Effect of establishment method and organic nutrient management practices on yieldandquality offingermillet

Abstract

Afieldexperimentwasconducteddur*ing**kharif*seasonsin2020and2021atAgronomy Main Research Farm, Department of Agronomy, College ofAgriculture,OdishaUniversityofAgricultureandTechnology,Bhubaneswartostudyeffectofestablishmentmethodandorganicnutrientmanagementonyieldandqualityparametersoffingermillet.(VarietyArjuna).Theexperimentwas laid out in a split plot design and replicated thrice.The treatmentscomprisedof2methodsofcropestablishment*viz.*conventionalmethodoflinetransplanting(20cmx10cm)andsystemoffingermilletintensification(25cmX25cm)inmainplotwithapplicationof4organicnutrientsources*viz.*FYM@100%RDN,FYM@50%RDN(basal)+Vermicompost@50%RDN(basal), FYM @ 50% RDN (basal) + Vermicompost @ 50% RDN (topdressing)andFYM@25%RDN(basal)+*toria*oilcake@25%RDN(basal) +Vermicompost@50%RDN(topdressing)allottedtosubplotinfingermilletdurin g *Kharif*season. SFMI method of establishment resulted in superiorgrainyield(2051kgha^{-1}),strawyield(2901kgha^{-1}),harvestindex(41.42%)and quality parameters of finger millet grains *viz.* protein (7.56%), crudefibre (3.6 g 100^{-1}), vitamin E (0.14 mg 100 g^{-1}), Ca (344.1 mg 100g^{-1}), Mg(164.3 mg 100 g^{-1}), Fe (4.86 mg 100g^{-1}), Zn (3.71 mg 100g^{-1}) content thanlinetransplanting.Thegrainyield(2092kgha^{-1}),strawyield(2889kgha^{-1}),harvestindex(42.00%)andqualityparametersoffingermilletgrains*viz.*protein (7.91%), crude fibre (3.9 g 100g^{-1}), vitamin E (0.16 mg 100 g^{-1}), Ca(346.7mg100g^{-1}),Mg(176.4mg100g^{-1}),Fe(4.94mg100g^{-1}),Zn(3.98mg 100g^{-1}) content were higher with the application of FYM @ 50% RDN(basal) + Vermicompost @ 50 % RDN (top dressing) in finger millet andwas statistically similar with application of FYM @ 25% RDN (basal) +*toria*oil cake @ 25% RDN (basal) + Vermicompost @ 50 % RDN (topdressing).ThebenefitcostratiowashigherinSFMIandwiththeapplicationof FYM@50%RDN(basal)+Vermicompost@50%RDN(topdressing)to finger millet. Interaction of establishment methods with organic nutrientmanagementwas significant.

Keywords:SFMI,organicnutrient,grainyield,qualityparameters

Introduction

Milletsaresometimesreferredtoas“Shree-Anna’’becauseoftheirimportanceashealthyfood.Milletscontainsabout10timesmoreCaand2-10timeshigherFethanwheator rice (Bala et al. 2010) [3]. Finger millet (*Eleusinecoracana*L.) is an important smallmilletrankingthirdinIndiainareaandproductionhavinghighestproductivity.Outofthetotal minor millets produced, finger millet accounts for about 85% of production in India(Sakamma*etal.*2018)[6].InOdisha,thearea,productionandproductivityis116.8th.ha, 128.73th.tonnesand1102kg/ha,respectively(5DecadesofOdishaAgricultureStatistics,2020) [1]. It is nutritionally superior with high nutrient profile of protein (6-8%), fat(1.3%),calcium(70-76%),lysine(2.86%),tryptophan(1.39%),methionine(2.86%),vitamins, minerals and fibre (Aparna and Ansari, 2017) [2]. It is rich source of calcium,iron, protein, and fiber having high levels of methionine and amino acid. Moreover,presence of antioxidant properties, low sugar content and phytochemicals make it easilyand slowly digestible and is also ideal for patients suffering from diabetes and digestiveproblemsasthegrainscontainanessentialaminoacidmethioninewhichhaslowglycemicindex and no gluten. Due to its plausible health benefits, it is sometimes referred to asmiraclegrain.SRIprinciplehavebeenfollowedinfingermilletwhichmainlyemphasizeson utilizing early growth and vigour of seedlings, less competition for light and nutrients,enhancingresourceuseefficiency(seeds,water,fertilizerandpesticide)andbringdownoverdependenceonchemicalfertilizers,breakingsoilanoxiaconditionandpromotinghealthyrootgrowth and increasing soil microbial activity; and thereby enhancing soil organic mattercontent.Conversionofmodernchemicallyintensiveagriculturetoamoresustainableformofagriculture like organic farming appears to be an option for maintaining the desirableagricultural production in future. Further, growing finger millet organically may insurenutritionalfoodandfarmingsecurityatthejunctureofclimatechange.

