EFFECT OF STORAGE CONDITONS AND DURATIONS OF UPROOTED SEEDLINGS ON THE PERFORMANCE OF AROMATIC RICE

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Approved by:

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CERTIFICATE

This is to certify that the thesis entitled **"EFFECT OF STORAGE CONDITIONS AND DURATIONS OF UPROOTED SEEDLINGS ON THE PERFORMANCE OF AROMATIC RICE"** submitted to the faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **AGRONOMY**, embodies the result of a piece of bonafide research work carried out by **SYED MOHAMMAD RABIUL KARIM**, Registration No. **26193/00487** under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Dated: (Prof. Md. Dr. Jafar Ullah)

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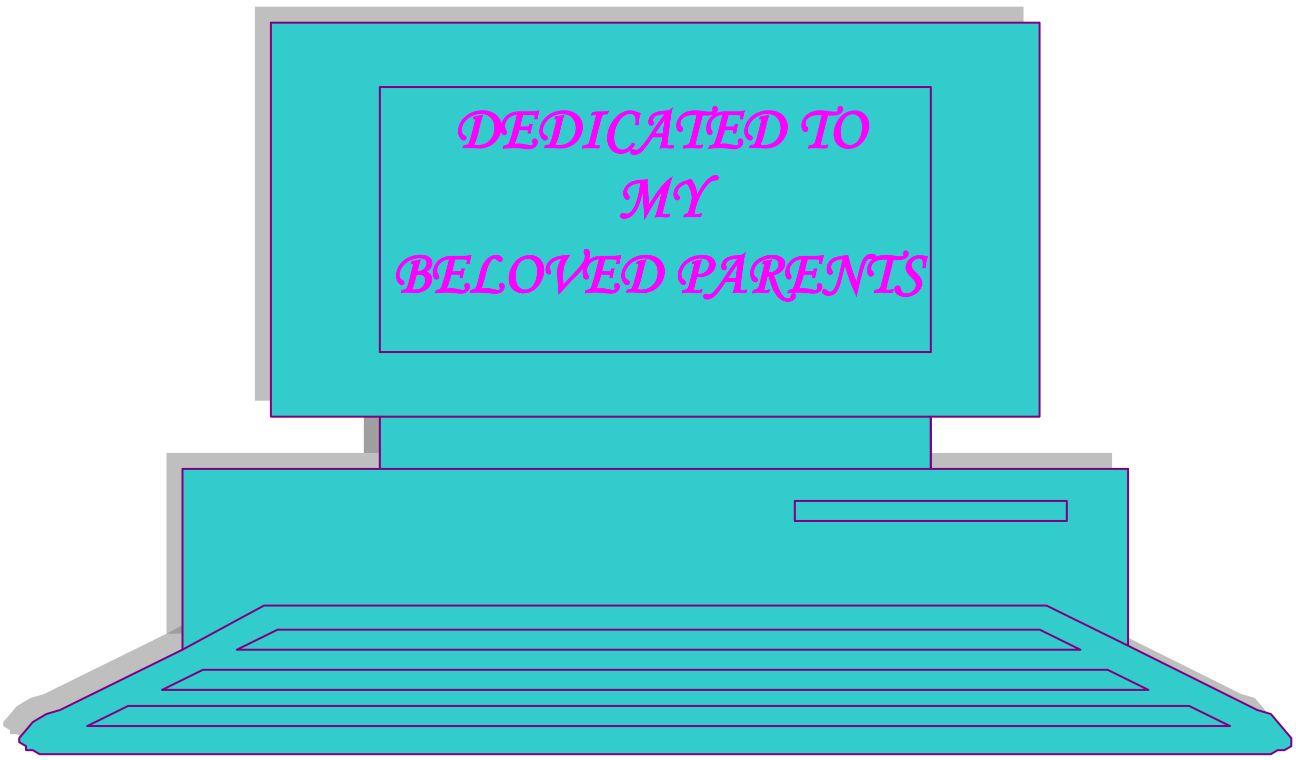
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Chapter I

Introduction

Chapter II
Review of literature

Chapter III

Materials and Methods

Chapter IV
Results and Discussion

Chapter v

Summary and conclusion

References

Appendices

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LIST OF CONTENTS

LIST OF CONTENTS (Contd.)

LIST OF CONTENTS (Contd.)

CHAPTER	TITLE		PAGE

LIST OF CONTENTS (Contd.)

CHAPTER	TITLE	PAGE

LIST OF CONTENTS (Contd.)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Contd.)

LIST OF APPENDICES

LIST OF ACRONYMS

AEZ	=	Agro-Ecological Zone
BAU	=	Bangladesh Agriculture University
BBS	=	Bangladesh Bureau of Statistics
BRRI	=	Bangladesh Rice Research Institute
^{0}C	=	Degree Centigrade
cm	=	Centimeter
CV%	=	Percentage of coefficient of variance
cv.	=	Cultivar (s)
DAT	=	Days after transplanting
et al.	=	and others *(et elli)*
Etc.	=	Etcetera
G	=	gram (s)
Kg	=	Kilogram (s)
Kg/ ha	=	Kilogram/hectare
LSD	=	Least Significant Difference
M	=	Meter
MP	=	Muriate of Potash
No.	=	Number
NS	=	Non significance
P^{H}	=	Hydrogen ion concentration.
RCBD	=	Randomized Complete Block Design
RH	=	Relative Humidity
SAU	=	Sher-e-Bangla Agricultural University
SRDI	=	Soil Resource Development Institute
TSP	=	Triple Super Phosphate
t ha^{-1}	=	Ton per hectare
Viz.	=	Namely
@	=	At the rate of
%	=	Percent

EFFECT OF STORAGE CONDITONS AND DURATIONS OF UPROOTED SEEDLINGS ON THE PERFORMANCE OF AROMATIC RICE

ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory, Sher-e-Bangla Agricultural University, Dhaka during the period from July, 2006 to December, 2006 with the objective to find out the effect of storage conditions and durations of uprooted seedlings on the performance of aromatic rice. The experiment was carried out in a Randomized Complete Block Design with three replications. Two storage conditions such as i) on the mud and ii) in the water with six storage durations viz. 0, 2, 4, 6, 8 and 10 days were included in the experiment. Results revealed that the storage conditions had significant effect on plant height, number of tillers hill^{-1}, total dry matter production, nmber of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, number of total grain panicle^{-1}, number of filled panicle^{-1}, number of unfilled grains panicle^{-1}, grain yield, straw yield and biological yield The best performance was exhibited by the seedlings which were stored on the mud. Storage durations also showed significant effect on plant height, number of tillers hill^{-1}, total dry matter production, number of total hills m^{2}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, number of total grain panicle^{-1}, number of filled grain panicle^{-1}, grain yield, straw yield and biological yield. The uprooted seedlings were found to be storable in mud up to 4 days and in water up to 2 days without any appreciable loss in grain yield.

CHAPTER I

INTRODUCTION

Rice (*oryza sativa L.*) belongs to cereal crops under Gramineae family. It is one of the major and most extensively cultivated cereals of the world including Bangladesh that feeds half of the total population. There are many rice-growing countries in the world that occupies about 146.5 million hectares (Anon, 2005). In many regions it is eaten with every meal and provides more calories than any other single food. Rice is a nutritious food, providing about 90 percent of calories from carbohydrates and as much as 13 percent of calories from protein (Anon, 2005). Rice contributes more than 70% of total production and 60-90% of daily calorie intake in China, India, Pakistan, Bangladesh and Nepal (Prasad *et al.*, 1999)

Bangladesh is a densely populated agricultural country where rice is the most extensively cultivated cereal crop. Increasing the cultivation of rice in this country is essential to meet the food demand of the teeming population. In Bangladesh, there is 8.65 million hectares of arable land of which 75% is devoted to rice cultivation (BBS, 2004). In Bangladesh three growing seasons of rice prevail in a year namely aus, aman and boro. Of the three, aman rice alone occupies about 52.46% of the total rice area contributing about 44% of the total production and the rest 47.54% of rice are occupied by aus and boro producing 56% of the rice crop (BBS, 2004).

Although, the climate and soil of Bangladesh is favourable for year round rice cultivation, unfortunately the average yield of rice in Bangladesh is around 2.36 t ha^{-1} which is less than the world average (2.90 t/ha) and frustratingly below the highest ranking country.

The rice yield in Bangladesh has significantly increased after the establishment of the Bangladesh Rice Research Institute which has released semi-dwarf high yielding rice varieties and improved modem production technology since 1960 (BRRI,1995). However, the full genetic potentiality may not be achieved due to various environmental and socioeconomic conditions.

Different varieties of rice have different characters. Rice grain is categorized into coarse, medium coarse and fine with different colour based on physical properties. Some of them have special appeal for their aroma. There are two type of transplant aman rice viz. coarse and fine rice and some of the fine rices are aromatic. The major aromatic varieties identified are Kalizira, Chinigura, Kataribhog, BR5, Bashful, BRRI dhan 34, BRRI dhan 37, BRRI dhan 38 (Bashmotitype), Khaskani, Badshabhog, Dudshagar, Tulshimala, Khirshabhog, Horibhog, Parbatjira, Khasha, Modhumadab, Tilkapur,Chinikanai, Khirkon and Shakhorkora.

Aromatic rice is high valued commodity in agricultural trade market of Bangladesh. It has high export potentials, great taste as well as better eating qualities and is used to prepare special dishes such as Polau, Khir, Firny, Paish, Chira, Khoi, Brainy, Jarda etc. Milled aromatic rice is used as a luxurious food in ceremonies like marriage day, Eid day etc. According to Bangladesh Rice Exporters Association (BREA) statistics (Anon, 2005), Bangladesh exported 700 metric tons of aromatic rice in 2001, 780 metric tons in 2002, 1000 metric tons in 2003, and 3300 metric tons in 2004. Export value of aromatic and fine rice stood at 200,000 US dollars in 2003-2004 fiscal years. So the production of aromatic rice in the country is economically profitable.

The Bangladesh agriculture is prone to numerous risks and hazards like drought, excessive rainfall, storm, flood and so on. Recently the magnitude and frequency of flood throughout the country have crossed the previous records. During the recent floods more than 50% of the total area of the country became inundated within the period of less than 48 hours of time.

Due to unexpected incessant rainfall or flash flood during the transplanted aman season, most of the cultivated lands, especially the low laying areas go under water causing severe damage to the rice seedlings in the nursery beds as well as in the freshly transplanted fields. As a result, an acute shortage of rice seedlings occurs very frequently when the flood water recedes. Under such situation, the rice seedlings may be saved by uprooting them from the nursery beds at the advent of floods and stored in a suitable place for some time so that those can be transplanted after recession of flood water. Sometimes it is seen that due to scarcity of good seeds or some other reasons farmers cannot produce rice seedlings up to their requirements. So, they had to purchase seedlings from the far away market places wasting a considerable period of time from uprooting to transplanting of rice seedlings in the field. Uprooted rice seedlings are found to be preserved under various conditions such as in water, in the sun, in mud and under shade and so on. Sometimes, seedlings are transported keeping them in bundles inside the gunny bags. It is expected that the viability and strength of uprooted rice seedlings may be adversely affected in different manners under variable condition of preservation.

It is not yet clearly known how and how long the uprooted rice seedlings may be preserved without deteriorating their qualities and vigour

Objectives:

Under the above mentioned circumstances, the present study was conducted with the following objectives:

(a) to determine the effect of various storage conditions of uprooted seedlings on the performance of aromatic rice.

(b) to evaluate the effect of storage durations of the uprooted seedlings on the performance of aromatic rice.

CHAPTER II
REVIEW OF LITERATURE

In Bangladesh, T. aman rice grown in the area where the depth of water does not usually exceed 0.5 m. Very often the transplanting schedule of transplant aman rice can not be maintained in this country particularly in the low lying areas due to tidal inundation or flash flood caused by incessant rainfall. On the contrary, the scarcity of rice seedlings of transplant aman after recession of flood water was also a common phenomenon for the last few years. Proper attention had not been given on the storage duration as well as on storage conditions of uprooted rice seedlings which were usually stored for certain period before transplanting due to unfavorable conditions. Experimental evidences on these aspects are so rare both here and abroad. However, the available literature related to the storage conditions and storage durations of uprooted rice seedlings have been presented below.

2.1 Effect of storage conditions

Kaykobad *et al.* (2003) conducted an experiment to evaluate the effect of storage conditions and storage durations of uprooted seedlings with five storage conditions such as in mud, in water, in shade, in shade with frequent watering and four storage durations (0, 24, 48 and 72 hours storage of seedlings). Best performance was exhibited by seedlings stored in mud followed by those stored in water, in shade with time to time watering, in shade and in sun and the difference was generally significant. Some decrease in the value of subsequent crop characters occurred with an increase in the period of storage from 0 to72 hours. However, the differences between treatments were not significant.

BRRI (2000a) conducted an experiment to evaluate the performance of four varieties viz. Basmati 406(4508), Kataribhog, BRRI dhan34 and Basmati during *aman* season and reported that plant height differed significantly among the varieties. Result revealed that the tallest plant was recorded from Basmati 406 (126cm) and the shortest one from Kataribhog (115cm).

From the result of an experiment, BRRI (1998) reported that highest plant height was obtained from Kataribhog (153cm) followed by Khaskani (143cm), BR4384-2B-2-2-4 (130cm), BR4384-2B-2-2-6 (125cm) and BR4384-2B-2-2-2HR3 (125cm)

Alam *et al.* (1996) conducted an experiment to evaluate the performance of different rice varieties. Among the fine rice varieties, Kalijira produced the tallest plant which was followed by Pajam.

BRRI (1991a) reported that during the storage, the dry matter content of 40 days old seedlings was much higher than those of 20 days old ones at all the storage periods from 0 to 28 days under both water and mud storage conditions. The dry matter content of mud stored seedlings was much higher than that of water stored ones at all storage periods, irrespective of seedlings age. A decreasing trend in the dry matter content of seedling was noticed with the increase of storage duration from 0 to 28 days.

BRRI (1991b) studied the effect of storage periods and storage conditions of uprooted BR11 rice seedlings and found about 85 percent seedlings survived and produced 3.0 $t ha^{-1}$ grain yields when those were stored for 4 weeks in mud. On the other hand, the survival percent of seedlings stored for more than 4 weeks in water was very low. Survival percent was found to be better in older seedlings stored in water than that of younger ones.

BRRI (1991c) revealed that a significant decrease in grain yield was observed due to storage of uprooted rice seedlings in mud than those transplanted immediately after uprooting irrespective of seedling age, although the grain yield was not less than about 3.0 t ha^{-1}. But in case of seedlings stored in water, the grain yield was severely affected in negative direction. However, more than 3.0 tha^{-1} of grain yield was obtained from 40 days old seedlings stored in water for 7 days, but the 20 day old seedlings stored for the same period in water produced much lower grain yield of only 1.4 tha^{-1}.

Gomosta *et al.* (1990) evaluated the performance of uprooted rice seedlings which were stored in water as well as in mud for a number of days. They observed that 20 and 40 day old seedlings of BR11 rice, transplanted after 1 to 4 weeks of storage in mud, showed 85% survivability irrespective of age of seedlings. The survivability percentage decreased with the increase in storage duration in case of water storage. In some cases the grain yield became even nil when the seedlings were stored in water for 3 to 4 weeks. On the other hand, it varied from 2.8 to 3.5 t ha^{-1} in case of mud storage of seedlings. They concluded that to obtain reasonable grain yield, uprooted seedlings of transplant aman rice should be stored in mud up to 4 weeks irrespective of seedling age ranging from 20 to 40 days.

BRRI (1985) studied the mortality of uprooted rice seedlings of BR4 imposing different storage conditions, either keeping erect in mud or packed in gunny bags for 3, 6, 9 and 12 days. Higher mortality percentage of uprooted seedlings was found when stored in gunny bags for more than 6 days and 100 percent mortality was observed when seedlings were stored for 12 days. However, no substantial decrease in mortality was seen in case of seedlings stored in mud even 12 days. The grain yield also showed the similar trend. Seedlings stored for more than 6 days in gunny bags also gave significantly lower grain yield, while no such reduction in yield was found in case of seedlings stored in mud up to 12 days.

2.2 Effect of storage durations

Akber (2004) reported that total tiller $hill^{-1}$ was significantly influenced by seedling age in all growth stage. From the result of his experiment, he reported that younger plant produced the highest number of total tillers $hill^{-1}$ up to 45 DAT (Days after transplanting) and then it was gradually decreased. At 45 DAT, 15 days old seedling produced the highest number of total tillers $hill^{-1}$ (34.93) whereas the lowest (28.56) was given by 25 days old seedlings

Kewat (2002) conducted an investigation during the rainy seasons of 1998 and 1999 at Jabalpur, Madhya Pradesh, India to evaluate the effect of divergent plant spacings and seedling age on the yield and economics of 'Pro-Agro 6201' hybrid rice (*Oryza sativa*). Transplanting of 21 and 28 day old seedlings recorded significantly higher grain and straw yields, net monetary returns and benefit: cost ratio than transplanting 14-day-old seedlings.

