INFLUENCE OF HALO PRIMING ON GROWTH AND YIELD OF THREE CHILLI VARITIES (*Capsicum annuum*)

MD. IMAMUL ISLAM

INSTITUTE OF SEED TECHNOLOGY

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

DHAKA-1207

JUNE, 2017

INFLUENCE OF HALO PRIMING ON GROWTH AND YIELD OF THREE CHILLI VARITIES (*Capsicum annuum*)

By

MD. IMAMUL ISLAM
REGISTRATION NO. 11-04506

A Thesis
submitted to the Institute of Seed Technology,
Sher-e-Bangla Agricultural University, Dhaka,
in partial fulfilment of the requirements
for the degree of

MASTER OF SCIENCE

IN

SEED TECHNOLOGY

SEMESTER: JANUARY-JUNE, 2016

Approved by:

(Prof. Dr. A.K.M. Ruhul Amin)	**(Prof. Dr. Tahmina Mostarin)**
Supervisor	**Co-supervisor**

(Prof. Dr. Mohammad Ali)
Chairman
Examination Committee

CERTIFICATE

*This is to certify that the thesis entitled "**INFLUENCE OF HALO PRIMING ON GROWTH AND YIELD OF THREE CHILLI VARITIES (Capsicum annuum)**" submitted to the Institute of Seed Technology, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M.S.)** in **SEED TECHNOLOGY**, embodies the results of a piece of bona fide research work carried out by **MD. IMAMUL ISLAM**, Registration. No. **11-04506** under my supervision and guidance. No part of this 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:

Dhaka, Bangladesh

(Prof. Dr. A.K.M. RUHUL AMIN)
Supervisor

ACKNOWLEDGEMENTS

All praises to Almighty Allah, the Supreme Ruler of the universe who enables the author to complete this present piece of work.

The author would like to express his heartfelt gratitude to his research supervisor, ***Prof. Dr. A.K.M. Ruhul Amin****, Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207, for his constant supervision, valuable suggestions, scholastic guidance, continuous inspiration, constructive comments, extending generous help and encouragement during the research work and guidance in preparation of manuscript of the thesis.*

The author sincerely expresses his heartiest respect, deepest sense of gratitude and profound appreciation to his co-supervisor ***Prof. Dr. Tahmina Mostarin****, Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka-1207, for her constant encouragement, cordial suggestions, constructive criticisms and valuable advice during the research period and preparing the thesis.*

The author would like to express his deepest respect and boundless gratitude to all the respected teachers of the Institute of Seed Technology, Sher-e-Bangla Agricultural University, Dhaka-1207, for the valuable teaching, sympathetic co-operation and inspirations throughout the course of this study and suggestions and encouragement to research work.

The author would like to express his cordial thanks to his friends Md. Maskurur Rahman and the departmental and field staff for their active help during the experimental period.

At last but not the least, the author feels indebtedness to his beloved parents whose sacrifice, inspiration, encouragement and continuous blessing paved the way to his higher education.

June, 2017

INFLUENCE OF HALO PRIMING ON GROWTH AND YIELD OF THREE CHILLI VARITIES (*Capsicum annuum*)

ABSTRACT

The experiment was conducted to study the influence of seed priming and yield comparison of three chilli genotypes (*Capsicum annuum*) in the laboratory and then at the net house of Agronomy field, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh during June to October, 2016. Treatments consisted of three different varieties of chilli: V_1= Bona (local), V_2= BARI Morich-1 (HYV) and V_3= Siam Hot (hybrid), and four levels of priming with sodium chloride: S_0= Control, S_1= 3 dS/m, S_2= 6 dS/m, S_3= 9 dS/m. The experiment was laid out following Completely Randomized Design (CRD) with three replications. Result revealed that germination, seedling growth and yield of chilli was significantly influenced by variety and priming where BARI Morich-1, 3 dS/m, and BARI Morich-1 with 3 dS/m gave the highest germination percentage (75.42%, 60.56%, and 88.33%, respectively). The highest number of marketable fruit was obtained from BARI Morich-1, 6 dS/m, and BARI Morich-1 with 6 dS/m (97, 94, and 111, respectively). The highest yield of the interaction treatment was attributed to the dry weight of seedling as well as the highest number of capsule plant^{-1} and total dry weight of capsule. Therefore, it can be concluded that the priming with sodium chloride (3 or 6 dS/m) had a positive impact on BARI Morich-1 (HYV) of chilli.

LIST OF CONTENTS

LIST OF CONTENTS (Cont.)

LIST OF CONTENTS (Cont.)

LIST OF CONTENTS (Cont.)

LIST OF CONTENTS (Cont.)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF PLATES

LIST OF ABREVIATION

AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
Co	Cobalt
CV%	Percentage of coefficient of variance
cv.	Cultivar
DAE	Days after emergence
DAS	Days after sowing
^{0}C	Degree Celsius
et al	And others
FAO	Food and Agriculture Organization
g	gram(s)
ha^{-1}	Per hectare
HI	Harvest Index
kg	Kilogram
Max	Maximum
mg	Milligram
Min	Minimum
MoP	Muriate of Potash
N	Nitrogen
No.	Number
NS	Not significant
%	Percent
SAU	Sher-e-Bangla Agricultural University
SRDI	Soil Resources and Development Institute
TSP	Triple Super Phosphate
UPOV	Union for the Protection of Plant Varieties
Wt.	Weight

CHAPTER 1

INTRODUCTION

Chilli *(Capsicum annuum* L.) is a valuable spice and also one of the most important cash crops grown in Bangladesh. It is available and used in the form of green, dried and powdered. It has become an essential ingredient in Bangladeshi meals (BBS, 2015). Chillies are the fruits or berries of plants belonging to the genus *Capsicum* under the family, Solanaceae. Chilli is one of the most important domesticated spices in Bangladesh. It is grown throughout the year and used as green and dry stages for their pungency and color (Basavaraj, 2008). Chilli contain numerous chemicals including steam-volatile oil, fatty oils, carotenoids, vitamins, protein, fiber and mineral elements (Bosland and Votava, 2000) and are used for different purposes because of their nutritional value, flavor, aroma, texture, pungency and color. *Capsicum annuum* L. also have antifungal property against fungal species belonging to *Aspergillus* and *Fusarium* (Lucca *et al.*, 2006). Chilli occupies about 227000 acres with a production of 123000 tons (BBS, 2016). Rapid, uniform and complete germination is a pre requisite for successful transplant production and stand estoblishment in vegetable crops. But delayed and non-uniform germination and poor emergence are the characteristics problem in Chillies (Demir and Ermis, 2003). It has also been reported that chilli seed germination and emergence is slow and non-uniform under normal as well as stressed conditions (Demir and Okcu, 2004). Increased emergence of plant growth regulator (PGR) primed seeds over unprimed seeds is in accordance with the findings of Afzal *et al.* (2005). His findings also shown that PGR seed priming also induced salt tolerance in Chilli seedlings. Seed priming with different salts, especially NaCl, have shown to improve germination and growth of many crops under stressed conditions (Sivritepe and Sivritepe, 2007). Maximum increase in germination and other seedling parameters was witnessed in halopriming and in osmopriming. It could also improve the performance of

crop by alleviating the effect of salts under saline soil conditions (Mohammadi 2009).

Research on priming has proved that crop seeds primed with water germinated early, root and shoot development started rapidly, grew more vigorously and seedling length was also significantly greater than nonprime seeds. It could also improve the performance of crop by alleviating the effect of salts under saline soil conditions (Mohammadi *et al*., 2009). Khan *et al*. (2009) evaluated the response of seeds primed with NaCl solution (1 mM) at different salinity levels 0, 3, 6 and 9 dS/m in relation to early growth stage and concluded that seed priming with NaCl has been found to be better treatment as compared to non-primed seeds in case of hot pepper for improving the seedling vigour and stand establishment under salt stressed conditions. Seed treatment will play an important role in protecting the seeds and seedlings from seed borne diseases and insect pests affecting crop emergence and its growth. (Nicholas and Steven, 2013). Priming enhances seed performance under normal as well as under saline conditions and this technique is considered as feasible and very cheap (Souguir *et al.,* 2013). Cold, drought and salinity stresses are the most important abiotic stresses responsible of crop failure worldwide, decreasing average yields for most major crops by more than 50% leading to significant losses attaining hundreds of million dollars each year (Mahajan and Tuteja, 2005) which represents a serious menace for the sustainability of agricultural industry (Mahajan and Tuteja, 2005).

Priming of seeds of different crops alleviates the adverse effects of salinity stress and enhance crop yield (Ahmed, *et al.* 1998; Hedegree and Varite 2000; Harris *et al*., 1999; Pill and Kilan, 2000). Pepper is an important, widespread agricultural crop in the Mediterranean area, grown commercially in semi-arid regions where salinity is a potential problem and farmers are forced to use saline water, this being the major yield-limiting factor for crops and the cause of damage to soil physicochemical properties (Biswas, 1993).

Furthermore, salinity also affected Chilli production. There is a very little work has conducted on seed priming of Chilli. So, there is a scope to take research in this aspect. Thus, the present study was carried out by the following objectives:

- To evaluate the effect of priming in comparison with unprimed seeds on emergence, seedling vigor and yield,
- To evaluate the effects of different levels of NaCl on the germination, subsequent seedling growth and yield of chilli, and
- To compare the performance of the local, high yielding and hybrid chilli variety with priming of seed.

CHAPTER 2

REVIEW OF LITERATURE

A field (Tob) experiment was conducted at the Sher-e-Bangla Agricultural University farm to study the influence of halo priming on growth and yield of three chilli varities (*Capsicum annuum*). Some related research findings of home and abroad have been cited below:

2.1. Effect of seed priming on germination and seedling growth

Among the abiotic stresses, salinity is a major limiting factor in the crop productivity all over the world. Salinity affects almost every aspect of the physiology and biochemistry of plants which in turn significantly reduces yield (Ashraf, 1994; Parida and Das, 2005) being a major environmental factor (Ashraf and McNeilly, 1987; Munns, 2002). It has been estimated that 20% of cultivated area of the world and half of the world's irrigated lands are affected by the salinity (Szabolcs, 1994; Flower and Yeo, 1995; Chinnusamy *et al.*, 2005). Soil salinity, if not properly managed, can become a limiting factor for chilli stand estoblishment (Flynn *et al.*, 2003) causing decrease in germination rate and germination percentage of pepper seeds (Chartzoulakis and Klapaki 2000).

Seed germination and early seedling growth are the most sensitive stages which are stressed by salinity in most of the crops (Sivritepe *et al.*, 2003; Ashraf and Foolad, 2005). Salinity adversely affects seeds and seedlings and greatly contributes in estoblishment of poor stand and eventually poor production of vegetable crops (Grassbaugh and Bennett, 1998).It has also been reported that chilli seed germination and emergence is slow and non-uniform under normal as well as stressed conditions (Demir and Okcu, 2004). Soil salinity, if not properly managed, can become a limiting factor for chilli stand establishment (Flynn *et al.*, 2003) causing decrease in germination rate and germination percentage of pepper seeds (Chartzoulakis, 2000). Seed priming is a technique of seed enhancement that improves germination or seedling growth and rate or uniformity of the seedling establishment (Taylor *et al.*, 1998).

Seed priming improves seed performance by rapid and uniform germination, normal and vigorous seedlings, which resulted in faster and better germination and emergence in different crops (Pill, 1995; Warren and Bennet, 1997; Powell *et al.*, 2000; Cantliffe, 2003). This also helps seedlings to grow in stressed conditions (Welbaum, *et al.*, 1998; Ashraf and Foolad, 2005; Carbineau and Come, 2006). Seed priming is a technique of seed enhancement that improves germination or seedling growth and rate or uniformity of the seedling establishment (Taylor *et al.*, 1998). Seed priming with different salts, especially NaCl, have shown to improve germination and growth of many crops under stressed conditions (Sivritepe *et al.*, 1999; Sivritepe *et al.*, 2003; Omami, 2005; Basra *et al.*, 2005; Esmaielpour *et al.*, 2006; Sivritepe and Sivritepe, 2007). Improvement of germination in pepper plant by priming with water and NaCl has also been reported (Smith and Cobb, 1991).

Many authors have concluded that seed priming ameliorates the uniformity of germination and the final germination percentage of seeds compared with control (Basra *et al.*, 2002; Farooq *et al.*, 2004; Souguir *et al.*, 2013). Also, priming improves seed performance by activating the synthesis of many proteins and enzymes involved in cell metabolism such as carbohydrates (α and β amylases) and lipids mobilization (isocitrate lyase), which are implicated in the mobilization of storage reserves (Varier *et al.*, 2010). So, priming enhances seed performance under normal as well as under saline conditions and this technique is considered as feasible and very cheap (Souguir *et al.*, 2013).

