PERFORMANCE OF CHILLI (*Capsicum frutescens* L.) GERMPLASM FOR YIELD AND QUALITY CHARACTERS IN KHARIF SEASON

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CERTIFICATE

This is to certify that the thesis entitled ***"PERFOMANCE OF CHILLI (Capsicum frutescens L.) GERMPLASM FOR YIELD AND QUALITY CHARACTERS IN KHARIF SEASON"*** *submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University (SAU), Dhaka in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE (M.S.)*** *in* ***AGRICULTURAL BOTANY,*** *embodies the results of a piece of bona fide research work carried out by* ***FARZANA HOQUE,*** *Registration no.* ***08-03161*** *under my supervision and 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:
Place: Dhaka, Bangladesh

Prof. Dr. Shahnaz Sarkar
Supervisor

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PERFORMANCE OF CHILLI (*Capsicum frutescens* L.) GERMPLASM FOR YIELD AND QUALITY CHARACTERS IN KHARIF SEASON

ABSTRACT

Field experiment was conducted at the research field of Sher-e-Bangla Agricultural University, Dhaka to study performance of germplasm for yield and quality characters of chilli in kharif season. Six germplasm of chilli such as, Premium Hybrid , Surjomukhi, Magura Morich, Kajoli Morich, BARI morich1 and Vaduria Morich are cultivated during March-september (kharif season), 2014. The experiment was laid out in Randomized Complete Block Design (RCBD) having one factor with four replications. The highest plant height at different days after transplanting (40.80 cm, 93.85 cm and 105.6 cm at first flowering, first harvest and final harvest respectively), was observed in Magura Morich. The highest number of branches at different days after transplanting (7.75, 14.75 and 22.0 at first flowering, first harvest and final harvest respectively), was found in Premium Hybrid. Vaduria Morich required minimum (12 days) and Magura Morich required maximum (34 days) for flower bud initiation. Vaduria Morich produced the maximum number of flower per plant (170) upto 2 month from first flowering and maximum number of fruit per plant (733) upto harvest. Length of fruit was the highest (10.06 cm) in Premium Hybrid but diameter of fruit was the highest (7.58 mm) in Vaduria Morich. Dry weight of 50 fruits (40.75 g), dry weight of fruit plant^{-1} (365.70 g) and 1000-seeds weight (4.33 g) were the highest in Premium Hybrid. Seed fruit^{-1} was the highest (55) in Vaduria Morich. Dry weight of plant was the highest (150.6g) in Premium Hybrid and the lowest (38.2g) in Kajoli Morich. The highest SPAD value (67.65%) was obtained in leaf of Kajoli Morich. Kajoli Morich contained highest (67.15 mg/100g) and BARI morich1 contained lowest (45.07 mg/100g) vitamin C in green chilli fruit. Maximum yield plant^{-1} (1118 g), yield plot^{-1} (14310 g) and the maximum yield (16.67 ton/ha) was observed in Premium Hybrid. Finally, the results revealed that Premium Hybrid and Vaduria Morich planted in Kharif season (April 25) would be beneficial.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

ABBREVIATIONS	FULL WORD
@	At the rate of
AEZ	Agro-Ecological Zone
ANOVA	Analysis of variance
BARI	Bangladesh Agriculture Research Institute
BBS	Bangladesh Bureau of Statistics
Cm	Centimeter
CV	Co-efficient of variation
DAT	Days after transplanting
Df	Degree of freedom
EC	Emulsifiable concentrate
Ems	Error mean square
FW	Fresh weight
LS	Level of significance
LSD	Least significant difference
M	Meter
Mm	Millimeter
^{o}C	Degree centigrade
%	Percentage
SAU	Sher-e-Bangla Agricultural University
t ha^{-1}	Ton per hectare
WP	Wettable powder

CHAPTER I

INTRODUCTION

Chilli (*Capsicum frutescens* L.) is one of the most important solanaceous crops in the world. Chilli is emerging as one of the commercial vegetable crops at the global level and is probably most important vegetable after tomato (Grubben,1977). It also an important spices all over the world. It is frequently used in everyday diet of the people of the south and south-east Asia. Particularly in Bangladesh, there is no home which does not consume chilli. It is used both at green and ripe stage and is used and marketed as whole as well as powder form. It finds a place in pharmaceuticals also. It is useful for industrial purpose due to extraction of oleoresin. Green fruits of chilli is quite rich in nutritive value and supposed to contain certain medicinal properties (Chowdhury,1976). Green chillies are rich in vitamin A and C and the seed contain traces of starch (Saimbhi *et al*.,1977; Sayed and Bagvandas, 1980.). Green fruits of chilli is one of the richest sources of anti-oxidant and this antioxidant protect the occurrence of cancer. The chief constituent of chilli (*capsicum frutescens)* pericarp is a crystalline colorless pungent principle known as capsaicin or capsicutin ($C_{18}H_{27}NO_3$). The capsaicin alkaloid is responsible for pungency of chilli and it has also medicinal value. These pungent are used in the manufacture of sauces and curry powders and also in preparation of pickles. Fruits of chilli are widely used for coloring, antioxidant properties, flavoring of garnishes, meats, barbecue sauces, ketchup, cheese, snack food, dips, chilli con, salads, curry powder. Red or hot chilli from *Capsicum frutescens* L. are the most pungent chilli and used extensively in Bangladeshi, Mexican and Italian foods.

Chilli plants are bushy and grow upto 54.4-102.4 cm (Padda *et al.,1970*) tall. They are semi-perrinials but usually grown as annual in cultivation. Chilli have tap root system and its stem is erect densely branched. Chilli have simple leaf

with reticulate venation. The single flowers are an off-white (sometimes purplish) color. Flower is bisexual with five stamen and one gynoecium. The flower also have five sepal and five petal. The unripe fruits are green or purple in colour but turn red, orange, yellow or brown when ripe (Udoh *et al*., 2005). Chilli fruit have peduncle, calyx, placenta, seed, capsaicine gland, exocarp, mesocarp, endocarp and apex.

Chilli grows well in warm and humid climate. It grow well at temperature between 18 to 30°C (65–86°F). Deep, loamy, fertile soils rich in organic matter are preferred by the crop for satisfactory growth. The soil should have a pH between 6 and 7. It also need well drained soils with adequate soil moisture for the growth. This crop grows well in the dry and the intermediate part of Bangladesh. Chilli plants should be in a position that receives a good amount of light. Chillies should not be in a position where the nightly temperature falls below 12°C. Growth will be inhibited if temperatures fall below 15°C. Chilli pepper plants is a type of seasonal crops (annual plant) which only live for one season then died. In Bangladesh, chillies are grown in all the districts but plenty of chillies are produced in the district of Bogra, Rangpur, Kurigram, Jamalpur, Natore and Jessore. From Food and Agriculture Organization (FAO,2012) world wide chilli grown on more than 1.98 million hectares with productivity of 16847.88 kg/ha. In Bangladesh, chillies are grown all over the country both kharif & robi seasons and grown around 1.23 lakh tons of dry chillies from an estimated area of 0.92 lakh hectares with productivity of 1.47 tons/ha during 2014-15(BBS,2015). The low yield of chilli in Bangladesh may be attributed to a number of reasons such as unavailability of quality seeds of high yielding germplasm, limited availability of irrigation facilities, poor fertilizer management, disease and insect infestation etc. All of the *Capsicum frutescens* has economic importance in Bangladesh. The crop can be cultivated in both Kharif and Robi season and average yield of green chillies is 5.5 tons/hectare (BBS, 2005). There are many local and hybrid germplasm

cultivated in Bangladesh. Most of the germplasm are cultivated during Robi season. Only few local cultivars are grown in kharif season such as kajoli, Vaduria Morich, surjomukhi, magura Morich along with BARI Morich1 and few hybrids.

The production of chilli in kharif season is very low because it cannot survive under waterlogged condition. In waterlogged soil, diffusion of gases through soil pores is so strongly inhibited by their water content that it fails to match the needs of growing roots. A slowing of oxygen influx is the principal cause of injury to roots, and the shoots they support (Vartapetian and Jackson, 1997). Waterlogging also causes deficiency of several essential nutrients such as N, P, K, Ca, Mg, S, Fe etc. On the other hand, water logging cause damping off disease of chilli plant. So the price of chilli rise at that time. It is important to select germplasm which give high yield and quality among them and survive in kharif season. But in our country there are very few research works for focusing on the germplasm screening of chilli production during kharif season in Bangladesh. So we should done research work to select high yielding and quality germplasm for kharif season.

The present study is undertaken with following objectives:

- To know the yield performance of different germplasm of chilli during kharif season.
- To estimate the quality characters of different chilli germplasm.
- To select high yield and quality germplasm of chilli for kharif season.

CHAPTER II

REVIEW OF LITERATURE

Chilli is one of the most important spices crops grown under field condition. This spices crop received much attention of the researchers throughout the world because of its various ways of consumption and nutritional value. Scientists are working continuously with crops for development of new varieties and improvement of production techniques. Their findings suggest that growth and development of chilli plants largely depend on the germplasm. Large number of researchers has studied the effect of germplasm on the morpho-physiological, yield attributes of chilli in different countries of the world, but their findings have little relevance to the agro-ecological situation of Bangladesh. However, the available research findings in this concern over the world have been reviewed under some sub-heading in this chapter :

2.1 Plant Height (cm)

Jaisankar *et al.* (2015) observed that the tallest plant was found from V_3 (69.38 cm), while the shortest from V_{12} (32.02 cm) at 80 DAT from an experiment on twelve varieties of Chilli (*Capsicum annuum* L.) showed wide differences in their variation for fruit yield and morphological traits in a varietal evaluation conducted at research farm of CIARI, South Andaman.

Kaouther *et al.* (2015) stated that plant height (56.16 to 114.83 cm) where Kb cv demonstrated the best values while Sj cv had the lowest one among five local accessions of chilli pepper (*Capsicum frutescens* L.): Tébourba, Somâa, Korba, Awled Haffouz and Souk Jedid, were cultivated in the experimental station of Higher Institute of Agronomy, Chott Mariem, Sousse (Tunisia) for their agronomic evaluation.

Barche *et al.* (2013) recorded that plant height at 30 days after transplanting (30 DAT) ranged from 8.73 to 26.00cm and 26.73 to 71.26cm at 120 DAT in KA-2 and 2011/CHIVAR-2 genotypes respectively from five randomly selected plants of each genotype in each replication. It is done by an experiment at Horticulture complex, J.N.K.V.V. Jabalpur to study the performance of 22 diverse chilli (*Capsicum annuum* L.) genotypes collected from different parts of India including two control *viz.*, LCA-334 and KA-2 at the Kymore plateau Region of Madhya Pradesh.

Tembhurne *et al.* (2004) observed that maximum plant height (80.93cm) in B.Kaddi and minimum plant height (50.17cm) in HCS G_2 among the 11 advanced lines evaluated by an experiment at College of Agriculture, Bheemarayanagudi to know the varietal performance, variability and association of traits in chilli. These eleven elite advanced lines obtained from Chilli Research Station, Devihosur were evaluated along with KDC 1, Byadgi Dabbi and Byadgi Kaddi as checks.

Padda *et al.* (1970) found that the cultivar differences in plant height were statistically significant and ranged from 54.4 to 102.4 cm by evaluating plant and fruit characteristics of eleven cultivars of chilli.

Shoemaker (1953) noted that chilli plant grew 30.5 to 76.4 cm in height.

2.2 Branches per Plant (nos)

Jaisankar *et al.* (2015) found that maximum number of branches was found from V_3 (26.57/plant), while the minimum from V_5 (11.69/ plant) at 80 DAT from an experiment on twelve varieties of Chilli (*Capsicum annuum L.*).

Hasan *et al*. (2014) Observed maximum number of branches (26.5/plant), was recorded from L_4 and minimum number of branches (21.5/plant) from L_3 at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh to study the morpho-physiological and yield performance of four chilli lines (coded from L_1 to L_4) during November 2013 to May 2014.

Barche *et al.* (2013) found that number of primary branches per plant at 30 days after transplanting (30 DAT) ranged from 2.68 in 2011/CHIVAR-1 to 6.86 in 2012/CHIVAR-2 and 5.40 in KA-2 to 10.21 in 2012/CHIVAR-2 at 120 DAT genotypes from five randomly selected plants of each genotype in each replication.

Tembhurne *et al.* (2005) recorded maximum no of primary branches (5.73) in HCS G_8, minimum no of primary branches (4.33) in HCS G_2, maximum no of secondary branches (7.13) in HCS G_1 and minimum no of secondary branches (2.73) in 9626-6-1 among the 11 advanced lines.

