EFFECT OF NYLON NET, KAOLIN AND 4-CPA ON GROWTH AND YIELD OF BELL PEPPER (*Capsicum annuum*)

ASHRAFUNNESSA

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

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BY

ASHRAFUNNESSA
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APPROVED BY:

……..	……..
Dr. Mohammad Humayun Kabir	**Dr. Tahmina Mostarin**
Associate Professor	Associate Professor
Department of Horticulture	Department of Horticulture
Sher-e-Bangla Agricultural University	Sher-e-Bangla Agricultural University
Supervisor	**Co-Supervisor**

……..
Dr. Tahmina Mostarin
Chairman
Examination Committee

Department of Horticulture

Sher-e-Bangla Agricultural University
Sher-e -Bangla Nagar, Dhaka-1207

Memo No:SAU/HORT/.....

CERTIFICATE

This is to certify that the thesis entitled **"Effect of Nylon Net, Kaolin and 4-CPA on Growth and Yield of Bell Pepper (*Capsicum annuum*)"** submitted to the Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in Horticulture**, embodies the result of a piece of *bona fide* research work carried out by **Ashrafunnessa**, Registration No. **10-04069** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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Date: December, 2015
Dhaka, Bangladesh

Dr. Mohammad Humayun Kabir
Associate Professor
Department of Horticulture
Sher-e-Bangla Agricultural University
Dhaka-1207
Supervisor

DEDICATED
TO
MY BELOVED PARENTS

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The Author

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ABSTRACT

An experiment was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh to determine the response of nylon net, kaolin and plant growth regulator 4-CPA on growth and yield of capsicum. The experiment consisted of two factors: Factor A: Use of nylon net and kaolin as P_0: Open Condition (control); P_1: Kaolin Spray; P_2: Nylon net condition; P_3: Use of nylon net + kaolin and Factor B: Application of 4-CPA as H_0: Control (water spray), H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm. Two factorial experiments were laid out in a Randomized Complete Block Design with four replications. In case of nylon net and kaolin, the maximum yield (48.06 t/ha) was attained from P_3, while the minimum yield (18.58 t/ha) from P_0. For plant growth regulator 4-CPA, the highest yield (34.80 t/ha) was recorded from H_1, whereas the lowest (29.20 t/ha) from H_0. Due to the interaction effect of nylon net, kaolin and 4-CPA, the highest yield (50.55 t/ha) was found from P_3H_1, while the lowest yield (16.89 t/ha) from P_0H_0. So, combination with nylon net, kaolin and 4-CPA was found best for growth and yield of bell pepper.

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CHAPTER I

INTRODUCTION

Bell pepper (*Capsicum annuum*) is a flowering plant under the genus Capsicum and belongs to the family Solanaceae. In Bangladesh it is commonly known as capsicum. It is relatively non-pungent with thick flesh and is the world's second most important vegetable after tomato (AVRDC, 1989). Tropical South America, especially Brazil is thought to be the original home of pepper (Shoemaker and Teskey, 1995). It is now widely cultivated in Central and South America, Peru, Bolivia, Costa Rica, Mexico, in almost all the European countries, Honkong and India. Most of the peppers cultivated in temperate and tropical areas belong to the botanical spices *Capsicum annuum*, thought to originate in Mexico and Central America. Economically it is the second most important vegetable crop in Bulgaria and is thought to be the original home of pepper (Panajotov, 1998). Small scale cultivation is found in peri-urban areas primarily for the supply to some city markets in Bangladesh (Saha, 2001).

Bell pepper is considered a minor vegetable crop in Bangladesh (Hasanuzzaman, 1999). The popularity of sweet pepper is increasing day by day in Bangladesh especially among the urban people because of its high nutritive value and possible diversified use in making different palatable foods. It is rich in capsaicin and has powerful antioxidant properties that may help works against inflammation. Bell pepper has different colors-range from green to yellow, red, orange, purple, and black. Other bell peppers include the red, heart-shaped; the pale green, slender and curved bull's horn which range in color from yellow to red and sweet banana pepper which is yellow and banana shaped (Teshm Tadesse Michael *et al*., 1999). Bell pepper is chosen because of its higher nutritive value and generally it contains 1.29 mg protein, 11 mg calcium, 870 I.U. vitamin A, 17.5 mg ascorbic acid, 0.6 mg thiamin, 0.03 mg riboflavin and 0.55 mg niacin per 100 g of edible fruit (Joshi and Singh, 1975).

The species *annuum* includes eleven groups which can be divided into two sub group sweet and hot peppers. The genus *Bell pepper* contains about 20 species and now five domesticated species *Capsicum annuum*, *C. frutescens*, *C. chinense*, *C. baccatum*, *C. pubescens* are only recognized. Within *C. annuum*, a tremendous range in size, shape and mature color of fruits has been selected that now forms the basis for the types used in commerce throughout the world. All these species of bell pepper have many cultivated varieties suited to different agro-climatic conditions.

Large scale production of bell pepper is limited in Bangladesh due to some problems in the production system and lack of familiarities to the growers. Bell pepper production has some constraints which include flower dropping, poor fruit set, and susceptibility to viral diseases and it is a serious concern for the successful introduction of this crop. However, growth regulators may be effective to reduce dropping of bell pepper and may increase fruit number, fruit size and fruit weight.

Plant growth regulators are organic compounds which modify the physiological process of plant. It plays an essential role in many aspects of plant growth and development, stem elongation and flower development (Chaudhary *et al*., 2006; Ouzounidou *et al*., 2008). It affects primarily on vegetative growth, influences the fruit, and may induce modifications in vegetative and fruiting parts (Leclerc *et al*., 2006).

4-chlorophenoxyacetic acid (4-CPA) is one of the plant growth regulators which increases fruit set (Sasaki *et al* 2005). 4-Chlorophenoxyacetic acid (4-CPA) is a synthetic pesticide similar to chemicals in a group of plant hormones called auxins. Plants treated with 4-CPA (Sasaki *et al*., 2005) showed increased fruit set and proportion of normal fruits. 4-chlorophenoxyacetic acid (4-CPA) is widely used to increase fruit set (Karakurt, 2000). Nutritive content enriched with the application of PGR, especially 4-CPA (Gupta *et al*., 1999).