2.2. Effect of priming on yield

Poor seedling emergence and seedling vigor cause poor establishment in crops. For which different seed treatment practices have been adopted in different crops. Post-harvest seed enhancement treatments improve germination and seedling vigor. Priming of seeds of different crops alleviates the adverse effects of salinity stress and enhance crop yield (Ahmed, 1988; Harris *et al.*, 1999; Hedegree *et al.*, 2000; Pill and Khan, 2000). Seed pre-soaking causes hydration

of membrane proteins and initiation of several metabolic processes and re-drying of seeds arrest the process (Bewelley, 1982). On the other hand osmo-priming of seeds with NaCl nullify the adverse effects of salt stress (Watkinson and Pill, 1998). Interesting, under salt stress, the seedling of tomato emerges earlier in NaCl-primed seeds than the non-primed seeds (Cayuella, 1996). Similarly, hydro-priming improved germination and later growth of different crops species such as maize, rice, and chickpea (Harris, 1999). This technique has been employed to increase germination rate and seedling vigor in several vegetable crops. Conversely, there is a general consensus that priming decreases longevity.

Priming of seeds is a well-established technology to improve seed emergence and seedling vigor. Gupta *et al*. (2008) made during the rainy season, 2010. In an earlier study carried out during rabi season, different priming techniques were adopted. It was reported that primed seeds of tomato, chilli, okra, water-melon, cabbage and cucumber showed higher seedling vigor and yield compared to control. To confirm this, experiments were conducted during last rainy season in few vegetable crops, though due to heavy rain the response was lower as mentioned below.

The technology is described in the following. There are several seed priming methods such as hydro-priming, osmotic priming and halo-priming. Seeds are soaked in three different methods viz. water for hydro-priming, KNO3 (3%) for halo-priming and polyethylene glycol (PEG) -1.0 MPa for osmotic priming. Thereafter, the treated seeds are allowed to shade dry for 4-5 days. In this study, different priming techniques were applied on hybrids of eight vegetable crops such as tomato, okra, chilli, Bottle gourd, ridge gourd, spong gourd, onion and cucumber. The time required for treatment is standardized in previous experiments. For example, in the case of hydro-priming it was noted first the time required for each species to initiate germination. On the basis of that, two times were selected; suboptimum near to the initiation of germination for example 20 hours and another half of this viz. 10 hours in the case of

tomato. The selection of time varies according to the species and cultivars. Two replications for each treatment of each species were employed.

It was conducted one experiment in all the species mentioned above. Seeds were soaked in 3 different ways: water for hydro-priming, 3 % KNO3 solution for halo-priming and polyethylene glycol (-1.0 MPa) solution. And at last review on seed priming. Molecular markers have been identified for priming of seeds in chilli (Lanteri *et al.*, 2000). It is reported that aerated hydration treatment of pepper at 25^0C followed by drying increased germination percentage (Demir and Okcu, 2004). Different seed enhancement and priming techniques have been documented by Maiti *et al.* (2009). Maiti *et al.* (2009) studied the effect of priming on seedling vigor and productivity of tomato, chilli, cucumber and cabbage during post-rainy seasons, demonstrating that priming improved germination and seedling development and yield of these vegetable species. They used hydro-priming, halo-priming, and osmo-priming treatments. It is observed that few priming technique improved seedling emergence, seedling vigor as well as agronomic traits including yield of the crop species. These findings clearly demonstrated that in all the crops studied, the priming technique improved growth and yield of all the crops showing variations among treatments.

Furthermore, chilli yield is reduced upto 14% for every increase in unit of salinity above its threshold (Rhoades *et al.*, 1992). Maas (1986) and recently, Niu *et al*. (2010) reported that plant tolerance to salinity is usually evaluated in one of the three following ways: (1) the ability of a plant to survive on saline soils, (2) the absolute plant growth or yield, and (3) the relative growth on saline soils as compared with that on non-saline soils. Although plant response to saline water can vary greatly depending, among other factors, on the specific characteristics of the plants (Barbieri, 1995), the response in this experiment of pepper, grown under commercial conditions, to moderate salinity was similar to those found in previous studies with pepper grown in nutrient solution (Navarro *et al*., 2002). However, the marketable yield as a percentage of total yield was affected less by salinity, the values being 87% for control plants and

73% and 66% for 15 and 30 mM NaCl, respectively, since the mean weight of marketable fruits was increased with regard to total mean weight (24%, 38% and 51% for control, 15 and 30 mM NaCl, respectively). The salt tolerance of pepper plants is cultivar-dependent (Chartzoulakis and Klapaki, 2000) and new commercial varieties are more sensitive to salinity than older ones (Navarro *et al*., 2002).

Salinity had no effect on fruit firmness of peppers as we found in previous studies with salinity levels similar to those used in this experiment (Navarro *et al.*, 2002). Some authors have found an increase of fruit firmness with fruit age (Gu *et al*., 1999; Tadesse *et al*., 2002) however; we observed a similar increase with maturation only for saline treatments and a decrease with maturation for control fruits. The responses of pH and acidity to salinity depended on the maturity state. Salinity decreased pH and increased acidity of the fruit juice for red fruits, but the contrary was observed with green fruits although the decrease of acidity was not significant. The lower pH values for NaCl treated versus control plants found in red peppers could be due to an increase in organic acid concentrations, probably due to a higher ratio of inorganic cation/anion uptake (Davies, 1964).

CHAPTER 3

MATERIALS AND METHODS

The experiment was conducted at the net house of Agronomy field, Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from June to October, 2016. The experiment was conducted to study the influence of halo priming on growth and yield of three chilli varities (*Capsicum annuum*). Detailed of the experimental materials and methods followed in the study are presented in this chapter.

3.1 Site description

3.1.1 Geographical location

The experimental area was situated at 23°77′N latitude and 90°33′E longitude at an altitude of 8.6 meter above the sea level (Anon., 2004).

3.1.2 Agro-ecological region

The experimental field belongs to the Agro-ecological zone of "The Modhupur Tract", AEZ-28 (Anon., 1988a). This was a region of complex relief and soils developed over the Modhupur clay, where flood plain sediments buried the dissected edges of the Modhupur Tract leaving small hillocks of red soils as 'islands' surrounded by floodplain (Anon., 1988b).

3.1.3 Climate

The area has sub-tropical climate, characterized by high temperature, high relative humidity and heavy rainfall with occasional gusty winds in Kharif season (April-September) and scanty rainfall associated with moderately low temperature during the Rabi season (October-March). Weather information regarding temperature, relative humidity and rainfall prevailed at the experimental site during the study period were presented in Appendix I.

3.1.4 Soil

The soil of the experimental site belongs to the general soil type, Shallow Red Brown Terrace Soils under Tejgaon Series. Top soils were clay loam in texture, olive-gray with common fine to medium distinct dark yellowish brown mottles. Soil pH ranged from 5.6-6.5 and had organic matter 1.10-1.99%. The experiment was conducted in tob and the soil was collected from SAU Agronomy farm field. The analyses were done by Soil Resource and Development Institute (SRDI), Dhaka. The physical and chemical properties of the soil were presented in Appendix II.

3.2 Details of the experiment

3.2.1 Treatments

The experiment consisted of 2 factors:

Factors A: Varieties of Chilli-3

They were-

(a) V_1 = Bona (local)
(b) V_2 = BARI Morich-1 (HYV)
(c) V_3= Siam Hot (hybrid)

Factors B: Priming level-4

There were four levels of saline solution. They were-

(a) S_0 = 0 (Control)
(b) S_1 = 3 dS/m
(c) S_2 = 6 dS/m
(d) S_3 = 9 dS/m

Treatment combination

S_0V_1, S_1V_1, S_2V_1, S_3V_1, S_0V_2, S_1V_2, S_2V_2, S_3V_2, S_0V_3, S_1V_3, S_2V_3, S_3V_3

3.2.2 Experimental design and layout

The experiment was laid out in a factorial CRD design with three replications. There were 12 treatment combinations. The total numbers of tobs were 36.

3.3 Experiment petridis

Thirty six petridis were collected from the agronomy laboratory of Sher-e-Bangla Agricultural University. Glass petri-dishes (9cm in diameter) were used in conducting the laboratory experiment.

3.3.1 Preparation of experimental petridis

The petri-dishes were firstly washed and then dried. After drying the petri-dishes were ready for experiment. Sand was used as a matrix for seed germination. Sands were cleaned properly. The cleaned sands were then washed with distilled water. After washing the sands were dried in the sun properly. The sands were then poured in petridis.

3.4 Experimental tob

The thirty six tob were collected from Agargoan market. The diameter of the tab was 32 cm and the height of the tob was 45 cm.

3.4.1 Preparation of experimental tob

The tobs were prepared by adding 8.5 kg (app.) soil in each tob with cow dung 0.5 kg, urea 15g, TSP 20 g, and 15 g.

3.5 Crop/planting material

Bona (local), BARI Morich-1 (HYV), Siam Hot (hybrid) were used as plant material.

3.6 Seed collection

Seeds of BARI Morich-1(HYV) were collected from Spice Research Centre, BARI, Joydebpur, Gazipur, Bangladesh. Bona (local) was collected from Rajabazar, Bogra. Siam Hot (hybrid) was collected from Siddique Bazar, Dhaka.

3.6.1 Description of varieties

BARI Morich-1(HYV)

The seeds of BARI Morich-1(HYV), Bona (local), Siam Hot (hybrid) Chilli varieties were used as experimental material. BARI Morich-1 was developed by Horticulture Research Centre, (BARI), Gazipur. The plants life cycle lasts for 135-140 days (seed to seed) and asynchronous type. The plants are dwarf and spreading, average plant height (30-35cm), average no. of fruits/plant (400-500), average fruit weight (1.5-2.00g), average yield per plant (700-750g).

Bona (local)

Bona (local) was developed in Bogra region. The plants life cycle lasts for 145-160 days (seed to seed) and asynchronous type. The plants are dwarf and spreading, average plant height (25-30cm), average no. of fruits/plant (450-550), average fruit weight (1.2-1.7g), average yield per plant (680-730g).

Siam Hot (hybrid)

Siam Hot (hybrid) was developed by Chia Tai Seeds Co. Ltd, Thailand and imported by Zillion Seed Co., Jamalpur, Bangladesh. The plants life cycle lasts for 145-160 days (seed to seed) and asynchronous type. The plants are dwarf and less spreading, average plant height (32-37cm), average no. of fruits/plant (250-350), average fruit weight (2.2-2.7g), average yield per plant (800-850g).

3.6.2 Fertilization

The recommended chemical fertilizer doses were cow dung 0.5 kg, urea 15 g, TSP 20 g, and 15 g per tob. (source: BARI, Fertilizer recommendation guide).

3.6.3 Preparation of saline solution

There were four (4) salinity levels including control where development of salinity by adding respected amount of commercial NaCl salt to the soil/pot as water dissolved solution. The salinity levels were S_0 (control, i.e. no salt

added), S_1 (3dSm^{-1}), S_2 (6dSm^{-1}), and S_3 (9dSm^{-1}). The sodium chloride was weighed by an electric balance in 0, 15, 30, and 45, g/1000ml, respectively. Soil salinity was found 0 dSm^{-1}, 3 dSm^{-1}, 6 dSm^{-1}, and 9 dSm^{-1} as denoted by S_0, S_1, S_2, and S_3 respectively.

3.7 Crop management

3.7.3 Collection and preparation of initial soil sample

The tobs were filled with soils which were collected from SAU research field. Soil was collected from 0-15 cm soils depth. After collection of soil samples, the plant roots, leaves etc. were removed. Then the samples were air-dried and sieved through a 10-mesh sieve and stored in a clean plastic container for physical and chemical analysis.

3.7.2 Seed sowing

In petridis: Seeds were sowed for germination test on 13 June, 2016 in petridis where every petridis contain 25 seeds. Seeds were sowed as per treatment and design. Before sowing seeds were soaked in 3 levels (3 dS/m, 6 dS/m, 9 dS/m) of saline solution for 2 days then the seeds ware dried for 9 hours.

Seedling transplanting in tob: Healthy and uniform 25 days old chilli seedlings were transplanted in the experimental pots on 08 July, 2016. The seedlings were uprooted carefully from the petrisis to avoid damage to the root system. This allowed an accommodation of one plants per pot. Immediately after planting, the seedlings were watered.

3.7.3 Fertilizer application

All the fertilizers along with half of urea were applied at the soil of tob before planting. After first flowering stage rest half urea fertilizer was applied.

