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Influence of integrated nutrient management on growth attributes and yield of foxtail millet in red soil

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Abstract

A field experiment was conducted to evaluate the effect of Integrated Nutrient Management on growth and yield of foxtail millet in Madurai district. The treatments enclosed with various combinations of organic (FYM, Vermicompost, Poultry manure, Neemcake) and inorganic sources (Urea, Single Super Phosphate) along with bio-fertilizer (Azophos). The results revealed that combined use of organic and inorganic sources along with bio-fertilizers were significantly influenced the growth parameters and grain yield in red soil. Application of 50% RDF + 25% Neem cake N Based + 25% Bio-fertilizer (T15) superior effect on plant height, number of tillers, panicle length, Test weight, grain and straw yield.

Keywords: Organic manures, inorganic fertilizers, Bio-fertilizers, growth and yield attribute

Introduction

Foxtail millet (*Setaria italica*) is an important cereal crop grown under arid and semi-arid region of the world. It commonly called as Thenai or Italian millet. It originated in India, China and Japan. The Major production centre is China and India. It is a staple food for humans have a better health and nutritional security. In India 9.1 m.ha areas under the cultivation of foxtail millet and its production are 7.3 m.ha and its productivity 780 kg ha⁻¹. It has high content of calcium, dietary fiber and phenolic compounds. In 100g of foxtail millet grain contains excellent source of good Fibre 8g; Protein 12.3g; Carbohydrates 60.9g; Fat 4.3g; Calcium 31mg; Iron 2.8mg; Phosphorus 290mg; Vitamins 3.3g; Amino acids; Minerals 3.3g and food energy 323-350 K Cal (Vanithasri *et al.*, 2012) [15]. In order to, improves the productivity of foxtail millet with various combinations of nutrient sources. Among that, FYM was improved the fertilizer use efficiency, physical property and conserves the fertility of soil (Khan *et al.*, 2010) [6]. It supplies approximately 33 million tonnes of NPK per year in India. Vermicompost contain vitamins and growth hormones enhance plant growth, build up soil nutrient and sustaining the yield of crop and it improves the water holding capacity, physical, chemical and biological property of soil and sustaining soil fertility (Sanjivkumar *et al.*, 2009). Poultry manure had highest nitrogen content (40-70% of total N) for the reason that contain a huge amount of uric acid (Murakami *et al.*, 2011) and it reduce the loss of nitrogen due to slow release pattern of manures (Govindappa *et al.*, 2009) [2]. Neem cake is a natural product rich in Nitrogen, Phosphorus, Sulphur and Calcium. It had more fertile due to ingredient block the microbial activity from conversion of nitrogenous compound to Nitrogen gas. It acts as a Nitrogen inhibitor. Azophos is a consortium of Azospirillum and Phosphobacteria (50:50) and it improves the biological fixation of Nitrogen and solubilization of Phosphorus to enhance the availability of nutrient to crop (Ibrahim *et al.*, 2015) [5]. Integration of organic, inorganic and bio-fertilizer play a pivotal role to enhancing crop productivity, sustaining a soil health and reduce environmental impact. Since the combined effect of organic and inorganic sources along with bio-fertilizers are improved the crop growth and yield with cost effective is delivered.

Materials and Methods

The experimental study area was situated in kalligudi block, Madurai, Tamil Nadu, it geographically located at 9° 6' N Latitude and 77° 95' E Longitude. Red soil was sandy loam in texture, neutral in nature (7.61) and EC was 0.17 d Sm⁻¹. It contains 182 kg ha⁻¹ of alkaline permanganate N, 9.8 kg ha⁻¹ of Olsen P, 318 kg ha⁻¹ of Neutral Normal ammonium acetate K and 0.42% of wet digested OC. The fifteen treatments were replicated thrice in a Randomized Block Design (RBD).

