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Influence of Organic Sources on Growth and Yield of Finger Millet in Finger Millet - Groundnut Cropping Sequence

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ABSTRACT

A field experiment was conducted at research and demonstration block of Research Institute on Organic Farming, UAS, GKVK, Bengaluru during *kharif* 2021 and 2022 to study the influence of organic sources on growth and yield of finger millet in finger millet-groundnut cropping sequence. The experiment was laid out in randomized block design with factorial concept and replicated thrice. The experiment consists of 12 treatment combinations of two levels of N equivalent and six organic sources along with absolute control and UAS-B package. The experimental soil was red sandy loam having medium organic carbon (0.63%), N (294.3 kg ha^{-1}), P_2O_5 (27.9 kg ha^{-1}) and K_2O (236.5 kg ha^{-1}). The experimental results indicated that application of bio-compost at 150 % N equivalent resulted in higher plant height (102.93 cm), number of leaves per hill (55.23), number of tillers per hill (9.24), total dry matter accumulation (81.58 g hill^{-1}), grain yield (3459 kg ha^{-1}) and straw yield of finger millet (5842 kg ha^{-1}) followed by application of poultry manure at 150% N equivalent and found significantly superior over other treatments in the studies. However, UAS-B package *i.e.,* 50:40:37.5 kg N: P_2O_5: K_2O ha^{-1} recorded significantly higher plant height (104.12 cm), number of leaves per hill (56.36), number of tillers per hill (9.36), total dry matter accumulation (82.29 g hill^{-1}), grain yield (3493 kg ha^{-1}) and straw yield (5942 kg ha^{-1}) and was on par with application of bio-compost at 150% N equivalent.

Keywords : Organic sources, Bio-compost, Finger millet, Cropping sequence

FINGER MILLET (*Eleusine coracana* L. Gaertin) is one of the important rainfed crop and is widely cultivated in dry tracts of red soil in Southern Karnataka under constrained resources. It is also called as kurrakan millet or koracan millet, ragi, nachni (India), African millet, rapoko (South Africa), dagusa (Ethiopia). It is one of the important millet crops grown for grain and fodder purpose under varied agroclimatic conditions. In India, it is grown in Karnataka, Tamil Nadu, Andra Pradesh, Orissa, Jharkand, Maharastra and Uttaranchal over an area of 11.19 lakh hectares with the production of 19.80 lakh tonnes and the productivity is 1720 kg ha^{-1}. Karnataka is the largest producer of finger millet in India and is grown in an area of 7.80 lakh ha, with an annual production of 13.60 lakh tonnes and productivity of 1740 kg ha^{-1} (Anonymous, 2022). Finger millet-groundnut cropping system has several advantages, such as improves of soil fertility, increase soil organic carbon, nitrogen and phosphorous availability, suppress weed growth through smothering effects, increase production per unit area, enhance land use efficiency, reduce runoff and soil loss, etc. inclusion of legume provides sustainability to non-legume cereal component by enriching soil fertility and increasing system productivity and returns. Over the years, health of Indian soils has deteriorated rustling in declining of organic carbon, soil biodiversity and soil physico-chemical properties and build up multi nutrient deficiencies over a larger area

due to reduction in addition of organic manures, imbalanced use of fertilizers and monocropping. It is reported that plant nutrient removal from soils by different crops annually is 10-12 million tonnes higher than addition from various sources, resulting negative nutrient balance. Considering these disadvantages and escalation of fertilizer costs there is a paradigm shift from inorganic to organic farming. To sustain soil health addition of organic matter as source of nutrients is pivotal and in such situation, organic agriculture plays vital role in Indian farming. Organic agriculture is a production system which avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent possible, organic farming system relies on crop rotations, crop residues, animal manures, legumes, green manures, on-farm organic wastes and aspects of biological pest control to maintain soil productivity and health. (Anup Das *et al*., 2018).

Keep these points in view; the investigating was carried out at UAS, GKVK, Bengaluru to study the influence of organic sources on growth and yield of finger millet in finger millet-groundnut cropping sequence.

Material and Methods

A field experiment was conducted at research and demonstration block of Research Institute on Organic Farming (RIOF), Gandhi Krishi Vignan Kendra (GKVK), University of Agricultural Sciences, Bangalore. It is situated in Eastern Dry Zone of Karnataka at latitude of 13° 09' North, longitude of 77º 57' East and an altitude of 924 m above mean sea level (MSL). Finger millet was sown from the month of August and harvested in the month of December 2021-22 and groundnut was taken up after harvest of finger millet in the month of February and harvested in the month of June 2022-23. Meteorological data was recorded during crop growth period in both years. Major portion of rainfall was received during August, September and October (130 mm, 194 mm and 167.8 mm, respectively). The mean monthly maximum air temperature ranged between 26.3°C to 33.6°C and monthly minimum air temperature ranged between 13.5°C to 21.1°C. The highest mean monthly temperature was recorded during April (33.6°C) and it was followed in the months of May and March (32.9 and 32.6°C, respectively). The mean monthly relative humidity ranged from 55.5 per cent in March to 89 per cent in August. The mean monthly bright sunshine hours were maximum during February (9.60) followed by March (9.30). The potential evapotranspiration ranged between 3.1 to 5.1 mm. The highest PET was in April (5.1 mm) and lowest in January (3.1 mm). Studies were conducted to know the influence of organic sources on growth and yield of finger millet during *kharif* 2021 and to asses the residual effect on growth and yield of groundnut during summer 2022

