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Study the Effect of Organic and Inorganic Sources of Nitrogen on Growth and Yield of *Kharif* Pearl Millet

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ABSTRACT

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Among the response of different hybrids to levels of nitrogen, treatment T₉ i.e., V₃ + 100:45:45 kg ha⁻¹ NPK, recorded maximum plant height (175.30cm), number of tillers plant⁻¹ (3.67), dry weight (47.73g), crop growth rate (1.53 g m⁻² day⁻¹), relative growth rate (0.052 g g⁻¹ day⁻¹), number of ear plant⁻¹ 2.37, length of ear (27.52cm), number of Grains ear⁻¹ (2406.49) test weight (10.29g), grain yield (3.72 t ha⁻¹), straw yield (6.98 t ha⁻¹), protein content (13.43%) and harvest index (36.15%). Whereas the lowest value in terms of plant height (164.47cm), number of tillers (2.60 plant⁻¹), dry weight (40.80g), crop growth rate (1.30 g m⁻² day⁻¹), relative growth rate (0.045 g g⁻¹ day⁻¹), number of ear (1.37 plant⁻¹), grain yield (2.47 t ha⁻¹) and straw yield (4.62 t ha⁻¹) was observed in the treatment T₁ i.e., V₁ + 80:45:45 kg ha⁻¹ NPK). Further, ear length of (21.16cm) was observed in the treatment T₈ i.e., V₃ + 90:45:45 kg ha⁻¹ NPK). In terms of number of grains (2406.49 ear⁻¹), test weight (8.04 g) was recorded in the treatment T₅ i.e., V₂ + 90:45:45 kg ha⁻¹ NPK). Further, protein content (9.48%) was observed in the treatment T₅ i.e., V₂ + 90:45:45 kg ha⁻¹ NPK) and harvest index (19.01%) respectively in the treatment T₄ i.e., V₂ + 80:45:45 kg ha⁻¹ NPK).

Introduction

Pearlmillet (*Pennisetum glaucum* L.) is largely grown for grain and fodder purpose under those situations where other crops generally fail. Pearlmillet as a food crop is limited to the developing countries in Asia, and particularly in Africa and ranked sixth in the world followed by rice, wheat, maize, barley and sorghum (Anonymous, 2010-11). The important pearlmillet growing countries are India, China, Nigeria, Pakistan, Sudan, Egypt, Arabia, and Russia. It is estimated that over 95% of pearlmillet production is used as food, the reminder being divided between

animal and poultry feed (7%), other uses (seed, bakery products, snacks, etc.) and waste. Pearlmillet is used in flat breads (roti) or mixed up to 25% with wheat flour for use in yeast breads. In India, pearlmillet is popularly known as *Bajra*, and it is the fourth most important cereal crop after rice, wheat and sorghum. It has the greatest potential among all the millets. The major producing states are Rajasthan (46%), Maharashtra (19%), Gujarat (11%), Uttar Pradesh (8%) and Haryana (6%) (Sonawane *et al.*, 2010). Nutrient management system refers to

combined application of all nutrient source viz. Vermicompost, use of Biofertilizer (*Azotobacter*) and inorganic fertilizer (urea). The combined effect of organic and inorganic source of nutrient help in maintaining yield stability through correction of nutrients deficiencies, enhancing their efficiency and providing favorable soil physiological condition (Behera *et al.*, 2007). Biofertilizers play an important role in increasing the availability of native and applied nutrients and productivity in sustainable manner. *Azotobacter* is a free-living nitrogen fixing bacteria. It has been reported to fix about 20 kg N ha⁻¹ per year in a field of non-legume crop and also secretes some growth promoting substances (Kumawat and Jat, 2007).

Materials and Methods

The experiment entitled, “Study the effect of organic and inorganic sources of nitrogen on growth and yield of *kharif* pearnillet” was carried out at Crop Research Farm, Department of Agronomy, Sam Higginbottom Institute of Agriculture, Technology and Sciences, (Deemed University), (Formally Allahabad Agricultural Institute), Allahabad.

During the *kharif* season of 2015, laid out in Randomized Block Design, having ten treatments and three replications. The experiment was conducted to, “Study the effect of organic and inorganic sources f nitrogeon on growth and yield of *kharif* pearnillet”. The experimental findings based on parameters are summarized below.

Experimental details

The experiment was laid out in Randomized Block Design, comprising of ten treatment combinations each replicated thrice. Treatments were randomly arranged in each replication, divided into ten plots. The treatment tested, specifications of the layout,

etc are given below.

