of its seeds [1]. An important plant in traditional medicine, is widely grown in Mediterranean countries, India and China [2]. It is commonly used as a condiment and seasoning in food preparations; is assumed to possess nutritive and restorative properties and has been used in folk medicine for centuries for a wide range of diseases including diabetes [3].Seeds of fenugreek have locally been used as a natural yellow dye material, for cosmetics production and medicinal purpose. Fenugreek is also a good soil renovator and has widely been used as a green manure in agricultural production [4].Fenugreek seeds and leaves are reach in minerals, proteins and carbohydrate, but low in oil [5].The seeds are used as spice on the worldwide, whereas the leaves are used as green leafy vegetables in diets. Fenugreek seeds has bitter taste and has been known over 2500 years for their medicinal qualities [6].Ground seeds of fenugreek are consumed for producing spice and pastrami, a kind of traditional meat product in Turkey [7] Among several seeds production approaches Judicious application of plant nutrients and optimum planting density have be found to be effective in increasing fenugreek yield [8].Plant density is an important variable for achieving maximum yields .optimal plant density can be achieved by establishing appropriate distance both between the rows as well as in the rows of plant. one of the significant factors for increasing yield and quality is to regulate the optimum plant density on the field . In fenugreek this can be modified by the inter row spacing , since the plant to plant distance within a row is ideally at 8-10 cm. Plant density varies according to the cultivar, yield capacity of the soil, irrigation condition and cultivation objectives[9].The

aim of this study was to determine the effects of plant density on the growth and yield components of fenugreek in Sulaimani – Iraq ecological conditions.

Material and Methods

The experiment was conducted at the research farm of Bakrajo belong to Technical Agricultural Institute– Sulaimani Governorate during autumn season (2013-2014), which is located (11) km west of Sulaimani center, with altitude of (847)m above sea level. The soil in the experimental field was sandy-clay-loam texture (Table 1).The mean of rainfall received in the experimental year (635.8 mm). The minimum temperature value was (-12^{o}C) and the maximum value was (44 ^{o}C). The trial was carried out in Randomized Complete Block Design with three replications (RCBD), and the size of the plots was 1.83*1.83m. In the study, three different plant and row spacing (T1=20 , T2=30 , T3=40cm) were applied , thereby making 9 treatments combinations . The crop was sown on 31 October 2013. The field was keet weed-free throughout the cropping period and other standard cultural practices were followed to raise the crop. Observations were recorded on 10 randomly selected plants for plant height, number of branches per plant, number of seeds per pod, weight of thousand seed, dry plant weight and dry root weight but seed yield calculated were plots harvested completely at the end of July. The data was subjected to statistical analyses in (RCBD) using (SPSS) computer program and means were compared at p = 0.05 prospects [10].

Table 1: soil physical and chemical analysis.

Properties	*Sample value*
EC	*0.31*
pH	*7.14*
%N	*0.28*
Available P (ppm)	*28*
Soluble K+ Meq/L	*0.231*
Soluble K+ Meq/L.	*0.385*
Soluble K+Meq/L.	*1.2*
% Sand	*12.36*
% Silt	*43.48*
% Clay	*43.17*
Sandy - clay - loam	

Results and Discussion

Results showed that growth and the yield components of fenugreek were significantly affected by different plant density except dry root weight in the experimental treatments (table 2).

Table 2: Mean square of treatments and their interaction.

S.O.V	*df*	*Plant high (cm)*	*Number of reaches /plant*	*Number of pod/plant*	*Dry weight gm/plant*	*Dry root weight gm/plant*	*No. of seed pod/plant*	*1000 seed weight (gm)*	*Yield Hectare (kg)*
Replication	*2*	*6.901*	*0.334*	*5.934*	*34.138*	*0.003*	*0.235*	*0.271*	*31440.991*
Treatment	*2*	*161.521***	*11.10**	*106.25**	*220.334***	*0.07*	*30.45***	*7.52**	*918706.93***
Error	*4*	*7.474*	*0.903*	*7.811*	*5.741*	*113*	*1.227*	*0.818*	*20511.804*

1. Plant Height:

The effects of different plant and row spacing on the plant height were found to be significant. There were statistical differences in plant height between treatments (table 3). The highest mean plant height (68.067 cm) was obtained from 20 cm plant and row spacing. The lowest values were obtained from 40 cm (54.633 cm). Plant height increased with decreasing plant and row spacing [11] while the plant spacing are decreased the competitions on the environmental resources will increased and ultimately plant height and some growth characters increased. Higher plant heights in 22.5 cm row spacing were reported while [12] and [13]

obtained the highest plant heights of fenugreek from (30) cm row spacing. On the other hand,[14] reported that plant height of fenugreek was not affected by increase in row space.

Table 3: Means of some growth components at different plant spacing applications in fenugreek.

Traits / *Treatments*	*Plant height Cm*	*Number of branches/plant*	*Dry weight per plant gm*	*Dry root weight per plant gm*
T 1	*68.067a*	*9.467bc*	*39. 533bc*	*0.967a*
T2	*66.467b*	*12.033a*	*40.567b*	*1.167a*
T3	*54.633bc*	*13.233a*	*57.867a*	*1.267a*

* [Means followed by the same letter within a column are not significantly difference according to Duncan's multiple range test at $P < 0.05$] .