Bell peppers are cultivated in greenhouse or net house in different country. In Bangladesh bell peppers are cultivated in open condition. This crop is susceptible to many pests and diseases, so open field cultivation gives fewer yields than net house condition. Net protect plant from insect infestation and dissemination of viral disease. So, farmer use net to protect plant from pest and disease to cultivate bell pepper. Use of net in open field gives many higher yields than open cultivation. But use of net is cost effective method in Bangladesh.

Kaolin is a non- abrasive, non-toxic aluminosilicate ($Al_4Si_4O_{10}(OH)_8$) clay mineral was found to decrease leaf temperature (Nakano and Uhera, 1996). At the same time, it forms a barrier coating on crops that acts as a physical barrier between pest and its host plant (Engelhard Surround® WP Crop Protestant product label; Kerns and Wright, 2001; Glenn and Puterka, 2005).

Leaf coating with white kaolin mineral reduces foliar diseases (Ziv and Frederiksen, 1986; Glenn *et al*., 1999; Kamp, 1985; Schon, 1993; Han, 1990) and suppresses insect pests including vectors of plant viruses (Cottrell *et al*., 2002; Liang and Lui, 2002; Marco, 1993; Puterka, *et al*., 2000; Showler 2002). Kaolin easily disperses in water and is chemically inert over a wide pH range (Glenn *et al*., 1999). Kaolin particles can be coated with chrome complexes, stearic acid, organo-silicone oil or plant and mineral materials to become hydrophobic (Puterka *et al*., 2000). Hydrophobic and hydrophilic formulations of kaolin-based particle films, applied as liquid suspensions, have shown to prevent arthropod infestations or disease infections.

After being sprayed on the plant surface, kaolin based particle films create a powdery film, which serves as a physical barrier repelling arthropods and/or suppressing infestations by making the plant visually or tactually unrecognizable as a host. Furthermore, it hampers insect movement, feeding and other physical activities (Glenn *et al*., 1999). Such technology has

effectively suppressed plant diseases and several plant-feeding and virus-vector arthropods such as *Bemisia* on melon (Liang and Liu, 2002); *Circulifer tenellus* on chili pepper (Creamer *et al*., 2005); *Aphis spireacola Patch*, *Cacopsylla pyricola Foerster, Tetranychus urticae Koch* and *Empoasca fabae* in pear and apple (Glenn *et al*., 1999); *Cydia pomonella* in apple and pear (Unruh *et al*., 2000); and *Anthonomus grandis* in cotton (Liang and Liu, 2002).

In addition to the potential of kaolin-based particle films in IPM, such technology has also provided some physiological benefits to apple and pear orchards (Thomas *et al*., 2004) and significantly reduced virus incidence on chili pepper (Creamer *et al*., 2005). Studies conducted on soybean, cotton, artichoke, melons and peach have shown that foliar applications of kaolin particle films reduce plant stress, which is important for optimum plant growth, yield and quality (Creamer *et al*., 2005). The nature of the film does not seem to affect plant photosynthesis or productivity (Glenn *et al*., 1999). Although kaolin-based products are reportedly efficient against thrips (Puterka *et al*., 2000).

The experiment may inspire the growers to cultivate capsicum commercially as well as to improve health and economic status of peoples of Bangladesh. Our initiative was to use some elements such as plant growth regulator 4-CPA, plant protector nylon net and kaolin by which we can improve the yield and quality by regulating or reducing the adverse effect of viral disease and increased fruit setting of the bell pepper plant.

However, considering the above circumstances, the present study was undertaken with the following objectives:

1. To evaluate the effect of 4-CPA on some quality and quantity characteristics of Bell pepper.

2. To evaluate the effect of nylon net and kaolin based particle film on growth and yield of bell pepper.

3. To determine the growth and yield of bell pepper with combined application of kaolin, nylon net and 4-CPA.

CHAPTER II

REVIEW OF LITERATURE

Bell pepper is considered a minor vegetable crop in Bangladesh and its popularity is increasing day by day among the urban people because of its high nutritive value and possible diversified use in making different palatable foods. Due to some advantages, bell pepper cultivation in Bangladesh is becoming more popular and total yearly production is increasing gradually. Although the farmers of Bangladesh are not knowledgeable regarding the procedures of increasing fruit setting, fruit size, individual fruit weight as well as yield. A very few research works related to bell pepper cultivation emphasis on use of nylon net, kaolin spray and plant growth regulator 4-CPA have been carried out in Bangladesh. Nevertheless, some of the important and informative works regarding the use of nylon net, kaolin spray and 4-CPA spray so far been done at home and abroad of this crop have been reviewed below under the following headings-

2.1 Review in Relation to the Plant Growth Regulator (4-CPA)

Baliyan *et al*. (2013) was conducted an experiment to know the effects of different concentrations of 4-chlorophenoxyacetic acid (4-CPA) plant growth regulator on fruit set, yield and economic benefit of capsicum (*Lycopersicon esculentum*) growing in high temperatures in Botswana (Southern Africa). In a field experiment laid under complete randomized block design, Capsicum flowers were treated with four different concentrations of 00 ppm (control), 15ppm, 45ppm and 75ppm of 4-CPA growth regulator. Data collected involved number of fruit set, weight of small capsicums, weight of cracked capsicums, weight of cat face capsicums, weight of rotten capsicums, weight of pest damaged and marketable capsicums. A two way analysis of variance (ANOVA) was performed using the SPSS software ver.19 to analyze the data.

The application of 4-CPA hormone indicated a positive and significant effect on the fruit set and yields of capsicum. A positive relationship between the hormone concentration and the fruit set as well as total yield of capsicum was also established (higher the concentration, higher the fruit set and capsicum yield). The 75 ppm concentration of 4-CPA resulted not only the highest increase in fruit set but also increased the tomato yield and hence economic benefit in capsicum production increased. It was concluded that use of 4-CPA hormone increased the fruit set, yield and economic benefit of summer capsicum production. Suggested future research can be conducted to observe the effect of higher concentration of the 4-CPA hormone on fruit set, yield and fruit quality of capsicum.