Materialsandmethod

The field experiment was conducted at the Agronomy Main ResearchFarm,Department of Agronomy, College of Agriculture, Orissa University of Agriculture andTechnology(OUAT),Bhubaneswar,Odishawithfingermilletgrownduring*kharif*season*of* 2020 and 2021. The experimental site is situated between 20°15' N latitude, 85°52'

Elongitude and at an altitude of 25.9 m above the mean sea-level and about 64 km away oftheBayofBengal,Odisha.Thesoilwassandyloamintexture,acidicinreaction(pH4.64),

lowinorganiccarbon(4.24gkg),mediuminavailablenitrogen(298.1kgha^{-1}),mediuminavailablephosphorus(17.6kgha^{-1})andlowinavailablepotassium(95kgha^{-1}).Totalrainfallamounting to 989.1 mm (44 rainy days) and 1317.9 mm (59 rainy days) was receivedduring*Kharif*seasonof2020and2021,respectively.Theexperimentwaslaidoutinsplitplotdesign with three replications. The treatments comprised of 2 methods of plant establishment*viz.*M_1:conventionalmethodoflinetransplanting(20cmx10cm)andM_2:systemoffingermilletintensification(25cmX25cm)inmainplotwith4organicnutrientsources*viz.*N_1:FYM@100%RDN(basal),N_2:FYM@50%RDN(basal)+Vermicompost@50%RDN(basal), N_3: FYM @ 50% RDN (basal) + Vermicompost @ 50% RDN (top dressing), N_4:FYM@25%RDN(basal)+*toria*oilcake@25%RDN(basal)+Vermicompost@50%RDN(topdressing)allottedtosubplotinfingermillet.Therecommendeddoseofnitrogen(RDN) applied to finger millet was 60 kg ha^{-1}. In SFMI, square plantingof 12 days oldseedlingwasdone@oneseedlinghill^{-1}.Theorganicformulation'*Jibamruta*'wassprayeduniformlytoallthetreatments at21DATfor controllinginsectpestsanddiseases.WeedingoperationwasdoneinSFMIbyusingacycleweeder.

Observations on grain yield, straw yield of finger millet were recorded at harvestand the quality parameters of grains were analyzed. The collected data were analyzedstatistically by standard analysis of variance technique for split plot design as suggestedby Gomez and Gomez (1984) [4] and significant different between the treatments werecomparedwiththecriticaldifferenceat ±5% probabilitybyleastsignificantdifference.

Comment [DAL1]: Where did you inspire? In the literature? Please indicate an author

Comment [DAL2]: With what software?

Resultanddiscussion

The pooled data of two years of *Kharif*season of 2020 and 2021 for yield andqualityparameters of finger millet arepresented in Table 1 to3.

