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REGULAR ARTICLE

RESPONSE OF PEARL MILLET TO INTEGRATED USE OF ORGANICS AND FERTILIZERS

N. SENTHILKUMAR*, P. POONKODI, N. PRABHU

Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalai Nagar 608 002, Tamil Nadu, India

ABSTRACT

In the present study, the integrated organic fertilizers were used to estimate the growth and yield of pearl millet. The treatments consisted of application of increased levels of recommended dose of fertilizer with organic manures for pearl millet. The treatments were; T_1-100% RDF, T_2-125% RDF, T_3-75% RDF, T_4-100% RDF+FYM @ 12.5 t ha^{-1}, T_5-100% RDF+Poultrymanure@5tha^{-1},T_6-100 % RDF+Vermicompost @ 5 t ha^{-1}, T_7-100 % RDF+Pressmud@5tha^{-1}, T_8-125% RDF+Poultry manure @ 5 t ha^{-1}, T_9-125 % RDF+Vermicompost @ 5 t ha^{-1}, T_{10}-125 % RDF+Pressmud @ 5 t ha^{-1}, T_{11}-75% RDF+Poultry manure @ 5 t ha^{-1}, T_{12}-75 % RDF+Vermicompost @ 5 t ha^{-1} and T_{13}-75 % RDF+Pressmud @ 5 t ha^{-1}. The experiments were laid out in randomized block design (RBD) and replicated thrice. The result of the experiment revealed that the application of 125% recommended dose of fertilizer+vermicompost@5tha^{-1}(T_9), significantly increased the growth, yield, quality and nutrient uptake of pearl millet followed by, T_{10} (125% recommended dose of fertilizer+Pressmud @ 5 t ha^{-1}) respectively.

Keywords: Inorganic fertilizer, Organic sources, Growth, Stover and grain yield

INTRODUCTION

Pearl millet [*Pennisetum glaucum*) is one of the important millet crop of hot and dry areas of arid and semi-arid climatic condition [1]. It has been estimated that pearl millet embodies a tremendous productivity potential particularly in areas having extreme environmental stress condition on account of drought [2]. Pearl millet grain is more nutritious with high protein of good quality. The grain contains 11-19 per cent protein, 60-78 per cent carbohydrates and 3.0-4.6 per cent fat good amount of phosphorus and iron [3]. India is one of the main producers of pearl millet [2]. It is a dual purpose crop of arid and semiarid areas as it provides cheap food, comparatively rich in various nutrients, protein, fat, carbohydrates and minerals for poor masses and feed for poultry birds as well as green fodder for cattle [4].

Recycling of agricultural and industrial wastes and utilization in agriculture as an alternative to fertilizer is promising [5]. Integrated use of chemical fertilizers with organics has been found to be quite promising in maintaining high productivity and greater stability for crop production [6]. Vermicompost improves microbial load in soil and increases microbial availability of phosphorus and nitrogen [7]. Green revolution in India witnessed phenomenal increase in fertilizer consumption and it may not be desirable to spend huge sum of money towards the import of fertilizers [8]. More–over, the present hike in the prices of chemical fertilizers has compelled the Indian farmers to resort to imbalance nutrition for their crops and thus reduction in crop yields. At this critical juncture, there is an urgent need to optimize nutrient recycling to sustain crop production without affecting soil health and protecting the environment. Keeping in view of the above situation, the present investigation was carried out to study the integrated organic fertilizers were used to estimate the growth and yield of pearl millet.

Research methodology

A field experiment was conducted during 2016 at Venganur village, Perambalur district, Tamil Nadu with pearl millet *cv.* CO-7 to study the effect of integrated nutrient management on yield of pearl millet and soil health. The experimental soil was clay loam with a pH of 7.85, EC of 0.43 dSm^{-1} and CEC of 30.40 cmol (p^+) kg^{-1}. The available nitrogen, phosphorus, potassium and sulphur contents were 272, 14, 255 kg $ha^{-1}$and 12.5 mg kg^{-1}respectively. The exchangeable calcium, magnesium, potassium and sodium contents were 8.8, 7.9, 6.9 and 6.5 cmol (p^+) kg^{-1} respectively. The treatments consisted of application of increased levels of recommended dose of fertilizer with organic manures for pearl millet.

