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# Effect of Different Organic Manures on Yield, Nutritional Quality and Soil Properties in Rice-lentil Sequence on Inceptisols Under Temperate Conditions of Kashmir

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ABSTRACT

A field experiment was conducted during Kharif season of 2008-2009 and 2009-2010 to study the effect of different organic manures viz. farmyard manure, sheep manure and poultry manure on rice-lentil yield, grain quality and their resultant effect on soil properties. Improved rice grain yield ( 4.83 Mg $ha^{-1}$), rice grain quality such as carbohydrates (83.10%), protein (6.21%), methionine (1.57 mg $(100g)^{-1}$ protein) and cysteine (1.34 mg $(100g)^{-1}$ protein) resulted due to application of different manures individually or in combination over control. Similarly lentil yield (0.874 Mg $ha^{-1}$) and quality viz. carbohydrates (61.08 %), proteins (28.9%), methionine (1.72 mg $(100g)^{-1}$ protein), and cystein (1.59 mg $(100g)^{-1}$ protein) were proved significant by the application of different manures individually or in combination over control. Application of Farm Yard manure + Sheep and +Poultry manure showed highest organic carbon content (0.81 %), available N (344.0 kg $ha^{-1}$), available K (152.40 kg $ha^{-1}$) whereas, the contents of available P (27.7 kg $ha^{-1}$), available S (23.9 kg $ha^{-1}$) and DTPA-Zn (0.73 mg $ha^{-1}$) and Fe (25.16 mg $ha^{-1}$) were highest with the combined application of poultry manure and sheep manure

Key Words: Fertility; Lentil; Organic Manures, Grain Quality; Rice Yield.

## INTRODUCTION

Organic manures play an important role not only in supplying macro and micro nutrients to the crops, but also improve the physical, chemical and biological properties of soils, besides leaving substantial residual effect that lasts for several seasons Singh et al. (2008). Escalating cost of production due to prevailing energy crisis and low affordability of poor farmers, reduced microbial diversity, water pollution and the chemical residues in the food grains and health risk to population due to use of chemical fertilizers are the reasons to think for substituting the nutritional requirements of crops through different organic manures. Chemical fertilizers are the source of nutrients but not the source of principle substances like enzymes and growth regulators that is why better quality of produce is obtained by the application of organic manures and not due to difference in the nature and properties of nutrients supplied through fertilizers and manures. Quality parameters of grains/ seeds are generally controlled genetically but agricultural practices like nutrient management, irrigation etc are important modifiers. Continuous cultivation and indiscriminate use of fertilizers has resulted not only in the deficiency of some nutrients but also in soil and water pollution, besides improper uptake of nutrients by crops

Singh et al. (2008). The deficiency of one element effects the utilization of other nutrients. There is meager information on the nutritional quality of rice and lentil sequence as influenced by the application of various manures. Hence, the effects of organic manures on nutritional quality, mineral nutrient content as well as on the soil properties in rice-lentil sequence were evaluated in a field study under temperate conditions.

## MATERIALS AND METHODS

Field experiments were conducted during 2008-2009 and 2009-2010 at Faculty farm of SKUAST- K at Wadura, Sopore, Kashmir to evaluate the effect of organic manures on nutritional quality, mineral content and soil properties in rice–lentil cropping sequence. The experimental field classified under Inceptisol was fallow for a period of 15 years having the characteristics *viz;* clay loam texture (clay 32.7%, silt 28.9% and sand 38.0%), pH 7.17, organic carbon 0.73%, available N, P, K and S (325.00, 24.80, 145.00 and 18.80 kg $ha^{-1}$), respectively. The DTPA extractable Zn and Fe were 0.54 and 15.80 mg $kg^{-1}$ soil, respectively.

