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FIBRE QUALITIES OF BOLLS DEVELOPED UNDER DIFFERENT DAY AND NIGHT TEMPERATURES IN VARIOUS PAKISTANI COTTON VARIETIES AND MUTANT STRAINS

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Four commercial cotton varieties NIAB-78, B-557, SLH-41, MNH-93 and four advanced mutants strains N-82, L-21, L-25 and M-626 were used to study the effect of temperature on fibre quality during boll developing stage. The results showed that varieties differed significantly in all fibre quality parameters. There was significant increase in fibre length under medium temperature range while significant increase in fibre strength and highly significant increase in Micronaire values and maturity index under high temperature conditions. The medium temperature range (24.5 to 30.6°C) seemed to be ideal for cotton fibre development.

Keywords: Cotton, Fibre quality, Temperature effect, Developing bolls

1. Introduction

Cotton, the silver fibre, is the most important natural fibre whose versatility and individuality is recognized throughout the world. Being a natural fibre crop, its quality parameters are impaired during the growth of fibre and are the result of interaction between genetic and environmental factors. Most fibre properties depend upon variety, while others are influenced more by the environment. Foreign matter, neps, short fibre contents and contamination are the outcome of growing, harvesting and ginning practices. Two distinct periods exist during fibre growth; first one is the elongation upto 25 days after anthesis and then the secondary wall formation from 25th day till boll opening. A third period is the weathering of fibre on the plant after opening of the boll. Ideal day and night temperature (26 °C to 28 °C), sunshine, adequate weather, sufficient nutrition elements and effective weed control warrant high maturity value. On the other hand early defoliation and infestation of pests and diseases result in low maturity.

Some previous research workers have studied the effect of temperature on the fibre qualities in the past. Gibson and Ray [5] reported that temperature below 20 ^{o}C reduces fibre length, fibre elongation period increases and fibre growth rate is slow. Shakkur [9] revealed that increase in the temperature decreases the G.O.T, while micronaire value and fibre maturity are increased. Winjura and Barker [15] reported that the Micronaire is positively correlated with temperature and 27 ^{o}C appears to be an adequate temperature to achieve maximum Micronaire. Fibre strength increases as the temperature increases while fibre length is not affected. Cui et al. [2] stated that the length of cotton fibre varies not only between the varieties, but also within the same variety due to growth environment, within the same plant due to position of the boll, within the same boll due to individual seed nutrient and within the same seed due to position of the fibre on the seed. While Hsieh and Wang [7] concluded that the length depends upon both Varietal (genetic) and growing (environmental and developmental) factors. They further mentioned that lower tensile strength of fibre from mature bolls may be due to exposure to different environmental i.e. extended time on the plant or exposure to the moisture and heat level. According to Thaker et al. [14] staple length is not affected with temperature and according to Gibson and Ray [5] growth and development of cotton fibre is closely associated with night temperature. In the same perspective Liu et al. [9] stated that the length variations of single fibre properties within a single variety suggest a very strong influence of growth condition and development.

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Hesketh and Low [6] reported that at high temperature G.O.T and staple length decreased while Micronaire and maturity increased. According to Quensenberry and Kohal [11] long staple cotton varieties are more responsive to heat units than the short staple cotton varieties. The previous work was reported to be performed under controlled laboratory conditions, therefore, this experiment was planned to study and confirm the temperature effect under field conditions.

2. Materials and Methods

Cotton seed of NIAB-78, MNH-93, B-557, SLH-41, (Commercial Cotton varieties) NIAB-82, L-21, L-25 and M-626 (Mutant Strains) were sown in the cotton experimental area of Nuclear Institute for agriculture and Biology on 20th May 1997 in six replications. The fertilizer, irrigation, plant protection and other inter cultural practices were according to normal agronomic practices. All the varieties began to flower from 15th to 30th July 1997, and 200 flowers were tagged on 1st. August, 1st September and 1st. October 1997 in each variety as well as replication. Three temperature ranges (high, medium and low) were 26.55 to 34 ^{o}C, 24.5 to 30.6 ^{O}C and 15.4 to 21.5 ^{O}C (Average day-night temperature of August-September, September-October and October-November) respectively. Fifty bolls samples were picked from each variety in each replication and seed cotton was ginned on roller ginning machine. The lint samples were cleaned and blended on Shirley Analyzer and were analyzed for physical fibre qualities in our fibre testing laboratory NIAB. The staple length, Micronaire value, fibre strength and maturity index were determined by tuft method, Sheffield Micronaire, Pressley strength tester and two compression method respectively using ASTM Standard Techniques ASTM [1]. The data was statistically analyzed and the mean values were compared by using Duncan Multiple Range Test [13].

3. Results and Discussion

3.1. Staple length

The staple length showed significant differences at different temperature regimes (Table 1); whereas the differences among the varieties as well as interaction between the two were highly significant. The medium temperature with mean value (28.78 ^{o}C) gave significantly higher staple length as compared to other two length value. The lowest temperature significantly reduced the staple length (28.57 ^{o}C), while the high temperature with mean value (28.68 ^{o}C) was in between the two temperatures. The data regarding varieties showed that NIAB-82 gave the longest staple length i.e 30.20 followed by L-25 and Mut-626 with mean values of 29.88 and 29.56 respectively. The variety B-557 gave the shortest staple length (27.29 ^{o}C) followed variety SLH-41 (27.39 ^{o}C). The present studies are supported by the findings of [5, 6 and 9]. According to them fibre development is directly associated with the night temperature and staple length reduced below 20°C. Medium temperature range (24.5 to 30.6 °C) seemed to be ideal for the development of cotton fibre.

