

Original Research Article

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## Performance of Different Sources of Livestock and Poultry Waste as Organic Manures on Growth and Yield of Fodder Maize (*Zea mays*)

Prasad Mithare\*, U.S. Biradar, Pratik Jawarkar, M. Vaishali, Saste Ashwini, Kamalakar and Avinash Karbari

Department of Livestock Farm Complex, Veterinary College, Bidar, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, India

\*Corresponding author

### ABSTRACT

The field experiment was conducted during *kharif* season of 2019 at Fodder Production Unit of Livestock Farm Complex Department, Veterinary College Bidar. The aim of the experiment was to study the performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize. The experimental layout which was laid out in Randomized Block Design (RBD) with three replications. The results revealed that treatment T<sub>5</sub> (Poultry Manure 12 t ha<sup>-1</sup>) has performed significantly better than all other treatments namely, plant height (206.47 cm), number of leaves plant<sup>-1</sup> (12.00), dry weight (28.82 g), leaf area index (5.57), stalk length (140.66 cm), stalk girth (13.47 cm), number of cobs plant<sup>-1</sup> (2.33), cob Length (16.35), cob girth (15.52), cob weight (85.35 g), green cob weight per m<sup>2</sup> (3175.52 g), green cob weight per ha<sup>-1</sup> (3175.52 g), green fodder yield plant<sup>-1</sup> (195.75 g), green fodder yield per m<sup>2</sup> (3132.05 g), green fodder yield ha<sup>-1</sup> (31.32 t), dry fodder yield plant<sup>-1</sup> (41.22 g), dry fodder yield per m<sup>2</sup> (659.57 g) and dry fodder yield ha<sup>-1</sup> (6.60 t). Whereas, treatment T<sub>1</sub> (Control) has performed poor among all the treatments. However, treatment T<sub>4</sub> (Sheep Manure 12 t ha<sup>-1</sup>), T<sub>9</sub> (Fermented Bio-Slurry [Dung + Urine (1:1)] Soil Application 20 t ha<sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS) and T<sub>8</sub> {Fresh Bio-Slurry [Dung + Urine (1:1)] Soil Application 20 t ha<sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS} were statistically at par with treatment T<sub>5</sub> (Poultry Manure 12 t ha<sup>-1</sup>), respectively.

#### Keywords

Bio-slurry, Forage, FYM, Organic material and silage

#### Article Info

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### Introduction

Animal husbandry plays an important role in livelihood security and economic sustenance of farmers, especially in rainfed areas. As per 20<sup>th</sup> Livestock Census of 2019, the total livestock population in India was 535.78 million in country showing an increase of

4.6% over livestock census 2012. Karnataka is the 9<sup>th</sup> largest state in cattle and buffalo population in the country, accounting for 29 million and it is 4.70% of the total population as per the latest Livestock Census, 2019 GOI, DAHD 2019. The increasing population and diversified food and fodder requirement of the country is expanding at faster rate, enhancing

food production for future years is very challenging. The growth of animal husbandry is linked with production, productivity and quality of forages. India inhabits 15% of world livestock on 2% geographical area with 5.23% cultivated fodder area. The fodder production in the country is not sufficient to meet the requirements; also the forages offered are mostly of poor quality. Present availability of green fodder is 462 million tonnes and dry fodder is 394 million tones and contribution of crop residue, cultivated fodder and grasslands is 54, 28 and 18% respectively. Currently, India is deficit by 35.6% in green fodder and 10.95% in dry fodder and 44% concentrate feed. This gap in demand and supply may further rise due to consistent growth of livestock population at the rate of 1.23% in the coming years and the demand of green fodder will rise to 1012 million tonnes by the year 2050. To meet out the deficit, green forage supply has to rise at 1.69% annually Rakesh Kumar 2016. Maize (*Zea mays*) is an ideal forage crop grown throughout the year. It is quick growing, high yielding and provides palatable nutritious forage which can be fed at any stage of growth without any risk to animals. Maize produces good quality herbaceous fodder with high digestibility. On an average, it contains 9-10% crude protein, 60-64% neutral detergent fibre, 38-41% acid detergent fibre, 28-30% cellulose and 23-25% hemi cellulose on dry matter basis when harvested at milk to early-dough stage. It can be fed as green or dry and makes excellent silage (Kumar *et al.*, 2012). FYM is the principle source of organic matter in our country and it is a source of primary, secondary and micronutrients to the plant growth. It is a constant source of energy for heterotrophic microorganisms, help in increasing the availability of nutrient and crop produce quality. The entire amount of nutrients present in farmyard manure is not available immediately but about 30% of nitrogen, 60 to 70% of phosphorus and 70% of

potassium are available to the first crop, while remaining amount of nutrients will be available to succeeding crop Hussain *et al.*, (2019). The application of FYM also enhanced the availability of plant nutrient present in soil, while FYM is a store house of nutrient, which contains all essential plant nutrients Nawab *et al.*, (2011). Vermicompost is an excellent base for the establishment of beneficial free living and symbiotic microbes. Application of vermicompost increases the total microbial population of nitrogen fixing bacteria that convert nutrient in soil into plant available form. Poultry litter is a mixture of manure and bedding materials, and it has been used successfully as an alternative plant nutrient source to inorganic fertilizer for the cultivation of numerous economically important crops, including maize, cotton, and pasture Kingery *et al.*, (1993), Moss *et al.*, (2001), Adeli *et al.*, (2007), Mosquera *et al.*, (2008). The use of poultry litter as a source of nutrients on agricultural lands is a safe and environmentally friendly way of disposing of their waste Hirzel *et al.*, (2007). Poultry manure improves biological activities, soil tilth and soil chemical properties Michael and George, 2008. Superiority of poultry manure was also reported by Chandrasekhar *et al.*, (2000) and Saranappa *et al.*, (2002) showed 7.62 % increase in seed yield of maize with the application of poultry manure. Bio-slurry is a mixture of (Dung + Urine) obtained from the livestock shed, which is collected in the digester tank. The composition of the bio-slurry can consist of 93% water and 7% of dry matter, of which 4.5% is organic matter and 2.5% is non-organic matter. Although bio-slurry contains higher amount of phosphorus, potassium, zinc, iron, manganese and copper, which is limited factor in many soils. Bio-slurry with the dose of 10 to 20 tons ha<sup>-1</sup> in irrigated areas and 5 to 10 tons ha<sup>-1</sup> in rainfed crops can show significant increase in yields. Indeed, bio-slurry increases crop revenues by 25% on average Maria *et al.*, (2014). The

effects of bio-slurry application are comparable to the effects of the application of chemical fertilizers. As such, bio-slurry can be a serious alternative to chemical fertilizers (Warnars *et al.*, 2013). Use of the slurry inhibits disease and increase yields (Liu *et al.*, 2008).

