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Research Paper

Effect of wheat straw incorporation and nitrogen on yield of wheat and soil fertility and their residual effect on succeeding *Kharif* pearl millet crop

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ABSTRACT

A field experiment was conducted at the Anand Agricultural University, Anand during the year 2005-06 and 2006-07 to study the effect of wheat straw incorporation and inorganic fertilizer on yield of wheat, physiochemical properties of soil at harvest of wheat and yield of succeeding *Kharif* pearl millet crop. Grain and straw yields of wheat was observed significantly the highest under the treatment of wheat straw incorporation @ 5 t ha^{-1} along with 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 DBS. Soil reaction and electrical conductivity did not influenced significantly, but organic carbon content, total nitrogen and available potash status of soil after harvest of wheat were observed maximum under the WSI @ 5 t ha^{-1} at 30 DBS. Available phosphorus status of soil was remained higher under the treatments of WSI @ 5 t ha^{-1} along with 20 kg P_2O_5 ha^{-1} at 30 DBS. Grain and fodder yields of succeeding *Kharif* pearl millet were found significantly superior under the WSI @ 5 t ha^{-1} along with 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 DBS. Each successive increment in levels of nitrogen application significantly linear increase in the grain and straw yields of wheat. Similarly, significant improvement in organic carbon content, total nitrogen and potash status of soil was noted under the application of 120 kg N ha^{-1} over 60 kg ha^{-1} after harvest of wheat. Application of 120 N Kg ha^{-1} to wheat showed its residual effect more pronounced in pearlmillet rain and fodder production than application 60 and 90 N kg ha^{-1}. The interaction effect of grain yield of wheat presented in Table 2 revealed that when the wheat crop was sown under the application of wheat straw @ 5 t ha^{-1} along with 20 kg N and 20 kg P_2O_5 ha^{-1} and fertilized with application of 120 kg N ha^{-1} the highest grain yield was recorded.

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Key words : Wheat Straw incorporation, Wheat yield, Residual effect

INTRODUCTION

The key to improve the sustainability of agricultural farming system is soil productivity. Soil fertility and productivity to a great extent depends on soil organic matter. Management of crop residues and returning of farm waste to cultivated field offer the best possible means of restoring and maintaining the organic matter content of the soils.

Crop residues are important renewable organic sources of nutrients. Large quantities of crop residues are available with the farmers which can be utilized as complementary sources to chemical fertilizer. Besides supplementing the fertilizers for major nutrients, crop residues are also important in improving the soil quality.

In view of the above, the present investigation was undertaken to study the "Effect of wheat straw incorporation and nitrogen on yield of wheat and soil fertility and their residual effect on succeeding *Kharif* pearl-millet crop".

MATERIALS AND METHODS

A field experiment was conducted at College Agronomy Farm, Anand Agricultural University, Anand, (22^0-35^l N and 72^0-55^l E) with an altitude of 45.1 m above mean sea level during the *Rabi* and *Kharif* seasons of the years 2005-06 and 2006-07. The soil of the experimental field was loamy sand in texture (locally known as *Goradu* soil) having pH ranging from 7.8 to 8.0. The experimental soil was low in organic carbon and total nitrogen, medium in available phosphorus and high in available potassium. Eighteen treatments comprised of all possible combinations of six levels of residue management

practices (R_0: control, R_1: wheat straw incorporation (WSI) @ 5 t ha^{-1} at 30 days before sowing (DBS), R_2: WSI @ 5 t ha^{-1} + 20 kg N ha^{-1} at 30 DBS, R_3: WSI @ 5 t ha^{-1} + 20 kg P_2O_5 ha^{-1} at 30 DBS, R_4: WSI @ 5 t ha^{-1} + 20 kg N plus 20 kg P_2O_5 ha^{-1} at 30 DBS and R_5: FYM @ 10 t ha^{-1} two DBS) and three levels of nitrogen application (N_1: 60 kg N ha^{-1}, N_2: 90 kg N ha^{-1} and N_3: 120 kg N ha^{-1}) were tested in Factorial Randomized Block Design with three replications. Entire quantity of wheat straw as per treatments was applied uniformly in experimental plots 30 days before sowing of wheat with irrigation. Then after, either nitrogen or phosphorus or both @ 20 kg ha^{-1} as per treatments through urea for nitrogen and single super phosphate for P_2O_5 were applied uniformly in plots to decompose the wheat straw. The cellulolytic bacterial and fungus culture was also sprayed on wheat straw applied plots for faster decomposition of wheat straw. Then, wheat straw was thoroughly mixed with the soil. FYM was applied as per treatment in the experimental plots just two days before sowing of wheat. Half treatmental N through urea was applied at the time of wheat sowing, remaining half dose of N was top dress after one month of sowing. The crop was raised as per recommended package of practices. Pearl millet crop was followed after wheat in *Kharif* season at the same site of *Rabi* to study the residual effect of treatments impose on wheat an experiment without any application of fertilizer was undertaken.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as well as relevant discussion have been presented under following heads :

