FINAL TECHNICAL REPORT

"R8071- PARTICIPATORY PLANT BREEDING IN HIGH POTENTIAL PRODUCTION SYSTEMS—VALIDATING PPB PRODUCTS, TESTING DIFFERENT BREEDING METHODS AND SCALING UP OF NEW RICE VARIETIES"

Submitted by

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EXECUTIVE SUMMARY

Client Oriented Breeding (COB), formerly known as Participatory Plant Breeding (PPB), in High Potential Production Systems (HPPS) was implemented in Chitwan and Nawalparasi districts of Nepal since 1998. This project was implemented by LI-BIRD and CAZS Natural Resources (CAZS NR) in collaboration with National Rice Research Programme (NRRP/NARC), District Agriculture Development Offices (DADOs), I/NGOs, several Community Based Seed Producer's Groups and other local level Community Based Organizations (CBOs) and Agrovets. This project made only 21 crosses using diverse parents and was successful to develop a number of farmer preferred promising rice varieties for diverse environmental condition. Many of these varieties have already occupied significant area in various districts of Nepal. This project was successful to scale up some of the varieties identified and developed through COB in India and Bangladesh. Although initial project activities were mainly conducted in Chitwan and Nawalparasi districts, it was successful to test, verify and scale up the promising genotypes in almost all terai and more than 10 mid-hill districts of Nepal with significant spread outside.

The project also contributed in the refinement of breeding techniques and approaches and contributed for the institutionalization of COB approach. Selection of diverse parents with broad genetic base for crossing, working on few carefully chosen crosses with the use of large population size and making selection in the target environment is the key to refinement of the process. LI-BIRD and CAZS NR successfully tested and verified collaborative breeding, modified bulk breeding, and made use of single-seed-descent or equal seed descent methods for rapid generation advancement

Better understanding of genotype x environment interaction using mother baby trial, utilization of farmers' knowledge, practice, and rapid generation advance by utilizing special micro-climatic niches, screening of genotypes for disease reaction, after micro-milling and organoleptic traits to ensure only farmer acceptable varieties are promoted , Simulteneous testing in mother and baby trials and large scale seed multiplication, distribution, and scaling up using multi-partner model made possible to reduce the breeding cycle nearly by half. Networking with government offices (GO), non-governmental offices (NGOs), community based organizations (CBOs), Agrovets, farmers groups and individual farmers was very effective for varieity testing, seed production and dissemination. COB bred varieties are becoming very popular among the farmers in 21 terai and 10 mid-hill districts of Nepal due to their higher yield, better post harvest quality traits, better tolerance to biotic and abiotic stresses and combination of number of traits over their popular local genotype.

Realizing the farmers' ever growing demand of COB bred varieties and its contribution in ensuring food security through providing basket of choice, LI-BIRD has started decentralized seed multiplication programme. In main season 2005 alone, farmers and their groups produced more than 100 tons seed of COB bred varieties. Release proposal for Barkhe 3004, a rice variety bred using COB approaches, has been submitted for official release for long standing water regime. It has better grain quality with high yield potential (1 ton ha^{-1} more yield than Masuli in farmers' management condition). Release proposals for Sugandha 2002 (Sunaulo Sugandha) for irrigated to long standing water regime and Barkhe 2014 for irrigated condition are in preparation. Barkhe 2014 is high yielding, disease free,

better eating quality with glume colour resembling to rice varieties Masuli and Kanchhi masuli. Sunaulo Sugandha is aromatic rice with long slender grain, having yield potential of more than 6 tons per hectare in optimum management condition and higher market price (Rs 5 kg^{-1} more for un-milled rice) than popular cultivar Masuli. This could be one of the best varieties for rice growers, entrepreneurs and consumers.

There are other several promising varieties in pipeline suitable for diverse eco-geographic condition, e.g. Judi 572 and Judi 591 for spring season, Barkhe 1027 and Sugandgha-1 for limited water condition in normal season, Barkhe 2044 for cold tolerant winter season (Boro), Barkhe 2024 for irrigated condition and Super 3004 for irrigated to long standing water condition. Judi 591is the only variety that has glume color similar to masuli rice with higher yield than any popular spring season rice variety. Barkhe 2044 has higher yield with cold tolerance which is gaining popularity among winter rice growers. Barkhe 1027 has good eating quality and is suitable for vegetable growing areas of Nepal and Sugandha-1 is popular in marginal fertility areas. These varieties are being tested and promoted by DADOs and farmers' groups in different parts of Nepal.

The COB bred varieties are not only popular in Nepal but have performed extremely well in Bangladesh and India. In Bangladesh, Judi 582 has out yielded BRRI lines and has been proposed for registration in 2005. Judi 567 is also popular in Bangladesh has out yielded popular varieties in West Bengal and Jharkhand, and is being promoted by Gramin Vikas Trust (GVT) in India.

BACKGROUND

LI-BIRD started Participatory Plant Breeding (PPB) in High Potential Production System (HPPS) of Nepal since 1998 to evaluate the product and process of breeding. In last nine years several rice lines have been developed that are suitable for different production environment of eastern to western terai and selected mid hill districts of Nepal and are becoming popular in these domains.

In Client Oriented Breeding (COB), breeder and farmer work jointly for selection, evaluation and dissemination of the breeding materials. Breeders make very low number of crosses between genetically diverse parents and advance those materials in high population size that permits expression of entire range of variability and allows all possible recombinants to appear. Selection of target population traits (TPT) is always done in target population environment (TPE) to increase selection efficiency. Modified bulk method of breeding has been the major breeding approach used. However, use of mutation breeding and collaborative breeding is also applied.

Three rice varieties are in the process of release, e.g. Barkhe 3004, Barkhe 2014 and Sugandha 2002 (Sunaulo Sugandha). This will be the first case of releasing rice varieties developed through Non government sector in Nepal.

PROGRAMME PURPOSE: Participatory methods for plant breeding developed and promoted. Uptake of rice varieties validated and most acceptable rice lines widely promoted, different participatory plant breeding approaches tested validated and efficiency of the breeding methods evaluated and knowledge gained widely disseminated.

RESEARCH ACTIVITIES

Participatory plant breeding project in HPPS (validating PPB products, testing different breeding methods and scaling up of new rice varieties) aimed at increasing rice productivity sustainably in HPPS of Nepal. This project had tested, validate and scaled up PPB methods in wide rang of partners and collaborators. Major activities were:

1. Development of variety and monitoring of uptake

1. Parent selection, crossing, disease screening for Blast and BLB, micro milling and organoleptic, multiplication, testing, verification and scaling up
2. Monitoring of uptake of varieties produced from client-oriented breeding
3. Impact assessment of access, spread and acceptability of COB bred varieties

2. Testing of participatory methods

1. Evaluation of collaborative breeding using modified bulk breeding
2. Monitoring of farmers' selection, spread and rejection of bulks from a cross between Kalinga III x IR64 in transect from 300-1500 m altitude and in the *terai* in Chitwan
3. Collection of advanced selections from these bulks from participating farmers and evaluation of their performance relative to the same bulks selected by breeders

3. Evaluation of methods of collaborative bulk breeding in two crosses (Kalinga III x IR64 and CH45 x MT1)

1. Evaluation of acceptability of different bulks for PPB according to their agronomic performance relative to local varieties and their genetic diversity in two crosses (Kalinga III x IR64 and CH45 x MT1).

4. Evaluation of methods of pure-line-from-bulk breeding in two crosses

1. Evaluation of acceptability of pure line breeding from modified bulk and equal seed descent populations among farmers after providing training

5. Comparison of performance of varieties from different breeding methods

1. Evaluation of performance of lines selected from bulks (bulk population breeding), lines derived from the bulks (pure line from bulk breeding), and lines derived from the same cross by pedigree breeding. Varieties bred by COB were tested and verified through participatory varietal selection (PVS) using Mother and Baby trial system for varietal testing, promotion and scaling up.

6. Evaluation of reliability of participatory organoleptic testing

1. Evaluation of participatory organoleptic test and find the agreement between multiple judges for organoleptic traits.
2. Comparison of participatory results with laboratory quality tests.
3. Comparison of micro-milling techniques with large scale tests.

7. Scaling up

1. Promotion of products of PPB widely
2. Large scale seed multiplication of varieties from PPB that are preferred by farmers in PVS trials using community based seed production system across the country.

3. Promotion and widely testing of accepted varieties in collaboration with NARC for multi-location trials and in collaboration with DADO in 21 terai and 10 mid-hill districts of Nepal for rapid scaling up and adoption.
4. Propose acceptable entries for official release.

8. Dissemination

1. Wide dissemination of PPB methodology through organised visits to the project area, by publication in national and international journals.

TARGET INSTITUTIONS

A. In Nepal:

1. LI-BIRD
2. CAZS-NR
3. National Rice Research Programme (NRRP)/NARC
4. District Agriculture Development Offices of 31 districts (21 Terai namely Chitwan, Nawalparasi, Jhapa, Morang, Sunsari, Saptari, Siraha, Dhanusa, Mahottari, Rautahat, Sarlahi, Bara, Parsha, Makawanpur, Rupendehi, Kapilbastu, Dang, Banke, Bardiya, Kailali and Kanchanpur and 10 mid-hill namely Gorkha, Lamjung, Tanahun, Kaski, Syangja, Parbat, Palpa, Dhadhing, Udaipur and Accham districts of Nepal)
5. Three Non-Governmental Organizations namely FORWARD in Kapilbastu, Saptari and Jhapa, Morang, Sirha, Banke, SUPPORT Foundation in Kailali and Kanchanpur and CDRC Community Research and Development Center (CDRC), in Morang district of Nepal
6. Eight Community Based Seed Producers Groups namely Unnat, Shree Ram and Devujjal Seed Producers groups in Chitwan, Nawa Adharsha Farmer Seed Producers Group in Jhapa, Radhakrishna and Krishnapranami Women Seed Producers Group in Rautahat, Surayadaya Bahu Uddeshe Krishak Sahakari Sanstha Ltd. in Dang, Kalika Seed Production Group in Kailali and Siddhanath Seed Producers Group in Kanchanpur districts of Nepal
7. Other CBOs and Agrovets

B. In India: Gramin Vikash Trust (GVT), Cathlic Relief Services, a number of State Agricultural Universities (SAUs)

C. In Bangladesh: PROVA and 10 other NGOs

GEOGRAPHIC FOCUS: Direct project intervention through LI-BIRD i.e. Chitwan and Nawalparasi districts and indirect intervention in collaboration with DADOs of 21 terai and 10 midhill districts of Nepal

BENEFICIARIES: Five different categories of beneficiaries have been idetified

1. Primary immediate:	Rice growing farmers and community based seed producers groups of terai and mid-hill districts of Nepal
2. Primary short term:	Rice growing farmers in Nepal in non-project areas after varietal spread of PPB produced varieties.
3. Primary medium term:	Rice farmers in other countries where the PPB bred varieties are adapted. Particularly India and Bangladesh where several PPB bred cultivars are spreading through PSP/CAZS-NR and bilateral projects.
4. Primary long term:	Rice farmers in other HPPSs where national and international breeding programs adopt similar participatory methods as a result of this project.
5. Secondary:	Labourers employed on rice farms and rice consumers that benefit from quality and cheaper rice.

OUTPUTS

Original outputs:

1. Validation

1.1. Monitoring the uptake of varieties produced in project R7412.
1.2. Monitor the uptake of varieties from modified mutation breeding
1.3. Monitor the uptake of varieties from collaborative PPB.
1.4. Monitor the uptake of varieties from modified bulk breeding.
1.5. Monitor the uptake of varieties from pedigree breeding.

2. Testing of participatory methods

2.1 Results of collaborative PPB using modified-bulk breeding evaluated.
2.2 Continue to monitor farmers' selection, spread and rejection of bulks from a cross between Kalinga III x IR64 in transect from 300-1500 m altitude and in the *terai* in Chitwan.
2.3 Collect advanced selections from these bulks from participating farmers and evaluate their performance relative to the same bulks selected by breeders.

3. Methods of collaborative bulk breeding in two crosses evaluated

3.1 Evaluate acceptability of different bulks for PPB according to their agronomic performance relative to local varieties and their genetic diversity in two crosses (Kalinga III x IR64 and CH45 x MT1).

4. In two crosses, methods of pure-line-from-bulk breeding evaluated.

4.1 Evaluate acceptability to farmers, after training, of employing pure line breeding from modified bulk and equal seed descent populations.

1. ***Performance of varieties from different breeding methods compared.***

a. Test in yield trials selected bulks (bulk population breeding), lines derived from the bulks (pure line from bulk breeding), and lines derived from the same cross by pedigree breeding.

2. Reliability of participatory organoleptic testing evaluated

a. In the participatory organoleptic testing evaluate the agreement between multiple judges for organoleptic traits. Compare participatory results with laboratory quality tests. Compare micro-milling techniques with large scale tests.

7. Scaling up

7.1 Products of PPB widely promoted
7.2 Multiply on a large scale varieties from PPB that are preferred by farmers in PVS trials. Promote accepted varieties with DADO in at least three districts in Nepal. Widely test these entries in Nepal in collaboration with DADO and in multi-location trials with NARC. Propose acceptable entries for official release.

8. Dissemination

8.1 PPB methodology disseminated widely. Dissemination of results by organised visits to the project area, by publication in national and international journals.

ACHIEVEMENTS

1. Cross history

Since the beginning of the project to date, LI-BIRD and CAZS NR made 21 crosses using diverse parents (Table 1).
Majority of the farmer preferred and successful varieties have been derived from KIII/IR64,) and Radha 32/KIII. For example Barkhe 3004, Super 3004, Barkhe 3019, Barkhe 2014, Barkhe 1027, Judi 565, Judi 567, Judi 503, Judi 591, Judi 508, DR Dhan, Judi 141F. Irradiated Pusa Basmati (IPB) produced Sugandha 1, Sunaulo Sugandha (Sugandha 2002), Barkhe 1006, Barkhe 2001, Barkhe 2024, Barkhe 2044. Similarly Judi 572 and Judi 582 are from Radha 32/KIII.

Table 1. Summary of crosses

SN	Parent	Cross Year	Made in	2004M	Early C	2005M	2006C	Status	Target	Grown
1	Barkhe 2014/Sugandha 2002	2005 C	LI-BIRD			**F 1 to F 2**	**F2-F3**		Medium	Chaite & Main
2	Sabitri/Barkhe 1027	2005C	LI-BIRD			**F 1 to F 2**	**F2-F3**		Upland & Medium	Chaite & Main
3	Super 3004/RC 32	2005 C	LI-BIRD			**F 1 to F 2**	**F2-F3**		Medium & Lowland	Chaite & Main
4	RC 32/Judi 567	2005 C	LI-BIRD			**F 1 to F 2**	**F2-F3**		Upland & Medium	Chaite & Main
5	Judi 567/Judi 582	2005 C	LI-BIRD			**F 1 to F 2**	**F2-F3**		Upland & Medium	Chaite & Main
6	Judi 582/Judi 572 (R32/KIII//R32/KIII)	2004	LI-BIRD		Cross	**F 1 to F 2**	**F2-F3**	1	Medium	Chaite & Main
7	Sugandha 2002/Kalanimak	2004	LI-BIRD	Cross		F 1 to F 2	Cross not succeeded	2	In situ	
8	Sugandha 2002/Lalkabasmati	2004	LI-BIRD	Cross		F 1 to F 2	Not geminated	2	In situ	
9	Sugandha 2002/Gajalemasino	2004	LI-BIRD	Cross		F 1 to F 2	F2-F3	2	In situ	
10	Barkhe 3004/Barkhe 2001 (KIII/IR64//IPB)	2004	LI-BIRD		Cross	F 1 to F 2		6 Dropped		
11	Barkhe 3004/Sugandha 1 (KIII/IR64//IPB)	2004	LI-BIRD		Cross	F 1 to F 2		6 Dropped		
12	Judi 582/Barkhe 2027(Radha 32/KIII//IPB)	2002	CAZS	F 3		F 4 single plant selection	F4-F5	1	Medium	Main Season Only
13	Azucena KIIIBC/ Sugandha 1	2002	CAZS/LI-BIRD	F3	F4	F5 single plant selection	F5-F6	1	Upland aromatic	Chaite & Main
14	Judi 582/Judi101 (Radha 32/KIII//KIII/IR64)	2002	CAZS	F 4	F 5 Grown Late bulk selected	F5-F 6 Late bulk advanced	F6-F7 single plant selection	1	Upland	Main
	Judi 582/Judi101 (Radha 32/KIII//KIII/IR64)	2002	CAZS	F 4	F 5 Grown early bulk selected	F 6 early bulk advanced	F6-F7 single plant selection	1	Upland	Chaite
15	Judi 582/Ashoka 200F (Radha 32/KIII//KIII/IR64)	2002	CAZS	F 4	F 5 single plant selections	not grown		3 Only India?	Upland	Chaite
16	P# 71/Ashoka 200F (Radha 32/KIII//KIII/IR64)	2002	CAZS	F 4	F 5 single plant selections	not grown		3 Only India?	Upland	Chaite
17	Mansuli/ IR 64	2000 M	LI-BIRD	F 5		F 6 (28 +2 families selected)	F6-F7	1	Lowland	
18	CH 45/MT 1(KIII/IR64)	2000 M	LI-BIRD	F 6			8 families advanced			Chaite and main

Table 1. Summary of crosses. *Cont*

SN	Parent	Cross Year	Made in	2004M	Early C	2005M	2006C	Status	Target	Grown
19	Mansuli/MT 4(KIII/IR64)	1999 M	LI-BIRD	F 7		F 8 (2 families selected)		1	Lowland	
	Mansuli/MT 4(KIII/IR64)			SPS in Decentralized		65 families selction in Sunsari and 10 families selction in				
20	Radha 32/K III	1998 M	LI-BIRD	F 8	F8-F9	F9-F10		4 completed	Upland/medium	
21	Kalinga III/IR 64	1997	IRRI/CAZS	F n				4 completed	All	

2. Performance of COB bred varieties

Performance of COB bred varieties both for main season and spring season rice were assessed in mother trial, baby trials Initial Evaluation Trials (IET) and Co-ordinated Varietal Trials (CVT). Mother trials were conducted by LI-BIRD, FORWARD and CDRC (NGOs working in the field of rice research), IET and CVT were conducted by National Rice Research Programme (NRRP/NARC) and baby trials were conducted mainly by District Agriculture Development Offices of Terai and Mid-hill districts.

2.1. Mother trial

2.1.1. Main season rice

2.1.1.1. Upland

Several rice entries have been tested since 2002 in the upland conditions and Barkhe 1027, Judi 567, Judi 572, Judi 582 and Sugandha-1 were found promising entries for upland environment (Table 2, Figure 1).

Table 2. Performance of various genotypes tested in upland in different years

	Total no. of trials					Maturity (DAS)					No. of tillers per hill				
Genotype	**2002**	**2003**	**2004**	**2005**	**Total**	**2002**	**2003**	**2004**	**2005**	**Combined mean**	**2002**	**2003**	**2004**	**2005**	**Combined mean**
B 6149F			5	8	13			125.20	118.00	120.77			7.84	7.5	7.63
Barkhe 1006		7	18	8	33		131.57	125.30	121.13	125.62		8.60	9.37	8.625	9.02
Barkhe 1014		7			7		134.71			134.71		7.54			7.54
Barkhe 1019			18		18			131.75		131.75			9.53		9.53
Barkhe 1025		7			7		128.86			128.86		8.06			8.06
Barkhe 1027	**10**	**7**	**18**	**8**	**43**	**114.8**	**124.86**	**111.33**	**114.00**	**114.84**	**8.34**	**9.40**	**10.26**	**9.475**	**9.53**
BG 1442	6				6	124				124.00	8.83				8.83
BRRI Dhan 28			18		18			103.83		103.83			9.02		9.02
CNTLR				8	8				115.88	115.88				9.475	9.48
H # 8 A				8	8				106.38	106.38				6.925	6.93
H # 8 B				8	8				105.50	105.50				7	7.00
Judi 566		7			7		127.71			127.71		8.74			8.74
Judi 567				**8**	**8**				**117.25**	**117.25**				**8.15**	**8.15**
Judi 572		**7**	**18**	**8**	**33**		**124.57**	**111.50**	**115.38**	**115.21**		**8.80**	**9.24**	**8.675**	**9.01**
Judi 582				**8**	**8**				**114.00**	**114.00**				**8.875**	**8.88**
Local	**4**		**13**		**17**	**131.5**		**128.62**		**129.29**	**6.20**		**11.07**		**9.92**
PR101		7			7		113.00			113.00		10.69			10.69
Radha 4		**7**	**18**	**8**	**33**		**121.86**	**113.28**	**114.50**	**115.39**		**8.34**	**9.38**	**8.45**	**8.93**
Sugandha 1	**10**	**7**	**18**	**8**	**43**	**114.7**	**124.00**	**118.44**	**111.25**	**117.14**	**7.08**	**6.97**	**8.31**	**7.325**	**7.62**
Combined mean						118.8	125.7	117.9	113.9	118.4	7.7	8.6	9.4	8.2	8.77
LSD at P=0.05															

Table 2. (Cont.)

