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Research Article

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IMPACT OF ORGANIC AND INORGANIC FERTILIZERS ON FODDER AND GRAIN YIELD OF MAIZE (*ZEA MAYS* L.) IN THE CLIMATIC CONDITIONS OF RAWALAKOT

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ABSTRACT

The research was carried out under rain-fed conditions in Rawalakot to evaluate the impact of different organic and chemical fertilizers on maize yield and its components. Eight different treatments were tested using a randomized complete block design (RCBD) with three replications. Organic fertilizers used were farmyard manure (FYM) and poultry manure (PM), while NPK was the inorganic fertilizer. The maize variety tested was Kashmir Gold. Data were analyzed using ANOVA, and differences between treatments were assessed through the least significant difference (LSD) test. The results showed a significant impact of different fertilizers on maize growth and yield. Treatment T3, which combined half the recommended dose of NPK with farmyard manure, produced the best results, including the highest number of plants (10), tallest plant height (208.2 cm), most grain rows per cob (41.5), heaviest 1000-grain weight (187.8 g), and highest grain yield (8271.12 g). This study suggests that using a mix of 50% organic (FYM) and 50% inorganic (NPK) fertilizers can be an effective nutrient strategy for maize cultivation in rain-fed areas like Rawalakot.

Keywords: Rawalakot, Poultry Manure, Inorganic, Soil Nutrient, Farm Yard Manure

INTRODUCTION

Organic fertilizers also referred to as organic sources like farm yard manure (FYM), poultry manure (PM), green manure and compost etc., not supply the organic matters but also increase the fertility status of soil. The organic sources have been reported to improve the soil fertility, promote good soil aggregation, improve moisture infiltration and increase the water holding capacity of the soil, increase the soil organic carbon, soil available nutrients (N, P, and K), soil enzymes (dehydrogenase and alkaline phosphatase), and microbial biomass C in the top 0-15 cm soil, improve the fertilizer use efficiency to a great extent, and to have the ability to prevent nutrient losses due to irregular and heavy rainfall. Additionally, they have the ability to increase the P availability of the already present P by rendering it more accessible to crops through reducing the soil P absorption capacity, increasing the pH by decreasing the exchangeable acidity and aluminium in soil solution through chelation, and increasing the soil biological activity of the soil (Mukuralinda *et al*., 2010). Maize is a major grain and fodder crop in Rawalakot but it's per hectare yield is low. However, it is cultivated using traditional methods and its productivity is low than national yield. There are different factors which contribute to its low productivity; soil fertility is a major concern of crop production in the area. Nitrogen and phosphorus are highly confining nutrients contribute towards good growth and development (Wondewosen, 2009) due to continuous cropping systems using low fertilizer (Tenaw et al., 2006). Preferably continuous use of chemical fertilizers and high prices turned the farmers to think about alternatives. The contrary, the substitute organic fertilizers cannot meet crop nutrient demand over large area because of limited availability, low nutrient composition and high labour requirement (Tolera et al., 2005). Proper application of organic and inorganic fertilizers can increase the

activities of soil micro-organisms and enzymes and soil available nutrient contents (He and Li, 2004; Saha et al., 2008). He and Li (2004) indicated that combined application of organic and inorganic fertilizers can increase the activities of soil invertase and available nutrient content. Accordingly, the higher the price of chemical fertilizers and the higher organic residue demand in the field, could call up the combined use of compost with inorganic fertilizer approach. As reported by Baghdadi *et al*., 2018, the integration of organic fertilizer with inorganic fertilizer increases the potential of the applied fertilizer there by increases crop productivity. Therefore, this study was conducted to evaluate soil property, growth, productivity and economic performance of maize in response to integrated fertilizer application.