2. Number of branches:

There were significant differences of the number of major and secondary branches value of fenugreek in the experiment (Table 3) the effect of different plant and row spacing on the number of branches was found statistically significant. As the highest number of branches (13.233) was obtained from 40 cm plant and row spacing, while 20 cm plant and row spacing gave the lowest value (9.467) branches per plant. The number of branches per plant increased when plant and row spacing were increased. In previous studies, similar results were reported by [12] and [13] and [14] for the number of branches in fenugreek.

3. Dry plant weight:

The effects of different plant and row spacing on the dry plant weight were found to be significant (Table 3). There were statistical different for dry plant weight between treatments. The highest mean for dry plant weight were (57.867) g obtained from 40 cm plant and row spacing. While the lowest mean value (39.533) g were obtained from 20 cm plant and row spacing. The number of brunches increased when plant and row spacing were increased. Our finding was in harmony with the results of [15].

4. Dry root weight:

The results of statistical analysis indicated that different plant and row spacing had no statistically significant differences on the dry root weight between treatments (Table 3). The highest value (1.26 g) was obtained from 40 cm. while the lowest value (0.967 g) was taken from 20 cm applications. It belongs to plant root natural or external factors. Our finding was in harmony with the results of [15] .

5. Number of pods:

The effects of plant and row spacing on the number of pods of fenugreek were statistically significant (Table 4). The highest number of pods per plant (70.133) was recorded in 40 cm plant and row spacing, while the lowest value (59.333) was obtained from the 20 cm plant and row spacing. The number of pods increased with increasing plant and row spacing and that is may be because of increasing number of branches . An increase in the plant density results in increased competition among the plants for growth requirement factors such as adequate space for growth and development of shoots and roots, light, nutrients and moisture .The results of [16] who reported that the number of pods increased by increasing row spacing in fenugreek supported our results.

Table 4: Means of some yield components at different plant and row spacing applications in fenugreek.

Traits / *Treatments*	*No. of Pod per plant*	*No. of Seed per pod*	*Thousand Seed g*	*Yield hectare kg*
T1	*59.333bc*	*10.867c*	*11.733b*	*1407.267a*
T2	*60.400b*	*13.000b*	*14.33a*	*583.330b*
T3	*70.133a*	*17.130a*	*14.50a*	*355.200b*

6. Number of seeds in pod:

There was a statistical difference between treatments in the number of seeds in a pod. Data analysis showed that the number of seeds per pod was affected significantly by different plant and row spacing (Table 4). The highest mean number of seeds in pod (17.13) was obtained from 40 cm plant and row spacing, while applying 20 cm plant and row spacing gave the lowest mean number of seeds in a pod (10.867). The number of seeds per pod increased with increasing plant and row spacing. The number of seeds per pod is predominantly controlled by the plant genotype rather than any external factors. An increase in the plant density results in increased competition among the plants for growth requirement factors such as adequate space for growth and development of shoots and roots, light, nutrients and moisture. The results were in agreement with that of [12] and [13] who found positive effects in row spacing applications on the yield characteristics of fenugreek. Our result is in harmony with the results of many other researchers.

7. Thousand-seed weight:

There was statistically significant between the treatments in the thousand-seed weight of fenugreek. Thousand-seed weights were significantly affected by different plant and row spacing (Table 4). The highest mean number of thousand-seeds weight (14.6) was obtained from 40 cm plant and row spacing, while the lowest was obtained from 20 cm plant and row spacing (11.73). An increase in the plant density results in increased competition among the plants for growth requirement factors such as adequate space for growth and development of shoots and roots, light, nutrients and moisture [17]. These results were compatible with our finding for thousand-seed weight.

8. Seed Yield

There was statistically significant difference for the seed yields between experimental treatments (Table 4). The effects of plant and row spacing on the seed yield were statistically important. The highest seed yield (1407.267 kg/ha) was obtained from 20 cm plant and row spacing, while the lowest mean (355.2) was obtained from 40 cm plant and row spacing. It's productivity is quite high compared to the world average of about 1350kg/ha [17] . In related studies, [9] and [16] found the maximum seed yields which were obtained from the closer row spacing treatments, the total seed yield per unit area increases due the increased number of plants per area [18].

Conclusions

In this study one of the significant factors for increasing the growth and yield is to regulate the optimum plant density on the field . In the present study three plant and row spacing of 20,30, and 40cm were applied which showed significant effect on all agronomic parameters excpet dry root weight . An increase in the plant density results in increased competition among the plants for growth requirement factors such as adequate space for growth and development of shoots and roots, light, nutrients and moisture the total seed yield per unit area increases due the increased number of plants per area . On the basis of results , it may be concluded that regulation of plant population , application of plant and row spacing of 20 cm was found to be most suitable for obtaining highest yield of fenugreek seed and thus , may be recommended for sandy clay loam soil conditions of Sulaimani but increasing plant and row spacing up to 40 cm affected positively on all growth and yield parameters except for plant height and seed yields was positively affected by 20 cm plant and row spacing. As a result, it can be said that the plant spacing of 20 cm is optimum for the highest seed yields in fenugreek under Sulaimani ecological conditions.

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