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RESEARCH PAPER

Organic nutrient management of finger millet and foxtail millet in black and red soils of northern transition zone of Karnataka

M. M. VARSHA*, U. K. SHANWAD, S. S. HALLIKERI AND B. G. NAGAPPA

Department of Agronomy, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, India
*E-mail: varshamm98@gmail.com

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Abstract: A field experiment was conducted during *kharif* 2021 at MARS, UAS, Dharwad to study the organic nutrient management of finger millet and foxtail millet in black and red soils of Northern Transition Zone of Karnataka. The experiment was laid out in a split-plot design with two main plots and nine subplots with three replications. Among the two millets, finger millet recorded significantly higher grain yield (1943 and 1900 kg ha^{-1}), gross returns (₹ 56329 and ₹ 55021 ha^{-1}), net returns (₹ 24240 and ₹ 22931 ha^{-1}) and B:C ratio (l .76 and 1 .73), respectively in black and red soils compared to foxtail millet (grain yield- 1135 and 1034 kg ha^{-1}, gross returns- ₹ 37466 and ₹ 34092 ha^{-1}, Net returns- ₹ 9147 and ₹ 5773 ha^{-1} and B:C ratio1.33 and 1.22, respectively in black and red soils). Among the nutrient management practices, application of RDF recorded significantly higher grain yield (1895 and 1829 kg ha^{-1}), straw yield (3517 and 3415 kg ha^{-1}), gross returns (₹ 56715 and ₹ 55575 ha^{-1}), net returns (₹ 32185 and ₹ 31045 ha^{-1}) and B:C ratio (2.30 and 2.25), respectively in black and red soils. Among the organic source of nutrients, application of 50% N through compost + 50% N through vermicompost recorded significantly higher grain yield (1813 kg ha^{-1}), straw yield (3330 kg ha^{-1}) and gross returns (₹ 55362 ha^{-1}). However, application of 100% N through goat manure recorded significantly higher net returns (₹ 22609 ha^{-1}) and B:C ratio (1.79) in black soil. Whereas, in case of red soil, among the organic source of nutrients, application of 50% N through compost + 50% N through goat manure recorded significantly higher grain yield (1681 kgha^{-1}), straw yield (2991 kg ha^{-1}), gross returns (₹ 50592 ha^{-1}) and net returns (₹ 19615 ha^{-1}). Whereas, B:C ratio (l .67) was significantly higher under the application of 100% N through goat manure over rest of the treatments. Hence, in Northern Transition Zone of Karnataka the application of split doses of organic manures to both finger millet and foxtail millet in black and red soils is found to be promising in terms of productivity and economics.

Key words: Compost, Finger millet, Foxtail millet, Goat manure, Natural farming, Vermicompost

Introduction

India is the largest producer of millets in the world, and accounts for more than 40 per cent of the global consumption. Millet cultivation is the mainstay of rainfed farming. Millets are most unique amongst cereals. Agronomic advantages are that they are highly adapted to low rainfall conditions, able to withstand fairly long dry spells, recover fast after delayed rain, make them good contingent crops. Being C_4 plants these are more environment friendly with high water use efficiency and low input requirement, but equally responsive to high input management. Besides being farmer-friendly, the unique nutritional properties of millets, *i.e.*, high fibre, quality protein and mineral composition, being called as "Nutri-cereals". Improper varietal selection, poor crop establishment, weeds and several biotic stresses also influences the millet yield negatively. In addition, soil and land related constraints such as poor soil organic matter content, low moisture retention, macro and micronutrients deficiencies, alkalinity and undulated topography in the millet growing region of India makes millet cultivation and nutrient management in millets challenging. The global quest for nutritious food, security of farmers, sustainable agriculture and conservation of environment is fuelling a revolution in organics and millets. Now, the agricultural research is focused on evolving ecologically sound, biologically sustainable and socio-economically viable technologies. There is a need for a fresh look to exploit the organic farming approaches using the local manurial and bio-pesticide sources for growing organic crops. Organic manure apart from supplying all essential nutrients required by plants, improve soil structure, aeration and encourage good root growth. Organic manures also enhance nitrogen availability, improve soil structure, water retention and increases soil organic matter. So, by taking the above factors into consideration the present investigation was designed to find out the response of selected millets to optimum doses of organic nutrient sources and comparison between organic nutrient sources, recommended dose of fertilizers, natural farming practices and absolute control.

Material and methods

A field study was conducted to study the organic nutrient management of finger millet and foxtail millet in black and red soils of Northern Transition Zone of Karnataka at Main Agricultural Research Station and Bio-resource farm, Institute of Organic Farming, University of Agricultural Sciences, Dharwad, Karnataka during *kharif* 2021. It is located at 15^{0}49' North latitude, 74^{0}99' East longitude and 678 m above mean sea level (MSL). The experimental site soil type was medium deep black clay soil at Main Agricultural Research Station and it is red sandy loam at Bio-resource farm. Composite soil samples were collected from both the experimental sites before sowing from a depth of 0 to 30 cm and analysed for physical and chemical

characteristics. The initial soil pH was 7.41 in black soil and 6.98 in red soil. Nutrient status was medium in available nitrogen (256.8 and 283.0 kg ha^{-1}), medium in available phosphorus (28.7 and 26.5 kg ha^{-1}) and high in available potassium (372.3 and 356.8 kg ha^{-1}), respectively in black and red soils. The experiment was laid out in split plot design with two main plots and nine sub plots replicated thrice. The treatment includes finger millet and foxtail millet as main plots and organic nutrient management under sub plots which included natural farming practices as one of the treatments (N_8).

