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Interaction effect of wheat straw incorporation and nitrogen levels on grain and straw yield of wheat

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ABSTRACT : A field experiment was conducted for two consecutive years on same site at AAU, Anand, during the year 2004-05 and 2005-06, to evaluate the effect of crop residue management practices and nitrogen on yield of wheat. Eighteen treatment combinations involving six residue management practices and three levels of nitrogen were tested in Factorial Randomize Block Design replicated thrice. Interaction effect of wheat straw incorporation @ 5 t /ha along with 20 kg N and 20 kg P_2O_5 /ha at 30 days before sowing along with the 120 kg N/ha produced significantly the highest grain and straw yields of wheat as well as net return.

KEY **W**ORDS : Wheat straw incorporation, FYM, Days before sowing, Grain yield

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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 interaction effect of residue management practices and rate of nitrogen on yield of wheat".

RESEARCH PROCEDURE

A field experiment was conducted at College Agronomy Farm, Anand Agricultural University, Anand,

(22^0-35' N and 72^0-55' E) with an altitude of 45.1 m above mean sea level during the *Rabi* season of the years 2004-05 and 2005-06. 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 at 30 days before sowing (DBS), R_2: WSI @ 5 t /ha+ 20 kg N /haat 30 DBS, R_3: WSI @ 5 t / ha + 20 kg P_2O_5 /haat 30 DBS, R_4: WSI @ 5 t /ha + 20 kg N plus 20 kg P_2O_5 /ha at 30 DBS and R_5: FYM @ 10 t /ha two DBS) and three levels of nitrogen application (N_1: 60 kg N/ ha, N_2: 90 kg N /ha and N_3: 120 kg N/ ha) 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 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 dose of recommended nitrogen (60 kg/ha) through urea was applied at the time of wheat sowing. Remaining half does of N was top dressed after one month of sowing. Wheat variety GW-496 was selected and the crop raised as per recommended package of practices.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under following heads :

Effect of residue managements practices :

Grain and straw yields of wheat were significantly influenced by different residue management practices (Table 1 and 2). Incorporation of wheat straw @ 5 t /ha at 30 DBS alone and wheat straw @ 5 t /ha along with 20 P_2O_5 /ha at 30 DBS remained at par in respect of grain and straw yields of wheat during the both the year and pooled analysis. Similarly, addition of wheat straw @ 5 t /ha plus 20 kg N /ha 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 during the both the year and pooled analysis. Significantly the highest wheat grain and straw yields was obtained under the incorporation of wheat straw @ 5 t /ha plus 20 kg N and 20 kg P_2O_5 /ha at 30 DBS in pooled results. These finding are in close agreement with those reported by Jat *et al*. (2004).

Effect of nitrogen rates :

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

Interaction effect :

The interaction effect between residue management practices and nitrogen levels were observed significant during the both years and in pooled analysis. The data summarized in Table 1 indicated that the treatment combination R_4N_3 recorded significantly highest grain yield of 6057, 6083 and 6070 kg /ha as compared to all other treatment combinations during the years 2004-05, 2005-06 and in pooled results, respectively. The second highest grain yield (5485 kg ha^{-1}) was recorded under the treatment combination R_2N_3, which remained at par with the treatment combinations R_4N_2 (5363 kg/ha), R_1N_3 (5292 kg/ha), R_3N_3 (5225 kg/ha), R_5N_3 (5199 kg/ha) and R_2N_2 (5183 kg/ha) on pooled basis. Comparatively lowest grain yield of 3642, 3660 and 3651 kg /ha were recorded under the treatment combination R_0N_1 as compared to all other treatment combinations, except the treatment combination R_5N_1 during the year 2004-05, 2005-06 and in pooled results, respectively.

Simiar types of results were observed in case of straw yield (Table 2). The treatment combination R_4N_3 recorded significantly the highest straw yield of 9049, 9035 and 9042 kg /ha as compared to all other treatment combinations during the years 2004-05, 2005-06 and in pooled results, respectively. The second highest straw yield (8169 kg/ha) was observed under the treatment combination R_2N_3 followed by R_4N_2 (8040 kg ha^{-1}), R_3N_3 (7961 kg ha^{-1}), R_1N_3 (7917 kg ha^{-1}), R_5N_3 (7809 kg/ha) and R_2N_2 (7746 kg/ha) on pooled basis. Significantly the lowest straw yield of 5436, 5420 and 5428 kg /ha was

observed under R_0N_1 treatment combination as compared to all other treatment combinations, except R_5N_1, during the years 2004-05, 2005-06 and in pooled results, respectively. The marked increase in grain and straw yield under R_4N_3 interaction might be due to enrichment of soil fertility through straw addition in to soil along with nitrogen enhanced the easy and faster mineralization of these organic matters. Thus, it helped in increasing the availability and uptake of the nutrients and thereby increased the growth and finally the yield. The present results closely resembles with those of Rajput *et al*. (1992); Sidhu *et al.* (1994); Subbaiah and Mittra (1997); Hegde (1998); Sharma and Bali (1998); Subrahmaniyan *et al*. (1999); Brar *et al.* (2000) and Sharma (2002).

