YIELD AND YIELD CONTRIBUTES OF CORIANDER (*CORIANDRUM SATIVUM* L.) AS INFLUENCED BY SPACING AND VARIETY

ABDUL KAIUM

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DEPARTMENT OF AGRICULTURAL BOTANY
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA 1207

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BY

ABDUL KAIUM
REGISTRATION NO. 07-02272

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Approved by:

Prof. Asim Kumar Bhadra Department of Agricultural Botany SAU, Dhaka **Supervisor**	**Dr. Mohd. Moniruzzaman** Senior Scientific Officer (Horticulture) Bangladesh Agricultural Research Institute (BARI), Gazipur **Co-Supervisor**

Assoc. Prof. Dr. Mohammad Mahbub Islam
Chairman
Examination Committee

DEPARTMENT OF AGRICULTURAL BOTANY
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207
Bangladesh

Cell: +8801710487750
Fax: +88028155800
e-mail:
asimbhadra@yahoo.com

Ref : **Date:**

CERTIFICATE

This is to certify that the thesis entitled, "**YIELD AND YIELD CONTRIBUTES OF CORIANDER (*CORIANDRUM SATIVUM* L.) AS INFLUENCED BY SPACING AND VARIETY**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL BOTANY**, embodies the result of a piece of bonafide research work carried out by **ABDUL KAIUM**, Registration No. **07-02272** 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: Dec, 2013
Place: Dhaka, Bangladesh

……..……..……..……
Prof. Asim Kumar Bhadra
Department of Agricultural Botany
Sher-e-Bangla Agricultural University
Supervisor

Dedicated

To My

Beloved Parents

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The Author

YIELD AND YIELD CONTRIBUTES OF CORIANDER (*CORIANDRUM SATIVUM* L.) AS INFLUENCED BY SPACING AND VARIETY

ABSTRACT

A field experiment on coriander (*Coriandrum sativum* L.) taking two varieties (BARI Dhonia 1 and Faridpur local) and six spacing (20 cm x 10 cm, 25 cm x 10 cm, 30 cm x 10 cm, 20 cm x 15 cm, 25 cm x 15 cm and 30 cm x 15 cm) was conducted to find out the effect of variety and spacing on yield attributes and seed yield of the crop at Sher-e-Bangla Agricultural University farm, Dhaka, Bangladesh during the *rabi* season of 2011-2012. The experiment was laid out in randomized complete block design (RCBD) with three replications. Varieties, spacing and their combination showed significant variation in yield attributes and seed yield of coriander. Both the varieties produced identical results in respect of most yield attributes and seed yield. The variety BARI Dhonia 1 gave higher values in respect of number of umbels plant^{-1}, number of seeds umbel^{-1} and umbellate^{-1} and 1000 seed weight compared to Faridpur local. The wider spacing of 30 cm x 15 cm produced the maximum plant, number of secondary branches plant^{-1}, number of seeds umbel^{-1} and umbellate^{-1} and seed yield plant^{-1} compared to the closer spacing (20 cm x 10 cm). The spacing of 30 cm x 10 cm produced the maximum seed yield (2.01t ha^{-1}) which was statistically similar with 20 x 15 cm (1.99 t ha^{-1}), 25 cm x 10 cm (1.94 t ha^{-1}) and 20 x 10 cm spacing (1.95 t ha^{-1}). The variety Faridpur local in combination with 30 x 10 cm spacing gave the highest seed yield (2.16 t ha^{-1}) identical with 25 cm x 10 cm spacing with the same variety Faridpur local (2.10 t ha^{-1}).

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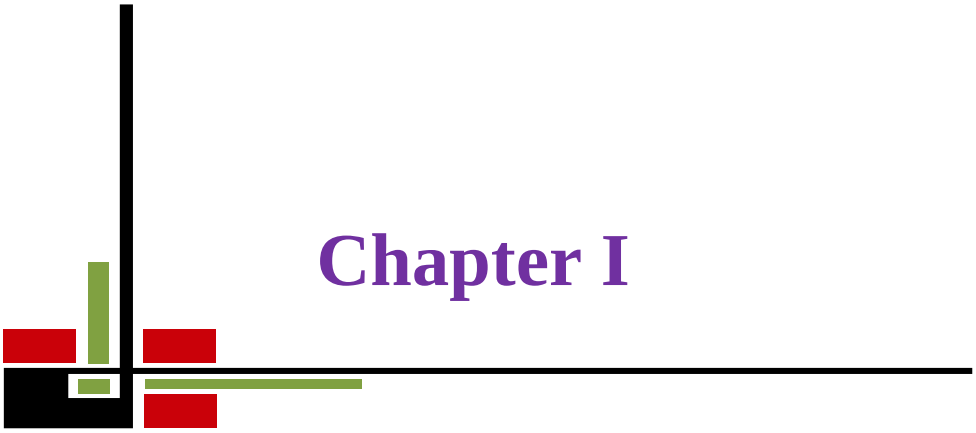
LIST OF ACRONYMS

ABBREVIATIONS	ELABORATIONS
%	Percent
@	At the rate
°C	Degree centigrade
AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
CV	Coefficient of Variation
CHO	Carbohydrate
DMRT	Duncan's Multiple Range Test
et al.	And others
etc.	Etcetera
FAO	Food and Agriculture Organization
LSD	Least Significant Difference
MSTAT	Michigan State University Statistical Package for Data Analysis
pH	Hydrogen ion concentration
RARS	Regional Agriculture Research Station
RCBD	Randomized Complete Block Design
SRDI	Soil Resource Development Institute
Vit	Vitamin



Chapter I

Introduction

CHAPTER I

INTRODUCTION

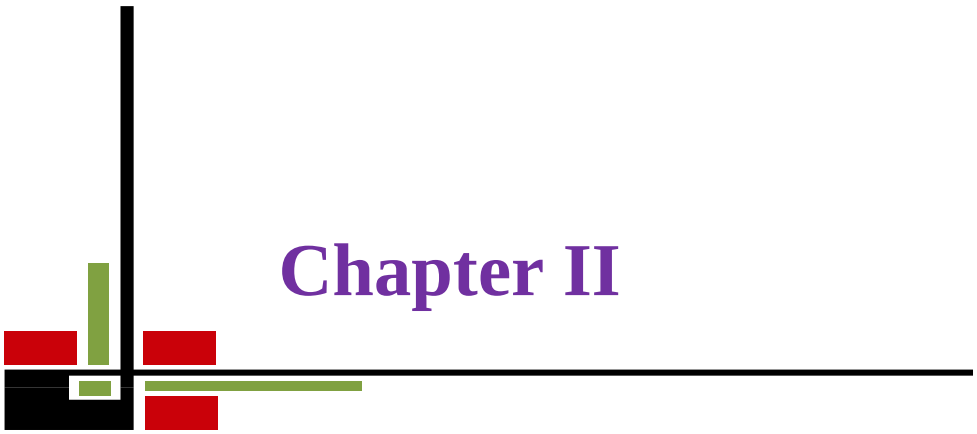
Coriander (*Coriandrum sativum* L.) belonging to the family of *Apiaceae* is an important spice crop in Bangladesh which is normally cultivated in winter (*rabi*) season. In Bengali it is known as 'Dhonia'. Coriander is native to South Europe and the Mediterranean region, and is extensively grown in Russia, Bulgaria, Mexico, USA, Argentina, China, Romania, Italy, Japan, Hungary, Poland, Czech, Morocco and India and has been cultivated since human antiquity (Tiwari and Agarwal, 2004). It is also described as a native to southern Europe and Asia Minor. Preciously Italy is presumed as the native place of coriander (Thumburaj and Singh, 2004).

The entire plant of young coriander is used as appetizer in preparing fresh chutneys and sauces, leaves are used to flavour food, curries, soups, fish sauce, and cream sauce for chicken, tomato soup, pickling sausages, bakery preparations, liqueurs, gins and meat. Seeds are used in pastry, cookies, cakes, soups, sausage, pickles, curries, in preparation of curry powder. Essential oil like oleoresin is used for flavouring beverages, pickles, chocolates, sauces etc. Seeds and essential oils are used to scent perfumes, deodorants and soaps. They are also used in seasonings for sausage and other meat products. (Janardhanan and Thoppil, 2004; Tiwary and Agarwal, 2004).The seeds are also used in medicine as a carminative, refrigerant, diuretic and aphrodisiac. It is used in the preparation of many household medicines to cure bed cold, seasonal fever, nausea, vomiting and stomach disorder. Pharmaceutical use of coriander is to mask the taste of other medicinal compounds or to calm the irritating effects on the stomach that some medicines cause (Sharma and Sharma, 2004).

Coriander leaves and seeds are valued as food mainly for its high Vit. A and Vit. C. Its leaves contain 88% water, 32 kcal, 6.0 g CHO, 2.7 protein, 0.5 g fat, 1.0 g fiber and 1.7 g ash , 150 mg. C, 0.01 mg B1, 0.01 mg B2, 1.0 mg Niacin, 150 mg Ca, 55 mg P, 540 mg K, 6 mg Fe per 100 g fresh weight of leave and 10, 000 I.U. Vit. A (Rubatzky *et al*., 1999). On the contrary coriander seed contains 11.4% water, 22.7 g CHO, 11.5 g protein, 19.1 g fat, 28.4 g fiber, 500 mg P, 12 mg Vit. C per 100 g of fresh seed, 175 IU Vit. A (Pruthi, 1998).

It is well known that establishment of an optimum plant density per unit area is one of the most important factors contributing to the increased productivity of a crop. Plant spacing controls the plant density of the crop. Wider or too low spacing beyond the optimum can affect the yield of crop. Besides cultivar itself plays a great role in cultivation of the crop. Before reaching the hand of the farmers, the cultivars/varieties must be tested for its yield potential. Keeping the above facts in view the present investigation was carried out with the following objectives:

1. To find out the optimum plant spacing for the higher seed yield of coriander.
2. To test the seed yield potential of BARI Dhonia-1 and Faridpur local.



Chapter II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

Coriander (*Coriandrum sativum* L.) is an important spice crop grown during the Rabi season in Bangladesh. It is cultivated for both leaf and seed. There has not been much systematic research work on variety performances, growth and yield of leaf as well seed influenced by variety, sowing method, sowing time, seed rate, row to row spacing, plant to plant spacing, fertilizer, irrigation in Bangladesh. Some of the research efforts on related to the present study were done by the researchers in different parts of the world. Therefore information available to these aspects of coriander had been reviewed and presented here.

2.1 Effect of genetic variability

Variety is the most important factor for emergence, growth, development and yield of any field crops. Coriander is a field crops and its emergence, growth, development and yield depend on varieties. So the following established review of literature would help the present study the effects of variety on yield of coriander.

Islam *et al*. (2004) conducted a performance trial with 14 genotypes of coriander (*Coriandrum sativum* L.) at Bangabondhu Seikh Mujibur Rahman Agricultural University, Gazipur during Rabi season of 1999-2000. The genotype CR0013 took the shortest possible period of 43 days, whereas genotypes CR0008 and CR0013 took the longest period (52.25 and 52.00 days, respectively) for flower stalk emergence. The genotype CR0001 produced the highest seed yield per plant (11.30 g) as well as per

hectare (1.73 t). Considering seed germination, the genotype CR0022 exhibited the highest score (78.25%) and CR0013 had the lowest (68.25%).

The experiment taking three promising coriander lines (CR0001, CR0011 and CR0022) and a check (BARI Dhonia-1) was studied in two locations, at Spices Research Sub-Centre, BARI, Gazipur and Spices Research Sub –Centre, Magura and Gazipur. The crop was harvested on March 15, 2001 in both locations. At Magura plant height ranged from 84.00-91.43 cm, number of primary branches plant^{-1} from 5.70 to 7.90, no. of umbels plant^{-1} from 24.10-33.70, no. of Umbellates umbel^{-1} from 12.22-19.58, wt. of fruits plant^{-1} from 6.36-8.54 g and yield from 1.56-1.95 t/ha. But at Gazipur plant height ranged from 74.07-82.53 cm, number of primary branches plant^{-1} from 5.63 to 6.73, no. of umbels plant^{-1} from 62.13-69.93, no of Umbellates umbel^{-1} from 7.43-7.80, and yield from 0.98-1.24 t/ha. CR0022 gave the highest yield at Magura (1.95 t/ha) while CR0011, at Gazipur (1.24 t/ha). BARI Dhonia-1 produced 1.80 t/ha at Magura and 1.02 t/ha at Gazipur (Anon., 2002).

Rajagopalan *et al*. (1996) evaluated thirteen *Coriandrum sativum* cultivars for seed and essential oil yield during 1990-91 and 1991-92 at the Tamil nadu Agricultural University, Coimbatore, India. Seed yield was in the range of 359.2-683.4 kg/ha.

Kalra *et al*. (2003) evaluated a set of 120 Indian accessions of coriander (*Coriandrum sativum* L.) were screened under late planted conditions for time taken for flowering and fruit maturity, seed yield, seed size, percent content of essential oil in seeds, oil yield and susceptibility to powdery mildew and stem gall diseases. It was concluded that these accessions (CIMAP 2053 and CIMAP 2096) would be suitable for cultivation of

coriander under late sown conditions in Indo-Gangetic plains for higher yield of seeds and essential oil, respectively. Days to flowering ranged from 65-80, days to mature, from 100-125, Seed yield per plot (6 m^2), from 0.17-1.39, 1000- seed weight from 8.8-14.6 g.

Singh *et al.* (2005) evaluated seventy genotypes of coriander (*Coriandrum sativum* L.) of diverse eco-geographical origin. The 70 genotypes were grouped into 9 clusters depending upon the genetic architecture of genotypes and characters uniformity and confirmed by canonical analysis. The maximum inter cluster distance was between I and IV (96.20) followed by III and IV (91.13) and I and VII (87.15). The cluster VI was very unique having genotypes of high mean values for most of the component traits. The cluster VII had highest seed $umbel^{-1}$ (35.3 ± 2.24), and leaves $plant^{-1}$ (12.93 ± 0.55), earliest flowering (65.05 ± 1.30) and moderately high mean values for other characters.

Patel *et al.* (2000) worked on 48 genotypes of *Coriandrum sativum* L which were collected from different villages of an important and major coriander growing district-Guna (Madhya Pradesh). Data were recorded on 10 different characters. D-square values between pairs of genotypes ranged from 2.50 to 96.96. By using D^2 analysis the genotypes were grouped into nine clusters. The clustering was at random and without any relationship between genetic diversity and geographic diversity. Seed yield per plant had highest contribution towards genetic divergence followed by secondary branches and umbellets per plant.

The population consisting of 40 genotypes of coriander was subjected to multivariate analysis using D^2 statistics by Srivastava *et al.* (2000). The characters studied were plant height, primary $branches^{-1}$, secondary $branches^{-1}$, days to flowering, and days to maturity, number of $umbel^{-1}$,

and number of umbellets per umbel, number of seeds per umbel, 1000-seed weight and seed yield ha^{-1}. The assessment revealed considerable variability among the stock for all characters except primary $branches^{-1}$, umbellets per umbel and 1000-seed weight. The 40 genotypes were grouped into four clusters depending on similarities of their D^2 values. Clusters numbers II and IV captured 10 and 7 genotypes. Based on cluster means, characters such as days to flowering, days to maturity and number of secondary $branches^{-1}$ were major factors of differentiation among genotypes, which may be taken into account while selecting parents for hybridization programme.

Bhandari and Gupta (1993) reported 200 hundred genotypes of *Coriandrum sativum* L exhibited genetic variability for plant height, primary and effective branches, days to flowering and maturity, umbels and umbellets per plant, seeds per umbellets, thousand seed weight, straw and grain yield per plant and harvest index. Plant height ranged from 11.8-86.1 cm, no. of primary branches from 1.4-8.6, days to flowering from 65.0-118.8, days to maturity from 112.0-145.0, umbels per plant from 3.2-39.3, umbellets per plant from 7.1-177.8, seeds per umbellet from 7.1-177.8, seeds per umbellet from 1.7-11.8, 1000-seed weight from 5.0-22.1 g, grain yield per plant from 0.2-7.8g and harvest index from 8.9-84.8.

Sharma and Sharma (1989) studied about 200 genotypes of coriander and they could find significant variability for plant height, branches per plant, days to flowering, days to maturity, umbels per plant, seeds per umbellet, 1000-seed weight, straw and seed yield per plant.

Qureshi *et al*. (2009) evaluated 29 indigenous germplasm of coriander and reported that days to maturity ranged from 190-194, branches per plant from 5-18, umbels per plant from 121-336, days to flowering from 96-152 and 1000-seed weight from 6.0-11.6 g.

