I J T A
© Serials Publications
National Academy of Agricultural Science (NAAS) Rating : 3.03

Screening Barley Accessions for Corn Leaf Aphid (*Rhopalosiphum Maidis*) Resistance

Subhash Katare, R Selvakumar, A. S. Kharb, R.P.S Verma, Rajendra Kumar Swati Verma, Indu Sharma and Rekha Malik*

Abstract: *Corn leaf aphid (CLA) is one of the major biotic constraints in barley sowing regions and may results in significant yield losses (10-30%) during severe infestation. Aphids develop colonies on various plant parts causing damage by sucking sap from tender leaves and developing grains. Host resistance is most suitable approach to control barley crop damage by CLA infestation during crop season. Very few sources of resistance are available against corn leaf aphid in India. In this study, a set of 360 exotic accessions received from ICARDA, Rabat was evaluated for under Dry Land Cereal Project CRP 3.6project for CLA infestation in a low cost enclosed structure in natural environmental conditions. Most of lines were scored susceptible when screened against resistant checks (DL529, EB921& K144) and susceptible checks (Alfa93&IWFBCB94). Only one line (BCU7635) was found resistant and fourteen accessions like BCU7600, BCU7624, BCU7628, BCU7629, BCU7640 etc. showed moderate resistance against CLA infestationduring this study. These identified resistant-moderately resistant sources are of significant importance that may be used to introgress CLA resistance in barley breeding program under all India coordinated wheat & barley improvement program (AICW&BIP).*

Key Words: *Barley, Corn Leaf Aphid (CLA), Low cost screening*

INTRODUCTION

Barley (*Hordeum vulgare)* is an important *rabi* crop commonly grown in northern plains of India. It is considered as better option than wheat for harsh environments like drought and marginal lands, in addition to saline–alkaline soils. In India barley is cultivated on about 6.95 lacs ha area with production of 17.43 lacs tones and productivity of 2508 kg/ha (Anonnymous, 2013). The maximum productivity is recorded in the Punjab (3692 kg/ha). It is attacked by a number of insect pests viz. Aphids, termites, armyworm, brown mite etc. but corn leaf aphid *Rhopalosiphum maidis* (Fitch) CLA, is the most serious pest of this crop in barley sowing areas. The aphid develops colonies on leaves, stem and green ears. Both nymphs and adults cause damage by sucking sap from tender leaves and developing grains. They excrete honey dew on different plant parts on which sooty mould develops and inhibits photosynthesis (Bhatiaand Singh, 1977). The mild climate between end of January and beginning of March is very favourable for CLA infestation in barley. The populations build up peaks in mid-February coinciding with the flowering to grain filling stage (Verma *et al.*, 2011).

The yield losses caused by corn leaf aphid have varied from 2.3 to 17 per cent in Haryana (Chillar and Verma, 1982), 2.8 to 67.5 per cent in New Delhi (Bhatia and Singh, 1977) and 27 to 100 per cent in Purrjab (Murthy *et al.*,1968; Bhatia *et al.*, 1973). In India, chemical control is the only tool to manage this pest. The use of insecticides increases the cost of cultivation, creates environmental pollution and is hazardous to users and other non-target organisms. However, chemical use to control CLA is also not promoted by breweries due to residual effect of insecticides in barley malt (Verma *et al.*, 2011). Therefore, host resistance against aphids is the best method to counter CLA infestation for the stability and sustainability of barley production. As reported earlier, very few sources of resistance are available against corn leaf aphid in India therefore; this study was conducted to

ICAR-Indian Institute of Wheat and Barley Research, Karnal-132001, India
**Corresponding Author: rekhasmalik@gmail.com*

identify promising sources for CLA resistance using exotic germplasm

MATERIAL AND METHODS

Plant Material: A set of 360 exotic accessions received from ICARDA, Rabat were screened against corn leaf aphid (CLA) during *rabi* season in 2014-15. The screening was donein specialized low cost structure under epiphytotic conditions at Directorate of Wheat Research, Karnal (29°42′N, 77°02′E), Haryana.

