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FIBER QUALITY OF COTTON (*Gossypium hirsutum*) CULTIVARS UNDER DIFFERENT PHOSPHORUS LEVELS

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ABSTRACT

The present study investigates the effect of phosphorus levels on fiber quality traits of three cotton cultivars (CIM 496, MNH 786 and FH 901) field tested during kharif 2008 against four phosphorus levels (0, 30, 60 and 90 kg ha^{-1}). Cultivars differed significantly with respect to fiber quality traits but Phosphorus levels did not show significant effect except for ginning out turn. MNH 786 showed maximum fiber strength, fineness, uniformity, fiber elongation and minimum GOT, while FH 901 showed maximum GOT against minimum values for other quality traits.

Key words: Cotton cultivars, phosphorus, GOT, fiber quality.

INTRODUCTION

Cotton (*Gossypium hirsutum*) is the most important fiber crop of the world (Killi and Aloglu, 2000), cash crop of Pakistan which earns a good fortune for the country in the form of foreign exchange (Ahmad *et al*., 2009). Cotton genotypes vary with respect to fiber quality (Mohammad, 2001) and lint percentage (Moser *et al*., 2000). Soil test carried out in Pakistan showed lack of nitrogen, severe deficiency of phosphorus and little deficiency of potassium (Wahhab, 1985) whereas response of cotton to phosphorus has been positive and economical (Gill *et al*., 2000). Due to indeterminate growth habit and deep root system phosphorus requirement of cotton are very low (Malik *et al*., 1996), however fiber properties of cotton may be affected by temperature, humidity, soil moisture (Killi *et al*., 2005) and fertilizers (Abid *et al*., 2007). The lint percentage was little affected due to phosphorus application (Makhdum *et al*., 2000) while lint index increased with increasing phosphorus levels which could be the nutrient response and availability leading to initiation and development of greater number of fibers per seed (Sawan *et al*., 2008). Fiber strength was highest with the highest P fertilizer while fiber fineness, uniformity ratio, length and maturity coefficient did not change (Mehetre *et al*., 1990). Malik *et al*. (1992) observed that phosphorus had no consistent effect on fiber properties. El-Debaby *et al*. (1995) reported that higher p rate resulted in a slight reduction in lint percentage. Sharma *et al*. (1991) stated that fiber quality improved by phosphorus application. Vieira *et al*. (1998) found that fiber length of cotton was increased by phosphorus application. Keeping in view the above contradictory reports, a study was planned to see the effect of phosphorus application rates on quality determining traits of diverse cotton cultivars.

MATERIALS AND METHODS

A field experiment was carried out to determine the effect of phosphorus on fiber quality traits of 3 cotton cultivars at Agronomic Research Area, University of Agriculture Faisalabad during Kharif 2008. The trial was arranged in a randomized complete block design with factorial arrangement and replicated thrice. Seedbed was prepared by cultivating the field two times with tractor mounted cultivar each followed by planking. The crop was sown on sandy clay loam soil. Sowing was done on well prepared seed beds on 2nd June, 2008, with the help of single row hand drill. Each plot consisted of four rows (6 m long) with 0.75 m distance between rows. Thinning was done at four leaf stage to keep P x P distance of 0.30 m. Experimental treatments comprised of three cotton cultivars viz. CIM 496 (V1), MNH 786 (V2) and FH 901 (V3) and four phosphorus levels viz. 0 (P0), 30 (P1), 60 (P2) and 90 (P3) kg ha^{-1}. A dose of 120 kg N ha^{-1} and phosphorus as per treatment were applied in the form of urea and single super phosphate, respectively. Whole of P was applied at sowing and nitrogen was applied in three equal splits viz. at sowing, after 35 days and 65 days of sowing. Overall nine irrigations were applied and weeds were controlled by two hoeings at 30 and 65 days after planting. Insecticides were applied to control the sucking insects (Aphid, Jassid, Whitefly, Thrips and Mites) and bollworms (American bollworm, Pink bollworm and Spotted bollworm). All other agronomic practices were kept normal and uniform for all the treatments. When seedlings were well established, ten guarded representative plants were selected randomly in each plot

and marked for identification. These plants were monitored and tagged to record data. Ginning out turn (%) was calculated after roller ginning approximately 150 g samples of the harvested seed cotton and GOT (%) was computed by using the following formula given by Singh (2004).