The experiment was laid in RBD with three replications and five treatments viz. ($T_1$): FYM @ 7.5 Mg $ha^{-1}$+ SM @2. 5 Mg $ha^{-1}$, ($T_2$): FYM @ 7.5 Mg $ha^{-1}$+ PM @ 2.5 Mg $ha^{-1}$, ($T_3$): SM @ 5 Mg $ha^{-1}$+ PM @ 2.5 Mg $ha^{-1}$ , ($T_4$): FYM @ 5 Mg $ha^{-1}$+ SM @ 3.3 Mg $ha^{-1}$+PM @1.7 Mg $ha^{-1}$, ($T_5$): Control, in fixed plots of 4 square meters during Kharif and Rabi seasons of 2008-2009 & 2009-2010 with rice (var. Jehlum) and lentil (var. Precose) as test crop .The rice crop was trans-planted during second week of June and harvested in the last week of September and Lentil was sown in 3rd week of October harvested in last week of May. The composition of manures is shown in Table 1. Manures were applied based on nitrogen equivalents and nitrogen requirement of the crops. The calculated doses of manures were applied 15 days before transplanting /sowing of each crop after mixing thoroughly with the soil. Yield and nutritional quality parameters of the crops were evaluated after the harvest of crops and the changes in soil properties were assessed at the end of two years. At maturity, rice and lentil were harvested, processed and the seeds were used for analysis of quality parameters and mineral contents. The total carbohydrates were estimated by the method of Hedge and Hofreiter (1962).

The protein content was determined by estimating total nitrogen using modified Kjeldahl's method and multiplying N% with factor 6.25. Sulphur containing amino acids were estimated by Horn et al. (1946) and Leach (1966). Soil samples were collected at the termination of the experiment and used for analysis. The N, P and K contents were estimated by the methods outlined as per Jackson (1973) and S content by Tandon (1993). The Zn and Fe content were estimated by Atomic Absorption Spectrometry.

Table 1 . Composition of various organic manures.

| Nutrient | Farm yard manure | Sheep manure | Poultry manure |
|---|---|---|---|
| N (%) | 0.55 | 0.81 | 1.20 |
| P (%) | 0.29 | 0.46 | 0.95 |
| K (%) | 0.41 | 0.21 | 0.51 |
| S (%) | 0.18 | 0.29 | 0.43 |
| Zn (mg $kg^{-1}$) | 56.0 | 61.0 | 76.0 |
| Fe (mg $kg^{-1}$) | 460.0 | 690.0 | 760.0 |

## RESULT AND DISCUSSION

### Yield and Quality of Rice Grain and Lentil Seed

Marked difference in yield of rice was recorded due to application of manures (Table 2). It is evident from the data that seed yield of rice significantly increased by the application of manures over control .The maximum yield (4.83 Mg $ha^{-1}$) was recorded with $T_4$ treatment (Farm Yard manure + Sheep manure + Poultry manure) combination of organic manures which was significantly superior to all other manure combinations including control. The improved yield which could be ascribed to steady supply of nutrients, besides providing congenial environment to growing plants. Superiority of combined application of manures is in agreement with the findings of Singh et al. (2008).The yields resulting by other combinations were statistically at par with each other but superior to control.

The quality parameters of rice grain *viz* total carbohydrates, proteins and sulphur containing amino acids like cysteine and methionine were significantly increased by the combined application of manures over control (Table 2). Maximum increase in carbohydrate content (83.10%) was recorded with $T_4$ followed by $T_3$ and $T_2$. Increase in carbohydrate content could be ascribed to better uptake which might have favored greater synthesis of carbohydrates and their efficient portioning into different sinks including grain Neetu et

al. (2011). Similarly, the contents of proteins and sulphur containing amino acids increased with the application of manures over control (Table 2). The maximum protein content (6.21%) was noticed with $T_4$ treatment which was significantly superior to all other treatments whereas the sulphur containing amino acids methionine (1.57 % protein) and cysteine (1.34% protein) were recorded with $T_4$ treatment which was significantly superior to control but statistically at par with other treatments. The significant increase in protein content and sulphur containing amino acids could be due to supply of all growth promoting substances like enzymes, hormones, growth regulators, besides better availability of nutrients especially nitrogen and sulphur from manures which might have increased the synthesis of proteins and sulphur containing amino acids.

Table 2. Effect of various organic manures on yield and quality of rice and lentil crop sequence during 2008-2009 and 2009-2010. Values are means of two years.

