The Pharma Innovation Journal 2021; 10(10): 1866-1870

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(10): 1866-1870

www.thepharmajournal.com
Received: 04-08-2021
Accepted: 06-09-2021

Chowdam Reddy Jayasimha Virat
Department of Agronomy,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj,
Uttar Pradesh, India

Shikha Singh
Department of Agronomy,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj,
Uttar Pradesh, India

Corresponding Author:
Chowdam Reddy Jayasimha Virat
Department of Agronomy,
Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj,
Uttar Pradesh, India

Effect of levels of nutrients and spacing on growth and yield of pearl millet (*Pennisetum glaucum* L.)

Chowdam Reddy Jayasimha Virat and Shikha Singh

Abstract
The field investigations entitled "Effect of Levels of Nutrients and Spacing on Growth and Yield of Pearl millet (*Pennisetum glaucum* L.)" was conducted during the *zaid* season of 2020 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology & sciences. Prayagraj. The experiment was laid out in randomized block design with 9 treatments which included T1 Control (N80:P40: K40 + 45 x 15), T2(N120:P75: K50+30 x 15), T3(N100:P60: K45+ 30 x 15), T4(N80:P40:K40+ 30 x 15),T5(N60:P30: K30 + 30 x 15), T6(N120:P75: K50+ 40 x 15), T7(N100:P60: K45 + 40 x 15), T8(N 80: P40: K40 + 40 x 15), T9(N60:P30: K30 + 40 x 15). The gross and net plot size of each experimental unit was 3 x3 m respectively. Sowing was done on 23April, 2020 by dibbling the seeds at spacing 40 x 15 cm and 30 x 15 cm. Maximum plant height (191.52 cm), Maximum No. of ears/m2 (4.04), No. of grains/head (2168.00), test weight (9.10), Grain yield (3.94 t/ha), Stalk yield (7.36 t/ha) were recorded with application of (N120:P75: K50+ 40 cm x 15 cm).Higher Gross returns (84831 ₹/ha), Net returns (50951 ₹/ha) and Benefit Cost Ratio (2.50) were obtained with application of (N120:P75: K50+ 40 cm x 15 cm).Hence, concluded that treatment no.6 (N120:P75: K50+ 40 cm x 15 cm) spacing was economically sound, preferred for farmers.

Keywords: pearl millet, NPK, spacing, growth, yield, economics

Introduction
In developing countries, pearl millet is recognized as an important crop which helps with food shortages and meeting the nutritional demands of an increasing population. It constitutes an important source of dietary calories and protein in the daily diet of a large segment of the poor population. Although pearl millet is consumed as a major staple food, the nutrient availability to the human gut is constrained by certain inherent anti-nutritional factors (polyphenols and phyticacid). More important in view of the fact that soils of India having low organic matter content are generally poor in fertility and also soils have consistently been depleted of their finite nutrient resource due to continuous cultivation for many centuries. Indian agriculture is operating at 8-10 m t annum-1 net negative balances of plant nutrients and land is also suffering from multi-nutrient deficiencies. This continuous nutrient depletion and imbalance can become staggering when we consider a future. It hardly needs to be emphasized that in a country like India, where land is a limited resource, and soil fertility is a limiting factor, the only way of increasing the resource base is through increased productivity and for this purpose use of external inputs. For this reason, optimum use of inorganic fertilizers supplemented with farm manures, green manures, crop residues, and biological N2 fixation is indispensable. The low level of utilization of nutrients supplied through fertilizers call for choosing appropriate combination of crops to utilize nutrients efficiently for long- term sustainability to get maximum profit. The low grain yields are a result of a myriad of factors including nutrient losses via wind erosion (Bielders *et al*., 2002) [1], declining and inherent poor soil fertility unimproved pearl millet cultivars, and unreliable and erratic rainfall which usually falls in high intensity. Plant density is one of the most important factors affecting plant productivity (Cusicanqui and Lauer, 1999) [2]. The optimum plant density varies depending on genotypes or environmental factors such soil fertility, moisture supply and planting date. Berenguer and Faci (2001) [3] reported that an increase in plant density can reduce water availability to the individual plant and lead to water deficiency, followed by yield decrease. Generally, previous results worthy cleared that yield per single plant decreases as the plant density per unit area increase, also plant density can affect plant morphology and dry matter content (Lafrage and Hammer, 2002) [4], Rosenthal, *et al.*, 1993) [5]. Almass *et al.* (2007) [6] found that pearl millet grain yield at 0.4 m row spacing was greater than at 0.9 m spacing due to increases in number

