Nilgiri Wheat News

(September – December, 2012)

IARI, Regional Station, Wellington
Vol 4 (3)

Popularizing wheat cultivation in non-traditonal areas of Tamil Nadu and Karnataka

P. Jayaprakash, M.Sivasamy, Vikas,V.K. and J. Kumar

Wheat is not commonly grown in the foothills of the southern hills and in adjoining districts of Tamil Nadu and Southern Karnataka (Non-traditional areas) due to very short winter and unfavorable conditions for its cultivation. These areas also have comparatively high temperature and the crop gets damaged due to the high infection of *Sclerotium* foot rot. The demand for wheat has increased due to change in dietary habit of the local people. Water for growing paddy crop during November-February is also scarce if North-East monsoon fails. Also the most adaptive crops like ragi and paddy need more than 120 days for maturity and sorghum is also long duration crop. The agro-ecological conditions prevailing in these areas prompted us to develop an early maturing thermo-tolerant and foot-rot resistant genotype of bread wheat (*Triticum aestivum* L.) which could fit well in local crop rotation. Several genotypes were tested in adaptive research trials at 77 locations covering 14 districts of Tamil Nadu and 5 of Karnataka. Based on the yield performance across the locations, HW3094 (CoW (W)-1) was identified and subsequently released and notified by CVRC in 2004. Subsequently HD 2833 (released jointly by IARI, New Delhi and R.S., Wellington) was also released for the Peninsular zone and this variety is also becoming popular in this region. Further research and efforts to introduce samba *(dicoccum*) wheat resulted in release of COW2 a semi - dwarf high yielding *dicoccum* wheat variety for the non-traditional areas. These varieties are thermo-tolerant and also resistant to foot rot. The average yield of CoW (W)-1 and HD 2833 under need based/restricted irrigation (up to four) was 3 tonnes/hectare and 2.8 t/ha respectively with premium grain quality. Since wheat varieties CoW (W)-1, Cow2 & HD 2833 matures in 90-95 days, are thermo-tolerant and foot-rot resistant, hence have become choice and an alternative crop to the resource poor farmers in the area, where in erratic and unpredictable North-East monsoon occurs. The cultivation of wheat in this area not only ensures grain but also fodder for cattle thus helps in sustaining the livelihood of farmers. Sizable number of Front Line Demonstrations sponsored by Ministry of Agriculture on a regular basis have given an impetus for spreading the wheat cultivation in these non-traditional areas for benefit of the farmers.

A farmers day was held at IARI, R.S., Wellington on 11.10.2012 for farmers of Vellore. This was jointly organized by IARI and ATMA KVK where 45 farmers attended the event. A field demonstration was organised and lectures were also delivered on wheat cultivation technology by the scientists of IARI, Wellington. Subsequently another field day was also organized at Vellore by ATMA KVK and Dr. P. Jayaprakash and Dr. M. Sivasamy attended it on 20.12.2012. Around 85 farmers who have sown wheat were briefed about wheat cultivation and their problems in cultivation aspects were addressed. The collector of Vellore has taken initiatives to popularize the wheat who also attended the meeting.

Phenotypic and Molecular Characterization of Durable Adult Plant Resistance (APR) Genes - *Lr34/Yr18, Lr46/Yr29 and Lr67/Yr46* - linked to *Ltn* in selected wheat lines