Datta and Choudhuri (2006) evaluated and reported that 17 germplasm lines of coriander (*Coriandrum sativum* L.) showed significant variation for most of the character studied. Genotype RCr-41 produced the highest seed yield (1.51 t/ha) followed by DH-246 (1.43 t/ha). RCr-41 and ACR-69 were found free from wilt and stem gall disease incidence. In this experiment plant height ranged from 42.87-98.77 cm, primary branches plant^{-1} from 5.37-8.23, secondary branches plant^{-1} from 10.10-16.75, umbels plant^{-1} from 20.83-34.67, seeds umbel^{-1} from 33.47-35.57 and 1000-seed weight from 9.33-13.82 g seed yield ranged from 686-1506 g per hectare. Seed colour was classified as yellowish green and light yellowish while seed shape, as oblong, roundish oblong and round. 9 lines infested with stem gall disease.

Sing *et al.* (1995) reported that two-year trials were conducted in Uttar Pradesh with 8 coriander cultivars in 1989 and 1990. Udaipur Dhania 1 and Pant Haritma produced the tallest plants both at flowering and harvesting. Pant Haritma produced the highest seed yield of 1455 and 1238 kg/ha in 1989 and 1990, respectively.

Rao and Reddy (1984) identified the promising varieties for Andhra Pradesh was Lam CS 2, Lam CS 4 and CS 6 (Swathi). The seed yields of those varieties were 1400, 1500, and 850 kg/ha, respectively.

Maurya (1989) worked on 10 characters for 10 genotypes of coriander grown during 1982-83 and 1983-84. From average two years it was observed that plant height ranged from 68.00-90.33 cm, umbels per plant from 17.0-41.67, umbellets per umbel from 4.40-9.40, fruits per umbel from 28.00-46.00, days to flowering from 46.67-80.67, days to maturity from 91.00-117.61, yield plant^{-1} from 7.93 to 15.08 g, 1000-fruit weight from 8.82-18.52 g and harvest index from 28.25-46.45.

Rahman (2000) evaluated 14 coriander genotypes reported that days to 50% germination ranged from 8.50-12.00days, leaves plant^{-1} from 23.13-36.00, days to green leaf harvest from 33.50-42.00 days, green yield ranged from 2.84-5.08 g/plant. The range of primary branches plant^{-1} and secondary branches plant^{-1} was 6.50-8.02 and 15.85-25.50, respectively. The green yield ranged from 0.94-1.78 t/ha. Among morphological characters, leaf colour was light to dark green, flower colour off white, whitish pink and pink, fruit colour light brown, deep brown and yellowish brown. Fruit shape was round and elliptical. He used plant spacing of 30 x 10 cm.

Ayanoglu *et al*. (2002) reported that forty-three coriander lines were under east Mediterranean conditions for two years to determine the best yielding lines in winter season. The seed yields of coriander lines varied between 1138 (K11) and 2297 kg /ha (K46). The highest seed yields were obtained from the lines K67, K28, K69 and K46. The seed Yields of those lines were higher than currently planted cultivars.

Selverajan *et al*. (2002) reported that nine genotypes of coriander (*Coriandrum sativum* L), i.e. CS 97, CS 102 and CS 123 from Jobner (Rajasthan, India); CS 12 and CS 203 from Coimbatore (Tamil Nadu, India); and CS 8, CS 101, CS 208 from Hissar (Haryana, India), were

evaluated to identify the suitable types for cultivation in Tamil Nadu under irrigated conditions. The result of the pooled analysis of the 3-years (1998-2000) data indicated that CS12 was the best with the highest yield of 579.3 kg/ha, followed by CS 102, recording yield of 56.10 kg/ha. The increase in yield for CS 12 was 10% over the control cultivar CO3, which recorded yield of 529.6 kg/ha.

2.2 Effect of spacing

Kumar (2007) stated that density of 25 plants m^{-2} had the highest plant height while the highest branch number per main stem belonged to density of 10 plants m^{-2} treatment.

Khorshidi *et al.* (2009) showed that with increase in inter-plants space significantly increased number of branches per main stem of fennel.

Ghobadi and Ghobadi (2010) studied the effect of different Coriander plant densities (10, 30, 50 and 70 plant per m^{-2}) and concluded that number of umbels per plant and number of seed per umbel reduced with increasing plant density but no significant difference was observed in 1000-fruit weight.

Akbarinia *et al.* (2006) studied the coriander densities of 20, 30, 40, 50 and 60 plants/$m^{-2}$and concluded that fruit and essential oil yield were higher in 30 plants/m^{-2} densities.

Ahmed and Haque (1986) studied the effect of row spacing (15, 20, 25 and 30cm) and time of sowing (November 1, November 20, December 10 and December 30) on the yield of black cumin (*Nigella sativa*) in

Bangladesh, they found that closer row spacing (15 cm) and early sowing (November 1) was the best for higher seed yield of black cumin.

Diereichsen (1996) reported that maximum fruit yield of Coriander was obtained with density of 50 plants per m^2 and decreasing plant density, the plant to some extent compensates the yield reduction by producing new branches.

Okut and Yidrim (2005) studies showed that maximum fruit yield and biological yield of coriander were obtained from 30 cm row spacing.

Shareh (1999) reported that increasing of density reduced yield components and harvest index but increased fruit and biological yield per area unit.

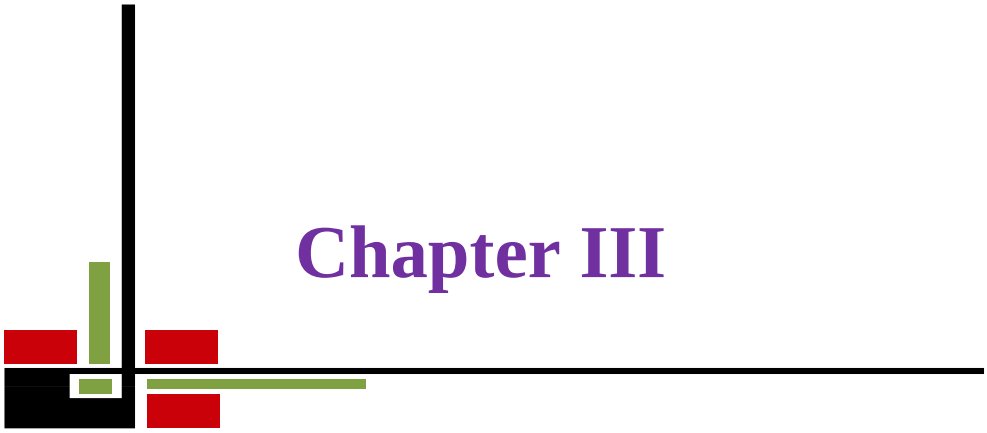
Mozumder (2003) reported that plant spacing is an important factor for seed production in eryngium. It is cultivated densely for its higher fresh leaf yield but fewer amounts of seeds (80-100 kg seed/ha) are produced in that way.

Verzalova *et al* (1988) reported that row spacing of funnel did not effect on the plant height but number of umbel and seed yield per plant was increased at the wider spacing.

Masood *et al* (2004) investigated the effect of row spacing (40, 50, 60 and 70 cm) on morphological characters and seed yield of fennel and reported that the greatest plant height, seed yield per umbel, and seed yield per hectare were obtained with the lowest row spacing but the lowest plant height, seed yield per umbel, and seed yield per hectare were obtained with the greatest row spacing.

Nahdibadi *et al* (2002) with study of the effect of different plant densities on yield dry material of Thyme (*Thymus vulgaris*) showed that the higher yield of dry material was obtained with 15 cm densities of planting.

Arabasi and Bayran (2004) with planting sweet basil in three plant density (20, 40, and 60 plant per m^{-2}) reported that the highest amount of dry matter, percentage and the yield of effective substances produced in 20 plants per m^{-2}.



Chapter III

Materials and Methods

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted at Sher-e-Bangla Agricultural University farm, Dhaka, Bangladesh during the period from November 2012 to February 2013 to determine the effect of variety and spacing on the yield of coriander. This chapter deals with a brief description on experimental site, climate, soil, land preparation, layout of the experimental design, intercultural operations, data recording and their analyses under the following headings and sub-headings.

3.1 Experimental site and soil

A field experiment was conducted at the Sher-e-Bangla Agricultural University (SAU), Dhaka, Bangladesh during rabi (November 2012 – February2013) to study the yield performance of Coriander in response to plant spacing and variety. The experimental field is located at $23^0$41' N latitude and 90^o 22' E longitude at a height of 8.6m above the mean sea level. It belongs to the AEZ 28, Modhupur Tract (FAO, 1998). The experimental site was shown in the map of AEZ of Bangladesh in Appendix I.

3.2 Climate

The experimental field was situated under Sub-tropical climate; usually the rainfall is heavy during kharif season, (April to September) and scantly in Rabi season (October to March). In Rabi season temperature is generally low and there is plenty of sunshine. The temperature tends to increase from February as the season proceeds towards kharif. The site where the experiment was conducted has a subtropical climate rabi season extends from October to early March. The monthly total rainfall, average temperature during the study period (March to early June) has been presented in Appendix II.

3.3 Crop

Coriander (*Coriandrum sativum* L.) is an annual herb and, according to the climatic conditions, is cultivated as a summer or winter annual crop. At flowering, the glabrous plant can reach heights between 0.20 and 1.40 m. The germination is epigaeal and the plant has a tap root. The stem is more or less erect and sympodial, monochasial-branched, sometimes with several side branches at the basal node. Each branch finishes with an inflorescence. The colour of the more or less ribbed stem is green and sometimes turns to red or violet during the flowering period. The stem of the adult plant is hallow, and its basal parts can reach a diameter of up to 2 cm. The leaves alternate, and the first ones are often gathered in a rosette. The plant is diversifolious. The inflorescence is a compound umbel. Sometimes there are one or two linear bracts. The umbel has two to eight primary rays, which are of different length, in such a way that the umbellets are located at the same level. Coriander has an inferior ovary and five calyx teeth are of different length, as are the petals in peripherally situated flowers.

3.4 Treatments

Six levels of spacing and two varieties and their interaction were used in the experiment. These were:

Factor A: Six levels of spacing

i) 20 x 10 cm(S_1)
ii) 25 x 10 cm(S_2)
iii) 30 x 10 cm (S_3)
iv) 20 x 15 cm (S_4)
v) 25 x 15 cm (S_5)
vi) 30 x 15 cm (S_6)

Factor B: Two varieties

i) BARI Dhonia-1 (V_1)

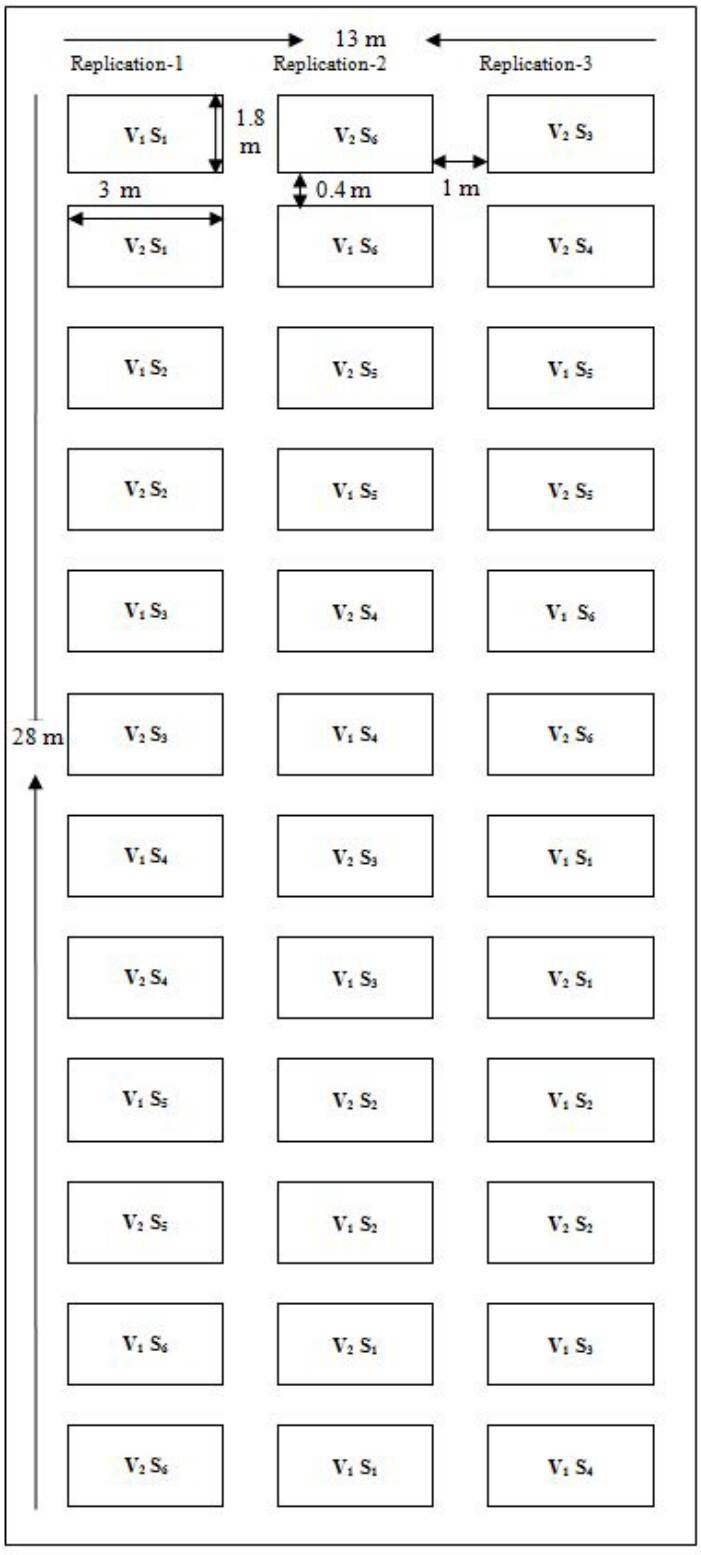
ii) Local (Faridpur) (V_2)

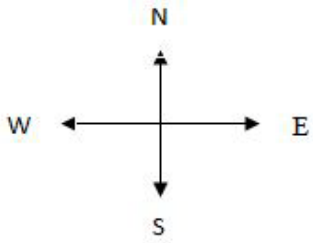
A total of 12 treatment combinations are as follows:

S_1 x V_1	S_1 x V_2
S_2 x V_1	S_2 x V_2
S_3 x V_1	S_3 x V_2
S_4 x V_1	S_4 x V_2
S_5 x V_1	S_5 x V_2
S_6 x V_1	S_6 x V_2

3.5 Design and layout of the Experiment

The experiment was laid out in randomized complete block design (RCBD) having twelve treatments with 3 replications. The size of unit plot was 3 m x 1.8 m. The total number of treatments was (6 Levels of population density × 2 varieties) 12 and the number of plots were 36.





Plot size: 3 m x 1.8 m
Spacing between plots: 0 .4 m
Spacing between replication: 1 m

Factor A: Six levels of spacing
- i) 20 x 10 cm(S_1)
- ii) 25 x 10 cm(S_2)
- iii) 30 x 10 cm (S_3)
- iv) 20 x 15 cm (S_4)
- v) 25 x 15 cm (S_5)
- vi) 30 x 15 cm (S_6)

Factor B: Two varieties
- i) BARI Dhonia-1 (V_1)
- ii) Local (Faridpur) (V_2)

There were 12 (6 × 2) treatments combination such as:

V_1S_1, V_2S_1, V_1S_2, V_2S_2, V_1S_3, V_2S_3, V_1S_4, V_2S_4, V_1S_5, V_2S_5, V_1S_6 and V_2S_6

Field layout of the two factors experiment in the Randomized complete Block Design

3.6 Land preparation

The land was opened by disc plough 15 days before seeding. Thereafter, the land was prepared thoroughly by ploughing and cross ploughing followed by laddering and harrowing to have good tilth. Weeds and stubbles of the previous crops were collected and removed from the field during land preparation. Soil clods were broken and plots were prepared as 15 cm raised seed bed so that irrigation and rain water easily could drain out and seeds could easily be germinated.