of plants per unit area not increase in yield per plant. Ali (2010) [7] showed that sowing pearl millet at the medium plant density (250 thousand plant/ha) gave the highest values of most studied traits. Numerous experiments showed that plant density and planting pattern differently affected yield and morphological traits Gautam. R.C (1994) [8]. In the view of above consideration the present investigation entitled "Effect of Levels of Nutrients and Spacing on Growth and Yield of Pearl millet (*Pennisetum glaucum* L.)" was carried out.

Materials and Methods

The experiment was conducted during the *Zaid* season 2020, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25039‟42‟‟Nlatitude,81067‟‟56”E longitude and 98m altitude above the mean sea level (MSL). To assess the "Effect of different levels of nutrients and spacing on growth and yield of pearl millet (*Pennisetum glaucum* L.)" The experiment was laid out in Randomized Block Design. The treatment comprised of 4 levels of nutrients i.e., N1:120:75:50 kg/ha; N2: 100:60:45 kg/ha; N3: 80:40:40 kg/ha & N4: 60:30:30 kg/ha and 2 levels of plant spacing i.e., 30 x 15cm and 40 x 15 cm. There were 9 treatments (including farmer practice) and each replicated thrice. Treatments were randomly arranged in each replication, divided into Twenty-seven plots. The factors are combined to frame the 9 treatment combinations that are depicted in Table-1. The nutrient sources were Urea, DAP and MOP to fulfill the requirement of Nitrogen, Phosphorus and Potassium. Each treatment was treated with treatment combinations of nitrogen, potassium and phosphorus as shown in table-1 accordingly. Plant protection measures were followed as per recommendations for the region. Five random plants were selected and tagged properly in each plot for recording plant height, plant dry matter accumulation, number of ears/m2 and number of grains/ear at an interval of 20, 40, 60 and 80 DAS of the crop. To record plant dry matter accumulation three random plants were selected from border rows of each plot. The crop was harvested from the net plot area (1 m2) and manual threshing was carried out after proper drying. Later winnowed, cleaned and weighed the grain per net plot value, the grain yield per ha was computed and expressed in quintal per hectare. The data were computed and analyzed by following the statistical method**.** After thorough field preparation, initial soil samples were taken to analyze for available major nutrients. Nitrogen (N), phosphorous (P), potassium (K), Organic Carbon (OC), pH and soluble salts. The type of soil in the experimental field is sandy loam. The pH of the experimental field was 7.1, EC of 0.41 d/Sm, organic carbon was 0.28%. The N status of the experimental field was 225 kg/ha, available P was 19.60 kg/ha, while available K status was 92 kg/ha. Yield parameters grain yield q/ha, straw yield q/ha, were recorded as per the standard method. The monetary parameters like cost of cultivation, gross returns, net returns, and Benefit: Cost ratios were worked out as per the standard method.