2.3 Days to Flower Bud Initiation after Transplanting (nos)

Kaouther *et al*. (2015) stated that Tebourba cv was the earliest to flowering with 44 days while Sm cv took the longest days (58 days) by a trial on five local accessions of chilli pepper (*Capsicum frutescens* L.).

Hasan *et al.* (2014) recorded early flower bud initiation from L_1 (30 days) whereas late from L_4 (42 days) at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh.

Barche *et al.* (2013) recorded that from five randomly selected plants of each genotype in each replication for thirteen yield and its attributing characters. Among the flowering parameters, genotype 2011/CHIVAR-8 was found to early which flowered in 40.66 DAT, whereas, late flowering 53.66 DAT was noted in the controlled genotype KA-2.

2.4 Number of Flower Plant^{-1}

Kaouther *et al*. (2015) stated that Kb cv had the highest number of flowers per plant (356.5) whereas Tb cv had the lowest number (212.7 flowers) by a trial on five local accessions of chilli pepper *(Capsicum frutescens* L.).

Jaisankar *et al.* (2015) found that The maximum number of flowers was found from V_3 (63.98/plant) followed by V_{11} (61.58/plant), whereas the minimum from V_1 (31.28/plant).

Hasan *et al*. (2014) found Maximum number of flower was found from L_2 (49.8/plant) while minimum from L_1 (22.3/pant) by study of the morpho-physiological and yield performance of four chilli lines (coded from L_1 to L_4) at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh.

Abdullah *et al.* (2006) find that a wide genetic variation among the genotypes for number of flowers per plant by an experiment on variability, correlation and path analysis of thirteen sweet pepper genotypes. They also reported that number of flowers per plant exhibited significant positive correlations with plant height at final harvest both at phenotypic and genotypic levels.

2.5 Canopy Length (cm)

Raikar *et al.* (2005) demonstrated the interrelationships that tall and spreading plants with higher number of secondary branches and early maturity would be high-yielding types by an experiment on variability and path-coefficient analysis in chilli with 40 strains in pune, Maharastra and India during kharif season.

2.6 Number of Fruit Plant^{-1}

Farooq *et al.* (2015) observed that Orobella rank first regarding number of fruit/plant (43.47), The study was carried out at the Horticultural Research Institute, NARC, Islamabad during 2009-2010 to investigate the growth and yield of sweet pepper hybrids under plastic tunnel. The experiment comprises five hybrids viz., Orobelle, Figaro, Green Beauty, Mighty, Capistrano with control Yolowonder.

Jaisankar *et al.* (2015) noted that the maximum number of fruits was found from V_{11} (33.12/plant) which was followed by V_7 (31.28/plant), whereas the minimum from V_1 (11.11/plant).

Hasan *et al.* (2014) recorded Maximum number of fruit was found from L_2 (33.0/plant) which was statistically similar with L_3 (28.3/plant) and L_4 (26.0/plant) while minimum from L_1 (14.3/pant) which was statistically similar with L_4 (26.0/plant).

Abdullah *et al.* (2006) revealed that the number of fruits per plant and fruit length are the important components of fruit yield on the basis of the estimates of path analysis.

Mohanty *et al.* (2005) found that maximum number of fruits/plant (243.47) was recorded in X 235 by an experiment to assessment of chilli varieties. Eight varieties of chilli *(Capsicum annum* L.) were evaluated over 3 years.

Tembhurne *et al.* (2005) observed that HCS G_1 recorded significantly highest number of fruits per plant (144.2), among the 11 advanced lines evaluated.

Sharma (1975) made a experiment on plant in India and fruit characters, yield and capsaicin content of chilli cultivars. He found that there were no relationship between capsaicin content and the colour, size, shape and number of the fruits per plant from all selections.

Padda *et al.* (1970) stated that the data of fruits per plant also showed highly significant differences among the cultivars and on an average ranged from 82.0 to 532.2.

2.7 Dry weight of 50-fruits (g)

Hasan *et al*. (2014) noted that maximum fresh weight was found from L_3 (65.4 g/50-fruits) whereas minimum from L_1 (56.0 g/50-fruits) which was statistically similar with L_2 (56.3 g/50-fruits).

2.8 Individual Fruit Fresh Weight (g)

Jaisankar *et al.* (2015) noted that maximum single fruit weight was found among different lines in V_1 (4.64 g) followed by V_5 (2.78 g) which was on par with V_{10} (2.67 g) whereas minimum from V_{11} (1.32 g).

Hasan *et al.* (2014) found that maximum individual fruit weight was found from L_3 (1.3 g) while minimum from L_4 (0.9 g) at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh.

Barche *et al.* (2013) recorded that genotype 2011/CHIVAR-8 recorded the highest fruit weight (5.15g) while fruit weight of genotype 2012/CHIVAR-2 was at par with 5.12g green chilli.

Tairu *et al.* (2013) observed that although the accessions did not differ significantly in their yield potential, PP9955-15 had the highest average fruit weight (13.39 g).

Tembhurne *et al.* (2005) observed that maximum Individual fruit weight (1.12 g) in HCS G_3 and minimum Individual fruit weight (0.4 g) in HCS G_8 among the 11 advanced lines.

Das *et al.* (2004) evaluated the performance of chilli genotypes during summer season at Sabour, Bihar, India. They observed the genotype 94-3 showed the highest fruit weight of 20.31g.

2.9 Fruit Length (cm)

Jaisankar *et al.*(2015) stated that maximum fruit length was recorded in V_3 (6.06cm) which was on par with V_6 (6.19 cm) while the minimum was recorded in V_{11}(3.93 cm).

Farooq *et al.* (2015) observed that Orobella rank first regarding hybrid produced highest (5.98 cm) value for fruit length.

Hasan *et al.* (2014) recorded that highest fruit length of individual fruit was found from L_2 (7.5 cm) at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh.

Barche *et al.* (2013) found that maximum fruit length (11.38 cm) was recorded in genotype 2012/CHIVAR-2 with regards to fruit length.

Tairu *et al.* (2013) recorded Fruit length (14.81 cm) was the maximum in accession PP9955-15 while all other cultivars were statistically at par with the check varieties.

Das *et al.* (2004) observed the genotype 94-3 showed the highest fruit length of 5.90 cm by evaluating the performance of chilli genotypes during summer season at Sabour, Bihar, India.

Tembhurne *et al.* (2005) assessed that B. Kaddi fruit showed highest length (11.78cm) and lowest length (7.73cm) in HCS G_4.

Padda *et al.* (1970) observed that the fruit length varied from 2.0 to 8.6 cm by evaluating plant and fruit characteristics of eleven cultivars of chilli.

Heiser and Smith (1953) stated that fruit size, shape and colour were extremely variable and the fruits varied from 4.0 to 30.0 cm in length and other vegetative characters also varied greatly.

2.10 Fruit Diameter (mm)

Jaisankar *et al.* (2015) stated the maximum fruit diameter was found from V_1 (1.41 cm) followed by V_5 (1.14 cm)and minimum was recorded in V_9 (0.85 cm).

Farooq *et al.* (2015) observed that Orobella rank first regarding hybrid produced highest (6.27 cm) value for fruit diameter.

Hasan *et al.* (2014) found that maximum fruit diameter was found from L_3 (0.7 cm) while minimum from L_4 (0.5 cm).

Barche *et al.* (2013) noted that maximum fruit width (1.43 cm) was recorded in genotype 2012/CHIVAR-2 with regards to fruit width.

Tairu *et al.* (2013)recorded fruit width (2.8 cm) was the maximum in accession PP9955-15 while all other cultivars were statistically at par with the check varieties.

Tembhurne *et al.* (2005) observed that HCS G_1 recorded significantly highest fruit width (1.36 cm) among eleven elite advanced lines obtained from Chilli Research Station, Devihosur. On the other hand, better performance of 9626-6-1 was due to fruit weight and fruit width.

Padda *et al.* (1970) recorded fruit breath from 0.6 to 1.5 cm by evaluating plant and fruit characteristics of eleven cultivars of chilli.

2.11 Seed Fruit^{-1} (nos)

Jaisankar *et al.* (2015) found that the maximum number of seeds was found in V_5 (99.24/fruit), while the minimum was recorded in V_{11} (48.04/fruit).

Kaouther *et al.* (2015) nated that Tb cv produced the higher number of seeds (126.8) while Sj cv produced the lowest one (63.26) by a research on five local accessions of chilli pepper (*Capsicum frutescens* L.).

Hasan *et al.* (2014) observed that number of seed/fruit was varied significantly among the chilli lines. Maximum number of seeds/fruit was found from L_2 (69.0) which was statistically similar with L_3 (67.3) while minimum from L_4 (46.8).

Tairu *et al*. (2013) highest number of seeds per pod (48*)* was also recorded in PP9955-15 as regards seed production by five exotic pepper accessions.

Nkansah *et al.* (2010) found the highest seed number per fruit (155) in ICPN16#7 while ICPN16#2 had the least (65).

Nandpuri *et al.* (1971) carried out an extensive investigation on 25 strains of chilli in the Punjab in India and they found the cultivar Fazilaka, Rujpura. Long red, T23-2/2 and 72-2/1 were to be the best in performance for seed weight.

2.12 1000-Seeds Weight (g)

Tairu *et al*. (2013) recorded highest 1000-seeds weight was also recorded in PP9955-15 as regards seed production by five exotic pepper accessions, obtained from AVRDC, The World Vegetable Center (PP9955-15, PP0337-7562, PP0201-7532, PP9950-5197, PP9952-173).

Zewdie (1997) made a trial to studied variation in Yugoslavian hot pepper (*Capsicum annuum L.*). He evaluated 67 accessions of hot pepper based on 35 morphological and physiological characters and recorded highly significant differences among the genotypes were observed in a number of characters. He grouped the accessions into six clusters and mainly based on 1000-seeds weight, fruit weight, fruit number per plant and yield per plant showed wide genetic diversity among the genotypes.

2.13 SPAD Value (%)

Hasan *et al.* (2014) found maximum Chlorophyll Content (57.7%) from L_1 among four chilli lines (coded from L_1 to L_4) during November 2013 to May 2014 at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh.

2.14 Vitamin-C Content in Green Chilli Fruits (mg/100g)

Hasan *et al.* (2014) found highest Vit-C was from L_1 (80.5 mg/100 g fruit) followed by L_3 (77.2 mg/100 g fruit) whereas lowest from L_4 (65.6 mg/100 g fruit) which was statistically similar with L_2 (68.2 mg/100 g fruit) by a trial at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh.

Tilahun *et al.* (2013) found that Bayadaggi kaddi variety showed the highest ascorbic acid content (189 mg/100 FW) and the accession CA 97 showed the lowest ascorbic acid contents (55.3 mg/100 FW).

Padda *et al.* (1970) found that significant cultivar differences at both green and red of fruit maturity and the contents of vitamin c ranged from 75.7 to 220.0 mg/100g in green chilli while 68.7 to 250.3 g/100g in red fruits by evaluating plant and fruit characteristics of eleven cultivars of chilli.

Misra *et al. (*1963) reported that higher vitamin C contents were found in red chilli than in green ones. They also stated that plant height, fruit size, shape and colour were extremely variable.

Rikovsi (1956) noted that ripening increased the vitamin C content and other morphological characters in some cultivars of chilli.

Heiser and Smith *et al.* (1953) noted that the high nutritional value in chilli lay in the vitamin C content, the ripe fruit had 150-180 mg/100g green weight which was higher than that found in tomatoes (20-25 mg).

Shoemaker (1953) found that Vitamin C ranged from 75.7 to 220.0 mg/100g in green chilli while 68.7 to 250.3g in red fruits.

2.15 Yield Plot^{-1} (g)

Hasan *et al.* (2014)) stated that L_3 had given the highest total yield (947.3 g/plot) whereas lowest from L_1 (522.5 g/plot) at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh to study the morpho-physiological and yield performance of four chilli lines (coded from L_1 to L_4) during November 2013 to May 2014.

2.16 Yield Plant^{-1} (g)

Jaisankar *et al.* (2015) the maximum yield was found in 3 subscript (69.74 g/plant) followed by 2 subscript (55.26 g/plant), whereas the minimum was recorded in V_5 (37.68 g/plant).

Kaouther *et al.* (2015) stated that yield in g per plant showed that Kb cv was the most performing accession (870.61 g) while Sj cv produce the lowest yield per plant (406.8 g).

Farooq *et al.* (2015) observed that Orobella rank first regarding fruit weight/plant (1.96 kg). The study was carried out at the Horticultural Research Institute, NARC, Islamabad during 2009-2010.

Hasan *et al.* (2014) Observed maximum yield was found from L_3 (149.2 g/plant) whereas minimum from L_1 (45.0 g/plant) by an experiment conducted at Horticulture farm of Sher-e-Bangla Agricultural University, Bangladesh to study the morpho-physiological and yield performance of four chilli lines.