## Materials and Methods

The field experiment was conducted during kharif season of 2019 at Fodder Production Unit of Livestock Farm Complex Department, Veterinary College Bidar. The experiment site lies between 17.86° N latitude, 77.47° E Longitude and 710 meters altitude. The climate of the experimental location is characterized by warm and moderate humid weather during rainy season. The rainy season starts from second week of June to mid-October with mean temperature of 19.82°C. The soil of the experimental site was sandy loam in texture having a pH (6.8), EC (0.346 dSm<sup>-1</sup>), organic carbon (0.58%), available N (310 kg ha<sup>-1</sup>), P (20.16 kg ha<sup>-1</sup>), K (301 kg ha<sup>-1</sup>), S (14.70 ppm) Zn (0.50 ppm), Fe (4.61), Mn (1.80 ppm) and Cu (0.18 ppm) during the experimental season. The experiment was laid down in randomized block design (RBD) with 9 treatments and 3 replications. The sowing was carried out in fodder production unit on 18<sup>th</sup> July 2019, at a spacing of 30 x 10 cm. The control treatment was fertilized with recommended dose of NPK 80:40:30 kg ha<sup>-1</sup> was applied. The (100%) full dose phosphorus and potassium, whereas, (50%) of nitrogen was applied at the time of planting as basal dose and remaining nitrogen was applied as top dressing at knee height stage. Irrigation was scheduled at 8-10 days interval during vegetative growth stage; however other normal cultural practices were followed timely as hand weeding at 20 DAS and 40 DAS, respectively. One quadrat (1 m<sup>2</sup>) was harvested in every plot for the determination of results and data was subjected to statistical

analysis separately by using analysis of variance technique. The difference among treatment means was compared by using least significant difference test at 5% probability levels. The treatment consisted of T<sub>1</sub>: Control (RDF 80:40:30 Kg NPK ha<sup>-1</sup>), T<sub>2</sub>: FYM (16 t ha<sup>-1</sup>), T<sub>3</sub>: Vermicompost (12 t ha<sup>-1</sup>), T<sub>4</sub>: Sheep Manure (12 t ha<sup>-1</sup>), T<sub>5</sub>: Poultry Manure (12 t ha<sup>-1</sup>), T<sub>6</sub>: Fresh Bio Slurry [Dung + Urine (1:1)] Soil Application 20 t ha<sup>-1</sup>, T<sub>7</sub>: Fermented Bio-Slurry [Dung + Urine (1:1)] Soil Application 20 t ha<sup>-1</sup>, T<sub>8</sub>: Fresh Bio-Slurry [Dung + Urine (1:1)] Soil Application 20 t ha<sup>-1</sup> and Foliar Spray (10%) @ 15, 30 and 45 DAS, T<sub>9</sub>: Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha<sup>-1</sup> and Foliar Spray (10%) @ 15, 30 and 45 DAS.

## Results and Discussion

### Growth attributes

#### Plant height (cm)

Plant height is the main yield component especially in fodder crops and it indicates the influence of various nutrients uptake on plant metabolism and vigor. Significantly maximum plant height (49.25 cm), (146.91 cm) and (206.47 cm) were recorded in treatment T<sub>5</sub> at 20, 40 and 60 DAS. While minimum plant height (30.08 cm), (123.82 cm) and (160.09 cm) were recorded in treatment T<sub>1</sub>. However, treatment T<sub>9</sub> and T<sub>8</sub> was statistically at par with treatment T<sub>5</sub> at 20 DAS, whereas, T<sub>9</sub> and T<sub>4</sub> was found statistically at par with treatment T<sub>5</sub> at 40 and 60 DAS, respectively (Table 1 and Fig. 1).

#### Number of leaves plant<sup>-1</sup>

The observations on number of leaves plant<sup>-1</sup> was recorded significant difference between the treatments. The maximum number of leaves plant<sup>-1</sup> (8.00), (10.00) and (12.00) were recorded in treatment T<sub>5</sub> Poultry Manure (12 t

ha<sup>-1</sup>) at 20, 40 and 60 DAS. While minimum number of leaves plant<sup>-1</sup> (6.00), (8.00) and (10.00) were recorded in treatment T<sub>1</sub> (Control). However, treatment T<sub>9</sub> and T<sub>8</sub> was statistically at par with treatment T<sub>5</sub> at 20 DAS, whereas, treatment T<sub>9</sub> and T<sub>4</sub> was statistically at par with treatment T<sub>5</sub> at 40 and 60 DAS, respectively (Table 1 and Fig. 1).

### **Plant dry weight (g)**

The observations regarding plant dry weight revealed significant difference between the treatments. Highest plant dry weight (2.16 g), (17.02 g) and (28.82 g) were recorded in treatment T<sub>5</sub> Poultry Manure (12 t ha<sup>-1</sup>) at 20, 40 and 60 DAS. While, lowest plant dry weight (0.99 g), (8.48 g) and (17.84) were recorded in treatment T<sub>1</sub> (Control). However, treatment T<sub>9</sub> and T<sub>8</sub> was statistically at par with treatment T<sub>5</sub> at 20 DAS, whereas, treatment T<sub>9</sub> and T<sub>4</sub> was statistically at par with treatment T<sub>5</sub> at 40 DAS. Similarly, treatment T<sub>4</sub> and T<sub>9</sub> was statistically at par with treatment T<sub>5</sub> at 60 DAS, respectively (Table 2 and Fig. 2).

### **Leaf Area Index**

Leaf Area Index is the main yield component in fodder crops and indicates influence of various nutrients uptake on plant metabolism and vigor. Significantly highest leaf area index (1.86), (3.78) and (5.57) were recorded in treatment T<sub>5</sub> at 20, 40 and 60 DAS. While minimum leaf area index (1.59), (2.82) and (4.68) were recorded in treatment T<sub>1</sub>. However, treatment T<sub>9</sub> and T<sub>4</sub> was statistically at par with treatment T<sub>5</sub> at 20 and 40 DAS, whereas, T<sub>9</sub> and T<sub>8</sub> was statistically at par with treatment T<sub>5</sub> at 40 and 60 DAS, respectively (Table 2 and Fig. 2).

### **Crop growth rate (g m<sup>-2</sup> day<sup>-1</sup>)**

Highest CGR (0.1078) and (0.7435) were recorded in treatment T<sub>5</sub> at 0-20 and 20-40

DAS. Whereas, highest CGR (0.6196) at 40-60 DAS was recorded in treatment T<sub>3</sub>. While lowest CGR (0.0495) and (0.3745) were recorded in treatment T<sub>1</sub> at 0-20 and 20-40 DAS. Similarly lowest CGR (0.4311) was recorded in treatment T<sub>2</sub> at 40-60 DAS.