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Foxtail millet variety CO (Te) 7 was sown at 5 x 4 (20 m²) plot. Uniform fertilization was allocated equivalent to recommend nitrogen as per the crop. The treatments combinations were T₁: Absolute Control; T₂: 100 per cent RDF (44:22:0); T₃: 100 per cent N as FYM; T₄: 100 per cent N as Vermicompost; T₅: 100 per cent N as Poultry Manure; T₆: 100 per cent N as Neem cake; T₇: 75 per cent RDF + 25 per cent N as FYM; T₈: 75 per cent RDF + 25 per cent N as Vermicompost; T₉: 75 per cent RDF + 25 per cent N as Poultry Manure; T₁₀: 75 per cent RDF + 25 per cent N as Neem cake; T₁₁: 75 per cent RDF + 25 per cent Azophos; T₁₂: 50 per cent RDF + 25 per cent N as FYM + 25 per cent Azophos; T₁₃: 50 per cent RDF + 25 per cent N as Vermicompost + 25 per cent Azophos; T₁₄: 50 per cent RDF + 25 per cent N as Poultry Manure + 25 per cent Azophos; T₁₅: 50 per cent RDF + 25 per cent N as Neem cake + 25 per cent Azophos; used for the study.

From each plot five plants were selected at random and recorded growth and yield parameters at corresponding stages.

Results and Discussion

Plant height

The importance of the study stated that integrated use of fertilizers was significantly influenced the plant height, no. of tillers, panicle length, Test weight, grain and straw yield of foxtail millet. Application of 50% RDF + 25% Neem cake N Based + 25% Bio-fertilizer (T₁₅) significantly registered the highest plant height (132.3 cm), followed by 50% RDF + 25% Poultry manure N Based + 25% Bio-fertilizer (T₁₄) was found that statistically on par with 50% RDF + 25% Vermicompost N Based + 25% Bio-fertilizer (T₁₃) and 75% RDF with 25% Neem cake N Based (T₁₀). The plant height of foxtail millet increased from tillering to harvest, which is a quite natural phenomenon. The higher soil available NPK during crop growth might have helped the plant to absorb adequate nutrients and improved the plant growth. This is in line with the findings of Togas *et al.* (2017)^[14], Pallavi (2014)^[8] who observed increase in the plant height of finger millet with increasing levels of N.

Number of productive tillers

The number of tillers per plant increased with different combinations of organic and inorganic sources along with bio-fertilizers. The different combinations was significantly influenced the total tiller numbers as compared to control. Application of 50% RDF + 25% Neem cake N Based + 25% Bio-fertilizer (T₁₅) was significantly altered the number of tiller per plant (7.2), followed by 50% RDF + 25% Poultry manure N Based + 25% Bio-fertilizer (T₁₄). Absolute control (T₁) had the lowest number of tillers per plant (3.2). Organic manures had a more role to supply, all vital nutrients required by the plants. N being the growth element is reported to increase the tiller numbers. In the present investigation Integrated use of manures and fertilizers was improved the

plant growth parameters compared to application manures and fertilizers alone. These results corroborate with the findings of Rakesh *et al.* (2014)^[9], Thumar *et al.* (2016)^[13], Husain *et al.* (2017).

Panicle length

Increase in N recorded progressive increase in panicle length with the highest panicle length (17.8 cm) recording at 50% RDF + 25% Neem cake N Based + 25% Bio-fertilizer (T₁₅), followed by 50% RDF + 25% Poultry manure N Based + 25% Bio-fertilizer (T₁₄). Addition of excess doses N to plant have helped to enhancement of plant growth similar results reported from Husain *et al.* (2017)^[4], Senthilkumar *et al.* (2018)^[10].

Test weight (1000 grains)

Test weight of foxtail millet was significantly influenced by various nutrient combinations. Among the various combinations application of 50% RDF + 25% Neem cake N Based + 25% Bio-fertilizer (T₁₅) was recorded higher grain weight (2.73 g). This is followed by 50% RDF + 25% Poultry manure N Based + 25% Bio-fertilizer (T₁₄). This might be due to translocation of synthesized food materials from source to sink. This could be possible due to non limiting supplies of nutrient like N, P and K from the soil owing to their high content. This is in line with the findings of Hasan *et al.* (2013)^[3].