3.7 Fertilizer application

Manures and fertilizers were applied at the following doses as par Anon., 2001:

Nutrient/Fertilizer	Dose
Cowdung	10 tha^{-1}
Nitrogen	80 $kgha^{-1}$
Phosphorus	35 $kgha^{-1}$
Potassium	60 $kgha^{-1}$
Sulphur	20 $kgha^{-1}$

The entire amount of Cowdung, phosphorus from TSP, and potassium from MP, Sulphur from Gypsum with one-half of nitrogen and applied during final land preparation. The rest of the nitrogen was applied in two equal splits at 30 and 60 days after sowing of seeds as top dress.

3.8 Sowing

The seeds (fruits) were rubbed for separating the two mericarps (seeds) and were soaked in water for 24 hours to enhance germination. Seed were also

treated with Bavistin at 2 g per kg of seeds before sowing. The seeds were sown in rows 20 cm apart continuously by hand @ 40 kg/ha. To allow uniform sowing in rows seeds were mixed with some loose soil (about four to five times of weight of seeds). The seeds were covered with good pulverized soil just after sowing and gently pressed by hands. The sowing was done on November 14, 2012 with slight watering just to supply sufficient moisture needed for quick germination. Seedlings of the plots were thinned later to maintain of experiential spacing after 25 days after sowing (DAS).

3.9 Intercultural operations

The desired population density was maintained by thinning plants 15 days after emergence. Irrigation, mulching, weeding and plant protection measures etc. were performed as needed to uniform germination, better crop establishment and proper plant growth.

3.10 Weeding

The field was kept free by hand weeding. First weeding was done after 25 days after sowing (DAS). Plant thinning was also done at the time of weeding. Second and third weeding was done after 50 and 60 DAS, respectively.

3.11 Irrigation

For good germination water was given to the plots every two days by water can with fine mashed nozzle till germination. Then four irrigations were given at 20, 30, 60 and 90 days after sowing.

3.12 Harvesting

Seeds were harvested when half of the fruits on the plant changed from green to brown colour as suggested by Singhania *et al*. (2006). To avoid shattering of fruits, harvesting of seed plant was cut to the base by sickles in the early morning. Then the stalks with seeds were dried in the sun. Seeds (grains) were separated by beating with sticks and cleaned by winnowing and dried properly (10% moisture of seed).

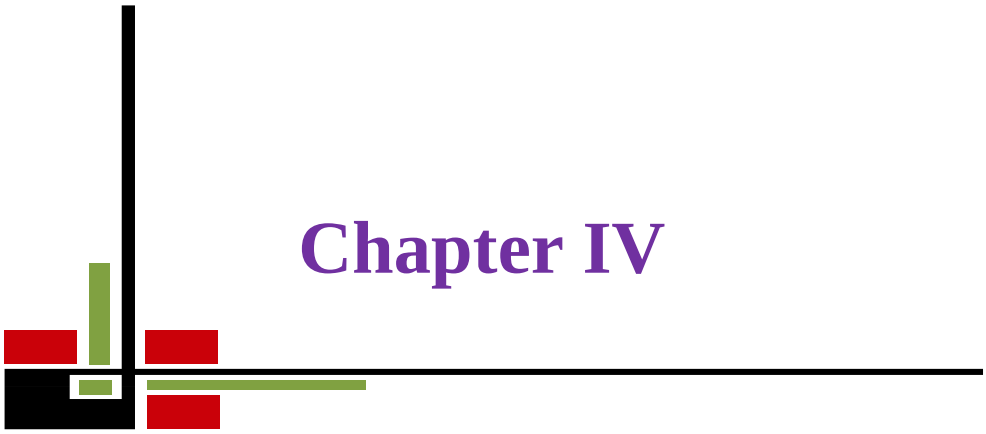
3.13 Collection of data

1. **Plant height at bolting (cm):** Plant height was measured at bolting in centimeter from the base (rosette) of the plant up to the tip of the longest leaf with the help of a meter scale from randomly selected 10 plants from each plot. The mean of 10 plants were counted as plant height.
2. **Number of primary branches plant^{-1}**: Average number of branches produced by randomly selected 10 plants per unit plot.
3. **Number of secondary branches plant^{-1}:** Average number of branches which were developed from primary branches, from randomly selected 10 plants per unit plot.
4. **Number of umbels plant^{-1}:** Average number of umbels produced by 10 plants per unit plot.
5. **Umbel circumference and diameter (cm):** Five umbels were considered for recording this data. At first circumference of umbel at flower condition was circled by a piece of thread and then the length of thread was measured be meter scale. The half of this measurement was taken and the average data was taken and the average data was taken as umbel diameter.
6. **No. of umbellates umbel^{-1}:** Five umbels of each of selected plants were considered for recording this data.
7. **No. of seeds umbel^{-1}:** Five umbels of each of selected plants were considered and then seeds per umbel were counted from all the umbels and the average data were taken as number of seeds/umbel.
8. **No. of seeds umbellate^{-1}**: Five umbels of each of selected plants were considered and then seeds per umbellate were counted from all the umbelete and the average data were taken as number of seeds/umbellate.
9. **No. of seeds plant^{-1}:** Average number of seeds produced by 10 plants.

10. **Dry seed yield plant^{-1} (g):** The average weight of dry seeds harvested from 10 randomly selected plants per unit plot.
11. **Dry seed yield plot^{-1} (g):** The average weight of dry seeds harvested from per unit plot.
12. **Thousand seed weight (g):** At first 1000 dry seeds were randomly counted from each treatment. Then weight of 1000 seeds was recorded with the help of an electric balance in the laboratory from the collected dry seeds.
13. **Dry seed yield (tha^{-1}):** After maturity seeds of all plots were harvested, cleaned and dried. First seed weight plant was measured with an appropriate spring scale balance and thus plot yield was obtained in kg. Then plot yield was converted to yield per hectare in tons.
14. **Stover yield (straw yield) plot^{-1} (g):** The average weight of straw harvested from per unit plot.
15. **Stover yield (straw yield) (tha^{-1}):** After seed harvested all plant stalks per plot were dried and weight was taken. Then plot stover yield was converted to per hectare yield.

3.14 Statistical analysis

The data were analyzed statistically by F-test to examine whether the treatment effects were significant. The mean comparisons of the treatments were evaluated by DMRT (Ducan's Multiple Range Test). The analysis of variance (ANOVA) for different parameters was done by a computer package programme MSTAT C.



Chapter IV

Results and Discussion

CHAPTER IV

RESULTS AND DISCUSSION

The results of the study regarding the effect variety and spacing on growth yield and yield related traits of coriander have been presented and possible interpretations have been made in this chapter which is given below:

4.1 Plant height

4.1.1. Effect of variety

Plant height was not significantly varied by varieties. Though the highest plant height was obtained by BARI Dhonia 1 (81.853 cm) while for Faridpur local it was recorded 80.367 cm (Table 1).

Bhandari and Gupta (1993) conducted an experiment with 200 hundred genotypes of coriander and reported that plant height ranged from 11.8-86.1 cm. Datta and Choudhuri (2006) reported that 17 germplasm lines of coriander got plant height ranged from 42.87-98.77 cm.

Table 1. Effect of variety on yield attributes of Coriander

Variety	Plant height (cm)	No. of primary branches plant^{-1}	No. of secondary branches plant^{-1}	No. of umbels plant^{-1}
BARI Dhonia-1	81.85	7.06	15.84	32.17 a
Faridpur local	80.37	6.99	15.85	31.64 b
CV (%)	2.88	6.42	3.62	1.89%
Level of significance	ns	ns	ns	*

Level of significance means in a column having different letters are significant by DMRT. ns = Non-significant,* = Significant at 5% probability,

4.1.2. Effect of spacing

Spacing had a significant effect on plant height of coriander. The tallest plant (84.43 cm) (Fig. 1 and Appendix VIII) was noted with the 25 cm x 15 cm row to row and plant to plant spacing, while the shortest plant (78.40 cm) was found with 25 cm x 10 cm spacing. Result showed that, 82.87 cm, 84.43 cm & 81.93 cm plant height was found with 30 cm x 15 cm, 25 cm x 15cm, 20 cm x 15 cm spacing, while 79.50 cm, 78.40 cm and 79.53 cm plant height was found in 30 cm x 10 cm, 25 cm x 10 cm and 20 cm x 10 cm spacing, respectively the densed plant population increased the competition for nutrients, space and light that might have resulted in the stunted growth.

The result revealed that the plant height decreased as the plant to plant spacing decreased. The plant height of 15 cm plant to plant spacing was higher than 10 cm plant to plant spacing.

Verzalova *et al.* (1988) reported that row spacing of fennel did not effect on the plant height. Masood *et al.* (2004) investigated that the greatest plant height were obtained with the lowest row spacing.

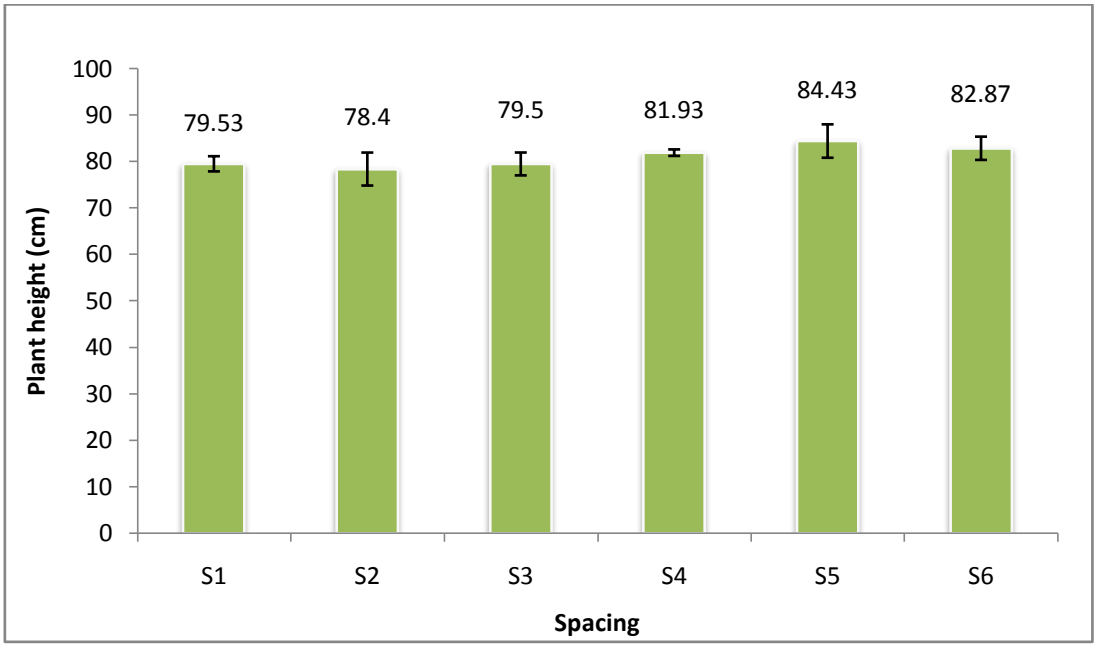


Figure 1. Effect of spacing on the plant height of coriander.

4.1.3 Interaction effects of variety and spacing

There was no significant interaction between variety and spacing on plant height (Table 2). However there were differences when spacing increased. The highest plant height (85.60 cm) was found from the treatment combination of variety Faridpur local with 25 cm x 15 cm spacing. The lowest plant height (75.93 cm) was found from the variety Faridpur local with 25 cm x 10 cm spacing.

4.2 Number of primary branches plant^{-1}

4.2.1 Effect of variety

There was no significant variation in number of primary branches plant^{-1} among the varieties (Table 1). The variety BARI Dhonia 1 produced the highest number of primary branches plant^{-1} (7.06) and the lowest number of primary branches plant^{-1} (6.99) was produced by the variety Faridpur local.

Bhandari and Gupta (1993) reported that the primary branches per plant ranged from 1.4-8.6 among 200 genotypes. Rahman (2000) also got primary branches per plant which ranged from 6.10-8.02. Datta and Choudhuri (2006) reported that 17 germplasm lines of coriander produced primary branches/plant from 5.37-8.23. Srivastava *et al.* (2000) produced no variability among primary branches.

4.2.2 Effect of spacing

Spacing significantly influenced the number of primary branches plant^{-1} (Fig. 2 and Appendix VIII). The spacing of 20 cm x 10 cm produced the highest primary branches plant^{-1} (7.58) followed by 7.16, 7.03, 6.88 and 6.88 with 25 cm x 10 cm, 30 cm x 15 cm, 25 cm x 15 cm and 20 cm x 15 cm plant to plant and row to row spacing. The lowest primary branches plant^{-1} (6.72) produced by 30 cm x 10 cm spacing. This is in agreement with the reports of Kumar (2007) and Khorshidi *et al.* (2009).

Kumar (2007) stated that the highest number of primary branches plant^{-1} found from the density of 10 plants m^{-2} treatment. Khortshidi *et al.* (2009) showed that with the increase in inter-plants space primary branches plant^{-1} increased significantly.

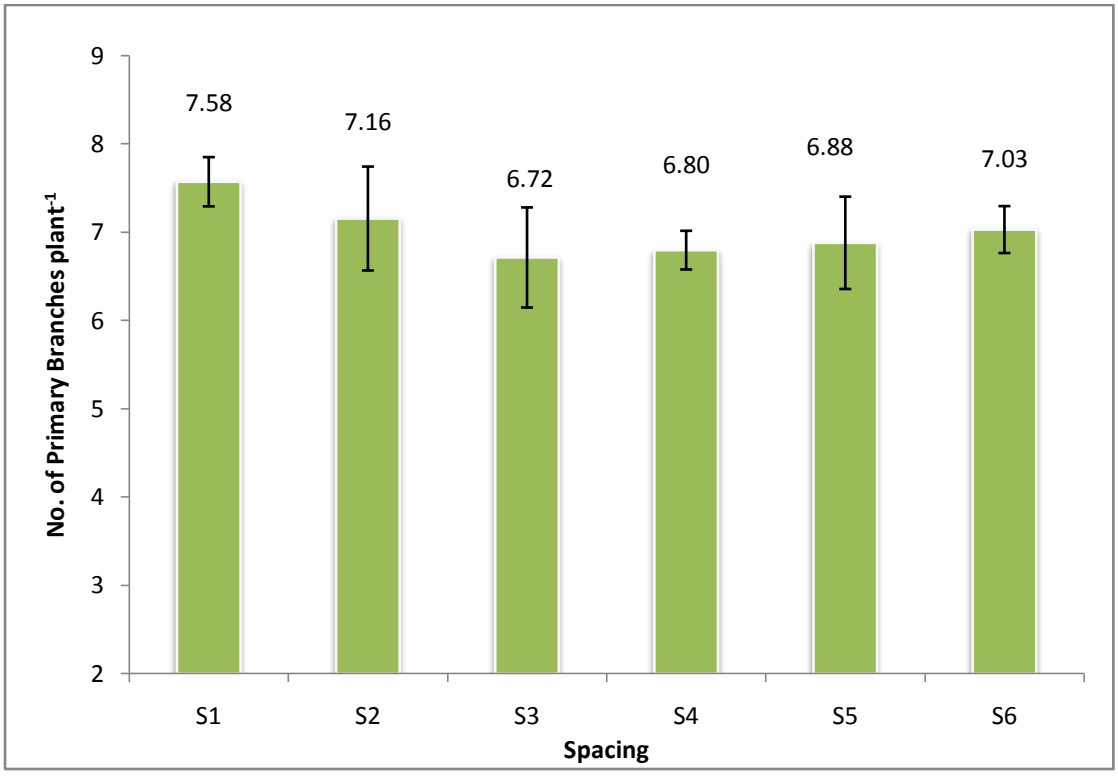


Figure 2. Effect of spacing on the primary branches plant^{-1} of coriander.

4.2.3 Interaction effects of variety and spacing

Number of primary branches plant^{-1} was not significantly influenced by the interaction effect of variety and spacing (Table 2). The maximum number of primary branches plant^{-1} (7.70) was produced by the interaction effect of BARI Dhonia 1 with 20 cm x10 cm spacing. But it showed similar result with V_2S_1, V_1S_2, V_1S_6 and V_2S_5 treatment. The lowest number of primary branches plant^{-1} was produced by the interaction effects of BARI Dhonia 1 with 30 cm x10 cm spacing.

4.3. Number of secondary branches plant^{-1}

4.3.1 Effect of variety

There was no significant variation in number of secondary branches plant^{-1} among the varieties (Table 1). The variety BARI Dhonia 1 produced secondary branches plant^{-1}(15.84), while the variety Faridpur local produced secondary branches plant^{-1} (15.85).

