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Rajdeep (IET 17713): A New Rainfed Lowland High Yielding Rice Variety for Semideep Situation

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ABSTRACT

In eastern India, more than 13.0 million ha of rice lands are affected by excess water and periodically suffer from flash floods and complete submergence. Most of the traditional and adapted rice varieties of this situation are low yielders. To overcome these problems the high yielding rice variety (HYV), Rajdeep (IET 17713) has been developed by Rice Research Station, Government of West Bengal, Chinsurah, Hooghly as high yielding rice variety for semideep water situation. Field experiment was conducted to evaluate the performance of promising semideep water rice (*Oryza sativa* L.) genotypes under lowland situation during wet season of 2002-2013. Performance of Rajdeep, semideep water rice was better and therefore it was released. It is tolerant to sheath blight, sheath rot diseases and stem borer, leaf folder insect-pests. The high yielding semideep rice variety, Rajdeep exhibited superiority over national check (Sabita), regional check (Purnendu) and local check tested in different locations under All India Coordinated Rice Improvement Project (AICRIP) trials during *kharif*, 2002-2003 conducted by ICAR-Indian Institute of Rice Research, Hyderabed, India. This variety was also tested in multi-locational yield trials (2003-2013) along with check variety Swarna-Sub 1/ Bhudeb at different locations of West Bengal. After testing at national level as well as at state level, based on yield performance of the variety, the HYV semideep rice variety Rajdeep was released and notified by Government of India in the Gazette of India vide Notification No. S.O. 1007(E) on 30th March, 2017.

Key words: HYV, IET 17713, Rainfed lowland rice, Rajdeep, Semideep rice.

INTRODUCTION

In recent years, a field planted or sown with semideep or deepwater rice variety may face a more favourable situation of intermediate or shallow lowland (Rautaray, 2006). Thus, there is a need to screen the semideep or deepwater rice lines for their better performance in favourable situation to develop a high yielding rice under this situation. Earlier works (Datta and Bannerjee, 1980) on this aspect revealed that traditional deepwater rice varieties exhibited better growth habit and yield attributes under deepwater than under normal conditions. However, information is meager regarding the performance of newly developed semideep or deepwater rice genotypes under favourable situation of intermediate lowland.

Rainfed lowland rice accounting for nearly 40% of the rice area in India (Khush *et al.*, 1998). During the wet season (*kharif*), 30% of the rice-growing area comes under the purview of rainfed lowlands (Dana and Chatterjee, 2012). In eastern India, 13 million ha (approx.) of rice lands are unfavourably affected by excess water and periodically suffer from flash floods and complete submergence. The average yield of rice in the semideep water ecosystem (41-75 cm) is less than 2 tonnes ha^{-1} compared with 4 tonnes ha^{-1} observed in the irrigated ecosystem (Mallik *et al.,* 2003). In eastern India, ~13 million ha of rice lands are unfavourably affected by excess water and periodically suffer from flash-floods and complete submergence. Improvement of germplasm is likely the best option to withstand submergence and stabilize productivity in these environments (Sarkar *et al.,* 2006). Most of the traditional and adapted rice varieties of that situation are low yielders. To mitigate the above problems the high yielding rice variety, Rajdeep has been developed for semideep situation.

MATERIALS AND METHODS

Rajdeep, IET 17713 was developed through hybridization between widely adapted variety for semideep situation, Sabita and IR 57540-8 (developed by IRRI) followed by pedigree method of selection. Sabita is a selection from landrace Boyen. This variety can tolerate stagnant flooding up to 40-70 cm of water depth. IR 57540-8 is a high yielding line of IRRI germplasm, whose parentage is IR 5-114-3-1-2/IR 38699-49-3-1-2//IR 41389-20-1-5. The variety was developed at Rice Research Station (at 22°52´N latitude and 88°24´E longitude and at an altitude of 8.6 m.), Government of West Bengal, Chinsurah, Hooghly, West Bengal.