Barche *et al.* (2013) recorded that the genotype 2012/ CHIVAR-2 recorded the highest fresh fruit yield (993.33g) as well as dry fruit yield per plant (59.70g). Among the twenty two genotypes studied 2011/CHIVAR-8 was found to be superior followed by 2012/CHIVAR-2 and 2011/CHIVAR-6 for this region.

Abdullah *et al.* (2006) find that a wide genetic variation among the genotypes for fruit yield per plant by an experiment on variability, correlation and path analysis among different characters of thirteen sweet pepper genotypes.

Tembhurne *et al.* (2005) observed that HCS G_1 recorded significantly highest yield per plant (100.2 g) by an experiment carried out at College of Agriculture, Bheemarayanagudi.

Tembhurne *et al*. (2004) concluded that the yield performance of chilli genotype 9608 extremely good over others. Traits with good heritability coupled with good genetic advance (yield per plant and fruit weight) can be improved by selection. Yield was found positively associated with number of fruits per plant and fruit weight where as it had negative association with ancillary parameters studied. . On the basis of present study it is evident that characters *viz.*, yield per plant, number of fruits, fruit weight deserve due weightage while fomulating selection strategies for yield improvement in chilli by conducting an experiment at Genetics and Plant Breeding Unit, College of Agriculture, Bheemarayanagudi with seven chilli genotypes (D3-79, 9908, KI-4, LCA -206, 9608, Byadgi kaddi and Byadgi dabbi).

Padda *et al.* (1970) found that the yield of fruits per plant was found to vary 113.7 to 399.8 g by evaluating plant and fruit characteristics of eleven cultivars of chilli.

2.17 Yield Ha^{-1} (ton)

Farooq *et al.* (2015) observed that Orobella rank first regarding yield (51 t ha^{-1}) followed by Figaro (48.57 t ha^{-1}) and Capistrano (45.90 t ha^{-1}), respectively.

Jaisankar *et al.* (2015) highest fruit yield of 4.06 t/ha was recorded in V_3 followed by V_2 (3.34 t/ha) and the minimum was recorded in V_5 (2.24 t/ha). from an experiment on twelve varieties of Chilli (*Capsicum annuum* L.).

Kaouther *et al*. (2015) stated that the yield per hectare ranged from 10.16 ton (Sj cv) to 21.76 ton (Kb cv) in the experimental station of Higher Institute of Agronomy, Chott Mariem, Sousse (Tunisia) for their agronomic evaluation.

Tairu *et al.* (2013) recorded although the accessions did not differ significantly in their yield potential, PP9955-15 had the highest average fruit yield (16.23 t/ha) that is 11.2% higher than the local check.

Ikeh *et al.* (2012) Stated that the application of 8 t/ha poultry manure produced 22.75 and 23.56 t/ha of fresh chilli in 2007 and 2008, respectively while 10 t/ha produced 22.70 and 23.91 t/ha of fresh chilli in 2007 and 2008, respectively. This implies that application above 8t/ha rate will not be economical and beneficial to the farmer. Field trial was carried out during the early cropping seasons of 2007 and 2008 at University of Uyo Teaching and Research Farm, Uyo, Akwa Ibom State, Nigeria to evaluate the effects of poultry manure rates (0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, and 22 t/ha) on growth and yield of chilli(*Capsicum frutescens* L.).

Nkansah *et al.* (2010) ICPN16#7 recorded the highest yield of 30.8 t ha^{-1} (forest) and 29.7 t ha^{-1} (Savanna) while Legon 18 had the lowest of 14.2 t ha^{-1}

and 12.6 t ha^{-1} in the forest and Savanna zones, respectively during 2008. In 2009, ICPN#7 had the highest yield of 28.3 t ha^{-1} (forest) and 25.2 t ha^{-1} (Savanna) while Legon 18 recorded the lowest of 12.7 t ha^{-1} (forest) and 10.1 t ha^{-1} (savanna).

Mohanty *et al.* (2005) found that the highest green fruit yield of 146.40 q/ha was produced by X 235 followed by G_4 (135.13 q/ha). The best performing varieties X 235 and G_4 were advocated for commercial cultivation by an experiment to assess the performance of chilli varieties and eight varieties of chilli *(Capsicum annum* L.) were evaluated over 3 years for this regard.

Tembhurne *et al.* (2005) observed that among the 11 advanced lines evaluated, the mean (2004 and 2005) dry chilli yield per hectare was highest in 9626-6-1(12.75 q/ha) followed by HCS G_1 (12.64 q/ha). HCS G_1 recorded significantly highest yield (18.52 q/ ha) due to highest number of fruits per plant (144.2) .

Das *et al.* (2004) stated the genotype 94-3 showed the highest fruit yield of 110.82 q/ha with a fruit weight of 20.31g and fruit length of 5.90cm followed by plant-C1 and 85-2 which gave high yield (106.82 and 102.43 q/ha) and oppositely genotype 95-1 performed the lowest yield of 31.66 q/ha.

Padda *et al.* (1970) found that yield of red fruits per hectare varied from 4544.0 to 16004.2 kg.

CHAPTER III

MATERIALS AND METHODS

This chapter illustrates information concerning methodology that was used in the execution of the experiment. It comprises a short description of experimental site, climatic condition, materials used for the experiment, treatments of the experiment, data collection procedure statistical analysis etc.

3.1 Experimental Sites

3.1.1 Location

The experiment was conducted at the experimental farm of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh during the period of kharif season from April 2014 to September 2014.

3.1.2 Geographical Location

Geographically the experimental field of Sher-e-Bangla Agricultural University (SAU), Dhaka-1207 is located at $23^0 77'$ N latitude and $90^0 37'$ longitude at an altitude of 9 m above the sea level (BBS, 2004), which belongs to the agro-ecological zone of 28 (AEZ-28) named as Madhupur Tract.

3.2 Climatic Conditions

Experimental site was located in the subtropical monsoon climatic zone, heavy rainfall occurred during the months of April to September (Kharif season) and scantly of rain fall during the rest of the year (Rabi season). Heavy rainfall and high temperature prevails during this season, which is sometime very harmful for chilli cultivation in Bangladesh.

3.3 Soil of the Experimental Field

The experimental area situated to the Modhupur Tract (UNDP, 1988) under the AEZ no. 28 and Tejgoan soil series (FAO, 1988). The soil was sandy loam in texture with pH 5.47- 5.63. The physical and chemical characteristics of soil have been presented in Appendix I.

3.4 Materials

3.4.1 Plant Material

The local landrace chilli germplasm were used in the experiment. Chilli plants are mostly grown from the seed. The seed of chilli were collected from local market and farmers in northern and southern part of Bangladesh.

3.5 Seedbed Preparation

Seedbed was prepared on 18 March 2014 for raising seedlings of chilli and the size of the seedbed was 4m × 1m. For making seedbed, the soil was well ploughed and converted into loose friable and dried masses to obtained good tilth. Dead roots, weeds and stubbles were removed from the seedbed. Cow dung was applied to the prepared seedbed at the rate of 10 t/ha. The soil was treated by sevin 50 WP @ 5 kg/ha to protect the young plants from the attack of ants, mole crickets and cutworm.

3.6 Seed Treatment

Seeds were treated by Vitavax-200 @ 5 g/kg seeds to protect some seed borne diseases such as leaf spot, blight, anthracnose etc.

3.7 Seed Sowing

Seeds were sown on 20 March 2014 in the seedbed. Sowing was done thinly in lines at 3cm spacing. Seeds were sown at a depth of 2 cm and covered with a

fine layer of soil followed by light watering by water can. Thereafter the beds were covered with dry straw to maintain essential moisture and temperature. The cover of dry straw was removed immediately after emergence of seed sprout. When the seeds were germinated, shade by bamboo mat (Chatai) was provided to protect the young seedlings from direct sunshine and rain.

3.8. Raising of Seedlings

Light watering and weeding were done several times. No chemical fertilizers were applied for rising of seedlings. Recommended cultural plant protection measures were taken before and after sowing the seeds. Healthy and 30 days old seedlings were transplanted into the experimental field on 20 April 2014.

3.9 Manuring and Fertilizing

Manure and fertilizers such as Cowdung, Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MOP) were applied in the experimental field as per recommendation of BARI (2012) are showed in Table 1.

Table 1: Recommended fertilizer dose for the experiment.

Manure/ Fertilizer	Dose per hectare	Applied during land preparation	Applied in pit a week before transplanting	Applied as top-dressing in rows	
				1st installment at 3 weeks of transplanting	2nd installment at 5 weeks of transplanting
Cowdung	10 ton	10ton	-	-	-
Urea	550 kg	-	200kg	175 kg	175 kg
TSP	450 kg	-	450kg	-	-
MOP	250 kg	-	100kg	75 kg	75 kg

The entire amount of cowdung applied as basal during land preparation.

3.10 Experimental Methods

3.10.1 Treatments in the Experiment

The experiment was conducted to evaluate the performance of germplasm of chilli for yield and quality characters in kharif season. There was one factor in this experiment. This was as follows:

Factor : Different local germplasm of chilli

1. V_1 = Premium hybrid - Commercial varieties
2. V_2 = Surjomukhi- Commercial varieties
3. V_3 = Magura Morich- Local cultivars
4. V_4 = Kajoli Morich- Unknown landlaces
5. V_5 = BARI Morich1- Commercial varieties
6. V_6 = Vaduria Morich- Unknown landlaces

3.10.2 Experimental Design and Lay out

The experimental was laid out in a Randomized Complete Block Design with four replications. The size of the plot was 1.5 m x 1m. Distances between block to block and plot to plot were 1.0 and 0.5 meter, respectively. Plant to plant distance at 40 cm and row to row distance at 40 cm were maintained.

3.11 Land Preparation

The land of the experiment site was first opened in 2nd week of April 2014 with power tiller. Then, the land was ploughed and cross-ploughed three times followed by laddering to obtain the desire tilth. After ploughing and laddering, the corners of the land were spaded and larger clodes were broken into smaller pieces. All the stubbles and uprooted weeds were removed from land and then the land was made ready.

3.12 Transplanting

The seedbed was watered before uprooting the seedlings to reduce the damage of roots. At the time of uprooting, care was taken so that root damage become minimum and some soil remained with the roots. Thirty days-old healthy seedlings were transplanted at the spacing of 40 cm × 40 cm in the experimental plots on 20 April 2014. Thus the 12 plants were accommodated in each unit plot. Planting was done in the afternoon. Light irrigation was given to each seedling immediately after transplanting for their better establishment. The transplanting seedlings were shaded for five days with the help of white polythene to protect them from direct sunlight, watering was done up to five days until they became capable of establishing on their own root system.

3.13. Intercultural Operations

3.13.1 Gap Filling

Very few seedlings have been damaged after transplanting and replaced these by new seedlings from the same stock.

3.13.2 Weeding

The plants were kept under careful observation. Three times weeding were done during cropping period, viz. 5^{th} May, 20^{th} May and 10^{th} June for proper growth and development of the plants.

3.13.3 Spading

After each irrigation soils of each plot were pulverized by spade for easy aeration.

3.13.4 Irrigation

Irrigation was given by observing the soil moisture condition. Four times irrigation were done during crop period, viz. 4th May, 16th May, 4th June and 20th June for proper growth and development of plants.

3.13.5 Earthing up

Earthing up was done by taking the soil from the space between the rows on 16th June 2014.

3.13.6 Insects and Disease Control

The schedule of plant protection measures followed against the pests and diseases during the period of investigation are presented in Table 2.

Table 2: List of plant protection measures were taken in the experimental field.

Chemical	Dosage	Against (pest/disease)
Lithaphos 20EC	@ 2 ml/l	Cut worms
Confidor	@ 0.25 ml/l	Sucking pests
Acarin	@ 2.5 ml/l	Mites
Acidazim 50F	@ 0.5 g/l	Fruit rot

Poison bait trap: Trap is made by sevin 50wp 2g with cucumber mash 200g to protect from fruit fly.

3.14 Harvesting

Green fruits were harvested at weekly intervals depending on the maturity. Harvesting was started at 65 DAT and continued till 170 DAT.

3.15 Parameters

Four plants were selected at randomly and data were collected from each plot and mean data on the following parameters were recorded.

3.15.1 Crop growth Characters

- Plant height (cm)
- Branches per Plant (nos)
- Canopy length (cm)
- SPAD value of leaf (%)
- Days to flower bud initiation after transplanting (nos)

3.15.2 Yield Characters

- Flowers plant^{-1} (counting up to 60 days/2 months)
- Fruits plant^{-1} (nos)
- Fruits plot^{-1} (nos)
- Yield plant^{-1} (g)
- Yield plot^{-1} (g)
- Yield (ton ha^{-1})

3.15.3 Quality Characters

- Dry weight of 50-fruits (g)
- Dry weight (Fruit/plant) (g)
- Dry weight (Plant) (g)
- Fruit diameter (mm)
- Fruit length (cm)
- 1000-seeds weight (g)
- Seed /fruit (nos)
- Vitamin-C content in green chilli fruits (mg/100g)

3.16 Collection of Experimental Data

In the net plot area, four plants were randomly selected and tagged for recording biometric as well as yield observations.