	Plant height (cm)					Grain Yield (t/ha)				
Genotype	**2002**	**2003**	**2004**	**2005**	**Combined mean**	**2002**	**2003**	**2004**	**2005**	**Combined mean**
B 6149F			122.7	124.6	123.8			3.1	4.2	3.7
Barkhe 1006		105	99.9	98.6	100.7		2.8	2.7	3.3	2.8
Barkhe 1014		94.1			94.1		2.4			2.4
Barkhe 1019			136.0		136.0			2.6		2.6
Barkhe 1025		130			129.6		1.9			1.9
Barkhe 1027	**78.4**	**89.1**	**88.6**	**96.6**	**87.8**	**3.3**	**2.5**	**3.1**	**3.4**	**3.1**
BG 1442	101				100.7	4.5				4.5
BRRI Dhan 28			92.3		92.3			2.7		2.7
CNTLR				95.9	95.9				3.7	3.7
H # 8 A				101.3	101.3				3.8	3.8
H # 8 B				98.2	98.2				3.6	3.6
Judi 566		89.3			89.3		2.3			2.3
Judi 567				**94.1**	**94.1**				**3.3**	**3.3**
Judi 572		**98.3**	**93.7**	**105.0**	**97.4**		**2.2**	**2.7**	**3.4**	**2.8**
Judi 582				**99.3**	**99.3**				**4.2**	**4.2**
Local	**87.4**		**109.3**		**104.1**	**3.6**		**3.1**		**3.2**
PR101		81			81.0		1.7			1.7
Radha 4		**94.4**	**94.1**	**99.6**	**95.5**		**2.9**	**2.8**	**4.5**	**3.2**
Sugandha 1	**108**	**121**	**118.1**	**134.7**	**119.3**	**3.6**	**2.3**	**2.5**	**3.7**	**2.9**
Combined mean	93.8	100	104.5	104.3	102.6	3.7	2.3	2.8	3.7	3.0
LSD at P=0.05										

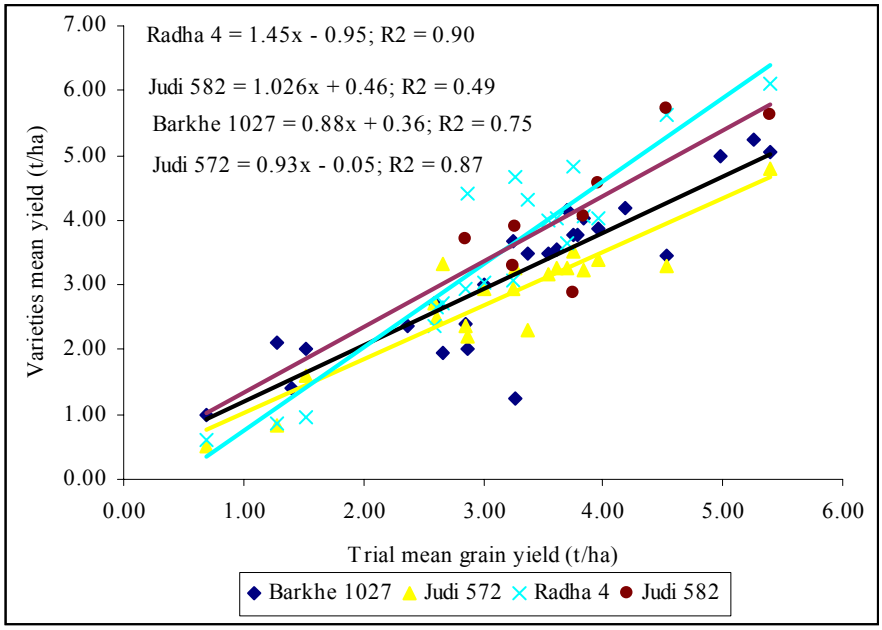


Figure 1. Performance trend of COB bred varieties based on 26 mother trial data in upland environment

2.1.1.2. Medium land

Among the various entries tested since 2002, Barkhe 2014, Barkhe 2024, Barkhe 2044 and Sugandha 2002 (Sunaulo Sugandha) were found promising entries for medium land environment (Table 3, Figure 2).

Table 3. Performance of various genotypes tested in medium land environment in different years

	Total no. of trials					Days to maturity (DAS)					No. of tillers per hill				
Genotype	**2002**	**2003**	**2004**	**2005**	**Total**	**2002**	**2003**	**2004**	**2005**	**Combined mean**	**2002**	**2003**	**2004**	**2005**	**Combined mean**
Barkhe 2001	26.0	8.0	6.0		40.0	130.2	136.1	136.8		132.4	7.1	7.9	8.6		7.5
Barkhe 2014	**26.0**	**8.0**	**6.0**	**9.0**	**49.0**	**133.3**	**142.9**	**144.3**	**144.6**	**138.3**	**8.2**	**7.6**	**9.2**	**9.9**	**8.6**
Barkhe 2022		8.0			8.0		142.8			142.8		6.6			6.6
Barkhe 2024		**8.0**	**6.0**	**9.0**	**23.0**		**145.4**	**146.3**	**143.7**	**145.0**		**7.5**	**9.7**	**9.4**	**8.9**
Barkhe 2026	28.0				28.0	134.3				134.3	7.1				7.1
Barkhe 2027	24.0				24.0	133.3				133.3	6.6				6.6
Barkhe 2029		8.0			8.0		139.3			139.3		7.3			7.3
Barkhe 2031		8.0			8.0		137.7			137.7		6.0			6.0
Barkhe 2043		8.0			8.0		135.4			135.4		6.7			6.7
Barkhe 2044		**8.0**	**6.0**	**9.0**	**23.0**		**138.6**	**139.5**	**140.9**	**139.7**		**7.0**	**8.2**	**7.9**	**7.7**
Barkhe 2045			6.0	9.0	15.0			143.7	136.3	139.3			8.7	8.4	8.5
Barkhe 3017			6.0	9.0	15.0			143.2	140.2	141.4			8.3	8.7	8.6
BPI-3-2				9.0	9.0				140.7	140.7				8.5	8.5
Hajariaya	1.0				1.0	118.0				118.0	6.8				6.8
IAASR 16	26.0				26.0	128.2				128.2	7.2				7.2
IAASR 32	26.0				26.0	132.0				132.0	6.6				6.6
Kanchhi Masuli	**1.0**			**9.0**	**10.0**	**142.0**			**141.9**	**141.9**	**12.8**			**9.4**	**9.7**
Local	15.0				15.0	135.2				135.2	7.2				7.2
Local Check														14.1	14.1
Mala	1.0				1.0	131.0				131.0	8.0				8.0
Masuli	3.0			9.0	12.0	149.0			150.0	149.8	9.1			6.6	7.2
NR 1190				9.0	9.0				145.4	145.4				8.1	8.1
OR 367				9.0	9.0				143.2	143.2				9.6	9.6
Radha 17	2.0				2.0	126.5				126.5	6.6				6.6
Sabitri	**3.0**	**8.0**	**6.0**		**17.0**	**133.0**	**144.9**	**145.2**		**142.9**	**9.9**	**6.8**	**8.8**		**8.0**
Sugandha 1	26.0				26.0	122.2				122.2	6.8				6.8
Sugandha 2002			**6.0**		**6.0**			**155.5**		**155.5**			**8.6**		**8.6**
Combined mean						131.1	140.3	144.3	142.7	136.7	7.2	7.0	8.8	9.0	7.8
LSD at P=0.05															

Table 3. (Cont.)

	Plant height (cm)					Grain Yield (t/ha)				
Genotype	**2002**	**2003**	**2004**	**2005**	**Combined mean**	**2002**	**2003**	**2004**	**2005**	**Combined mean**
Barkhe 2001	97.1	110.5	110.2		101.7	3.6	3.5	3.1		3.5
Barkhe 2014	**91.6**	**117.8**	**116.9**	**115.7**	**104.1**	**3.8**	**3.8**	**4.2**	**4.2**	**3.9**
Barkhe 2022		96.4			96.4		3.0			3.0
Barkhe 2024		**96.0**	**98.2**	**102.5**	**99.5**		**3.8**	**3.4**	**4.2**	**3.9**
Barkhe 2026	94.2				94.2	3.7				3.7
Barkhe 2027	83.7				83.7	3.7				3.7
Barkhe 2029		93.8			93.8		3.8			3.8
Barkhe 2031		93.0			93.0		2.6			2.6
Barkhe 2043		100.4			100.4		2.6			2.6
Barkhe 2044		**96.0**	**88.8**	**97.1**	**94.8**		**2.8**	**2.7**	**3.5**	**3.1**
Barkhe 2045			133.3	141.3	138.6			2.8	3.5	3.3
Barkhe 3017			124.7	123.6	124.0			3.0	3.5	3.3
BPI 3-2				101.9	101.9				3.7	3.7
Hajariaya	99.4				99.4	6.1				6.1
IAASR 16	77.2				77.2	3.2				3.2
IAASR 32	103.3				103.3	3.3				3.3
Kanchhi Masuli	**110.0**			**113.3**	**113.1**	**2.4**			**4.1**	**3.9**
Local	78.6				78.6	2.9				2.9
Local Check				120.7	120.7				4.0	4.0
Mala	120.0				120.0	2.9				2.9
Masuli	129.5			129.3	129.4	5.2			4.2	4.5
NR 1190				138.9	138.9				4.4	4.4
OR 367				100.1	100.1				4.2	4.2
Radha 17	112.7				112.7	5.0				5.0
Sabitri	**114.7**	**103.5**	**99.7**		**104.1**	**4.2**	**4.2**	**3.4**		**3.9**
Sugandha 1	110.1				110.1	3.0				3.0
Sugandha 2002			**112.6**		**112.6**			**3.3**		**3.3**
Combined mean	94.1	100.8	110.6	116.2	102.9	3.5	3.3	3.2	3.9	3.6
LSD at P=0.05										

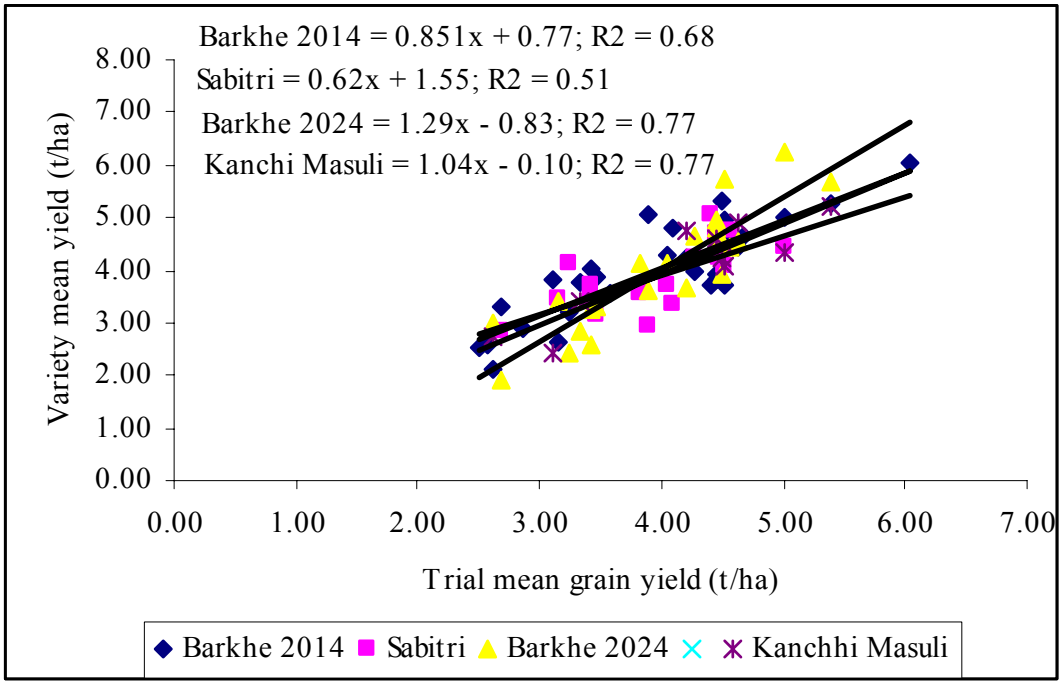


Figure 2. Performance trend of COB bred varieties based on 33 mother trial data in medium land environment

2.1.1.3. Lowland

Among the various entries tested since 2002, Barkhe 3004, Barkhe 3019, Super 3004 and Sugandha 2002 (Sunaulo Sugandha) were found promising entries for lowland environment (Table 4, 5 & 6 and Figure 3 & 4).

Table 4. Performance of various genotypes tested in lowland environment in different years

	Total no. of trials					Days to maturity (DAS)					No. of tillers per hill				
Genotype	**2002**	**2003**	**2004**	**2005**	**Total**	**2002**	**2003**	**2004**	**2005**	**Combined mean**	**2002**	**2003**	**2004**	**2005**	**Combined mean**
Barkhe 3004	**5**	**5**	**6**	**7**	**23**	**157.2**	**158.6**	**156.8**	**153.1**	**156.2**	**8.8**	**8.0**	**8.4**	**9.8**	**8.8**
Barkhe 3009	5				5	157.0				157.0	8.4				8.4
Barkhe 3010	5	5			10	155.4	158.0			156.7	10.0	9.2			9.6
Barkhe 3011	5				5	154.0				154.0	9.0				9.0
Barkhe 3012		5			5		159.2			159.2		8.8			8.8
Barkhe 3013		5			5		159.2			159.2		9.2			9.2
Barkhe 3014		5			5		159.2			159.2		8.4			8.4
Barkhe 3015			6		6			145.7		145.7			9.7		9.7
Barkhe 3017			6	7	13			146.2	135.9	140.6			7.8	7.9	7.8
Barkhe 3018				7	7				154.0	154.0				9.0	9.0
Barkhe 3019				**7**	**7**				**153.9**	**153.9**				**9.1**	**9.1**
Hajariya			1		1			153.0		153.0			6.2		6.2
Masuli	**1**	**5**	**3**	**7**	**16**	**165.0**	**158.8**	**153.0**	**151.4**	**154.9**	**7.6**	**7.4**	**6.7**	**7.7**	**7.4**
Radha 17			2		2			158.5		158.5			8.8		8.8
Sugandha 2002			**6**	**7**	**13**			**156.3**	**152.1**	**154.1**			**8.2**	**10.0**	**9.2**
Super 3004			**6.00**	**7.00**	**13.00**			**157.7**	**153.1**	**155.2**			**9.3**	**9.9**	**9.6**
Sworna	4.00				4.00	156.0				156.0	9.6				9.6
Combined mean						156.3	158.8	152.9	150.5	153.9	9.1	8.5	8.5	9.1	8.8
LSD at P=0.05															

Table 4. (Cont.)

	Plant height (cm)					Grain Yield (t/ha)				
Genotype	**2002**	**2003**	**2004**	**2005**	**Combined mean**	**2002**	**2003**	**2004**	**2005**	**Combined Mean**
Barkhe 3004	**111.6**	**97.6**	**104.3**	**105.5**	**104.8**	**5.8**	**3.2**	**2.9**	**4.2**	**4.0**
Barkhe 3009	119.8				119.8	5.9				5.9
Barkhe 3010	116.3	103.2			109.7	5.9	2.9			4.4
Barkhe 3011	107.9				107.9	4.6				4.6
Barkhe 3012		101.4			101.4		3.1			3.1
Barkhe 3013		100.2			100.2		3.2			3.2
Barkhe 3014		100.8			100.8		3.1			3.1
Barkhe 3015			145.2		145.2			1.9		1.9
Barkhe 3017			136.3	133.7	134.9			1.8	2.6	2.2
Barkhe 3018				107.4	107.4				4.3	4.3
Barkhe 3019				**105.9**	**105.9**				**4.7**	**4.7**
Hajariya			128.4		128.4			2.4		2.4
Masuli	**112.2**	**128.4**	**142.5**	**133.2**	**132.2**	**6.4**	**3.3**	**2.5**	**3.3**	**3.3**
Radha 17			126.5		126.5			3.2		3.2
Sugandha 2002			120.8	116.1	118.2			3.0	3.8	3.4
Super 3004			**111.7**	**110.1**	**110.8**			**3.7**	**4.2**	**4.0**
Sworna	111.4				111.4	6.4				6.4
Combined mean	113.4	105.3	125.5	116.0	115.7	5.7	3.1	2.7	3.9	3.7
LSD at P=0.05										

Table 5. Regression parameters for Barkhe 3004, Masuli and Local check for rainfed lowland environment when variety mean grain yield was regressed on trial mean yield

Variety	**N§**	**Mean grain yield (t/ha)**	**R^2 (%)**	**b**	**SE of b**	**t- value**	**Regression Error MS‡**
Barkhe 3004	28	3.36	42.3	0.9798**	0.2245	4.36	0.3232** (26)
Masuli	28	2.99	58.8	1.0758**	0.1768	6.09	0.2003** (26)
Local (Jaswa, Kanchhi masuli, Rambilash and Nenki)	28	2.49	49.8	0.9518**	0.1876	5.07	0.2256 ** (26)

§ Indicates number of trial for individual variety, ‡ figures in the parenthesis represent degree of freedom, ***= p at 0.05 highly significant, ns= non-significant

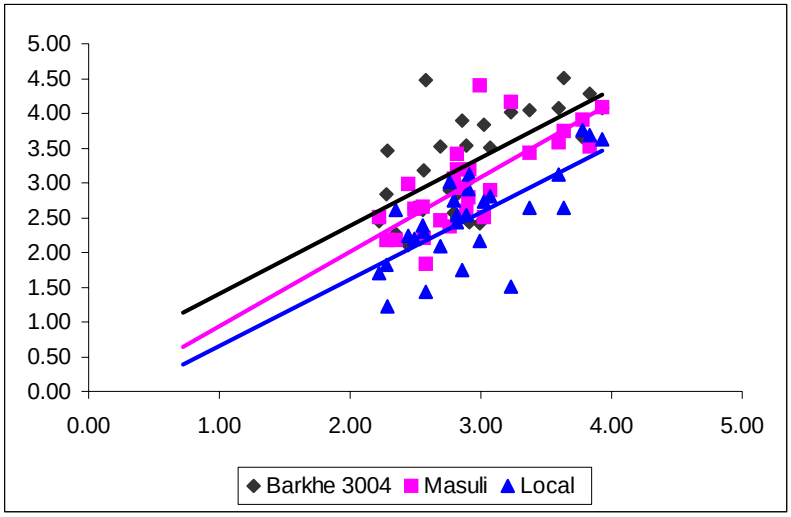


Figure 3. Stability of Barkhe 3004 over check variety Masuli and Local (Jaswa, Kanchhi masuli, Rambilash and Nenki). Trend lines are based on the predicted values from regression equations. Co-ordinated varietal trials data since 2003 to 2005 of Hardinath, Parwanipur and Itahari are used for regression analysis. Barkhe 3004 y=0.415 + 0.980x; n=28, Masuli y =-0.153+1.08x; n=28, Local y = -0.285+0.952x; n=28

Table 6. Crop cut yield comparison of Barkhe 3004 with local varieties in different districts of Nepal during main season 2005.

SN	District	N	Local Variety	Yield Local (t/ha) †	Yield Barkhe 3004 (t/ha)†	% higher yield than local	t-at P =0.05
1	Chitwan	11	Masuli, Sabitri	3.54±0.22	4.48±0.32	26.55	0.025*
2	Nawalparasi	9	Masuli, Mala, Sabitri, Swarna	3.77±0.37	4.83±0.53	28.12	0.048*
3	Morang	9	Masuli	3.58±0.23	5.20±0.37	45.25	0.000**
4	Siraha	11	Jhapali Masuli, Rambilash, Mala, Masuli, Sona Masuli	2.49±0.34	3.33±0.48	33.73	0.017*
5	Bara	22	Sona Masuli	4.21±0.29	4.43±0.26	5.23	0.530ns
6	Kailali	16	Sarjoo 52, Radha, Masuli,	3.14±0.16	3.30±0.29	5.10	0.630ns
7	Kanchanpur	7	Sarjoo 52, Jhapali Masuli, Pusa 44	3.20±0.33	3.86±0.25	20.63	0.150ns
8	Overall	85	Masuli, Sabitri, Sarjoo 52, Sona Masuli, Jhapali Masuli, Rambilash, Mala, Pusa 44, Radha, Swarna	3.50±0.12	4.16±0.14	18.86	0.000***

†Mean±SEM

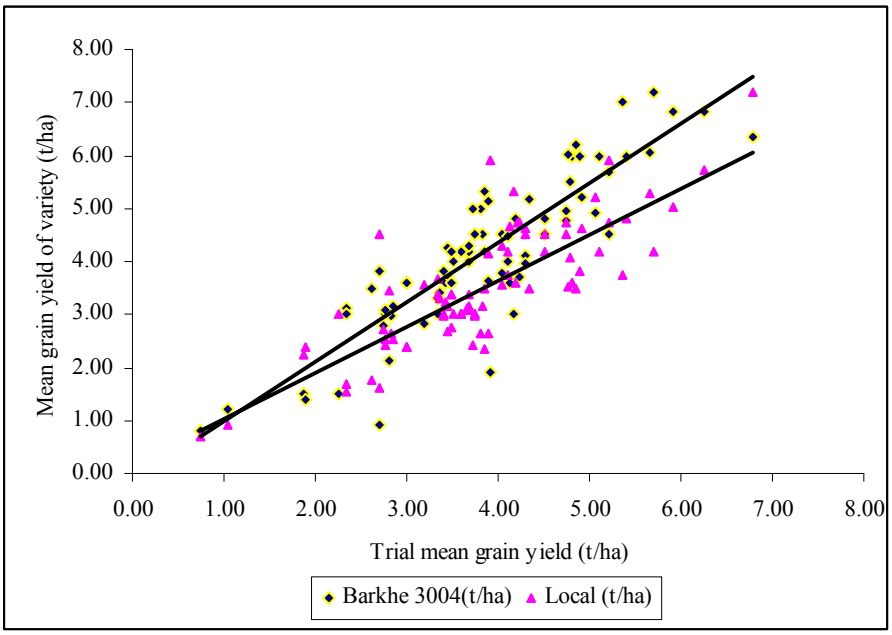


Figure 4. Stability of Barkhe 3004 over popular local check (Masuli, Sabitri, Sarjoo 52, Sona Masuli, Jhapali Masuli, Rambilash, Mala, Pusa 44, Radha, Swarna) from Baby trials (n=85) in Morang, Siraha, Bara, Chitwan, Nawalparasi, Kailali and Kanchanpur districts of Nepal based on predicted value from regression equation. Barkhe 3004 y=1.129x-0.165; R^2=0.77, Local y= 0.87x+0.165; R^2=0.66

2.1.2. Spring season rice

Among the various COB bred genotypes tested in the spring season, Judi 111#5, Judi 541, Judi 547, Judi 552, Judi 591 and ET remnant found promising for spring season (Table 7). All these genotypes out yielded standard check variety CH 45 in the overall performance. DR Dhan and Judi 141F are the two genotypes selected and promoted by the farmer named Dev Raj Sapkota.