The variety Rajdeep was first nominated to National Semi Deep Water Screening Nursery (NSDWSN) trial during 2002 under All India Co-ordinated Rice Improvement Project

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(AICRIP) trials of Directorate of Rice Research (DRR). In 2002, it had been tested in all over India with National Check (NC): Sabita, Regional Check (RC): Purnendu and Local Check (LC) over eight locations in India (Coochbehar, Cuttack, Chinsurah, Canning, Faizabad, Madurai, Ghagraghat, Bhubaneswar).

The field experiment on was conducted during wet season (*Kharif*) at different locations of West Bengal with check variety Swarna-Sub 1/ Bhudeb (Bhudeb was high yielder under intermediate lowland situation, Rautaray, 2006) over the years (2003-2013) to evaluate the performance of semideep rice variety, Rajdeep. Seeds of these varieties were sown in nursery on 2nd week of June and the seedlings were transplanted on 2nd week of July at a spacing of 20 cm × 20 cm in every year of 2003-2013. A lower fertilizer dose of 40, 20 and 20 kg @ N, P_2O_5 and K_2O ha^{-1} were applied in transplanted field. The experiment was conducted in different locations in each year *viz* in 2003 two locations (Bhartargachhi in Hooghly district and Bora in North 24 Parganas district), in 2004 four locations (on-farm at RRS, Chinsurah and Kirtinagar in Hooghly district; Gayshpur in Nadia district and Bora in North 24 Parganas district), in 2005 three locations (on-farm at RRS, Chinsurah; Kirtinagar and Gotu in Hooghly district), in 2006 four locations (on-farm at RRS, Chinsurah; Gotu and Digha in Hooghly district; Bora in North 24 Parganas district), in 2007 one location (on-farm at RRS, Chinsurah in Hooghly district), in 2008, three locations (on-farm at RRS, Chinsurah and Gotu in Hooghly district; Bora in North 24 Parganas district), in 2009, four locations (on-farm at RRS, Chinsurah; Damra; Malipara and Nawpara in Hooghly district), in 2010 four locations (on-farm at RRS, Chinsurah; Belle; Baidyabati and Akna in Hooghly district), in 2011 four locations (on-farm at RRS, Chinsurah; Belle and Baidyabati in Hooghly district; Bolgona in Burdwan district), in 2012 six locations (on-farm at RRS, Chinsurah; Mogra and Dhaniakhali in Hooghly district; Chakdah and Ranaghat in Nadia district; Galsi in Burdwan district) and in 2013 four locations (on-farm at RRS, Chinsurah; Mogra; Baidyabati and Khalsi in Hooghly district).

During *kharif*, 2002, the disease reaction of leaf blast, neck blast, brown spot, sheath blight, sheath rot, bacterial leaf blight and rice tungro was tested in different locations of India. In the same year, the insect-pests reactions of brown plant hopper (BPH), white back plant hopper (WBPH), plant hopper (PH), green leaf hopper (GLH), stem borer, leaf folder (LF) and whorl maggot (WM) in field condition were tested. Days to 50% flowering (DFF), panicles sq m^{-1}, plant height (cm) and different grain quality characteristics of Rajdeep were also measured.

RESULTS AND DISCUSSION

Yield performance

Rajdeep (IET 17713) exhibited 10.10%, 13.28% and 13.52% yield increase over Sabita (NC), Purnendu (RC) and LC tested throughout eight locations in India under All India Coordinated Rice Improvement Project (AICRIP) trials in *kharif*, 2002 (Table 1). During 2003-2013, through multi-locational yield performance trial in West Bengal, the variety exhibited 6.15%. 8.41%, 4.77%, 11.04%, 18.52%, 9.80%, 44.54%, 10.60%, 7.43%, 6.63% and 8.81% yield increase over local check (Table 2). Highest grain yield (6400 kg ha^{-1}) was recorded in 2007. It provided mean yield of 4823 kg ha^{-1} with average yield increase of 12.52% over check variety, Swarna-Sub 1/Bhudeb.

