Final Technical Report –

R 7323: Participatory Crop Improvement in High Potential Production Systems and Salt Affected Areas of Patiala District of Punjab State

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Executive Summary

The farmers participatory varietal evaluation in wheat and rice was conducted for three consecutive years i.e. 1999 to 2002. The study aimed at providing farmers with alternative to their land race to enable them to break the mono-culture in these crops to avoid the risk of yield losses and enlist farmers varietal selection criteria for further breeding work. In the year 1999, baseline survey was conducted which was followed by a search for varieties and their seed acquisition. Eleven released and pre-released on pipeline varieties of paddy arranged. These varieties were evaluated under field conditions in 12 different villages during Kharif 1999. In Kharif 2000-2001,farmers managed on-farm trials were conducted and farmer evaluation performance of experimental varieties against local grown cultivars was done. Preferred variety (IR64) identified and initiative taken to defuse the variety through local seed systems. Out of 11 varieties tested which researchers considers the top, farmers selected only one i.e. IR64. The selection and introduction of this variety into a farming system where farmers were growing only one local variety Pusa44 helps the farmers to take an additional legume crop in between paddy and wheat. This will not only improve the soil health, but also increases the genetic diversity. The study also confirmed that increasing farmers excess to varieties of their preference will result in better speed of diffusion through farmer to farmer seed exchange.

To identify this IR64 variety, 11 different varieties in 496 trials during Kharif 1999, 8 varieties in 291 trials during Kharif 2000 and 5 different varieties on 91 trials in Kharif 2001 were conducted. In addition to this, two Basmati lines got from IRRI, Philippines were evaluated which did not show good promise.

This variety (IR64) being highly resistant to BLB, white plant hopper, lodging resistant and with superfine grains gave clear advantage over the existing cultivars of the area. Due to short duration of the variety, it also gave a sufficient time to raise third crop (legume) in between the time of harvesting of wheat crop and paddy transplanting. This is an alternative choice to the farmers for better and sustainable rice cultivation in addition to more return per unit area and without spoiling the soil health.

To improve the soil health, **40 demonstrations in 20 villages for green manuring** (Susbenia) were conducted during the year Kharif 2000. The adoption was quick at large scale. To save natural resources like ground water, direct seeding of paddy with manual driven drum seeder was demonstrated to the farmers at their farms in 9 and 17 trials during Kharif 2000 and 2001 respectively.

Before the start of the **field performance evaluation of wheat varieties**, a group consisting of 8 wheat varieties procured from different geographical regions were tested in 21 villages including three villages in salt affected areas. This represented reasonably large sample of farmers involved in evaluation of various genetic materials. The farmers were identified for on-farm and demonstration trials through informal discussions.

During 1999-2000, 8 varieties i.e. 7+1 (check) were evaluated at 21 villages in 448 trials and out of these, the data was recorded from 404 trials where PBW343 was a common check. None of the variety could out yield PBW 343 except HD 2687 which numerically out yielded PBW343 in total of 78 trials. During this season another variety which showed better performance was UP 2382 which was carried over for evaluation during the next season i.e. Rabi 2000-01. From trial stage to the next stage an overwhelming attention come to yield performance while other traits of economical importance to the farmers as well as for the longevity/ sustainability of the variety in the field takes second place. The assessment of stains in other than yield was kept in mind during critical analysis of the variety before it is released. Though the variety HD2687 showed more impressive field stand and also yielded numerically higher than PBW 343, but the data recorded by the Plant Pathologist over the locations showed higher susceptibility to yellow rust. Due to this weakness of this variety, it was dropped for

further evaluation. The variety UP 2382 also numerically out yielded PBW343, but it was only tested at four locations during this season. To confirm its sustainability in performance over the local check, this variety was selected for further evaluation in the year 2000-01 along with 7 other varieties freshly selected from other sources for field trials.

During the year 2000-01, 79 trials were conducted where UP2382 was pitted against PBW343 at 61 different locations where it numerically out yielded PBW343. None of the other cultivars were superior in yielded to PBW343. For conventional wheat growing area and salt affected area of the district, three varieties i.e. UP2382, PBW 474 and KRL-19 were evaluated during Rabi 2001-02 against PBW343 under 49 different locations. During this season, UP2382 was statistically at par with PBW343 whereas none of the other variety could out yielded the local check. When it averaged over the years i.e. Rabi 1999-2000, 2000-2001 and 2001-2002, the variety UP2382 gave higher yield than PBW343. This will not only decrease the dependency of the farmer on one genotype but also increase genetic diversity in the field. The yield potential is not only of the criteria that farmer use in considering new variety but also the acceptability depends upon the range of environmental and socio-economic factors.

In addition to the varietal performance and evaluation, 55 trials were conducted to evaluate the advantage of **seed priming versus non-priming in wheat** during the year 1999-2000, using HD2687 and PBW 343 wheat varieties. The results over the years concluded non significant differences.

To **generate more genetic diversity** in the wheat crop, a crossing programme involving 19 different wheat varieties were done. F1 and F2 generations were raised and selection of the most promising plants were done (Annexure VIII).

To benefit the farming community especially small and marginal farmers, a new innovation i.e. **zero tillage cultivation was popularized** by raising demonstrations on large number of locations in the project command area. This zero tillage was accepted by the farmers without any reluctance which gave them saving by Rs. 600-1000 per acre depending upon the soil condition by the way of reducing expenditure on diesel, less weeds and less damage to the

farm machinery. For sowing wheat this is a common practice among the farmers of the villages under PCI project, in the district of Patiala and spreading to the adjoining district of the Punjab as well as Haryana State.

Background:

In the prevailing system adopted by the Research Institutions responsible for developing and releasing of new crop varieties, the farmers involvement, preference is practically negligible. Whatever material is recommended for cultivation, the farmers have to try because of lack of alternative choice for a specific area/environment. So, following were the aims of this project to address the farmers constraints by involving farmers at various stages of the variety development, release and spread/adoption and providing them an alternative choice.