Datta and Choudhuri (2006) reported that 17 germplasm lines of coriander produced secondary branches plant^{-1} from 10.10-16.75. Rahman (2000) reported that secondary branches plant^{-1} ranged 15.85-25.50 in coriander.

4.3.2 Effect of spacing

Spacing significantly influenced the number of secondary branches plant^{-1} (Fig. 3 and Appendix VIII). Increase of spacing increased the number of secondary branches plant^{-1} significantly. The spacing of (30 cm x 15 cm) produced the highest number of branches plant^{-1} (17.17). The closer spacing (20 cm x10 cm) produced the lowest number of secondary branches plant^{-1} (14.68). The wider row spacing produced higher number of primary branches plant^{-1} which might be due to less interplant competition for light, space nutrients and environmental resources.

Rahman (2000) obtained secondary branches per plant ranged from 15.85 to 25.50 found from 30cm x10 cm spacing. Khorshidi et al. (2009) showed that with increase in inter-plants space number of secondary branches plant^{-1} increased significantly.

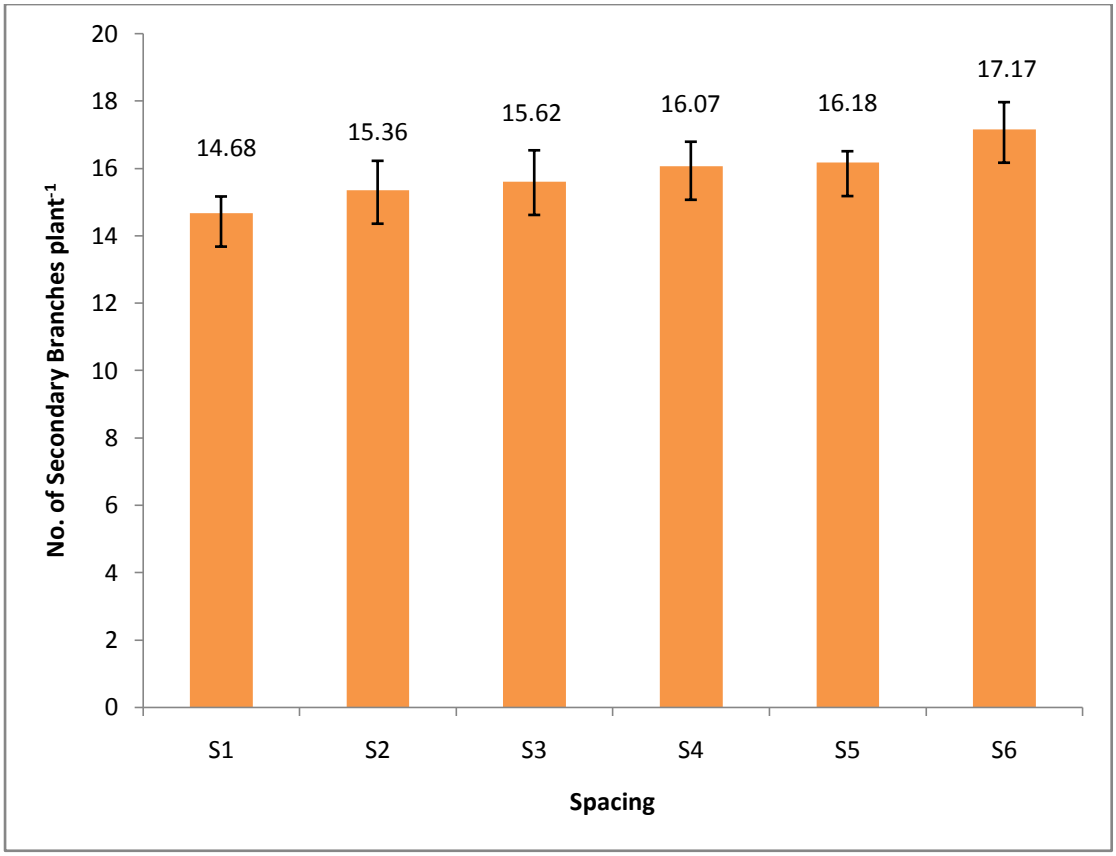


Figure 3. Effect of spacing on the secondary branches plant^{-1} of coriander.

4.3.3 Interaction effects of variety and spacing

Number of secondary branches plant $^{-1}$ was not significantly influenced by the interaction effect of variety and spacing (Table 2). The maximum number of secondary branches plant^{-1} (17.53) produced by the interaction effects of BARI Dhonia 1 with 30 cm x15 cm spacing which was similar with Faridpur local with 30 cm x15 cm and 20 cm x15 cm spacing. The lowest number of branches plant^{-1} was produced by the interaction effects of Faridpur local with 20 cm x10 cm spacing.

4.4. Number of umbels plant^{-1}

4.4.1 Effect of variety

There was found a significant difference in number of umbels between two varieties of coriander (Table 1). The highest number of umbels plant^{-1} (32.172) was produced by the variety BARI Dhonia 1 and the lowest by the variety Faridpur local produced (31.64) umbels plant^{-1}.

Islam *et al.* (2004) reported that number of umbels plant^{-1} ranged from 24.10-33.70. Anon. (2002) reported that the range of number of umbels per plant was 24.10-33.70 at Magura and 62.13-69.93 at Gazipur. Maurya (1989) got umbels per plant in the range of 17.00-41.67 while Datta and Choudhuri (2006) obtained from 20.83-34.67. Bhandari and Gupta (1993) reported the range of number of umbels per plant from 3.2-39.3.

4.4.2 Effect of spacing

The number of umbels plant^{-1} differed significantly due to variation of spacing and as the spacing increased the number of umbels plant^{-1} also increased significantly (Fig. 4 and Appendix VIII). The maximum number of umbels plant^{-1} (33.18) was found from the spacing of 30 cm x 15 cm and the lowest (29.02) was found from 20 cm x 10 cm spacing. Wider spacing produced more number of umbels plant^{-1} than closer spacing mainly because of the fact that wider spacing facilitated maximum utilization of solar energy as well as other environmental resources which helped more dry matter production.

Ghobadi and Ghobadi (2010) reported number of umbels plant^{-1} increased with the increased plant spacing.

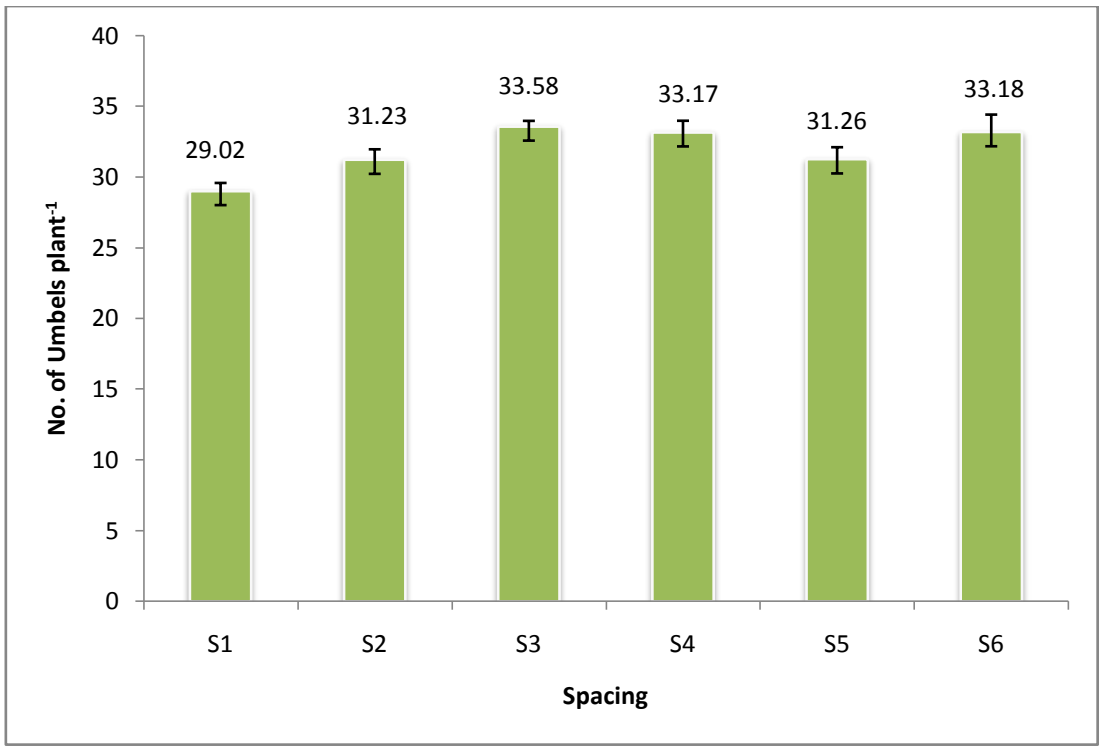


Figure 4. Effect of spacing on the number of umbels plant^{-1} of coriander.

4.4.3 Interaction effects of variety and spacing

There was found a significant effect on number of umbels plant^{-1} due to variety and spacing interaction (Table 2). Result showed that with the increase of spacing in both the varieties, the number of umbels plant^{-1} increased. The highest number of umbels plants^{-1} was found from the combination of variety Faridpur local with 30 cm x 15 cm spacing (34.57) closely followed by BARI Dhonia 1 with 20 cm x 15 cm spacing (33.82). The reasonable number of umbels plant^{-1} was recorded from BARI Dhonia 1 with 30 cm x 10 cm spacing (33.25) and from Faridpur local with 30 cm x 10 cm spacing (33.12). The variety BARI Dhonia 1 coupled with closer spacing 20 cm x 10 cm produced the lowest number of umbels plant^{-1} (29.01) which was statistically similar with the result of Faridpur local with the same spacing.

Table 2. Interaction of variety and spacing on yield and yield attributes of Coriander

Variety × Spacing	Plant height (cm)	No of primary branches/plant	No of secondary branches/plant	No. of umbels/plant
V_1S_1	79.85	7.70	14.88	29.01 f
V_1S_2	80.87	7.40	15.35	31.70 de
V_1S_3	81.07	6.60	15.60	33.25 bc
V_1S_4	81.93	6.80	15.47	33.82 ab
V_1S_5	83.27	6.67	16.18	30.69 e
V_1S_6	84.13	7.20	17.53	32.60 cd
V_2S_1	79.20	7.45	14.47	29.03 f
V_2S_2	75.93	6.92	15.37	30.75 e
V_2S_3	77.93	6.84	15.63	33.12 bc
V_2S_4	81.93	6.80	16.67	32.53 cd
V_2S_5	85.60	7.10	16.17	31.83 d
V_2S_6	81.60	6.87	16.80	34.57 a
CV (%)	2.88	6.42	3.62	1.89
LSD (0.05)	3.95	0.76	0.97	1.01
Level of significance	ns	ns	ns	**

Level of significance means in a column having different letters are significant by DMRT. ** = Significant at 1% probability, ns = Non-significant,* = Significant at 5% probability**,** V_1= BARI Dhonia 1, V_2= Faridpur local, S_1= 20 cm x10 cm, S_2= 25 cm x10 cm, S_3= 30 cm x10 cm, S_4= 20 cm x15 cm, S_5= 25 cm x15 cm and S_6= 30 cm x15 cm.

4.5 Number of umbellates umbel^{-1}

4.5.1 Effect of variety

The variety had no significant effects on number of umbellates umbel^{-1} (Table 3). BARI Dhonia 1 produced (4.59) umbellates umbel^{-1} while Faridpur local produced (4.80) umbellates umbel^{-1}. Both the varieties were statistically similar in umbellates umbel^{-1}.

Islam *et al*. (2004) did not find significant variation among genotypes in respect of number of umbellate per umbel. It was 7.43-7.80 at Gazipur (Anon 2002). Maurya (1989) obtained the number of umbellates per umbel in the range of 4.0-9.40. The result of this investigation corroborates the results of Maurya (1989).

Table 3. Effect of variety on yield attributes of Coriander.

Variety	No of umbellates umbel^{-1}	No of Seeds umbel^{-1}	No of seeds umbellate^{-1}	Umbel circumference (cm)
BARI Dhonia-1	4.86	37.58 a	6.84 a	21.62
Faridpur local	4.80	35.29 b	6.46 b	21.68
CV (%)	5.51%	4.02%	5.04%	8.02
Level of significance	ns	**	**	ns

Level of significance means in a column having different letters are significant by DMRT, ** = Significant at 1% probability, ns = Non-significant

4.5.2 Effect of spacing

Number of umbellates umbel^{-1} was significantly influenced by spacing (Fig. 5 and Appendix VIII). The highest number of umbellates umbel^{-1} (5.07) found in 20 cm x10 cm spacing closely followed by 30 cm x 10 cm and 25cm x 15 cm spacing. But the lowest number of umbellates umbel^{-1} was found in 25 cm x10 cm spacing.

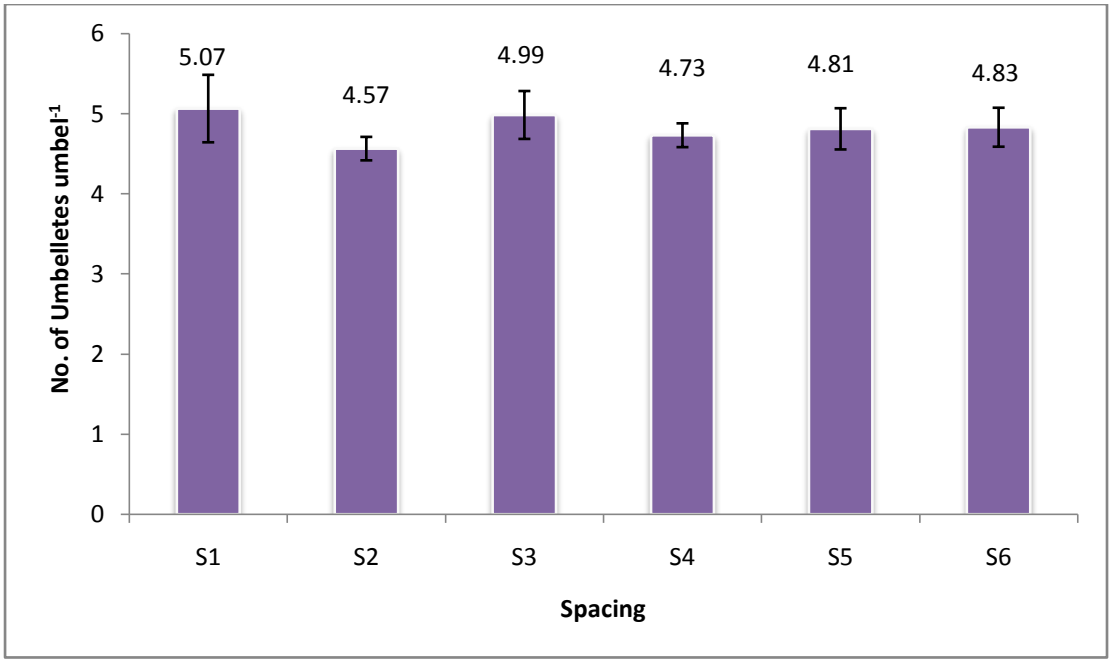


Figure 5. Effect of spacing on the number of umbellates umbel^{-1} of coriander.

4.5.3 Interaction effects of variety and spacing

There was no significant difference in number of umbellates umbel^{-1} due to variety and spacing interaction (Table 4). Result showed that both the varieties with all spacing produced statistically similar number of umbellates umbel^{-1}. However higher number of umbellates umbel^{-1} was recorded from BARI Dhonia 1 with 20 cm x10 cm spacing (5.33) and lower number from Faridpur local with 25 cm x10 cm (4.47).

4.6 Number of seeds umbel^{-1}

4.6.1 Effect of variety

There was a significant variation in number of seeds umbel^{-1} between two varieties (Table 3). The number of seeds umbel^{-1} (37.58) produced by the variety BARI Dhonia 1 was the highest. The minimum seeds umbel^{-1} (35.29) was produced by the variety Faridpur local.

Maurya (1989) recorded 28.00-46.00 seeds per umbel. Datta and Choudhuri (2006) got the seeds per umbel in the range of 33.47-35.57. The result under study is in partial fulfillment of Maurya (1989) and Datta and Choudhuri (2006).

4.6.2 Effect of spacing

Spacing had a significant effect on number of seeds umbel^{-1} (Fig. 6 and Appendix VIII). The highest number of seeds umbel^{-1} (38.99) was recorded from the spacing of 30 cm x 15 cm closely followed by 20 cm x 15 cm spacing and the lowest number of seeds umbel^{-1} (33.88) was obtained from the spacing of 25 cm x10 cm. The result revealed that the number of seeds umbel^{-1} decreased as the spacing decreased.

