

**PROCEEDINGS OF THE 9<sup>th</sup> RAC Meeting**

**Directorate of Wheat Research**

**Karnal**

**April 7-8, 2004**

## **Proceedings of the 9<sup>th</sup> RAC meeting held on April 7-8, 2004 at DWR Karnal**

The 9<sup>th</sup> meeting of the Research Advisory Committee was held on 7-8<sup>th</sup> April, 2004 under the chairmanship of Professor V.L.Chopra, President National Academy of Agricultural Sciences and National Professor, NRC on Plant Biotechnology IARI, New Delhi. Following members of the RAC attended the meeting.

1.	Professor V.L.Chopra	Chairman
2.	Dr. S.N.Shukla	Member
3.	Professor D.N.Jha	Member
4.	Professor Randhir Singh	Member
5.	Dr. B.M.Singh	Member
6.	Dr. Bachan Singh	Member
7.	Mrs. Rajesh Kumari	Member
8.	Dr. Jag Shoran	Member
9.	Dr. A.D.Mongia	Member-Secretary

List of other scientists who attended the RAC meeting is enclosed as Annexure-1.

At the outset, Project Director (Dr. Jag Shoran) DWR Karnal welcomed the members and requested Prof. Chopra, Chairman to conduct the proceedings of the meeting. Member Secretary Dr. Mongia presented the action taken report on the recommendations/observations made by the 8<sup>th</sup> RAC meeting held on 4-5<sup>th</sup> April 2003. In all there were 16 points in the action taken report. The action taken for all the 16 points was approved by the RAC.

An overview of various activities of DWR was presented by Dr. Jag Shoran, Project Director followed by presentation of the scientific achievements by different disciplines of DWR unit by the respective PIs. The work completed by scientists of various disciplines was highly acclaimed by the members of the RAC. The

highlights of presentations of the Project Director & Principal Investigators of different disciplines is enclosed as Annexure-II.

On the basis of the presentations made by the Project Director, respective Principal Investigators on 7<sup>th</sup> April, 2004 followed by field visit and final discussions with the members of the Research advisory committee on 8<sup>th</sup> April, the following recommendations/ suggestions have emerged :

**Recommendations :**

- While discussing on hybrid programme following CHA route, Chairman emphasised that since breaking yield barriers of wheat is important, it is worth to continue work on CHA system, as it facilitates to perform large number of crosses and allows narrowing down the crosses to those exhibiting heterosis in short time as compared to hand inactivation technique and CMS system. Once we identify a real heterotic cross, the CMS and restorer systems can be created in the parental lines for production of commercial hybrids.
- Chairman, Professor Chopra while appreciating the work on wheat quality suggested that work on characterisation of parameters which define the chapati making quality of wheat be strengthened. DWR should either go for patent to enhance the visibility of quality work or bring it to the public forum by bringing it in the form of a document.
- Dr. Chopra was of the opinion that a wheat technology and processing unit should be set up at DWR and efforts should be made to bring out the

technology for wheat based products. He stressed the need for intensification of work on selecting donors for quality traits in wheat.

- He further mentioned that stability of male sterility created through CHA is not high. Genetic stock for hybrid programme should be selected in such a way as to get rid off the problems of male fertility in hybrid programme through CHA route.
- All the RAC members, during the field visit of Crop Improvement programme, stressed the need for purchase of chlorophyll fluorescence meter for the plant physiology unit to assess the physiological status of plants under stress conditions.
- Dr. Randhir Singh suggested that mechanism of tolerance to high temperature in thermo tolerant varieties be studied for which facilities of growth chambers be created at DWR.
- Dr. Shukla ADG suggested that diversification /interruption of traditional rice wheat system through rice-mustard-green gram using FIRB technology be advocated for the larger interest of the farmers as it is most profitable and well suited cropping system.
- Dr. Jha suggested that statistical/economic analysis of crops should be evaluated on rice-wheat system basis rather than individual crops. Efforts should be made to acquire statistical techniques for system base analysis. Presently DWR do not have such programme.
- Dr. Bachan Singh suggested the fabrication/developing of machines for loose rice residue management to facilitate the seeding of wheat as well as building up of organic matter in the soil. He further suggested that list of publications/bulletins of DWR should be given to all the members of the RAC.

