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INFLUENCE OF DIFFERENT NUTRIENT SOURCES ON GROWTH, YIELD AND NUTRITIVE VALUE OF FODDER MAIZE

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Abstract

A study was carried out to assess the effects of two types of organic manure *i.e.*, FYM (20 t/ha) and Jeevamrut (500 L/ha) and inorganic fertilizer (60 N kg/ha) on growth and yield performance of fodder maize. The application of recommended dose of fertilizer (RDF) (T3) significantly increased fodder maize plant height (170.03 cm), number of leaves per plant (12.40), leaf length (92.76 cm), leaf width (8.00 cm), stem girth (5.93 cm), green fodder yield (29.20 t/ha) and dry matter yield (7.99 t/ha). The nutritional parameters were also better on the application of RDF with CP 8.40, EE 0.98, TA 8.08, AIA 1.09, NFE 52.38, DM 27.37, CF 30.15, NDF 55.37, and ADF 35.29 %. The application of RDF resulted in better plant growth parameters as compared to FYM and Jeevamrut.

Introduction

Maize *(Zea mays* L.) is an annual crop belonging to the family Poaceae. India produced 31.51 million tonnes in an area of 9.86 million hectares (Anonymous 2021) ranking 4th in area and 7th in production representing 4 and 2% of the world maize area and production, respectively. It is the most nutritious, succulent, and palatable fodder crop among cereals (Anonymous 2011).

Green fodder influences the growth of the dairy sector and reduces the cost of production of milk as well as meets the nutritional demands of the livestock. Fodder maize is quick growing and produces high biomass containing sufficient quantities of protein and minerals and possesses high digestibility (Chaudhary *et al.* 2014).

Farmyard manure is the major source of soil organic matter in India. The conjoint use of organic manures and chemical fertilizers can help in enhancing and maintaining stability in production (Kumar *et al.* 2018). Natural farming is gaining importance because of sustained agriculture and maintaining ecological balance. It lies in the simple principle of utilizing cheap and local inputs with zero utilization of chemicals in any form like fertilizer, herbicide, pesticide, antibiotic, hormone etc. (Palekar 2005). Apart from using conventional farm-based products, there is an increasing demand for improvised materials like jeevamrut, panchagavya, fish amino acids, fermented plant juices, etc. which not only enrich the soil with micro-organisms but also decrease the incidence of diseases in many crops. Therefore, this study was carried out with the objective to examine the influence of different nutrient sources on the growth, yield and nutritive value of fodder maize.

Material and Methods

The field experiment was conducted during *Kharif* season (2019-20) at SAF experimental farm, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India, which is located between 30^{o} 51' North latitude and 76^{o} 11' East longitude and at an altitude of 1200 m above mean sea level having slope of 7-8%. The site represents transitional

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zone between sub-tropical and sub-temperate region of state of Himachal Pradesh. The physicochemical properties of soils of the experimental site from the composite soil sample of 0-30 cm depth were analyzed. The area receives an annual rainfall varying from 1000 mm to 1600 mm and 75% of it receive during monsoon season (July- September). The average annual minimum and maximum temperature was 11.9 and 25°C, respectively (Source: Meteorological observatory, Department of Environment Science, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India).

The field was thoroughly ploughed with the help of a tractor followed by planking. Before sowing seeds, 58.5 g of nitrogen (N), 225 g of phosphorus (P), 22.5 g potassium (K)/plot were applied and another dose of N= 58.5 g were applied 20-25 days after sowing per plot. Fodder maize (var. African tall) was sown in the month of July with 4 treatments and 5 replications in a 3 × 3 m plots with 20 cm plant to plant spacing and 60 cm row to row spacing with a randomized block design (RBD). Treatment details consist of the following: T_0 (a control plot with no fertilizer or organic supply) was included in each replication plot, T_1 (FYM 20 t/ha) and T_2 (Jeevamrut 500 L/ha). The seeds of the fodder maize were first treated with Beejamrut and Jeevamrut was applied to the soil as drench @ 0.45 L diluted in 8 L of water one time before sowing of seeds and 3 times after sowing at 15 days interval with total four applications. T_3 (RDF) *i.e.*, N (60 kg/ha): P_2O_5 (40 kg/ha): K_2O (15 kg/ha). Full dose of P_2O_5, K_2O and 1/2 N as basal were applied.

Fodder maize parameters *i.e.*, plant height, number of leaves, leaf length, leaf width, stem girth, green fodder yield and dry matter yield were observed. After harvesting, the prepared samples were subjected to nutritive analysis and dry matter (DM), crude protein (CP), ether extract (EE), crude fibre (CF), neutral detergent fibre (NDF), acid detergent fibre (ADF), total ash (TA), acid insoluble ash (AIA) and nitrogen free extract (NFE) were determined.