However, treatment T<sub>9</sub> and T<sub>8</sub> was statistically at par with treatment T<sub>5</sub> at 0-20 DAS, whereas treatment T<sub>9</sub> and T<sub>4</sub> was statistically at par with treatment T<sub>5</sub> at 20-40 DAS. Similarly, treatment T<sub>5</sub> and T<sub>6</sub> was statistically at par with treatment T<sub>3</sub> at 40-60 DAS, respectively (Table 3 and Fig. 3).

### **Relative growth rate (g g<sup>-1</sup> day<sup>-1</sup>)**

Highest RGR (0.0482) and (0.0170) was observed in treatment T<sub>4</sub> and T<sub>3</sub> at 20-40 and 40-60 DAS. While lowest RGR (0.0408) and (0.0099) was in treatment T<sub>3</sub> and T<sub>9</sub>. However, treatment T<sub>9</sub> and T<sub>1</sub> was statistically at par with treatment T<sub>4</sub> at 20-40 DAS, whereas treatment T<sub>1</sub> and T<sub>6</sub> was statistically at par with treatment T<sub>3</sub> at 40-60 DAS, respectively (Table 3 and Fig. 3).

### **Stalk length (cm) and Stalk girth (cm)**

The stalk length and stalk girth shown significant difference between the treatments. The highest stalk length (11.53 cm), (79.50 cm), (140.66 cm) and highest stalk girth (4.88 cm), (9.87 cm), (13.47 cm) were recorded in treatment T<sub>5</sub> at 20, 40 and 60 DAS. While lowest stalk length (8.18 cm), (46.83 cm), (84.70 cm) and lowest stalk girth (3.16 cm), (6.63 cm), (8.53 cm) were recorded in treatment T<sub>1</sub>. However, treatment T<sub>9</sub>, T<sub>4</sub>, T<sub>8</sub> and T<sub>6</sub> were statistically at par with treatment T<sub>5</sub>, respectively (Table 4 and Fig. 4).

### **Yield attributes**

The minimum number of days to 50% Tasseling was observed in treatment T<sub>5</sub> (55.66

days) followed by T<sub>9</sub> (57.33 days), T<sub>7</sub> (57.66 days) and T<sub>4</sub> (58.33 days). While maximum number of days to 50% tasseling was observed in treatment T<sub>1</sub> (65.66 days) respectively. Similarly the observations regarding yield attributes are being presented and were observed significant difference between the treatments. The maximum yield attributes viz., number of cobs plant<sup>-1</sup> (2.33), cob girth (15.52 cm), cob weight plant<sup>-1</sup> (85.35 g), cob yield per m<sup>2</sup> (3175.52 g), cob yield (31.75 t ha<sup>-1</sup>) was recorded in treatment T<sub>5</sub>. While minimum number of cobs plant<sup>-1</sup> (1.00), cob girth (10.81 cm), cob weight plant<sup>-1</sup> (45.12 g), cob yield per m<sup>2</sup> (721.86 g), cob yield (7.21 t ha<sup>-1</sup>) was recorded in treatment T<sub>1</sub>. However, treatment T<sub>4</sub> and T<sub>9</sub> was statistically at par with treatment T<sub>5</sub>, respectively (Table 5 and Fig. 5).

## Yield

Fodder maize had a significant effect on the yield with different sources of livestock and poultry waste as organic manure. The observations regarding yield attributes are being presented and were observed significant difference between the treatments. The highest green fodder yield plant<sup>-1</sup> (195.75 g), green fodder yield per m<sup>2</sup> (3132.05 g), green fodder yield (31.32 t ha<sup>-1</sup>), dry fodder yield plant<sup>-1</sup> (41.22 g), dry fodder yield per m<sup>2</sup> (659.57 g), dry fodder yield (6.60 t ha<sup>-1</sup>) was observed in treatment T<sub>5</sub>.

While lowest green fodder yield plant<sup>-1</sup> (135.81 g), green fodder yield per m<sup>2</sup> (2173.06 g), green fodder yield (21.73 t ha<sup>-1</sup>), dry fodder yield plant<sup>-1</sup> (26.52 g), dry fodder yield per m<sup>2</sup> (424.37 g), dry fodder yield (4.24 t ha<sup>-1</sup>) was recorded in treatment T<sub>1</sub>. However treatment T<sub>4</sub> and T<sub>9</sub> was statistically at par with treatment T<sub>5</sub> with respect to all yield attributes, whereas, dry fodder yield ha<sup>-1</sup> treatment T<sub>9</sub> and T<sub>8</sub> was found statistically at par with treatment T<sub>5</sub>, respectively (Table 6 and Fig. 6).

## Growth attributes

The results revealed that Plant height (cm), Number of leaves plant<sup>-1</sup>, Plant dry weight (g), Leaf Area Index, Crop growth rate (g m<sup>-2</sup> day<sup>-1</sup>), Relative growth rate (g g<sup>-1</sup> day<sup>-1</sup>), Stalk Length (cm) and Stalk girth (cm) significant difference between the treatments at different intervals. Plant height is the main yield component mainly in fodder crops and indicates the influence of various nutrients uptake on plant metabolism and vigor. Number of leaves plant<sup>-1</sup> may have helped in increasing the photosynthetic area for photosynthesis in plant. In maize plant the effect on number of leaves plant<sup>-1</sup> production at all the growth stages was significant. Estimation of leaf area is an essential component of plant growth analysis and evapo-transpirational studies. Leaf area is important for crop light interception and therefore has a large influence on growth Boote *et al.*, (1988), transpiration Enoch and Hurd (1979) and growth rate Leith *et al.*, (1986). Leaf area production is essential for energy transference and dry matter accumulation processes in crop canopies. It is also useful in the analysis of canopy architecture as it allows determination of leaf area index, which is important for light interception, radiation use efficiency, plant growth, etc. The increase in plant dry weight (g) might be due to more assimilatory surface leading to higher dry matter production coupled with effective translocation and distribution of photosynthates from source to sink.

The percentage increase in CGR and RGR may be due to prevalence of optimum temperature coupled with less humidity at the growth stage and also application of organic manures which helps in easy availability of phosphorus and might be due to synergistic action of organisms which increased the phosphorus uptake. Abubakar and Ali (2018)

reported that nitrogen influences plant height by affecting cell size, leading to rapid elongation of the internodes and consequently, the final plant height. Similarly leaves are the main photosynthetic organs of the plant, having less leaf number could result in the reduction of assimilates produced and partitioned to the grain Johnson *et al.*, 2008.

