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Effect of different farming types on uptake of primary and secondary nutrients by finger millet under finger millet based intercropping systems

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Abstract
A Field experiment was conducted on performance of finger millet based inter cropping system under different farming types during *kharif* 2019-20 and 2020-21 at College of Agriculture, KSN UAHS Shivamogga. Experiment was laid out with split-plot design having Three farming types as main plots (conventional, organic, and natural farming) and Ragi based inter cropping system as subplots (Ragi + Red gram, Ragi + field bean, Sole Ragi, sole redgram and sole fieldbean) in three replications. Among different farming types, conventional farming type recorded significantly higher uptake and among finger millet based inter cropping system sole finger millet recorded statistically higher uptake compare to other cropping system.

Keywords: Growth, Yield, finger-millet, farming systems and inter cropping systems

Introduction

Finger millet (*Eleusine coracana* L. Gaertin) is one of the important rainfed crop widely cultivated in dry tracts of Southern Karnataka for grain and fodder purpose in varied agro climatic conditions under resource constrained situations. It is also called as kurrakan millet or koracan millet, ragi, nachni in India, African millet and rapoko in South Africa and dagusa in Ethiopia. In India, it is grown in Karnataka, Tamil Nadu, Andra Pradesh, Orissa, Jharkand, Maharastra and Uttarakhand over an area of 11.17 lakh hectares with the production of 20.60 lakh tonnes with an average productivity of 1661 kg ha^{-1}. Karnataka is the largest producer of finger millet in India grown in an area of 6.28 lakh ha with annual production of 9.3 lakh tonnes and productivity of 1759 kg ha^{-1} (Anon., 2019) [1]. More importantly, its greater plasticity and adaptability to different ecological condition, feasibility for transplanting, better suitability to different cropping systems and mid-season correction during vagaries of monsoon in the contingent plans made it so popular crop Krishne Gowda, (2004) [2].

Many experts in the field of agriculture have voiced concern that any more efforts to persist with increased and often indiscriminate use of chemical inputs will only prove counterproductive in the long run and cause irreparable damage to soil health. Marching towards achieving sustainability in agriculture, is one of the major concerns of humanity as on today. In wake of this reverting to non – chemical agriculture practice has assumed great importance to attain sustainability in production. In this search for ecofriendly and farmer friendly alternate type of farming organic or natural farming is increasingly becoming popular nowadays.

Diversification of cropping system is necessary to get higher yield and returns, to maintain soil health, preserve environment and meet daily food and fodder requirement of human and animal syatem (Padhi and Panigrahi, 2006) [3]. Organic or natural farming relies on adoption of diversified multi cropping systems. The cereal-legume intercropping is mainly practiced in subsistence agriculture. Legumes are included in intercropping system to mainly get protein requirement of the family with some additional returns. Scientific intercropping of pulses with cereals and other non-legume companion crops have certain inbuilt advantage over pure cropping (Velautham and Somasundaram, 2000) [4]. Keeping these things in view, an experiment entitled "Performance of different farming types in finger millet based inter cropping system under Southern Transition Zone of Karnataka" was undertaken with the following objective to study the effect of different farming types on growth, yield and yield attributing parameters of finger millet under finger millet based intercropping systems

Materials and Methods

Field experiment on Performance of different farming types in finger millet based inter cropping system under Southern Transition Zone of Karnataka was conducted during *kharif* seasons for two consecutive years during during 2019 and 2020 at field unit, Department of Agronomy, College of Agriculture, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Navile, Shivamogga, Karnataka.

There were three main plots and five sub plots treatments which comprised of two factors for study *viz.*, farming types (three) and cropping system (five) and details of the field experiment conducted is given below.

Main plot (Farming types)

M_1**:** Conventional farming (CF)
M_2**:** Organic farming (OF)
M_3**:** Natural farming (NF)

Sub plot (Cropping systems)

S_1: Finger millet + Red gram (8:2)
S_2: Finger millet + Field bean (8:1)
S_3: Sole Finger millet crop
S_4: Sole Red gram crop
S_5: Sole Field bean crop

3.5.1.2 Treatment combinations

T_1: CF - (Finger millet + Red gram)
T_2: CF - (Finger millet + Field bean)
T_3: CF - (Sole finger millet crop)
T_4: CF - (Sole red gram crop)
T_5: CF - (Sole field bean crop)
T_6: OF - (Finger millet + Red gram)
T_7: OF - (Finger millet + Field bean)
T_8: OF - (Sole finger millet crop)
T_9: OF - (Sole red gram crop)
T_{10}: OF - (Sole field bean crop)
T_{11}: NF - (Finger millet + Red gram)
T_{12}: NF - (Finger millet + Field bean)
T_{13}: NF - (Sole finger millet crop)
T_{14}: NF - (Sole red gram crop)
T_{15}: NF - (Sole field bean crop)