## ANNEXURE-II

**Research Activities at DWR – An Overview :** presentation by Project Director Dr. Jag Shoran, Project Director, While presenting an overview of various activities of DWR mentioned that the main theme of the Directorate is to make India the largest wheat growing and exporting country in the world. He highlighted the role played by new wheat production technologies in sustaining the wheat productivity. The mean yield (kg per ha) and productivity (million tonnes) of wheat increased from 2485 and 66.4 during 1997-98 to 2710 and 78 (targeted) yield during 2003-04 respectively while the area under wheat crop almost remains stagnant (26.7 – 27.3 million ha). Project Director further mentioned that the crop during current year was very good and free from all pests and diseases and a record production of 78 million tonnes was expected but after 10<sup>th</sup> of March, 2004, temperature started increasing which caused enhanced maturity and may result, on an average, 3-4 million tonnes loss in yield.

He gave an account of released genotypes by CVRC and SVRC for wheat and barley, new promising strains of wheat, dicoccum, triticale and saline alkaline resistant genotypes for different wheat zones. Efforts were made for widening the genetic base by searching for new stocks and development of new crosses. During 2002-03 a large number of germplasm lines were screened and about 35 promising lines possessing field resistance (upto 35 reaction in double-digit scale) against leaf blight were identified and selected. For this exercise, materials planted under

various natural and super natural nurseries/trials and other exotic sources were screened and the potential donor lines were identified.

These lines will be further tested under poly house condition with artificial epiphytotic conditions along with hot spot screening and then only confirmed sources will be further distributed and utilised in hybridisation programme. He also mentioned that 29 new genetic stocks of bread wheat (19) and durum wheat (10) have been registered. Out of 19 bread wheat genetic stocks, 5 are from DWR Shimla and out of 10 durum wheat registered one is from DWR, Karnal. Dr. Jag Shoran mentioned the drawbacks of hybrid seed production using CHA route but emphasised that this is the quickest mean for production of large number of crosses. After narrowing down the crosses, CMS route will be followed for production of hybrids. He informed the house that molecular markers for resistant genes for rust have been standardised and for monitoring of yellow rust in diseased area of NWPZ, donors or multiple resistance have been multiplied. The Project Director emphasised the need to diversify the rice wheat system by introducing pulses/oilseeds to sustain the soil and crop productivity and also to reduce the burden on oil imports. Keeping in view the vast potential existing for increasing wheat productivity in the eastern part of India, emphasis has been placed on shuttle breeding approach for developing improved wheat germplasm resistant to brown rust and leaf blight and possessing tolerance to terminal heat. The advantage of zero tillage and rotary tillage in cutting down the cost of cultivation was highlighted. Both the tillage systems have the advantage of saving time, labour and fuel and providing equally high yields of wheat. FIRB system of wheat

cultivation has indicated saving of seeds, fertilisers and water. Dr. Jag Shoran, Project Director, gave an account of utilisation of summer nursery at Lahaul Spitti for generation advancement. Test entries planted at Lahaul Spitti were increased considerably during 1990 to 2003. In 2003 , 18000 test entries were planted at Dalag Maidan ( L&S ), HP. The germplasm from the countries like China etc. was imported and multiplied in off-season nursery at Lahaul Spitti. These germplasms were planted at Karnal during 2003-04 crop season for evaluation of yield attributing characters, quality and disease resistant genes and then will be included in the crossing block. 8 germplasm lines developed at DWR RS Flowerdale were procured to widen the genetic base for disease resistance. This will be extensively used to cross the elite pre breeding fixed breeding material. The linkages with the CIMMYT, Rice-Wheat Consortium, ICARDA for genotypes x wheat x disease resistance interaction, genotype x tillage interaction and evaluation of elite international exotic of germplasm for rice-wheat cropping system have been strengthened.

The possible biotechnological applications for wheat improvement are Marker Added Selection (MAS) for disease resistance and quality traits, production of double haploids and transgenics. At DWR Karnal, besides improving the grain quality of wheat, molecular markers have been used to differentiate head scab pathotypes and to tag Yr 16 gene providing adult plant resistance against yellow rust.

