NILGIRI WHEAT NEWS

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TAMIL NADU

Multiple disease resistant wheat lines in the back ground of C 306 with reduced height developed at IARI RS Wellington

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The popular wheat cultivar C 306 was widely cultivated under rain fed conditions of Central zone in India and its grain is in high demand from the processing industries because of its best chappati making quality. Subsequently HW 2004(Amar) a back crossed derivative of C306 which carry Lr24/Sr24 was also released a became popular. Considerable yield loss in these popular cultivars is attributed to its susceptibility to leaf and stem rust in C 306 and stem rust alone in HW 2004 (where Sr24 is not effective in India) diseases and coupled with lodging due to its tallness(>100cm ht). Under these circumstance the farmers are looking for rain fed varieties with reduced height and resistance to rust diseases in the back-ground of C 306. Keeping this objective in mind an effort was made at IARI, RS, Wellington for introgression and pyramiding of *Aegilops speltoides*-derived gene *Lr*47 and *Triticum timopheevi*-derived gene *Sr*36/*Pm*6 into C306 employing conventional(limited back-cross) and MAS approach.

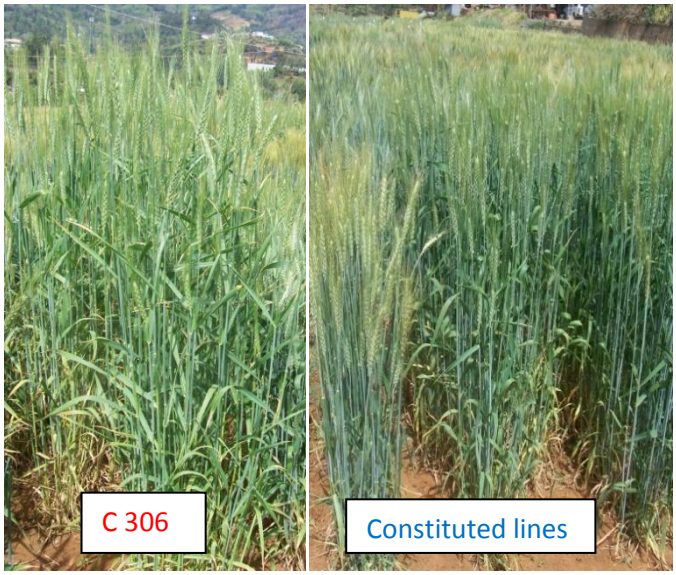
Initially Lr47 was transferred to C 306 through back-cross and the line selected conferring resistance to leaf rust based on field and seedling response at BC3F1 which was further crossed to genetic stock HW 4444(pedigree: HUW 234*2//Cook) carrying *Sr36/Pm6.* The stock HW 4444 is a semi-dwarf wheat line with dwarfing genes Rht1 and Rht2 in the back-ground of HUW 234. The resultant lines with reduced heights were constituted at BC2F5 stage having the height range of 88-98 cm and conferring multiple disease resistance to leaf, stem rusts and powdery mildew attributed to the rust resistance genes *Lr47, Sr36/Pm6* along with APR gene(s) *Lr34/Yr18/Pm38/Bdv1/Sr resistance/Ltn* were christened as HW 4701, HW 4701-1 and HW 4701-2. The field response to rust diseases at Wellington and multi-location testing under PDSN is given in table-1 and table-2 respectively. The PDSN results shows that one of the constituted lines HW 4701-1 showing resistance to all three rusts and blight as well. The introgression of Lr47 and Sr36 is being confirmed through PCR based RFLP marker Xabc465. The preliminary yield data from station trial(Table-1) indicating that all the final constituted lines were yielding better than the check C306. These lines can be potential yielding ones under Central zone rain fed conditions which can even perform well under limited irrigations as well as an replacement for C 306 and HW 2004. They will be further tested in IARI Common varietal trials(CVT) in the ensuing years for further promotions.

