Al-Muthanna J. For Agric Sci Print ISSN: 2226-4086 Online ISSN:2572-5149
Vol. 10 , Issue. 01. 2023
https://muthjas.mu.edu.iq/ http://doi.org/10.52113/mjas04/10.1/6

Effect of planting distances between lines and nitrogen fertilization on yield and its components of millet yield *(Pennisetum glaucum)*

Thullfukar Mohammed wali1, Faisal Mehbas Al-Tahir

Field Crops Department, College of Agriculture, Al-Muthanna University, Iraq.

Email: agrpl.grad.thullfukar8@mu.edu.iq

Received on 15/2/2023 Accepted on 4/4/2023 Published on 15/06/2023

Abstract

A field experiment was carried out in Al-Rumaitha district (25 km north of Samawah, the center of the governorate) in the summer season (2022), to investigate how millet grows and yields in relation to planting spacing between rows and degrees of nitrogen fertilization. experimental design was, split plots according to the (R.C.B.D.) with three replicates, as nitrogen fertilization levels (0, 25, 50 , 75 kg N ha^{-1}) the main plots contained, and the distances between plants (40, 50, 60 and 70) cm were at the sub plots.

The results data indicated a significant superiority of the level of fertilizer 75 kg N ha^{-1} by giving it the highest averages for the weight of 1000 grains and the percentage of protein was 3.52 g, 10.99%, respectively, while the fertilizer level was superior to 50 kg (N) ha^{-1} by giving it the highest average of Number of spikes m^{-2} and yield of grain which averaged 688.25 spikes m^{-2} and 0.48 tons ha^{-1} respectively, regarding the distance of 70 cm excelled, it gave the greatest average protein content of 9.96%. While the distance of 40 cm excelled by giving it the highest averages for the spikes number m^{-2}, biological yield and grain yield, as the averages were 3.78 689.50 seedlings m^{-2} 5.80 tons ha^{-1}, 0.47 tons ha^{-1} respectively.

Concern to the interaction between the factors, the combination (50 cm X 75 kg N ha^{-1}) excelled in the weight of 1000 grains, reaching 4.81 g, While (60 cm X 75 kg N ha^{-1}) combination excelled in the protein percentage of 11.24%, and the combination (40 cm X 50 kg N ha^{-1}) gave the highest average of the spikes number bearing spikes, which amounted to 1227.00 tillers m^{-2}.

Keyword: fertilization, millet, planting distances, grain yield .

Introduction

Cereal crops are great importance in the life of humans and animals, because they make up a significant portion of the essential daily diet, their starchy grains are the primary source of carbohydrates, and they also include protein, vitamins, and some salts that support body growth. It also represents an important economic aspect in the production of meat and other animal products indirectly, as it is an important part of animal nutrition, whether it is green material or grain (1).

The amount of nitrogen absorbed has an effect on the amount of carbohydrates stored in the plant, as the plant combines nitrogen with the carbohydrates formed during the photosynthesis process, and it forms the amino acids that make up the proteins, so the lack of nitrogen makes the plant unable to use the carbohydrates to produce protein, which leads to the accumulation of carbohydrates in the Plant. Nitrogen is part of chlorophyll, which is important in the process of photosynthesis. Moreover, it contributes to the development of the energy transfer molecules ATP, CTP, GTP, and ADP and acts to strengthen plants' roots system (2).

One prerequisite for achieving high productivity is determining the ideal plant density per unit area. By minimizing plant competition and shade, which encourages the plant to utilize growth inputs like hydration, light, nutrients, etc. to the fullest extent with high efficiency, which is positively reflected in increased production. Therefore, determining plant density is an important and specific scientific practice for crop production (3), The goal of this experiment was to find the ideal line-to-line spacing under the impact of various nitrogen concentrations in order to find the ratio that would produce the highest yield in terms of both quantity and quality.

Materials and methods

The experimental land was plowed with a reciprocating plow, two orthogonal plows, after performing the process of truss, then smoothed and leveled, and divided according to the design used into planks with an area of (3m x 3m = $9m^2$), fertilizer (P_2O_5) was added at once before planting, after which millet seeds were sown on lines with distances specified on 17/5, with a seed quantity of (3.75 g $Line^{-1}$). Two equal batches of urea fertilizer (46% N) were used for nitrogen fertilization (tillers stage, booting stage), and if needed, watering and weeding procedures were also carried out. The harvest was done on 17/8. Four levels of nitrogen fertilizers were used in the experiment (0, 25, 50, 75 kg N ha^{-1}), Urea fertilizer has been used as a source of fertilizer of nitrogen, and planting distances between the lines (40, 50, 60 , 70 cm)

Experiment site and Soil analysis

The experiment was carried out on the land of a farmer in the Rumaitha district of Al-Muthanna province during the 2022 agricultural season. Samples were taken randomly from several different places in the soil of the experiment field from a depth of (0-30 cm) and from different locations in the field, then the analysis was carried out to estimate some chemical and physical properties (Table 1).