### **Discussion/Suggestion by RAC members**

Soon after the presentation of Dr. Jag Shoran, Professor V.L.Chopra mentioned that the role of DWR should be catalytic and suggested not to involve in all the activities as it is neither feasible nor desirable. DWR should aim at investigating only those issues, which will bring supreme advocacy to DWR. Dr. Randhir Singh, Member RAC stressed the need for use of bio fertilisers in wheat. Dr. Bachan Singh emphasised the need to work on managing loose rice residue after harvest of paddy through improved machinery. To the suggestion made by Dr. Randhir Singh, Dr. Mongia informed the house that work on biofertiliser has already been initiated.

### **Disciplinewise presentation of research highlights**

**Presentation by Principal Investigator (Crop Improvement):** The significant research findings of crop improvement were presented by Dr. S.S.Bisht , Principal Investigator (CI) . Dr. Bisht pointed out that DBW 14, a new modern genotype developed at DWR Karnal and released by CVRC for late situation of north eastern plains zone has covered sizeable area in the zone and it is becoming popular among the farmers. Genotypes CBW 31, CBW 32, CBW 33, DBW 15, DBW 16, DBW 18, DBW 20 are some of the genotypes under national testing in different AVTs and NIVTs. While referring to the work in wheat physiology, Dr. Bisht pointed out that genotypes were screened under high temperature conditions created in poly houses and two genotypes namely WH 730 and CBW 12 showed high degree of thermal tolerance. These identified lines can be used as donors. Carbon isotope discrimination has been standardised as a technique for screening crop



varieties for moisture stress tolerance and a national facility to characterise and screen wheat genotypes for heat and drought tolerance is available at UAS, Bangalore . More than 50 lines have been identified for leaf blight resistance and are being used in the hybridisation programme. The segregating materials developed at DWR under leaf blight programme were shared with centres in east and far east region for exercising site specific selections. About 10 lines of durum wheat were selected for high beta-carotene (>8.5 ppm) and five lines for high protein (>15%) and these lines were used in crossing programme for improving quality traits. The material thus developed was also shared with centres in central and peninsular zone.

The hybrid wheat programme has registered a line "GIANT 3" for grains per spike/long spike and spikelets per spike. The extent of standard heterosis under hybrid wheat programme was found up to 25% over DWR 162 (local check) in the peninsular parts of India. The breeding material (F2-F4 generations) developed from winter x spring wheat hybridisation programme was distributed to the centres across the zones to facilitate them with the material coming out of winter wheat gene pool.

Under pre breeding programme large number of crosses with wild, diploid and tetraploid species, synthetics and bultre type material were attempted. The material emanating from this programme has been shared with fellow wheat breeders working in different zones. The cytological studies conducted in wide crosses confirmed the formation of multivalents and thus recombination might take place between the diverse gene pools. Under the maintenance of wheat

germplasm programme characterisation of 132 released varieties and rejuvenation of 1180 other accessions was completed. One durum wheat genotype "Bawaji" was registered for high 1000 grain weight. Molecular marker for stripe rust resistance gene Yr 10 and HMW glu 8 protein sub unit has been developed to strengthen the MAS based screening process at early stage. While referring to work on barley, Dr. Bisht pointed out that a total of 40 new introductions were obtained for malting quality in barley. Two genotypes of malt barley developed at DWR are under test in AVT. Seven lines possessing high malting quality traits are being used in the hybridisation programme. The future thrust areas for the crop improvement programme will be as under :

- Enhancement of germplasm with respect to yield potential , disease resistance and grain quality traits for developing / identifying improved genotypes adapted to varying agroclimatic & production conditions.
- Procurement, evaluation and characterization of new germplasm of bread, durum and dicoccum wheats.
- Developing and sharing of advance lines having resistance to leaf blight and brown rust to meet the requirements in rice-wheat cropping systems emphasizing more on eastern India.
- Developing and sharing of advance lines having resistance to rusts and yellow berry with product specific quality traits for central, Peninsular and North West India.
- Enriching germplasm through introduction of new lines from international collaborative programmes particularly with CIMMYT, Mexico and ICARDA, Syria.
- Germplasm enhancement through transferring new variability from non-conventional sources to support and strengthen ongoing component breeding programmes at various active wheat research centres.