Weather Data: The mild climate between end of January and beginning of March is very favourable for CLA infestation in barley. This duration marks the end of chilling and foggy weather of winter season in north Indian. At the end of January, temperature starts raising with few degrees and with rise of temperature the aphids starts propagating and develop colonies on barley crop. By the end of February, temperature becomes little hot (app. 25-28°C) with bright sunny days that elevates the aphids population at its peak in fields. This year, although winters were marked with intermittent rainfall still conditions became very conducive for aphids infestation with mild cool nights and bright cool days with apparently nil rainfall during first half of February as shown in figure 1.

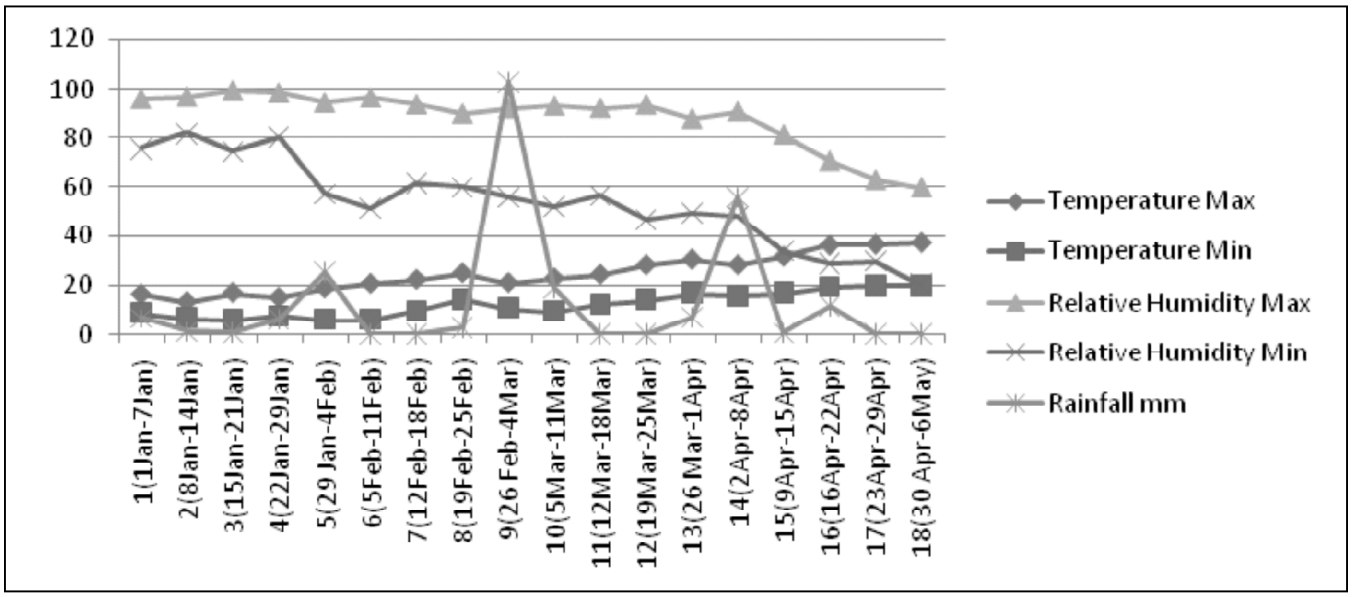

Figure 1: Weather data of Karnal during infestation of corn leaf aphids on barley crop at experimental field, IIWBR, Karnal

Phenotypic Screening for CLA Infestation

All the entries were sown on 11th Nov., 2014 in one metre row length replicated thrice with one row of Alfa93after every 20 rows as a check.The CLA resistance screening was done in a modified low cost structure instead of the normal poly-house screening (Verma and Malik, 2010). Only a limited number of plants can be grown for adult plant resistance screening in such poly-houses. Against the routine poly-house, the present construction has a polythene roof for protection from rains to avoid washing away of the CLA population. All sides are of muslin cloth for good aeration and confining the CLA inside the chambers. The construction is supported by angle iron frames tied with thin wires. The muslin cloth sides and partition were stitched in such a way that they can be lifted if necessary for providing aeration, evaporation of excess moisture from the leaves or facilitate movement of persons for inoculation. These structures were much cheaper than regular poly-houses and proved very useful in creating high levels of CLA populationon the test lines. The dimension of each construction was 5 × 20 mwith 2.5 mheight. The initial CLA population was collected in field from early crop and multiplied on susceptible parent (Alfa93). The aphids from poly house were transferred to test material using detached leaf method in mid January when the crop was in vegetative phase just before the boot leaf emergence. The artificial infestation was repeated for about 10 days to ensure high load of CLA. The observations were recorded on aphid count per shoot from three spots in each row at weekly intervals.

