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Impact of Integrated Nutrient Management on Yield of Different Varieties of Oat †

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Abstract: Oat is an essential Rabi crop commonly used as green fodder. The nutritional requirements of oats are higher than those of other Rabi fodder crops. Higher doses of inorganic fertilizers are required to meet this demand, which is not economical for fodder production. This study evaluates the best economical dose of integrated nutrient management for attaining higher yield and better nutritional quality of oat. The experiment was conducted on the Agronomy Research Farm, University of Agriculture, Faisalabad, Punjab, Pakistan. The seed varieties used in this experiment were Oat-2011 Sargodha and Oat-F-411 (2021) Faisalabad. The experimental treatments were organized in factorial Randomized Complete Block Design (RCBD) arrangements, with each treatment replicated three times. The results revealed that treatment (T4) 50% RDF + 5 t/ha. Farmyard Manure + seed inoculation azotobacter was found to be the most appropriate than all other treatments.

Keywords: fodder; nutritional quality; Oat

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1. Introduction

Agriculture is a vital component of Pakistan's economy. Pakistan's agricultural contribution to the gross domestic product is 21%, with a 2.7% annual growth rate [1]. Under irrigated conditions, it is an important winter fodder crop, either as a sole crop or in combination with barseem. Oat is a single-cut crop that provides fodder for a shorter period of time than barseem. In Pakistan, oat is grown under both rainfed and irrigated conditions. Oat is one of the most important cereal fodder crops grown in Pakistan during the winter [2]. The majority of oat fodder is fed in its green state, but any excess is dried or fermented into hay or silage to store for use during times of fodder shortages. It is a favorite food source for all types of animals, and its straw is superior to that of wheat and barley in both quality and pliability. Oat grain is also a good source of food for dairy cows, pigs, chickens, and other young animals that are used for breeding [3].

Traditional fodder crops in the area can feed half as many animals per unit of land, while improved oat types have the ability to produce three times as much green fodder as traditional fodder crops, which would be between 60 and 80 tonnes per acre [4]. Crop development and normal growth are primarily determined by the availability of irrigation water. Crop water requirements are related to the moisture-sensitive period. The authors of [5] demonstrated that during particular phases of plant development, the plant may be

or appear to be more sensitive to changes in the amount of moisture present in the soil than it is during other stages of plant development. It can grow in a variety of soil types, altitudes, and rainfall conditions. It can withstand wet conditions better than most other cereals. It grows best in temperate and cool sub-tropical climates. During the four-month period, a well-distributed rainfall of 500 to 600 mm and an optimum temperature range of (18–35) °C are sufficient to meet its necessities as a fodder crop [6]. As a result, scientific society was driven to investigate the concept of integrated nutrient usage. Integrated nutrient management has good prospects, not only for ensuring high productivity but also for preventing soil degradation. Continuous use of large amounts of chemical fertilizers has had a negative effect, resulting in a decline in productivity due to a lack of one or more micronutrients. It also had a negative impact on soil health, resulting in several other issues.

Furthermore, to reduce the environmental impacts and increases in prices connected with chemical fertilizers, organic sources of nutrients are now emerging as attractive choices that can be used in conjunction with inorganic fertilizers because they are naturally balanced [7]. Integrated nutrient management (INM) using a combination of organic fertilizers and inorganic fertilizers may benefit soil characteristics and crop output. This might be performed in a sustainable way that does not compromise soil health, environmental safety, or other natural resources. Aside from this, INM procedures assist in lowering production costs and increasing farmer returns to evaluate the best economical dose of integrated nutrient management for attaining higher yield and better nutritional quality of oat. Keeping the above situation in view, the present study plans to investigate the impact of integrated nutrient management on the yield of different varieties of oat.

2. Methodology

The experimental site with geographical coordinates of 31°43′ N and 73°07′ E was conducted on oat crop during the year 2021–2022 at the agronomy-farm university of agriculture Faisalabad, Punjab, Pakistan. The experimental site is in Rachna Doab [8]. Faisalabad is located in the semi-arid region of Punjab, with humid summers and dry winters. Faisalabad's climate is classified as a hot desert. Summer temperatures can reach 50 °C as shown in Figure 1.