Table 1
Nutrient composition of organic manures

Organic manure	N %			P (%)			K (%)		
	I	II	Mean	I	II	Mean	I	II	Mean
Farm yard manure	0.42	0.51	0.47	0.25	0.21	0.23	0.41	0.39	0.40
Bio-compost	2.10	2.20	2.15	1.48	1.51	1.51	1.69	1.72	1.71
Urban compost	1.24	1.31	1.28	0.51	0.49	0.50	0.78	0.75	0.76
Vermicompost	1.45	1.47	1.46	0.54	0.57	0.56	1.23	1.27	1.25
Poultry manure	2.20	2.19	2.19	1.60	1.64	1.62	1.24	1.29	1.27
Jeevamrutha	0.51	0.55	0.52	0.44	0.41	0.43	0.39	0.27	0.33

Note : I : *kharif* 2021; II : *kharif* 2022

and same sequence was followed during *kharif* 2022 and summer 2023. The experiment consists of 12 treatment combinations of two levels of N equivalent (N_1: 100% N equivalent; N_2; 150% N equivalent) and six organic sources (F_1: FYM; F_2: Bio-compost; F_3: Urban compost; F_4: Vermicompost; F_5: Poultry manure (pre-cured); F_6: Jeevamrutha) along with control and UAS-B package was laid out in randomized block design with factorial concept and replicated thrice. The experimental soil was red sandy loam having medium organic carbon content (0.63%), N (294.3 kg ha^{-1}), P_2O_5 (27.9 kg ha^{-1}) and K_2O (236.5 kg ha^{-1}) content. The nutrient composition of organic manures used in experiment presented in Table 1.

Finger millet variety ML-365 was sown with spacing of 30 cm × 10 cm and followed agronomic practices for cultivating the crop. Nutrient sources *viz.,* bio-compost, poultry manure vermicompost, urban compost, FYM and jeevamrutha were applied on N equivalent basis after analyzing the nutrient content. 50 per cent N equivalent jeevamrutha was added as a basal application remaining 25 per cent at tillering stage and 25 per cent at flowering stage. 7.5 t FYM ha^{-1} was applied for all the treatments as per package of practice. Groundnut (Kadiri Lepakshi) crop was sown after harvest of finger millet at a spacing of 30 cm × 15 cm without application of organic nutrient sources.

Biometric observations on growth parameters were recorded randomly on selected five plants at 30, 60, 90 days after sowing and at harvest in net plot. Data related to yield was recorded at the time of harvest of the crop. Based on the observations, data were subjected to statistical analysis as per the procedure outline by Gomez and Gomez (1984). To know the effect of individual factors and to compare treatment combinations with control treatments, statistical procedure of factorial randomized complete block design was followed, respectively.

Results and Discussion

Plant Height (cm)

The pooled data of two seasons pertaining to plant height at different growth stages of finger millet as influenced by organic sources in finger millet-groundnut cropping sequence is presented in Table 2. Application of organic sources in finger millet-groundnut cropping sequence did not influence plant height at 30 DAS of finger millet and it was found to be statistically non significant for nitrogen equivalent levels, organic sources and for interaction between nitrogen equivalent levels and organic sources. Plant height of finger millet varied significantly at 60, 90 DAS and at harvest as influenced by organic sources. Application of organic sources at 150% N equivalent recorded significantly higher plant height (45.33,

Table 2

Plant height (cm) of finger millet at different growth stages as influenced by organic sources in finger millet-groundnut cropping sequence

Treatments	30 DAS			60 DAS			90 DAS			At harvest		
	I	II	Pooled	I	II	Pooled	I	II	Pooled	I	II	Pooled
Nitrogen equivalent levels (N)												
N_1	10.42	11.81	11.12	35.71	42.98	39.35	74.30	79.15	76.72	81.31	84.38	82.84
N_2	10.96	12.39	11.68	41.38	49.27	45.33	83.98	88.99	86.48	90.41	93.80	92.10
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.66	0.63	0.65	0.94	0.95	0.94	1.00	1.06	1.02
C.D. (p=0.05)	-	-	-	1.94	1.86	1.89	2.74	2.79	2.75	2.92	3.10	2.98
Organic sources (F)												
F_1	10.35	11.71	11.03	36.07	43.21	39.64	74.87	79.64	77.25	82.14	85.38	83.76

Table 2 Conti....