Table-1: Field response of constituted lines to diseases at IARI, RS, Wellington and grain yield and plant height in the station trial

Sl.No	Variety	Response to Rust diseases			Powdery mildew (0-9 scale)	Grain yield (q/ha)	Plant height (cm)
		Stem(Bl)	Leaf(Br)	Yellow(Yr)			
1	C 306	60S	80S	F	6	28	114
2	HW 4701	F	F	F	1	38	88
3	HW 4701-1	F	F	F	0	36	92
4	HW 4701-2	F	F	F	1	34	98
5	HW 4444	F	60S	10S	0	-	82

Table-2: Performance of Plant Disease Screening Nursery (PDSN) wheat entries HW 4701, HW 4701-1 and HW 4702-1 against all the three Rusts and Leaf blight at different hot spot locations during 2016-17

Sl. No.	Genotype	Stripe rust			Leaf rust				Stem rust			Leaf blight
		Delhi	Katrain	Dhaulakuan	Delhi	Wellington	Indore	Pusa (Bihar)	Delhi	Wellington	Indore	Pusa (Bihar)
1	HW 4701	40S	5S	20S	0	0	0	0	0	0	0	67
2	HW 4701-1	0	5S	0	0	0	0	0	0	0	0	24
3	HW 4701-2	60S	5S	20S	0	0	0	0	0	5MR	0	46



The useful rust resistance genes from primary, secondary and tertiary gene pools transferred to released Indian wheat cultivars to develop multiple and durable disease resistant varieties

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Wheat as major food crop achieved record global production of 830 million tonnes harvested from 270million ha (USDA report) during 2016-17 ensuring food security across the nations. Nevertheless India too reported a record wheat harvest of over 97mt produced from over 31mha during the same period. This remarkable achievements could be attributed to several factors like cultivation disease resistant high yielding varieties, adopting better agro techniques, effective disease management, favorable climate, govt. support price etc.,. One of the production constraints in wheat is continued to be biotic stresses caused by rusts, blight, leaf spots and powdery mildew etc depending on the agro-climatic areas. To manage these diseases cultivation of disease resistant wheat varieties are the best and economical options. So far many genes conferring resistance to these diseases has been identified and catalogued which include nearly 60 stem rust, >77 leaf rust/yellow rust and up to 58 powdery mildew(pm) genes. Although many genes have been identified and catalogued only few of them has been validated and widely used worldwide to checkmate the rust and other diseases. Effectiveness of some of the deployed genes has been overcome by evolving new pathotypes time to

time worldwide. Among the comity of catalogued genes fewer effective major genes viz.,.*Lr9, Lr19/Sr25, Lr24/Sr24, Lr26/Sr31/Yr9/Pm8, Lr28, Lr32, Lr35, Lr37/Sr38/Yr17* for leaf rust*, Sr22, Sr25/Lr19, Sr26, Sr27, Sr36/Pm6* for stem rust and *Yr5, Yr9, Yr10, Yr15 and Yr17/Lr37/Sr38* for yellow rusts were transferred and commercially exploited widely.

Over the period its exploitation newer pathotypes has overcome some these genes like *Lr9* (North and South America, Indian sub continent and in some parts of Europe), *Lr19* (India in low frequency), *Lr24* (North and South America and South Africa), *Lr26* (most wheat growing areas) and *Lr28*(Australia, North America and India), *Sr22*(Israel), *Sr24* (South Africa, India and Australia and by Ug99 in Africa), *Sr25*(Low frequency in Ethiopia and Nepal), *Sr27*(South Africa and Australia and low frequency elsewhere), *Yr9*(Africa, China, Europe, South America and Indian Sub-continent and elsewhere). The use of pyramided race non-specific APR genes like *Lr34+, Lr46+, Lr67+, Lr68+, Sr2+* in combination of race specific major genes is being advocated for durable rust resistance in wheat. In India the leaf rust resistance genes viz.,. *Lr19, Lr24, Lr32, Lr35, Lr37, Lr44, Lr45, Lr47, Lr53, Lr57* for leaf rust*, Sr22, Sr24, Sr25, Sr26, Sr27, Sr33, Sr36, Sr38* for stem rust*, Yr5* (Virulent races of low frequency reported way back in 1986), *Yr10, Yr15 and Yr17* for yellow rust and *Pm6* for powdery mildew are still very effective against the occurring pathotypes can be effectively used to combat the rusts and powdery mildew.