Table 1
Different grades used for scoring corn leaf aphid infestation during crop season

Grades	*Approx. No.of aphids/shoot*	*Rating*
I	0	Immune
II	1 to 5	Resistant
III	6 to 10	Moderately Resistant
IV	11 to 20	Susceptible
V	21 and above	Highly Susceptible

Table 2
Genotypes used as checks for CLA screening

Sr No.	*Name*	*Origin*	*Damage score (0-5 scale)*	*Reaction*
1.	Alfa93	Argentina	5	S
2.	IWFBCB94	-	5	S
3.	EB-921	Taiwan	2	R
4.	EB-2507	Unknown	3	MR
5.	Manjula	India	3	MR
6.	DL529	India	2	R
7.	K144	India	2	R

RESULTS AND DISCUSSION

CLA is a major biotic constraint affecting the yield of barley crop during heavy infestation period during crop season in India. Very few sources of resistance are available against corn leaf aphid in India. Earlier studies conducted for phenotypic characterization for CLA resistance documented only few barley lines viz. BCU284, EB921, EB2507, Manjula, DL529 and K144 as resistant to moderately resistant (Verma, 1993; Yadav, 2003). This suggests the need to incorporate CLA resistance in barley breeding program and necessasity to explore exotic germplasm for novel CLA resistant sources. Therefore, 360 exotic barley lines received from ICARDA, Rabat were phenotyped under specially designed cost effective structure providing natural conditions for infestation and propagation of aphids (Verma and Malik, 2010).

The artificial inoculation conducted for CLA created very high incidence of aphid on the test material. This was ensured by favourable environment inside the chambers, which supported growth and multiplication of CLA even in January month when outside temperature was low in north Indian plains. In selected set, only 14 entries were observed moderately resistant with scoring grade of 03 as compared to 05 of susceptible check lines, Alfa93 and IWFBCB94 (Table 3).

Only one entry, BCU7635, was observed resistant and showed insect infestation at the score 02 and found equivalently resistant with resistant check lines DL529, EB921 and K144. Among the remaining 339 entries, 128 entries were scored as susceptible with

Table 3
Barley genotypesidentified for Corn leaf aphid resistance during study

S.No.	*Entry Number*	*Cross / Pedigree*	*Damage score (0-5 scale)*	*Reaction*
1.	BCU7600	Villa	3	MR
2.	BCU7624	CLE 233	3	MR
3.	BCU7628	MN 610	3	MR
4.	BCU7629	Br2	3	MR
5.	BCU7635	MN 599	2	R
6.	BCU7640	Clivia	3	MR
7.	BCU7649	C 9053	3	MR
8.	BCU7651	ND 15140	3	MR
9.	BCU7652	ND 14016	3	MR
10.	BCU7653	ND 14600	3	MR
11.	BCU7659	C9528	3	MR
12.	BCU7721	C97006	3	MR
13.	BCU7746	ARAMIR/ COSSACK	3	MR
14.	BCU7842	CABUYA/ ESMERALDA	3	MR
15.	BCU7916	Aim	3	MR