Choudhury *et al*. (2013) was carried out an investigation to assess the effect of different PGRs on tomato during summer season at Horticulture Farm of Sher-e-Bangla Agriculture University, Dhaka-1207. They have exposed the plant in plant growth regulators (PGR) viz. PGR0 = Control, PGR1= 4-CPA (4-chloro-phenoxy acetic acid) @ 20 ppm, PGR2 = GA3 (gibberellic Acid) @ 20 ppm and PGR3= 4-CPA + GA3 @20 ppm through foliar application. They have concluded that the growth and yield contributing characters of tomato plants were significantly differed due to different plant growth regulators. They have found the maximum plant height at 60 DAT, number of flowers cluster per plant, number of flowers per plant, number of fruits per plant, maximum individual fruit weight and maximum yield in the treatment PGR3, and the minimum for all parameters were found in control (PGR0) treatment.

Sasaki *et al. (*2005) was conducted a field experiment on reduction of high temperature inhibition in tomato fruit set by plant growth regulators. They examined the effect of plant growth regulators on fruit set of tomato (*Lycopersicon esculentu*m Mill.) under high temperature and in a controlled environment in the field under rain shelter. Tomato plants exposed to high temperature ($34/20^0$C) had reduced fruit set. Treatments of plant growth

regulators reduced the fruit set inhibition by high temperature to some extent, especially treatment with mixture of 4-chlorophenoxy acetic acid (4-CPA) and gibberellins (Gas). They have found, in the field experiment, tomato treated with a mixture of 4-CPA and Gas showed increased fruit set and the number of normal fruits (excluding abnormal types such as puffy fruit) were more than the plants treated with 4-CPA alone during summer.

Bhosle *et al.* (2002) was carried out an investigation to know the effects of NAA (25, 50 and 75 ppm), gibberellic acid (15, 30 and 45 ppm) and 4-CPA (25, 50 and 75 ppm) on the growth and yield of tomato cultivars Dhanashree and Rajashree through the field experiment conducted in Rahuri, Maharashtra, India during the summer of 1997. They have concluded that the number of flowers per cluster, fruit weight and marketable yield increased with increasing rates of the plant growth regulators. Treatment with 30 ppm gibberellic acid resulted in the tallest plants, whereas treatment with 25 ppm 4-CPA and 45 ppm gibberellic acid resulted in the highest number of primary branches of Dhanashree (4.16) and Rajashree (5.38) respectively. The highest marketable yield of Dhanashree and Rajashree resulted from treatment with 75 ppm 4-CPA.

Karakurt (2000) was studied on foliar application of 4-CPA in capsicum hybrids under greenhouse conditions with pruning of some flowers in the inflorescence. He has concluded that foliar application of 4-CPA and pruning had positive effects on crop yield, development and maturation.

Gupta *et al.* (1999) was conducted a field experiment in Allahabad, Bangalore, Karnataka, India to investigate the effect of the plant growth regulators (PGRs) IAA and NAA (25 and 75 ppm), and of the micronutrient mixtures Multiplex (2500 ppm) [Ca, Mg, S, Fe, Zn, Mo, Mn, B and NAA] and Humaur (2000 ppm) on the nutritive value of capsicum (cv. Krishna) fruits. PGRs were applied at 25 and 75 days after transplanting (DAT). Treatment with

micronutrient mixtures was conducted at 25 and 75 DAT. Higher nutritive content was obtained with the application of both PGRs and micronutrient mixtures than treatment with either PGR or micronutrient mixture. NAA at 75 ppm+Multiplex increased P content by 16.12% and iron content by 23.33%. The application of 75 ppm NAA+Humaur increased K content by 23.80% and Ca concentration by 52.38%. The Mg content increased by 43.84% due to the application of 25 ppm NAA+Humaur.

Cgsar *et al.* (1995) was carried out a study in Antalya, Turkey, to determine the effect of vibration and 4-CPA (5, 10, 15, 20 and 40 ppm, applied 1-3 times to all clusters on fruit set of tomatoes in grown in an unheated greenhouse. Harvested fruits were screened for 4-CPA residues. Fruits harvested from plants treated with 10, 20 and 40 ppm 4-CPA applied twice did not have 4-CPA residues. Vibration promoted fruit set during the autumn and spring seasons, but had no effect on fruit set between December and March, necessitating the use of 4-CPA at this time to promote fruit set.

Randolph *et al.* (1959) was conducted a field experiment on the effect of fruit-setting plant hormones and nitrogen level in relation to quality and storage life of tomatoes studied. The field plots were in commercial fields and consisted of replicated blocks in split-plot design. Plants were grown with two or more levels of nitrogen as ammonium sulphate applied usually in three side-dressed applications prior to and during the period when hormones were applied. Each nitrogen level was split into two plots, one untreated. The treated plot received hormone sprays, usually three replications of 50 ppm (parts per million) of 4-CPA spaced at 10-days to two week intervals. They have concluded that application of 4-CPA resulted in significant increase in both pointed and puffy fruit, as well as increase in early yield.

A study was conducted by Ouzounidou *et al*. (2010) at the Institute of Food Technology, National Agricultural Research Foundation, Lycovrissi, Greece to

study the pre- and post-harvest physiology and quality responses of green pepper (*Capsicum annuum* L. cv 'Standar p.13/0211003-01-Agris') on exogenous Gibberellic acid-GA3 (100 μM), Prohexadione-Calcium (100 mg l-1), Cycocel (100 mg l-1) ,Ethephon (100 mg l-1) and 4-CPA (4 ppm) applied as foliar sprays, were investigated. Among PGRs, 4-CPA was effective in promoting flowering and better for vegetative characteristics.

