Economics of growing rice seedlings in dry seed bed covered with polythene sheet during boro season

M. Rashid, M.M. Hossain[1], M.S.A. Sarker[1]
Department of Agricultural Extension (DAE), Khamarbari, Dhaka, [1]Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202

Abstract: This paper focuses on the advantages of growing rice seedlings in dry seedbed covered with polythene sheets. This technique is known as *Manikganj Model* for growing seedlings of *Boro* rice. Polythene sheets act as an alternative to green house. It helps to protect the young rice seedlings from the cold injury occurred during *Boro* season in Bangladesh. Seedlings grown in dry bed yielded the higher values for all the parameters studied in this experiment compared to the seedlings grown in the wet bed. Yield of *Boro* rice might be increased by 34.96% with the reduction of seed requirement by 50% through growing seedlings in dry bed covered with polythene sheet.
Key words: Dry seed bed, wet seed bed, boro rice, yield, cold injury.

Introduction

Rice (*Oryza sativa*) is the staple food in Asia where people receives two third of their daily calories (about 370 kcal energy 100 g^{-1} of grain) from it (FAO, 2008). The production of rice in the country was 9.77 million tons from 9.2 million hectares of land in 1971-72 which was 33.54 million tons from 11.53 million hectares in 2010-11 (BBS, 2012). Thus, over the four decades the rice production in the country has been increased by 3.4 folds. The agricultural land of Bangladesh is being reducing by about 1.0% per annum while the population is being increasing by 1.14%. The projected population of the country by 2050 will be 233.2 million against the present population of 152 million in 2012 (BBS, 2012). The food requirement will be 55.0 million tons by 2050 against the present requirement of 33.0 million tons (BBS, 2012). Therefore, rice production needs to be increased to a great extent to maintain the food security in the country. Among the three growing seasons (*viz. Aus, Aman* and *Boro*), the rice production is the highest in *Boro* season. The contributions of *Boro, Aman* and *Aus* rice to total rice production (33.54 million tons) in 2010-11 were 55.50% 38.81% and 5.69%, respectively. Farmers are very much interested to grow rice in boro season because of high yield. In Bangladesh, food security is therefore, depends mostly on the boro rice production (Rahman and Masood, 2012).

The maximum *Boro* rice production has been reported in Comilla (5427 kg/ha) and minimum in Rajshahi (3102 kg/ha) in 2008. It was also found that the average production at Barisal, Comilla and Sylhet district were above 5000 kg/ha; where as in Rajshahi and Satkhira it was below 4000 kg/ha. Therefore a certain amount of *Boro* rice production varied at different locations in Bangladesh for different climatic conditions and hydrological properties of soil. In case of raising seedlings for *bore* season climatic parameters especially temperature plays a vital role in Bangladesh (Basak, 2009). Germination and seedling establishment are sensitive growth stages for rice. Temperature during seedling establishment (October to early November) drops to about 10ºC and such low temperature significantly reduces seedling growth and establishment (Humphreys *et al.,* 1996).

Low temperature affects plant growth and yield of rice in two ways simultaneously. First, developmental events in the shoot apex are affected which directly determine the differentiation of panicle and hence potential yield and spikelet fertility resulting in fewer grains (Bodapati *et al.*, 2005, Takeoka *et al.,* 1992, Qiujie *et al.*, 1990). This damage is particularly significant during micro-sporogenesis stage of the pollen (Heenan, 1984) and causes male sterility. Secondly, photosynthesis is impaired (Smillie *et al.,* 1988) which reduces growth and results in direct yield loss because there is less carbohydrate available for grain production. Lowering the night/day temperature by 5ºC from the optimum has been shown to reduce plant growth by about 60% (Lewin and McCaffery, 1985).

In Bangladesh low temperature i.e. cold occurs in winter season usually during November to February when minimum temperature remains often below 20^0C. Sometimes minimum temperature occur bellow 20^0C in March and April in some parts of the country. A Boro crop encountering critical low temperature is appeared to suffer from cold injury. The extent of cold injury depends on the nature and duration of low temperature and diurnal change of low temperature and diurnal change of low (night) and high (day) temperature. The critical low temperature for a rice crop at agronomic panicle initiation (API), reduction division (RD) and anthesis are 18^0C, 19^0C and 22^0C, respectively. Low temperature offers a negative impact on Boro rice yield that reduce about 0.40 to 13.1% due to increase 2^0C minimum temperature and 0.11 to 15.5% for 4^0C minimum temperature (Basak, 2009).

