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Effect of organic and inorganic sources of nutrients on growth, yield attribute, yield and quality, of pearl millet *(Pennisetum glaucum)* in pearl millet-lentil crop sequence

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Abstract

A field experiment was conducted at Agricultural Research farm of R.B.S. College Bichpuri Agra during kharif seasons of 2021 and 2022 to study the effect of organic and inorganic sources of nutrients on growth, yield attribute yield and quality, of pearl millet crop. The experiment was layout in randomized block design with eleven treatments of (T_1) 5 t FYM ha^{-1}, (T_2) 2.5 t Vermicompost ha^{-1}, (T_3) 50% RDF ha^{-1}, (T_4) 50% RDF + 5 t FYM ha^{-1}, (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (T_7) 75% RDF ha^{-1}, (T_8) 75% RDF + 5 t FYM ha^{-1}, (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (T_{10}) 75% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1} and (T_{11}) 100% RDF and three replications. The results revealed that the application of T_{10} @ 75% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1} treatment proved significantly superior over the rest of the treatments. Application of @ T_{10} @ 75% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1} recorded significantly higher the number of plant height, ear length, grain weight ear^{-1}, test weight, grain yield, straw yield and biological yield of pearl millet over (T_1) 5 t FYM ha^{-1} treatment. Similarly, the increase in the number of plant height, ear length, grain ear^{-1}, test weight, grain yield, straw yield and biological yield of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4)> (T_6)> (T_7) > (T_9) > (T_8) > (T_{11}) > (T_{10}) levels of nutrient management over (T_1) 5 t FYM ha^{-1} treatment.

Keywords: FYM, Vermicompost, yield attribute, yield, pearl millet

Introduction

Fertilizer is the key to increasing agricultural production by enhancing the land productivity. The modern agricultural technology emphasizes the widespread use of fertilizers as source of nutrients. In fact, fertilizer use is considered as a barometer of agricultural productivity fertilizers no doubt played a key role in agricultural production and changed Asia from a region of scarcity to food sufficiency. No country in the world developed or developing has been able to increase agriculture productivity without expanding the use of fertilizers and India can not be an exception. In fact, the most significant factor of poor oilseed production in India is low consumption of fertilizers and manures. As the mineral fertilizers alone cannot meet the requirements of crops and cropping systems (because of high cost and also environmental related risks involved in its application and usage), complementary use of organics and biofertilizers with inorganic fertilizers is desired.

The application of FYM in the soil helps in increasing the fertility of the soils as physical condition including its water holding capacity. Organic manures, which were perhaps the major sources of plant nutrients in tradition agriculture, receive less emphasis with the advent of high analysis chemical fertilizers. Without detracting from the fact that chemical fertilizer will continue to be main instrument for quickening the pace for agricultural production the recent researches indicate that a judicious combination of organic manures and fertilizer better maintain the long-term soil fertility and sustain high levels of productivity. Therefore, use of both organic manure and chemical fertilizers in appropriate proportion assume special significance as complementary and supplementary to each other in crop production. Pearl millet-lentil sequence is common in Agra region. Even with the application of recommended dose of fertilizers, yield potential of this sequence has reached a plateau because of deterioration in soil health. In sustainable crop production, organic manure plays an important role. The results of a large number of experiments on manure and fertilizers conducted in the country and abroad reveal that neither the chemical fertilizers alone nor the organic sources exclusively can achieve the production sustainability of soil as well as crop under highly intensive cropping system. Therefore it becomes necessary to know the suitable combination of chemical fertilizers, with organic manures for profitable crop production in cereal based cropping system.