Keeping this in mind for developing multiple disease resistant wheat varieties the released and adapted wheat cultivars HD 2833 (carrying *Lr24/Sr24, Sr31/Lr26/Yr9/Pm8* and *Sr2*), HW 5207 (carrying *Lr24/Sr24, Sr2* and *Yr15*) and HW 5216 (carrying *Lr24/Sr24, Sr31/Lr26/Yr9/Pm8* and *Sr2*) were pyramided with *Triticum thimopheevi*-derived linked genes *Sr36/Pm6* present in the stock HW 4444(HUW234*2// Cook) at IARI, Regional station, Wellington employing conventional and MAS approach. The back-crossed lines of HD 2833, HW 5207 and HW 5216 pyramided with rust resistance gene(s) sources from primary gene pool viz.,. *Sr2*(*Triticum turgidum*), Yr15(*T. dicocoides*), secondary source *Sr36/Pm6* (*Triticum timopheevi)* and from tertiary gene pool viz. *Lr24/Sr24* (*Thinopyrum ponticum*) and *Sr31/Lr26/Yr9/Pm8*(*Secale cereal)* were christened as **HW 2436-1, HW 2436-2 and HW 2436-3** respectively which were constituted at BC_2F_5 stage(Plate 1-3).

The presence of *Sr2* in these varieties can well be confirmed through pheno-typical marker ***Pbc****(*pseudo black chaff*)* on glumes and pigmentation on nodal regions on these lines(figure-1 and 2). However its expression is highly influenced by environment and better expressed under low temperature. The SSR markers *gwm271A*-for *Sr36/Pm6* and *Sr24#12* for *Sr24/Lr24* were used to confirm the presence of these genes in the derived lines (figure 3 & 4). The field response to diseases, agronomic traits and PDSN multi-location data of the recurrent parents and derived lines are given in table 1 & 2. The presence of rust resistance genes *Sr2(APR), Lr24/Sr24, Sr36/Pm6* in lines HW 2436-1 and HW 2436-3 along with Sr31/Lr26/Yr9/Pm8 and also *Sr2(APR), Lr24/Sr24, Sr36/Pm6* and *Yr15* in HW 2436-2 are expected to have durable and multiple disease resistance especially against all three rusts and Pm races in India. The time line in developing these varieties with pyramided genes at Wellington was 10-12 years. The constituted lines **HW 2436-1, HW 2436-2 and HW 2436-3** are having the maturity range of 108-118 days which will be further tested in yield trials of timely sown or late sown environments. Further it can act as genetic stocks carrying pyramided rust resistance genes in better agronomic back-ground for use by breeders in wheat improvement programme to develop multiple disease resistant wheat varieties.

Table-1: Field response of constituted lines to diseases at IARI, RS, Wellington and grain yield and plant height in the station trial

Sl. No	Variety	Rust genes it carries	Response to Rust diseases			Powdery mildew (0-9 scale)	Grain yield (q/ha)	Plant height (cm)	Days to maturity
			Stem(Bl)	Leaf(Br)	Yellow(Yr)				
1	HD 2833	*Lr24/Sr24, Sr31/Lr26/Yr9/Pm8, Sr2*	F	F	F	6	46	90	105
2	HW 5207	*Lr24/Sr24, Sr2 and Yr15*	F	F	F	4	56	88	110
3	HW 5216	*Lr24/Sr24, Sr31/Lr26/Yr9/Pm8, Sr2*	F	F	F	8	52	94	115
4	HW 2436-1	*Lr24/Sr24, Sr31/Lr26/Yr9/Pm8, Sr2 and Sr36/Pm6*	F	F	F	F	51	91	108
5	HW 2436-2	*Lr24/Sr24, Sr2, Yr15and Sr36/Pm6*	F	F	F	F	58	90	112
6	HW 2436-3	*Lr24/Sr24, Sr31/Lr26/Yr9/Pm8, Sr2 and Sr36/Pm6*	F	F	F	F	54	95	118