Result and Discussion

Data pertaining to the plant height of fodder maize at harvesting are presented in Fig. 1. Plant height of fodder maize was significantly increased with the application of recommended dose of fertilizers, FYM and Jeevamrut in comparison to control. Amongst all the treatments, the highest plant height (170.03 cm) was recorded on application of recommended dose of fertilizers. The plant height (145.29 cm) was recorded lowest in control plots where no fertilizer was applied. Average plant height of maize recorded in the study was consistent with the previous studies of Masih and Swaroop (2016) and Mahato and Neupane (2017). Kalra and Sharma (2015) further reported that plant height was higher on application of 25 t/ha FYM which were also comparable to the application of 120 kg/ha N.

Application of recommended dose of fertilizers (RDF), farmyard manure (FYM) and Jeevamrut had a significant effect on the number of leaves per plant of fodder maize (Fig. 1). The maximum numbers of leaves per plant (12.40) were recorded on application of RDF, which was significantly higher than the application of Jeevamrut (10.08), FYM (9.51) and control (8.14). Studies of Masih and Swaroop (2016), Marngar and Dawson (2017) and Singh *et al.* (2018) also reported the average number of leaves per plant ranged from 11-13 in fodder maize.

The data pertaining to the leaf length of fodder maize are also presented in Fig. 1. The mean values of leaf length on application of RDF, FYM, Jeevamrut and in control were 92.76, 83.38, 80.00 and 70.06 cm, respectively. Application of RDF resulted in significantly higher leaf length than other treatments. Application of FYM and Jeevamrut also resulted in increase in leaf length as compared to control. Vyas *et al.* (2015), Mahato and Neupane (2017), Olowoboko *et al.* (2017) and Peram *et al.* (2018) also reported similar results where the leaf length of 50-110 cm had been reported.

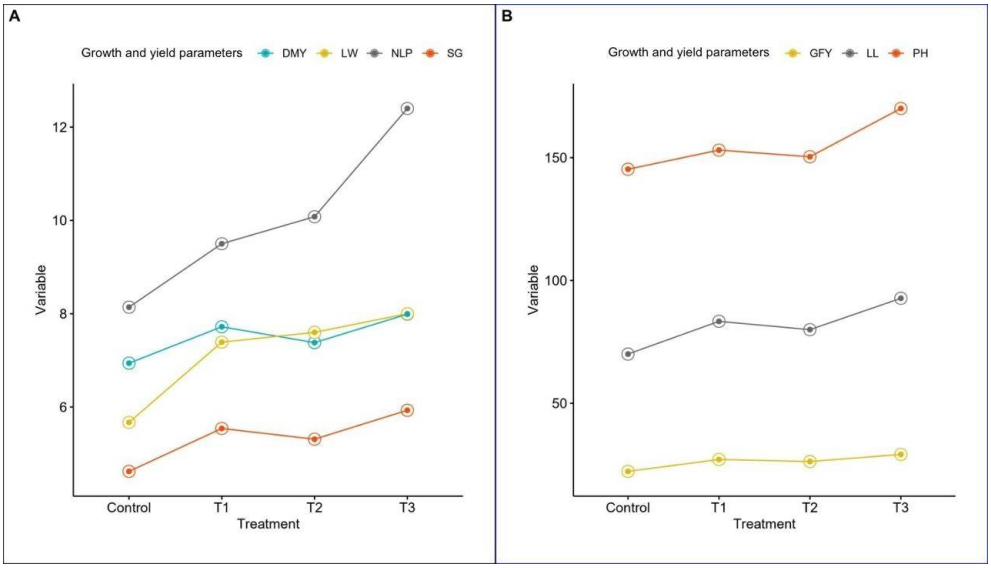

Fig. 1. Influence of different nutrient sources on growth and yield parameters of fodder maize. T1: Farm yard manure, T2: Jeevamrut, T3: Recommended dose of fertilizer, DMY: Dry matter yield (t/ha), LW: Leaf width, NLP: Number of leaves per plant, SG: Stem girth (cm), GFY: Green fodder yield (t/ha), LL: Leaf length (cm), PH: Plant height (cm).

Leaf width is also an important parameter for the determination of leaf area which decides photosynthetic efficiency, yield and quality of green fodder. The result showed that the leaf width was significantly increased with the application of RDF (8.00 cm) as compared to Jeevamrut (7.60 cm), FYM (7.32 cm) and control (5.67 cm) (Fig. 1). Singh *et al.* (2015) and Olowoboko *et al.* (2017), also reported similar results where the leaf width of 5-11 cm has been recorded in fodder maize.