Table 1: Treatment combination

S. no	Treatment no	Treatment combination
1	T1	Control
2	T2	S1F1= 30 x 15+N120:P75: K50
3	T3	S1F2= 30 x 15+N100:P60: K45
4	T4	S1F3= 30 x 15+N80:P40: K40
5	T5	S1F4= 30 x 15+N60:P30: K30
6	T6	S2F1= 40 x 15+N120:P75: K50
7	T7	S2F2=40 x 15+N100:P60: K45
8	T8	S2F3= 40 x 15+N80:P40: K40
9	T9	S2F4= 40 x 15+N60:P30: K30

Results and Discussions

Growth parameters

The data on plant height was found to be significant in 40,60 and 80 DAS. Increase in plant height was continuous upto harvest of the crop. The rate of increase in plant height was initially very fast between 20-40 and 40-60 days age of the crop. The rate of increase was slow between 60-80 days age of the crop and also it was slowed down till harvest. The mean plant height was influenced significantly due to various treatments tried. Rana *et al*. (2009) [9] reported the fertility levels affected plant height significantly during both the years. Tallest plants recorded with 90 kg N + 45 kg P2O5 ha which was statistically at par with 60 kg N + 30 kg P2O5 ha. Both these treatments were significantly better than control and 30 kg N +15 kg P2O5 ha both the year. Bidinger and Raju (2000) [10] reported the mean panicle number per plant increased more than threefold across the range of plant population densities. However, the six fold difference in plant numbers over the population treatments resulted in a net decline in panicle numbers. Rathore *et al* (2007) [11] was conducted a field experiment to find out suitable spacing for pearl millet hybrids along with N and P levels so as to increase the productivity and net return of pearl millet. Highest grain yield was recorded when the crop was sown at a spacing of 45x12 cm and fertilized with 90 kg ha-1N+45 kg P2O5 ha but was at par with 60 kg haN+30 kg haP2O5. At 60 DAS, significant plant height was recorded in treatment T6 (N120:P75: K50+ 40 cm x 15 cm) than the rest of the treatments, however, it was found at par with the treatment T2 (N120:P75: K50+ 30 x 15 cm) and lowest plant height was recorded in T1 (Control). At 60 DAS, significantly higher total dry matter accumulation per m2 was recorded by the treatment T2 (N120:P75: K50+ 30 x 15 cm) than the rest of the treatments, however, it was found at par with the treatment T3 (N100:P60: K45+ 30 x 15 cm) and lowest was observed in (T1). At 40-60 DAS interval significant and highest CGR value (12.58 g/m2/day) was observed in treatment T5 (N60:P30: K30+ 30 cm X 10 cm and all the other treatments were at par with it. The RGR was increased from 40-60 days and remained in constantly increasing up to 80 days. Thereafter, it decreased drastically towards maturity. The maximum RGR in T1 control, (i.e., N80:P40: K40+ 45 x 15 cm) 0.059 was observed during 40-60days. The data was presented in Table-2.

Table 2: Effect of Nutrients and Spacing on Growth attributes of Pearl millet.

S. no	Treatments	Plant height (cm) 60 DAS	Plant dry matter accumulation 2 (g/m) 60 DAS	Crop growth 2 rate (g/m /day) 40-60 DAS	Relative growth rate (g/g/day) 40-60 DAS
1	T1	165.47	475.25	12.03	0.059
2	T2	175.74	778.51	11.84	0.047
3	T3	168.94	722.48	11.70	0.053
4	T4	167.77	698.06	11.43	0.053
5	T5	173.38	718.59	12.58	0.059
6	T6	176.25	635.74	12.56	0.049
7	T7	173.30	594.15	11.79	0.048
8	T8	171.76	586.22	11.79	0.049
9	T9	170.41	566.33	11.64	0.051
	F-test	S	S	S	NS
	SEm±	0.95	13.57	0.45	0.002
	CD(P=0.05)	2.83	40.32	1.36	-

