EFFECT OF INTEGRATED USE OF ORGANIC AND INORGANIC FERTILIZERS ON FODDER YIELD OF SORGHUM (SORGHUM BICOLOR L.)

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A field study was conducted to determine the effect of different rates of organic and inorganic fertilizers on fodder yield of sorghum at Postgraduate Agricultural Research Station (PARS), University of Agriculture, Faisalabad, Pakistan during 2005. Various fertilizer applications involving synthetic and organic fertilizers alone and in variable combinations were evaluated. Significant effect of these treatments was indicated for germination count m^{-2}, plant height, number of plants m^{-2} at harvest, number of leaves $plant^{-1}$, leaf area $plant^{-1}$ and green fodder yield. The maximum green fodder yield (16 t ha^{-1}) was recorded in the treatment where inorganic fertilizer (NP) were applied @ 75:60 kg ha^{-1} while the minimum green fodder yield (20.9 t ha^{-1}) was observed in the control treatment. It was suggested that the use of recommended dose of inorganic fertilizers (N:P @ of 75:60 kg ha^{-1}) proved to be best than all other treatments. However the combination of inorganic fertilizers and organic manures i.e. (50% NP +50% poultry manures kg ha^{-1}) can be utilized for exploiting the yield potential of sorghum cultivar JS 88 under given set of conditions. It was concluded that although green fodder yield was increased with the application of inorganic fertilizers, however, green fodder yield obtained with a combination of inorganic fertilizers and organic sources, was as good as with inorganic fertilizers alone. Continuous use of FYM with inorganic fertilizers not only increases the availability of nutrients but also improves soil fertility and ultimately enhances fodder production. Thus, integrated use of inorganic fertilizers and organic sources has been suggested to exploit the yields of fodder sorghum 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.
Keywords: Fodder yield, sorghum, organic manure, inorganic fertilizer

INTRODUCTION

Sorghum (*Sorghum bicolor* L.) is predominantly a crop of rain fed areas of Pakistan and is grown both for fodder and grain purpose. With the introduction of early maturing and high yielding hybrids, the crop has gained importance in the irrigated areas as well. It has potential of adoption to adverse climatic conditions. However, it is inferior in quality due to low protein contents and presence of hydrocyanic acid (Hingra *et al*, 1995), but still it is relished by animals due to succulence and palatability. Thus, improvement if sorghum fodder yield is required.

The crops need to be supplemented with synthetic fertilizers added with organic fertilizers to enhance agricultural productivity. According to Patel *et al*. (1994) dry matter yield was increased with increased nitrogen application from 40 to 120 kg ha^{-1}. However, they observed that crude fibre contents were decreased with increasing nitrogen rate.

The interest in the use of organic fertilizers is increasing due to polluting effects of chemical fertilizers in the aerial and soil environment and gradual decline in the soil fertility. Thus, continuous use of synthetic fertilizers may deteriorate soil health affecting plants, human and cattle. Most of the nitrogenous fertilizers leach down to the root zone or pollute the groundwater causing certain diseases in plants and human being.

The use of agrochemicals causes the degradation of cultivable land and increasing agricultural pollution, hence creating the unhealthy situation. In order to balance this situation organic farming might be practice in which instead of using of chemicals, natural resources such as organic matters, minerals and microbes are used. Organic farming system relies on large- scale application of animal wastes, farm yard manure (FYM), poultry manure (PM), compost, crop residues and green manuring, etc. which are best substitute of harmful chemicals.

The organic farming systems is benefited over inorganic systems, because the long term use of the combined application of organic and inorganic fertilizers not only increase the soil fertility through increase in nitrogen availability in soil and nitrogen uptake by plants but also have an improvement in yield of grain as well as fodder crops.

The recycling and the use of nutrients from organic manure have been given more consideration for insuring sustainable land use in agricultural production development. The long term effects of the combined application of organic and inorganic fertilizers in improving soil fertility and crop yield have been demonstrated by many workers (Xie *et al*., 1987; Chen *et al*., 1988). Recently, Wang *et al*.,(2001) reported that organic and inorganic fertilizers showed great benefits not only for the increase in the N uptake by the plant but also the improvement of the fodder yield. Materechera and Salagae (2002) used partially decomposed cattle and chicken manure amended with wood ash and reported that higher plant yield of fodder maize was obtained by the use of chicken manure. Variable response of cultivars to fertilizer applications has also been reported (Chandravanshi *et al*., 1973). Mohammad and Hassan (1994) reported that sorghum CSH 6 and CSH 9 responded better to applied nitrogen than CSH 14 and SPV 946.

In Pakistan little information is available on the interactive effect of organic and inorganic fertilizers on the growth and yield of sorghum fodder. The present study was planned to evaluate the integrated effect of organic and inorganic fertilizers on the fodder yield of sorghum.