Table 7. Performance of various spring season rice genotypes tested in different years in mother trials in various locations

	Total no. of trials					Days to maturity (DAS)					No. of tillers per hill				
Genotype	2002	2003	2004	2005	Total	2002	2003	2004	2005	Combined mean	2002	2003	2004	2005	Combined mean
Bhumikala			4		4			121.0		121.0			7.1		7.1
CH 45	**22**	**10**	**23**	**15**	**71**	**121.6**	**120.3**	**116.3**	**122.5**	**119.9**	**10.1**	**8.9**	**7.2**	**9.4**	**8.8**
Chaite 2			4	3	7			126.8	127.3	127.0			6.3	5.5	5.9
DR Dhan			**4**	**12**	**16**			**121.3**	**122.3**	**122.0**			**7.3**	**10.0**	**9.3**
ET Remnant	**18**		**4**	**5**	**27**	**118.4**		**117.3**	**117.6**	**117.7**	**8.9**		**9.9**	**10.7**	**9.8**
Hardinath 1	22	14	24	15	75	125.3	116.9	121.2	126.9	122.8	7.8	9.2	8.2	8.1	8.3
Judi 101	10				10	114.1				114.1	7.6				7.6
Judi 102	18		4		22	120.8		117.0		120.1	8.2		7.8		8.1
Judi 111	18				18	122.3				122.3	8.4				8.4
Judi 111 # 5				**5**	**5**				**122.2**	**122.2**				**10.2**	**10.2**
Judi 115	22				22	121.6				121.6	9.0				9.0
Judi 141F	22	14	24	5	65	116.1	111.1	109.7	112.6	112.4	7.9	9.2	7.9	9.9	8.7
Judi 503	**18**	**11**	**8**		**37**	**123.3**	**115.6**	**118.9**		**120.1**	**7.8**	**8.5**	**9.4**		**8.4**
Judi 506	8				8	129.4				129.4	9.6				9.6
Judi 521	18	11			29	125.8	119.8			123.5	8.1	9.0			8.4
Judi 534		10			10		113.8			113.8		9.3			9.3
Judi 541		**10**	**10**		**20**		**123.9**	**120.4**		**122.2**		**9.5**	**8.4**		**9.0**
Judi 547		**10**	**8**		**18**		**115.8**	**116.4**		**116.0**		**9.4**	**7.8**		**8.7**
Judi 549		10			10		115.6			115.6		9.0			9.0
Judi 552		**4**			**4**		**119.8**			**119.8**		**10.3**			**10.3**
Judi 560				7	7				134.0	134.0				9.3	9.3
Judi 565		**4**			**4**		**126.3**			**126.3**		**7.7**			**7.7**
Judi 566	4	4			8	126.0	128.3			127.1	9.2	9.1			9.1
Judi 567	4	4		7	15	127.3	127.0		137.4	131.9	9.3	8.8		9.8	9.4
Judi 568		4			4		126.5			126.5		8.9			8.9
Judi 572		10	20	15	45		117.2	119.8	131.0	122.9		8.1	9.3	9.2	9.0
Judi 573			**9**		**9**			**124.4**		**124.4**			**8.0**		**8.0**
Judi 577			9		9			124.6		124.6			7.3		7.3
Judi 581	4				4	119.5				119.5	9.6				9.6
Judi 582	4			12	16	120.3			132.3	129.3	9.0			10.3	9.9
Judi 582/Barkhe 2027				7	7				136.0	136.0				9.7	9.7
Judi 591			**11**	**5**	**16**			**119.9**	**123.2**	**120.9**			**9.7**	**11.0**	**10.2**
MT1 Remnant	18				18	123.7				123.7	8.7				8.7
MT3 Remnant	18				18	127.6				127.6	8.5				8.5
NR 1969-51			4	7	11			127.0	134.7	131.9			6.3	9.7	8.5
NR 274-10-1-2-1-2-1-2-1			4	7	11			126.0	129.3	127.6			7.3	8.5	7.9
NR 274-11-2-1				3	3				134.3	134.3				6.7	6.7
PR 101		3	9	2	14		110.3	104.4	116.0	107.4		9.9	7.7	8.8	8.3
Combined mean	248	133	215	167	764	122.3	118.0	118.1	127.3	121.4	8.5	9.0	7.9	9.1	8.6

Table 7. (Cont.)

	Plant height (cm)					Grain yield (t/ha)				
Genotype	**2002**	**2003**	**2004**	**2005**	**Combined**	**2002**	**2003**	**2004**	**2005**	**Combined**
Bhumikala			120.8		120.8			3.572		3.572
CH 45	**98.3**	**106.6**	**117.9**	**98.2**	**105.9**	**3.600**	**4.660**	**3.959**	**3.411**	**3.815**
Chaite 2			87.9	76.6	83.0			3.510	2.591	3.116
DR Dhan			**124.2**	**105.5**	**110.2**			**3.621**	**3.358**	**3.424**
ET Remnant	**100.9**		**116.9**	**120.9**	**112.9**	**3.035**		**4.756**	**4.364**	**4.052**
Hardinath 1	**86.6**	**99.3**	**99.9**	**86.7**	**93.3**	**3.430**	**4.446**	**4.579**	**3.995**	**4.100**
Judi 101	82.8				82.8	2.436				2.436
Judi 102	100.6		118.2		103.8	3.364		4.115		3.500
Judi 111	105.2				105.2	3.278				3.278
Judi 111 # 5				**113.5**	**113.5**				**4.956**	**4.956**
Judi 115	105.7				105.7	3.652				3.652
Judi 141F	**100.5**	**115.3**	**118.4**	**110.3**	**111.2**	**3.093**	**3.815**	**3.449**	**3.410**	**3.442**
Judi 503	106.8	118.3	125.5		114.3	3.411	4.505	3.641		3.786
Judi 506	108.2				108.2	3.148				3.148
Judi 521	112.3	126.0			117.5	3.431	4.407			3.801
Judi 534		95.2			95.2		4.119			4.119
Judi 541		**121.0**	**135.5**		**128.2**		**4.265**	**3.957**		**4.111**
Judi 547		**115.6**	**120.1**		**117.6**		**4.121**	**4.098**		**4.111**
Judi 549		98.7			98.7		4.106			4.106
Judi 552		**113.0**			**113.0**		**4.417**			**4.417**
Judi 560				82.1	82.1				2.951	2.951
Judi 565		**86.6**			**86.6**		**4.062**			**4.062**
Judi 566	90.1	89.6			89.9	3.278	2.722			3.000
Judi 567	87.4	88.0		83.3	85.6	3.350	3.223		2.247	2.801
Judi 568		87.5			87.5		3.194			3.194
Judi 572		**102.5**	**90.2**	**87.0**	**91.9**		**3.937**	**3.873**	**2.951**	**3.580**
Judi 573			**99.1**		**99.1**			**4.076**		**4.076**
Judi 577			98.0		98.0			3.867		3.867
Judi 581	68.1				68.1	3.196				3.196
Judi 582	85.8			82.8	83.5	3.427			2.977	3.090
Judi 582/Barkhe 2027				87.7	87.7				2.448	2.448
Judi 591			**117.4**	**111.4**	**115.5**			**3.879**	**5.161**	**4.280**
MT1 Remnant	106.7				106.7	3.253				3.253
MT3 Remnant	111.8				111.8	3.077				3.077
NR 1969-51			104.3	103.7	103.9			3.885	2.457	2.976
NR 274-10-1-2-1-2-1-2-1			110.4	101.0	105.7			3.515	3.202	3.359
NR 274-11-2-1				104.2	104.2				1.689	1.689
PR 101		64.8	85.3	62.0	77.6		2.846	3.231	1.475	2.898
Combined mean	100.9	106.3	110.6	92.8	102.8	3.294	4.096	3.854	3.044	3.535

2.2. Baby trial

For further validation of the results from mother trial, IET and CVT, LI-BIRD conducted several baby trials of each genotype in almost 30 districts in Terai and Mid-hill region of Nepal in collaboration with District Agriculture Development Offices; non-governmental organizations like CDRC, FORWARD, SUPPORT Foundation; Community Based Seed Producers Groups and other projects of LI-BIRD. The preferred trait of the promising genotypes in comparison with popular farmer's local varieties in various districts is presented below.

2.2.1. Barkhe 3004

Based on results from 262 baby trials conducted for three years in several districts of Nepal, Barkhe 3004 is clearly a preferred variety due to higher yield, higher tillering capacity, lodging tolerance, disease resistance, better eating quality, easy threshing and higher market price than the farmers' popular local varieties (Table 8).

Table 8. Farmers' perceptions on eleven traits for Barkhe 3004 in 111 Baby trials in 2003, 27 baby trials in 2004 and 124 baby trials in 2005 and their intentions for growing the variety in the following year in Chitwan, Nawalparasi, Jhapa, Morang, Sunsari, Siraha, Bara, Makawanpur and Saptari districts of Nepal.

		Number of farmers				
Trait	**Year**	**Barkhe 3004 preferred**	**Equally preferred**	**Check preferred**	**Preference for Barkhe 3004 (%)**	**Probability†**
Maturity	2003	13	19	78	11.8	0.000**
	2004	6	3	18	22.2	0.014*
	2005	30	41	45	25.9	0.083ns
Tillering capacity	2003	28	76	6	25.5	0.000**
	2004	21	3	1	84.0	0.000**
	2005	68	45	7	56.7	0.000**
Lodging	2003	45	59	7	40.5	0.000**
	2004	14	5	7	53.8	0.127ns
	2005	107		3	97.3	0.000**
Disease	2003	53	48	5	50.0	0.000**
	2004	15	3	7	60.0	0.080ns
	2005	61	31	28	50.8	0.000**
Threshing	2003	69	31	9	63.3	0.000**
	2004	18	5	3	69.2	0.001**
	2005	61	41	18	50.8	0.000**
Milling recovery	2003	77	28	3	71.3	0.000**
	2004	7	12	3	31.8	0.206ns
	2005	38	67	10	33.0	0.000**
Eating quality	2003	75	16	17	69.4	0.000**
	2004	5	6	13	20.8	0.059ns
	2005	59	38	16	52.2	0.000**
Market price	2003	45	19	20	53.6	0.002**
	2005	23	70	21	20.2	0.763ns
Straw yield	2003	53	38	20	47.7	0.000**
	2004	8	8	9	32.0	0.808ns
	2005	24	42	55	19.8	0.000**
Grain yield	2003	22	36	22	27.5	0.000**
	2004	14	8	5	51.9	0.039*
	2005	58	41	22	47.9	0.000**
Will grow again	2003	71		38	65.1	0.002**
	2004	13		11	54.2	0.433ns
	2005	81		36	69.2	0.000**

†'Barkhe 3004 preferred' *versus* 'Check preferred' using χ^2 test.

Stakeholders' perceptions

Farmers' perceptions about Barkhe 3004 from Chitwan, Nawalparasi, Jhapa, Morang, Sunsari, Siraha, Bara, Makawanpur and Saptari districts were collected in 2005, which are as follows:

Preferred traits

1. High yielding
2. Good eating quality
3. High disease resistance
4. Early maturity than some of their local varieties
5. Non lodging
6. Suitable for high fertility condition (fertilizer responsive)
7. Soft straw so preferred by cattle
8. Easy threshing
9. High tillering
10. Good storage
11. High market price
12. Long panicle and higher number of grain per panicle
13. High number of filled grain per panicle
14. Suitable for long standing water condition where other varieties performs poor
15. Tasty for eating
16. High milling recovery

Non-preferred traits

1. Gundhi bug problem
2. Stem borer problem
3. Not suitable for upland (Radha 4 domain)

2.2.2. Barkhe 2014

Based on results from 154 baby trials conducted during 2005 in several districts of Nepal, Barkhe 2014 is a preferred variety due to its early maturity, higher tillering capacity, lodging tolerance, resistance to diseases and pests, easy threshing, higher milling recovery, better eating quality, higher grain and straw yield than the farmer's popular local varieties (Table 9).

Table 9. Farmers' perceptions on 154 baby trials in eleven districts of Nepal [Chitwan (36), Bara (10), Jhapa (9), Kailali (4), Makawanpur (10), Morang (5), Saptari (7), Siraha (10), Sunsari (38), Gorkha (3) and Kaski (4)] during 2005

	Number of farmers				
Trait	Barkhe 2014 preferred	Equally preferred	Check preferred	Preference for Barkhe 2014 (%)	Probability†
Maturity	86	41	21	56	0.000**
Tillering capacity	77	60	12	50	0.000**
Lodging	43	105	1	28	0.000**
Disease	81	54	15	53	0.000**
Threshing	96	43	10	62	0.000**
Milling recovery	75	67	2	49	0.000**
Eating quality	69	67	7	45	0.000**
Market price	24	89	22	16	0.768ns
Straw yield	63	49	38	41	0.013*
Grain yield	71	45	26	46	0.000**
Will grow again	114		31	74	0.000**
Overall performance	85	41	11	55	0.000**

†'Barkhe 2014 preferred' *versus* 'Check preferred' using χ^2 test.

Stakeholders' perceptions

Farmers' perceptions about Barkhe 2014 from 11 districts Chitwan, Bara, Jhapa, Kailali, Makawanpur, Morang, Saptari, Siraha, Sunsari, Gorkha and Kaski districts in main season 2005.

Preferred traits

1. Disease insect resistant
2. High grain and straw yield
3. No lodging problem
4. No Shattering problem, good eating quality and fine grain than Kanchhi Masuli
5. Easy threshing and than Kanchhi Masuli
6. Early maturity, allow land quickly for next season crop growing
7. High milling percentage
8. Appealing visual glume color (Masuli glume color)
9. No disease problem
10. Good taste
11. Suitable for rainfed condition

Non-preferred traits

1. Shattering problem
2. Short panicle length
3. Lodging problem in some high fertility areas

2.2.3. Sugandha 2002

Based on results from 32 baby trials conducted during 2005 in several districts of Nepal, Sugandha 2002 is a preferred variety for its higher tillering capacity, lodging tolerance, easy threshing, higher

milling recovery, excellent eating quality, higher market price and higher grain yield than the farmer's popular local varieties (Table 10).

Table 10. Farmers' perceptions on 32 baby trials in seven districts of Nepal [Kailali (2), Kanchanpur (1), Makawanpur (10), Morang (2), Saptari (3), Siraha (5) and Sunsari (9)] during 2005

	Number of farmers				
Trait	**Sugandha 2002 preferred**	**Equally preferred**	**Check preferred**	**Preference for Sugandha 2002 (%)**	**Probability†**
Maturity	9	15	6	30.00	0.439ns
Tillering capacity	12	16	3	40.00	0.020*
Lodging	5	25	0	16.67	0.000**
Disease	16	8	8	53.33	0.102ns
Threshing	17	13	2	56.67	0.001**
Milling recovery	14	15	3	46.67	0.008**
Eating quality	27	3	2	90.00	0.000**
Market price	9	12	1	30.00	0.011*
Straw yield	13	11	8	43.33	0.275ns
Grain yield	15	14	3	50.00	0.005**
Will grow again	25		4	83.33	0.002**
Overall performance	25	4	1	83.33	0.000**

†'Sugandha 2002 preferred' *versus* 'Check preferred' using χ^2 test.

Stake holder's perception

Farmer's perception about Sugandha 2002 from seven districts Kailali, Kanchanpur, Makawanpur, Morang, Saptari, Siraha and Sunsari districts in main season 2005.

Preferred traits

1. Aromatic fine grain rice
2. High grain and straw yield
3. Good eating quality
4. High milling percentage
5. Long panicle
6. Fertilizer responsive
7. Long Panicle

Non-preferred traits

1. Late Maturity
2. Insect (stem borer) and disease (BLB) problem

2.2.4. Sugandha 1

Based on results from 89 baby trials conducted during 2005 in several districts of Nepal, Sugandha 1 is also a preferred variety due to its early maturity, easy threshing, higher milling recovery, excellent eating quality, higher market price and higher grain and straw yield than the farmer's popular local varieties (Table 11).

Table 11. Farmers' perceptions on 89 baby trials in ten districts of Nepal [Bara (7), Chitwan (14), Jhapa (10), Kailali (6), Kanchanpur (4), Kaski (4), Makawanpur (9), Saptari (7), Siraha (12) and Sunsari (11)] during 2005

	Number of farmers				
Trait	**Sugandha 1 preferred**	**Equally preferred**	**Check preferred**	**Preference for Sugandha 1 (%)**	**Probability†**
Maturity	59	17	13	66.29	0.000**
Tillering capacity	26	26	29	29.21	0.686ns
Lodging	49	39	1	55.06	0.000**
Disease	40	26	23	44.94	0.032*
Threshing	62	22	5	69.66	0.000**
Milling recovery	44	40	6	49.44	0.000**
Eating quality	75	10	4	84.27	0.000**
Market price	42	42	7	47.19	0.000**
Straw yield	43	33	15	48.31	0.000**
Grain yield	45	25	19	50.56	0.000**
Will grow again	76		11	85.39	0.000**
Overall performance	75	11	1	84.27	0.000**

†'Sugandha 1 preferred' *versus* 'Check preferred' using χ^2 test.

Stake holder's perception

Farmer's perception about Sugandha 1 from ten districts Bara, Chitwan, Jhapa, Kailali, Kanchanpur, Kaski, Makawanpur, Saptari, Siraha and Sunsari districts in main season 2005.

Preferred traits

1. Early maturity
2. Good eating quality
3. Suitable for low fertility condition
4. High grain and straw yield than other varieties of upland rainfed domain
5. Good market price
6. Better yield and quality than Jethobudho, popular local landrace of Pokhara valley
7. Soft cooking quality
8. Suitable for rainfed condition
9. Soft straw which is preferred by the cattle

Non-preferred traits

1. Bug problem
2. Poor tillering
3. Lodging problem

2.3. Coordinated Varietal Trial (CVT)

In collaboration with NRRP/NARC, COB bred varieties had been tested in different research stations since 2003 in CVT. A letter of agreement (LOA) was signed between NRRP and LI-BIRD for

collaborative rice research including disease screening for COB lines by RRP, including promising materials in their advanced yield trials and micro-milling and organoleptic testing of NRRP's cultivars by LI-BIRD. Results of all those CVT date are presented here.

2.3.1. Rainfed Lowland Medium

Based on three years data,Barkhe 3004 gave 12% higher yield than popular released variety Masuli in the CVT in Rainfed Lowland Medium (RLM) environment (Table 12). Barkhe 2014 and Sugandha 2002 were tested for the first time in 2005 in CVT. Barkhe 2014 is mainly targeted for the Kanchhi Masuli domain whereas Sugandha 2002 is the best available aromatic rice with high yield at present in the rice gene pool of Nepal. Detailed performance of COB bred varieties in other agronomic traits in 2003, 2004 and 2005 were presented in the Table 13, 14 and 15, respectively.

Table 12. Grain yield (t/ha) of different rice genotypes in Co-ordinated Varietal Trial in Rainfed Lowland Medium (CVTRLM) environment in different research stations 2003-2005

Genotype	2003			2004			2005				Grand mean
	Hardhinath	Parawanipur	Combined mean	Hardhinath	Parawanipur	Combined mean	Hardhinath	Itahari	Parawanipur	Combined mean	
Balam							2.259	2.687	2.652	2.533	2.533
Barkhe 2001	3.216	3.689	3.452	2.912	2.879	2.895					3.174
Barkhe 2014							**2.785**	**2.973**	**2.299**	**2.686**	**2.686**
Barkhe 2045				1.821	1.094	1.458					1.458
Barkhe 3004	**3.616**	**4.177**	**3.896**	**3.470**	**2.900**	**3.185**	**3.125**	**2.631**	**3.286**	**3.014**	**3.365**
BR 6631-45-31-1							2.140	2.430	2.891	2.487	2.487
BRRI Dhan 29							1.664	3.373	3.125	2.721	2.721
Gaji							1.087	2.734	2.677	2.166	2.166
IR 62558-SRN-17-2				2.488	3.062	2.775					2.775
IR 9925	2.978	3.844	3.411								3.411
Local	2.188	3.172	2.680	2.955	2.478	2.716	1.647	2.828	2.166	2.214	2.490
Makwanpur 1	3.302	4.169	3.735	3.847	3.432	3.639					3.687
Masuli	**3.798**	**3.468**	**3.633**	**3.187**	**2.479**	**2.833**	**2.378**	**3.112**	**2.485**	**2.658**	**2.987**
NR 1190-24-4-2	4.756	4.443	4.599	3.357	3.166	3.261					3.930
NR 1485-3-2-3-2-1	4.326	4.413	4.369								4.369
NR 1748-12-1-1-4-3	2.817	2.122	2.469								2.469
NR 1769-34-2-1-1-3-1-1							3.057	3.185	3.516	3.252	3.252
NR 1769-34-2-1-3-1-2	2.654	3.232	2.943								2.943
NR 1769-4-2-2							2.140	3.086	3.584	2.936	2.936
NR 1887-4-3-1-1				2.579	1.483	2.031					2.031
NR 1887-8-1-1-2-2				3.023	2.973	2.998	2.972	3.594	3.682	3.416	3.249
NR 1892-20-21-1-1				2.814	3.160	2.987					2.987
NR 1893-17-2-3	4.124	4.322	4.223	3.090	3.126	3.108	3.091	2.297	2.898	2.762	3.278
NR 1894-10-3-2-3	4.313	4.424	4.368	3.225	3.103	3.164	3.040	3.955	2.680	3.225	3.534
NR 1910-10-3-2							1.546	2.044	2.653	2.081	2.081
NR 1923-30-1-2							2.106	2.753	3.289	2.716	2.716
NR 268-4-6-1-4-3	4.242	4.622	4.432	2.430	3.247	2.839					3.635
NR1887-8-1-1-1-3	3.160	3.651	3.406								3.406
PSBRC 68	3.813	4.437	4.125								4.125
PSBRC 70	3.994	3.766	3.880	2.129	2.008	2.068					2.974
Radha 11							2.599	3.370	2.207	2.725	2.725

Table 12. *Cont.*

Genotype	**2003**	**2004**	**2005**	**Grand mean**							
	Hardhinath	**Parawanipur**	**Combined mean**	**Hardhinath**	**Parawanipur**	**Combined mean**	**Hardhinath**	**Itahari**	**Parawanipur**	**Combined mean**	
Sugandha 2002				**2.620**	**2.704**	**2.662**					**2.662**
Grand Total	3.563	3.872	3.717	2.872	2.706	2.789	2.352	2.941	2.880	2.724	3.026
LSD at (P=0.05)	ns	ns	0.633	0.567	0.728	0.299	ns	0.606	0.773	0.395	

Table 13. Agronomic traits of different rice genotypes in Co-ordinated Varietal Trial in Rainfed Lowland Medium (CVTRLM) environment in different research stations in 2003.