- Varietal choice in crop such as wheat and rice is very limited.
- Baseline survey shows that in project area, due to wheat-paddy long duration rotation, soil health is deteriorating and water level is going low.
- To make the farmers aware and near to the new genetic material which is limited at present.
- There is a lack of consideration of farmer preferences, farmer needs and their involvement in variety testing.
- By identifying high yielding, short duration paddy variety to enable the farmers to take pulse crop/green manuring which will not only improve the soil health and check the water level going low but also increase in total production. This will stablize grain price and also contribute positively for food security and more employment for the poor.
- Varieties are developed and recommended for general cultivation over the state though, there is vast difference within any of these environments/areas.
- Formal system is still promoting a few high yielding crop varieties with due consideration to various variation, physical environments and socio-economic condition of the farmers e.g. Pusa44 is highly susceptible to BLB which is a major risk and also takes long time to mature. It not only adds to the worsening of the already scarce water availability but also deteriorate the soil health.
- So far, no serious efforts have been undertaken to involve the farmers in varietal improvement for area specific and need base.

Project Purpose:

- PVS and IRD are effective FPR methods
- Punjab Agricultural University and other Agricutlural Institutes show no pre-conceived bias towards un-conventional FPR strategies in evaluation and adoption.

Research Activities:

The project was designed as a cluster approach and all the twenty one villages were clubbed in three different clusters. The list of FAMPAR is given below:

Name of Cluster	Villages selected	FAMPAR	IRD
Patiala Block	Khalifewala Kalwa Chalaila Mohabatpura Gaunspura Dhindsa Kauli Bhedpura Barsat Gajjumajra Jauramajra	Khalifewala Mohabatpura Bhedpura	Kalwa Chalaila Gaunspura Dhindsa Kauli Barsat Gajjumajra Jauramajra
Bhunerheri Block	Behl Kathgarh Gagrola Ramgarh Partapgarh Kartarpur Salempur Jattan	Behl Partapgarh	Kathgarh Gagrola Kartarpur Salempur Jattan Ramgarh
Nabha Block	Kaidonpur Pedani Dhangera	Kaidonpur	Pedani Dhangera

The **research activities** conducted in the project are as follows:

- Baseline Study
- FAMPAR and IRD
- Intensive Data Plots

- On-farm Seed Priming
- Introductory Trials on Green Manuring
- Raising of legume crop as a third crop
- Direct sowing of paddy with Drum Seeder
- Monitoring of varietal spread and adoption
- Popularization of Zero Tillage Cultivation in wheat and its monitoring for spread and adoption

Some of the **important activities under this project's research** are listed below:-

- The seed of new varieties were distributed among the beneficiaries without any bias.
- The farmers indigenous knowledge of crop production strengthened the new approaches.
- In FAMPAR, frequent visits to interact, monitor and supervise the trials at the farmer's field was done.
- FAMPAR and IRD approaches gave free hand to the farmer to evaluate the test entries at their farm under their own management according to their local needs without any interference.
- Evaluation of test entries was done through farm walk and focus group discussion at the site of the trials.
- Regular group meetings of all the beneficiaries in the cluster was a regular feature to share the experiences among all.
- After harvesting and taking the final evaluation in respect of yield as well as other characters like durations, quality and resistance to various insect-pests and diseases, adoption/rejection of particular variety was done.

Baseline Study (Annexure VII):

A comprehensive baseline survey at household level was undertaken during the year 1999 covering 328 households spread in 6 FAMPAR villages and 15 IRD villages in three clusters of participatory crop improvement (PCI) project. Prior to the survey, a participatory wealth ranking exercise was done in each of the study villages. This involved collecting information assigned to individual household in three categories relating to their resources and made three categories viz. rich, medium and poor. The baseline study covered family profile, demographic situations, farming systems profile, land resources, source of fuel, irrigation, major crops, cropping pattern, application of organic manures, application of chemical fertilizers, use of pesticides, livestock ownership and social sustainability etc. **The study focused on the status of current use and the use over the last five years of these profiles for different wealth categories.** Baseline survey also studied the general level of grain production and consumption in the project area. Farmers access to public extension services and financial institutions in high potential production systems was also studied.

FAMPAR and IRD:

Farmer Participatory Research (FAMPAR) and Informal Research and Development (IRD) approaches were used in the project. These activities conducted on Rice and Wheat. A total no. of **924 participatory trials were conducted on Rice** over three seasons i.e. Kharif 1999 to 2001. A total no. of **657 participatory trials were conducted on Wheat** over three seasons i.e. Rabi 1999-00 to 2001-02.

Intensive Data Plots (IDP):

IDP trials (Demonstration Plots) assessed the details of farmers inputs and outputs in rice and wheat crops. The objective of the study was to find out the level of net returns with existing and new crop varieties. The study also tried to understand the level of mechanization, labour supply situation and other interactions that take place at the farm level.

On-Farm Seed Priming:

On-farm seed priming trials were conducted on wheat. Standard method of seed priming was followed. Primed seed plots were compared with un-primed seed plots grown exactly under the same condition and with same variety. The on-farm seed priming trials were designed to enhance seed germination, plant stand, early maturity and also escaping the adverse effects of dry spells during terminal growth stages of plants.

Introductory trial on green manuring:

Forty demonstrations in 20 villages for green manuring (Susbenia) were conducted. Farmers adopted this practice on large scale. This is a very positive and encouraging step to improve the soil health.

Raising of legume crop as a third crop:

In addition to green manuring, raising of short duration moong pulse crop in between the harvesting of wheat and transplanting of paddy crop was a successful experiment. It not only improved the soil health but also gave an additional economic returns to the farmers and generated more employment for rural poors.

Direct Sowing of Paddy with Drum Seeder:

A new innovative method of direct sowing of paddy with drum seeder was undertaken and 26 trials were laid out at different locations. The trials gave encouraging results and this practice is being followed as it reduces total period of crop in the fields. This practice is very

useful in preserving the natural resources (underground water) without compromising yield of the crop.

Monitoring of varietal spread and adoption:

The monitoring of varietal spread and its further adoption by the farmers has been compiled and enlisted in Annexure IX (Paddy-Wheat Seed Follow).

Zero Tillage Cultivation:

To benefit the farming community specially small and marginal farmers, a new innovative method i.e. zero tillage cultivation of wheat was popularized in the project area. The farmers adopted this practice on large scale without any reluctance which gave the poverty sticken farmers saving by Rs. 600-1000 per acre.