Design and experimental details

Design		**Split plot design**
Treatments Combination		15
Replications		03
Gross plot size		7.2 m × 4.2 m
Net plot size		6.0 m × 3.6 m
Season		*Kharif* of 2018-19 and 2019-20
Location		ZAHRS, Shivamogga
Plan of layout		Fig :3.2
Crop		Main crop finger millet, intercrops red gram and field bean
Finger millet		ML-365
Variety of red gram		BRG-4
Variety of field bean		Local field bean
Spacing		Finger millet 30 cm × 10 cm Red gram 60 cm × 30 cm Field bean 60 cm × 30 cm
Recommended dose of fertilizers		Finger millet 50:40:25 N, P_2O_5, K_2O kg ha^{-1}. Red gram 25:50:25 N, P_2O_5, K_20 kg ha^{-1} Field bean 25:50:25 N, P_2O_5, K_20 kg ha^{-1}
Date of sowing	Season - I	18-07-2019
	Season - II	02-07-2020
Date of harvest	Season - I	12-12-2019
	Season - II	26 -11-2020

Details of the inputs used in the experiments:

In case of conventional farming, FYM @ 7.5 t ha^{-1} applied before sowing. Recommended dose of Nutrients 50:40:25 kg N: P_2O_5: K_2O ha^{-1} along with micronutrients such as $ZnSO_4$ @ 12.5 kg ha^{-1} and Borax @ 10 kg ha^{-1} were applied as soil application. The Seeds were treated with Carbendazim @ 2g kg^{-1} of seeds before sowing and bio fertilizers were Pseudomonas and trichoderma viride @ 500 g each mixed with 25 kg of FYM and then applied. The practices followed in organic farming were applied recommended dose of nutrients, supplied through FYM on N equivalent basis and FYM @ 7.5 t ha^{-1} applied before sowing. Seeds are treated with Rhizobium @ 20 g kg^{-1} of seed. The Biofertilizers such as Azospirillum and phosphorus solubilizing bacteria (PSB) were applied @ 1 kg ha^{-1} each mixing with FYM. The Nimbicidin @ 2 ml per litre of water as a bio insecticide to control pests and diseases in organic farming system. Where as in case of natural farming, seeds were treated with beejamrutha at the time of sowing. Soil application of Ghana Jeevamrutha @ 1000 kg ha^{-1} at the time of sowing was applied. The Foliar application of jeevamrutha @ 500 lit ha^{-1} at 30, 60 and 90 days after sowing was carried out. Neemastra @ 3 lit per 100 litres of water and sour butter milk @ 5 litres per 100 litre of water to control pests and diseases.

Collection and preparation of plant samples

Grain and Stover samples were collected at the time of harvest dried at 65 ºC in a hot air oven and powdered using a grinder fitted with stainless steel blades and preserved in polythene bags for further analysis (Jackson, 1973) [5].

Total nitrogen: Total nitrogen was determined by Kjeldahl's method of nitrogen determination as described by

Jackson (1973) [5]. In this method, a powdered sample of 0.5 g was digested with concentrated H_2SO_4 in presence of digestion mixture (K_2SO_4:$CuSO_4.5H_2O$: Se in the proportion of 100:20:1) and distilled under alkaline medium. NH_3 liberated was trapped in boric acid containing mixed indicator and titrated against standard H_2SO_4.

Digestion of plant samples with di-acid mixture

A powdered sample of 0.5 g was pre-digested with 5 ml of concentrated HNO_3 and followed by a di-acid mixture (HNO_3: $HClO_4$ in the proportion of 10:4 ratio) and volume was made up to 100 ml with distilled water and preserved for total elemental analysis (Jackson, 1973) [5].

Total phosphorus

Total phosphorus was determined by taking a known volume of the digested materials by adopting the vanado molybdo phosphoric yellow colour method as described by Jackson (1973) [5].

Total potassium

Using the respective di-acid digested extract potassium was estimated using flame photometer under suitable measuring conditions as described by Jackson (1973) [5].

Calcium, Magnesium and Sulphur

Calcium and magnesium were estimated from di-acid extractant by titrating against standard versenate solution (Piper, 1966) [6]. Whereas, sulphur content was estimated by turbidometric method from diacid extractant (Black, 1965) [7].

