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NITROGEN MANAGEMENT IN FODDER OAT–PEARL MILLET CROPPING SYSTEM UNDER ORGANIC FARMING

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SUMMARY

A field experiment was conducted at Centre for Research on Integrated Farming Systems, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during 2018-19 to 2021-22 with effect of nitrogen management in fodder oat – pearl millet cropping system under organic farming. The experiments were laid out in randomized block design with factorial concept and replicated quadruple in loamy sand soil. Twelve treatment combination comprising of three levels of nitrogen (50%, 75% and 100% RDN) and four levels of source of nitrogen (50% through FYM + 25% through vermi-compost + 25% through castor cake, 75% through FYM + 25% through vermi-compost, 75% through FYM + 25% through castor cake and 100 % through inorganic fertilizer). In the case of oat, application of 100% RDN led to significantly higher plant height, tiller count, crude protein yield and total green as well as dry fodder yield. Regarding different nitrogen sources, the use of 100% inorganic fertilizer resulted in significantly higher total green and dry fodder yields. The interaction effect of nitrogen levels and sources was non-significant for most parameters, except for crude protein yield and total dry fodder yield. In the case of pearl millet, increasing nitrogen levels similarly led to improved growth, yield, and quality attributes, with 100% RDN yielding the best results. Differences in nitrogen sources primarily impacted plant height, tiller count, and total green fodder yield.

Key words: Castor cake, crude protein, vermicompost, FYM, soil test value, green oat equivalent yield of system

Agriculture and animal husbandry are culturally, religiously and economically intertwined with the intricate fabric of human society, as mixed farming and livestock rearing are a vital element of rural life (Dagar, 2017). Draught power, rural transportation, manure, fuel, milk and meat all are provided by livestock, which is quite often the only source of monetary revenue for subsistence farmers and also act as insurance against the crop failure. It also directly affects the livelihood and food security of nearly a billion people around the world and affects the diet and health of many more (Downing *et al.,* 2017; Hurst *et al*., 2005). Fodder production in India varies greatly across the country, and its use is determined by cropping pattern, climate, socioeconomic conditions and the type of cattle. Cattle and buffaloes are often fed fodder from cultivated regions, with collected grasses and top feeds supplementing it to a small extent (Shashikala *et al*., 2017). Livestock rearing is a very important part of our rural economy. The low productivity is mainly due to inadequate supplies of quality feeds and fodders. The milk production can be easily increased by adequate supply of nutritious feeds and fodders. To meet demand of fodder, efforts are to be made for reducing large gap between demand and supply of the fodder. Continuous use of high levels of chemical fertilizer is adversely affecting the sustainability of agricultural production and causing environmental pollution. Therefore, emphasis should be reducing the use of inorganic fertilizer. Intensive input use, continuous over mining of nutrients and imbalanced fertilizer use lead to deterioration of soil fertility and productivity. Looking to the above fact, the experiment on "Nitrogen management in fodder oat – pearl millet cropping system under organic farming" was framed.

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MATERIALS AND METHODS

A field experiment was conducted at Centre for Research on Integrated Farming Systems, S. D. Agricultural University, Sardarkrushinagar, Gujarat, India, during *rabi*-summer season of 2018-19 to 2021-22, to find out a nitrogen management in fodder oat – pearl millet cropping system under organic farming. The experimental soil was loamy sand in texture, alkaline in reaction (pH 7.68), 0.310 % organic carbon, 148kg/ha available nitrogen and 13.58kg/ha P_2O_5 and 191 K_2O. Variable involved in this study were three treatments of nitrogen levels (50% RDN, 75% RDN, 100% RDN, respectively) and four levels of source of nitrogen (50 % through FYM + 25 % through vermi-compost + 25 % through castor cake, 75 % through FYM + 25 % through vermi-compost, 75 % through FYM + 25 % through castor cake, 100 % through inorganic fertilizer, respectively) laid out in Factorial Randomized Block Design. Recommended dose of fertilizer for oat is 120:30:00 NPK/ha and fodder pearl millet is 120:60:00 NPK/ha. Oat and fodder pearl millet seeds treated with *Azotobactor@*10 ml/kg seed. Experiment conducted on fix site and inorganic fertilizer treatments carried out at outside the organic plot. *Rabi* oat crop dry fodder yield of two cut and summer fodder pearl millet crop dry fodder yield of two cuts. Economic yield of the component crops was converted into dry fodder oat equivalent yield taking into account the prevailing farm gate price (Rs./kg) of crop produce. The representative soil samples were collected and analyzed for organic carbon, available nitrogen, phosphorus and potassium after completion of crop sequence. The cost of cultivation was calculated based on existing input cost. Net return was calculated by subtracting cost of cultivation from gross income of system. The benefit: cost ratio (BCR) was worked out dividing net return by the cost of cultivation. The data on yield of crops and dry matter production of crops under cropping system and economics were recorded and subjected to statistical analysis. No severe pests and diseases were observed during the crop growth; however, necessary plant protection measures were taken on need basis.

