emergent
Life Sciences Research

Research Article

# Micronutrients enriched organic manure and biofertilizer as influenced on multi-cut fodder oat [*Avena sativa* (L.)]

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**Received:** 10 June 2023
**Accepted:** 28 August 2023 2023
**Online:** 11 september 2023

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**Emer Life Sci Res (2023) 9(2): 120-130**

**E-ISSN: 2395-6658**
**P-ISSN: 2395-664X**

**DOI**: https://doi.org/10.31783/elsr.2023.92120130

## Abstract

Micronutrients enriched organic manure and biofertilizer as influenced on multi-cut fodder oat" conducted during *rabi* 2021-22 at MFRS, AAU, Anand 388110 (Gujarat) with ten different treatments i.e $T_1$ RDF (80-40-0 NPK/ha), $T_2$ (RDF + NPK consortia), $T_3$ (RDF + Micronutrients Enriched FYM 0.5 t/ha), $T_4$ (RDF + Micronutrients Enriched FYM 1 t/ha), $T_5$ (RDF + Micronutrients Enriched VC 0.5 t/ha), $T_6$ (RDF + Micronutrients Enriched VC 1 t/ha), $T_7$ (RDF + Micronutrients Enriched FYM 0.5 t/ha + NPK consortia), $T_8$ (RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia), $T_9$ (RDF + Micronutrients Enriched VC 0.5 t/ha + NPK consortia) and $T_{10}$ (RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia) and an experiment data analysis done with randomized block statistical design having three replications.

Plant population, plant height at 20 and 40 DAS, DM% gave non-significant differences due to different treatments. An application of RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia ($T_{10}$) gave significantly higher plant height at 1st cut (103.32 cm), 30 days after 1st cut (21.37 cm) and at 2nd cut (37.86 cm) and LSR (2.35 and 0.93 both cuts, respectively). Economical yield at 1st and 2nd cut (430.56 & 358.13 q/ha, respectively) and TGFY yield (788.69 q/ha) was observed higher in treatment $T_{10}$ (RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia). CP % (Crude protein) [11.35 and 11.13 % at 1st and 2nd cut] was noted higher treatment $T_{10}$ and $T_8$, respectively) whereas DMY (Dry matter yield) (63.48, 78.60, and 142.06 q/ha at 1st and 2nd cut and total DMY, respectively) and CPY (Crude protein yield) (7.22, 8.57, 15.76 q/ha at 1st and 2nd cut and total DMY, respectively) by application of RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia ($T_{10}$). Lower ADF content (29.91 %) was reported in treatment $T_8$ (RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia) at 1st cut, whereas the response of treatment on fodder oat was found to be non-significant in the case of ADF content in 2nd cut and NDF content in both cuts. Higher gross income (157740 `/ha), and net realization (94887 `/ha) with 2.51 BCR were also reported with $T_{10}$, while treatment $T_2$ (RDF + NPK consortia) reported a higher BCR of 3.14.

**Keywords** enriched organic manure, green fodder, micronutrients, oat, vermicompost

## Introduction

Livestock is a major contributor to a nation's economy and it plays a crucial role in food supply to burgeoning population [1]. Livestock contributed 7% of NGDP and provided employment sources for rural youth. For green biomass productivity, cereal crops are well known source. Fodder oat is one of the most important forage crops sown in spring, their excellent growth habit and regrowth capacity ultimately provide quality green fodder for milchig animals. Oats are splendid in carbohydrates, vitamins, minerals, and total digestible nutrients as well as a good source of protein (13 to 15 %). It is used as green fodder and hay also useful during fodder [2]. Due to higher palatability and softness, it is preferred and fed by all animals.

India accounts for 2.29% of the world's land area, 17.4% of the world's human population, and 10.7% of the cattle population, the major feed resources are grazing on pastureland, crop byproducts, and crop residue left on harvested fields, as well as other agricultural waste that may be used to feed animals. Green fodder is mostly obtained from field fodder and other harvested grasses. Out of the total geographical area, 16% is occupied by grazing land which is gradually decreasing over the years. 3.3% of the total area is under permanent grazing and pasture lands which are generally decreasing over the years [3].

Higher green forage and fodder demand can be satisfied through quality production of forage and fodder [4]. Many factors are responsible for better crop production like growth, yield, and quality, and among all the factors soil fertility is the major factor responsible for higher green feed and fodder production. Providing nutrients at the proper stage can increase nutrient use efficiency by applying nutrients in the right quality, at the right time, and at the right stage from the right source [5]. Other well rotten organic residue is left in the field as a by-product of harvesting different crops. Urine and dung along with litter and waste materials of fodder and feed to livestock is farmyard manure. Organic manure contains macro and micronutrients in small quantities, but it is most beneficial for improving soil properties and also enhances the applied nutrient efficiency.

