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Mulches and Nitrogen Application Improves Cotton Yield and Fiber Quality

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ABSTRACT

Cotton is an important cash crop and source of foreign exchange. Nitrogen is a critical nutrient for plant growth throughout the life span of the crop. Wheat straw mulch not only source of nitrogen supply but also improves soil fertility and reduces soil erosion. The current study was performed to investigate the effects of mulches and nitrogen application on cotton productivity and fiber quality at the Central Cotton Research Institute (CCRI), Multan. Two crop residues i.e. wheat straw and non wheat straw were used in main plots while nitrogen levels viz. 0,50, 100 and 150 kg ha-1 were randomized in subplots. The highest seed cotton yield (22.99 t ha-1) was obtained by the combination of nitrogen fertilizer application highest level (150 kg N ha-1) along with the wheat straw (20.27 t ha-1). The fiber quality was also affected by the wheat straw along with nitrogen application 150 kg N ha-1 and gave maximum results. In conclusion, wheat straw along with 150 kg ha-1 of Nitrogen application gave maximum results on cotton production as compared to non straw with low nitrogen application.

INTRODUCTION

Agriculture has great importance as concerned to Pakistan and other developing countries. At the time of independence, agriculture was the primary occupation in Pakistan. But with the passage of time industrialization become more important in Pakistan as compared to agriculture. But agriculture has also played its role in the development of the industries. If we exclude agriculture from industries, then we come to know the real importance of agriculture in industries of Pakistan. Cotton (*Gossypium hirsutum*) is a vital and non-food cash crop as well as a source of foreign exchange for different developing countries like Pakistan, India, Bangladesh etc. Cotton contributed 7.0% in foreign exchange as concerned to agriculture and about 1.5% of the total GDP of Pakistan. The total area under cotton crop is about 2879 thousand hectares. It was about 1.6% more as compared to last year area under cotton crop which is about 2835 thousand hectares and giving an average of about 769 kg ha^{-1}. During 2012-13, 13.0 million bales were produced which was 4.0 % less than the previous year (13.6 million bales) and was about 10.3 % less than the target of 14.5 million bales which was mainly caused by less amount of irrigation water provided to plants, less amount of nitrogen fertilizer used in field by the farmers, attack by Cotton Leaf Curl Virus (CLCV) on the plants, the insects and pests of the cotton crop i.e. Mealy Bug, Whitefly, Aphids, Thrips, Bollworms etc. and last picking of the cotton crop due to the higher rates of wheat that was announced by the Government (Govt. of Pakistan, 2012-13).

Cotton belongs to the Malvaceae family. Its fruiting body is called BOLL. The flowers of the cotton plant are self-pollinated and perfect. After picking, seeds and fiber is separated by the simple process of ginning. The fiber is known as the lint which is used for making fabrics as well as clothing (Driscol, 1990). After separating the lint, the seed is used for extracting oil which is used by the food industries and after extracting the remaining husk is used for feeding livestock and is considered as a very nourishing feed for livestock.

Different agronomic practices may change the quality, quantity and placement of plant residues that increase the carbon (C) and nitrogen (N) amount present in the soil. Presence of leguminous crop in the crop rotation increases the amount of nitrogen when it is incorporated back into the soil to the greater depth by using conventional tillage practices (Sianju *et al*., 2006). Mulches which are incorporated in the soil are the main source of biomass which provides energy to the plants and also minimized the fertilizer population (Liu *et al*., 2008). The plots in which wheat straw is incorporated gave higher cotton lint yield as compared to the plots in which the wheat was harvested manually with sickles (Jalota *et al*., 2008).

Cover crop and nitrogen fertilization can make reservoirs of C and enhance its input amount, and give high seed cotton yield (Sianju *et al*., 2006). The less amount of nitrogen can affect the cotton plants in many ways i.e. decreases fiber length, strength, micronaire and large percentage of bolls, by early shedding or by not producing the good quality and quantity of fiber and finally, it leaves effect on the yield of the plants (Read *et al*.,2005).

Nitrogen for plants growth is very important in all stage of its life cycle. As increase with seed cotton yield amount, it increases the seed viability and seedling vigour due to a great amount of nitrogen that is provided to plants in a different time and on different stages (Sawan *et al*., 2009). Organic matter and microorganism cannot increase the yield of cotton alone; however, in the presence of nitrogen, the yield of cotton can be increased. Organic matter and microorganisms along with nitrogen, phosphorus and potassium resulted in a remarkable increase in the seed cotton yield (Khaliq *et al*., 2005). It is hypothesized that mulches along with nitrogen application can enhance cotton yield and quality.