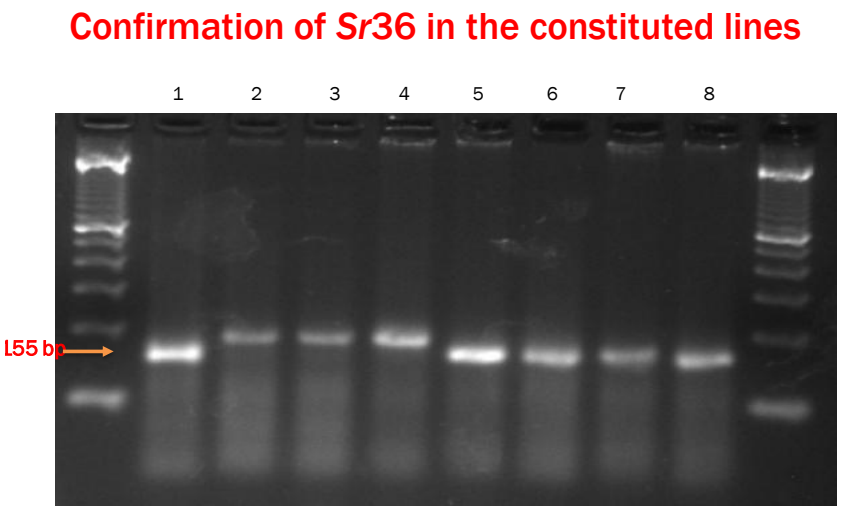
Table-2: Performance of Plant Disease Screening Nursery (PDSN) wheat entries HW 4701, HW 4701-1 and HW 4702-1 against all the three Rusts and Leaf blight at different hot spot locations during 2016-17

Sl. No	Genotype	Stripe rust			Leaf rust				Stem rust			Leaf blight
		Delhi	Katrain	Dhaulakuan	Delhi	Wellington	Indore	Pusa (Bihar)	Delhi	Wellington	Indore	Pusa (Bihar)
1	HW 2436-1	40S	5S	40S	0	0	0	0	0	TR	0	46
2	HW 2436-2	40S	0	30S	0	0	0	0	0	0	0	56
3	HW 2436-2	80S	5S	60S	0	0	0,30S	0	0	0	TR	35

Figure-1 : *Pbc* on ear

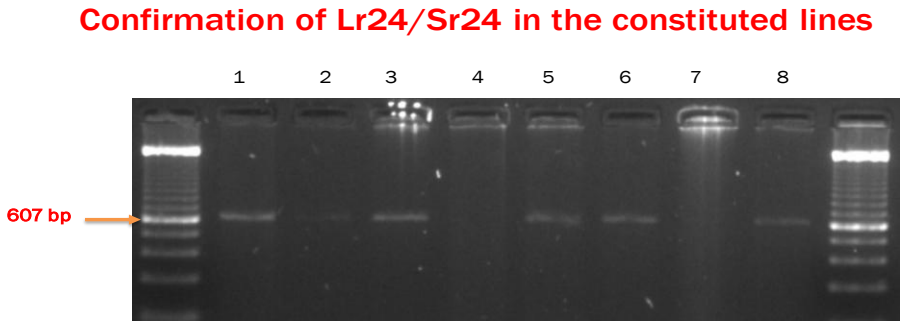
Figure-2: Pigmentation on nods

Figure-3



1) Sr 36, 2) HD 2833, 3) HW 5207, 4) HW 5216, 5) HW 2436-1, 6)HW 2436-2, 7)HW 2436-3, 8) HW 2436-3-1

Figure-4



- 1) Dwarf kite, 2) HW 2833, 3) HW 5207, 4) HW 5216, 5) HW 2436-1, 6) HW 2436-2, 7) HW 2436-3, 8) 2436-3-1