Masood *et al.* (2004) reported that the maximum seed yield per umbel of funnel with the wider row spacing. Ghobadi and Ghobadi (2010) reported that number of seeds per umbel reduced with the increasing plant density. The present findings are in line with Masood *et al.* (2004) and Ghobadi and Ghobadi (2010).

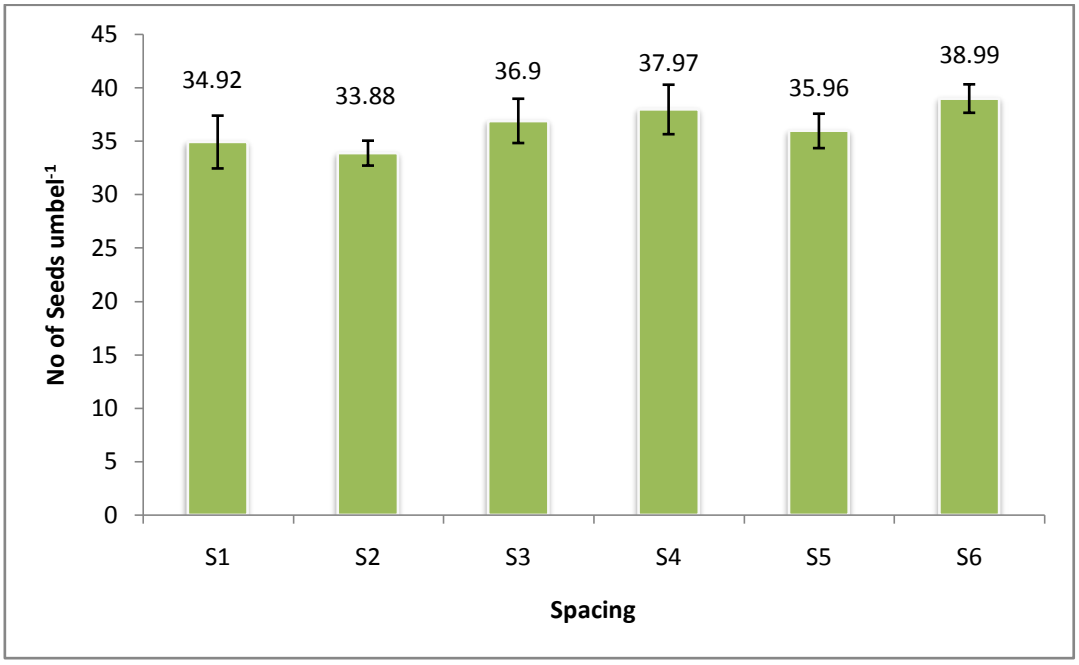


Figure 6. Effect of spacing on the number seeds umbel^{-1} of coriander.

4.6.3 Interaction effect of variety and spacing

There was no significant difference in number of seeds umbel^{-1} due to variety and spacing interaction (Table 4). Result showed that all variety with all spacing produces statistically similar number of seeds umbel^{-1}. Though higher number of seeds umbel^{-1} was recorded in V_1S_4 (40.05) and lower from and V_2S_2 (33.00).

4.7 Number of seed umbellate^{-1}

4.7.1 Effect of variety

There was a significant variation in number of seeds umbellate^{-1} among the varieties (Table 3). The number of seeds umbellate^{-1} (6.840) produced by the variety BARI Dhonia 1 was the highest. The minimum number of seeds umbellate^{-1} (6.456) was produced by the variety Faridpur local.

Bhandari and Gupta (1993) reported the seeds per umbellate was in the range of 1.7-11.8. The result of the present investigation regarding seeds per umbellate is in agreement with Bhandari and Gupta (1993).

4.7.2 Effect of spacing

Spacing had a significant effect on number of seeds umbellate^{-1} (Fig. 7 and Appendix VIII). The highest number of seeds umbellate^{-1} (7.35) was recorded from spacing of 30 cm x 15 cm and the lowest number of seeds umbellate^{-1} (6.38) was obtained from spacing of 20 cm x10 cm (6.18), 25 cm x 10 cm (6.33) and 30 cm x10 cm (6.39). The result revealed that the number of seeds umbellate^{-1} decreased as the spacing decreased.

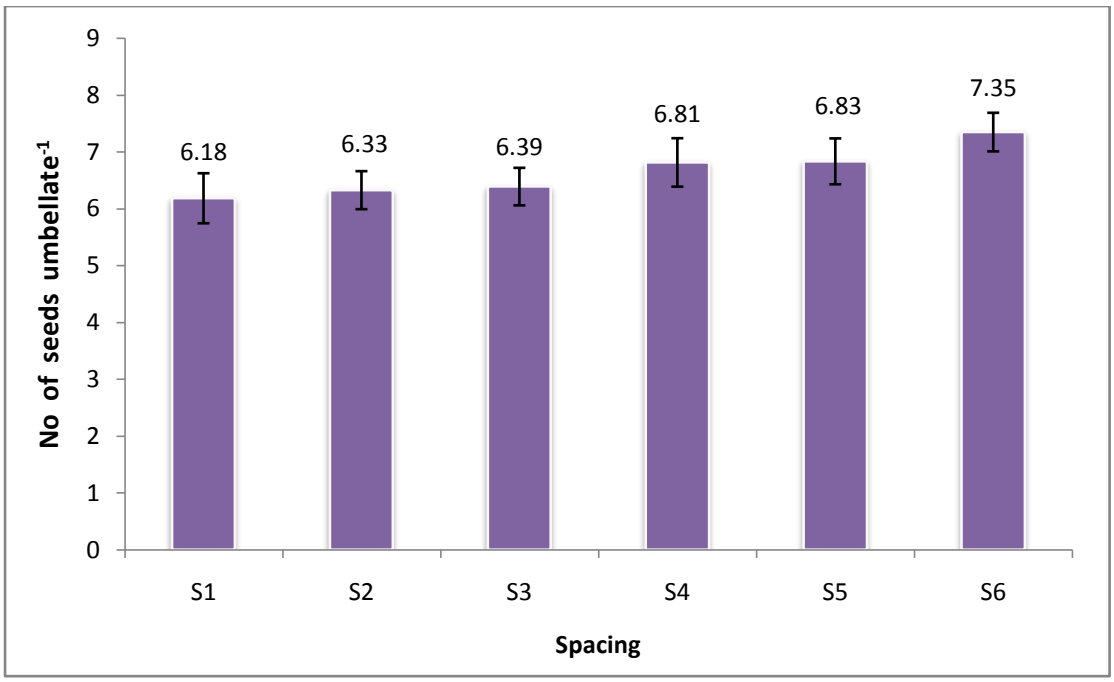


Figure 7. Effect of spacing on the number seeds umbellate^{-1} of coriander.

4.7.3 Interaction effect of variety and spacing

There was no significant difference in number of seeds umbellate^{-1} due to interaction effect of variety and spacing (Table 4). Result showed that both the varieties with all spacing produced statistically similar number of seeds umbellate^{-1}. Though higher number of seeds umbellate^{-1} was recorded in BARI Dhonia 1 with 30 cm x15 cm (7.36), lower from Faridpur local with 20 cm x10 cm (5.80).

4.8 Umbel circumference

4.8.1 Effect of variety

There was no significant variation in umbel circumference between the two varieties (Table 3). For BARI Dhonia 1 umbel circumference was found 21.62 cm while for Faridpur local it was 21.68 cm. Both varieties are statistically similar in umbel circumference.

4.8.2 Effect of spacing

There was no significant difference in umbel circumference due to spacing (Fig. 8 and Appendix IX). Result showed that all spacing produced statistically similar umbel circumference.

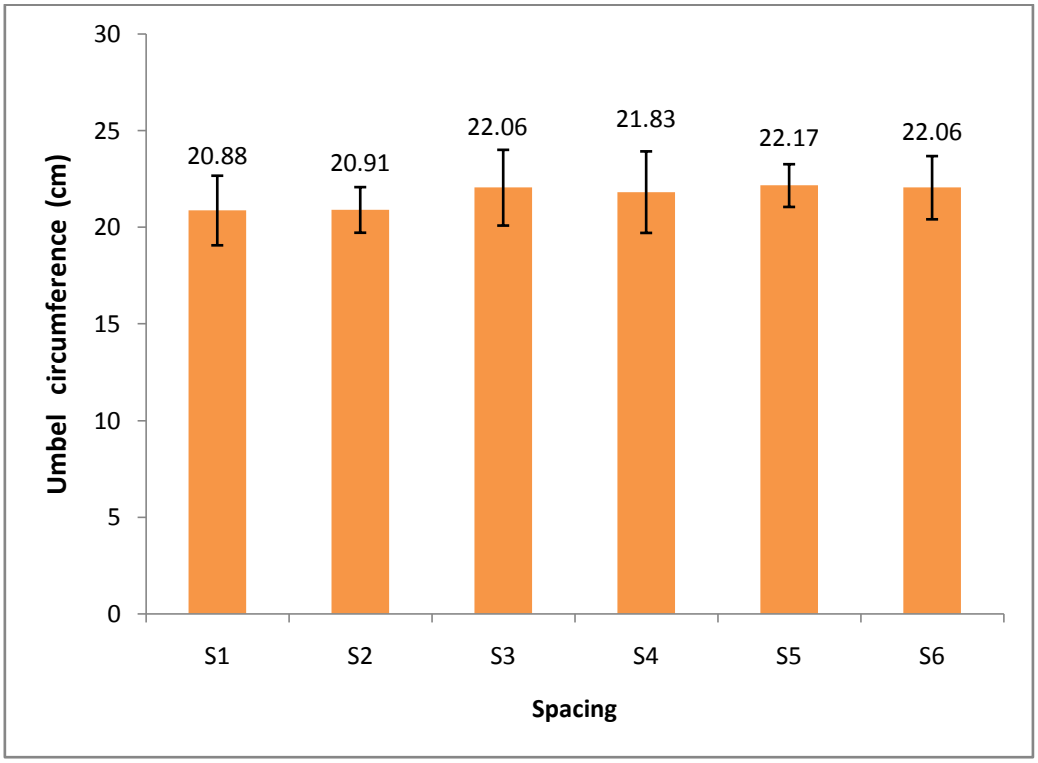


Figure 8. Effect of spacing on the umbel circumference of coriander.

4.8.3 Interaction effect of variety and spacing

There was no significant difference in umbel circumference due to variety and spacing interaction (Table 4). Result showed that both the varieties with all spacing produced statistically similar number of umbel circumference.

Table 4. Interaction of variety and spacing on yield and yield attributes of Coriander

Variety × Spacing	No of umbellates umbel^{-1}	No of seeds umbel^{-1}	No of seeds umbellate^{-1}	Umbel circumference (cm)
V_1S_1	5.33	36.57	6.57	21.20
V_1S_2	4.66	34.77	6.48	21.30
V_1S_3	4.92	38.00	6.61	20.87
V_1S_4	4.69	40.05	6.99	21.71
V_1S_5	4.77	36.67	7.05	22.58
V_1S_6	4.78	39.42	7.36	22.08
V_2S_1	4.80	33.27	5.80	20.57
V_2S_2	4.47	33.00	6.17	20.52
V_2S_3	5.05	35.80	6.17	23.25
V_2S_4	4.78	35.89	6.63	21.94
V_2S_5	4.85	35.24	6.61	21.75
V_2S_6	4.89	38.57	7.33	22.03
CV (%)	5.51	4.02	5.04	8.02
LSD (0.05)	0.45	2.48	0.56	2.94
Level of significance	ns	ns	ns	ns

Level of significance means in a column having different letters are significant by DMRT. ** = Significant at 1% probability, ns = Non-significant,* = Significant at 5% probability**,** V_1= BARI Dhonia 1, V_2= Faridpur local, S_1= 20 cm x10 cm, S_2= 25 cm x10 cm, S_3= 30 cm x10 cm, S_4= 20 cm x15 cm, S_5= 25 cm x15 cm and S_6= 30 cm x15 cm.

4.9 Seed yield plant^{-1}

4.9.1 Effect of variety

There was a no significant variation in seed yield plant^{-1} (Table 5). The highest seed yield (10.75 g) was found by BARI Dhonia 1 while Faridpur local gave 10.67 g seed yield plant^{-1}.

Islam *et al*. (2004) obtained seed yield/plant in the range of 7.30 to 11.30 g. Maurya (1989) got seed yield per plant ranging from 7.93 to 15.08 g.

Table 5. Effect of variety on yield and yield attributes of Coriander

Variety	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (g)	No. of seeds plant^{-1}
BARI Dhonia-1	10.75	1028.0	955.7
Faridpur local	10.67	1053.0	967.5
CV (%)	7.49	5.37	6.44
Level of significance	ns	ns	ns

Level of significance means in a column having different letters are significant by DMRT. ns = Non-significant.

4.9.2 Effect of spacing

Spacing had significant effect on seed yield plant^{-1} (Fig. 10 and Appendix IX). The highest seed yield plant^{-1} (12.79 g) was recorded from the spacing of 30 cm x15 cm and the lowest seed yield plant^{-1} was recorded from spacing of 20 cm x10 cm, 25 cm x10 cm and 20 cm x15 cm respectively. The result revealed that the seed yield plant^{-1} decreased as the spacing decreased.

Islam *et al*. (2004) obtained the maximum seed yield using wider spacing (30 cm x15 cm) compared to the narrower one (20 cm x 10 cm). The result of present study was in consonance with the respect of Islam *et al*. (2004).

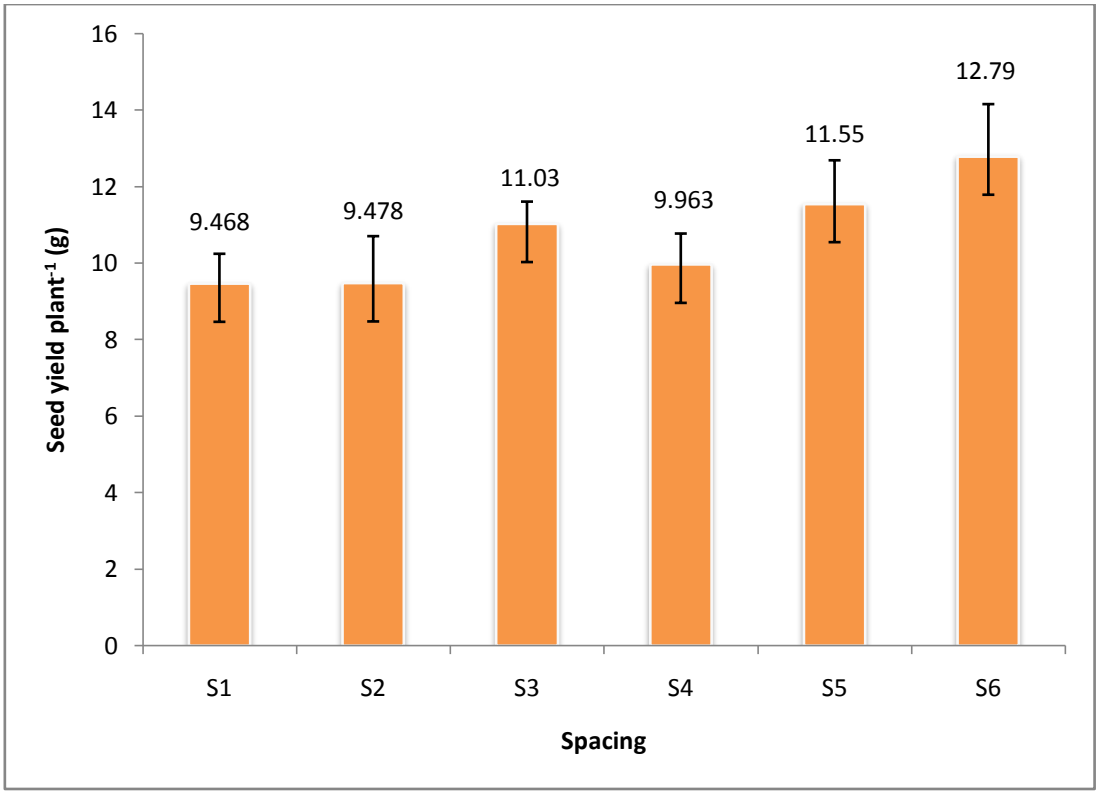


Figure 9. Effect of spacing on the seed yield plant^{-1} of coriander.