MATERIALS AND METHODS

The experiment was designed to study the effect of organic and inorganic fertilizers to test productivity, soil nutrients status and economics of the crop-soil-management systems. The influence of seven different organic and inorganic and integrated treatments was evaluated on the basis of crop productivity and economic returns using RCBD. Subplot size was kept 2 x 2 m. Different fertilizer levels were as under:

T_0 = Control

T_1 = Farmyard Manure (FYM) @ 30 tons ha^{-1}.

T_2 = NPK (recommended dose) @ 120-90-60 kg ha^{-1}

T_3 = Poultry manure @ 20 tons ha^{-1}.

T_4 = Inoculation by Phosphorus mobilizing microorganisms (PSM) @ 2.5 packets ha^{-1}

T5 = Farmyard Manure (FYM) @ 30 tons ha^{-1} + NPK @ 120-90-60 kg ha^{-1}

T6 = Poultry manure @ 20 tons ha^{-1} + NPK @ 120-90-60 kg ha^{-1}

T7 = PSM @ 2.5 packets ha^{-1} + 120-90-60 kg ha^{-1}

Experiment undertaken

Field experiment was performed in Randomized complete block design with seven treatments allotted randomly in three replicates. All the cultural practices were done according to the recommendations. Crop was harvested at full vegetative stage for fodder purpose and at full maturity for grain purpose.

Sampling and measurements

Soil samples were taken before and after the experiment to check the fertility status. Plant samples were taken to measure different variables of growth and yield of maize.

Statistical analysis

The collected data was analyzed statistically by using statistix 8.1 and means were subjected to Tukey test to test the significance of the treatment means.

RESULTS AND DISCUSSIONS

Fodder yield is a function of genetic as well as environmental factors which plays a vital role in plant growth and development. Green fodder yield was significantly affected both by organic and inorganic fertilizers (Table 1).

Table 1: Effect of organic and inorganic fertilizer on forage yield, grain yield and benefit cost ratio (BCR)

Treatments	Forage yield (t ha^{-1})	Grain yield (kg ha^{-1})	BCR
T0	34.00 f	4340 f	0.95
T1	39.00 d	5319 d	1.17
T2	41.19 c	5539 c	1.21
T3	38.59 de	5220 de	1.10
T4	36.98 e	5041 e	1.00
T5	45.00 a	6060 a	1.42
T6	43.20 b	5723 b	1.30
T7	40.69 c	5466 c	1.19
LSD	1.59	199	

All the treatments differed significantly from one another except T2 and T7 which were statistically at par with each other. The treatment receiving (FYM) @ 30 tons ha^{-1} + NPK @ 120-90-60 kg ha^{-1} produced significantly higher green fodder yield (45 t ha^{-1}) than the rest of the treatments followed by T6 (Poultry manure @ 20 tons ha^{-1} + NPK @ 120-90-60 kg ha^{-1}). The minimum (34 t ha^{-1}) green forage yield was recorded in control. The increase in yield with organic and inorganic application might be due to higher number of leaves $plant^{-1}$, plat height and leaf area $plant^{-1}$. These results are in line with the findings of Ahmad *et al*. (2007).

Similarly lakoo *et al*. (2004) reported that organic manures and inorganic fertilizers increase the maize fodder yield. Grain yield was also found maximum

(6060 kg ha^{-1}) that was followed by T6 having grain yield of 5723 kg ha^{-1}. Treatments T2 and T7 could not reach a level of significance from one another. While minimum grain yield (4340 kg ha-1) was recorded in control treatment where no fertilizer was applied. Mtambanengwe and Mapfumo (2006) reported between 24% and 104% increase in grain yield under mineral N–organic manure combinations. It was also reported that integrated use of organic and inorganic fertilizers increase maize yield (Fandika *et al*., 2007). Benefit cost ratio was also noted higher (1.42) in treatment where FYM @ 30 tons ha^{-1} + NPK @ 120-90-60 kg ha^{-1} was used. It could be seen from the table 2 the pre and post analysis of the soil. The analysis showed that after experiment the soil was rich in observed nutrients.