Plant growth, yield, quality, uptake, and concentration of nutrients in plants are affected by different factors. Those factors that affect the plant are climatic conditions, soil fertility, crop response to soil, type of fertilizer and cropping system, different sources of nutrients, and crop management practice. Micronutrient deficiencies are very commonly found in soil. In the world, soil contains low Zn levels where cereals crops are grown [6]. By the adoption of modern Agricultural technologies and higher use of NPK fertilizers without free micronutrients micronutrient deficiency will increase day by day [7]. Adequate fertilization in terms of primary secondary and micronutrients is effective to ensure the quantity and quality of green fodder.

The main constraint in realizing the yield potential of fodder crops of oat is an unbalanced, frequently same continuous cropping system and the use of unbalanced and straight fertilizer results in micronutrient deficiency in harvested straw and grain including Fe, Zn, Mn, and Cu [8]. By use of micronutrient enriched organic manure provides macro and micronutrients to soil and it finally enters in plant system. Research on bio-fertilization through micronutrients is stated to reduce malnutrition activities for healthy and wealthy people of India. Enrichment of organic manures with micronutrients not only improves the micronutrient used efficiency but also helps in reducing the load of inorganic chemicals as well as the quantity of organic to a considerable extent [9-10].

## Methodology

Micronutrient enriched organic manure and biofertilizer as influenced by multi-cut fodder oat was implemented during the rabi season of the year 2021-22 at MFRS, AAU, Anand 388110 (Gujarat) during rabi season 2022 (Figure 1 Metrological graph).

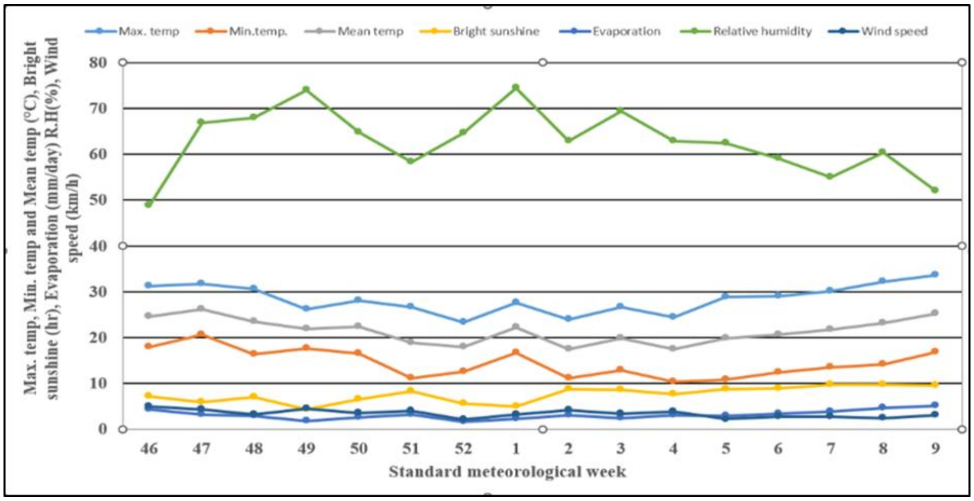


**Figure 1. Mean weekly weather parameters recorded during experimentation**

Before sowing of the crop for experiment initial soil status was observed as below (Table 1).

**Table 1. Initial chemical status of soil before sowing**

| | |
|---|---|
| Soil pH | 7.51 |
| Organic carbon | 0.23 % |
| Available Nitrogen | 249 kg/ha |
| Available phosphorus | 41 kg/ha |
| Available Sulphur | 11.09 mg/kg |