M. Sivasamy, M. Aparna, J.Kumar, John Peter, R .Nisha, P. Jayaprakash, V.K Vikas and E. Punniakotti

Nearly twenty thousand wheat lines conserved by the National Bureau of Plant Genetic Resources (NBPGR) maintained at IARI ,Regional Station, Wellington were visually screened for the presence of leaf tip necrosis (*Ltn*), a phenotypic trait linked to the adult plant resistance (APR) genes for leaf rust namely, *Lr34*, *Lr46* and *Lr67* which are having pleiotropic association with stripe rust resistance genes *Yr18*, *Yr29* and *Yr46*. Thirty six lines were showing prominent *Ltn* with a moderate level of leaf rust severity at the adult plant stage. These lines were subjected to Seedling Resistant Test (SRT) that revealed susceptible and mixed infection types, a characteristic of APR genes. Molecular confirmation for the presence of these genes were done using available microsatellite markers. Thirteen genotypes showed the presence of combination of two genes whereas three genotypes carried all the three genes. Nine genotypes did not carry any of the genes. The resistance based on minor APR genes when combined with a few additional minor genes in the background of high yielding cultivars will enable high level of race non-specific resistance, and is believed to be durable. Wheat cultivars with combinations of *Lr*34+, *Lr*46+ and *Lr*67+ are resistant and will be an immediate available resource of durable resistance.

An effective leaf rust resistance gene *Lr* 47 derived from *Aegilops speltoides* - introgressed into popular Indian bread wheat cultivars

Sivasamy. M, P. Jayaprakash, V.K.Vikas, Jagdish Kumar, K.Sivan, R.Nisha and John Peter

At IARI, Regional station Wellington a meticulously planned breeding programme to introgress effective rust reistance genes through conventional and molecular aprroach is in place. The transfer of single gene and pyramiding of rust resistance genes of leaf, stem and stripe rusts genes which include *Lr9, Lr19+Sr25, Lr24+Sr24, Lr28, Lr32, Lr37+Sr38+Yr17, Lr26+Sr32+Yr9+Pm8, Lr45, Sr2, Sr26, Sr27, Sr36+Pm6, Yr10 and Yr15* in to nearly 30 popular Indian bread wheat cultivars namely C 306, Kalyansona, WH 147, HD 2285, HD 2329, HD 2402, HD 2687, HS 240, HUW 234, Lok1, MACS 2496, NI 5439, PBW 226, PBW 343, WH542, HD 2733, HD 2877, NIAW 34, HI 1077, HI 977, RAJ 3077, PBN 51, KRL 99, HP 1205, HW 3070, PBW 502, NI 5439, J 24 etc., are complete and shared with many scientists in the country. The efforts to incorporate the single genes *Lr42, Lr44, Lr46, Lr47, Lr53, Lr54, Lr57, Lr67, Sr2, Sr22, Sr26, Sr27, Sr33, Sr35, Sr39, Sr40, Sr44, Sr47 and Sr49* are in progress. Out of these the introgression of *Aegilops speltoidies* - derived effective leaf rust resistance gene *Lr 47* is nearing completion in the back-ground of 30 adapted wheat cultivars. Leaf rust resistance gene *Lr47* is located within a interstitial segment of *Triticum speltoides* Taush. 7S chromosome translocated to the short arm of chromosome 7A of bread wheat. This gene is resistant against currently occurring predominant races of leaf rust in India and other parts of the world. Isogenic or back-crossed lines with and without *Lr47* developed from 30 cultivars were also subjected for fore ground selection using the microsatellite marker *gwm 60,*th e only marker that co-segregated completely linked to *Lr47*. These data indicate that *gwm 60* could be a valuable marker to introgress *Lr47* in wheat germplasm. From our preliminary observations this alien gene is noted to be very effective against occurring Indian leaf rust pathotypes, conferring high degree of resistance and combines very well with other leaf, stem and stripe rust genes in developing elite high yielding wheat genotypes. We haven't observed any negative traits associated with this gene like altering grain quality, yield reduction etc.

7DL.7Ag translocation as a substitute for 1BL.1BR translocation in spring wheat ?