Table 2: properties of soil (0-15cm) at Rawalakot before and after experiment.

Properties	**Pre analysis**	**Post analysis**
Sand	40	40
Silt	42	43
Clay	18	17
Texture	Clay loam	Clay loam
Ph	6.8	6.4
Organic matter	0.85	1.11
EC (dS m^{-1})	0.225	0.231
NO_3 –N (mg kg^{-1})	1.13	1.25
Available Phosphorus (mg kg^{-1})	2.09	2.30
Exchangeable K (mg kg^{-1})	43.33	54.68
Zinc (mg kg^{-1})	1.22	2.56
Mn (mg kg^{-1})	2.35	2.56

Number of plants /m^{-2}

Combined application of farm yard manure and NPK significantly enhanced the number of plants of maize per m2. The treatment T1,T6 and T9 = (Half NPK fertilizer + farm yard manure@ 5 tons ha-1) produced the highest number of plants (10.00m^{-2}). These results confirmed that mixed application of inorganic fertilizers are better source nutrients as compare to poultry manure and chemical fertilizer. The results due to inorganic fertilizer in mix provides nutrients to crop at early growth stages while during alter stages nutrients are provided by organic component of fertilizer mixture after decomposition. These results were endorsed by finding of Amujoyegbe et al. (2007) and Ahmad et al. (2007).

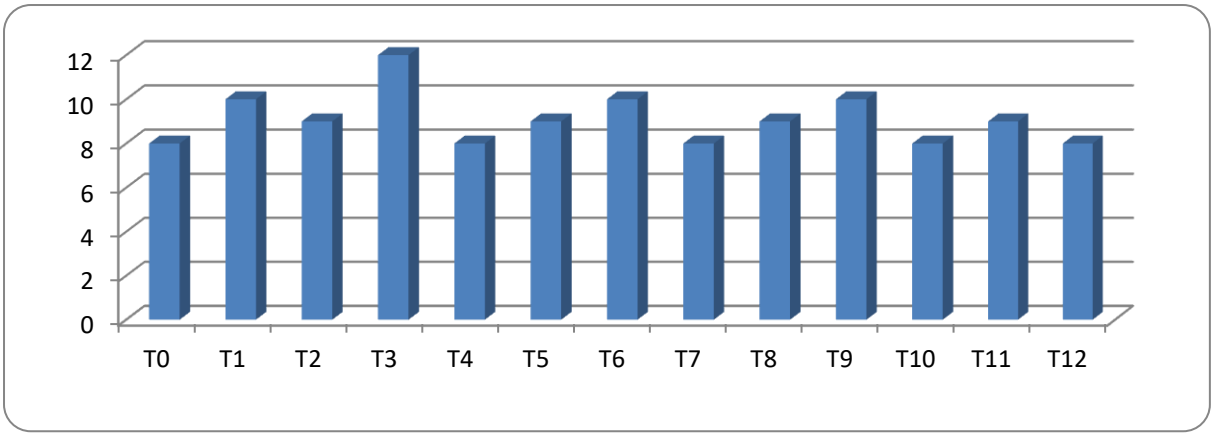

Figure.1: Figure indicated the number of plants/m^{-2}

Plant height (cm)

Plant height is considered as one the most important characters for yield improvement in fodder crops. High uptake of NPK nutrients by crop results in increased vegetative growth like number and size of leave and plant height. Maximum plant height (208.02cm) was recorded form treatment T3 (50 % FYM+ 50 % NPK). This may be due to quick release of nutrient from inorganic component at early nutrient to the crop at initial growth stage, while the organic component

slowly release nutrient at the later vegetative growth stages of the crop Ahmad et al. (2007).