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*Corresponding Author

N. Senthilkumar

Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalai Nagar 608 002, Tamil Nadu, India

Email: senthilkumar.n.au@gmail.com

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The treatments were; T_1-100% RDF, T_2-125% RDF, T_3-75%RDF, T_4-100% RDF+FYM @ 12.5 t ha^{-1}, T_5-100% RDF + Poultry manure@5tha^{-1}, T_6-100 % RDF+ Vermicompost @ 5 t ha^{-1}, T_7-100 % RDF+ Pressmud @5tha^{-1}, T_8-125% RDF + Poultry manure @ 5 t ha^{-1}, T_9-125 % RDF + Vermicompost @ 5 t ha^{-1}, T_{10}-125 % RDF+ Pressmud @ 5 t ha^{-1}, T_{11}-75% RDF + Poultry manure @ 5 t ha^{-1}, T_{12}-75 % RDF+Vermicompost @ 5 t ha^{-1} and T_{13}-75 % RDF + Pressmud @ 5 t ha^{-1}. The experiments were laid out in randomized block design (RBD) and replicated thrice. The recommended dose of fertilizers *viz*., 70: 35: 35 kg N: P_2O_5: K_2O ha^{-1} nitrogen was split application, phosphorus and potassium applied basal dose to all plots. The growth attribute *viz.,* plant height was recorded on 30, 60 and 90th days after transplanting. The number of tillers per hill was recorded on 60 and 90thdays after transplanting. The ear head weight, length, girth and thousand grain weight was recorded at harvest. The stover and grain yield were recorded at harvest. The ash, protein and fibre contents were also estimated in the grain at harvest stage. The nutrient uptake *viz.,* N, P, K, S, Ca, Mg, Na and K by stover and grain at harvest were computed from the dry matter production stover and grain yield and their nutrient contents (N, P, K, S, Ca, Mg, Na and K). The available nutrient status of post-harvest soils was analysed. The experimental data were statistically analyzed by the method described by Snedecor and Cochran [9].

RESULTSAND DISCUSSION

Physico–chemical properties of initial experimental soil

The initial soil was analysed for the physico–chemical properties and the results are furnished in table 1. The soil of Venganur village was found to contain 51.20, 11.10, and 36.80 per cent sand, silt and clay respectively, being to the textural class of clay loam. The bulk density, partial density, pore space, pH, electrical conductivity and cation exchange capacity of the soil were 1.25, 2.60 Mg m^{-3} 37.5per cent, 7.85, 0.43 dSm^{-1} and 30.4 cmo (p^+) kg^{-1} respectively. The organic carbon content of soil was 0.51 g kg^{-1}. The available N, P and K content of soil was 271, 14 and 255 kg ha^{-1} respectively. The available Sulphur content was 12.5 mg kg^{-1}. The exchangeable calcium, magnesium, potassium and sodium content were 8.8, 7.9, 6.5 and 6.9 cmol (p^+) kg ha^{-1}respectively.

Growth components

Plant height

The data on plant height recorded at 30, 60 and 90 DAT are presented in table 2. Among the different treatments, the highest plant height was recorded under 125% recommended NPK+vermicompost @ 5 t ha^{-1}(T_9) at all stage of crop growth. This treatment was found to be significantly superior to other treatments by recording the highest plant height of 56.77, 175.20 and 182.60 cm at 30, 60 and 90 DAT respectively. It was followed by the treatments *viz.,* 125% RDF+pressmud @ 5 t ha^{-1} (T_{10}), 125% RDF+poultry manure @ 5 t ha^{-1}(T_8), 100% RDF+ vermicompost @ 5 t ha^{-1}(T_6), 100% RDF+vermicompost @ 5 t ha^{-1}(T_7), 100% RDF+ poultrymanure @ 5 t ha^{-1}(T_5), 100% RDF+FYM @ 12.5 t ha^{-1}(T_4), 75 % RDF+ vermicompost @ 5 t ha^{-1} (T_{12}), 75 % RDF+pressmud @ 5 t ha^{-1} (T_{13}), 75 % RDF+poultry manure @ 5 t ha^{-1} (T_{11}), 125 % RDF (T_2) and 100 % RDF (T_1) at all the stages of crop growth. The least plant height of 15.17, 67.56 and 71.57 cm at 30,60 and 90 DAT respectively were recorded in the treatment T_3 (75% RDF)