Stem girth is an important parameter which decides the cell wall constituents such as NDF, ADF, ADL and lignin content of the plant. It is evident from the data that there was a significant effect of inorganic fertilizers on the stem girth of maize plant. The mean values of stem girth (cm) on application of RDF, FYM, Jeevamrut and in control group were 5.93, 5.54, 5.31 and 4.62 cm, respectively (Fig. 1). The results obtained which were significantly increased by the application of RDF in the present study were supported by Sangma *et al.* (2017) and Bhatt *et al.* (2020).

Efficiency of any agronomic management practices are mainly reflected on the quantity of green fodder produced in the experiment. Results obtained on analysis of data on fresh weight per plant on application of RDF, FYM, Jeevamrut and control are presented in Fig. 1. The significantly higher green fodder yield (29.20 t/ha) was recorded on application of recommended dose of fertilizer than FYM (27.14 t/ha), Jeevamrut (26.30 t/ha) and control (22.30 t/ha), respectively. Ali and Anjum (2017) also reported that the maize green fodder yield of 23.78 t/ha was recorded on application of 70 kg N/ha.

The application of RDF, FYM and Jeevamrut significantly affected the dry matter yield. From the data presented in Fig. 1, it is evident that the dry matter yield was significantly higher in RDF followed by FYM, Jeevamrut and control. Results in the present study corroborate with the study of Vyas *et al.* (2015).

The dry matter (DM) per cent in the fodder maize was significantly higher in the control (31.14%) than in FYM (28.44%), Jeevamrut (28.07%) and RDF (27.37%), respectively (Table 1).

Crude fibre per cent was significantly higher in the control (38.17%) than RDF (30.15%), FYM (32.22%) and Jeevamrut (33.75%). Crude fibre content in maize fodder was statistically at par in Jeevamrut and FYM treatment groups and was significantly higher than recorded in maize fodder samples grown on application of RDF. Hafez and Abdelaal (2015) also reported 32.45% crude fibre in maize hybrids on application of 60 kg N/ha, which were in agreement to the findings of the present study.

Table 1. Influence of different nutrient sources on nutritive parameters of fodder maize.

Parameters	Control	T_1 (FYM)	T_2 (Jeevamrut)	T_3 (RDF)
Dry Matter (%)	31.14^a	28.44^b	28.07^c	27.37^d
Crude Protein (%)	6.27^d	7.22^c	7.59^b	8.40^a
Ether Extract (%)	0.80^d	0.92^c	0.96^b	0.98^a
Crude fibre (%)	38.17^a	32.22^c	33.75^b	30.15^d
Neutral Detergent Fibre (%)	65.84^a	59.70^c	61.51^b	55.37^d
Acid Detergent Fibre (%)	40.75^a	38.39^b	37.46^c	35.29^d
Total ash (%)	7.16^d	7.52^c	7.70^b	8.08^a
Acid Insoluble Ash (%)	0.98^d	1.07^b	1.04^c	1.09^a
Nitrogen free extract (%)	47.59^d	52.12^b	50.00^c	52.38^a

*Means bearing different superscripts within a row are statistically different to each other.

Neutral detergent fibre (NDF) content was significantly higher in control group (65.84 %) than other treatment groups. NDF content in maize fodder on application of FYM (59.70%) and Jeevamrut (61.51%) were statistically at par to each other and were significantly higher than the NDF content recorded on application of RDF**.** Findings in the present study were in agreement with the previous studies of Vyas *et al.* (2015).

The per cent crude protein (CP) in maize fodder was significantly higher with the application of RDF than other treatments. Crude protein per cent in maize fodder was higher on application of FYM and was statistically at par with the application of Jeevamrut. It was also observed that the crude protein content increased (5.53%) when higher doses of nitrogenous fertilizers were applied. Begum *et al*. (2018) on comparing the effects of different levels of inorganic fertilizers also reported increase in crude protein content on increasing the nitrogen levels.

Critical appraisal of the data revealed that the acid detergent fibre (ADF) varied significantly between different treatment groups. The ADF content was significantly higher in control (40.75%), followed by FYM (38.39%), Jeevamrut (37.46%) and RDF (35.29%) (Table 1). The ADF per cent in maize fodder was at par with FYM and Jeevamrut treatment and was significantly higher than the application of RDF. Subrahmanya *et al*. (2017) also reported 31.79% ADF on application of RDF and the ADF content decreased on increasing the doses of fertilizers.