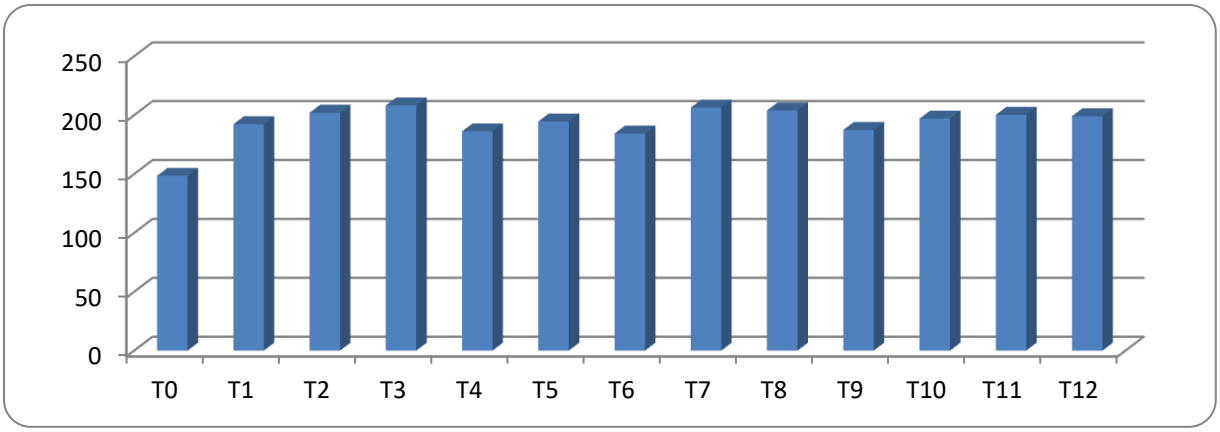

Figure.2: Figure indicated the Plant height (cm).

Cob Length (cm)

Cob length is an essentially contributes to yield improvement in maize. It considerably contributed to kernel yield in maize because it influenced both grain on size and numbers of grains. The maximum cob length (20.67 cm) were obtained in treatment T12. Integrated use of inorganic and organic fertilizers. The causes for the improved cob length may be due to the fact that of more photosynthesis occurs maize plants in improved supply of nitrogen because Nitrogen is a crucial element for crop growth. The probable argument for this may be judicious nutrient to the plant to produce a cob of more grains and length. Therefore, an improved cob length will be the key of the improvement economical yield in maize crop (Malaiya et al., 2004).

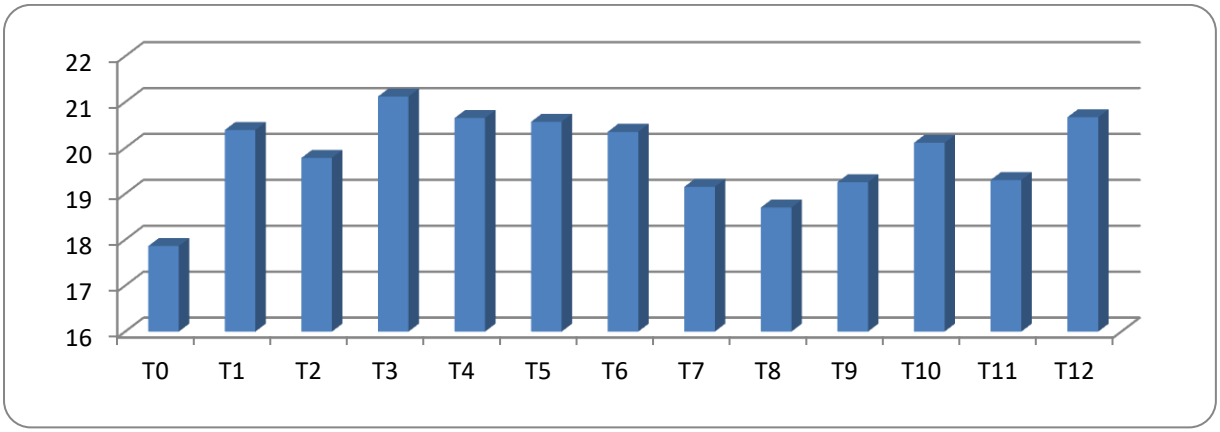

Figure.3: Figure indicated the cob length (cm).