| Treatment | Grain Yield (Mg ha$^{-1}$ ) | Carbohydrates (%) | Proteins (%) | Methionine (% protein) | Cysteine (% protein) |
|---|---|---|---|---|---|
| Rice | | | | | |
| T1 | 4.690 | 81.90 | 5.59 | 1.50 | 1.29 |
| T2 | 4.698 | 82.01 | 6.00 | 1.52 | 1.30 |
| T3 | 4.711 | 83.01 | 6.08 | 1.54 | 1.31 |
| T4 | **4.831*** | **83.10*** | **6.21*** | **1.57*** | **1.34*** |
| T5 | 4.218 | 71.70 | 5.21 | 1.40 | 1.23 |
| CD≤0.05 | 0.024 | 0.42 | 0.08 | 0.09 | 0.09 |
| Lentil | | | | | |
| T1 | 0.856 | 60.70 | 24.81 | 1.63 | 1.50 |
| T2 | 0.860 | 60.74 | 24.83 | 1.66 | 1.52 |
| T3 | 0.863 | 60.92 | 25.02 | 1.68 | 1.56 |
| T4 | **0.874*** | **61.08*** | **28.91*** | **1.72*** | **1.59*** |
| T5 | 0.851 | 58.78 | 23.40 | 1.47 | 1.42 |
| CD≤0.05 | 0.020 | 0.40 | 0.30 | 0.08 | 0.08 |

Table 3. Effect of various organic manures on nutrients content in rice and lentil crop sequence during 2008-2009 and 2009-2010. Values are means of two years.

| Treatments | N(%) | P (%) | K ( %) | S(%) | Zn ( mg kg$^{-1}$ ) | Fe (mg kg$^{-1}$) |
|---|---|---|---|---|---|---|
| Rice | | | | | | |
| T1 | 0.86 | 0.22 | 0.71 | 0.13 | 15.70 | 3.60 |
| T2 | 0.88 | 0.24 | 0.72 | 0.14 | 16.20 | 3.80 |
| T3 | 0.97 | **0.26*** | 0.74 | 0.15 | 18.40 | 3.90 |
| T4 | **0.99*** | 0.25 | **0.73*** | **0.16*** | **18.60*** | **4.30*** |
| T5 | 0.83 | 0.19 | 0.62 | 0.12 | 14.10 | 3.50 |
| CD≤0.05 | 0.10 | 0.03 | 0.02 | 0.01 | 1.40 | 0.07 |
| Lentil | | | | | | |
| T1 | 3.94 | 0.30 | 0.62 | 0.26 | 36.00 | 5.90 |
| T2 | 3.96 | 0.32 | 0.64 | 0.27 | 37.00 | 5.90 |
| T3 | 3.98 | **0.35*** | **0.66*** | 0.30 | 39.00 | **6.40*** |
| T4 | **4.00*** | 0.33 | 0.65 | **0.33*** | **40.00*** | 6.10 |
| T5 | 3.74 | 0.29 | 0.59 | 0.24 | 30.00 | 5.30 |

The seed yield of lentil did not differ significantly with the application of different manure combinations but all the manure treatments were superior to control (Table 2). Maximum lentil yield (0.874 Mg $ha^{-1}$) was observed with the combined applications of Farm Yard manure + Sheep manure + Poultry manure ($T_4$). These results collaborate with the findings of Singh et al. (2008). Application of different organic manure combinations increased the carbohydrate, proteins and sulphur containing amino acids in lentil seeds. There was no significant difference among treatments, but there was significant improvement in all these quality parameters over control. The maximum carbohydrate content (61.08 %), proteins (28.91 %), methionine and cystein (1.72 and 1.59gm/100 gm protein respectively) registered with $T_4$ treatment (Table 2). Agrawal et al. (2007) has also reported improved quality of organically grown pea.

**Nutrient Content of Rice and Lentil**

Mineral content of rice grain presented in (Table 3) revealed that the combined application of various manures significantly increased the mineral content of rice grain over control. Highest contents of N (0.99%) and S (0.16%) were recorded with $T_4$ treatment whereas highest contents of P (0.26%) and K (0.73%) were noticed with $T_3$ treatment being statistically at par with $T_4$ treatment .These results are in agreement with the finding of Chatoo et al. (2010). Similarly, the content of Zn and Fe were also improved in the rice grain by the application of manures (Table 3). Significant improvement in Zn and Fe (18.60 mg $kg^{-1}$and 4.3mg $kg^{-1}$, respectively) was recorded in $T_4$ treatment in the rice grain. However the treatment $T_3$ and $T_4$ in respect of Zn content were statistically at par. Similarly, mineral content of lentil seed was significantly improved by the application of manures over control (Table 3). Maximum N and S content (4.00% and 0.33%) respectively were recorded with the combination of Farm Yard manure+ Sheep manure +Poultry manure ($T_4$ treatment) which was however, statistically at par with $T_3$ and $T_2$ treatment in respect of N content and at par with $T_3$ treatment in respect of S content. The increase in nitrogen and sulphur content in these combinations could be attributed to the greater multiplication of soil microbes which could convert organically bound N and S to inorganic forms Thakur et al. (2011) and their absorption and accumulation by plants. Higher contents of P (0.35 %) and K (0.66 %) in the lentil were recorded with $T_3$ treatment followed by $T_4$ treatment. Zn and Fe content in lentil seed was significantly improved by the application of manures over control Table 3. Significantly higher contents of Zn (40.00 mg $kg^{-1}$) and Fe (6.40 mg $kg^{-1}$) were noticed in treatments $T_4$ and $T_3$ respectively which can be ascribed to increased availability and absorption of these nutrients by providing the chelating agents that helped in maintaining the solubility and availability in soil. No significant differences in the contents of Zn between the treatment $T_4$ and $T_3$ was observed.