SN	Varieties	Days to heading		Loc. Mean	Days to maturity		Loc. Mean	Plant height (cm)		Loc. Mean	Panicle m-2		Loc. Mean	Grain yield (Kg ha-1)		Loc. Mean	Grains panicle^{-1}	1000 Grain wt. (gm)	L/B ratio (mm)
		NRRP/H	RARS/P		NRRP/H	RARS/P		NRRP/H	RARS/P		NRRP/H	RARS/P		NRRP/H	RARS/P		NRRP/H	NRRP/H	NRRP/H
1	NR 1736-4-6-2-1	118	125	122	148	153	151	121.9	117	119.4	235	231	233	4325	4412	4368	193	23.6	2.4
2	BR 268-4-6-1-4-3-3-5	117	123	120	142	151	147	139.4	120	129.7	202	236	219	4288	4622	4455	234	19.4	2
3	NR 1190-24-4-2-2-2-2-3	112	116	114	136	144	140	124.9	126	125.4	217	225	221	4741	4443	4592	199	23.3	2.38
4	IR 9925	115	126	121	142	154	148	83.3	89	86.1	241	208	225	3268	3844	3556	136	28.8	2.57
5	PSBRC 68	115	127	121	142	155	149	101.5	109	105.2	214	234	224	3815	4436	4125	138	29.5	3.05
6	PSBRC 70	120	130	125	146	159	153	98.3	101	99.6	257	233	245	3994	3741	3843	122	31.7	3.15
7	Barkhe 2001	102	108	105	121	137	129	98.5	108	103.2	234	294	264	2729	3689	3209	113	20.8	3.13
8	**Barkhe 3004**	**117**	**125**	**121**	**143**	**153**	**148**	**56**	**93**	**89.5**	**257**	**271**	**264**	**3616**	**4177**	**3896**	**113**	**23.9**	**2.99**
9	NR 1748-12-1-1-4-3	126	134	130	150	163	157	128.6	121	124.8	227	246	265	2817	2122	2470	210	21	2.66
10	NR 1893-17-2-3	116	127	122	141	155	148	86.2	88	87.1	239	252	246	4113	4322	4227	182	21.7	2.48
11	NR 1894-10-3-2-3	122	129	126	149	158	154	108.9	105	106.9	250	263	257	4313	4439	4376	154	27.9	2.42
12	NR 1887-8-1-1-1-3-3	103	109	106	125	137	131	85	91	88	265	324	299	3168	3651	3410	139	18.7	2.79
13	NR 1769-34-2-1-3-1-2	107	123	115	132	150	141	86.2	98	92.1	255	241	248	2301	3232	2767	106	24.1	3.1
14	***Masuli (St. check)***	***117***	***123***	***120***	***136***	***151***	***144***	***126***	***115***	***120***	***271***	***272***	***272***	***3798***	***3468***	***3633***	***203***	***17.7***	***2.41***
15	*Mak-1 (St check)*	*122*	*132*	*127*	*150*	*160*	*155*	*89.1*	*93*	*91.1*	*279*	*263*	*271*	*3314*	*4169*	*3742*	*123*	*26.7*	*2.24*
16	*Local check*	*122*	*130*	*126*	*153*	*159*	*156*	*134*	*126*	*130*	*320*	*279*	*310*	*2188*	*3172*	*2680*	*115*	*18.2*	*2.96*
F test		**	**		**	**		**	**		**	*		**	**			**	**
CV%		1.29	1.48		2.18	1.31		5.62	4.49		15	13.4		16.7	12.7		17.7	6.4	5.8
Grand Mean		115	124		141	152		106	107		247	254		3350	3871		154.8	23.5	2.6
FLSD0.05		2.1	2.5		4.2	2.8		8.4	6.7		52	48		838	699		39	2.1	0.2

NOTE : Local check- In NRRP/Hardinath = Ram Bilash; In RARS/Parwanipur = Radha 11

Source: Choudhary *et al.*, 2004.

Table 14: Agronomic traits of different rice genotypes in Co-ordinated Varietal Trial in Rainfed Lowland Medium (CVTRLM) environment in different research stations in **2004**

		Days to maturity		LOC Mean	Plant height (cm)		LOC Mean	Panicle/ M2		LOC Mean	Grain yield (kg/ha)		LOC Mean	1000 grains wt (gm)
SN	VAREITIES	NRRP/H	RARS/P		NRRP/H	RARS/P		NRRP/H	NMRP/P		NRRP/H	NMRP/P		NRRP/H
1	**SUGANDHA 2002**	**151**	**153**	**152**	**106**	**97**	**101.2**	**294**	**274**	**284**	**2620**	**2704**	**2662**	**20**
2	NR 268-4-6-1-4	146	148	147	129	123	125.7	246	214	230	3222	3244	3233	17.9
3	NR 1190-24-4	142	141	142	125	116	120.5	279	241	260	3357	3165	3261	24.1
4	BARKHE 2001	134	134	134	104	108	106	261	301	281	2911	2879	2895	21.2
5	PSBRC 70	158	158	158	90.5	89	89.7	265	228	246	2128	2008	2068	27.9
6	**BARKHE 3004**	**148**	**154**	**151**	**88.7**	**79**	**83.8**	**316**	**301**	**308**	**3470**	**2900**	**3185**	**22.9**
7	NR 1893-17-2-3	148	151	150	91.7	83	87.3	302	285	293	3089	3131	3110	21.5
8	NR 1894-10-3-2-3	158	159	159	104	94	98.8	329	257	293	3215	3103	3159	26.5
9	BARKHE 2045	136	135	136	136	104	119.7	275	138	206	1821	1094	1457	19
10	NR 1892-20-21-1-1-2	148	151	150	89.4	84	86.7	306	276	291	2563	3160	2862	21.4
11	NR 1887-4-3-1-1-2	143	141	142	149	136	142.5	235	185	210	2579	1482	2030	19.2
12	IR 62558 – SRN-17-2	149	146	148	104	94	98.8	287	288	287	2487	3062	2774	25.7
13	NR 1887-8-1-1-2-2-2	141	146	144	103	97	99.7	273	345	309	3022	2973	2998	18.7
14	**MASULI (St. Check)**	**147**	**146**	**147**	**117**	**116**	**116.5**	**321**	**251**	**286**	**3187**	**2479**	**2833**	**16.9**
15	**MAKAWANPUR – 1 (St. Check)**	**159**	**160**	**160**	**86**	**85**	**85.5**	**297**	**273**	**285**	**3847**	**3431**	**3639**	**25.1**
16	**LOCAL CHECK**	**160**	**144**	**152**	**108**	**109**	**108.5**	**365**	**271**	**318**	**2954**	**2478**	**2716**	**20**
	F test	**	**		**	**		**	**		**	**		**
	CV %	112	0.9		4.6	5.9		14	10		17.8	13.8		6.16
	GRAND MEAN	119	147		109	102		290	265		2904	2705		21.7
	FLSD 0.05	2.3	1.9		7.1	8.3		57	12		732	531		1.89

NOTE : Local check- In NRRP/Hardinath = Ram Bilash; In RARS/Parwanipur = Radha 11

Source: Chaudhary et al., 2005.

Table 15. Agronomic traits of different rice genotypes in Co-ordinated Varietal Trial in Rainfed Lowland Medium (CVTRLM) environment in different research stations in 2005

	Days to heading				Days to maturity				Grain yield (kg/ha)				Plant height (cm)			
Cultivar	Hardh inath	Itahari	Paraw anipur	Combined mean	Hardh inath	Itahari	Paraw anipur	Combine d mean	Hardh inath	Itahari	Paraw anipur	Combine d mean	Hardh inath	Itahari	Parawa nipur	Combined mean
Balam	119.3	100.8	97.3	105.8	148.5	133.3	126.5	136.1	2.259	2.687	2.652	2.533	102.0	105.5	108.5	105.3
Barkhe 2014	**130.3**	**110.8**	**103.3**	**114.8**	**156.8**	**145.8**	**132.3**	**144.9**	**2.785**	**2.973**	**2.299**	**2.686**	**108.3**	**106.5**	**118.5**	**111.1**
Barkhe 3004	**129.5**	**121.3**	**112.0**	**120.9**	**165.3**	**155.3**	**141.3**	**153.9**	**3.125**	**2.631**	**3.286**	**3.014**	**88.8**	**86.0**	**96.5**	**90.4**
BR 6631-45-31-1	118.5	100.5	97.8	105.6	147.5	132.5	126.8	135.6	2.140	2.430	2.891	2.487	84.2	87.3	95.5	89.0
BRRI Dhan 29	118.8	99.0	98.0	105.3	148.8	131.3	127.0	135.7	1.664	3.373	3.125	2.721	87.9	93.5	94.3	91.9
Gaji	113.5	100.0	98.5	104.0	142.3	130.8	127.3	133.4	1.087	2.734	2.677	2.166	112.0	106.8	111.5	110.1
Kanchi masuli		**108.3**		**108.3**		**141.3**		**141.3**		**2.828**		**2.828**		**112.8**		**112.8**
Masuli	**132.5**	**118.5**	**114.0**	**121.7**	**158.8**	**152.5**	**140.8**	**150.7**	**2.378**	**3.112**	**2.485**	**2.658**	**114.5**	**111.0**	**127.3**	**117.6**
Nenki (Local check)			**128.0**	**128.0**			**157.5**	**157.5**			**2.166**	**2.166**			**132.0**	**132.0**
NR 1769-34-2-1-1-3-1-1	131.5	112.3	106.0	116.6	158.3	146.3	134.8	146.4	3.057	3.185	3.516	3.252	108.3	102.8	110.5	107.2
NR 1769-4-2-2	124.3	106.8	99.3	110.1	153.5	140.5	128.8	140.9	2.140	3.086	3.584	2.936	117.2	114.0	112.8	114.7
NR 1887-8-1-1-2-2	124.5	109.5	104.3	112.8	153.3	144.3	131.8	143.1	2.972	3.594	3.682	3.416	114.8	99.5	110.8	108.4
NR 1893-17-2-3	137.0	120.0	113.3	123.4	168.5	155.0	142.0	155.2	3.091	2.297	2.898	2.762	88.2	88.5	95.0	90.6
NR 1894-10-3-2-3	140.5	123.3	118.8	127.5	169.5	158.0	148.8	158.8	3.040	3.955	2.680	3.225	105.7	108.8	112.5	109.0
NR 1910-10-3-2	128.3	111.8	105.8	115.3	160.0	145.8	135.3	147.0	1.546	2.044	2.653	2.081	126.7	127.5	135.0	129.7
NR 1923-30-1-2	132.5	106.0	99.5	112.7	160.0	141.5	128.5	143.3	2.106	2.753	3.289	2.716	100.5	106.3	106.5	104.4
Radha 11	130.3	119.5	112.5	120.8	157.5	153.0	141.5	150.7	2.599	3.370	2.207	2.725	118.2	115.8	126.3	120.1
Rambilas (Local check)	139.5			139.5	166.8			166.8	1.647			1.647	113.8			113.8
Grand mean	128.2	110.5	106.8	115.1	157.2	144.2	135.7	145.7	2.352	2.941	2.880	2.724	105.7	104.5	112.1	107.4
LSD at (P=0.05)	0.8	1.7	1.2	0.8	2.5	2.2	1.6	1.3	ns	0.606	0.773	0.395	8.2	9.1	4.9	4.9

Table 15. Cont.

	Panicle length (cm)				No. of tillers/m2				No. of filled grain/5 panicle			No. of unfilled grain/5 panicle			1000 gr. wt. (gm)		
Cultivar	Hardh inath	Itahari	Paraw anipur	Combined mean	Hardh inath	Itahari	Paraw anipur	Combined mean	Hardh inath	Itahari	Combined mean	Hardh inath	Itahari	Combined mean	Hard hinath	Itahari	Combined mean
Balam	22.8	24.5	25.0	24.1	272.8	210.0	269.3	250.7	414.0	524.5	469.3	361.3	388.8	375.0	22.2	21.8	22.0
Barkhe 2014	**21.1**	**21.3**	**23.0**	**21.8**	**275.3**	**251.5**	**249.8**	**258.8**	**480.3**	**585.3**	**532.8**	**226.5**	**108.3**	**167.4**	**22.0**	**21.0**	**21.5**
Barkhe 3004	**22.9**	**23.0**	**26.3**	**24.0**	**256.8**	**213.0**	**253.0**	**240.9**	**441.0**	**428.0**	**434.5**	**228.8**	**213.3**	**221.0**	**23.9**	**24.3**	**24.1**
BR 6631-45-31-1	22.4	23.8	26.0	24.1	260.3	251.0	311.5	274.3	405.3	415.8	410.5	350.8	345.8	348.3	16.9	20.0	18.5
BRRI Dhan 29	21.4	24.3	25.3	23.6	261.0	214.8	267.5	247.8	338.8	461.0	399.9	319.5	251.5	285.5	20.0	20.3	20.1
Gaji	23.2	23.0	24.8	23.6	264.3	247.3	288.3	266.6	364.0	432.5	398.3	255.0	280.5	267.8	21.9	23.3	22.6
Kanchi masuli		**21.3**		**21.3**		**306.0**		**306.0**		**660.5**	**660.5**		**150.5**	**150.5**		**17.3**	**17.3**
Masuli	**22.6**	**21.8**	**25.3**	**23.2**	**266.5**	**258.3**	**269.8**	**264.8**	**663.3**	**816.8**	**740.0**	**170.8**	**203.8**	**187.3**	**19.5**	**16.5**	**18.0**
Nenki (Local check)			24.0	24.0			293.5	293.5									
NR 1769-34-2-1-1-3-1-1	23.2	22.3	22.5	22.6	272.5	266.5	269.8	269.6	406.3	599.8	503.0	299.0	281.3	290.1	21.2	18.8	20.0
NR 1769-4-2-2	22.0	22.3	22.3	22.2	267.8	240.5	287.8	265.3	373.3	595.8	500.4	408.0	330.8	363.9	21.4	20.0	20.7
NR 1887-8-1-1-2-2	21.7	22.3	22.3	22.1	260.0	277.0	298.3	278.4	426.3	472.0	449.1	355.3	170.3	262.8	21.3	18.5	19.9
NR 1893-17-2-3	21.2	23.8	25.8	23.6	286.8	228.3	238.8	251.3	459.3	682.8	587.0	184.7	267.3	231.9	22.9	21.5	22.2
NR 1894-10-3-2-3	22.7	24.0	26.3	24.3	279.0	226.0	240.5	248.5	438.0	633.0	535.5	260.8	219.8	240.3	26.8	25.5	26.1
NR 1910-10-3-2	23.4	26.0	27.3	25.6	259.3	154.0	214.8	209.3	616.3	985.8	801.0	386.0	390.5	388.3	17.5	14.3	15.9
NR 1923-30-1-2	22.1	23.5	24.8	23.5	260.8	268.3	277.0	268.7	284.9	478.5	381.7	261.0	321.0	291.0	22.2	20.8	21.5
Radha 11	22.0	21.3	24.5	22.6	265.5	238.8	267.3	257.2	742.0	900.3	821.1	281.8	173.3	227.5	19.4	18.0	18.7
Rambilas (Local check)	21.1			21.1	267.0			267.0	586.0		586.0	265.5		265.5	18.9		18.9
Grand mean	22.2	23.0	24.7	23.3	267.2	240.7	268.5	258.8	466.5	604.5	536.6	288.1	256.0	271.8	21.1	20.1	20.6
LSD at (P=0.05)	1.6	2.2	1.4	1.1	32.5	37.6	50.8	25.1	220.0	194.4	144.0	164.5	132.3	104.5	3.2	2.0	1838.0

2.3.2. Rainfed lowland Early

Based on last three years data, Barkhe 1027, Judi 565, Judi 567, Judi 572, Sugandha 1 and Barkhe 1006 were found promising cultivars in CVT in Rainfed Lowland Early (RLE) environment,. Judi 565 is continuously giving higher yield with greater stability over the location and year over the check variety. Similar performance was found for Barkhe 1027 and Judi 572. Detail performance of COB bred varieties in other agronomic traits in 2003, 2004 and 2005 were presented in the Table 16, 17 and 18, respectively.

Table 16. Performance of different rice genotypes in Coordinated Varietal Trial Rainfed Lowland Early (CVT RLE) in different research stations in 2003

SN.	Varieties	Days to maturity						Loc Mean	Plant height (cm)						Loc Mean
		NRR P/H	NW RP/B	RAR S/P	RAR S/N	RAR S/L	NMR P/R		NRR P/H	NWR P/B	RAR S/P	RAR S/N	RAR S/L	NRR P/R	
1	BR 425-189-1-6-2-1-1	131	147	134	138	138	133	137	126.8	115	115	116.6	141	106.5	120.1
2	B 6149F-MR-7	117	128	125	136	131	123	126	116.1	107	99	125	138	103.1	114.7
3	B 6144F-MR-6	119	127	123	127	138	122	125	114.8	107	103	124.2	136	102.1	114.5
4	IR 555435-2	115	116	125	123	128	127	122	114.7	101	102	122.9	136	107.8	114
5	NR 1769-4-2-2-3-2-2	132	132	134	140	139	136	136	120	114	107	123.6	135	101.1	116.9
6	IR 70219-35-2-1-1-1-3	126	138	129	132	133	134	132	103.8	84	92	97.5	107	76.4	93.5
7	NR 1824-21-1-1-1-2-1-2	118	132	127	127	129	128	127	115.8	93	102	120.9	126	90.1	107.9
8	NR 1893-17-2-3-1-1-1	146	147	154	149	142	138	146	86.8	68	92	90.2	99	82	86.3
9	**Sugandha 1**	**117**	**130**	**123**	**129**	**130**	**124**	**126**	**124.6**	**110**	**115**	**123.8**	**138**	**110.2**	**120.2**
10	**Barkhe 1006**	**127**	**128**	**145**	**135**	**137**	**136**	**135**	**93.8**	**74**	**88**	**94**	**105**	**81.3**	**89.3**
11	Pusa 834	113	116	122	121	127	126	121	94	76	86	94.9	105	80.3	89.4
12	Chaite 6	112	116	127	124	126	125	122	93.5	79	86	89.5	104	82.7	89.1
13	Radha 4	119	122	134	127	128	134	127	107.9	82	96	96.4	108	89.2	96.5
14	Local Check	100	101	113	115	112	122	111	124	102	129	119.5	116	100.2	115.2
	F test	**	**	**	**	**	**		**	**	**	**	**	**	
	CV%	1.96	3.9	1.96	1.6	3.46	1.49		6.43	7.29	3.75	4.3	5.8	5.83	
	Grand Mean	120	127	128	129	131	129		109.4	93.3	100	109.9	121	93.8	
	LSD 0.05	3.3	7	3.5	2.9	7.3	2.7		9.9	9.7	5.3	6.7	11	7.8	

Table 16. Cont.