A field experiment was conducted by Kumar *et al.* (2002) during kharif 1998 and 1999 in New Delhi, India, to determine the proper age of seedlings and appropriate plant density of a scented (Pusa RH-10) and non-scented (Pusa RH-6) hybrid rice. The treatments comprised 3 ages of seedlings (20, 25 and 30 days old) and 3 plant densities (25, 33 and 50 plants/m^2). Transplanting of 20 days old seedlings exhibited higher growth and yield parameters and registered 11.6% higher grain yield over 30 days old seedlings. Plant density of 25 plants/ m^2 appeared more appropriate and yielded 7.6 and 17.5% higher grain yield over 33 and 50 plants m^{-2} respectively.

Hossain (2001) found that the highest number of effective tillers hill^{-1} (11.31 out of 12.29 total tillers hill^{-1}) and number of non bearing tillers hill^{-1} was lowest (0.98 out of 12.29 total tillers hill^{-1}) from 15 day old seedling.

An experiment was conducted by Molla (2001) during 1998 and 1999 wet season in West Bengal, India to examine the performance of hybrids rice and high-yielding cultivars (HYV) with different seedling ages and seedling number per hill. The treatments consisted of 2 hybrid rice (Pro-Agro 6201 and CNRH 3) and one HYV (IET4786), 2 seedling ages (21- and 28-day-old) and 2 levels of seedling number per hill (1 and 2 seedlings per hill for hybrid rice and 3 and 6 seedlings per hill for HYV). Results revealed that 28 days old seedlings produced more tiller, panicles/m^2, and grain yield than 21 days old seedlings. Seedlings per hill significantly influenced the number of tillers, mature panicles/m^2 and rice yield. Two seedlings per hill had significantly higher yield than one seedling, including other parameters, in hybrids. For HYV, no significant response was obtained by increasing the number of seedlings from 3 to 6.

A field experiment was carried out by Pattar *et al.* (2001) in Karnataka, India, during the kharif season of 1998 and 1999 to study the effect of planting date and seedling age on rice (cv. Sonamasuri) yield. Seedlings of ages 25, 35 and 45 days were planted on the first and second fortnight of August and the first fortnight of September. Planting on the first fortnight of August had higher yield than those planted on later dates. Planting of 35 or 45 days old seedlings produced significantly higher yields, grain weight and number of filled grains per panicle compared to 25-day-old seedlings. When transplanting was delayed to the second fortnight of August, the performance of both 35 and 45 days old seedlings was greater than that of 25-day-old seedlings. In general, there was a drastic reduction in yield when planting was done in the first fortnight of September.

Razzaque *et al.* (2000) reported that seedling age had significant effect on plant height. The 30 days old seedlings produced the tallest plants followed by the seedlings of 45 and 60 days old seedlings which produced the smallest plants

Hundal *et al.*(1999) conducted a research work to observe the effects of various dates of transplanting on rice yield. They reported that early transplanted rice performed better when the seedling age was reduced from 40 to 30 days. Younger seedlings (20 day old) proved better than older (40 days) ones when other variables were kept constant.

Sanbagavalli *et al.* (1999) observed that 30 days old seedlings of rice gave higher yield than 20 or 40 days old seedlings of the same varieties.

Shi *et al.* (1999) carried out an experiment with rice and tested 25, 30, 35, 40 and 45 day old seedlings in terms of grain yield. They found that yield was negatively correlated with seedling age at transplanting. Mean yields were 6.7, 6.5, 5.9, 4.7 and 4.5 t ha^{-1} with transplanting 25, 30, 35, 40 and 45 day old seedlings respectively. Yield with 25 or 30 day old seedlings were significantly higher than that with 40 or 45 day old seedlings.

From the field study at Kumarganj, Uttar Pradesh, Singh and Singh (1999) reported that irrigated rice cv. Sarjoo-52 when transplanted using 3 seedling ages viz. 25, 35 and 45 day old gave yield of 4.92, 4.64 and 4.22 t ha^{-1} respectively.

Haque (1997) observed that the uprooted seedlings of BR11 rice can be stored in water even up to 8 days in case of emergency and in the sun or shade for 0 to 2 days without any appreciable loss in grain yield.

BRRI (1996) conducted a field trial of preserving uprooted seedlings of BR23 and Sadamata rice varieties before transplanting in gunny, floating in water and on mud for 0, 5 and 10 days. The institute observed that seedlings of both the varieties preserved for 5 days gave significantly higher grain yield than that those stored for 10 days in each of the storage conditions. The grain yield obtained from BR23 rice seedlings stored for 5 days under various conditions was identical to that of fresh seedlings which were not stored before transplanting. But the yield from the seedlings of the same storage condition for 10 days was significantly lower than that of fresh seedlings. The variety Sadamata also showed similar performance as did the variety BR23.

Villela and Junir (1996) used 21, 28, 35, 42, 49 and 56 days old seedlings and observed that 35 days older seedlings caused reduction in grain yield as compared to younger ones. The best yield was achieved with the use of 28 day old seedlings.

Islam (1995) carried out an experiment to determine the effect of storage period of uprooted boro rice seedlings up to 72 hours on the grain yield. He reported that 0 and 24 hours storage periods produced higher grain yield of 5.6 and 5.4 tha^{-1} respectively, each of which was significantly higher than that (5.2 tha^{-1}) obtained from the seedlings stored for 48 and 72 hours. There was no significant variation between the yields from 0 and 24 hours and between 48 and 72 hours of seedling storage. The straw yield also showed similar response due to different storage periods.

Khatun (1995) observed that the tiller production was higher with 30 days old seedlings in transplant aman season than others.

Das and Mukherjee (1992) in a field experiment did not find any significant variation in grain and straw yield of IR36 rice due to storing of uprooted seedlings from 0 to 6 days, although a numerical decrease in grain yield was observed from seedlings transplanted 6 days after uprooting.

Roy *et al.* (1992) reported that the number of grains panicle^{-1} slightly decreased with the increased of seedling age in rice cv. BR14 and IR50. The highest number of grain panicle^{-1} was obtained from 28 day old seedlings in case of 60 old seedlings.

Roy and Sattar (1992) observed that the tillering rate was influenced by seedling age. The absolute tillering rate was more in younger seedlings. When the seedling age was increased, the tillering rate gradually decreased. They also stated that within a variety total number of tillers hill^{-1} decreased when the seedling age was increased.

Kamdi *et al.* (1991) reported evaluating the results of an experiment with 30, 35 and 60 days old seedlings that 30 days old seedlings significantly increased 1000-grains weight.

Mohaputra and Kar (1991) also reported that 1000-grains weight was decreased when aged seedlings were transplanted.

Kumar and Gupta (1990) conducted an experiment on IR36 rice (*Oryza sativa L.*) with three uprooting times. Twenty days old seedlings were uprooted 0, 3, and 6 days before transplanting. They found that the seedlings uprooting time did not affect grain and straw yields of rice significantly, though declining trend in grain yield was observed with seedlings transplanted 6 days after uprooting. Seedlings transplanted immediately or 3 or 6 days after uprooting produced similar grain and straw yields.

Rashid *et al.* (1990) reported that 40 day old seedlings gave higher straw yields than 20 and 60 day old seedlings. Whereas Das and Mukherjee (1989) reported that seedling age had no effect on straw yield.

Ashraf and Mahmood (1989) conducted an experiment where two varieties of Basmati rice were planted with 30, 45 and 60 day old seedlings. They reported that yield and yield attributes declined significantly with the increase of seedling age. The yield decline was partly attributable to fewer productive tillers hill^{-1} and fewer spikelets panicle^{-1}. They also observed that 30 day old seedlings gave the higher yield followed by 45 and 60 day old seedlings.

Larrea and sanchez (1989) conducted an experiment where 30, 45 and 60 days old seedlings of two varieties of Basmati rice were planted. They reported that yield and yield attributes declined significantly with increased seedling age. They also observed that 30 day old seedlings gave higher yield followed by 45 and 60 day old seedlings.

Raju *et al.* (1989) conducted an experiment with 30, 45 and 60 days old seedlings which gave the yield of 4.85, 4.40 and 1.19 t/ha respectively. Number of grains panicle^{-1}and 1000-grains weight was also the highest with 30 days old seedlings.

Hossain and Haque (1988) found in a research work that the number of the tillers hill^{-1} increased more with 30 days old seedlings than 60 days old seedlings.

Koshta *et al.* (1987) conducted an experiment with rice cultivars using three ages of seedlings as treatments. They found that 20 day old seedlings produced more tillers hill^{-1} as compared to those of 28 and 36 days old.

Panikar *et al.* (1981) observed that the straw yield significantly increased with 21 day old seedling than that of 28 or 35 day old seedlings.

Islam and Ahmed (1981) found that 30 day old seedlings gave significantly the highest grain yield than those of 20 and 40 day old seedlings.

Reddy and Narayana (1981) observed that number of total spikelets panicle^{-1} decreased significantly with each 10 day increase in seedling age. Spikelet sterility was 14.0, 9.7 and 8.1 % in 20, 30 and 40 day old seedlings, respectively.

Singh and Tarat (1978) reported that the highest number of tillers was observed from medium and long duration varieties with 29 day old seedlings. The short duration variety produced less number of tillers with the increase of seedling age.

Rao *et al.* (1976) showed that the straw yield was the highest with younger seedlings of 25 days old than older seedlings of 35 and 45 days.

Enyi (1963) observed that the maximum number of tillers was produced by 30 day old seedlings than that of older seedlings. The slow recovery of older seedlings resulted in the lower number of tillers as compared to younger ones.

Rao (1961) conducted an experiment and found that transplanting of 30 day old seedling proved to produce higher yield. Alim *et al.* (1962) also reported that the optimum seedling age was 30-40 days for getting higher production in *aman* seas

From the presented review, it is clear that the storage conditions and durations of uprooted rice seedlings played vital role on different characters and grain yield of rice.

CHAPTER III

MATERIALS AND METHODS

Details of different materials used and methodologies followed in the experiment are presented in this chapter.

3.1 Description of the experimental site

3.1.1 Location

The experiment was conducted at the Agronomy Field Laboratory, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka, under the agro-ecological zone of Modhupur Tract (AEZ-28) during the period from July 12, 2006 to December 04, 2006 to study the effect of storage conditions and durations of uprooted seedlings on the performance of aromatic transplant aman cv. BRRI dhan 38. For better understanding about the experiment site location is shown in the Map of AEZ of Bangladesh in appendix I.

3.1.2 Soil

The farm belonged to the General soil type, Shallow Red Brown Terrace Soils under Tejgaon Series. The land was above flood level and its fertility level was medium. The pH value of the soil was 5.8. The physiochemical properties of the soil are presented in appendix II

3.1.3 Climate

The experimental area was under the subtropical climate and was characterized by high temperature, high humidity and heavy precipitation with occasional gusty winds during the Kharif season (April-September). But it was associated with scanty rainfall along with moderately low temperature during the Rabi season (October-March). The detailed meteorological data in respect of air temperature, relative humidity, rainfall and sunshine hour during the study period at experimental site are presented in Appendix III.

3.2 Experimental details

3.2.1 Treatments

Two factors were included in the experiment namely, storage conditions and storage durations. The treatments were designated as follows:

Factor A. Storage conditions of the uprooted seedling: 2

1. On the mud (C_1) - In this method, a hand full seedlings were tied in bundles and were placed upright on the mud conforming a close contact of roots with soil.

2. In the water (C_2) - In this method, the bundles of seedlings were placed in water so that the seedlings were floated and roots did not come in close contact with soil.

Factor B. Storage durations of the uprooted seedling: 6

1. 0 days after uprooting (Do)
2. 2 days after uprooting (D_2)
3. 4 days after uprooting (D_4)
4. 6 days after uprooting (D_6)
5. 8 days after uprooting (D_8)
6. 10 days after uprooting (D_{10})

3.2.2 Experimental design and layout

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each block was divided into twelve unit plots. Total number of unit plots was 36. The net size of unit plot was 6 m^2 (3.0 m x 2.0 m). The distance between plot to plot was 1.0 m and block to block was 1.5 m. The treatments were allocated randomly. The layout of experiment has been shown in Appendix IV.

3.3 Varietal description

The variety was released by Bangladesh Rice Research Institute (BRRI) in 1998. It has been recommended for *aman* season. It is a photosensitive variety. It was developed from the cross between Basmati and BR 5 (Dulabhog). The genetic line number of the variety was BR4384-2B-2-2-4. Plants of this variety were stronger than those of Basmati. The panicle looked attractive due to densely arranged spikelets. Spikelets bore long sharp awn at the end. The grain and awn of this variety were golden white. It was a scented rice and its export quality is good. Its grain was elongated and fine. It was moderately resistant to leaf blight diseases (BRRI, 2000b)

3.4 Conduction of the experiment

3.4.1 Seed collection

Certified seeds of aromatic rice variety BRRI dhan 38 were collected from Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur.

3.4.2 Seed sprouting

Healthy seeds were selected by specific gravity method and immersed in water in a bucket for 24 hours. Then the seeds were taken out of water and spread thickly under gunny bags. The seeds started sprouting after 48 hours and were sown after 72 hours.

3.4.3 Preparation of nursery bed and seed sowing

The land for raising seedlings was prepared by a country plough. It was then cleaned and leveled with ladder. Sprouted seed were sown in the nursery bed on July 11, 2006. Irrigation was given in the seedbed as and when necessary and proper care was also taken so that there was no infestation of pests and damage by birds.

3.4.4 Main field preparation

The experimental field was opened by a tractor driven rotavator 15 days before transplanting. It was then ploughed well to make the soil nearly ready for transplanting. Weeds and stubble were removed and the field was leveled by laddering. The experimental field was then divided into unit plots. The unit plots were spaded one day before transplanting for incorporating the fertilizers which were applied as basal. The individual plots were finally prepared before transplantation according to the experimental design adopted.

3.4.5 Fertilizer application

The field was fertilized with 220, 80, 120, 55 and 10 kg ha^{-1} urea, TSP, MP, gypsum and zinc sulphate respectively as per recommendation of Bangladesh Rice Research Institute (BRRI, 2000b). The whole amounts of TSP, MP, gypsum and zinc sulphate were applied at final land preparation. Urea was top dressed in three equal splits on 10, 30 and 55 days after transplanting (DAT).

3.4.6 Seedlings uprooting

The nursery bed was made wet by the application of water in the evening of each previous day of uprooting the seedlings. Without causing any mechanical injury to the roots, the seedlings were uprooted carefully from the nursery bed on 2, 4, 6, 8, 10 and 12

August, 2006 and stored on soft mud and in water for 10, 8, 6, 4, 2 and 0 days respectively as per the design of experiment before they were transplanted.

3.4.7 Transplanting of seedlings

The uprooted seedlings of 10, 8, 6, 4, 2 and 0 days storage durations were transplanted on the well puddle experimental plot on August 12, 2006 in main field at the rate of 3 seedlings hill^{-1}. Line to line distance was 25 cm and hill to hill distance was 15 cm.

3.4.8 Intercultural operations

The following intercultural operations were done for ensuring the normal growth of the crop.

3.4.8.1 Weeding

The experimental plots were weeded three times at 15, 30 and 45 DAT respectively by hand pulling to keep the weed competition at minimum level. Shama (*Echinochloa crusgalli*) was the prominent weeds found in the experimental plots.

3.4.8.2 Irrigation and drainage

Experimental plot was given flood irrigation to maintain a constant level of standing water up to 6 cm at the early stage to enhance tillering and 10-12 cm in later stage to discourage late tillering. A total of seven irrigation was needed throughout the growing season. The field was finally drained out before 15 days of harvest to enhance maturity.

3.4.8.3 Plant protection measures

The plots were infested by rice hispa and rice stem borer (*Sesamia inferens*) which was successfully controlled by applying Diazinon 10 G at the rate of 16.8 kg ha^{-1}. It was infested by stem rot disease caused by *sclerotium rolfs,* a soil born fungus that was controlled by applying Vevestin.

3.4.8.4 Harvesting and processing

The date of harvesting was confirmed when 90% of the grains attained maturity. The crop was harvested at 140 days after transplanting. The harvested crop of the individual plot was separately bundled, properly tagged and brought to the threshing floor. The crop was threshed by hand. Grains were cleaned and sun dried to a moisture content of 14%. Straws were also sun dried properly. Finally, the grain and straw yield per plot were recorded and converted into t/ha.