Plant leaves number in all the weeks increases irrespective of the rate of PM, CD and NPK. NPK has the highest leave number as observed in week 4 followed by PM, and CD which also explains the reason behind the significant difference in leave number among the treatments. However, plants having PM and CD showed higher biomass compared to the control of the local variety. The organic manures and chemical fertilizers which were supplied as essential nutrition at initial establishment stage recorded the best results for the measured variables like height of the plant, width of the stem, dry weight of the shoots and roots.

The results of the experiment confirm the findings of Gonzalez *et al.*, (2001). Similarly Materechera and Salagae (2002) reported higher plant height of maize could be achieved with the application of chicken and cattle manure. Poultry manures contains higher amount of essential nutrients and abruptly fulfil plant nutrients demand and also improve soil properties that can ultimately help in settling of nutrients in soil for a long period of time, highest plant height were obtained from treatment 6 having Poultry Manure and Humic Acid applied at 12.5 tons and 1 kg ha<sup>-1</sup> (Hussain *et al.*, 2018).

However, we can state here is that bio-slurry is not only rich in mineral and organic dry matter, but also rich in nutrients like N, P, K, Ca, Mg, Fe, Mn, organic matter, different amino acids and metals like copper and zinc. There seems to be a good match between soil N supply and plant N demand of liquid bio-

slurry which boosts crop vigor Oppenoorth *et al.*, (2014). Similar findings are also reported by Warnars (2012).

### **Yield attributes**

The findings of growth attributes namely; number of cobs plant<sup>-1</sup>, cob girth (cm), cob weight plant<sup>-1</sup> (g), cob yield per m<sup>2</sup> (g), cob yield (t ha<sup>-1</sup>), green fodder yield (t ha<sup>-1</sup>) and dry fodder yield (t ha<sup>-1</sup>) are being presented and were observed significant difference between the treatments at different intervals.

This might be due to genetic ability of the variety attributed to higher biomass accumulation coupled with effective translocation and distribution of photosynthates from source to sink, which in turn resulted into elevated stature of yield attributes.

The probable reason for recording higher yield under treatment with Poultry Manure (12 t ha<sup>-1</sup>), followed by Sheep Manure (12 t ha<sup>-1</sup>), and treatment with Fermented Bio-Slurry [Dung + Urine (1:1)] Soil Application 20 t ha<sup>-1</sup> and Foliar Spray (10%) @ 15, 30 and 45 DAS was statistically at par among the treatments. Badu *et al.*, (2012) reported that fodder yield is a function of genetic as well as the environmental factors, which plays a vital role in plant growth and development and ultimately contributed to fodder yield.

Statistically the maximum green forage yield (74.67 t ha<sup>-1</sup>) was observed in T<sub>2</sub> (N: P<sub>2</sub>O<sub>5</sub> 150:60 kg ha<sup>-1</sup>) while the minimum green forage yield of (38.13 t ha<sup>-1</sup>) in untreated treatment T<sub>1</sub> (control). Next to the treatment T<sub>2</sub>, T<sub>6</sub> (N: P<sub>2</sub>O<sub>5</sub> 112:45+ FYM 1000 kg ha<sup>-1</sup>) and T<sub>5</sub> (N: P<sub>2</sub>O<sub>5</sub> 112:45+ Poultry manure 750 kg ha<sup>-1</sup>) were statistically at par with each other and gave significantly higher green forage yield of 70 and 69 t ha<sup>-1</sup>, respectively compared to all other treatments.

**Table.1** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize

	Treatments	Plant height (cm) 20 DAS	Plant height (cm) 40 DAS	Plant height (cm) 60 DAS	No. of leaves plant <sup>-1</sup> 20 DAS	No. of leaves plant <sup>-1</sup> 40 DAS	No. of leaves plant <sup>-1</sup> 60 DAS
T <sub>1</sub>	Control (RDF 80:40:30 Kg NPK ha <sup>-1</sup> )	30.08	123.82	160.09	6.00	8.00	10.00
T <sub>2</sub>	FYM (16 t ha <sup>-1</sup> )	42.93	127.28	166.02	6.66	8.50	10.50
T <sub>3</sub>	Vermicompost (12 t ha <sup>-1</sup> )	43.50	135.58	175.74	7.00	8.67	10.67
T <sub>4</sub>	Sheep Manure (12 t ha <sup>-1</sup> )	45.20	141.70	187.06	7.33	9.50	11.50
T <sub>5</sub>	Poultry Manure (12 t ha <sup>-1</sup> )	49.25	146.91	206.47	8.00	10.0	12.00
T <sub>6</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	48.46	133.85	174.34	7.50	8.17	10.17
T <sub>7</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	47.36	137.72	179.81	7.16	8.50	10.50
T <sub>8</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	48.61	141.00	184.97	7.66	8.33	10.83
T <sub>9</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	48.73	142.41	193.64	7.83	9.50	11.67
<b>F-test</b>		<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
<b>C.D. (p=0.05)</b>		<b>10.00</b>	<b>5.29</b>	<b>5.28</b>	<b>0.89</b>	<b>0.58</b>	<b>0.56</b>
<b>CV (%)</b>		<b>12.87</b>	<b>2.24</b>	<b>1.69</b>	<b>7.08</b>	<b>3.80</b>	<b>2.98</b>
<b>S.Ed. (±)</b>		<b>4.72</b>	<b>2.49</b>	<b>2.49</b>	<b>0.42</b>	<b>0.27</b>	<b>0.26</b>
<b>SEm(±)</b>		<b>3.34</b>	<b>1.76</b>	<b>1.76</b>	<b>0.30</b>	<b>0.19</b>	<b>0.19</b>

Note: S (Significant), NS (Non-Significant)

**Table.2** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize

	Treatments	Plant dry weight (g) 20 DAS	Plant dry weight (g) 40 DAS	Plant dry weight (g) 60 DAS	Leaf Area Index 20 DAS	Leaf Area Index 40 DAS	Leaf Area Index 60 DAS
T <sub>1</sub>	Control (RDF 80:40:30 Kg NPK ha <sup>-1</sup> )	0.99	8.48	17.84	1.59	2.82	4.68
T <sub>2</sub>	FYM (16 t ha <sup>-1</sup> )	1.22	10.25	18.93	1.77	3.32	5.21
T <sub>3</sub>	Vermicompost (12 t ha <sup>-1</sup> )	1.58	10.38	22.78	1.78	3.34	5.39
T <sub>4</sub>	Sheep Manure (12 t ha <sup>-1</sup> )	1.62	15.01	24.54	1.81	3.59	5.45
T <sub>5</sub>	Poultry Manure (12 t ha <sup>-1</sup> )	2.16	17.02	28.82	1.86	3.78	5.57
T <sub>6</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	1.66	11.55	23.10	1.77	3.41	5.22
T <sub>7</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	1.58	12.30	23.73	1.78	3.48	5.34
T <sub>8</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	1.89	13.82	23.96	1.80	3.55	5.53
T <sub>9</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	1.90	15.33	24.26	1.84	3.82	5.56
	<b>F-test</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	<b>C.D. (p=0.05)</b>	<b>0.24</b>	<b>0.54</b>	<b>0.95</b>	<b>0.02</b>	<b>0.08</b>	<b>0.10</b>
	<b>CV (%)</b>	<b>8.65</b>	<b>2.48</b>	<b>2.39</b>	<b>1.15</b>	<b>1.28</b>	<b>1.13</b>
	<b>S.Ed. (±)</b>	<b>0.11</b>	<b>0.26</b>	<b>0.45</b>	<b>0.01</b>	<b>0.03</b>	<b>0.03</b>
	<b>SEm(±)</b>	<b>0.08</b>	<b>0.18</b>	<b>0.32</b>	<b>0.01</b>	<b>0.04</b>	<b>0.05</b>