SN	Varieties	1000 grain weight gm				Loc Mean	Grain L/B Ratio (mm)	Grain yield kg/ha						Loc Mean
		NRR P/H	NW RP/N	RAR S/B	NMR P/R		NRR P/H	NRR P/H	NW RP/B	RAR S/P	RAR S/N	RAR S/L	NMR P/R	
1	BR 425-189-1-6-2-1-1	16.9	19.1	19.5	17.2	18.1	2.67	3558	4490	4184	3822	4812	2840	3951
2	B 6149F-MR-7	24	25.7	26.7	24.7	25.2	3.02	3282	4950	3608	4158	4648	2921	3927
3	B 6144F-MR-6	23.7	25.2	26.8	24.1	25	2.6	3065	4843	3654	3631	4687	2786	3873
4	IR 555435-2	21.7	23.2	24.2	22.1	22.8	3.13	3840	5696	4005	3744	4158	3165	4101
5	NR 1769-4-2-2-3-2-2	20.1	22.1	22.7	20.7	21.4	2.62	4487	4524	4838	4480	4974	3003	4402
6	IR 70219-35-2-1-1-1-3	21.8	22	22.8	20.9	21.8	3.25	3445	3960	4472	3678	4420	2245	3737
7	NR 1824-21-1-1-1-2-1-2	18.4	18.8	21	17.3	18.8	2.75	3791	4649	3377	4255	4833	2191	3849
8	NR 1893-17-2-3-1-1-1	**20.5**	**22.4**	**23.3**	**20.2**	**21.6**	**2.8**	3453	5648	5216	4610	3376	3192	3736
9	**Sugandha 1**	**21.5**	**22.7**	**24.2**	**21.1**	**22.3**	**3.59**	**3999**	**4650**	**4579**	**4249**	**4467**	**2759**	**4117**
10	**Barkhe 1006**	20.5	22.6	24.3	20.8	22	2.45	**4097**	**5003**	**4050**	**4085**	**4509**	**2949**	**4181**
11	Pusa 834	22.1	20.7	22.6	21	21.6	3.25	3148	5032	3340	3237	4685	2543	3659
12	Chaite 6	20.2	20.2	21.3	20	20.4	2.77	4005	5298	3922	3518	4861	2894	4083
13	Radha 4	25.4	24.6	27.2	24.9	25.5	2.52	3843	5813	5082	4153	4693	2806	4382
14	Local Check	22.8	21.8	21.8	20.5	21.7	2.4	3415	3711	2481	1563	1630	919	2277
	F test	**	**		**			*	**	**	**	**	**	
	CV%	10.3	3.15		3.16			12.8	11.4	12.4	10.4	18.6	15.3	
	Grand Mean	21.2	22		21.6			3666	4901	4093	3813	4339	26.58	
	LSD 0.05	3	0.9		0.9			667	790	719	563	1318	581	

Table 17. Performance of different rice genotypes in Coordinated Varietal Trial Rainfed Lowland Early (CVT RLE) in different research stations in 2004

S.N	Varieties	Grain yield kg./ha						Days to Maturity					
		NRRP/H	RARS/P	NWRP/B	RARS/NEP	NMRP/ RAM	LOC Mean	NRRP/H	RARS/P	NWRP/B	RARS/NEP	NMRP/ RAM	LOC Mean
1	B6149F-MR-7	3354	2320	5286	2767	2884	3322	128	126	118	134	122	126
2	IR55539-2	3303	2924	5294	2556	2814	3378	124	123	113	129	121	122
3	NR1769-4-2-2	3225	2632	4820	1784	3784	3249	137	135	126	142	128	134
4	NR1824-21-1-1-1	3854	2461	4090	2768	2654	3165	128	123	122	130	123	125
5	**BARKHE 1027**	**2875**	**1913**	**5575**	**2547**	**2570**	**3096**	**123**	**119**	**113**	**126**	**120**	**120**
6	**JUDI 565**	**2744**	**2412**	**5859**	**2844**	**2998**	**3371**	**123**	**120**	**112**	**123**	**127**	**121**
7	JUDI 566	2910	1614	4836	2474	3061	2979	125	125	118	127	126	124
8	**JUDI 567**	**3224**	**2321**	**5763**	**2770**	**3578**	**3521**	**128**	**127**	**118**	**127**	**127**	**125**
9	IET 3137	2775	2203	5529	2298	3396	3240	126	126	119	132	123	125
10	JUDI 569	2455	1496	5404	2194	2602	2830	123	121	120	131	122	123
11	**JUDI 572**	**2597**	**1354**	**4976**	**1664**	**2486**	**2615**	**125**	**120**	**115**	**132**	**121**	**122**
12	**BARKHE 1006**	**2556**	**2653**	**4908**	**1792**	**3114**	**3005**	**133**	**132**	**121**	**136**	**123**	**129**
13	**RADHA 4**	**3701**	**2718**	**5823**	**1896**	**2612**	**3350**	**126**	**125**	**110**	**130**	**122**	**123**
14	LOCAL CHECK	1888	1729	2824	1383	2141	1993	105	108	103	114	105	107
	F test	**	**	**	**	**		**	**	**	**	**	
	CV %	16.2	17.5	7.98	28	7.64		1.08	1.06	2.54	1.8	0.99	
	GRAND MEAN	2962	2192	5070	2267	-		125	164	115	172	122	
	LSD 0.05	678	544	572	911	290		1.9	1.89	4.1	3.2	1.7	

Table 17. Cont.

S.N	Varieties	Plant Height (cm)						Panicle/m^2					1000 gr wt. (gm)					Straw yield (kg/ha)		
		NRR P/H	RA RS/P	NW RP/B	RAR S/NEP	NMR P/RAM	LOC Mean	NRR P/H	RAR S/P	NWR P/B	RAR S/NEP	LOC Mean	NRR P/H	NWR P/B	RAR S/NEP	NMRP /RAM	LOC Mean	NW RP/B	NMRP /RAM	Loc mean
1	B6149F-MR-7	123.7	109	138.5	109	118.7	119.7	264	294	263	199	255	25.6	25.1	24.5	24.1	24.8	11400	2884	7142
2	IR55539-2	120.5	106	137.2	113	116.2	118.5	242	272	250	171	234	23.1	20.6	22.7	23	22.3	10100	2814	6457
3	NR1769-4-2-2	117.7	105	142	107	119.2	118.1	282	353	281	204	280	21.9	21.7	20	20.7	21	10600	3784	7192
4	NR1824-21-1-1-1	123	110	141	113	121.5	121.7	283	383	308	219	298	18.6	19.4	17.7	17.8	18.3	7920	2654	5287
5	BARKHE 1027	93	91	101	87.5	93.1	93.1	275	301	332	214	281	24.6	25.2	22.7	23.1	23.9	7560	2570	5065
6	**JUDI 565**	**90.5**	**84**	**98.7**	**88.5**	**88.7**	**90.1**	**238**	**318**	**281**	**208**	**261**	**23.7**	**25.5**	**23**	**21.8**	**23.5**	**7950**	**2998**	**5474**
7	JUDI 566	92	85	108	90.2	97.3	94.5	230	323	279	201	273	22.2	23.8	21.5	21.9	22.3	8770	3061	5915.5
8	**JUDI 567**	**94**	**80**	**101.7**	**90.2**	**96.1**	**92.4**	**256**	**311**	**298**	**222**	**272**	**22.2**	**23.5**	**20.7**	**20.5**	**21.7**	**9600**	**3578**	**6589**
9	IET 3137	86	75	93.7	83.7	90.4	85.7	304	322	350	223	299	20.2	21.9	21.5	19.2	20.7	9700	3396	6548
10	JUDI 569	91.7	86	100.5	98.5	93.2	91.9	321	295	288	200	276	21.7	23.9	22.2	21.9	22.4	11090	2602	6846
11	**JUDI 572**	**99.2**	**95**	**115**	**91**	**100.1**	**100**	**287**	**292**	**278**	**169**	**257**	**20.7**	**22.2**	**21.2**	**21.2**	**21.3**	**10401**	**2486**	**6443.5**
12	**BARKHE 1006**	**96.2**	**89**	**112**	**88.2**	**98.8**	**96.8**	**264**	**308**	**261**	**176**	**252**	**23.1**	**23.4**	**21.2**	**22**	**22.4**	**8505**	**3114**	**5809.5**
13	**RADHA 4**	**98.7**	**91**	**111.2**	**84.2**	**99.4**	**96.9**	**280**	**300**	**288**	**179**	**261**	**24.4**	**27.2**	**23.7**	**24.5**	**24.9**	**11210**	**2612**	**6911**
14	LOCAL CHECK	113.7	119	129	118.7	121.7	120.4	299	344	313	285	310	22.6	22.7	22	22.2	22.3	5380	2141	3760.5
	F test	**	**	**	**	**		ns	**	**	**	-	**	**	**	**		**		
	CV %	2.5	3.4	3.9	7.1	3.41		18.5	10.4	8.1	15.5	-	4.6	1.79	4.9	4.89		14.3		
	GRAND MEAN	102.8	94.6	116	96.6	103.9		277	315	290	204	-	22.5	23.6	21.7	21.74		2907		
	LSD 0.05	3.6	4.6	3.27	9.7	5		-	46	33.3	44.6	-	1.4	0.59	1.5	3		589		

Table 18. Performance of different rice genotypes in Coordinated Varietal Trial Rainfed Lowland Early (CVT RLE) in different research stations during 2005

	Days to heading			Days to maturity			Plant height			Panicle length (cm)		
Genotype	Hardh inath	Paraw anipur	Combined mean	Hard hinath	Paraw anipur	Combined mean	Hardh inath	Paraw anipur	Combined mean	Hard hinath	Paraw anipur	Combined mean
B 5592-5-st-31	106.8	87.5	97.1	136.5	115.3	125.9	118.7	116.8	117.7	22.4	20.3	21.3
Barkhe 1027	**99.8**	**84.5**	**92.1**	**128.5**	**113.3**	**120.9**	**88.4**	**95.5**	**92.0**	**24.8**	**26.3**	**25.5**
BR 6342-63-2-1	93.3	81.3	87.3	121.3	110.3	115.8	85.1	87.3	86.2	23.3	23.3	23.3
BR 6475	93.5	80.8	87.1	121.0	109.0	115.0	84.7	100.8	92.7	22.5	23.0	22.7
BRRI Dhan 26	96.0	80.0	88.0	122.8	108.0	115.4	84.0	98.8	91.4	22.9	23.0	23.0
BRRI Dhan 28	96.5	79.8	88.1	122.8	108.5	115.6	85.6	95.5	90.6	23.4	22.5	22.9
IET 3137	108.5	89.8	99.1	140.0	118.0	129.0	81.7	81.0	81.3	23.1	22.8	22.9
IR 70745	104.3	83.0	93.6	128.5	111.3	119.9	92.7	105.0	98.9	26.0	27.3	26.6
Judi 503	**89.8**	**76.3**	**83.0**	**118.3**	**104.5**	**111.4**	**108.6**	**125.8**	**117.2**	**24.4**	**23.3**	**23.8**
Judi 565	**97.5**	**85.8**	**91.6**	**126.5**	**113.8**	**120.1**	**83.3**	**91.3**	**87.3**	**22.3**	**23.3**	**22.8**
Judi 567	**101.8**	**90.3**	**96.0**	**129.8**	**116.8**	**123.3**	**83.2**	**90.8**	**87.0**	**24.2**	**23.0**	**23.6**
Judi 572	**105.0**	**86.0**	**95.5**	**135.8**	**114.5**	**125.1**	**92.0**	**98.8**	**95.4**	**25.2**	**25.3**	**25.2**
Pant 10	107.5	86.0	96.8	135.5	115.0	125.3	90.3	97.5	93.9	24.7	25.3	25.0
Radha 4	**109.3**	**88.5**	**98.9**	**139.5**	**117.3**	**128.4**	**98.8**	**95.3**	**97.0**	**24.2**	**22.5**	**23.3**
Grand mean	100.7	84.2	92.4	129.0	112.5	120.8	91.2	98.6	94.9	23.8	23.6	23.7

Table 18. Cont.

Genotype	Tillers/m2			Filled grain/5 panicles	Unfilled grain/5 panicles	Grain yield (t/ha)		
	Hard hinath	Paraw anipur	Combined mean	Hardh inath	Hardhinat h	Hardhinat h	Parawanipu r	Combined mean
B 5592-5-st-31	296.5	248.5	272.5	258.5	238.5	2.140	4.629	3.384
Barkhe 1027	**295.3**	**284.0**	**289.6**	**266.8**	**196.3**	**1.427**	**4.251**	**2.839**
BR 6342-63-2-1	300.0	303.5	301.8	411.5	188.0	2.140	3.498	2.819
BR 6475	301.8	269.5	285.6	342.5	92.0	1.834	3.912	2.873
BRRI Dhan 26	299.8	291.8	295.8	356.5	117.3	2.191	3.630	2.910
BRRI Dhan 28	318.5	288.0	303.3	351.8	145.5	2.140	3.290	2.715
IET 3137	330.3	303.5	316.9	407.3	197.0	1.919	2.656	2.287
IR 70745	293.8	235.3	264.5	372.8	237.3	2.378	3.607	2.992
Judi 503	**334.0**	**278.3**	**306.1**	**289.0**	**142.3**	**1.359**	**3.442**	**2.400**
Judi 565	**286.5**	**274.0**	**280.3**	**326.0**	**196.3**	**2.106**	**4.091**	**3.098**
Judi 567	**291.0**	**300.5**	**295.8**	**333.3**	**203.5**	**2.004**	**3.616**	**2.810**
Judi 572	**302.0**	**277.8**	**289.9**	**331.0**	**314.3**	**1.715**	**4.180**	**2.947**
Pant 10	316.0	276.5	296.3	345.5	222.0	2.446	3.071	2.758
Radha 4	240.5	278.8	259.6	398.3	296.8	2.089	4.101	3.095
Grand mean	300.4	279.3	289.8	342.2	199.1	1.992	3.712	2.852

2.3.3. Initial Evaluation Trial (IET)

Some of the COB bred varieties were tested in Initial Evaluation Trial since 2002 at Hardhinath. Among the COB bred varieties tested in IET Barkhe 1027, Judi 565, Judi 567, Judi 572, Judi 111, Judi 566, Sugandha 1 and Barkhe 1006 found promising cultivars. Judi 141F, cultivar from collaborative breeding also found promising for spring upland condition. Detail performance of COB bred varieties in other agronomic traits in 2002, 2003 and 2005 were presented in the Table 19, 20 and 21, respectively.

Table 19. Performance of rice genotypes tested in IET-RLE at NRRP, Hardinath during 2002

S.N.	Designation	Days to heading	Days to maturity	Plant height (cm)	Panicle length (cm)	No. of panicles/ m^2	Grain yield (kg/ha)
1	NR 1824-21-1-1-1-2-1-2	99	123	108.9	23.4	341	2307
2	NR 1863-62-2-1-5-4-1	108	134	113.4	19.4	175	1587
3	IR 70177-19-3-1-2-1	102	128	83.4	21.2	211	1583
4	NR 1558-69-1-1-1-1-2-2-1-1-3-3-3	116	139	69.4	16.6	146	1582
5	NR 1558-69-1-1-1-1-2-2-1-1-3-4-1-2	113	140	75.8	17.8	153	862
6	NR 1894-1-3-2-1-3-2	126	148	91.3	22	151	941
7	NR 1579-11-1-2-2-1-2-1-5-5-4-1	128	155	96.4	20.4	132	798
8	NR 1891-58-3-2-2-3-1-2	114	139	85.9	19.4	142	1918
9	NR 1891-58-3-2-2-3-1-3	113	141	93.2	20.8	155	1139
10	NR 1893-17-2-3-1-1-1	118	142	75.4	19.6	150	2130
11	NR 1855-1-1-2-1-1-1	120	144	118.9	21.3	138	2432
12	NR 1892-12-2-6-1-3-1	102	131	95.4	20	161	1182
13	NR 1892-12-2-6-1-3-2	101	128	90.4	19.8	210	1782
14	NR 1892-20-2-1-1-2-2	111	140	88	20.6	134	1823
15	**Judi 101**	**72**	**102**	**104.1**	**19.6**	**208**	**975**
16	**Barkhe 1006**	**108**	**133**	**69.2**	**18.6**	**216**	**1671**
17	**Sugandha-1**	**97**	**123**	**108.7**	**22.2**	**166**	**1913**
18	Chaite-2 (St Check)	93	117	80.4	21.6	209	1835
19	Radha 4 (St Check)	95	120	92.6	23.8	201	1359
20	Bagari (Local Check)	79	96	113.8	20	313	2034
	F test	**	**	**	**	**	**
	CV%	2.01	3.89	14.6	7.14	20.1	20.5
	LSD 0.05	3	8	11	2.3	62	534
	Grand Mean	106	131	92.7	20.4	185	1593

DH= Days to heading, DM= Days to maturity, PLH= Plant height, PL= Panicle length, P/m^2= Panicle/m^2

Table 20. Performance of rice genotypes tested in IET-RLE at NRRP, Hardinath during 2003

SN.	Varieties	Days to heading	Days to maturity	Plant height (cm)	Panicle length (cm)	No. of panicles /m^2	No. of grains / panicle	1000 gr wt. (gm)	Grain L/B Ratio (mm)	Grain yield (kg/ha)
1	NR1824-21-1-1-1-1-2	90	115	114.4	25.4	253	153	19.6	2.4	4968
2	NR1893-17-2-3-1-1-1	119	141	89.3	25.8	232	184	20.5	2.3	3033
3	**Judi111**	**70**	**98**	**122.2**	**24.6**	**251**	**121**	**23.3**	**2.9**	**3185**
4	**Sugandha-1**	**90**	**118**	**112.2**	**24.4**	**190**	**151**	**20.8**	**3.1**	**3814**
5	Pant-10	82	117	88	23.5	240	115	24.7	2.9	3113
6	IAASR-32	100	130	114.2	22.6	246	145	20.1	2.1	3646
7	**Judi-102**	**66**	**94**	**120.5**	**25.1**	**213**	**66**	**20.9**	**2.8**	**2204**
8	**Judi-565**	**89**	**117**	**82.9**	**23.7**	**277**	**124**	**24.1**	**2.8**	**4564**
9	**Judi-566**	**94**	**119**	**89.6**	**24.3**	**270**	**146**	**19.8**	**2.9**	**4078**
10	**Judi-567**	**97**	**120**	**88.3**	**24.2**	**268**	**132**	**20.4**	**2.8**	**4570**
11	Gautam	86	113	89.8	22.4	298	99	23.2	2.6	4006
12	Pravat	82	111	82.7	21.6	279	82	20.9	2.8	3776
13	Saroj	90	115	103.4	24.1	249	135	19.2	3	3965
14	NR1969-51-5-2-6-2	88	107	112.8	22.7	288	142	14.5	2.8	3309
15	NR 274-10-1-2-1	85	109	117.5	24.6	305	131	15.9	2.4	3421
16	NR 274-11-2-1	89	108	120	25.4	238	190	15.3	2.5	3285
17	**Judi-568**	**85**	**115**	**88.5**	**23.6**	**235**	**114**	**23.5**	**3**	**3021**
18	**Judi-569**	**94**	**125**	**87.6**	**24.6**	**208**	**128**	**20.2**	**2.9**	**3182**
19	IET 3137	98	126	83.4	23.7	254	124	20.6	3.1	4224
20	DR 31	103	129	96.6	24.8	230	104	25.7	3.2	3188
21	FRX 73 B-26F4-B5	96	120	88.8	25.7	220	115	19.7	2.9	3088
22	IR 68743-17-2	99	121	89.1	23.7	243	70	19.6	3.1	1861
23	IR 36	120	149	105.5	26.1	256	139	21	2.5	3784
24	**Judi-572**	**89**	**118**	**92**	**24.6**	**220**	**150**	**20.2**	**2.9**	**3616**
25	**Judi-141F**	**65**	**94**	**119.2**	**22.5**	**246**	**66**	**21.2**	**2.7**	**2310**
26	Radha-4 (St check)	95	123	95.5	22.4	255	125	21.8	2.1	4943
27	Chaite-6 (St check)	89	115	83.8	21.8	250	93	21.4	2.5	4232
28	Bagari(Local check)	78	99	125	21.6	319	120	22.4	2.4	4541
	F test	**	**	**	**	*	**	**	**	**
	CV%	3.1	2.01	5.5	4.1	14.6	2.71	13.2	10.8	14
	Grand Mean	90	117	100	23.9	251	123	20.6	2.7	3605
	LSD 0.05	4.6	3.8	9	1.6	60	55	4.4	0.4	825

Table 21: Means of different agronomic traits in IET trial conducted in Hardinath in main season 2005

Treatment	Heading (DAS)	Maturity (DAS)	Plant height (cm)	Panicle length (cm)	Grain yield (t/ha)	Effective tiller/m2
Barkhe 1027	6.13	123.00	86.27	24.33	1.92	286.33
Barkhe 2044	6.21	137.00	84.67	22.67	3.00	271.67
Barkhe 3004	**7.15**	**150.67**	**89.40**	**23.53**	**3.81**	**289.33**
Barkhe 3018	7.35	149.33	93.07	23.73	2.85	255.33
Barkhe 3019	**7.14**	**149.33**	**92.67**	**23.60**	**3.50**	**288.00**
IR 74600-26-1-3-2	6.27	138.33	90.67	24.93	2.25	305.00
Judi 582	**6.15**	**125.33**	**85.20**	**24.33**	**2.63**	**317.33**
Namsagai 19	6.16	131.00	123.13	25.27	1.35	279.00
Sugandha 2002	7.20	155.33	103.00	26.33	1.83	283.67
Super 3004	**7.38**	**149.33**	**90.87**	**22.93**	**3.40**	**295.33**
Grand mean	6.71	140.87	93.89	24.17	2.65	287.10
LSD	0.300	4.178	5.707	1.591	0.914	62.020

3. Collaborative breeding

The breeding programme was based on two crosses: Kalinga III/IR64, and CH45/ MT1 a population derived from the cross Kalinga III/IR64. The cross Kalinga III/IR64 was made by Dr Brigitte Courtois at the International Rice Research Institute (IRRI) in 1996, at the request of Dr John Witcombe of CAZS, and a large quantity of F_2 seed was produced and supplied by CAZS to Birsa Agricultural University (BAU) through the National Bureau of Plant Genetic Resources, New Delhi. An F_2 population of about 10,300 plants were grown in the rainy season of 1997. From the F_2 generation onwards the material was selected in a PPB programme in India. The breeding programme in Nepal commenced with 290 F_3 lines of the cross in a farmer's field in Chitwan, district, in the spring (*Chaite*) season of 1998. There was much variation among the lines and they were grouped into 6 bulks based on their height (tall or dwarf) and maturity classes (early <110 days seed to seed; medium 110-125 days; and late > 125 days). The entire harvest of the F_3 lines was used to make the bulks and the bulks were made by individual plant selection within and among lines

The resultant F_4 bulks were grown in the main season of 1998 and named as: ED = Early Dwarf; ET = Early Tall; MD = Medium Dwarf; MT = Medium Tall; LD = Late Dwarf and LT = Late Tall. Of these, the early dwarf proved to be poor and was dropped. In the main season of 1998 the highly variable MT bulk was further divided into four by selection among the F_4 plants to produce F_5 bulk seed for: MT1 = earlier shorter; MT2 = earlier taller; MT3 = later shorter; and MT4 = later taller.