Grain yield

Appreciable increase in the grain yield of foxtail millet could be observed due to combination of organic and inorganic sources along with bio-fertilizers. Treatment carrying combinations of 50% RDF + 25% Neem cake N Based + 25% Bio-fertilizer (T₁₅) was recorded higher yield (2385 kg ha⁻¹) followed by The lower yield (1374 kg ha⁻¹) recorded in absolute control (T₁). It could be attributed to the fact that higher availability of NPK during crop growth period might have improved the plant growth characters like plant height, number of tillers hill⁻¹, and weight of the grains which eventually led to higher yield. This is in agreement with the findings of (Singh *et al.*, 2003)^[12], Govindappa *et al.* (2009)^[2], Shivakumar *et al.* (2011)^[11], Gawade *et al.* (2013)^[1].

Straw yield

Numerical increase in straw yield of foxtail millet could be recorded due to application of 50% RDF + 25% Neem cake N Based + 25% Bio-fertilizer (T₁₅) was recorded higher straw yield (4293 kg ha⁻¹) followed by the absolute control (T₁) recorded lower yield (3087 kg ha⁻¹). This could be attributed to the higher availability of NPK during crop growth period might have improved the plant height, number of tillers eventually increase the straw yield. This agreement with the findings of Hasan *et al.* (2013)^[3] who observed foxtail millet straw yield improved up to higher availability of NPK supply.

Table 1: Effect of different levels of organic manure and inorganic fertilizers combined with bio-fertilizers on plant height (cm), Number of tillers per plant (Nos plant⁻¹), Panicle Length (cm), Test weight (g) of foxtail millet

Treatments	Plant Height (cm)	Number of tillers (no. per plant)	Panicle Length (cm)	Test Weight (1000 grains)
T ₁	88.5	3.2	9.2	2.17
T ₂	108.8	5.4	10.6	2.28
T ₃	96.5	4.0	11.0	2.29
T ₄	104.5	4.5	12.0	2.39
T ₅	104.6	4.7	11.9	2.40
T ₆	108.2	5.1	12.1	2.39

T ₇	104.7	4.7	12.1	2.39
T ₈	112.9	5.8	14.0	2.50
T ₉	113.0	5.9	14.3	2.51
T ₁₀	120.6	6.6	15.9	2.62
T ₁₁	105.9	5.3	10.9	2.28
T ₁₂	112.7	5.5	13.8	2.50
T ₁₃	120.8	6.6	16.0	2.62
T ₁₄	124.1	6.8	16.2	2.63
T ₁₅	132.3	7.2	17.8	2.73
S.Ed	3.0	0.2	0.7	0.04
CD (P=0.05)	6.2	0.4	1.3	0.08

Table 2: Effect of different levels of organic manure and inorganic fertilizers combined with bio-fertilizers on Grain yield (kg ha⁻¹), Straw yield (kg ha⁻¹) of foxtail millet

Treatments	Straw yield (kg ha ⁻¹)	Grain yield (kg ha ⁻¹)
T ₁	3087	1374
T ₂	3245	1543
T ₃	3701	1786
T ₄	3833	1921
T ₅	3834	1958
T ₆	3641	1813
T ₇	3810	1954
T ₈	3850	2033
T ₉	3865	2040
T ₁₀	3798	2113
T ₁₁	3552	1680
T ₁₂	3860	2037
T ₁₃	4018	2151
T ₁₄	4032	2160
T ₁₅	4293	2385
SEd	75.39	49.33
CD (P=0.05)	154.33	101.05