Materials and Methods

The field experiments were conducted at the Agricultural Research farm of R.B.S. College Bichpuri, Agra (located in semi arid or gray steppe arid region of South-Western Uttar Pradesh the intersect of 27.2 0 N attitude and 77.9 0 E longitude), during two consecutive kharif seasons of 2021 and 2022 on sandy loam soil. The soil had EC 0.18 dSm^{-1}, pH 8.3, organic carbon 3.9 g kg^{-1}, available N 188.6, P 12.4 and K 205.6 kg ha^{-1}. The experiment was laid out in randomized block design with three replications. The treatments were comprised of (T_1) 5 t FYM ha^{-1}, (T_2) 2.5 t Vermicompost ha^{-1}, (T_3) 50% RDF ha^{-1}, (T_4) 50% RDF + 5 t FYM ha^{-1}, (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (T_7) 75% RDF ha^{-1}, (T_8) 75% RDF + 5 t FYM ha^{-1}, (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (T_{10}) 75% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1} and (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O ha^{-1}). The N, P and K were applied through urea, single super phosphate and muriate of potash, respectively. Phosphorus and potassium were applied to the plots as per treatments at the time of sowing. The half dose of N was applied at time of sowing and remaining N was applied in two splits as per treatment. The pearl millet (MP-7171) was sown in first week of August in both the years. The crop was harvested at the physiological maturity. The growth, yield attributing characters and yields were recorded at harvest.

Results and discussion

Plant height

The plant height of pearl millet crop at different growth stages varied from 57.2 to 259.3 cm across the treatments at both the years of experimentation and pooled analysis (Table 1). Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} recorded significantly higher plant height of pearl millet crop at different growth stages (82.7, 84.3, 83.5 and 234.7, 236.3, 235.5 and 250.5, 259.3, 254.9 cm) Followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O $ha^{-1)}$ (79.3, 78.5, 78.9 and 228.9, 228.5, 228.7 and 245.9, 255.3, 250.6 cm), (T_8) 75% RDF + 5 t FYM ha^{-1} (75.4, 76.7, 76.0 and 224.0, 222.3, 223.2 and 241.2, 250.8, 246.0 cm), (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (73.1, 74.3, 73.7 and 219.0, 218.0, 218.5 and 235.7, 244.7, 240.2 cm), (T_7) 75% RDF ha^{-1}, (71.1, 71.8, 71.5 and 211.9, 211.0, 211.4 and 232.0, 241.3, 236.7 cm), (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (69.3, 70.2, 69.8 and 205.2, 206.2, 205.7 and 231.1, 236.7, 233.9cm), (T_4) 50% RDF + 5 t FYM ha^{-1}, (67.3, 68.0, 67.7 and 201.0, 198.7, 199.8 and 227.6, 233.2, 230.4 cm), (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (65.8, 65.5, 65.7 and 196.7, 195.8, 196.3 and 221.1, 226.7, 223.9 cm), (T_3) 50% RDF ha^{-1}, (63.9, 62.7, 63.3 and 192.5, 192.2, 192.3 and 219.5, 222.3, 220.9 cm), (T_2) 2.5 t Vermicompost ha^{-1} (61.9, 59.7, 60.8 and 187.1, 187.7, 187.4 and 216.3, 216.5, 216.4 cm) compared to (T_1) 5 t FYM ha^{-1} treatment (59.5, 57.2, 58.4 and 178.1, 177.2, 177.7 and 212.3, 211.2, 211.8 cm) respectively, at both the years of experimentation and pooled analysis. Similarly, the increase in plant height of pearl millet crop at different growth stages

Table 1: Effect of organic and inorganic sources of nutrients on plant height (cm) of pearl millet in pearl millet-lentil crop sequence

Treatments	Plant height (cm) at 30 DAS			Plant height (cm) at 60 DAS			Plant height (cm) at harvest		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	59.5	57.2	58.4	178.1	177.2	177.7	212.3	211.2	211.8
T_2	61.9	59.7	60.8	187.1	187.7	187.4	216.3	216.5	216.4
T_3	63.9	62.7	63.3	192.5	192.2	192.3	219.5	222.3	220.9
T_4	67.3	68.0	67.7	201.0	198.7	199.8	227.6	233.2	230.4
T_5	65.8	65.5	65.7	196.7	195.8	196.3	221.1	226.7	223.9
T_6	69.3	70.2	69.8	205.2	206.2	205.7	231.1	236.7	233.9
T_7	71.1	71.8	71.5	211.9	211.0	211.4	232.0	241.3	236.7
T_8	75.4	76.7	76.0	224.0	222.3	223.2	241.2	250.8	246.0
T_9	73.1	74.3	73.7	219.0	218.0	218.5	235.7	244.7	240.2
T_{10}	82.7	84.3	83.5	234.7	236.3	235.5	250.5	259.3	254.9
T_{11}	79.3	78.5	78.9	228.9	228.5	228.7	245.9	255.3	250.6
SEm±	2.89	3.01	2.07	5.102	6.55	5.10	7.64	6.98	5.12
CD @ 5%	6.02	6.27	4.32	10.64	13.65	10.60	15.93	14.56	10.68