### *Treatment details*

The experiment was laid out in a Randomized Block Design with three replications. The ten micronutrients enriched organic manure and biofertilizer treatments viz., $T_1$ : RDF (80-40-0 NPK kg/ha), $T_2$ : RDF + NPK consortia, $T_3$ : RDF + Micronutrients Enriched FYM 0.5 t/ha, $T_4$ : RDF + Micronutrients Enriched FYM 1 t/ha, $T_5$ : RDF + Micronutrients Enriched VC 0.5 t/ha, $T_6$ : RDF + Micronutrients Enriched VC 1 t/ha, $T_7$ : RDF + Micronutrients Enriched FYM 0.5 t/ha + NPK consortia, $T_8$ : RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia , $T_9$ : RDF + Micronutrients Enriched VC 0.5 t/ha + NPK consortia, $T_{10}$ : RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia. Different locally available organics like Farm Yard Manure and vermicompost were selected for the enrichment study. For enrichment of organic manures use a plastic compost bag, a bag filled up with farmyard manure and vermicompost, and mix proper quality of Grade V micronutrients, during incubation maintain proper moisture and material turns every fortnight. An application of half dose (50% N) as a basal dose, 25% nitrogen at 40 DAS, and 25% nitrogen was applied after 1$^{st}$ cut was applied through urea. Through SSP full quantity of phosphorus was applied as a basal. NPK consortia were applied 1 L/ha through drenching just after the first irrigation. For biometric observations, tag five plants from each net plot area, and tag plants are used for recording all growth and yield attributes observation. Before sowing one composite soil sample and after harvesting or completion of the experiment, soil samples were collected from each plot area for chemical analysis.

### *Statistical analysis*

Data on different growth and yield parameters of oat were subjected to statistical analysis as per the standard methodology of Randomized Block Design. The data was analyzed through computer software following the procedure prescribed [11] at the Department of Agricultural Statistics, B. A. College of Agriculture, Anand Agricultural University, Anand. The variances of different sources of variation in ANOVA were tested by "F - test" and compared with the value of Table F at a 5 % level of significance. S.Em±, critical differences, and coefficient of variation (CV %) were also worked out.

***Incubation method***

The FYM and vermicompost were analyzed for their micronutrient contents (Fe, Mn, Zn, Cu, and B), and on the basis of value of micronutrient content of both the manures, the quantity of micronutrients fertilizer was calculated to reach the level of content of multi-micronutrient Grade-V (Fe-2%, Mn-0.5%, Zn-5%, Cu-0.2%, B-0.5%) for enrichment of the manures (Initial soil nutrient status reported in Table 2).

The manure enrichment process was started six weeks before its use by mixing manures with micronutrient fertilizers by the pit method. The material was covered with gunny bags and allowable for incubation. The mixture was turned at weekly intervals and maintained optimum moisture level. The enrichment process was considered complete after 6 weeks. At the end of the process, manure samples were analyzed for their micronutrient content before application in the field (after incubation manure nutrient status reported in Table 3).

***Initial soil micronutrient status of soil***

The initial status of soil micronutrients is given below (Table 2) before the sowing of the experiment for the idea about soil status.

**Table 2. Initial soil nutrient status**

| SN. | Micronutrient | mg/kg |
|---|---|---|
| 1 | Zn | 1.02 |
| 2 | Fe | 5.18 |
| 3 | B | 0.30 |
| 4 | Mn | 5.26 |
| 5 | Cu | 1.06 |

***Enriched organic source's nutrient status before and after the enriched process***

Enrichment is an important process before the incubation of organic manures. Before and after organic manures enrich nutrient status is presented in below given Table 3.

**Table 3. Organic manures before and after nutrient status**

| SN. | Particular | Nutrient content (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | N | $P_2O_5$ | $K_2O$ | S | Fe | Mn | Zn | Cu | B |
| **Before enriched status** | | | | | | | | | | |
| 1 | FYM | 1.22 | 0.42 | 0.45 | 0.25 | 1.02 | 0.032 | 0.011 | 0.0026 | 0.0007 |
| 2 | VC | 2.02 | 1.70 | 1.27 | 0.77 | 0.62 | 0.025 | 0.21 | 0.0042 | 0.0009 |
| **After the enriched nutrient status** | | | | | | | | | | |
| 1 | FYM | 1.0 | 0.61 | 0.40 | 1.5 | 2.13 | 0.50 | 4.65 | 0.10 | 0.45 |
| 2 | VC | 1.8 | 1.49 | 1.22 | 2.0 | 2.17 | 0.71 | 4.85 | 0.19 | 0.41 |

***Calculation of various quality parameters by following***

***DM (%)***

For dry matter content analysis, 500 g of green fodder fresh sample from net plot area and green material was chopped into small pieces. Put it for air dried for three to four days. Again air-dried samples were dried in the oven at 70 °C till constant weight was attained. DM (%) was calculated by using the given formula:

$$\text{DM\%} = \frac{Oven\ dried\ fodderweight\ (g)}{Fresh\ fodder\ fodder}\ \text{X}\ 100$$

***DMY (q/ha)***
The DMY (q/ha) was estimated by multiplying DM (%) with GFY (Green fodder yield) (q/ha) by employing the formula below and expressed in q/ha.

$$\text{DMY (q/ha)} = \frac{DM\ (\%)\ \text{X}\ GFY\ (q/ha)}{100}$$

***CP (%)***
For computing CP (%), first noted nitrogen content (%) from oven dried fodder samples using Kjeldhal's method [12]. CP % was calculated by multiplying the percentage of nitrogen with the factor 6.25.

