

IMPACT OF ORGANIC AND INORGANIC SOURCES OF NITROGEN AND PHOSPHORUS FERTILIZERS ON GROWTH, YIELD AND QUALITY OF FORAGE OAT (*AVENA SATIVA* L.)

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ABSTRACT. A field trial was carried out to examine the comparative efficacy of organic and inorganic sources of nitrogen and phosphorous fertilizers alone and in different combinations to find the yield and quality contributing factors of oat (*Avena sativa* L.) during 2008-09 at Agronomic Research Area, University of Agriculture Faisalabad. The treatments were tested under randomized complete block design using three replications. Significant result were found in respect of plant height (146.3 cm), number of leaves per plant (6.87), number of tillers per plant (8.02), number of tillers m⁻² (336), leaf area per plant (128 cm²), fresh weight per tiller (30.10g), dry weight per tiller (5.01g) and green fodder yield (74.67 t ha⁻¹) in contrast to organic manures and its combination with inorganic fertilizer (inorganic sources of manures). From the present study it can be concluded to meet the needs of fodder; it is better to use inorganic sources that are more effective and quick in response while organic sources are more environmental friendly than inorganic sources.

Key words: Oat; Organic; Inorganic; Fertilizer; Manure.

INTRODUCTION

Oat (*Avena sativa* L.) is one of the important cereal forages grown in winter throughout the Pakistan. It is adapted to a wide range of soil types, altitude and rainfall conditions. It can tolerate waterlogged conditions better than most of others cereals (Alemayehu, 1997). Fodder production in Pakistan is approximately 52-54 percent less than actual requirement (Bhatti, 1992). This unsatisfactory crop yield is due to many constrains, among those appropriate nutrient supply is the most important (Oad *et al.*, 2004). Organic sources like farm yard manure (FYM), poultry manure (PM), green manuring and compost etc not supply

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the organic matters but also increase the fertility status of soil (Chang *et al.*, 1991; Brady, 1996; Chung *et al.*, 2000; Keupper and Gegner, 2004). Manures not only supply the important nutrients but also improve physical and chemical properties of the soil (Sharpley *et al.*, 2004). Chemical fertilizers being crucial input for improving soil fertility have become an integral part of modern technology for crop production. There is no complete substitute of chemicals fertilizers (NFDC, 1997). The integration of organic and inorganic sources of nutrients not only supplied essential nutrients but also some positive interaction with chemical fertilizers to increase their efficiency and there by reduce environment hazards (Ahmad *et al.*, 1996). For consistent cropping combined use of FYM and inorganic fertilizers is helpful (The World Bank, 1999). Keeping in view the above fact and for further confirmation, the study was executed to evaluate the impact of organic and inorganic sources of fertilizers on growth, yield and quality of oat fodder under Faisalabad conditions.

MATERIALS AND METHODS

The study to estimate the effect of organic and inorganic sources of fertilizer on growth and yield of forage oat was carried out at the agronomic research area, University of Agriculture, Faisalabad. The experiment was laid out in 1.8 m x 3.0 m plot size with three replicates under Randomized Complete Block Design. Soil samples were taken

before sowing of crop at a depth of 30 cm for physio-chemical analysis. Physiochemical characteristics showed that soil of the area was loamy having pH 7.8, total nitrogen contents 0.033 mg kg⁻¹, available phosphorous 8.8 mg kg⁻¹, available potassium 285 ppm and organic matter 0.65%.

The treatments were comprised of control (T₁), N: P₂O₅ 150:60 kg ha⁻¹ (T₂), farm yard manure 4000 kg ha⁻¹ (T₃), poultry manure 3000 kg ha⁻¹ (T₄), N: P₂O₅ 112:45+ poultry manure 750 kg ha⁻¹ (T₅), N: P₂O₅ 112:45+ farm yard manure 1000 kg ha⁻¹ (T₆), N: P₂O₅ 37.5:15+ poultry manure 2250 kg ha⁻¹ (T₇), N: P₂O₅ 37.5:15+ farm yard manure 3000 kg ha⁻¹ (T₈). Oat variety, Oat-2000 was sown at 20 cm apart rows with single row hand drill 60 kg of seed ha⁻¹. Full dose of well rotted FYM and poultry manure were added three weeks before sowing and thoroughly mixed in the field. Full dose of phosphorus and half dose of nitrogen were added as urea and diammonium phosphate accordingly in respective plots before sowing and the remaining half nitrogen at the time of first irrigation. All other agronomic practices were kept normal and uniform for all the treatments.