Crop Growth Parameters

Plant height (cm), number of branch Plant^{-1}, Canopy length were recorded three times at first flowering, first harvesting and final harvesting.

3.16.1 Plant Height (cm)

Plant height was measured from four randomly selected plants of each germplasm from the base of the plant to the growing tip by holding the plant vertically. The mean plant height was expressed in centimetre (cm).

3.16.2 Branches per Plant (nos)

Number of branches was counted from four randomly selected plants of each germplasm and average branches plant^{-1} was calculated.

3.16.3 Canopy Length (cm)

Canopy length was measure by measuring tape from four randomly selected plants of each germplasm and the mean canopy length was expressed in centimeter (cm).

3.16.4 Measurement of SPAD Value of Leaf (%)

Leaf chlorophyll content was measured by using chlorophyll meter SPAD-502 plus (%). The chlorophyll content was measured 4 times from leaf tip to the leaf base and then averaged for analysis.

3.16.5 Days to Flower Bud Initiation after Transplanting (nos)

Days to flower bud initiation (visual observation) was counted the days from the date of chilli seedling transplanting.

Yield Parameters

3.16.6 Flowers Plant^{-1} (counting up to 60 days/2 months) (nos)

Flowers of four randomly selected plants of each replication were counted and then the average number of flowers for each plant was determined. It was done at every 10 day interval from the first flower continued up to two months.

3.16.7 Fruits Plant^{-1} (nos)

Fruits of four randomly selected plants of each replication were counted and then the average number of fruits for each plant was determined. It was done continued up to final harvesting.

3.16.8 Fruits Plot^{-1} (nos)

Total numbers of fruits per plot (12 plants) were counted and it was done continued up to final harvesting.

3.16.9 Yield Plant^{-1} (g)

Fruits weight of four randomly selected plants of each replication were counted by using electric precision balance in gram (g). Then average weight of fruit for each plant was determined. It was done continued up to final harvesting.

3.16.10 Yield Plot^{-1} (g)

Total weight of fruits per plot (12 plants) were counted by using electric precision balance in gram (g) and it was done continued up to final harvesting.

3.16.11 Yield (ton ha^{-1})

Total weight of fruits per plot was converted to yield (ton ha^{-1}).

Quality Parameter

3.16.12 Measurement of Dry Weight (g) of 50-Fruits

Dry weight of 50 fruits was measured by electric precision balance in gram (g). Fifty randomly selected fresh fruits from each treatment were dry in room temperature. Then dry fifty fruits were weighted.

3.16.13 Dry Weight (g) (Fruits/ Plant)

Dry weight of fruits/plant was measured by electric precision balance in gram.

3.16.14 Dry Weight (g) of Plant

Dry weight of Plant was measured by electric precision balance in gram (g).

3.16.15 Measurement of Fruit Diameter (mm) and Length (cm)

Fruit length was measured by using linear scale in centimeter (cm) and Fruit diameter was measured by using digital caliper-515 (DC-515) in millimeter (mm). Mean was calculated from each treatment.

3.16.16 1000-Seeds Weight (g)

1000-seeds weight was measured by electric precision balance in gram (g). 1000 seed from each treatment were counted then weighted. Then averaged for analysis.

3.16.17 Seed Fruit^{-1} (nos)

Fifty randomly selected fruits seed from each treatment were counted and then divided by fifty to get average number of seed fruit^{-1}.

3.16.18 Vitamin C Content in Green Chilli Fruit (mg/100g)

Vitamin C content of green chilli fruit was determined by 2, 6-dichlorophenol indophenols visual titration method as described by Plummer (1971) and measured as described by Wayne *et al*., (2002). The following reagents were used for the estimation of vitamin C content.

3.16.18.1 Reagents

3% Metaphosphoric acid (HPO_3): 3% metaphosphoric acid (HPO_3) was prepared by dissolving 30 g of HPO_3 and 80 ml glacial acetic acid in distilled water and volumed up to one liter.

Standard ascorbic acid solution: 10% of L-ascorbic acid solution was prepared by dissolving ascorbic acid in 3% metaphosphoric acid solution.

Dye solution: It was prepared by dissolving 260 mg of 2, 6-dicholophenol indophenol and 21 mg of sodium salt in one liter of distilled water.

3.16.18.2 Procedure

Standardization of Dye Solution

5 ml of standard ascorbic acid solution dilute with 5 ml of meta phosphoric acid. A micro burette was filled with dye solution and the mixed solution was titrated with dye solution using phenolphthalein as indicator to the pink colored end point which persisted for at least 15 sec.

The following formula was used for calculating dye factor :

$$\text{Dye factor} = \frac{0.5}{\text{Titre}}$$

Preparation of Sample

Five grams of fresh fruit was taken in a 100 ml beaker with 50 ml 3% metaphosphoric acid and then it was transferred to a blender and homogenized with same concentration of metaphosphoric acid. After blending it was filtered and centrifuged at 2000 rpm for 5 minutes. The homogenized liquid was transferred to a 100 ml volumetric flask and was volumed up to the mark with 3% metaphosphoric acid.

Titration

Five ml of the sample was taken in a conical flask and titrated with 2, 6-dicholophenol indophenols dye, phenolphthalein was used as indicator to a pink colored end point, which persisted at least 15 seconds.

$$\text{Ascorbic acid (mg /100g)} = \frac{T \times D \times V_1 \times 100}{V_2 \times W}$$

By using the following formula the ascorbic acid content (vitamin C) of the sample was calculated.

Where,

T = Titre value (ml)

D = Dye factor

V_1= Volume to be made (ml)

V_2 = Volume of extract taken for titration (ml)

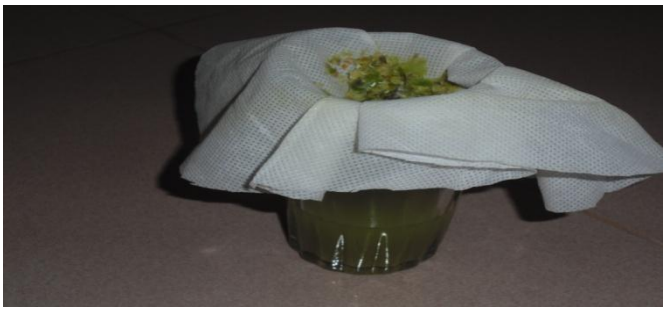
W = Weight of sample taken for estimation (g)

3.19 Statistical Analysis

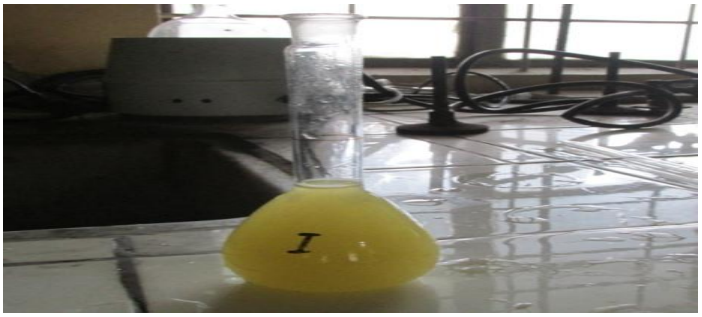
The data in respect of growth and yield components were statistically analyzed to find out the significance of the experimental results. The means of all the treatments were calculated and the analysis of variance for each of the characters under study was performed by F test. The difference among the treatment means was evaluated by Least Significant Difference (LSD) test (Gomez and Gomez, 1984) at 5% level of significance.

A

B



C



D

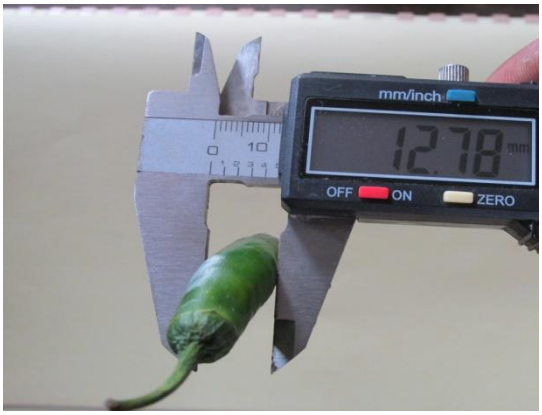
E

F

G

Plate 1.Photograph showing general procedure of estimating vitamin C content. (A = Weighing, B = Blending, C = Filtering, D = Sampling, E = Pipetting, F = Sample transferring, G = Titrating).

A



B

C

Plate 2: Photograph showing fruit length, fruit diameter and fruit weight measurement of Chilli

A. Fruit length (cm) measurement using Linear scale.

B. Fruit diameter measurement using Digital caliper-515 (DC-515) in millimeter (mm).

C. Fruit weight measurement by using electronic precision balance in gram (g).

CHAPTER IV

RESULTS AND DISCUSSION

The results of the study have been presented in this chapter. As already mentioned, experiment was conducted in kharif seasons of 2014. The experiment was conducted to determine growth, yield performance of six germplasm in kharif season to know comparative vegetative, reproductive and quantitative performance of the germplasm. Some of the data have been presented and expressed in table (s) and others in graphs for ease of discussion, comparison and understanding. A summary of the analysis of variances in respect of all parameters have been shown in the appendices and possible interpretations wherever necessary have been presented under the following headings.

4.1 Plant Height (cm) at Different Days after Transplanting

Plant height at different days after transplanting has been showed in Figure 1. Plant height is one of the most important growth parameters that indicates vegetative growth trend of plants. So, for easy understanding and comparison of vegetative growth of chilli, plant height was recorded at different days such as at first flowering, first harvest and at final harvest.

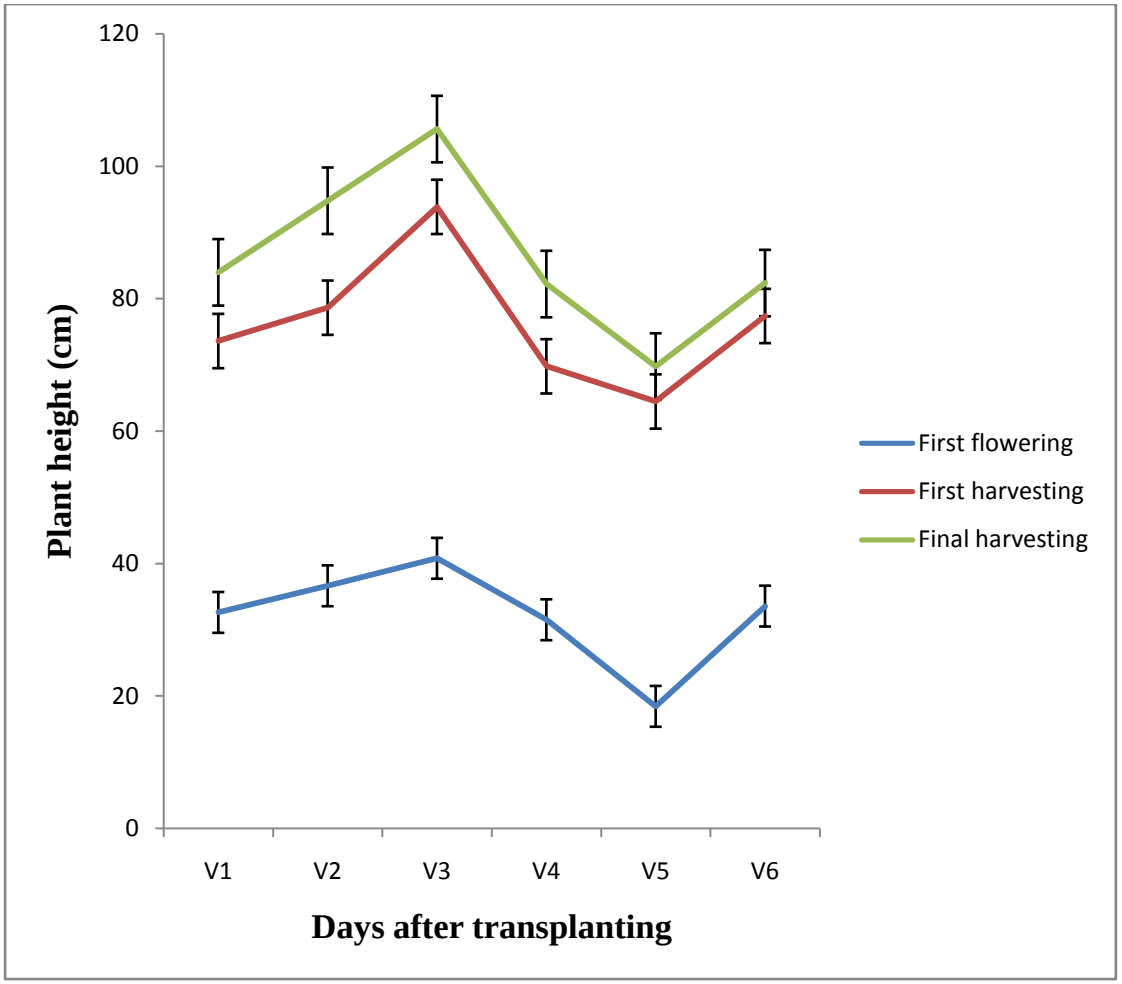
The effect of germplasm on plant height was significantly varied at different days after transplanting (Appendix III). It was found that V_3 (Magura Morich) produced the tallest plant at first flowering (40.80cm), which was statistically similar to V_2 (Surjomukhi) varied significantly with the other germplasm. The V_5 (BARI Morich1) produced the shortest plant at first flowering (18.45 cm) which was statistically varied significantly with the other germplasm.