Table 1: Some chemical and physical properties of field soil

Traits	Value	measruing unit	Dissolved ions mg/l	Value	measruing unit
pH	7.39	–	Ca	**175**	mg/l
ECe	2.91	dsm-1	Mg	**82**	mg/l
N	54		Na	**219**	mg/l
P	9.8		K	**11**	mg/l
K	136		Cl	**421**	mg/l
Sand	22.7	%	So	**351**	mg/l
Silt	48.0	%	Hco3	**189**	mg/l
Clay	29.3	%	No3	**13.5**	mg/l
soil texture	Clay Loam		Po4	**0.47**	mg/l
organic matter	1.13	%			
CaCO3	28.6	%			

xperiment design

The randomized complete block design was used to conduct the experiment in a split-plans fashion (R.C.B.D) and with three replications, each repetition contained 16 experimental units, so the number of experimental units in the experiment reached 48 experimental units, as the levels of nitrogen fertilization were placed in the main plots, and the distances between the lines were placed in the secondary plots.

Studied traits

The fertile tiller number, fertile tillage number grains number (grain spike^{-1}), Weight of 1000 grains (g), Cereal yield (µg ha^{-1}), The biological yield (µg ha^{-1}), Harvest index %

Statistical analysis

The experiment data analyzed statistically by using the statistical program of Genstat, as well as all averages were compared at the level of 0.05 by using the least significant difference.

Results and discussion

Number of spikes (spike m^{-2}).

The data of results of table (2) showed that there were significant variations between the planting distances, as the distance of (40 cm) the highest rate was recorded at 689.50 spikes m^{-2}, which was significantly superior to the other distances, while the distance 70 cm gave the least average of 357.75 spikes of m^{-2}.

The results of the same table indicated that the fertilization level of 50 kg N ha^{-1} was significantly superior to the other levels, as it averaged 688.25 spikes m^{-2}, while the treatment of 75 kg N ha^{-1} gave the lowest average of 389.00 spikes m^{-2}, with no significant difference from control treatment (without addition) which gave an average of 416.25 spikes m.

With regard to impact of the interaction, the combination (40 cm x 50 kg N ha^{-1}) recorded the highest average of 1227.00 spikes m^{-2}, significantly superior to all other combinations, while the combination (50 cm x comparison treatment) recorded a low average of151.00 spikes m^{-2} one can interpret the aforementioned results, These factors worked together to raise the number of tillers, which in turn improved the plant's capacity to branch out. Increasing the total number of tillers in the above-mentioned treatments led to an increase in the probability of increasing the number of tillers bearing spikes, as well as the role of narrow distances between lines in increasing the number of plants per unit area with the role of nitrogen.

.

Table (2) The effect of the distance between lines and fertilization of nitrogen and the interaction on the number of fertile spikes m^2

Nitrogen levels (kg ha^{-1})	Planting distances between lines (cm)				Fertilizer mean
	40	50	60	70	
0	402.00	542.00	570.00	151.00	416.25
25	657.00	399.00	460.00	636.00	538.00
50	1227.00	539.00	602.00	385.00	688.25
75	472.00	311.00	514.00	259.00	389.00

Distance mean	689.50	447.75	536.50	357.75	
LSD(0.05)	Nitrogen	distances		Interaction	
	49.0	76.8		138.2	

Grains number (grain Spike^{-1})

The data of table (3) showed that the distance of 70 cm was significantly greater in the number of grains per spike reached 366.75 grains spike^{-1}, while the treatment (distance 60 cm) recorded the lowest rate of 258.50 grains spike^{-1}, without a significant difference for the distances 40 and 50 cm, which gave 260.80 and 272.67 grains spike^{-1}, respectively

it was observed that the level of 75 kg N ha^{-1} was significantly superior to the other levels, with an average of 356.85 grains spike^{-1}, while the level 25 kg N ha^{-1} gave the lowest average number of grains per spike, which amounted to 259.40 grains spike^{-1}, without Significant variation from the control and the fertilizer level of 50 kg N ha^{-1}, were 261.82 and 280.65 grains spike^{-1}, respectively, and this result agreed with (5)

With regarding of the interaction, (70 cm x 75 kg ha 1) showed a clear superiority over the rest of the interactions, with an average of 560.70 grains spike^{-1}, while the combination (70 cm x 25 kg N ha^{-1}) gave the lowest value. (196.00 grains spike^{-1}), this may be due to the treatment of 70 cm and the fertilizer level 75k g. N h^{-1} leads to superiority in vegetative growth, which results in intercepting the largest amount of seeds and the dry matter production, which reduces the state of competition between plant parts, which increases the number of grains per spike and decrease in the number of fertile spikes, which reduced the competition and increased grain formation.

