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Response of Little millet (*Panicum sumatrense*) to organic management practices under rainfed condition

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Abstract

A field experiment was conducted during *kharif* 2019, 2020 and 2021 at Agricultural Research Station, Tiptur to study the growth and yield of Little millet as influenced by spacing and organic nutrient management practices. It was laid out in factorial randomized complete block design with three replication comprising of two spacing and six organic nutrient management practices. Soil of the experimental site was red sandy loam classified as *Alfisols*. Among the spacing Narrow spacing of 22.5 cm X 7.5 cm (S₁) recorded significantly higher grain yield (2517 kg/ha, 2402 kg/ha, 2519 kg/ha and 2480 kg/ha, respectively) in 2019, 2020, 2021 and pooled data as compared to wider spacing of 30 cm X 7.5 cm. Application of 125% N equivalent Vermicompost + FYM @ 7.5 t/ha (N₆) recorded significantly higher grain yield (2708 kg/ha) and straw yield (5208 kg/ha) as compared to other organic nutrient sources and levels in three years pooled data. Among the interactions, growing of Little millet with a spacing of 22.5 cm X 7.5 cm with application of 125% N equivalent Vermicompost + FYM @ 5.0 t/ha (S₁N₆) recorded significantly higher grain yield (2736 kg/ha) and straw yield (4924 kg/ha) as compared to others interaction treatments. However it was at par with a spacing of 30 cm X 7.5 cm along with application of 125% N equivalent Vermicompost + FYM @ 7.5 t/ha in grain yield (2680 kg/ha) in three years pooled data.

Keywords: Vermicompost, FYM, little millet, organic nutrient sources and spacing

1. Introduction

Little millet is one of the minor millet, which belongs to the family Poaceae. It is another reliable catch crop because of its earliness and resistance to adverse agro-climatic conditions of high drought as well as water logging. It is grown throughout India and a traditional crop of Karnataka. It is mostly cropped with other millets, pulses and oilseeds. It is generally consumed as rice and any recipe that demands staple rice can be prepared using little millet. It is described as a "quick -growing, short duration cereal which withstands both drought and water logging". Doubtless this is a valuable crop in difficult situations. It occurs as a wild crop in Northern India and South-Eastern Asia. It will yield some grain and useful fodder under very poor conditions.

Millets contains 60.9 g carbohydrates, 12.3g protein, 8.0 g fibre, 3.3g mineral, 2.8mg iron, and 31 mg calcium per 100 gm and food energy 331 kilo calorie (Sarita, 2016; Vanithasri *et al.*, 2012; Banerjee and Maitra, 2018) ^[8, 11, 2]. They are rich source of phytochemicals and micronutrients. It also provides different health benefits as it improves glycemic control, inhibits hyper-insulinemia and decreases lipid concentrations in patient with type-2 diabetes (Jali *et al.*, 2012) ^[6].

The crop is a balanced and staple food for tribal and economically poor sections of the population. It provides low priced proteins, minerals and vitamins in the form of sustainable food. The stover is a good fodder for cattle. Each 100 g little millet grain contains 65.5 g carbohydrate, 10.1 g protein, 3.89 g fat, 346 Kcal energy, 7.7 g dietary fiber, 16.1 mg calcium, 130 mg phosphorus, 91 mg magnesium, 1.8 mg zinc, 1.2 mg iron, 0.26 mg thiamin, 0.05 mg riboflavin, 1.3 mg niacin and 362µg folic acid (Venkatesh Bhat *et al.* 2018) ^[12].

Millets are small seeded coarse cereals; that belongs to the family Poaceae, widely cultivated in the world, mainly in Eurasia and Africa in arid and tropical regions. Minor millets were important food crops of the past and presently claimed as the future foods considering the ill

effects of global warming and climate change pronounced more prominently in fragile ecological conditions. These can be adapted to a wide range of temperature, moisture-regime and input conditions and can be a potential option for providing food and feed to millions of smallholders of drylands and domestic animals. Moreover, as C4 plant, millets sequester carbon, thereby adding to CO₂ reduction opportunities, contribute to improved agro biodiversity by their diversity and allow mutually beneficial intercropping with other vital crops (BrahmaChari *et al.* 2018) [2]. The acreage of small millets in India is around 7.0 lakh ha with productivity of 633 kg ha⁻¹ (Anbukkani *et al.* 2017) [1].