V.K.Vikas, M. Sivasamy, Jagdish Kumar, P. Jayaprakash , Arun Kumar, John Peter, R. Nisha and E. Punniakotti

Resistance to three rust pathogens (leaf, stem and stripe rust) is due to different resistance genes. The translocation of the short arm of rye (*Secale cereale* L.) chromosome one (1RS) to the long arm of wheat

chromosome 1B (1BL) is one of the most common and significant translocation in spring wheat, because it carries genes *Sr31, Lr26, Yr9* and *Pm8* conferring resistance to stem rust (*Puccinia graminis* Pers.f.sp.*tritici* Eriks & E. Henn), leaf rust (*Puccinis triticina*), stripe rust (*Puccinia striiformis* Westend) and powdery mildew (*Erysiphe graminis*). It also played a vital role in enhancing grain yield. Similarly, the 7DL.7Ag translocation from *Agropyron elongatum* that carries *Lr*19, a leaf rust resistance gene and *Sr*25, a stem rust resistance gene appears to be a promising gene not only through the resistance to rust conferred by this gene, but also because of yield increase observed in different backgrounds when *Lr*19/*Sr*25 is introgressed. Two field experiments were carried out during Rabi (2011-12) and Summer (2012) seasons at IARI Regional Station, Wellington. Experiment was conducted on near isogenic lines carrying *Lr*19/*Sr*25 gene introgressed in ten genetic backgrounds with and without fungicide treatment along with their respective recurrent parents.

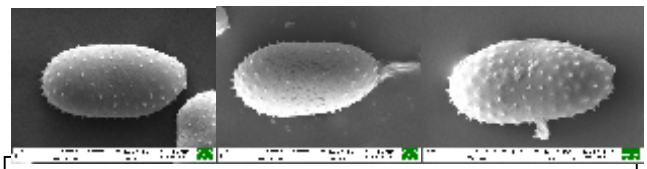
Results showed that *Lr*19/*Sr*25 was associated with increased grain yield, 1000 grain weight, number of productive tillers and number of grains per panicle, besides resistance to stem rust races and leaf rust races (except race 77-8) prevalent in Nilgiris. Moreover *Lr*19/*Sr*25 gene increased the duration of the near isogenic lines from 8-14 days in different genetic background than their recurrent parent, thus imparting stay green trait to the lines and providing more period for grain filling. It is not clear, if higher yields are the result of pleotropic effect of *Lr*19/*Sr*25 gene or the effects of other gene(s) located on the translocated part. Earlier report attributed increase in yield due to higher sink strength. Yield gain associated with *Lr*19/*Sr*25 is not uniform in all background, but depended greatly upon the genetic background of the recipient parent. Therefore 7AL.7Ag translocation could be used as source for enhancing yield , thus providing an alternative to 1BL.1BR translocation as far as Nilgiri location is concerned. Same lines should be tested in other wheat growing environment to arrive at a general conclusion.

Photographs taken 110 days after sowing

HD2329 (+*Lr*19) **HD2329 (-*Lr*19)**

Standardization of Scanning electron microscopic (SEM) technique and analysis of rusts from Barberry and their cross inoculations

P. Nallathambi, J. Kumar, C. Umamaheswari and Naresh K Mehsram



Images of Urediniospores ;respectively left to right: on wheat (I), rye (II) (obtained after inoculation with urediniospores of barberry) and naturally prevailing *Puccinia graminis tritici(III)*

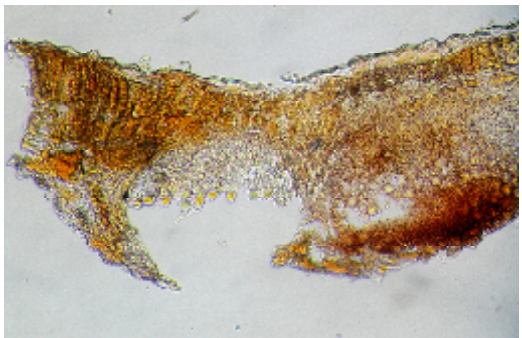
Scanning electron microscopic technique was standardized for morphological characterization of the *Puccinia* spp. urediniospores infecting wheat, rye and barberry. Initially, different combinations of palladium coating, time interval (minutes) and vaccum pressure were applied. Out of various combinations, vaccum pressure at 20 KV with 90 minutes coating of palladium on untreated spores resulted in the best quality images under SEM. Images of urediniospores collected from barberry bushes from locations viz., thoattapetta-1, thoattapetta-1, Hupathali and Minala were captured and analysed using instrument dedicated software. The barberry isolate which was cross inoculated on wheat (Agra local) and rye resulted in symptoms of black rust. Urediniospores of two standard races (40-1 and 40-A) of *Puccinia graminis tritici* were also simultaneously subjected to SEM for the purpose of