Table (3): the effect of N, distances and the interaction on the number of grains

Nitrogen levels (kg ha^{-1})	Planting distances between lines (cm)				Fertilizer mean
	40	50	60	70	
0	319.30	245.70	131.30	351.00	261.82
25	251.30	219.30	371.00	196.00	259.40
50	204.30	280.00	279.00	359.30	280.65
75	268.30	345.70	252.70	560.70	356.85
Distance mean	260.80	272.67	258.50	366.75	

LSD(0.05)	nitrogen	Distances	Interaction
	24.05	18.18	37.15

Weight of one thousand grain (gm)

The data of results of table (4) indicated that there are significant variations between the planting distances, where the 50 cm distance gave the highest average of 3.69 g, which was significantly superior to the other distances, while the 40 cm distance gave the lowest average of 2.86 g without significant difference for the 60 cm distance, which recorded an average of 2.86 g. 3.16 g.

The results of the same table showed that the level of fertilization 75 kg N ha^{-1} gave the highest mean for the trait amounted to 3.52 g without a significant difference for the treatment of 25 kg N ha^{-1}, which recorded an average of 3.43 g, and did not differ significantly with the control treatment, which averaged 3.18 gm, while the 50 kg N ha^{-1} level gave an average of 2.80 gm, this result agreed with (6)

The results of Table (4) indicated that there was a significant effect, as the combination (50 cm × 75 kg N ha^{-1}) gave the highest average of 4.81 g, without a significant difference from the combination (70 cm × 25 kg N ha^{-1}) that gave an average It reached 3.50 gm, while the combination (40 cm x 50 kg N ha^{-1}) a very low average record for this trait was 1.66 grams.

Table (4): The effect of the distance between the lines, N. fertilizer and their interaction on weight of one thousand grain (g)

Nitrogen levels (kg ha^{-1})	Planting distances between lines (cm)				Fertilizer mean
	40	50	60	70	
0	3.13	3.42	3.22	2.97	3.18
25	3.46	3.32	3.46	3.50	3.43
50	1.66	3.21	2.95	3.39	2.80
75	3.20	4.81	3.02	3.07	3.52
Distance mean	2.86	3.69	3.16	3.23	
LSD(0.05)	nitrogen	distances		Interaction	
	0.24	0.15		0.33	

Grain yield (ton ha^{-1})

The data of the results of table (5) indicated that there were significant differences between the planting distances. The distance

of 40 cm recorded the highest rate of 0.47 tons hectare 1, and did not differ significantly from the distance. 50 cm (0.1 ton ha-1), whereas the treatment of distance of 70 cm registered the lowest average of grain yield of 0.36 ton ha^{-1}, and this result agreed with what was found by (7).

According to the results of the same table, the level of 50 kg N ha-1 fertilization produced the highest mean for the trait of 0.48 tons ha^{-1}, without significantly differing from the level of 25 kg N ha^{-1}, which produced 0.46 tons ha^{-1}, while the control treatment produced the lowest average of 0.30 tons per hectare, and this finding was consistent with that of (8)

It is noted from the results of Table (5) that there is a significant impact of the interaction on the grain yield, as the interaction (40 cm x 25 kg N ha^{-1}) gave the highest average of 0.59 tons ha^{-1} without a significant difference for the two interaction (60 cm × 25 kg N). kg N ha^{-1}) and (40 cm × 50 kg N ha^{-1}) with two averages of 0.56 and 0.51 ton ha^{-1}, whereas the interaction (70 cm × control) registered the lowest mean of 0.15 ton ha^{-1}.

Table. 5: The impact of distance between lines and nitrogen fertilization and their interaction on grain yield (ton $ha^{-1)}$

Levels of nitrogen (kg ha^{-1})	The distances between lines (cm)				Fertilizer mean
	40	50	60	70	
0	0.39	0.43	0.24	0.15	0.30
25	0.59	0.29	0.56	0.41	0.46
50	0.51	0.48	0.49	0.45	0.48
75	0.40	0.43	0.39	0.44	0.41
Distance mean	0.47	0.41	0.42	0.36	
LSD(0.05)	nitrogen	distances		Interaction	
	0.054	0.053		0.101	

Biological Yield (Ton ha^{-1})

The data of results of table (6) demonstrated that were significant variations of the planting distances, with the distance of 40 cm producing the highest mean biological yield of 5.80 tons ha-1, which was significantly higher than the other distances, and the distance of 70 cm producing the lowest average of the trait, which was 3.75. This result was consistent with the conclusions of (7)

The superiority of narrow distances may be due to their superiority in plant height, the total number of tillers, as well as their superiority in the grain yield, which is one of the two components of the biological yield.