Natural farming practices includes,

Seedtreatment with beejamrutha

Application of ghanajeevamrutha @ 1000 kg ha^{-1} (50% as basal dose and 50% at 30 DAS)

Jeevamrutha application @ 500 lit ha^{-1} twice at 21 days interval

Crop residue mulching

Pest and disease control (organically)

Results and discussion

Yield and yield parameters

Among the two millets, finger millet recorded significantly higher number of grains/earhead (2510 and 2258), thousand grain weight (3.46 and 3.25 g) and grain yield (1943 and 1900 kg ha^{-1}), respectively in black and red soils. Whereas, foxtail millet recorded significantly higher productive tillers/m row length (98.93 and 97.96) and straw yield (3246 and 2925 kg ha^{-1}), respectively in black and red soils (Table 2 and 3).

Among the nutrient management practices, application of RDF (N_7) resulted in significantly higher number of grains/earhead (2311 and 2150), productive tillers/m row length (103.25 and 97.50), thousand grain weight (4.25 and 3.98 g), grain yield (1895 and 1829 kg ha^{-1}) and straw yield (3517 and 3415 kg ha^{-1}), respectively in black and red soils.

Among the organic source of nutrients, significantly higher number of grains/earhead (2082), productive tillers/m row length (98.75), thousand grain weight (3.78 g), grain yield (1813 kg ha^{-1}) and straw yield (3330 kg ha^{-1}) were recorded under the application of 50 per cent N through compost + 50 per cent N through vermicompost (N_4) in black soil. Whereas, in case of red soil application of 50 per cent N through compost + 50 per cent N through goat manure (N_5) resulted in significantly higher number of grains/earhead (1935), productive tillers/m row length (90.75), thousand grain weight (3.46 g), grain yield (1681 kg ha^{-1}) and straw yield (2991 kg ha^{-1}).

Among the interaction of finger millet with nutrient management practices in black soil, application of 50 per cent N through compost + 50 per cent N through vermicompost (M_1N_4) recorded significantly higher number of grains/earhead (3006), productive tillers/m row length (94.50), grain yield (2450 kg ha^{-1}) and straw yield (3307 kg ha^{-1}). Whereas, thousand grain weight (4.21 g) was significantly higher under the application of RDF (M_1N_7). Among the interaction of finger millet with nutrient management practices in red soil, application of 50 per cent N through compost + 50 per cent N through goat manure (M_1N_5) recorded significantly higher number of grains/earhead (2829), productive tillers/m row length (82.00), grain yield (2335 kg ha^{-1}) and straw yield (3109 kg ha^{-1}) when compared to rest of the treatments. Whereas, thousand grain weight (4.02 g) was significantly higher under the application of RDF (M_1N_7). Application of organic manures alone or in combined form on N equivalent basis could have released the nutrients slowly into the soil solution to match the required absorption pattern of millets. The adequate supply of nutrients during the crop growth stages could have resulted in higher nutrient uptake like nitrogen, phosphorus, potassium and resulted in higher yield and yield parameters of finger millet. Improvement in yield attributes could also be due to higher quantity of macro and micronutrients added to soil in the form of FYM and vermicompost resulting in increased availability of nutrients in root zone thus more uptake by crop resulting in higher values of yield attributing characters. These results are in conformity with the findings of Poornesh *et al.* (2004), Bangar *et al.* (2008) and Ullasa *et al.* (2017).

Table 1. Description about the nutrients and their quantities used in the experiment

Nutrient source	N (%)	P_2O_5 (%)	K_2O (%)	qha^{-1} (Finger millet)	qha^{-1}(Foxtail millet)
Compost	0.50	0.15	0.50	100.00	60.00
Vermicompost	2.20	0.90	1.12	22.73	13.64
Goat manure	1.41	0.73	0.98	35.46	21.28

Among the interaction of foxtail millet with nutrient management practices, application of RDF (M_2N_7) produced significantly higher number of grains/earhead (1688 and 1575), productive tillers/m row length (119 and 117), thousand grain weight (4.29 and 3.95 g), grain yield (1456 and 1403 kg ha^{-1}) and straw yield (3999 and 3859 kg ha^{-1}), respectively in black and red soils. However, among the organic source of nutrients in black soil, application of 100 per cent N through vermicompost (M_2N_2) recorded significantly higher number of grains/earhead (1423), productive tillers/m row length (110.50), thousand grain weight (3.77 g), grain yield (1285 kg ha^{-1}) and straw yield (3496 kg ha^{-1}). In red soil, application of 50 per cent N through compost + 50 per cent N through vermicompost (M_2N_4) recorded significantly higher number of grains/earhead (1269), productive tillers/m row length (106.17), thousand grain weight (3.42 g), grain yield (1176 kg ha^{-1}) and straw yield (3194 kg ha^{-1}) over rest of the treatments. Influence of all beneficial activities of earthworms and microorganisms increased the supply of plant hormones in addition to the supply of primary, secondary and micronutrients which resulted in increased yield. Similar findings were also reported by Bana *et al.* (2012), Choudhary *et al.* (2014), Choudhary *et al.* (2018), Bharat and Gajbhiye (2020) and Nikitha and Mehera (2022).