Investigations were carried out by Kannan *et al*. (2009) to study the effect of different growth regulators in paprika (*Capsicum annuum* var. longum) cv. KtPl-19 at Coconut nursery garden, Tamil Nadu Agricultural University, Coimbatore. The experiment was conducted in randomized block design with three replications. The growth regulators treated consist of Mepiquat chloride (50 and 100 ppm), 2, 4-D (5 and 10 ppm), NAA (25 and 50 ppm), GA3 (25 and 50 ppm) and Nitro benzene (0.1 and 0.2%). The treatment NAA at 50 ppm recorded the greatest fresh fruit yield per plot (6.82 and 5.98 kg) and estimated yield per hectare (12.89 and 12.28 t) during winter and summer respectively.

A field study was carried out by Hasanuzzaman *et al*. (2007) at the Horticulture Research Centre Farm, Bangladesh Agricultural Research Institute, Jopdebpur, Gazipur to determine the performance of different bell pepper (*Capsicum annuum* L.) genotypes in response to synthetic hormones. Ten genotypes and two synthetic hormones Milstim and Litosen along with control (fresh water) were used as treatments in this study. It was found that, due to hormonal treatments significant variation exists among the genotypes in respect of morphological characters, physiological parameters, fruit yield and seeds per fruit.

An investigation was carried out by Chaudhary *et al*. (2006) in the plain areas of Chitwan to determine the promising plant growth regulators (PGR) promoting growth and yield of chilli cultivars Jwala and Suryamukhi. Suryamukhi ranked superior to Jwala for most of the yield attributing

characters, whereas Jwala was better in vegetative characters than Suryamukhi. Among PGRs, 2,4-D at 2 ppm was better for fruit set, number of fruits per plant, fruit length, number of seeds per fruit, seed weight per fruits, 1000 seed weight and fruit yield where as NAA at 40 ppm gave the highest leaf area index (LAI). PGRs were ineffective in promoting flowering and fruiting during winter season. GA3 at 10 ppm exhibited maximum amount of ascorbic acid content. The treatments, 2 ppm 2,4-D, 5 ppm triacontanol, 40 ppm NAA and 10 ppm GA3 produced 28.75%, 25.70%, 13.61% and 2.30% higher fruit yield over control, respectively. The highest net profit and B:C ratio were recorded in case of 2 ppm 2,4-D. The use of GA3 as foliar spray was not economical.

Genotype CP0039 plants treated Milstim and Litosen produced 20 and 18 fruits per plant resulting 20.37 t ha-1 and 19.93 t ha-1 yield, respectively. Lowest fruit bearing (4 fruits/ plant) and yield (4.14 t ha-1) were recorded in control plants of CP0068. Both Milstim and Litosen treated plants performed better than control plants regarding fruit bearing and yield.

2.2 Review in Relation to Use of Nylon Net and Kaolin Spray

In Bangladesh, farmers usually use net in field to protect bell pepper plants from pest and different viral diseases. Use of net in open field gives higher yields than open cultivation.

Creamer *et al*. (2005) was carried out a field experiment to know the effect of kaolin film particle application on Beet Curly Top Virus and physiological parameters of chile pepper (*Capsicum annuum* L.) in southern New Mexico. There were two treatments for this work, kaolin-treated and untreated. Beginning at the 6–8 leaf stage, plants were treated with a 3% kaolin suspension (Surround WP, Engelhard, Iselin, NJ) until thoroughly wetted using hand-held pump-action sprayers that were agitated constantly. Curly top incidence was significantly lower in kaolin-treated chile blocks than untreated blocks. Peppers treated with the kaolin-reflectant showed significantly less

water stress and higher photochemical reflectance than untreated plants during active growth periods. Treated plants had significantly higher levels of Chlorophyll–A and higher reflectance than untreated plants.

However, yield taken was only from plants without BCTV-infection. Likely total yield from all plants in a treatment would have been significantly better in treated blocks compared to untreated, since curly top infected plants produce no marketable pods, leading to complete yield loss in infected plants. These results suggest that kaolin treatments would be useful in New Mexico chile production in years with moderate disease pressure.

An another Research was conducted by Bennett (1971) in a certified organic apple (*Malus x domestica* Borkh.) orchard to determine the effect of organic pest management techniques on pest control, apple yields and microbial populations on harvested apples. In the Experiment, apple colouring bags, sticky red spheres, kaolin particle film, kaolin particle film plus sticky red spheres, or colouring bags plus sticky red spheres were applied to Redfree, Jonafree, and Liberty apple trees in a split-plot design. Insects and diseases were sampled in the control and kaolin particle film treatments.

Apple yields and insect damage ratings at harvest were determined for all treatments. There was a significant treatment x cultivar interaction related to insect damage on apples. Insect and disease damage ratings throughout the growing season and at harvest were lowest in Jonafree trees treated with kaolin particle film or colouring bags. There was no effect of treatment on beneficial insects during the growing season.

A Laboratory studies were conducted by Jifon and Syvertsen (2003) to evaluate the effects of a kaolin-based particle film on biological characteristics of the onion thrips, Thrips tabaci Lindeman on onions. Oviposition rate was significantly reduced on kaolin-treated vs. water-treated onion leaves and

plants, in choice and no-choice assays. Hatch rate was reduced when kaolin particle film was applied over eggs on onion leaves.

The time required for development of larval stages was significantly increased and mortality was significantly higher on kaolin than on water-treated onion leaves. Feeding choice was influenced by the presence of the kaolin treatment and in choice assays both larvae and adults fed significantly less on kaolin-treated than on water-treated leaves. In a field study, significantly more adults were captured in the beginning of the season on control than on kaolin-treated plots, and at population peaks significantly more larvae and adults were harbored in control plots. The results indicate the potential of kaolin particle film against onion thrips in an integrated pest management program.

Studies were conducted by Tworkoshi *et al*. (2002) to evaluate the effect of processed kaolin-based particle film applications on the incidence and severity of apple diseases. Greenhouse and field studies demonstrated that pre-emptive application of kaolin particles reduced the incidence of fire blight (Wiinsche *et al*., 2004) in blossoms and injured shoots. Kaolin based particles film suppressed sooty blotch and flyspeck to levels equivalent to conventional fungicides. Kaolin did reduce powdery mildew russetting on fruit.