RESULTS AND DISCUSSION

An experiment was conducted during *rabi* and summer seasons of 2018-19 to 2021-2022 at Centre for Research on Integrated Farming Systems, Sardarkrushinagar to identify nitrogen management in fodder oat – pearl millet cropping system under organic farming.

Effect on oat

The linear increase in growth, yield and quality attributing characters as well as yield were noticed with increase in level of nitrogen from N_1 (60 kg N/ha) to N_3 (120 kg N/ha) from pooled analysis (Table 1). The data revealed that 100% RDN gave significantly highest plant height at first (75.27 cm) and second (61.33 cm) cut, number of tillers per metre row length (80.15), crude protein yield (334 kg/ha), total green (39.84 t/ha) and dry (8.34 t/ha) fodder yield. Due to increased its availability and internal concentration, which resulted better partitioning of biomass between roots and shoots

TABLE 1
Effect of nitrogen levels and source of nitrogen on growth, yield and quality parameters of oat (Pooled of four years)

Treatments	Plant height (cm) at 1st cut	Plant height (cm) at 2nd cut	No. of tillers/ metre row length	Crude fibre content (%)	Crude protein content (%)	Crude protein yield (kg/ha)	Total green fodder yield (t/ha)	Total dry fodder yield (t/ha)
A. Level of nitrogen								
N_1: 50% RDN	69.34	55.42	72.00	28.73	3.92	233	27.88	5.95
N_2: 75% RDN	71.71	58.69	75.55	28.58	3.97	277	32.64	6.99
N_3: 100% RDN	75.27	61.33	80.15	28.03	4.00	334	39.84	8.34
S. Em±	0.769	0.609	0.809	0.213	0.024	10.70	0.836	0.279
C. D. (P=0.05)	2.15	1.71	2.27	NS	NS	37.02	2.891	0.964
B. Source of nitrogen								
S_1: 50% through FYM+25% through vermi-compost+ 25% through castor cake	71.72	58.25	75.39	28.36	3.98	286	33.76	7.19
S_2: 75% through FYM+25% through vermi-compost	70.73	57.84	75.47	28.39	3.94	275	32.84	6.97
S_3: 75% through FYM+25% through castor cake	71.87	58.16	77.89	28.61	3.98	272	32.32	6.81
S_4: 100% through inorganic fertilizer	74.10	59.68	77.86	28.43	3.95	292	34.90	7.39
S. Em±	0.89	0.70	0.93	0.25	0.028	4.56	0.418	0.104
C. D. (P=0.05)	NS	NS	NS	NS	NS	29.96	2.340	0.780
Interaction (N x S)								
N x S	NS	NS	NS	NS	NS	286	NS	7.19
CV%	8.53	8.34	8.53	5.98	4.86	275	8.65	6.97

with higher level of nitrogen and it also alter plant morphology, nutrient availability and net photosynthesis. These findings are in agreement with the results in fodder oats. The same result found with (Midha *et al*., 2015) and (Pravalika, and Gaikwad., 2021). Crude protein and crude fibre content were found non-significant due to various levels of nitrogen.

In case of different source of nitrogen, significantly higher total green (34.90 t/ha) as well as dry (7.39 t/ha) fodder yield recorded with application of nitrogen - 100% through inorganic fertilizer and found statistically at par with S_2; 75% through FYM + 25% through vermi-compost. While crude protein yield was found significantly higher in 50% through FYM + 25% through vermi-compost + 25% through castor cake. Other parameters viz. plant height at 1st and 2nd cut, number of tillers per metre row length, crude protein content and crude fibre content did not significantly affected by different source of nitrogen. Interaction effect of nitrogen levels and their source were found non-significant for all parameters except crude protein yield and total dry fodder yield. Due to sufficient time available for the successful completion of both vegetative as well as reproductive phases of crop under the conducive environment conditions, which resulted better resource utilization. The low yield in late sown situation could be attributed due to higher temperature at later stage of growth which hastened the flowering leading to early maturation, increased respiration and shortened the crop duration was observed in oats. The same finding with Joshi *et al*. 1993 and Patel *et al*., 2022.

Effect on pearlmillet

An incremental pattern of growth, yield, and quality-related characteristics, as well as overall yield, was observed as the nitrogen level increased from N_1 (60 kg N/ha) to N_3 (120 kg N/ha) in pooled analysis. The data indicated that providing 100% of the recommended nitrogen (RDN) resulted in the significantly higher plant height for both the first (143.54 cm) and second (127.03 cm) cuts, a higher number of tillers per metre of row length (69.88), crude crude protein content (5.29%), crude protein yield (497 kg/ha), increased total green fodder yield (42.24 t/ha), and total dry fodder yield (9.41 t/ha). However, the content of crude fiber was not significantly affected by the various nitrogen levels.

When considering various nitrogen sources, notably higher plant height during the second cut (125.50 cm), a greater number of tillers per metre of row length (69.71), and an increased total green fodder yield (38.08 t/ha) were observed with the application of 100% inorganic fertilizer. However, other factors such as plant height during the first cut, crude fiber content, protein content, crude protein yield, and total dry fodder yield were not significantly influenced by the choice of nitrogen source. There was no significant interaction effect between nitrogen levels and their sources for any of the parameters.