4.9.3 Interaction effect of variety and spacing

There was a significant difference in seed yield plant^{-1} due to variety and spacing interaction (Table 6). Result showed that with the increasing of spacing in two varieties, the seed yield plant^{-1} increased. The highest seed yield plant^{-1} was found from the treatment combination of variety Faridpur local with 30 cm x15 cm spacing (13.08 g) and the lowest seed yield plant^{-1} was found from the treatment combination of variety Faridpur local with 25 cm x10 cm spacing (8.517 g).

4.10 Seed yield plot^{-1}

4.10.1 Effect of variety

There was no significant variation between two varieties in respect of seed yield plot^{-1} (Table 5). However the highest seed yield plot^{-1} (1053.0 g) was found by Faridpur local and BARI Dhonia 1 gave 1028.0 g seed yield plot^{-1}. Both varieties are statistically similar in seed yield plot^{-1}.

Kalra *et al*. (2003) reported that seed yield per plot (6 m^2) varied from 0.17-1.39 kg, which supported the present study result.

4.10.2 Effect of spacing

Spacing had a significant effect on seed yield plot^{-1} (Fig. 11 and Appendix IX). The highest seed yield plot^{-1} (1083.3 g) was recorded from spacing of 30 cm x 10 cm closely followed by 20cm x 10 cm, 25 cm x 10 cm and 20cm x 15 cm. The lowest seed yield plant^{-1} (975.0g) was recorded by spacing of 30 cm x15 cm.

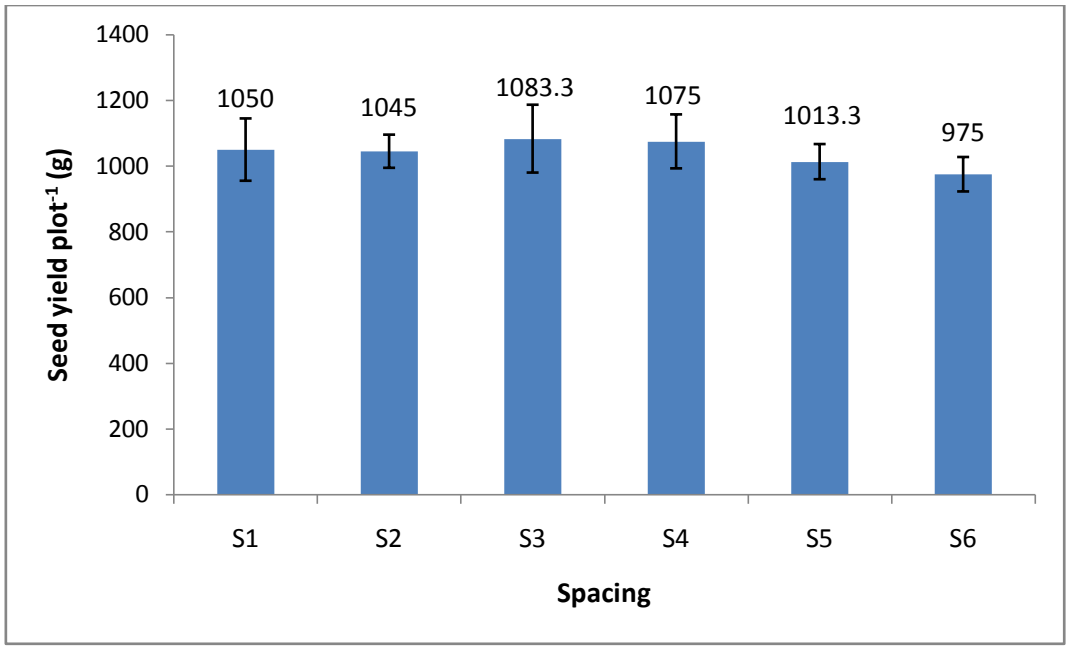


Figure 10. Effect of spacing on the seed yield plot^{-1}of coriander.

4.10.3 Interaction effect of variety and spacing

There was a significant difference in seed yield plot^{-1} due to variety and spacing interaction (Table 6). the highest seed yield plot^{-1} was found from the combination of variety Faridpur local with 30 cm x10 cm spacing (1166.7 g) closely followed by Faridpur local with 20 cm x 15 cm spacing and BARI Dhonia 1 with 20 cm x 10 cm spacing and the lowest number seed yield plot^{-1} was found from the treatment combination of variety Faridpur local with 30 cm x15 cm spacing (8.517 g).

4.11 Number of seeds plant^{-1}

4.11.1 Effect of variety

There was no significant variation between two varieties in respect of number of seeds plant^{-1} (Table 5). The highest number of seeds plant^{-1} (967.5) was obtained from Faridpur local but BARI Dhonia 1 gave number of seeds plant^{-1} (955.7). Both varieties are statistically similar in number of seeds plant^{-1} (Fig. 12).

4.11.2 Effect of spacing

Spacing had a significant effect on number of seeds plant^{-1} (Fig. 12 and Appendix IX). The highest number of seeds plant^{-1} (1020.8) was recorded from the spacing of spacing of 25 cm x 15 cm closely followed by 20 cm x 10 cm and 20 cm x 15 cm spacing and the lowest number of seeds plant^{-1} (909.2) was recorded from spacing of (30x15) cm.

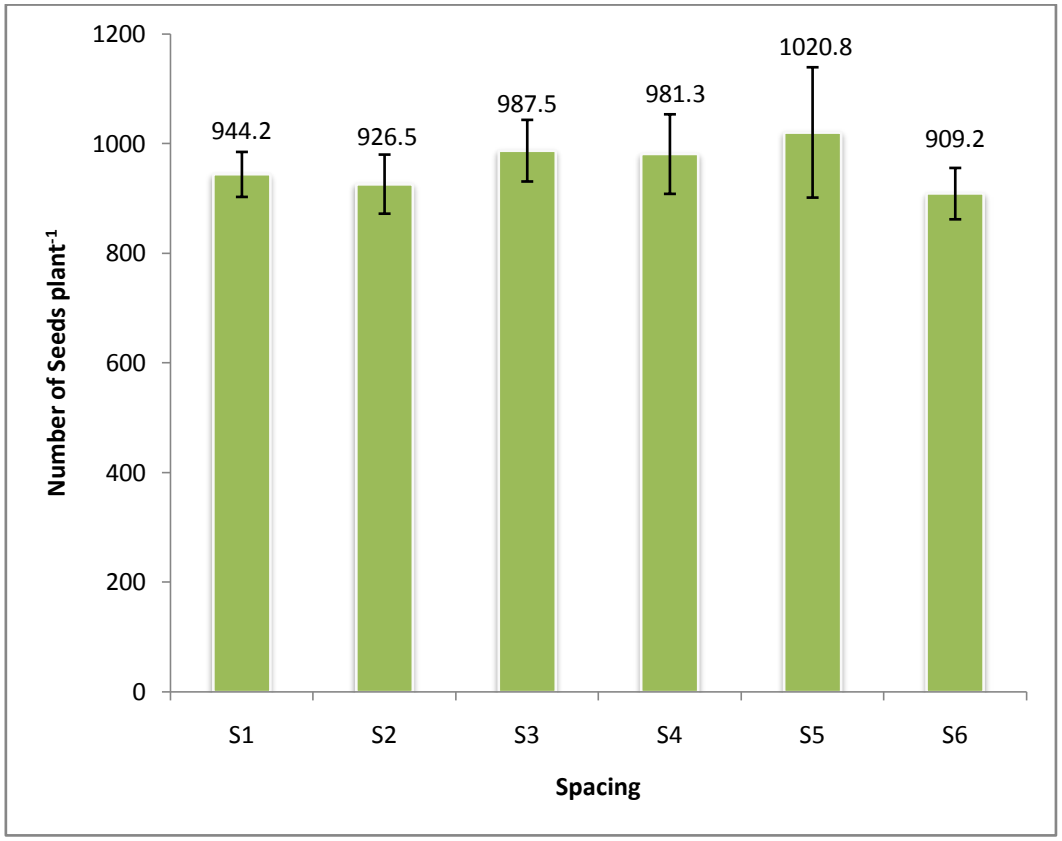


Figure 11. Effect of spacing on the number of seeds plant^{-1} of coriander

4.11.3 Interaction effect of variety and spacing

There was no significant difference in number of seeds plant^{-1} due to variety and spacing interaction (Table 6). Both the two varieties with all spacing produced statistically similar result number of seeds plant^{-1}. However higher number of seeds plant^{-1} was recorded from Faridpur local with 25 cm x15 cm spacing (1028.3) and lower from Faridpur local with 30 cm x 15 cm spacing (885.0).

Table 6. Interaction of variety and spacing on yield and yield attributes of Coriander

Variety × Spacing	Seed yield plant^{-1} (g)	Seed yield plot^{-1} (g)	Number of seeds plant^{-1}
V_1S_1	10.05 cde	1100.0 abc	940.0
V_1S_2	10.44 cd	1056.7 bcd	946.3
V_1S_3	11.26 bc	1000.0 de	948.3
V_1S_4	9.59 def	1016.7 cde	952.7
V_1S_5	10.67 cd	976.7 de	1013.3
V_1S_6	12.50 ab	1016.7 cde	933.3
V_2S_1	8.88 ef	1000.0 de	948.3
V_2S_2	8.52 f	1033.3 cd	906.7
V_2S_3	10.80 cd	1166.7 a	1027.0
V_2S_4	10.33 cd	1133.3 ab	1010.0
V_2S_5	12.42 ab	1050.0 bcd	1028.3
V_2S_6	13.08 a	933.3 e	885.0
CV (%)	7.49	5.37	6.44
LSD (0.05)	1.36	94.60	104.8
Level of significance	**	**	ns

Level of significance means in a column having different letters are significant by DMRT. ** = Significant at 1% probability, ns = Non-significant,* = Significant at 5% probability**,** V_1= BARI Dhonia 1, V_2= Faridpur local, S_1= 20 cm x10 cm, S_2= 25 cm x10 cm, S_3= 30 cm x10 cm, S_4= 20 cm x15 cm, S_5= 25 cm x15 cm and S_6= 30 cm x15 cm.

4.12 Stover yield plot^{-1}

4.12.1 Effect of variety

There was a significant variation in stover yield plot^{-1} between the varieties (Table 7). The highest stover yield plot^{-1} (726.67 g) was produced by the variety Faridpur local. The lowest stover yield plot^{-1} (669.44 g) was produced by the variety BARI Dhonia 1.

Table 7. Effect of variety on yield of Coriander

Variety	Stover yield plot^{-1} (g)	1000-seed weight (g)	Seed yield (t/ha)	Stover yield (t/ha)
BARI Dhonia-1	669.44 b	10.74 a	1.90	1.24 b
Faridpur local	726.67 a	8.92 b	1.95	1.35 a
CV (%)	7.06	2.15	5.37	7.06
Level of significance	**	**	ns	**

Level of significance means in a column having different letters are significant by DMRT. ** = Significant at 1% probability, ns = Non-significant

4.12.2 Effect of spacing

Spacing had a significant effect on stover yield plot^{-1} (Fig. 13 and Appendix IX). The highest stover yield plot^{-1} (775 g) was obtained from the spacing of 20 cm x10 cm closely followed by 25 cm x 10 cm spacing and the lowest stover yield plot^{-1} (641.7 g) was recorded from spacing of 30 cm x15 cm. The result revealed that the stover yield plot^{-1} decreased as the spacing increased.

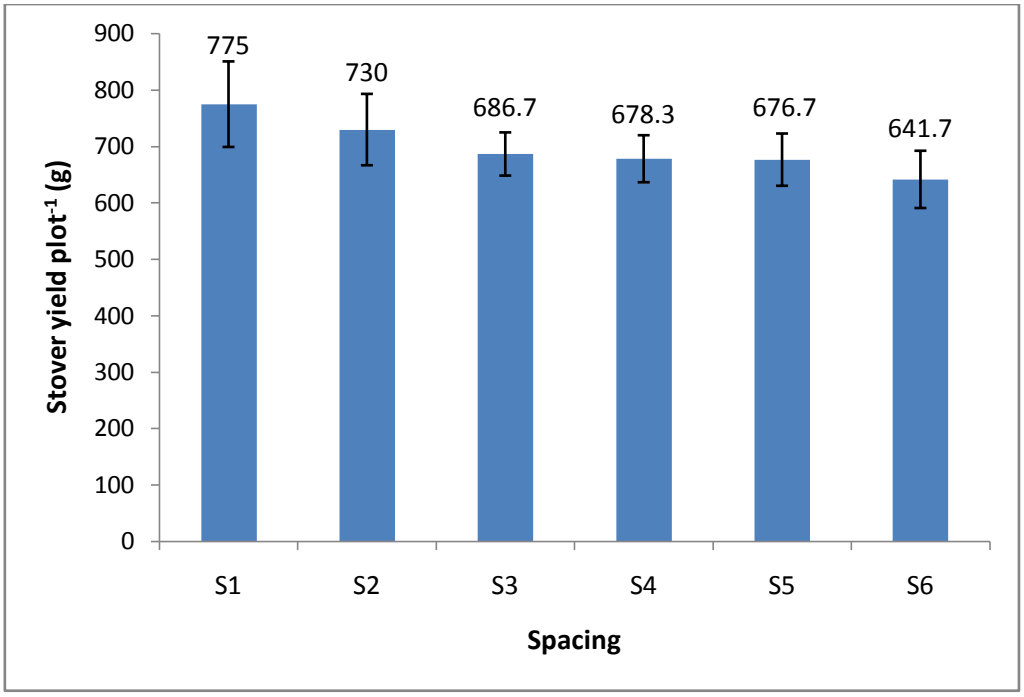


Figure12. Effect of spacing on the stover yield plot^{-1} of coriander.

4.12.3 Interaction effect of variety and spacing

There was no significant difference in stover yield plot^{-1} due to variety and spacing interaction (Table 8). Result showed that both the varieties with all spacing produces statistically similar stover yield plot^{-1}. However, higher stover yield plot^{-1} was recorded in Faridpur local with 20 cm x10 cm spacing (800 g) and lower from BARI Dhonia 1 with 30 cm x15 cm spacing (600 g).

4.13 Thousand-seed weight

4.13.1 Effect of variety

There was a significant variation in respect of 1000-seed weight between the two varieties (Table 7). The highest 1000-seed weight (10.74 g) was produced by the variety BARI Dhonia 1. The lowest 1000-seed weight (8.92 g) was produced by the variety Faridpur local.

Islam *et al*. (2004) obtained 1000-seed weight in the range of 10.25 to 11.73 g. Maurya (1989) got 1000-seed weight from 8.82-18.52g and Datta and Choudhuri (2006) from 9.33-13.82g. The result regarding 1000-seed weight of the present study was in the range of all authors.

4.13.2 Effect of spacing

Spacing had a significant effect on 1000-seed weight (Fig. 14 and Appendix IX). The highest 1000-seed weight (11.03 g) was found from spacing of 30 cm x15 cm and the lowest 1000-seed weight (9.050 g) from spacing of 20 cm x10 cm. The result revealed that the 1000-seed weight decreased as the spacing decreased.

Ghobadi and Ghobadi (2010) reported that no significant difference was observed in 1000-fruit weight which was not in support of the present study result.

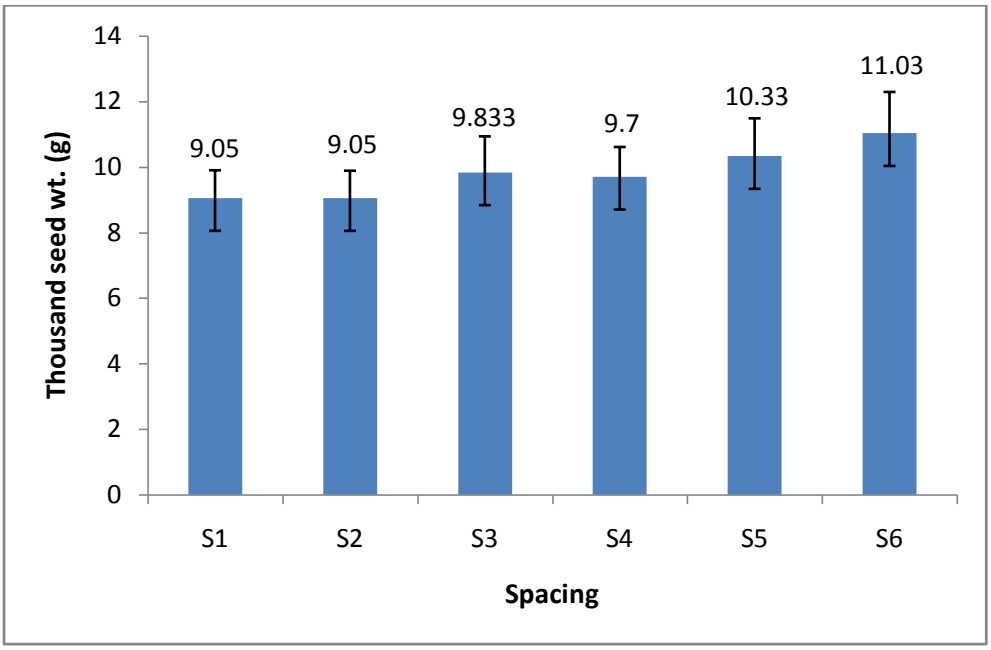


Figure 13. Effect of spacing on the thousand seed weight of coriander.