Number of grain rows per cob

Grain rows per are important to improve no of grains and yield. The maximum number of grains per row was recorded form treatment T12 (41.5). Number of grain in rows me be increase due to N availability to plants at right time, which is essential for growth improvement and moisture retention improvement and improvement of soil structure by farm yard manures. Tamayo et al. (1997) stated that addition of organic compost improve number of grain rows per cob due to accessibility to the nutrients at proper time particularly at grain setting and filling stages.

Number of grains per row

Number of grains per row is an important trait that significantly contributes to the yield. Maximum number of grain per row recorded for T12 (41.5 Grains). The improvement in number of grains row-l of maize bay be results due to the prolonged grain filling period, accessibility to the plant to essential nutrients at critical stages and ears length. The increased nitrogen doses results improvement in the grains per row. Grains per row improved with addition of compost @ 5 t ha-l. This improvement may results due to nutrients availability at proper stage from integrated sources helps plant growth and development, increase cob length and diameter and improved seed development. Pandey et al. (2000) reported that seed weight increase with increase in grains ear-l and reduces the infertility of ears in maize crop.

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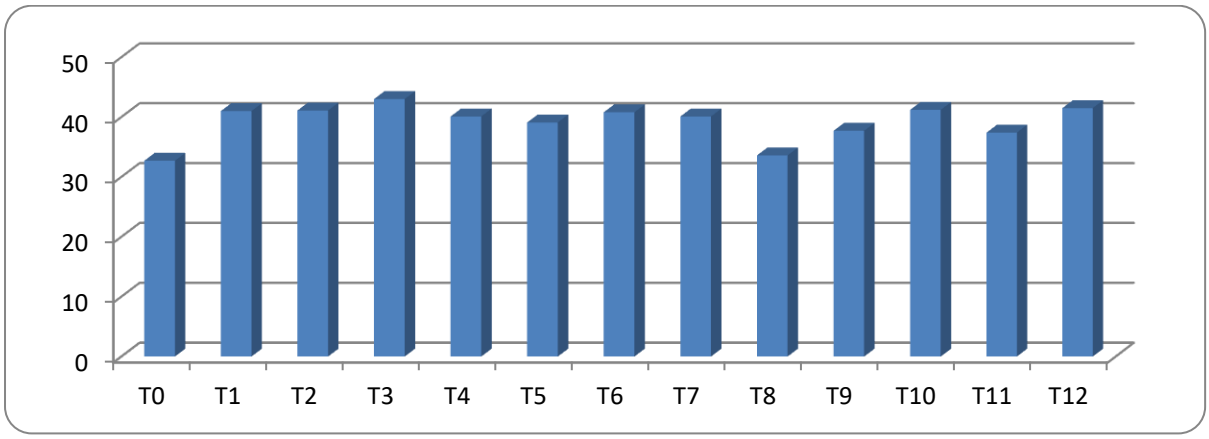

Figure.4: Figure indicated the number of grain rows per cob.