3.7.4 Intercultural operations

3.7.4.1 Weeding

The crop was infested with some weeds during the early stage of crop establishment. Two hand weedings were done, first weeding was done at 15 days after sowing followed by second weeding at 15 days after first weeding.

3.7.4.2 Application of irrigation water

Irrigation water was added to each tob, irrigation was done regularly with 2 days interval up to germination. After germination irrigation was done when needed.

3.7.4.3 Drainage

There was a heavy rainfall during the experimental period. Drainage system was properly prepared to easy and quick drained out of excess water from tob.

3.7.4.4 Plant protection measures

The crop was infested by insects and diseases, those were effectively and timely controlled by applying recommended insecticides and fungicides. In spite of Cirocarb 3G applications during final land preparation few young plants were damaged due to attack of mole cricket and cut worm. Cut worms were controlled both mechanically and spraying Darsban 29 EC @ 3%. Some of plants were infected by *Alternaria* leaf spot diseases caused by *Alternariabrassicae*. To prevent the spread of the disease Rovral @ 2 gm per liter of water was sprayed in the pots.

3.7.5 Harvesting and post-harvest operation

Maturity of crop was determined when 60-70% of the capsules become marketable. The harvesting was done up to 23 October, 2016. Capsules were collected at 20 days intervals. The capsules were harvested and packed, properly tagged and then brought to the threshing floor for recording number of capsules per plant and for different data. The capsules were sun dried to a

moisture content of 12%. Plants were uprooted 1st November and sun dried properly. Finally capsule and stover yields of each plant were determined.

3.7.6 Recording of data

Emergences of seedlings were counted from starting to a constant number of seedlings of each petridis in laboratory. Tob experimental data were determined from 25 days of growth duration and continued until harvest. Dry weights of plant were collected by harvesting each plant. The following data were recorded during the experimentation.

A. Seed quality data during priming

1. Speed of germination (%)
2. Germination percentage
3. Root length
4. Shoot length
5. Seedling length
6. Dry weight of seedling

B. Yield and other crop characters in Tob

1. Marketable capsules plant^{-1} (no.)
2. Capsule length(cm)
3. Fresh weight capsule^{-1}(g)
4. Dry weight of capsule plant^{-1}(g)
5. Dry weight plant^{-1}(g)
6. Harvest index (%)

3.7.7 Detailed procedures of recording data

A brief outline of the data recording procedure followed during the study is given below:

A. Germination and seedling growth characters in laboratory

3.7.7.1 Speed of germination (%)

Emerged plants were counted daily up to a constant number when germination stopped.

Speed of germination = (n1/d1) + (n2/d2) + (n3/d3) + - - - - - -
Where, n = number of germinated seeds, d= number of days.

3.7.7.2 Germination percentage

The germinated seedlings were counted and finally calculated germination percentage after 15 days after sowing.

$$\text{Germination percentage} = \frac{\text{Number of total germinated seeds}}{\text{Number of total seeds sown}} \times 100$$

3.7.7.3 Root length

After 15 days of growth, the seedling were up rooted and washed with distilled water to remove the foreign particles of sand. Root length of five randomly selected seedlings from each replicate was measured in centimeters (cm) from the base of hypocotyls to the tip of the longest root with the help of meter rod. The average of each replication was calculated.

3.7.7.4 Shoot length

After 15 days of growth, the seedling were up rooted and washed with distilled water to remove the foreign particles of sand. Shoot length of five randomly selected seedlings from each replicate was measured in centimeters (cm) from the base of hypocotyls to the tip of the longest Shoot with the help of meter rod. The average of each replication was calculated.

3.7.7.5 Seedling length

The root length and shoot length was added to measure the seedling length. It was taken from the average value of five seedlings.

3.7.7.6 Dry weight of seedling

The seedling were uprooted and dried at the age of 15 days. The number of uprooted seedling counted and the average dry weight of seedling was calculated.

B. Yield and other crop characters

3.7.7.7 Marketable capsules plant^{-1} (no.)

The marketable capsules were collected from each plant at 20 days interval up to final harvest and then counted total number by adding the entire collected capsule from each plant.

3.7.7.8 Capsules length (cm)

The 10 capsules were selected to measure the capsule length and then averaged them.

3.7.7.10 Fresh weight capsule^{-1}(g)

Fresh weight of ten capsules from each plant was taken and averaged them to get fresh weight of capsule.

3.7.7.11 Capsule dry weight plant^{-1}(g)

The total capsule from each plant were dried and then weighted in every 20 days of interval of harvest. Then make the sum to find out the total capsule dry weight plant^{-1}.

3.7.7.12 Dry weight plant^{-1}

The plants were uprooted after final harvest. Then dried in sun and finally collected the dry weight.

3.7.7.13 Harvest index

Harvest index denotes the ratio of economic yield (seed yield) to biological yield and was calculated with following formula (Donald, 1963; Gardner *et al*., 1985).

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

3.8 Statistical analysis

All the collected data were analyzed following the analysis of variance (ANOVA) technique using a statistical computer software IBM-SPSS (Version 20.0) and Statistix10 the means were adjusted by Tukey's Test at 0.05% level of significance.

CHAPTER IV

RESULTS AND DISCUSSION

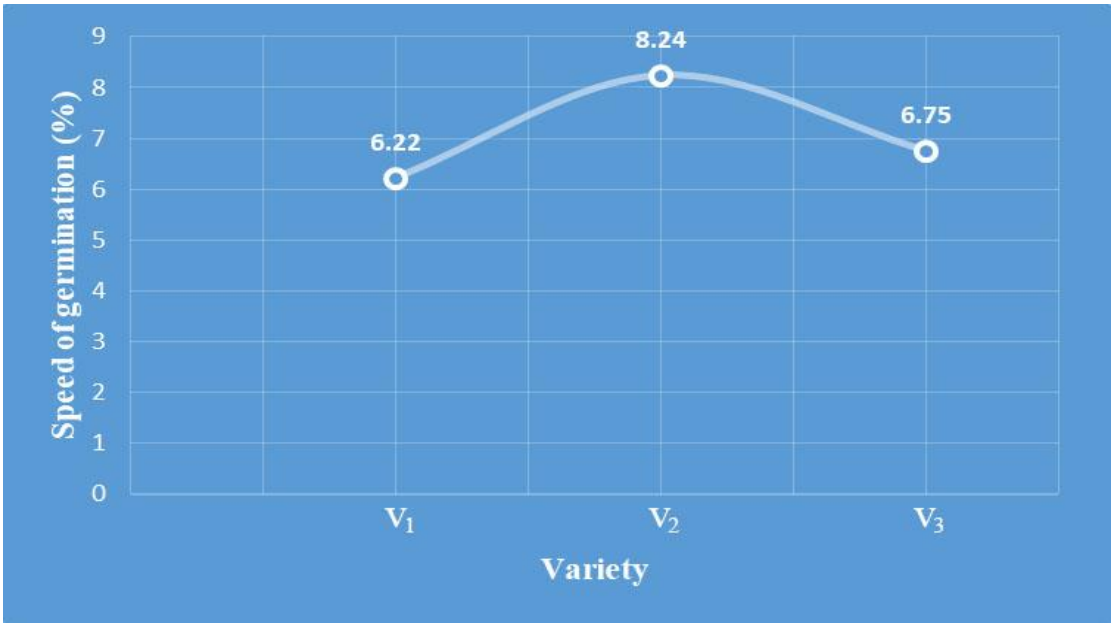
This chapter represents the result and discussions of the present study. Summary of mean square values at different parameters are also given in the appendices from III to IX.

4.1 Effect of priming with sodium chloride on chilli seed

4.1.1 Speed of germination

4.1.1.1 Effect on variety

Speed of germination had a significant impact among three chilli varieties. BARI Morich-1(V_2) showed highest speed of germination (8.24%) where Siam Hot (V_3) produced (6.76%) and Bona (V_1) produced (6.23%), respectively (Figure 1). This might be due to quick response of BARI Morich-1(V_2) on priming with sodium chloride.

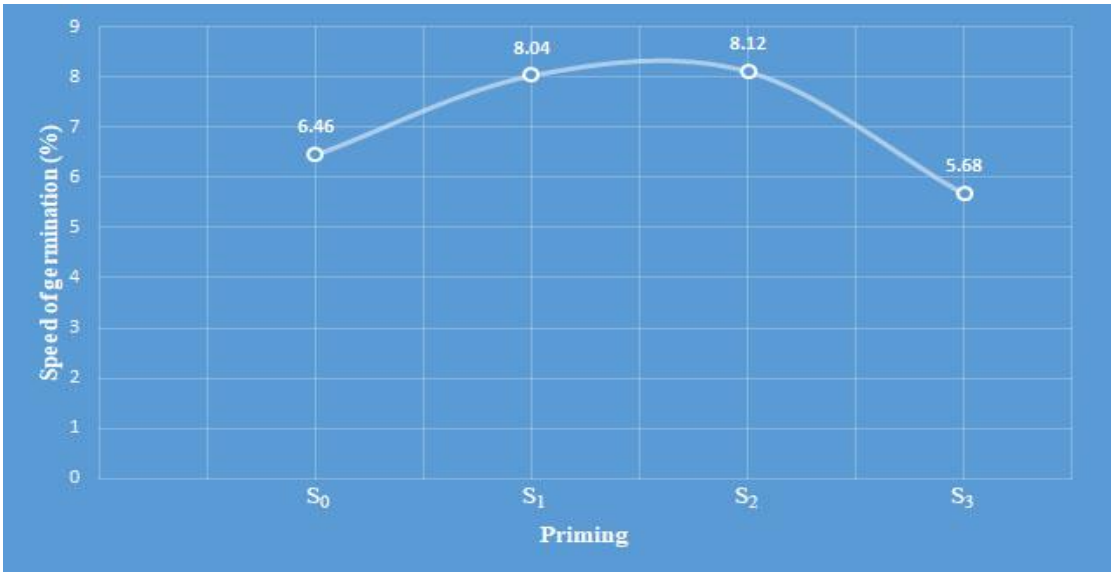


V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid).

Figure 1. Effect of variety on speed of germination of chilli ($LSD_{.05}$ = 0.4004)

4.1.1.2 Effect of priming

Speed of germination showed different response on different priming levels. All four combinations of priming levels are significant where S_2 and S_1 showed highest speed of germination (8.12% and 8.04%), respectively which showed statistically similar result. S_3 showed lowest speed of germination (5.68%) in comparison to S_2 and S_1. This might be due to the different level of priming effect on speed of germination. Many authors have concluded that seed priming ameliorates the uniformity of germination (Farooq *et al.,* 2004; Souguir *et al.,* 2013).



S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 2. Effect of priming on speed of germination of chilli ($LSD_{.05}$ = 0.511)

4.1.1.4 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result (Table 1). Where V_2S_2 showed highest result (9.54%) which was statistically similar with V_2S_1 (8.56%) and V_1S_3 showed lowest result (4.41%) which was statistically similar with V_1S_0 (5.44%) and V_2S_1 (5.47%). The level of seed priming is more high by NaCl may reduce the speed of germination.

Table 1. Interaction effect of variety and priming on speed of germination of chilli

Treatments	Speed of germination (%)
V_1S_0	5.44 ef
V_1S_1	7.41 bc
V_1S_2	7.66 bc
V_1S_3	4.41 f
V_2S_0	7.71 bc
V_2S_1	8.56 ab
V_2S_2	9.54 a
V_2S_3	7.17 cd
V_3S_0	6.24 de
V_3S_1	8.15 bc
V_3S_2	7.16 cd
V_3S_3	5.47 ef
$LSD_{.05}$	**1.15**
CV (%)	**7.64**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

4.1.2 Germination percentage

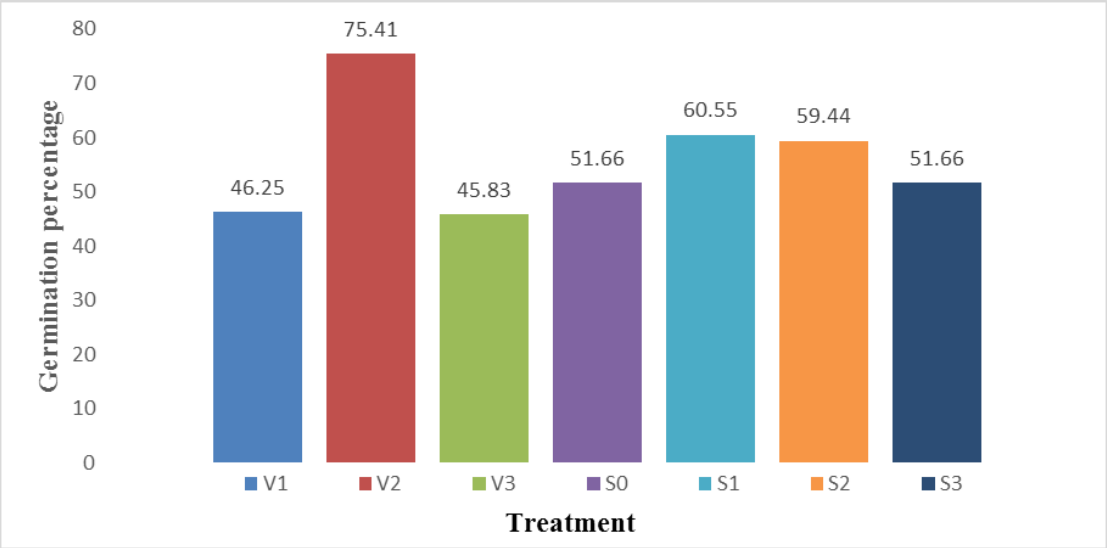
4.1.2.1 Effect on variety

Germination percentage had a significant impact among three chilli varieties. BARI Morich-1(V_2) shown highest germination percentage (75.42%) where Bona (V_1) produced (46.25%) and Siam Hot (V_3) produced (45.83%) respectively (Figure 3). Here V_1 and V_3 showed statically similar result. BARI Morich-1 (V_2) showed highest result due to quick response on priming with sodium Chloride.