Organic manures are the key components in Integrated nutrient Management of millets under rainfed conditions. The normal requirement of FYM for different crops ranges from 5 to 15 t ha⁻¹. However, the availability of organic manures is decreasing due to the reduction in cattle population and hence, an alternate and locally available organic fertilizer source needs the demand and for avoiding complete reliance on organic manures. Recycling of crop residues/stubbles into useful manure is a sound option and is the need of the hour, apart from being an environmentally viable technology (Sudheendra).

Farmyard manure occupies an important position among organic manures. FYM seems to act directly by increasing crop yield by acceleration of respiratory process or by cell permeability or by hormonal growth action. Under organic management, nutrients release and crop demand synchrony is very much required; hence, a thorough understanding of nutrients release pattern from organic sources is essential to avoid nutrients stress. "FYM application has been reported to improve crop growth by supplying plant nutrients including micronutrients as well as improving soil physical, chemical, and biological properties" [Dejene, *et al.*, 2011] [4]. "Faster water infiltration rate due to enhanced soil aggregation is the other benefit of FYM amendments to soil".

Material and Methods

The field study was conducted during *kharif* seasons of 2019, 2020 and 2022 at Agricultural Research Station, Tiptur. The experiment was laid out in factorial randomized complete block design in which Factor 1 comprised of two spacing (S₁: 22.5 cm × 7.5 cm and S₂: 30 cm × 7.5 cm) and Factor 2 comprised of Six nutrient levels through organic manures (N) (N₁: 75% N equivalent through FYM + FYM 5 t/ha, N₂: 100% N equivalent through FYM + FYM 5 t/ha, N₃: 125% N equivalent through FYM + FYM 5 t/ha, N₄: 75% N equivalent through Vermicompost + FYM 7.5 t/ha, N₅: 100% N equivalent through Vermicompost + FYM 7.5t/ha and N₆: 125% N equivalent through Vermicompost + FYM 7.5t/ha).

The N Equivalent organic manures supplied through FYM and Vermicompost. The Recommended N equivalent FYM, Vermicompost and recommended FYM are applied 15 days before sowing of Foxtail millet. The Little millet sown 15 days after organic manures applied and little millet was harvested at 100 to 110 days after sowing.

The initial soil available nutrient analysed by soil sampling before organic manures are applied. The observations like Plant height (cm), Grain yield (kg/ha) and straw yield

(kg/ha) were recorded at harvest. The mean values were subjected to t-test analysis.

Results and Discussion

1. Grain yield (kg/ha)

Among spacing narrow spacing of 22.5 cm X 7.5 cm (S₁) found optimum for Little millet to get significantly higher grain yield (2517 kg/ha, 2402 kg/ha, 2519 kg/ha and 2480 kg/ha, respectively) during 2019, 2020, 2021 and pooled data respectively as compared to wider spacing of 30 cm X 7.5 cm (2371 kg/ha, 2232 kg/ha, 2369 kg/ha and 2324 kg/ha, respectively) (Table.1).

Application of 125% N equivalent Vermicompost + FYM @ 7.5 t/ha (N₆) recorded significantly higher grain yield (2776 kg/ha, 2570 kg/ha, 2806 kg/ha and 27180 kg/ha) in 2019, 2020, 2021 and pooled data respectively (Table.1) as compared to other organic nutrient sources and levels. Among the interactions, growing of Little millet with a spacing of 22.5 cm X 7.5 cm with application of 125% N equivalent Vermicompost + FYM @ 5.0 t/ha (S₁N₆) recorded significantly higher grain yield (2783 kg/ha, 2641 kg/ha, 2813 kg/ha and 2746 kg/ha) in 2019, 2020, 2021 and pooled data respectively (Table.1) as compared to other interaction treatments. The significantly higher yield might be due to the higher production efficiency that has been reflected through improvement in different yield attributing characters. Similar findings were reported by Chamely *et al.* (2015) [3] and (Hari Kumar *et al.*, 2022) [5].

2. Straw yield (kg/ha)

Among spacing narrow spacing of 30 cm X 7.5 cm found optimum for Little millet to get significantly higher grain yield (5634 kg/ha, 3909 kg/ha, 5660 kg/ha and 5068 kg/ha, respectively) during 2019, 2020, 2021 and pooled data respectively as compared to wider spacing of 22.5 cm X 7.5 cm (5215 kg/ha, 3254 kg/ha, 5190 kg/ha and 4553 kg/ha, respectively) (Table.1).