Treatment combinations

T₁: 100 % RDN through Urea

T₂: 100 % RDN through Urea + *Azotobacter*

T₃: 100 % RDN through VC

T₄: 100 % RDN through VC + *Azotobacter*

T₅: 75 % RDN through VC + 25 % N through Urea

T₆: 75 % RDN through VC + 25 % N through Urea + *Azotobacter*

T₇: 50 % RDN through VC + 50 % N through Urea

T₈: 50 % RDN through VC + 50 % N through Urea+ *Azotobacter*

T₉: 25 % RDN through VC + 75 % N through Urea

T₁₀: 25 % RDN through VC + 75 % N through Urea + *Azotobacter*

Recommended dose of fertilizer 120: 60: 40 N:P:K.

Nitrogen application in two splits (½ basal and ½ top dressing at 30 DAS).

Full dose of P&K used as basal.

Observation recorded

Pre-harvest observation

Plant height (cm)

Height of ten plants tagged in each plot was measured from ground level to the base of the flag leaf at 20, 40, 60 and 80 DAS.

Average value for each plant was computed and expressed in cm.

Dry weight plant⁻¹ (g)

To study the dry matter accumulation of crops, five plants were uprooted from sampling rows from each plot randomly at 20, 40, 60 and 80 DAS. After removing the root portion, the above ground parts of each plant were first sundried, and then oven dried at 70°C for 72 hours. After complete drying, plants were weighed and the unit expressed in g.

Crop growth rate (g m⁻² day⁻¹)

It represents dry weight gained by a unit area of crop in a unit time expressed as g m⁻² day⁻¹ (Brown and Mayer, 1988). The values of plant dry weight at 20, 40, 60 and 80 DAS intervals were used for calculating the CGR. It was calculated with the help of following formula:

$$\text{Crop Growth Rate} = \frac{W_2 - W_1}{t_2 - t_1} \text{ (g m}^{-2} \text{ day}^{-1}\text{)}$$

Where,

W_1 = dry matter production per unit area at time t_1

W_2 = dry matter production per unit area at time t_2

t_1 = days to first sampling

t_2 = days to second sampling

Relative growth rate (gg⁻¹day⁻¹)

It indicates the increase in dry weight per unit dry matter over any specific time interval and it was calculated by the following equation:

$$\text{Relative Growth Rate (RGR)} = \frac{\text{Log}_e W_2 - \text{Log}_e W_1}{t_2 - t_1} \text{ (g g}^{-1} \text{ day}^{-1}\text{)}$$

Where,

W_1 =Initial dry weight of plant (g)

W_2 = Final dry weight of plant (g)

t_1 =Initial time period

t_2 =Final time period

It is also called efficiency index (y) and can be expressed in g g⁻¹ day⁻¹

This parameter was calculated at different time intervals *i.e.*, 20, 40, 60 and 80 DAS. Using the data obtained from dry weight of plants.

Post-harvest observation

Length of ear (cm)

Three ear lengths were measured by scale from each plots and the average value for each ear was computed and expressed in cm.

Test weight (g)

A small seed sample was taken from the produce of each plots harvested and weight of 1000-seeds from each plot was taken and the average test weight of each plot was recorded.

Pearlmillet grain yield (t ha⁻¹)

The grain yield of each plot was recorded after cleaning the threshed produce and it was converted as (t ha⁻¹).

Stover yield (t ha⁻¹)

The Stover yield was obtained by subtracting the seed yield from biological yield plot⁻¹ recorded earlier and then converted in terms of (t ha⁻¹).

Harvest index (%)

The harvest index was worked out using feed and stover yield with the help of formula given by Donald (1962).

$$\text{Harvest Index (HI \%)} = \frac{\text{Economic yield (kg}^{-\text{ha}}\text{)}}{\text{Biological yield (kg}^{-\text{ha}}\text{)}} \times 100$$

Results and Discussion

The findings of the present are presented and discussed in the following pages under appropriate headings.

Data on pre-harvest and post-harvest observations were analyzed and discussion on experimental findings has been stated.

The parameters are also illustrated with the help of graphs wherever felt essential to clarify the results.