3.13.6 Uptake of nutrients

The uptake of nutrients by different parts of plants was worked out by multiplying the nutrient content and yield of the plant part as given in the following formulae;

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content \%} \times \text{Dry matter yield (kg ha}^{-1})}{100}$$

Results and Discussion

Primary nutrients

For higher growth and development of crop, nutrients are very much essential. As the uptake of nutrients by crop increases, the grain yield also increases because of more production of dry matter and subsequent translocation of dry matter into economic parts. For efficient use of applied nutrients, there should be better uptake of applied nutrients which in turn give higher yield. The data on primary nutrient uptake of finger millet in finger millet based inter cropping system under different farming types is depicted in Table 4.32-4.34.

Among different farming types, significantly higher nitrogen uptake was noticed with conventional farming (12.83, 48.28, 52.33 and 57.24 kg ha^{-1}) followed by organic farming (11.42, 38.27, 40.72 and 44.07 kg ha^{-1}) and lesser nitrogen uptake was observed in natural farming (10.31, 23.54, 24.46 and 26.05 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. Where as in phosphorous, higher uptake was recorded in conventional farming (1.74, 8.50, 11.94 and 15.67 kg ha^{-1}) followed by organic farming (1.38, 6.67, 8.70 and 12.18 kg ha^{-1}) and lower was observed in natural farming (1.18, 4.41, 5.36 and 7.00 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. Similarly higher potassium uptake was noticed in conventional farming (9.14, 46.46, 50.63 and 61.08 kg ha^{-1}) followed by organic farming (8.00, 37.82, 42.59 and 48.66 kg ha^{-1}) and lower was observed in natural farming (6.89, 26.46, 29.25 and 31.28 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. The higher uptake of N, P_2O_5 and K_2O in conventional farming was mainly due to significantly higher uptake of N, P_2O_5 and K_2O by grains (32.38, 8.01 and 15.48 kg ha^{-1}) as well as straw (24.86, 7.66 and 45.59 kg ha^{-1}) and lower uptake of nutrient was observed in natural farming (26.05, 7.00 and 31.28 kg ha^{-1}). The lower uptake was mainly due to lesser uptake by grains (15.19, 3.78 and 7.53 kg ha^{-1}) and straw (10.86, 3.22 and 23.75 kg ha^{-1}) (Tables 4.32 to 4.34 and Fig. 4.9– 4.11).

Better uptake of major nutrients, might be also due to balanced application of nutrients through organic and inorganics sources of nutrients under conventional farming which provided sufficient availability of N, P and K contents in soil which ultimately increased nutrient content in the plant tissues and also resulted in greater biomass production. Since the uptake of nutrient is a function of dry matter and nutrient content, the increased grain and straw yield together with higher NPK content resulted in greater uptake of these elements under conventional farming. Where as in organic farming moderate nutrient uptake with organic manure might be attributed to solubilization of native nutrients, chelation of complex intermediate organic molecules produced during decomposition of added organic manures, their mobilization and accumulation of different nutrients in different plant parts.(Sharma *et al*. 2013; Nambiar. 1994) [8, 9].

Under natural farming, application of jeevamrutha and ghana jeevamrutha provided certain macro and micronutrients as well as growth regulators like auxins and GA which helped in producing plant bio mass and also in better recovery of secondary nutrients in plant. Beaulah (2002) [10] and Kumawat *et al*. (2009) [11] opined soil enzyme and biological activities are believed to be direct indicators of the enhancement of soil fertility resulting from the incorporation of organic manures (Devakumar *et al*., 2008) [12]. But application of only organic manure and jeevamrutha did not show much influence in terms of grain yield like greater yield improvement in conventional farming, because organic manures are slow release in nature and the entire nutrient is not released from organic manures in single crop cycle. But, organic manures and jeevamrutha are known to improve the soil physio-chemical and biological properties. Integrated application of inorganic, organic and biofertilizer also performed well in the resource poor soil as reported by Vinay *et al.* (2020) [13]. Among the inter cropping system significantly higher nitrogen uptake was noticed in sole finger millet (12.80, 42.18, 44.88 and 49.55 kg ha^{-1}) followed by finger millet + red gram (11.50, 36.80, 39.32 and 42.26 kg ha^{-1}) and lesser nitrogen uptake was observed in finger millet + field bean (10.27, 31.12, 33.30 and 35.55 kg ha^{-1}) at 30, 60, 90 and at harvest, respectively.