with: (T_2) > (T_3) > (T_5) > (T_4)> (T_6)> (T_7) > (T_9)> (T_8)> (T_{11})> (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 4.2, 8.5, 12.5, 16.0, 19.5, 22.5, 26.3, 30.3, 35.2, 43.2 and 5.5, 8.3, 10.5, 12.5, 15.8, 19.0, 23.0, 25.6, 28.7, 32.6 and 2.2, 4.3, 5.7, 8.8, 10.4, 11.8, 13.4, 16.2, 18.3, 20.4% respectively during the pooled data of the two years respectively. Similar results were also reported by Prasad et al. (2019) and Singh (2020).

Ear length

The ear length of pearl millet crop at both the years of experimentation and pooled analysis varied from 21.7 to 26.1cm across the treatments (Table 2). Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1} recorded significantly higher ear length of pearl millet crop (25.8, 26.1, 26.0 cm) followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O $ha^{-1)}$ (25.5, 25.5, 25.5 cm), (T_8) 75% RDF + 5 t FYM ha^{-1} (25.2, 25.1, 25.1cm), (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (24.8, 24.8, 24.8 cm), (T_7) 75% RDF ha^{-1}, (24.3, 24.2, 24.3 cm), (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (23.9, 23.9, 23.9 cm), (T_4) 50% RDF + 5 t FYM ha^{-1}, (23.6, 23.6, 23.6 cm), (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (23.3, 23.4, 23.3 cm), (T_3) 50% RDF ha^{-1}, (22.9, 23.1, 23.0 cm), (T_2) 2.5 t vermicompost ha^{-1} (22.5, 22.8, 22.6 cm) compared to (T_1) 5 t FYM ha^{-1} treatment (21.7, 21.9, 21.8 cm) respectively, at both the years of experimentation and pooled analysis. Similarly, the increase in ear length of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4) > (T_6) > (T_7) > (T_9) > (T_8) > (T_{11}) > (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 3.8, 5.4, 7.0, 8.2, 9.7, 11.4, 13.7, 15.4, 16.9 and 19.2% respectively during the pooled data of the two years respectively. Similar results were also reported by Prasad et al. (2019) and Singh (2020).

Grain weight ear^{-1} (gm)

The grain weight ear^{-1} of pearl millet crop at both the years of experimentation and pooled analysis varied from 22.10 to 25.90 gm across the treatments (Table 2). Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1} recorded significantly higher grain weight ear^{-1} of pearl millet crop (25.80, 25.90,

Table 2: Effect of organic and inorganic sources of nutrients on ear length (cm), grain weight ear^{-1} (gm) and test weight (gm) of pearl millet in pearl millet-lentil crop sequence

Treatments	Ear length (cm)			Grain weight ear^{-1} (gm)			Test weight 1000 grain (gm)		
	2021	2022	Pooled	2021	2022	Pooled	2021	2022	Pooled
T_1	21.7	21.9	21.8	22.10	22.17	22.1	11.33	11.63	11.48
T_2	22.5	22.8	22.6	22.50	22.60	22.6	11.62	11.94	11.78
T_3	22.9	23.1	23.0	22.87	23.00	22.9	11.88	12.05	11.96
T_4	23.6	23.6	23.6	23.57	23.77	23.7	12.54	12.81	12.68
T_5	23.3	23.4	23.3	23.17	23.50	23.3	12.25	12.37	12.31
T_6	23.9	23.9	23.9	24.00	24.23	24.1	12.68	13.23	12.96
T_7	24.3	24.2	24.3	24.33	24.60	24.5	13.06	13.70	13.38
T_8	25.2	25.1	25.1	25.10	25.20	25.2	13.75	14.26	14.00
T_9	24.8	24.8	24.8	24.60	24.90	24.8	13.50	13.97	13.74
T_{10}	25.8	26.1	26.0	25.80	25.90	25.9	14.47	14.76	14.62
T_{11}	25.5	25.5	25.5	25.53	25.63	25.6	14.27	14.50	14.38
SEm±	0.65	0.61	0.49	0.55	0.58	0.42	0.60	0.61	0.43
CD @ 5%	1.35	1.28	1.02	1.14	1.22	0.88	1.25	1.28	0.89