Note: S (Significant), NS (Non-Significant)



**Table.3** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize

	Treatments	CGR (g/m <sup>2</sup> /day) 0-20 DAS	CGR (g/m <sup>2</sup> /day) 20-40 DAS	CGR (g/m <sup>2</sup> /day) 40-60 DAS	RGR (gg <sup>-1</sup> day <sup>-1</sup> ) 20-40 DAS	RGR (gg <sup>-1</sup> day <sup>-1</sup> ) 40-60 DAS
T <sub>1</sub>	Control (RDF 80:40:30 Kg NPK ha <sup>-1</sup> )	0.0495	0.3745	0.4681	0.0465	0.0162
T <sub>2</sub>	FYM (16 t ha <sup>-1</sup> )	0.0610	0.4513	0.4311	0.0461	0.0132
T <sub>3</sub>	Vermicompost (12 t ha <sup>-1</sup> )	0.0791	0.440	0.6196	0.0408	0.0170
T <sub>4</sub>	Sheep Manure (12 t ha <sup>-1</sup> )	0.0813	0.6691	0.4763	0.0482	0.0106
T <sub>5</sub>	Poultry Manure (12 t ha <sup>-1</sup> )	0.1078	0.7435	0.5898	0.0449	0.0122
T <sub>6</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	0.0795	0.4980	0.5776	0.0430	0.0150
T <sub>7</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	0.0793	0.5356	0.5713	0.0444	0.0142
T <sub>8</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	0.0943	0.5971	0.5066	0.0432	0.0119
T <sub>9</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	0.0950	0.6713	0.4463	0.0456	0.0099
	F-test	S	S	S	S	S
	C.D. (p=0.05)	0.01	0.03	0.05	0.003	0.002
	CV (%)	8.65	2.93	5.55	3.75	7.16
	S.Ed. (±)	0.01	0.01	0.02	0.001	0.001
	SEm(±)	0.01	0.01	0.02	0.001	0.001

Note: S (Significant), NS (Non-Significant)

**Table.4** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize

	Treatments	Stalk Length (cm) 20DAS	Stalk Length (cm) 40 DAS	Stalk Length (cm) 60 DAS	Stalk Girth (cm) 20 DAS	Stalk Girth (cm) 40 DAS	Stalk Girth (cm) 60 DAS
T <sub>1</sub>	Control (RDF 80:40:30 Kg NPK ha <sup>-1</sup> )	8.18	46.83	84.70	3.16	6.63	8.53
T <sub>2</sub>	FYM (16 t ha <sup>-1</sup> )	9.23	56.50	96.84	3.76	8.10	10.20
T <sub>3</sub>	Vermicompost (12 t ha <sup>-1</sup> )	9.35	60.67	102.40	3.90	8.23	10.63
T <sub>4</sub>	Sheep Manure (12 t ha <sup>-1</sup> )	9.71	68.17	115.12	4.21	9.08	12.08
T <sub>5</sub>	Poultry Manure (12 t ha <sup>-1</sup> )	11.53	79.50	140.66	4.88	9.87	13.47
T <sub>6</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	9.93	68.87	110.95	4.03	8.08	10.58
T <sub>7</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	9.46	67.17	110.85	4.13	8.37	11.07
T <sub>8</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	10.05	68.50	114.21	4.58	8.73	11.63
T <sub>9</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	10.95	75.50	128.33	4.80	9.17	12.47
	<b>F-test</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	<b>C.D. (p=0.05)</b>	<b>1.48</b>	<b>4.36</b>	<b>4.36</b>	<b>0.49</b>	<b>0.39</b>	<b>0.39</b>
	<b>CV (%)</b>	<b>8.68</b>	<b>3.84</b>	<b>2.26</b>	<b>6.77</b>	<b>2.66</b>	<b>2.02</b>
	<b>S.Ed. (±)</b>	<b>0.70</b>	<b>2.06</b>	<b>2.06</b>	<b>0.23</b>	<b>0.18</b>	<b>0.18</b>
	<b>SEm(±)</b>	<b>0.49</b>	<b>1.46</b>	<b>1.46</b>	<b>0.16</b>	<b>0.13</b>	<b>0.13</b>

Note: S (Significant), NS (Non-Significant)

**Table.5** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize

	Treatments	No. of days to (50%) Tasseling	No. of Cobs plant <sup>-1</sup>	Cob Length (cm)	Cob Girth (cm)	Cob weight plant <sup>-1</sup> (g)	Cob weight per m <sup>2</sup> (g)	Cob weight (t ha <sup>-1</sup> )
T <sub>1</sub>	Control (RDF 80:40:30 Kg NPK ha <sup>-1</sup> )	65.66	1.00	15.31	10.81	45.12	721.86	7.21
T <sub>2</sub>	FYM (16 t ha <sup>-1</sup> )	64.00	1.33	15.53	12.55	48.28	1030.45	10.29
T <sub>3</sub>	Vermicompost (12 t ha <sup>-1</sup> )	61.33	1.50	15.44	13.43	55.30	1327.2	13.27
T <sub>4</sub>	Sheep Manure (12 t ha <sup>-1</sup> )	58.33	2.17	15.55	14.98	74.62	2583.70	25.83
T <sub>5</sub>	Poultry Manure (12 t ha <sup>-1</sup> )	55.66	2.33	16.35	15.52	85.35	3175.52	31.89
T <sub>6</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	63.33	1.67	15.83	13.74	57.14	1518.48	15.18
T <sub>7</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	57.66	1.67	15.50	14.00	62.50	1666.40	16.65
T <sub>8</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	60.00	1.83	15.40	14.07	65.43	1919.73	19.19
T <sub>9</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	57.33	2.17	15.72	14.81	71.81	2489.09	24.88
F-test		S	S	NS	S	S	S	S
C.D. (p=0.05)		1.97	0.39	0.70	0.69	3.52	374.18	3.74
CV (%)		1.89	12.96	2.57	2.91	3.24	11.84	11.85
S.Ed. (±)		0.93	0.18	0.33	0.33	1.66	176.51	1.77
SEm(±)		0.66	0.13	0.23	0.23	1.17	124.81	1.25

