

SCREENING OF CANDIDATE VARIETIES IN NCVT (2007-08) FOR COTTON LEAF CURL VIRUS BY A MODIFIED DISEASE SCORING SCALE

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ABSTRACT

Twenty advanced lines of cotton in the National Coordinated Varietals Trial were screened for cotton leaf curl disease (CLCuD) and seed cotton yield during the year 2007-08. The experiment was laid out according to RCB design in four replicates. All the cultural operations and plant protection measures were adopted in optimal fashion. A rapid and convenient modified scale for rating of CLCuD was developed for screening the material in the field for large population and also for single plants. Among these one line showed traces (Rating 2) of disease and was highly resistant. Nine lines were resistant having a rating of up to 3 and six were tolerant (Rating 4) while three were rated as moderately tolerant with rating of 5 and one line was found to be susceptible (Rating 6). The highest seed cotton yield (6033 kg ha⁻¹) was found in VH-255 with a plant population ha⁻¹ of 35557 and resistant to CLCuD followed by Cris 129 (5815 kg ha⁻¹ seed cotton yield), and Cris 342 (5793 kg ha⁻¹ seed cotton yield) with rating of 3. NIAB-846 rated 4 with the yield of 5794 kg ha⁻¹.

Key Words: Cotton, Cotton Leaf Curl Virus, disease rating, seed cotton yield, resistance

INTRODUCTION

Cotton being the most important fiber and food crop of Pakistan contributes significantly to the national economy. It accounts 10.5 % of value added in Agriculture and about 2.4 % to GDP. In Pakistan, it is grown over a vast area of about 3.08 million hectares with annual production of 12.86 million bales (Anonymous, 2008). A number of promising mutants including NIAB-78 were developed during 1980 decade by irradiation of F1 hybrid seed and from direct seed irradiation. With the introduction of NIAB-78 the total cotton production of Pakistan jumped from 3 million bales of lint with 223 Kg average yield ha⁻¹ during 1983-84 to 12.8 million bales of lint with 769 Kg ha⁻¹ average yield during 1991-92 (Ahloowalia *et al.*, 2004). Cotton production dropped to 8.0 million bales in 1993-94 and the situation prevailed in next years with yield fluctuation due to main cause of Cotton Leaf Curl Virus (CLCuV). Other main causes were heavy insect/pest infestation (especially mealy bug damage in recent years) and lack of such varieties which could have wider adaptability against diseases and pests. There are some candidate varieties which are not resistant but have very good yield potential even in the presence of (CLCuV). So a new disease rating scale for virus has been introduced in this study to screen out candidate lines for best performance in terms of seed cotton yield.

MATERIALS AND METHODS

The study was conducted in 2007-08 at Nuclear Institute for Agriculture and Biology, Faisalabad on sandy clay loam, alkaline (pH 8.0), non-saline (EC: 0.30 ms/cm), low organic matter (0.92%), Nitrogen (0.06%), low available Phosphorus (8.0 ppm) and high exchangeable K (224.0 ppm) soil. Twenty new strains of different research stations/institutes of Pakistan and one commercial variety CIM-496 (control) were tested for their performance related to yield, quality and disease resistance under the agro-climatic conditions of Faisalabad. The experimental design was randomized complete block with four replications. Plot size was 4.5 x 5.3 m, with planting density row to row 2.5ft and plant to plant 1.0ft. All inputs such as water, fertilizer, weeds and pest control were managed in an optimal fashion. Three applications of nitrogen were made consisting of 50 kg Nha⁻¹ at sowing on 1st week of June, 50 kg Nha⁻¹ at flowering stage in early August and 50 kg Nha⁻¹ at 50 kg Nha⁻¹ at boll development stage in the month of September. Phosphorus or P₂O₅ was uniformly applied to all the treatments @ 70 kg ha⁻¹ at sowing. Total five irrigations were applied up to crop maturity. The first irrigation was applied on 16th July and the remaining irrigations were applied fortnightly with final irrigation in the end October while skipping three irrigations due to rain during different growth stages. Plant population was recorded by counting the total number of plants from every treatment, CLCuV infestation was recorded at dense fruiting stage in September on a modified disease scale developed for single plant rating and also for large population (Table 1).

Table 1: **Modified Disease Scale.****Disease Rating Scale for CLCuD on Single Plant of cotton**

Rating Scale	Disease Reaction
1	Healthy.
2	Mild infection found upon search.
3	Infection clearly observed with vein thickening but plant is normal.
4	Most of the leaves infected and partially curled.
5	Most of the leaves curled and plant stunted

Disease Rating against CLCuD for large population of cotton Crop

Rating Scale	Disease Reaction
1	Healthy
2	Infection mild find on traces on few plants
3	Infections frequently observe on Plants leaves
4	Infection severe (leaves severely curled) with 5 % plants showing stunted growth
5	Severe infection with Plants between 5 .1 to 15 % showings stunted growth
6	Severe infection with plants having 15 to 50% stunted growth.
7	Severe infection with above 50% plants with stunted growth.



Fig 1. Stunted growth with vein thickening and curling of leaves.

Fifty boll samples were taken at random from each treatment and weighed. To estimate total seed cotton production, all plots were harvested manually and weighed. Data were analyzed statistically (Steel and Torrie, 1984) by using computer based M Stat-C program.

Table 2. Plant Population and Seed Cotton Yield of Advance Strains According to New Disease Rating Scales.