*S-Significant at P < 0.05; NS-Non-significant at P > 0.05

Effect on yield and yield attributes of pearl millet

The statistical data regarding yield and yield attributes were presented in Table-3. The process of number of ears per m2 was at harvest was recorded. The maximum number of ears per m2 observed **(**4.04) at harvest with application of various levels of Nutrients and Spacing. Significantly number of ears per m2 was recorded by the treatment T_6 (N_{120}:P_{75}: K_{50}+ 40 x 15 cm) than the rest of the treatments and lowest was observed in T1 control (N80:P40: K40+ 45 cm x 15 cm). The process of total Number of grains /Head at harvest was recorded. The maximum Number of grains /ear observed **(**2168) at harvest with application of various levels of Nutrients and Spacing. Significantly higher Number of grains /ear was recorded by the treatment T6 (N120:P75: K50+ 40 cm x 15 cm) than the rest of the treatments and However, it was found at par with the treatments T2 (N120:P75: K50+ 30 cm x 15 cm) lowest was observed in T1 control (N80:P40: K40+ 45 cm x 15 cm). Maximum pooled grain (29.41 q ha) as well as stover yield (92.83 q ha) was harvested with 90 kg N + 45 kg ha which was at par with 60 kg N + 30 kg P2O5 ha. The results corroborate the findings of Yadav and Jangir (1997) [12]. The maximum Test Weight was observed **(**9.10 g) at harvest with application of various levels of Nutrients and Spacing, significantly higher Test Weight was recorded by the treatment T6 (N120:P75: K50+ 40 cm x 15 cm) than the rest of the treatments, however, it was found at par with the treatments T2 (N120:P75: K50+ 30 x 15 cm) and lowest was observed in T1 control (N80:P40: K40+ 45 cm x 15 cm). Significantly Stover yield was recorded by the treatment T6 (N120:P75: K50+ 40 cm x 15 cm) than the rest of the treatments, however, it was found at par with the treatments T2 (N120:P75: K50+ 30 cm x 15 cm), T7(N100:P60: K45+ 40 cm x 15 cm), T8(N80:P40: K40+ 40 x 15 cm), T9(N60:P30: K30+ 40 x 15 cm) and lowest was observed in T1 control (N80:P40: K40+ 45 cm x 15 cm). The maximum Stover yield was observed **(**73.64) q/ha at harvest with application of various levels of Nutrients and Spacing. The maximum Grain yield was observed **(**39.46) q/ha at harvest with application of various levels of Nutrients and Spacing. Significantly higher Grain yield was recorded by the treatment T6 (N120:P75: K50+ 40 cm x 15 cm) than the rest of the treatments, however, it was found at par with the treatments T2 (N120:P75: K50+ 30 cm x 15 cm), T7(N100:P60: K45+ 40 cm x 15 cm), T8(N80:P40: K40+ 40 cm x 15 cm), T3(N100:P60: K45+ 30 cm x 15 cm) and lowest was observed in T1 control (N80:P40: K40+45cmx15cm)**.** Wide inter-row spacing might have helped the crop in gaining the higher grain and stover yield because the competition between plants might have reduced and equal distribution of all the resources like solar radiation, minerals, nutrients, and water. Increased trend of yield with increase of NPK dosage shows that it might have played a crucial role in enhancing the yield by its role in physiologically improved dry matter accumulation further led to hiking the stover yield Similar results were obtained by Guggari *et al*., (2005) [13], Gupta *et al*., (1983) [14] and Mohammad *et al*., (1994) [15]. Yield attributes and yield are represented in Table-3

Table 3: Effect of Nutrients and Spacing on Yield and Yield attributes of Pearl millet

S. no	Treatment no	No. of grains/ear	No. of ears/m2	Test weight(g)	Grain yield(q/ha)	Stover yield(q/ha)	Harvest index (%)
1	T1	1415	2.41	8.08	27.93	57.75	32.50
2	T2	2063	3.28	8.73	38.62	72.19	34.78
3	T3	1873	2.76	8.43	35.12	65.81	34.73
4	T4	1852	2.36	8.38	33.35	61.94	35.05
5	T5	1555	2.03	8.12	30.92	60.66	33.63
6	T6	2168	4.04	9.10	39.46	73.64	34.86
7	T7	1941	2.96	8.54	36.02	71.88	33.38
8	T8	1922	2.85	8.41	35.46	70.88	33.30
9	T9	1650	2.43	8.18	32.94	69.40	32.22
	F-test	S	S	S	S	S	S
	SEm±	65.93	0.22	0.12	1.81	1.83	1.30
	CD (P=0.05)	195.90	0.66	0.38	5.39	5.46	3.87