Application of 125% N equivalent Vermicompost + FYM @ 7.5 t/ha (N₆) recorded significantly higher Straw yield (6444 kg/ha, 3876 kg/ha, 5604 kg/ha and 5308 kg/ha) in 2019, 2020, 2021 and pooled data respectively (Table.1) as compared to other organic nutrient sources and levels. Among the interactions, growing of Little millet with a spacing of 22.5 cm X 7.5 cm with application of 125% N equivalent Vermicompost + FYM @ 5.0 t/ha recorded significantly higher grain yield (6903 kg/ha, 3410 kg/ha, 6167 kg/ha and 5493 kg/ha) in 2019, 2020, 2021 and pooled data respectively (Table.1) as compared to other interaction treatments. The beneficial response of organic manures to dry matter and yield attributes might also be attributed to the availability of sufficient amounts of easily utilizable from of plant nutrients throughout the growth period and especially at critical growth periods of crop resulting in better uptake, vigour plant and superior yield attributes. The results were found to be similar with Togas *et al.* (2017) [10].

3. Harvest index (HI)

Among spacing narrow spacing of 22.5 cm X 7.5 cm found optimum for Little millet to get significantly higher grain yield (0.328, 0.431, 0.329 and 0.354, respectively) during 2019, 2020, 2021 and pooled data respectively as compared to wider spacing of 30 cm X 7.5 cm (0.298 kg/ha, 0.369 kg/ha, 0.397 kg/ha and 0.314 kg/ha, respectively) (Table.1).

Table 1: Effect of plant geometry and organic manures on grain yield, Straw yield and HI of Little millet.

Treatments	Grain Yield (kg/ha)				Straw yield (kg/ha)				HI			
	2019	2020	2021	Pooled	2019	2020	2021	Pooled	2019	2020	2021	Pooled
Factor 1: Spacing (S)												
S ₁	2517	2402	2519	2480	5215	3254	5190	4553	0.328	0.431	0.329	0.354
S ₂	2371	2232	2369	2324	5634	3909	5660	5068	0.298	0.369	0.297	0.314
S.E.m. ±	39.71	54.42	39.75	31.04	42.10	168.20	42.10	58.96	0.004	0.011	0.003	0.003
CD @ 5%	116.46	159.62	116.58	91.04	123.47	493.31	123.47	172.91	0.011	0.033	0.009	0.010
Factor 2: Nutrient levels through organic manures (N)												
N ₁	2166	2050	2165	2127	4438	2880	5528	4282	0.331	0.426	0.282	0.335
N ₂	2388	2168	2353	2303	5604	3101	4181	4295	0.297	0.419	0.361	0.351
N ₃	2471	2335	2499	2435	5507	3851	5028	4795	0.309	0.383	0.333	0.337
N ₄	2360	2372	2401	2378	4625	4184	6326	5045	0.341	0.365	0.276	0.321
N ₅	2506	2407	2471	2461	5931	3900	5882	5237	0.297	0.386	0.295	0.320
N ₆	2776	2570	2806	2718	6444	3876	5604	5308	0.302	0.420	0.332	0.342
S.E.m. ±	68.77	94.26	68.85	53.76	72.92	291.33	72.92	102.12	0.006	0.020	0.006	0.006
CD @ 5%	201.71	276.46	201.92	157.68	213.86	854.45	213.86	299.49	0.019	0.057	0.016	0.017
Interaction												
S ₁ N ₁	2270	2156	2269	2232	3806	2252	5069	3709	0.373	0.488	0.308	0.375
S ₁ N ₂	2436	2270	2436	2381	5042	2763	3806	3870	0.326	0.455	0.390	0.381
S ₁ N ₃	2617	2363	2547	2509	5653	3429	5361	4814	0.316	0.410	0.322	0.343
S ₁ N ₄	2450	2456	2464	2456	4694	3645	5750	4696	0.343	0.403	0.300	0.343
S ₁ N ₅	2547	2530	2617	2564	5986	3743	5042	4924	0.294	0.413	0.300	0.326
S ₁ N ₆	2783	2641	2813	2746	6903	3410	6167	5493	0.317	0.416	0.355	0.357
S ₂ N ₁	2061	1944	2061	2022	5069	3507	5986	4854	0.289	0.365	0.256	0.295
S ₂ N ₂	2339	2067	2269	2225	6167	3439	4556	4720	0.269	0.383	0.332	0.321
S ₂ N ₃	2325	2307	2450	2361	5361	4272	4694	4776	0.303	0.355	0.343	0.331
S ₂ N ₄	2269	2289	2339	2299	4556	4722	6903	5394	0.339	0.328	0.253	0.299
S ₂ N ₅	2464	2285	2325	2358	5750	4105	5653	5169	0.300	0.359	0.291	0.314
S ₂ N ₆	2769	2500	2769	2680	6111	3694	6111	5305	0.286	0.423	0.310	0.328
S.E.m. ±	97.26	133.31	97.36	76.03	103.12	412.01	103.12	144.41	0.009	0.028	0.008	0.008
CD @ 5%	285.26	390.98	285.55	222.99	302.45	1208.37	302.45	423.55	0.027	0.081	0.023	0.024