***CPY (q/ha)***
Calculated CPY by multiplying crude protein (%) with DMY (q/ha) by employing the formula below and expressed in q/ha.

$$\text{CPY (q/ha)} = \frac{\text{DMY (q/ha) X}\ CP\ (\%)}{100}$$

***ADF (%)***
Thoroughly chore and mixed dry samples of each treatment and replication were taken for estimation of ADF content percent by the method developed [13].

***NDF (%)***
Thoroughly grinded and mixed dry samples of each treatment were taken for estimation of NDF content percent by using the method developed [13].

**Results and Discussion**

***Effect of treatment on growth and yield of fodder***
Because fodder oats require a lot of fertilizers to produce succulent and high-quality herbage, research on biofortification has already begun in industrialized countries. Examination of the data presented in Table 4 exhibited response of different treatments on plant stand per meter row length at 15 DAS was found non-significant. It indicated that the plant population was uniformly distributed in all experimental plots.

Response of various enriched treatments on the periodical height of the plant at 20, 40 DAS was found to be non-significant (Table 4), while oat height at 1$^{st}$ cut (103.32 cm), 30 days after 1$^{st}$ cut (21.36 cm) and at 2$^{nd}$ cut (37.86 cm) were found statistically higher as compared to other enriched organic manures treatments, but at 1$^{st}$ cut, treatment $T_{10}$ (103.32 cm) was statistically at par with treatments $T_3$ (92.11 cm), $T_7$ (90.23 cm), $T_8$ (99.00 cm) and $T_9$ (99.78 cm), plant height at 30 days after 1$^{st}$ cut treatment $T_{10}$ (21.36 cm) did not differ significantly with treatment $T_6$ (19.00 cm), $T_7$ (19.73 cm), $T_8$ (19.03 cm) and $T_9$ (20.20 cm) and plant height at 2$^{nd}$ cut, treatment $T_{10}$ (RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia) reported higher plant but (37.86 cm) it treatment remain at par with $T_4$ (34.33 cm), T8 (36.53 cm) and $T_9$ (36.26). Application of 100 % RDF

**Table 4. Response of treatments on growth and green fodder yield of multi cut fodder oat**

| Treatments | Plant Population | Plant height (cm) | | | | | Leaf: stem | | Green fodder yield (q/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 20 DAS | 40 DAS | 1$^{st}$ cut | 30 days after 1$^{st}$ cut | At 2$^{nd}$ cut | 1$^{st}$ cut | 2$^{nd}$ cut | 1$^{st}$ cut | 2$^{nd}$ cut | Total |
| $T_1$ | 79.80 | 15.83 | 50.00 | $81.16^{d}$ | $17.03^{d}$ | $29.53^{e}$ | $1.9^{a}$ | $0.69^{a}$ | $305.56^{g}$ | $258.9^{de}$ | $564.46^{g}$ |
| $T_2$ | 80.60 | 18.56 | 57.53 | $85.58^{cd}$ | $17.76^{bcd}$ | $29.73^{e}$ | $1.62^{a}$ | $0.81^{a}$ | $416.66^{b}$ | $187.5^{f}$ | $604.16^{f}$ |
| $T_3$ | 76.00 | 18.13 | 55.40 | $92.11^{b}$ | $18^{bcd}$ | $31.06^{de}$ | $1.35^{a}$ | $0.6^{a}$ | $380.2^{de}$ | $250^{e}$ | $630.2^{e}$ |
| $T_4$ | 76.20 | 16.50 | 57.86 | $82.98^{d}$ | $17.6^{cd}$ | $34.33^{bc}$ | $2^{a}$ | $0.62^{a}$ | $361.83^{f}$ | $284.73^{c}$ | $646.56^{d}$ |
| $T_5$ | 84.80 | 18.16 | 54.06 | $82.3^{d}$ | $18.16^{bcd}$ | $31.66^{cde}$ | $1.44^{a}$ | $0.84^{a}$ | $366.3^{f}$ | $288.06^{c}$ | $654.36^{d}$ |
| $T_6$ | 84.47 | 18.16 | 57.06 | $89.75^{bc}$ | $19^{abcd}$ | $33.2^{cd}$ | $1.96^{a}$ | $0.84^{a}$ | $371.3^{ef}$ | $277.96^{c}$ | $649.26^{d}$ |
| $T_7$ | 77.07 | 17.36 | 56.06 | $90.23^{bc}$ | $19.73^{abc}$ | $30.4^{de}$ | $1.66^{a}$ | $0.85^{a}$ | $395.83^{c}$ | $263.86^{d}$ | $659.69^{d}$ |
| $T_8$ | 83.40 | 17.73 | 54.33 | $99^{a}$ | $19.03^{abcd}$ | $36.53^{ab}$ | $2.35^{a}$ | $0.93^{a}$ | $408^{b}$ | $343.76^{b}$ | $751.76^{b}$ |
| $T_9$ | 77.93 | 18.06 | 56.40 | $99.78^{a}$ | $20.2^{ab}$ | $36.26^{ab}$ | $2^{a}$ | $0.81^{a}$ | $383.66^{d}$ | $347.23^{ab}$ | $730.89^{c}$ |
| $T_{10}$ | 88.47 | 19.40 | 58.46 | $103.32^{a}$ | $21.36^{a}$ | $37.86^{a}$ | $2.24^{a}$ | $0.83^{a}$ | $430.56^{a}$ | $358.13^{a}$ | $788.69^{a}$ |
| **S.Em.±** | **5.64** | **1.00** | **2.30** | **4.53** | **0.82** | **1.41** | **0.19** | **0.06** | **21.00** | **28.00** | **30.00** |