Outputs:

Season Kharif 1999 :

The project started during Kharif 1999. During this season, 11 different rice cultivars with varying background of adoption were selected and grown in 496 trials in 12 different villages representing over all agro-climatic regions of the district (Table 1). These varieties were evaluated against PR 114 latest release of the Punjab Agricultural University and Pusa44 – a popular variety of the area. The transplanting of varieties varied from first week to the last week of June. On the basis of data for transplanting dates, IR64 gave better yield over the most preferred variety i.e. Pusa44 (Table 4). Though this variety did not do well in the 1st week of June, but its yield increased 12% when transplanted from 20-25th of June. This gave an edge over the Pusa44 not only in yield but also in maturity i.e. 26 days early than Pusa44. This variety was identified to pursue further in the next season i.e. Kharif 2000. IR64 also out yielded PR111 the early maturing variety of PAU when transplanted after 10th of June (Table 5). The final yield data was recorded in those trials only which did not lodge.

Rice varieties evaluated during Kharif 1999

Table 1

No. of Varieties	11
Locatio (Villages)	12
No. of Trials	496
Name of varieties	PR114, IR 36, IR64, PUSA834, HKR120, HKR 126, Pantdhan4, Pantdhan-10, Govind, Gurjari ,Kalinga-III

(Elaborated Data in Annexure 1)

Avg. yield performance of rice varieties over Pusa44 during Kharif 1999

Table 2.

Group no.	Name of varieties compared	No of locations	Avg. yield over locations (Qtl/ha)
G1	Pusa834 Pusa44	11	**61.00** **66.00**
G2	Govind Pusa44	06	**55.00** **66.00**
G3	Gurjari Pusa44	08	**55.00** **65.00**
G4	Pantdhan4 Pusa44	10	**55.00** **66.00**
G5	Pantdhan10 Pusa44	15	**56.00** **66.00**
G6	HKR120 Pusa44	05	**59.00** **67.00**
G7	HKR126 Pusa44	03	**66.00** **66.00**
G8	IR36 Pusa44	14	**70.00** **66.00**
G9	Kalinga3 Pusa44	02	**22.00** **69.00**
G10	PR114 Pusa44	08	**71.00** **63.00**

Avg. yield performance of rice varieties over PR111 during Kharif 1999

Table 3

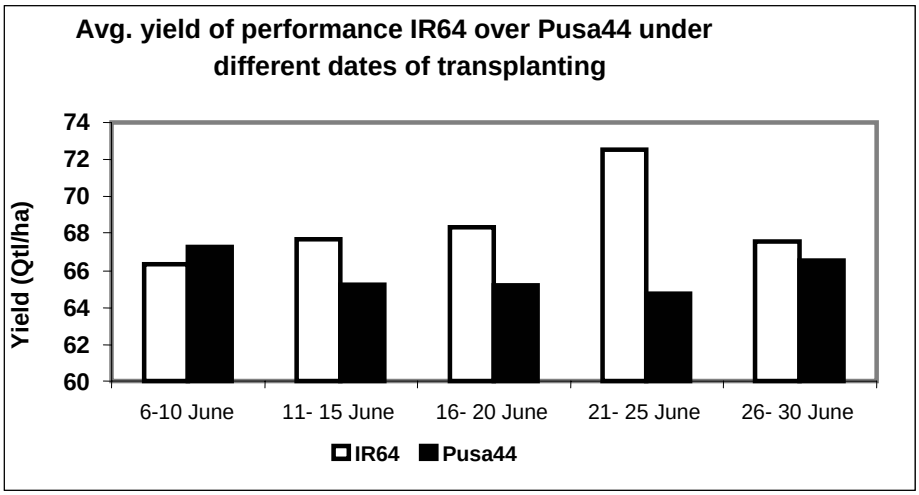
Group no.	Name of varieties compared	No of locations	Avg. yield over locations (Qtl/ha)
G1	Pusa834 PR111	07	60.00 67.00
G2	Govind PR111	08	64.00 67.00
G3	Gurjari PR111	06	66.00 67.00
G4	Pantdhan4 PR111	02	66.00 69.00
G5	Pantdhan10 PR111	01	53.00 71.00
G6	HKR120 PR111	07	65.00 67.00
G7	HKR126 PR111	04	70.00 67.00
G8	Kalinga3 PR111	02	14.00 67.00
G9	PR114 PR111	04	70.00 67.00

Mean yield of IR-64 vs. Pusa-44 in farmer's field trials (Kharif 1999)

Table 4

S. No.	Date of transplanting	Locations	Yield (q/ha)		Percent increase/ decrease	Days to maturity	
			IR-64	**Pusa-44**		**IR-64**	**Pusa-44**
1	6-10 June	5	66.32	67.26	-1.4	143	170
2	11-15 June	9	67.71	65.21	3.8	143	172
3	16-20 June	14	68.30	65.20	4.8	144	171
4	21-25 June	8	72.51	64.73	12.0	147	167
5	26-30 June	8	67.58	66.57	1.5	145	167
	Mean of 44 locations		**68.63**	**65.54***	**4.71**	**144**	**170**

t-value (calculated on the basis of 44 locations) = 4.1
***Significant, both at 1% and 5% level of significance**

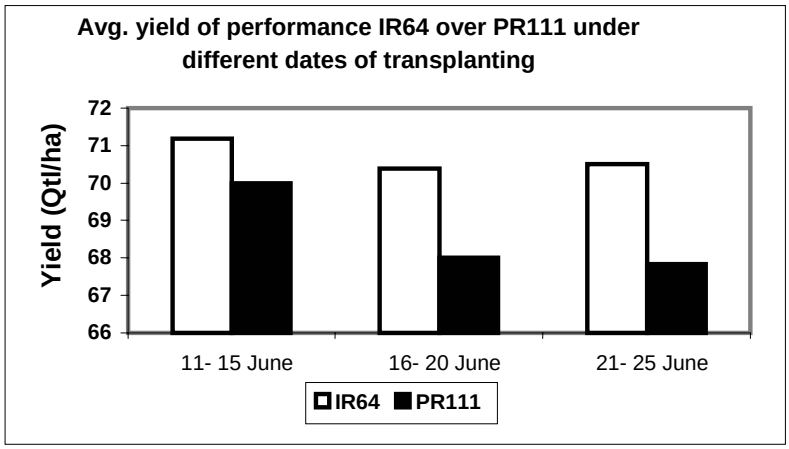


Mean performance of IR-64 vs. PR-111 on farmer's field trials (Kharif 1999)

Table 5

S. No.	Date of transplanting	Location	Yield (q/ha)		Percent increase/ decrease	Days to maturity	
			IR-64	**PR-111**		**IR-64**	**PR-111**
1	11-15 June	1	71.20	70.00	1.7	146	138
2	16-20 June	4	70.40	68.00	3.5	143	140
3	21-25 June	2	70.50	67.83	3.9	142	135
	Mean of 7 locations		**70.60**	**68.24***	**3.45**	**144**	**138**

t-value (calculated on the basis of 7 locations) = 3.3
***Significant at both 5% and 1% level of significance.**



Kharif 2000 :

On the basis of IR64's performance during the last Kharif season (1999), this variety was tested in 291 trials in 21 different villages during Kharif 2000 with Pusa44, PR116, PR111, PR115 as checks (Table 6). Variety IR64 could not out yield these four varieties during this season. Though, this variety was at par with most adopted variety PR114 compared in 111 trials (Table 7). This may act as an alternate choice to the farmer for general cultivation.