4.1.2.2 Effect of priming

Germination percentage showed significant different response on different priming levels in chillies. Among the four priming levels S_1 and S_2 showed highest germination percentage (60.56% and 59.44%, respectively). S_0 and S_3 showed lowest germination (51.66%) in comparison to S_2 and S_1. This might be due to the different level of priming effect on germination percentage. The

result corroborates with the findings of Basra *et al* (2005) and Sivritepe (2007) who reported that seed priming with different salts, especially NaCl, have shown to improve germination and growth of many crops under stressed conditions.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 3. Effect of variety and priming on germination percentage of chilli ($LSD_{.05}$ = 8.73 and 11.15 for variety and priming, respectively)

4.1.2.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result (Table 2). Where V_2S_2 showed highest result (88.33%). The second highest result observed in case of V_2S_0 and V_2S_1 (73.33%) where V_3S_0 showed lowest result (36.67%). This might be the effect of priming by optimum level of NaCl. Improvement of germination in pepper plant by priming with water and NaCl has also been reported (Smith and Cobb, 1991).

Table 2. Interaction effect of variety and priming on germination percentage of chilli

Treatments	Germination (%)
V_1S_0	45 cd
V_1S_1	48.33 bcd
V_1S_2	46.67 cd
V_1S_3	45 cd
V_2S_0	73.33 ab
V_2S_1	73.33 ab
V_2S_2	88.33 a
V_2S_3	66.67 abc
V_3S_0	36.67 d
V_3S_1	60 bcd
V_3S_2	43.33 cd
V_3S_3	43.33 cd
$LSD_{.05}$	**25.28**
CV (%)	**17.38**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

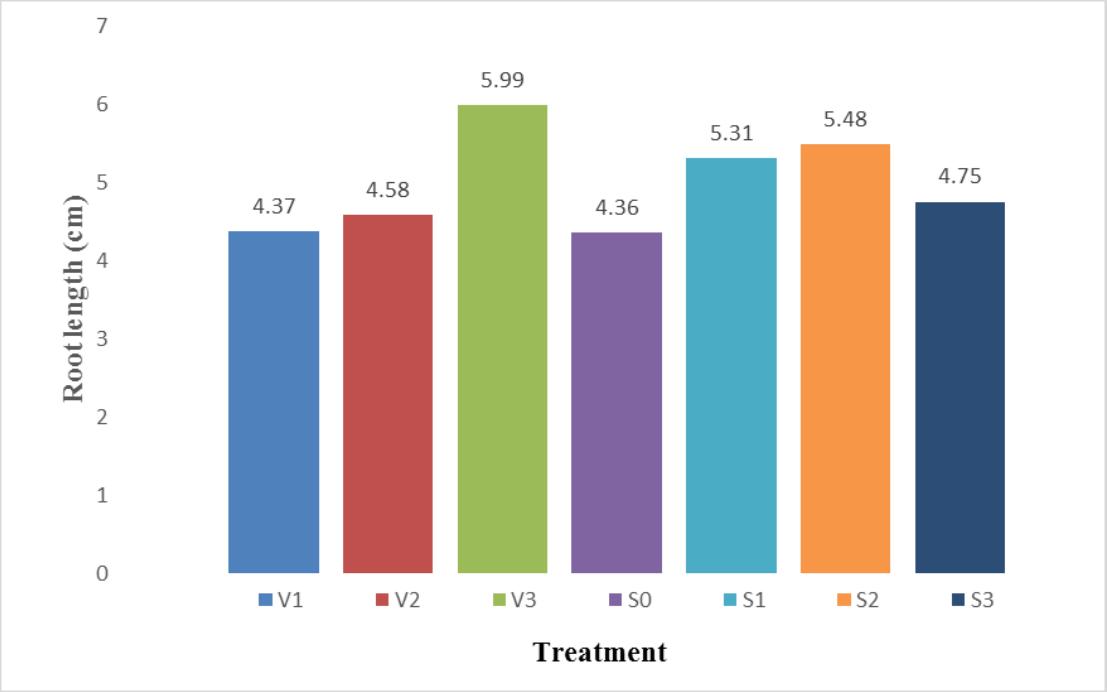
4.1.3 Root length (cm)

4.1.3.1 Effect on variety

Root length had a significant effect among three chilli varieties. Siam Hot (V_3) showed highest root length (5.99 cm) where BARI Morich-1(V_2) root length was medium (4.56 cm) and Bona(V_1) root length was short (4.37 cm) (Figure 4). This might be due to quick response of Siam Hot (V_3) on priming with sodium Chloride.

4.1.3.2 Effect of priming

Root length exhibited significant difference on different priming levels. Among the priming levels S_2 and S_1 showed highest root length (5.48 cm and 5.32 cm, respectively). These two salinity levels showed statistically similar result. S_0 showed lowest root length (4.37 cm) in comparison to others. This might be due to the different level of priming effect on root length.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 4. Effect of variety and priming on root length of chilli ($LSD_{.05}$ = 0.707 and 0.903 for variety and priming, respectively)

4.1.3.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result on root length of chilli (Table 3). Where V_3S_2 showed highest result (6.74 cm) which was statistically similar with V_3S,, V_3S_0, V_2S_3, V_2S_2, V_2S_1, V_3S_3, and V_1S_2 interaction (6.16 cm, 5.98 cm, 5.00 cm, 4.72 cm, 5.47 cm,5.08 cm and 4.99 am, respectively). Whereas V_2S_0 interaction showed the lowest root length (3.15 cm).

Table 3. Interaction effect of variety and priming on root length of chilli

Treatments	Root length (cm)
V_1S_0	3.97 cd
V_1S_1	4.33 bcd
V_1S_2	4.99 a-d
V_1S_3	4.20 bcd
V_2S_0	3.15 d
V_2S_1	5.47 abc
V_2S_2	4.72 a-d
V_2S_3	5.00 a-d
V_3S_0	5.98 abc
V_3S_1	6.16 ab
V_3S_2	6.74 a
V_3S_3	5.08 a-d
$LSD_{.05}$	**2.04**
CV (%)	**16.30**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

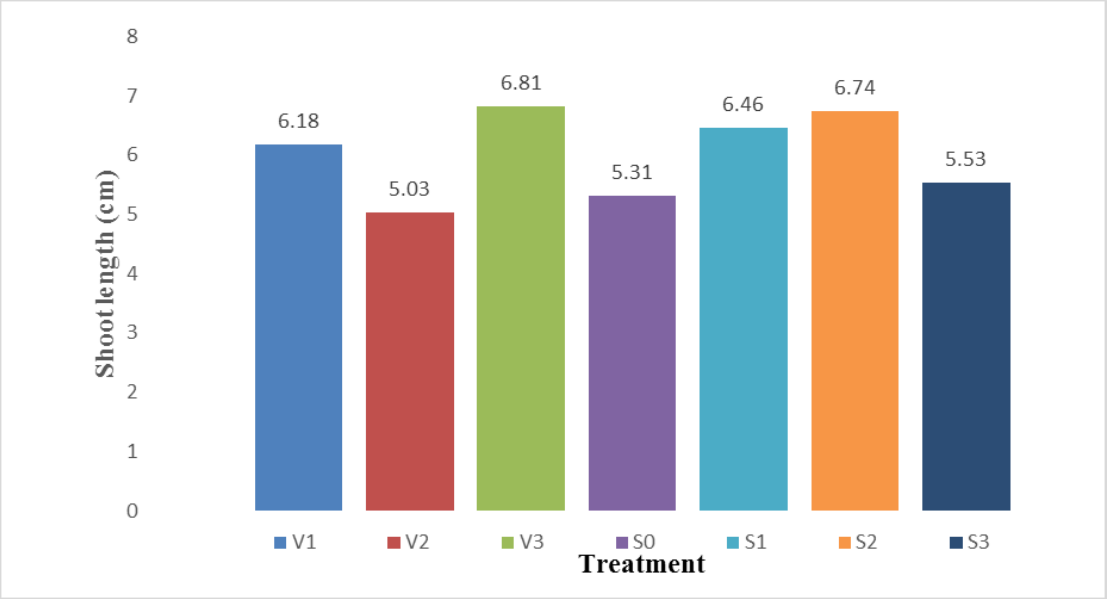
4.1.4 Shoot length (cm)

4.1.4.1 Effect on variety

Shoot length had a significant effect among three chilli varieties. Siam Hot (V_3) showed highest root length (6.81 cm) where Bona(V_1) shoot length was medium (6.18 cm) and BARI Morich-1(V_2) shoot length was short (5.04 cm). (Figure 5). This might be due to quick response of Siam Hot (V_3) on priming with sodium Chloride.

4.1.4.2 Effect of priming

All four combinations of priming levels were statistically significant where S_2 and S_1 showed highest shoot length (6.76 cm and 6.46 cm, respectively). S_3 and S_0 showed shorter shoot (5.50 cm and 5.31 cm, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on shoot length.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 5. Effect of variety and priming on shoot length of chilli ($LSD_{.05}$ = 0.773 and 0.986 for variety and priming, respectively)

4.1.4.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result (Table 4). Interaction V_3S_2 and V_3S_1 showed highest shoot length (7.68 cm and 7.51 cm, respectively) which were statistically similar. On the other hand V_2S_3 showed shoot length (4.44 cm).

Table 4. Interaction effect of variety and priming on shoot length of chilli

Treatments	Shoot length (cm)
V_1S_0	5.47 abc
V_1S_1	6.67 a
V_1S_2	6.93 ab
V_1S_3	5.67 abc
V_2S_0	4.83 bc
V_2S_1	5.22 bc
V_2S_2	5.67 abc
V_2S_3	4.44 c
V_3S_0	5.64 abc
V_3S_1	7.51 a
V_3S_2	7.68 a
V_3S_3	6.41 abc
$LSD_{.05}$	**2.23**
CV (%)	**11.94**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

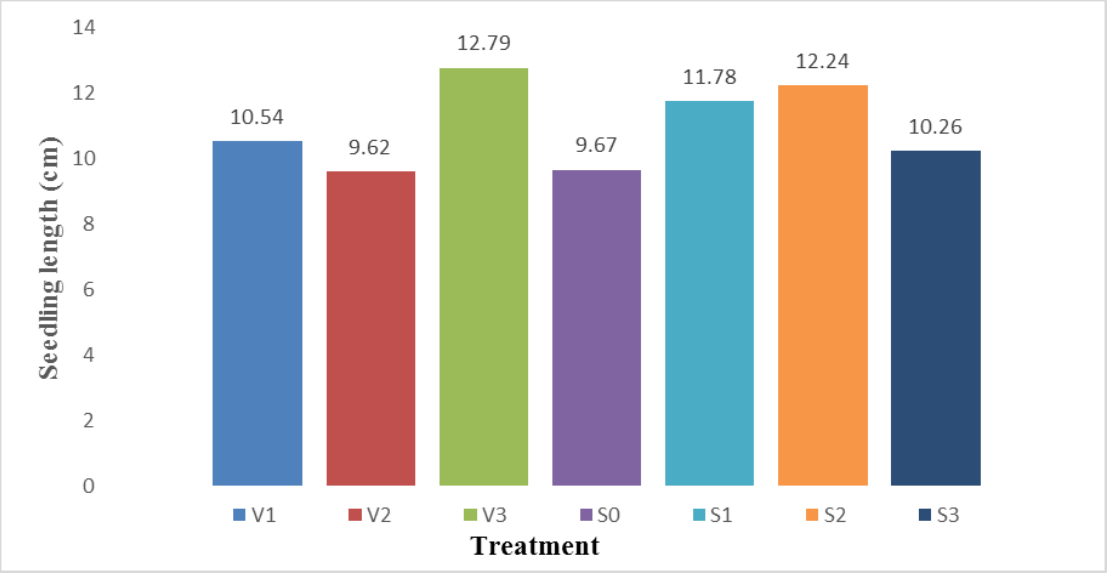
4.1.5 Seedling length (cm)

4.1.5.1 Effect on variety

Seedling length had a significant impact among three chilli varieties. Among the varieties Siam Hot (V_3) showed the highest seedling length (12.79 cm) where Bona (V_1) gave medium seedling length (10.55 cm) and BARI Morich-1(V_2) gave shortest (9.62 cm) length (Figure 6). This might be due to quick response of Siam Hot (V_3) on priming with sodium chloride.