Effect on system productivity and economics

The pooled result found significantly highest green oat equivalent yield of system (82.08 t/ha) with

TABLE 2
Effect of nitrogen levels and source of nitrogen on growth, yield and quality parameters ofpearlmillet (Pooled of four years)

Treatments	Plant height (cm) at 1st cut	Plant height (cm) at 2nd cut	No. of tillers/ metre row length	Crude fibre content (%)	Crude protein content (%)	Crude protein yield (kg/ha)	Total green fodder yield (t/ha)	Total dry fodder yield (t/ha)
A. Level of nitrogen								
N_1: 50% RDN	131.60	116.50	63.06	28.32	5.17	382	31.28	7.33
N_2: 75% RDN	138.44	122.22	66.83	27.97	5.22	438	36.49	8.23
N_3: 100% RDN	143.54	127.03	69.88	27.65	5.29	497	42.24	9.41
S. Em±	1.325	1.093	0.856	0.192	0.031	5.6	0.469	0.094
C. D. (P=0.05)	3.71	3.06	2.40	NS	0.11	15.8	1.314	0.263
B. Source of nitrogen								
S_1: 50% through FYM+25% through vermi-compost+ 25 % through castor cake	136.13	120.62	66.68	27.91	5.24	442	36.45	8.30
S_2: 75% through FYM+25% through vermi-compost	137.21	120.40	65.18	27.85	5.25	440	36.25	8.20
S_3: 75% through FYM+25% through castor cake	138.10	121.16	64.79	28.16	5.22	434	35.89	8.28
S_4: 100% through inorganic fertilizer	140.01	125.50	69.71	28.01	5.19	440	38.08	8.50
S. Em±	1.53	1.26	0.99	0.22	0.023	6.5	0.542	0.109
C. D. (P=0.05)	NS	3	2	NS	NS	NS	1.314	NS
Interaction (N x S)								
N x S	NS	NS	NS	NS	NS	NS	NS	NS
CV%	7.69	116.50	10.29	5.48	3.00	10.25	8.65	9.04

TABLE 3
Effect of nitrogen levels and source of nitrogen on productivity and economics of fodder oat-pearlmillet system (Pooled of four years)

Treatments	Green oat equivalent yield of system (t/ha)	Gross return of system (Rs./ha)	Net return of system (Rs./ha)	B:C ratio of system
A. Level of nitrogen				
N_1: 50% RDN	59.16	118320	12630	1.13
N_2: 75% RDN	69.13	138263	24568	1.23
N_3: 100% RDN	82.08	164154	42455	1.38
S. Em±	0.996	1991	1991	0.018
C. D. (P=0.05)	3.445	6891	6891	0.064
B. Source of nitrogen				
S_1: 50% through FYM+25% through vermi-compost+ 25% through castor cake	70.21	140421	12951	1.10
S_2: 75% through FYM+25% through vermi-compost	69.09	138174	15117	1.12
S_3: 75% through FYM+25% through castor cake	68.21	136428	27339	1.25
S_4: 100% through inorganic fertilizer	72.98	145959	50796	1.53
S. Em±	0.731	1462	1462	0.020
C. D. (P=0.05)	2.788	5576	5576	0.059
Interaction (N x S)				
N x S	NS			
CV %	7.22			

Rate of produce and inputs used in oat and fodder pearl millet

1.	Selling price of green forage oat	Rs. 2/kg	4.	FYM	Rs. 0.5/kg	7. Biofertilizer	Rs. 150/lit
2.	Selling price of green foragepearl millet	Rs. 2/ kg	5.	Vermi compost	Rs. 6/kg	8. Urea	Rs. 5.88/ kg
3.	Labour charge	Rs. 340/day	6.	Castor cake	Rs. 7.8/kg	9. DAP	Rs. 24/ kg

N_3 (100% RND) than rest of other levels of nitrogen. While, under source of nitrogen, significantly higher green oat equivalent yield (72.98 t/ha) recorded under 100% through inorganic fertilizer and found at par with 50% through FYM + 25% through vermi-compost + 25% through castor cake (70.21 t/ha). Gross return, net return and B:C ratio were also found similar results as per green oat equivalent yield in level of nitrogen (Rs. 1,64,154/ha, Rs. 42455/ha and 1.38, respectively) as well as source of nitrogen (Rs. 1,45,959/ha, Rs. 50796/ha and 1.53, respectively). The interaction effect found non-significantly affected in green oat equivalent yield of system.

CONCLUSION

Based on the three years experiment, it can be concluded that forage oat-fodder pearlmillet crop sequence after sunhemp green manuring under organic farming are recommended to apply recommended dose of nitrogen to each crop in the ratio of 50:25:25 through FYM : vermicompost : castor cake on the basis of nitrogen content for obtaining higher oat green fodder equivalent yield and better fodder quality. It also improves the soil health.

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