Economics :

The data shown in Table 3 indicated that the highest net return was obtained when wheat straw was incorporated along with 20 kg N and 20 kg P_2O_5 /ha at 30 DBS. Application of nitrogen @ 120 kg N /ha was recorded the highest net return of Rs. 29192 ha^{-1}. In case of interaction effect, the highest net return of Rs. 33707 /ha was secured with the treatment combination of R_4N_3,

Table 1 : Grain yield of wheat as affected by different interaction effect of residue management practices and nitrogen levels

Treatments	Grain yield (kg ha^{-1})						
	R_0	R_1	R_2	R_3	R_4	R_5	Av.
2004-05							
N_1	3642	4700	5053	4982	4930	3784	4515
N_2	4564	4877	5177	4995	5377	4707	4950
N_3	4821	5277	5484	5216	6057	5167	5337
Av.	4342	4951	5238	5064	5455	4553	
	R		N		R x N		
S.E. ±	102.75		72.658		177.98		
C.D.	295.32		208.82		511.51		
C.V. %			6.25				
2005-06							
N_1	3660	4684	5063	4859	5037	3776	4513
N_2	4341	4946	5189	5076	5349	4790	4949
N_3	5030	5307	5487	5234	6083	5231	5395
	4344	4979	5246	5056	5490	4599	
	R		N		R x N		
S.E. ±	100.50		71.067		174.08		
C.D.	288.85		204.25		500.31		
C.V. %			6.09				
Pooled							
N_1	3651	4692	5058	4920	4983	3780	4514
N_2	4453	4911	5183	5036	5363	4749	4949
N_3	4926	5292	5485	5225	6070	5199	5366
	4343	4965	5242	5060	5472	4576	
	R		N		R x N		
S.E. ±	71.87		50.818		124.48		
C.D.	202.81		143.41		351.28		
C.V. %			6.17				

Table 2 : Straw yield of wheat as affected by different interaction effect of residue management practices and nitrogen levels

Treatments	Straw yield (kg ha^{-1})						
	R_0	R_1	R_2	R_3	R_4	R_5	Av.
2004-05							
N_1	5436	7050	7580	7406	7385	5629	6748
N_2	6831	7307	7753	7475	8055	7054	7413
N_3	7212	7898	8214	7803	9049	7728	7984
Av.	6493	7418	7849	7561	8163	6804	
	R		N		R x N		
S.E. ±	150.32		106.29		260.37		
C.D.	432.03		305.49		748.30		
C.V. %			6.11				
2005-06							
N_1	5420	6969	7342	7269	7434	5717	6692
N_2	6501	7332	7740	7595	8025	7519	7452
N_3	7596	7936	8124	8119	9035	7890	8117
	6506	7412	7735	7661	8165	7042	
	R		N		R x N		
S.E. ±	149.11		105.45		258.26		
C.D.	428.54		303.02		742.25		
C.V. %			6.03				
Pooled							
N_1	5428	7010	7461	7337	7410	5673	6720
N_2	6666	7320	7746	7535	8040	7286	7432
N_3	7404	7917	8169	7961	9042	7809	8050
	6499	7416	7792	7611	8164	6923	
	R		N		R x N		
S.E. ±	105.87		74.86		187.32		
C.D.	298.76		211.25		517.46		
C.V. %			6.07				

Table 3 : Economics of different treatment combinations (Average of two years)

Treatments	Net realization (Rs ha^{-1})						
	R_0	R_1	R_2	R_3	R_4	R_5	Av.
Pooled							
N_1	18890	23744	26391	25376	25559	18332	23049
N_2	25110	25133	27056	25928	28311	25993	26255
N_3	28619	27879	29130	27155	33707	29228	29286
Av.	24206	25585	27526	26153	29192	24518	

followed by 29228 Rs. /ha and 29130 Rs. /ha under the treatment combination of R_5N_3 and R_2N_3, respectively. The lowest net return of Rs. 18890 /ha was accrued under treatment combination R_0N_1.

Conclusion :

It is, therefore, concluded that incorporation of wheat straw @ 5 t /ha+ 20 kg N + 20 kg P_2O_5/ha at 30 days before sowing along with application of 120 kg N /ha obtained highest yield of wheat (GW-496), net return and reduce phosphorus requirement (40 kg P_2O_5 / ha) of the crop.

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