The data on growth yield and quality parameters was recorded by adopting standard procedure. The data collected was analyzed by using Fisher's analysis of variance technique. Individual comparison of treatments' means will be made by using least significant difference (LSD) test at 5 % probability level (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Germination count (m⁻²). Data regarding germination count m⁻² of oat are presented in *Table 1* revealed that the germination count was not

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influenced by the application of different organic and inorganic sources of fertilizers. The means for germination count m^{-2} was in the range of 190 to 196. These results are quite in line with Theodora *et al.* (2003) who concluded that application of farmyard manure had no effect on seed germination. Similarly Loecke *et al.* (2004) and Harris (1996) also endorsed that adding manure did not affect seedling emergence, but resulted in enhanced growth.

Number of tillers per plant greatly contributes towards fodder yield. Significant effects of fertilizers were recorded on number of tillers per plant presented in *Table 1*. Maximum number of tillers per plant (8.02) was observed in T_2 where nitrogen and phosphorous was applied 150 and 60 $kg\ ha^{-1}$ followed by T_5 (N: P_2O_5 112:45+ Poultry manure 750 $kg\ ha^{-1}$) and T_6 (N: P_2O_5 112:45+ Farm yard manure 1000 $kg\ ha^{-1}$) having 7.89 and 7.53 respectively which were statistically at par with T_2 treatment. While the minimum number of tillers 5.94 were observed in T_1 where no fertilizers were applied. These results coincides with the findings of Hasan and Shah (2000) who concluded that increase in nitrogen levels increased the number of tillers per plant in oat (*Avena sativa* L). While Chellamuthu *et al.* (2000) reported that combined application of biofertilizers together with N and P fertilizers increased number of tillers per plant in bajra-napier hybrid grass.

Number of tillers per m^2 is one of the important yield contributing factors which was significantly affected by the application of different fertilizer sources as shown in *Table 1*. Nitrogen and phosphorous applied 150: 60 $kg\ ha^{-1}$ (T_2) produced maximum number of tillers 338 than others. Combination of inorganic N and P sources with poultry and farm yard manure (T_5 and T_6) recorded significantly less number of tillers m^{-2} (320) than T_2 (338), however, have higher number of tillers m^{-2} compared to rest of treatments. These results are in contrast with the findings of Sasireka *et al.* (1998) who reported that organic and in organic manures increased the number of tillers in bajra-napier. Similarly Jayanthi *et al.* (2002) also revealed that the application of combined source of organic and inorganic fertilizers recorded higher number of tillers m^{-2} in oat.

Plant height (cm). The results regarding plant height as presented in *Table 1* showed significant affect of organic and inorganic fertilizer application. Maximum plant height 146.3 cm was observed in T_2 (N: P_2O_5 150:60 $kg\ ha^{-1}$) followed by T_5 (N: P_2O_5 112:45+ Poultry manure 750 $kg\ ha^{-1}$) and T_6 (N: P_2O_5 112:45+ Farm yard manure 1000 $kg\ ha^{-1}$) where 141.7 and 140 cm plant height was recorded respectively. While in case of control T_1 (no fertilizer), showed minimum plant height of 116.6 cm.

Table 1 - Impact of organic and inorganic sources of nitrogen and phosphorus fertilizers on germination count, No. of tillers per plant, No. of tillers m⁻², plant height, No. of leaves per plant and leaf area per plant of forage oat (*Avena sativa* L.)