In the *Chaite* season of 1999 three bulks (ET, MD and LT) were advanced from F_5 to F_6 without further division. However, in five of the bulks (MT1 to MT4 and LD) further division was made at harvest, by selecting among the F_6 plants, into three grain types, i.e., long, intermediate or short in length. In the main season, 1999, the bulks were multiplied and advanced from the F_6 to the F_7. Some were rejected on the basis of maturity and grain type.

3.1. Collaborative breeding without farmer training

In the F_6 generation, eight bulks namely ET, MT1, MT2, MT3, MT4, LT, MD and LD were distributed to 2, 43, 38, 1, 11, 3, 6 and 1 farmers respectively in the main season of 1999 in a transect from Chitwan (250 m altitude) and along the Prithivi Highway to Marangche village (1450 m) in Kaski district (Figure 5). At least 105 farmers grew these bulks along the transact and the fates of the bulks wee similarly monitored. No training was given to farmers in the case of the transect.

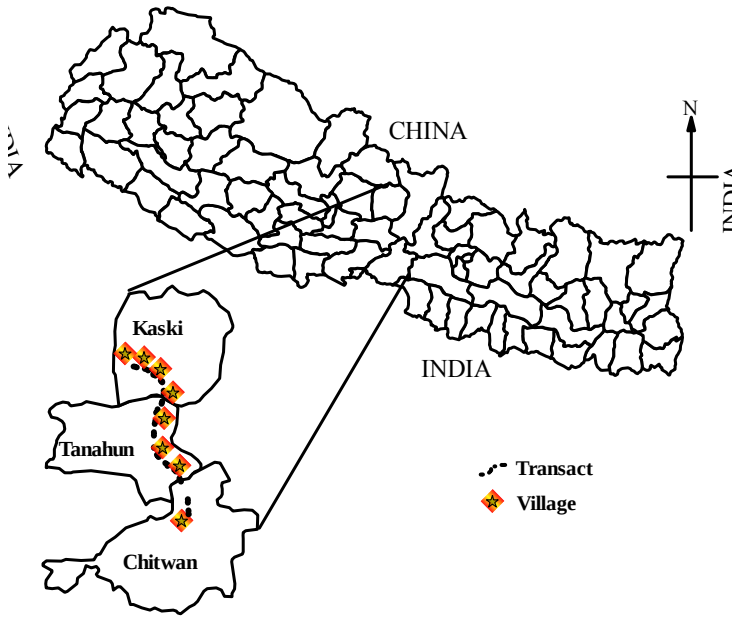


Figure 5. Distribution of F6 modified bulks in the transact from Chitwan through Tanahun to Kaski district in 1999 in Nepal.

Table 22. Summary of collaborative PPB programme on main season rice along a transact up to Sherachaur Kaski, main season 2000.

Location	District	Altitude (m)	Distance from Chitwan (km)	Participating farmers(number)
Yampa	Tanahun	400	56	16
Ghasnikunwa	Tanahun	450	71	21
Seratar	Tanahun	500	96	27
Gagandauda	Kaski	650	111	15
Arghaun	Kaski	800	118	15
Hemja	Kaski	950	138	17
Sherachaur	Kaski	1250	148	19

When the bulks were distributed in the main season without training the recipient farmers, the proportion of farmers who continued with the bulks was much lower (Figure 6). Only three bulks out of eight were advanced to the next generation. Of these, MT1 had the greatest uptake (11%), while one farmer each selected and advanced the other two bulks; MT2 (3%) and MT4 (9%). The main reason for dropping a bulk was found to be excessively early maturity (Table 23) because they were severely damaged by diseases, insect pests, rodents and birds. All the farmers that grew the late dwarf bulk rejected it because of its poor straw yield.

Table 23. Response of 107 collaborating farmers (% responding) on reasons for rejection of bulks, main season, 2000.

Reasons for rejection of bulk	MT1	MT2	MT3	MT4	ET	LT	MD	LD	Total
Too short duration (extra early)	36	68	100	18	100	33	50		50
Disease and insect pest	23	51	27		100				32
Lodging	11	6		10		50			8
Poor straw yield	7						67	100	8
Shattering	11			10			10		7
Poor taste	5	3							3

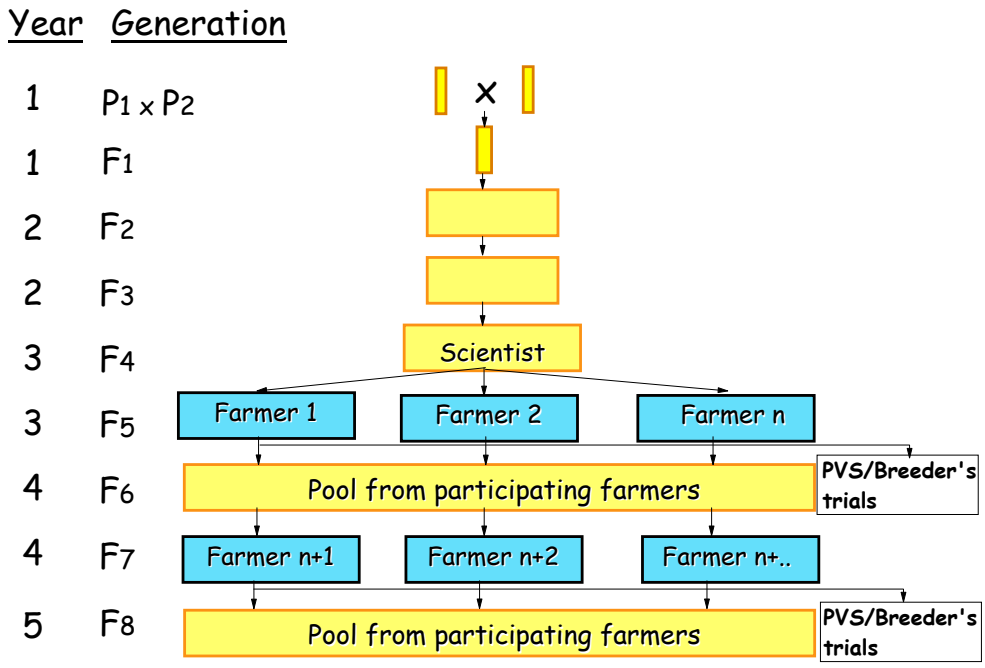


Figure 6. A schematic diagram of a collaborative breeding programme using replicated-pooled-bulk selection. The farmers' bulks can be pooled and redivided at alternating generations. Eventually the best performing genotypes across farmers and years will predominate.

3.2. Collaborative breeding with farmer training

In the F_7 generation, in *Chaite* 2000, four selected bulks (ET; MT1 long grain; MT2 long grain; and MT3 short grain) were distributed to 24 farmers (six farmers per bulk) in Chitwan district for collaborative PPB. Similarly 38 farmers were involved in collaborative bulk breeding of CH45/MT1 in east Chitwan. The farmers that volunteered for the programme had initial training in a group that took several hours. At about the booting or early panicle stage LI-BIRD scientists visited the plots with the farmers and discussed selection strategies. Thereafter, the fate of the bulks was monitored. By repeated interviews over seasons it was determined which farmers continued to grow the bulk, whether she or he gave the bulk to other farmers who were then included in the interviews, and how farmers selected in the bulks.

There was an initial group meeting to identify farmers and to explain the general principles of the programme. It started with discussions of the target population of environments (TPEs), i.e., the

varying fields of the participating farmers in the *Chaite* season. The target set of traits (TSTs) were also discussed. At the early grain-filling stage training was organized on which traits breed true and which do not, i.e., which of the identified TSTs were amenable to selection. This training took 4-5 hours per group in each village, including a field visit. The reasons for heterogeneity in the bulk were explained, and it was also explained how such a diverse population could be made uniform by selection along with practical examples in the field visit.

Mother and baby trials. Varieties from the collaborative breeding of COB programme were tested in participatory trials using a mother and baby trials system. The mother trials were grown as a single-replicate at each site (a farmer's field) with all the entries in each replicate (Table 24). We compared farmers' selection from the ET bulk and lines selected from cross CH45/MT1, i.e. Judi 141F, *Dev Raj Dhan* with the breeders' selection from the same bulk, i.e. Judi 102. and *Bhumikala Dhan* compared with CH 45 and BG 1442 as check varieties. The management of the trials was that of the farmer. There were more replicates of the baby trials of Judi 141F in which farmers test a sub-set of the varieties in their own fields under their own management. The sub-sets was either only a single variety or a pair of varieties from the mother trials (Table 25).

Table 24. The participant farmers in mother trials in rainfed bunded, upland domain of spring (Chaite) rice in Nepal in 2002, 2003 and 2004.

Name of the participants	Village	District
2002		
Kul Prasad Amgain	Krishna Mandir	East Chitwan
Netra Neupane, Sadananda Dhakal, Pandu Khadaka	Devnagar	West Chitwan
Kamala Bista, Khir Kumari Mahato	Chormara	Nawalparasi
Siva Ram Mahato	Abhiyun	Nawalparasi
2003 and 2004		
Devi Datta Poudel	Krishna Mandir	East Chitwan
Netra Prasad Neupane	Devnagar	West Chitwan
Man Bdr Khand, Sadananda Dhakal, Hom Nath Gautam	Ujjwalnagar	West Chitwan
Chandra Kanta Dhugana	Ganganagar	West Chitwan

Table 25. Summary of baby trials on Judi 141F conducted by project in 2003 and 2004 in different locations in Nepal.

Number of farmers	Locations of PVS trials	District	Check variety	Year
18	Kumroj	Chitwan	CH 45 (5) BG 1442 (13)	2003
3	Sarada Nagar	Chitwan	CH 45 (1) BG 1442 (2)	2003
1	Krishna Mandir	Chitwan	CH 45 (1)	2003
22	East and west Chitwan	Chitwan	CH 45 (11) BG 1442 (11)	2004
2	-	Syangja	Gola (1), Gudura (1), Jarneli (1)	2004

Value in parenthesis represents frequency of check varieties in baby trials

Before the F_7 bulks were given to farmers an initial selection was made among the bulks three grain types had been selected. Farmer preferences were clear; in the case of later-maturing bulks, such as

MT3, that matched more or less the maturity of the most popular Chaite variety, CH45, only non-slender grains were acceptable. This was because in this maturity group the harvest coincides with the rains, so it is only economic to produce roasted, flattened rice, for which less slender-grained varieties are most suitable. In contrast, in the earlier groups all three grain types were acceptable but long slender grains were preferred for their higher market price.

By the F_7 generation, in the *Chaite* and main seasons of 2000, the bulks that were given to farmers were recognisable by them as distinctive populations because most of the plants shared common traits - the maturity range was limited to about 10 days and the grain type was nearly uniform. Nevertheless, the bulks still had sufficient genetic heterogeneity within them for farmers to be able to make selections. Farmers identified grain yield, grain quality, tall plant height and earliness as important traits for selection.

All farmers were initially willing in the first season in *Chaite* 2000 to partake in the programme but the number of farmers growing the bulks in the *Chaite* season later declined (Figure 7). Of the original 24 farmers, 50% grew the bulk in *Chaite* 2001 and only 12% in *Chaite* 2002. As would be expected, fewer farmers grew the bulks in the main season than in the target *Chaite* season. Continued participation depended on the performance of the bulk they grew. An increasing number of farmers grew one bulk, ET. One farmer, Mr Dev Raj Sapkota (DRS), took great interest in selecting in the ET bulk despite having limited upland to which ET was adapted. Hence, he cooperated with Mr Tirtha Poudel (TP), a neighbour with much more upland (Figure 8). DRS selected early, intermediate-height, high-yielding, disease-resistant plants with longer, more slender grains than CH45. As a result of the monitoring, breeders identified the selected ET bulk, named it as Judi 141F, and entered it into mother and baby trials.

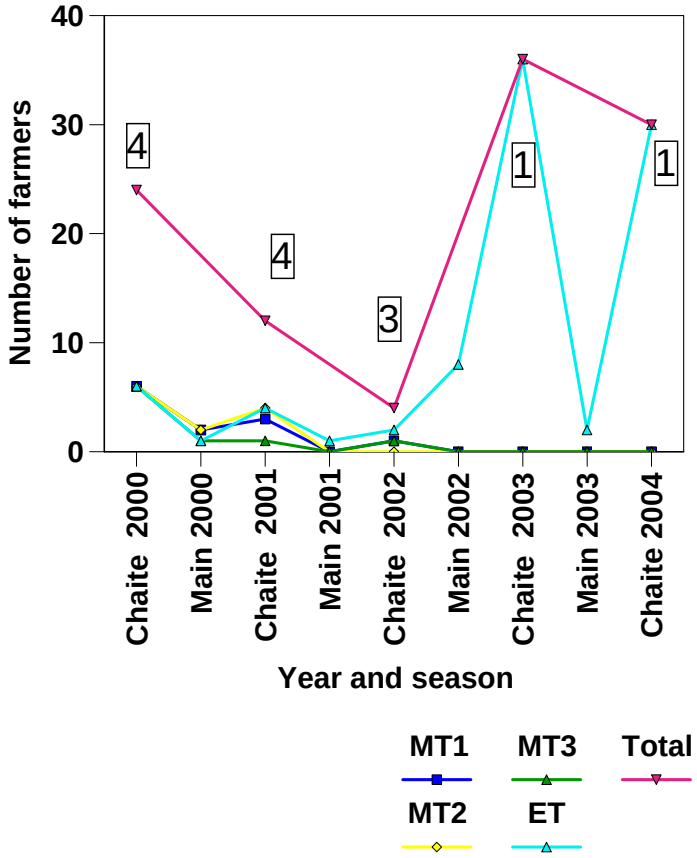


Figure 7. The number of farmers continuing to grow the four bulks in the collaborative PPB programme. The number of bulks represented in the total are shown in the boxes.

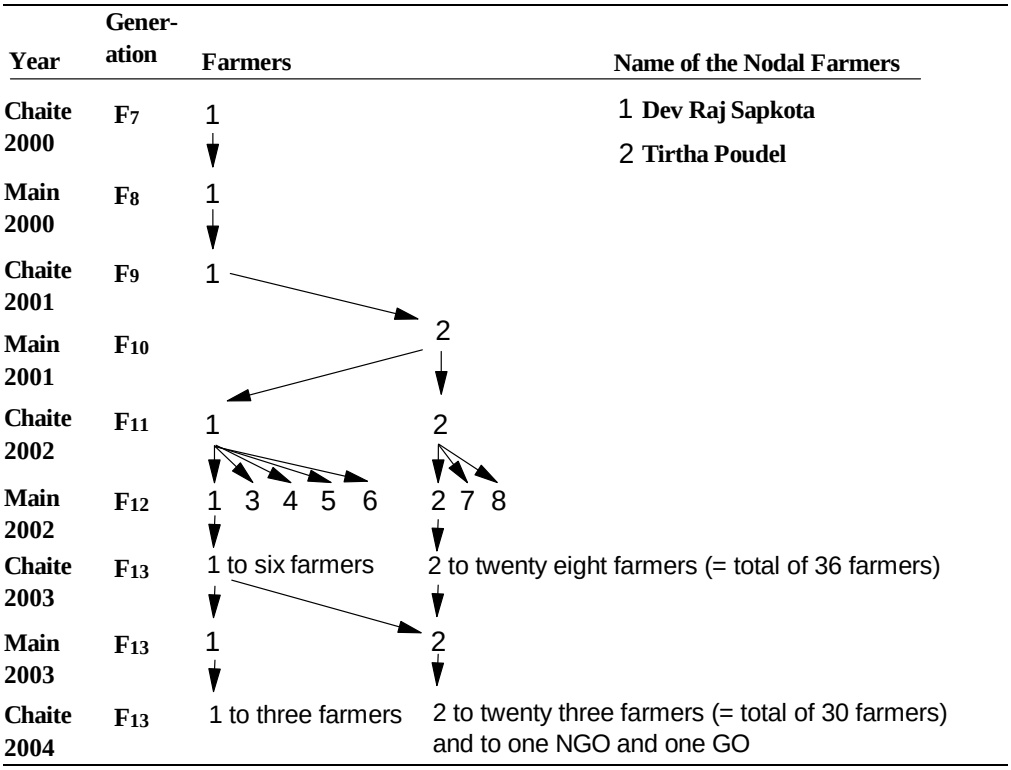


Figure 8. An example of collaborative plant breeding where a farmer has grown a bulk for several years to produce variety Judi 141F (first designated as such in the F_{11} generation). The bulk has been distributed to seven additional farmers. Open arrow continuing adoption, closed arrow farmer-to-farmer spread

In the mother and baby trials in 2002, 2003 and 2004 were encouraging Judi 141F matured one week to twelve days earlier than most other entries and was comparable to Judi 102 (the breeders' selection from the same bulk), CH 45 and BG 1442 for grain yield (Table 26). In the overall ranking of varieties in the mother trials Judi 141F was ranked as one of the best entries in all years. In 2004, the mother trials of lines derived from collaborative breeding revealed that *Dev Raj Dhan* and *Bhumikala Dhan* were preferred by farmers (Table 27). These two entries were selected by Mr. Dev Raj and Ms Bhumikala respectively in collaborative breeding programme.

Table 26. Means of various traits measured for seven spring rice lines in mother trials during spring season in Chitwan and Nawalparasi in 2004.

Varieties	Days to maturity			Grain yield (t ha^{-1})			Ranking		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
BG 1442	127A	125A	117A	3.2AB	3.5	4.7A	3.9	1.3B	2.1B
CH 45	123B	120B	113B	3.5A	3.8	3.9B	2.1	2.5A	4.3A
Judi 141 F	117C	111C	106C	2.9AB	3.3	3.9B	4.5	2.1A	4.3A
Judi 102	120B	-	-	3.0AB	-	-	4.0	-	-
F-test	**	***	***	**	NS	***	NS	***	***

Values given in column followed by the same letter do not differ significantly at the 0.05 probability level. **, *** Significantly different at 0.01 and 0.001 probability level respectively. NS= Non significant. Ranking: lowest score=the worst, highest score=the best

Table 27. Means of various traits measured for seven spring rice lines in mother trials during spring season in Chitwan and Nawalparasi in 2004.

Rice lines	Maturity	Grain yield (t ha^{-1})	Preference ranking
BG 1442	122A	5.15A	3.3CD
CH45	117B	4.10AB	8.3B
Judi 141F	113C	3.44BC	11A
Judi 102	121A	3.57BC	4.6C
DevRaj Dhan	121A	3.62BC	2.0D
Bhumikala Dhan	117B	4.11AB	7.0B
F-test	**	*	*

Values given in column followed by the same letter do not differ significantly at the 0.05 probability level. **, * Significantly different at 0.01 and 0.05 probability level respectively. Ranking: lowest score=the best, highest score=the worst

4. Disease screening

Leaf blast and bacterial leaf blight are the two major diseases in rice. Disease screening for leaf blast and bacterial leaf blight was done by NRRP/NARC. Reaction of COB bred genotypes with those diseases in various research stations is presented in Table 28a. 28b, 28c and 28d.