4. Plant height (cm)

Among the spacing there is no significant difference in Plant height during 2019, 2020, 2021 and pooled data (Table.2). Application of 125% N equivalent Vermicompost + FYM @ 7.5 t/ha (N₆) recorded significantly higher grain yield (130.37 cm, 125.59 cm, 131.66 cm and 129.11 cm) in 2019, 2020, 2021 and pooled data respectively (Table.2) as compared to other organic nutrient sources and levels. Among the interactions, growing of Little millet with a spacing of 22.5 cm X 7.5 cm with application of 125% N

equivalent Vermicompost + FYM @ 5.0 t/ha recorded significantly higher grain yield (122.31 cm, 128.17 cm, 133.77 cm and 133.57 cm) in 2019, 2020, 2021 and pooled data respectively (Table.2) as compared to other interaction treatments. Organic manure influence both growth and yield by improving supply of plant micronutrients need and thus help to sustain crop productivity (Montaghian *et al.* 2008). This resulted in the higher plant height and the results are in close conformity with the findings of Raundal and Patil (2017)^[7] and Togas *et al.* (2017)^[10].

Table 2: Effect of plant geometry and organic manures on plant height of Little millet

Treatments	Plant height (cm)			
	2019	2020	2021	Pooled
Factor 1: Spacing (S)				
S ₁	124.14	123.24	123.06	123.48
S ₂	123.75	127.21	124.84	125.27
S.E.m. ±	0.88	2.19	0.88	0.90
CD @ 5%	NS	NS	NS	NS
Factor 2: Nutrient levels through organic manures (N)				
N ₁	124.05	127.71	128.35	126.70
N ₂	122.66	122.46	121.49	122.20
N ₃	122.06	124.79	124.68	123.84
N ₄	124.32	125.00	125.58	124.96
N ₅	120.24	126.08	120.95	122.42
N ₆	130.37	125.29	131.66	129.11
S.E.m. ±	1.52	2.07	1.52	1.03
CD @ 5%	4.45	6.06	4.45	3.03
Interaction				
S ₁ N ₁	120.66	127.33	127.43	127.43
S ₁ N ₂	126.73	124.33	120.66	120.66
S ₁ N ₃	121.09	119.50	123.03	123.03
S ₁ N ₄	126.32	121.83	119.68	119.68

S ₁ N ₅	120.80	120.58	120.80	120.80
S ₁ N ₆	122.31	128.17	137.77	133.57
S ₂ N ₁	127.43	128.08	129.26	129.26
S ₂ N ₂	118.59	120.58	122.31	122.31
S ₂ N ₃	123.03	130.08	126.32	126.32
S ₂ N ₄	129.26	125.83	126.73	126.73
S ₂ N ₅	119.68	131.58	121.09	121.09
S ₂ N ₆	131.47	124.75	118.59	118.59
S.Em. ±	2.15	2.92	2.15	2.15
CD @ 5%	6.30	8.57	6.30	6.30

Conclusion

Sowing of Little millet at the spacing of 22.5 cm X 7.5 cm with application of 125% N equivalent Vermicompost + FYM @ 5.0 t/ha was found to enhance productivity, soil fertility and economics.

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