3.5 Data collection

Data had been recorded for measuring growth parameters at different growth stages (45, 75 and at harvest). For this purpose, five hills (excluding border ones) from each plot was selected randomly and tagged with bamboo sticks just after transplanting for measuring plant height (cm), total dry matter (g/plant) and number of total tillers per hill.

i. Plant height (cm)

The height was taken from the base of plants to the tip of the longest leaf or panicle which one was seemed to be on the top and was expressed in cm.

ii. Total dry matter

One represented hill per plot was carefully uprooted for dry matter at maximum tillering, flowering and harvest stage. The represented hills were packed separately in labeled brown paper bag and were oven dried for 24 hours at 85±5° C. Dry weight of the samples were then measured separately with a digital electrical balance.

iii. Total number of tillers per hill

Number of tillers was counted from the selected hills. Tillers that had at least three leaves were counted and recorded at the time of measuring plant height.

At harvest, five hills were selected at random from each unit plot and following data were recorded.

i. Number of effective tillers hill^{-1}

The panicle which had at least one grain was considered as effective tiller.

ii. Number of non-effective tillers hill^{-1}

The panicle which had no grain was considered as non-effective tiller.

iii. Panicle length

Panicle length was recorded from the basal node of the rachis to the apex of each panicle. Each observation was an average of 10 panicles.

iv. Total number of spikelets panicle^{-1}

The number of spikelets, both sterile and non-sterile, of each panicle gave the total number of spikelets panicle^{-1}.

v. Number of filled grains panicle^{-1}

Filled and partially filled spikelets were considered as filled grains and total number of grains present on each panicle was recorded

vi. Number of sterile spikelets panicle^{-1}

Unfilled spikelets were considered as sterile spikelets and such spikelets present on each panicle were counted.

vii. Weight of 1000-grains

One thousand clean dried grains were counted from the seed lot obtained from plot and weighed by using an electric balance at the stage when the sun dried grain retained 12% moisture. The grain weights were expressed in gram.

viii. Grain yield

The grain obtained from each unit plot was cleaned, sun dried and then weighed carefully. The dry weight of grains from the plants of sample hills was converted to the yield plot^{-1}. The grain yield was then eventually converted to t ha^{-1}. Grain moisture content was measured by using an electric oven.

ix. Straw yield

Straw yield of five sample hills of respective unit plot was dried in the sun and weighed to record the final straw yield plot^{-1}. It was then converted to t ha^{-1}.

x. Biological yield

Grain yields together with straw yield were regarded as biological yield. As such the biological yield was calculated with the following formule.

Biological yield = Grain yield + Straw yield.

xi. Harvest index

Harvest index is the ratio of economic yield to biological yield and was calculated with the formule.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

3.6 Statistical analysis

Data recorded for different parameter were compiled and tabulated in proper form for statistical analysis. Analysis of variance was done following randomized complete block design with the help of computer package MSTAT programme. Mean differences among the treatments were tested by Least Significance Difference (LSD) technique at 5% level (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

Present experiment was conducted with different storage conditions and storage durations of uprooted seedlings to study their effect on the performance of an aromatic transplant aman rice cv. BRRI dhan 38. The result regarding the effect of storage conditions, storage durations and their interaction on different growth and yield parameter are presented and discussed in this chapter.

4.1 Growth attributes at different sampling dates

Effect of different storage conditions and storage durations of uprooted seedlings on different vegetative growth parameters such as plant height, number of tillers hill^{-1} and total dry matter are discussed below.

4.1.1 Plant height

4.1.1.1 Effect of storage conditions

The plant height was affected significantly due to different storage conditions at 45, 75 days after transplanting (DAT) and also at harvest (Fig. 1).

The result revealed that at 45 DAT, the tallest plant height (89.22 cm) was obtained from the plants grown from the seedlings which were stored on mud before transplanting. On the other hand, the shortest plant height (84.87 cm) was obtained from those which were stored in water. Similar trend of plant height was observed at 75 DAT and at harvest. At harvest, the tallest plant height was (140.79 cm) obtained from the plants grown from the seedlings which were stored on mud while, the shortest plant height was (135.20 cm) shown by the plants grown from the seedlings which were stored in water. Plant height increased over water storage condition to mud storage condition were 5.12%, 4.17% and 4.07% at 45, 75 and at harvest respectively. BARRI (2000a and 1998) and Alam *et al*. (1996) also reported that fine rice showed tallest plant height in normal condition.

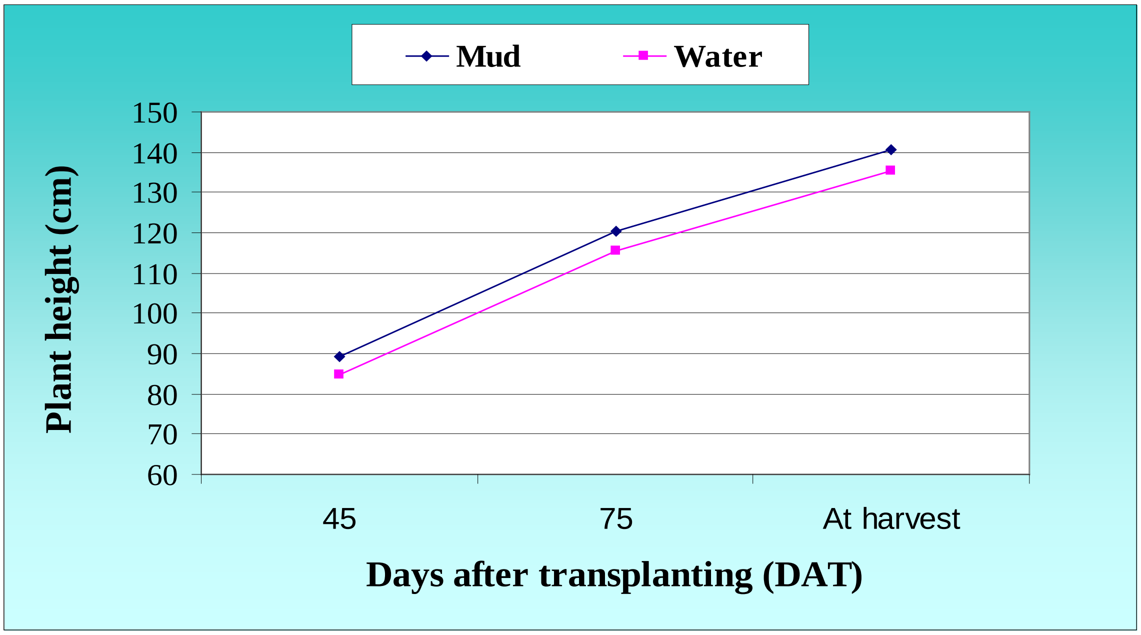

Fig. 1. Effect of storage conditions of uprooted seedlings on plant height of aromatic rice at different days after transplanting (LSD $_{0.05}$ = 1.56, 1.34 and 1.05 at 45, 75 DAT and at harvest respectively).

4.1.1.2 Effect of storage durations

The plant height was differed significantly due to storage durations (Fig. 2). The plant height exhibited a decreasing trend with the increase in the storage durations of uprooted seedlings from 0 to 10 days at 45, 75 DAT and at harvest. At all the growth stages, the tallest plant height was produced in the treatment 0 day of storage and the shortest plant height was found when seedlings were stored for 10 days. Probably, due to prolonged storage durations, the vigour of the seedlings decreased which intern decreased plant height. Similar findings were also reported by Razzaque *et al.* (2000). They reported that 30 days old seedlings produced the tallest plants followed by the seedlings of 45 and 60 days old seedlings which produced the smallest plants

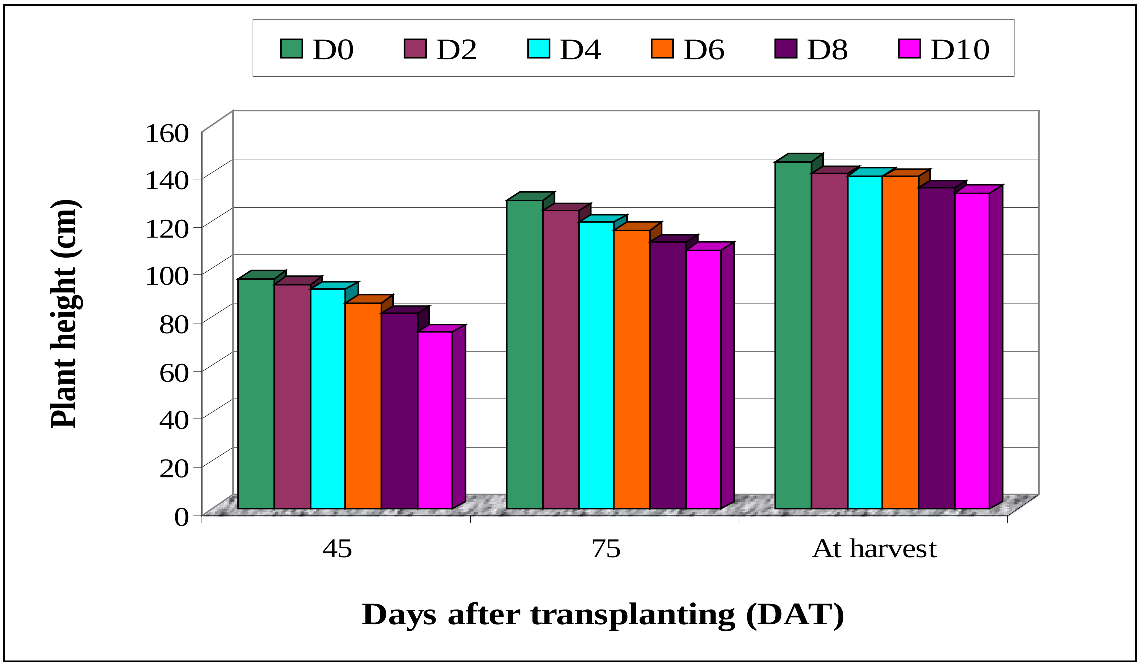

Fig. 2. Effect of storage durations of uprooted seedlings on plant height of aromatic rice at different days after transplanting (LSD $_{0.05}$ = 2.71, 2.33 and 1.81 at 45, 75 DAT and at harvest respectively).

4.1.1.3 Interaction effect of storage conditions and storage durations

The interaction effect of storage conditions and durations on plant height was significant at different stages of growth (Table 1). At 45 DAT, the tallest plant height (96.50 cm) was obtained from the seedlings stored on mud for 0 day which was significantly higher than other treatments but was statistically at par with those stored on mud up to 4 days and in water for 0 days respectively. The shortest plant height (73.10 cm) was found from the seedlings stored in water for 10 days which was statistically identical with that stored in water for 8 days and on mud for 10 days.

At 75 DAT, the tallest plant height (129.25 cm) was obtained from the seedling which was stored on mud for 0 day. This was significantly higher than other treatments while, the shortest plant height (102.00 cm) was found from the seedlings stored in water for 10 days

Table 1. Interaction effect of storage conditions and durations of uprooted seedlings on plant height of aromatic rice.

Treatments*		Plant height (cm)		
		Days after transplanting (DAT)		
		45	75	At harvest
Storage conditions × Storage Durations	C_1D_0	96.50	129.25	144.54
	C_1D_2	95.33	125.70	141.30
	C_1D_4	93.72	120.53	140.54
	C_1D_6	89.49	116.00	140.83
	C_1D8	86.76	113.77	138.37
	C_1D10	74.45	113.60	135.53
	C_2D_0	95.54	125.27	141.81
	C_2D_2	91.48	122.73	138.34
	C_2D_4	89.47	118.40	137.62
	C_2D_6	82.57	116.30	136.32
	C_2D_8	76.08	108.50	129.29
	C_2D_{10}	73.10	102.00	128.26
	LSD (0.05)	3.84	3.29	2.56

*C_1 = On the mud, C_2 = In the water, D = Storage durations of uprooted seedlings, Subscripted number after D denotes days of storing after uprooting.

At harvest, the tallest plant height (144.54 cm) was obtained from the seedlings stored on mud for 0 day which was significantly higher than other treatments. On the other hand, the shortest plant height (128.26 cm) was found from the seedlings stored in water for 10 days which was identical with that stored in water for 8 days.

4.1.2 Number of total tillers hill^{-1}

4.1.2.1 Effect of storage conditions

The number of total tiller hill^{-1} was significantly influenced by storage conditions at 45, 75 days after transplanting. But the effect was insignificancat at harvest (Fig. 3). At 45, 75 DAT and at harvest higher number of tillers hill^{-1} was produced by the seedlings stored in water compared to the seedlings stored on mud. In case of the both storage conditions, the highest number of tillers hill^{-1} was counted at 45 DAT and then it decreased. Higher tiller hill^{-1} might be due to the tillering characteristics of rice plant that showed higher number of tillers at the maximum vegetative stage. It declined thereafter due to competition among tillers and mother culm for assimilates. Such opinion was also given by Biswas (2001) who mentioned that tillering in rice increased up to 30 to 45 days after transplanting depending upon the age of seedlings and tillering ability of rice variety.

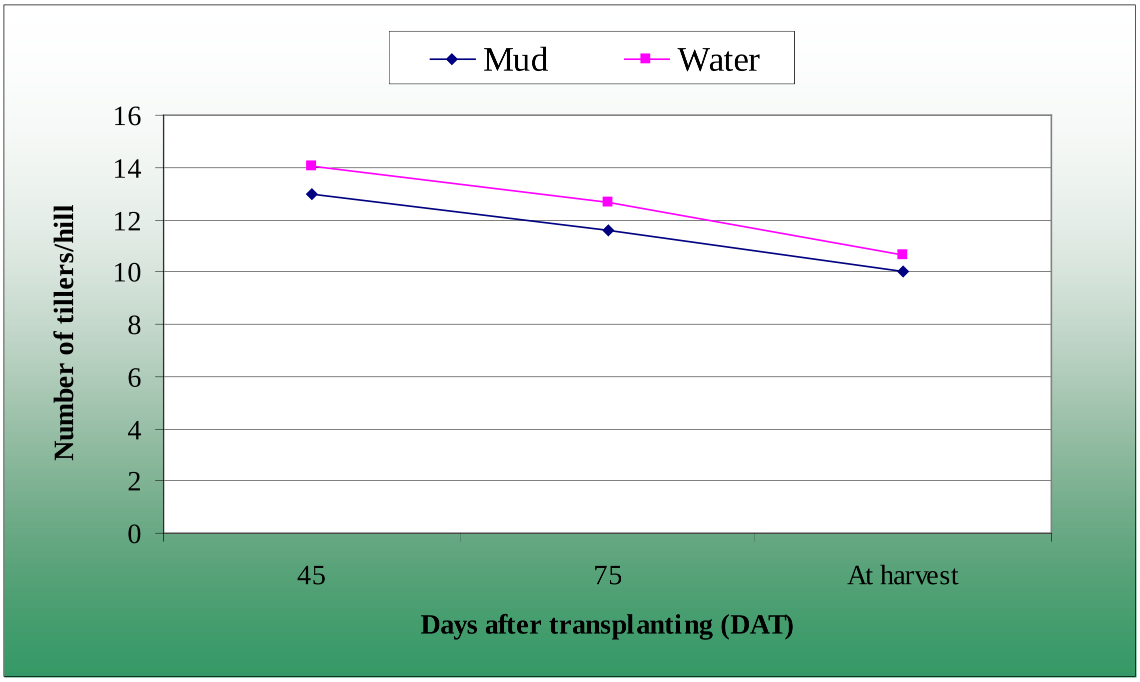

Fig.3. Effect of storage conditions of uprooted seedlings on the number of total tillers hill^{-1} of aromatic rice at different days after transplanting (LSD $_{0.05}$ = 2.71, 2.33 and 1.81 at 45, 75 DAT and at harvest respectively).

4.1.2.2 Effect of storage durations

Number of total tillers hill^{-1} was significantly influenced by storage durations at all stages of growth (Fig. 4). At 45 DAT, the maximum number of tillers hill^{-1} (15.12) was obtained from seedlings stored for 10 day and the minimum (11.85) by seedlings stored for 0 days which was statistically identical with the seedlings stored for 2 days.

But at 75 DAT, the maximum number of tillers hill^{-1} (13.86) was obtained from seedlings stored for 10 day which was statistically identical with the seedlings stored for 8 and 6 days. and the minimum (10.92) by seedlings stored for 2 days which was statistically identical with 0 days of storing.