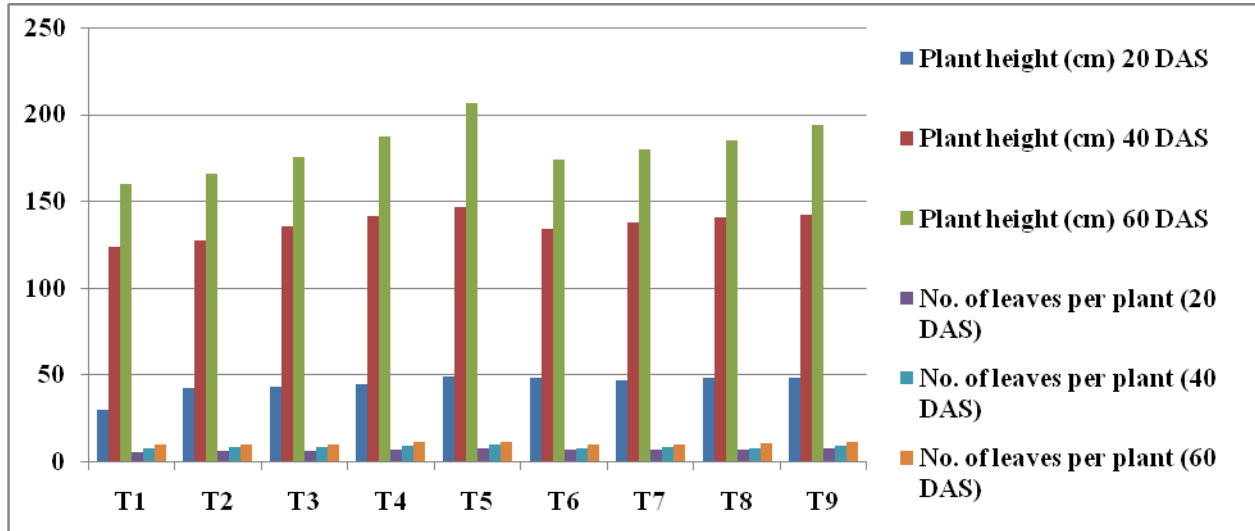
Note: S (Significant), NS (Non-Significant)

**Table.6** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize

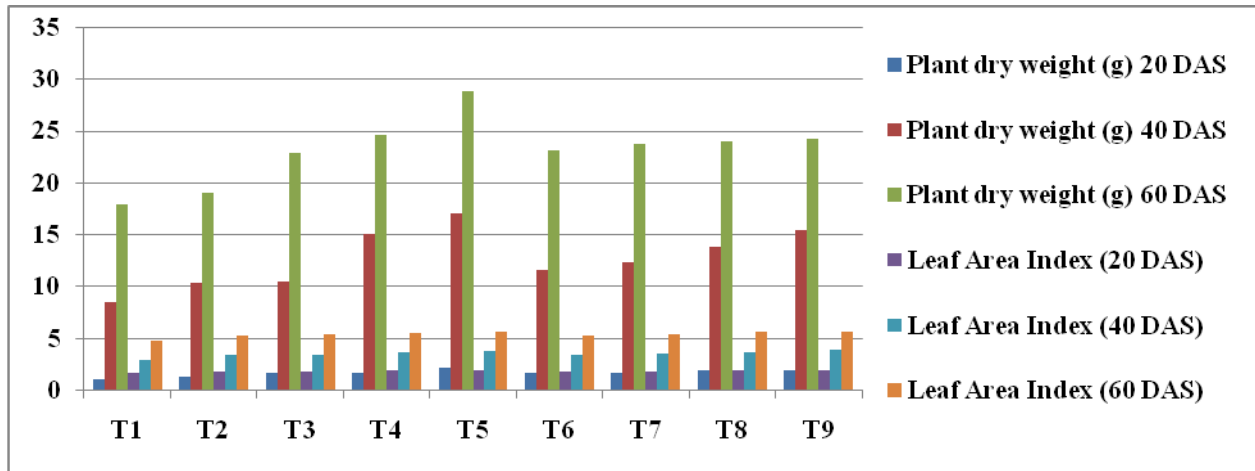
	Treatments	Green Fodder Yield Plant <sup>-1</sup> (g)	Green Fodder Yield Per m <sup>2</sup> (g)	Green Fodder Yield (t ha <sup>-1</sup> )	Dry Fodder Yield Plant <sup>-1</sup> (g)	Dry Fodder Yield Per m <sup>2</sup> (g)	Dry Fodder Yield (t ha <sup>-1</sup> )
T <sub>1</sub>	Control (RDF 80:40:30 Kg NPK ha <sup>-1</sup> )	135.81	2173.06	21.730	26.52	424.37	4.24
T <sub>2</sub>	FYM (16 t ha <sup>-1</sup> )	147.17	2354.72	23.547	27.85	445.70	4.46
T <sub>3</sub>	Vermicompost (12 t ha <sup>-1</sup> )	147.92	2366.77	23.677	32.14	514.24	5.14
T <sub>4</sub>	Sheep Manure (12 t ha <sup>-1</sup> )	165.07	2641.06	26.410	36.22	581.44	5.18
T <sub>5</sub>	Poultry Manure (12 t ha <sup>-1</sup> )	195.75	3132.05	31.320	41.22	659.57	6.60
T <sub>6</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	148.37	2373.97	23.739	32.63	522.08	5.22
T <sub>7</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup>	151.59	2425.49	24.254	33.44	535.04	5.35
T <sub>8</sub>	Fresh Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	155.17	2482.77	24.827	35.38	566.18	5.66
T <sub>9</sub>	Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha <sup>-1</sup> and Foliar Spray (10%) @ 15, 30 & 45 DAS	162.17	2594.72	25.947	35.80	572.90	5.73
	<b>F-test</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>	<b>S</b>
	<b>C.D. (p=0.05)</b>	<b>15.08</b>	<b>241.22</b>	<b>2.41</b>	<b>0.89</b>	<b>14.29</b>	<b>0.14</b>
	<b>CV (%)</b>	<b>5.56</b>	<b>5.56</b>	<b>5.56</b>	<b>1.54</b>	<b>1.54</b>	<b>1.54</b>
	<b>S.Ed. (±)</b>	<b>7.11</b>	<b>113.79</b>	<b>1.14</b>	<b>0.42</b>	<b>6.74</b>	<b>0.07</b>
	<b>SEm(±)</b>	<b>5.03</b>	<b>80.46</b>	<b>0.80</b>	<b>0.30</b>	<b>4.77</b>	<b>0.05</b>