Observation recorded

Pre-harvest observations of pearl millet (at 20, 40, 60 and 80 DAS)

Plant height (cm)
Plant dry weight (g)
No. Tillers
Crop growth rate ($\text{g m}^{-2} \text{ day}^{-1}$)
Relative growth rate ($\text{g g}^{-1} \text{ day}^{-1}$)

Post-harvest observations of pearl millet

Number of ear plant⁻¹
Length of ear (cm)
Test weight (g)
Grain yield (t ha^{-1})
Stover yield (t ha^{-1})
Biological yield (t ha^{-1})
Harvest index (%)
Protein content (%)

Growth parameters of pearl millet

Pre-harvest observations of pearl millet Plant height (cm)

The observations of plant height are being presented in table 1. A perusal of that there was a steady increase in the plant height from 20 to 80 DAS. At 40, 60 and 80 DAS were significant influence in plant height due to different treatments, while at 20 DAS non-significant. At 20 DAS, there was no significant difference between different treatments. Maximum plant height (86.88 cm) was obtained by the application of T₁ (100 % RDN through Urea), whereas the lowest value 76.30 cm in T₃ (100 % RDN through VC). At 40 DAS, there was significant difference between different treatments. Maximum plant height (189.34 cm) was obtained by the application of T₁₀ (25 % RDN through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 159.67 cm in T₃ (100 % RDN through VC). However, T₉ (25% RDN VC + 75 % N through Urea), T₂ (100 % RDN through Urea + *Azotobacter*) and T₈ (100 % RDN through VC + 50 % N through Urea + *Azotobacter*) were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). At 60 DAS, there was significant difference between different treatments. Maximum plant height (243.33 cm) was obtained by the application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). Whereas the lowest value 226.64 cm in T₃ (100 % RDN through VC). However, T₉ (25% RDN VC + 75 % N through Urea), T₈ (100 % RDN through VC + 50 % N through Urea + *Azotobacter*), and T₁ (100 % RDN through Urea) were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). At 80 DAS, there was significant difference between different treatments. Maximum plant height (53.60 cm) was obtained by the

application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 246.33 cm in T₃ (100 % RDN through VC). However, T₈ (100 % RDN through VC + 50 % N through Urea + *Azotobacter*), and T₂ (100 % RDN through Urea + *Azotobacter*) were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental finding showed that due to application of nitrogen at 120 kg ha⁻¹ over 80 kg ha⁻¹ attributed to significantly higher plant height, number of green leaves and tillers per plant in pearl millet (Babu *et al.*, 1995).

Dry weight (gm)

The observations of plant height are being presented in table 2 that reveals that there was a steady increase in the plant dry weight from 20 to 80 DAS. At 60 and 80 DAS were significant influence in plant height due to different treatments, while at 20 and 40 DAS non- significant. At 20 DAS, there was no significantly difference between different treatments. Maximum dry weight (2.03) was obtained by the application of T₁₀ (100 % RDN through Urea), whereas the lowest value 1.15 cm in T₃ (100 % RDN through VC). At 40 DAS, there was no significantly difference between different treatments. Maximum dry weight (8.39) was obtained by the application of T₁₀ (25 % RDN through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 6.38 in T₃ (100 % RDN through VC). However, T₉ (25 % RDN through VC + 75 % N through Urea), T₂ (100 % RDN through Urea), T₃ (75 % RDN through VC + 25 % N through Urea + *Azotobacter*), were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). At 60 DAS, there was significant difference between different treatments. Maximum plant dry weight (59.13) was obtained by the application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 43.93

in T₃ (100 % RDN through VC). However, T₉ (25 % RDN through VC + 75 % N through Urea), T₂ (100 % RDN through Urea), T₃ (75 % RDN through VC + 25 % N through Urea + *Azotobacter*), were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). At 80 DAS, there was significant difference between different treatments. Maximum plant dry weight (105.30) was obtained by the application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 98.83 in T₃ (100 % RDN through VC). However, T₉ (25 % RDN through VC + 75 % through Urea + *Azotobacter*), T₂ (100 % RDN through Urea + *Azotobacter*), T₄ (100 % RDN through VC + *Azotobacter*), T₈ (50 % RDN through VC + 50 % N through Urea + *Azotobacter*), T₅ (75 % RDN through VC + 25 % N through Urea) were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). The probable reasons for recording higher stature of growth attributes viz., plant height, leaf area index, dry matter production and number of tillers m⁻² was observed in different varieties due to increased levels of nitrogen with the application of 50 kg N ha⁻¹. While all these parameters were at their lowest value with no nitrogen application in foxtail millet (*Setaria italica* L.) (AICRP Forage Crops, 2006).