Treatments	30 DAS			60 DAS			90 DAS			At harvest		
	I	II	Pooled	I	II	Pooled	I	II	Pooled	I	II	Pooled
F_2	11.08	12.51	11.79	43.25	50.72	46.98	84.35	89.86	87.11	91.60	94.98	93.29
F_3	10.56	11.99	11.28	36.59	44.90	40.74	78.30	83.28	80.79	84.62	88.61	86.62
F_4	10.67	12.09	11.38	38.78	46.38	42.58	79.86	84.54	82.20	85.71	88.80	87.25
F_5	11.02	12.43	11.72	40.18	47.47	43.82	80.10	85.35	82.73	87.80	90.66	89.23
F_6	10.47	11.89	11.18	36.43	44.07	40.25	77.36	81.74	79.55	83.27	86.10	84.69
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	1.15	1.10	1.12	1.62	1.65	1.62	1.73	1.83	1.76
C.D. (p=0.05)	-	-	-	3.36	3.21	3.28	4.75	4.83	4.76	5.06	5.37	5.17
Interaction (N x F)												
N_1F_1	10.16	11.43	10.79	35.03	41.99	38.51	73.64	77.57	75.60	80.52	83.76	82.14
N_1F_2	10.54	11.97	11.25	36.87	44.13	40.50	75.03	80.05	77.54	82.18	85.11	83.64
N_1F_3	10.48	11.88	11.18	35.48	42.92	39.20	74.12	79.15	76.63	81.25	84.20	82.73
N_1F_4	10.49	11.90	11.19	35.72	43.04	39.38	74.40	79.36	76.88	81.37	84.31	82.84
N_1F_5	10.50	11.93	11.21	35.76	43.41	39.59	74.77	79.81	77.29	81.53	84.77	83.15
N_1F_6	10.36	11.78	11.07	35.42	42.37	38.89	73.85	78.96	76.41	80.99	84.11	82.55
N_2F_1	10.55	11.99	11.27	37.11	44.43	40.77	76.10	81.71	78.90	83.76	87.00	85.38
N_2F_2	11.61	13.05	12.33	49.63	57.31	53.47	93.67	99.67	96.67	101.02	104.85	102.93
N_2F_3	10.65	12.11	11.38	37.69	46.88	42.28	82.47	87.40	84.94	87.99	93.03	90.51
N_2F_4	10.86	12.29	11.57	41.84	49.73	45.78	85.33	89.72	87.52	90.04	93.28	91.66
N_2F_5	11.55	12.92	12.23	44.59	51.52	48.06	85.43	90.90	88.17	94.07	96.54	95.31
N_2F_6	10.57	12.01	11.29	37.44	45.76	41.60	80.88	84.52	82.70	85.56	88.09	86.82
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	1.62	1.55	1.58	2.29	2.33	2.30	2.44	2.59	2.49
C.D. (p=0.05)	-	-	-	4.75	4.55	4.64	6.72	6.83	6.73	7.16	7.59	7.31
Control	9.25	10.34	9.80	28.78	37.10	32.94	66.82	71.80	69.31	72.76	75.78	74.27
RDF	12.75	13.51	13.13	53.00	60.04	56.52	94.33	100.28	97.30	101.91	106.33	104.12
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	1.55	1.52	1.53	2.44	2.56	2.48	2.71	2.82	2.67
C.D. (p=0.05)	-	-	-	4.50	4.42	4.44	7.09	7.44	7.22	7.88	8.21	7.77

Note : N_1: 100 per cent N equivalent; N_2: 150 per cent N equivalent; F_1: Farm Yard Manure; F_2: Bio compost; F_3: Urban compost; F_4: Vermicompost; F_5: Poultry manure (pre-cured); F_6: Jeevamrutha; Control; RDF (50:40:37.5 kg N: P_2O_5: K_2O ha^{-1}); I: *Kharif* 2021; II: *Kharif* 2022

86.48 and 92.10 cm at 60, 90 DAS and at harvest, respectively) as compared to 100% N equivalent (39.35, 76.72 and 82.84 cm at 60, 90 DAS and at harvest, respectively). Among organic sources, application of bio-compost resulted in significantly higher plant height (46.98, 87.11 and 93.29 cm at 60, 90 DAS and at harvest, respectively) followed by poultry manure (43.82, 82.73 and 89.23 cm at 60, 90 DAS and at harvest, respectively), vermicompost (42.58, 82.20 and 87.25 cm at 60, 90 DAS and at

harvest, respectively), urban compost (40.74, 80.79 and 86.62 cm at 60, 90 DAS and at harvest, respectively), jeevamrutha (40.25, 79.55 and 84.69 cm at 60, 90 DAS and at harvest, respectively) and lower plant height was recorded in farm yard manure applied plots (39.64, 77.25 and 83.76 cm at 60, 90 DAS and at harvest, respectively).

Interaction effect between organic sources and levels of nitrogen was found to be significant. Application of bio-compost at 150 per cent N equivalent recorded higher plant height (53.47, 96.67 and 102.93 cm at 60, 90 DAS and at harvest, respectively) which was on par with UAS-B package *i.e.,* 50:40:37.5 kg N: P_2O_5: K_2O ha^{-1} (56.52, 101.91 and 104.12 cm at 60, 90 DAS and at harvest, respectively) and lower plant height was observed in control (32.94, 72.76 and 74.27 cm at 60, 90 DAS and at harvest, respectively). Higher plant height with bio-compost may be attributed to higher amount of nutrients. Higher growth of finger millet plants may be attributed to higher growth rate of leaf and stem that has played a major role in increasing plant height. This is in conformity with Prajwal Kumar *et al*. (2022). Similarly, Korai *et al*. (2014) revealed that there were pronounced positive effects of adding bio-compost, as well as N on plant height of finger millet.