A new innovative method of **direct sowing of paddy** with drum seeder was undertaken and the trails were laid out at **nine different locations** (Table 8). These trials gave very encouraging results. It not only reduces total period of crop in fields without sacrificing yield but also reduces the water requirement of the crop.

To utilize the period in between wheat harvested and paddy transplanting, **to improve the soil health and decrease the application of total nitrogen fertilizer to paddy crop, 40 demonstration trials** in 21 villages for green manuring (Susbenia) were conducted (Table 9), which were followed by transplanting of paddy trials. The farmers were convinced to follow this practice and save money by applying less nitrogenous fertilizers to paddy crop. This improved the soil health and reduce the expenditure on crop production.

By seeing the performance of IR64 during Kharif 1999, the farmers were very much convinced and they took seed from the fellow farmers at their own to sow during Kharif 2000 (Table 10).

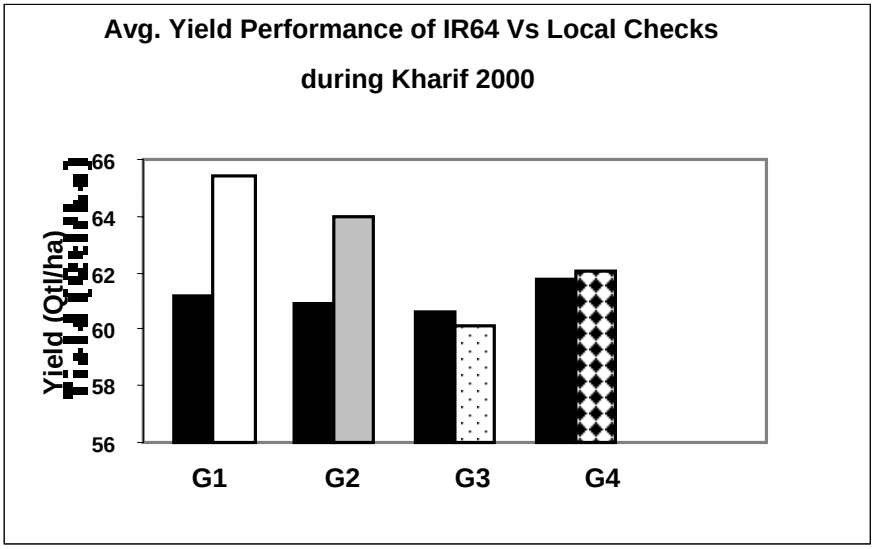


Table 6

No. of Varieties	8
Locations (Villages)	21
No. of Trials	291
Name of varieties	IR 64, IR 36, NDR 97, Govind, Pusa44, PR114, PR115, PR116

(Elaborated Data in Annexure II)

Averaged yield data of IR64 compared to other check varieties during Kharif 2000

Table 7

Group No.	Name of Varieties	No. of Locations	Avg. Yield (Qtl/ha)
G1	IR64 PUSA44	52	61.16 65.41
G2	IR64 PR116	70	60.93 63.97
G3	IR64 PR114	111	60.61 60.17
G4	IR64 PR115	11	61.80 62.05

Direct sowing Trials of Rice – Kharif 2000

Table 8

Method	Drum Seeding
No. of Trials	09
Name of Variety	Govind
Date of sowing range	22.6.2000 to 3.7.2000
Yield (Qtl/ha) range	40.63 to 65.45

No. of Green Manure Plots followed by IR64 Paddy Variety during Kharif 2000

Table 9

Name of Green Manuring Crop	Susbenia
No. of Locations (Villages)	20
No. of Trials	40

IR 64 Spread – Kharif 2000

Table 10

Sr. no.	Name of the Farmer	Village	seed given by PCI/kgs	Area sown (m2)	Yield/ Kgs	Kept/ Kgs	Sold/kg	Sold to other farmers	kgs	Village
1	**Mohar Singh**	Khalifewala	4	1750	1270	1270	Nil	K.B. Singh	70	Jagraon
								Bhajan Singh	60	Khalifewala
								Ajmer Singh	30	Fagganmajra
								Amrik Singh	5	Lang
								Lakhwinder Singh	25	Machhiwara
								Didar Singh	50	Kalwa
2	**Gurjant Singh**	Chalaila	4	4000	2860	100	2760	Badal Singh	5	Hardaspur
3	**Karamjit Singh**	GajjuMajra	2	1000	674	100	1050	Najar Singh	50	Gajju Majra
4	**Inderbir Singh**	GajjuMajra	2	800	550	350	200	Jaswinder Singh	30	GajjuMajra
								Kaur Singh	10	GajjuMajra
								Inderjit Singh	20	GajjuMajra
								Surjit Singh	40	GajjuMajra
								Tarsem Singh	15	GajjuMajra
								Harbhajan Singh	50	Amargarh
5	**Maghar Singh**	Kaidonpur	2	1600	1100	200	900	K.B. Singh	50	Jagraon

Kharif 2001 :

To confirm the yield superiority, sustainability and adoption of IR64 on the basis of data collected during the last seasons, this variety along with another variety PBRC78 a very promising variety of Phillippines, were evaluated in 21 different villages during Kharif 2001 (Table 11). The yield performance of IR64 against PR114 latest release by the PAU were again at par with an average over 27 locations during this season. PBRC78 did not out yield any of the checks (Table 12).