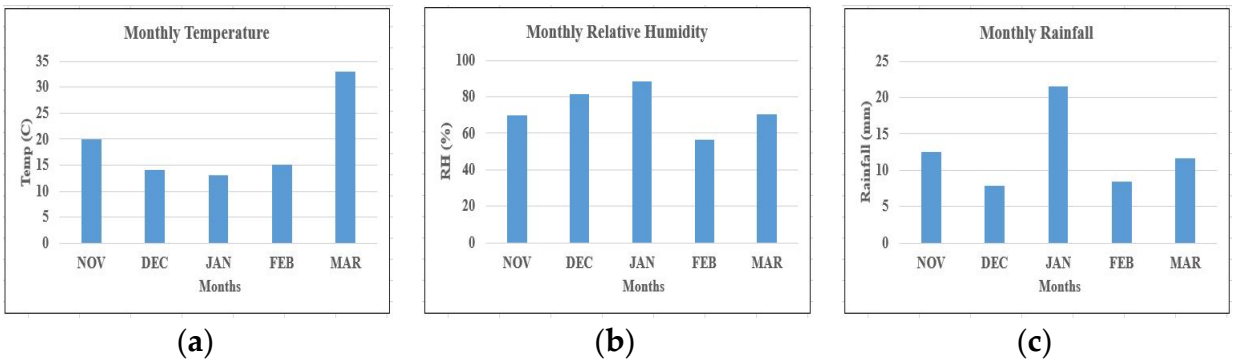
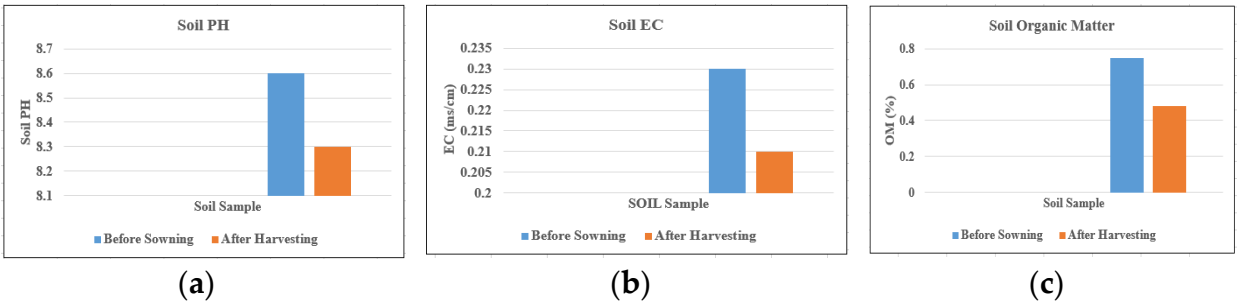


Figure 1. (**a**) Average monthly temperature; (**b**) monthly relative humidity; (**c**) average monthly rainfall.

2.1. Soil Sample Analysis

Soil samples were collected from a crop field with flood irrigation fields. Soil samples were collected from various points throughout the field to create a composite sample before sowing and after harvesting to get the status of soil (Figure 2).



(**a**) (**b**) (**c**)

Figure 2. (**a**) Soil PH; (**b**) soil EC; (**c**) soil organic matter.

2.2. Treatments: Factor A: Varieties

V1: Oat-2011 (2011) SGD; V2: Oat-F-411 (2021) FSD
Factor B: Integrated Nutrient Management (INM)
T1: Recommended dose of fertilizer (RDF) N:P:K = 150:85:62 kg ha^{-1} (control)
T2: RDF + 5 t ha^{-1} Farmyard Manure
T3: RDF + 5 t ha^{-1} Poultry Manure
T4: 50% RDF + 5 ton ha^{-1} Farmyard Manure + (seed inoculation with azotobacter)
T5: 50% RDF + 5 ton ha^{-1} Poultry Manure + (seed inoculation with azotobacter)
T6: 25% RDF + 5 ton ha^{-1} Farmyard Manure + (seed inoculation with azotobacter)
T7: 25% RDF + 5 ton ha^{-1} Poultry Manure + (seed inoculation with azotobacter)

3. Results

Effect of (INM) on Oat Varieties with Different Treatments

The cultivars were quite different from one another in many respects. The cultivar Faisalabad F-411 had a significant effect on germination count (m^2), plant height (cm), number of tillers (m^2), leaf area per tiller (cm^2), number of leaves per tiller, green forage yield (t ha^{-1}), dry matter yield (t ha^{-1}), dry matter, crude protein, crude fiber, total ash and ether-extractable fat (%) under INM in all treatments of F 411 (2021) as compared to Oat 2011 SGD (Figures 3 and 4). The maximum germination count (208.4 m^2), plant height (144.7 cm), number of tillers (780.35 m^2), no. of leaf per tiller (6.49), leaf area per tiller (202.43 cm^2), leaf-to-stem ratio (0.414), green forage yield (72.1 t ha), dry matter yield (11.8 t ha), dry matter (16.31%) crude protein (10.22%), total ash (34.6%) and ether-extractable fat (4.5%) were recorded from the cultivar Faisalabad F-411.