From the discussion of above reviewed literature it is revealed that nylon net and kaolin itself and growth regulator 4-CPA have significant effect on growth, yield contributing characters and yield of bell pepper.

CHAPTER III

MATERIALS AND METHODS

The experiment was conducted during the period from October 2015 to March 2016 to study the response of capsicum on nylon net, kaolin and plant growth regulator 4-CPA. This chapter includes a brief description of the location of experimental site, soil and climate condition, materials used for the experiment, design of the experiment, intercultural operations, data collection procedure and procedure of data analysis that were used for conducting the experiment**.**

3.1 Experimental site

The experiment was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka, Bangladesh. The experiment was carried out during rabi season. The location of the study site is situated in 23074/N latitude and 90035/E longitude (Anon., 1989). The altitude of the location is 8 m from the sea level (The Meteorological Department of Bangladesh, Agargaon, Dhaka).

3.2 Characteristics of soil

The soil of the experimental area belongs to the Modhupur Tract (UNDP, 1988) under AEZ No. 28. The selected plot was medium high land and the soil series was Tejgaon (FAO, 1988). The characteristics of the soil under the experimental plot were analyzed in the Soil Testing Laboratory, SRDI Farmgate, Dhaka and details soil characteristics are presented in Appendix I.

3.3 Climatic condition of the experimental site

The experimental site was under the subtropical climate, characterized by three distinct seasons, winter season from November to February and the pre-monsoon or hot season from March to April and the monsoon period from May

to October (Edris *et al*., 1979). Details of the meteorological data during the period of the experiment was collected from the Bangladesh Meteorological Department, Agargoan, Dhaka and presented in Appendix II.

3.4 Planting materials

One hybrid bell pepper variety 'Siam' was used as experimental materials. The seeds were collected from Manik Seed Company, 145, Siddique bazar, Dhaka-1000.

3.5 Treatment of the experiment

The experiment consisted of two factors:

Factor A: Use of nylon net and kaolin

i. P_0: Open condition (control)

ii. P_1: Kaolin spray ("Aluminosilicate" $Al_4Si_4O_{10}(OH)_8$) @ 4% solution

iii. P_2: Nylon net condition

iv. P_3: Use of nylon net+kaolin ("Aluminosilicate" $Al_4Si_4O_{10}(OH)_8$) @ 4% solution

Factor B: Plant growth regulator (4-CPA) as

i. H_0: Control (spraying only water)

ii. H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm (according to previous research report)

There were 8 (2 × 4) treatment combinations such as P_0H_0, P_1H_0, P_2H_0, P_3H_0, P_0H_1, P_1H_1, P_2H_1, P_3H_1.

According to manufactures recommendation and previous research report Kaolin@4% solution and 4-CPA was used as 4 ml/L of water and then converted into ppm.

3.6 Design and layout of the experiment

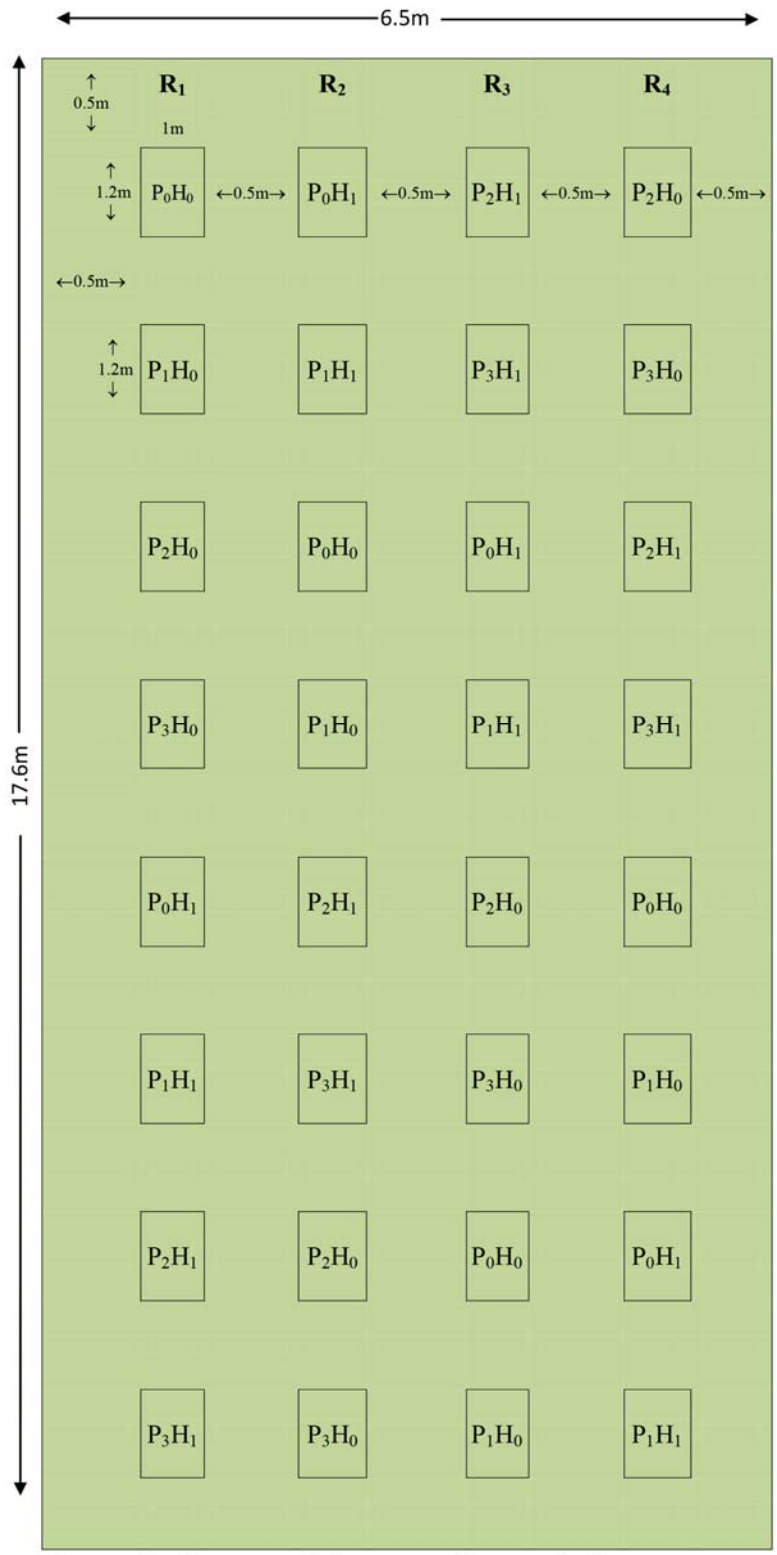
The two factors experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The total area of the experimental plot was 114.4 m^2 with length 17.6 m and width 6.5 m which was divided into four equal blocks. Each block was divided into 8 plots where 8 treatments combination were allotted at random. There were 32 unit plots altogether in the experiment. The size of the each plot was 1.2 m × 1 m. The distance maintained between two blocks and two plots were 0.5 m. Seeds were transplanted in the plot with maintaining distance between row to row and plant to plant was 50 cm and 30 cm, respectively. The layout of the experiment is shown in Figure 1.