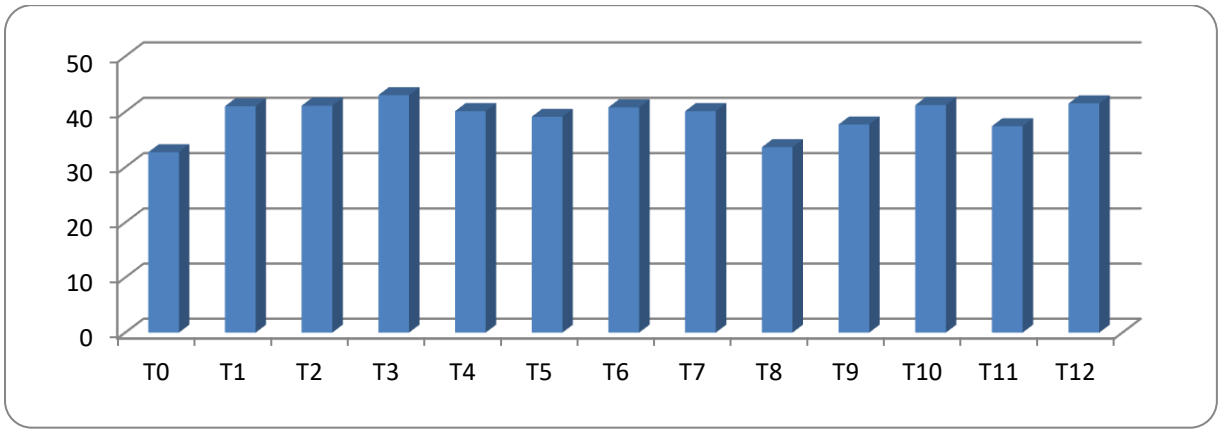

Figure.5: Figure indicated the number of grain per row.

Number of grains per cob^{-1}

Maximum grains/cob were recorded for T3. (637.4 grains) trailed by T11 (580.8 grains). These result showed that IFFYM is a good nutrient source. It may results due to release nutrients for inorganic source at early vegetative crop growth, whereas organic source provides essential nutrient to crop at reproductive stage. The grain yield improvement is positively correlated with number of grains/cob as and cobs/plant. Our findings are in line with results of Tamayo et al. (1997).

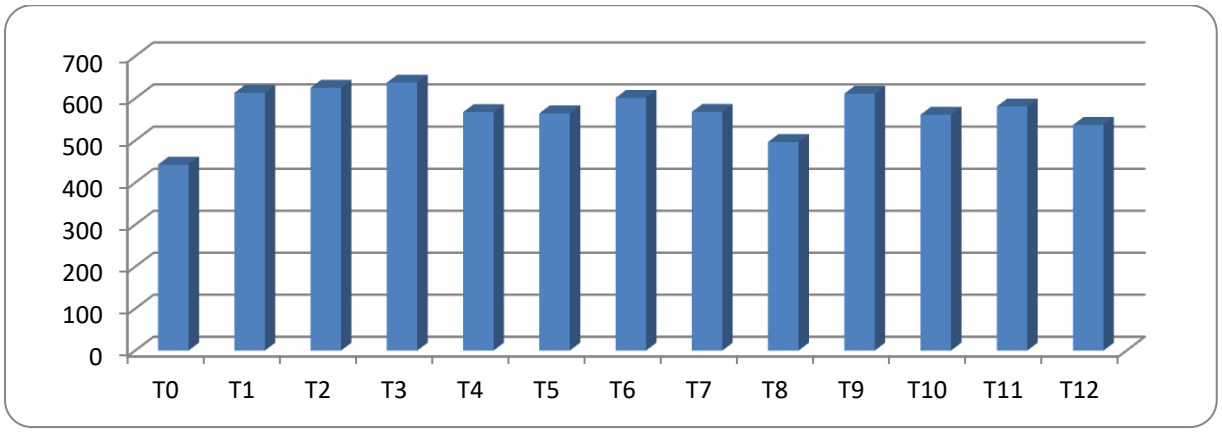

Figure.6: Figure indicated the number of grain per cob.

1000- Grain weight (g)

Grain weight is the most important yield contributing character of maize crop. Maximum grain weight recorded for T4 (187.8 g). Among different traits contributing to the crop yield, 1000 grain weight is most significant. The combined application of inorganic + organic results improvement in grain yield. Sharif et al. (2004)

reported that integrated use of inorganic and FYM positively affected on 1000 grain weight. The enhancement in grain weight was results attributable to adequate supply of plant nutrients from both inorganic urea and organic Poultry manure during the period of grain development and Filling. Current findings are at par with findings of Shah et al. (2009).