Plate-1 ,2 & 3

Variable climatic conditions influence diversified pattern of resistance against Fusarium head blight incidence on *Triticum* species in Nilgiris

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Fungal diseases are major constraint to produce quality wheat grains in India. Out of various diseases, Fusarium head blight (FHB) or head scab (HS) incited by *Fusarium graminearum* Schwabe [teleomorph: *Gibberella zeae* (Schwein.) Petch], is devastating disease in *Triticum* species. Being a polygenic and necrotrophic type of pathogen with aggressive colonization in infected parts, drastic reduction in grain yield and quality are realized. Therefore, strategic management is essentially required especially under variable environmental conditions. The climatic conditions in southern hills with special reference to Nilgiris play vital role in identification of resistant types from very large number of genetic stocks. However, variation in resistance pattern of wheat genotypes/variety over the period is being experienced. Therefore, as case study, we analyzed the head scab reaction profile of two consecutive years (2016 and 2017) and correlated with major weather parameters which are normally preferred in any plant disease epidemiology other than inoculum potential (*F.graminearum*) of the target pathogen. A set of wheat varieties developed from different agro-climatic zones viz., NHZ-northern hill zone, NWPZ-north western plain zone, NEPZ-north eastern plain zone, CZ-Central zone, PZ-Peninsular zone and special trials were considered and interpreted with key factors. To begin with, out of the weather conditions of both seasons, the solar radiation was 173.39 Dgt/m^2 in head scab evaluation period (rabi season, 2016) than 163.13 Dgt/m^2 in 2017. Leaf wetness was also in higher side (4545 min) than 2526.7 mm. Similarly, mean temperature was 2 ^{o}C more (18 ^{o}C) than preceding season (16.3 ^{o}C). Minimum and

maximum temperatures were 6.7 ^{o}C and 27.45 ^{o}C in 2016 as compared to 4.87 ^{o}C and 25.76 ^{o}C respectively in 2017. Atmospheric humidity (78.4%) was also relatively higher (5%) than 73.7% in previous year. Importantly, precipitation was very high (156.2 mm) as compared to just 58.4 mm during the weeks of head scab scoring.

These epidemiological parameters in relation to head scab incidence clearly demonstrated that an elevated temperature coupled with high atmospheric humidity and precipitation could positively favor to attain high intensity of head scab. Any change in these weather conditions could influence the head scab intensity level. To agree with this hypothesis, out of total genotypes, few namely VL 892 (C), K 0307 (C), MACS 6478 (C), TL 2942 (C) and HD 2967 recorded 5-10% high incidence intensity of head blight than preceding

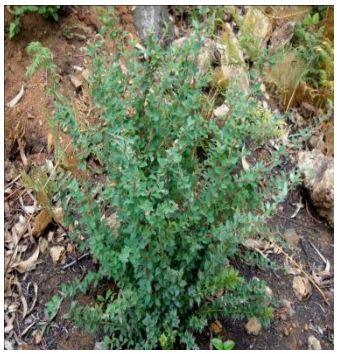
season. Genotypes viz., C 306 (C), AKDW 2997-16 (d) C, MACS 6222 (C) and NIAW 1415 (C) recorded significantly high incidence of head scab in rabi season of 2017 in comparison with previous season (rabi 2016), wherein the proportion climatic factors were relatively less. It could be summarized that above parameters contribute in change of climate are crucial for attaining relative distribution of head scab in wheat genotypes to identify true type of resistance and further evaluation to process to contain the disease in Nilgiri hills.