Economics

Economics of crop production is dependent on market price of inputs and quantity of output produced and its price in the market. The prevailing price for finger millet grains was ₹ 27 kg^{-1}, for foxtail millet grains it was ₹ 29 kg^{-1} and price of straw for

Table 2. Yield parameters of finger millet and foxtail millet as influenced by different organic nutrient management practices in black and red soils

Treatment details	Black soil			Red soil		
	No.of grains/ earhead	Productive tillers/m row length	1000-grain weight (g)	No.of grains / earhead	Productive tillers /m row length	1000 grain weight (g)
MAIN PLOTS						
M_1: Finger millet	2510[a] *	78.06[b]	3.46[a]	2258[a]	66.72[b]	3.25[a]
M_2: Foxtail millet	1177[b]	98.93[a]	3.30[b]	1076[b]	97.96[a]	3.14[b]
S.Em. ± **	29	1.44	0.03	19	0.61	0.01
SUB PLOTS						
N_1: 100% N through compost	1714[cd]	83.00[cd]	3.01[cd]	1486[c]	79.00[c]	2.96[cd]
N_2: 100% N through vermicompost	1920[bc]	92.08[bc]	3.48[b]	1771[b]	84.25[bc]	3.20[bc]
N_3: 100% N through goat manure	1895[bc]	89.92[bc]	3.38[bc]	1746[b]	83.00[bc]	3.11[b-d]
N_4: 50% N through compost + 50% N through vermicompost	2082[ab]	98.75[b]	3.78[b]	1906[b]	87.33[b]	3.35[b]
N_5: 50% N through compost + 50% N through goat manure	1972[bc]	94.00[bc]	3.62[b]	1935[ab]	90.75[ab]	3.46[b]
N_6: 50% N through vermicompost + 50% N through goat manure	1898[bc]	92.92[bc]	3.53[b]	1905[b]	87.00[bc]	3.36[b]
N_7: RDF	2311[a]	103.25[a]	4.25[a]	2150[a]	97.50[a]	3.98[a]
N_8: Natural farming	1493[de]	76.75[de]	2.78[d]	1219[d]	70.75[d]	2.78[de]
N_9: Absolute control	1306[e]	65.75[e]	2.59[d]	883[e]	61.50[e]	2.56[e]
S.Em± 76	2.64	0.09	53	1.82	0.08	
INTERACTION						
M_1N_1: Finger millet + 100% N through compost	2396[c]	72.00[g]	3.09[c-g]	1984[e]	63.00[ij]	3.02[e-g]
M_1N_2: Finger millet + 100% N through vermicompost	2417[c]	73.67[fg]	3.19[d-f]	2301[d]	64.50[hi]	3.10[d-g]
M_1N_3: Finger millet + 100% N through goat manure	2700[a-c]	84.50[d-f]	3.81[bc]	2454[cd]	68.00[g-i]	3.20[c-f]
M_1N_4: Finger millet + 50% N through compost + 50% N through vermicompost	3006[a]	94.50[cd]	4.06[ab]	2543[bc]	68.50[g-i]	3.28[c-f]
M_1N_5: Finger millet + 50% N through compost +50% N through goat manure	2598[bc]	78.50[e-g]	3.56[cd]	2829[a]	82.00[de]	3.82[ab]
M_1N_6: Finger millet + 50% N through vermicompost + 50% N through goat manure	2685[a-c]	84.33[d-f]	3.66[bc]	2743[ab]	71.50[f-h]	3.52[bc]
M_1N_7: Finger millet + RDF	2933[ab]	87.50[de]	4.21[a]	2726[ab]	78.00[d-f]	4.02[a]
M_1N_8: Finger millet + Natural farming	2065[d]	69.00[gh]	2.89[f-i]	1540[f]	56.50[jk]	2.77[gh]
M_1N_9: Finger millet + Absolute control	1793[de]	58.50[h]	2.69[g-i]	1197[gh]	48.50[k]	2.57[h]
M_2N_1: Foxtail millet + 100% N through compost	1031[hi]	94.00[cd]	2.92[f-i]	989[hi]	95.00[c]	2.90[f-h]
M_2N_2: Foxtail millet + 100% N through vermicompost	1423[fg]	110.50[ab]	3.77[bc]	1241[g]	104.00[b]	3.30[c-e]
M_2N_3: Foxtail millet + 100% N through goat manure	1090[g-i]	95.33[cd]	2.96[f-h]	1038[g-i]	98.00[bc]	3.02[e-g]
M_2N_4: Foxtail millet + 50% N through compost + 50% N through vermicompost	1158[g-i]	103.00[bc]	3.49[c-e]	1269[g]	106.17[b]	3.42[cd]
M_2N_5: Foxtail millet + 50% N through compost +50% N through goat manure	1347[gh]	109.50[ab]	3.67[bc]	1042[g-i]	99.50[bc]	3.10[d-g]
M_2N_6: Foxtail millet + 50% N through vermicompost + 50% N through goat manure	1112[g-i]	101.50[bc]	3.39[c-e]	1068[g-i]	102.50[bc]	3.20[c-f]
M_2N_7: Foxtail millet + RDF	1688[ef]	119.00[a]	4.29[a]	1575[f]	117.00[a]	3.95[a]
M_2N_8: Foxtail millet + Natural farming	922[i]	84.50[d-f]	2.67[hi]	898[i]	85.00[d]	2.80[gh]
M_2N_9: Foxtail millet + Absolute control	820[i]	73.00[fg]	2.49[i]	569[j]	74.50[e-g]	2.55[h]
S.Em±	108	3.73	0.12	76	2.57	0.11