Seed rate also plays an important factor for crop production. In case of traditional wet seed bed it requires higher amount of seed, not only that it also takes longer period of time and as well as it increases the input cost.

With the view to solving these problems a new technique has been evolved which is known as *Manikganj Model*. This model comprises the growing of seedlings in a seed beds covered with polythene sheets. Using this technique seed rate might be minimized by 50 % and yield might be maximized by 25-30 % with the same cost of production. Considering this point, a field trial was conducted by DAE at Manikganj with the objectives of growing rice seedlings in dry seed beds covered with polythene sheet to increase the yield of *boro* rice through escaping cold injury as well as to reduce the total field duration and input cost.

Materials and Methods

The field trials were conducted in seven different farmer's field of Manikganj district during the *boro* season in the year of 2011-2012. It was a single factor experiment with two treatments *viz*. seedlings of dry seed bed and seedlings of wet seedbed. The design of the experiment was RCBD with three replications. There were 42 (7×2×3) trial plots and the unit plot size was 400 m^2. In case of wet seed bed normal traditional practices were done and pre-germinated seeds were sown for seedling raising. On the other hand in case of dry seed bed after land preparation pre-germinated seeds were sown. After that seed were covered with soil containing 50% cow dung and finally covered with a polythene sheet. The polythene sheet was uncovered at 4-5 days interval to observe the condition of the seedlings. One month old seedlings were transplanted on 25 January 2012 maintaining row and hill spacing of 20 cm and 15 cm, respectively. Intercultural operations were done in order to ensure and maintain the normal growth of the crop as and when necessary. When 90% of grain became golden yellow in color, five hills (excluding border hills) were randomly selected from each unit plot for recording data on different agronomic crop characters. Data were analyzed using the analysis of variance technique and the mean differences were adjudged by Duncan's Multiple Range Test.

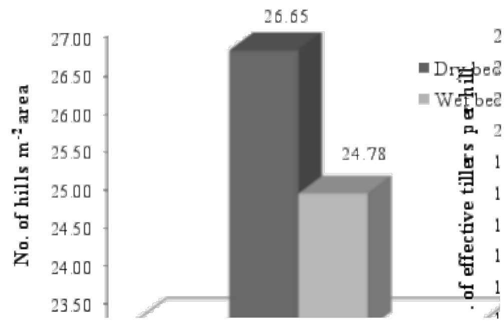
Results and Discussion

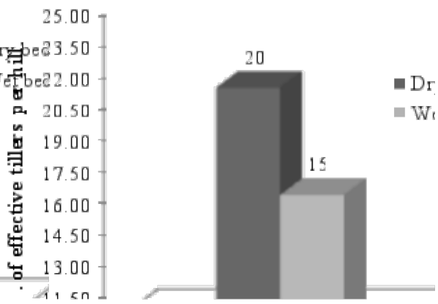
Differences in number of hills per m^2 area: Number of hills per m^2 area differed significantly (Table 1). Fig. 1 revealed that seedlings of dry seedbed established more hills compared to seedlings of wet seedbed. There were 26.65 hills in the field transplanted with the seedlings of dry bed where 24.78 hills with the seedlings of wet bed per m^2 area.

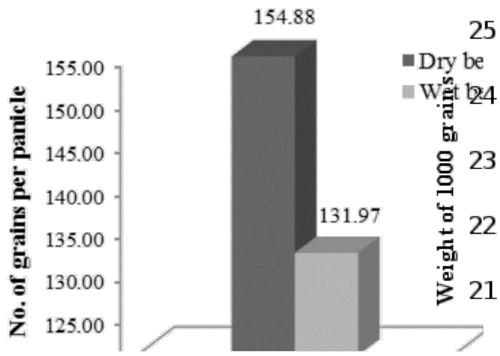
Table 1. Influence of seedlings on the yield attributes