V_3 (Magura Morich) produced the tallest plant at first harvest (93.85 cm), which was statistically varied significantly with the other germplasm. The V_5 (BARI Morich1) produced the shortest plant at first harvest (64.47 cm) which was statistically similar to the V_4 (Kajoli Morich) but varied significantly with the other germplasm.

V_3 (Magura Morich) produced the tallest plant at final harvest (105.6 cm), which varied significantly with the other germplasm. V_5 (BARI Morich1) produced the shortest plant at final harvest (69.75 cm) which was statistically varied significantly with the other germplasm.

From the result of plant height at different days such as first flowering, first harvest and final harvest (Fig.1), it can be stated that plants of all germplasm possessed a normal growth rate in kharif season. It is clear that germplasm has significant effect on plant growth rate and they differ from each other. Growth of V_3 (Magura Morich) was significantly higher in early vegetative to successive days after planting indicating its high vigor over the other germplasm. Growth of V_5 (BARI Morich1) was significantly lower in early vegetative to successive days after planting indicating its low vigor than any other germplasm.

At final harvest V_3 (Magura Morich) produced the tallest plant (105.6 cm) and V_5 (BARI Morich1) produced the shortest plant at final harvest (69.75 cm). Similar results also reported by Kaouther *et al.* (2015) found that plant height ranged from 56.16 cm to 114.83 cm in chilli where Kb cv demonstrated the best values while Sj cv had the lowest one.



V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 =Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

Figure 1. Effect of Germplasm on plant height at different days after transplanting ($LSD_{0.05}$ = 3.952, 7.305 and 8.943 at first flowering, first harvest and first harvest respectively)

4.2 Number of Branches per Plant

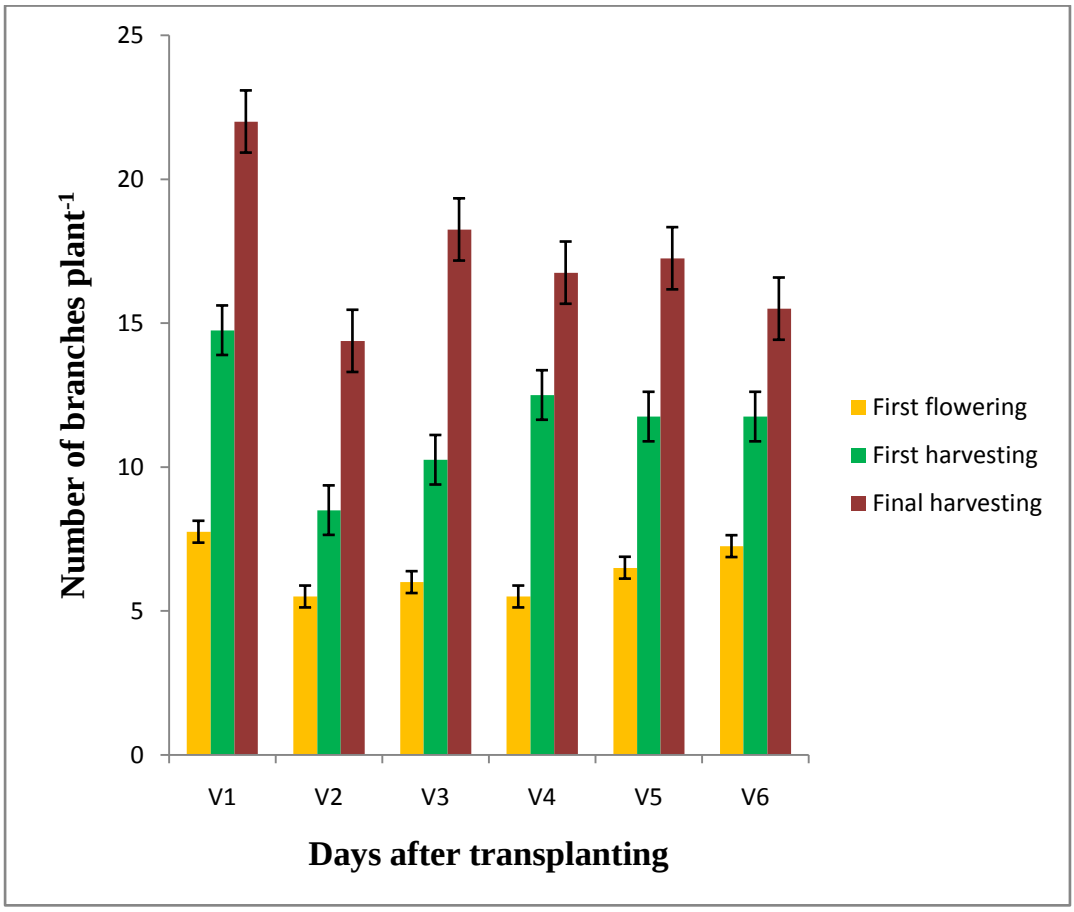
Analysis of variance showed that the effect of Chilli germplasm on Number of Branches per plant at first flowering, first harvest and final harvest was varied significantly (Appendix VI). The maximum no of branches (7.750 plant^{-1}) was found in V_1 (Premium hybrid) which was statistically similar to V_6 (Vaduria Morich) but varied significantly with any other germplasm (Fig 2) at first flowering. At first flowering the minimum no of branches (5.50 plant^{-1}) was found both in V_2 (Surjomukhi) and V_4 (Kajoli Morich) which was statistically similar to and V_3 (Magura Morich) but varied significantly with other germplasm (Fig 2).

At first harvest, the maximum no of branches (14.75 plant^{-1}) was found in V_1 (Premium hybrid) which was varied significantly with any other germplasm (Fig 2). The minimum no of branches (8.500 plant^{-1}) was found in V_2 (Surjomukhi) but varied significantly with any other germplasm (Fig 2) at first harvest.

At final harvest, the maximum no of branches (22.0 plant^{-1}) was found in V_1 (Premium hybrid) which was varied significantly with any other germplasm (Fig 2). The minimum no of branches (14.38 plant^{-1}) was found in V_2 (Surjomukhi) which was statistically similar to V_4 (Kajoli Morich) and V_6 (Vaduria Morich) but varied significantly with any other germplasm (Fig 2) at final harvest. Jaisankar *et al.* (2015) found that maximum number of branches was found from V_3 (26.57/plant), while the minimum from V_5 (11.69/ plant) which is justify this experiment.

From the result of no of branches at different days such as first flowering, first harvest and final harvest (Fig.2), it can be stated that plants of all germplasm possessed a normal growth rate in kharif season. It is clear that germplasm has significant effect on no of branches and they differ from each other. No of branches was significantly higher in V1 (Premium hybrid) from early

vegetative to successive days after planting indicating its high vigor over the other germplasm. No of branches of V_2 (Surjomukhi) was significantly lower in early vegetative to successive days after planting indicating its low vigor than any other germplasm.



V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 =Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

Figure 2. Effect of Germplasm on no of branches plant^{-1} at different days after transplanting ($LSD_{0.05}$ = 1.604, 1.261 and 2.817 at first flowering, first harvest and first harvest respectively).

4.3 Days to Flower Bud Initiation after Transplanting (nos)

The time required for flower bud initiation after transplanting was varied significantly among the germplasm (Appendix V). It was found that V_3 (Magura Morich) required maximum time (33.75 days) for the first appearance of inflorescence which was varied significantly with any other germplasm. The minimum time (12.0 days) for first appearance of inflorescence was required by V_6 (Vaduria Morich), which was statistically similar to V_4 (Kajoli Morich) but varied significantly with other germplasm (Table 3). Hasan *et al.* (2014) observed early flower bud initiation in L_1 (30 days) whereas late in L_4 (42 days).

4.4 Number of Flower plant^{-1}

Analysis of variance indicated that the effect of germplasm on flower per plant upto 60 days from first flowering was varied significantly (Appendix V). It was found that maximum flower per plant (170.5) was produced by V_6 (Vaduria Morich) which was significantly higher than the other germplasm. On the other hand, minimum flower per plant (106.8) was produced by V_2 (Surjomukhi) followed by V_3 (Magura Morich) produce (114.5) flower/ plant which was statistically similar but varied significantly with the other germplasm (Table 3). Kaouther *et al*. (2015) stated that Kb cv had the highest number of flowers per plant (356.5) whereas Tb cv had the lowest number (212.7 flowers).

From the experiment, it can be stated that flower intiation by V_6 (Vaduria Morich) required only 12 DAT being more time for flowering thus number of flowers in this germplasm was also more.

Table 3. Effect of Germplasm on Days to flower bud initiation after transplanting and number of flowers plant^{-1}.

Germplasm	Days to flower bud initiation after transplanting	Number of flowers plant^{-1} (Upto 60 days from first flowering)
V_1	18.25 cd	131.0 c
V_2	25.00 b	106.8 d
V_3	33.75 a	114.5 d
V_4	15.50 de	133.5 c
V_5	20.75 c	147.0 b
V_6	12.00 e	170.5 a
LSD (0.05)	3.512	9.304
CV (%)	11.16	4.61

V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 = Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

4.5 Canopy Length (cm)

At 30 DAT analysis of variance indicated that the effect of germplasm on canopy length was varied significantly (Appendix VI). It was found that maximum Canopy length (58.25 cm) and (57.0 cm) were produced by V_5 (BARI Morich1) and V_6 (Vaduria Morich) respectively which were statistically similar to all other germplasm. On the other hand, minimum canopy length (42.75 cm) was produced by V_2 (Surjomukhi) which was statistically similar to all other germplasm (Fig 3).

At 40 DAT analysis of variance indicated that the effect of germplasm on canopy length was varied significantly (Appendix VI). It was found that maximum Canopy length (98.75 cm) was produced by V_5 (BARI Morich1) which was statistically similar to V_1 (Premium hybrid), V_3 (Magura Morich), V_4 (Kajoli Morich) and V_6 (Vaduria Morich) but significantly higher than V_2 (Surjomukhi). On the other hand, minimum canopy length (66.50 cm) was produced by V_2 (Surjomukhi) which was statistically similar to V_1 (Premium hybrid), V_4 (Kajoli Morich) and V_6 (Vaduria Morich) varied significantly with the other chilli germplasm (Fig 3).

At 50 DAT analysis of variance indicated that the effect of germplasm on canopy length was varied significantly (Appendix VI). It was found that maximum canopy length (119.3 cm) was produced by V_5 (BARI Morich1) which was statistically similar to V_1 (Premium hybrid), V_3 (Magura Morich), V_4 (Kajoli Morich) and V_6 (Vaduria Morich) but significantly higher than V_2 (Surjomukhi). On the other hand, minimum canopy length (70.25 cm) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Fig 3).