- Identifying trait specific markers for supporting the early selection process in segregating generations under active breeding programmes.
- Identifying genotypes possessing high tolerance to various abiotic stresses namely heat, moisture and problematic soils.
- Efforts will be intensified to break the yield ceilings through new approaches like hybrid wheat, double haploids and pre-breeding to meet the growing demand of increasing population and to provide nutritional security.
- Production of quality seed of newly developed varieties under AICWIP to meet the area specific seed demand and popularization of improved varieties.
- Improvement in quality of malt barley by increasing  $\alpha$ -amylase and decreasing di methyl sulphate content through breeding programme.
- Creating leaf blight resistance in new varieties of barley and incorporation of new variability through exotic barley especially from Europe, Canada and Australia.

#### **Discussion/Suggestions offered by the RAC members**

After presentation by the PI (Crop Improvement), Chairman of RAC Professor Chopra mentioned that breeders should screen/develop material which should be in system perspective i.e. breeding/selection of varieties suited to different resource conservation technologies, varieties recommended for diversification of rice wheat system. Dr. Randhir Singh member RAC suggested that basic research on biochemistry of thermo tolerant varieties should be carried out at DWR in collaboration with IARI or identify linkages with such institutes who are working on thermo tolerant varieties. Dr. Shukla, ADG member RAC suggested that small discussion group be made to chalk out the research programme and sort out

material for inclusion in the thermo tolerant programme. If possible, this programme may be included in the All India Co-ordinated Wheat & Barley Improvement programme. The Chairman further emphasised that the programme on heat tolerance and drought tolerance be separated and we should work on larger platform with intensified efforts. He also mentioned that potential for hybrid programme be studied carefully. The route through which hybrids can be commercialised need to be carefully evaluated out of CMS/CHS route. While discussing on hybrid programme following CHA route, Chairman emphasised that since breaking yield barriers of wheat is important, it is worth to continue work on CHA system, as it will provide large number of heterotic crosses in short time as compared to CMS system. Once we identify heterotic crosses, we may use them to create CMS system for production of hybrid wheat.

**Presentation by Principal Investigator (Resource Management)**

Dr. A. D. Mongia, Principal Investigator (RM) highlighted the results of various field experiments conducted to address the issues like tillage, diversification of rice wheat system and integrated nutrient and weed management for increasing productivity and quality of wheat. Sowing of wheat cultivars on FIRB, zero tillage, rotary tillage and conventional tillage has once again demonstrated that rotary tillage is a better option in producing highest grain yield with a yield gain of about 10% over the conventional system. Apart from saving energy, time and labour, rotary tillage has shown promise even for rice cultivation with or without puddling. During the course of presentation, it was mentioned by the Principal Investigator that in the current rabi season about 75 rotavators have been sold and it is

expected that in the coming rabi season about 400 rotavators will be sold to the farmers which may cover around 3000-4000 ha area per season. The members of RAC appreciated the efforts made by the Resource Management unit for this endeavour. FIRB technology of wheat cultivation was found to be nutrient and water efficient although it produces lower yields as compared to other tillage options. Continuous use of zero tillage for 3 years, though resulted in slight increase in bulk density of soil between 0-10 cm layer but no reduction in yield was observed. However, long term studies are required to study the impact of continuous use of zero tillage on soil compaction. Dr. Mongia further mentioned that diversification/intensification of rice-wheat cropping system is possible by growing crop on FIRB. Inclusion of crops like pigeon pea, vegetable-pea, mustard, soybean and green gram in the rice-wheat rotation has given better returns compared to traditional rice-wheat system. During field visit, Dr. Chopra, Chairman and Dr. Shukla, ADG & other members of RAC emphasised the need to popularise the rice-mustard-green gram rotation on FIRB, which is quite profitable.

Sulphur application through cosavet @ 8 kg/ha was found to increase the yield of wheat by about 2 qtls. per ha and protein content of wheat grain by 11% ( from 10 to 11.2 ). Experiments on tillage, nutrient management and diversification of rice-wheat system were appreciated by all the RAC members.

Since *Phalaris minor* has developed resistance against isoproturon weedicide, a large number of new molecules of herbicides alone and in combination were tried. Out of these sulfo-sulfuron and Sencor were quite effective in controlling *Phalaris minor* and other broad leaved weeds. Topic, Purna Super and Domain were also

found to be equally effective in controlling the *Phalaris minor*. After the presentation, Dr. Bachan Singh, member RAC advised to make research efforts on designing/fabricating a machine for sowing of wheat under loose rice residue. Dr. Chopra, Chairman, ADG Dr. Shukla and Dr. Randhir Singh, member RAC while discussing the diversification of rice-wheat system, advised to popularise the rice-mustard (FIRB) & green gram (FIRB) rotation in Haryana which is quite remunerative and cost effective.