Variety	Disease Reaction (Replicates)					**Plant population ha ⁻¹					***Seed cotton yield ha ⁻¹				
	R1	R2	R3	R4	*M	R1	R2	R3	R4	Average	R1	R2	R3	R4	Average
CRIS-129	2	2	3	2	3	39348	40578	40988	40578	40373 a	5300	5779	6341	5841	5815 ab
GH-102	3	4	3	4	4	30741	31151	38529	27052	31868 def	4767	5132	5185	4480	4891 cdef
TH-86-02	3	3	3	3	3	32380	27872	29101	29511	29716 efg	4648	4513	4685	4894	4685 defg
VH-255	2	2	2	3	3	34020	34020	40578	33610	35557 abcde	5624	5820	6861	5828	6033 a
CRSM-38	3	2	2	2	3	23363	9017	19264	11477	15780 i	5115	3000	4390	2886	3848 h
CINI-554	3	3	3	4	4	31561	38119	42627	38938	37811 abcd	4566	4824	5779	5296	5116 bcdef
NIAB-777	2	4	5	5	5	36889	36069	40578	41808	38836 abc	5312	3541	5271	5787	4978 bcdef
GS-1	2	2	3	3	3	25822	37709	42218	29101	33713 bcdef	4451	4964	5701	4775	4973 bcdef
NIAB-846	2	3	4	3	4	39758	28282	37299	39758	36274 abcd	5517	5845	6017	5796	5794 ab
CINI-496	3	2	3	3	3	34430	38529	40988	28282	35557 abcde	5222	5414	6251	4828	5429 abcd
CINI-541	4	4	4	6	6	31151	33610	35659	31971	33099 cdef	4148	4152	4197	3701	4050 gh
CRIS-342	2	2	3	2	3	31151	36069	40168	36889	36069 abcd	4509	6386	6406	5869	5793 ab
FH-113	4	3	3	5	5	23363	30741	31971	29511	28896 fg	4554	5292	6374	5189	5352 abcd
CRSM-70	3	2	3	3	3	21724	11886	26642	25003	21314 ij	4939	2849	5246	4865	4475 efg
TH-198/94	3	3	2	4	4	12706	17625	22953	18445	17932 i	3935	4164	4587	4357	4261 fgh
SLH-284	3	4	4	3	4	25822	26332	25412	20904	24593 gh	5455	5697	5337	4878	5342 abcde
ASR-1	3	3	3	3	3	34430	35659	36479	34840	35352 abcde	5382	5915	6570	5095	5740 abc
NIBGF-115	2	2	2	2	2	32790	35250	41808	29921	34942 abcdef	4611	4705	5189	4451	4739 defg
BH-167	4	5	4	5	5	29511	40168	40578	37709	36992 abcd	4824	5267	6156	5029	5319 abcde
RH-610	3	4	3	4	4	40168	36069	42218	40988	39861 ab	5324	4910	5611	5583	5357 abcd

*M: Maximum Disease infection among all replicates; ** Plant Population ha⁻¹ LSD value = 5377

*** Seed cotton yield ha⁻¹ LSD value = 743

Average followed by different letters are significantly different by Duncan's Multiple Range Test (p<0.05)

RESULTS AND DISCUSSION

The advance varieties screened for CLCuD under field conditions were found to show variable disease incidence (Table 2). Most of the replicates were having relative disease scores within their replicates. This proves that the pathogens had uniform chances of spread into the field and the scale developed to record the disease was very useful to get the real picture about resistance among varieties screened. The rating of the CLCuD was taken for the highest score within replicates and it was observed that NIBGE-115 was highly resistant with only trace of infection on few plants with rating of 2. Nine lines were found resistant with frequent infection observed on plant leaves with a rating of 3. Six were found tolerant (Rating 4) having severe infection on leaves with up to 5% plants showing stunted growth. Three lines proved to be moderately tolerant (Rating 5) having 5-15% stunted plants due to CLCuD. CIM 541 was found susceptible with disease scale of 6 due to severe infection on all plants with 15-50% stunted plants. A modified disease scale was developed to score the disease reaction on single plant/ plant population depicting a clear picture upon its symptoms (Fig-1) and severity (Table 1). VH-255 produced maximum seed cotton yield (6033 Kg ha⁻¹) followed by CRS-129 (5815 Kg ha⁻¹) and NIAB-846 (5794 Kg ha⁻¹) although the plant population in VH-255 was lower as compared to NIAB-846 and CRS-129 these findings suggest that there are other factors including virus infestation which affect seed cotton yield and due to the presence of disease a strain can't perform better even if it has higher number of plants in the field. The yield variation is due to heterosis in agronomic characteristics of different strains (Masood-ul-Hassan *et al.*, 2006). These findings are supported by results of Marani (1963); Hawkins *et al.* (1965), Young and Murray (1966) and Rafique (1972).

In this study the disease rating in relation to yield was based on new disease scale developed to identify against disease severity and losses, which showed the best resistance against disease has been found with significantly less yield (4739 Kg ha⁻¹) as compared to CRSM 38 and FH-113, however the resistance achieved in this line could be utilized to incorporate with other lines/variety to achieve a better resistant lines with higher yields. The Resistance observed in several lines in the National coordinated varieties trials against CLCuD reflects that good efforts are underway to develop varieties at different Institutes to combat the threat of leaf virus for the cotton cultivation in Pakistan. Lines screened that proved to bear a good resistance at NIAB if found equally good in other fields may be approved for commercial cultivation to increase sustainable yield supporting the economic growth and GDP of Pakistan. Variation in virus infestation in different line was also observed in early studies and CRIS-168, CRIS-468 and CRIS-467 were found to be 9.77, 6.03 and 1.81% viral susceptible respectively during 2006 (Masood-ul-Hassan *et al.*, 2006).

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