Number of Tillers per Hill

Number of tillers per hill of finger millet at 30 DAS found to be statistically non significant for nitrogen equivalent levels, organic sources and for interaction between nitrogen equivalent levels and organic sources. Significantly higher number of tillers per hill of finger millet (Table 4) was recorded with the application of organic sources at 150% N equivalent (3.84, 7.84 and 8.35 at 60, 90 DAS and at harvest, respectively) and lower number of tillers per hill was observed in 100% N equivalent (3.43, 7.26 and 7.62 at 60, 90 DAS and at harvest, respectively). Significantly higher number of tillers per hill of finger millet was recorded in bio-compost applied plot (3.97, 8.04 and 8.60 at 60, 90 DAS and at harvest, respectively) and was found to be statistically superior over poultry manure (3.75, 7.73 and 8.21 at 60, 90 DAS and at harvest, respectively) and lower number of tillers per hill was recorded in FYM (3.18, 6.88 and 7.18 at 60, 90 DAS and at harvest, respectively).

TABLE 3

Number of tillers per hill at different growth stages of fingermillet as influenced by organic sources in fingermillet-groundnut cropping sequence

Treatments	30 DAS			60 DAS			90 DAS			At harvest		
	I	II	Pooled	I	II	Pooled	I	II	Pooled	I	II	Pooled
Nitrogen equivalent levels (N)												
N_1	1.37	1.57	1.47	3.05	3.80	3.43	7.07	7.44	7.26	7.45	7.80	7.62
N_2	1.50	1.72	1.61	3.43	4.25	3.84	7.68	8.00	7.84	8.25	8.45	8.35
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.06	0.05	0.05	0.07	0.08	0.07	0.10	0.11	0.09
C.D. (p=0.05)	-	-	-	0.16	0.15	0.14	0.22	0.25	0.20	0.28	0.32	0.27
Organic sources (F)												
F_1	1.37	1.57	1.47	2.83	3.54	3.18	6.77	6.98	6.88	7.07	7.30	7.18
F_2	1.50	1.71	1.60	3.57	4.38	3.97	7.87	8.21	8.04	8.47	8.73	8.60
F_3	1.42	1.65	1.53	3.24	4.04	3.64	7.32	7.74	7.53	7.79	8.12	7.95
F_4	1.45	1.67	1.56	3.28	4.06	3.67	7.42	7.77	7.60	7.97	8.16	8.07

Table 3 Conti....

Treatments	30 DAS			60 DAS			90 DAS			At harvest		
	I	II	Pooled	I	II	Pooled	I	II	Pooled	I	II	Pooled
F_5	1.47	1.68	1.57	3.35	4.16	3.75	7.55	7.92	7.73	8.07	8.36	8.21
F_6	1.38	1.60	1.49	3.19	3.97	3.58	7.30	7.71	7.50	7.75	8.08	7.92
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.10	0.09	0.08	0.13	0.15	0.12	0.17	0.19	0.16
C.D. (p=0.05)	-	-	-	0.28	0.26	0.24	0.38	0.43	0.35	0.49	0.56	0.47
Interaction (N x F)												
N_1F_1	1.29	1.50	1.40	2.37	2.99	2.68	6.16	6.19	6.18	6.28	6.45	6.37
N_1F_2	1.44	1.63	1.53	3.27	4.06	3.67	7.31	7.75	7.53	7.79	8.14	7.96
N_1F_3	1.35	1.57	1.46	3.17	3.93	3.55	7.22	7.67	7.44	7.62	8.02	7.82
N_1F_4	1.38	1.59	1.48	3.20	3.95	3.57	7.24	7.71	7.48	7.68	8.07	7.88
N_1F_5	1.42	1.61	1.51	3.24	4.03	3.63	7.28	7.72	7.50	7.72	8.10	7.91
N_1F_6	1.31	1.52	1.42	3.08	3.84	3.46	7.19	7.63	7.41	7.61	7.99	7.80
N_2F_1	1.45	1.64	1.55	3.28	4.09	3.69	7.38	7.77	7.58	7.85	8.15	8.00
N_2F_2	1.56	1.79	1.68	3.87	4.69	4.28	8.43	8.68	8.56	9.15	9.32	9.24
N_2F_3	1.48	1.72	1.60	3.31	4.15	3.73	7.42	7.81	7.61	7.95	8.22	8.08
N_2F_4	1.51	1.75	1.63	3.37	4.17	3.77	7.60	7.83	7.72	8.25	8.27	8.26
N_2F_5	1.53	1.74	1.64	3.45	4.29	3.87	7.82	8.11	7.96	8.42	8.61	8.52
N_2F_6	1.46	1.67	1.56	3.30	4.10	3.70	7.41	7.78	7.59	7.88	8.17	8.03
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.14	0.13	0.12	0.18	0.21	0.17	0.23	0.27	0.22
C.D. (p=0.05)	-	-	-	0.40	0.37	0.34	0.53	0.60	0.50	0.69	0.79	0.66
Control	1.20	1.44	1.32	2.07	2.63	2.35	5.91	5.98	5.95	6.07	6.15	6.11
RDF	1.67	1.83	1.75	3.90	4.71	4.31	8.46	8.70	8.58	9.26	9.46	9.36
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.16	0.18	0.15	0.28	0.27	0.25	0.39	0.34	0.35
C.D. (p=0.05)	-	-	-	0.47	0.51	0.45	0.80	0.79	0.73	1.14	1.00	1.01