Tillers plant⁻¹

The observations of tillers plant⁻¹ are being presented in table 3. A perusal of the table 3 reveals that there was a steady increase in the tillers plant⁻¹ from 20 to 80 DAS. At 20, 40, 60 and 80 DAS were significant influence on no. of tillers plant⁻¹ due to different treatments. At 20 DAS, there was significantly difference between different treatments. Maximum tillers plant⁻¹ (1.67) was obtained by the application of T₁₀ (25 % RDN through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 0.73 in T₁ (100 % RDN through Urea). However,

T₉ (25 % RDN through VC + 75 % N through Urea), was found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). At 40 DAS, there was significant difference between different treatments. Maximum tillers plant⁻¹ (2.40) was obtained by the application of T₁₀ (25 % RDN through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 1.27 in T₃ (100 % RDN through VC). However, T₉ (25 % RDN through VC + 75 % N through Urea), T₈ (50 % RDN through VC + 50 % N through Urea + *Azotobacter*), were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). At 60 DAS, there was significant difference between different treatments. Maximum tillers plant⁻¹ (2.87) was obtained by the application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 1.60 in T₁ (100 % RDN through Urea). However, T₉ (25 % RDN through VC + 75 % N through Urea), T₈ (50 % RDN through VC + 50 % N through Urea + *Azotobacter*), were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). At 80 DAS, there was significant difference between different treatments. Maximum tillers plant⁻¹ (3.40) was obtained by the application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 2.03 in T₁ (100 % RDN through Urea). However, T₉ (25 % RDN through VC + 75 % through Urea + *Azotobacter*), T₈ (50 % RDN through VC + 50 % N through Urea + *Azotobacter*), T₆ (75 % RDN through VC + 25 % N through Urea + *Azotobacter*), T₅ (75 % RDN through VC + 25 % N through Urea), T₇ (50 % RDN through VC + 50 % N through Urea) were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental finding showed that the application of organic manures increased the number of effective tillers, grain weight per ear head and grain and biological

yield of wheat over no organic manure. The probable reasons for recording higher stature of growth attributes viz., plant height, leaf area index, dry matter production and number of tillers m⁻² was observed in different varieties due to increased levels of nitrogen with the application of 50 kg N ha⁻¹. While all these parameters were at their lowest value with no nitrogen application in foxtail millet (*Setaria italica* L.) (AICRP Forage Crops 2006).

Crop Growth Rate (CGR) (g m⁻¹ day⁻¹)

The observations of crop growth rate are being presented in table 4. A perusal of table 4 reveals that there was a steady increase in the crop growth rate from 20 to 80 DAS. At 20, 40, 60 and 80 DAS were no significant influence in crop growth rate. At 0-20 DAS, there was no significant difference between different treatments. Maximum crop growth rate (0.10) was obtained by the application of T₁₀ (100 % RDN through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 0.05 in T₃ (100 % RDN through VC). At 20-40 DAS, there was no significant difference between different treatments. Maximum crop growth rate (8.39) was obtained by the application of T₁₀ (25 % RDN through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 0.23 in T₃ (100 % RDN through VC). At 40-60 DAS, there was no significant difference between different treatments. Maximum crop growth rate (2.53) was obtained by the application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 1.82 in T₃ (100 % RDN through VC). At 80 DAS, there was no significant difference between different treatments. Maximum crop growth rate (2.74) was obtained by the application of T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), whereas the lowest value 2.29 in T₁ (100 % RDN through Urea).

Table.1 Effect of organic and inorganic sources of nitrogen on plant height (cm) in pearl millet

No	Treatment	Plant height(cm)			
		20 DAS	40 DAS	60 DAS	80 DAS
T ₁	100 % RDN through Urea	86.88	178.16	234.73	268.77
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	86.22	181.17	230.10	270.19
T ₃	100 % RDN through VC	76.30	159.67	226.64	246.33
T ₄	100 % RDN through VC + <i>Azotobacter</i>	81.93	168.30	229.27	261.57
T ₅	75 % RDN through VC + 25 % N through Urea	83.83	176.80	220.67	252.97
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	76.70	172.32	226.03	255.67
T ₇	50 % RDN through VC + 50 % N through Urea	79.25	176.40	222.44	257.70
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	81.93	179.97	235.57	264.17
T ₉	25 % RDN through VC + 75 % N through Urea	85.50	184.45	236.50	272.70
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	84.67	189.34	243.33	277.17
	F- test	NS	S	S	S
	S. Ed. ($\pm$)	7.66	5.74	5.42	3.45
	C. D. (P = 0.05)	-	12.07	11.40	7.26

Table.2 Effect of organic and inorganic sources of nitrogen on dry weight (gm) in pearl millet

