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Research Paper

Recycling effect of wheat straw incorporation and inorganic fertilizer on growth, yield and quality of wheat and their residual effect on yield of succeeding *Kharif* pearl millet

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ABSTRACT

A field experiment was conducted for two consecutive years on same site at AAU, Anand, during the year 2005-06 and 2006-07, to evaluate the effect of crop residue management practices and nitrogen on yield and quality of wheat and their residual effect on yield of succeeding *Kharif* pearl-millet. Eighteen treatment combination involving six residue management practices and three levels of nitrogen were tested in factorial randomize block design replicated thrice. Growth and yield attributes, total chlorophyll and protein content of wheat crop were increased due to different residue management treatments and FYM than that of control. Addition of wheat straw with N or P_2O_5 or both proved better than its application alone. However, addition of wheat straw @ 5 t ha^{-1} along with 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 days before sowing produced significantly the highest grain and straw yields of wheat. All the growth and yield contributing character, including the grain and straw yields as well as protein content of wheat were recorded highest under the application of 120 kg N ha^{-1} to wheat. Incorporation of wheat straw @ 5 t ha^{-1} alone at 30 days before sowing, wheat straw plus 20 kg P_2O_5 ha^{-1} at 30 days before sowing and wheat straw along with 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 days before sowing showed better residual effect in term of yield of succeeding pearl millet crop.

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Key words : Wheat straw incorporation, FYM, Pearl millet, Protein content, Chlorophyll content

INTRODUCTION

Increasing demand of food to feed the ever growing population along with rising cost of chemical fertilizers and depleting soil fertility owing to intensive cropping system necessitates judicious use of renewable (organic) and non-renewable (inorganic) sources of input energy production which minimize the dependence of crop production on commercial source of energy. Under this junction of national energy crisis, the urgent need is to test easily available alternative sources of energy as farm yard manure, green manuring, rice straw, wheat straw, etc for sustainable crop production and soil health as well to sustain the soil fertility. The complementary effect of organic and inorganic sources may be pronounced in cropping system rather than a single crop.

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. The incorporation of such a large quantities of crop residues, resulted in temporary immobilization of plant nutrients, due to their wider C:N ratio. There by, leading to nitrogen deficiency at early stage of crop growth even after application of recommendation doses of nitrogen. Therefore, application of urea at the time of field preparation may accelerate the rate of decomposition of crop residues, resulting in to grater availability of nitrate N at early stage of crop growth.

Keeping all this in a view, the present experiment was planned to investigate the "effect of residue management practices and rate of nitrogen on growth and yield of wheat and their residual effect on yield of succeeding pear millet crop".

MATERIALS AND METHODS

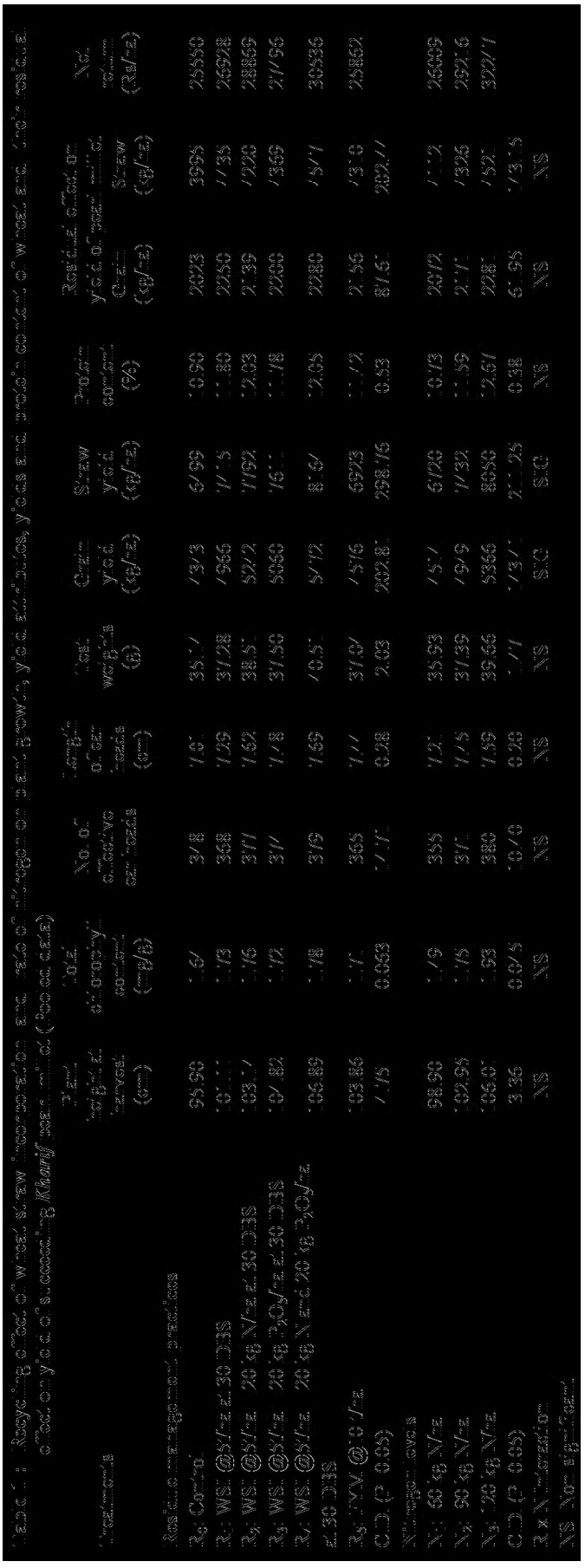
A field experiment was conducted at College Agronomy Farm, Anand Agricultural University, Anand, (22^0-35^l N and 72^0-55^l E) with an altitude of 45.1 m above mean sea level during the *Rabi* and *Kharif* season of the years 2005-06 and 2006-07. The soil of the experimental field was loamy sand in texture (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 spraied 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 does 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* experiment without any application of fertilizers to study the residual effect of treatments impose on wheat.