MATERIALS AND METHODS

The experiment conducted at Postgraduate Agricultural Research Station (PARS), University of Agriculture, Faisalabad, Pakistan, was laid out in a Randomized Complete Block Design with three replications. The treatments included were T_0=control (no fertilizer or manure), T_1=NP @ 75:60 kg ha^{-1} (recommended dose), T_2= FYM @ 2820 kg ha^{-1}, T_3 = PM @ 2344 kg ha^{-1}, T_4 = 50% NP + 50% FYM, T_5=50% NP + 50% PM, T_6 = 50% PM + 50% FYM, T_7=75% NP + 75% PM + 75% FYM.

Table 1. Analysis of variance of different plant parameters of sorghum as affected by integrated use of organic and inorganic fertilizers (Mean squares)

SOV	df	Germination count m^{-2}	Plants m^{-2} at harvest	Plant height (cm)	No. of leaves plant^{-1}	Leaf area (cm^2)	Green fodder yield (t ha^{-1})
Replication	2	1.50	6.54	1.29	0.67	224.67	5.47
Treatments	7	0.47	373.47**	669.71**	1.80*	10008.47**	258.95*
Error	14	0.59	15.54	27.48	1.29	118.76	0.13

* P ≤ 0.01
** P ≤ 0.05

Sorghum (cv. JS 88) was sown using single row hand drill on well prepared seed bed @ 75 kg ha^{-1} in 30 cm apart rows on 13th August ,2005. Full dose of well rottened FYM and poultry manure (PM) were added three weeks before sowing according to the specified treatments and thoroughly mixed in the soil. The quantity of FYM and PM to be added was calculated according to Rashid and Memon (2001). Full dose of phosphate (P) and half dose of nitrogen (N) were added in the soil as urea and diammonium phosphate in the respective plots before sowing and remaining half dose of N was applied with first irrigation. All other agronomic practices were kept normal and uniform. The data on various growth and plant traits viz., germination count m^{-2}, plant height, number of plants m^{-2} at harvest, number of leaves plant^{-1}, leaf area plant^{-1} and green fodder yield were recorded. The data collected were analyzed statistically according to Steel and Torrie, (1984). LSD test was employed to sort out significant differences among treatment means.

RESULTS AND DISCUSSION

Germination count (m^{-2})

Optimum emergence is a key factor for obtaining higher yield in fodder. The results (Table 1) indicated a non-significant effect of fertilizer application treatments on the emergence of the crop plants. Table 2 indicated that it varied from 80.33 to 81.67 m^{-2}. The results suggested that the factors like soil moisture and environment required for seed germination were similar throughout the field and thus, crop response was similar in all the treatments. These results were quite in line with Theodora *et al.* (2003) who concluded that application of farmyard manure did not affected germination. Similarly, Loecke *et al.* (2004) also conducted that plant emergence was not affected by manure treatments.

Number of plants (m^{-2}) at harvest

The yield of a crop is mainly a function of the stand density per unit area at harvest. It was revealed (Table 1) that the final plant population was affected significantly by different fertilizer application treatments. Significantly the maximum (72.00 m^{-2}) plant population of fodder sorghum at harvest was observed where inorganic fertilizer source of NP at the rate of 75:60 kg ha^{-1} was applied than rest of the treatments (Table 2), followed by T_4 treatment (50% NP + 50% FM) with a plant population of 62.67 m^{-2}. The minimum (36.00 m^{-2}) plant population at harvest was recorded in control where no fertilizer was applied, however, it was statistically at par with T_7 treatment where inorganic fertilizers were applied with organic manure. These results are in contrast with Siddique *et al.* (1980), who reported that number of plants m^{-2} at harvest was not influenced by N rates. These contradictory results might be obtained due to variation in fertility status of the soil, climatic conditions and variation in response of cultivar to fertilizer application.

Table 2. Mean values of different parameters as influenced by integrated use of organic and inorganic fertilizers

Treatments	Germination count m^{-2}	Plants m^{-2} at harvest	Plant height (cm)	No. of leaves $plant^{-1}$	Leaf area (cm^2)	Green fodder yield (t ha^{-1})
T_0 (Control; no fertilizer)	80.33	30.00 d	131.3 e	7.00 b	325.0 d	20.90 g
T_1 (NP @ 75:60 kg ha^{-1})	81.67	72.00a	175.7 a	13.33 a	380.7a	46.00 a
T_2 (FYM @ 2820 kg ha^{-1})	81.33	53.00c	139.0 de	7.667 b	338.7 cd	25.33 f
T_3 (PM @ 2344 kg ha^{-1})	81.00	54.00c	144.7 d	8.00 b	334.3 bcd	26.47 e
T_4 (50% NP + 50 % FYM)	81.33	62.67b	164.7 b	9.667 b	361.0 b	42.00 c
T_5 (50% NP + 50% PM)	81.00	57.33c	165.3 b	10.33 ab	349.3 bc	43.00 b
T_6 (50 % FYM + 50 % PM)	81.33	54.33c	148.0 cd	9.00 b	333.7 cd	31.20 d
T_7 (75 %NP + 75% FYM + 75 % PM)	81.00	42.33d	154.0 c	7.00 b	329.7 d	31.10 d
LSD	1.35	6.91	9.18	1.99	19.09	0.63