3.7 Seedbed preparation

Seedbed was prepared on 1 October 2012 for raising seedlings of capsicum and the size of the seedbed was 3m × 1m. For making seedbed, the soil was well ploughed. Weeds, stubbles and dead roots were removed from the seedbed. Cowdung was applied to the prepared seedbed @ 10 t/ha. The soil was treated by Sevin 50WP @ 5 kg/ha to protect the young plants from the attack of ants and cutworms. Seeds were treated by Vitavex-200 @ 5g/1kg seeds to protect some seed borne diseases such as leaf spot, blight, anthracnose etc.

3.8 Seed sowing

Seeds were sown on 10 October, 2012 in the seedbed. Sowing was done in lines spaced at 5 cm distance. Seeds were sown at a depth of 2 cm and covered with a fine layer of soil followed by light watering by watering can. Thereafter, the beds were covered with polythene to maintain required temperature and moisture.



Plot size= 1.2mx1m=1.2m^2

Plant to plant distance= 30cm

Row to row distance= 50cm

Between block= 1m

Length= 17.6m

Width= 6.5m

Total area= 114.4m^2

Factor A:
Use of nylon net and kaolin
i. P_0: Open Condition (control)
ii. P_1: Kaolin Spray
iii. P_2: Nylon net use
iv. P_3: Use of Nylon net+ Kaolin

Factor B:
Plant growth regulators (4-CPA) as
i. H_0: Control (spraying only water)
ii. H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm

Figure 1. Layout of the experimental plot.

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3.9 Raising of seedlings

Light watering and weeding were done several times as per needed. No chemical fertilizers were applied for raising of seedlings. Seedlings were not attacked by any kind of insect or disease. Healthy and 30 days old seedlings were transplanted into the experimental field on 10 November 2012.

3.10 Preparation of the main field

The plot selected for conducting the experiment was opened in the first week of November 2012, with a power tiller and left exposed to the sun for a week to kill soil born pathogens and soil inhabitant insects. After one week the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain until good tilth. The land was leveled, corners were shaped and the clods were broken into pieces. Weeds, crop residues and stables were removed from the field. The basal dose of manure and fertilizers were applied at the finally ploughing. The plots were prepared according to design and layout of the experiment. The soil of the plot was treated by Sevin 50WP @ 5 kg/ha to protect the young plants from the attack of ants and cutworm.

3.11 Application of manure and fertilizers

The fertilizers N, P, K, S and Zn in the form of urea, TSP, MoP, gypsum and zinc oxide respectively were applied. Half of the quantity of cowdung was applied during final land preparation. The remaining half of cowdung, the entire amount of TSP, gypsum, zinc oxide and one third of urea and MoP were applied during pit preparation. Urea and MoP were applied in two equal installments at before flowering and fruit setting. The dose and method of application of fertilizer are shown in Table 1.

Table 1. Dose and method of application of fertilizers in capsicum field

Manure and Fertilizers		Dose (ha)		Application (%)	
Final land preparation		Installments			
Pit preparation		Before flowering		Fruiting stage	
Cowdung	10 ton	50.00	50.00	--	--
Urea	250 kg	--	33.33	33.33	33.33
TSP	330 kg	--	100.00	--	--
MoP	250 kg	--	33.33	33.33	33.33
Gypsum	110 kg	--	100.00	--	--
Zinc	5 kg	--	100.00	--	--

Source: Krishi Projukti Hatboi, BARI, 2011

3.12 Transplanting

Healthy and uniform bell pepper seedlings of 30 days old seedlings with 5-6 leaves were transplanting in the experimental plots on 16 November, 2015. The seedlings were uprooted carefully from the seed bed to avoid damage to the root system. To minimize the damage to the roots of seedlings, the seedbeds were watered one hour before uprooting the seedlings. Transplanting was done in the afternoon. The seedlings were watered immediately after transplanting. Seedlings were transplanted in the plot with maintaining distance between row to row and plant to plant was 50 cm and 30 cm respectively and total 6 plants were accommodated in each plot. The young transplants were shaded by banana leaf sheath during day time to protect them from scorching sunshine up to 7 days until they were set in the soil. Those (transplants) were kept open at night to allow them receiving dew. A number of seedlings were also planted in the border of the experimental plots for gap filling.

3.13 Intercultural operations

After raising seedlings, various intercultural operations, such as gap filling, weeding, earthing up, irrigation, pest and disease control etc. were accomplished for better growth and development of the bell pepper seedlings.