Number of tillers $hill^{-1}$

Among the different treatments tried, the maximum number of tillers per hill was noticed with application of 125% recommended fertilizer+vermicompost @ 5 t ha^{-1}(T_9) recording 7.47 and 8.40 at 60 and 90 DAT respectively. This was followed by T_{10} (125% recommended fertilizers+ pressmud @ 5 t ha^{-1} recording 6.99 and 7.88 at 60 and 90 DAT respectively. This treatment was followed by T_8, T_6, T_7, T_5, T_4, T_2, and T_1. The least number of tillers per $hill^{-1}$ 1.77 and 2.19 at 60 and 90 DAT respectively were recorded in control (T_3). These results are in agreement with findings of Chellamuthu and Agrawal [10] who also reported significant improvement in growth parameters of pearl millet due to fertilizer application. Other findings [11,12] also supports these findings.

Ear head characters

Earhead weight, length and girth

The earhead weight, earhead length and earhead girth of pearl millet were significantly influenced by the level of organic manures (vermicompost, pressmud, and poultry manure). Among the different treatments tried, application of 125% RD NPK+vermicompost @ 5 t ha^{-1}(T_9) recorded the maximum weight of earhead (54.83 gm), length of earhead (32.08 cm) and girth of earhead (9.96 cm). This was followed by 125% RDF NPK+pressmud @ 5t ha^{-1} (T_{10}), which recorded a earhead weight, length and girth of 51.96 gm, 30.17 and 9.17 cm respectively at harvest. The treatments next in order were T_{10}, T_6, T_7, T_5, T_4, T_2, and T_1. The lowest earhead weight, length and girth of 20.38 gm, 8.69 and 2.83 cm respectively at harvest were recorded in control (T_3)

Yield

Grain yield

The data recorded on grain yield are presented in table 3. Among the various treatments tried, recommended 125% NPK + vermicompost @ 5 t ha^{-1} (T_9) recorded the highest grain yield of 3,445 kg ha^{-1}. The treatments next in order were T_{10}, T_8, T_6, T_7, T_5 and T_4. The least grain yield of 1,140 kg $ha^{-1}$was observed under T_3 (75% RDF)

Stover yield

The recorded data on stover yield are presented in table 3. The stover yield was significantly influenced by the application of 125% RDF+vermicompost @ 5 t ha^{-1} (T_9), which registered the highest stover yield of 7,530 kg ha^{-1}. The treatments *viz.,* T_{10}, T_8, T_6, T_7, T_5, T_4, T_{12}, T_{13}, T_{11}, T_2 and T_1, stood next in order of ranking. The treatment T_3 75% RDF registered the lowest stover yield of 2,296 kg ha^{-1}

The yield attributes like earhead weight, length and girth were significantly increased by the application of 125% recommended dose of fertilizers+vermicompost @ 5 t ha^{-1} (T_9), followed by the application of 125% recommended fertilizers + pressmud @ 5 t ha^{-1} (T_{10}). The increased level of fertilizer with organics significantly increased the yield components of pearl millet. Similar effect of integration of inorganic and organics sources of plant nutrients on crop production was earlier reported earlier [13-15].

Significantly, the higher grain yield was recorded with 120 kg N ha^{-1}over rest of the levels except 90 kg Nha^{-1}. The higher grain yield could be due to cumulative effect of improvement in yield attributes *viz*., number of effective tillers $plant^{-1}$, ear head length, thickness and test weight.

Further, yield improvement was possible on account of better nitrogen use efficiency as was evident from the higher nitrogen uptake under this level. Stover yield was also significantly increased up to 120 kg Nha^{-1}. The improvement in stover yield was mainly on account of increase in growth parameters due to higher level of N 120 kg ha^{-1}. These data are in agreement with earlier findings [11, 16-18].

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the present field experiment, it is concluded that, the application of 125 % recommended fertilizer+vermicompost @ 5 t ha^{-1} was significantly superior in performance with respect to growth, yield attributes, yield and quality attributes of pearl millet and found to be effective in improving the post-harvest soil fertility and nutrient uptake by pearl millet. It can be recommended to farmers to achieve more benefit out of giving pearl millet as a poor man crop.