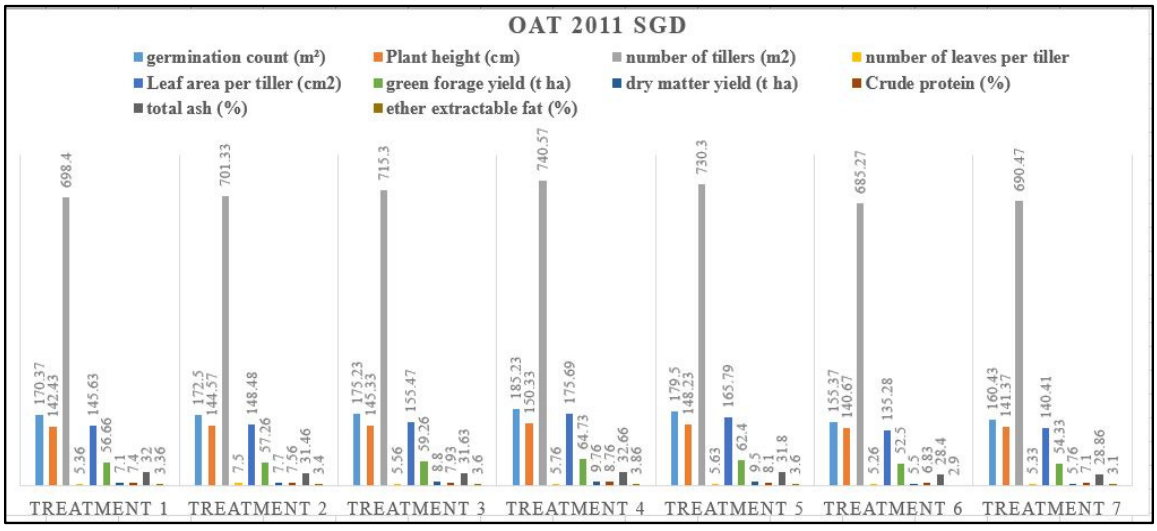


Figure 3. Effect of (INM) on oat cultivar Sargodha 2011.

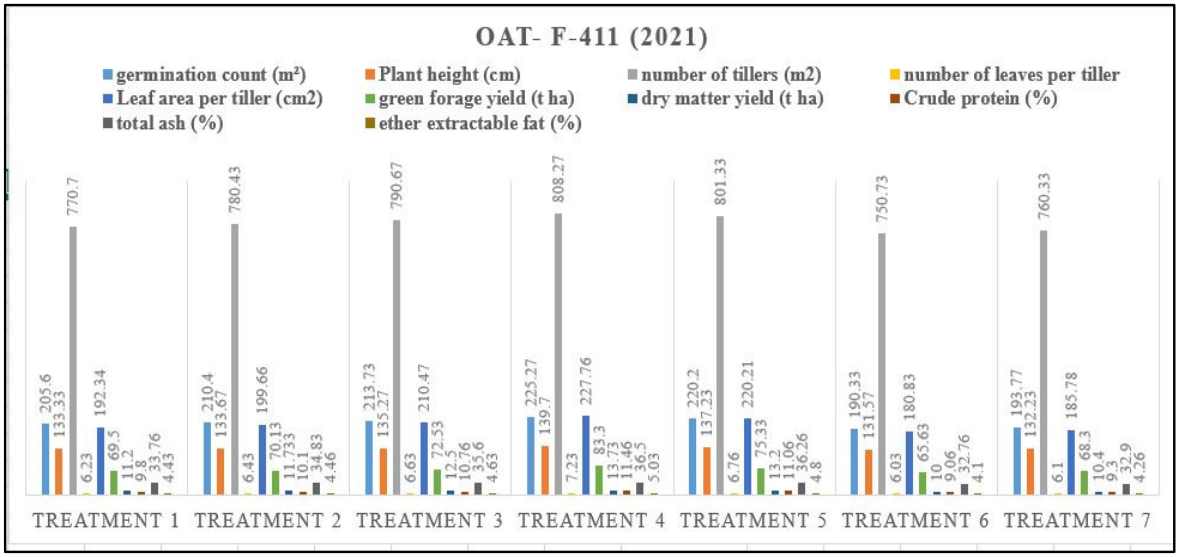


Figure 4. Effect of (INM) on oat cultivar F-411 Faisalabad.

4. Conclusions

From the results of the experiment and keeping overall performance in view, it can be concluded that treatment T_4 50% RDF + 5 t ha^{-1} Farmyard Manure + seed inoculation azotobacter was found to be the most appropriate of all the treatments studied in the experiment for exploiting the yield potential of oat (*Avena sativa* L.), and cultivar Faisalabad F-411 gave more forage yield of good quality under Faisalabad conditions.

Author Contributions: L.A. and A.R. gathered and processed the data set and performed the experiments. L.A. and M.R. supervised the experiments. L.A., A.R., M.R., S.H. and M.S.W. contributed to analyzing the results and writing the manuscript. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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