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, Hyderabad, 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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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   | 22.3 | 22 |
| Purnendu (RC)    | 78.0  | 66.0  | 61.6 | 5.03     | 2.24 | 2.21 | SB         | VOC         | 4.0   | 23.7 | 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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