(80-40-0 NPK kg/ha) treatment reported significantly lower plant height at 1$^{st}$ cut (81.16 cm), at 30 days after 1$^{st}$ cut (17.03 cm), and at 2$^{nd}$ cut (29.53 cm). The reason behind to increase in fodder oat plant height could be attributed to crop growth and development, which is dependent on the developing start of organ primordia, cell differentiation, and expansion of component cells until plant characteristics are realized. Height increases with different treatments because nitrogen and phosphorus from treatment materials and NPK consortia help in nutrient mineralization throughout the crop period and exudates some plant growth regulating constituents such as Auxin, Gibberellins, and Cytokines in significant quantities, which help in increasing plant height of oats [14-15]. Another reason for higher plant height may be due to improved obtainability of nitrogen and essential plant nutrients to plant resulting in increased synthesis of carbohydrates and consequently converted into protoplasm, as a result, there is less accessibility for the synthesis of dietary items that are nitrogen-related and for the creation of cell walls, resulting in greater cell division and cell elongation and ultimately increasing plant height [16-17].

Leaf stem ratios at both cuts were significantly affected by different treatment (Table 4). At 1$^{st}$ cut (2.35%) and 2$^{nd}$ cut (0.93%) found significantly higher leaf stem ratio with treatment $T_8$ (RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia) but it did not differ significantly with treatment $T_1$ (RDF 80-40-0 NPK kg/ha), $T_4$ (RDF + Micronutrients Enriched FYM 1 t/ha ), $T_6$ (RDF + Micronutrients Enriched VC 1 t/ha ), $T_9$ (RDF + Micronutrients Enriched VC 0.5 t/ha + NPK consortia ) and $T_{10}$ (RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia) at 1$^{st}$ cut and at 2$^{nd}$ cut treatment $T_8$ (RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia) was statistically at par with treatment $T_2$ (RDF + NPK consortia), $T_5$ (RDF + Micronutrients Enriched VC 0.5 t/ha ), $T_6$ (RDF + Micronutrients Enriched VC 1 t/ha ), $T_7$ (RDF + Micronutrients Enriched FYM 0.5 t/ha + NPK consortia ), $T_9$ (RDF + Micronutrients Enriched VC 0.5 t/ha + NPK consortia ) and $T_{10}$ (RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia). A significantly lower leaf stem ratio was observed in treatment $T_3$ (RDF + Micronutrients Enriched FYM 0.5 t/ha) at 1$^{st}$ cut (1.35) and 2$^{nd}$ cut (0.60). It might be attributed to a greater supply of balanced nutrition resulting in increased protein synthesis, which could have permitted a rise in the quantity, size, and succulence of leaves, as well as plant development by these observed higher leaves [18-21].