Rice varieties evaluated during Kharif 2001

Table 11

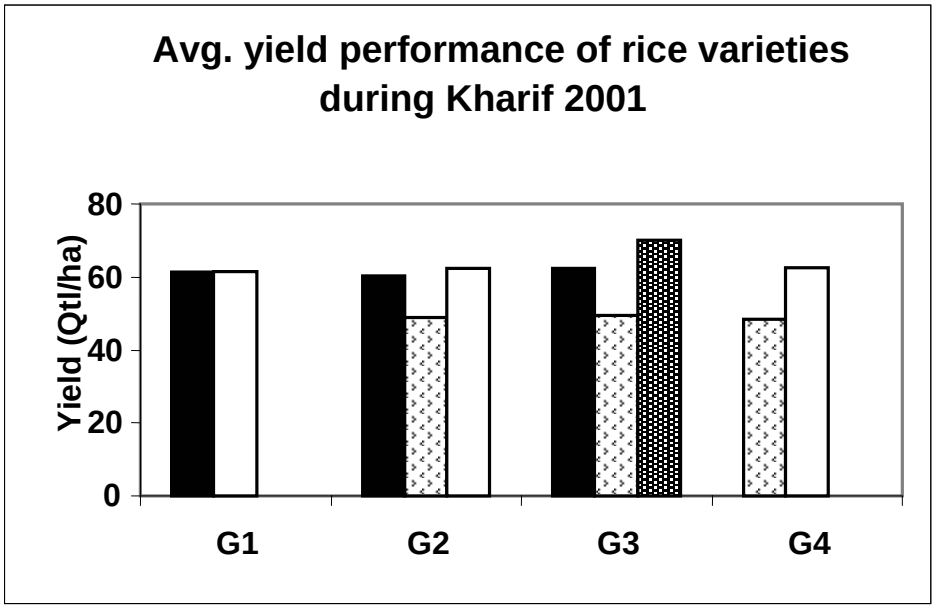
No. of Varieties	5
Locations (Villages)	21
No. of Trials No. of Basmati Trials	91 20
Name of Varieties	IR64, PR114, PUSA44, PBRC78, PR116

(Elaborated Data in Annexure III)

Average yield of rice varieties during Kharif 2001

Table 12

Group No.	Name of Varieties	No. of Locations	Avg. Yield (Qtl/ha)
G1	IR64 PR114	27	61.38 61.54
G2	IR64 PBRC78 PR114	47	60.20 48.89 62.43
G3	IR64 PBRC78 PUSA44	27	62.41 49.44 70.12
G4	PBRC78 PR114	25	48.32 62.73
G5	IR64 PR116	15	61.80 63.24

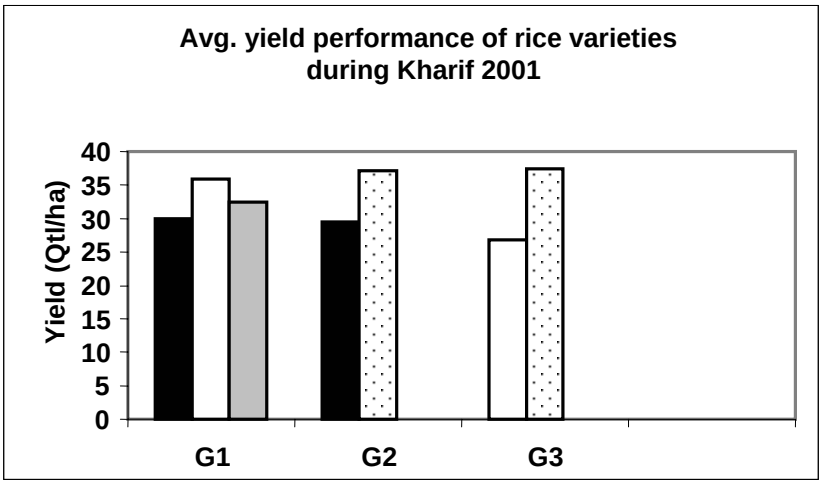


The two basmati lines got from IRRI, Phillippines were evaluated during Kharif 2001 and found that these two lines did not performed well. These lines had low aroma and bad cooking quality (Table 13).

Avg. yield performance of Basmati Trials during Kharif 2001

Table 13

Group No.	Name of Varieties	No. of Locations	Avg. Yield (Qtl/ha)
G1	Line – 3 Line – 5 Basmati 370	03	29.97 35.90 32.44
G2	Line – 3 Sharbati	04	29.55 37.17
G3	Line – 5 Sharbati	06	26.76 37.52



Direct sowing trials of Rice – Kharif 2001

Table 14

Method	Drum Seeding Vs Transplanting
No. of Trials	17
Name of Variety	PR116 PR114
Date of sowing range	12.6.2001 to 28.6.2001
Yield (Qtl/ha) range	PR 116 – 47.82 to 67.18 PR 114 – 58.79 to 67.18

Avg. yield performance of Rice varieties over the years
(Kharif 1999 – Kharif 2001)

Table 15

	Avg. yield (Qtl/ha) Kharif 1999	Avg. yield (Qtl/ha) Kharif 2000	Avg. yield (Qtl/ha) Kharif 2001	No. locations over the three years	Mean Yield over the years
IR64	69.62	61.13	61.33	404	**64.03**
PR114	67.03	60.17	62.23	222	**63.14**
Pusa44	65.54	65.41	70.12	123	**67.02**
PR116	-	63.97	63.24	85	**63.60**

Rabi 1999-2000 :

To identify high yielding variety of wheat with wider adaptability, 7 varieties with different genetic as well as geographic background were selected to evaluate on the farmers field against the most popular variety of the area i.e. PBW343. Total 448 trials were laid out at farmers field in 21 different villages (Table 16). From the different trials, none of the variety could out yield PBW 343 except HD 2687 which recorded numerical edge over PBW343 in yield (tested at 78 locations). Unfortunately, this variety scumed to yellow rust and dropped from further evaluation in the project. A promising variety UP 2382 tested over four locations also showed better yield and pursuaded in the next season (Table 17).

To get good germination and more number of plants per unit area, **55 trials of Seed Priming** were laid out during Rabi 1999-2000 (Table 18) and non-significant differences in yield were noted. Two genotypes PBW 343 and HD 2687 were included in these trials (Tables 19 & 20).