4.1.5.2 Effect of priming

Among the four priming levels there observed a significant variation on seedling length of chilli where S_2 and S_1 showed highest seedling length (12.24 cm and 11.78 cm, respectively). S_3 and S_0 showed shorter seedling (10.26 cm and 9.68 cm, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on seedling length.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 6. Effect of variety and priming on Seedling length of chilli ($LSD_{.05}$ = 1.31 and 1.67 for variety and priming, respectively)

4.1.5.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result (Table 5). Interaction V_3S_2 showed tallest seedling (14.42 cm) which was statistically similar with V_3S_1, V_1S_2, V_1S_0, V_3S_1, V_1S_1 and V_2S_1 (13.67 cm, 11.93 cm, 11.62 cm, 11.49 cm, 10.99 cm and 10.69, respectively). On the other hand V_2S_0 interaction the shortest seedling length (7.98 cm).

Table 5. Interaction effect of variety and priming on Seedling length of chilli

Treatments	Seedling length (cm)
V_1S_0	9.43 cd
V_1S_1	10.99 a-d
V_1S_2	11.93 abc
V_1S_3	9.86 bcd
V_2S_0	7.98 d
V_2S_1	10.69 a-d
V_2S_2	10.38 bcd
V_2S_3	9.44 cd
V_3S_0	11.62 a-d
V_3S_1	13.67 ab
V_3S_2	14.42 a
V_3S_3	11.49 a-d
$LSD_{.05}$	**3.80**
CV (%)	**10.91**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

4.1.6 Dry weight of seedling (g)

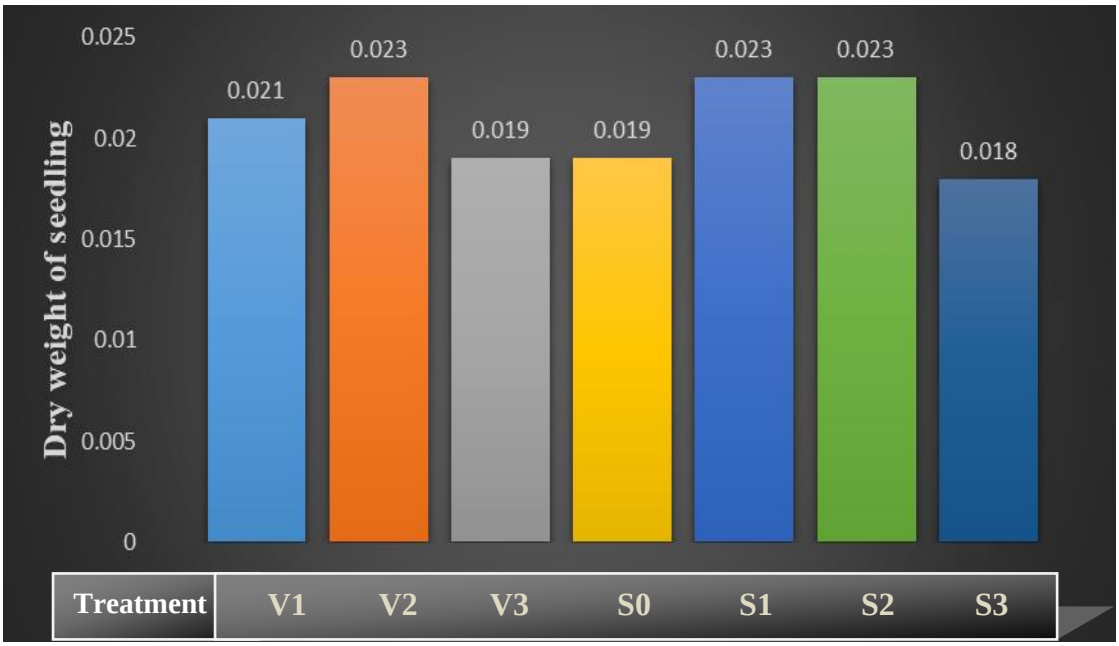
4.1.6.1 Effect on variety

Dry weight of seedling had a significant impact among three chilli varieties. BARI Morich-1(V_2) showed highest dry weight of seedling (0.023 g) where Bona(V_1) dry weight of seedling was medium (0.021 g) and Siam Hot (V_3) dry weight of seedling was low (0.019 g) (Figure 7). This might be due to quick response of BARI Morich-1(V_2) on priming with sodium Chloride.

4.1.6.2 Effect of priming

Dry weight of seedling showed significant variation due to different response on different priming levels in chilli. Priming treatment S_1 and S_2 showed the highest dry weight of seedling (0.023 g). On the other hand S_0 and S_3 showed lower dry weight of seedling (0.019 g and 0.018 g, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on dry weight of seedling.

Maiti *et al.* (2009) studied the effect of priming on seedling vigor and productivity of chilli demonstrating that priming improved germination and seedling development.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 7. Effect of variety and priming on Dry weight of seedling of chilli ($LSD_{.05}$ = 2.774E-03 and 3.50E-03 for variety and priming, respectively)

4.1.6.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result (Table 6). Interaction of V_2S_1 and V_2S_2 showed highest result (0.026 g) which was statistically similar with V_1S_1, V_1S_2, V_2S_0, V_3S_1 and V_3S_3 interactions. On the other hand V_3S_0 showed lowest (0.0167 g) which was statistically at per with V_3S_2, V_1S_0, V_1S_3 and V_2S_3.

Table 6. Interaction effect of variety and priming on dry weight of seedling of chilli

Treatments	Dry weight of seedling (g)
V_1S_0	0.018 b
V_1S_1	0.023 ab
V_1S_2	0.024 ab
V_1S_3	0.018 b
V_2S_0	0.021 ab
V_2S_1	0.026 a
V_2S_2	0.026 a
V_2S_3	0.018 b
V_3S_0	0.017 b
V_3S_1	0.019 ab
V_3S_2	0.018 b
V_3S_3	0.020 ab
$LSD_{.05}$	**7.94E-03**
CV (%)	**15.09**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

4.2 Effect priming with sodium chloride on yield

4.2.1 Effect of number of marketable capsule plant^{-1}

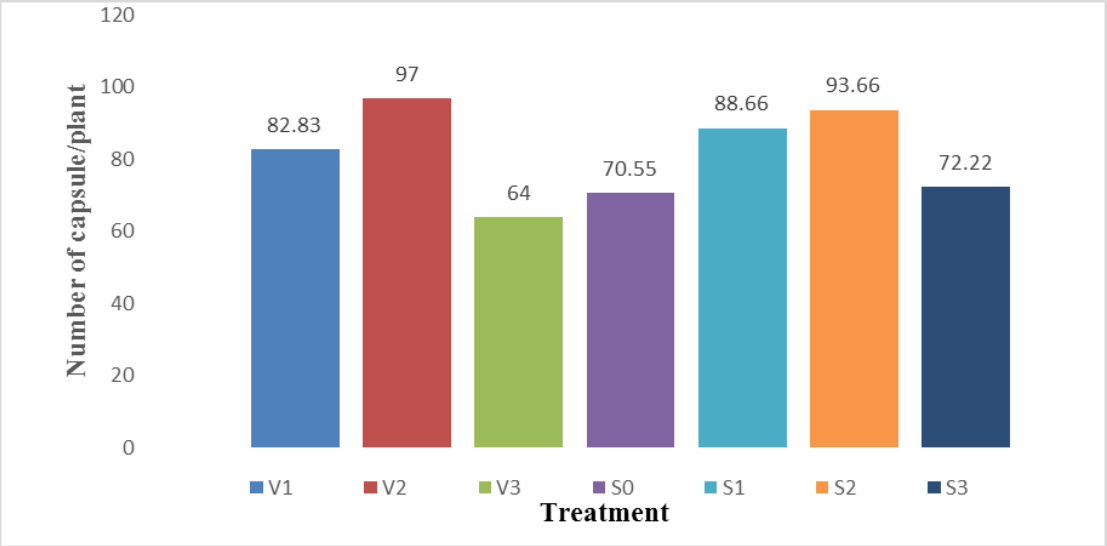
4.2.1.1 Effect on variety

Number of marketable capsule plant^{-1} had a significant impact among three chilli varieties. BARI Morich-1(V_2) shown highest number of fruits (97) where Bona (V_1) produced (83) and Siam Hot(V_3) produced (64) respectively (Figure 8). This might be due to quick response of BARI Morich-1(V_2) on priming with sodium chloride.

4.2.1.2 Effect of priming

Number of marketable capsule plant^{-1} differs significantly on chilli capsule due to priming levels. Priming treatment S_2 and S_1 showed highest number of fruits yield (94 and 89, respectively). S_3 and S_0 showed lower number of fruits yield (73 and 71, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on number of fruits yield. Navarro *et al*. (2002)

reported similar result thet yields was increased by priming the values being 73% and 66% for 15 and 30 mM NaCl, respectively, since the mean weight of marketable fruits was increased with regard to total mean weight 24%, 38% and 51% for control, 15 and 30 mM NaCl, respectively.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 8. Effect of variety and priming on number of fruits yield of chilli ($LSD_{.05}$ = 2.47 and 3.15 for variety and priming, respectively)

4.2.1.3 Interaction effect of variety and priming

Interaction effect of variety and priming on number of fruits yield showed significant variation on capsule plant^{-1} of chili (Table7). Where V_2S_2 showed highest result (111) and V_3S_0 showed lowest result (58).

Table 7. Interaction effect of variety and priming on number of fruits yield of chilli

Treatments	number of fruits yield
V_1S_0	74 d
V_1S_1	94 c
V_1S_2	99 bc
V_1S_3	65 fgh
V_2S_0	80 d
V_2S_1	105 ab
V_2S_2	111 a
V_2S_3	92 c
V_3S_0	58 h
V_3S_1	67 efg
V_3S_2	71 ef
V_3S_3	60 gh
$LSD_{.05}$	**7.15**
CV (%)	**7.11**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

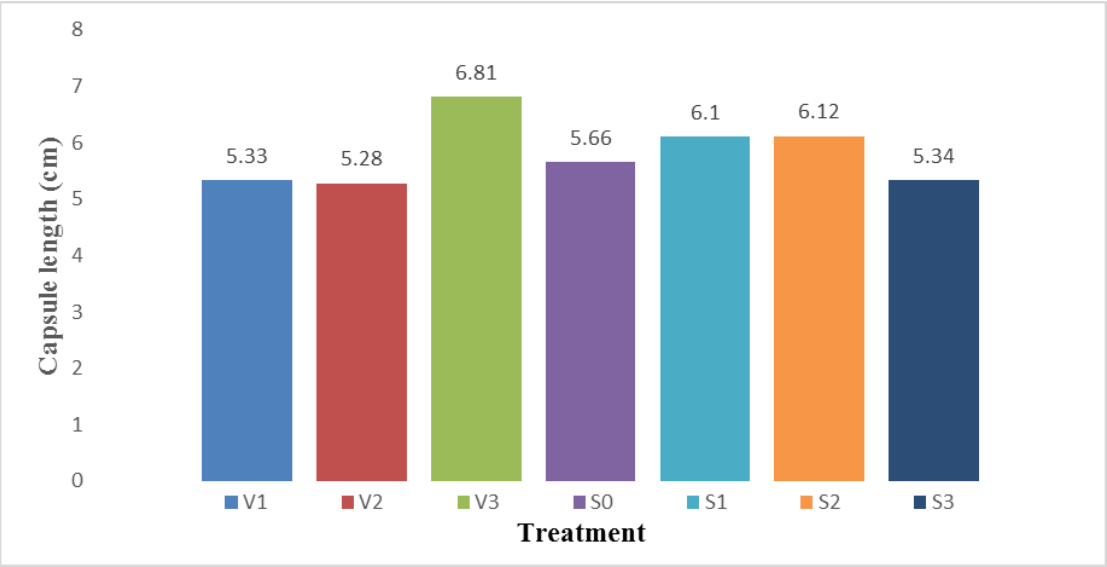
4.2.2 Effect of capsule length (cm)

4.2.2.1 Effect on variety

Capsule length had a significant impact among three chilli varieties. The result revealed that Siam Hot (V_3) showed highest capsule length (6.81 cm) where Bona (V_1) produced (5.34 cm) and BARI Morich-1(V_2) produced (5.28 cm) respectively (Figure 9). This might be due to quick response of Siam Hot (V_3) on priming with sodium chloride or its hybridity.