25.9 gm) followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O $ha^{-1)}$ (25.53, 25.63, 25.6 gm), (T_8) 75% RDF + 5 t FYM ha^{-1} (25.10, 25.20, 25.2 gm), (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (24.60, 24.90, 24.8 gm), (T_7) 75% RDF ha^{-1}, (24.33, 24.60, 24.5 gm), (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (24.00, 24.23, 24.1 gm), (T_4) 50% RDF + 5 t FYM ha^{-1}, (23.57, 23.77, 23.7 gm), (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (23.17, 23.50, 23.3 gm), (T_3) 50% RDF ha^{-1}, (22.87, 23.00, 22.9 gm), (T_2) 2.5 t vermicompost ha^{-1} (22.50, 22.60, 22.6 gm) compared to (T_1) 5 t FYM ha^{-1} treatment (22.10, 22.17, 22.1gm) respectively, at both the years of experimentation and pooled analysis. Similarly, the increase in grain weight ear^{-1} of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4)> (T_6)> (T_7) > (T_9)> (T_8)> (T_{11})> (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 1.9, 3.6, 5.4, 6.9, 9.0, 10.5, 11.8, 13.6, 15.6 and 16.8 % respectively during the pooled data of the two years respectively. Similar results were also reported by Munna et al. (2019), Prasad et al. (2019) and Kumar et al. (2020).

Test weight 1000 grain (gm)

The test weight of pearl millet crop at both the years of experimentation and pooled analysis varied from 22.10 to 25.90 gm across the treatments (Table 2). Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1} recorded significantly higher test weight of pearl millet crop (14.47, 14.76, 14.62 gm) followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O $ha^{-1)}$ (14.27, 14.50, 14.38 gm), (T_8) 75% RDF + 5 t FYM ha^{-1} (13.75, 14.26, 14.00 gm), (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (13.50, 13.97, 13.74 gm), (T_7) 75% RDF ha^{-1}, (13.06, 13.70, 13.38 gm), (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (12.68, 13.23, 12.96 gm), (T_4) 50% RDF + 5 t FYM ha^{-1}, (12.54, 12.81, 12.68 gm), (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (12.25, 12.37, 12.31 gm), (T_3) 50% RDF ha^{-1}, (11.88, 12.05, 11.96 gm), (T_2) 2.5 t vermicompost ha^{-1} (11.62, 11.94, 11.78 gm) compared to (T_1) 5 t FYM ha^{-1} treatment (11.33, 11.63, 11.48 gm) respectively, at both the years of experimentation and pooled analysis. Similarly, the increase in test weight of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4) > (T_6) > (T_7) > (T_9) > (T_8) > (T_{11}) > (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 2.6, 4.2, 7.2, 10.4, 12.8, 16.5, 19.6, 22.0, 25.3 and 27.3% respectively during the pooled

Table 3: Effect of organic and inorganic sources of nutrients on grain and stover yield (q ha^{-1}) of pearl millet in pearl millet-lentil crop sequence

Treatments	Grain yield (q ha^{-1})			Stover yield (q ha^{-1})		
	2021	2022	Pooled	2021	2022	Pooled
T_1	21.9	22.8	22.4	45.2	47.3	46.3
T_2	23.1	23.8	23.5	47.2	50.0	48.6
T_3	24.1	24.5	24.3	48.9	51.8	50.4
T_4	25.6	25.9	25.8	51.6	55.0	53.3
T_5	24.6	25.1	24.9	50.3	53.5	51.9
T_6	25.9	26.2	26.0	52.8	56.5	54.6
T_7	26.3	27.0	26.6	54.8	59.4	57.1
T_8	27.3	28.3	27.8	57.0	64.0	60.5
T_9	26.7	27.6	27.2	56.2	62.2	59.2
T_{10}	29.1	30.6	29.9	61.1	66.1	63.6
T_{11}	28.2	29.1	28.6	58.5	65.0	61.8
SEm±	1.52	1.50	1.09	2.07	2.00	1.63
CD @ 5%	3.17	3.12	2.28	4.33	4.17	3.39

data of the two years respectively. Similar results were also reported by Prasad et al. (2019) and Kumar et al. (2020).