Higher phosphorous uptake was recorded in sole finger millet (1.63, 7.44, 10.37 and 13.95 kg ha^{-1}) followed by finger millet + red gram (1.43, 6.55, 8.46 and 11.59 kg ha^{-1}) and lower was observed in finger millet + field bean (1.25, 5.60, 7.19 and 9.31 kg ha^{-1}) at 30, 60, 90 and at harvest, respectively. Statistically higher potassium uptake was noticed in sole finger millet (8.90, 40.73, 46.82 and 55.86 kg ha^{-1}) followed by finger millet + red gram (8.05, 36.80, 41.12 and 47.44 kg ha^{-1}) and lower was observed in finger millet + field bean (7.08, 33.20, 34.52 and 37.71 kg ha^{-1}) at 30, 60, 90 and at harvest respectively.

The higher uptake of N, P_2O_5 and K_2O in sole finger millet was mainly due to significantly higher uptake of N, P_2O_5 and K_2O by grains (28.38, 7.22 and 14.65 kg ha^{-1}) as well as straw (21.17, 6.73 and 41.21 kg ha^{-1}). This could be mainly due to significant higher uptake of nutrient by grains and straw because of their higher grain and straw yield as a consequence of increased total dry matter in finger millet. Uptake of any nutrient by crop is directly proportional to dry matter production, grain and straw yield, the increased grain and straw yield have led to higher uptake of these nutrients under sole finger millet. The reason for higher grain and straw yields under sole crop favoured increased uptake $plant^{-1}$ which was due to better availability of nutrients and water in root zone through balanced application of both organic and inorganic source of nutrients. These results are in accordance with Venkatesha (2008) [14]. Significantly lower uptake of nutrient was observed in finger millet + field bean (35.55, 9.31 and 37.71 kg ha^{-1}) due to lower grain uptake (20.26, 4.81 and 8.85 kg ha^{-1}) and straw uptake (15.29, 4.50 and 28.85 kg ha^{-1}) followed by finger millet + red gram (42.26, 11.59 and 47.44, kg ha^{-1}), respectively. Lower uptake of nutrients in finger millet + red gram, was a consequence of less contribution from grain (24.28, 5.96 and 11.78 kg ha^{-1}) and straw (17.97, 5.63 and 35.66 kg ha^{-1}) respectively, (Tables 4.32 to 4.34).

Secondary nutrient

The data on secondary nutrients uptake in plant and grain of finger millet in different farming types under finger millet based inter cropping system depicted in Table 4.35-4.37

Conventional farming witnessed significantly higher uptake of secondary nutrient calcium (2.42, 10.18, 13.39, and 15.16 kg ha^{-1}) as compared to organic farming (2.15, 8.21, 10.71 and 12.91 kg ha^{-1}) and lower uptake was observed in natural farming (1.84, 6.89, 9.71 and 10.75 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. Higher uptake of magnesium was noticed in conventional farming (1.71, 8.70, 10.01 and 12.25 kg ha^{-1}) over the organic farming (1.55, 6.86, 7.89 and 10.18 kg ha^{-1}) and statistically lower was observed in natural farming (1.54, 5.69, 6.40 and 7.20 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. Whereas higher sulphur content was recorded in conventional farming (2.67, 12.20, 14.48 and 18.39 kg ha^{-1}) as compared to organic farming (2.39, 10.10, 11.85 and 14.56 kg ha^{-1}) and lower uptake was observed in natural farming (2.37, 7.47, 8.62 and 10.08 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. Significantly higher uptake of secondary nutrients (Tables 4.31 to 4.33) was associated with higher uptake in grain (8.45, 4.64 and 3.87 kg ha^{-1}) and straw (6.71, 7.62 and 14.52 kg ha^{-1}) respectively.

Sole finger millet witnessed significantly higher uptake of secondary nutrient calcium (2.44, 9.64, 12.76, and 15.24 kg ha^{-1}) as compared to finger millet + red gram (2.01, 8.03, 11.07 and 12.20 kg ha^{-1}) and lower uptake was observed in finger millet + field bean. (1.95, 7.62, 9.98 and 11.37 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. Higher uptake of magnesium was noticed in sole finger millet (1.82, 8.18, 9.37 and 11.71 kg ha^{-1}) over the finger millet + red gram (1.56, 6.96, 7.97 and 9.65 kg ha^{-1}) and statistically lower was observed in finger millet + field bean (1.42, 6.11, 6.96 and 8.27 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively. Whereas higher sulphur content was recorded in sole finger millet (2.79, 11.23, 13.16 and 16.89 kg ha^{-1}) as compared to finger millet + red gram (2.36, 9.79, 11.59 and 14.09 kg ha^{-1}) and lower uptake was observed in finger millet + field bean (2.27, 8.74, 10.22 and 12.05 kg ha^{-1}) at 30, 60, 90 DAS and at harvest, respectively.