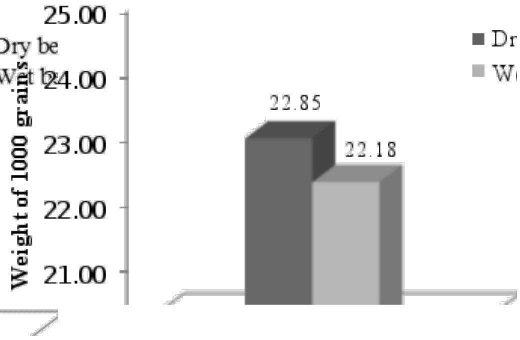
Seedlings	No. of hills per m^2 area	No. of effective tillers per hill	No. of grains per panicle	Weight of 1000 grains (g)	Yield (tha^{-1})	Total cost of production (BDT)	Total outcome (BDT)	Net profit (BDT)
Seedlings of dry seed bed	26.65a	20.96a	154.80a	22.85a	8.26a	36,382 a	60,120 a	23,738a
Seedlings of wet seed bed	22.78b	15.85b	131.97b	22.18a	6.12b	36,776 a	49,320 b	12,544b
$LSD_{0.05}$	0.55	0.23	3.99	0.60	0.26	0.67	0.61	0.23
Level of sig.	**	**	**	NS	**	NS	**	**
CV%	3.15	5.70	4.38	3.51	5.55	3.47	5.21	5.67

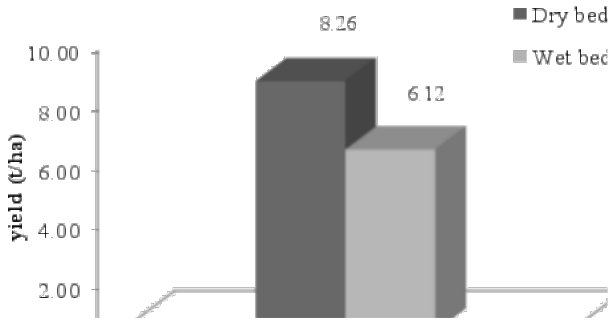
** = Significance at 1% level of probability











Differences in number of effective tillers per hills: There was a significant difference in number of effective tillers per hills (Table 1). Fig. 2 expressed that number of effective tillers per hill was 32.23 percent higher in the plot transplanted with the seedlings of dry bed (20.96) compared to wet bed (15.85) which leads to the higher yields with the seedlings of dry bed.

Differences in number of grains per panicle: Number of grains per panicle differed significantly in the study (Table 1). Fig. 3 showed that number of grains per panicle was 17.36 percent higher in the plot transplanted with the seedlings of dry bed (154.88) compared to wet bed (131.97). Number of grains per panicle is one of the yield attributes of rice, which leads to the higher yields with the seedlings of dry bed.

Differences in weight 1000 of grains: Table 1 and Fig. 4 revealed that there was no significant difference regarding to1000 grains weight. In case of dry bed the value was 22.85 and wet bed 22.18.

Differences in yield: Fig. 5 expressed that there was a significant difference in the yield. Seedlings of dry seed bed produced 8.26 ton ha^{-1} rice where the value for wet seedlings was 6.12 ton ha^{-1}. From the figure it can be said that, Seedlings of dry seed bed produced 2.14 tons higher yield and overall there was 34.96 percent yield increment compared to seedlings of wet seed bed.

Economic Analysis for Rice Production

Cost for growing seedlings: Three decimals of land (for both case) was used to grow seedlings. Table 2 presented that, 3,457 BDT was used to grow seedlings in dry seed bed whereas 4,830 BDT was used in wet seed bed. It can be said that, 1,373 might be saved BDT through growing seedlings in dry bed. Cost for growing seedlings in dry bed was 39.71% less compared to wet bed. Table 3 divulged that, one acre land requires 36,382 BDT to transplant using the seedlings of dry bed where as it requires 36,776 BDT to transplant with the seedlings of wet bed. Seedling of dry bed demands 394 BDT (1.08 %) less compared to wet bed.

Table 2. Costs regarding to seed bed preparation (land: 3 decimals)

Sl. No.	Items	Cost (BDT)	
		Dry bed	Wet bed
1.	Seed	10 kg @36 = 360	25kg @36 = 900
2.	Labor	3 @300 = 900	5 @300 = 1500
3.	Fertilizer:		
	1) Urea	1.5 kg @20 = 30	1.5 kg @20 = 30
	2) TSP	2 kg @22= 44	0
	3) MOP	1.5 kg @15 = 23	0
	3) Cow dung	30 kg @10 = 300	0
4.	Polythene sheet (for 2 years)	5 kg @120 = 600	0
5.	Irrigation	0	600
6.	Seedlings uprooting (Labor)	2 @300 = 600	6 @300 = 1800
7.	Care (Labor)	2 @300 = 600	0
	Total cost (BDT)	3,457	4,830