**Soil Properties**

The pH of the soil increased to (7.24) to initial level of (7.17) with the combined applications of manures (Table 4). A relatively high pH (7.24) In $T_4$ treatment (Farm Yard manure + Poultry manure + Sheep manure) combination might be ascribed to increased retention of exchangeable bases and increased CEC of the soil. These results are in agreement with the findings of Laxminarayan et al. (2006) who also reported increase in soil pH by the combined application of organic manures and inorganic fertilizers. Application of manures in combination significantly increased the soil organic carbon over control. As it is evident from (Table 4), Continuous cropping without manure application of manures reduced the soil organic carbon content from (0.73 to 0.69%) in control. Significantly higher soil organic carbon content (0.81%) was recorded with the incorporation of FYM +Sheep manure +Poultry manure ($T_4$ Treatment). Increase in organic carbon content of soil due to manure application could be attributed to direct addition through manures besides left over crop stubbles and crop residues.

**Available Macro and Micro Nutrients**

The available nitrogen content in soil increased significantly with the application of manures over control (Table 4). Highest available nitrogen (344 kg $ha^{-1}$) was recorded with $T_4$ treatment which was at par with other treatments. The increase in available nitrogen due to combined application of manures could be attributed to greater multiplication of microbes which could convert organically bound nitrogen to inorganic form Kumar et al. (2008). Application of organic manures significantly increased the available phosphorus over control (Table 4). Maximum increase in available phosphorus ( 27.70 kg $ha^{-1}$) was recorded with the application of Poultry manure + sheep manure ($T_3$) over rest of the treatments which could be due to better mineralization of phosphorus from this source owing to

Table 4. Effect of various organic manures on soil properties (2008-2009) (2009-2010) mean value.

| Treatments | pH | OC (%) | Available nutrients (kg ha$^{-1}$) | | | DTPA Extractable (mg kg$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | N | P | K | S | Zn | Fe |
| T1 | 7.23 | 0.77 | 336.00 | 23.50 | 147.50 | 20.50 | 0.67 | 21.30 |
| T2 | 7.21 | 0.80 | 340.00 | 24.80 | 149.60 | 21.90 | 0.70 | 22.12 |
| T3 | 7.22 | 0.76 | 338.00 | **27.70*** | 148.80 | **23.90*** | **0.73*** | **25.16*** |
| T4 | **7.24*** | **0.81*** | **344.00*** | 25.90 | **152.40*** | 22.20 | 0.72 | 23.80 |
| T5 | 7.17 | 0.69 | 325.00 | 23.80 | 145.00 | 18.80 | 0.54 | 15.80 |
| CD≤0.05 | - | 0.03 | 8.2 | 1.50 | 5.8 | 1.71 | 0.01 | 1.45 |

high phosphorus content in this sources as compared to others. Significant increase in available potassium content was observed by the application of manure over control (Table 4). All the treatment combinations were equally effective in increasing the potassium content of the soil as there were no significant differences among treatments which could be due to direct addition from these sources besides increasing the availability of potassium by reducing potassium fixation and release due to interaction of organic matter with clay .These results are in agreement with the findings of Singh et al. (2008). Available Sulphur also showed a significant increase by the application of organic manures over control (Table 4). $T_3$ treatment recorded maximum available sulphur (23.90 kg ha$^{-1}$) in the soil which was stastically at par with $T_4$. Chattoo et al. (2010) also reported increase in available sulphur by incorporation of organic manures to soil.