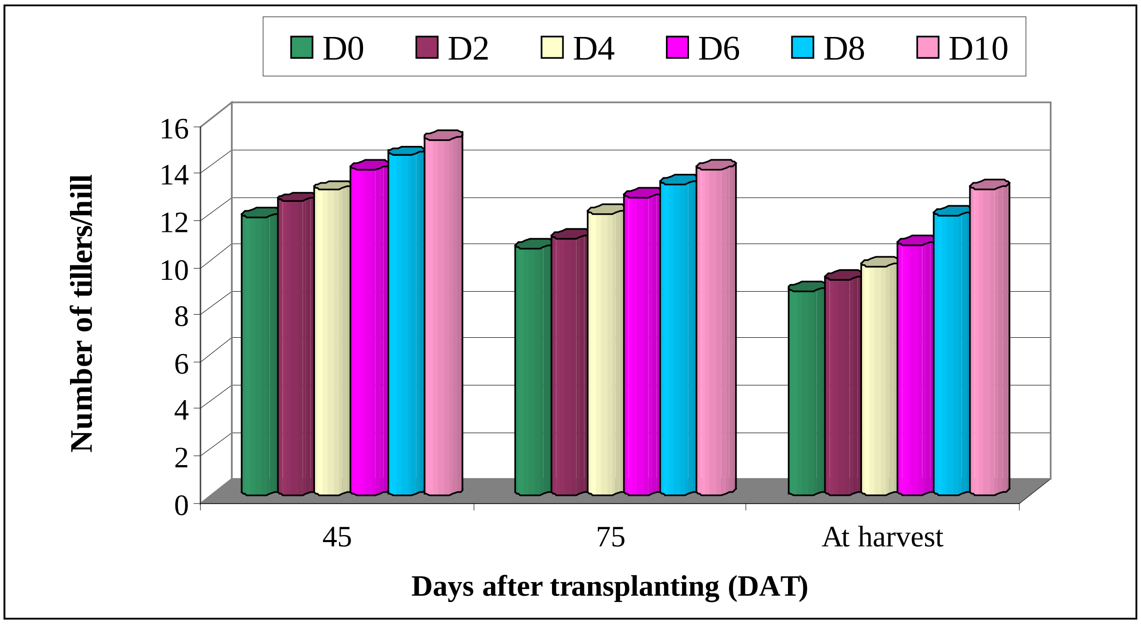

Fig. 4. Effect of storage durations of uprooted seedlings on the number of total tillers hill^{-1} of aromatic rice at different days after transplanting (LSD $_{0.05}$ = 1.75, 1.52 and 1.61 at 45, 75 DAT and at harvest respectively).

At harvest, the maximum number (13.04) was obtained from seedlings stored for 10 day which was statistically identical with the seedlings stored for 8 days and the minimum (8.72) from the seedlings stored for 0 days which was statistically identical with 2 and 4 days of storing. In this study it was observed that number of tillers hill^{-1} was gradually increased when seedlings were stored for 0-10 days. Probably, this happened because of the fact that in these treatments the numbers of hills m^{-2} were lesser than other treatments which facilitated the scope of having more space for tillering. The findings of the study are in disagreement with the findings of Akber (2004), Hossain (2001), Roy and Sattar (1992), Koshta et al. (1987) who reported that the absolute tillering rate was more in younger seedlings and when seedling age was increased, the tillering rate gradually decreased. However, Hossain and Haque (1988), Khatun (1995), Enyi (1963), Singh and

Tarat (1978) reported that the tiller production was higher with 30 days old seedlings in transplant aman season than others.

4.1.2.3 Interaction effect of storage conditions and storage durations

Tiller number hill^{-1} was significantly affected by the interaction between storage conditions and storage durations at 45, 75 DAT and also at harvest (Table 2). At 45 DAT, the maximum number of tillers hill^{-1} (15.54) was seen from the seedlings stored in water for 10 days which was statistically identical with seedlings stored in water for 4, 6 and 8 days and on mud for 4 and 10 days. The fewest tillers (11.28) was obtained from the seedlings stored on mud for 0 days which was statistically identical with seedlings stored on mud for 2 and 4 days and in water for 0 days.

At 75 DAT, the maximum number of tillers hill^{-1} (14.29) was found from the seedlings stored in water for 10 days which was statistically identical with seedlings stored in water for 6 and 8 days and on mud for 8 and 10 days. The fewest tillers (9.98) was obtained from the seedlings stored on mud for 0 days which was statistically identical with seedlings stored on mud for 2 and 4 days and in water for 0 days.

At harvest, the maximum number of tillers hill^{-1} (13.10) was recorded from the seedlings stored on mud for 10 days which was statistically identical with seedlings stored in water for 8 and 10 days and on mud for 8 days. The fewest tillers (8.52) was obtained from the seedlings stored on mud for 0 days which was statistically identical with seedlings stored on mud for 2 and 4 days and in water for 0, 2 and 4 days.

Table 2. Interaction effect of storage conditions and durations of uprooted seedlings on the number of total tillers hill^{-1} of aromatic rice.

Treatments*		Number of total tillers hill^{-1}		
		Days after transplanting (DAT)		
		45	75	At harvest
Storage conditions × Storage durations	C_1D_0	11.28	9.98	8.52
	C_1D_2	11.71	10.12	9.02
	C_1D_4	12.67	11.31	9.53
	C_1D_6	13.51	11.92	10.62
	C_1D8	14.31	12.90	11.85
	C_1D10	14.69	13.82	13.10
	C_2D_0	12.42	11.04	8.91
	C_2D_2	13.33	11.73	9.33
	C_2D_4	13.94	12.62	10.00
	C_2D_6	14.27	13.43	10.71
	C_2D_8	14.83	13.62	11.97
	C_2D_{10}	15.54	14.29	12.98
	LSD (0.05)	1.62	1.41	1.48

*C_1 = On the mud, C_2 = In the water, D = Storage durations of uprooted seedlings
Subscripted number after D denotes days of storing after uprooting.

4.1.3 Dry matter production

4.1.3.1 Effect of storage conditions

Total dry weight per hill was significantly influenced by different storage conditions at maximum tillering stage, flowering stage and at harvest (Fig. 5). At, maximum tillering stage, the maximum dry weight (33.62 g hill^{-1}) was obtained from the plants grown from the seedlings which were stored on mud before transplanting. This was statistically higher than that stored in water (30.55 g hill^{-1}). Similar trend was also observed at flowering and even at harvest. This finding is in conformation with that of BRRI (1991a) who reported that the dry matter content of mud stored seedlings was much higher than that of water stored ones at all storage periods, irrespective of seedlings age.

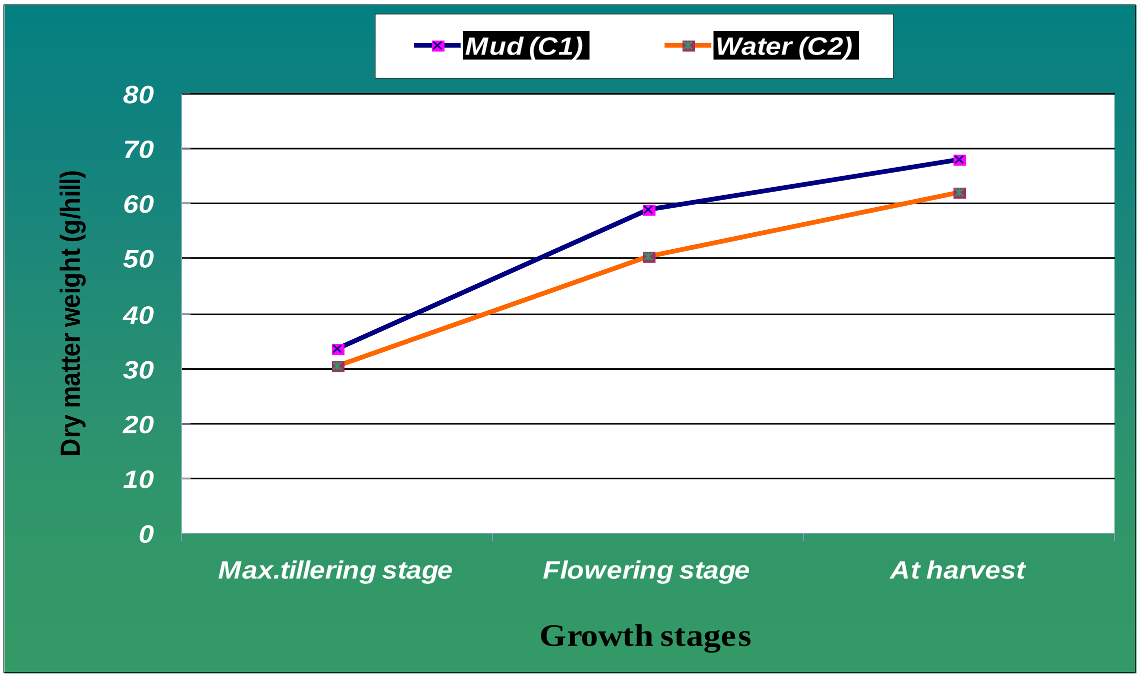

Fig. 5. Effect of storage conditions of uprooted seedlings on dry matter production of aromatic rice at different growth stage (LSD $_{0.05}$ = 1.80, 1.84 and 1.77 at max. tillering stage, flowering stage and at harvest respectively).

4.1.3.2 Effect of storage durations

Total dry weight per hill was differed significantly due to storage conditions at maximum tillering stage, flowering stage and at harvest (Fig. 6). The dry matter production of plant exhibited a decreasing trend with the increase in the storage durations of uprooted seedlings from 0 to 10 days at maximum tillering stage, flowering stage and at harvest.

At maximum tillering stage, the maximum dry matter weight of plant (39.81 g hill^{-1}) was obtained from the treatment 0 day of storage and the minimum dry matter weight (25.89 g hill^{-1}) was found when seedlings were stored for 10 days.

At flowering stage, the maximum dry matter weight of plant (67.03 g hill^{-1}) was obtained from the treatment 0 day of storage and the minimum dry matter weight (43.33 g hill^{-1}) was found when seedlings were stored for 10

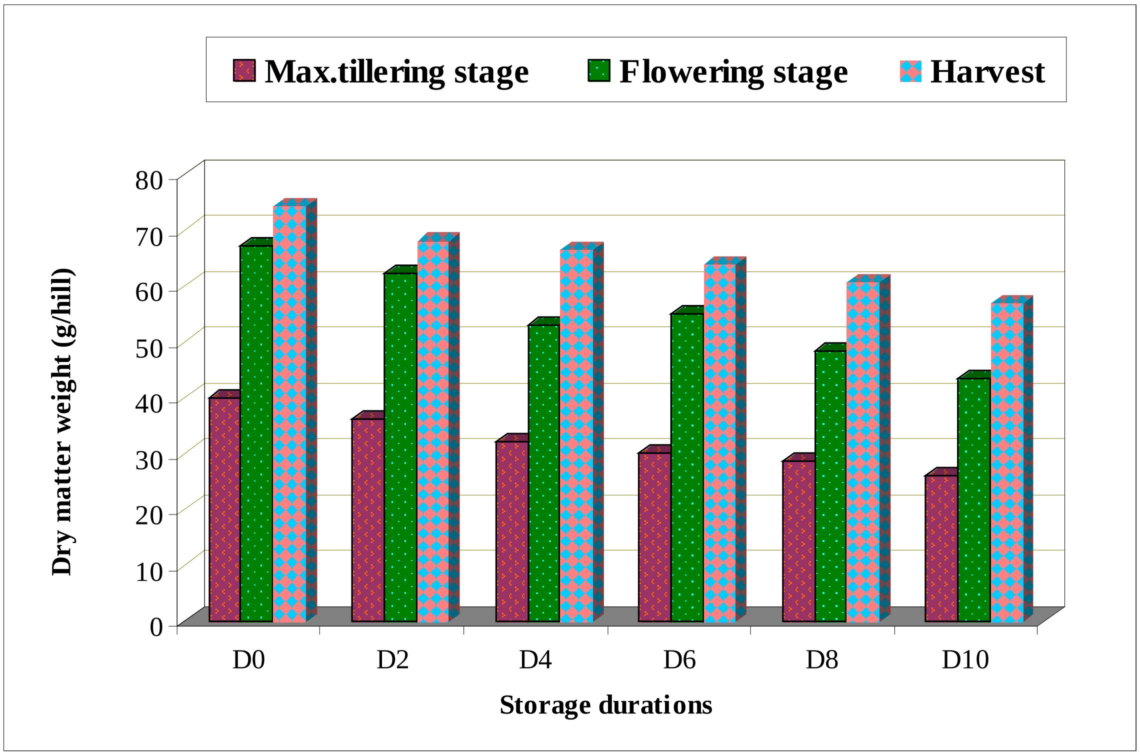

Fig. 6. Effect of storage durations of uprooted seedlings on dry matter production of aromatic rice at different growth stage (LSD $_{0.05}$ = 3.13, 3.20 and 3.03 at max. tillering stage, flowering stage and at harvest respectively).

At harvest, the maximum dry matter weight of plant (74.23 g hill^{-1}) was obtained from the treatment 0 day of storage and the minimum dry matter weight (57.04 g hill^{-1}) was found when seedlings were stored for 10 days. Probably, due to prolonged storage durations, the vigour of the seedlings decreased which in tern decreased plant height and dry matter.

4.1.3.3 Interaction effect of storage conditions and storage durations

Total dry weight per hill was significantly influenced by the interaction effect of storage conditions and durations at flowering stage and also at harvest, but it was insignificant at the maximum tillering stage (Table 3).

Table 3. Interaction effect of storage conditions and durations of uprooted seedlings on dry matter production (g hill^{-1}) of aromatic rice.

Treatments*		Growth Stages		
		Maximum tillering stage	**Flowering Stage**	**At harvest**
Storage conditions X Storage durations	C_1D_0	37.43	72.84	76.86
	C_1D_2	35.46	68.15	72.24
	C_1D_4	32.58	54.95	67.66
	C_1D_6	30.49	57.86	64.46
	C_1D8	29.76	50.84	62.75
	C_1D10	27.92	49.29	58.57
	C_2D_0	36.19	63.22	66.04
	C_2D_2	33.32	56.18	63.92
	C_2D_4	31.50	50.68	65.37
	C_2D_6	29.72	52.03	63.51
	C_2D_8	27.63	45.49	58.64
	C_2D_{10}	23.85	37.36	55.52
	LSD (0.05)	NS	4.52	4.33

*C_1 = On the mud, C_2 = In the water, D = Storage durations of uprooted seedlings, Subscripted number after D denotes days of storing after uprooting.

At flowering stage, significantly the maximum dry matter production (72.84 g hill^{-1}) was noticed from the treatment combination of seedlings stored on mud for 0 day. The minimum dry matter production (37.36 g hill^{-1}) was found when the seedlings were stored in water for 10 days. At harvest, significantly the maximum dry matter production (76.86 g hill^{-1}) was obtained from the treatment combination of seedlings stored on mud for 0 day. While the minimum (55.52 g hill^{-1}) from the seedlings stored in the water for 10 days.

4.2 Yield contributing characters

4.2.1 Number of total hills m^{-2}

4.2.1.1 Effect of storage conditions

The number of total hills m^{-2} was not significantly influenced by storage conditions (Fig. 7). The seedlings which were stored on mud before transplanting produced higher number of total hills m^{-2} (21.42). The lowest number of total hills m^{-2} (20.77) was obtained from the seedlings which were stored in water. The number of total hills m^{-2} was 12.16% higher under mud storage condition than those under water storage condition. Number of total hills m^{-2} was closely related to the survivability of seedlings after transplantation.

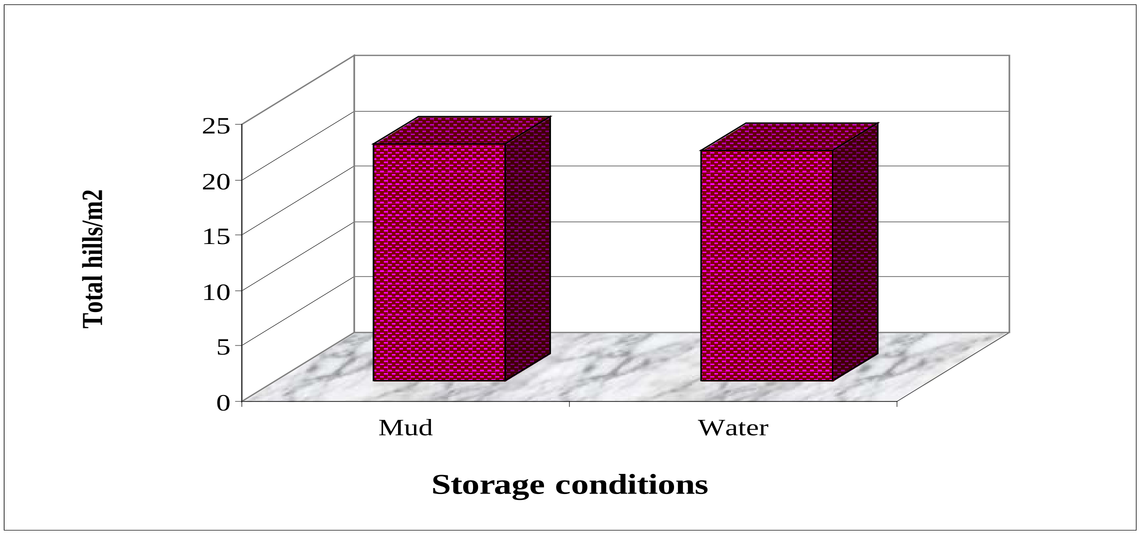

Fig. 7. Effect of storage conditions of uprooted seedlings on the number of total hills m^{-2} (LSD $_{0.05}$ = NS) of aromatic rice at different growth stage.