Treatment	Germination count (m ⁻²)	No. of tillers per plant	No. of tillers per m ²	Plant Height (cm)	No. of leaves per plant	Leaf area per plant (cm ²)
T ₁ = Control (no fertilizer)	189.83	5.94 e	277 e	116.6 e	4.83 g	105.2 f
T ₂ = N: P ₂ O ₅ - 150:60 kg ha ⁻¹	195.47	8.02 a	338 a	146.3 a	6.87 a	128.0 a
T ₃ = Farm yard manure - 4000 kg ha ⁻¹	192.64	6.35 de	290 d	122.4 d	5.80 cd	109.8 de
T ₄ = Poultry manure - 3000 kg ha ⁻¹	190.70	6.50 cd	294 d	120.2 de	5.47 de	107.2 ef
T ₅ = N: P ₂ O ₅ -112:45+ Poultry manure @ 750 kg ha ⁻¹	193.30	7.89 a	320 b	141.7 b	6.27 b	123.7 b
T ₆ = N: P ₂ O ₅ - 112:45+ Farm yard manure - 1000 kg ha ⁻¹	190.23	7.53 ab	317 b	140.0 b	6.00 bc	116.6 c
T ₇ = N: P ₂ O ₅ - 37.5:15+ Poultry manure - 2250 kg ha ⁻¹	191.86	7.03 bc	308 c	132.0 c	5.23 ef	113.5 cd
T ₈ = N: P ₂ O ₅ - 37.5:15+ Farm yard manure - 3000 kg ha ⁻¹	194.69	6.87 cd	306 c	131.4 c	5.00 fg	114.7 c
F-value	1.84^{NS}	17.08**	279.36**	68.33**	36.76**	35.40**
LSD value	--	0.5482	2.892	3.997	0.3414	4.009

Means sharing same letter are non-significant at 5% level of probability.

NS = non-significant, ** = highly significant

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Table 2 - Impact of organic and inorganic sources of nitrogen and phosphorus fertilizers on fresh weight per tiller, dry weight per tiller, green fodder yield, crude protein, crude fiber and total ash of forage oat (*Avena sativa* L.)

Treatment	Fresh weight per tiller (g)	Dry weight per tiller (g)	Green fodder yield (t ha ⁻¹)	Crude protein (%)	Crude fiber (%)	Total ash (%)
T ₁ = Control (no fertilizer)	17.87 g	2.98 f	38.13 e	7.86 d	30.10 c	10.17 d
T ₂ = N: P ₂ O ₅ - 150:60 kg ha ⁻¹	30.10 a	5.01 a	74.67 a	10.76 a	37.00 a	15.14 a
T ₃ = Farm yard manure - 4000 kg ha ⁻¹	24.33 d	4.05 cd	61.03 c	8.93 c	34.83 ab	11.07 d
T ₄ = Poultry manure - 3000 kg ha ⁻¹	23.33 e	3.89 d	63.47 c	8.90 c	34.83 ab	11.13 d
T ₅ = N: P ₂ O ₅ - 112:45+ Poultry manure - 750 kg ha ⁻¹	27.30 b	4.55 b	69.00 b	9.84 b	35.24 ab	13.67 b
T ₆ = N: P ₂ O ₅ - 112:45+ Farm yard manure - 1000 kg ha ⁻¹	26.16 c	4.36 bc	70.00 b	9.83 b	35.20 ab	13.67 b
T ₇ = N: P ₂ O ₅ - 37.5:15+ Poultry manure - 2250 kg ha ⁻¹	20.40 f	3.40 e	49.53 d	7.74 d	33.33 b	12.84 bc
T ₈ = N: P ₂ O ₅ - 37.5:15+ Farm yard manure - 3000 kg ha ⁻¹	20.30 f	3.38 e	51.70 d	8.01 d	33.33 b	12.50 c
F-value	415.09**	27.83**	263.80**	35.38**	8.11**	26.03**
LSD value	0.6092	0.3916	0.5593	0.5593	2.16	0.9750

Means sharing same letter are non-significant at 5% level of probability. NS = non-significant, ** = highly significant

These findings are in contrast with the results of Zada *et al.* (2000), who reported that plant height increases with the increase in farmyard manure and nitrogen doses. Similarly Oad *et al.* (2004) also reported that maximum plant height 150.82 cm of maize fodder was recorded with application of 120 kg nitrogen + 3000 kg FYM ha⁻¹ and Chellamuthu *et al.* (2000) that the combine application of biofertilizer together with 75% of recommended NP increase plant height compare with 100% NP alone.

Number of leaves per plant.