Table 28a. Reaction of COB bred genotypes with leaf blast and bacterial leaf blight conducted by NRRP, Hardhinath during 2002-2005

		Leaf Blast					Bacterial Leaf Blight							Leaf Blast					Bacterial Leaf Blight				
Sn	Genotypes	2002	2003	2004	2005	Max	2002	2003	2004	2005	Max	Sn	Genotypes	2002	2003	2004	2005	Max	2002	2003	2004	2005	Max
1	Barkhe 1002	1	NG			1	3	5			5	82	Super 3004			NG	0	0			5	3	5
2	Barkhe 1004	1				1	3				3	83	Hill # 14			1		1			5		5
3	Barkhe 1005	1	1			1	3	5			5	84	Hill # 15			NG					7		7
4	Barkhe 1005 E		0			0		5			5	85	Hill # 19			NG					5		5
5	Barkhe 1006	2	0		0	2	5	5		5	5	86	Hill # 39			NG					7		7
6	Barkhe 1007	0	0			0	5	7			7	87	Hill # 9			NG					5		5
7	Barkhe 1009	0	0			0	5	7			7	88	DR Dhan			4	4	4			3	7	7
8	Barkhe 1010		NG					3			3	89	ET #6				0	0				5	5
9	Barkhe 1012		NG					5			5	90	ET-Reminant				0	0				7	7
10	Barkhe 1014		0			0		5			5	91	Judi 101	1				1	5				5
11	Barkhe 1016	0				0	5				5	92	Judi 102	2				2	3				3
12	Barkhe 1017	1				1	3				3	93	Judi 103	3				3	3				3
13	Barkhe 1019	1	0	NG	0	1	3	3	1	5	5	94	Judi 104 E		0			0		3			3
14	Barkhe 1022	0				0	5				5	95	Judi 111	1				1	3				3
15	Barkhe 1025		NG					3			3	96	Judi 111#5				0	0				5	5
16	Barkhe 1026	1				1	5				5	97	Judi 114	0				0	5				5
17	Barkhe 1027	0	1	3	4	4	7	5	5	5	7	98	Judi 115		NG	0		0		3	3		3
18	Barkhe 1028	1	0			1	7	5			7	99	Judi 119		NG	0		0			3		3
19	Barkhe 1029	0	0			0	5	5			5	100	Judi 122		NG					NG			
20	Barkhe 1032				0	0				3	3	101	Judi 141 F			NG	0	0			5	3	5
21	Barkhe 1033				0	0				3	3	102	Judi 503		NG	NG	2	2		0	5	7	7
22	Barkhe 1034				3	3				5	5	103	Judi 508 E			4	6	6			5	3	5
23	Barkhe 1035				0	0				5	5	104	Judi 508 L			NG		9			5		5
24	Barkhe 1036				0	0				3	3	105	Judi 508# 23				8	8				7	7
25	Barkhe 1037				0	0				5	5	106	Judi 508# 37				5	5				3	3
26	Barkhe 2001	2	0	NG	0	2	5	5	3	7	7	107	Judi 508#30				7	7				5	5
27	Barkhe 2001 T1			3		3			3		3	108	Judi 518			5		5			1		1
28	Barkhe 2001 T10			3		3			5		5	109	Judi 521		NG	NG				NG	5		5
29	Barkhe 2001 T12			3		3			3		3	110	Judi 534	1	NG				7	NG			7
30	Barkhe 2001 T5			3		3			5		5	111	Judi 541		NG	NG	3	3		3	5	3	5
31	Barkhe 2001 T7			3		3			3		3	112	Judi 547		NG					NG			
32	Barkhe 2001 T8			3		3			3		3	113	Judi 549		NG	2		2		NG	3		3
33	Barkhe 2002	5				5	7				7	114	Judi 557		NG					NG			
34	Barkhe 2003	4				4	3				3	115	Judi 559		NG					NG			
35	Barkhe 2004	4				4	3				3	116	Judi 560		NG	NG	0	0		NG	5	7	7
36	Barkhe 2006 E		0			0		5			5	117	Judi 564			3		3			5		5
37	Barkhe 2012	9				9	5				5	118	Judi 565				2	2				7	7
38	Barkhe 2014	3	0	NG	1	3	5	3	3	3	5	119	Judi 566			NG					5		5
39	Barkhe 2016	7	0			7	5	5			5	120	Judi 567	3			1	3	5			7	7
40	Barkhe 2016 S		3			3		7			7	121	Judi 569			7		7			7		7
41	Barkhe 2017	7				7	5				5	122	Judi 571		NG			0		NG			
42	Barkhe 2017 S		0			0		3			3	123	Judi 572			NG	1	1			5	5	5
43	Barkhe 2017 T		4			4		7			7	124	Judi 573			NG		9			7		7
44	Barkhe 2018	7				7	5				5	125	Judi 575		NG					NG			
45	Barkhe 2018 S		0			0		7			7	126	Judi 577		NG	NG	3	3		NG	5		5
46	Barkhe 2018 T		0			0		7			7	127	Judi 579		0			4		0			7
47	Barkhe 2019	2				2	7				7	128	Judi 582				1	1				3	3
48	Barkhe 2020	5				5	5				5	129	Judi 591			6	8	8			3	3	3
49	Barkhe 2022	1	NG			1	5	5			5	130	JUDI-577				3	3				5	5

Table 28a. *Cont.*

		Leaf Blast					Bacterial Leaf Blight							Leaf Blast					Bacterial Leaf Blight				
Sn	Genotypes	2002	2003	2004	2005	Max	2002	2003	2004	2005	Max	Sn	Genotypes	2002	2003	2004	2005	Max	2002	2003	2004	2005	Max
50	Barkhe 2024	1	0	3	0	3	3	3	5	5	5	131	BRRI Dhan 28			NG	0	0			7	7	7
51	Barkhe 2025	6				6	5				5	132	Masuli/IR				8	8				5	5
52	Barkhe 2026	3	0			3	5	5			5	133	Masuli/IR 64#6				8	8				3	3
53	Barkhe 2027	1				1	5				5	134	Masuli/IR 64#8				4	4				3	3
54	Barkhe 2029		0			0		5			5	135	Masuli/IR64#9				6	6				5	5
55	Barkhe 2031		0			0		3			3	136	Masuli/MT				5	5				5	5
56	Barkhe 2034	4				4	3				3	137	Masuli/MT 4#11				7	7				3	3
57	Barkhe 2035	5				5	3				3	138	Masuli/MT				4	4				5	5
58	Barkhe 2038	3				3	5				5	139	Masuli/MT				6	6				5	5
59	Barkhe 2042	4	3			4	3	5			5	140	Masuli/MT				5	5				5	5
60	Barkhe 2043		0			0		7			7	141	Masuli/MT				5	5				5	5
61	Barkhe 2044		0	NG	0	0		7	3	3	7	142	Masuli/MT				7	7				3	3
62	Barkhe 2045			3	7	7			5	5	5	143	Masuli/MT				4	4				5	5
63	Barkhe 2048		0			0		5			5	144	Masuli/MT 4#69				7	7				3	3
64	Barkhe 3004	1	0	3	1	3	3	5	3	5	5	145	Masuli/MT 4#86				8	8				3	3
65	Barkhe 3005	1				1	3				3	146	MT 3	1				1	3				3
66	Barkhe 3006	2				2	3				3	147	MT 4	1				1	3				3
67	Barkhe 3007	1				1	5				5	148	IPB plot# 1			5		5			3		3
68	Barkhe 3008	1	0			1	5	5			5	149	IPB plot# 6			4		4			3		3
69	Barkhe 3009	3				3	7				7	150	IPB plot# 63			4		4			3		3
70	Barkhe 3010		0			0		3			3	151	IPB plot# 13			5		5			5		5
71	Barkhe 3011 A			3		3			3		3	152	IPB plot# 14			8		8			5		5
72	Barkhe 3012		0			0		5			5	153	IPB plot# 18			4		4			5		5
73	Barkhe 3013		NG	3	1	3		5	5	3	5	154	IPB plot# 2			4		4			3		3
74	Barkhe 3014		NG					5			5	155	IPB plot# 20			9		9			3		3
75	Barkhe 3015			3	7	7			5	3	5	156	IPB plot# 24			4		4			3		3
76	Barkhe 3017			2	4	4			3	3	3	157	IPB plot# 26			6		6			3		3
77	Barkhe 3018				0	0				5	5	158	IPB plot# 30			3		3			5		5
78	Barkhe 3019				1	1				5	5	159	IPB plot# 5			8		8			3		3
79	Sugandha 1		0	2	0	2		7	7	7	7	160	RC 32				3	3				3	3
80	Sugandha 2002		NG	NG	0	0		7	5	7	7	161	R.Check	1			0	1	3			3	3
81	Sugandha 2003		NG					7			7	162	S.Check	9			8	9	9			9	9

Table 28b. Rice genotypes showing resistant to blast over the four locations tested in NRBN during 2002

EN	Designation	Leaf blast score			
		NRRP/H	RARS/L	NMRP/R	RARS/T
131	Judi 115	1	0	0	0
134	Judi 121	1	2	-	0
138	Judi 503	1	0	0	-
174	Judi 566	1	1	0	1
203	Barkhe 1002	1	0	0	2
207	Barkhe 1027	0	0	-	0
208	Barkhe 1028	1	0	0	0
210	Barkhe 1017	1	0	0	0
211	Barkhe 1029	0	0	-	1
213	Barkhe 1016	0	0	0	0
214	Barkhe 1022	0	0	0	2
215	Barkhe 1019	1	2	-	0
216	Barkhe 1007	0	0	-	1
217	Barkhe 3004	1	0	-	0
218	Barkhe 3005	1	2	0	1
221	Barkhe 3006	2	0	-	2
222	Barkhe 3007	1	2	0	0
223	Barkhe 3008	1	1	0	1

Table 28c. Rice genotypes showing resistant to blast over the four locations tested in NRBN during 2003

EN	Designation	Leaf Blast score (0-9)			
		NRRP/H	NORP/N	PPD/K	RARS/T
155	Pant-10	-	1	2	0
156	Judi-102	0	1	-	0
157	Judi-565	-	1	1	0
158	Judi-566	-	1	2	0
166	IR 36	-	1	2	0
167	Judi 572	0	2	2	0
170	BPI 3-2	-	1	2	0
196	Barkhe-1002	-	1	2	0
197	Barkhe-1005M	1	1	3	0
198	Barkhe-1006	0	1	1	0
201	Barkhe-1007	0	1	2	0
202	Barkhe-1009	0	1	2	0
204	Barkhe-1012	-	1	2	1
206	Barkhe-1025	-	1	1	0
209	Barkhe-1029	0	1	1	0
210	Barkhe-2001	0	1	1	0
211	Barkhe-2014	0	1	1	1
215	Barkhe-2018T	0	2	2	0
216	Barkhe-2022	-	1	2	0
217	Barkhe-2024	0	1	1	0
218	Barkhe-2026	0	1	1	1
221	Barkhe-1029	0	1	2	0
222	Barkhe-2031	0	1	1	0
224	Barkhe-2043	0	1	2	0
225	Barkhe1014	0	1	2	0
226	Barkhe-3004	0	1	2	0
228	Barkhe-3010	0	1	2	0
229	Barkhe-3012	0	1	1	1
230	Barkhe-3013	-	1	2	0
231	Barkhe-3014	-	1	1	0
232	Sugandha-1	0	1	1	0
233	Sugandha-2002	-	1	2	1
234	Sugandha-2003	-	1	2	0
235	Barkhe-2018S	0	1	1	0
238	Barkhe-2048	0	1	2	0
241	Barkhe-2017S	0	1	1	0
275	Barkhe-1005E	0	1	1	1

Table 28d. Rice genotypes rated resistant to moderately resistant to BB over the three locations tested in NRBBN during 2002

E.N.	Designation	BB Score (0-9)		
		NRRP, Hardinath	RARS, Parwanipur	NWRP, Bhairahawa
127	Judi 102	3	1	3
128	Judi 103	3	3	3
132	Judi 119	3	0	3
133	Judi 120	3	0	3
136	Judi 127	3	0	3
137	Judi 133	3	3	3
138	Judi 503	3	1	3
141	Judi 506	3	1	3
142	Judi 508	3	1	3
143	Judi 521	3	1	3
145	Judi 532	3	3	3
147	Judi 537	3	1	3
148	Judi 541	3	1	3
156	Judi 575	3	0	3
165	Judi 551	3	0	3
181	Barkhe 2003	3	0	3
182	Barkhe 2004	3	0	3
192	Barkhe 2034	3	3	3
195	Barkhe 2042	3	0	3
202	Barkhe 2024	3	0	3
203	Barkhe 1002	3	0	3
204	Barkhe 1004	3	0	3
205	Barkhe 1005	3	0	3
210	Barkhe 1017	3	0	3
215	Barkhe 1019	3	0	3
217	Barkhe 3004	3	0	3
218	Barkhe 3005	3	0	3

5. Agronomic/Fertilizer response of COB bred varieties

5.1. Response of Barkhe 3004 on different dose and method of fertilizer application

Response of Barkhe 3004 on different dose and method of nitrogenous, phosphatic and potassium fertilizers was studied for two years in Chitwan district of Nepal. The treatments were control, poor management (25:0:0 kgNPK/ha), general farmers practices (50:30:0 NPK/ha), recommended practices (100:30:30 NPK/ha) and high management practices (120:30:30 NPK/ha). Grain yield of Barkhe 3004 varied significantly according to fertilizer dose and method of application (Table 29). Although, the highest grain yield was recorded in 120:30:30 kg NPK kg ha $^{-1}$ fertilizer application which was over 60% higher than the control (no application of fertilizer). However, a benefit cost (B: C) study of the application of chemical fertilizers on this variety revealed that 50:50:0 kg NPK actually gave the highest B:C ratio of 1.33, which was 8% higher than the highest level of fertilizer application. Increase in grain yield by the addition of another 50 units of nitrogen was small to compensate for the increase in the use of inputs.

Table 29. Response of Barkhe 3004 to different doses of fertilizer in trial conducted in main season 2004 and 2005 in Chitwan district.

		Plant height (cm)	No. of tillers/hill	No. of unfilled grains per panicle			No. of filled grains per panicle			Panicle length (cm)			Grain yield (t/ha)		
Treatment	Treatment Explanation	2005	2005	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean	2004	2005	Mean
0:0:0 NPK/ha	Control	89.35	6.70	12.48	20.15	16.31	82.20	129.45	105.83	20.70	24.37	22.53	2.48	3.09	2.79
25:0:0 NPK/ha	One time top dressing at booting stage only	90.75	7.40	10.28	21.45	15.86	82.25	135.80	109.03	20.49	24.90	22.69	2.45	3.41	2.93
50:30:0 NPK/ha	1/2 N at basal and 1/2 at top dressing	93.00	7.65	11.85	21.30	16.58	96.85	188.85	142.85	21.73	24.80	23.27	3.41	4.09	3.75
100:30:30 NPK/ha	50 kg N top dress two times	98.65	8.80	12.33	18.25	15.29	92.68	137.75	115.21	22.15	25.40	23.78	3.81	4.19	4.00
120:30:30 NPK/ha	80 kg N top dresses at 2 times + Zinc	101.95	8.00	12.10	18.60	15.35	88.05	154.00	121.03	21.38	26.09	23.73	3.83	4.97	4.40
Grand Mean		94.74	7.71	11.81	19.95	15.88	88.41	149.17	118.79	21.29	25.11	23.20	3.19	3.95	3.57
LSD at p=0.05		4.535	1.886	4.94	6.98	4.074	15.79	72.7	38.43	1.55	0.71	1.045	0.4716	0.76	0.5408

5.2. Response of Barkhe 2014 on different dose and method of fertilizer application

Response of Barkhe 2014 on different dose and method of nitrogenous, phosphatic and potassium fertilizers was studied in Chitwan district in main season rice 2005. The treatments were control, poor management (25:0:0 kg NPK/ha), general farmers practices (50:30:0 NPK/ha), recommended practices (100:30:30 NPK/ha) and high management practices (120:30:30 NPK/ha). Grain yield of Barkhe 2014 did not vary significantly according to fertilizer dose and method of application (Table 30). This indicated that this variety is not very responsive to differential levels of nitrogenous fertilizers.

Table 30: Response of Barkhe 2014 to different doses of fertilizer in trial conducted in main season 2004 and 2005 in Chitwan district.

Treatment	Treatment Explanation	Plant height (cm)	Avg. no. of tillers/hill	No. of chaffy grain/panicle	No. filled grain/panicle	Panicle length (cm)	Grain yield (t/ha)
0:0:0 NPK/ha	Control	88.45	7.0	15.9	114.6	23.47	3.54
25:0:0 NPK/ha	One time top dressing at booting stage only	88.65	7.2	17.3	113.9	22.24	3.56
50:30:0 NPK/ha	1/2 N at basal and 1/2 at top dressing	96.35	8.5	11.1	116.8	21.64	3.69
100:30:30 NPK/ha	50 kg N top dress two times	102.15	9.4	11.6	123.9	22.64	3.85
120:30:30 NPK/ha	80 kg N top dresses at 2 times + Zinc	106.75	8.9	12.0	113.25	38.44	4.14
Mean		96.47	8.2	13.5	116.49	25.68	3.75
LSD at (P=0.05)		8.5	1.2	ns	ns	ns	ns

5.3. Response of Super 3004 on different dose and method of fertilizer application

Response of Super 3004 on different dose and method of nitrogenous, phosphatic and potassium fertilizers was also studied in Chitwan district in main season rice 2005. The treatments were control, poor management (25:0:0 kgNPK/ha), general farmers practices (50:30:0 NPK/ha), recommended practices (100:30:30 NPK/ha) and high management practices (120:30:30 NPK/ha). Grain yield of Super 3004 varied significantly according to fertilizer dose and method of application (Table 31).

Table 31: Response of Super 3004 to different doses of fertilizer in trial conducted in main season 2004 and 2005 in Chitwan district.

Treatment	Treatment Explanation	Plant height (cm)	Avg. no. of tillers/hill	No. of chaffy grain/panicle	No. filled grain/panicle	Panicle length (cm)	Grain yield (t/ha)
0:0:0 NPK/ha	Control	98.50	6.60	14.65	156.95	25.30	4.15
25:0:0 NPK/ha	One time top dressing at booting stage only	105.10	8.05	11.10	154.35	26.86	4.70
50:30:0 NPK/ha	1/2 N at basal and 1/2 at top dressing	105.10	8.80	11.90	147.70	25.68	4.70
100:30:30 NPK/ha	50 kg N top dress two times	109.40	7.85	11.55	170.00	26.80	4.97
120:30:30 NPK/ha	80 kg N top dresses at 2 times + Zinc	111.05	7.90	15.70	176.55	27.12	5.40
Mean		105.83	7.84	12.98	161.11	26.35	4.78
LSD at (P=0.05)		3.00	1.03	ns	ns	1.25	0.48

5.3. Response of Judi 572 on different dose and method of fertilizer application

Response of Judi 572 on different dose and method of nitrogenous, phosphatic and potassium fertilizers was studied in Chitwan district in main season rice 2005. The treatments were control, poor management (25:0:0 kgNPK/ha), general farmers practices (50:30:0 NPK/ha), recommended practices (100:30:30 NPK/ha) and high management practices (120:30:30 NPK/ha). Grain yield of Judi 572 did not vary significantly according to fertilizer dose and method of application (Table 32).

Table 32: Response of Judi 572 to different doses of fertilizer in trial conducted in main season 2004 and 2005 in Chitwan district.

Treatment	Treatment Explanation	Grain yield (t/ha)
0:0:0 NPK/ha	Control	3.55
25:0:0 NPK/ha	One time top dressing at booting stage only	3.52
50:30:0 NPK/ha	1/2 N at basal and 1/2 at top dressing	3.73
100:30:30 NPK/ha	50 kg N top dress two times	3.55
120:30:30 NPK/ha	80 kg N top dresses at 2 times + Zinc	3.37
Mean		3.54
LSD at (P=0.05)		ns

6. Visual assessment, micro-milling and organoleptic (Post-harvest evaluation)

Consumer preference for milling traits and cooking quality of new variety is important criteria for the adoption or rejection of the variety. Both quantitative and qualitative judgment of the variety after harvesting is also equally important to the growers and consumers. Post harvest quality characteristics in rice may be categorized into physical characteristics and organoleptic traits. Physical Characteristics includes milling and visual traits and organoleptic traits include taste, aroma and culinary characteristics.

Micro-milling: High head rice recovery percentage and total milled rice turnout is important for adoption of variety but the head rice recovery percentage depends on the variety, moisture content of the grain, grain type, chalkiness, and cultural practices. Two samples of 162-gram of rough rice for each entry is milled in GRAINMAN model 60-220-50-2AT micro-mill that removes the hulls in first run (60s) and polish the bran in second run (another 60s). Milled rice that has length more than 3/4 is head rice and smaller than that are considered as broken rice. Based on milling performance calculation of head rice recovery, breakage, total milling rice and unhulled rice percentage is done. In comparison to the local and standard check; the lines, which show the superiority in head rice recovery and total milling percentage are selected for advancement.

***General appearance*:** Overall appearance of the processed kernel is extremely important for judging the quality of rice. Consumers demand clear, vitreous, translucent kernels and the coloured, damaged and the imperfect kernels will not attract the consumer appeal in the market. The white powdery portion of a rice grain is known as the chalky part that results lower milling yields and deteriorates the quality of processed rice by breaking during milling.

The samples of rough as well as milled rice of COB rice lines along with standard and local checks were displayed on paper plates on a table. Participant farmers (both male and female), consumers, millers, merchant fixed criteria for visual evaluation of rice and ranked rice samples based on

appearance; those lines that are poor in general appearance than standard checks were rejected. Mostly farmers/ consumers prefer non-chalky grain, ghee colour rice with less broken percentage.

***Organoleptic test*:** Sensory evaluation of combined qualities of appearance, taste, aroma, flavour and other culinary characteristics are important in organoleptic test.

The lines selected on visual observation (10-15 samples) were cooked separately by the experienced ladies and standard and local check varieties were also included in a regular interval. Cooked rice samples were distributed to all participants of taste panel (both male and female) to taste and rank the individual sample. The lines that showed better performance with respect to qualitative traits, e.g. softness, inner hardiness, stickiness, grain integrity, aroma and other culinary characteristics such as cooking time, volume expansion and water absorption over the checks were selected and poorer ones were rejected.

Post Harvest Evaluation in COB Increases the Selection Efficiency

Post harvest quality characteristics in rice are categorized into physical characteristics (milling traits and visual traits) and organoleptic traits (taste, aroma and culinary characteristics). Consumer preference for milling traits and cooking quality of new variety is important criteria for the adoption or rejection of the variety. Use of post harvest evaluation tools in screening of breeding materials helps to save the time and resources by selecting the superior or discarding the inferior lines in early generation.

Micro-milling

Based on milling data, only 14 (out of 84), 10 (out of 23) and 43 (out of 64) lines were superior than standard check (CH 45) in Chaite rice of 2002, 2003 and 2004 respectively (Figure 9) and only 235 (out of 242), 42 (out of 43) and 43 (out of 57) lines were superior than standard check (Sabitri) and local check (Masuli) in main season rice of 2002, 2003 and 2004 respectively (Figure 10).