Such finding was in agreement with Gomosta *et al.* (1990) who stated that 20 and 40 days old seedlings of BR11 rice, transplanted after 1 to 4 weeks of storing in mud, showed 85% survivability irrespective of age of seedlings. The survivability percentage decreased with the increase in storage duration in case of water storage. BRRI (1991b) also observed that the survival percent of seedlings stored for a longer period in water was very low. Whereas BRRI (1985) recorded that no substantial decrease in mortality was seen in case of seedlings stored in mud even for12 days.

4.2.1.2 Effect of storage durations

Number of total hills m^{-2} was significantly influenced by storage durations (Fig. 8). The maximum number (26.59) was produced from the seedlings which were stored for 0 day before transplanting and this was significantly higher than those of other treatments. The minimum number (13.09) was obtained from the seedlings stored for 10 days. Probably, the prolonged storage durations resulted in increased seedlings mortality.

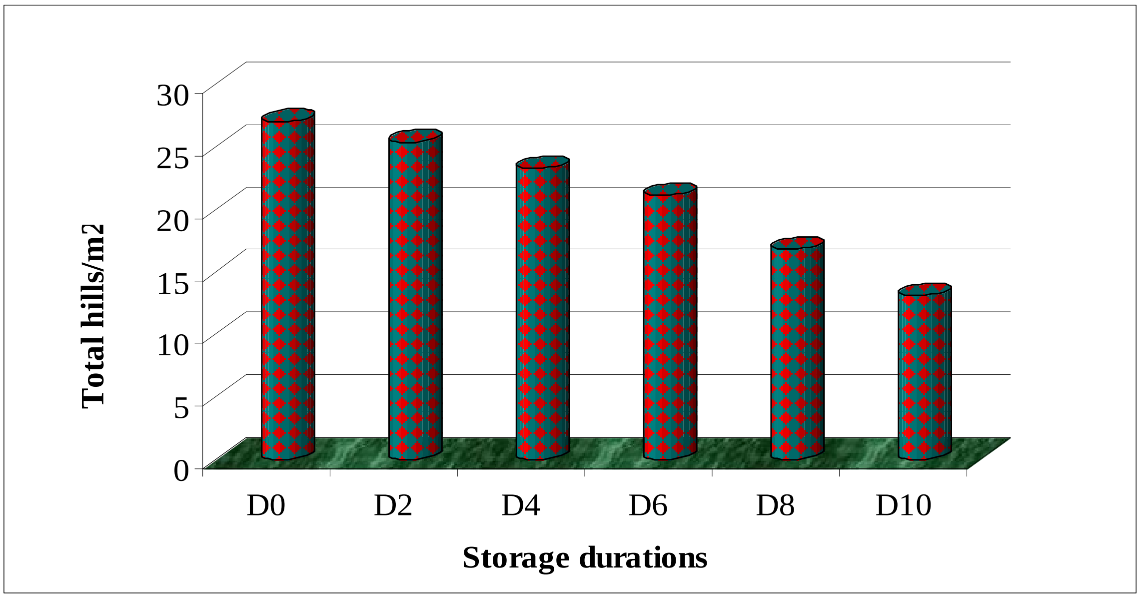

Fig. 8. Effect of storage durations of uprooted seedlings on the number of total hills m^{-2} (LSD $_{0.05}$ = 1.92) of aromatic rice at different growth stage.

4.2.1.3 Interaction effect of storage conditions and storage durations

Number of total hills m^{-2} was significantly influenced by the interaction of storage conditions and storage durations (Table 4). Significantly the maximum number of total hills m^{-2} (26.66) was produced from the seedlings stored on mud for 0 day. But this was statistically identical with those stored in water for 0 and 2 days and on mud for 2, 4 days. The minimum number (12.62) was obtained from the seedlings stored in water for 10 days which was statistically at par with that stored on mud for 10 days.

4.2.2 Number of effective tillers hill^{-1}

4.2.2.1 Effect of storage conditions

The number of effective tillers hill^{-1} was significantly influenced due to different storage conditions (Fig. 9). The maximum number of effective tillers hill^{-1} (8.05) was produced by the seedlings stored on mud which was significantly higher than the results shown by the seedlings stored in water. The minimum number of effective tillers hill^{-1} (7.53) was obtained from the seedlings stored in water.

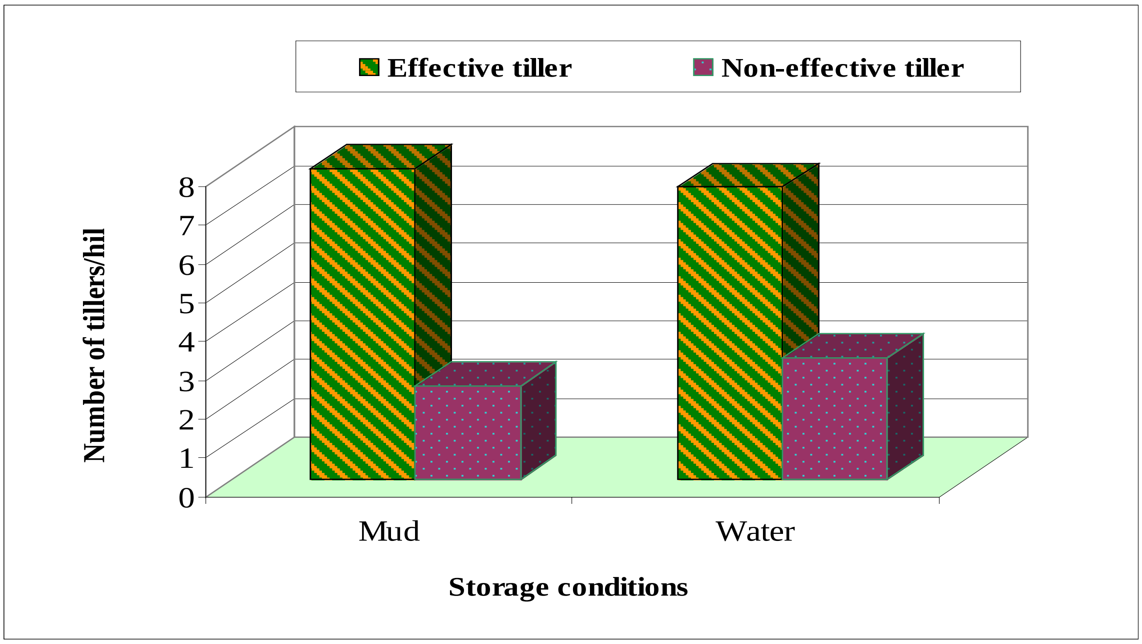

Fig. 9. Effect of storage conditions of uprooted seedlings on the number of effective tillers (LSD $_{0.05}$ = 0.49) and non-effective (LSD $_{0.05}$ = 0.16) tillers hill^{-1} of aromatic rice.

4.2.2.2 Effect of storage durations

Number of effective tillers hill^{-1} in all treatments varied significantly from each other due to different storage durations of the uprooted seedlings (Fig. 10). The maximum number of effective tillers hill^{-1} (8.53) resulted from 10 days storage which was identical with the number produced by 8 days storage. The lowest number of effective tillers hill^{-1} (7.19) was observed from 0 day storage which was identical with the number of effective tillers produced by 2 days storage

4.2.2.3 Interaction effect of storage conditions and storage durations

The number of effective tillers hill^{-1} did not show any significant difference due to the interaction effect of storage conditions and durations of uprooted rice seedlings (Table 4). The maximum number of effective tillers hill^{-1} (8.90) was obtained from the seedlings stored on mud for 10 days. The lowest number of effective tillers hill^{-1} (7.10) was resulted from the seedlings stored in water for 0 days .

Table 4. Interaction effect of storage conditions and durations of uprooted seedlings on the number of total hills m^{-2}, effective tillers hill^{-1} and non-effective tillers hill^{-1} of aromatic rice.

Treatments*		Number of total hills m^{-2}	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{1}
Storage conditions × Storage Durations	C_1D_0	26.66	7.28	1.24
	C_1D_2	25.70	7.63	1.39
	C_1D_4	24.20	7.72	1.81
	C_1D_6	21.28	8.16	2.46
	C_1D8	17.14	8.65	3.20
	C_1D10	13.56	8.90	4.21
	C_2D_0	26.53	7.10	1.81
	C_2D_2	25.00	7.30	1.95
	C_2D_4	23.25	7.50	2.50
	C_2D_6	20.87	7.71	3.0
	C_2D_8	16.40	7.90	4.07
	C_2D_{10}	12.62	8.17	4.81
	LSD(0.05)	2.53	NS	0.72

*C_1 = On the mud, C_2 = In the water, D = Storage durations of uprooted seedlings, Subscripted number after D denotes days of storing after uprooting.

4.2.3 Number of non-effective tillers hill^{-1}

4.2.3.1 Effect of storage conditions

The results showed that there was significant difference in number of non-effective tillers hill^{-1} due to storage conditions (Fig. 9). The higher number of non-effective tillers hill^{-1} (3.02) was produced by the seedlings stored in water which was significantly higher than the results shown by the seedlings stored on mud. The lowest number of non-effective tillers hill^{-1}(2.60) obtained was from the seedlings stored on mud.

4.2.3.2 Effect of storage durations

The number of non-effective tillers hill^{-1} was produced by the seedlings under different storage conditions showed significant difference (Fig. 10). The maximum number of non-effective tillers hill^{-1} (4.51) resulted from 10 days storage. The minimum number of effective tillers hill^{-1} (1.52) was observed from 0 days storage which was identical with the number of effective tillers produced by 0, 2and 4 days storage.

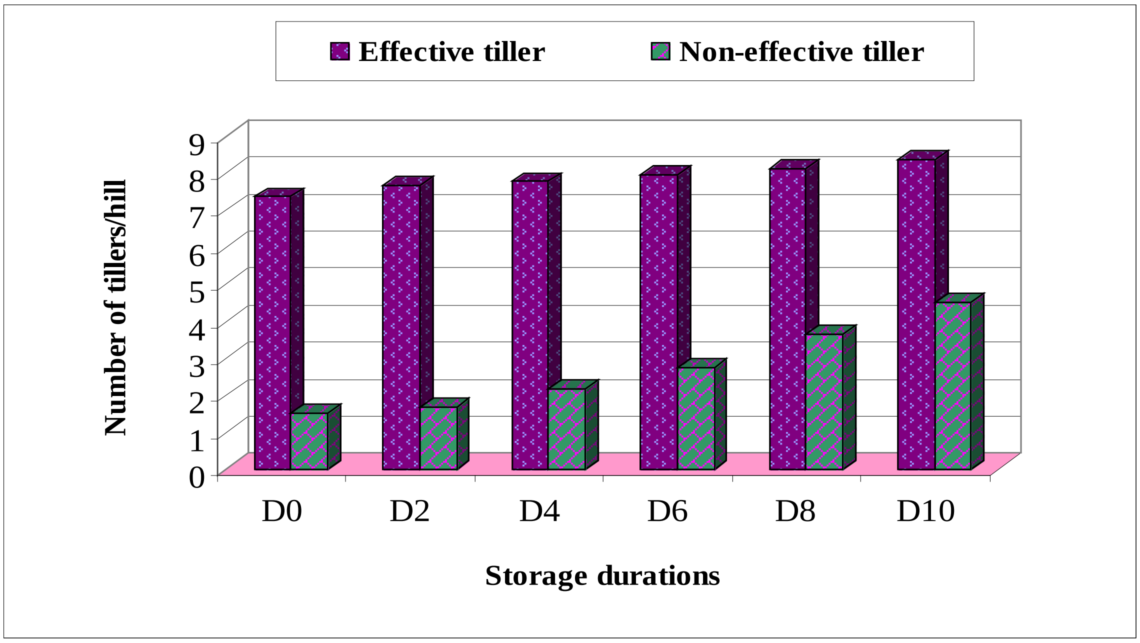

Fig.10. Effect of storage durations of uprooted seedlings on the number of effective tillers (LSD $_{0.05}$ = 0.36) and non-effective tillers hill^{-1} (LSD $_{0.05}$ = 0.74) of aromatic rice.

4.2.3.3 Interaction effect of storage conditions and storage duration

The number of non-effective tillers hill^{-1} showed significant variation due to the interaction effect of storage conditions and storage durations of uprooted rice seedlings, although the numerical values were different in each storage duration (Table 4). The maximum number of non-effective tillers hill^{-1} (4.81) was obtained from the seedlings stored in water for 10 days which was identical with the number of effective tillers produced on mud by 2 days storage. The lowest number of non-effective tillers hill^{-1} (1.24) was resulted from the seedlings stored on mud for 0 days which was identical with the number of effective tillers produced on mud by 2 and 4 days storage

4.2.4 Panicle length

4.2.4.1 Effect of storage conditions

The panicle length did not show any significant variation due to the effect of storage conditions of uprooted rice seedlings (Fig. 11). The highest panicle length (26.07 cm) was observed from the seedlings which was stored in water and the lowest (25.86 cm) from the seedlings storage on mud.

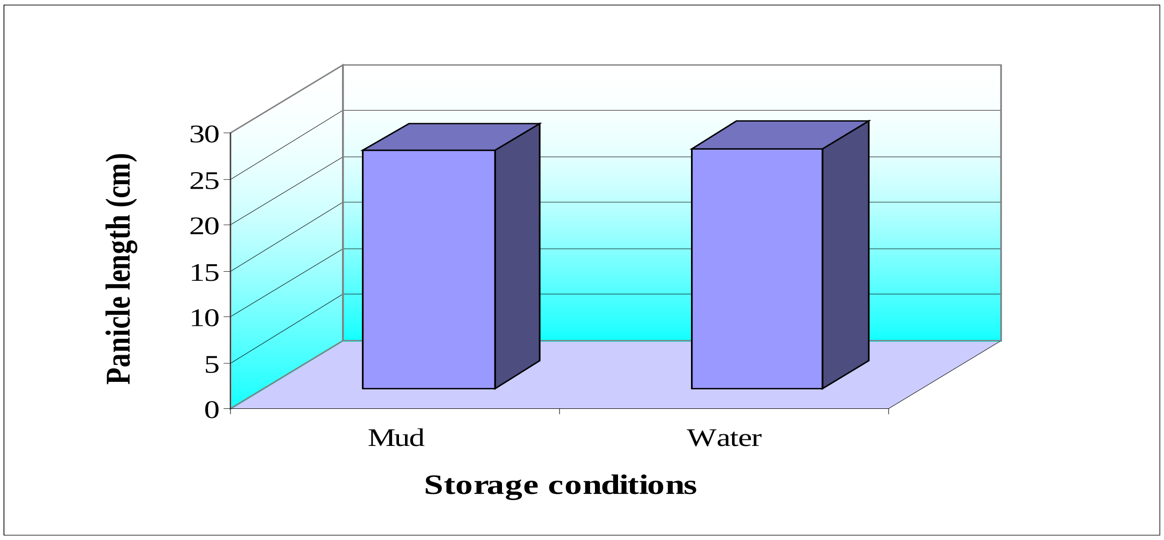

Fig. 11. Effect of storage conditions of uprooted seedlings on panicle length (LSD $_{0.05}$ = NS) of aromatic rice.

4.2.4.2 Effect of storage durations

The panicle length did not show any significant variation due to the effect of storage durations of uprooted rice seedlings (Fig. 12). The highest panicle length (26.22 cm) was observed from the seedlings which were stored for 2 days and the lowest (25.61 cm) was recorded from the seedlings stored for 8 days.