There was a significant effect of organic and inorganic sources of fertilizers used alone or in combination on number of leaves per plant at harvest as shown in *Table 1*. Maximum number of leaves per plant (6.87) were observed in the treatment T₂ where only inorganic fertilizers N and P were applied at the rate of 150 and 60 kg ha⁻¹ followed by T₅ (N: P₂O₅ 112:45+ Poultry manure 750 kg ha⁻¹) having (6.27) number of leaves per plant but was statistically at par with the treatment T₆ (N: P₂O₅ 112:45+ Farm yard manure 1000 kg ha⁻¹) produced 6.00 number of leaves per plant. The rest of treatments in respect to number of leaves per plant intermediated. The variation in number of leaves per plant may be due to the timely availability of nutrients from inorganic and organic source of fertilizers. These results are not in line with the findings of Oad *et al.* (2004) who found that number of leaves per plant were affected

significantly by using varying combinations of farmyard manure and inorganic fertilizers. Similar results were also reported by Chaudhary and Khade (1991) and Randhawa *et al.* (1994).

Leaf area per plant (cm²).

Application of inorganic fertilizer N:P at the rate of 150:60 kg ha⁻¹ produced maximum leaf area plant⁻¹ (128 cm²) than the rest of the treatments as shown in *Table 1*. While the treatment T₅ where combination of inorganic and organic fertilizers were applied (N: P₂O₅ 112:45+ Poultry manure 750 kg ha⁻¹) recorded significantly lower leaf area of 123.7 cm² per plant than treatment T₂ but higher than T₆, T₇ and T₈ with leaf area of 116.6 cm², 113.5 cm² and 114.7 cm² respectively which were also statistically at par with each other but higher the control treatment which have 105.2 cm² leaf area per plant. The increase or decrease in leaf area per plant in different treatments may be a result of less or more number of leaves per plant and availability flow of nutrients from inorganic and organic sources of fertilizers. These results are in accordance with the findings of Ayub *et al.* (2002) who reported that application of NP fertilizer significantly affected the leaf area per plant of maize fodder while Haq and Jan (2001) concluded that leaf area increased with progressive increase in fertilizer level.

Fresh weight per tiller (g).

It was evident from the data presented in *Table 2* that fresh weight per tiller was affected significantly by the

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application of organic and inorganic fertilizers. Statistically the maximum fresh weight per tiller (30.10 g) was recorded in treatment T₂ fertilized with inorganic source (N: P₂O₅ 150:60 kg ha⁻¹) followed by T₅ (27.30 g) where combination of inorganic and organic sources of fertilizer were used at the rate of (N: P₂O₅ 112:45+ Poultry manure 750 kg ha⁻¹). The minimum fresh weight per tiller (17.87 g) was recorded in T₁ where no source of fertilizer was used. The increase in fresh weight per tiller in the treatments other than control treatment with organic and inorganic fertilizers application alone and in combinations was probably due to higher number of leaves per plant, plant height and leaf area per plant. These results are not in accordance with the findings of Naterchera and Salagae (2002) who reported that fodder yield per plant of fodder maize increased with the application of cattle and chicken manure.

Dry matter per tiller (g).

Among the sources, recommended dose of inorganic fertilizers T₂ (N: P₂O₅ 150:60 kg ha⁻¹) produced significantly the highest dry matter per tiller (5.01 g) which was followed by T₅ (N: P₂O₅ 112:45+ Poultry manure 750 kg ha⁻¹) and T₆ (N: P₂O₅ 112:45+ Farm yard manure 1000 kg ha⁻¹) producing 4.55 and 4.36 g dry weight per tiller, respectively (*Table 2*). The treatment T₃ fertilized with organic manure alone (farm yard manure 4000 kg ha⁻¹) and T₄ (poultry manure 3000 kg ha⁻¹) yielded 4.05 and 3.89 g dry weight per tiller were

statistically at par with each other but higher than the combination of inorganic and organic sources. The minimum dry weight 2.98 g per tiller was recorded in control. These results are in agreement with Karki *et al.* (2005) who revealed that recommended dose of fertilizer on maize gave statistically highest dry weight per plant than different combinations of fertilizer and FYM while Ogboghodo *et al.* (2004) contradictly reported that maize dry matter per plant was increased with the application of poultry manure and fertilizer.