Effect of wheat straw incorporation:

Difference in wheat grain yield was found significant due to residue management practices. The highest wheat yield was obtained under incorporation of wheat straw @ 5 t ha^{-1} along with 20 kg N plus 20 kg P_2O_5 ha^{-1}. Further, it was observed that addition of wheat straw along with either 20 kg N ha or 20 kg P_2O_5 ha^{-1} produced significantly higher grain yield as compared to wheat straw alone. Moreover, it was observed that incorporation of wheat straw alone recorded significantly higher grain yield as compared to application of FYM @ 10 t ha^{-1}. Application of nitrogen and phosphorous with incorporation of wheat straw proved better than its application alone. Similar results was also obtained in straw yield of wheat. The present results are closely in resemblence with those of Tiwari *et.al*. (2000).

After harvest of wheat crop the fertility status of soil

Table 2 : Different interaction effect of residue management practices and rate of nitrogen on grain and straw yields of wheat (Pooled)

Treatments	R_0	R_1	R_2	R_3	R_4	R_5
Grain yield (kg/ha)						
N_1	3651	4692	5058	4920	4983	3780
N_2	4453	4911	5183	5036	5363	4749
N_3	4926	5292	5485	5225	6070	5199
C.D. (P=0.05)			351.28			
Straw yield (kg/ha)						
N_1	5428	7010	7461	7337	7410	5673
N_2	6666	7320	7746	7535	8040	7286
N_3	7404	7971	8169	7961	9042	7809
C.D. (P=0.05)			517.46			

was assessed. Additions of crop residue or FYM had no effect on pH and EC of soil recorded after harvest of wheat. Carbon content and total nitrogen of soil was noted significantly higher in all the treatments where in wheat straw was applied. Noticeable increase in organic carbon and total nitrogen contents was observed when wheat straw was incorporated alone @ 5 t ha^{-1}. The lowest organic carbon and total nitrogen content showed in control. Recycling of crop residue like wheat straw in conjunction with 20 kg N or 20 kg P_2O_5 ha^{-1} at the time of incorporation helped to reduced the C: N ratio of crop residue and sustained the grain yield of wheat also improved the chemical properties of soil.

The available status of phosphorus in the soil showed significant improvement due to incorporation of wheat straw along with 20 kg P_2O_5 ha^{-1} alone or 20 kg N plus 20 kg P_2O_5 ha^{-1}. Misra and Das (2000)described this increase in available phosphorous due to solubilization of organic amendments. There was appreciable build up of available potash if the soil in case of all the treatments where the wheat straw was incorporated. Verma (2001) also reported that wheat straw incorporation increases organic carbon, total nitrogen and available potash contents in soil.

Incorporation of wheat straw holds a promise to perceive the production of succeeding peralmillet crop. Addition of wheat straw @ 5 t ha^{-1} inconjuction with 20 kg N plus 20 kg P_2O_5 ha^{-1} at 30 days before sowing, wheat straw @ 5 t ha^{-1} plus 20 kg P_2O_5 ha^{-1} at 30 days before sowing and wheat straw alone @ 5 t ha^{-1} at 30 days before sowing produce significantly higher grain and straw yields of succeeding *Kharif* pearl millet crop as compared to rest of treatments. Almost similar results were also reported by Surya *et. al.* (2000).

Effect of nitrogen:

Differences in wheat grain and sraw yields were found significant due to different rate of nitrogen application. The application of graded levels of nitrogen registered liner and significantly increased in grain and straw yields of wheat. Nitrogen application @ 120 kg ha^{-1} significantly increased the grain and straw yields over 60 and 90 kg nitrogen ha^{-1}. The magnitudes of yield increased owing to direct application of nitrogen to wheat (120 kg ha^{-1}) were 18.9 and 8.4 per cent over the applications 60 and 90 kg N ha^{-1}, respectively.

Application of nitrogen caused significant variation in organic carbon content of soil after harvest of wheat but it did not influenced the soil reaction (pH) and EC. The highest organic carbon content was recorded with the application of 120 kg nitrogen ha^{-1}. Total nitrogen and available potash were found maximum under the application of 120 and 90 kg nitrogen ha^{-1}. Difference in available phosphorus content was non significant.

Application of 120 kg nitrogen ha^{-1} also showed its residual effect on grain and straw yields of succeeding Kharif pearl millet crop.

Interaction effect:

Interaction effect of crop residue management practices and rate of nitrogen on grain and straw yields was found significant (Table 2). Significantly the highest grain yield was observed with the treatment combination of wheat straw @ 5 t ha^{-1} incorporated in soil along with 20 kg nitrogen and 20 kg P_2O_5 ha^{-1} at 30 days before sowing and nitrogen application @ 120 kg ha^{-1}. Such trend may be due to the fact that application of nitrogen and phosphorous at the time of incorporation of wheat straw might have synergistic effect in mineralization of wheat straw and nitrogen may be insufficient for the growth of wheat resulted the succeeding response of nitrogen.

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