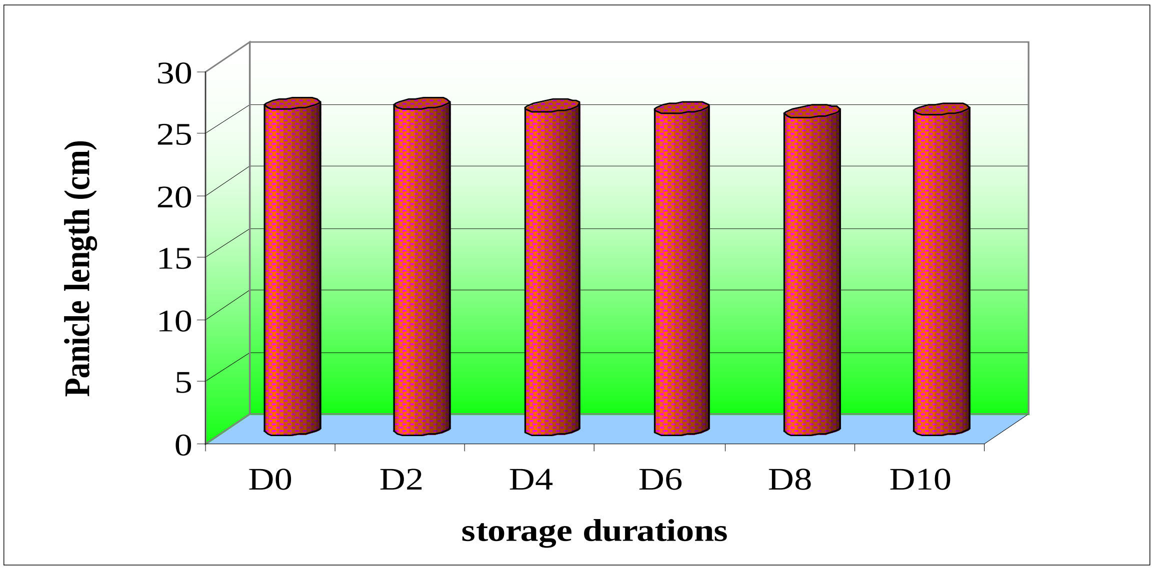

Fig. 12. Effect of storage durations of uprooted seedlings on panicle length (LSD $_{0.05}$ = NS) of aromatic rice.

4.2.4.3 Interaction effect of storage conditions and storage duration

No significant influence was observed on panicle length due to the interaction effect of storage conditions and durations of uprooted rice seedlings, although the numerical values were found to be different in each storage duration (Table 5). The highest panicle length (26.50) was observed from the seedlings which were stored on mud for 0 days and the lowest (25.35 cm) was recorded from the seedlings stored on mud for 8 days.

4.2.5 Number of total grains panicle^{-1}

4.2.5.1 Effect of storage conditions

The storage conditions had significant effect on the number of total grains panicle^{-1} (Fig. 13). The maximum number of filled grains panicle^{-1} (114.73) was produced by the seedlings stored on mud. Whereas, the lowest number of total grains panicle^{-1} (113.28) was produced by the seedlings stored in water. The number of total grains panicle^{-1} was 1.26% higher under mud storage condition than that under water storage condition.

4.2.5.2 Effect of storage durations

Number of total grains panicle^{-1} varied significantly due to the variation in the storage durations (Fig. 14). A decreasing trend in the number of total grains panicle^{-1} was observed with the increase in the storage durations. The maximum number of total grains panicle^{-1} (117.18) was produced by the seedlings stored for 0 days. The lowest number of total grains panicle^{-1} (111.66) was produced by the seedlings stored for 10 days which was significantly at par with those stored for 8 days. Reddy and Narayana (1981) also observed that number of total spikelets panicle^{-1} decreased significantly with each 10 day increase in seedling age

4.2.5.3 Interaction effect of storage conditions and storage duration

The number of total grains panicle^{-1} was not significantly influenced by the interaction effect of storage conditions and durations of uprooted rice seedlings, although the numerical values were different in each storage duration (Table 5). The maximum number of total grains panicle^{-1} (117.54) was observed from the seedlings which were stored on mud for 0 days and the lowest (111.39) was recorded from the seedlings stored on mud for 10 days

4.2.6 Number of filled grains panicle^{-1}

4.2.6.1 Effect of storage conditions

The storage conditions had significant effect on the number of filled grains panicle^{-1} (Fig.13). The maximum number of filled grains panicle^{-1} (102.82) was produced by the seedlings stored on mud which was significantly higher than the result observed by the seedlings stored in water. Number of filled grains panicle^{-1} obtained from the seedlings stored on mud was the lowest (101.35). In the present study, the percent filled grain was 89.61 and 88.40 of total grains under mud and water storage conditions respectively.

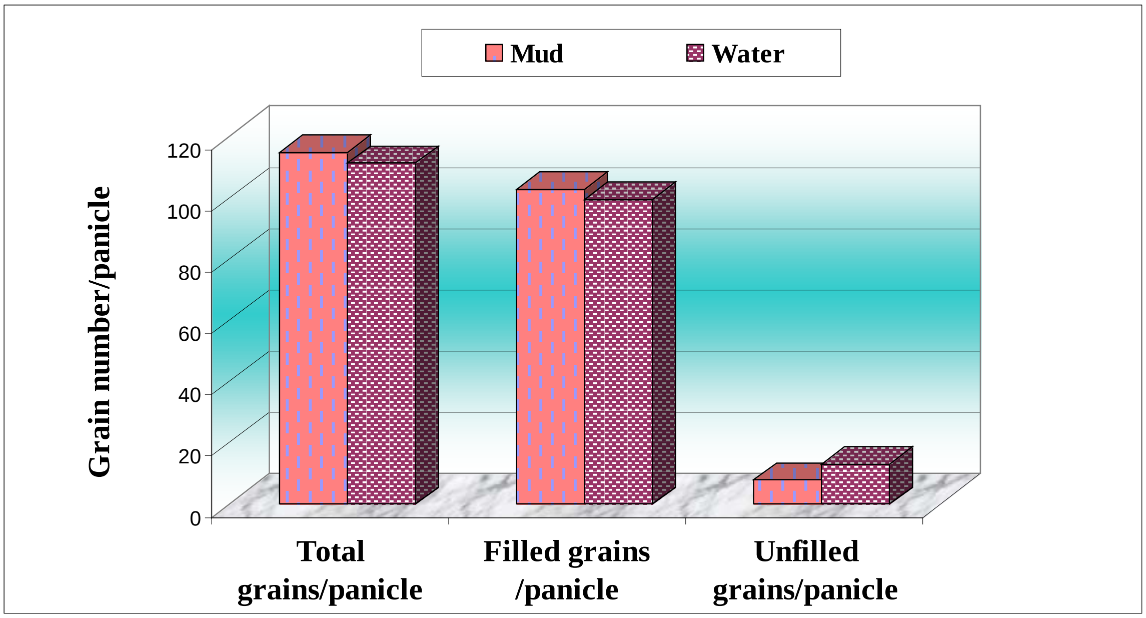

Fig. 13. Effect of storage conditions on the number of total grains panicle^{-1} (LSD $_{0.05}$ = 0.61), filled grains panicle^{-1} (LSD $_{0.05}$ = 0.0.75) and unfilled grains panicle^{-1} (LSD $_{0.05}$ = 2.95) of aromatic rice.

4.2.6.2 Effect of storage durations

Number of filled grains panicle^{-1} in all treatments was significantly influenced by different storage durations of uprooted seedlings (Fig. 14). The maximum number of filled grains panicle^{-1} (106.98) was resulted from 0 days storage followed by 2 and 4 days storage. The lowest number of filled grains panicle^{-1} (97.55) observed from 10 days storage. Probably, prolonged storage durations resulted in the decreased number of filled grains panicle^{-1} which could be attributed to the increased competition among the tillers the long duration treatments. Similar result was also obtained by Razzzaque *et al.* (2000), Roy *et al.* (1992) and Ashraf and Mahmood (1989). They reported that the number of grains panicle^{-1} slightly decreased with the increase of seedling age.

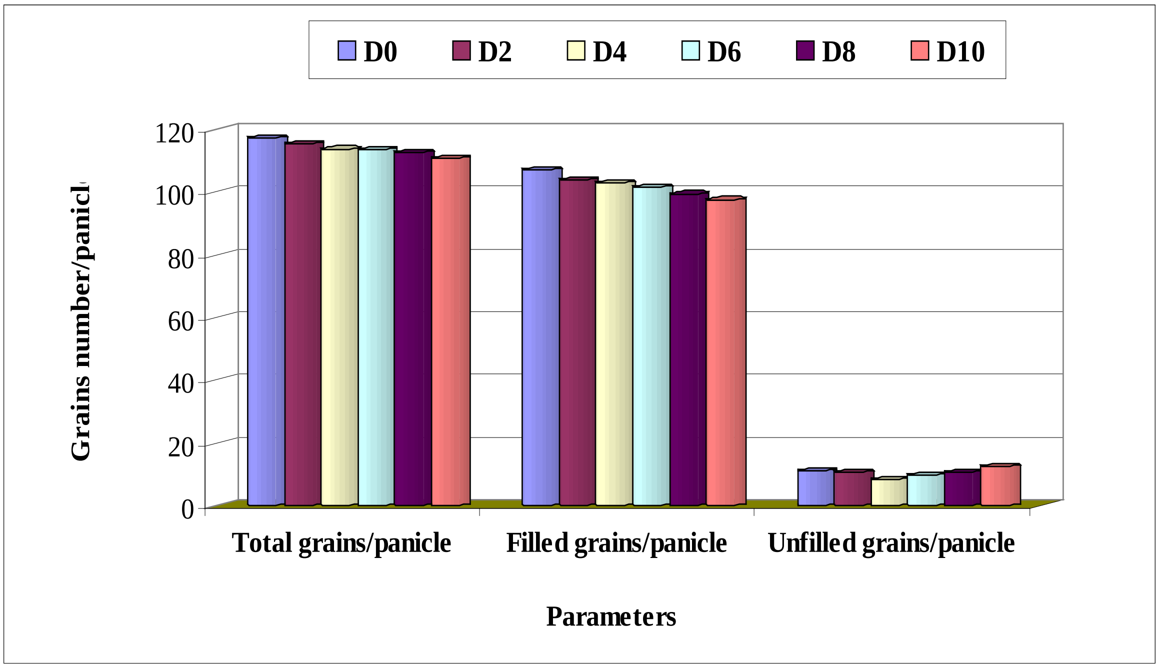

Fig. 14. Effect of storage durations of uprooted seedlings on the number of total grains panicle^{-1} (LSD $_{0.05}$ = 1.60), filled grains panicle^{-1} (LSD $_{0.05}$ = 1.96 and unfilled grains panicle^{1} (LSD $_{0.05}$ = NS) of aromatic rice.

4.2.6.3 Interaction effect of storage condition and storage duration

Number of filled grains panicle^{-1} differed significantly by the interaction effect of storage condition and duration (Table 5). The highest number of filled grains panicle^{-1} (107.30) was recorded from the seedlings stored on mud for 0 days but it was at par with those stored in water for 0, 2 days and on mud for 2, 4 days. The lowest number (96.70) was obtained from the seedlings stored in water for 10 days but it was at par with those stored on mud for 10 days and on water for 6, 8 days.

Table 5. Interaction effect of storage conditions and durations of uprooted seedlings on the panicle length, number of total grains panicle^{-1}, filled grains panicle^{-1} and unfilled grains panicle^{-1} of aromatic rice.

Treatments*		Panicle length (cm)	Number of Total grains panicle^{-1}	Number of filled grains panicle^{-1}	Number of unfilled grains panicle^{-1}
Storage conditions × Storage durations	C_1D_0	26.50	117.54	107.30	10.24
	C_1D_2	26.29	116.48	104.16	12.32
	C_1D_4	25.46	114.27	103.66	10.61
	C_1D_6	25.59	114.73	102.73	12.00
	C_1D8	25.35	113.43	100.83	12.60
	C_1D10	25.99	111.93	98.40	13.53
	C_2D_0	25.93	117.21	106.85	10.36
	C_2D_2	26.16	114.28	103.53	10.75
	C_2D_4	26.38	113.21	101.96	11.25
	C_2D_6	25.94	112.40	100.20	12.20
	C_2D_8	25.87	111.60	98.82	12.78
	C_2D_{10}	26.15	111.39	96.70	14.69
	LSD (0.05)	NS	NS	3.87	NS

*C_1 = On the mud, C_2 = In the water, D = Storage durations of uprooted seedlings, Subscripted number after D denotes days of storing after uprooting.

4.2.7 Number of unfilled grains panicle^{-1}

4.2.7.1 Effect of storage conditions

Different storage conditions of uprooted seedlings had significant effect on the number of unfilled grains panicle^{-1} (Fig. 13). The maximum number of unfilled grains panicle^{-1} (13.70) was obtained from the seedlings stored in water while the minimum number of unfilled grains panicle^{-1} (7.90) was found with seedlings stored on mud.

4.2.7.2 Effect of storage durations

Storage durations of the uprooted seedlings did not show any significant effect on the number of unfilled grains panicle^{-1}, although the numerical values were found to be different in each storage condition (Fig. 14). The maximum number of unfilled grains panicle^{-1} (13.35) resulted from 10 day storage while the lowest number of unfilled grains panicle^{-1} (11.08) was observed from 0 days.

4.2.7.3 Interaction effect of storage condition and storage duration

No significant influence was observed on number of unfilled grains panicle1^{-1} due to the interaction effect of storage conditions and durations of uprooted rice seedlings, although the numerical values were different in each storage duration (Table 5). The maximum number of unfilled grains panicle1^{-1} (14.69) was obtained from the seedlings stored in water for 10 days. The lowest number of unfilled grains panicle1^{-1} (10.24) was resulted from the seedlings stored on mud for 0 days.

4.2.8 Weight of 1000 grains

4.2.8.1 Effect of storage condition

Weight of 1000 grains was not significantly affected by different storage conditions (Fig. 15). The maximum weight of 1000 grains (16.49) was obtained from the seedlings stored on mud while, the minimum weight of 1000 (15.95) grains was found with seedlings stored in water.

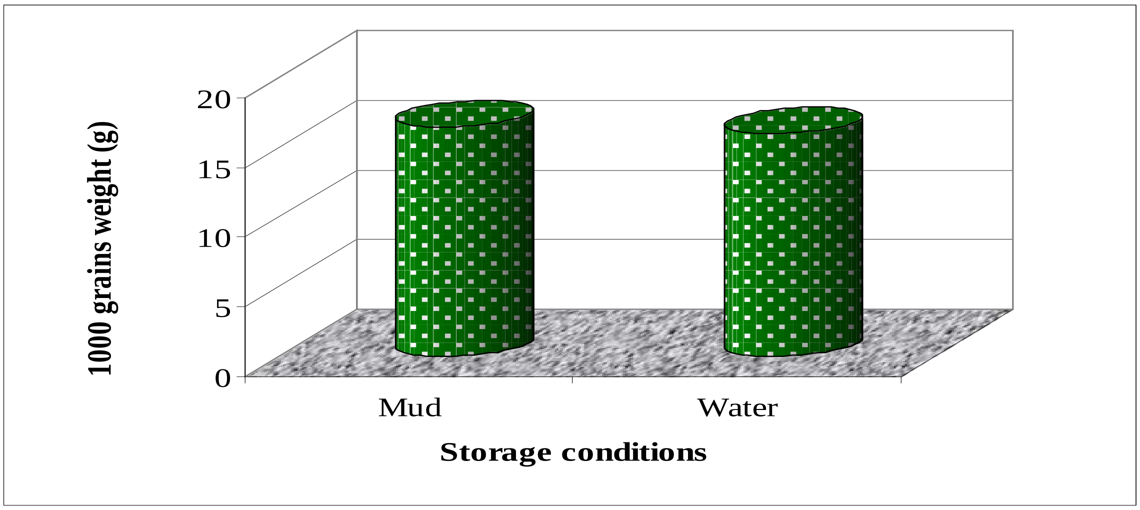

Fig. 15. Effect of storage conditions of uprooted seedlings on 1000 grains weight (LSD $_{0.05}$ = NS) of aromatic rice

4.2.8.2 Effect of storage durations

Storage durations of uprooted rice seedlings had no significant effect on the weight of 1000 grains (Fig. 16). The maximum weight of 1000 grains (16.62) was resulted from 0 day storage and the minimum weight of 1000 grains (15.93) was observed from10 days. Mohaputra and Kar (1991) reported that 1000-grains weight was decreased when aged seedlings were transplanted. On the other hand, Kamdi *et al*. (1991) and Raju *et al*. (1989) found that 1000 grains weight was the highest at 30 days old seedlings.