Successful establishment of Barberry species at Wellington (The Nilgiris)

P. Nallathambi, Jagdish Kumar, C. Umamaheswari, M. Sivasamy, C. Manjunatha, A. Kumar, G. Boobalakrishnan, Naresh Meshram and Rajesh Meena

The genus *Barberis* as deciduous shrub consists about 500 species. Few species were reported as alternate hosts for wheat rust pathogens worldwide. We also identified few types /species of Baberry with different stages of life cycle of rusts. Association of rust pathogen (*Puccinia* spp) was confirmed from *Barberry* spp and reported earlier. The identidy of Barberry was also confirmed by 16S rDNA sequence analysis in addition to phenotypic characterization. Some of existing species namely *B. vulgaris, B. aristata, B. lyciurn, B. umbellate* and *B. pseudumbellata*), *B. aristata* (Himachal Pradesh) has a long history of use in Ayurvedic medicine. Recurrent surveys indicated few land races from southern hills, which are susceptible and resistant pattern of reactions to natural incidence of rusts. However, investigations on role of *Barberry* spp habituated in Nilgiris and Kodaikanal hills for rusts pathogenesis

as main/ alternate hosts is still under progress in our station. Large number of plants is essentially required for different purposes including rust pathogenesis. Owing to hardy shrub nature, no standard method is available for producing large number of desired plants from land races. Therefore, we made efforts to multiply adult plants under field conditions at IARI Regional Station, Wellington. The best establishment and consistency in survival of adult plants were recorded from seedlings of true seeds as compared to vegetative propagation. All seedlings attained to adult plant stage with profuse blooming stage within a period of 48 months from date of planting. Therefore, propagation method standardized from this station will be useful for establishment and rapid multiplication of large number of plants. Such plants will have the commercial value in Ayurvedic medicine in addition to further research on rust pathogenesis in India.



Barberry shrub in forest

Seedlings and adult plant established in field at Wellington

ICAR-IARI Regional Station Wellington organized "Wheat Field Days" part of FLD 2016-17

Nanjundan.J, M.Sivasamy, P.Nallathambi, P.Jayaprakash, V.K.Vikas, J.Berliner, C.Manjunatha, Mohanlal Meena, Rajesh Meena, Arun, K.Sivan and Satyavir Singh*

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To augment the ongoing efforts to popularize wheat cultivation in non-traditional areas of Tamil Nadu and through Front Line Demonstration (FLD) programme (allotted by Indian Institute of Barley and wheat Research (IIWBR), Karnal, which was the approved component under the direct funded programme of Macro Management of Agriculture Scheme, Department of Agriculture, Cooperation &, Farmers Welfare (DAC&FW), Ministry of Agriculture &. Farmers Welfare (MOA&FW), Government of India) 15 ha FLD covering non-traditional areas and dicoccum growing areas were conducted during rabi 2016-17. Part of the programme two wheat field days were organized jointly one at Hosur by IARI Regional Station, Wellington and Athiyaman College of Agriculture and Research (ACAR), Hosur through Perumal KVK, Krishnagiri and the second at Najanadu, Ooty by IARI, RS, Wellington and Dept of Horticulutre, O/O, JDH, Udhagamandalam. In the first event held at Athiyaman College of Agriculture and Research (ACAR), Athimugam, Hosur, on 23rd February, 2017, around 50 farmers from nearby villages were participated. First the farmers visited the well raised FLD crop of Hw 5216 and HW 1098(dicoccum) and impressed with the crop stand and interacted with scientists to know more about

agro-technics involved crop husbandry. Further in the event Mr. Narayanan, Chairman, ACAR, Athimugam, Hosur welcomed the participants which was followed by the addresses by Dr. M. Sivasamy (Head , ICAR-IARI, RS, Wellington), Dr. P. Nallathambi (Principal Scientist, ICAR-IARI, RS, Wellington), Dr. Rudra Naik (Professor/Principal scientist, UAS, Dharwad), Dr. Sundarrajan (Project Co-ordinator, Perumal KVK, Krishnagiri) and Dr Dr. V.K. Vikas **(**Scientist, ICAR-IARI, RS, Wellington). The gathering was also addressed by other scientists from the IARI Regional Station, Wellington on various themes covering all aspects of wheat cultivation. In the event, few framers were encouraged to share their experiences about wheat cultivation. The programme was ended with vote of thanks by Dr Laxmana Kumar, Assist. Prof., ACAR, Athimugam, Hosur which was followed by lunch.