MATERIALS AND METHODS

A field experiment was performed at Central Cotton Research Institute (CCRI), Multan during 2011 to determine the effect of mulches and nitrogen application on cotton productivity under agro-climatic conditions of Multan. The experiment was replicated four times using Randomized Complete Block Design with Spilt plot arrangement. Two wheat straw levels as mulches were placed in main plots while four nitrogen levels viz. 0, 50, 100, 150 kg ha-1 were kept in subplots. The crop was sown on May 06, 2011. The seed was taken from Central Cotton Research Institute, Multan. Sowing was done on beds by dibbling the seeds manually and then irrigated. The plant to plant distance was 22.5cm while 75cm was maintained between rows. To avoid the patchy appearance gap filling was done after seven days. When the cotton plants reached 22cm length, thinning was done to obtain the required plant population. First irrigation was applied to the seventh day after planting the crop and subsequent irrigations were made when required by the crop.

Observations: First picking was done manually on November 11, 2011, from five randomly selected plants from each plot. Plant height was measured from the first cotyledon node above the ground surface with the help of measuring tape. Five numbers of buds, bolls and nodes per plant were taken randomly from each plot and then averaged. The seed cotton yield was taken by picking the cotton from each plot and was computed in kg ha^{-1}. Fiber characteristics, staple length (inches), micronaire, uni. index value (%) and fiber strength were studied by using the High Volume Instrument (HVI).

Statistical analysis: Recorded data was subjected to statistical analysis on MSTATC software and ANOVA technique was used to compute the means. The significance among means was tested by LSD test using 5% probability (Steel and Torrie, 1997). Microsoft Excel 2007 computer program was used to present the data in graphical form.

RESULTS

Data presented show that the influence of nitrogen application was significant for plant height, buds per plant and bolls per plant (Table 1). Similarly, straw mulch significantly enhanced the plant height; however, the influence was non-significant for buds per plant and bolls per plant (Table 1). However, the interaction of nitrogen with mulches was non-significant for plant height, buds per plant and bolls per plant (Table 1). Likewise, nitrogen application significantly affected the seed cotton yield and boll opening percentage; however, the influence was not significant for fiber quality in terms of staple length, micronira, uni index value and fiber strength (Table 2). Straw mulches also significantly influenced the seed cotton yield and boll opening percentage; whereas, fiber quality remained uninfluenced for mulch application (Table 2). Interaction of nitrogen with mulch was not significant for seed cotton yield, boll opening percentage, staple length, micronira, uni index value and fiber strength (Table 2).

Increase in nitrogen amount application increased the plant height, buds per plant and bolls per plant with maximum value from the application of 150 kg ha-1 N. Maximum seed cotton yield, boll opening percentage, fiber quality was obtained from the application of 150 kg ha-1 N (Table 1-2). Similarly, application of straw mulch increased plant height, yield and yield components and improved fiber quality as compared to non straw mulch (Table 1-2). Although the influence of nitrogen and mulching was not significant for fiber quality parameters; however, an increasing trend was observed with increase in nitrogen concentration and mulching (Table 1-2).

Table 1: Influence of mulches and nitrogen application on plant height, buds per plant and bolls per plant of cotton

Treatments	Plant height (cm)		Buds per plant	Bolls per plant	
	October	November	October	October	November
Nitrogen (N)					
0	96.84c	96.85c	19.78ab	14.85c	15.50c
50	99.75b	99.85bc	21.13a	18.26bc	20.00b
100	101.38ab	101.57ab	21.75a	19.13b	23.50ab
150	103.40a	103.40a	22.38a	20.54a	24.50a
Significance	2.29*	3.21*	1.74*	1.23*	2.89*
Mulches (M)					
Straw	101.06a	101.13	21.53	19.16	21.75
Non straw	99.74b	99.71	20.99	17.23	20.00
Significance	1.17*	ns	ns	ns	ns
N×M					
Significance	ns	ns	ns	ns	ns

Figures sharing same letter did not differ significantly at $P \leq 0.05$, * = significant, ns = non significant

Table 2: Influence of mulches and nitrogen application on yield, boll opening percentage, staple length, micronire, uni index value and fiber strength of cotton

Treatments	Yield (t ha^{-1})	Boll opening %age	Staple length (inches)	Micronira (%)	Uni index value (%)	Fiber strength
Nitrogen (N)						
0	13.96d	62.45a	27.02	5.29	82.38	28.09
50	17.92c	55.70d	27.09	5.15	82.40	27.45
100	21.66b	61.10b	26.99	5.16	81.86	27.98
150	22.99a	57.50c	26.93	5.24	82.16	27.25
Significance	1.19*	1.19*	ns	ns	ns	ns
Mulches (M)						
Straw	20.27a	66.6a	27.09	5.18	81.95	27.41
Non straw	17.99b	51.7b	26.93	5.24	82.44	27.98
Significance	1.73*	1.23*	ns	ns	ns	ns
N× M						
Significance	0.84*	ns	ns	ns	ns	ns

Figure sharing same letter did not differ significantly at $P \leq 0.05$, * = significant, ns = non significant

Interestingly, it was observed that as we increased the amount of nitrogen fertilizer in different time the plant physiology, yield and yield components and fiber quality also enhanced along with the mulches of wheat straw and there is a uniformity as in the start the recorded data of physiology, yield and yield components and quality parameters are more on high level of nitrogen in the plot where the mulch is present in form of wheat straw as compared to same applied nitrogen level in the field with no mulch is present in the field (Table 1-2).