Future researchable areas for Resource Management programme will be :

- Resource conservation technologies with emphasis on management of loose rice residue which could add to the soil and plant health and reduce environmental pollution due to burning of loose rice straw. Fabrication of machine for residue management is in progress and will be completed very shortly.
- Increasing Nutrients and water use efficiency under different tillage systems and residue management
- Dynamics of changes in the physico chemical properties of soil following different tillage systems and rice-wheat diversification programme.
- Diversification of Rice-Wheat system through FIRB technology
- Conduct trials on sustainability of wheat yield and quality through integrated nutrient management.
- Dynamics of changes in weed flora following different resource conservation technologies will be studied and new molecules for control of complex wheat flora will be tested.

### **Discussion/Suggestions offered by the RAC members**

Having been convinced with the benefit of resource conservation technologies, Professor Chopra suggested that root traits in relation to zero tillage and other RCTs should be studied for effective interpretation of the results and final recommendations of varieties suited to different RCT.

**Presentation by Principal Investigator (Crop Protection) :**Dr. A.K. Sharma, Principal Investigator (Crop protection), presented the achievements of the ongoing projects and new project proposals with regard to the Crop Protection Programme. In his presentation on "Generating basic knowledge on important disease and pests of wheat " Dr. Sharma mentioned that infection response of wheat genotypes at seedling stage and at adult stage against *Bipolaris sorokiniana* was shown to be similar in > 85 per cent entries which suggested that the screening at seedling stage can be used for resistance evaluation against *B.sorokiniana*. Reciprocal crosses were made between susceptible and resistant types.

Four to five years of studies on " Cropping system induced changes in pest system, synthesis of IPM modules and PRA for KB of wheat" revealed that the tillage practices influence the pest situation under rice-wheat system. The major pests being influenced were, powdery mildew, Karnal bunt, termites and foot rot. Organic matter content of soil also influenced the soil insect pests (termites) and nematodes. The alternative means of Karnal bunt of wheat were achieved through the use of bioagents and the epidemiological approach. The IPM modules evaluated at the farmers' fields were also presented wherein, over a period of four years, the gain per hectare was calculated to be Rs. 2991.00 with var. HD 2687

and Rs. 1975.00 with variety PBW 343 in two villages and four sites at farmers' fields. , whereas the gain at DWR research farm was Rs. 2398.80 under FIRBS (Var. PBW 343) and Rs. 3702.90 under conventional tillage(Var. HD 2687).

While presenting the work on “Epidemiology and management of Karnal bunt (*Tilletia indica*) and head scab (*Fusarium* spp.) of wheat” Dr. Sharma informed the house that based on molecular analysis, protein polymorphism in population of *T.indica* was confirmed with specific distribution pattern in NWPZ. DNA profile of protein variants was also presented. The effect of temperature on KB sporogenesis was elucidated through the data generated under this project. Six species of *Fusarium* causing head scab, were identified and the DNA amplification was done in case of *F.graminearum*, the most dominant species causing head scab. Dendrogram from banding pattern of *F.graminearum* was also derived.

A new project entitled, “Development of ecofriendly and cost effective crop protection technology in wheat under wheat based cropping systems” was proposed with different sub projects as follows:

Sub project 1: “Role of induced systemic resistance (ISR) in wheat against major pests through PGPR/PRPR like organisms and their integration with other components of IPM.

Sub-project 2: “Further studies on Karnal bunt (*T.indica*) of wheat – host resistance and pathogen variability.

Sub-project 3: “Basic studies on management of field and storage insect pests in wheat under wheat based cropping systems”



The RAC members and the Chairman expressed their satisfaction and agreed to the new project proposals. It was, however, cautioned that work on black rust must be continued despite negligible presence of this disease in northern plains.