*S-Significant at P < 0.05; NS-Non-significant at P > 0.05

Effect on economical parameters of pearl millet

The data regarding monetary parameters were presented in Table-4. The average mean gross monetary return of Pearl millet was recorded as (Rs.66613 INR/ha).The gross monetary return was differed significantly due to different treatments. The significantly highest gross monetary return (Rs.84831INR/ha) was obtained with T6 (N120:P75: K50+ 40 cm x 15 cm) over rest of the treatments. The average mean net monetary return of Pearl millet was recorded as (Rs.36865 INR/ha). The net monetary return (INR/ha) of Pearl millet was influenced significantly due to different treatments. The treatment T6 (N120:P75: K50+ 40 cm x 15 cm) recorded significantly higher net monetary return (Rs.50951 INR/ha). The average mean B:C ratio was observed as (2.01). The treatment T6 (N120:P75: K50+ 40 cm x 15 cm) recorded higher B:C ratio (2.50). The treatment T1 control (N80:P40: K40+ 45 cm x 15 cm) was recorded lowest B:C ratio (1.85). Rathore *et al* (2007) [16] was conducted a field experiment to find out suitable spacing for pearl millet hybrids along with N and P levels so as to increase the productivity and net return of pearl millet. Highest grain yield was recorded when the crop was sown at a spacing of 45x12 cm and fertilized with 90 kg ha-1N+45 kg P2O5 ha but was at par with 60 kg haN+30 kg haP2O5. Highest gross (Rs. 27316 and 25319) and net returns (Rs. 11935 and 10880) were obtained under 90 kg N+45 kg P2O5 ha productivity level during both the years. Monetary parameters are the prime criteria to weigh up the superlative treatment which represents the economically sound and that be able to be time-honoured by farming society. In the present study, the maximum gross returns, net returns, and B: C ratios were obtained by treatment T6. Similar findings were supported by Kumar *et al*., (2008) [17], Lone *et al*., (2010) [18] and Mcintire *et al*., (1989) [19].

Table 4: Effect of nutrients and spacing on economical parameters of pearl millet

S. no	T. no	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	Benefit cost ratio
1	T1	32520.00	60049.50	27529.50	1.85
2	T2	33880.00	83040.17	49160.17	2.45
3	T3	33390.00	75515.17	42125.17	2.26
4	T4	32885.00	71709.67	38824.67	2.18
5	T5	32324.00	66478.00	34154.00	2.06
6	T6	33880.00	84831.83	50951.83	2.50
7	T7	33390.00	77450.17	44060.17	2.32
8	T8	32885.00	76231.83	43346.83	2.32
9	T9	32324.00	70828.17	38504.17	2.19

Note: Monetary parameters were not subjected to statistical analysis

Conclusion

As the monetary units are the supreme importance in the farmer perspective, for obtaining the highest yield, yield attributes and economical parameters the treatment T6 is the best treatment combination.

Acknowledgement

I express my gratitude to my advisor Dr. Shikha Singh for the constant support, guidance and for his valuable suggestions for improving the quality of this work and all the faculty members of Department of Agronomy, SHUATS, Prayagraj, Uttar Pradesh (U.P), India for providing necessary facilities, for their cooperation, encouragement and support.