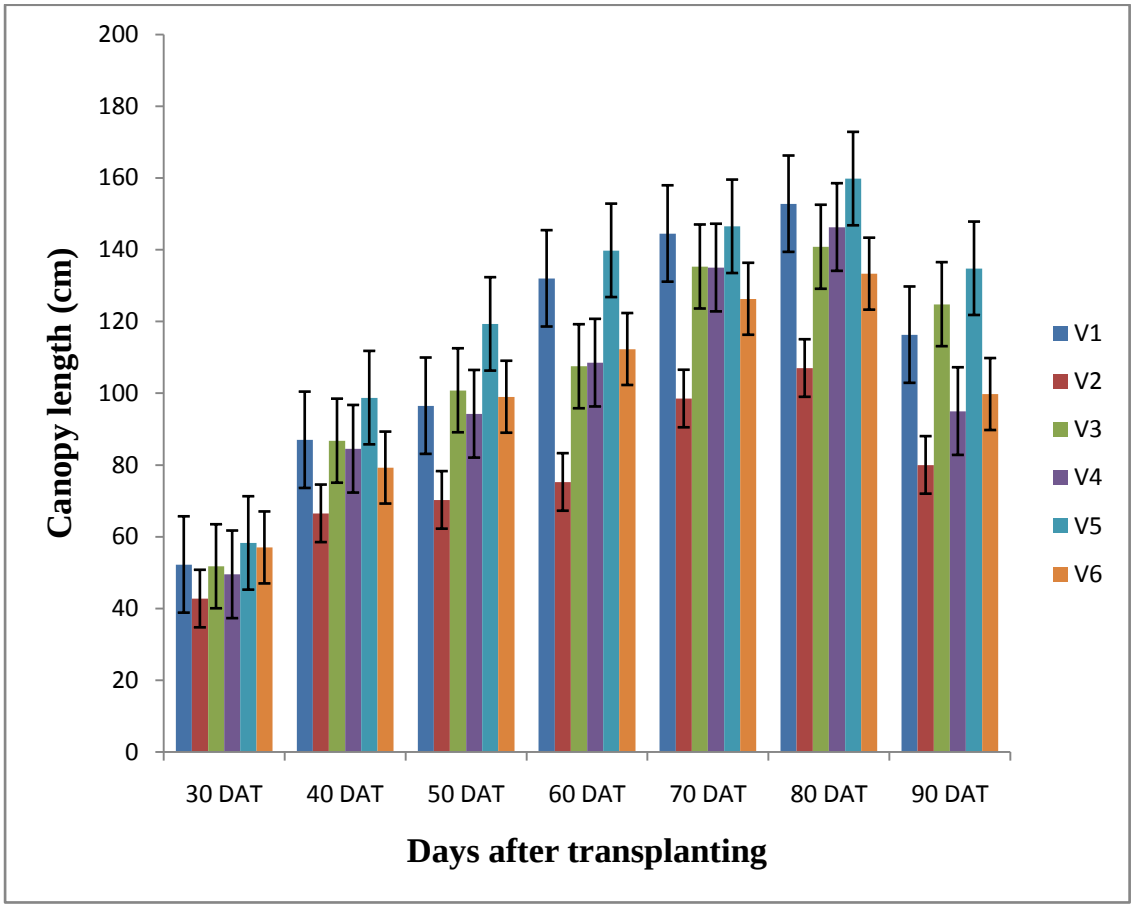
At 60 DAT analysis of variance indicated that the effect of germplasm on canopy length was varied significantly (Appendix VI). It was found that maximum Canopy length (139.8 cm) was produced by V_5 (BARI Morich1) and

(132.0 cm) was produced by V_1 (Premium hybrid) which was significantly higher than other germplasm. On the other hand, minimum canopy length (75.25 cm) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Fig 3).

At 70 DAT analysis of variance indicated that the effect of germplasm on canopy length was varied significantly (Appendix VI). It was found that maximum canopy length (146.5 cm) was produced by V_5 (BARI Morich1) which was statistically similar to V_1 (Premium hybrid), V_3 (Magura Morich), V_4 (Kajoli Morich) and V_6 (Vaduria Morich) but significantly higher than V_2 (Surjomukhi). On the other hand, minimum canopy length (98.50 cm) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Fig 3).

At 80 DAT analysis of variance indicated that the effect of germplasm on canopy length was varied significantly (Appendix VI). It was found that maximum Canopy Length (159.8 cm) was produced by V_5 (BARI Morich1) which was statistically similar to V_1 (Premium hybrid), V_3 (Magura Morich) and V_4 (Kajoli Morich) but significantly higher than other chilli germplasm. On the other hand, minimum canopy length (107.0 cm) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Fig 3).

At 90 DAT analysis of variance indicated that the effect of germplasm on canopy length was varied significantly (Appendix VI). It was found that maximum canopy length (134.8 cm) was produced by V_5 (BARI Morich1) which was statistically similar to V_1 (Premium hybrid) and V_3 (Magura Morich) significantly higher than other chilli germplasm . On the other hand, minimum canopy length (80.0 cm) was produced by V_2 (Surjomukhi) which was statistically similar to V_4 (Kajoli Morich) but varied significantly with the other chilli germplasm (Fig 3).



V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 = Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

Figure 3. Effect of Germplasm on canopy length at different days after transplanting ($LSD_{0.05}$ = 10.75, 12.92, 13.85, 16.96, 22.88, 25.86 and 23.74) at 30 DAT, 40 DAT, 50 DAT, 60 DAT, 70 DAT, 80 DAT and 90 DAT respectively)

4.6 Number of Fruit Plant^{-1}

Analysis of variance indicated that the effect of germplasm on number of fruit plant^{-1} was varied significantly (Appendix VII). It was found that maximum number of fruit plant^{-1} (733.5) was produced by V_6 (Vaduria Morich) which was statistically similar to V_4 (Kajoli Morich) but significantly higher than other chilli germplasm . On the other hand, minimum number of fruit plant^{-1} (538.8) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Table 4). Padda *et al.* (1970) found that fruits per plant ranged from 82.0 to 532.2.

4.7 Number of Fruit Plot^{-1}

Analysis of variance indicated that the effect of germplasm on number of fruit plot^{-1} was varied significantly (Appendix VII). It was found that maximum number of fruit plot^{-1} (8775) was produced by V_6 (Vaduria Morich) which was statistically similar to V_4 (Kajoli Morich) but significantly higher than other chilli germplasm . On the other hand, minimum number of fruit plot^{-1} (1665) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Table 4).

Table 4. Effect of Germplasm on Number of Fruits plant^{-1} and Number of fruit plot^{-1}.

Germplasm	Number of Fruits plant^{-1}	Number of fruit plot^{-1}
V_1	623.8 b	5385. c
V_2	538.8 c	1665. e
V_3	588.8 b	3795. d
V_4	716.3 a	8595. a
V_5	620.3 b	7143. b
V_6	733.5 a	8775. a
LSD (0.05)	49.80	822.1
CV (%)	5.19	9.26

V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 =Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

4.8 Dry Weight of 50 Fruits (g)

Analysis of variance indicated that the effect of germplasm on dry weight of 50 fruits was varied significantly (Appendix VII). It was found that maximum dry weight of 50 fruits (40.75 g) was produced by V_1 (Premium hybrid) which was significantly higher than other chilli germplasm . On the other hand, minimum dry weight of 50 fruits (9.488 g) was produced by V_4 (Kajoli Morich) which was statistically similar to V_2 (Surjomukhi) and V_3 (Magura Morich) but varied significantly with the other chilli germplasm (Table 5).

4.9 Dry Weight (Fruit Plant^{-1}) (g)

Analysis of variance indicated that the effect of germplasm on dry weight (fruit plant^{-1}) was varied significantly (Appendix VII). It was found that maximum dry weight (fruit plant^{-1}) (365.7 g) was produced by V_1 (Premium hybrid) which was significantly higher than other chilli germplasm . On the other hand, minimum dry weight (fruit plant^{-1}) (29.6 g) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Table 5).

Table 5. Effect of Germplasm on Dry weight of 50 fruit (g) and Dry weight of fruit plant^{-1}

Germplasm	Dry weight of 50 fruits (g)	Dry weight of fruit plant^{-1}
V_1	40.75 a	365.7 a
V_2	10.70 c	29.6 e
V_3	10.45 c	66.0 d
V_4	9.488 c	123.0 c
V_5	14.52 b	172.6 b
V_6	13.82 b	201.8 b
LSD (0.05)	1.613	31.32
CV (%)	6.44	13.01

V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 = Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

4.10 Length of Fruit (cm)

Analysis of variance indicated that the effect of germplasm on length of fruit was varied significantly (Appendix VII). It was found that maximum length of fruit (10.06 cm) was produced by V_1 (Premium hybrid) which was significantly higher than other chilli germplasm . On the other hand, minimum length of fruit (6.35 cm) was produced by V_2 (Surjomukhi) which was statistically similar to V_4 (Kajoli Morich), V_5 (BARI Morich1) and V_6 (Vaduria Morich) but varied significantly with the other chilli germplasm (Table 6). Heiser and Smith (1953) stated that the fruits varied from 4.0 to 30.0 cm in length. Barche *et al.* (2013) found that maximum fruit length (11.38 cm) was recorded in genotype 2012/CHIVAR-2. Tairu *et al.* (2013) recorded fruit length (14.81 cm) was the maximum in accession PP9955-15 which is similar to this experiment.

4.11 Diameter of Fruit (mm)

Analysis of variance indicated that the effect of germplasm on diameter of fruit was varied significantly (Appendix VIII). It was found that maximum diameter of fruit (7.58 mm) was produced by V_6 (Vaduria Morich) which was statistically similar to V_1 (Premium hybrid) varied significantly with other chilli germplasm . On the other hand, minimum diameter of fruit (5.67 mm) was produced by V_4 (Kajoli Morich) which was statistically similar to V_2 (Surjomukhi) and V_3 (Magura Morich) but varied significantly with the other chilli germplasm (Table 6). Hasan *et al*. (2014) found that maximum fruit diameter was found from L_3 (0.7 cm) while minimum from L_4 (0.5 cm) which is justify this experiment.

Table 6. Effect of Germplasm on Length of Fruit (cm) and Diameter of Fruit (mm)

Germplasm	Length of Fruit (cm)	Diameter of Fruit (mm)
V_1	10.06 a	7.153 ab
V_2	6.345 c	5.940 cd
V_3	8.505 b	6.222 cd
V_4	6.975 c	5.665 d
V_5	7.120 c	6.573 bc
V_6	7.050 c	7.577 a
LSD (0.05)	1.031	0.6394
CV (%)	8.91	6.51

V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 =Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

4.12 Seed Fruit^{-1} (nos)

Analysis of variance indicated that the effect of germplasm on seed fruit^{-1} was varied significantly (Appendix VIII). It was found that maximum seed fruit^{-1} (54.75) was produced by V_6 (Vaduria Morich) which was significantly higher than other chilli germplasm . On the other hand, minimum seed fruit^{-1} (32.50) was produced by V_2 (Surjomukhi) which was statistically similar to V_3 (Magura Morich) but varied significantly with the other chilli germplasm (Table 7). Jaisankar *et al.* (2015) found that the maximum number of seeds was found in V_5 (99.24/fruit), while the minimum was recorded in V_{11} (48.04/fruit).

4.13 1000-Seeds Weight (g)

Analysis of variance indicated that the effect of germplasm on 1000-seeds weight was varied significantly (Appendix VIII). It was found that maximum 1000-seeds weight (4.33 g) was produced by V_1 (Premium hybrid) which was significantly higher than other chilli germplasm. On the other hand, minimum 1000-seeds weight (2.85 g) was produced by V_4 (Kajoli Morich) which was varied significantly with the other chilli germplasm (Table 7).

4.14 Dry Weight of Plant (g)

Analysis of variance indicated that the effect of germplasm on dry weight of plant was varied significantly (Appendix VIII). It was found that maximum dry weight of plant (150.6 g) was produced by V_1 (Premium hybrid) which was significantly higher than other chilli germplasm . On the other hand, minimum dry weight of plant (55.2 g) was produced by V_2 (Surjomukhi) which was varied significantly with the other chilli germplasm (Table 7).

Table 7. Effect of Germplasm on Seed fruit^{-1}, 1000-seeds weight (g) and Dry weight of plant.

Germplasm	Seed fruit^{-1} (nos)	1000-seeds weight (g)	Dry weight of plant (g)
V_1	36.50 c	4.325 a	150.6 a
V_2	32.50 d	3.150 c	55.2 d
V_3	33.50 d	3.325 b	62.2 c
V_4	43.00 b	2.850 d	38.2 e
V_5	37.00 c	3.225 bc	67.4 b
V_6	54.75 a	3.125 c	62.6 c
LSD (0.05)	2.648	0.1718	3.6
CV (%)	4.44	3.44	3.3

V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 = Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

4.15 SPAD Value of Leaf (%)

SPAD meter reading of leaf was analyzed and presented in order to having an idea about relative leaf chlorophyll content per unit leaf area of the chilli germplasm. Analysis of variance indicated that the effect of chilli germplasm on relative chlorophyll content of leaf was varied significantly (Appendix IX). The maximum SPAD value (67.65%) was recorded in leaf of V_4 (Kajoli Morich) which was statistically similar to V_1 (Premium hybrid) and V_3 (Magura Morich) but varied significantly to other chilli germplasm. The higher SPAD value obtained from the former chilli germplasm indicated that leaves of these germplasm contained relatively higher but statistically similar amount of chlorophyll per unit leaf area compare to the later one (Table 8). Hasan *et al.* (2014) found maximum chlorophyll content (57.7%) from L_1.