Effectofestablishmentmethodsonyieldandqualityparametersoffingermilletgrains

Theyieldparameterslikegrainyield(2051kgha^{-1}),strawyield(2901kgha^{-1})andharvestindex(41.42%)were higherinSFMI than the conventionalmethodof linetransplanting. Similarly, the quality parameters of finger millet grains *viz.* protein content(7.56%), protein yield (155.8 kg ha^{-1}), crude fibre (3.6 g 100^{-1}), and vitamin E (0.14 mg100g^{-1})werehigherinSFMIthanlinetransplanting.Themineralcontentofgrains*viz.*Ca(344.1mg100

g^{-1}),Mg(164.3mg100g^{-1}),Fe(4.86mg100g^{-1})andZn(3.71mg100g^{-1})
content were also higher in SFMI than line transplanting. Yield and quality parametersexhibitedhighervaluesinSFMIduetobettercongenialenvironmentprovidedtoaug ment

photosynthesisandmobilizationofphotosynthatesfromsourcetosink(SomashekharandLoganandhan.,2020) [8].

Effect of organic nutrient management on yield and quality parameters of fingermilletgrains

The grain yield (2092 kg ha^{-1}), straw yield(2889 kg ha^{-1}), harvest index (42.00 %)werehigherwhenFYM@50%RDN(basal)+Vermicompost@50%RDN(topdressing)was appliedtofingermilletbutwasstatisticallyatparwithapplicationofFYM@25%RDN(basal)+*toria*oilcake@25%RDN(basal)+Vermicompost@50%RDN(topdressing).Balanced combination of organic sources is indispensable to supplement nutrients inaccordancewiththedemandofplantsforensuringhigherproductionandproductivitywithouthavingdeleteriouseffectonsoilhealth.ApplicationofFYMprovidednecessarynutrientsreadily and top dressing of vermicompost ensured continuous availability of nutrientsthroughoutthecropgrowthstagesduetosteadytransformation,mineralization,solubilisation,decomposition of minerals and nutrients that might helped in ensuring superior yieldattributingcharacters,yieldandqualityofgrains.Supplyofnitrogenandothernutrientsatrighttimeandquantityenabletheplantstoassimilatesufficientphotosyntheticproductsandthusincreasedyieldattributesandyieldofthecropandalsobringanimprovementtowardsphysical properties of soil and thereby improving nutrient and water holding capacity(BhardwajandGaur,1985)[2].Sharmaetal.(2020)[7]alsoreportedthatincreaseinyieldofrice due to addition of various organic manures could be attributed to adequate supply ofnutrients,higheruptakeandrecoveryofappliednutrients,whichinturn,musthaveimprovedsynthesis and translocation of metabolites to various reproductive structures of the plant.Similarly,qualityparameters*viz.*protein(7.91%),crudefiber(3.9g$100g^{-1}$)andvitaminE(0.16mg$100g^{-1}$)werehigherwhenFYM @50%RDN(basal)+Vermicompost@50%RDN(topdressing)wasappliedtofingermilletbutwasstatisticallyatparwithapplicationofFYM@25%RDN(basal)+*toria*oilcake@25%RDN(basal)+Vermicompost@50%RDN(topdressing).Mineralcontent*viz.*Ca(346.7mg$100g^{-1}$),Mg(176.4mg$100g^{-1}$),Fe(4.94mg$100g^{-1}$),Zn(3.98mg$100g^{-1}$)contentoffingermilletwerealsohigherwhenFYM@ 50% RDN (basal) + Vermicompost @ 50 % RDN (top dressing) was applied to fingermilletbutwasstatisticallyatparwithapplicationofFYM@25%RDN(basal)+*toria*oilcake@25%RDN(basal)+Vermicompost@50%RDN(topdressing).Improvementinqualityparametersduetocombineduseof FYMandvermicompostwasalsoreportedbyDixit&Gupta.(2000)[5]. Theincreaseduptakeofnitrogentothefingermilletduetovermicompostalongwith FYMresultedi

nhigheraccumulationofphotosynthateswhichhavetranslocated

tosinkduetobetterdevelopmentofsource-sinkchannelresultinginimprovedgrainproteinandnutrientcontentoffingermillet.Similarfindingswerereportedby BanaandGautam.(2009)[4].