3.13.1 Gap filling

The transplanted seedlings in the experimental plot were kept under careful observation. Very few seedlings were damaged after transplanting and such seedling were replaced by new seedlings from the same stock planted earlier on the border of the experimental plots. Those seedlings were transplanted with a big mass of soil with roots to minimize transplanting stock. Replacement was done with healthy seedling having a boll of earth. The transplants were given shading and watering for 7 days for their proper establishment.

3.13.2 Collection and application of chemicals

Plant growth regulator and kaolin were collected from Siddique bazar, Dhaka-1000 and applied as per treatment. 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm was applied at four times during vegetative stage, flower initiation stage and 2 times at blooming flowers and kaolin @ 4% solution was applied at ten days interval by a mini hand sprayer. Nets were collected from horticulture farm office of Sher-e-Bangla agricultural university.

3.13.3 Weeding

The hand weeding was done 15, 30, 45 and 60 days after transplanting to keep the plots free from weeds.

3.13.4 Earthing up

Earthing up was done at 20 and 40 days after transplanting on both sides of rows by taking the soil from the space between the rows by a small spade.

3.13.5 Irrigation

Light watering was given by a watering cane at every morning and afternoon. Following transplanting and it was continued for a week for rapid and well establishment of the transplanted seedlings.

3.14 Harvesting

Harvesting of fruits was started at 80 DAT and continued upto final harvest based on the marketable sized of fruits. Harvesting was done by hand picking.

3.15 Data collection

Three plants were randomly selected for data collection from the middle rows of each unit plot for avoiding border effect, except yields of fruits, which was recorded plot wise. Data were collected in respect of the following parameters to assess plant growth, yield attributes and yields.

3.15.1 Plant height (cm)

Plant height of bell pepper was measured from sample plants in centimeter from the ground level to the tip of the longest stem and mean value was calculated. Plant height was also recorded starting from 40 days after transplanting (DAT) up to 100 DAT at 20 days interval and at final harvest to observe the vegetative growth rate of plants.

3.15.2 Number of branches per plant

The total number of branches per plant was counted from each selected plant of bell pepper. Data were recorded as the average of 5 plants selected at random of each plot from 40 DAT to 100 DAT at 20 days interval and at final harvest.

3.15.3 Number of leaves per plant

The total number of leaves per plant was counted from each selected plant. Data were recorded as the average of 5 plants selected at random of each plot from 40 DAT to 100 DAT at 20 days interval and at final harvest.

3.15.4 Foliar coverege (cm)

Foliar coverage was measured with a meter scale. It was estimated at the point where the plan was highly covered the area by the expansion of leaves. It was measured at the day of final harvest.

3.15.5 Days from transplanting to 1st flowering

Difference between the dates of transplanting to the date of 1st flower emergence of a plot was counted and recorded.

3.15.6 Days from transplanting to 50% flowering

Difference between the dates of transplanting to the date of flowering of a plot was counted as days to 50% flowering. Days to 50% flowering was recorded when 50% flowers of a plot were at the flowering stage.

3.15.7 Number of flowers/ plant

The number of flowers per plant was counted from each plot after flowering and recorded per plant basis.

3.15.8 Days from transplanting to 1st harvest

Difference between the dates of transplanting to the 1st harvest of a plot was counted as days to 1st harvest. Days to 1st harvest was recorded when harvest of fruit was started.

3.15.9 Number of fruits/ plant

The number of fruits per plant was counted after setting of fruits and recorded per plant basis.

3.15.10 Fruit setting (%)

Fruit setting was calculated by using the following formula and recorded -

$$\% \text{ Fruit setting} = \frac{\text{Number of fruits per plant}}{\text{Number of flowers per plant}} \times 100$$

3.15.11 Individual fruit weight (g)

The weight of individual fruit was recorded in gram (g) by a beam balance from all fruits of selected three plants and converted individually.

3.15.12 Length of fruit (cm)

The length of individual fruit was measured in one side to another side of fruit from five selected fruits with a meter scale and average of individual fruit length recorded and expressed in centimeter (cm).

3.15.13 Diameter of fruit (cm)

The diameter of individual fruit was measured in several directions with meter scale and the average of all directions was finally recorded and expressed in centimeter (cm).

3.15.14 Pericarp thickness (cm)

The thickness of paricarp of individual fruit was measured in one side to another side of pericarp from five selected fruits with a meter scale and average of pericarp thickness recorded and expressed in centimeter (cm).

3.15.15 Plant dry weight (g)

After recording fresh weight, plants were placed in a 60^{o}C oven for approximately three days. After removing from oven plants were weighing and recorded in gram (g)

3.15.16 Plant fresh weight (g)

Plants were collected in labeled plastic bags and bring to the laboratory. Plant fresh weight were measured by electric balance and recorded in gram (g)

3.15.17 Chlorophyll content (%)

A leaf from each plant was collected and brings it to the laboratory. The leaf was collected considering a specific distance of plant from the base and the age of the leaf was same which estimated by visual observation. Chlorophyll content was estimated by using SPAD meter. The measured chlorophyll content was expressed as percentage (%). It was estimated for three times and makes an average as a final data.

3.15.18 Fruit yield/plant (g)

Fruit yield per plant was recorded in gram by a multiplying individual fruit weight and number of fruits/plant by a digital weight machine.

3.15.19 Fruit yield/plot (kg)

Yield of capsicum per plot was recorded as the whole fruit per plot and was expressed in kilogram.

3.15.20 Fruit yield/hectare (ton)

Yield per hectare of capsicum was calculated by converting the weight of plot yield into hectare and was expressed in ton.

3.16 Statistical analysis

The data obtained for different characters were statistically analyzed using MSTAT-C software. The significance of the difference among the treatments means was estimated by Least Significant Difference (LSD) Test at 5% level of probability (Gomez and Gomez, 1984).