GOT (%) = (Weight of lint in sample / Weight of seed cotton in that sample) x 100

After ginning, 50 g lint samples were used for determination of various quality parameters. Lint quality parameters were determined in high volume instruments (HVI): (a) fiber strength as force (g tex^{-1}) necessary to break the fiber bundle, (b) fiber fineness; expressed in standard micronaire units, (c) fiber uniformity; determined as the ratio of the mean length to upper-half mean length expressed as percentage and (d) fiber elongation; expressed in percentage. All fiber tests were carried out at the laboratories of Fiber technology department in University of Agriculture, Faisalabad.

Statistical analysis: Data collected on different parameters were analyzed statistically by using MSTAT-C program (Anonymous, 1986) for analysis of variance and means were compared using Fisher's protected least significance difference (LSD) test at 5 % probability level (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Cultivar is the main factor influencing fiber quality while agronomic practices are of secondary importance in cotton crop (Bednarz *et al*., 2005). Application of fertilizers increased ginning out turn (Kumbhar *et al*., 2008) while application of phosphatic fertilizer did show non-significant effect on quality of cotton fiber (Makhdum *et al*., 2000). The presented study indicated that fiber quality characters mainly remained unaffected (P>0.05) by phosphorus application rates while varieties differed with respect to most of quality traits.

Ginning out turn (%): Data pertaining to ginning out turn showed significant effect on cultivars and phosphorus levels while interaction cultivars x phosphorus levels was found to be non significant (Table 1). Statistically maximum GOT (38.9 %) was recorded in FH 901, followed by CIM 496 (37.7 %) and MNH 786 (36.8 %) while phosphorus levels maximum GOT (39.2 %) was observed at phosphorus level of 90 kg ha^{-1}, followed by (38.5, 37.1 and 36.4 %) 60, 30 and 0 kg ha^{-1} (Table 2). Our findings are similar to Malik *et al*. (1996) who reported that genetic effects on quality of fiber while little direct effect from phosphorus can be elucidated. Hassan *et al*. (2006) and Wang *et al*. (2004) reported that GOT was affected by cultivars while phosphorus levels had significant effect on lint index (Sawan *et al*., 2008).

Fiber strength (g tex^{-1}): Fiber strength is an important trait in determining yarn spinability, because weak fiber (low strength) are difficult to handle during manufacturing process (Saleem *et al*., 2010). Table 1 shows that cultivars (V) affected significantly while phosphorus (P) and interaction, V x P were found to be non significant in this respect. Maximum fiber strength (25.2 g tex^{-1}) was observed in MNH 786 and minimum was recorded in FH 901 (24.1 g tex^{-1}) (Table 2). Faircloth (2007) reported that fiber strength varies among cultivars. Linear correlation coefficient for ginning out turn (%) vs. fiber strength (g/tex) was -0.356 (Fig-1a) that shows that fiber strength decreased with increase in ginning out turn.

Fiber fineness (micronaire): The comparison of treatment means indicated that cultivars had significant effect on fiber fineness while phosphorus levels and interaction cultivars x phosphorus levels was non significant (Table 1). Statistically maximum thickness of fiber (minimum fineness) was recorded in case of MNH 786 (3.4 micronaire) while minimum fiber thickness (maximum fineness) was found in CIM 496 (3.0 micronaire) which was at par with FH 901 (3.1 micronaire). Copur (2006) and Ehsan *et al*. (2008) concluded that cultivars differed with respect to fiber fineness. The was a negative correlation (-0.354) between fiber fines and GOT indicating that fiber fineness will be more poor with more GOT.