Note : N_1: 100 per cent N equivalent; N_2: 150 per cent N equivalent; F_1: Farm Yard Manure; F_2: Biocompost; F_3: Urban compost; F_4: Vermicompost; F_5: Poultry manure (pre-cured); F_6: Jeevamrutha; Control; RDF (50:40:37.5 kg N: P_2O_5: K_2O ha^{-1}); I: *Kharif* 2021; II: *Kharif* 2022

Number of tillers per hill was found to be significant for the interaction between nitrogen equivalent levels and organic sources. Bio-compost application at 150% N equivalent resulted in significantly higher number of tillers per hill (4.28, 8.56 and 9.24 at 60, 90 DAS and at harvest, respectively) compared to other treatments and was on par with UAS-B package *i.e.,* 50:40:37.5 kg N: P_2O_5: K_2O ha^{-1} (4.31, 8.58 and 9.36 at 60, 90 DAS and at harvest, respectively) and lower number of tillers per was recorded in control plot (2.35, 6.07 and 6.11 at 60, 90 DAS and at harvest, respectively). Application of different organic nutrient sources in conjunction increased the plant height and number of tillers $plant^{-1}$ which could be attributed to the balanced supply of nutrients (Sable *et al*., 2007).

TABLE 4

Total dry matter accumulation (g hill^{-1}) of fingermillet at different growth stages as influenced by organic sources in fingermillet-groundnut cropping sequence

Treatments	30 DAS			60 DAS			90 DAS			At harvest		
	I	II	Pooled	I	II	Pooled	I	II	Pooled	I	II	Pooled
Nitrogen equivalent levels (N)												
N_1	5.01	5.28	5.14	13.99	14.62	14.31	37.03	38.19	37.61	61.45	64.84	63.14
N_2	5.48	5.70	5.59	15.40	16.04	15.72	42.10	43.39	42.74	70.40	74.14	72.27
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.16	0.17	0.16	0.45	0.46	0.22	0.76	0.77	0.76
C.D. (p=0.05)	-	-	-	0.48	0.48	0.48	1.31	1.33	0.64	2.23	2.27	2.24
Organic sources (F)												
F_1	5.03	5.32	5.17	13.99	14.60	14.29	37.59	38.73	38.16	62.33	65.99	64.16
F_2	5.53	5.75	5.64	16.01	16.66	16.34	42.69	44.10	43.39	71.29	75.09	73.19
F_3	5.20	5.43	5.31	14.48	15.11	14.80	38.84	40.12	39.48	64.37	68.02	66.20
F_4	5.26	5.48	5.37	14.70	15.33	15.01	39.75	40.96	40.35	66.03	69.52	67.78
F_5	5.38	5.60	5.49	14.82	15.46	15.14	40.07	41.37	40.72	67.31	71.01	69.16
F_6	5.09	5.36	5.22	14.17	14.83	14.50	38.44	39.45	38.94	64.19	67.32	65.75
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.29	0.29	0.29	0.78	0.79	0.38	1.32	1.34	1.32
C.D. (p=0.05)	-	-	-	0.84	0.84	0.84	2.28	2.31	1.12	3.87	3.93	3.89
Interaction (N x F)												
N_1F_1	4.85	5.20	5.02	13.27	13.89	13.58	35.61	36.65	36.13	59.49	62.94	61.22
N_1F_2	5.15	5.38	5.26	14.39	15.03	14.71	37.72	39.05	38.39	63.00	66.60	64.80
N_1F_3	4.97	5.25	5.11	14.11	14.75	14.43	37.31	38.33	37.82	61.33	64.59	62.96
N_1F_4	5.07	5.28	5.18	14.19	14.82	14.50	37.36	38.44	37.90	61.68	65.13	63.41
N_1F_5	5.13	5.33	5.23	14.37	15.00	14.69	37.37	38.63	38.00	61.74	65.19	63.46
N_1F_6	4.91	5.22	5.06	13.60	14.25	13.93	36.79	38.03	37.41	61.45	64.60	63.02
N_2F_1	5.20	5.44	5.32	14.70	15.31	15.01	39.56	40.81	40.19	65.17	69.04	67.10
N_2F_2	5.91	6.12	6.01	17.64	18.29	17.97	47.66	49.15	48.40	79.59	83.57	81.58
N_2F_3	5.43	5.60	5.52	14.85	15.47	15.16	40.37	41.91	41.14	67.41	71.45	69.43
N_2F_4	5.45	5.68	5.57	15.20	15.84	15.52	42.15	43.48	42.81	70.38	73.91	72.15
N_2F_5	5.64	5.87	5.76	15.28	15.91	15.60	42.78	44.12	43.45	72.89	76.83	74.86
N_2F_6	5.28	5.49	5.38	14.75	15.40	15.07	40.08	40.86	40.47	66.93	70.03	68.48
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.40	0.40	0.40	1.10	1.11	0.54	1.86	1.89	1.87
C.D. (p=0.05)	-	-	-	1.18	1.19	1.19	3.22	3.27	1.58	5.47	5.55	5.49
Control	4.63	4.92	4.77	11.06	11.69	11.37	31.81	33.03	32.42	53.13	56.58	54.85
RDF	6.03	6.37	6.20	17.83	18.49	18.16	48.14	49.36	48.75	80.40	84.18	82.29