Table 3. Total cost of production and net profit

SL No.	Items	Costs (BDT)	
		Transplanted with the seedlings of dry bed	Transplanted with the seedlings of wet bed
1.	Seed bed preparation, seedlings growing and uprooting (Table 2)	3,457	4,830
2.	Land preparation	3,000	3,000
3.	Fertilizers 1) Urea	120 kg = 2,400	100 kg= 2,000
	2) TSP	75 kg = 1,650	75 kg= 1,650
	3) MOP	125 kg = 1,875	60 kg= 900
	4) Gypsum	50 kg = 500	50 kg= 500
	5) Zinc Sulphate	4 kg = 600	4 kg= 600
4.	Transplanting	2,000	2,000
5.	Irrigation	10,500	10,500
6.	Intercultural operation	3,600	3,600
7.	Pesticides	500	500
8.	Harvesting 12 labors @ 300/-	3,600	3,600
9.	Threshing and winnowing 6 labors @ 300/-	1,800	1,800
10.	Miscellaneous	900	900
Total costs (BDT)		36,382	36,776
Outcome		3.34 ton/acre	2.74 ton/acre
Yield and price (18000 BDT per ton)		= 60,120	= 49,320
Net Profit= Total outcome (BDT) – Total cost (BDT)		23,738	12,544

Total Outcome: One acre of land transplanted with the seedlings of dry seed bed and wet seedbed produced 3.34 and 2.74 tons paddy respectively. Adjusting the market price 18000 BDT per ton products, 3.34 tons returned 60,120 BDT and 2.74 tons returned 49,320 BDT.

Net profit: Net profit was calculated as follows: Net Profit = {Total outcome (BDT) – Total cost (BDT)}.This experiment revealed that, one acre of land transplanted with the seedlings of wet bed earned net profit 12,544 BDT and the same amount of land transplanted with the seedlings of dry seedbed gave net profit 23,738 BDT which is 89.23% higher compared to the first one.

From the results of this experiment it might be concluded that, rice seedlings could be saved from the cold injury by growing them in dry bed covered with polythene sheets not only that yield might be increased by 22% with the same cost of production compared to growing of seedlings in the wet bed. Seedling grown in dry bed yielded the higher values for all the parameter studied in this experiment than the seedlings grown the wet bed as well as reducing 50% seed requirement. If this technique could be extended to the whole country, huge loss regarding to seeds and seedlings caused by cold injury and over use of seed in *boro* season, could be saved. Consequently, this technique for growing of seedlings in *boro* season might play a vital role to ensure the food security in Bangladesh.

References

Basak, J.K. 2009. Climate change impacts on rice production in Bangladesh: Results from a model. Annual scientific research report (Unnayan Onneshan-The Innovators) 2: 10-12

BBS (Bangladesh Bureau of Statistics). 2012. Statistical Year Book of Bangladesh Bureau of Statistics, Stat. Div., Minis. Plan., Govt. People's Repub. Bangladesh, Dhaka.127 p

Bodapati, N., Gunawardena, T. and Fukai, S. 2005. Increasing cold tolerance in rice by selecting for high polyamine and gibberellic acid content. Rural industries research and development corporation, Australia. 05(090): 45-57

FAO (Food and Agriculture Organization). 2008. Agriculture and Consumer Protection Department. Rome, Italy. (Accessed November 2008).

Humphreys, L., Sides, R. and Fattore A .1996. Rice establishment. Farmers' News Letter Large Area 147, 30-31.

Heenan, D.P. 1984. Low-temperature induced floret sterility in the rice cultivars Calrose and Inga as influenced by nitrogen supply. Australian Journal of Experimental Agriculture 24, 255-259.

Lewin L, and Mccaffery, D. 1985. Rice seedling growth is influenced by water depth and temperature. Farmer's Newsletter Large Area 127.

Rahman, M.M. and Masood, M. 2012. Aerobic system: A potential water saving *boro* rice production technology. Adaptation of aerobic system for *boro* rice cultivation in farmer's field for saving irrigation water and attaining food security-Project. P: 1-2

Smillie, R., Hetherington, S.E., Hie, J. and Nott, R. 1988. Photo inhibition at Chilling temperatures. In 'Ecology of photosynthesis in sun and shade'. (Eds JR Evans, SV Caemmerer and WWA III) pp. 207-222.

Takeoka Y, Al-Mamun A., and Kaufman, B. 1992. Reproductive adaptations of rice to environmental stress. *Philipp j. Crop Sci.,* 19 (3):187-194

Qiujie, D., Benito, S. and Romeo, M. 1990. Amelioration of cold injury in Rice (*Oryza sativa* L.):Improving root oxidizing activity by plant growth regulators. *Philipp j. Crop Sci.,* 15(1):49-54.