No	Treatment	Dry weight (gm)			
		20 DAS	40 DAS	60 DAS	80 DAS
T ₁	100 % RDN through Urea	1.55	6.95	46.60	98.87
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	1.57	7.25	54.27	101.93
T ₃	100 % RDN through VC	1.15	6.38	43.93	98.83
T ₄	100 % RDN through VC + <i>Azotobacter</i>	1.12	6.79	45.40	100.67
T ₅	75 % RDN through VC + 25 % N through Urea	1.46	6.97	45.03	100.73
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	1.53	7.92	50.63	96.48
T ₇	50 % RDN through VC + 50 % N through Urea	1.45	6.58	47.40	98.07
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	1.65	6.77	47.33	101.17
T ₉	25 % RDN through VC + 75 % N through Urea	1.93	7.53	55.10	102.87
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	2.03	8.39	59.13	105.30
	F- test	NS	NS	S	S
	S. Ed. ($\pm$)	0.43	0.56	3.80	2.24
	C. D. (P = 0.05)	-	-	8.00	4.72

Table.3 Effect of organic and inorganic sources of nitrogen on Tillers plant⁻¹ of pearl millet

No	Treatment	Tillers plant ⁻¹			
		20 DAS	40 DAS	60 DAS	80 DAS
T ₁	100 % RDN through Urea	0.73	1.53	1.60	2.03
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	0.80	1.60	2.07	2.20
T ₃	100 % RDN through VC	0.93	1.27	1.87	2.27
T ₄	100 % RDN through VC + <i>Azotobacter</i>	0.87	1.40	1.73	2.60
T ₅	75 % RDN through VC + 25 % N through Urea	0.80	1.40	1.93	2.87
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	0.87	1.33	1.87	2.93
T ₇	50 % RDN through VC + 50 % N through Urea	0.80	1.47	1.80	2.70
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	0.87	2.00	2.33	3.07
T ₉	25 % RDN through VC + 75 % N through Urea	1.00	2.07	2.60	3.13
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	1.67	2.40	2.87	3.40
	F- test	S	S	S	S
	S. Ed. (s±)	0.21	0.36	0.33	0.36
	C. D. (P = 0.05)	0.46	0.77	0.70	0.76

Table.4 Effect of organic and inorganic sources of nitrogen on Crop Growth Rate (g m⁻² day⁻¹) of pearl millet

No	Treatment	Crop Growth Rate (g m ⁻² day ⁻¹)			
		0-20 DAS	0-20 DAS	0-20 DAS	0-20 DAS
T ₁	100 % RDN through Urea	0.08	0.26	1.82	2.29
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	0.08	0.28	2.35	2.46
T ₃	100 % RDN through VC	0.06	0.23	1.82	2.31
T ₄	100 % RDN through VC + <i>Azotobacter</i>	0.05	0.28	1.93	2.45
T ₅	75 % RDN through VC + 25 % N through Urea	0.07	0.27	1.88	2.62
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	0.07	0.29	2.13	2.61
T ₇	50 % RDN through VC + 50 % N through Urea	0.07	0.25	1.98	2.53
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	0.08	0.28	2.04	2.66
T ₉	25 % RDN through VC + 75 % N through Urea	0.09	0.27	2.37	2.38
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	0.10	0.31	2.53	2.74
	F- test	NS	NS	NS	NS
	S. Ed. (±)	0.02	0.03	0.23	0.24
	C. D. (P = 0.05)	-	-	-	-

Table.5 Effect of organic and inorganic sources of nitrogen on Relative Growth Rate (g g⁻¹ day⁻¹) of pearl millet

No	Treatment	Relative Growth Rate (g g ⁻¹ day ⁻¹)			
		0-20 DAS	0-20 DAS	0-20 DAS	0-20 DAS
T ₁	100 % RDN through Urea	0.01	0.08	0.09	0.03
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	0.02	0.08	0.10	0.03
T ₃	100 % RDN through VC	0.00	0.07	0.09	0.04
T ₄	100 % RDN through VC + <i>Azotobacter</i>	0.02	0.09	0.09	0.04
T ₅	75 % RDN through VC + 25 % N through Urea	0.02	0.08	0.09	0.04
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	0.02	0.07	0.09	0.03
T ₇	50 % RDN through VC + 50 % N through Urea	0.02	0.07	0.10	0.04
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	0.02	0.07	0.10	0.03
T ₉	25 % RDN through VC + 75 % N through Urea	0.03	0.07	0.10	0.03
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	0.03	0.09	0.10	0.04
	F- test	NS	NS	NS	NS
	S. Ed. (±)	0.060	0.016	0.005	0.004
	C. D. (P = 0.05)	-	-	-	-