References

1. Bielders CL, Rajot JL, Amadou M. Transport of soil and nutrients by wind in bush fallow land and traditionally managed cultivated fields in the Sahel, Geoderma 2002;109:19-39,
2. Cusicanqui JA, Lauer JG. Plant density and hybrid influence on corn forage yield and quality, Agronomy Journal 1999;91:911-915.
3. Berenguer MJ, Faci JM. Sorghum (*Sorghum bicolor* L.) yield compensation processes under different plant densities and variable water supply, Europian Journal of Agronomy 2001;15:43-55.
4. Lafrage TA, Hammer GL. Shoot assimilate partitioning and leaf area ratio are stable for a wide range of sorghum population densities, Field Crop Research 2002;77:137-151.
5. Rosenthal WD, Gerik TJ, Wade LJ. Radiation-use efficiency among grain sorghum cultivars and plant densities, Agronomy Journal 1993;85:703-705.
6. Almass JF, Hanna WW, Mullinix BG. Planting dates and row spacing affects grain yield and height of pearlmillettrifgrain 102 in thesoutheast coastal plain of united states, Journal SAT Agriculture Research 2007;1:1-4.
7. Ali EA. Grain yield and nitrogen use efficiency of pearlmillet as affected by plant density, nitrogen rate and splitting in sandy soil, American-Eurasian Journal Agriculture and Environment Sciences 2010;7(3):327-335.
8. Gautam RC. Influence of planting patterns and rates of nitrogen on the performance of pearlmillet and castor in the intercropping system, Annals of Agricultural Research, 1994;15(2):252-253.
9. Rana VS, Rathore BS, Nanwal RK, Ashwani Kumar, Vasist R. Effect of hybrids, plant density and fertility levels on nutrient concentration, uptake and productivity of pearl millet in semi-arid environment, The South Pacific Journal of Natural Science 2009;27:45-48.
10. Bidinger FR, Hash CT. Pearl millet. In H.T. Nguyen and A. Blum (ed.) Physiology and biotechnology integration for plant breeding, Marcel Dekker, New York 2004, 225-270.
11. Rathore BS, Nanwal RK, Rana VS, Hooda RS. Yield and economics of pearlmillet as affected by hybrids, plant density, nitrogen and phosphorus treatments under limited irrigation conditions, Journal of Research 2007;37(2):93-96.
12. Yadav RS, Jangir RP. Spatial arrangement of pearl millet (*Pennisetum glaucum*) under different plant densities in arid zone of Rajasthan, Indian Journal of Agriculture Sciences 1997;67:318-319.
13. Guggari AK, Kalaghatagi SB. Effect of fertilizer and

biofertilizer on pearl millet (*Pennisetum glaucum*) and pigeonpea (*Cajanus cajan*) intercropping system under rainfed conditions, Indian Journal of Agronomy 2005;50(1):24-26.
14. Gupta AP, Khanna SS, Tomar NK. Direct, residual and cumulative effect on N, P and K fertilizers on yield and nutrient uptake by bajra wheat cropping system, Haryana Agriculture University Journal Research 1983;13:386-395.
15. Mohammad D, Hussain A, Khan S, Bhatti MB. Forage yield and quality potential of pearl millet cultivars under rainfed conditions, Journal of Agriculture Research 1994;32(4):383-388.
16. Rathore BS, Singh VP, Hooda RS. Inoculation of pearlmillet seed with mixed biofertilizer for nitrogen economy, Haryana Journal of Agronomy 2005;21(1):84-85.
17. Kumar Anil, Kumar Pramod, Singh Ravindra, Tomar RS. Assesment of sustainable net return in pearlmillet - Wheat sequence, Bhartiya Krishi Anusandhan Patrika, 2008;23(2):73-80.
18. Lone BA, Badr-ul-Hassan, Ansar-ul-Haq S, Khan MH. Effect of seed rate, row spacing and fertility levels on relative economics of soybean (*Glycine max* L.) under temperate conditions, African Journal of Agricultural Research, 2010;5:322-324.
19. Mcintire J, Fussell LK. On-farm experiments with millet in Niger, crop establishment, yield loss factors and economic analysis, Experimental Agriculture 1989;25:217-233.