4.2.2.2 Effect of priming

Capsule length varied significantly due to priming of chilli seed. Priming treatment S_2 and S_1 showed highest Capsule length (6.12 cm and 6.1 cm, respectively). S_0 and S_3 showed lowest capsule length (5.67 cm and 5.34 cm, respectively). This might be due to the different level of priming effect on capsule length.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 9. Effect of variety and priming on capsule length of chilli ($LSD_{.05}$ = 0.59 and 0.76 for variety and priming, respectively)

4.2.2.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result (Table 8). Where V_3S_1 and V_3S_2 showed the highest result (7.55 cm and 7.23 cm). Which was significantly similar with V_3S_3, V_2S_2, V_1S_1 and V_1S_0 interactions (6.22 cm, 6.20 cm, 5.85 cm and 5.89 cm, respectively). Interaction of V_1S_3 showed lowest result (4.67 cm).

Table 8. Interaction effect of variety and priming on capsule length of chilli

Treatments	capsule length (cm)
V_1S_0	5.89 abc
V_1S_1	5.85 abc
V_1S_2	4.96 bc
V_1S_3	4.67 c
V_2S_0	5.07 bc
V_2S_1	4.91 bc
V_2S_2	6.20 abc
V_2S_3	4.95 bc
V_3S_0	6.05 bc
V_3S_1	7.55 a
V_3S_2	7.23 a
V_3S_3	6.22 abc
$LSD_{.05}$	**1.72**
CV (%)	**12.55**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

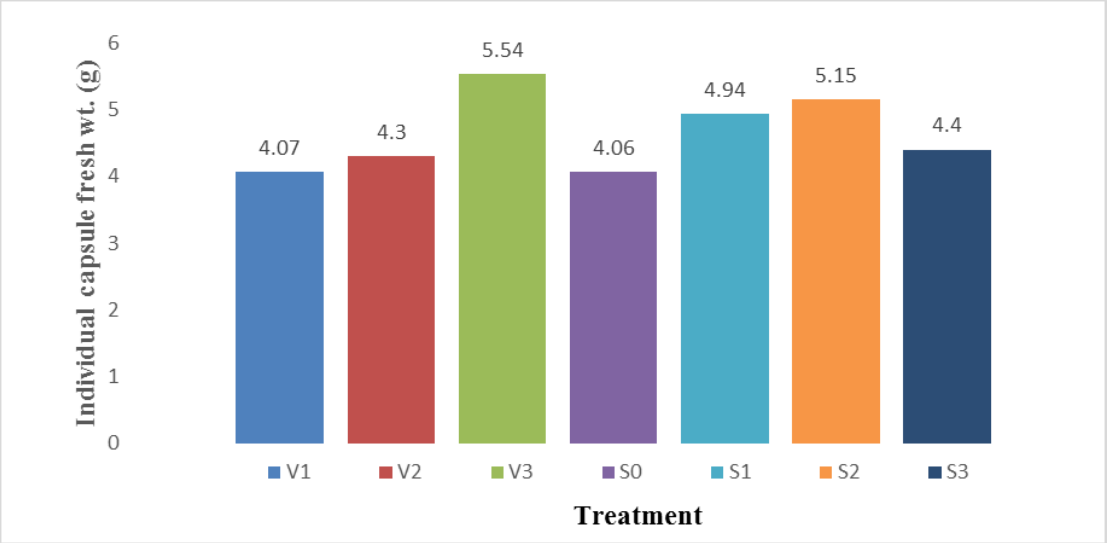
4.2.3 Fresh weight capsule^{-1}

4.2.3.1 Effect on variety

Fresh weight capsule^{-1} had a significant impact among three chilli varieties. Variety Siam Hot (V_3) showed highest fresh weight capsule^{-1} (5.54 g) where BARI Morich-1(V_2) produced (4.31 g) and Bona (V_1) produced (4.08 g) (Figure 10). This might be due to quick response of Siam Hot (V_3) on priming with sodium Chloride or its hybridity.

4.2.3.2 Effect of priming

Four priming levels are statistically significant where S_2 and S_1 showed highest individual capsule fresh weight (5.15 g and 4.94 g, respectively). Priming treatment S_3 and S_0 showed individual capsule fresh weight (4.40 g and 4.07 g, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on individual capsule fresh weight.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 10. Effect of variety and priming on individual capsule fresh weight of chilli ($LSD_{.05}$ = 0.485 and 0.62 for variety and priming, respectively)

4.2.3.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant result (Table 9). Where V_3S_2, V_3S_1 and V_3S_3 showed highest result (5.79 g, 5.78 g and 5.76 g, respectively). These three showed statistically similar result. Where as V_1S_1, V_2S_0, V_1S_3, V_2S_3 and V_1S_0 showed lowest result (4.09 g, 3.81 g, 3.74 g, 3.69 g and 3.57 g, respectively). These five interactions showed statistically similar result.

Table 9. Interaction effect of variety and priming on fresh weight capsule^{-1} of chilli

Treatments	fresh weight capsule^{-1} (g)
V_1S_0	3.57 b
V_1S_1	4.09 b
V_1S_2	4.90 ab
V_1S_3	3.75 b
V_2S_0	3.81 b
V_2S_1	4.96 ab
V_2S_2	4.76 ab
V_2S_3	3.69 b
V_3S_0	4.82 ab
V_3S_1	5.78 a
V_3S_2	5.79 a
V_3S_3	5.76 a
$LSD_{.05}$	**1.40**
CV (%)	**10.96**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

4.2.4 Dry weight of capsule plant^{-1}

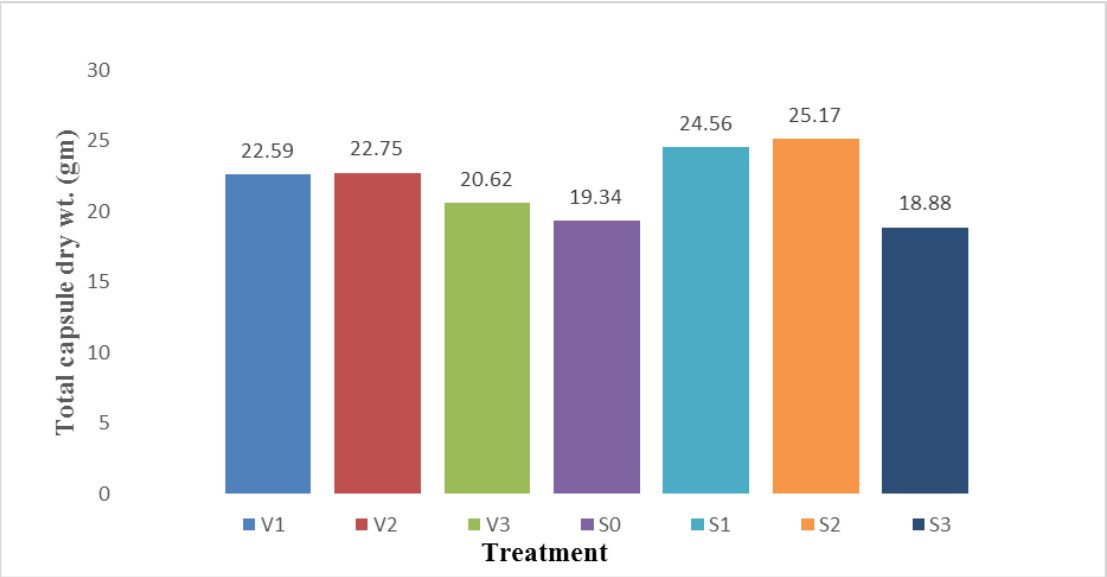
4.2.4.1 Effect on variety

Dry weight of capsule plant^{-1} exerted significant variation among three chilli varieties. BARI Morich-1(V_2) showed highest dry weight of capsule plant^{-1} (22.76 g) where Bona (V_1) produced (22.59 g) and Siam Hot (V_3) produced (20.63 g) respectively (Figure 11). This might be due to quick response of BARI Morich-1 (V_2) on priming with sodium chloride.

4.2.4.2 Effect of priming

Priming treatment showed significant effect on dry weight of capsule plant^{-1} in chilli. Among the priming levels, S_2 and S_1 treatment showed highest dry weight of capsule plant^{-1} (25.17 g and 24.57 g, respectively). S_0 and S_3 showed lower dry weight of capsule plant^{-1} (19.34 g and 18.89 g, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on total capsule dry weight. Some authors have found an increase of fruit

firmness with fruit age however, increase with maturation only for saline treatments (Gu *et al*., 1999 and Tadesse *et al*., 2002).



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 11. Effect of variety and priming on total capsule dry weight of chilli ($LSD_{.05}$ = 1.16 and 1.48 for variety and priming, respectively)

4.2.4.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant on dry capsule weight plant^{-1} in chilli (Table 10). Where V_1S_2 showed highest result (26.79 g). V_3S_2, V_1S_3 and V_3S_0 showed lowest result (18.70 g, 18.10 g and 17.90 g, respectively). These three interactions showed statistically similar result.

Table 10. Interaction effect of variety and priming on total dry weight of capsule plant^{-1} of chilli

Treatments	dry weight of capsule plant^{-1} (g)
V_1S_0	19.91 cd
V_1S_1	25.59 ab
V_1S_2	26.79 a
V_1S_3	18.11 d
V_2S_0	20.21 cd
V_2S_1	24.97 ab
V_2S_2	25.99 ab
V_2S_3	19.83 cd
V_3S_0	17.90 d
V_3S_1	23.15 bc
V_3S_2	22.75 bc
V_3S_3	18.71 d
$LSD_{.05}$	**3.36**
CV (%)	**5.81**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

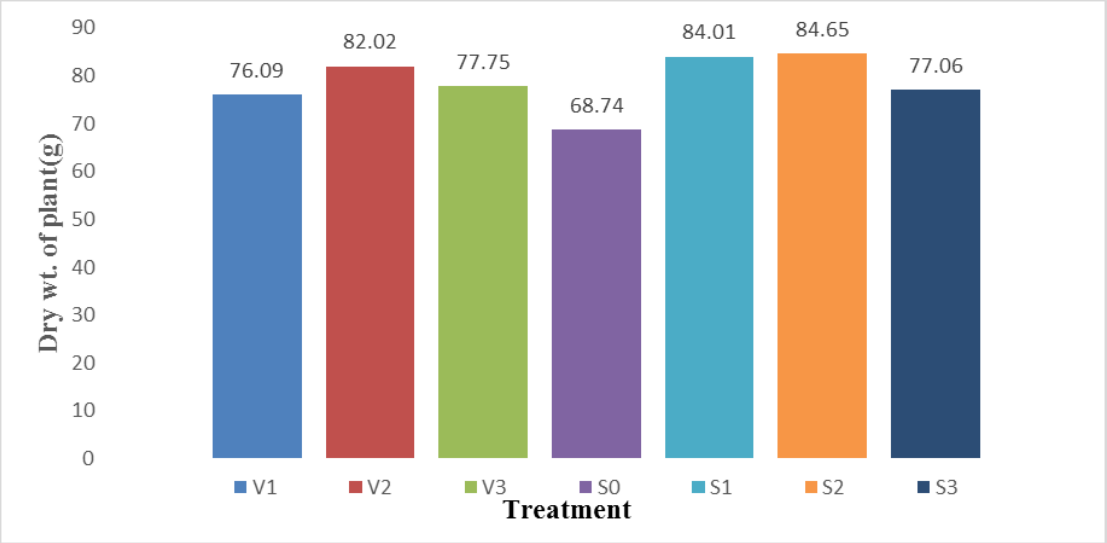
4.2.5 Dry weight plant^{-1}

4.2.5.1 Effect on variety

Dry weight plant^{-1} had a significant impact among three chilli varieties. BARI Morich-1(V_2) showed highest dry weight of plant (82.03 g) where Siam Hot (V_3) produced (77.74 g) and Bona (V_1) produced (76.09 g) respectively (Figure 12). This might be due to quick response of BARI Morich-1(V_2) on priming with sodium chloride.