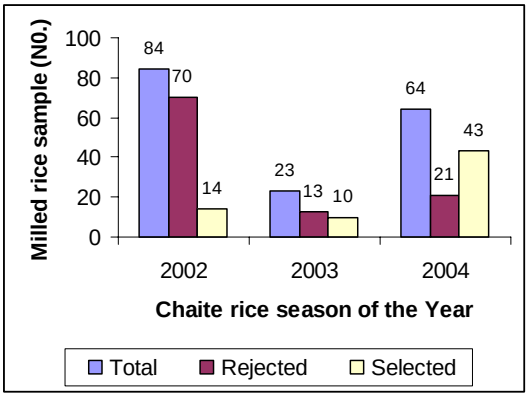


Figure 9. Number of selected and rejected lines based on milling % of *Chaite* season rice since 2002-05

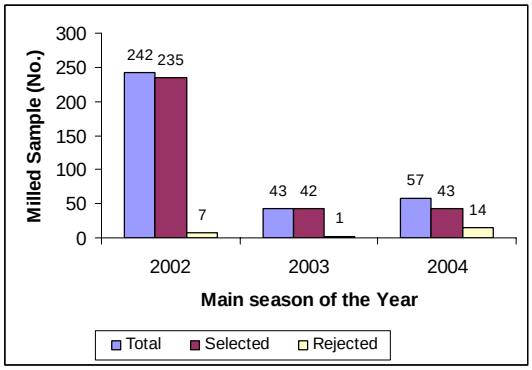


Figure 10. Number of selected and rejected lines based on milling % of Main season rice since 2002-05

***General appearance*:** Overall appearance of the processed kernel is extremely important for judging the quality of the rice. The samples of rough as well as milled rice along with standard and local checks are displayed on paper plates in a table. Participant farmers' (both male and female) fixed criteria for visual evaluation of rice and they give rank to different samples based on appearance; those lines that are poor in general appearance than standard checks are rejected.

Figure 11. Number of selected and rejected lines based on visual observation of Main season rice since 2002-05

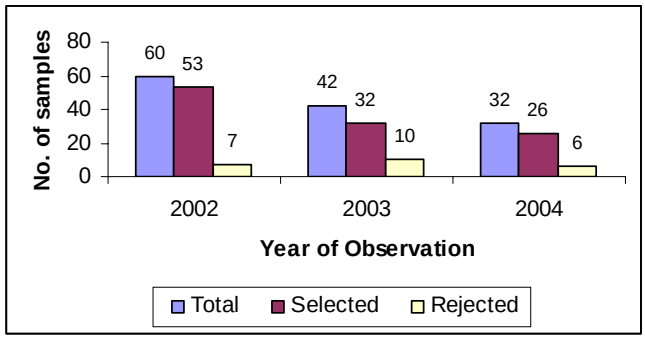
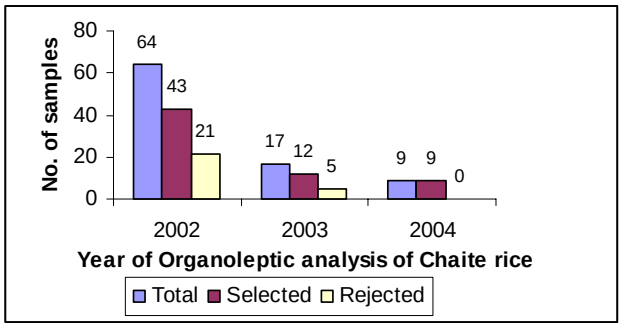


Figure 11 explains that 53 (out of 60), 32 (out of 42), 26 (out of 32) lines are selected based on visual observation of main season rice in 2002, 2003 and 2005 respectively. Mostly farmers/ consumers prefer non-chalky grain, ghee color rice with less broken percentage.

***Organoleptic test*:** Sensory evaluation of combined qualities of appearance, taste, aroma, flavor and other culinary characteristics are important in organoleptic test.

Figure 12. Number of selected and rejected lines based on organoleptic test of Chaite season rice since 2002-05



The lines selected on visual observation are cooked along with standard and local check separately by the experienced ladies in cooking and distributed to all participants' (both male and female) to taste and comment on those lines.

The lines that show better performance in respect to different qualitative traits over the check are selected and poorer than check are rejected (Fig. 12 and 13) in Chaite and main season rice. This shows the importance of organoleptic test to reduce the large volume of segregating materials into manageable size with quality judgment of the materials.

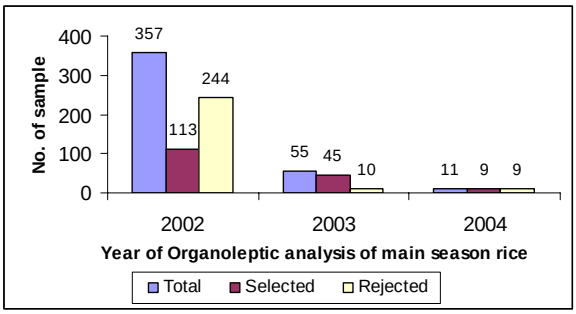


Figure 13: Number of selected and rejected lines based on organoleptic test of Main season rice since 2002-05

On the basis of above mentioned parameters (i.e. micro-milling, visual analysis and organoleptic test) and yield advantage as well as response to biotic and abiotic stresses, only the superior genotypes in all traits are advanced for next generation. Hence, we can conclude that post harvest evaluation tools helps to speed up the selection process select outstanding genotypes in terms of the quality also.

7. Seed production, scaling up and dissemination

Products of COB bred varieties were tested and scaled up in 21 terai and 10 mid-hill districts of Nepal in collaboration with the respective District Agriculture Development Offices, eight decentralized community based seed producers groups, three non-governmental organizations, Agrovets and large scale seed production and distribution as IRD and Minikits by LI-BIRD. The COB bred varieties are not only popular in Nepal but have performed extremely well in Bangladesh and India. In Bangladesh, Judi 582 has out-yielded BRRI varieties, e.g. BRRIdhan 32, BRRIdhan 28 and BRRIdhan 39 and has recently been proposed for registration in 2005. Judi 567 has out-yielded popular varieties in West Bengal and Jharkhand, and is being promoted by Gramin Vikas Trust (GVT) West in India.

7.1. Informal Research and Development in partnership with DADO: Effective tool for selecting farmer's preferred variety and rapid scaling up

Informal Research and Development (IRD) is one of the approaches adopted for selection and scaling up of farmers preferred COB bred varieties. This approach provides the feedback of farmer's preferred traits and farmers preference of the test cultivars in comparison to the locally adapted varieties. It increased the efficiency of formal breeding programmes by providing feedback and popularizing varieties appropriate for farmers in their local setting.

Using this approach LI-BIRD distributed considerable amount of seed of COB bred cultivars over last seven years to various GO, NGO and private organisations. CBOs, other development practitioners and individual farmers.

This approach has significantly contributed to increase access of farmers to seeds of new varieties, increasing agrobiodiversity, increasing food security and ultimately contributing to enhance the livelihood of the poor marginalized farmers by providing better, high yielding, farmers preferred locally adapted released and pre-released cultivars.

7.2. Community based seed production: A novel way sustaining the seed supply system

Community based seed production (CBSP) system is an approach to quality seed production in the community with participatory involvement of farmers, researchers and extension workers collaborating in a group, which may be formed voluntarily by the farmers or by GO, NGO and are registered legally in District agriculture Development Offices. There is an element of voluntary participation in the organization whether in the form of small numbers of Board members or large number of members or beneficiaries giving their time voluntarily. Objectives of CBSP groups are to:

- strengthening on-farm seed production,
- facilitate local level seed exchange, movement and contribute to seed sufficiency
- develop small scale seed entrepreneurship,
- facilitate development of seed market locally
- Generate income from the sale of farmers preferred varieties and increase productivity and food security through timely supply of improved quality seed to farmers.

Participatory Plant Breeding (PPB) project in HPPS initiated CBSP model of seed production and dissemination in 2001 in Chitwan. After 2-3 years experience, PPB team realized that CBSP is the only sustainable mechanism of seed supply in the developing countries like Nepal, and initiated decentralized CBSP system in Jhapa, Rautahat, Chitwan, Dang, Kailali and Kanchanpur districts of Nepal. These groups are producing and marketing considerable amount of seed of certified, improved and truthful labeled seed of rice, wheat, maize, grain legume and oilseed crops. In Chitwan, only three community based seed producers groups viz. (Unnat Seed Producers Group, Patihani, Shreeram Seed Producers Group, Parbatipur and Devujjal Seed Producers Group, Gitanagar) established and initiated seed production in between 2001-2003, produced and marketed 51, 144 and 453 ton seed of different cereal crops and earned net profit of NRs. US $ 183, 1787 and 3995 in 2003, 2004 and 2005, respectively. Now these groups are supplying cereal seed to more than 30 terai and mid-hill districts of Nepal and becoming Chitwan as one of the source district of cereal seed. While, breeder, foundation and certified seed production programme of NARCs' commodity research programme is very low. NRRP produced and marketed 55 and 60 ton rice seed and NWRP produced and marketed 160 and 168 ton wheat seed in 2003 and 2004, respectively and government's other seed supplying organizations like National Seed Company also cannot producing and supplying required quantity of seed and the seed produced and distributed by NSC has very poor quality. At present, only 5% of the total seed demanded is supplying from formal sector.

Now these government programmes are facing financial crisis due to political instability and government's current policy. But farmer's groups are affected less due to these situations. They take the programme as their own and for the group strengthening farmers tries any sorts of effort. Most important reason to flourish community based seed production system in Chitwan is due to technical and managerial support and backstopping from LI-BIRD and DADO. Now it is realized that for sustainable growth of seed producers groups they need some sorts of backstopping and support for the initial few years. Here a case study of a community based seed producers group is presented

A novel way of seed production and dissemination: Case study of a Unnat Seed Producers Group, Patihani, Chitwan

With the technical and logistic support from LI-BIRD, a Community Based Seed Producers' group (CBSPG) named Unnat Seed Producer's Group was formed in September 2002 at Patihani Village Development Committee (VDC and was officially registered with DADO Chitwan Objectives of this group were: to encourage and strengthen local level seed production and dissemination to enhance local and district level seed sufficiency and germplasm exchange, develop small scale seed entrepreneurship and facilitate to development of huge seed market in future.

This group has 30 shareholders, 80 general members. The group has democratically elected Executive Committee and three sub committees (which are elected by voting after every two years). The sub-committees are marketing, technical and advisory to facilitate proper seed marketing, maintaining seed quality for enhancing coordination and linkages with diverse partners and collaborators.

Initially they started collecting US $ 1.4 per member per month to sustain the group and initiate seed production activities. LI-BIRD organized on-the- spot training to all the members of the group on group formation and management, co-ordination and linkages with other organizations, record and book keeping, seed quality, marketing, certification, storage, and seed production technology of individual crops. For the first two years, LI-BIRD used this group to produce its required amount of rice seed. From this, they earned some profit, and more important is they have got opportunities to develop and strengthen their knowledge and competencies in the field of seed production, quality control, development of co-ordination and linkages with other agencies and establishing marketing network. In this way they have started their seed production activities and have produced 45 tons of seed of released and pre-released varieties of rice, wheat, maize and lentil and have earned profit of US $ 183 from selling those seed in first year i.e. 2002/03. They have gradually increased their seed production activities in the coming years and produced and successfully marketed 74 and 258 tons seed of released and pre-released varieties of rice, wheat, maize, lentil, mungbean, kidney bean and mustard and have earned profit of US $ 1620 and 2817 in 2^{nd} and 3^{rd} years, respectively. Now they have established and strengthened good co-ordination and linkages with government organization like DADOs, and other government's line agencies, several NGOs, Agrovets, other private and public organizations, individual farmers and farmers groups; and selling seed to these partners in more than in 30 districts of Nepal. Recognizing them as organized and well managed community based seed producers group and for their outstanding contribution in the local, district and regional level seed supply system, last year only, DADO, Chitwan awarded them US$ 845 as seed money and for the recognizition of their excellence His Majesty's King of Nepal, *Gyanendra Bir Bikram Shahdev* awarded *Gorkha Dakchinbahu Fourth* to this group. Directorate of Agriculture Engineering-Department of Agriculture started a large scale project with this group to establish and install seed processing, storage, harvesting, threshing, seed testing and other accessories in this group. Now, apart from seed production and distribution, this group is actively engaged in research in emerging issues and resource conservation technologies (RCTs) like minimum tillage, surface seeding etc. in

collaboration and partnership with other organizations.

Generally they produce truthfully labelled and improved seed of released, pre-released and other farmers preferred landraces of different crops. They have their own bag, tag and other accessories needed for seed production and marketing. Seed quality is maintained i.e. through farmers capacity Group members are trained on seed quality mamagement and they adopt innovative was of managing seed quality through household and field visit by the group members in the standing crop, seed quality verification from seed testing laboratory etc and for effective marketing they collect demand prior to seed production, use local FM radios, newsletter, personal correspondence through letter, leaflets, website and participation in exhibition and fare for advertisement.

From the experience, it can be strongly recommended that if some organization would like to strengthen the seed producers group, it is necessary to allocate some amount of money to provide those groups as loan with low interest rate for the period of six months. If the governmental and non-governmental organizations working in the seed sector adopt this approach for community empowerment, the country can be self sufficient in seed within few years. This could be one of the best options to increase the accessibility of the improved seed in the country. Since groups are empowered, to some extent guarantee for sustainability.

Table 33. Amount of seed of different crops produced by different community based seed producers groups during 2002-2005

Name of seed producers group	District/ Institution	Year of establishment	Total amount of seed produced and sold (ton)			No. of Participating farmers in 2004-05
			2002-03	2003-04	2004-05	
Unnat Seed producers group, Patihani	Chitwan	October 21, 2001	45	74	258	35
Shreeram seed producers group, Parbatipur	Chitwan	December 29, 2002	5	62	149	50
Devujjal seed proucers group, Gitanagar	Chitwan	December 24, 2002	-	8	46	103
Siddhanath Seed Producers Group	Kanchanpur	2001	-	5	7	17
Kalika Seed Producers Group	Kailali	April 5, 1998	-	-	3	4
Surayadaya Bahu Uddeshe Krishak sahakari Sanstha Ltd. Bela - 2 Dang	Dang	March 31, 1999	23	25	56	46
Nawa Adharsha Farmer Seed Producers Group	Jhapa	1998	2	25	14	25

Table 34. Income and expenditure of different community based seed producers groups initiated and strengthened by LI-BIRD in Chitwan and other districts of Nepal

Seed producers group	Total cost (US$)			Total income (US$)			Total profit (US$)		
	2001-02	2002-03	2003-04	2001-02	2002-03	2003-04	2001-02	2002-03	2003-04
Unnat Seed producers group, Chitwan	1925	7942	14085	2108	30	16901	183	1620	2817
Shreeram seed producers group, Chitwan	-	880	10451	-	1048	11570	-	168	1120
Devujjal seed proucers group, Chitwan	-	-	929	-	-	988	-	-	59
Surayadaya Bahu Uddeshe Krishak sahakari Sanstha Ltd. Bela - 2 Dang	3225	3437	7028	6155	7070	14620	2930	3634	7592
Nawa Adharsha Farmer Seed Producers Group, Jhapa	NA	NA	NA	352	5	451	NA	NA	NA

They take breeder and foundation seed of rice, wheat maize, legume and other crop from respective Commodity Research Program and NGOs like LI-BIRD and FORWARD. Now these groups are supplying cereal seed to more than 30 terai and mid-hill districts of Nepal and becoming Chitwan as one of the source district of cereal seed. Any government agencies cannot supply in this huge amount of seed to the farmers in Nepal.

8. Impact of COB bred varieties in agro-biodiversity conservation and food security

In a impact assessment survey conducted in November 2005 by an independent organization named Support Foundation (NGO working in far Western region of Nepal) in randomly selected 14 villages of Chitwan (Figure 14) using GPS found that COB bred cultivars occupied over 1% of the total main season rice growing area. More adoption of COB bred varieties was found in low land areas which covered 4% of the total lowland rice growing area in Chitwan. Major farmers preferred varieties bred by this project occupying significant area in the farmers field are Barkhe 3004, Barkhe 2014, Super 3004, Barkhe 1027, Barkhe 2001, Judi 572, Sugandha 1 and Sugnadha 2002. Besides in Chitwan, these varieties are occupying significant area in several other districts of Nepal. For example, Barkhe 2001 has more than 600 ha area in Sarlahi, and 500 ha area in Dhanusha, more than 150 ha area in Chitwan and Nawalparasi and has significant area in other districts as well like Jhapa, Saptari, Kailali and Kanchnapur. Similarly, Sugandha 1 is spreading and occupying upland drought prone areas of Banke, Jhapa, Morang, Kapilbastu and Dang districts, replacing mainly Radha 4 and Bindeswori (released varieties by formal sector). Barkhe 1027 is adopted and rapidly spreading in Dang and replacing Radha 4 and Bindeswori. Barkhe 3004 and Super 3004 are adopted by the farmers for lowland areas of Bara, Parsha, Rautahat, Rupendehi and Jhapa districts and replacing Swarna, Masuli and Sabitri. Barkhe 2014 and Judi 572 is rapidly spreading in Morang, Chitwan, Saptari Jhapa and several other districts which is mainly replacing Kanchhi Masuli (farmers popular variety) in those districts. The project has created options for rice varieties to the farmers based production domains with higher cooking and eating quality and better market prices. This has validated the value of client oriented breeding which successfully brought together farmers, extensionists, scientist, and market forces.

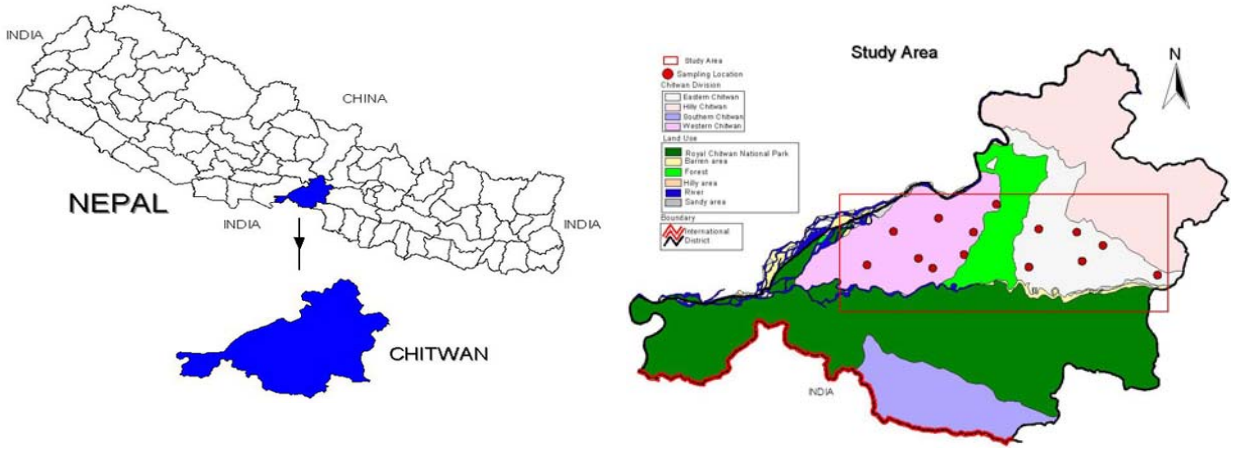


Figure 14. Impact study area in Chitwan district

Dissemination

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Contribution of Outputs

This project has tested, verified and scaled up various breeding and non-breeding approaches, technologies and materials with the aim to increase food security and livelihood of the poor farmers by increasing production and productivity of rice and rice based cropping system through the development of suitable rice varieties. This project has developed number of promising lines that has higher yield, better eating quality, resistant to biotic and abiotic stress for different rice growing micro-climatic environment (upland, medium land, lowland, drought condition, high management condition) in spring, boro and main season rice e. g. Sugandha-1, Barkhe 1027, Judi 572, Judi 591, Judi 582, Judi 567, Judi 565 etc, for medium land condition e. g. Sugnadha 2002, Barkhe 2014, Barkhe 2024, Barkhe 2044 etc. for long water standing condition e.g. Barkhe 3004, Super 3004, Barkhe 3019, Sugandha 2002 etc. From the field testing for several years in several locations, it was found that in general these COB bred cultivars are yielding 15% higher yield (in some cases up to 50% higher yield also recorded) than the local varieties. The additional yield advantage over popular local varieties using COB bred varieties is significantly contributing to sustain the food security not only in Nepal but also in India (GVT's research sites) and Bangladesh (in PROVA's research sites).

This project has been successful in testing, validating and scaling up of PPB process as effective method of developing farmers preferred varieties for target population environment. This method is found effective than conventional breeding in terms of resources and time. This project is successful to achieve its goal in terms of policy influence. Such as variety release format was updated in such a way that provision of variety release was made using participatory data by the other agencies other than national agriculture through inclusion of participatory research data in the variety release format. Now PPB approaches are adopted by national commodity research programme of of NARC like rice, wheat and maize, some DADOs, and some NGOs.

To promote the findings and sustain project activities, this project established and strengthened several decentralized Community Based Seed Producer's Groups in several districts of Nepal, has initiated and strengthened collaboration with various DADOs, NGOs, Agrovets and currently with Institute of Agriculture and Animal Science (IAAS/TU). Most important achievement of this project is collaboration with National Rice Research Programme/NARC. In this project the role of NRRP remained very important to generate data of CVT, IET and disease screening and also to scaling up of the best entries identified in the CVT. NRRP distributes minikit of those entries to DADOs, I/NGOs, farmer's groups and individual farmer's. This way, this project is directly or indirectly adopting partnership and collaboration with both formal and informal i.e. governmental, non-governmental and farmer's groups, which are very important pathways to deliver the findings to the targeted beneficiaries and sustain the project outputs. Partnership with those organizations found most sustainable approaches. For the further sustainability of the project, we need to follow up those organizations. This way the output of the project is contributing significantly towards the project goal.