Table.6 Effect of organic and inorganic sources of nitrogen on ear plant⁻¹ of pearl millet

Treatment		Ear plant ⁻¹
T ₁	100 % RDN through Urea	2.33
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	3.00
T ₃	100 % RDN through VC	2.67
T ₄	100 % RDN through VC + <i>Azotobacter</i>	3.00
T ₅	75 % RDN through VC + 25 % N through Urea	2.39
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	2.73
T ₇	50 % RDN through VC + 50 % N through Urea	3.34
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	3.13
T ₉	25 % RDN through VC + 75 % N through Urea	3.34
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	3.57
F-test		S
S. Ed. (±)		0.36
C. D. (P = 0.05)		0.76

Table.7 Effect of organic and inorganic sources of nitrogen on length of ear (cm) of pearl millet

Treatment		Length of Ear(cm)
T ₁	100 % RDN through Urea	26.07
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	27.97
T ₃	100 % RDN through VC	26.73
T ₄	100 % RDN through VC + <i>Azotobacter</i>	27.53
T ₅	75 % RDN through VC + 25 % N through Urea	26.53
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	28.80
T ₇	50 % RDN through VC + 50 % N through Urea	28.97
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	29.93
T ₉	25 % RDN through VC + 75 % N through Urea	30.63
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	31.85
F-test		S
S. Ed. (±)		1.26
C. D. (P = 0.05)		2.66

Table.8 Effect of organic and inorganic sources of nitrogen on Length of no. of Grains ear⁻¹ of pearl millet

Treatment		No. of Grains Ear ⁻¹
T ₁	100 % RDN through Urea	2866.67
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	3085.33
T ₃	100 % RDN through VC	2803.33
T ₄	100 % RDN through VC + <i>Azotobacter</i>	2760.00
T ₅	75 % RDN through VC + 25 % N through Urea	2833.33
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	2966.67
T ₇	50 % RDN through VC + 50 % N through Urea	2715.67
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	3099.00
T ₉	25 % RDN through VC + 75 % N through Urea	3233.33
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	3433.33
F-test		S
S. Ed. (±)		206.96
C. D. (P = 0.05)		434.84

Table.9 Effect of organic and inorganic sources of nitrogen on Test weight (gm) of pearl millet

Treatment		Test weight (gm)
T ₁	100 % RDN through Urea	7.15
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	7.51
T ₃	100 % RDN through VC	7.86
T ₄	100 % RDN through VC + <i>Azotobacter</i>	7.94
T ₅	75 % RDN through VC + 25 % N through Urea	7.75
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	8.07
T ₇	50 % RDN through VC + 50 % N through Urea	7.77
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	8.31
T ₉	25 % RDN through VC + 75 % N through Urea	8.38
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	8.39
F-test		S
S. Ed. ($\pm$)		0.35
C. D. (P = 0.05)		0.74

Table.10 Effect of organic and inorganic sources of nitrogen on Grain yield (t ha⁻¹) of pearl millet

Treatment		Grain yield (t ha ⁻¹)
T ₁	100 % RDN through Urea	3.04
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	3.29
T ₃	100 % RDN through VC	2.51
T ₄	100 % RDN through VC + <i>Azotobacter</i>	2.68
T ₅	75 % RDN through VC + 25 % N through Urea	3.11
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	3.14
T ₇	50 % RDN through VC + 50 % N through Urea	3.77
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	4.68
T ₉	25 % RDN through VC + 75 % N through Urea	4.72
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	4.97
F-test		S
S. Ed. ($\pm$)		0.20
C. D. (P = 0.05)		0.43

Table.11 Effect of organic and inorganic sources of nitrogen on Stover yield (t ha⁻¹) of pearl millet

Treatment		Stover yield (t ha ⁻¹)
T ₁	100 % RDN through Urea	11.39
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	11.51
T ₃	100 % RDN through VC	9.30
T ₄	100 % RDN through VC + <i>Azotobacter</i>	9.33
T ₅	75 % RDN through VC + 25 % N through Urea	10.15
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	10.59
T ₇	50 % RDN through VC + 50 % N through Urea	11.01
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	11.32
T ₉	25 % RDN through VC + 75 % N through Urea	12.67
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	12.99
F-test		S
S. Ed. ($\pm$)		0.39
C. D. (P = 0.05)		0.82

Table.12 Effect of organic and inorganic sources of nitrogen on harvest index (%) of pearl millet