Higher macro, secondary and micronutient uptake by sole crop of finger millet might be due to higher biomass production coupled with higher availability of all the nutrient. The nutrient uptake is a function of yield and nutrient concentration in plant. Thus, significant improvement in uptake of nitrogen, phosphorus and potassium. This might have enhanced the vegetative growth of crop which ultimately increased nutrient concentration in total biomass of plants. The results of present investigation are in close agreement with the findings of Singh and Sarkar (2001) [15]; Parasuraman (2000) [16]; Sharma *et al.* (2012) [17]; Dibaba (2012) [18] and Pagad (2014) [19].

Conclusion

Among different farming types conventional farming recorded higher primary and secondary nutrient uptake as compared to other farming types.

Between different finger millet based inter cropping systems, sole finger millet recorded higher primary and secondary nutrient uptake as compared to other finger millet based inter cropping systems.

Table 1: Nitrogen uptake of finger millet as influenced by different farming types in finger millet based intercropping system at Harvest.

Treatments	Nitrogen uptake (kg ha^{-1})								
	Grain uptake (kg ha^{-1})			Straw uptake (kg ha^{-1})			Total uptake (kg ha^{-1})		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
FARMING TYPES (M)									
Conventional farming	30.98	33.79	32.38	22.71	27.01	24.86	53.69	60.80	57.24
Organic farming	23.46	27.24	25.35	16.75	20.68	18.72	40.21	47.92	44.07
Natural farming	14.77	15.61	15.19	10.75	10.97	10.86	25.52	26.58	26.05
S. Em±	0.28	0.55	0.40	0.39	0.42	0.37	0.66	0.97	0.77
C.D @ 5%	1.09	2.15	1.57	1.52	1.66	1.46	2.61	3.81	3.02
Finger millet based cropping systems (s)									
Finger millet + Red gram	23.13	25.44	24.28	16.75	19.19	17.97	39.88	44.63	42.26
Finger millet + Field bean	19.29	21.24	20.26	14.02	16.56	15.29	33.31	37.80	35.55
Sole Finger millet	26.80	29.96	28.38	19.43	22.91	21.17	46.23	52.87	49.55
S. Em±	0.42	0.55	0.46	0.38	0.47	0.38	0.79	1.01	0.83
C.D @ 5%	1.28	1.68	1.41	1.17	1.44	1.16	2.45	3.12	2.57
Interactions (M X S)									
CF: Finger millet + Red gram	30.92	33.79	32.35	23.41	27.46	25.43	54.33	61.25	57.79

CF: Finger millet + Field bean	27.04	28.30	27.67	19.03	22.90	20.97	46.07	51.20	48.64
CF: Sole Finger millet	34.98	39.27	37.13	25.68	30.68	28.18	60.66	69.95	65.31
OF: Finger millet + Red gram	23.81	27.18	25.50	15.72	19.07	17.40	39.54	46.25	42.89
OF: Finger millet + Field bean	18.70	22.09	20.40	14.51	17.98	16.25	33.22	40.07	36.64
OF: Sole Finger millet	27.86	32.45	30.16	20.01	25.00	22.51	47.87	57.46	52.66
NF: Finger millet + Red gram	14.65	15.35	15.00	11.13	11.05	11.09	25.78	26.40	26.09
NF: Finger millet + Field bean	12.13	13.33	12.73	8.51	8.80	8.65	20.63	22.13	21.38
NF: Sole Finger millet	17.55	18.14	17.84	12.60	13.06	12.83	30.15	31.20	30.67
S. Em±	0.72	0.95	0.79	0.66	0.81	0.65	1.38	1.75	1.44
C.D (SP at same level of MP)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.D (MP at same or different level of SP)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: DAS: Days after sowing, NS: Non significant, MP: Main plot, SP: Sub plot

Table 2: Phosphorous uptake of finger millet as influenced by different farming types in finger millet based intercropping system at harvest.