Note: S (Significant), NS (Non-Significant)

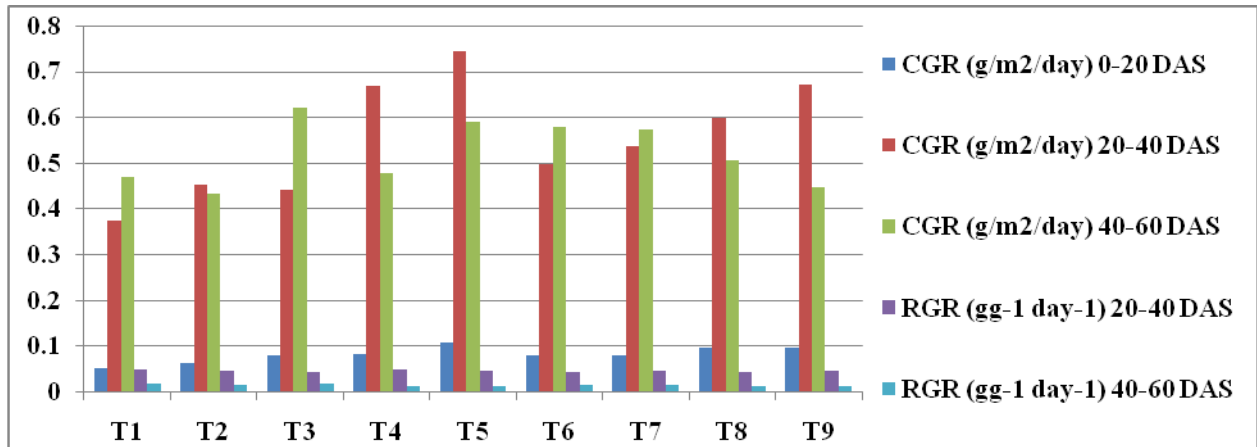
**Fig.1** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize



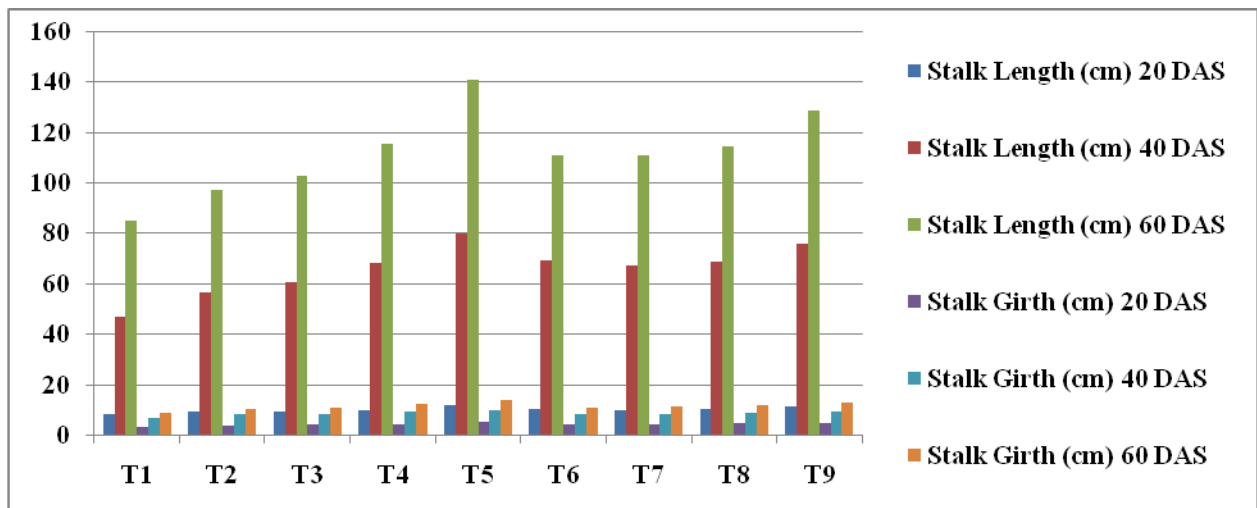
**Fig.2** Performance of different sources of livestock and poultry waste as organic manures on growth and yield of fodder maize



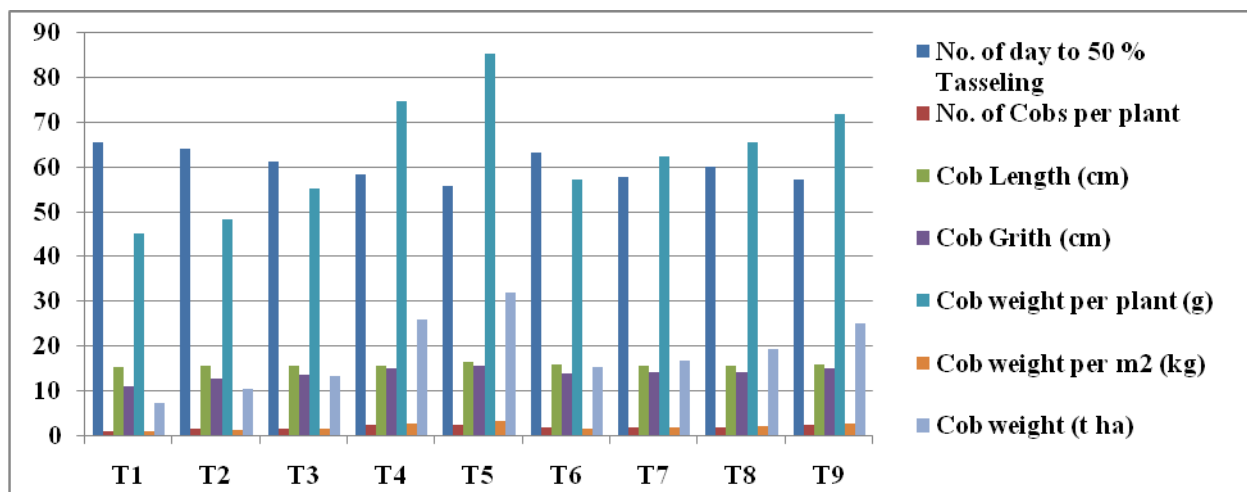
**Fig.3** Performance of Different Sources of Livestock and Poultry Waste as Organic Manures on Growth and Yield of Fodder Maize