4.16 Vitamin C content in Green Chilli Fruit (mg/100g)

Analysis of variance indicated that the effect of chilli germplasm on relative Vitamin C content in green chilli fruit was varied significantly (Appendix IX). The maximum vitamin C content in green chilli fruit (67.15 mg/100g) was recorded in leaf of V_4 (Kajoli Morich) which was varied significantly to other chilli germplasm. The minimum vitamin C content in green chilli fruit (45.07 mg/100g) was recorded in V_5 (BARI Morich1) which was varied significantly to other chilli germplasm. The higher vitamin C content in green chilli fruit obtained from the former chilli germplasm indicated that green fruit of these germplasm contained relatively higher vitamin C per unit fruit compare to the later one (Table 8). Tilahun *et al.* (2013) found that the highest ascorbic acid content (189 mg/100 FW) in Bayadaggi kaddi and the lowest ascorbic acid content (55.3 mg/100 FW) in CA 97.

Table 8. Effect of Germplasm on SPAD value of leaf (%) and Vitamin-C content in green chilli fruits (%).

Germplasm	SPAD value of leaf (%)	Vitamin- C content in green fruits (mg/100g)
V_1	61.67 ab	53.38 d
V_2	57.35 b	60.88 c
V_3	61.22 ab	50.07 e
V_4	67.65 a	67.15 a
V_5	58.55 b	45.07 f
V_6	58.72 b	64.82 b
LSD (0.05)	6.915	2.155
CV (%)	7.54	2.51

V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 = Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

4.17 Yield Plot^{-1} (g)

The effect of germplasm on total fruit weight per plot showed significant variation (Appendix IX). The maximum total fruit weight (14310 g plot^{-1}) was given by V_1 (Premium hybrid) which was varied significantly to other chilli germplasm. On the other hand, minimum total fruit weight (1222 g plot^{-1}) was given by V_2 (Surjomukhi) which was statistically similar to V_3 (Magura Morich) significantly lower than other chilli germplasm (Table 9).

4.18 Yield plant^{-1} (g)

The effect of germplasm on total fruit weight per plot showed significant variation (Appendix IX). The maximum total fruit weight (1118 g plant^{-1}) was given by V_1 (Premium hybrid) which was varied significantly to other chilli germplasm. On the other hand, minimum total fruit weight (501.9 g plant^{-1}) was given by V_2 (Surjomukhi) which was statistically similar to V_3 (Magura Morich) and V_4 (Kajoli Morich) significantly lower than other chilli germplasm (Table 9). Farooq *et al.* (2015) observed that Orobella rank first regarding fruit weight/plant (1.96 kg). Barche *et al.* (2013) recorded that the genotype 2012/ CHIVAR-2 recorded the highest fresh fruit yield (993.33g) per plant.

4.19 Yield (ton ha^{-1})

The effect of germplasm on total fruit weight per haectare showed significantly variation (Appendix IX). The maximum total fruit weight (16.67 ton ha^{-1}) was given by V_1 (Premium hybrid) which was varied significantly to other chilli germplasm. On the other hand, minimum total fruit weight (5.983 ton ha^{-1}) was given by V_2 (Surjomukhi) which was significantly lower than other chilli germplasm (Table 9). Kaouther *et al.* (2015) stated that the yield per hectare ranged from 10.16 ton (Sj cv) to 21.76 ton (Kb cv) and Jaisankar *et al.* (2015)

highest fruit yield of 4.06 t/ha was found in V_3 (Magura Morich) followed by the minimum was recorded in V_5 (2.24 t/ha). Padda *et al.* (1970) found that yield of red fruits per hectare varied from 4544.0 to 16004.2 kg.

Table 9. Effect of Germplasm on Yield (g)plot^{-1}, Yield (g) plant^{-1} and Yield (t/ha).

Germplasm	Yield (g) plot^{-1}	Yield (g) plant^{-1}	Yield (t/ha)
V_1	14310. a	1118. a	16.67 a
V_2	1222. d	501.9 c	5.983 e
V_3	2497. d	525.5 c	10.23 d
V_4	6310. c	525.8 c	12.02 cd
V_5	7778. b	648.2 b	13.11 bc
V_6	7344. bc	612.0 b	14.12 b
LSD (0.05)	1294.	79.49	1.847
CV (%)	13.06	8.05	10.19

V_1 = Premium hybrid , V_2 = Surjomukhi, V_3 = Magura Morich, V_4 = Kajoli Morich, V_5 = BARI Morich1 and V_6 = Vaduria Morich.

CHAPTER V

SUMMARY AND CONCLUSION

The research was comprised of field experiments conducted at the research farm of Sher-e-Bangla Agricultural University (SAU) during kharif season, 2014. The treatment of the experiment was six selected chilli germplasm, namely, Premium hybrid , Surjomukhi, Magura Morich, Kajoli Morich, BARI Morich1 and Vaduria Morich. They were planted on April 25, 2014 during kharif seasons . The experiment was laid out in Randomized Complete Block Design (RCBD) having one factor with four replications.

Data were taken on growth, yield contributing characters, yield and quality in order to study morpho-physiological as well as yield contributing character of the selected chilli germplasm during kharif seasons. The data were statistically analyzed using MSTAT-C statistical analysis software for evaluation. The summary of the results has been presented in this chapter.

The effect of germplasm was found to be significant in all parameters. The tallest plant at different days after transplanting (40.80 cm, 93.85 cm and 105.6 cm at first flowering, first harvest and final harvest respectively), was produced by V_3 (Magura Morich), which was, however, significantly varied with other chilli germplasm. The highest number of branches at different days after transplanting (8.0, 15.0 and 22.00 at first flowering, first harvest and final harvest respectively), was found in V_1 (Premium hybrid), which was, however, significantly varied with other chilli germplasm.

Days to flower bud initiation after transplanting was significantly influenced by germplasm. The minimum days from transplanting to appearance of first inflorescence was required by V_6 (Vaduria Morich). V_6 (Vaduria Morich) required lowest (12 days) and V_3 (Magura Morich) required highest (34 days) for flower bud initiation. Significant variation in number of flower and number of fruits per plant was observed due to varietal influence. V_6 (Vaduria Morich) produced the maximum number of flower per plant (170) upto 2 month and

maximum number of fruit per plant (733) upto harvest Produced by same germplasm which was statistically similar to V_4 (Kajoli Morich). Length of fruit is the highest (10.06 mm) in V_1 (Premium hybrid) but diameter of fruit is the highest (7.58 mm) in V_6 (Vaduria Morich).

Dry weight of 50 fruits (40.75 g) and dry weight of fruit plant^{-1} (365.70 g) was the highest in V_1 (Premium hybrid), which was significantly varied with other chilli germplasm. Seed fruit^{-1} and 1000-seeds weight also had significant variation in different chilli germplasm. Seed fruit^{-1} was the highest (55) in V_6 (Vaduria Morich), which was, however, significantly varied with other chilli germplasm. Moreover, 1000-seeds weight was the highest (4.33 g) in V_1 (Premium hybrid), which was, also significantly varied with other chilli germplasm.

Dry weight of plant represent the dry matter accumulation of plant which is an important for know the physiological behavior of germplasm. Dry weight of plant was the highest (150.6) in V_1 (Premium hybrid) and the lowest (38.2) in V_4 (Kajoli Morich) which were, however, significantly varied with other chilli germplasm. Relative chlorophyll content per unit leaf area based on SPAD value was significantly varied and the maximum SPAD value (67.65%) was obtained in leaf of V_4 (Kajoli Morich) which was statistically similar to V_1 (Premium hybrid) and V_3 (Magura Morich). Vitamin C content (mg/100g) in green chilli fruit is an vital quality character to a chilli germplasm. V_4 (Kajoli Morich) contained the highest (67.15 mg/100g) and V_5 (BARI Morich1) contained lowest (45.07 mg/100g) vitamin C in green chilli fruit.

Yield plant^{-1} and Yield plot^{-1} are main characters to select a germplasm of chilli in kharif season. Maximum yield plant^{-1} (1118 g) was observed in V_1 (Premium hybrid), which was, however, significantly varied with other chilli germplasm. So, the maximum yield plot^{-1} (14310 g) was estimated in (Premium hybrid), which was, however, significantly varied with other chilli germplasm. Maximum yield (16.67 ton/ha) was produced by (Premium hybrid), which was, however, significantly varied with other chilli germplasm.

Conclusion

Based on the findings of the present study, it may be concluded that germplasm have remarkable influence on growth,yield and quality characters of six chilli. V_1 (Premium hybrid) and V_6 (Vaduria Morich) planted on kharif season (April 25) would be beneficial at farmers' level but V_4 (Kajoli Morich) would be better when quality (SPAD value 67.65% and Vitamin C 67.15 mg/100 g) is concern.

Suggestions:

- Chilli should be cultivated in high well aerated land in kharif season to reduce death of plant.
- Farmers' should cultivate Premium hybrid and Vaduria Morich in kharif season because these two germplasm produce the higher yield than other germplasm.

Recommendations:

- Further experiment should conduct on performance of different chilli germplasm in kharif season.
- Awareness among farmers' should be increased about chilli cultivation in kharif season.

REFERENCES

BARI. 2012. Krishe Projukti Hatboi (Book in Bengali). Horticulture Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. p. 144.

Barche, S. and Nair, R. 2013. Evaluation of chilli genotypes for vegetative and fruit characters under kymore plateau region of madhya pradesh. An International Quarterly Journal of Environmental Sciences. Vol. VI : 121-125.

BBS. 2004. Statistical Year Book of Bangladesh. Bangladesh Bureau of Statistics. Statistics Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, Dhaka. p. 58.

BBS (Bangladesh Bureau of Statistics), 2005. Agricultural statistics of Bangladesh, Ministry of planning, Govt. of the People Republic of Bangladesh, Dhaka. p.112.

BBS (Bangladesh Bureau of Statistics), 2015. Agricultural statistics of Bangladesh, Ministry of planning, Govt. of the People Republic of Bangladesh, Dhaka. p.98.

Chowdhury, B. 1976. Vegetables (4^{th} edition). National Book. Trust, New Dehli, India.pp.50-58.

Das, S. and Maurya, K.R. 2004. Performance of chilli genotypes during summer season. *J. Appl. Bio*. **14**(1):24-26.

FAO, 1988. Production year book. Food and Agricultural Organization of the United Nations, Rome, Italy.

FAO, 2015. *http*://faostat3.fao.org

Farooq, M., Ramzan, A., Chattha, M.R., Qasim, U., Nawab, N.N. and Hidyatulllah. 2015**.** Studies on the Performance of Sweet Pepper (*Capsicum annum* L.) Hybrids under Plastic Tunnel. *Journal of Science, Technology and Development*, **34** (3): 155-157.

Gomez, K.A. and Gomez, A.A. 1984. Statistical procedures for agricultural research. 2nd edn. John Wiley and Sons. New York: 680.

Grubeen, 1977, Tropical vegetables and their genetic resource, IPRGR, Rome, Italy. P-197.

Hasan, M., Haider, T., Chowdhury, M.S.N., Howlader, M.F. and Uddin, A.F.M.J. 2014. Study on Morpho-physiological and Yield Performance of Four Chilli (*Capsicum* spp.) Lines. *Journal of Bioscience and Agriculture Research.* **2**: 1-7.

Ikeh, A.O., Ndaeyo, N.U. , Uduak, I.G., Iwo, G.A., Ugbe, L.A., Udoh, E.I. and Effiong, G.S. 2012. Growth and Yield Responses of Pepper (*Capsicum frutescens* L.) to Varied Poultry Manure Rates in UYO, Southeastern Nigeria. *ARPN Journal of Agricultural and Biological Science*, **7**(9): 735-742.

Jaisankar I., Singh, S., Goutham, R.K., Velmurugan, A., Singh, A.K., Roy, S.D., Parisa, D. and Soan, S. 2015. Performance of Chilli Genotypes for Green Fruit Yield in Andaman and Nicobar Islands. *AVTJournal of the Andaman Science Association.* **20**(1):39-42.

Kaouther, Z., Hamdi, W., Sedraoui, S., Fendri R., Lajimi, O. and Hannachi, C. 2015. A comparative study of morphological characterization of Tunisian accessions of Chilli pepper (*Capsicum frutescens* L.). *IRJET.* **2**(4): 87-94.

Misra, A.P, Dutta, K.K. 1963. A comparative study of two isolates of Colletotrichum capsici. *Journal of Indian Botanical Society.* **42** : 74-85.

Mohanty, B.K. and Prusti, A.M. 2005. Assessment of chilli varieties in western undulating zone of Orissa. *Indian Journal of Agricultural Research*. **39** : 76-78.