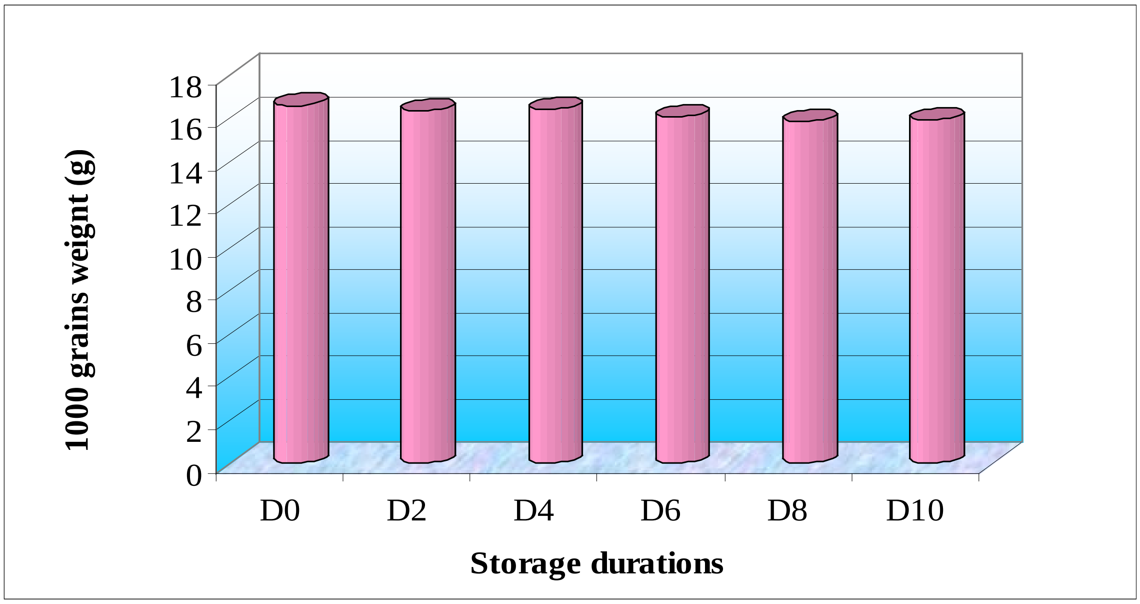

Fig. 16. Effect of storage durations of uprooted seedlings on 1000 grains weight (LSD $_{0.05}$ = NS) of aromatic rice.

4.2.8.3 Interaction effect of storage condition and storage duration

Weight of 1000 grains was not significantly affected by the interaction effect of storage conditions and durations (Table 6). The maximum weight of 1000 grains (16.80) was obtained from the seedlings stored on mud for 2 days. The minimum weight of 1000 grains (15.46) was resulted from the seedlings stored in water for 10 days.

4.2.9 Grain yield

4.2.9.1 Effect of storage conditions

Grain yield of BRRI dhan 38 was significantly affected due to different storage conditions of uprooted seedlings (Fig. 17). The seedlings which were stored on mud produced significantly the highest grain yield (3.15 t ha^{-1}) and the minimum grain yield (2.60 ha^{-1}) was obtained from the seedlings stored in water. This might have resulted due to the cumulative effect of all the yield contributing characters with the same treatment. Again the uprooted seedlings stored on the mud might have got more favorable condition than those stored in the water to continue their physiological process together with absorption of nutrients present in soil. This phenomenon might have favoured to retain the vigour of the seedlings and growth of roots which ultimately reduced the shock of root damage due to uprooting. The finding was in agreement with Kaykobad *et al.* (2003) who reported that best performance was exhibited by seedlings stored in mud followed by those stored in water, in shade with time to time watering, in shade and in sun and the difference was generally significant. BRRI (1991c) also reported that a significant decrease in grain yield was observed due to storage of uprooted rice seedlings in mud than those transplanted immediately after uprooting irrespective of seedling age.

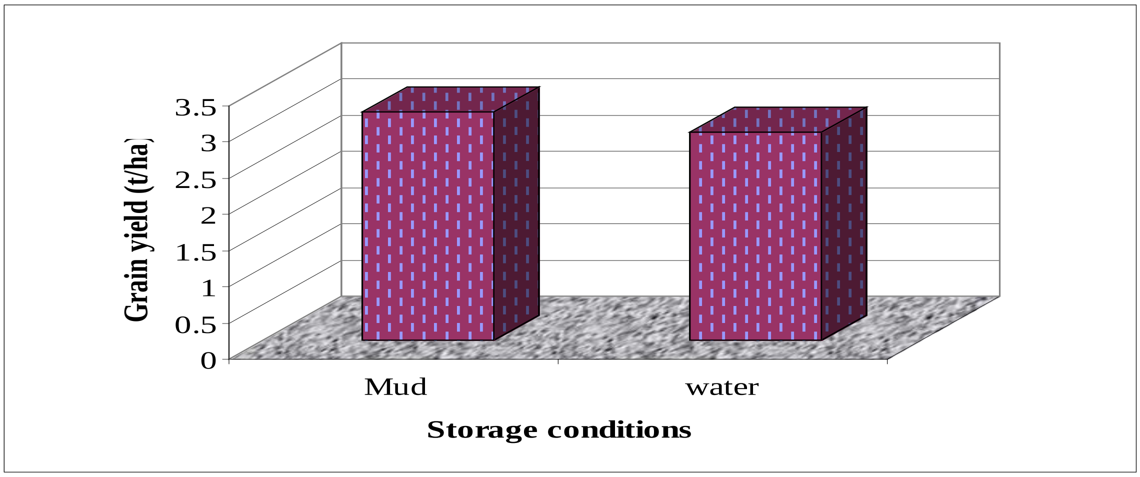

Fig. 17. Effect of storage conditions of uprooted seedlings on grain yield ($LSD_{0.05}$ = 0.21) of aromatic rice.

4.2.9.2 Effect of storage durations

The storage durations of uprooted rice seedlings had significant effect on grain yield. The grain yield exhibited a regular decreasing trend with the increase in the storage duration from 0 to 10 days after uprooting (Fig. 18). The maximum grain yield (3.46 t ha^{-1}) was obtained from 0 days storage which was statistically identical with the seedlings stored for 2 and 4 days. The lowest grain yield (1.71 t ha^{-1}) was obtained from 10 days storage. Low grain yield of the long duration treatments could be attributed to lower value of total hills m^{-2} coupled with lower number of filled grains $panicle^{-1}$. The result of the present experiment suggested that after uprooting, the seedlings should be transplanted within 4 days to get maximum grain yield. The findings of the present study are in partial agreement with those of Haque (1997), BRRI (1996) and Islam (1995) who observed significant yield difference under different storage durations. But the result disagreed with that Das and Mukherjee (1992). Molla (2001), Pattar *et al.* (2001), Sanbagavalli *et al.* (1999), Villela and Junir (1996), Larrea and sanchez (1989), Islam and Ahmed (1981), Alim *et al.* (1962) and Rao (1961) found that transplanting of 28 and 30 –45 days old seedlings gave significantly the highest grain yield. But, Kumar et al. (2002), Shi *et al.* (1999), Hundal *et al.* (1999) and Singh and Singh (1999) reported that yield was negatively correlated with seedling age at transplanting.

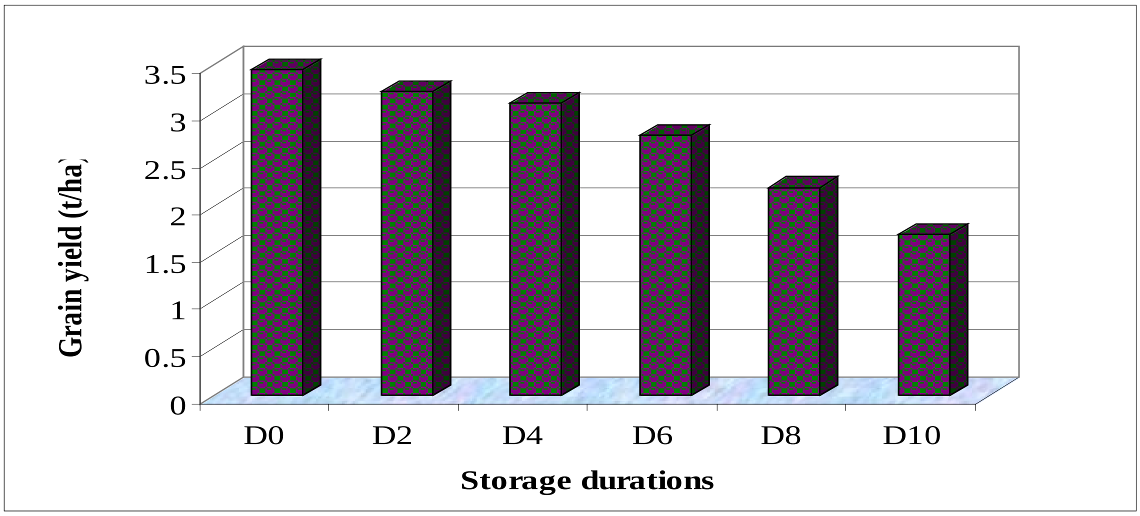

Fig.18. Effect of storage durations of uprooted seedlings on grain yield (LSD $_{0.05}$ = 0.38) of aromatic rice.

4.2.9.3 Interaction effect of storage conditions and storage durations

The interaction effect of storage conditions and durations was significant on grain yield (Table 6). Significantly the maximum grain yield (3.51 t ha^{-1}) was obtained from the seedlings stored on mud for 0 day. But this was statistically identical with those stored on mud for 2, 4 and in water for 0, 2 days. The lowest grain yield (1.54 t ha^{-1}) was resulted from the seedlings stored in water for 10 days which was statistically at par with that stored on mud for 10 days. From the interaction of storage conditions and storage durations it was observed that the highest yield was given by the seedlings which were stored on mud up to 4 days and in water up to 2 days. The reasons for the higher grain yield in the above-mentioned treatment combinations might be due to the favorable cumulative effect of the yield contributing characters in the said treatments. The seedlings stored on the mud might have got comparatively more favourable environment and nutrients than those stored in water to continue their normal physiological activities even for considerably longer duration of 10 days.

4.2.10 Straw yield

4.2.10.1 Effect of storage conditions

The straw yield was significantly affected by the storage conditions (Fig. 19). The maximum straw yield (6.03 t ha^{-1}) was obtained in case of seedlings stored on mud and the lowest straw yield (5.74 t ha^{-1}) was produced by the seedlings stored in water

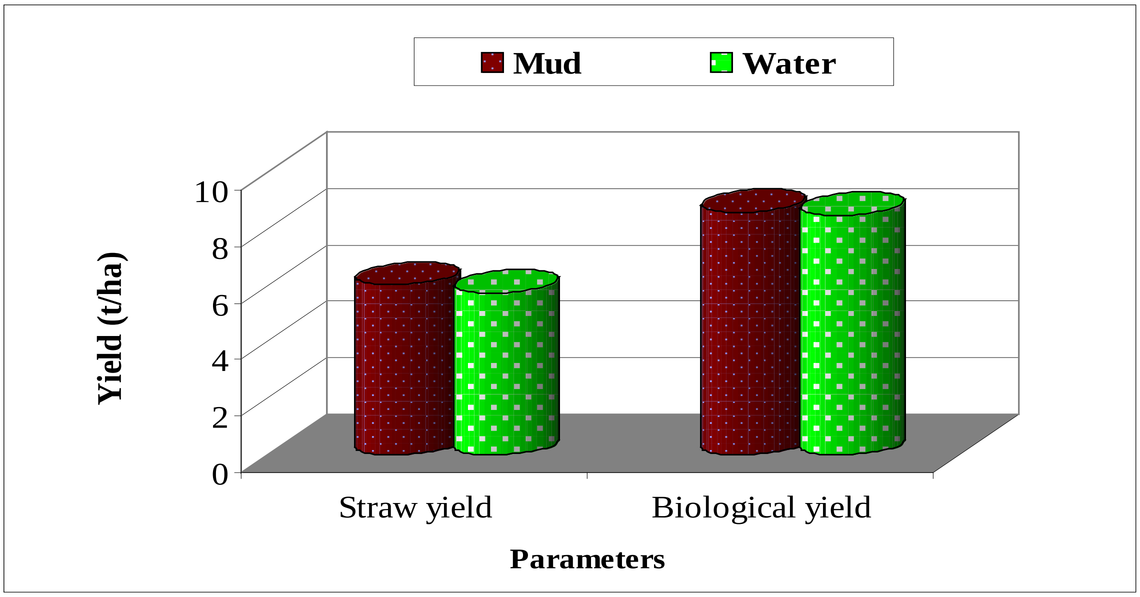

Fig.19. Effect of storage conditions of uprooted seedlings on straw yield (LSD $_{0.05}$ = 0.26) and biological yield (LSD $_{0.05}$ = 0.62) of aromatic rice.

4.2.10.2 Effect of storage durations

The straw yield was significantly affected by the storage durations of uprooted rice seedlings (Fig. 20). The maximum straw yield (7.18 t ha^{-1}) was recorded from 0 day storage which was significantly different from other storage durations. The minimum straw yield (4.82 t ha^{-1}) was obtained from 10 days storing of seedlings which was statistically identical with that stored for 8 days. Low straw yield of the long duration treatments could be attributed to shorter plant height. These results were not supported by Kumar and Gupta (1990) who reveled that the seedlings uprooting time did not affect straw yield of rice significantly. Kewat (2002), Panikar *et al.* (1981) and Rao *et al.* (1976) showed that the straw yield was the highest with younger seedlings than older ones. But, Rashid *et al.* (1990) reported that 40 day old seedlings gave higher straw yields than 20 and 60 day old seedlings. Whereas Das and Mukherjee (1989) reported that seedling age had no effect on straw yield.

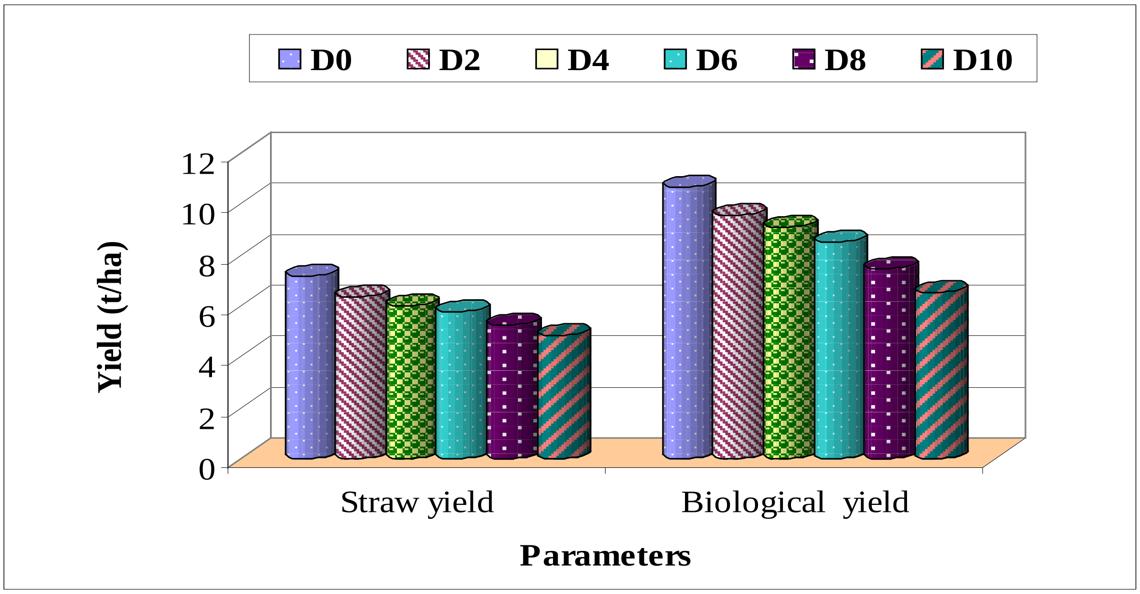

Fig. 20. Effect of storage durations of uprooted seedlings on straw yield (LSD $_{0.05}$ = 0.47) and biological yield (LSD $_{0.05}$ = 0.91) of aromatic rice.

4.2.10.3 Interaction effect of storage condition and storage duration

The interaction effect of storage condition and storage durations was significant for straw yield (Table 6). However, the maximum straw yield (7.36 t ha^{-1}) was obtained from the seedlings stored on mud for 0 day which was statistically identical with that stored on mud for 2, 4 days and in water for 0, 2 days and the lowest (4.40 t ha^{-1}) was resulted from the seedlings stored in water for 10 days which was statistically identical with that stored in water for 6, 8 days and on mud for 8, 10 days.