4.2.5.2 Effect of priming

Dry weight plant^{-1} showed significant variation among the different priming treatments. Priming treatment S_2 and S_1 showed highest dry weight plant^{-1} (84.66 g and 84.02 g, respectively). On the other hand treatment S_3 and S_0 showed dry weight of plant (77.07 g and 68.74 g, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on dry weight plant^{-1}.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 12. Effect of variety and priming on dry weight plant^{-1} of chilli ($LSD_{.05}$ = 1.49 and 1.90 for variety and priming, respectively)

4.2.5.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant variation on dry weight plant^{-1} of chilli (Table 11). The data revealed that interaction V_2S_2 showed highest dry weight plant^{-1} (89.33 g) which was statistically similar with V_2S_1 (88.11 g). On the other hand V_1S_0 dry weight plant^{-1} (65.63g) which was statistically similar V_3S_0 (68.77 g) in chilli.

Table 11. Interaction effect of variety and priming on dry weight plant^{-1} of chilli

Treatments	dry weight plant^{-1} (g)
V_1S_0	65.63 g
V_1S_1	81.77 bc
V_1S_2	82.30 b
V_1S_3	74.67 de
V_2S_0	71.83 ef
V_2S_1	88.12 a
V_2S_2	89.33 a
V_2S_3	78.83 bcd
V_3S_0	68.77 fg
V_3S_1	82.16 b
V_3S_2	82.33 b
V_3S_3	77.70 cd
$LSD_{.05}$	**4.32**
CV (%)	**2.16**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

4.2.6 Harvest index

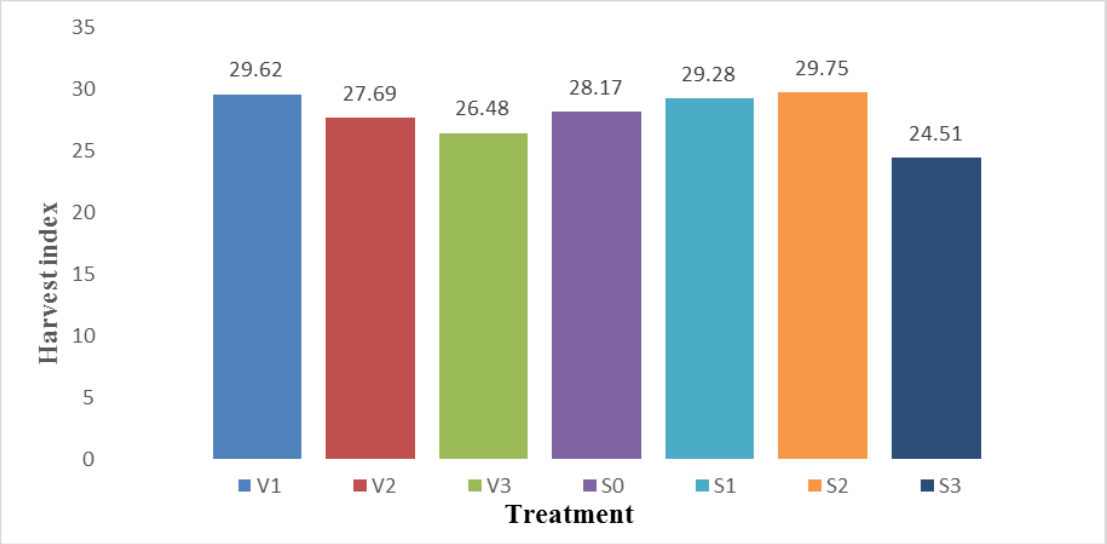
4.2.6.1 Effect on variety

Harvest index varied significant among three chilli varieties. Among the tested varieties Bona (V_1) showed highest harvest index (29.62%) where BARI Morich-1(V_2) produced (27.69%) and Siam Hot (V_3) produced (26.48%) (Figure 13). This might be due to quick response of Bona (V_1) on priming with sodium chloride.

4.2.6.2 Effect of priming

Harvest index showed different response on different priming levels (Figure 13). Harvest indes data presented in (figure 13) showed a gradual increase with the increment of salinity concentration upto S_2 treatments. A further increase of salinity reduced the harvest index value significantly. However, priming levels S_2 and S_1 showed highest harvest index (29.77% and 29.28%, respectively). Whereas treatment S_0 and S_3 showed the lower harvest index (28.17% and

24.51%, respectively) in comparison to S_2 and S_1. This might be due to the different level of priming effect on harvest index.



V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

Figure 13. Effect of variety and priming on harvest index of chilli ($LSD_{.05}$ = 1.54 and 1.98 for variety and priming, respectively)

4.2.6.3 Interaction effect of variety and priming

Interaction effect of variety and priming showed significant variation on harvest index of chilli. Data presented in table showed that V_1S_2 interaction gave highest result harvest index (32.56%) whiuch was statiostically similar with all the interactions except V_1S_3, V_2S_3, V_3S_0, V_3S_2 and V_3S_3 interactions. On the other hand V_3S_3 interaction showed the lowest harvest index 24.08% which was followed by V_1S_3 interaction (24.26%).

Table 12. Interaction effect of variety and priming on harvest index of chilli

Treatments	harvest index (%)
V_1S_0	30.35 abc
V_1S_1	31.32 ab
V_1S_2	32.56 a
V_1S_3	24.26 e
V_2S_0	28.15 a-e
V_2S_1	28.34 a-e
V_2S_2	29.09 a-d
V_2S_3	25.19 de
V_3S_0	26.03 cde
V_3S_1	28.19 a-e
V_3S_2	27.62 b-e
V_3S_3	24.08 e
$LSD_{.05}$	**4.98**
CV (%)	**5.96**

V_1 = Bona (Local), V_2 = BARI Morich-1 (HYV), V_3= Siam Hot (Hybrid); S_0=control, S_1= 3dS/m saline solution (NaCl); S_2= 6dS/m saline solution (NaCl), S_3= 9dS/m saline solution (NaCl).

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the net house of Agronomy field, Sher-e-Bangla Agricultural University, Dhaka-1207 during the period from June to October, 2016 to find out the influence of halo priming on growth and yield of three chilli varities. The experiment comprised with two factors-viz. factor A. variety-3, Bona (local) (V1), BARI Morich-1 (HYV) (V2) and Siam Hot (hybrid) (V3) and factor B. priming-4, 0 (Control) (S_0), 3 dS/m (S_1), 6 dS/m (S_2), 9 dS/m (S_3). The experiment was conducted following CRD design with three replications. The present investigation indicated that the seed priming with sodium chloride on different varieties had a positive effect on germination and reproductive development as well as yield of chilli.

In case of priming on laboratory speed of germination (%), germination percentage and dry weight of seedling showed the highest result in case of BARI Morich-1 (HYV). Whereas Siam Hot (hybrid) showed the lowest result. Priming treatment S_2 (6 dS/m) gave highest result for speed of germination (%), root length, shoot length, and seedling length and give lowest for S_3 (9 dS/m).

Germination percentage was highest values for V_2 (75.42%) and lowest for V_3 (45.83%). In case of priming highest values obtained for S_1 (60.56%) and lowest for S_3 and S_0 (51.63%). Dry weight of seedling was highest values for V_2 (0.023 g) and lowest for V_3 (0.019 g). In case of priming highest values obtained for S_1 and S_2 (0.023 g) and lowest for S_3 (0.018 g).

In case interaction of variety and priming all treatments showed significant result on laboratory. Where V_2S_2 was highest for speed of germination (9.54 %), V_2S_2 for germination percentage (88.33 %), V_3S_2 for root length (6.74 cm),

V_3S_1 for shoot length (7.51 cm), V_3S_2 for seedling length (14.42 cm) and V_2S_2 for dry weight of seedling (0.026).

In case of priming on tob number of fruit plant^{-1}, dry weight of capsule^{-1} and dry weight plant^{-1} showed the highest result in case of BARI Morich-1 (HYV). Whereas Siam Hot (hybrid) showed the lowest result. Priming treatment S_2 (6 dS/m) gave highest result for number of fruit plant^{-1}, capsule length, capsule fresh weight, total capsule dry weight, dry weight of plant and harvest index and give lowest for S_3 (9 dS/m).

Number of fruit plant^{-1} was highest for V_2 (97) and lowest for V_3 (64). In case of priming highest values obtained for S_2 (94) and lowest for S_0 (71). Total capsule dry weight was highest for V_2 (22.76g) and lowest for V_3 (20.63g). In case of priming highest values obtained for S_2 (25.17g) and lowest for S_3 (18.89g). Harvest index was highest for V_1 (29.62%) and lowest for V_3 (26.48%). In case of priming highest values obtained for S_2 (29.77%) and lowest for S_3 (24.51%).

In case interaction of variety and priming all treatments showed significant result on tob experiment. Where V_2S_2 was highest for number of fruit yield (111), V_3S_2 for capsule length (7.23 cm), V_3S_2 for fresh weight capsule^{-1} (5.79 cm), V_1S_2 for dry weight of capsule plnat^{-1} (26.79 g), V_2S_2 for dry weight plnat^{-1} (89.33 g) and V_1S_2 for harvest indesx (32.56 %).

Above results revealed that priming with sodium chloride in BARI Morich-1 (HYV) increased the germination, seedling growth and yield. The highest value of vegetative growth and yield contributing character like the number of fruit, capsule dry weight, capsule length, capsule fresh weight and harvest index explained that dry matter increased by V_2 (BARI Morich-1) due to the priming did transform into the reproductive organs. Furthermore, probably the dry

matter produced by the priming contributed to the vegetative growth and was enough to be partitioned into yield components.

To have a clear idea, we should continue the study furthermore by alternating the level sodium chloride for priming. So further study should be carried out to verify optimum level of sodium chloride for priming. Therefore, it can be concluded that the priming with sodium chloride had a positive impact on BARI Morich-1 (HYV) of chilli.

REFERENCES

Adedire, C.O. and Akinkurolere, R.O. (2005). Bioactivity of four plant extracts on coleopterous pests of stored cereals and grain legumes in Nigeria. *Zool. Res.* **26**(3): 243-249.

Afzal, I., Basra, S.M.A. and Iqbal, A. (2005). The Effects of seed soaking with plant growth regulators on seedling vigour of wheat under salinity stress. *J. Stress Physiol. and Biochem.* **1**(1): 6-14.

Ahmed, S., Anwar, M., and Ullah, H. (1988). Wheat and pre-soaking by improved germination. *Crop Sci*. **181**: 125-127.

Akhtar (2009). Hormonal priming alleviates salt stress in hot pepper (*Capsicum annuum* L.). *Pakistan J. Soil & Environ*. **28**(2): 130-135

Nicholas, K., Rop and Steven P.C. Groot (2013). Assessment of non-chemical seed treatment methods in organic seeds: Assessment of physiological sensitivity of seeds to physical treatment. Publisher-LAP Lambert Academic Publishing (22 January, 2013). pp. 88.

Akhtar, M. (2009). Hormonal priming alleviates salt stress in hot pepper (*Capsicum annuum* L.). *Pakistan J. Soil & Environ*. **28**(2): 130-135.

Ashraf, M. (1994). Breeding for salinity tolerance in plants. *Critical Reviews in Plant Sciences.* **13**: 17-42.

Ashraf, M. and Foolad, M.R. (2005). Pre-sowing seed treatment – A shotgun approach to improve germination, growth and crop yield under saline and non-saline conditions. *Advan. Agron.* **88**: 223-271.

Ashraf, M. and McNeilly, T. (1987). Salinity effects on five cultivars/lines of pearl millet (*Pennisetum americanum* L Leeke). *Plant and Soil.* **103**: 13-19.

Barbieri, G. (1995). Restrizione delle risorse idriche e strategie di irrigazione. Atti Accademie Dei Georgofili. Ser VII Vol XLII, 589-600.

Basavaraj, N. (2008). Production on cenarioof Byadagichilli. *Ind. J. Arecanut, Spices Med. Plants.* 186-193.

Basra, S.M.A., Zia M.N., Mahmood T., Afzal I. and Khaliq, A. (2002) .Comparison of different invigoration techniques in wheat (*Triticum aestivum* L.) seeds. *Pak. J. Arid. Agric.* **5**: 11-16.

Basra, S.M.A., Afzal, I., Hameed, A. and Rashid, R.A. (2005). Inducing salt tolerance in wheat by seed vigor enhancement techniques. *International Journal of Agriculture and Biology*. **2**(1): 173-179.

BBS (Bangladesh Bureau of Statistics) (2015). Report on the Productivity Survey of Chilli Crop, Productivity Assessment Survey of Different Agricultural Crops Programme, Bangladesh Bureau of Statistics,Ministry of Planning. Govt. of the People's Republic of Bangladesh, Dhaka. pp: 04.