Interaction

Interactionofestablishmentmethodswithorganicnutrientmanagementwassignificant .SFMIwithapplicationofFYM@50%RDN(basal)+Vermicompost@50%RDN (top dressing) produced higher yield and quality parameters. However, it was at parwith application of FYM @ 25% RDN (basal) + *toria*oil cake @ 25% RDN (basal) +Vermicompost@50%RDN(topdressing).ThiscorroboratesthefindingsofSomashekharand Loganandhan. (2020) [8].

Table1.

Grainyield,strawyieldandharvestindexoffingermilletasinfluencedbyestablishmentmethodandorganicnutrientmanagement

Treatment	Grain yield(kgha^{-1})			Straw yield (kgha^{-1})			Harvestindex(%)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Establishmentmethod(M)infingermillet									
M1:Linetransplanting	1642	1714	1678	2483	2579	2531	39.81	39.93	39.87
M2:SFMI	2007	2095	2051	2844	2958	2901	41.37	41.46	41.42
SEm±	46.60	53.30	35.32	57.1	58.89	41.01	0.46	0.46	0.33
CD(0.05)	141.2	161.5	102.3	173.1	178.4	118.8	1.4	1.4	0.9
Nutrient management(N)infingermillet									
N1:FYM@100%RDN (basal)	1510	1610	1560	2504	2562	2533	37.62	38.59	38.10
N2:FYM@50%RDN(basal)+Vermicompost@ 50%RDN(basal)	1800	1840	1820	2565	2712	2638.5	41.24	40.42	40.83
N3:FYM@50%RDN(basal)+Vermicompost@ 50%RDN(topdressing)	2028	2157	2092	2812	2967	2889.5	41.90	42.10	42.00
N4:FYM@25%(basal)+*toria*oilcake@25%RDN (basal)+Vermicompost@50%RDN(topdressing)	1961	2011	1986	2773	2833	2803	41.42	41.52	41.47
S.Em(±)	65.90	75.37	49.95	80.73	82.57	57.74	0.20	0.20	0.14
C.D(0.05)	199.7	228.4	144.6	244.8	252.2	167.2	0.6	0.6	0.4
M x N									
S.Em(±)	126.10	139.60	93.95	148.30	152.20	106.25	0.78	0.78	0.55
CD(0.05)	382.0	422.9	270.6	449.3	461.1	306.0	2.4	2.4	1.6

Comment [DAL3]: Must be perform!!!After doing the ANOVA, the p-value will allow to affirm if the observed differences in the variation of the studied parameters is significant.

Table2. Qualityparametersoffingermilletasinfluencedbyestablishmentmethodandorganicnutrientmanagement

Treatment	Proteincontent(%)			Proteinyield(kg ha^{-1})			Crudefibre(g/100 g)			Vitamin E(mg/100g)		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Establishmentmethod(M)infingermillet												
M1:Linetransplanting	7.44	7.50	7.47	122.1	128.6	125.3	3.0	3.4	3.2	0.08	0.12	0.1
M2:SFMI	7.56	7.63	7.59	151.8	159.7	155.8	3.5	3.7	3.6	0.12	0.16	0.14
SEm±	0.03	0.03	0.02	5.38	6.03	4.03	0.13	0.06	0.06	0.009	0.009	0.006
C.D(0.05)	0.10	0.11	0.06	16.32	18.28	11.7	0.4	0.2	0.19	0.03	0.03	0.01
Nutrientmanagement(N)infingermillet												
N1: FYM@100%RDN(basal)	7.06	7.13	7.09	106.6	114.7	110.7	2.9	3.1	3.0	0.06	0.1	0.08
N2: FYM @ 50% RDN (basal) + Vermicompost @50%RDN(basal)	7.44	7.56	7.50	133.9	139.2	136.5	3.0	3.2	3.1	0.09	0.11	0.10
N3: FYM @ 50% RDN (basal) + Vermicompost @50%RDN(top dressing)	7.88	7.94	7.91	159.7	171.2	165.5	3.8	4.0	3.9	0.14	0.18	0.16
N4: FYM@25% (basal+*toria*oilcake @25% RDN (basal) + Vermicompost @ 50% RDN(topdressing)	7.62	7.63	7.63	149.5	153.3	151.4	3.3	3.9	3.6	0.11	0.17	0.14
S.E.m(±)	0.13	0.10	0.008	5.65	6.10	4.15	0.23	0.19	0.14	0.01	0.02	0.01
C.D(0.05)	0.41	0.32	0.23	17.1	18.5	12.04	0.7	0.6	0.43	0.04	0.05	0.03
M x N												
S.Em(±)	0.22	0.23	0.15	12.3	12.8	8.87	0.48	0.36	0.29	0.02	0.02	0.01
CD(0.05)	0.7	0.7	0.45	37.2	38.8	25.6	1.4	1.0	0.85	0.06	0.06	0.04