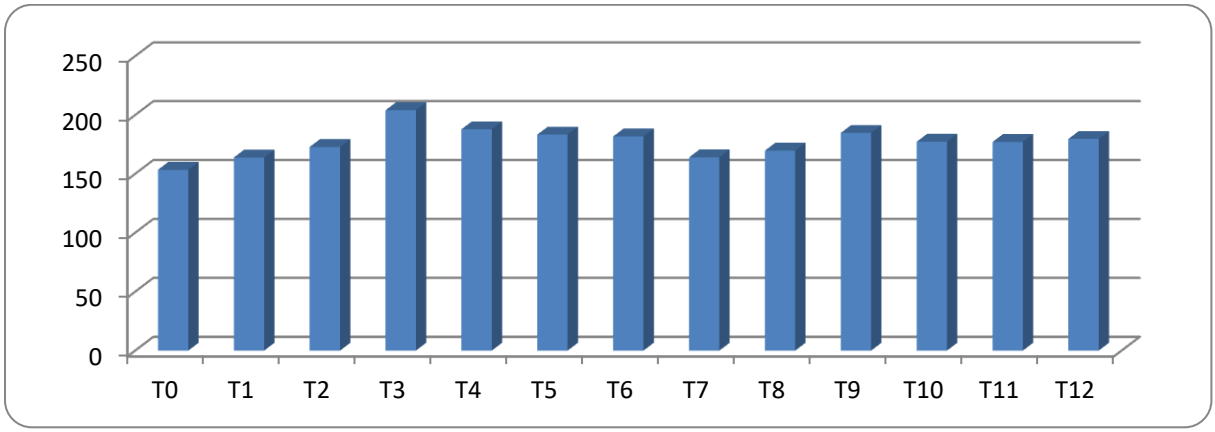

Figure.7: Figure indicated the 1000-grains weight.

Grain yield (kg ha^{-1})

Grain yield is the final result and it is resultant of various complex physiological and processes morphological occurs during the growth and development of plants (Nagassa et al., 2005). Maximum yield was produced from treatment T11 produced (4705.92kg ha-1) trailed by T10 (4544.59 kg ha^{-1}). The high grain yield is combined with application of nutrient sources batter plant growth attributes, grain development and efficient use of nutrient by plants. Yield is the main goal of any crop grown.

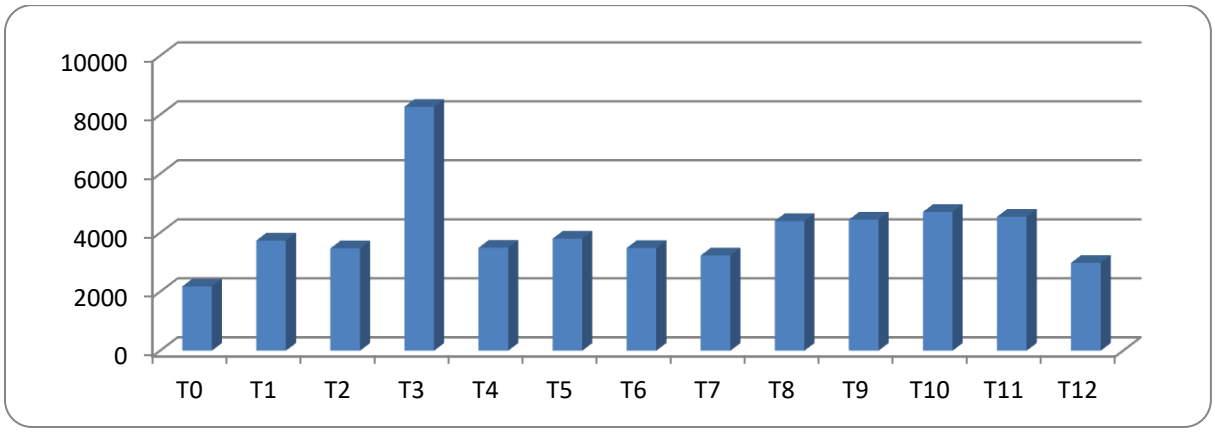

Figure.8: Figure indicated the grain yield (kg ha^{-1}).