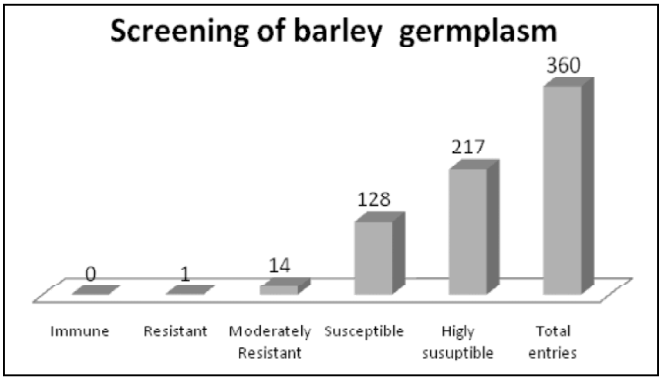

Figure 2: Phenotypic scores of exotic barley lines for corn leaf aphid resistance during rabi season 2014-15

score value 04 and rest 217 were found highly susceptible at 05 score value as shown in figure 2. Some of the highly susceptible entries harboured more than 80 aphids per shoot during phenotyping for CLA in this study. Similar observations were reported by Singh and Singh (2009) during screening more than 5000 lines of barley germplasm for CLA under field conditions. In other reports also similar level of resistance was documented for CLA infestations (Yadav and Jain, 2000; Verma *et al.*, 1980). Similarly, Singh *et al.* (2006) identified a few entries having moderate level of resistance but none of them showed resistant reaction in Punjab.

The present studies revealed that there are very few sources of resistance against corn leaf aphids are available in barley. Therefore, sources identified resistant during this study especially genotype BCU7635 may be used to introgress CLA resistance

in barley improvement program in India. This information further facilitates the mapping of plant insect-resistant genes using these sources as parental lines and ensures optimal cost-effectiveness for efficient screening of large populations during marker assisted studies in barley breeding program.

ACKNOWLEDGEMENTS

The authors are thankful to ICARDA, Rabat for providing financial support to conduct this studyUnder Dry Land Cereal Project CRP 3.6project.

REFERENCES

Anonymous (2013), Progress report of All India Coordinated Wheat and Barley Improvement Project 2013-13, Vol. VI Barley Network. Directorate of Wheat Resaerch, Karnal, India. P. 327.

Bhatia SK and Singh VS (1977), Effect of corn leaf aphid infestation on yield of varieties. Entomon. 2 (1): 63-66.

Bhatia S K, Young W R, Phadke K G and Srivastva A N C (1973), Control of corn leaf aphid on barley in India. J. econ. Ent. 66: 463-67.

Chillar BS and Verma AN (1982), Yield losses caused by aphid. *Rhopaloisphum maidis* (Fitch.) in different varieties/strains of barley crop. Haryana Agric. Univ. J. Res. 12(2): 298-300.

Murthy BN, Jain KBL, Mathur VS, Gulathi SC and Satyawal D (1968), Aphid resistance in barley. Indian J. Genet. & Plant Breeding. 28: 91- 93.

Singh B and Singh S (2009), Screening and identification of source of resistance against corn leaf aphid, *Rhopalosiphum maidis* Fitch in Barley. Indian J. Ent. 71(1): 255-58.

Singh B, Dhindsa G S and Singh H (2006), Screening of Barley (*Hordeum valgare*) germplasm against corn leaf aphid, *Rhopalosiphum maidis* Fitch. Crop Improvement 33(1) : 58-61.

Verma RPS, Malik R, Kumar R and Singh SS (2011), Genetics of aphid resistance in barley. Cereal Research Communication. 39 (1).pp 130-136.

Verma RPS and Malik R (2010), Cost-Effective Technique for screening against Corn Leaf Aphid in Barley. Barley Newsletter: Volume 53.

Verma, R.P.S., (1993), New Sources of resistance to aphid in barley. Agric. Sci. Digest. 13(1): 45-48.

Verma, AN, Khurna AD, Vasudev DR and Singh D (1980), Screening of some promising barleystrains and recommended varieties for resistance to barley aphid *Rhopalosiphum maidis* Fitch. Haryana Agric Univ. J. Res. 10: 499-504.

Yadav, R. (2003), A combined source of resistance against corn leaf aphid and yellow rust in barley. International Journal of Pest Management. 49 (4): 293-296.

Yadav RC and Jain PC (2000), Studies on relative resistance of barley varieties to barley aphid *(Rhopalosiphum maidis* Fitch) under irrigated conditions. Crop Res.19(3): 466-68.