Reaction to pests

Rajdeep was moderately resistant to neck blast (Severity Index : 2.00) and bacterial leaf blight (Severity Index : 6.33) diseases. Among the insect-pests the stem borer and leaf folder infestation in Rajdeep was very low over the locations (Table 3 and 4). The variety, Rajdeep was tolerant to sheath blight, sheath rot diseases and stem borer, leaf folder insect-pests (Rabindra Babu *et al.,* 2016). Insect-pests contribute substantially to yield loss in rice production and productivity (Chatterjee *et al.,* 2016). In an experiment on field screening against insect-pests of rice during 2016, Chatterjee *et al*. (2019) proved that the lowest whorl maggot and dead heart (yellow stem borer) infestations were recorded in Rajdeep rice variety. They also found the lower attack of rice leaf folder on Rajdeep.

Varietal characteristics

Photoperiod sensitivity is a desirable trait in rainfed lowland rice (Ahmad, 1979) and knowledge on flowering time is essential in selecting a variety for a lowland ecology. The days to 50% flowering of Rajdeep was 125 days and seed to seed maturity was 155 days (Table 1). Average number panicles sq m^{-1} of the variety was recorded 214 (Table 1). Rajdeep exhibited semi tall plant height 109 cm (Table 1), dark green leaf colour, even remains green upto maturity

Table 1: Yield performance and morphological indices of Rajdeep (IET 17713) in different locations of India in *kharif*, 2002.

Variety	Grain yield (kg ha^{-1}) (Mean of 8 locations in India)	Yield increase % over check varieties	Days to 50% flowering (Mean of 8 locations in India)	Panicles sq m^{-1} (Mean of 3 locations in India)	Plant height (cm) (Mean of 7 locations in India)
Rajdeep	3531	-	125	214	109
Sabita (NC)	3207	10.10	123	221	146
Purnendu (RC)	3117	13.28	132	173	143
Local check (LC)	3111	13.52	128	149	132

NC: National check; RC : Regional check.

(Source: DRR Annual Progress Report, 2002, Varietal Improvement Vol. 1, pp. 1.78-1.81).

(Table 5). It had high head rice recovery (HRR) with 66.1% with medium slender grains (Table 5). It had stiff culm and does not lodge at maturity. The plants of the said variety had erect flag leaf standing over panicle so that birds could not damage the matured grains.

Grain quality characteristics

The test weight of awn less grain of Rajdeep was 20.0-20.5 g (Table 6). The cooking quality of the parboiled rice was also tested amongst the farmers and the results showed that the taste, colour, softness and non-stickiness characters of the variety were very much preferred by the farming community. This variety was preferred by the farmers because it did not lodge and shatter at maturity. The most conspicuous feature was that the plants of Rajdeep stayed green up to the maturity.

Table 2: Yield performance of Rajdeep (IET 17713) through multi-locational yield trial in West Bengal during *kharif* 2003 – 2013.

Testing year	Tested locations in West Bengal	Yield of Rajdeep over the locations (kg ha^{-1})	Check variety (Swarna-Sub 1/ Bhudeb) yield (kg ha^{-1})	% yield increase over check variety (Swarna-Sub 1/ Bhudeb)
2003	2	4537	4274	6.15
2004	4	4431	4088	8.41
2005	3	4460	4257	4.77
2006	4	5280	4755	11.04
2007	1	6400	5400	18.52
2008	3	3731	3398	9.80
2009	4	5033	3482	44.54
2010	4	5791	5236	10.60
2011	4	3917	3646	7.43
2012	6	5115	4797	6.63
2013	4	5646	5189	8.81
Mean		**4823**	**4303**	**12.52**

Table 3: Reaction to major diseases in terms of severity index (SI) of Rajdeep along with check varieties in *kharif*, 2002.

Tested variety	Leaf blast (tested in 15 locations in India)	Neck blast (tested in 2 locations in India)	Brown spot (tested in 8 locations in India)	Sheath blight (tested in 10 locations in India)	Sheath rot (tested in 6 locations in India)	Bacterial leaf blight (tested in 18 locations in India)	Rice tungro (tested in 3 locations in India)
Rajdeep	4.38	2.00	4.75	5.40	5.17	6.33	4.33
Sabita (NC)	3.47	4.00	6.00	4.90	2.67	7.28	1.50
Purnendu (RC)	4.20	3.00	5.12	5.40	1.67	6.78	2.00
Dinesh (LC)	4.40	2.50	5.12	4.70	1.60	7.00	2.00
Savithri (LC)	4.27	0.00	4.75	4.60	1.60	6.00	2.50

NC: National check; RC : Regional check; LC : Local check.