comparison with urediniospores obtained from barberry. In all the samples, spindle shape uredinospores with spiny surfaces were observed. Similar size of the spores (29 x 12 µm) were observed from Mynala and Hupathalai areas. Uredinospores from barberry samples from thottapetta revealed slightly smaller (27 x 13-15 µm) size. Black rust incidence and uredinospores production on wheat and rye after inoculation with urediniospores of barberry indicated almost similar size and shape of uredinospores on wheat and rye. Uredinospores size under SEM was 24.23 x 13.84 µm in wheat and 25.45 x 13.63 µm in rye as compared to 26 x 13.6 µm of uredinospores collected from natural incidence of black rust at Wellington. In both the cases (wheat and rye), distribution of spines was moderate, short with sharp ends. Spores size was 26.8 x 12.04 µm in case of race 40-1 and 19.5 x 13.8 in race 40-A. The overall results indicated some similarities among the morphological features of urediniospores available on wheat and rye after inoculation with barberry uredinispores and those of *Puccinia graminis tritici* collected from naturally infected wheat plants at Wellington. Further studies on this aspect are in progress.

Identification of Puccinia spp. infecting Barberry in Nilgiri hills

C. Umamaheshwari, P.Nallthambi and J. Kumar

During survey of Nilgiri hills conducted to elucidate the role of alternate/ collateral hosts in perpetuation of wheat rusts, samples of *Berberis* species infected with rusts were collected. Based on morphological characterization of different stages of spores, the rust occuring on some of the *Berberis* species inhabited in Nilgiri hills has been identified as *Puccinia droogensis* Butler. It is an autoecious rust.



Aecial cup of *Puccinia droogensis* on barberry leaf : vertical section

We observed the uredial, telial and aecial stages of *Puccinia droogensis* in these samples.

Aecia of *Puccinia droogensis* are cup shaped, aeciospores are yellow and polyhydral in shape. Uredosori are yellow and uredospores are pedicellate, clavate or ellipsoidal in shape and minutely verrucose. Telial sori are purplish brown and found in concentric rings. Teliospores are two celled, pedicellate, rounded at both ends and constricted at the septa.

Wheat rust surveys in Nilgiris

J. Kumar, P. Nalthambi, C. Uma Maheshwari, M. Sivasamy, P. Jayaprakash, V.K. Vikas, John Peter and R. Nisha

Out of 60 samples of brown rust analysed, pathotype 77-8 dominated followed by 77-5 and 77-7 in Nilgiri hills during the immediate last quarter of the year 2012 . Only a single race 40A could be monitored in 14 samples of black rust analysed. Ug 99 and its variants could not be observed in the Ug99 trap nursery.

News

Promotions

- Dr. M. Sivasamy (Seed Technology) promoted to Principal Scientist w.e.f 1.1.2009
- Dr. P. Nallathambi (Plant Pathology) promoted to Principal Scientist w.e.f 1.1.2009

New joining

- Dr. E. P. Venkatasalam Scientist (SS) (Seed Technology) transferred from CPRI, Shimla to IARI, RS, Wellington and has joined this station on 17th December, 2012.
- Mr. Rajesh Kumar Meena, T-3 joined station in November, 2012.
- Dr. (Mrs.) Shilpi Aggarwal, T-3 joined station in December, 2012.

Award

- Dr. Jagdish Kumar, PS and Head has been awarded Sh. V.P. Gokhale prize by Maharashtra Association for Cultivation of Science (MACS) and Agharkar Research Institute (ARI), Pune for his contributions in the field of plant pathology.