DISCUSSION

The results of the study clearly indicated that mulches and nitrogen application improved the productivity of cotton crop in terms of plant height, lint yield and boll opening percentage and fiber quality. Maximum seed cotton yield was observed where 150 kg of nitrogen was applied along with straw mulching (Table 2). Higher seed cotton yield in the crop is the direct result of the availability of maximum nitrogen concentration to the plants which favours the photosynthetic rate and is directly involved in plant growth and development. High nitrogen availability along with straw mulch enhances the availability of nitrogen to the plants and reduces moisture and nutrient losses through leaching and evaporation. High availability of nitrogen resulted in more photosynthetic rate and thus enhanced the plant height, the number of nodes per plant, number of bolls per plant, higher boll opening %age and finally more yield (Table 1-2). Cover crop and nitrogen fertilization can make reservoirs of C and enhance its input amount, and give high seed cotton yield (Sianju *et al*., 2006). Mulches which are incorporated in the soil are the main source of biomass which provides energy to the plants and also minimized the fertilizer population (Liu *et al*., 2008).

Nitrogen has a significant effect on seed cotton yield and its components. Among the yield components, the number of bolls per plant reduced from 150 to 0 kg of nitrogen application respectively. Earlier, the decline in boll weight was also observed due to decline in nitrogen concentration and straw mulch improved boll weight. The plots in which wheat straw is incorporated gave higher cotton lint yield as compared to the plots in which the wheat was harvested manually with sickles (Jalota *et al*., 2008).

The cause of the reduction in seed cotton yield and its components are only due to low nitrogen availability but also due to various disease infestations that can be managed via agronomic practices. The cotton genotypes can be managed with increasing plant population and nitrogen fertilizer to achieve optimum seed cotton yield and reduce the chances of disease infestation (Iqbal *et al*., 2005). The variability in the natural incidence of the disease depends upon the genetic makeup of the cultivar, concentration of inoculum of the disease and cultural management at different sites. The results of this study corroborate with those of Liu *et al*. (2008) who reported that mulches which are incorporated in the soil are the main source of biomass which provides energy to the plants and also minimized the fertilizer population.

CONCLUSION

From the results, it is concluded that a decreased amount of nitrogen decreased the seed cotton yield along with its components. However, straw mulch along with nitrogen application improved the seed cotton yield. Among different nitrogen and mulches used, 150 kg of nitrogen along with straw mulch was the most effective combination and proved worthwhile in this regard.

REFERENCES

Driscol, C.J. 1990. Plant Sciences; Production, genetics and breeding. Elli Horwood Limited, England. P. 81.

GOP. 2012. Economic Survey. 2012-13. Government of Pakistan, Ministry of Finance, Division, Economic Wing, Islamabad.

Iqbal, M., M. Z. Iqbal, R. S. A. Khan and K. Hayat, 2005. Comparison of obsolete and modern varieties in view to stagnancy in yield of cotton (Gossypium hirsutum L.). Asian J. Pl. Sci. 4: 374-378

Jalota, S.K., G.S. Buttar, A. Sood, G.B.S. Chahal, S.S. Ray and S. Panigrahy. 2008. Effect of sowing date, tillage and residue management on productivity of cotton-wheat system in northwest India. Soil and Tillage Research, 99: 76-83.

Khaliq, A., M.K. Abbasi and T. Hussain. 2005. Effects of integrated use of organic and inorganic nutrient sources with Effective microorganisms on seed cotton yield in Pakistan.

Liu, R.X., Z.G. Zhou, W.Q. Guo, B.L. Chen and D.M. Oosterhuis.2008. Effect of N fertilization on root development and activity of water stressed cotton plants. Agricultural Water Management,95:1261-1270.

Read, J.J., K.R. Reddy and N. Jenkins. 2005. Yield and fiber quality of upland cotton as influenced by nitrogen and potassium nutrition. European Journal of Agronomy, 24:282- 290.

Sainju, U.M., A.Lenssen, T.C. Thonthat and J. Waddle. 2006. Dryland plant biomass and soil carbon and nitrogen fractions on transient land as influenced by tillage and crop rotation. Soil and Tillage Research, 93:452-461

Sainju, U.M., B.P. Singh, W.F. Whitehead and S. Wang. 2006. Carbon supply and storage in tilled and non tilled soils as influenced by cover crops and nitrogen fertilization. Journal of Environmental Quality, 35:452-461

Steel, R. G. D. and J. H. Torrie, 1997. Principles and Procedures of Statistics: A Biometrical Approach, pp: 187–188. McGraw Hill Company: New York.