Treatments	Phosphorous uptake (kg ha^{-1})								
	Grain uptake (kg ha^{-1})			Straw uptake(kg ha^{-1})			Total uptake (kg ha^{-1})		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
FARMING TYPES (M)									
Conventional farming	7.58	8.44	8.01	7.07	8.25	7.66	14.64	16.69	15.67
Organic farming	5.62	6.77	6.19	5.46	6.52	5.99	11.08	13.29	12.18
Natural farming	3.65	3.91	3.78	3.18	3.26	3.22	6.83	7.18	7.00
S. Em±	0.07	0.09	0.08	0.10	0.12	0.05	0.17	0.21	0.12
C.D @ 5%	0.27	0.36	0.30	0.39	0.46	0.19	0.66	0.82	0.49
Finger Millet Based Cropping Systems (S)									
Finger millet + Red gram	5.58	6.34	5.96	5.26	6.00	5.63	10.84	12.35	11.59
Finger millet + Field bean	4.51	5.10	4.81	4.18	4.83	4.50	8.69	9.93	9.31
Sole Finger millet	6.75	7.68	7.22	6.26	7.20	6.73	13.02	14.88	13.95
S. Em±	0.10	0.14	0.11	0.17	0.17	0.16	0.27	0.32	0.27
C.D @ 5%	0.31	0.44	0.38	0.52	0.53	0.48	0.83	0.98	0.48
Interactions (M X S)									
CF: Finger millet + Red gram	7.55	8.45	8.00	7.02	8.19	7.61	14.58	16.64	15.61
CF: Finger millet + Field bean	6.24	6.70	6.47	5.62	6.65	6.13	11.86	13.35	12.60
CF: Sole Finger millet	8.94	10.18	9.56	8.56	9.91	9.24	17.50	20.09	18.80
OF: Finger millet + Red gram	5.48	6.63	6.06	5.44	6.43	5.93	10.92	13.06	11.99
OF: Finger millet + Field bean	4.68	5.62	5.15	4.49	5.30	4.89	9.16	10.92	10.04
OF: Sole Finger millet	6.70	8.05	7.37	6.44	7.83	7.14	13.14	15.88	14.51
NF: Finger millet + Red gram	3.70	3.95	3.83	3.32	3.39	3.35	7.02	7.34	7.18
NF: Finger millet + Field bean	2.63	2.99	2.81	2.43	2.53	2.48	5.06	5.53	5.29
NF: Sole Finger millet	4.63	4.80	4.71	3.78	3.87	3.82	8.41	8.66	8.53
S. Em±	0.17	0.25	0.20	0.29	0.30	0.27	0.47	0.55	0.47
C.D (SP at same level of MP)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.D (MP at same or different level of SP)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Potassium uptake of finger millet as influenced by different farming types in finger millet based intercropping system at harvest.

Treatments	Potassium uptake (kg ha^{-1})								
	Grain uptake (kg ha^{-1})			Straw uptake (kg ha^{-1})			Total uptake (kg ha^{-1})		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Farming Types (M)									
Conventional farming	15.39	15.58	15.48	41.10	50.08	45.59	56.49	65.66	61.08
Organic farming	11.57	12.98	12.28	32.74	40.02	36.38	44.32	53.01	48.66
Natural farming	7.38	7.67	7.53	23.31	24.19	23.75	30.69	31.86	31.28
S. Em±	0.40	0.20	0.28	0.44	1.13	0.76	0.84	1.33	1.04
C.D @ 5%	1.58	0.78	1.11	1.73	4.45	2.97	3.31	5.23	4.08
Finger Millet Based Cropping Systems (S)									
Finger millet + Red gram	11.44	12.12	11.78	32.70	38.63	35.66	44.14	50.75	47.44
Finger millet + Field bean	8.61	9.10	8.85	26.47	31.24	28.85	35.08	40.33	37.71
Sole Finger millet	14.29	15.02	14.65	37.98	44.43	41.21	52.27	59.45	55.86
S. Em±	0.38	0.33	0.30	0.95	1.17	1.00	1.33	1.49	1.31
C.D @ 5%	1.17	1.00	0.94	2.93	3.59	3.09	4.10	4.60	4.03
Interactions (M X S)									
CF: Finger millet + Red gram	15.58	15.81	15.69	41.54	52.30	46.92	57.11	68.11	62.61
CF: Finger millet + Field bean	11.65	11.86	11.75	32.45	39.90	36.17	44.10	51.75	47.92
CF: Sole Finger millet	18.94	19.07	19.00	49.33	58.06	53.69	68.26	77.12	72.69
OF: Finger millet + Red gram	11.34	12.85	12.10	32.66	38.84	35.75	44.00	51.69	47.85
OF: Finger millet + Field bean	8.68	9.69	9.19	26.91	32.86	29.89	35.60	42.55	39.07
OF: Sole Finger millet	14.69	16.42	15.55	38.66	48.37	43.51	53.35	64.78	59.06
NF: Finger millet + Red gram	7.40	7.70	7.55	23.92	24.74	24.33	31.32	32.44	31.88
NF: Finger millet + Field bean	5.50	5.75	5.63	20.05	20.95	20.50	25.55	26.70	26.12