Table3 Qualityparametersoffingermilletasinfluencedbyestablishmentmethodorganicnutrientmanagement

Treatment	Mineralcontent(mg $100g^{-1}$)											
	Ca			Mg			Fe			Zn		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
Establishmentmethod(M)infingermillet												
M1:Linetransplanting	311.6	312.6	312.1	144.1	149.2	147.1	4.69	4.76	4.72	3.53	3.55	3.54
M2:SFMI	344.0	344.2	344.1	160.3	168.1	164.3	4.85	4.88	4.86	3.69	3.72	3.71
SEm±	6.20	6.73	4.57	4.15	4.65	3.18	0.03	0.03	0.02	0.03	0.04	0.02
CD(0.05)	18.8	20.4	13.2	12.6	14.1	9.23	0.12	0.10	0.06	0.12	0.14	0.07
Nutrientmanagement(N)infingermillet												
N1:FYM@100%RDN(basal)	306.7	307.1	306.9	129.2	135.2	132.2	4.65	4.71	4.68	3.31	3.34	3.33
N2: FYM@50%RDN(basal)+Vermicompost@50% RDN(basal)	323.5	324.5	324.0	144.1	148.3	146.1	4.69	4.75	4.72	3.45	3.47	3.46
N3: FYM@50%RDN(basal)+Vermicompost@50% RDN(Topdressing)	346.3	347.1	346.7	174.2	178.8	176.4	4.93	4.95	4.94	3.97	3.99	3.98
N4:FYM@25%(basal)+Vermicompost@50%RDN (topdressing)+ *toria*oilcake@25%RDN(basal)	334.7	334.9	334.8	161.3	172.3	166.8	4.81	4.87	4.84	3.71	3.74	3.72
S.E.m(±)	6.0	4.7	3.78	4.52	4.05	3.03	0.05	0.05	0.02	0.10	0.11	0.07
CD(0.05)	18.3	14.4	10.9	13.7	12.3	8.8	0.18	0.17	0.07	0.31	0.34	0.21
M x N												
S.Em(±)	13.40	12.20	9.01	9.87	9.61	6.88	0.11	0.12	0.08	0.18	0.22	0.14
CD(0.05)	40.6	36.9	26.0	29.9	29.1	19.8	0.33	0.36	0.23	0.54	0.66	0.42

Conclusion

The study indicates that SFMI method of crop establishment resulted in superior grainyield, straw yield and harvest index of finger millet over the conventional method of linetransplanting. Application of FYM @ 50% RDN as basal + Vermicompost @ 50% RDNas top dressing to finger millet resulted in higher yield in finger millet and this wasstatistically similar with the application of FYM @ 25% RDN (basal) + *toria*oil cake @25%RDN(basal)+Vermicompost@50%RDN(topdressing)tofingermillet.

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