Second field day was held at Nanjanad farm, Department of Horticulture, Ooty, on 13th March, 2017. The programme started with the field visit wherein about 80 farmers from Nanjanad and nearby villages participated along with scientists of IARI, RS, Wellington and officials and scientists from Department of Horticulture,Ooty, HRS, TNAU, Ooty, ICAR-CSWCR&I, RS, Ooty and ICAR-CPRI, RS, Ooty. The farmers were taken to well laid out wheat demonstration plot with COW3(bread wheat) and HW 1098(dicoccum wheat) raised by the department of horticulture through FLD and after seeing the crop the impressed farmers interacted with officials by asking several queries about the wheat cultivation, agronomic practices to be followed etc. After a brief introduction about the event by Mr N. Mani, JDH, Ooty, Dr M Sivasamy (Head, ICAR-IARI, RS, Wellington) explained about the wheat as choice and alternate nutritional crop for people of Nilgiri hills and varietal options available in wheat for cultivation by the Nilgiri farmers. They further emphasized to have one crop of wheat in hills for ensuring food security of this hilly people which is highly prone for natural calamities like floods etc.,. Dr P. Jayaprakash (Pr. Scientist, Plant Breeding) and Dr J Nanjundan (Scientist, Plant Breeding) and other scientists from the IARI Wellington answered to the queries raised by the farmers about the seasons for cultivation, plant geometry, irrigation etc during the discussion took place in the field itself. Following the field visit, presentations and discussions were held on various aspects concerning the farmers of that village in particular and Niligiri's farmers in general.

The event further progressed with various lectures on important themes viz. "Experiences in raising wheat crop" by Mrs. G.K.Umarani (DDH, Department of Horticulture, Ooty); "Food & nutritional security of Nilgiri people through wheat cultivation" by Dr. M. Sivasamy (Head , ICAR-IARI, RS, Wellington); "Soil and water management in Nilgiri's hill agriculture" by Dr. O.P.S Khola (Head , ICAR-CSWCR&I, Ooty) & Dr. K.Kannan (Principal Scientist, ICAR-CSWCR&I, Ooty); "Potato-wheat crop rotation in Nilgiris" by Dr. P. Venkatachalam (Senior Scientist & I/c, CPRI, Ooty); "Crop protection issues in wheat based cropping system of Nilgiri" by Dr. P. Nallathambi (Principal Scientist & ICAR-IARI, RS, Wellington); "Front Line Demonstrations (FLD) and its role in popularization of wheat in Nilgiris" by Dr. P. Jayaprakash (Senior Scientist & ICAR-IARI, RS, Wellington); " Economics of wheat cultivation" by Dr Selvaraj (Prof. of Agrl. Economics, HRS-TNAU, Ooty) and finally Chief Guest's address by Thiru. N. Mani (JDH, Ooty). Dr. J. Nanjundan (Scientist, ICAR-IARI, RS, Wellington) anchored the event and facilitated the discussion in which farmers raised several issues which was suitably answered by the experts present there. Finally, vote of thanks was delivered by Dr. J. Berliner (Scientist, ICAR-IARI, RS, Wellington)

VISITS:

- Trainee scientists from SAARC countries under going training at Kothari Agricultural Management Centre, Coonoor visited IARI, RS, Wellington on 6th, March, 2017

- From Jan-April, 2017 more than 700 under graduate, post graduate students from the constituent colleges of TNAU, KAU, University of Kerala, UAS, Dharward visited IARI, RS, Wellington and acquainted knowledge on the wheat improvement and wheat pathology

Awards and Recognitions

- ✓ **Dr.V.K.Vikas, Scientist** (Pl.Breeding and Gen) awarded with Dr R.S.Paroda, Young scientist award by Indian Society of Plant Genetic Resources, NPBGR, New Delhi-12

- ✓ **Dr.P.Jayaprakash, Principal Scientist** (Pl.Breeding & Gen)), Awarded with Fellow of Indian Society of Plant Genetic Resources, NPBGR, New Delhi-12