*Mean followed by the same letters did not differ significantly, **S.Em. applicable to DMRT (P=0.05)

both the millets was ₹ 1.4 kg^{-1}. Among the two millets, finger millet recorded significantly higher gross returns (₹ 56329 and ₹ 55021 ha^{-1}), net returns (₹ 24240 and ₹ 22931 ha^{-1}) and B:C ratio (1.76 and 1.73), respectively in black and red soils (Table 4). This is due to finger millet recorded significantly higher grain yield which accounted for higher net returns.

Among the nutrient management practices, application of RDF (N_7) recorded significantly higher gross returns (₹ 56715 and ₹ 55575 ha^{-1}), net returns (₹ 32185 and ₹ 31045 ha^{-1}) and B:C ratio (2.30 and 2.25), respectively in black and red soils. Among the organic source of nutrients in black soil, application of 50 per cent N through compost + 50 per cent N through vermicompost (N_4) recorded significantly higher gross returns (₹ 55362 ha^{-1}). Whereas, net returns (₹ 22609 ha^{-1}) and B:C ratio (1.79) was significantly higher under the application of 100 per cent N through goat manure (N_3). Among the organic source of nutrients in red soil, application of 50 per cent N through

Table 3. Yield of finger millet and foxtail millet as influenced by different organic nutrient management practices in black and red soils

Treatment details	Black soil		Red soil	
	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
MAIN PLOTS				
M_1: Finger millet	1943^{a}*	2765^{b}	1900^{a}	2663^{b}
M_2: Foxtail millet	1135^{b}	3246^{a}	1034^{b}	2925^{a}
S.Em ± **	12	52	20	33
SUB PLOTS				
N_1: 100% N through compost	1559^{c}	2889^{c}	1464^{c}	2651^{cd}
N_2: 100% N through vermicompost	1681^{b}	3108^{bc}	1560^{bc}	2892^{bc}
N_3: 100% N through goat manure	1664^{b}	3104^{bc}	1555^{bc}	2791^{bc}
N_4: 50% N through compost + 50% N through vermicompost	1813^{ab}	3330^{ab}	1641^{b}	2970^{b}
N_5: 50% N through compost + 50% N through goat manure	1691^{b}	3183^{bc}	1681^{b}	2991^{b}
N_6: 50% N through vermicompost + 50% N through goat manure	1690^{b}	3137^{bc}	1648^{b}	2982^{b}
N_7: RDF	1895^{a}	3517^{a}	1829^{a}	3415^{a}
N_8: Natural farming	1065^{d}	2562^{d}	1069^{d}	2436^{d}
N_9: Absolute control	802^{e}	2220^{e}	758^{e}	2017^{e}
S.Em±	22	67	34	72
INTERACTION				
M_1N_1: Finger millet + 100% N through compost	1984^{f}	2656^{ef}	1910^{c}	2543^{e-g}
M_1N_2: Finger millet + 100% N through vermicompost	2078^{e}	2720^{ef}	2015^{bc}	2655^{d-g}
M_1N_3: Finger millet + 100% N through goat manure	2186^{cd}	3067^{cd}	2087^{b}	2717^{c-f}
M_1N_4: Finger millet + 50% N through compost + 50% N through vermicompost	2450^{a}	3307^{bc}	2107^{b}	2747^{c-f}
M_1N_5: Finger millet + 50% N through compost +50% N through goat manure	2133de	2899de	2335^{a}	3109^{b}
M_1N_6: Finger millet + 50% N through vermicompost + 50% N through goat manure	2228^{bc}	2940de	2263^{a}	3023^{bc}
M_1N_7: Finger millet + RDF	2335^{b}	3036^{cd}	2256^{a}	2972^{b-d}
M_1N_8: Finger millet + Natural farming	1207^{h-j}	2299^{g}	1286de	2346^{gh}
M_1N_9: Finger millet + Absolute control	894^{k}	1963^{h}	839^{hi}	1858^{i}
M_2N_1: Foxtail millet + 100% N through compost	1135^{j}	3123^{cd}	1018^{g}	2759^{c-f}
M_2N_2: Foxtail millet + 100% N through vermicompost	1285^{h}	3496^{b}	1105^{fg}	3128^{b}
M_2N_3: Foxtail millet + 100% N through goat manure	1142^{j}	3141^{cd}	1022^{fg}	2866^{b-e}
M_2N_4: Foxtail millet + 50% N through compost + 50% N through vermicompost	1177^{h-j}	3352^{bc}	1176^{ef}	3194^{b}
M_2N_5: Foxtail millet + 50% N through compost +50% N through goat manure	1248^{hi}	3468^{b}	1026^{fg}	2874^{b-e}
M_2N_6: Foxtail millet + 50% N through vermicompost + 50% N through goat manure	1152^{ij}	3334^{bc}	1032^{fg}	2941^{b-d}
M_2N_7: Foxtail millet + RDF	1456^{g}	3999^{a}	1403^{d}	3859^{a}
M_2N_8: Foxtail millet + Natural farming	923^{k}	2825de	851^{h}	2526^{fg}
M_2N_9: Foxtail millet + Absolute control	710^{l}	2476^{fg}	676^{i}	2176^{hi}
S.Em ±	31	95	48	102