Green fodder yield (t ha⁻¹).

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⁻¹) was observed in T₂ (N: P₂O₅ 150:60 kg ha⁻¹) while the minimum green forage yield of (38.13 t ha⁻¹) in untreated treatment T₁ (control). Next to the treatment T₂; T₆ (N: P₂O₅ 112:45+ Farm yard manure 1000 kg ha⁻¹) and T₅ (N: P₂O₅ 112:45+ Poultry manure 750 kg ha⁻¹) were statistically at par with each other and gave significantly higher green forage yield of 70 and 69 t ha⁻¹ respectively compared to all other treatments (*Table 2*). The green forage yield of other treatments was intermediated. These results are quite in line with the Ayub *et al.* (2002), who reported that NP produced significantly higher fodder yield of maize than control. Similarly Devi

(2002) also reported that fodder maize variety "African Tall" produced significantly higher green fodder yield at higher dose of nitrogen while biofertilizers produced lower yield. Green fodder yield increased significantly upto 120 kg N ha^{-1} . In contrast Reiad *et al.* (1992) and Lakoo *et al.* (2004) reported that organic manures and inorganic fertilizer increase the maize fodder yield.

Crude protein (%). Protein content is one of the most important parameters affecting the nutritional value of fodder crops. It was evident from the data that crude protein was affected significantly by different source of fertilizers. Statistically the maximum crude protein (10.76 %) was produced in treatment T_2 fertilized with inorganic sources (N: P_2O_5 150:60 kg ha^{-1}) followed by T_5 and T_6 treatments where combination of inorganic and organic sources of fertilizer were used N: P_2O_5 , 112:45+ Poultry manure 750 kg ha^{-1} and N: P_2O_5 112:45+ Farm yard manure 1000 kg ha^{-1} respectively (*Table 2*). Minimum crude protein of 7.74 and 8.01 % were recorded in T_7 and T_8 treatments where inorganic and organic sources of fertilizers were applied N: P_2O_5 , 37.5:15+ Poultry manure 2250 kg ha^{-1} and N: P_2O_5 , 37.5:15+ Farm yard manure 3000 kg ha^{-1} and were also statistically at par with control treatment having 7.86% crude protein. The results are in line with the findings of Safdar (1997) and Tariq (1998) reported that in fodder maize, by increasing nitrogen levels; crude protein, crude fiber and ash

contents were increased. Similarly, Ahmad (1999) also reported that crude protein percentage increased with the increase of nitrogen fertilizer.

Crude fiber (%) is another parameter influencing the quality of fodder crops. The higher is the fiber percentage in the feeding material the lower will be its quality. Data regarding the crude fiber % age in *Table 2* exhibited that all the treatments have highly significant effect on crude fiber %age. Statistically the maximum crude fiber (37.00%) was observed in T_2 (N: P_2O_5 150:60 kg ha^{-1}) followed by T_3 (Farm yard manure 4000 kg ha^{-1}), T_4 (Poultry manure 3000 kg ha^{-1}), T_5 (N: P_2O_5 112:45+ Poultry manure 750 kg ha^{-1}) and T_6 (N: P_2O_5 112:45+ Farm yard manure 1000 kg ha^{-1}) produced crude fiber % age of 34.83, 34.83, 35.24 and 35.2 respectively and were statistically same with each other. Minimum crude fiber 30.1 % was observed in T_1 where no source of fertilizers was applied. The results are similar with the findings of 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) 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.

Total ash (%). The higher value of total ash of 15.14 % was observed

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in the treatment T₂ (N: P₂O₅ 150:60 kg ha⁻¹) which differed significantly with all the other treatments (*Table 2*). The treatment T₅ (N: P₂O₅ 112:45+ Poultry manure 750 kg ha⁻¹) and T₆ (N: P₂O₅ 112:45+ Farm yard manure 1000 kg ha⁻¹) have same values 13.67 % and were statistically at par with treatment T₇ (12.84 %). The minimum ash percentage was recorded in the treatments T₁ (control) with ash %age of 10.17 which was found to be at par with T₃ (Farm yard manure 4000 kg ha⁻¹) and T₄ (Poultry manure 3000 kg ha⁻¹) with an ash %age of 11.07 and 11.13, respectively. The results are inconsonance with the findings of Safdar (1997) who reported that green fodder yield; protein, fiber and total ash contents were increased with various nitrogen rates in maize and in the same way Tariq (1998) observed that in fodder maize, by increasing nitrogen levels; crude protein, crude fiber and ash contents were also increased.