The green fodder yield of oats differed significantly with different treatments (Table 4). The experiment result revealed that an application of 100% RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia ($T_{10}$) was reported to significantly higher green fodder yield (Figure 2) at 1$^{st}$ cut (430.56 q/ha) and at 2$^{nd}$ cut (358.13 q/ha) as well as total green fodder yield (788.69 q/ha). At 1$^{st}$ cut green fodder yield, the response of treatment $T_{10}$ (100% RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia) did not show its significant effect on treatment $T_2$ (RDF + NPK consortia), $T_3$ (RDF +

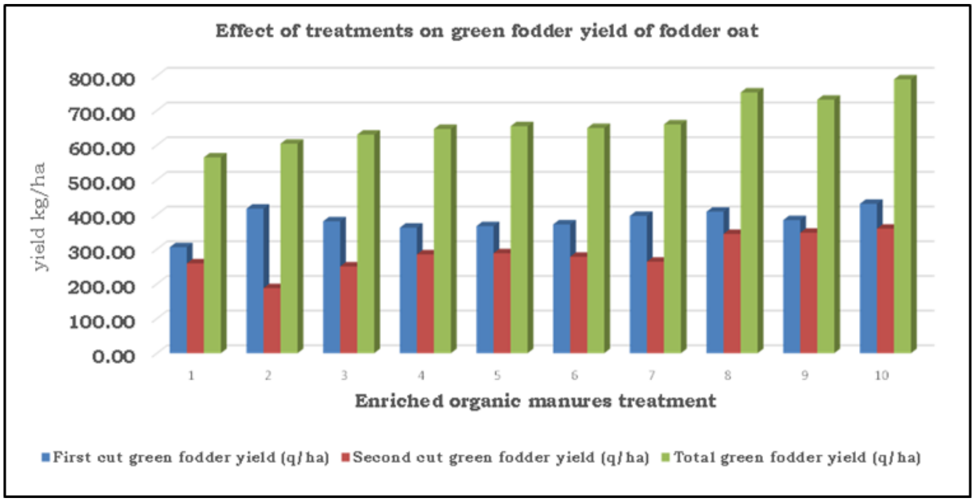


**Figure 2. Effect of different enriched organic manures on green fodder**

Micronutrients Enriched FYM 0.5 t/ha), $T_6$ (RDF + Micronutrients Enriched VC 1 t/ha), $T_7$ (RDF + Micronutrients Enriched FYM 0.5 t/ha + NPK consortia), $T_8$ (RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia) and $T_9$ (RDF + Micronutrients Enriched VC 0.5 t/ha + NPK consortia). Green fodder yield at 2nd cut, treatment $T_{10}$ (100% RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia) remain statistically at par with treatment $T_4$ (284.73 q/ha), $T_5$ (288.06 q/ha), $T_6$ (277.96 q/ha), $T_8$ (343.76 q/ha) and $T_9$ (347.23), Total green fodder yield treatment $T_{10}$ (RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia) being at par with $T_8$ (751.76 q/ha) and $T_9$ (730.89 q/ha). Lower green fodder yield at 1st cut (305.56 q/ha) and total green fodder yield (564.46 q/ha) was observed in $T_1$ (RDF 80-40-0 NPK kg/ha) treatment. At 2nd cut, treatment $T_2$ (RDF + NPK consortia) reported significantly lower green fodder yield (187.50 q/ha). The reason behind to higher green fodder yield during respective cuts might be due to increased crop growth and the direct impact of physiological factors including height, the number of tillers, and the leaf stem ratio. Furthermore, organic manures enhanced with micronutrients result in greater utilization of all available resources, which may have increased green fodder yield Micronutrient enriched organic manures may have developed healthy roots, allowing them to absorb moisture and macro and micronutrients from lower strata due to root proliferation depth in soil, resulting in improved growth parameters and a direct influence on green fodder yield [22]. Higher total green fodder production detected in treatment combining complete dosage of fertilizers with micronutrients enhanced organic manures and NPK consortia, which supply all important macro and micronutrients during growing period higher availability of all nutrients. Another reason might be due to the combined action of enriched organic manures and inorganic fertilizers, as well as NPK consortia, which provided a balanced proportion of essential nutrients, played a very important role in the decomposition of organic matter and the easy release of various nutrients from manure and soil, and increased the availability of nutrients for plants [23-25].

***Effect of treatment on quality of fodder***

A perusal of data presented in Table 5 revealed that dry matter content at 1st and 2nd cuts was found to be non-significant, while dry matter yield was significantly affected by micronutrient enriched organic manure treatment. Experiment data presented in Table 5 indicated that application of RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia ($T_{10}$) treatment recorded significantly higher dry matter yield (63.48, 78.60 and 142.08 q/ha at 1st and 2nd cuts and total dry matter yield, respectively). The increased dry matter content of fodder oats may be attributed to the continuous mineralization of organic manures and the balanced use of organic matter with inorganic nutrients, which provided