Treatment		Harvest index (%)
T ₁	100 % RDN through Urea	21.06
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	22.22
T ₃	100 % RDN through VC	21.53
T ₄	100 % RDN through VC + <i>Azotobacter</i>	22.31
T ₅	75 % RDN through VC + 25 % N through Urea	23.45
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	22.86
T ₇	50 % RDN through VC + 50 % N through Urea	25.50
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	27.76
T ₉	25 % RDN through VC + 75 % N through Urea	27.14
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	29.25
F-test		S
S. Ed. (±)		1.30
C. D. (P = 0.05)		2.74

Table.13 Effect of organic and inorganic sources of nitrogen on Protein content (%) of pearl millet

Treatment		Protein content (%)
T ₁	100 % RDN through Urea	9.15
T ₂	100 % RDN through Urea + <i>Azotobacter</i>	9.64
T ₃	100 % RDN through VC	10.45
T ₄	100 % RDN through VC + <i>Azotobacter</i>	12.78
T ₅	75 % RDN through VC + 25 % N through Urea	11.16
T ₆	75% RDN through VC + 25 % N through Urea + <i>Azotobacter</i>	11.43
T ₇	50 % RDN through VC + 50 % N through Urea	10.75
T ₈	50 % RDN through VC + 50 % N through Urea+ <i>Azotobacter</i>	10.02
T ₉	25 % RDN through VC + 75 % N through Urea	11.42
T ₁₀	25 % RDN through VC + 75 % N through Urea+ <i>Azotobacter</i>	13.03
F-test		S
S. Ed. (±)		3.55
C. D. (P = 0.05)		2.45

Post-harvest observations of pearl millet

Number of ear plant⁻¹

Tables 5 and 6 shows that there was significant effect of organic and inorganic sources of nitrogen on number of ear plant⁻¹. Maximum number of ear was found (3.57) with treatment T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*), while minimum number of ear (2.33) was observed in treatment T₁ (100 % RDN through U), However T₉ (25 % RDN through VC + 75 % N through Urea), T₈ (50 % RDN through VC + 50 % N through Urea + *Azotobacter*), T₄ (100 % RDN through Urea + *Azotobacter*), T₂ (100 % RDN through Urea) were found statistically at par with T₁₀ (25 % through VC

+ 75 % N through Urea + *Azotobacter*). Experimental findings showed that due the application of organic manure might be attributed to the better nutrient availability and its favorable effect on soil physical and biological properties resulting increased growth of plant and grain and straw yield (Rathor *et al.*, 2008).

Length of ear (cm)

Table 7 shows that there was significant effect of organic and inorganic sources of nitrogen on length of ear (cm). Maximum length of ear was found (31.85) with treatment T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*), while minimum length of ear (26.07) was observed in treatment T₁(100

% RDN through Urea), However T₉ (25 % RDN through VC +75 % N through Urea), T₈(50 % RDN through VC +50 % N through Urea + *Azotobacter*), were found statistically at par with T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental finding showed that application of nitrogen @ 120 kg/ha was at par with 160 kg N/ha, significantly increased crude protein content over control, 40 and 80 kg N/ha. in pearl millet (Rathor *et al.*, 2008).

Number of grains ear⁻¹

Table 8 shows that there was significant effect of organic and inorganic sources of nitrogen on number of grains ear⁻¹. Maximum number of grains ear⁻¹ was found (3433.33) with treatment T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*), while minimum number of grains ear⁻¹(2803.33) was observed in treatment T₃(100 % RDN through VC), However T₉ (25 % RDN through VC +75 % N through Urea), T₈(50 % RDN through VC +50 % N through Urea + *Azotobacter*), were found statistically at par with T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental finding showed that increase in yield attributes might be due to the effective potential of pearl millet is decided by growth and yield component. This was reflected in the present study (Rathor *et al.*, 2008).

Test weight (gm)

Table 9 shows that there was significant effect of organic and inorganic sources of nitrogen on test weight. Maximum test weight was found (8.39) with treatment T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), while lowest (7.15) was observed in treatment T₁(100 % RDN through Urea). However T₉ (25 % RDN through VC +75 % N through Urea), T₈ (50 % RDN through VC +50 % N through Urea + *Azotobacter*), T₆ (75% RDN

through VC + 25 % N through Urea + *Azotobacter* were found statistically at par with T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental finding showed that a dose of 90 kg N ha⁻¹ applied in 2 equal splits resulted in taller plants and more tillers plant⁻¹ and 1000 grains weight which in turn in higher grain yield and stover yield (Kumawat and Jat, 2007).

