Original Research Article

Effect of Natural Farming on Soil Health, Growth, Yield and Quality of Sorghum-Oat Fodder Production System

Abstract

Thefieldexperimentwasconductedonfoddersorghum(*Sorghumbicolor*L.)andfodderoat (*Avena sativa* L.) during the *kharif* and *rabi* season in 2022-23 at GPB Research Farm,AcharyaNarendraDevaUniversityofAgriculture&Technology,Kumarganj,Ayodhya(U.P).The experiment was laid out in randomized block design (RBD). Results revealed that thegrowth parameters of *kharif* sorghum and *rabi* oat *viz*., plant population (20.96 m^{-1} and 71.83m^{-1}), plant height (190.00 cm and 112.42 cm), Leaf: stem ratio (0.74 and 0.38), green fodderyield (274.46 q ha^{-1} and 263.9 q ha^{-1}), dry fodder yield (68.61 q ha^{-1} and 65.97 q ha^{-1}) andqualityparameters*viz*.,crudeproteincontent(8.83%and7.84%),crudeproteinyield(6.06qha^{-1} and 5.17 q ha^{-1}), ADF (40.22 % and 44.31 %) and NDF (65.59 % and 73.61%) at harvestwasimprovedbydifferentorganictreatmentsovercontrol,beinghighestunderFYM@5tha^{-1}+Naturalfarmingwithmulchfollowedby FYM @5tha^{-1}+Naturalfarmingwithoutmulch.

Keywords- *Natural Farming, FYM, Compost Tea,Yield, Quality, Fodder Production, Crude protein*

Introduction

Sorghum (*Sorghum bicolor* L.) belonging to the family *poaceae*, is an important *kharif*season dual purpose crop and the world'sfifth most important cereal, in terms of bothproduction and area planted. In India, Maharashtra is the top-state in terms of area andproduction withaproductivityof2150kgha^{-1}.UttarPradeshranks lower due to their smaller planted area (0.20 m ha) and lower production (0.28 m t).Sorghum (*Sorghum bicolor* L.) is a C4 cereal fodder crop with excellent photosyntheticproductivity. Its fodder contains more than 50% digestible nutrients which consist of 8%protein, 2.5% fat and 45% nitrogen-free-extract (NFE). Its feeding value has been reported asequal to that of corn and due to its palatability and succulence nature, it is relished well byanimals(Mahmud *et al*., 2003).

Oat(*Avenasativa*L.)belongingtothefamily*poaceae*,isamongstthemajorwintercerealforage scultivatedthroughoutthecountry.Itisafastgrowing,palatable,succulentandnutritivefodder (Nawaz *et al*., 2004; Alemayehu, 1997). It ranks sixth in the world cerealproduction statistics following wheat, maize, rice, barley and sorghum. It is a dual- purposecrop of tropical and subtropical. In India, oat is exclusively grown for fodder in western UttarPradesh, Haryana

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and Punjab. It is also grown on limited scale in some parts of Maharashtra,MadhyaPradesh,Gujarat,Orissa,BiharandWestBengal(RajBahadur,2002).Oatsha veahighcontentoffatand arerich in oleic and linoleicacids. It contains B1, B2, B6 and A, K & E vitamins.

Further (Raj Bahadur, 2002) include valuable minerals, micronutrients,antioxidants and sterols compared to barley or maize, oats have 1%–3% more crude protein.Also, when compared to the other cereals, oats have a balanced amino acid composition and ahigher concentration of essential amino acids, such as lysine, making it one of the mostpreferredfeed ingredients by livestock farmers

Being exhaustive crops, these crops require higher dose of nutrients for production inparticular, nitrogen. This requirement is fulfilled by applying inorganic fertilizers to the soil.Due to continuous use of inorganic fertilizers to fulfil the nutritional demand of these crops,the ill-effects of these high analysis fertilizers have been reported on the soil productivity andsustainability(Chakraborti and Singh, 2004).

Natural Farming is a term used to describe an ecological farming approach to produceorganicbasedfoodcrops.Itisanaturalagriculturealternativewhichpromoteslowerproducti on cost and at the same time is able to achieve product of high quality and yield withlower or without the usage of inorganic fertilizers and pesticides (Sulok *et al*., 2018). Thissystem of agriculture aims to meet the requirements of crops at the farm itself with the use oflocally available materials. As claimed, this concept helps to maintain ecological balance andalsosatisfying the conditions of thelawof biologicaldiversity.