**Table 5. Response of treatments on quality parameters of multicut fodder oat**

| Treatments | DM % | | DMY (q/ha) | | | CP % | | CPY (q/ha) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1st cut | 2nd cut | 1st cut | 2nd cut | Total DMY | 1st cut | 2nd cut | 1st cut | 2nd cut | Total CPY |
| $T_1$ | 12.80 | 19.66 | 39.08$^{c}$ | 50.7$^{d}$ | 89.78$^{f}$ | 9.31$^{ab}$ | 9.31$^{ab}$ | 3.64$^{d}$ | 4.72$^{cd}$ | 8.36$^{d}$ |
| $T_2$ | 13.06 | 19.40 | 54.21$^{b}$ | 36.68$^{e}$ | 90.89$^{f}$ | 10.64$^{ab}$ | 9.14b | 5.76$^{abc}$ | 3.36$^{d}$ | 9.12$^{cd}$ |
| $T_3$ | 14.36 | 21.86 | 54.15$^{b}$ | 54.46$^{cd}$ | 108.61$^{e}$ | 9$^{b}$ | 9.85$^{ab}$ | 4.88$^{bcd}$ | 5.36$^{cd}$ | 10.24$^{cd}$ |
| $T_4$ | 13.60 | 23.36 | 49.5$^{b}$ | 66.43$^{b}$ | 115.93$^{d}$ | 9.35$^{ab}$ | 8.94$^{b}$ | 4.53$^{cd}$ | 5.93$^{bcd}$ | 10.46$^{cd}$ |
| $T_5$ | 14.60 | 19.66 | 53.59$^{b}$ | 56.43$^{cd}$ | 110.02$^{de}$ | 10.44$^{ab}$ | 9.73$^{ab}$ | 5.63$^{abcd}$ | 5.43$^{cd}$ | 11.06$^{cd}$ |
| $T_6$ | 13.96 | 21.83 | 51.68$^{b}$ | 60.75$^{bc}$ | 112.43$^{de}$ | 10.48$^{ab}$ | 10.55$^{ab}$ | 5.42$^{abcd}$ | 6.35$^{abc}$ | 11.77$^{bc}$ |
| $T_7$ | 13.70 | 19.70 | 54.11$^{b}$ | 52.62$^{d}$ | 106.76$^{e}$ | 10.16$^{ab}$ | 10.24$^{ab}$ | 5.53$^{abcd}$ | 5.34$^{cd}$ | 10.87$^{cd}$ |
| $T_8$ | 14.56 | 21.50 | 59.35$^{a}$ | 73.93$^{a}$ | 133.28$^{b}$ | 11.31$^{a}$ | 11.13$^{a}$ | 6.74$^{ab}$ | 8.21$^{ab}$ | 14.95$^{a}$ |
| $T_9$ | 13.73 | 21.30 | 52.66$^{b}$ | 73.8$^{a}$ | 126.46$^{c}$ | 11.04$^{ab}$ | 10.81$^{ab}$ | 5.81$^{abc}$ | 7.95$^{ab}$ | 13.76$^{ab}$ |
| $T_{10}$ | 14.70 | 22.00 | 63.48$^{a}$ | 78.6$^{a}$ | 142.08$^{a}$ | 11.35$^{a}$ | 10.76$^{ab}$ | 7.22$^{a}$ | 8.57$^{a}$ | 15.79$^{a}$ |
| **S.Em.±** | **0.58** | **1.54** | **3.71** | **7.41** | **7.78** | **0.53** | **0.47** | **0.49** | **0.78** | **0.93** |

a constant supply of nutrients and improved soil fertility and biofertilizer. Increases the availability and absorption of nutrients to the plant, resulting in increased plant height and development of other vegetative plant parts due to cell expansion and higher photosynthesis [26], which turn into higher dry matter content and dry matter yield is directly proportional to dry matter content [27]. Examination of the data presented in Table 5 exhibited that the effect of different treatments on crude protein content was found to be significant. Treatment $T_{10}$ (RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia) reported significantly higher crude protein content at 1st cut (11.35%) and $T_8$ (RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia) at 2nd cut (11.13 %). The rise in crude protein in fodder oats may be related to higher nitrogen availability through organic and inorganic nitrogenous fertilizers, and biofertilizer increases nitrogen availability by altering its form. Nitrogen is the primary component of amino acids, which raises the crude protein level [28-31]. The crude protein yield of fodder oats presented in Table 5 was significantly affected by micronutrients enriched organic manures. An application of RDF + Micronutrients Enriched VC 1 t/ha + NPK consortia ($T_{10}$) reported significantly higher crude protein yield (7.22 and 8.57 q/ha at 1st and 2nd cuts, respectively) and total crude protein yield (15.79 q/ha). Nitrogen is a component of chlorophyll that contributes to enhanced meristematic and photosynthetic activity revealed that nitrogen's favorable effects on cell division and elongation, nucleotide synthesis, and co-enzymes resulted in increased activity of meristematic tissues and photosynthetic area, and therefore enhanced output, culminating in photosynthate build up [32].