Grain yield

The grain yield of pearl millet crop at both the years of experimentation and pooled analysis varied from 21.9 to 30.6 q ha^{-1} across the treatments (Table 3). Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} recorded significantly higher grain yield of pearl millet crop (29.1, 30.6, 29.9 q ha^{-1}) followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O ha$^{-1)}$ (28.2, 29.1, 28.6 q ha^{-1}), (T_8) 75% RDF + 5 t FYM ha^{-1} (27.3, 28.3, 27.8 q ha^{-1}), (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (26.7, 27.6, 27.2 q ha^{-1}), (T_7) 75% RDF ha^{-1}, (26.3, 27.0, 26.6 q ha^{-1}), (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (25.9, 26.2, 26.0 q ha^{-1}), (T_4) 50% RDF + 5 t FYM ha^{-1}, (25.6, 25.9, 25.8 q ha^{-1}), (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (24.6, 25.1, 24.9 q ha^{-1}), (T_3) 50% RDF ha^{-1}, (24.1, 24.5, 24.3 q ha^{-1}), (T_2) 2.5 t vermicompost ha^{-1} (23.1, 23.8, 23.5 q ha^{-1}) compared to (T_1) 5 t FYM ha^{-1} treatment (21.9, 22.8, 22.4 q ha^{-1}) respectively, at both the years of experimentation and pooled analysis. Similarly, the increase in grain yield of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4)> (T_6)> (T_7) > (T_9)> (T_8)> (T_{11})> (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 4.9, 8.7, 11.0, 15.1, 16.2, 19.0, 21.5, 24.2, 27.9 and 33.5 % respectively during the pooled data of the two years respectively. Similar results were also reported by Munna et al. (2016), Randhawa et al. (2020), Karol et al. (2023) and Jat et al. (2023).

Stover yield

The stover yield of pearl millet crop at both the years of experimentation and pooled analysis varied from 45.2 to 66.1q ha^{-1} across the treatments (Table 3). Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} recorded significantly higher stover yield of pearl millet crop (61.1, 66.1, 63.6 q ha^{-1}) followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O ha$^{-1)}$ (58.5, 65.0, 61.8 q ha^{-1}), (T_8) 75% RDF + 5 t FYM ha^{-1} (57.0, 64.0, 60.5 q ha^{-1}), (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (56.2, 62.2, 59.2 q ha^{-1}), (T_7) 75% RDF ha^{-1}, (54.8, 59.4, 57.1 q ha^{-1}), (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (52.8, 56.5, 54.6 q ha^{-1}), (T_4) 50% RDF + 5 t FYM ha^{-1}, (51.6, 55.0, 53.3 q ha^{-1}), (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (50.3, 53.5, 51.9 q ha^{-1}), (T_3) 50% RDF ha^{-1}, (48.9, 51.8, 50.4 q ha^{-1}), (T_2) 2.5 t vermicompost ha^{-1} (47.2, 50.0, 48.6 q ha^{-1}) compared to (T_1) 5 t FYM ha^{-1} treatment (45.2, 47.3, 46.3 q ha^{-1}) respectively, at both the years of experimentation and pooled analysis. Similarly, the increase in stover yield of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4)> (T_6)> (T_7) > (T_9) > (T_8) > (T_{11}) > (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 5.1, 8.9, 12.1, 15.1, 18.1, 23.4, 27.9, 30.8, 33.5 and 37.5 % respectively during the pooled data of the two years respectively. Similar results were also reported by Randhawa et al. (2020) and Karol et al. (2023).