Table 4 Conti....

Treatments	30 DAS			60 DAS			90 DAS			At harvest		
	I	II	Pooled	I	II	Pooled	I	II	Pooled	I	II	Pooled
F test	NS	NS	NS	*	*	*	*	*	*	*	*	*
S.Em ±	-	-	-	0.50	0.50	0.50	1.36	1.38	0.74	2.28	2.33	2.30
C.D. (p=0.05)	-	-	-	1.45	1.46	1.45	3.96	4.02	2.16	6.62	6.77	6.68

Note : N_1: 100 per cent N equivalent; N_2: 150 per cent N equivalent; F_1: Farm Yard Manure; F_2: Biocompost; F_3: Urban compost; F_4: Vermicompost; F_5: Poultry manure (pre-cured); F_6: Jeevamrutha; Control; RDF (50:40:37.5 kg N: P_2O_5: K_2O ha^{-1}); I: *Kharif* 2021; II: *Kharif* 2022

Leaf Area Index

Higher leaf area index of finger millet (Fig.1) was recorded with the application of organic sources at 150% N equivalent (0.53, 3.17, 6.19 and 3.60 at 30, 60, 90 DAS and at harvest, respectively) compared 100% N equivalent (0.49, 2.68, 5.23 and 3.05 at 30, 60, 90 DAS and at harvest, respectively). Among organic sources, higher leaf area index of finger millet was recorded in bio-compost applied plots (0.52, 3.24, 6.32 and 3.68 at 30, 60, 90 DAS and at harvest, respectively) followed by poultry manure (0.52, 3.02, 5.89 and 3.41 at 30, 60, 90 DAS and at harvest, respectively), vermicompost (0.52, 2.93, 5.71 and 3.33 at 30, 60, 90 DAS and at harvest, respectively), urban compost (0.51, 2.86, 5.59 and 3.26 at 30, 60, 90 DAS and at harvest, respectively) jeevamrutha (0.50, 2.79, 5.45 and 3.18 at 30, 60, 90 DAS and at harvest, respectively) and lower leaf area index in farm yard manure applied plots (0.48, 2.71, 5.29 and 3.09 at 30, 60, 90 DAS and at harvest, respectively).

Leaf area index for the interaction between nitrogen equivalent levels and organic sources, bio-compost application at 150% N equivalent resulted in higher leaf area index (0.54, 3.73, 7.27 and 4.23 at 30, 60, 90

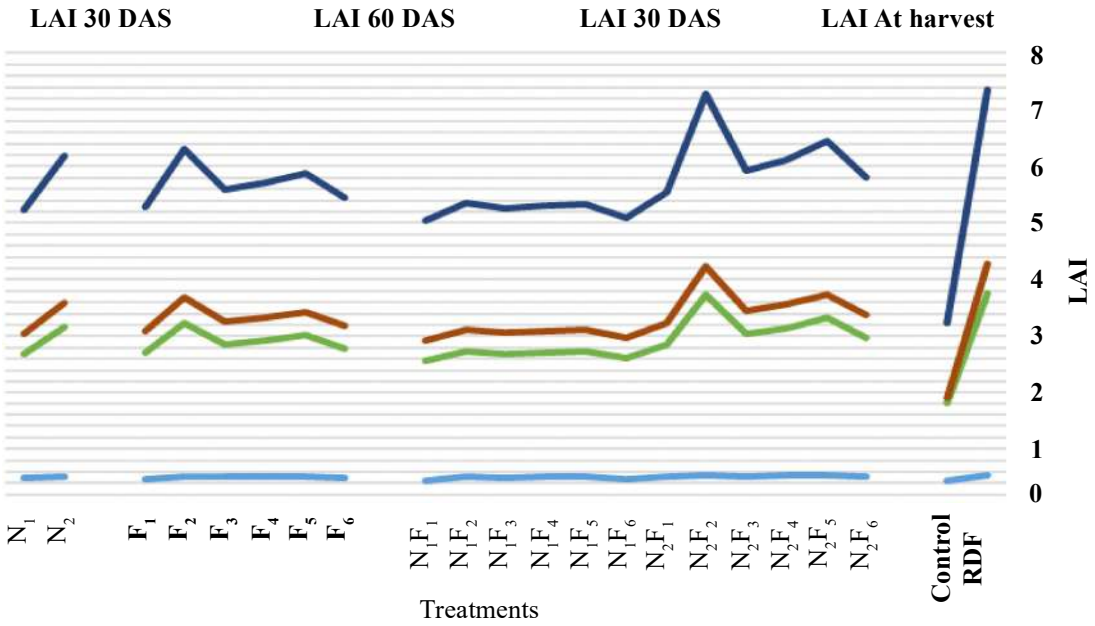

Fig. 1: Leaf area index of fingermillet at different growth stages as influenced by different organic sources in finger millet-groundnut cropping sequence (pooled data of two seasons