Treatment $T_8$ (RDF + Micronutrients Enriched FYM 1 t/ha + NPK consortia) reported that significantly lower ADF content (29.91%) at 1st cut while at 2nd cut response of micronutrients enriched organic manure on ADF content was found to be non-significant (Table 6). Response of different treatments on fodder oat NDF content was found to be non-significant. ADF content of fodder oats found significant might be due to the ADF rises as plants become older, more structural carbohydrates, cellulose, and fibrous material are produced, and these factors together with the plant's advancing age. ADF will less considered good property and safe for animals for digestion [28]. Application of various micronutrient enriched organic manures of fodder oat on neutral detergent fiber was found to be non-significant at 1st cut and 2nd cut.

***Economics***

After completion of the experiment and calculation of different treatments (Table 6) cost it was observed that the economics of the experiment showed that application of RDF + Micronutrients Enriched VC 0.5 t/ha + NPK consortia ($T_9$) reported higher net realization (95481 Rs/ha). Minimum net realization (74787 Rs/ha) observed in treatment $T_1$ (RDF 80-40-0 NPK kg/ha).

**Table 6. Response of treatments on acid detergent fibre, natural detergent fibre and economics of fodder oat**

| Treatments | ADF % | | NDF % | | Net realization | BCR |
|---|---|---|---|---|---|---|
| | 1st cut | 2nd cut | 1st cut | 2nd cut | | |
| $T_1$ | 32.16$^{ab}$ | 30.20 | 62.75 | 62.38 | 74787 | 2.96 |
| $T_2$ | 33.94$^{a}$ | 31.46 | 63.25 | 58.57 | 82291 | 3.14 |
| $T_3$ | 31.56$^{ab}$ | 29.53 | 59.23 | 63.45 | 77237 | 2.58 |
| $T_4$ | 32.73$^{a}$ | 29.90 | 61.77 | 59.57 | 69826 | 2.17 |
| $T_5$ | 33.17$^{a}$ | 31.16 | 63.53 | 58.46 | 80612 | 2.60 |
| $T_6$ | 32.41$^{a}$ | 32.32 | 60.74 | 59.65 | 67436 | 2.08 |
| $T_7$ | 33.11$^{a}$ | 32.74 | 62.61 | 60.32 | 82698 | 2.68 |
| $T_8$ | 29.91$^{b}$ | 32.65 | 63.19 | 63.33 | 90414 | 2.51 |
| $T_9$ | 33.33$^{a}$ | 30.29 | 62.75 | 62.88 | 95481 | 2.88 |
| $T_{10}$ | 31.98$^{ab}$ | 30.13 | 63.02 | 63.21 | 94885 | 2.51 |
| **S.Em.±** | **0.69** | **0.92** | **2.26** | **2.37** | **-** | **-** |

## Conclusion

Based on experimentation data, it could be concluded that the application of the recommended dose (100 kg NPK kg/ha) along with micronutrients enriched organic manure and biofertilizer (Micronutrients Enriched VC 1 t/ha + NPK consortia) to fodder oat showed its significant effect on physiological parameters, biological yield as well as quality parameter. Application of 100 % RDF alone reported significantly lower biological yield and quality parameters of fodder oat.

## Acknowledgments

The authors are highly grateful to the Director of Research and Dean PG studies, Anand Agricultural University, Anand, for providing scientific guidance, support, and facilities for carried out research. Research Scientist (FC), Main Forage Research Station, Anand Agricultural University, Anand and Associate Research Scientist, Micronutrient Research Project (ICAR) Anand Agricultural University, Anand for providing the necessary knowledge, laboratory working facilities, and infrastructure to carry out the research investigation and analysis.

## Abbreviations

GFY-Green fodder yield, CPY-Crude protein yield, DMY-Dry matter yield, TDMY-Total dry matter yield, TCPY-Total crude protein yield, CP-Crude protein, DM-Dry matter, RDF-Recommended Dose of fertilizer, ADF-Acid detergent fibre, NDF-Neutral detergent fibre, OM-Organic manure, FYM-Farmyard manure, q/ha-Quintal per hectare, 1st Cut-First cut, 2nd Cut-Second cut, NS-Non-significant, MFRS-Main Forage Research Station, AAU-Anand Agricultural University, Kg/ha-Kilogram per hectare

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