Wheat varieties evaluated during Rabi 1999-2000

Table 16

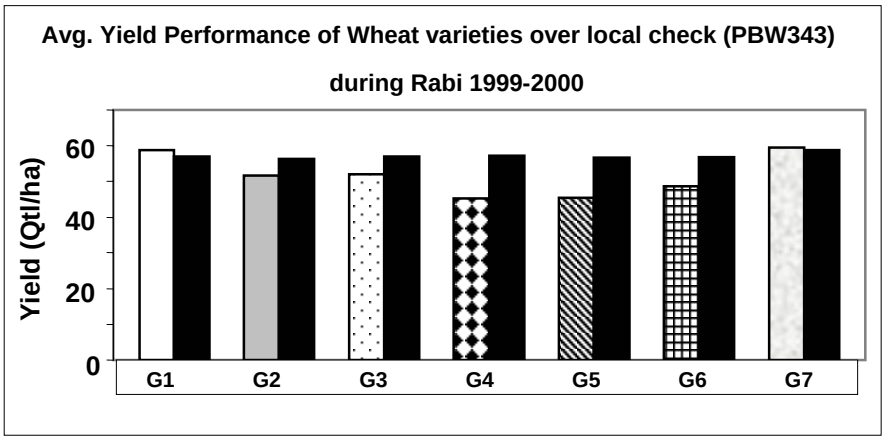
No. of Varieties	7+1
Locations (Villages)	21
No. of Trials	448
Name of Varieties	HD 2687, UP 2003, UP 2338, GW 496, GW 503, K9107, PBW 343, UP 2382

(Elaborated Data in Annexure IV)

Avg. yield performance of wheat varieties over local check (PBW343) during Rabi 1999-2000

Table 17

Group No.	Name of varieties compared	No. of locations	Avg. yield over locations (Qtl/ha)
G1	HD2687 PBW343	78	58.61 57.03
G2	UP2003 PBW343	90	51.51 56.31
G3	UP2338 PBW343	86	51.99 56.92
G4	K9107 PBW343	86	45.23 57.08
G5	GW496 PBW343	20	45.30 56.64
G6	GW503 PBW343	30	48.65 56.77
G7	UP2382 PBW343	04	59.38 58.66



Trials conducted on seed priming in wheat during Rabi 1999-2000

Table 18

No. of Varieties	2
Locations (Villages)	6
No. of Trials	55
Name of Varieties	HD 2687, PBW 343

Avg. yield (Qtl/ha) of HD 2687 wheat variety in Primed v/s Un-primed trials during Rabi 1999-2000

Table 19

Sr. No	**PVS Villages**	**No. of Trials**	Primed	Un-Primed
1.	Mohabatpura	3	59.85	57.76
2.	Behal	2	59.49	61.87
3.	Khalifewal	3	64.24	63.36
4.	Bhedpura	3	56.14	56.28
5.	Partapgarh	1	59.04	57.14
6.	Kaidonpur	5	63.73	64.15
	Overall Average Yield	**17**	**60.41**	**60.09**

Avg. yield (Qtl/ha) of PBW 343 wheat variety in Primed v/s Un-primed trials during Rabi 1999-2000

Table 20

Sr. No	**PVS Villages**	**No. of Trials**	Primed	Un- Primed
1.	Mohabatpura	3	56.61	58.40
2.	Behal	4	56.69	58.17
3.	Khalifewal	5	57.99	57.01
4.	Bhedpura	5	51.22	52.73
5.	Partapgarh	5	59.85	61.08
6.	Kaidonpur	5	54.12	56.28
	Overall Average Yield	**27**	**56.08**	**57.28**

Rabi 2000-2001 :

During Rabi 2000-2001, total 79 trials with 9 different genotypes were laid out in 20 different villages (Table 21). Out of these nine varieties, two varieties i.e. KRL19, KRL 1-4 (salt tolerant varieties) were included in salt affected areas of the project. The UP 2382 gave higher yield than PBW 343 based on 61 trials. This variety seems to be an alternative to PBW343 in the coming time. KRL19 and KRL 1-4 salt tolerant varieties could not out yield PBW343 (Table 22).

Wheat varieties evaluated during Rabi 2000-2001

Table 21

No. of Varieties	8+1
Locations (Villages)	20
No. of Trials	79
Name of Varieties	UP 2382, UP 2425, PBW474, HUW528, HD2402, KRL1-4, KRL19, GW503, PBW-343

(Elaborated Data in Annexure V)

Avg. yield performance of wheat varieties over local check (PBW 343) during Rabi 2000-01

Table 22

Group No.	Name of Varieties	No. of Locations	Avg. Yield (Qtl/ha)
G1	UP2382 PBW343	61	52.54 51.32
G2	HD2402 PBW343	12	43.99 53.11
G3	PBW474 PBW343	04	48.92 51.98
G4	HUW528 PBW343	04	41.96 51.98
G5	GW503 PBW343	11	42.86 52.19
G6	KRL1-4 PBW343	03	48.46 54.12
G7	KRL-19 PBW343	03	41.89 54.12

To confirm the performance **of primed vs un-primed under zero tillage and conventional methods**, **7 trials** were conducted with PBW343 variety (Table 23) and it was noticed that there was no difference of primed vs un-primed in the conventional as well as zero tillage method.

Yield performance with primed/un-primed seed under zero tillage and conventional methods of wheat sowing

Table 23

Name of Variety	PBW 343
No. of trials (Locations)	07
Performance in zero tillage (Qtl/ha)	
Primed	51.27
Un-primed	51.87
Performance in conventional method (Qtl/ha)	
Primed	50.53
Un-Primed	52.78

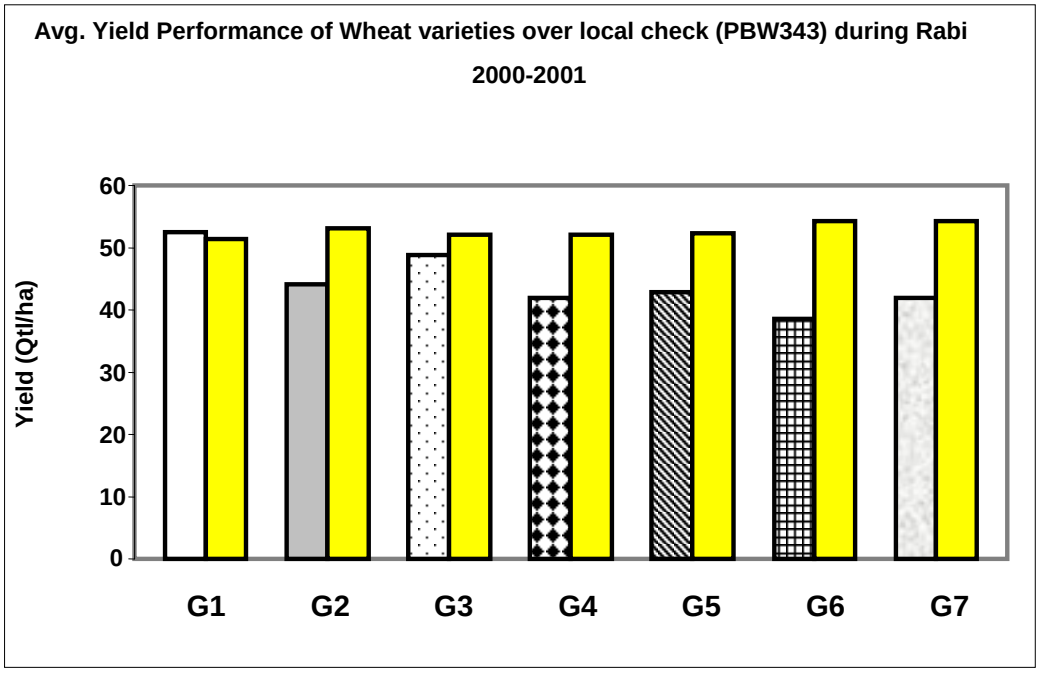
To know the behavior of primed vs un-primed conditions under different nitrogen levels (Table 24), the trials were also conducted where it showed that un-primed gave better performance and this was carried over to the next year.