Grain yield (t ha⁻¹)

Table 10 shows that there was significant effect of organic and inorganic sources of nitrogen on grain yield. Maximum grain yield was found (4.97) with treatment T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), while minimum grain yield(2.51) was observed in treatment T₃(100 % RDN through Urea), However T₉ (25 % RDN through VC +75 % N through Urea), T₈ (50 % RDN through VC +50 % N through Urea + *Azotobacter*), were found statistically at par with T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental findings showed that due the application of organic manure might be attributed to the better nutrient availability and its favorable effect on soil physical and biological properties resulting increased yield attributes and straw yield further, vermicompost increase the efficiency of added chemical fertilizers in soil and increased rate of humification. Humic acid in vermicompost enhances the availability of both native and added micronutrients in soil and thus plant yield attributes and yield increased (Singh *et al.*, 2005, Yadav and Solanki 2002).

Stover yield (t ha⁻¹)

Table 11 shows that there was significant effect of organic and inorganic sources of nitrogen on stover yield (t ha⁻¹). Maximum stover yield (t ha⁻¹) was found (12.99) with treatment T₁₀ (25 % through VC + 75 % N

through Urea + *Azotobacter*), while minimum stover yield (9.30) was observed in treatment T₃ (100 % RDN through VC). However T₉ (25 % RDN through VC +75 % N through Urea) was found statistically at par with T₁₀(25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental findings showed that due the application of organic manure might be attributed to the better nutrient availability and its favorable effect on soil physical and biological properties resulting increased growth of plant and grain and straw yield (Rathor *et al.*, 2008).

Harvest index (%)

Table 12 shows that there was significant effect of organic and inorganic sources of nitrogen on harvest index (%). Maximum harvest index (%) was found (27.67)with treatment T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), while minimum harvest index (21.06) was observed in treatment T₁ (100 % RDN through Urea), However T₈ (50 % RDN through VC +50 % N through Urea + *Azotobacter*), T₉ (25 % RDN through VC +75 % N through Urea), T₇ (50 % RDN through VC + 50 % through Urea), were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental findings showed that due the application of organic manure might be attributed to the better nutrient availability and its favorable effect on soil physical and biological properties resulting increased growth of plant, grain yield and straw yield (Rathore *et al.*, 2008).

Protein content (%)

Table 13 shows that there was significant effect of organic and inorganic sources of nitrogen on protein content (%). Maximum protein content (%) was found (13.04) with treatment T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*), while minimum protein content (9.15) was observed in

treatment T₁(100 % RDN through Urea), However T₄(100 % RDN through VC + *Azotobacter*), T₆ (75 % RDN through VC + 25 % through Urea + *Azotobacter*), T₉ (25 % RDN through VC +75 % N through Urea), T₅ (75 % RDN through VC + 25 % through Urea + *Azotobacter*), T₇ (50 % RDN through VC + 50 % through Urea), were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + *Azotobacter*). Experimental finding showed that protein content was highest when 75 per cent of RDF was combined with vermicompost at 10 t ha⁻¹ in pearl millet-hybrid napier (Jayanthi *et al.*, (2002 a).

In conclusion, effect of organic and inorganic sources of nitrogen under in treatment T₁₀ (25% RDN through VC + 75 % N through Urea + *Azotobacter*) recorded maximum plant height (277.17cm), plant dry weight (105.30g), tillers plant⁻¹ (3.40), crop growth rate (2.74 g m⁻² day⁻¹), relative growth rate (0.04 g g⁻¹ day⁻¹), ear plant⁻¹ (3.57), length of ear (31.85), no. of grains ear⁻¹ (3433.33), test weight (8.39 g), grain yield (4.97 t ha⁻¹), straw yield(12.99 t ha⁻¹), protein content (13.03%) and harvest index (27.67%). Whereas the lowest value in terms of plant height (246.33cm), dry weight (98.83g), number of grains (2803.33 ear⁻¹) grain yield (2.51 t ha⁻¹) and stover yield (9.30 t ha⁻¹) was observed in the treatment T₃ *i.e.*, (100% RDN through VC). Further, number of tillers (2.03 plant⁻¹), crop growth rate (2.29 g m⁻² day⁻¹), relative growth rate (0.03 g g⁻¹ day⁻¹), number of ear (2.33 plant⁻¹), length of ear (26.07cm), test weight (7.15g), protein content (9.15%), harvest index (21.06%) was recorded in the treatment T₁ (100 % RDN through Urea).

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