*Mean followed by the same letters did not differ significantly, **S.Em. applicable to DMRT (P=0.05)

compost + 50 per cent N through goat manure (N_5) recorded significantly higher gross returns (₹ 50592 ha^{-1}) and net returns (₹ 19615 ha^{-1}). Whereas, B:C ratio (1.67) was significantly higher under the application of 100 per cent N through goat manure (N_3) over rest of the treatments.

Among the interaction of finger millet with nutrient management practices in black soil, application of 50 per cent N through compost + 50 per cent N through vermicompost (M_1N_4) recorded significantly higher gross returns (₹ 71325 ha^{-1}). Whereas, net returns (₹ 41091 ha^{-1}) and B:C ratio (2.62) was significantly higher under the application of RDF (M_1N_7). Among the interaction of finger millet with nutrient management practices in red soil, application of 50 per cent N through compost + 50 per cent N through goat manure (M_1N_5) recorded significantly higher gross returns (₹ 67404 ha^{-1}). Whereas, net returns (₹ 39673 ha^{-1}) and B:C ratio (2.56) was significantly higher under the application of RDF (M_1N_7) over rest of the treatments. Among the interaction of foxtail millet with nutrient management practices, application of RDF (M_2N_7) recorded significantly higher ross returns (₹ 46945 and ₹ 46082 ha^{-1}), net returns (₹ 23279 and ₹ 22416 ha^{-1}) and B:C ratio (1.98 and 1.95), respectively in black and red soils. However, among the organic source of nutrients in black soil, application of 50 per cent N through compost + 50 per cent N through goat manure(M_2N_5) recorded significantly higher net returns (₹ 12289 ha^{-1}) and B:C ratio (1.43) closely followed by application 100 per cent N through goat manure (M_2N_3). However, among the organic source of nutrients in red soil, application of 100 per cent N through goat manure (M_2N_3) recorded significantly higher net returns (₹ 7266 ha^{-1}) and B:C ratio (1.28).

Nutrient Uptake Studies

Nutrient uptake by any crop in general results enhancing yield and nutrient content. Substantial increase in nutrient content or yield may increase the uptake of nutrient. Uptake of any nutrient is the function of its content and dry matter production by the crop.Among the two millets, foxtail millet

Table 4. Economics of cultivation of finger millet and foxtail millet by using different organic source of nutrients in black and red soils