Application of RDF on maize fodder had the highest total ash content (8.08%) followed by Jeevamrut (7.70%) and FYM (7.52%) (Table 1). It was observed that though the highest total ash content was recorded in the application of RDF, the ash content was statistically at par in treatment groups.

Table 1 revealed that nitrogen free extract (NFE) in maize fodder varied significantly among different treatments. The highest value of NFE per cent was recorded with the application of RDF (52.38%) followed by FYM (52.12%) and Jeevamrut (50.00&). Findings in this study was in agreement to Kashinath (2014).

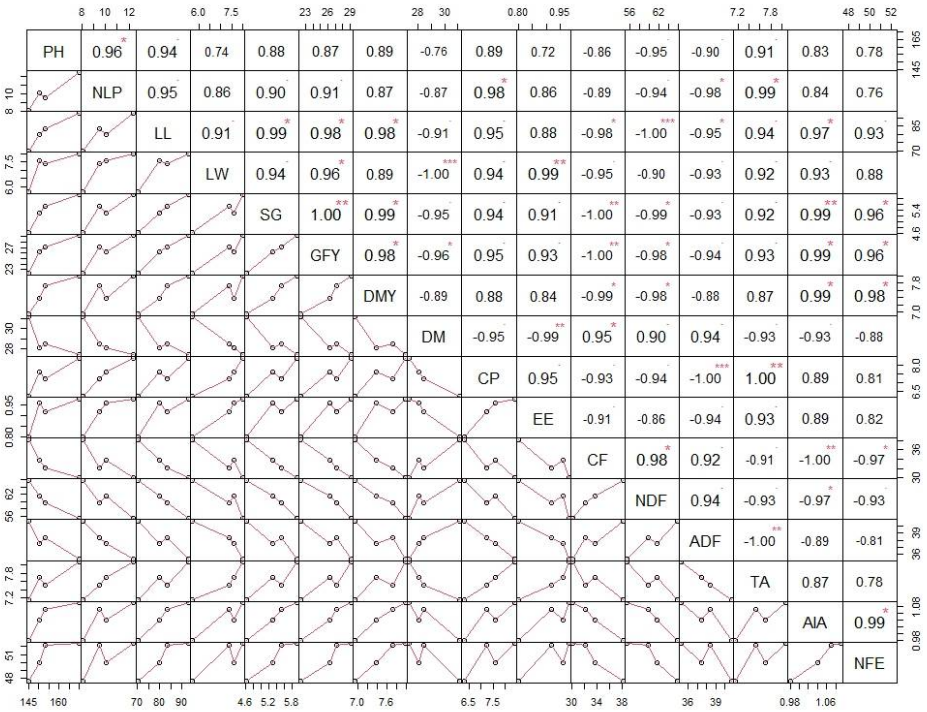

Fig. 2. Correlation between growth, yield, and nutritional parameters of fodder maize.
*, ** and *** indicate significance at 5%, 1% and 0.1%

In correlation matrix (Fig. 2), the parameters under study were observed to have a strong correlation with each other when studied at three different level of significance *i.e.* 5% (*), 1% (**) and 0.1% (***). At 5% level of significance, NLP showed a positive correlation with pH, CP, ADF and TA. LW was found to have positive correlation with GFY and EE at 5% and 1% level of significance, respectively. LL was also observed to be positively correlated with SG, DFY, GFY, CF, ADF and NDF suggesting that the length of leaves contribute to higher fodder yield, stronger stem along with increased fiber content. GFY correlates positively with DMY, DM, CF, NDF, AIA and NFE. However, DM showed a negative correlation with LW indicating a decrease in dry matter percentage in maize fodder with the increase in width of maize fodder leaves. CF was also found to be negatively correlated with DM, ADF and NDF implying that the increase in CF may result in lower DM and fiber fractions in fodder maize. CP displayed negative correlation with ADF and TA. Similarly, NDF and ADF were negatively correlated with TA and AIA. However AIA was positively correlated with NFE.

The study demonstrated that the application of RDF, FYM and Jeevamrut significantly affected the growth, yield and nutritive value of fodder maize with RDF having the highest plant height, number of leaves, leaf length, leaf width and stem girth. In addition to the growth and yield

parameters, green fodder yield and dry matter yield was also observed highest in RDF. Nutrient content analysis also revealed that the use of RDF resulted in higher CP, EE, TA, AIA and NFE content. FYM and Jeevamrut also showcased positive impacts on growth and yield parameters which can act as an alternative to chemical fertilizers. Further studies are needed to focus on the long-term impacts of integrating organic and chemical fertilizers for wider adoption and sustainable farming practices.

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