Evaluation of the versatile multi-crop planter for establishing sprouted direct-seeded rice

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Introduction

Wetland rice seeding is an increasingly common practice for irrigated and favourable rainfed lowlands. Most developed countries sow rice seed in saturated water to minimize cost and labour requirements (Smith and Show, 1996). Farmers in developing countries increasingly are adopting wet seeding because of the migration of farm labour to non-farm jobs and the consequent labour shortage and high costs for manual transplanting (Ho, 1995; Pandey, 1995; Pingali, 1994). Wet seeding in irrigated areas occurs into aerobic, anaerobic, and wet soils based on the level of oxygen in the vicinity of the germinating seed or the depth of flood water at seeding. Direct seeded rice either broadcasted or line sown gave significantly higher grain yield than transplanting under proper management (Elahi et al., 1997; Hussain et al., 2000). Santhi (1999) reported that the establishment of sprouted rice seed under broadcasted systems flowered 7.2 days earlier than transplanted rice seedling. The sprouted rice manually sown in lines had 7 days earlier flowering than transplanted rice in both dry and wet seasons. The delayed flowering in transplanted rice might be due to transplanting shock of the rice seedling. Islam (2008) observed that the radicle and plumule length was increased with the increase of incubation duration. Islam (2008) also reported that significantly higher grain yield was attained after 96 hours of rice seed incubation; however, using a drum seeder, no difference was observed among 24, 48 and 72 hours incubation. Very recently, CIMMYT has developed a 2-WT tractor-operated Versatile Multi-crop Planter (VMP) with the provision to use adjustable row spacing of crops for zero tillage, strip tillage, single pass shallow tillage, bed planting, and even conventional tillage (Islam et al 2010). The VMP has facilities to sow seed and place basal fertilizer simultaneously in a single pass operation under different tillage systems. To obtain the direct-seeded rice establishment benefits, the VMP was evaluated to assess the performance of sprouted rice seed sowing. A field study was undertaken to determine the establishment of sprouted rice seed and estimate the damage of radicle and plumule during mechanized sowing; and to determine the optimum time of rice seed incubation for grain yield.

Materials and Methods

The experiment was conducted in a farmer's field, Digram, Godagari, Rajshahi (24°31′57.54″N and 88°22′40.22″E) during the hot and dry *Kharif 1* season. A popular high-yielding rice variety - BRRI dhan42 was sown on 29th April, 2010. The seed treatments were: Dry seed **(**T_1); soaking overnight (T_2); soaking overnight and 24 hours incubation (T_3); soaking overnight and 48 hours incubation (T_4); and soaking overnight and 72 hours incubation (T_5). Equal dry weight of uniform seeds were put into fresh water and removed after 24 hours of soaking. The soaked rice seeds were kept in jute bags at ambient air temperate for incubation. Before sowing, seeds were removed from the jute bag and air dried in the shade for two hours. The length of plumule and radicle was measured from 15

randomly selected rice seeds in each treatment. Slide callipers were used to measure the length of plumule and radicle from their junction with the rice seed. Land preparation, seed sowing and application of recommended basal fertilizers were done simultaneously by using VMP in a single pass strip tillage operation. Seeds were sown in dry land followed by application of irrigation. A fluted-type seed meter with eight flutes was used in the VMP. In each treatment, rice seed samples were collected from the seed dispensing tube into polythene bags to measure the damage in whole rice seeds, plumule, and radicle. The clearance between flute and concave of seed meter was adjusted to maintain the actual seed rate as well as minimize the damage of whole seed, radicle and plumule. The spacing between rows was 20 cm. Soil samples were collected randomly from 0-7.5 cm and 7.5-15 cm depth. Core sampler was used to measure the bulk density and moisture content. Rice grain yield was recorded from each pre-selected 10 m^2 area per plot and adjusted to moisture content of 14 %. Data were analysed by using MSTAT-C software. Means were compared by the least significant difference (LSD) test.

Results and Discussion

The soil in experimental field was silty clay. Initial bulk density in 0-7.5 cm depth was 1.12 (g cm^{-3}) at 21.2 % gravimetric water content and bulk density in 7.5-15 cm depth was 1.36 (g cm^{-3}) at 22.4 % gravimetric water content. Longest radicles (11.14 mm) were observed after 72 hours of incubation and the shortest (3.0 mm) were observed after 24 hours of incubation. Plumule length was not much increased with the incubation period. No breakage was observed in plumule, radicle or whole rice seed due to rotation of the fluted type seed meters. Seeds were safely dispensed into the opened furrow of strip tillage. Emergence rate of incubated rice seed is given in Table 1. Irrespective of the length of incubation, 7 days were required for emergence of the rice seedling. The highest rate of emergence was found with 48 hrs incubation. The rice seed incubation time did not significantly affect the crop maturity date or number of tillers produced (Table 2). Numerically, dry rice seed produced higher numbers of tillers (381 m^{-2}) followed by 24 hours soaking with 48 hours incubation of seed. Lowest numbers of tillers (198 m^{-2}) were produced from 24 hours incubation of rice seed. However, percent of effective tillers was highest from sowing rice seed after 48 hours incubation. No statistical difference was found on panicle number m^{-2} among the treatments. Lowest panicle number was obtained for the 24 hours-incubated rice seed. Irrespective of incubation period, the rice crops matured within 100 days. Highest rice grain yield was obtained from sowing seed after 72 hrs incubation. There was no statistical difference in yield between dry rice seed and seed incubated for 72 hours. Similarly, there was no statistical difference between 24 hours soaking of rice seed; and 24 hours soaking followed by 48 hours incubation of seed. Incubate seed required more days to sprout but matured the rice crops in the same duration. Sprouted rice seed did not reduce the field duration. It can be concluded that sprouted rice seeds can be dispensed safely through the seed meters of VMP.

Table 1. Effect of incubation time on rice seedling emergence after 7-11 days (no. m^{-2}). Values are means of three replicates.

Treatment	Days after seeding				
	7	**8**	**9**	**10**	**11**
Dry seed **(**T_1)	62a	76a	78a	80ab	78ab
Soaking overnight (T_2)	35b	38b	39b	38b	35b
Soaking overnight and 24 hours incubation (T_3)	28b	33b	36b	34b	33b
Soaking overnight and 48 hours incubation (T_4)	75a	85a	93a	97a	98a
Soaking overnight and 72 hours incubation (T_5)	61a	74a	82a	84ab	84a
Level of significance	*	*	*	**	**
CV(%)	25.1	30.01	26.7	27.5	26.9
LSD	24.6	34.47	32.9	50.2	48.5

** Significance at 1% level, * Significance at 5% level.

Table 2. Effect of seed treatments on grain yield and yield contributing characters of *Kharif 1* season rice. Values are means of three replicates

Treatment	**Tiller (no. m^{-2})**	**Non-bearing tiller (no. m^{-2})**	**Panicle (no. m^{-2})**	**Grain yield (t ha^{-1})**
Dry seed **(**T_1)	381	63	318	3.5ab
Soaking overnight (T_2)	319	43	277	2.5c
Soaking overnight and 24 hours incubation (T_3)	198	18	180	2.3c
Soaking overnight and 48 hours incubation (T_4)	319	17	303	2.9bc
Soaking overnight and 72 hours incubation (T_5)	263	38	224	3.8a
Level of significance	NS	NS	NS	*
CV(%)	24.91	53.56	22.74	9.98

* Significance at 5% level; NS non significant.

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