Treatment details	Black soil			Red soil		
	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C ratio	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C ratio
MAIN PLOTS						
M_1: Finger millet	56329^{a} *	24240^{a}	1.76^{a}	55021^{a}	22931^{a}	1.73^{a}
M_2: Foxtail millet	37466^{b}	9147^{b}	1.33^{b}	34092^{b}	5773^{b}	1.22^{b}
S.Em± **	385	385	0.01	548	548	0.02
SUB PLOTS						
N_1: 100% N through compost	47286^{c}	13146^{d}	1.37^{e}	44251^{c}	10111^{d}	1.28^{cd}
N_2: 100% N through vermicompost	51035^{b}	14349^{d}	1.38^{e}	47273^{bc}	10587^{d}	1.27^{cd}
N_3: 100% N through goat manure	50423^{b}	22609^{b}	1.79^{b}	46903^{bc}	19089^{b}	1.67^{b}
N_4: 50% N through compost + 50% N through vermicompost	55362^{a}	19949^{bc}	1.53^{d}	49650^{b}	14237^{cd}	1.38^{c}
N_5: 50% N through compost + 50% N through goat manure	51356^{b}	20379^{bc}	1.64^{c}	50592^{b}	19615^{b}	1.60^{b}
N_6: 50% N through vermicompost + 50% N through goat manure	51168^{b}	18918^{c}	1.56^{cd}	49692^{b}	17443^{bc}	1.51^{b}
N_7: RDF	56715^{a}	32185^{a}	2.30^{a}	55575^{a}	31045^{a}	2.25^{a}
N_8: Natural farming	33267^{d}	5375^{e}	1.19^{f}	33117^{d}	5226^{e}	1.19^{de}
N_9: Absolute control	25470^{e}	3330^{e}	1.15^{f}	23958^{e}	1818^{e}	1.08^{e}
S.Em± 636	636	0.02	981	981	0.04	
INTERACTION						
M_1N_1: Finger millet + 100% N through compost	57283^{c}	20143^{e}	1.54^{c}	55126^{c}	17986^{e}	1.48^{de}
M_1N_2: Finger millet + 100% N through vermicompost	59923^{d}	19603^{e}	1.49^{ef}	58120^{bc}	17800^{e}	1.44^{e}
M_1N_3: Finger millet + 100% N through goat manure	63325^{c}	34093^{b}	2.17^{b}	60144^{b}	30912^{c}	2.06^{bc}
M_1N_4: Finger millet + 50% N through compost + 50% N through vermicompost	71325^{a}	32595^{b}	1.84^{d}	60722^{b}	21992de	1.57^{d}
M_1N_5: Finger millet + 50% N through compost +50% N through goat manure	61656^{cd}	28470^{c}	1.86^{d}	67404^{a}	34218^{b}	2.03^{b}
M_1N_6: Finger millet + 50% N through vermicompost + 50% N through goat manure	64264^{bc}	29488^{c}	1.85^{d}	65335^{a}	30559^{bc}	1.88^{c}
M_1N_7: Finger millet + RDF	66485^{b}	41091^{a}	2.62^{a}	65069^{a}	39673^{a}	2.56^{a}
M_1N_8: Finger millet + Natural farming	35810^{j}	7919^{hi}	1.28^{g}	38011^{ef}	10120^{f}	1.36^{ef}
M_1N_9: Finger millet + Absolute control	26894^{l}	4755^{jk}	1.21^{g}	25262^{hi}	3123^{g-i}	1.14^{hi}
M_2N_1: Foxtail millet + 100% N through compost	37289^{ij}	6149^{ij}	1.20^{g}	33375^{g}	2236^{hi}	1.07^{hi}
M_2N_2: Foxtail millet + 100% N through vermicompost	42147^{g}	9095^{gh}	1.28^{g}	36426^{e-g}	3374^{g-i}	1.10^{hi}
M_2N_3: Foxtail millet + 100% N through goat manure	37521^{ij}	11125^{fg}	1.42^{f}	33662^{fg}	7266^{fg}	1.28^{fg}
M_2N_4: Foxtail millet + 50% N through compost + 50% N through vermicompost	39398^{hi}	7303^{h-j}	1.23^{g}	38578^{e}	6483^{f-h}	1.20^{gh}
M_2N_5: Foxtail millet + 50% N through compost +50% N through goat manure	41057^{gh}	12289^{f}	1.43^{f}	33781^{fg}	5013^{g-i}	1.17^{gh}
M_2N_6: Foxtail millet + 50% N through vermicompost + 50% N through goat manure	38071^{ij}	8347^{hi}	1.28^{g}	34050^{fg}	4327^{g-i}	1.15^{hi}
M_2N_7: Foxtail millet + RDF	46945^{f}	23279^{d}	1.98^{c}	46082^{d}	22416^{d}	1.95^{c}
M_2N_8: Foxtail millet + Natural farming	30723^{k}	2832^{k}	1.10^{h}	28224^{h}	332^{i}	1.01^{i}
M_2N_9: Foxtail millet + Absolute control	24046^{l}	1906^{k}	1.09^{h}	22653^{i}	513^{i}	1.02^{i}
S.Em±	899	899	0.03	1388	1388	0.04

Finger millet grain- ₹ 27/kg, foxtail millet grain- ₹ 29/kg and straw- ₹ 1.4/kg *Mean followed by the same letters didn't differ significantly, **S.Em. applicable to DMRT (P=0.05)

recorded significantly higher NPK uptake (48.4, 22.9 and 62.8 kg ha^{-1}, respectively in black soil and 43.1, 21.2 and 57.1 kg ha^{-1}, respectively in red soil) compared to finger millet (42.5, 19.1 and 49.4 kg ha^{-1}, respectively in black soil and 40.7, 18.0 and 47.6 kg ha^{-1}, respectively in red soil) (Table 5). Higher nutrient content in the produce and higher biomass production by foxtail millet might be the pertinent reason for higher uptake of the nutrient. These results are in conformity with Upendranaik *et al.* (2018) and Sahoo *et al.* (2020).

Among the nutrient management practices, application of RDF (N_7) recorded significantly higher NPK uptake (56.4, 26.6 and 68.3 kg ha^{-1}, respectively in black soil and (54.5, 26.0 and 66.4 kg ha^{-1}, respectively in red soil). Pallavi *et al.* (2016), Bharat and Gajbhiye (2020) and Kakad *et al.*(2021) also reported significantly higher nutrient uptake with recommended dose of fertilizer over different organic sources which may be due to higher dry matter production under RDF plots.