4.2.11 Biological yield

4.2.11.1 Effect of storage conditions

Biological yield was significantly influenced by storage conditions (Fig. 19). However, the maximum biological yield (9.0 t ha^{-1}) was obtained in case of seedlings stored on mud and the lowest (8.28 t ha^{-1}) by the seedlings stored in water.

4.2.11.2 Effect of storage durations

The biological yield was significantly affected by the storage durations of uprooted rice seedlings (fig. 20). The maximum biological yield (10.63 t ha^{-1}) was recorded from 0 day storage. The minimum biological yield (6.52 t ha^{-1}) was obtained from 10 days storing of seedlings. Low biological yield of the long duration treatments could be attributed to lower grain and straw yield.

4.2.11.3 Interaction effect of storage condition and storage duration

The interaction effect of storage condition and storage duration was significant for biological yield (Table.6).

Table 6. Interaction effect of storage conditions and durations of uprooted seedlings 1000 grains weight, grain yield, straw yield, biological yield and at harvest index of aromatic rice.

Treatments*		1000 grains weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
Storage conditions × Storage durations	C_1D_0	16.82	3.51	7.36	10.87	32.29
	C_1D_2	16.42	3.35	6.47	9.82	34.11
	C_1D_4	16.62	3.21	6.10	9.31	34.45
	C_1D_6	16.80	3.00	6.03	9.03	33.21
	C_1D8	16.0	2.39	5.37	7.76	30.80
	C_1D10	15.75	1.87	5.23	7.10	26.35
	C_2D_0	16.83	3.40	7.00	10.39	32.69
	C_2D_2	16.33	3.12	6.20	9.32	33.47
	C_2D_4	16.89	3.00	5.90	8.90	33.70
	C_2D_6	15.88	2.52	5.47	7.99	31.53
	C_2D_8	16.0	2.04	5.10	7.14	28.57
	C_2D_{10}	15.46	1.54	4.40	5.94	25.93
	LSD (0.05)	NS	0.41	1.28	1.59	2.17

*C_1 = On the mud, C_2 = In the water, D = Storage durations uprooted seedlings, Subscripted number after D denotes days of storing after uprooting.

However, the maximum biological yield (10.87 t ha^{-1}) was obtained from the seedlings stored on mud for 0 day which was statistically identical with those stored on mud for 2, 4 days and in water for 0, 2 days and the lowest (5.94 t ha^{-1}) was resulted from the seedlings stored in the water for 10 day which was statistically at par with that stored in water for 8 days and on mud for 10 days

4.2.12 Harvest index

4.2.12.1 Effect of storage conditions

The harvest index was not significantly affected by the storage conditions (Fig.21). The maximum harvest index (31.86 %) was obtained in case of seedlings stored on mud and the lowest (30.98 %) by the seedlings stored in water.

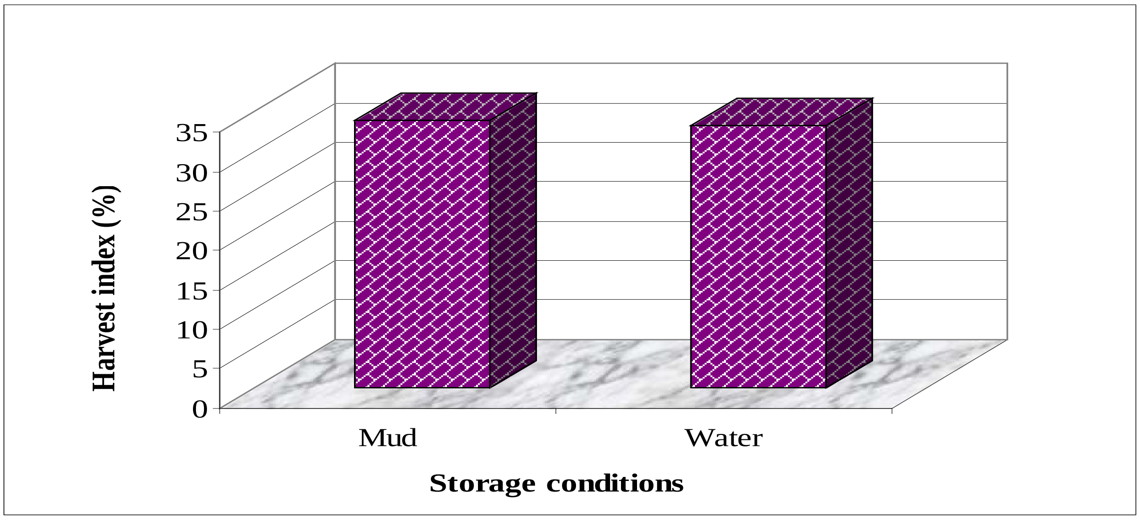

Fig. 21. Effect of storage conditions of uprooted seedlings on harvest index (LSD $_{0.05}$ = NS) of aromatic rice.

4.2.12.2 Effect of storage durations

Harvest index was not significantly affected by the storage durations (fig. 22). The maximum harvest index (32.49 %) was obtained when the seedlings were stored for 4 days. The minimum harvest index (31.53 %) was produced by the seedlings stored for 10 days.

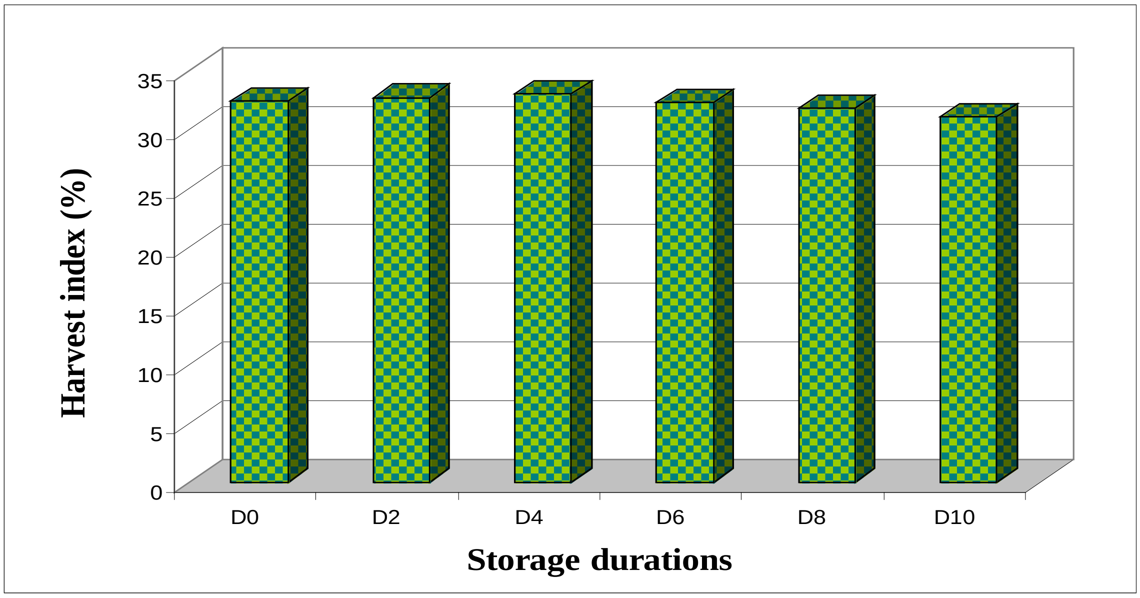

Fig. 22. Effect of storage durations of uprooted seedlings on harvest index (LSD $_{0.05}$ = NS) of aromatic rice.

4.2.12.3 Interaction effect of storage condition and storage duration

The interaction effect of storage condition and storage duration was significant on harvest index (Table 6). The maximum harvest index (34.45 %) was obtained from the seedlings stored on mud for 4 days which was significantly higher than all other treatments. But it was statistically identical with that stored on mud for 2, 4, 6 days and in water for 0, 2, 4 days. The lowest harvest index (25.93 %) was resulted from the seedlings stored in water for 10 days was statistically identical with that stored on mud for 10 days and in water for 10, 8 days.

CHAPTER V

SUMMARY AND CONCLUSION

An experiment was conducted at the Agronomy Field Laboratory, Sher-e-Bangla Agricultural University, Dhaka during the period from July to December, 2006 to asses the effect of seedling storage conditions and durations on the performance of transplant aman cv. BRRI dhan 38. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experimental treatments consisted of 2 storage conditions (seedlings were kept on mud and in water after uprooting) and 6 storing durations (0, 2, 4, 6, 8 and 10 days storage of seedlings).

Data were collected on different parameters such as plant height, number of total tillers hill^{-1}, total dry weight of plant, number of total hills m^{-2}, number of effective and non-effective tillers hill^{-1}, panicle length, number of filled and unfilled grains panicle^{-1}, 1000 grains weight, grain yield, straw yield and biological yield.

The parameters such as plant height, number of tillers hill^{-1}, total dry matter production, nmber of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, number of total grain panicle^{-1}, number of filled panicle^{-1}, number of unfilled grains panicle^{-1}, grain yield, straw yield and biological yield were significantly influenced due to the storage conditions. The seedlings stored on mud appeared to be the best followed by those stored in water for almost all the studied crop parameters.

The storage periods of uprooted seedlings also exhibited significant effect on the studied crop parameters which were plant height, number of tillers hill^{-1}, total dry matter production, number of total hills m^{2}, number of effective tillers hill^{-1}, number of non-effective tillers hill^{-1}, number of total grain panicle^{-1}, number of filled grain panicle^{-1}, grain yield, straw yield and biological yield. There was a regular trend of decrease in the values of the studied crop parameters with the increase in the durations of storage from 0 to 10 days.

The effect of interaction between storage conditions and storage durations of the uprooted seedlings was found to be significant for plant height, number of tillers hill^{-1} at 45 DAT and at harvest, total dry matter weight, number of total hill m^{-2}, number of filled grains panicle^{-1}, number of non-effective tillers hill^{-1}, grain yield, straw yield, biological yield and harvest index. In general, the seedlings stored on mud in combination with 0, 2, 4, 6, 8 and 10 days durations showed superiority over those stored in water.

Based on the result of the present study the following conclusion may be made –

1. Storing the uprooted seedlings in mud showed better performance on most of the growth parameters, yield and yield contributing characters.

2. In case of emergency the uprooted seedlings could be stored on mud up to 4 days and in water up to 2 days without any appreciable loss in grain yield.

However, to reach a specific conclusion and recommendation, more research work on storage conditions and durations should be done over different agro- ecological zones involving more varieties.

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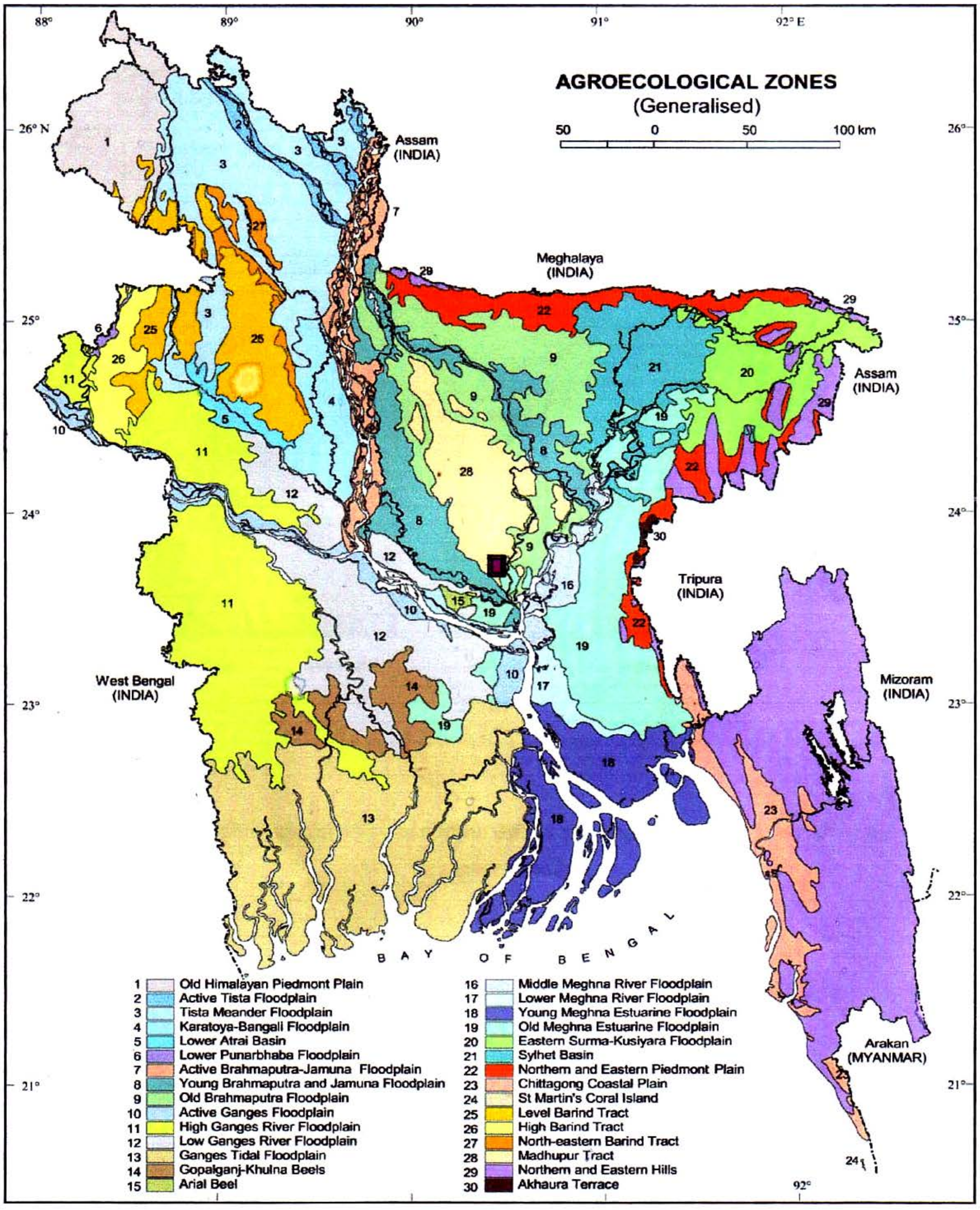
APPENDICES

Appendix I. Map showing the experimental site



The experimental site under study

Appendix II: Characteristics of experimental soil was analyzed at Soil Resources Development Institute (SRDI), Farmgate, Dhaka.

A. Morphological characteristics of the experimental field

Morphological features	***Characteristics***
Location	Agronomy Farm, SAU, Dhaka
AEZ	Modhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Not Applicable

Source: SRDI

B. Physical and chemical properties of the initial soil

Characteristics	*Value*
Partical size analysis	
% Sand	25
%Silt	41
% Clay	34
Textural class	Silty-clay
pH	5.7
Organic carbon (%)	0.49
Organic matter (%)	0.80
Total N (%)	0.03
Available P (ppm)	23.00
Exchangeable K (me/100 g soil)	0.11
Available S (ppm)	46

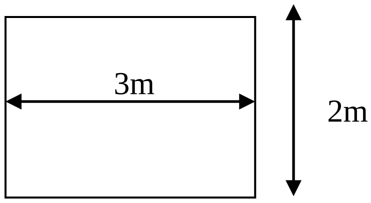
Source: SRDI

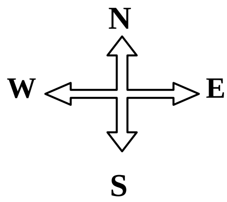
Appendix III: Monthly record of air temperature, rainfall, and relative humidity during the period from July-December, 2006

Month	***RH (%)***	***Air temperature (^oC)***			***Rainfall (mm)***
		Max.	***Min.***	***Mean***	
July	81	31.4	25.8	28.6	542
August	82	32.0	26.6	29.3	361
September	81	32.7	26.0	29.35	514
October	80	30.5	24.3	27.4	417
November	72	29.0	19.8	24.4	3
December	66	27.0	15.6	21.3	0

Source: Bangladesh Meterological Department (Climatic Division), Agargaon, Dhaka-1207.

Appendix IV. Lay out of experimental field





C_1D_{10}	C_2D_6	C_1D_8	C_2D_2	C_2D_2	C_1D_4
C_2D_0	C_1D_2	C_1D_4	C_1D_0	C_1D_{10}	C_2D_6
C_1D_4	C_1D_8	C_2D_{10}	C_2D_8	C_1D_6	C_2D_8
C_2D_8	C_1D_0	C_2D_6	C_1D_{10}	C_2D_4	C_1D_0
C_1D_6	C_2D_{10}	C_1D_2	C_2D_4	C_2D_0	C_1D_2
C_2D_2	C_2D_4	C_2D_0	C_1D_6	C_1D_8	C_2D_{10}

$\longleftrightarrow$ R_1 $\longleftrightarrow$ R_2 $\longleftrightarrow$ R_3