Table (6): The effect of the distance between lines and nitrogen fertilization and their interaction on the biological yield (ton ha^{-1})

Nitrogen levels (kg ha^{-1})	Planting distances between lines (cm)				Fertilizer mean
	40	50	60	70	
0	4.79	4.21	3.84	2.41	3.81
25	6.33	4.01	4.45	3.94	4.68
50	5.93	5.03	4.77	4.53	5.07
75	6.15	5.4	4.76	4.11	5.11
Distance mean	5.80	4.66	4.46	3.75	
LSD(0.05)	Nitrogen	distances		Interaction	
	N.S	0.610		N.S	

Harvest index (%)

The data of results showed the fertilization level of 25 kg N ha^{-1} was superior, as it gave the highest mean of the harvest index of 9.96%, and It did not differ significantly from the treatment of level of 50 kg N ha^{-1}, which gave an average of 9.57%, without significant differences with 75 kg N ha^{-1}, which gave an average of 8.23%, while the comparison treatment gave the lowest average of 7.68% for the trait (table (7).

Regarding the interaction between the planting distances between the lines and the levels of nitrogen fertilization, the interaction of (60 cm x 25 kg N ha^{-1}) recorded the highest mean for the trait amounted to 12.65%, significantly superior to the other interactions, while the combination (70 cm × control) gave the lowest average yield index of 6.08%.

The reason the aforementioned distance and combination outperformed in the harvest index to the economic part—was due to the high transformational efficiency, which was evident by their lack of superiority in grain and biological yields.

Table (7) The effect of the distance between lines and nitrogen fertilization and their Interaction on the harvest index %

Nitrogen levels (kg ha^{-1})	Planting distances between lines (cm)				Fertilizer mean
	40	50	60	70	
0	8.19	10.28	6.16	6.08	7.68
25	9.67	7.13	12.65	10.39	9.96

50	8.52	9.54	10.20	10.01	9.57
75	6.45	8.3	8.19	9.98	8.23
Distance mean	8.21	8.81	9.30	9.12	
LSD(0.05)	nitrogen	distances		Interaction	
	1.392	N.S		2.181	

Conclusions

1- The treatment (40 cm distance between the lines) recorded the highest averages in both grain yield and biological yield.

2-The nitrogen fertilizer level of 50 kg ha^{-1} gave the highest mean of grain yield, while the fertilizer level of 75 kg ha^{-1} gave the highest mean of biological yield, harvest index .

3- The interaction of (40 cm x 25 kg ha^{-1}) achieved high rate of yield trait.

Reference

1. Al-Younis, Abdel-Hamid Ahmed and Mohamed, Mahfouz Abdel-Qader. 1987. grain crops. Press of the Ministry of Higher Education and Scientific Research. Dar Al-Kutub Press for printing and publishing. University of Al Mosul .
2. Hassanein, Abdel Hamid Mohamed. 2020. Crop physiology College of Agriculture. Al-Azhar University. Edition The second, p. 262
3. Singh, K. P., Mishra, H. N., & Saha, S. (2010). Moisture-dependent properties of barnyard millet grain and kernel. Journal of Food Engineering, 96(4), 598-606
4. Al-Rawi, K. M., & Khalaf Allah, A. M. (1980). Design and analysis of agricultural experiments. El Mousel Univ., Iraq, 19, 487.
5. Abdel Karim, Diaa Abdel Nabi (2011). Effect of nitrogen fertilization and seed quantities on yield, its components and other characteristics of millet crop *Pennisetum americanum* L. Basra Journal of Agricultural Sciences. 24, Issue (1).
6. Raza, M. N., Nazeer, S., Ali, M., Sadia, A., & Mubashra, S. (2021). Modeling the Growth and Yield of Pearl Millet (*Pennisetum glaucum*) Crop. Journal of Agriculture, Food, Environment and Animal Sciences, 2(1), 61-76.
7. Jyothi, K. N., Sumathi, V., Subramanyam, D., Sudhakar, P., Krishna, T. G., Sagar, G. K.

Productivity Enhancement of Foxtail Millet (*Setaria italica* L.) through Critical Agronomic Interventions under Southern Agro-Climatic Zone of Andhra Pradesh.

8. Ullah, A., Ahmad, I., ur Rahman, M. H., Waseem, M., Waqas, M. M., Bhatti, M. A., & Ahmad, A. (2020). Optimizing management options through empirical modeling to improve pearl millet production for semi-arid and arid regions of Punjab, Pakistan. Sustainability, 12(18), 7715.