4.13.3 Interaction effect of variety and spacing

There was a significant difference in 1000-seed weight due to variety and spacing interaction (Table 8). The highest 1000-seed weight (12.17 g) was found from the treatment combination of variety BARI Dhonia 1 with 30 cm x 15 cm spacing and the lowest 1000-seed weight (8.300 g) was found from the treatment combination of variety Faridpur local with 20 cm x10 cm spacing and Faridpur local with 25 cm x 10 cm spacing.

4.14 Seed yield (tha^{-1})

4.14.1 Effect of variety

There was no significant variation in seed yield (tha^{-1}) between the varieties (Table 7). The highest seed yield (1.949 tha^{-1}) was recorded from Faridpur local while BARI Dhonia 1 gave seed yield 1.903 tha^{-1}.

Rajagopalan *et al.* (1996) obtained seed yield of 13 coriander cultivars in the range of 0.36-0.68 tha^{-1} at the Tamil Nadu Agricultural University, Coimbatore, India. Datta and Choudhuri (2006) reported that seed yields of 17 germplasm lines were in the range of 0.69-1.51 tha^{-1}. Anon (2002) reported that four lines of coriander produced seed yield in the range of 0.98-1.24 tha^{-1} in Gazipur while CR0022 gave highest yield 1.95 t/ha while BARI Dhonia 1 produced 1.80 tha^{-1}, which support the present study result that Faridpur local produce highest result.

4.14.2 Effect of spacing

Spacing had a significant effect on seed yield (tha^{-1}) (Fig. 15 and Appendix IX). The highest seed yield (2.00tha^{-1}) was found from spacing of 30 cm x10 cm closely followed by 20 cm x 15 cm (1.99 tha^{-1}), 25 cm x 15 cm (1.93 tha^{-1}) and 20 cm x 10 cm spacing (1.44 tha^{-1}) and the lowest seed yield (1.806 tha^{-1}) was recorded from spacing of 30 cm x15 cm.

Masood *et al.* (2004) reported seed yield per hectare were obtained with the lowest row spacing. Ahmed and Haque (1986) reported closer row spacing (15 cm) gave the higher seed yield of black cumin.

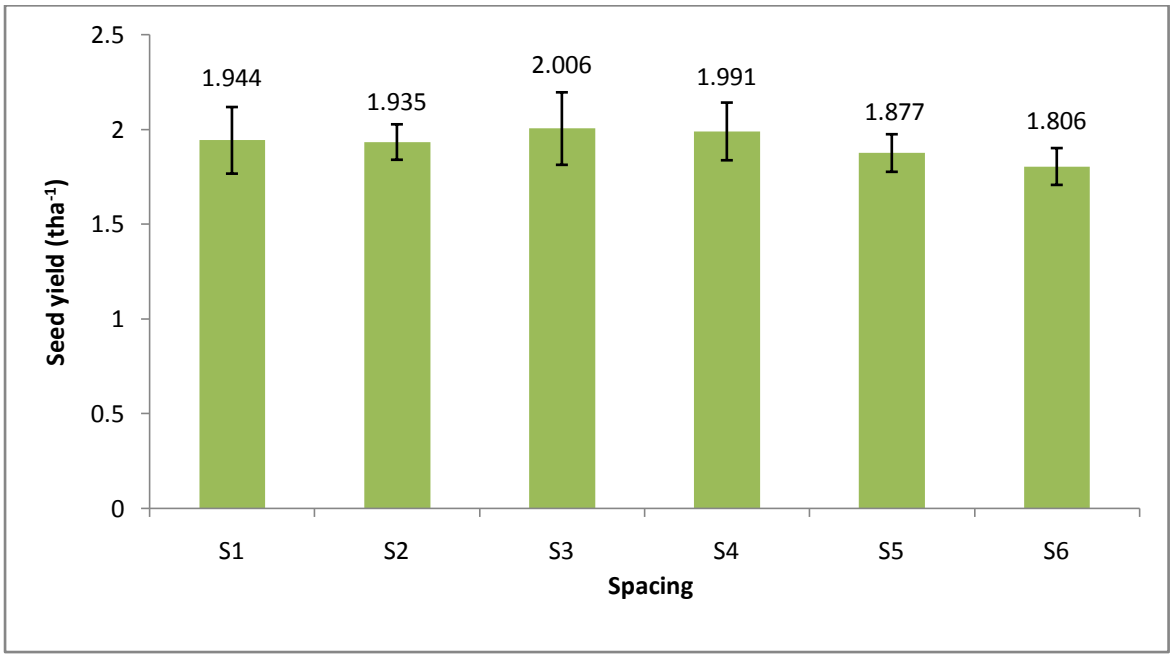


Figure 14. Effect of spacing on the seed yield (tha^{-1}) of coriander.

4.14.3 Interaction effect of variety and spacing

There was a significant difference in seed yield (tha^{-1}) due to variety and spacing interaction (Table 8). Apparently the highest seed yield (2.16 tha^{-1}) was found from the treatment combination of variety Faridpur local with 30 cm x10 cm spacing closely followed by Faridpur local with 20 cm x 15 cm spacing (2.10 tha^{-1}) and BARI Dhonia 1 with 20 cm x 10 cm (2.04 tha^{-1}) and the lowest seed yield (1.728 tha^{-1}) was found from the treatment combination of variety Faridpur local with 30 cm x15 cm spacing.

4.15 Stover yield (tha^{-1})

4.15.1 Effect of variety

There was a significant variation in stover yield (tha^{-1}) between the varieties (Table 7). The highest stover yield (1.35tha^{-1}) was produced by the variety Faridpur local and the variety BARI Dhonia 1 produced the lowest stover yield (tha^{-1}).

4.15.2 Effect of spacing

Spacing had a significant effect in stover yield (tha^{-1}) (Fig. 16 and Appendix IX). The highest stover yield (1.44 tha^{-1}) was recorded from spacing of 20 cm x10 cm and the lowest stover yield (1.19 tha^{-1}) from spacing of 30 cm x15 cm. The result revealed that the stover yield (tha^{-1}) decreased as the spacing increased.

Okut and Yidrim (2005) reported that maximum biological yield of Coriander was obtained in 30 cm row space.

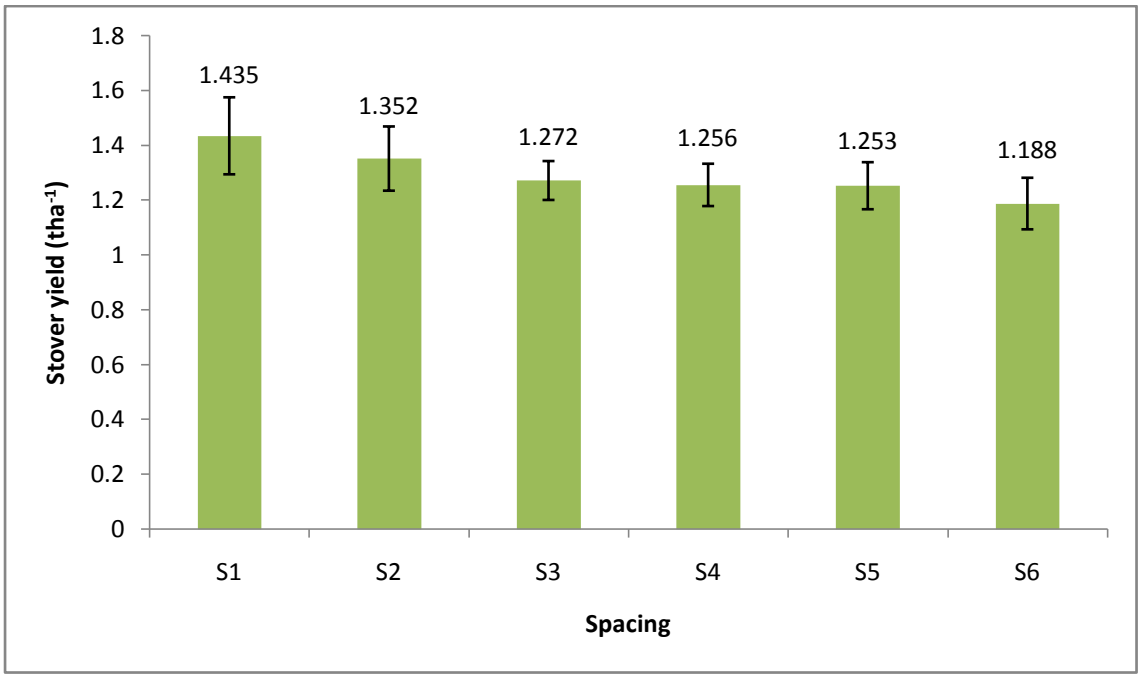


Figure 15. Effect of spacing on the stover yield (tha^{-1}) of coriander.

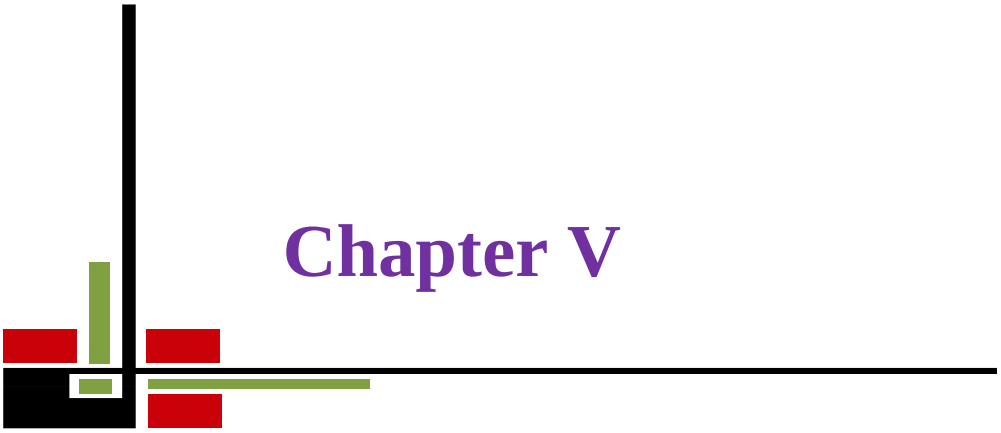
4.15.3 Interaction effect of variety and spacing

There was no significant difference in stover yield (tha^{-1}) due to variety and spacing interaction (Table 8) Result showed that two varieties with all spacing produced statistically similar result in stover yield (tha^{-1}). However higher stover yield was recorded from Faridpur local with 20 cm x10 cm spacing (1.48 tha^{-1}) and lower from BARI Dhonia 1 with 30 cm x15 cm spacing (1.11 tha^{-1}).

Table 8. Interaction of variety and spacing on yield of Coriander

Variety × Spacing	Stover yield $plot^{-1}$ (g)	1000 seed weight (g)	Seed yield (t/ha)	Stover yield (t/ha)
V_1S_1	750.0	9.80 d	2.04 abc	1.39
V_1S_2	710.0	9.80 d	1.96 bcd	1.32
V_1S_3	660.0	10.83 c	1.85 de	1.22
V_1S_4	656.7	10.50 c	1.88 cde	1.22
V_1S_5	640.0	11.37 b	1.81 de	1.19
V_1S_6	600.0	12.17 a	1.88 cde	1.11
V_2S_1	800.0	8.30 g	1.85 de	1.48
V_2S_2	750.0	8.30 g	1.91 cd	1.39
V_2S_3	713.3	8.83 f	2.16 a	1.32
V_2S_4	700.0	8.90f	2.10 ab	1.30
V_2S_5	713.3	9.30 e	1.94 bcd	1.32
V_2S_6	683.3	9.90 d	1.728 e	1.27
CV (%)	7.06	2.15	5.37	7.06
LSD (0.05)	83.41	0.359	0.177	0.151
Level of significance	ns	*	**	ns

Level of significance means in a column having different letters are significant by DMRT, ** = Significant at 1% probability, ns = Non-significant,* = Significant at 5% probability**,** V_1= BARI Dhonia 1, V_2= Faridpur local, S_1= 20 cm x10 cm, S_2= 25 cm x10 cm, S_3= 30 cm x10 cm, S_4= 20 cm x15 cm, S_5= 25 cm x15 cm and S_6= 30 cm x15 cm.



Chapter V

Summary and Conclusion

CHAPTER V

SUMMARY AND CONCLUSION

The field experiment was conducted at Sher-e-Bangla Agricultural University farm, Dhaka, Bangladesh during the period from November to February 2012 to evaluate the effect of variety and spacing on yield attributes and yield of coriander. The experiment was laid out in factorial randomized completely bock design (RCBD) with tree replications. The treatment consisted of six levels of spacing (S_1=20 cm x 10 cm, S_2 = 25 cm x 10 cm, S_3 = 30 cm x 10 cm, S_4 = 20 cm x 15cm, S_5 = 25 cm x 15 cm and S_6 = 30 cm x 15 cm) and two varieties (V_1 = BARI Dhania 1 and V_2 = Faridpur local). Data on different parameters (yield attributes and yield) were collected and analyzed by using MSTAT C programme and treatment means were compared by Duncan's Multiple Range Test (DMRT).

Variety had no significant effect on plant height, no. of primary branches plant^{-1}, no. of secondary branches plant^{-1}, umbel circumference, no of umbellates umbel^{-1}, seed yield plant^{-1}, seed yield plot^{-1}, no. of seeds plant^{-1}and seed yield ha^{-1}. The variety put significant influence only on no. of seeds umbel^{-1}, no. of seeds umbellate^{-1}, 1000 seed weight and stover yield. The variety BARI Dhonia 1 produced the maximum number of seeds umbel^{-1}, maximum number of seeds umbellate^{-1} and the highest 1000-seed weight. On the contrary the variety Faridpur local gave the maximum stover yield, both per plot and per hectare.

Spacing had significant effect on all parameters studied except umbel circumference. The tallest plant was recorded from 25 cm x 15 cm spacing while the shortest plant was from 25 cm x 10 cm spacing. Plant height of 82.87 cm, 84.43 cm and 81.93 cm was obtained from 30 cm x 15 cm, 25 cm x 15cm, 20 cm x 15 cm spacing, respectively while plant height of 79.50 cm, 78.40 cm

and 79.53 cm was found with 30 cm x10 cm, 25 cm x10 cm & 20 cm x10 cm spacing, respectively. The dense plant population increased the competition for nutrients, space and light that might have resulted in the stunted growth. The closer spacing of 20 cm x10 cm produced the maximum primary branches plant^{-1} followed by 25 cm x10 cm, 30 cm x15 cm, 25 cm x15 cm and 20 cm x15 cm spacing.

The closer spacing (20 cm x 10 cm) produced the lowest number of secondary branches plant^{-1}. The highest number of umbels plant^{-1} was recorded from 30 cm x15 cm spacing and the lowest from 20 cm x 10 cm spacing. The highest number of umbellates umbel^{-1} was obtained from 20 cm x 10 cm spacing and the lowest umbellates umbel^{-1} from in 25 cm x 10 cm spacing. The maximum number of seeds umbel^{-1} was observed from 30 cm x 15 cm spacing and its minimum value was observed from the spacing of 25 cm x10 cm. The result revealed that the number of seeds umbel^{-1} decreased as the spacing decreased. The highest number of seeds umbellate^{-1} was recorded from the wider spacing of 30 cm x15 cm and the lowest number of seeds umbellate^{-1} was observed from relatively closer spacing of 20 cm x 10 cm, 25 cm x 10 cm and 30 cm x 10 cm.