NF: Sole Finger millet	9.25	9.57	9.41	25.96	26.88	26.42	35.21	36.45	35.83
S. Em±	0.66	0.56	0.53	1.64	2.02	1.73	2.30	2.58	2.26
C.D (SP at same level of MP)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.D (MP at same or different level of SP)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: DAS: Days after sowing, NS: Non significant, MP: Main plot, SP: Sub plot

Table 4: Calcium uptake of finger millet as influenced by different farming types in finger millet based intercropping system at Harvest

Treatments	Calcium uptake (kg ha^{-1})								
	Grain uptake (kg ha^{-1})			Straw uptake (kg ha^{-1})			Total uptake (kg ha^{-1})		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
FARMING TYPES (M)									
Conventional farming	7.88	9.02	8.45	6.59	6.82	6.71	14.48	15.84	15.16
Organic farming	6.48	7.81	7.15	5.54	5.98	5.76	12.02	13.80	12.91
Natural farming	5.44	5.96	5.70	5.23	4.86	5.05	10.67	10.83	10.75
S. Em±	0.08	0.33	0.33	0.24	0.23	0.24	0.32	0.57	0.57
C.D @ 5%	0.33	1.30	1.30	0.94	0.92	0.93	1.27	2.22	2.23
Finger Millet Based Cropping Systems (S)									
Finger millet + Red gram	6.29	7.24	6.77	5.41	5.47	5.44	11.70	12.70	12.20
Finger millet + Field bean	5.78	6.68	6.23	5.10	5.19	5.14	10.87	11.87	11.37
Sole Finger millet	7.73	8.88	8.31	6.86	7.01	6.94	14.59	15.89	15.24
S. Em±	0.11	0.28	0.27	0.23	0.23	0.23	0.34	0.51	0.50
C.D @ 5%	0.35	0.85	0.85	0.70	0.71	0.71	1.05	1.56	1.55
Interactions (M X S)									
CF: Finger millet + Red gram	7.32	8.45	7.88	6.42	6.54	6.48	13.74	14.99	14.36
CF: Finger millet + Field bean	6.86	7.56	7.21	5.62	5.91	5.76	12.48	13.47	12.98
CF: Sole Finger millet	9.47	11.05	10.26	7.75	8.02	7.88	17.21	19.08	18.15
OF: Finger millet + Red gram	6.24	7.49	6.86	4.84	5.30	5.07	11.08	12.79	11.93
OF: Finger millet + Field bean	5.85	7.17	6.51	5.01	5.27	5.14	10.86	12.44	11.65
OF: Sole Finger millet	7.34	8.78	8.06	6.78	7.38	7.08	14.13	16.16	15.14
NF: Finger millet + Red gram	5.33	5.78	5.55	4.97	4.56	4.77	10.30	10.34	10.32
NF: Finger millet + Field bean	4.63	5.31	4.96	4.66	4.40	4.53	9.28	9.71	9.49
NF: Sole Finger millet	6.38	6.80	6.59	6.05	5.63	5.84	12.43	12.43	12.44
S. Em±	0.20	0.48	0.48	0.40	0.40	0.40	0.59	0.88	0.87
C.D (SP at same level of MP)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.D (MP at same or different level of SP)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 5: Magnesium uptake of finger millet as influenced by different farming types in finger millet based intercropping system at Harvest