Nkansah, G.O., Ayarna, A. and Gbokie, T.J. 2010. Morphological and Yield Evaluation of Some Capsicum Pepper Lines in Two Agro-Ecological Zones of Ghana. *Journal of Agronomy*. **10**(3): 84-91.

Nandpuri, K.S., Gupta,V.P. and Thakur P.C. 1971. Variabilities Studies in Chillies. J. Re.s Ludiana, India. 8(3):311-5. *Cited Hort. Abstr*. **43**(1):235.

Padda,D.S.Saimbhi, M.S. and Singh G. 1970. Comparative Performance of Chilli Varieties in Panjab. *The Punjab Hort. J*. **10**(1&2):150-4

Plummer, D.T. 1971. An introduction to Practical Biochemistry. Tata McGraw Hill Pub. Conn: Ltd., Bombay, New Delhi. 229p.

Raikar, G.N., Karad, S.R. and Navale, P.A. 2005. Variability and path co-efficient analysis in chilli. *Maharastra J. Agric. Univ.* **30**(1):90-91.

Rikovski,I. 1956. The Vitamin C value of some Yogoslav Varieties of pappers Review Res. Work Facul. *Agric. Belgrade*, **4**(1):97-102.

Saimbhi, M.S.; Kan, G. and Nandpuri, K.S. 1977. *Qualitus Plantarum*, **27**:171-175.

Sayed, S, and Bagvandas, M. 1980. Chilli contents vitamin C. *South Indian Horticulture*. **28**: 42-47.

Sharma, H.C. 1975. Pungent principle of chillies. Arecaunt and spice bull., U.P. Rice Res. Station. Faizbad, India. Hort. Abstr. **6**(4): 78-81.

Shoemaker, J.S. 1953. Growing Vegetables. Second edition. *Newyork,John Willey and Sons, Inc. Newyork*. P.371.

Smith, P.G. and Heiser, C.B. 1951. Texonomic and genetic studies on the cultivated peppers. (*Capsicum annum* and *C. frutescence* L.). *American J. Bot.*, **38**:362-8.

Sreelathakumary, I. and Rajamony L. 2004. Variability, Heritability and Genetic Advance in chilli (*Capsicum annuum* L.). *J. Trop. Agric.* **4291**(2):35-37.

Tairu, F.M., Olufolaji, A.O., Abdul, R.M.A. and Kouame, C. 2013. Comparative study on the performance of some exotic chilli pepper accessions in ibadan, southwestern Nigeria. *ActaHortic*.**1007**:29.

Tembhurne, B.V., Revanappa, and Kuchanur, P.H. 2004. Varietal Performance, Genetic Variability and Correlation Studies in Chilli (*Capsicum annuum* L.). *Karnataka J. Agric. Sci.* **21** (4) : 541-543.

Tembhurne, B.V., Revanappa, and Kuchanur, P.H. 2005. Performance of Chilli Genotypes in Upper Krishna Project Command Area. *Karnataka J.Agric.Sci.* **21**(4): 594-596.

Tilahun, S., Paramaguru, P.and Rajamani, K. 2013. Capsaicin and ascorbic acid variability in chilli and paprika cultivars as revealed by HPLC analysis. *ESci journal*. **1**: 75-81.

UNDP, 1988. Land Resource Appraisal of Bangladesh for Agricultural Development Report 2: Agro-Ecological Regions of Bangladesh, FAO, Rome, Italy. pp. 557.

Udoh, D. J., Ndon, B. A., Asuquo, P. E. and Ndaeyo, N. U. 2005. Crop Production Techniques for the Tropics. *Concept Publication ,Lagos,* Nigeria. p. 446.

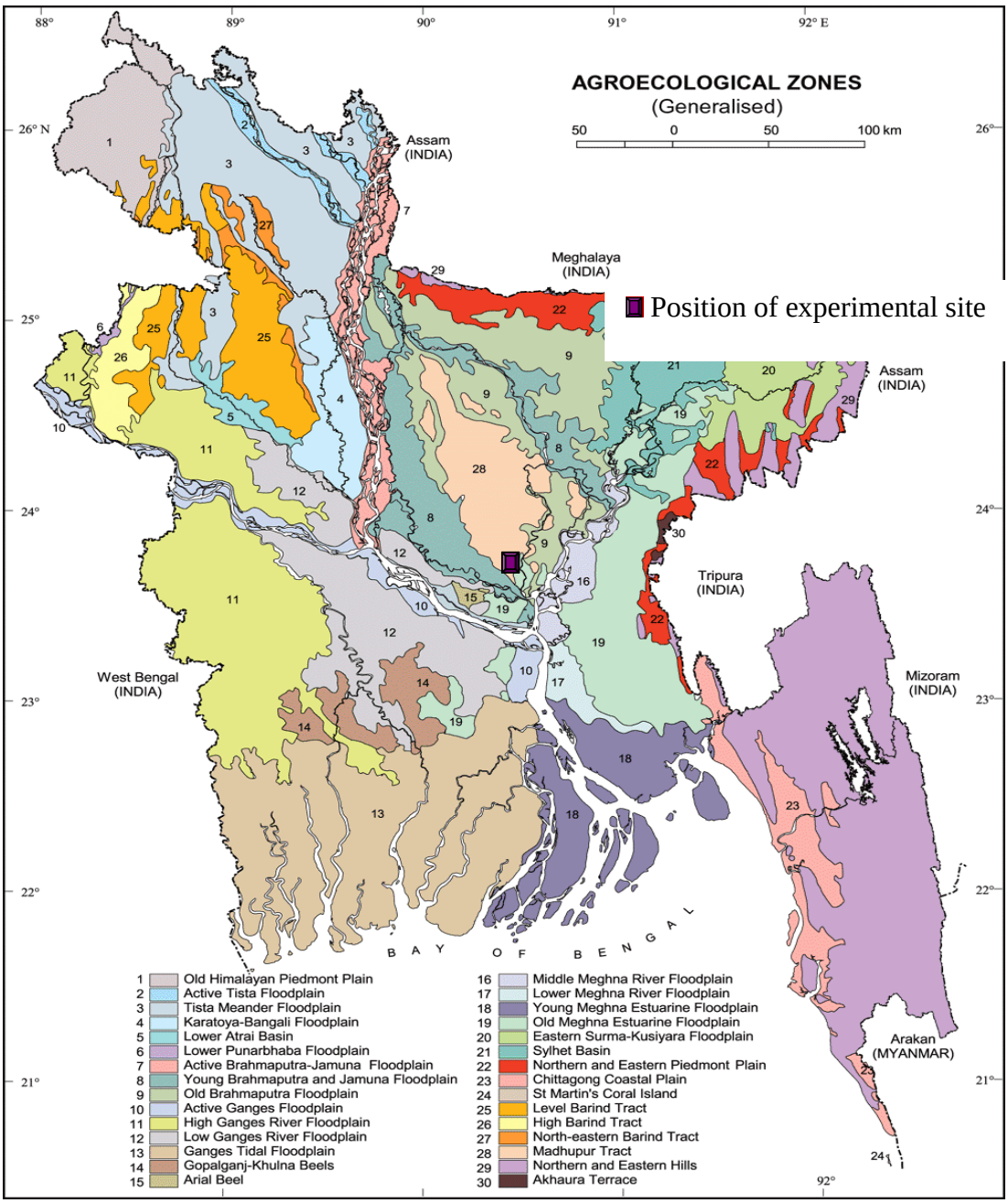
Vartapetian, B.B, Jackson, M.B (1997) Plant adaptations to anaerobic stress. *Ann. Bot*. **79**: 3–30.

Wayne W.F., Veazie P.P. and Collins J.K. 2002. A quantitative assay for lycopene that utilizes reduced volumes of organic solvents. J. *Food Comp. Anal.* **15**: 309-317.

Zewdie, Yayeh, Zeven, A.C. 1997. Variation in Yugoslavion hot pepper (*Capsicum annuum* L.). Euphytica. **97** (1).81-89.

APPENDICES

Appendix I. Experiment location on the map of Bangladesh including Agro-Ecological Zones.



Appendix II. Weather of dhaka: monthly average minimum and maximum temperature, rainfall and relative Humidity

Year	Month	Average Temperature (^{0}C)		Average rainfall (mm)	Average Relative Humidity (%)
		Maximum	Minimum		
2014	March	33	16	58	38
	April	35	23	103	42
	May	33	23.22	134	57.44
	June	32	24	269	72.36
	July	31	24	296	79
	August	31	24.72	245	78
	September	31	23.75	156	73

Source: SAU weather station, SAU, Dhaka.

Appendix III. Analysis of variance of the data on plant height (cm) at different DAT of chilli

		Mean Square for plant height (cm)		
Source of variation	**Degrees of Freedom (df)**	**First flowering**	**First harvesting**	**Final harvesting**
Replication	3	17.055	58.697	44.565
Factor A	5	228.257*	403.407*	604.733*
Error	15	6.876	23.491	35.209
***: Significant at 0.05 level of probability**				

Appendix IV. Analysis of variance of the data on branches number at different DAT of chilli

		Mean Square for branches number		
Source of variation	**Degrees of Freedom (df)**	**First flowering**	**First harvesting**	**Final harvesting**
Replication	3	0.500	2.833	1.844
Factor A	5	3.467*	17.767*	28.060*
Error	15	1.133	0.700	3.494
***: Significant at 0.05 level of probability**				

Appendix V. Analysis of variance of the data on days to flower bud initiation after transplanting, number of flower plant^{-1} of chilli

Source of variation	Degrees of Freedom (df)	Mean Square for: Days to flower bud initiation after transplanting	Mean Square for: Number of flower plant^{-1}
Replication	3	13.264	182.708
Factor A	5	237.875*	2106.575*
Error	15	5.431	38.108
***: Significant at 0.05 level of probability**			

Appendix VI. Analysis of variance of the data on canopy length (cm) of chilli

Source of variation	Degrees of Freedom (df)	Mean Square for canopy length (cm): 30 DAT	40 DAT	50 DAT	60 DAT	70 DAT	80 DAT	90 DAT
Replication	3	70.278	19.042	51.667	11.597	250.778	547.819	252.944
Factor A	5	124.767*	450.342*	988.667*	2041.142*	1228.30*	1381.442*	1667.367*
Error	15	50.878	73.542	84.467	126.631	230.544	294.286	248.144
***: Significant at 0.05 level of probability**								

Appendix VII. Analysis of variance of the data on number of fruits plant^{-1}, number of fruit plot^{-1}, dry weight (g) of 50 fruit, dry weight (g) (fruit plant^{-1}), length of fruit (cm) of chilli

		Mean Square for				
Source of variation	**Degrees of Freedom (df)**	**Number of fruits plant^{-1}**	**Number of fruit plot^{-1}**	**Dry weight of 50 fruit (g)**	**Dry weight (fruit plant^{-1}) (g)**	**Length of fruit (cm)**
Replication	3	7013.597	675688.000	0.942	648.788	1.574
Factor A	5	22423.975*	31763904.000*	574.779*	57136.567*	7.468*
Error	15	1091.731	297558.400	1.146	431.885	0.468
***: Significant at 0.05 level of probability**						

Appendix VIII. Analysis of variance of the data on diameter of fruit (mm), seed fruit^{-1} (nos), 1000-seeds weight (g) , dry weight (g) (plant) of chilli

		Mean Square for			
Source of variation	**Degrees of Freedom (df)**	**Diameter of fruit (mm)**	**Seed fruit^{-1} (nos)**	**1000-seeds weight (g)**	**Dry weight (g) (plant)**
Replication	3	0.011	14.486	0.024	1.085
Factor A	5	2.142*	276.042*	1.045*	6245.349*
Error	15	0.180	3.086	0.013	5.883
***: Significant at 0.05 level of probability**					

Appendix IX. Analysis of variance of the data on SPAD value (%), vitamin- C in green fruits (mg/100 g), yield (g) plot^{-1}, yield (g) plant^{-1}, yield (t/ha) of Chilli

		Mean Square for				
Source of variation	**Degrees of Freedom (df)**	**SPAD value (%)**	**Vitamin- C in green fruits (mg/100 g)**	**Yield plot^{-1} (g)**	**Yield (g) plant^{-1}**	**Yield (t/ha)**
Replication	3	38.652	648.788	578574.515	10744.835	3.293
Factor A	5	55.293*	57136.567*	85789219.628*	218264.558*	53.565*
Error	15	21.052	431.885	737268.104	2782.004	1.502
***: Significant at 0.05 level of probability**						

Appendix X. Photographs of different germplasm of chilli plant with their 4 replications

Appendix XI. Photographs of chilli fruit of different germplasm

Appendix XII. Photographs of chilli experiment field (A. seedling stage and B. mature stage) at SAU experimental farm

A

B