CONCLUSIONS

Application of organic and inorganic fertilizers contributed greatly towards the growth and yield contributing attributes of the oat. Nevertheless, the application of inorganic fertilizers surpassed in enhancing growth, yield and quality attributes then the organic fertilizer application. While organic fertilizers are more environmental friendly and reduce the risk of pollution then the inorganic ones. A combination of inorganic and organic fertilizers with

application of N:P 112:45 + poultry manure 750 kg ha⁻¹ can be a better alternative to the most responsive inorganic application of N:P 150:60 kg ha⁻¹.

REFERENCES

- Ahmad N., M. Rashid, A.G. Vaes, 1996** - Fertilizer and their uses in Pakistan. NFDC Publications pp 142-149 and 172-175.
- Ahmad B, 1999** - Effect of different levels nitrogen seeding density on growth yield and quality of maize fodder. MSc Thesis Dept Agron Uni Agri Faisalabad.
- Alemayehu M. 1997.** Conservation waste forage development for Ethiopia. Institute for sustainable development. Addis Ababa Ethiopia: 57-60.
- AOAC, 1990** - Official methods of analysis. Association of Analytical Chemists. 17th Ed Arlington Virginia USA.
- Ayub M., M.A. Nadeem, M.S. Sharar, N. Mahmood, 2002** - Response of maize (*Zea mays* L.) fodder to different levels of nitrogen and phosphorus. Asian J of plant Sci 4(1): 352-354.
- Bending G.D., K.T. Mary, J.E. Julie, 2002** - Interaction between crop residues and soil organic matter, quality and functional diversity of soil microbial communities. Soil Biol Biochem J 34(8): 1073-1083.
- Bhatti M.B., 1992** - National perspectives for fodder crops in Pakistan, NARC, Islamabad pp 1-2.
- Brady N.C. 1996** - Nature and properties of soil, 10th Ed Prantice- Hall India Pvt Ltd New Dehli pp 291.
- Chang C., T.G. Sommerfeldt, T. Entz, 1991** - Soil Chemistry after eleven annual application of cattle feedlot manure. J Environ Quality, 20: 475-480.