Biological yield

The biological yield of pearl millet crop at both the years of experimentation and pooled analysis varied from 67.1 to 96.7 q ha^{-1} across the treatments (Table 4). Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} recorded significantly increased biological yield of pearl millet crop (90.3, 96.7, 93.5 q ha^{-1}) followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O ha$^{-1)}$ (86.7, 94.1, 90.4 q ha^{-1}), (T_8) 75% RDF + 5 t FYM ha^{-1} (84.3, 92.4, 88.3 q ha^{-1}), (T_9) 75% RDF + 2.5 t FYM ha^{-1}, (82.9, 89.8, 86.4 q ha^{-1}), (T_7) 75% RDF ha^{-1}, (81.1, 86.4, 83.7 q ha^{-1}), (T_6) 50% RDF + 2.5 t FYM + 1.25 t Vermicompost ha^{-1}, (78.7, 82.6, 80.74 q ha^{-1}), (T_4) 50% RDF + 5 t FYM ha^{-1}, (77.2, 80.9, 79.0 q ha^{-1}), (T_5) 50% RDF + 2.5 t FYM ha^{-1}, (74.9, 78.6, 76.7 q ha^{-1}), (T_3) 50% RDF ha^{-1}, (73.0, 76.3, 74.7 q ha^{-1}), (T_2) 2.5 t vermicompost ha^{-1} (70.3, 73.9, 72.1 q ha^{-1}) compared to (T_1) 5 t FYM ha^{-1} treatment (67.1, 70.2, 68.6 q ha^{-1}) respectively, at both the years of experimentation and pooled analysis. Similarly, the increase in biological yield of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4) > (T_6) > (T_7) > (T_9) > (T_8) > (T_{11}) > (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 5.0, 8.8, 11.8, 15.1, 17.5, 22.0, 25.8, 28.7, 31.6 and 36.2 % respectively during the pooled data of the two years respectively. Similar results were also reported by Mali et al. (2017) and Prasad et al. (2019)

Table 4: Effect of organic and inorganic sources of nutrients on biological yield (q ha^{-1}) and harvest index (%) of pearl millet in pearl millet-lentil crop sequence

Treatments	Biological yield (q ha^{-1})			Harvest index (%)		
	2021	2022	Pooled	2021	2022	Pooled
T_1	67.1	70.2	68.6	32.7	32.5	32.6
T_2	70.3	73.9	72.1	32.8	32.3	32.6
T_3	73.0	76.3	74.7	33.0	32.1	32.6
T_4	77.2	80.9	79.0	33.2	32.0	32.6
T_5	74.9	78.6	76.7	32.9	31.9	32.4
T_6	78.7	82.6	80.7	32.9	31.7	32.3
T_7	81.1	86.4	83.7	32.4	31.2	31.8
T_8	84.3	92.4	88.3	32.3	30.7	31.5
T_9	82.9	89.8	86.4	32.2	30.8	31.5
T_{10}	90.3	96.7	93.5	32.3	31.7	32.0
T_{11}	86.7	94.1	90.4	32.5	30.9	31.7
SEm±	2.92	2.29	2.07	1.42	1.54	1.05
CD @ 5%	6.08	4.79	4.31	NS	NS	NS

Table 5: Effect of organic and inorganic sources of nutrients on protein content in grain and stover (%) of pearl millet in pearl millet-lentil crop sequence

Treatments	Protein content in grain (%)			Protein content in stover (%)		
	2021	2022	Pooled	2021	2022	Pooled
T1	8.98	9.06	9.02	3.29	3.04	3.17
T2	9.83	9.94	9.89	3.48	3.23	3.35
T3	10.06	10.19	10.13	3.60	3.29	3.45
T4	10.73	10.85	10.79	3.79	3.52	3.66
T5	10.42	10.56	10.49	3.69	3.40	3.54
T6	11.06	11.21	11.14	3.90	3.60	3.75
T7	11.38	11.52	11.45	4.00	3.69	3.84
T8	12.04	12.13	12.08	4.23	3.96	4.09
T9	11.71	11.85	11.78	4.13	3.79	3.96
T10	12.69	12.88	12.78	4.44	4.17	4.30
T11	12.25	12.42	12.33	4.31	4.08	4.20
SEm±	0.36	0.29	0.18	0.24	0.17	0.13
CD @ 5%	0.74	0.61	0.38	0.49	0.35	0.27

Harvest index

The harvest index of pearl millet as influenced by different organic and inorganic sources of nutrient management treatments is presented in (Table 4). The harvest index of pearl millet crop at both the years of experimentation and pooled analysis varied from 30.7 to 33.2 % across the treatments. The harvest index did not differ significantly due to various organic and inorganic sources of nutrient management treatments. However, the highest harvest index was recorded with (T_4) 50% RDF + 5 t FYM ha^{-1}, treatment and the lowest harvest was noted in (T_8) 75% RDF + 5 t FYM ha^{-1} treatment during both the years of investigation. Similar results were also reported by Reddy et al. (2021).