Fiber uniformity: Data regarding fiber uniformity (%) revealed that cultivars had significant while phosphorus levels and interaction (cultivars x phosphorus levels) were found to have non significant effect on fiber uniformity as shown in Table 1. Comparison of treatments' means (Table 2) showed that MNH 786 and CIM 496 had statistically more fiber uniformity (51.5 % and 51.2 %, respectively) than FH 901 (48.4 %). Our results are similar with the findings of Bednarz *et al*., 2005 who reported that fiber uniformity is a genetically controlled character and can be improved by selection. Relationship between GOT and fiber uniformity was poor (r = 0.423), however trend line indicates that improving a

Table 1. Mean square values from analysis of variance of fiber quality traits of cotton cultivars.

S.O.V	d.f	GOT (%)	FS (g/tex)	FF (micro-nair)	FU (%)	FE (%)
Replication	2	0.08	0.17	0.01	0.68	0.05
Varieties (V)	2	12.86*	3.36*	0.41*	34.38*	3.16*
Phosphorus (P)	3	14.84*	0.04ns	0.01ns	0.39ns	0.02ns
VxP	6	0.61ns	0.03 s	0.00ns	0.10ns	0.01ns
Error	22	0.33	0.32	0.04	0.55	0.09

ns= Non-significant, * Denotes significance at the 0.05 level of probability. **SOV=** Source of variation, **d.f=** Degree of freedom**, GOT=** Ginning out turn (%), **FS=** Fiber strength (g/tex), **FF=** fiber fineness (micronair), **FU=** Fiber uniformity (%) and **FE=** Fiber elongation (%).

variety for GOT will make it poor for fiber uniformity (Fig-1c).

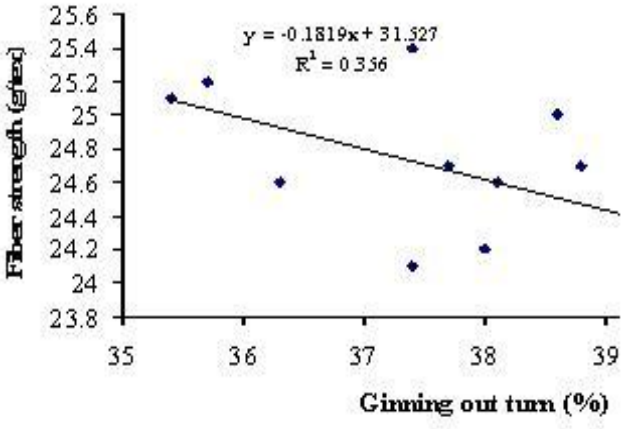
Fiber elongation: Analysis of variance (Table 1) shows that cultivars had significant while phosphorus levels and interaction had non significant effect on fiber elongation (%). Statistically maximum fiber elongation (6.6 %) was recorded in MNH 786 followed by CIM 496 (6.4 %) and FH 901 (5.7 %) as shown in Table 2. Our results are similar with the finding of Saleem *et al*. (2010) who reported that varieties differed with respect to fiber elongation and fertilizer application did not show any effect on fiber quality traits of cultivars. Linear correlation coefficient (r) value for ginning out turn vs. fiber elongation was 0.306 (Fig-1d) which indicates that the relation ship was poor.