CONCLUSION

It was concluded from the experiment that integrated use of farm yard manure and NPK @ 120-90-60 kg ha^{-1} increased the fodder and grain yield of maize amongst solo and other fertilizer treatments. Continuous use of FYM with inorganic fertilizers not only increases the availability of nutrients but also improves soil fertility and ultimately enhances fodder and grain production. Thus, integrated use of inorganic fertilizers and organic sources has been suggested to exploit the yields of fodder maize besides improving physical structure and fertility status of soil. Reduction of overall cost of production and increased income also help to raise the living standards of the farmers.

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REFERENCES

Ahmad, A. H., I. Qadir and N. Mahmood. 2007. Effect of integrated use of organic and inorganic fertilizers on fodder yield of sorghum (Sorghum bicolor L.). Pakistan Journal of Agricultural Sciences, 44: 415-

421.

Baghdadi, A., Ridwan, A. H., A. Ghasemzadeh, M. F. Ramlan and S. Z. Sakimin. 2018. Impact of organic and inorganic fertilizers on yield and quality of silage corn in intercropped system with soybean. Peer J. https://doi.org/10.7287/peerj.preprints.26905v1

Fandika, I. R., D. Kadyampakeni, C. Bottomani and H. Kakhiwa. 2007. Comparative response of varied irrigated maize to organic and inorganic fertilizer application. Physics and Chemistry of the Earth 32: 1107–1116.

He Y. Li R (2004). Eff ect of the organo–inorgano-mixed f ertilizer application on sugarcane yield and soil enzymatic activity. Sugar Crops China, 4: 36-38.

Lakoo A.A., F.C. Oad, A.A. Solangi and M.H. Siddiqui. 2004. Economics of maize fodder under organic and inorganic fertilizers. Int J Agric Biol 6(6): 1172-1173.

Malaiya, S., R. S. 2004. Tripathi and G. K. Shrivastava. Effect of variety, sowing time and integrated nutrient management on growth,yield attributes and yield of summer maize. Annals Agri. Res.25:155-158.

Mtambanengwe, F., Mapfumo, P., 2006. Effects of organic resource quality on soil profile N dynamics and maize yield on sandy soils in Zimbabwe. In: Soil and Plant ISSN 0032-079X, 281, pp. 173–191.

Mukuralinda, A., J. S. Tenywa,L. Verchot, J. Obua, N. L. Nabahungu and J. N. Chianu. 2010. Phosphorus uptake and maize response to organic and inorganic fertilizer inputs in Rubona, Southern Province of Rwanda. Agroforest System, 80: 211 – 221.

Saha S, Prakash V, Kundu S, Kumar N, Mina BL, (2008). Soil enzymatic activity as aff ected by long-term application of f armyard manure and mineral fertilizer under a rainf ed soybean–wheat system in N-W Himalaya. Eur. J. Soil Biol., 44: 309-315.

Tenaw, W., Husni, M.H.A., Anuar, A.R. & Rahman. Z.A. 2006. Effect of coffee residue and intercropping on soil physicochemical properties and yield of component crops in Southern Ethiopia", Ethiopian Journal of Natural Reesources.8 (2):199-216.

Tolera, A., Tamado T. & Pant, L.M. 2005. Grain yield and LER of maize-climbing bean intercropping as affected by inorganic, organic fertilizers and population density in Western Oromia, Ethiopia" Asian Journal of Plant Sciences.4 (5):458-465.

Wondwosen, T. 2009. Identification of growth limiting nutrient(s) in the major soil types of Kindo Koye and Delbo Atwaro watersheds", Woliaita zone, Southern Ethiopia. In: CIDA/UPCD Sustainable rural agriculture development project research Abstract collections, Hawassa University. P.26.