Protein content in grain

Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} recorded significantly higher protein content in grain of pearl millet crop (12.69, 12.88, 12.78 %) followed by (T_{11}) 100% RDF (100 kg N + 60 kg P_2O_5 + 40 kg K_2O ha^{-1}) (12.25, 12.42, 12.33 %), (T_8) 75% RDF + 5 t FYM ha^{-1} (12.04, 12.13, 12.08 %), (T_9) 75% RDF + 2.5 t FYM ha^{-1} (11.71, 11.85, 11.78 %), (T_7) 75% RDF ha^{-1} (11.38, 11.52, 11.45 %), (T_6) 50% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} (11.06, 11.21, 11.14 %), (T_4) 50% RDF + 5 t FYM ha^{-1}, (10.73, 10.85, 10.79 %), (T_5) 50% RDF + 2.5 t FYM ha^{-1} (10.42, 10.56, 10.49 %), (T_3) 50% RDF ha^{-1}, (10.06, 10.19, 10.13 %), (T_2) 2.5 t vermicompost ha^{-1} (9.83, 9.94, 9.89 %) compared to (T_1) 5 t FYM ha^{-1} treatment (8.98, 9.06, 9.02 %) respectively, at both the years of experimentation and pooled analysis (Table 5). Similarly, the increase in protein content in grain of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4) > (T_6) > (T_7) > (T_9) > (T_8) > (T_{11}) > (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 9.6, 12.2, 16.3, 19.6, 23.4, 26.9, 30.6, 33.9, 36.7 and 41.7% respectively during the pooled data of the two years respectively. Similar results were also reported by Reddy et al. (2021).

Protein content in stover

Among the organic and inorganic sources of nutrient management treatments, application of (T_{10}) @ 75% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} recorded significantly higher protein content in stover of pearl millet crop (4.44, 4.17, 4.30 %) followed by (T_{11}) 100% RDF (100 kg N + 60 kg

P_2O_5 + 40 kg K_2O ha^{-1}) (4.31, 4.08, 4.20 %), (T_8) 75% RDF + 5 t FYM ha^{-1} (4.23, 3.96, 4.09 %), (T_9) 75% RDF + 2.5 t FYM ha^{-1} (4.13, 3.79, 3.96 %), (T_7) 75% RDF ha^{-1} (4.00, 3.69, 3.84 %), (T_6) 50% RDF + 2.5 t FYM + 1.25 t vermicompost ha^{-1} (3.90, 3.60, 3.75 %), (T_4) 50% RDF + 5 t FYM ha^{-1}, (3.79, 3.52, 3.66 %), (T_5) 50% RDF + 2.5 t FYM ha^{-1} (3.69, 3.40, 3.54 %), (T_3) 50% RDF ha^{-1}, (3.60, 3.29, 3.45 %), (T_2) 2.5 t vermicompost ha^{-1} (3.48, 3.23, 3.35 %) compared to (T_1) 5 t FYM ha^{-1} treatment (3.29, 3.04, 3.17 %) respectively, at both the years of experimentation and pooled analysis(Table-5). Similarly, the increase in protein content in stover of pearl millet crop with: (T_2) > (T_3) > (T_5) > (T_4)> (T_6) > (T_7) > (T_9) > (T_8) > (T_{11}) > (T_{10}) levels of organic and inorganic sources of nutrient management treatments over (T_1) @ 5 t FYM ha^{-1} were 5.9, 8.9, 11.8, 15.5, 18.4, 21.4, 25.0, 29.3, 32.6 and 35.9% respectively during the pooled data of the two years respectively. Similar results were also reported by Reddy et al. (2021).

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