Nitrogen level Primed Vs Un-primed trial during Rabi 2000-01

Type of trial : Nitrogen level **Area :** 25 m2 **Nitrogen level :** N1= 40kg/acre
Variety : PBW343 **Seed/ plot :** 250 gms N2= 50kg/acre
D.O.S. : 13.11.2000 **Replication :** 4 N3= 60 kg/acre
N4= 70 kg/acre

Table 24

		Avg. Yield (Qtl/ha)	No. of Tillers (Avg)	PlantHeight (Avg)	Lodging Score
N1	Un-primed	27.27	91	91	No lodging
	Primed	28.45	104	97	No lodging
N2	Un-primed	28.85	103	98	No lodging
	Primed	2924	97	97	No lodging
N3	Un-primed	29.64	102	96	No lodging
	Primed	26.08	105	93	No lodging
N4	Un-primed	28.26	99	95	No lodging
	Primed	27.66	94	94	No lodging



Rabi 2001-02 :

To confirm the superiority of yield and to identify the variety as an alternative to PBW 343, three varieties were evaluated in 49 trials in 17 villages (Table 25 & 26).

Wheat varieties evaluated during Rabi 2001-2002

Table 25

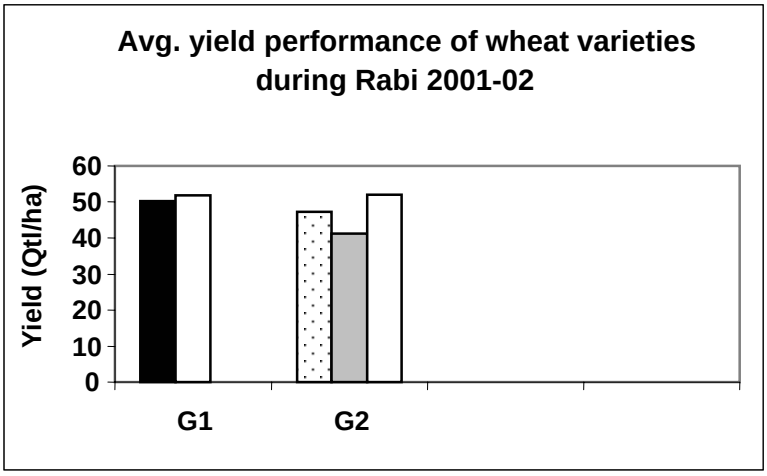
No. of Varieties	3+1
Locations (Villages)	17
No. of Trials	49
Name of Varieties	UP2382, PBW474, KRL19, PBW 343

(Elaborated Data in Annexure VI)

Avg. yield performance of wheat varieties over local check (PBW 343)
during Rabi 2001-02

Table 26

Group No.	Name of Varieties	No. of Locations	Avg. Yield (Qtl/ha)
G1	UP2382	49	50.31
	PBW343		51.78
G2	PBW474	15	47.12
	KRL19		41.19
	PBW343		52.11



Nitrogen level Primed Vs Un-primed trial during Rabi 2001-02

Type of trial : Nitrogen level
Variety : PBW343
D.O.S. : 24.12.01

Area : 15.75 m2
Seed/ plot : 200 gms
Replication : 3

Nitrogen level : N1= 40kg/acre
N2= 50kg/acre
N3= 60 kg/acre
N4= 70 kg/acre

Table 27

		Avg. Yield (Qtl/ha)	No. of Tillers (Avg)	Plant Height (Avg)	Lodging Score
N1	Un-primed	23.84	57	82	No lodging
	Primed	25.09	54	82	No lodging
N2	Un-primed	21.96	56	79	No lodging
	Primed	25.09	57	79	No lodging
N3	Un-primed	26.35	45	82	No lodging
	Primed	27.60	58	83	No lodging
N4	Un-primed	25.72	53	82	No lodging
	Primed	30.11	66	82	No lodging

There was non-significant difference in yield in primed and un-primed conditions but it confirmed the recommendations of the PAU that of nitrogen level i.e. 60 kg/acre gives better results (Table 27).

Yield performance under zero tillage and conventional methods of wheat sowing during Rabi 2001-02

Table 28

Name of Variety	PBW 343
No. of trials (Locations)	16
Performance in zero tillage (Qtl/ha)	51.93
Performance in conventional method (Qtl/ha)	51.07

To popularize the zero tillage cultivation of wheat for more return, 16 trials were conducted and average yield was more as compared to conventional methods (Table 28). It not only gave higher yield but also reduced the cost of cultivation upto Rs. 600/- per acre.

Avg. yield performance of Wheat varieties over the years (1999-2000 to 2001-02)

Table 29

	Avg. yield (Qtl/ha) Rabi 1999-2000	Avg. yield (Qtl/ha) Rabi 2000-01	Avg. yield (Qtl/ha) Rabi 2001-02	Total Locations over the three years	Mean Yield over the years
UP 2382	59.38	52.54	50.31	114	**54.08**
PBW343	58.66	51.32	51.78	114	**53.92**

Contributions of outputs to project goal:

As per the perusal of the data it is worth mentioning that IR64 when averaged over large number of locations over three years i.e. Kharif 1999 to Kharif 2001 gave as good yield as PR114 and PR116 the latest releases of the Punjab Agricultural University. IR64 could not out yield Pusa44 a non recommended variety highly susceptible to BLB and later takes about 3 weeks more to mature in the field. IR 64 has the following advantages :-

- Suitable for three crop systems i.e. clear advantage over existing paddy-wheat cereal rotation in terms of total production per unit area there by positevely contributing to food security as a whole.