MethodandMaterials

Theexperimentwasconductedduringthe*kharif* *2022*and*rabi*season2022-23atGPBResearchFarm,AcharyaNarendraDevaUniversityofAgriculture&Technology,Kumarganj,Ayodhya (U.P.) Geographically, the experimental site falls under humid, sub-tropical climateand is located at 26.47^0 N latitude and 82.12^0 E longitude on an elevation of about 113 meterabove mean sea level in the Indo-Gangetic alluvial soil belt of eastern Uttar Pradesh. The soilof field was slightly alkaline in reaction, low in organic carbon and available nitrogen, while mediumin phosphorus and rich in potassium. Plant population counted from each plot area at the timeof harvesting and was considered for recording the plant population. The height of fiverandomlyselectedplantsweremeasuredatharveststagebythemeterscale.Theaverageplantheig ht was calculated by taking the mean of height of 5 selected plants and expressed in

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cm.Tenplantsampleswerecollectedineachtreatmentoutsidethenetplotarealeavingtheextremebor der row and fresh weights of the samples were taken separately for leaves and stems andleafto stem ratio wascomputedat harvest stagebyusing the following formula:

$$\text{Leaf:stemratio}=\frac{Freshweightofleave\ (g)}{\text{Freshweightofstems(g)}}$$

Aciddetergentfiberpercentagewasmeasuredbyboilingofforageinanaciddetergentsoluti on,thenmeasuringtheresidueremaining.InthesamewayNDFwasmeasuredbyboilingtheforagein aneutraldetergentsolution,thenmeasuringthesolubleresidue.Nitrogencontent of plant samples was estimated by modified Micro kjeldahl method (Jackson et al., 1973)and the crude protein content was estimated by using the following formula which wasexpressedin percentage.

Crudeprotein (%)=N(%) ×6.25.

The crude protein yield (q ha^{-1}) was estimated by the following formula:

$$\text{Crudeproteinyield}(qha^{-1})=\frac{\boldsymbol{Crudeprotein}^{(\%)}}{\mathbf{100}}\times\text{Dryfodderyield}$$

Green fodder yield of each net plot was obtained by weighing of green fodder andfinally converting into quintal per hectare (q ha^{-1}). After the harvesting of green fodder yieldfrom each net plot, the plant samples were air dried in the sun and then in the oven at 70 ^{0}Ctill they attained a constant weight. The dry fodder yield for each treatment was computed toquintalperhectare.

ResultsandDiscussion:

The perusal of the data (Table 1) showed significant variation in plant population at harvest due to the effect of different treatments.Highest plant population (20.96 m^{-1} and 71.83 m^{-1}) was recorded under FYM @ 5 t ha^{-1} +Naturalfarmingwithmulch,whichwas*atpar*withFYM@5tha^{-1}+Naturalfarmingwithoutmulch, while significantly higher than rest of the treatments.This might be because of organicfertilizerswhichcontaingrowthpromoterslikeindoleaceticacidandgibberellicacidknowntoh ave positiveeffect on the germination of seed and growth of crop**.** The minimum plant population (m^{-1})in*kharif*sorghumand*rabi*oatwasrecordedundercontroltreatment. The results are in closeconformitywith that ofSreenivasa*etal*.,2009.Thehighestplantheight(190.00cmand112.42cm)atthetimeofharvestwasre cordedunderFYM@5tha^{-1}+Naturalfarmingwithmulch being on par with FYM @ 5 t ha^{-1} + Natural farming without mulch and FYM @ 10 t ha^{-1} whilesignificantlyhigheroverrestothertreatments;whereasminimumplantheight(cm) in *kharif*

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sorghum and *rabi* oat was recorded under control. Organic treatments like Beejamrit, Jeevamrit and Mulchwhichincreasemicrobialactivityinthesoilandultimatelyensuresthebetter availabilityofnutrientsto the crops might have contributed to increased plant growth and subsequently greater plant height. These findings align with the research conducted by Palekar, 2006) and Bhagat *et al.*, 2016.

Further, the data revealed that leaf:stemratioatharvesthavenotvariedsignificantlyin*kharif*sorghumwhilesignificant variation was observed in *rabi* oat under the influence of different treatments. Highest leaf: stemratio in *kharif*sorghumat harvest (0.74) was recorded under the effect of FYM @ 5 t ha^{-1} + Natural farming with mulch whereashighestleaf:stemratioin *rabi* oat atharvest(0.38)wasrecordedunderthe influence of FYM@5tha^{-1}+Naturalfarmingwithmulch,being on parwithFYM@5tha^{-1}+Naturalfarmingwithout mulch, but significantly higher than rest of the treatments. However minimumleaf:stemratioin*kharif*sorghumand*rabi*oatwasrecordedundercontroltreatment.Organic sources of nutrients, resulted in a greater number of shoots of crops per unit area,whichmighthavereducedthestemgirthduetomoreinterspecificcompetitionhenceresultedin better leaf stem ratio. These results are in accordancewith the findings of Brar, 2015.

The highestgreenfodderyield(274.46qha^{-1}and263.9qha^{-1})anddryfodderyield(68.61qha^{-1}and65.97q ha^{-1}) was recorded under FYM @ 5 t ha^{-1} + Natural farming with mulch, which was *at par*with FYM @ 5 t ha^{-1} + Natural farming without mulch while significantly higher over othertreatments in both *kharif* sorghum and *rabi* oat, whereas minimum green and dry fodder yield (qha^{-1})wasrecordedundercontrol.Organicsourcesof nutrients mighthaveimprovedphysio-chemicaland biological properties of the soil and further better availability of nutrients to the plant,improved the growth and yield attributes which ultimately resulted into higher green and dryfodder yield of the crop. Theseresults corroborate the findings of Patil et al, 2018.