Table 1: Physico-chemical properties of initial soil

I	Physical properties	Contents
a	Sand (%)	51.2
	Silt (%)	11.5
	Clay (%)	36.8
	Textural class	Clay loam
	Bulk density (Mg m^{-3})	1.25
	Partical density (Mg m^{-3})	2.60
	Pore space (%)	37.5
	Soil colour	10 YR 4/1 (dark gray)
II	**Physic-chemical properties**	
1	pH	7.85
2	EC (dSm^{-1}) (harmless)	0.43
3	Organic carbon (g kg^{-1}) (low)	0.50
4	CEC (cmol (p^+)kg^{-1}) (high)	30.40
5	**Available macronutrients**	
i	Akaline $KMnO_4$ (kg ha^{-1}) (low)	271.6
ii	Olsen's–p (kg ha^{-1}) (medium)	14.0
iii	NH_4OAC–K (kg ha^{-1}) (medium)	255.0
iv	Available sulphur (mg kg^{-1}) (medium)	12.15
6	**Exchangeable cations**	
A	Ca (cmol (p^+) kg^{-1})	8.8
B	Mg (cmol (p^+) kg^{-1})	7.9
C	Na (cmol (p^+) kg^{-1})	6.5
D	K (cmol (p^+) kg^{-1})	6.9

Table 2: Effect of integrated nutrient management on plant height of pearl millet

Treatment details	Plant height (cm)		
	30 DAT	60 DAT	90 DAT
T_1–100% RDF	19.17	76.53	80.66
T_2–125% RDF	22.59	85.52	89.56
T_3–75% RDF	15.17	67.56	71.57
T_4–100% RDF+FYM @12.5 t ha^{-1}	36.27	121.42	126.42
T_5–100% RDF+Poultry manure @ 5 t ha^{-1}	39.68	130.39	137.14
T_6–100% RDF+Vermicompost @ 5 t ha^{-1}	46.51	148.33	149.27
T_7–100% RDF+Pressmud @ 5 t ha^{-1}	43.07	139.35	138.27
T_8–125% RDF+Poultry manure @ 5 t ha^{-1}	49.94	157.27	160.37
T_9–125% RDF+Vermicompost @ 5 t ha^{-1}	56.77	175.20	182.60
T_{10}–125% RDF+Pressmud @ 5 t ha^{-1}	53.36	166.23	171.48
T_{11}–75% RDF+Poultry manure @ 5 t ha^{-1}	26.01	94.49	99.29
T_{12}–75% RDF+Vermicompost @ 5 t ha^{-1}	32.85	112.44	125.02
T_{13}–75% RDF+Pressmud @ 5 t ha^{-1}	29.44	103.47	107.91
S. Ed	1.63	4.04	4.35
CD(p=0.05)	3.37	8.34	8.97

Table 3: Effect of integrated nutrient management on ear head weight, length, girth, stover and grain yield of pearl millet

Treatments	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Percentage increase over control	Earhead weight (gm)	Earhead length (cm)	Earhead girth (cm)
T_1–100% RDF	1336	2729	17.19	23.24	10.65	3.41
T_2–125% RDF	1531	3147	34.29	26.12	12.59	3.98
T_3–75% RDF	1140	2296	-	20.38	8.69	2.83
T_4–100% RDF+FYM @12.5 t ha^{-1}	2302	4909	101.29	37.60	20.39	6.26
T_5–100% RDF+Poultry manure @ 5 t ha^{-1}	2495	5340	118.85	40.48	22.36	6.85
T_6–100% RDF+Vermicompost @ 5 t ha^{-1}	2880	6224	152.63	46.23	26.49	8.02
T_7–100% RDF+Pressmud @ 5 t ha^{-1}	2689	5783	135.87	43.37	24.32	7.44
T_8–125% RDF+Poultry manure @ 5 t ha^{-1}	3073	6652	169.56	49.10	28.25	8.59
T_9–125% RDF+Vermicompost @ 5 t ha^{-1}	3455	7530	203.07	54.83	32.08	9.76
T_{10}–125% RDF+Pressmud @ 5 t ha^{-1}	3263	7088	186.22	51.96	30.17	9.17
T_{11}–75% RDF+Poultry manure @ 5 t ha^{-1}	1723	3583	51.14	28.99	14.53	4.55
T_{12}–75% RDF+Vermicompost @ 5 t ha^{-1}	2110	4461	85.05	34.73	18.45	5.68
T_{13}–75% RDF+Pressmud @ 5 t ha^{-1}	1917	4061	68.15	31.86	16.5	5.11
S. Ed	83.54	192.47		1.26	0.64	0.22
CD(p=0.05)	172	397		2.60	1.33	0.46

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