Table 2. Effect of cotton cultivars and phosphorus rate on fiber quality

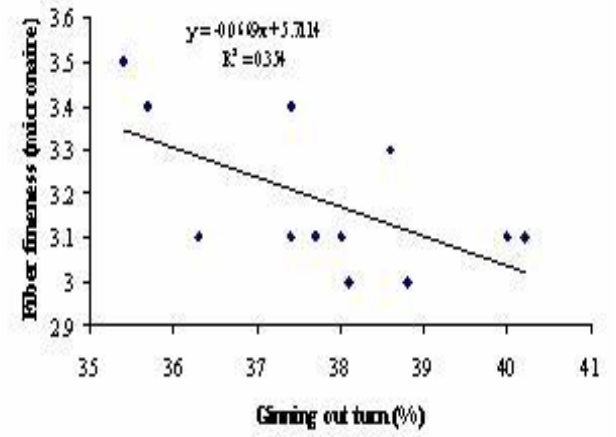
Treatments	GOT (%)	FS (g/tex)	FF (micro-nair)	FU (%)	FE (%)
Varieties (V)					
CIM 496	37.7 b	24.7 b	3.0 b	51.2 a	6.4 b
MNH 786	36.8 c	25.2 a	3.4 a	51.5 a	6.6 a
FH 901	38.9 a	24.1 c	3.1 b	48.4 b	5.7 c
LSD (p=0.05)	0.48	0.48	0.18	0.63	0.25
P rate kg ha^{-1} (P)					
0	36.4 d	24.6	3.2	50.6	6.2
30	37.1 c	24.7	3.2	50.4	6.3
60	38.5 b	24.7	3.2	50.2	6.2
90	39.2 a	24.6	3.1	50.1	6.2
LSD (p=0.05)	0.56	ns	ns	ns	ns
Interactions (V x P)					
CIM 496 x 0	36.3	24.6	3.1	51.6	6.4
CIM 496 x 30	37.7	24.7	3.1	51.3	6.4
CIM 496 x 60	38.1	24.6	3.0	50.8	6.3
CIM 496 x 90	38.8	24.7	3.0	51.0	6.4
MNH 786 x 0	35.4	25.1	3.5	51.7	6.6
MNH 786 x 30	35.7	25.2	3.4	51.5	6.8
MNH 786 x 60	37.4	25.4	3.4	51.5	6.7
MNH 786 x 90	38.6	25.0	3.3	51.1	6.6
FH 901 x 0	37.4	24.1	3.1	48.5	5.7
FH 901 x 30	38.0	24.2	3.1	48.5	5.8
FH 901 x 60	40.0	24.2	3.1	48.3	5.6
FH 901 x 90	40.2	24.0	3.1	48.3	5.6
LSD (p=0.05)	Ns	ns	ns	ns	ns

Mean not sharing a letter in common within a column differ significantly at 5% probability level. ns= Non-significant, **GOT=** Ginning out turn (%), **FS=** Fiber strength (g/tex), **FF=** fiber fineness (micronair), **FU=** Fiber uniformity (%) and **FE=** Fiber elongation (%).

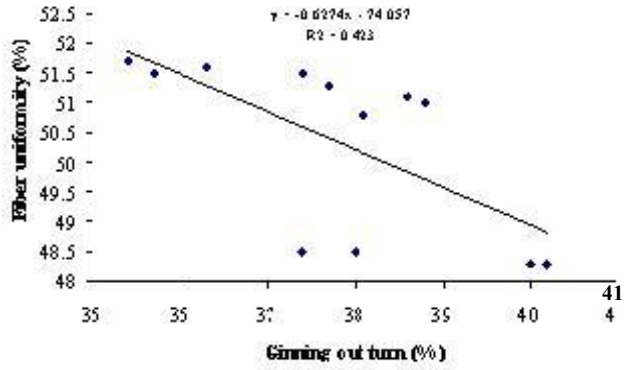
(a)



(b)



(c)



(d)

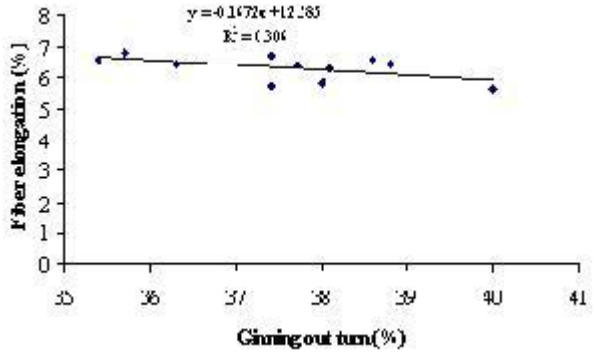


Fig.-1: Relationship between ginning out turn (%) and quality traits of cotton fiber.

Conclusion: Amongst the tested cultivars, MNH 786 showed significantly higher fiber strength, fiber fineness, fiber uniformity and fiber elongation but phosphorus application at any level did show no effect on these traits. Ginning out turn of a variety is negatively correlated with most fiber quality determining traits however; it showed improvement with increasing phosphorus application rate.

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