- Chaudhary R.V., S.T. Khade, 1991** - Growth and yield analysis of sorghum hybrid as affected by NPK. *Annals of P Physiology* 5(1): 97-102. (Sorghum and millet Absts 16(2): 862, 1991).
- Chellamuthu V., A.K.F. Khan, P. Malarvizhi, 2000** - Studies on effect of inorganic and biofertilizer on bajranapier hybrid grass. Range management and Agroforestry 21(2): 135-137 (CAB Absts 71(8): 375).
- Chung R., C.H. Wang, Y. Wang, R.S. Wang, C.W. Wang, Y.T. Wang, 2000** - Influence of organic matter and inorganic fertilizer on the growth and nitrogen accumulation of corn plants. *Taiwan Journal Plant Nutrition* 23(3): 297-311.
- Devi L.G., 2002** - Forage yield of maize (*Zea mays* L.) as influenced by nitrogen levels and biofertilizers. *Forage-Research* 27(4): 263-266.
- Hasan, B., W.A. Shah, 2000** - Biomass grain production and quality of oat (*Avena sativa*) under different cutting regimes and nitrogen levels. *Cereal Research Communications Vol* 28(1-2): 203-210.
- Haq I., A. Jan, 2001** - Effect of different fertilizer levels and time or irrigation on the fodder yield of sorghum (*Sorghum bicolor* L.). *J Biol Sci* 1(5): 348-349.
- Harris D, 1996** - The effect of manure, genotype, seed priming, depth and rate of sowing on the emergence and early growth of *Sorghum bicolor* (L.) Moench in semi-arid Botswana. *Soil and Tillage Res* 40(1-2): 73-88.
- Jayanthi, C., P. Malarvizhi, A.K. Fazullah, C. Chinnusamy, 2002** - Integrated nutrient management in forage oat (*Avena sativa*). *Indian Journal of Agronomy* 47(1): 130-133.
- Karki T.B., A. Kumar, R.C. Gautam, 2005** - Influence of integrated nutrient management on growth, yield and uptake of nutrients and soil fertility status in maize (*Zea mays*). *Ind J Agric Sci* 75(10): 682-685.
- Kuepper G., L. Gegner, 2004** - Organic crop production overview. ATTRA of National Centre for Appropriate Technology. Arkansa.www.attra.ncat.org
- Lakoo A.A., F.C. Oad, A.A. Solangi, M.H. Siddiqui, 2004** - Economics of maize fodder under organic and inorganic fertilizers. *Int J Agric Biol* 6(6): 1172-1173.
- Loecke T.D., M. Liebman, C.A. Cambardella, T.L. Richard, 2004** - Corn growth responses to composted and fresh solid swine manure. *Crop Sci* 44: 177-184.
- Naterchera L., B. Salagae, 2002** -Effect of cattle and chicken manure on the yield of forage maize. *Agron J* 25: 18-43.
- NFDC, 1997** - Fertilizer recommendation in Pakistan. Planning and development division. NFDC, Government of Pakistan, Islamabad, pp 7.
- Oad F.C., U.A. Buriro, S.K. Agha, 2004** - Effect of organic and inorganic fertilizer application on maize fodder production. *Asian J Plant Sci* 3(3): 375-377.
- Ogboghodo A., E.B. Erebers, I.O. Osemwota, H.H. Isitekhale, 2004** - The effect of application of poultry manure to crude oil polluted soils on maize (*Zea mays*) growth and soil properties. *Environmental Monitoring and assessment* 96:153-161.
- Rafiq M., J.K. Jadoon, K. Mahmood, M.A. Naqvi, 1996** - Economic benefits of supplementing lambs with urea molasses blocks on ranges of Pakistan. *Asian-Aust. J. Anim. Sci.*, 3: 127-132.
- Randhawa M.A., K. Jamil, R.M. Yousaf, M.Z. Siddiqui, M.A. Toor, 1994** - Influence of different nitrogen levels on the yield and quality of maize fodder. *Pakistan. J Agri Sci* 31(1): 27-29.
- Reiad M.S., E.L. Hakeem, M.A. Hammada, S.O.M. Abd-Alla, 1992** - Fodder sorghum yield and its components as affected by nitrogen

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- and organic manure fertilization rates under Siwa Oasis conditions. *Annals of Agric Sci Moshtohor* 33(2): 613-622.
- Safdar Z.** - Optimization of nitrogen and its effect on yield and quality of maize fodder. MSc. (Hons.) Agri. Thesis, Dept. of Agron., Univ. of Agric., Faisalabad, Pakistan, 1997.
- Sasireka K.P., A. Rangasamy, I. Sekar, 1998** - Effect of organic and inorganic sources of nitrogen and molybdenum on yield and quality of bajra-napied hybrid grass. *Madras Agri J* 85(2): 99-102 (CAB Absts 2000).
- Sharpley A.N., R.W. Mcdowell, P.J.A. Kleinman, 2004** - Amounts, forms and solubility of phosphorus in soils receiving manures. *Soil Science Society of America. American Journal* 68: 2048-2057.
- Steel R.G.D., J.H. Torrie, D.A. Dicky, 1997** - Principles and procedures of statistics, a biological approach. 3rd Ed. McGraw Hill Inc Book Co NY (USA) pp 352-358.
- Tariq M.** - Fodder yield and quality of two maize varieties at different nitrogen levels. MSc Thesis Dept. Agron. Univ. Agric. of Faisalabad, 1988.
- The World Bank, 1999** - Integrated nutrient management, rural development department, agriculture technology notes. No. 23. pp. 1-4.
- Theodora M., S.L. Anastasios, A.G. Athanasios, 2003** - Effect of Injected liquied cattle manure on growth and yield of winter wheat and soil characteristics. *Agron J* 95: 592-596.
- Zada K., P. Shah, M. Arif, 2000** - Management of organic farming: Effectiveness of farmyard manure and nitrogen for maize productivity. *Sarhad J Agric* 16(5): 461-465.