3.2. Micronaire value

The differences among the mean micronaire values of temperatures as well as varieties and the interactions between the two were highly significant (Table 2). At high temperature highest micronaire value (4.50) was recorded. The low temperature gave the lowest (3.75) and the medium temperature resulted in a value of (40.4). The results showed that the micronaire value is positively correlated with temperature. The data on varieties indicated that MNH-93 gave the highest Micronaire (4.54) followed by L-21 and NIAB-78 with mean values of 4.45 and 4.25 respectively. Mutant NIAB-82 gave the lowest Micronaire value of (3.77). Previously Devwer [3] mentioned that the micronaire is an indirect measure of fibre fineness. Excessive vegetative growth, cool night temperature and high population can lower micronaire. Late fruit shed, high night temperature and mild drought can raise it. These results are in confirmation with the findings of [8,12,15]. According to them micronaire value increased with the increase of the temperature.

3.3. Fibre strength

The data on fibre strength (Table 3) revealed that differences at different temperatures regimes as well as varieties and the interactions between the two were significant. The data on temperatures indicated that the fibre strength is positively associated with temperature. The high temperature with mean value gave the highest fibre strength (92.91), whereas the low temperature with mean value (91.80) indicated the lowest fibre strength while the medium temperature with mean value (92.82) was in between the two extreme temperatures. It is clear from the data that fibre strength increased with the increase of temperature. The data on varieties showed that MUT-626 gave highest fibre strength (95.47)

Table 1. Mean values of staple length (mm).

Var. Temp	NIAB 78	NIAB 82	L-21	L-25	MUT 626	B-557	MNH 93	SLH 41	Means
High	28.43	30.10	28.32	29.85	29.47	27.42	28.43	27.37	28.67ab
Med	28.67	30.57	28.20	29.92	29.67	27.38	28.17	27.67	28.78a
Low	28.45	29.95	27.98	29.88	29.53	27.08	28.50	27.15	28.57b
Means	28.52d	30.21a	28.17e	29.88b	29.56c	27.29f	28.37de	27.39f	

LSD-VAR: 5%=0.2682 LSD-TEMP: 5%=0.1642 LSD V X T: 5%=0.4645
1%=0.3546 1%=0.6143

Table 2. Mean values of micronaire (ug / in.)

Var. Temp	NIAB 78	NIAB 82	L-21	L-25	MUT 626	B-557	MNH 93	SLH 41	Means
High	4.56	4.63	4.93	4.35	4.28	4.45	4.97	4.34	4.50a
Med	4.19	3.72	4.33	4.04	3.93	3.73	4.48	3.88	4.04b
Low	4.00	3.47	4.09	3.49	3.73	3.58	4.16	3.69	3.75c
Means	4.25c	3.77f	4.45b	3.96d	3.98d	3.85e	4.54a	3.97d	

LSD-VAR: 5%=0.0362 LSD-TEMP: 5%=0.0222 LSD-V X T: 5%=0.0626
1%=0.0478 1%=0.0293 1%=0.0828

Table 3. Mean values of fibre strength (000psi).

Var. Temp	NIAB 78	NIAB 82	L-21	L-25	MUT 626	B-557	MNH 93	SLH 41	Means
High	94.00	91.67	92.95	93.77	96.83	91.72	90.03	92.32	92.91a
Med	92.82	91.55	91.98	93.40	95.55	91.73	90.20	92.40	92.82b
Low	92.65	90.88	91.57	93.13	94.02	91.03	89.15	91.95	91.80c
Means	93.16b	91.70d	91.17c	93.43b	95.47a	91.49d	89.79e	92.22c	

LSD-VAR: 5%=0.5722 LSD-TEMP: 5%=0.3504 LSD-V X T: 5%=0.9911
1%=0.7566 1%=0.4633 1%=1.3110

Table 4. Mean values of maturity index (%)

Var. Temp	NIAB 78	NIAB 82	L-21	L-25	MUT 626	B-557	MNH 93	SLH 41	Means
High	78.20	76.15	78.55	77.63	77.07	75.65	78.17	77.23	77.33a
Med	76.70	75.35	77.60	76.47	75.25	74.87	75.77	75.42	75.93b
Low	75.85	74.28	76.57	73.92	74.22	73.53	73.97	73.93	74.41c
Means	76.58b	75.76d	77.57a	76.01c	75.51d	74.68e	75.97c	75.53d	

LSD-VAR: 5%=0.3770 LSD-TEMP: 5%=0.2309 LSD-V X T: 5%=0.6530
1%=0.4985 1%=0.3053 1%=0.8634

followed by L-25 and NIAB-78 with mean values of (93.43) and (93.16) respectively. The present results are supported by those of [15] who reported that the strength increased with the increase of temperature.

3.4. Maturity Index

The data on maturity index indicated the differences among the temperatures as well as varieties and the interactions between the two were highly significant (Table 4). The data regarding the temperatures showed that high temperature gave highest maturity index (77.33) followed by medium temperature (75.93) and low temperature (74.41) showing that maturity decreased gradually with the decrease of temperature. L-21 gave the maximum fibre maturity (75.57) followed by NIAB-78. Previously Pyke and Schulze [10] concluded that variety, location, environment, processing and their interaction have a great significant effect upon fibre maturity. The present results coincide with the earlier reports [8,12, 15].

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