The closer spacing of 20 cm x 10 cm produced the highest number of plants plot^{-1} and the wider spacing 30 cm x15 cm produced the lowest number of plants plot^{-1}). The maximum seed yield plant^{-1} was recorded from 30 cm x 15 cm spacing and the lowest seed yield plant^{-1} was recorded from spacing of 20 cm x 10 cm. The highest number of seeds plant^{-1} was obtained from spacing of 25 cm x 15 cm and the lowest from 30 cm x 15 cm.

The highest 1000-seed weight was observed at wider spacing of 30 cm x 15 cm spacing and the lowest 1000-seed weight was observed at closer spacing of 20 cm x 10 cm. The result revealed that the 1000-seed weight decreased as the spacing decreased.

The spacing of 20 cm x 10 cm gave the highest stover yield plot^{-1} and ha-1 and the spacing of 30 cm x 15 cm produced the lowest stover yield, both per plot and hectare. The highest seed yield was recorded from 30 cm x 10 cm spacing and the lowest seed yield was recorded from the wider spacing of 30 cm x 15 cm.

Interaction of variety and spacing had significant effect on number of umbels plant^{-1}, seed yield, both per plant and plot, 1000 seed weight and seed yield ha^{-1}.The maximum number of umbels plants^{-1} was found from the variety Faridpur local with 30 cm x 15 cm spacing closely followed by BARI Dhonia 1 with 20 cm x 15 cm spacing and the lowest number of umbels plant^{-1} was recorded from the variety BARI Dhonia 1 (29.01) with 20 cm x 10 cm spacing which was statistically similar with Faridpur local with the same spacing. The highest 1000-seed weight was recorded from the combination of BARI Dhonia 1 with 30 cm x 15 cm spacing followed by 20 cm x 15 cm spacing and 30 cm x 10 cm spacing with the same variety. The lowest 1000-seed weight was found from the variety BARI Dhonia 1 with 20 cm x 10 cm spacing and BARI Dhonia 1 with 25 cm x 10 cm spacing.

The highest seed yield plant^{-1} was recorded from the combination of Faridpur local with 30 cm x 15 cm spacing closely followed by BARI dhonia-1 with the same spacing 30 cm x 15 cm and Faridpur local with 25 cm x 15 cm and the lowest seed yield plant^{-}was obtained from the combination of Faridpur local with 25 cm x 10 cm spacing. The maximum seed yield plot^{-1} was found from the combination of Faridpur local with 30 cm x10 cm spacing and the lowest seed yield plot^{-1} was obtained from the combination of variety Faridpur local with 30 cm x 15 cm spacing.

The variety Faridpur local coupled with 30 cm x 10 cm spacing gave the highest seed yield ha^{-1} closely followed by the same variety Faridpur local with 20 cm x 15 cm spacing and BARI Dhonia 1 with 20 cm x 10 cm spacing.

The lowest seed yield ha^{-1} was recorded from the combination of Faridpur local with 30 cm x15 cm spacing.

Based on the results and discussion of the present study, the following conclusions might be drawn:

1. There was no significant difference between two coriander varieties, BARI dhonia-1 and Faridpur local in respect of most of the yield parameters and seed yield.
2. The spacing of 30 cm x 10 cm gave the maximum coriander seed yield identical with 20 cm x 15 cm spacing.
3. The variety Faridpur local in combination with 30 cm x 10 cm spacing gave the highest seed yield of coriander closely followed by 25 cm x 15 cm spacing with the same variety Faridpur local. The variety BARI Dhonia-1 coupled with spacing of 20 cm x 10 cm produced the identical seed yield.

RECCOMENDATION

i. For coriander cultivation, either 30 cm x 10 cm or 20 cm x 15 spacing was suitable for maximum seed yield.
ii. Both the varieties, BARI Dhonia 1 and Faridpur local were found identical in their performance.
iii. The study might be conducted at the same Agro Ecological Condition for the conformation of the result.

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Appendices

APPENDICES

Appendix I. Analytical data of soil sample of the experimental plot

A. Morphological Characteristics

Morphological features	characteristics
Location	SAU Farm, Dhaka
AEZ	Modhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land Type	Medium high land
Soil Series	Tejgaon
Topography	Fairly leveled
Flood Level	Above flood level
Drainage	Well drained

B. Mechanical analysis

Constituents	Percent
Sand	27
Silt	43
Clay	30

C. Chemical analysis

Soil properties	Amount
Soil pH	5.8
Organic carbon (%)	0.45
Total nitrogen (%)	0.03
Available P (ppm)	20
Exchangeable K (%)	0.1
Available S (ppm)	45

Source: Soil Resource Development Institute (SRDI)

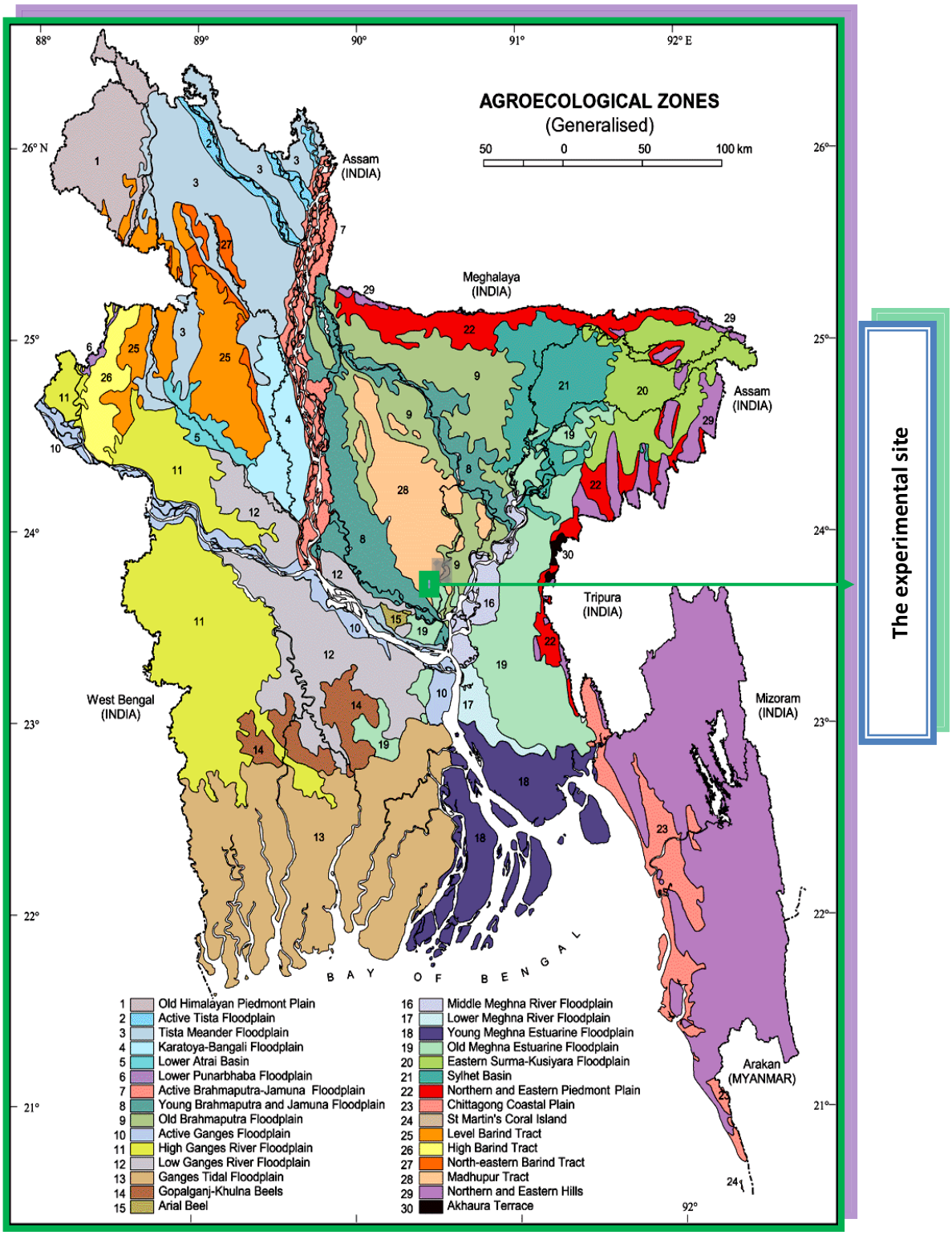
Appendix II. Monthly records of air temperature, relative humidity, rainfall and sunshine during the period from November 2012to March 2013

Year	Month	** Air temperature (^{0}C)			**Relative humidity (%)	*Rainfall (mm)	**Sunshine (Hours)
		Maximum	Minimum	Mean			
2012	November	28.79	18.54	23.76	82.53	83.1	235.0
	December	25.32	14.40	19.86	84.06	0.00	196.4
2013	January	21.77	10.17	15.97	83.65	Trace	165.6
	February	26.77	15.49	21.13	75.21	27.10	229.2
	March	27.95	18.11	23.03	75.39	114.00	199.3

*Monthly total, ** Monthly average

Source: Bangladesh Meteorological Department (Climate & weather division) Agargoan, Dhaka, Bangladesh

Appendix III. Map showing the experimental site



The experimental site

Appendix IV. Analysis of variance on data with the effect of variety and spacing on yield attributes of Coriander

Source of variation	Degrees of freedom	Plant height (cm)		No. of Primary Branches plant^{-1}		No. of Secondary Branches plant^{-1}		No. of umbels plant^{-1}	
		Mean square	F- value	Mean square	F- value	Mean square	F- value	Mean square	F- value
Replication	2	7.606	1.3921	0.121	0.5955	2.416	7.3480	0.077	0.2120
Factor A	1	19.877 ^{NS}	1.3921	0.040 ^{NS}	0.1967	0.002 ^{NS}	0.0053	2.502*	6.9088
Factor B	5	32.708**	5.9867	0.583*	2.8679	4.275**	13.0033	18.307**	50.5580
AB	5	9.957 ^{NS}	1.8224	0.187 ^{NS}	0.9186	0.646 ^{NS}	1.9635	1.825**	5.0395
Error	22	5.463		0.203		0.329		0.362	

^{NS} Not significant; * Significant at 5% level; ** Significant at 1% level

Appendix V. Analysis of variance on data with the effect of variety and spacing on yield attributes of Coriander

Source of variation	Degrees of freedom	No of Umbellates umbel^{-1}		No of Seeds umbel^{-1}		No of seeds umbellate^{-1}		Umbel circumference (cm)	
		Mean square	F- value	Mean square	F -value	Mean square	F -value	Mean square	F -value
Replication	2	0.033	0.4676	0.974	0.4539	0.040	0.3591	7.024	2.3306
Factor A	1	0.027 ^{NS}	0.3769	46.968**	21.8863	1.326**	11.8094	0.025 ^{NS}	0.0081
Factor B	5	0.191*	2.7032	21.787**	10.1523	1.124**	10.0101	2.122 ^{NS}	0.7041
AB	5	0.106 ^{NS}	1.4912	2.295 ^{NS}	1.0692	0.098 ^{NS}	0.8741	2.122 ^{NS}	0.7391
Error	22	0.071		2.146		0.112		3.014	

^{NS} Not significant; * Significant at 5% level; ** Significant at 1% level

Appendix VI. Analysis of variance on data with the effect of variety and spacing on yield attributes of Coriander

Source of variation	Degrees of freedom	Seed yield plant^{-1} (g)		Seed yield plot^{-1} (g)		Number of Seeds plant^{-1}	
		Mean square	F- value	Mean square	F -value	Mean square	F -value
Replication	2	1.684	2.6128	3936.111	1.2612	20955.083	5.4694
Factor A	1	0.059 ^{NS}	0.0919	5625.000 ^{NS}	1.8023	1260.250 ^{NS}	0.3289
Factor B	5	10.494**	16.2857	9796.111*	3.1388	10624.783*	2.7731
AB	5	2.757**	4.2789	18151.667**	5.8161	3836.117 ^{NS}	1.0012
Error	22	0.644		3120.960		3831.356	

^{NS} Not significant; * Significant at 5% level; ** Significant at 1% level

Appendix VII. Analysis of variance on data with the effect of variety and spacing on yield attributes of Coriander

Source of variation	Degrees of freedom	Stover yield plot^{-1} (g)		Thousand seed wt. (g)		seed yield ha^{-1}		strover yield ha^{-1}	
		Mean square	F -value	Mean square	F -value	Mean square	F -value	Mean square	F -value
Replication	2	1644.444	0.6778	0.032	0.7284	0.013	1.2576	0.006	0.6788
Factor A	1	29469.444 **	12.1460	29.884**	669.7369	0.019 ^{NS}	1.8062	0.101**	12.1260
Factor B	5	13316.111 **	5.4883	3.522**	78.9311	0.034*	3.1426	0.046**	5.4728
AB	5	449.444 ^{NS}	0.1852	0.164*	3.6704	0.062**	5.8153	0.002 ^{NS}	0.1848
Error	22	2426.263		0.045		0.011		0.008	

^{NS} Not significant; * Significant at 5% level; ** Significant at 1% level

Appendix VIII. Effect of spacing on plant height, no of primary branches, no of secondary branches/plant, no of plants/plot, no of umbels/plant, no of umbellates/umbel, no of seeds/umbel, no of seeds/umbellate.

Spacing	Plant height	No of Primary Branches plant^{-1}	No of Secondary Branches plant^{-1}	No of plants plot^{-1} (5.4 m^2)	No of Umbels plant^{-1}	No of Umbellates umbel^{-1}	No of Seeds umbel^{-1}	No of seeds umbellate^{-1}
20 × 10 (S_1)	79.53 bc	7.575 a	14.68 d	264.7 a	29.02 c	5.065 a	34.92 de	6.183 c
25 × 10 (S_2)	78.40 c	7.158 ab	15.36 cd	207.5 b	31.23 b	4.565 c	33.88 e	6.325 c
30 × 10 (S_3)	79.50 bc	6.717 b	15.62 bc	167.0 c	33.58 a	4.985 ab	36.90 bc	6.388 c
20 × 15 (S_4)	81.93 ab	6.800 b	16.07 b	175.8 c	33.17 a	4.732 bc	37.97 ab	6.813 b
25 × 15 (S_5)	84.43 a	6.883 b	16.18 b	137.3 d	31.26 b	4.812 abc	35.96 cd	6.832 b
30 × 15 (S_6)	82.87 a	7.033 b	17.17 a	116.7 e	33.18 a	4.832 abc	38.99 a	7.347 a
CV (%)	2.88	6.42	3.62	5.62	1.89%	5.51%	4.02%	5.04%
LSD (0.05)	2.79	0.53	0.68	11.99	0.7204	0.3190	1.754	0.4007
Level of significance	**	*	**	**	**	*	**	**

^{NS} Not significant; * Significant at 5% level; ** Significant at 1% level

Appendix IX. Effect of spacing on umbel circumference (cm), seed yield/plant (g), number of seeds/plant, stover yield/plot, 1000 seed wt., seed yield (t/ha), stover yield (t/ha).

Spacing	Umbel circumference (cm)	Seed yield plant $^{-1}$ (g)	Seed yield plot^{-1} (g)	Number of Seeds plant^{-1}	Stover yield plot^{-1}	1000 seed wt.	Seed yield (tha^{-1})	Stover yield (tha^{-1})
20 × 10 (S_1)	20.88	9.468 c	1050.0 ab	944.2 bc	775.0 a	9.050 d	1.944 ab	1.435 a
25 × 10 (S_2)	20.91	9.478 c	1045.0 ab	926.5 bc	730.0 ab	9.050 d	1.935 ab	1.352 ab
30 × 10 (S_3)	22.06	11.03 b	1083.3 a	987.5 ab	686.7 bc	9.833 c	2.006 a	1.272 bc
20 × 15 (S_4)	21.83	9.963 c	1075.0 ab	981.3 abc	678.3 bc	9.700 c	1.991 ab	1.256 bc
25 × 15 (S_5)	22.17	11.55 b	1013.3 bc	1020.8 a	676.7 bc	10.33 b	1.877 bc	1.253 bc
30 × 15 (S_6)	22.06	12.79 a	975.0 c	909.2 c	641.7 c	11.03 a	1.806 c	1.188 c
CV (%)	8.02%	7.49%	5.37%	6.44%	7.06%	2.15%	5.37%	7.06%
LSD (0.05)	2.079	0.9609	66.89	74.11	58.98	0.2540	0.1256	0.1071
Level of significance	ns	**	*	*	**	**	*	**

^{NS} Not significant; * Significant at 5% level; ** Significant at 1% level

Appendix IX . List of Plate

Plate 1: Panoramic view of experimental plot

Plate 2: Flowers of Coriander

Plate 3: Umbels of Coriander