RESULTS AND DISCUSSION

The results obtained from the present investigation have been discussed in the following sub heads :

Effect of residue managements practices:

The addition of wheat straw with or without inorganic fertilizer or application of FYM @ 10 t ha^{-1} alone significantly increased the plant height, number of effective ear head and length of ear head than that of control (Table



1). However, incase of, total chlorophyll content at 30 DAS and protein content were noticed higher in all wheat straw incorporation treatments, significantly the highest test weight was recorded under addition of wheat straw @ 5 t ha^{-1} along with 20 kg N and 20 kg P_2O_5 ha^{-1}at 30 DBS, which remained at par with incorporation of wheat straw @ 5 t ha^{-1} with 20 kg N ha^{-1} at 30 DBS. The lowest values for all these characters were noted in control. Similar types of results were reported by Brar *et al*. (2000).

Application of wheat straw @ 5 t ha^{-1} at 30 DBS alone or with fertilizer nutrients significantly increased the grain and straw yields of wheat compared with control as well as application of 10 t ha^{-1} FYM alone. Incorporation of wheat straw @ 5 t ha^{-1} at 30 DBS alone and wheat straw @ 5 t ha^{-1} along with 20 P_2O_5 ha^{-1} at 30 DBS remained at par in respect of grain and straw yields of wheat. Similarly, addition of wheat straw @ 5 t ha^{-1} plus 20 kg N ha^{-1} at 30 DBS and wheat straw with 20 kg P_2O_5 at 30 DBS were also found at par in terms of yields of wheat. Significantly highest wheat grain and straw yields was obtained under the incorporation of wheat straw @ 5 t ha^{-1} plus 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 DBS. These finding are in close agreement with those reported by Jat *et al*. (2004).

In corporation of wheat straw holds a promise to perceive the production of succeeding crop. Addition of wheat straw @ 5 t ha^{-1} in conjunction with 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 DBS, wheat straw @ 5 t ha^{-1} plus 20 kg P_2O_5 ha^{-1} at 30 DBS and wheat straw @ 5 t ha^{-1} at 30 DBS alone produced significantly higher grain and straw yields of succeeding *Kharif* pearl millet crop. Almost similar results were also reported by Verma (2001).

On the basis of two years pooled data, the highest net return was obtained when wheat straw was incorporated along with 20 kg N and 20 kg P_2O_5 ha^{-1} at 30 DBS.

Effect of nitrogen rates:

Difference in growth and yield attributes and yield of wheat were found significant due to different rates of N application (Table 1). Application of higher levels of N (120 kg ha^{-1}) significantly increased the plant height, total chlorophyll content at 30 DAS, test weight as well as protein content. While, number of effective ear heads per plant and length of ear head did not differ significantly with the application of 90 and 120 kg N ha^{-1}. The results were conformed by Kibe and Singh (2003).

The application of graded levels of N registered linear and significantly increase in grain and straw yields of wheat. Wheat grain and straw yields were significantly higher with 120 kg N ha^{-1} over 60 and 90 kg N ha^{-1}. The magnitude of yield increased owing to direct application of N with 120 kg ha^{-1} to wheat were 18.9 and 8.4 per cent over 60 and 90 kg N ha^{-1}, respectively.

Application of 120 kg N ha^{-1} also showed its carry over effect on grain and straw yields of succeeding *Kharif* pearl millet crops. The highest net return of Rs 32247 ha^{-1} was obtained with the application of 120 kg N ha^{-1}.

Interaction effect:

An interaction between crop residue management practices and rate of nitrogen was significant only in case of grain and straw yields of wheat (Table 2). When wheat straw @ 5 t ha^{-1} was incorporated along with 20 kg N and 20 Kg P_2O_5 at 30 DBS, grain and straw yields of wheat increased significantly with the increase in rate of nitrogen from 60 to 120 kg N ha^{-1}. Similar trend was also observed in application of FYM. Such trend may be due to the fact that application of N and P at the time of incorporation of wheat straw might have synergistic effect in mineralization of wheat straw and N may be insufficient for the growth of wheat resulted the successive response of N.

It is, therefore, concluded that incorporation of wheat

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

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			

straw @ 5 t ha^{-1} + 20 kg N + 20 kg P_2O_5 ha^{-1} at 30 days before sowing along with application of 120 kg N ha^{-1} obtained highest yield of wheat (GW-496), net return and reduce phosphorus requirement (40 kg P_2O_5 ha^{-1}) of the crop and this practice showed its good carry over effect in the succeeding *Kharif* pearl millet raised with recommended package of practices except without any fertilizer application.

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