The DTPA extractable micro nutrients showed a significant increase with the application of organic manures over control (Table 4).The maximum increase in DTPA zinc (0.73mg kg$^{-1}$) and iron (25.16 mg kg$^{-1}$) respectively were recorded with $T_3$ treatment which were stastically at par with $T_4$. The increase could be due to higher addition of zinc and iron from these sources besides providing complex agents that enhance the availability of these micronutrients.

## CONCLUSION

The results of the study lead to the conclusion that the application of different manures alone or in combination resulted not only in higher yield and quality of both rice and lentil but also improved the soil fertility. The findings indicated that combined application of manures FYM @ 5 Mg ha$^{-1}$+ SM @ 3.3 Mg ha$^{-1}$ +PM @1.7 Mg ha$^{-1}$ resulted in significant increase in yield and quality besides improved soil fertility.

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## REFERENCES

Agarwal, P.; Leena, B.; Kulshrestha, S. and Mahapatra, B. S. 2007. Effect of organic and inorganic and integrated methods of cultivation on quality of Fresh Green Pea. Journal of Eco-friendly Agriculture. 2 (1): 20-22

Bharadwaj, V. and Omanwar, P.K. 1994. Long term effects of continuous rotational cropping and fertilization on crop yields and soil properties-II. Effects on EC, pH, organic matter and available nutrients in soil. Journal of Indian Society of Soil Science 42: 387-392 .

Chatoo, M. A.; Najar, G. R.; Wani, S.A. and Faheema. 2010. Effect of organic manures and inorganic fertilizers on growth, yield, nutrient uptake and economics of onion cv Yellow Globe. Journal of Eco friendly Agriculture 5 (1): 12-14.

Hedge, J.E. and Hofreiter, B.T. 1962. Estimation of carbohydrate. Page 17-22, In: Whistler, R.L and Be Miller, J.N. (Editors) Carbohydrate Chemistry 17. Academic Press, New York.

Horn, J.M.; Jones, D. and Blum, A.E. 1946. Calorimetric determination of methionine in protein and foods. Journal of Biological Chemistry 116: 313-320.

Jackson, M. L. 1973. Soil Chemical Analysis. Prentice Hall of India, New Delhi. 895 pages.

Kumar, Vipin and Prasad, R.K. 2008. Integrated effect of mineral fertilizers and green manure on crop yield and nutrient avaliblity under rice wheat cropping system. Journal of Indian Society of Soil Science 56 (2): 209-214.

Laxminarayana, K . and Patiram. 2006. Effect of integrated use of inorganic, biological and organic manures on rice productivity and soil fertility in ultisols of Mizoram. Journal of Indian Society of Soil Science 54 (2): 213-220.

Leach, S.J. 1966. Determination of cystine by phosphotungustic acid. Pages 1-75, In: Alexander, P and Lundgrin, H.P (Editors) Laboratory Manual of Analytical Methods of Protein Chemistry, Volume 4. Pergamon Press, Oxford.

Neetu, P. and Yadav, B. L. 2011. Effect of organic manures on soil properties, soil microbial biomass and yield of mustard under irrigation of different residual sodium carbonate wastes. Journal of Indian Society of Soil Science 59 (4): 336-342.

Peer, F. A. and Ishaq, M. I. 2011. Integrated use of organic and inorganic fertilizers with bio-inoculants on yield, soil fertility and quality of apple (*Malus domestica*). Journal of Indian Society of Soil Science 59 (4): 362-367.

Singh, A. B.; Ramesh, P.; Panwar, N. R. and Ramana, S. 2008. Nutritional quality of Soyabean (*Glycine max*), Wheat (*Triticum durum*) and Chick pea (*Cicer arietinum*) and soil biological properties as influenced by different organic matter. Indian Journal of Agricultural Sciences 78: 781-784.

Singh, F.; Ravinder, K . and Samir, Pal. 2008. Integrated nutrient management in rice wheat cropping system for sustainable production. Journal of Indian Society of Soil Science 56 (2): 205-208

Tandon, H. L. S. 1993. Methods of Analysis of Soil, Plant, Waters and Fertilizers. Fertilizer Development and Consultation Organization, New Delhi. 204 pages.

Thakur, R.S.D.; Sawarkar, H.K.; Vaishya ???? and Muneshwar, P. 2011. Impact of continuous use of inorganic fertilizers and organic manures on soil properties and production under soyabean -wheat intensive cropping in vertisols. Journal of Indian Society of Soil Science 59 (1): 74-87 .

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