Among the organic source of nutrients in black soil, application of 50 per cent N through compost + 50 per cent N through vermicompost (N_4) recorded significantly higher NPK uptake (52.0, 24.1 and 63.6 kg ha^{-1}, respectively) compared to

Table 5. Nutrient uptake studies in finger millet and foxtail millet as influenced by organic nutrient management practices in black and red soils

Treatment details	Black soil			Red soil		
	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
MAIN PLOTS						
M_1: Finger millet	42.5^{b} *	19.1^{b}	49.4^{b}	40.7^{b} *	18.0^{b}	47.6^{b}
M_2: Foxtail millet	48.4^{a}	22.9^{a}	62.8^{a}	43.1^{a}	21.2^{a}	57.1^{a}
S.Em. ± **	0.9	0.5	1.3	0.3	0.4	1.0
SUB PLOTS						
N_1: 100% N through compost	44.4^{c}	20.5^{b}	54.5^{b}	40.1^{b}	18.9^{b}	50.1^{bc}
N_2: 100% N through vermicompost	48.3^{bc}	22.2^{b}	59.0^{b}	43.5^{b}	20.5^{b}	54.7^{b}
N_3: 100% N through goat manure	47.4^{bc}	21.2^{b}	57.8^{b}	42.7^{b}	19.4^{b}	53.2^{b}
N_4: 50% N through compost + 50% N through vermicompost	52.0^{ab}	24.1^{ab}	63.6^{ab}	46.2^{b}	21.8^{b}	57.4^{ab}
N_5: 50% N through compost + 50% N through goat manure	49.4^{a-c}	22.9^{b}	61.0^{ab}	46.1^{b}	21.7^{b}	57.4^{ab}
N_6: 50% N through vermicompost + 50% N through goat manure	49.3^{a-c}	23.1^{ab}	60.3^{ab}	46.5^{b}	21.9^{b}	57.5^{ab}
N_7: RDF	56.4^{a}	26.6^{a}	68.3^{a}	54.5^{a}	26.0^{a}	66.4^{a}
N_8: Natural farming	34.2^{d}	15.6^{c}	43.7^{c}	32.6^{c}	15.0^{c}	41.7^{cd}
N_9: Absolute control	27.3^{d}	12.5^{c}	36.5^{c}	24.8^{d}	11.5^{c}	33.0^{d}
S.Em. ± 1.6	0.8	2.0	1.6	0.9	2.2	
INTERACTION						
M_1N_1: Finger millet + 100% N through compost	41.9^{de}	18.0^{ef}	49.0^{ef}	39.2^{de}	16.8^{ef}	46.6^{ef}
M_1N_2: Finger millet + 100% N through vermicompost	43.0^{c-e}	18.6^{ef}	50.5^{ef}	41.2^{c-e}	17.6^{d-f}	48.6^{d-f}
M_1N_3: Finger millet + 100% N through goat manure	47.4^{b-d}	21.1^{c-e}	55.3^{d-f}	43.3^{b-d}	19.1^{c-e}	50.9^{c-f}
M_1N_4: Finger millet + 50% N through compost + 50% N through vermicompost	53.4^{b}	24.3^{bc}	61.9^{b-d}	44.4^{b-d}	20.0^{b-e}	51.9^{c-e}
M_1N_5: Finger millet + 50% N through compost +50% N through goat manure	46.4^{b-e}	21.4^{c-e}	54.2^{d-f}	49.4^{b}	22.7^{bc}	58.3^{b-d}
M_1N_6: Finger millet + 50% N through vermicompost + 50% N through goat manure	48.2^{b-d}	22.4^{b-d}	55.5^{d-f}	49.0^{b}	22.3^{bc}	56.6^{b-e}
M_1N_7: Finger millet + RDF	50.5^{bc}	23.6^{bc}	58.0^{c-e}	49.1^{b}	22.5^{bc}	56.1^{b-e}
M_1N_8: Finger millet + Natural farming	28.9^{fg}	12.5^{gh}	33.7^{g}	29.8^{f}	12.6^{gh}	34.9^{gh}
M_1N_9: Finger millet + Absolute control	22.4^{g}	9.5^{h}	26.5^{g}	20.8^{g}	8.7^{h}	24.6^{h}
M_2N_1: Foxtail millet + 100% N through compost	46.9^{b-d}	23.0^{bc}	60.0^{b-d}	41.0^{c-e}	20.9^{b-e}	53.6^{b-e}
M_2N_2: Foxtail millet + 100% N through vermicompost	53.5^{b}	25.8^{b}	67.6^{b}	45.8^{b-d}	23.3^{bc}	60.8^{bc}
M_2N_3: Foxtail millet + 100% N through goat manure	47.4^{b-d}	21.2^{c-e}	60.2^{b-d}	42.1^{b-e}	19.7^{b-e}	55.5^{b-e}
M_2N_4: Foxtail millet + 50% N through compost + 50% N through vermicompost	50.6^{bc}	23.9^{bc}	65.4^{bc}	48.0^{bc}	23.6^{b}	62.9^{b}
M_2N_5: Foxtail millet + 50% N through compost +50% N through goat manure	52.4^{b}	24.4^{bc}	67.9^{b}	42.7^{b-e}	20.6^{b-e}	56.6^{b-e}
M_2N_6: Foxtail millet + 50% N through vermicompost + 50% N through goat manure	50.3^{bc}	23.7^{bc}	65.1^{bc}	44.0^{b-d}	21.5^{b-d}	58.5^{b-d}
M_2N_7: Foxtail millet + RDF	62.3^{a}	29.6^{a}	78.7^{a}	59.8^{a}	29.5^{a}	76.6^{a}
M_2N_8: Foxtail millet + Natural farming	39.5^{e}	18.8^{d-f}	53.7^{d-f}	35.5^{ef}	17.5^{d-f}	48.5^{d-f}
M_2N_9: Foxtail millet + Absolute control	32.1^{f}	15.4^{fg}	46.6^{f}	28.8^{f}	14.3^{fg}	41.4^{fg}
S.Em. ± 2.3	1.2	2.9	2.3	1.3	3.1	