DatapresentedinTable2indicatedthatdifferenttreatmentscould not influencedthecrudeproteincontent(%), ADF(%)andNDF(%) significantly in*kharif*sorghumand*rabi*oat,however numerically maximum crude protein (8.83 % and 7.84 %), ADF (40.22 % and 44.31 %) and NDF (65.59 % and 73.61%) was recorded under FYM @ 5 t ha^{-1} + Natural farming with mulch in *kharif* sorghum and *rabi* oat. Data further reveals that application of different treatments had significant effect on crude protein yield (q ha^{-1}) of *kharif* sorghum and *rabi* oat.Maximum crude protein yield was recorded under FYM @ 5 t ha^{-1} + Natural farmingwithmulch(6.06qha^{-1}and5.17qha^{-}

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^{1})in*kharif*sorghumand*rabi*oatrespectively,whichwas *at par* with FYM @ 5 t ha^{-1}+ Natural farming without mulch. The minimum crudeprotein content (%), crude protein yield (q ha^{-1}), ADF (%) and NDF (%) was recorded undercontrol. Organic nutrients might have helped in enhancing the quality of crop. Theseresultsareinagreement with the findings of Kumbarand Devakumar, 2017.

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Table1-Effectofdifferentorganicnutrientsonthe Plantpopulation(m^{-1}), Plantheight(cm), Leaf:stemratio, Greenand Dryfodderyield (q ha^{-1}) at harvest in *kharif* sorghumand *rabi* oat.

Treatments	Plantpopulation		Plant height		Leaf:stem ratio		Greenfodderyield		Dryfodderyield	
	Sorghum	Oat	Sorghum	Oat	Sorghum	Oat	Sorghum	Oat	Sorghum	Oat
T_1-FYM@10t/ha	17.86	59.61	185.87	105.79	0.73	0.33	245.7	225.99	61.42	56.49
T_2-Natural Farmingwith Mulch	17.21	58.17	183.11	102.92	0.71	0.30	229.22	214.73	57.3	53.68
T_3-Natural Farmingwithout Mulch	16.84	57.45	181.78	100.80	0.71	0.31	210.35	211.46	52.58	52.86
T_4 - FYM @ 5 t/ha+Natural Farming withMulch	20.96	71.83	190.00	112.42	0.74	0.38	274.46	263.9	68.61	65.97
T_5- FYM @ 5 t/ha+Natural Farmingwithout Mulch	19.52	68.52	189.82	108.98	0.73	0.37	251.01	240.7	67.2	63.17
T_6-FYM@5 t/ha+CompostTea	16.53	55.89	178.39	97.61	0.69	0.31	204.92	204.69	51.23	51.17
T_7 – ControlSem	16.16	52.47	175.04	92.86	0.67	0.25	170.36	171.72	42.59	42.93
	0.60	2.04	1.66	3.05	0.02	0.01	7.68	7.42	1.91	1.92
	1.87	6.36	5.18	9.40	NS	0.05	23.93	23.13	5.88	6.00

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(±)

CD

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Table2-EffectofdifferentorganicnutrientsontheADF(%),NDF(%),Crudeproteincontent(%)andcrudeproteinyield(qha^{-1})atharvestin*kharif* sorghumand*rabi* oat.

Treatments	Acid detergentfiber		Neutral detergent fiber		Crudeproteincontent		Crudeproteinyield	
	Sorghum	Oat	Sorghum	Oat	Sorghum	Oat	Sorghum	Oat
T_1-FYM@10t/ha	38.61	43.81	61.38	69.30	8.26	7.46	5.07	4.21
T_2-NaturalFarmingwithMulch	37.34	43.36	60.37	67.20	8.1	7.33	4.64	3.93
T_3-Natural Farming withoutMulch	36.77	42.23	60.14	66.13	8.04	7.25	4.23	3.83
T_4 - FYM @ 5 t/ha+ NaturalFarmingwith Mulch	40.22	44.31	65.59	73.61	8.83	7.84	6.06	5.17
T_5-FYM@5t/ha+NaturalFarmingwithoutMulch	39.64	44.10	62.37	72.61	8.4	7.67	5.64	4.85
T_6-FYM@5 t/ha+ CompostTea	36.47	41.78	59.70	64.19	7.89	7.01	4.04	3.59
T_7– Control	35.52	38.72	59.46	64.13	7.42	6.96	3.16	2.99
Sem(±)	3.22	1.40	5.29	2.25	0.27	0.24	0.15	0.14
CD	NS	NS	NS	NS	NS	NS	0.47	0.43

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Conclusion

The fodder production in the country is not sufficient to meet the requirements of the growinglivestock population and also the forages offered to animals are mostly of poor quality. Thus,the need of the hour is not only to enhance the production of good quality fodder, but also tomake the fodder accessible round the year to dairy animals, so Natural farming is a way to getmaximum yield and quality without using toxic chemical fertilizers. The result of the presentstudy showed that by the application of FYM @ 5 t ha^{-1} + Natural farming with mulch helpedin achieving better growth parameters, better fodder quality and maximum fodder yield roundtheyearin *kharif* sorghum and *rabi* oat croppingsystem.

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