**Presentation by Principal Investigator (Quality & Basic Sciences) :** Dr. R.K.Gupta, Principal Investigator (Quality), while presenting the significant findings of the wheat quality programme, mentioned that based on detailed quality analysis of AVTs, NIVTs and special trials, product specific wheat varieties were identified for chapati, bread, biscuit and pasta products. Important physico-chemical, electrophoretic and rheological parameters influencing the end products quality were identified. All the AVT samples were also analysed for grain nutritional aspects viz.  $\beta$ -carotene content, iron, zinc, manganese and copper apart from protein. Genotypes both from *T.aestivum* and *T. durum* were identified showing superiority in various quality parameters. More than two thousand samples of wheat grain were collected from 108 mandis covering 11 major wheat growing states of the country and analysed for 20 quality parameters and percent samples of Indian wheat for individual grading parameters and also for overall grade according to U.S. grading system were determined and product specific varieties and areas were identified. To make use of molecular marker technology approach in wheat quality improvement, RILs were grown at Karnal, Kota and Pune. They were analysed for various quality parameters including baking evaluation. In association with NCL, Pune, molecular markers were identified related to bread making quality. Attempts have been made to design some primers for HMW glutenin subunits. For improving the wheat quality for chapati and bread, systematic crosses and back crosses involving product specific and agronomically superior parents were initiated during 1999-2000 season onward. The progenies have been

advanced using summer nursery facilities at Lahaul Spiti. At present sufficient material is available in F<sub>6</sub>, F<sub>4</sub> and F<sub>2</sub> generations. A large number of indigenous and exotic lines were screened to select the parents and while advancing the generations, the information on wheat quality parameters in the background of high yield and disease resistance was generated. Similarly attempts have been made to develop nutritionally rich wheat varieties. Germplasm lines and also advance material from AVTs and NIVTs registering high biscuit spreads have been identified. Various types of solvent retention capacities viz. sodium carbonate, sucrose, lactic acid, water and alkaline water SRCs have been correlated with biscuit spread factor. Cluster analysis based on solvent retention capacity has revealed that biscuits made from flour or whole meal flour give similar spread factor. The genes from NI 5439 and Hyb. 65 have been cloned and the reasons for their hardness have been explained. On recommendation of the 8<sup>th</sup> RAC, a brain storming session on "Chapati Quality" was held on 25<sup>th</sup> March 2004 at the Directorate. Proceedings of this meeting along with recommendations were presented by Dr. Gupta.

The following future thrust areas have been identified for quality group of DWR.

- To generate data on the quality parameters viz. grain appearance score, hectolitre weight, protein content, sedimentation value, HMW glutentin subunits, rheological properties, grain nutrition and baking evaluation of wheat grain samples received under AICW & BIP to facilitate the release of wheat varieties.
- To develop product specific and nutritionally rich wheat varieties right from the selection of parents and advancement of generations. The information will be

generated on wheat quality parameters in the background of high yield and disease resistance.

- Basic studies for identification of physico-chemical, biochemical, electrophoretic and rheological parameters influencing the end product quality including use of molecular markers for bread quality.
- Analysis of large number of wheat grain samples from mandis of all the wheat growing states of the country, for grading and non-grading parameters, flour characteristics, rheological properties and baking evaluation. This will facilitate in preparing an Atlas of various quality parameters, identification of product specific varieties & areas and also to classify & grade the Indian

#### **Discussions/suggestions offered by the RAC members**

During the course of discussion, the Chairman appreciated the ongoing efforts of the quality programme and suggested that in view of IPR, it will be appropriate to document different characteristic parameters of chapati and the processes involved in its preparation. He also advised to set up a wheat technology centre at DWR.

**Presentation by Principal Investigator (Stat. & Social Sciences):** The presentation of Statistics and Social Sciences was made by R.P.Singh PI (Stat. & SS). Field data of about 545 trials conducted under AICW & BIP were computerised and statistically analysed. The results were reported in the Co-ordinated annual progress report. Software required for the analysis of co-ordinated data were modified and a new software for statistical analysis of two way classified data was developed. Data and results of crop improvement and resource management programs for 2002-2003 were properly documented on electronic media as WHIP and WREMP respectively. It was informed by Mr. Singh that a hand book

on "Design and analysis of field data for AICW & BIP trials was published as a DWR technical bulletin containing all the details about the data management and analysis technique used for co-ordinated data. Under information technology, local area networking (LAN), Internet through VSAT & VSNL were made available to about 42 users.