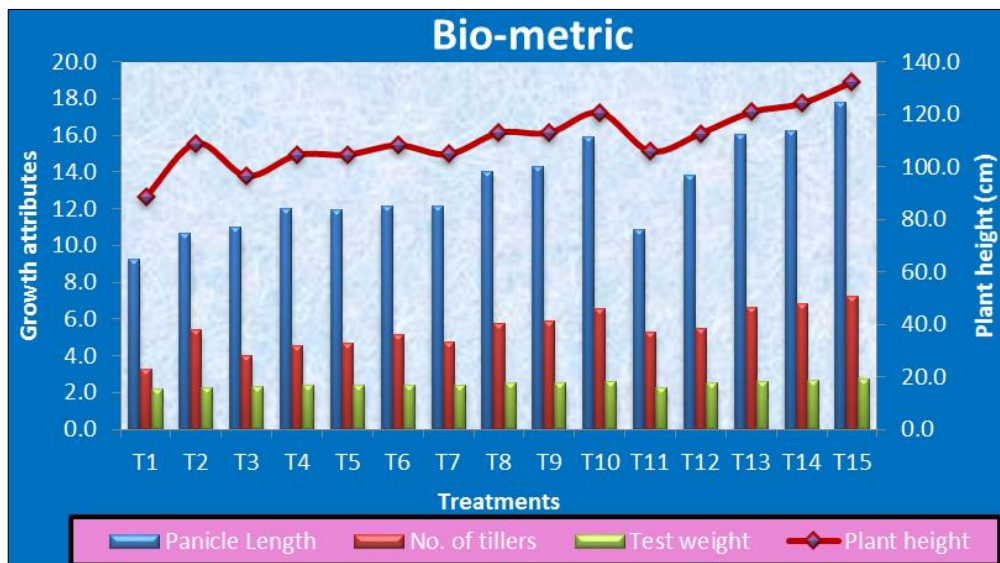


Fig 1: Influence of organic manure and inorganic fertilizers combined with bio-fertilizers on growth attributes of foxtail millet

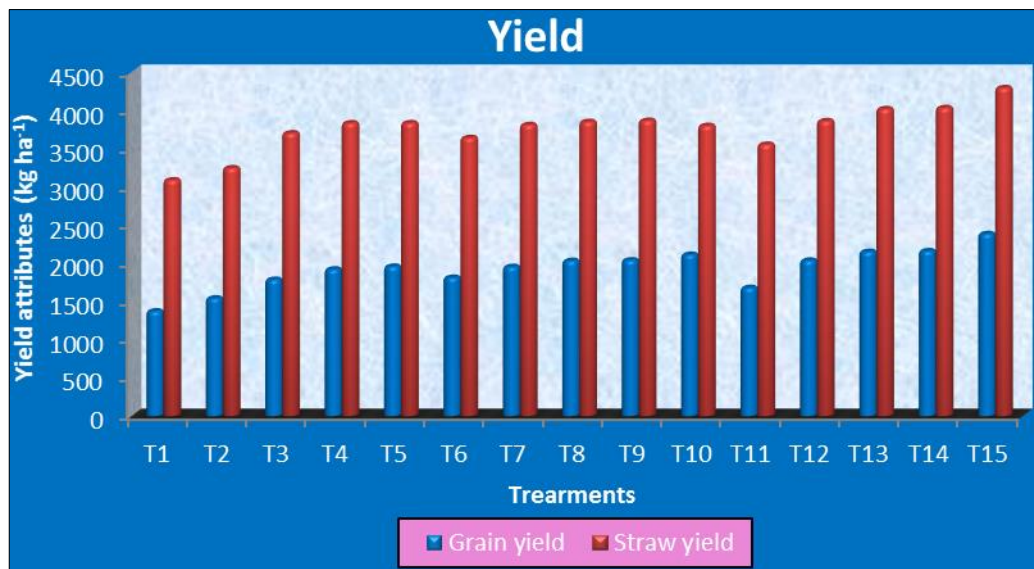


Fig 2: Influence of organic manure and inorganic fertilizers combined with bio-fertilizers on Yield attributes of foxtail millet

Conclusion

The present findings was clearly indicated that addition of organic amendments, which increase the growth and yield parameter of foxtail millet. Application of Neem cake in combination with organic and bio-fertilizer registered the highest productivity compared to other treatments. Based on the analytical conformational report we concluded that integrated use of manures improves the growth and yield of foxtail millet. Hence, the organic manures enhance the sustainable soil fertility and productivity over a long period of time. Therefore, integrated use of organic and inorganic fertilization was considered to be need of the hour to promote the maximum lump output in foxtail millet.

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