BBS (Bangladesh Bureau of Statistics) (2016). Report on the Productivity Survey of Chilli Crop, Productivity Assessment Survey of Different Agricultural Crops Programme, Bangladesh Bureau of Statistics,Ministry of Planning. Govt. of the People's Republic of Bangladesh, Dhaka. pp: 07-09.

Bewelley, J.D.A. and black, M. (1982). Physiology and biochemistry of seeds in relation to germination. Springer Verlag, Berlin, Germany.

Biswas A.K. (1993). Water for agricultural development, opportunities and constraints. *Intl. J. Water Res. Dev.* **9**: 3-12.

Bosland, P.W. and Votava, E.J. (2000). Peppers: Vegetables and Spice Capsicums. Crop Production Science in Horticulture 12. CAB International Publishing, Wallingford, England, UK. p: 204.

Bruce, R.R., Chesness, J.L., Keisling, T.C., Pallas, J.E., Smittle, D.A., Stansell, J.R. and Thomas, A.W. (1980). Irrigation of crops in the southeastern United States: Principles and practices. US Dept Agr, Sci Ed Admin Agr Rev Man ARM-S-9.

Cantliffe, D.J. (2003). Seed Enhancements. *Acta Hort.* **607**: 53-59.

Carbineau, F. and Come, D. (2006). Priming: a technique for improving seed quality. *Seed Testing Intl*. 132.

Cayuella, F., Perez-Alfoca, F., Caro, M. and Solaris, M.C. (1996). Priming of seeds with NaCl reduces physiological changes in tomato seedlings grown under salt stress. *Physiologia Plantarum*. pp. 231-236.

Chartzoulakis, K. and Klapaki, G. (2000). Response of two greenhouse pepper hybrids to NaCl salinity during different growth stages. *Sci. Hort.* **86**: 247-260.

Chinnusamy, V., Jagendorf, A. and Zhu, J. (2005). Understanding and improving salt tolerance in plants. *Crop Sci.* **45**: 437-448.

Choudhary, K., Lanteri, S., Roy, A. and Naseem, M. (2008). Effect of Halopriming of pepper seeds. (*Capsicum annuum* L.). *Hort. Sci. and Biotech.* **75**: 607-611.

Davies, J.N. (1964). Effects of nitrogen, phosphorus and potassium fertilizers on the non-volatile organic acids of tomato fruit. *J. Sci. Food Agr.* **15**: 665-673.

Demir, I. and Okcu, G. (2004). Aerated hydration treatment for improved germination seedling growth in aubergine (*Solanum melongena*) and pepper (*Capsicum annum*). *Annals Appl. Biol.* **144**: 121-123.

Esmaielpour, B., Ghassemi-Golezani, K., Khoei, F.R., Gregoorian, V. and Toorchi, M. (2006). The effect of NaCl priming on cucumber seedling growth under salinity stress. *J. Food Agric. and Environ.* **4**(2): 347-349.

Farooq, M., Basra, S.M.A., Karim, H.A. and Afzal, I. (2004). Optimization of seed hardening techniques for rice seed invigoration. *Emir. J. Agric. Sci.* **16**: 48-57.

Flowers, T.J. and Yeo, A.R. (1995). Breeding for salinity resistance in crop plants. Where next? *Australian J. Plant Physiol.* **22**: 875-884.

Flynn, R., Phillips, R., Ulery, A., Kochevar, R., Liess, L. and Villa, M. (2003). Chile seed germination as affected by temperature and salinity. New Mexico Chile Task Force, Cooperative Extension Service, Las Cruces, New Mexico, Report. **2**: 1-10.

Grassbaugh, E.M. and Bennett, M.A. (1998). Factors affecting vegetable stand estoblishment. *Scientia Agricola.* **55**: 116-120.

Gu, Y.S., Howaed, L.R. and Wagner, A.B. (1999). Physicochemical factors affecting firmness of pasteurized Jalapeno pepper rings. *J. Food Qual.* **22**: 619-629.

Gupta, A., Kumari, A., Naseem, M., Chaudhary, V.K. and Maiti, R.K. (2008). Seed priming: Aftermath. *Intl. J. Agric. Environ. & Biotech.* **1**: 212-219.

Harris, D., Joshi, A., Khan, P.K., Gothkar, P. and Sodhi, P.S. (1999). On farm seed priming is semi-arid agriculture. Development and evaluation of maize.

Hedegree, S.P. and Vanicto, S. (2000). Germination and emergence of primed grass seed under field and simulated field temperature regimes. *Annals Bot.* **85**: 379-390.

Hirota, O., Villavicencio, E., Chikushi, J., Takeuchi, S. and Nakano Y. (1999). Effect of saline water irrigation at fruit maturity stage on transpiration rate and growth in sweet pepper (*Capsicum annuum*). *J. Fac. Agric. Kyushu Univ*. **44:** 39-47.

Ho, L.C. and White, P.J. (2005). A cellular hypothesis for the induction of blossom-end rot in tomato fruit. *Ann Bot.* **95**: 571-581.

Lanteri, S., Foris, E., Bergervoet, H.W. amd Groot, E.P.C. (2000). Molecular markers for priming of pepper seeds (*Capsicum annuum* L.). *Horticultural Sci. Biotech.* **75**: 607-611.

Lucca, A.J., Boue, S. and Palmgren, M.S. (2006). Fungicidal properties of two saponins from *Capsicum frutescens* and the relationship of structure. *Can.Adian J. Microbiol*., **52**(4), 336-342.

Maas, E.V. (1986) Salt tolerance of plants. *Applied Agric. Res.* **1**: 12-16

Mahajan, S. and Tuteja, N. (2005). Cold, salinity and drought stresses: An overview. *Archives Biochem. and Biophysics*. **444**: 139-158

Maiti, R.K., Gupta, A., Umasahankar, P., Raj Kumar, D. and Vidyasagar, P. (2009). Effect of priming on seedling vigour and growth and productivity of few vegetable species: Tomato, Chilli, Cucumber and Cabbage. *Intl. J. Agric., Environ. Biotech.* **2**(4): 368-374.

Maiti, R.K., Sarkar, N.C. and Singh, V.P. (2006). Principles of post harvest seed physiology and technology. *Agrobios. India*. p. 226.

Marcelis, L.F.M. and Ho, L.C. (1999). Blossom-end rot in relation to growth and calcium content in fruits of sweet pepper (*Capsicum annuum* L.). *J. Expt. Bot.* **50**: 357-363.

Meiri, A. and Shalhevet, J. (1973). Pepper plant response to irrigation water quality and timing of leaching. Physical aspects of soil water and salts in ecosystems. *Ecol. Stud.* **4**: 421-429.

Mohammadi, G. R. (2009). The influence of NaCl priming on seed germination and seedling growth of canola (*Brassica napus* L.) under salinity conditions. *American-Eurasian J. Agric. Environ. Sci.* **5** (5): 696-700.

Morley, P.S. (1996). Calcium nutrition and the physiology of sweet pepper (*Capsicum annuum* L.) fruit. PhD thesis. Leeds University, UK.

Munns, R. (2002). Comparative physiology of salt and water stress. *Plant Cell Environ.* **25**: 239-250.

Navarro, J.M., Garrido, C., Carvajal, M. and Martínez, V. 2002. Yield and fruit quality of pepper plants under sulphate and chloride salinity. *J. Hortic. Sci. Biotech.* 77: 52-57.

Nicholas, K.R. and Steven, P.C. (2013). Assessment of non- chemical seed treatment methods in organic seeds: Assessment of physiological sensitivity of seeds to physical treatment. Publisher-LAP Lambert Academic Publishing (22 January, 2013). pp. 88.

Omami, E.N. (2005). Salt tolerance of amaranth as affected by seed priming. M.Sc. Thesis. University of Pretoria, South Africa.

Parida, A.K. and Das, A.B. (2005). Salt tolerance and silinity effects on plants: a review. *Ecotoxicology and Environmental Safety*. **60**: 324-349.

Pill, W.G. (1995). Low water potential and presowing germination treatments to improve seed quality. Food Products Press, Binghampton, New York.

Pill, W.G. and Kilan, E.A. (2000). Germination and emergence of parseley in response to osmotic or matric seed priming and treatment with gibberellins. *Hort. Sci.* **35**: 907-909.

Powell, A.A., Yule, L.J., Jingh, H.C. and Groots, P.C. (2000). The influence of aerated hydration seed treatment on seed longevity as assessed by the viability equation. *J. Exp. Bot.* **51**: 2031-2043.

Rhoades, J.D., Kandiah, A. and Mashali, A.M. (1992). The use of saline waters for crop production. Food and Agriculture Organization of United Nations (FAO), Irrigation and Drainage Paper 48. Fao, Rome. Italy.

Sivritepe, H.O. and Sivritepe, N. (2007). NaCl priming affects salt tolerance of onion (*Allium cepa* L.) seedlings. *Acta Horticulturae.* **729**: 157-161.

Sivritepe, H.O., Eris, A. and Sivritepe, N. (1999). The effect of NaCl priming on salt tolerance in melon seedlings. *Acta Horticulturae*. **492**: 77-84.

Sivritepe, N., Sivritepe, H.O. and Eris, A. (2003). The effects of NaCl priming on salt tolerance in melon seedlings grown under saline conditions. *Scientia Agricola.* **97**: 229-237.

Smith, P.T. and Cobb, B.G. (1991). Accelerated germination of pepper seed by priming with salt solutions and water. *Hort. Sci.* **26**: 417-419.

Souguir M., Hassiba F. and Hannachi, C. (2013) .Effect of NaCl priming on seed germination of Tunisian fenugreek (*Trigonella foenumgraecum* L.) under salinity conditions. *J. Stress Physiol. & Biochem.* **9**(2): 86-96.

Szabolcs, I. (1994). Soils and Salinization. Handbook of Plant and Crop Stress, Marcel Dekker, New York.

Tadesse, T., Hewett, E.W., Nichols, M.A. and Fisher, K.J. (2002). Changes in physicochemical attributes of sweet pepper cv. Domino during fruit growth and development. *Sci. Hort*. ***93***: 91-103.

Taylor, A.G., Allen, P.S., Bennett, M.A., Bradford, K.J., Burris, J.S. and Misra, M.K. (1998). Seed enhancement. *Seed Sci. Res.* **8**: 245-256.

Varier A., Vari A.K. and Dadlani, M. (2010). The subcellular basis of seed priming. *Current Sci.* **99**(4): 121-126.

Warren, G.A. and Bennett, M.A. (1997). Seed hydration using the drum priming system. *Hort. Sci.* **32**: 1220-1221.

Watkinson, J.I. and Pill, W.G. (1998). Gebberelic acid and presowing chilling increase seed germination of Indian grass (*Sargastrum nutans* L) Nash. *Hort. Sci.* **33**: 849-851.

Welbaum, G.E., Shen, Z., Oluoch, M.O. and Jett, L.W. (1998). The evolution and effects of priming vegetable seeds. *Seed Technol.* **20**: 209-235.

Westerhout J. (1962). Relation of fruit development to the incidence of blossom-end rot of tomatoes. *Neth. J. Agric. Sci.* **10**: 223-234.

Wiersum, L.K. (1966). Calcium content of fruits and storage tissues in relation to the mode of water supply. *Acta Botanica Neerlandica*. **15**: 406-418.

Yeo, A.R. (1999). Predicting the interaction between the effects of salinity and climate change on crop plants. *Sci. Hortic*. (Amsterdam). **78**: 159-174.

APPENDICES

Appendix I. Monthly record of air temperature, relative humidity and rainfall of the experimental site during the period of June, 2016 to October 2016

Month	Air temperature (^{0}C)		Relative humidity (%)		Rainfall (mm) (total)
	Maximum	Minimum	Maximum	Minimum	
June	34.1	22.4	86.4	51.8	247
July	33.3	21.2	84.6	49.2	225
August	32.4	19.2	80.2	46.4	202
September	28.4	18.4	75.2	39.2	65.60
October	25.2	16.3	60.2	35.6	12.5

Source: SAU mini weather station, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh

Appendix II. Soil test result of the experimental field reported by Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka

Element	Levels in the soil plot
pH	5.9
N	0.071%
K	0.31 meq/100g soil
Ca	6.36 meq/100g soil
P	14.04 µg/g soil
S	15.16 µg/g soil
B	0.30 µg/g soil

Plate 1. Priming with sodium chloride in laboratory and seed sowing in petridish

Plate 2. Seedling in laboratory and preparation of tob

Plate 3. Chilli plant with fruit

Plate 4. Green and ripe capsule at harvest