While referring to the work, Dr. Singh mentioned that during the crop season 2002-03, 608 WHEAT front line demonstrations were allotted, of which 550 were conducted covering an area of 578 ha and 1048 farmers were benefited. The yield and economic advantages of the demonstrated latest wheat production technologies such as improved varieties under different conditions, zero tillage, weed control, FIRB etc. were presented. All the new technologies demonstrated through FLD's in the farmer's field showed yield and economic gain over the conventional with varying amount. 48 barley frontline demonstrations were conducted benefiting 66 farmers covering an area of 48 ha. The results of Barley FLD's were also presented.

Under the PSR project "Accelerating the adoption of Resource Conservation Technologies (RCT)" four villages were adopted. The yield performance under ZT, FIRBS and conventional were presented. Phalaris minor population (broad leaf weed), pest scenario incidence of KB, BP and BD were presented under different technologies. Impact assessment of zero tillage was also presented. Details of other extension activities carried out were also informed.

Under economic studies, the data base was updated and results of trend analysis carried out on all India basis, zonal and state wise were presented. The cost structure in wheat cultivation for NW India and Eastern India was presented. The results of the constraint analysis using PRA technique for wheat were presented for technical and socio economic

constraints. While closing his presentation , Mr Singh gave the following future line of action for Stat & Social sciences programme.

- Need based software will be developed / modified with creation of new database .
- Coordination and conduct of Front line demonstration on wheat and barley.
- Impact assessment, economic and constraint analysis for important technologies and areas.

### **Discussions/suggestions offered by the RAC members**

After the presentation , Prof. Jha suggested that statistical/economic analysis of crops be evaluated on rice-wheat system basis rather than on the individual crop basis. Efforts should be made to acquire statistical techniques for system base analysis.

## **Annexure - I**

### **List of Participants**

# 9th R A C MEETING OF DWR

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2267834/1415	do	-	Amey
2267855/1276	dyg@yashwanth.com	-	Amey
do	do	do	Amey



Sl. No.	Name & Designation	Address	Phone No.	Fax No.	Email	Signature
1	Dr. V.L. Chhabra					V.L. Chhabra
2	Dr. S.N. Sankar					Sankar
3	Dr. Ramesh Singh					
4	Dr. Baktan Singh					
5	Dr. Rajesh Kumar					
6	Dr. B.M. Singh	रौतसगढ़				
7	Dr. D.P. Jha					
8	Dr. J.P. Sharma					
9	Dr. A. D. Magesh	DWR, Kavar				
10	Dr. R. S. Sharma					
11	Suman Jaha	DWR, Kavar				
12	Satish Singh	DWR, Kavar	0184-2265622	0184-2262396	dwr@vsnl.com	Satish Singh
13	Dr. S.C. Tripathi	DWR, Kavar				
14	Dr. Jha	DWR, Kavar				
15	Dr. S. Saravanan	DWR, Kavar				
16	Dr. Ramesh					
17	Dr. S. S. Singh					
18	Dr. S. S. Singh					
19	Dr. S. S. Singh	R. M. DWR, CI, Sagar, Kavar	2266110(R)			Kumarjit Singh
20	Dr. S. S. Singh	DWR, Flowerdale				
21	Dr. S. S. Singh					
22	Dr. S. S. Singh					
23	Dr. S. S. Singh					
24	Dr. S. S. Singh					
25	Dr. S. S. Singh					
26	Dr. S. S. Singh					
27	Dr. S. S. Singh					
28	Dr. S. S. Singh					
29	Dr. S. S. Singh					
30	Dr. S. S. Singh					

32.	Gayamendra Singh	CF, DWR.	G. Singh
33.	Biren Chandra	to -	Chandra
34.	R.P. Supt	P. Sai DWR	Supt
35.	A.K. Sharma	PICCO, DWR	Agst
36.	D. JHA	NCAP, N Delhi	Supt
37.	Kamini Singh	add. Secy to DWR	Agst
38.	Chandrasekhar	Field Eng. Co. Secy to DWR	Agst
39.	B.N. Singh	Rtd. Secy to DWR	Agst
40.	D. SINGH	D. of R. Kanwal	Agst
41.	A.K. SINGH	DWR Kanwal	Agst
42.	S. S. SINGH	DWR Kanwal	Agst
43.	P. S. Verma	to -	Agst