Treatments	Magnesium uptake (kg ha^{-1})								
	Grain uptake (kg ha^{-1})			Straw uptake (kg ha^{-1})			Total uptake (kg ha^{-1})		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
Farming Types (M)									
Conventional farming	4.09	5.18	4.64	6.65	8.58	7.62	10.74	13.76	12.25
Organic farming	3.30	4.41	3.85	5.46	7.19	6.32	8.75	11.60	10.18
Natural farming	2.94	3.51	3.22	3.70	4.25	3.98	6.64	7.76	7.20
S. Em±	0.12	0.22	0.18	0.23	0.32	0.27	0.35	0.54	0.45
C.D @ 5%	0.48	0.86	0.69	0.88	1.27	1.07	1.36	2.12	1.76
Finger Millet Based Cropping Systems (S)									
Finger millet + Red gram	3.19	4.08	3.63	5.34	6.70	6.02	8.53	10.78	9.65
Finger millet + Field bean	3.08	3.91	3.50	4.17	5.37	4.77	7.26	9.28	8.27
Sole Finger millet	4.06	5.11	4.58	6.29	7.95	7.12	10.35	13.06	11.71
S. Em±	0.14	0.22	0.17	0.23	0.33	0.28	0.37	0.55	0.45
C.D @ 5%	0.43	0.68	0.53	0.70	1.01	0.87	1.13	1.69	1.39
Interactions (M X S)									
CF: Finger millet + Red gram	3.54	4.61	4.07	6.80	8.72	7.76	10.34	13.32	11.83
CF: Finger millet + Field bean	3.74	4.54	4.14	4.99	6.65	5.82	8.74	11.19	9.96
CF: Sole Finger millet	5.00	6.40	5.70	8.15	10.38	9.27	13.15	16.78	14.97
OF: Finger millet + Red gram	3.21	4.28	3.75	5.44	7.06	6.25	8.66	11.34	10.00
OF: Finger millet + Field bean	3.01	4.07	3.54	4.49	5.89	5.19	7.49	9.96	8.73
OF: Sole Finger millet	3.67	4.88	4.28	6.44	8.61	7.53	10.12	13.49	11.80
NF: Finger millet + Red gram	2.81	3.34	3.08	3.79	4.32	4.06	6.60	7.67	7.13
NF: Finger millet + Field bean	2.50	3.13	2.81	3.04	3.56	3.30	5.54	6.69	6.11
NF: Sole Finger millet	3.51	4.05	3.78	4.28	4.86	4.57	7.79	8.91	8.35
S. Em±	0.24	0.38	0.30	0.40	0.57	0.49	0.63	0.95	0.78
C.D (SP at same level of MP)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.D (MP at same or different level of SP)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 6: Sulphur uptake of finger millet as influenced by different farming types in finger millet based intercropping system at Harvest

Treatments	Sulphur uptake (kg ha^{-1})								
	Grain uptake (kg ha^{-1})			Straw uptake (kg ha^{-1})			Total uptake (kg ha^{-1})		
	2019	2020	2019	2019	2020	Pooled	2019	2020	Pooled
Farming Types (M)									
Conventional farming	3.39	4.35	3.87	12.64	16.40	14.52	16.02	20.75	18.39
Organic farming	2.66	3.62	3.14	9.80	13.05	11.42	12.46	16.67	14.56
Natural farming	2.36	2.85	2.61	6.93	8.01	7.47	9.29	10.87	10.08
S. Em±	0.12	0.14	0.14	0.34	0.45	0.40	0.46	0.60	0.54
C.D @ 5%	0.47	0.57	0.55	1.35	1.78	1.56	1.82	2.34	2.11
Finger Millet Based Cropping systems (S)									
Finger millet + Red gram	2.50	3.33	2.92	9.87	12.48	11.18	12.38	15.81	14.09
Finger millet + Field bean	2.54	3.18	2.86	8.01	10.35	9.18	10.55	13.54	12.05
Sole Finger millet	3.37	4.31	3.84	11.48	14.63	13.05	14.84	18.94	16.89
S. Em±	0.13	0.15	0.14	0.29	0.39	0.34	0.42	0.54	0.48
C.D @ 5%	0.41	0.46	0.44	0.90	1.21	1.05	1.30	1.67	1.49
Interactions (M X S)									
CF: Finger millet + Red gram	2.83	3.84	3.34	12.84	16.56	14.70	15.67	20.40	18.04
CF: Finger millet + Field bean	3.12	3.67	3.40	9.98	13.30	11.64	13.10	16.97	15.04
CF: Sole Finger millet	4.21	5.53	4.87	15.08	19.35	17.22	19.29	24.88	22.08
OF: Finger millet + Red gram	2.46	3.42	2.94	9.68	12.71	11.19	12.13	16.14	14.13
OF: Finger millet + Field bean	2.51	3.29	2.90	8.18	10.85	9.51	10.68	14.14	12.41
OF: Sole Finger millet	3.02	4.15	3.59	11.53	15.58	13.55	14.55	19.72	17.14
NF: Finger millet + Red gram	2.22	2.74	2.48	7.10	8.17	7.64	9.32	10.90	10.11
NF: Finger millet + Field bean	2.00	2.58	2.29	5.87	6.91	6.39	7.87	9.50	8.69
NF: Sole Finger millet	2.87	3.24	3.06	7.81	8.96	8.39	10.68	12.20	11.44
S. Em±	0.23	0.26	0.25	0.50	0.68	0.59	0.73	0.94	0.84
C.D (SP at same level of MP)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.D (MP at same or different level of SP)	NS	NS	NS	NS	NS	NS	NS	NS	NS

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