Note: N_1 : 100 per cent N equivalent; N_2 : 150 per cent N equivalent; F_1 : Farm Yard Manure; F_2 : Bio compost; F_3 : Urban compost; F_4 : Vermicompost; F_5 : Poultry manure (pre-cured); F_6 : Jeevamrutha; Control; RDF (50 N: 40 P_2O_5 : 37.5 K_2O ha^{-1})

DAS and at harvest, respectively). However, lower leaf area index was observed in control plots (0.45, 1.80, 3.24 and 1.89 at 30, 60, 90 DAS and at harvest, respectively). Higher leaf area and leaf area index could be attributed to availability of macronutrients and micronutrients from organic manures, which is very essential for plant growth and development. The higher leaf area and leaf area index was primarily due to increased number of leaves per plant. The leaf area index (LAI) is a vital indicator of plant growth and for evaluating assimilation and fixation of photosynthates in plant physiological studies which is a major factor in determining the solar radiation interception, canopy photosynthesis and therefore yield (Duncon, 1975).

Total Dry Matter Accumulation (g hill^{-1})

Total dry matter accumulation of finger millet at 30 DAS found to be statistically non significant for nitrogen equivalent levels, organic sources and for interaction between nitrogen equivalent levels and organic sources. Significantly higher total dry matter accumulation of finger millet (Table 4) was recorded with the application of organic sources at 150% N equivalent (15.72, 42.74 and 72.27 g hill^{-1} at 60, 90 DAS and at harvest, respectively) and lower total dry matter accumulation was observed in 100% N equivalent (14.31, 37.61 and 63.14 g hill^{-1} at 60, 90 DAS and at harvest, respectively). Significantly higher dry matter accumulation of finger millet was recorded in bio-compost applied plot (16.34 43.39 and 73.19 g hill^{-1} at 60, 90 DAS and at harvest, respectively) and was found to be statistically superior over other treatments and lower total dry matter accumulation in FYM (14.29, 38.16 and 64.16 g hill^{-1} at 60, 90 DAS and at harvest, respectively).

Dry matter accumulation was found to be significant for the interaction between nitrogen equivalent levels and organic sources. Bio-compost application at 150% N equivalent resulted in significantly higher dry matter accumulation (17.97, 48.40 and 81.58 g hill^{-1} at 60, 90 DAS and at harvest, respectively) compared to other treatments and was on par with UAS-B package *i.e.,* 50:40:37.5 kg N: P_2O_5: K_2O ha^{-1} (18.16, 48.75 and 82.29 g hill^{-1} at 60, 90 DAS and at harvest, respectively). Lower dry matter accumulation was observed in control plot (11.37, 32.42 and 54.85 g hill^{-1} at 60, 90 DAS and at harvest, respectively). This is in conformity with Vishwajit and Devakumar (2018). Total dry matter production is a result of dry matter accumulation in plant parts, which depends on uptake of nutrients like N, P and K. Increase in dry matter was mainly due to increase in number of leaves produced per plant and better uptake of nutrients. Application of organic manures has increased biological efficiency and greater sink capacity in the crop which might have helped in higher photosynthetic efficiency and absorption of nutrients (Roopashree *et al*., 2019).

Grain Yield, Straw Yield and Harvest Index of Finger Millet

Grain and straw yield of finger millet (Table 5) differed significantly due to influence of organic sources in finger millet-groundnut cropping sequence. Significantly higher grain and straw yield of finger millet were obtained with the application of 150% N equivalent (2954 and 5124 kg ha^{-1}, respectively) and lower yield was observed in 100% N equivalent plots (2488 and 4361 kg ha^{-1}, respectively). Among organic sources, application of bio-compost produced higher grain and straw yield (3005 and 5291 kg ha^{-1}, respectively). However, lower grain and straw yield were obtained in farm yard manure applied plots (2520 and 4285 kg ha^{-1}, respectively).