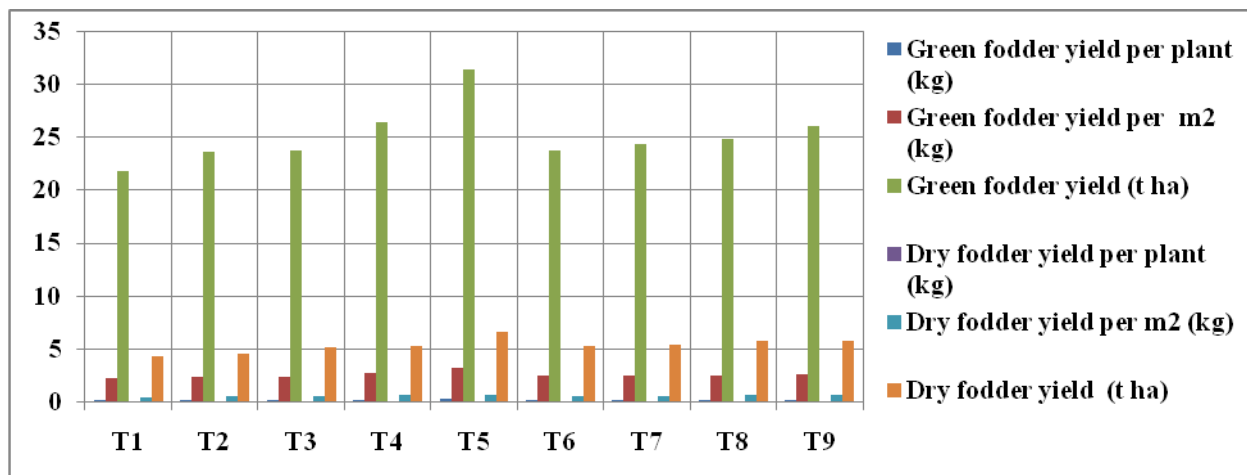
**Fig.4** Performance of Different Sources of Livestock and Poultry Waste as Organic Manures on Growth and Yield of Fodder Maize



**Fig.5** Performance of Different Sources of Livestock and Poultry Waste as Organic Manures on Growth and Yield of Fodder Maize



**Fig.6** Performance of Different Sources of Livestock and Poultry Waste as Organic Manures on Growth and Yield of Fodder Maize



The green forage yield of other treatments was intermediated. These results are quite in line with the Ayub *et al.*, (2002), who reported that Nitrogen and Phosphorus produced significantly higher fodder yield of maize than control. Devi 2002 also reported that fodder maize variety “African Tall” produced significantly higher green fodder yield at

higher dose of nitrogen while bio fertilizers produced lower yield.

Green fodder yield increased significantly upto 120 kg N ha<sup>-1</sup>. In contrast with Reiad *et al.*, (1992) and Lakoo *et al.*, (2004) the organic manures and inorganic fertilizer increases the maize fodder yield. The reason

behind the higher yield attributes recorded might be also due to higher availability of NPK which was directly related to the vegetative and reproductive phases of the crop and attributes complex phenomenon of phosphorus utilization in plant metabolism. It also helped in the efficient absorption and utilization of the other required plant nutrients which ultimately increased the yield Girma *et al.*, (2006) and Parvez *et al.*, (2009). Similar findings are reported by Singh and Khan 2003. Statistically the maximum crude fibre (37.00%) was observed in T<sub>2</sub> (N: P<sub>2</sub>O<sub>5</sub> 150:60 kg ha<sup>-1</sup>) followed by T<sub>3</sub> (FYM 4000 kg ha<sup>-1</sup>), T<sub>4</sub> (PM 3000 kg ha<sup>-1</sup>), T<sub>5</sub> (N:P<sub>2</sub>O<sub>5</sub> 112:45+ PM 750 kg ha<sup>-1</sup>) and T<sub>6</sub> (N: P<sub>2</sub>O<sub>5</sub> 112:45+ FYM 1000 kg ha<sup>-1</sup>) produced crude fibre% of 34.83, 34.83, 35.24 and 35.2, respectively and were statistically same with each other Ahmad *et al.*, (2011). The similar findings are confirmed by Rafiq *et al.*, (1996) who checked the effect of nitrogen application on growth, green fodder yield and quality of maize cv. Neelum. Similarly, Safdar (1997) also reported that green fodder yield; protein, fiber and total ash contents were increased with nitrogen rates in maize and in the same way Tariq (1998) also reported that in fodder maize, by increasing nitrogen levels; crude protein, crude fiber and ash contents were increased. Maria *et al.*, 2014 the bio-slurry contains higher amount of phosphorus, potassium, zinc, iron, manganese and copper, which is limited factor in many soils. Bio-slurry with the dose of 10 to 20 tons ha<sup>-1</sup> in irrigated areas and 5 to 10 tons ha<sup>-1</sup> in rainfed crops can show significant increase in yields. Indeed, bio-slurry increases crop revenues by 25% on average. Similarly, Gurung 1997 reported that bio-slurry also contains higher amount of nutrients like NPK and micro nutrients along with beneficial microorganism, which helps in conversion of non-available form to available form. He also reported that application of biogas slurry @ of 10 t ha<sup>-1</sup> in potato, tomato, brinjal, groundnut, jowar,

maize, and okra gave better yields than FYM. Sarkar *et al.*, (2017) the highest grain yield (8882.3 kg ha<sup>-1</sup>) was obtained in the treatment (4 ton Co-digested Bio-Slurry +75 kg N+60 kg p ha<sup>-1</sup>) and the lowest grain yield (2643.5 kg ha<sup>-1</sup>) was recorded in the control. Four ton Co-digested Bio-Slurry added with 75 kg N + 60 kg p ha<sup>-1</sup> was found to be the most profitable and cost effective treatment combination.

It could be concluded that by using Poultry Manure (12 t ha<sup>-1</sup>) followed by Sheep Manure (12 t ha<sup>-1</sup>) higher yield can be obtained as compared to control (RDF). Whereas, Fermented Bio-Slurry {Dung + Urine (1:1)} Soil Application 20 t ha<sup>-1</sup> and Foliar Spray (10%) @ 15, 30 and 45 DAS was significantly at par for obtaining higher yield attributes namely; number of cobs plant<sup>-1</sup>, cob girth (cm), cob weight plant<sup>-1</sup>, cob yield (t ha<sup>-1</sup>), green fodder yield (t ha<sup>-1</sup>) and dry fodder yield (t ha<sup>-1</sup>). Most of our farmers are involved in animal husbandry activities; fodder based enterprises could be a sustainable for income generation.

Greater attention may be paid towards increasing the net returns per unit area by reducing the input cost on chemical fertilizers by replacing them with organic manures and livestock waste utilization in fodder production, which plays a promising approach towards doubling the farm income of small and marginal farmers. Since the findings are based on the research done in one season, for further validation multi-location trial could be carried out.

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