- Resistant to BLB & White Back Plant Hopper at the farmers field means less use of pesticides and positive contribution towards better environment.

- Superfine grains and preference in the market means more returns in terms of money.

- Gives an alternative opportunity to the farmers to select an equally good variety with short duration, superfine grains and disease resistant without sacrifying yield.

- Enables the farmers to take legume crop (third crop) in between the period of wheat harvested and paddy transplanting. It will improve human and animal nutrition and soil health.

- Give more return per unit area and time.

This is a major contribution of the project to identify and gave an alternative choice to the farmers for better and sustainable rice cultivation.

- A new innovative method of direct sowing of paddy with drum seeding gave very encouraging results and this practice may be followed as it reduces total period of crop in the fields means preservation of the natural resources (soil health and water).

- To utilize the period between wheat harvested and paddy transplanting and to improve the soil health and decrease the use of fertilizer, trials conducted of green manuring (Susbenia & Summer Moong) followed by transplanting of paddy. People convinced to follow this practice to improve soil health and reduce the expenditure on crop production by using less fertilizer.

As per the perusal from the data the **UP 2382 (Table 29) wheat variety** when averaged over 114 locations over three years gave numerical higher yield than PBW 343 the most popular variety. This variety has a great hope to brake the mono-culture of PBW343 in the area. Farmers have an alternative choice for sowing. The disease and insect-pest reaction of UP2382 is at par with PBW 343.

- On farm **seed priming** of wheat helped in establishing good root system heading to better stand of the crop in the early stages.

- The contribution of **Zero tillage cultivation** of wheat was popularised in the area. The farmers have adopted this practice on large scale which has the following advantages:

    i) Financial saving by Rs. 600/- to Rs. 1000/- per acre.
    ii) Helps to reduce Phalarus minor there by reduces the expenditure on weedicides.
    iii) Saves sowing time by 50- 60%.
    iv) Save 60- 70% diesel.
    v) Lodging problem is reduced.
    vi) The problem of yellowing of wheat after Ist irrigation is reduced/ eliminated.
    vii) Permits early sowing by 7- 10 days.
    viii) The technique is useful in areas with late harvesting of paddy crop.
    ix) Due to less use of farm machinery it reduces wear and tear for the same.

Publications:

- "Equity Issues in Varietal Dissemination through Farmers' Fairs (Kisan melas) in Punjab, India" (2000) by Joginder Singh, S.S. Malhi, ,J.R. Witcombe and D.S. Virk.

- "Participatory Varietal Selection in Rice in the Punjab" (2000) by S.S. Malhi, J.R. Witcombe, D.S. Virk and K.B. Singh.

- "Participatory Varietal Selection and Biodiversity in Rice" (2000) by S.S. Malhi, J.R. Witcombe, D.S. Virk and K.S.Aulakh.

Internal Reports:

Submitted to CAZS (Period)	Date of submission
Quarterly Progress Report (February-March, 1999)	2.7.1999
Quarterly Progress Report (Apr-May-June, 1999)	2.7.1999
Quarterly Progress Report (July-Aug-Sept, 1999)	25.10.1999
Quarterly Progress Report (Oct-Nov-Dec, 1999)	8.1.2000
Annual Report 1999	6.3.2000
Quarterly Progress Report (Jan-Feb-March, 2000)	5.4.2000
Quarterly Progress Report (Apr-May-June, 2000)	16.6.2000
Quarterly Progress Report (July-Aug-Sept, 2000)	7.11.2000
Quarterly Progress Report (Oct-Nov, 2000)	7.11.2000
Quarterly Progress Report (Nov-Dec-Jan,2000)	30.1.2001
Annual Report, 2000	30.1.2001
Report (Feb-March-Apr-May-June,2001)	11.7.2001
Quarterly Progress Report(July-Aug-Sept,2001)	22.11.2001
Quarterly Progress Report (Oct-Dec,2001)	22.11.2001
Annual Report, 2001	1.3.2002
Quarterly Progress Report (Apr-May-June, 2002)	28.6.2002

Visits of Eminent Scientists at PCI Project, KVK, Patiala

Season	Name of Scientist	Date of Visit
Kharif 1999	Dr. Daljit Singh Virk	15-16 Aug, 1999
	Dr. David Harris	17-19 Sept, 1999
	Dr. Daljit Singh Virk	4-5 Oct, 1999
	Dr. Darshan Singh Brar	6th Oct, 1999
Rabi 1999-2000	Dr. P.A. Hollington	8th Dec, 1999
	Dr. G.S. Kalkat Dr. K.S. Aulakh	7th Feb, 2000
	Dr. J.S. Kolar	12th Feb, 2000
	Dr.J.R.Witcombe Dr.David Harris Dr. Daljit Singh Virk	16-18 Feb, 2000
	Dr. H.S. Randhawa	5th March, 2000 and 20th March, 2000
	Dr. P.A. Hollington Dr. Daljit Singh Virk	21-23rd March, 2000
	Dr. M.S. Bajwa Dr. J.S. Kolar	2nd March, 2000
Kharif 2000	Dr. Daljit Singh Virk	9th August, 2000
	Dr. J.S. Kolar Dr. M.S. Gill	2nd September, 2000
	Dr. David Harris	6-8 September, 2000
	Dr. G.S. Mangat	9th September, 2000
	Dr. John Beeching	17-20 September, 2000
	A five-member team from ASA, Gujrat	23-25th September,2000
Rabi 2000-2001	Dr. P.A. Hollington Dr. Daljit Singh Virk	4-6 December, 2000
	Dr. David Harris Dr. P. Hollington	18-22 March, 2001
Kharif 2001	Dr. Daljit Singh Virk	30th May, 2001
	Dr. Daljit Singh Virk	24th July, 2001
	Dr. K.D. Joshi	19-24th August, 2001
	Dr. J.S. Kolar Dr. G.S. Nanda Dr. S.S. Sokhi	8th September, 2001
	22-member Nepal delegates	15-18 September, 2001
	Dr. P.A. Hollington	18-22 September, 2001

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