(Source : DRR Screening Nurseries 2003 - Plant Pathology, National Screening Nurseries 2, pp. 118-152).

Table 4: Field reaction to major insect-pests in standard evaluation system scale (SES 0-9) of Rajdeep along with check varieties in *kharif*, 2002.

Tested variety	BPH (tested in 2 locations in India)	WBPH (tested in 2 locations in India)	PH (tested in 1 location in India)	GLH (tested in 1 location in India)	Stem borer (tested in 2 locations in India)	LF (tested in 2 locations in India)	WM (tested in 1 location in India)
Rajdeep	7	7	3	5	1	5	5
Sabita (NC)	7	5	7	5	3	7	7
Purnendu (RC)	5	7	5	5	3	7	3
Dinesh (LC)	5	7	5	9	1	5	5
Savithri (LC)	5	5	7	5	3	7	5

NC: National check; RC : Regional check; LC : Local check.

BPH : Brown plant hopper; WBPH : White backed plant hopper, PH : Plant hopper, GLH : Green leaf hopper; WM : Whorl maggot.

(Source : DRR Screening Nurseries 2003 - Entomology, National Screening Nurseries 2, pp. 61-76).

Table 5: Grain quality characteristics of Rajdeep.

Variety	Hull%	Mill%	HRR	KL	KB	L/B	Grain type	Grain chalk	ASV	AC	GC
Rajdeep	78.8	69.8	66.1	6.02	2.02	3.00	MS	VOC	4.0	25	44
Sabita (NC)	80.3	73.1	71.6	6.94	2.15	3.22	LS	VOC	4.0	22.32	22
Purnendu (RC)	78.0	66.0	61.6	5.03	2.24	2.21	SB	VOC	4.0	23.78	54

NC: National check; RC : Regional check.

HRR: Head rice recovery, KL: Kernel length, L/B : Length breadth ratio, MS : Medium slender, LS : Long slender, SB : Short bold, ASV. : Alkali spreading value, VOC : Very occasionally present, AC : Amylose content (%), GC : Gel consistency.

Table 6: Varietal characteristics of Rajdeep.

Plant characters		Measurement
Plant height	:	109 cm
Plant type	:	Semi tall
No. of tillers/plant	:	8-10
No. of panicles/sq m	:	214
Flowering duration (50% flowering)	:	125
Panicle length	:	24 cm
Panicle type	:	Semi-erect
Panicle weight	:	2.62 g
Filled grain/panicle	:	133
Panicle exertion	:	Fully exerted
Awning	:	Awnless
Apiculus colour	:	White
Basal leaf sheath colour	:	Green
1000 grain weight	:	20.0-20.5 gm
Grain length	:	8.90 mm
Grain breadth	:	2.37 mm
Grain thickness	:	1.89
L/B ratio of grain	:	3.7
Grain type	:	MS
Kernel length	:	6.02 mm
Kernel breadth	:	2.02 mm
Kernel thickness	:	1.62
L/B ratio of kernel	:	2.9-3.0
Kernel appearance	:	Translucent

CONCLUSION

Rajdeep was a stable performing variety of semideep lowland ecosystem. Since 2002 to 2013, the variety was tested along with check varieties at different farmers' field of West Bengal and it showed consistent yield advantage over Sabita (NC) as well as Bhudeb and Swarna-Sub 1 (LC). Rajdeep may be a good alternative as high yielding with diseases and insect-pests tolerant rice to Sabita, a renowned National Check for semideep lowland ecosystem over the country since last fifteen years (Dana *et al*., 2013). It was moderately resistant to sheath blight, sheath rot diseases and stem borer, leaf folder insect-pests. Finally the variety Rajdeep was notified by Ministry of Agriculture and Farmers Welfare (Department of Agriculture, Co-operation and Farmers Welfare), Government of India in Gazette of India *vide* Notification No. S.O. 1007(E) on 30th March, 2017.

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