Among interaction effect, application of bio-compost at 150% N equivalent (3459 and 5842 kg ha^{-1}, respectively) recorded significantly higher grain and straw yield and was on par with UAS-B package *i.e.,* 50:40:37.5 kg N: P_2O_5: K_2O ha^{-1} (3493 and 5942 kg ha^{-1}, respectively). Lower grain and straw yield were recorded in control plot (1555 and 2269 kg ha^{-1}, respectively). The results are in line with Ananda and Sharanappa (2017). The increase in yield is mainly attributed to higher yield parameters like number of productive tillers, earhead length, finger length and test weight. Higher growth and yield parameters could be attributed to availability of macronutrients and micronutrients from organic manure, which is very essential for plant growth and development (Boraiah

TABLE 5

Grain yield, straw yield and harvest index of fingermillet as influenced by organic sources in fingermillet-groundnut cropping sequence

Treatments	Grain yield (kg ha^{-1})			Straw yield (kg ha^{-1})			Harvest index (HI)		
	I	II	Pooled	I	II	Pooled	I	II	Pooled
Nitrogen equivalent levels (N)									
N_1	2452	2524	2488	4294	4428	4361	0.37	0.36	0.36
N_2	2909	2993	2951	5051	5197	5124	0.37	0.36	0.36
F test	*	*	*	*	*	*	NS	NS	NS
S. Em ±	37	36	36	70	65	66	-	-	-
C.D. (p=0.05)	108	105	106	206	191	194	-	-	-
Organic sources (F)									
F_1	2483	2557	2520	4206	4365	4285	0.38	0.37	0.37
F_2	2964	3045	3005	5216	5365	5291	0.36	0.36	0.36
F_3	2623	2704	2664	4607	4718	4663	0.36	0.37	0.36
F_4	2680	2753	2716	4763	4888	4826	0.36	0.36	0.36
F_5	2776	2859	2818	4832	4967	4899	0.37	0.37	0.37
F_6	2557	2634	2595	4411	4574	4493	0.37	0.37	0.37
F test	*	*	*	*	*	*	NS	NS	NS
S. Em ±	64	62	63	122	113	114	-	-	-
C.D. (p=0.05)	186	181	184	357	330	336	-	-	-
Interaction (N x F)									
N_1F_1	2360	2432	2396	3567	3733	3650	0.40	0.39	0.40
N_1F_2	2513	2587	2550	4665	4813	4739	0.35	0.35	0.35
N_1F_3	2462	2537	2499	4309	4396	4353	0.36	0.37	0.37
N_1F_4	2488	2558	2523	4604	4707	4655	0.35	0.35	0.35
N_1F_5	2499	2569	2534	4658	4776	4717	0.35	0.35	0.35
N_1F_6	2388	2464	2426	3960	4145	4053	0.38	0.37	0.37
N_2F_1	2605	2683	2644	4845	4996	4921	0.35	0.35	0.35
N_2F_2	3415	3504	3459	5767	5918	5842	0.37	0.37	0.37
N_2F_3	2784	2871	2828	4905	5040	4973	0.36	0.36	0.36
N_2F_4	2871	2948	2909	4923	5069	4996	0.37	0.37	0.37
N_2F_5	3054	3150	3102	5007	5158	5082	0.38	0.38	0.38
N_2F_6	2725	2803	2764	4862	5004	4933	0.36	0.36	0.36
F test	*	*	*	*	*	*	NS	NS	NS
S. Em ±	90	88	89	172	159	162	-	-	-
C.D. (p=0.05)	264	257	260	505	467	475	-	-	-
Control	1514	1595	1555	2202	2337	2269	0.41	0.41	0.41
RDF	3451	3535	3493	5883	6001	5942	0.37	0.38	0.37

Table 5 Conti....

Treatments	Grain yield (kg ha^{-1})			Straw yield (kg ha^{-1})			Harvest index (HI)		
	I	II	Pooled	I	II	Pooled	I	II	Pooled
F test	*	*	*	*	*	*	NS	NS	NS
S. Em ±	95	93	93	177	163	166	-	-	-
C.D. (p=0.05)	276	270	272	515	474	484	-	-	-

Note : N_1: 100 per cent N equivalent; N_2: 150 per cent N equivalent; F_1: Farm Yard Manure; F_2: Biocompost; F_3: Urban compost; F_4: Vermicompost; F_5: Poultry manure (pre-cured); F_6: Jeevamrutha; Control; RDF (50:40:37.5 kg N: P_2O_5: K_2O ha^{-1}); I: *Kharif* 2021; II: *Kharif* 2022

et al., 2017). The lower grain yield due to reduced availability of nutrients for the crop during early growth stages (vegetative period) and thus the crop might have starved of nutrients during later stage (reproductive stage), which might have affected the grain and stover yield (Urkurkar *et al.*, 2010).

Application of organic sources at nitrogen equivalent levels in finger millet-groundnut cropping sequence did not influence the harvest index of finger millet and it was found to be statistically non-significant (Table 5).

Higher grain and straw yield of finger millet were obtained with the application of 150% N equivalent (2954 and 5124 kg ha^{-1}, respectively) and lower yield was observed in 100% N equivalent. Among organic sources, application of bio-compost produced higher grain and straw yield (3005 and 5291 kg ha^{-1}, respectively). However, lower grain and straw yield were obtained in farm yard manure. Between interaction effects, application of bio-compost at 150% N equivalent (3459 and 5842 kg ha^{-1}, respectively) recorded higher grain and straw yield. Lower grain and straw yield were recorded in control plots.

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