*Mean followed by the same letters didn't differ significantly, **S.Em. applicable to DMRT (P=0.05)

natural farming practices (34.2, 15.6 and 43.7 kg ha^{-1}, respectively) and absolute control (27.3, 12.5 and 36.5 kg ha^{-1}, respectively). Andamong the organic source of nutrients in red soil, application of 50 per cent N through vermicompost + 50 per cent N through goat manure (N_6) recorded significantly higher NPK uptake (46.5, 21.9 and 57.5 kg ha^{-1}, respectively) compared to natural farming practices (32.6, 15.0 and 41.7 kg ha^{-1}, respectively) and absolute control (24.8, 11.5 and 33.0 kg ha^{-1}, respectively).Combined application of organic nutrients created favourable nutritional environment to the plant rhizosphere which enhanced the photosynthetic activity and translocation of nutrients thus increasing the grain yield and nutrient uptake by plant. Poornesh *et al.* (2004) and Ullasa *et al.* (2017) have reported the increased uptake of nutrients due combined application of organics.

Conclusion

The split application of organic manures on N equivalent basis showed significantly higher yield parameters, yield and economics. There is no significant difference was found between the black and red soils on performance of finger millet and foxtail millet under organic nutrient management practices. Thus, the application of split doses of locally available organic manures for both finger millet and foxtail millet in black and red soils is a promising approach to enhance productivity and profitability in the Northern Transition Zone of Karnataka.

References

Bana R S, Gautam R C and Rana K S, 2012, Effect of different organic sources on productivity and quality of pearl millet (*Pennisetum glaucum*) and their residual effect on wheat (*Triticum aestivum*). *Annals of Agricultural Research*, 33(3): 126-130.

Bangar, Ansa and Joseph, 2008, Yield and quality of rice crop as influenced by integrated nutrient management. *International Journal of Agriculture and Research*, 3(12): 106-112.

Bharat P A and GajbhiyeP N, 2020, Growth, yield and soil properties as influenced by long term use of organic manures in finger millet. *M.Sc.(Agri.)Thesis*, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India.

Choudhari M K, Tiwari R K, Mishra R M and Namdeo K N, 2018, Integrated nutrient management on growth, yield and economics of kodo millet (*Paspalum scrobiculatum* L.). *Annals of Plant and Soil Research*, 20(4): 405-408.

Choudhary R, Yadav L R and Parihar S, 2014, Studies on the interactive effect between vermicompost and fertility levels of pearl millet. *Annals of Agri-Bio Research*, 3:430-433.

Kakad C B, Chavan A P, Varnekar K D and Bodake P S, 2021, Effect of nutrient management on grain, straw yield and economics in transplanted proso millet. *Indian Journal of Agronomy*, 66(2): 246-250.

Nikitha T and Mehera B, 2022, Influence of spacing and organic manures on growth and yield of pearl millet (*Pennisetum glaucoma* L.). *The Pharma Innovation Journal*,11(4): 1517-1519.

Pallavi C, Joseph B, Aariff Khan M A and Hemalatha S, 2016, Economic evaluation of finger millet under different nutrient management practices. *International Journal of Current Microbiolology and Applied Sciences*, 5: 690-698.

Poornesh A S, Reddy V C and Kalyanamurthy K N, 2004, Effect of urban garbage compost and sewage sludge on yield of ragi (*Eleusine coracana* (L.) Gaertn) and soil properties. *Environment and Ecology,* 22(3): 720-723.

Sahoo I, Satish P, Hussain S A and Kumar S H, 2020, Influence of integrated nutrient management practices on yield and economics of foxtail millet varieties. *International Journal of Chemical Studies*, 8(4): 1990-1992.

Ullasa M Y, Pradeep S, Shrikantha C D and Sridhara S, 2017, Effect of different organic nutrient management practices on growth, yield and economics of finger millet, (*Eleusine coracana* (L.) Gaertn*).International Journal of Farm Sciences*, 7(2): 10-14.

Upendranaik P, Rao S, Desai B K, Krishnamurty D and Yadahalli V G, 2018, Effect of different sources of organic manures on growth and yield of foxtail millet (*Setaria italica* L.) under integrated organic farming system. *Advances in Research*,1-6.