Plant height

Plant height plays an important role in the final yield of fodder crops. Mean values (Table 2) regarding plant height indicated that both organic and inorganic fertilizers affect the plant height significantly. All the treatments fertilized with organic and inorganic fertilizers produced significantly taller plants as compared to control. The T_1 treatment (receiving NP @ 75:60 kg ha^{-1}) produced the tallest plants (175.7 cm) followed by T_5 and T_4 treatments which produced the plants with a height of 165.3 and 164.7 cm, respectively, being statistically at par with each other. In these treatments organic and inorganic fertilizer sources were used @ 50% NP + 50% PM and 50% NP + 50% FYM, respectively. The minimum (131.3

cm) plant height was observed in control. The results indicated that increased nitrogen application has pronounced effect in increasing vegetative growth of crop pants. Significant increase in plant height with nitrogenous fertilizers has also been observed in maize by Desai and Dore (1980), Bajwa *et al.* (1983), Abbas and Al-Younis (1980) Abdel-Gawad (1983), Safdar (1997) and Ahmad (1999).

Number of leaves plant^{-1}

An increase or decrease in number of leaves plant^{-1} has a direct bearing effect on the yield of fodder crops. Data (Table 1) indicated significant differences among the treatments for number of leaves plant^{-1}. Maximum (13.33) number of leaves plant^{-1} was recorded in T_1 treatment where NP dose @ 75:60 kg ha^{-1} was applied (Table 2). However, it was statistically at par with the treatment T_5 (50% NP + 50% PM) but statistically superior from the rest of the treatments. In contrast, the minimum (7.00) number of leaves plant^{-1} was recorded in control and in T_7. The increase in number of leaves plant^{-1} in T_1 might be due to readily available nutrients and favorable conditions during the growth period of the crop. An increase in number of leaves plant^{-1} with fertilizer application has also been reported by Ragheb *et al.* (1987).

Leaf area plant^{-1} (cm^2)

Leaf area is a measure of size of assimilatory system of plant and is a product of leaf length and breath. Although it is considered to be mainly concerned with the accumulation and partitioning of photosynthates to the economic parts of the plant but it plays an important role in the production of green fodder yield in fodder crops. Leaves also have a high nutritional value than stems. A perusal of Table 2 displayed that T_1 treatment (NP @ of 75:60 kg ha^{-1}) produced the highest (380 cm^2) leaf area plant^{-1} while the minimum (325 cm^2) leaf area plant^{-1} was observed in the treatment T_0 treatment (control), however, it was statistically at par with those of T_3, T_2 and T_7 where organic manure alone or in combination with organic fertilizer was applied. The decrease in leaf area plant^{-1} in the treatments where organic manure was used as a source of fertilizer alone or in combination with inorganic fertilizer might be due to slow availability of nutrient from organic manures during the growth and development of plants. These results are confirmed by the findings of Ayube *et al.* (1999) who reported that application of N fertilizer significantly increased the leaf area plant^{-1} of maize fodder.

Green fodder yield (t ha^{-1})

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). All the treatments differed significantly from one another except T_7 and T_8 which were statistically at par with each other (Table 2). The treatment receiving inorganic fertilizer at the rate of 75:60 kg ha^{-1} produced significantly higher green fodder yield (46 t ha^{-1}) than the rest of the treatments followed by treatment T_5 (43 t ha^{-1}) which received 50% NP and 50% PM. The minimum (20.90 t ha^{-1}) green fodder yield was recorded in control. The increase in yield with organic and inorganic application was probably due to the higher number of leaves plant^{-1}, plant height and leaf area plant^{-1}. Results are in agreement with Matkevish (1984), Kanwar *et al.*, (1992) and Ali (2000) who also reported significant effect of nitrogen application on green fodder yield of sorghum.

CONCLUSION

It was concluded that although green fodder yield was increased with the application of inorganic fertilizers (recommended dose), however, green fodder yield obtained with a combination of inorganic fertilizers and organic sources especially with PM, was as good as with inorganic fertilizers alone. Continuous use of FYM with inorganic fertilizers not only increases the availability of nutrients but also improves soil fertility

and ultimately enhances fodder production. Thus, integrated use of inorganic fertilizers and organic sources has been suggested to exploit the yields of fodder sorghum 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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