CHAPTER IV

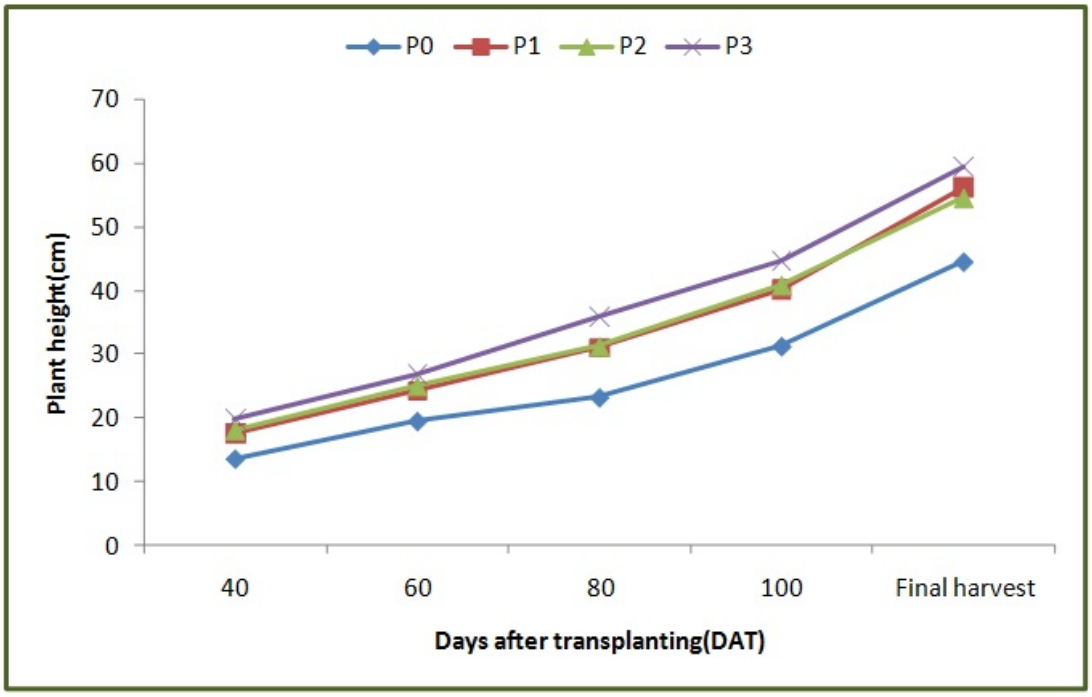
RESULTS AND DISCUSSION

The experiment was conducted to determine the response of capsicum on use of nylon net, kaolin and plant growth regulator 4-CPA. Data on growth, yield contributing characters and yields were recorded. Some of the data have been presented and expressed in table(s) and others in figures for case of discussion, comparison and understanding. A summary of the analysis of variance (ANOVA) of the data on different characters have been presented in Appendices. The results have been discussed and possible interpretations are given under the following headings:

4.1 Plant height

The plant height is one of the most important factors which affect the growth and yield of bell pepper. It depends on several factors like genetic makeup, nutrient availability and application of plant growth regulators (PGR), climate, soil etc. Among those plant protection measures and PGR application are the important factors for desirable plant height.

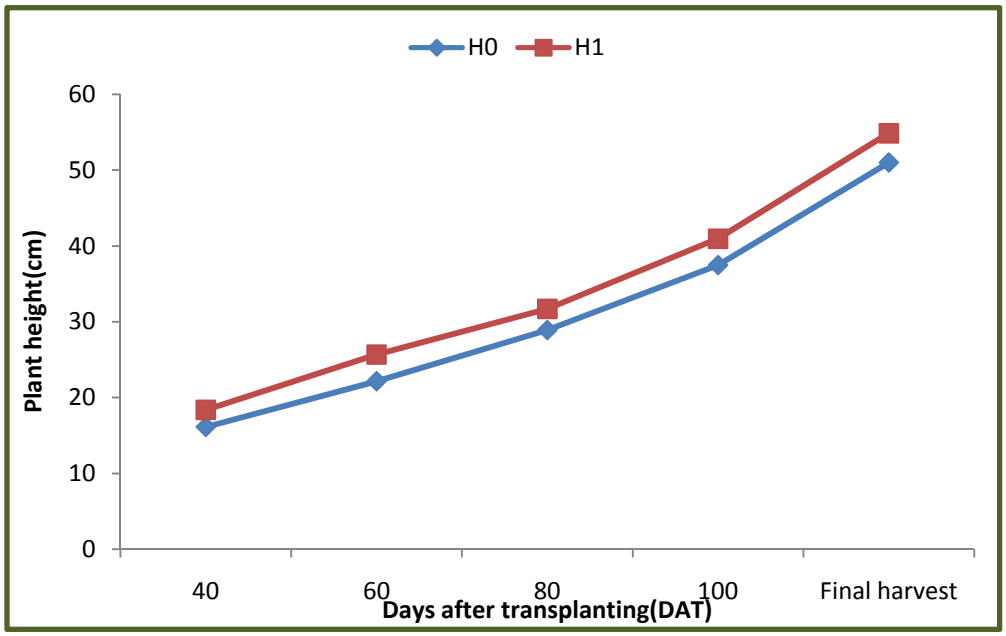
The trend of the plant height at different days after transplanting (DAT) has been shown (Appendix III). A marked variation in plant height was observed due to the influence of open Condition (P_0), kaolin Spray (P_1), nylon net condition (P_2) and use of nylon net+kaolin (P_3) and statistically it was highly significant at 40, 60, 80, 100 DAT and at the final harvest. The highest plant height (59.45 cm) was recorded with use of nylon net+kaolin (P_3) treatment whereas the shortest plant height (44.56 cm) was recorded open condition (P_0) treatment at final harvest (Figure 2).



[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+kaolin]

Figure 2: Effect of nylon net and kaolin on plant height at different DAT.

Plant height was significantly affected by plant growth regulator (4-CPA) treatments which have been shown (Appendix III). Plant height of capsicum varied significantly for different treatments which were control (H_0) and 4-Chloro Phenoxy Acetic Acid (H_1) at 40, 60, 80, 100 DAT and at final harvest (Figure 3). The tallest plant (54.88 cm) was marked from 4-Chloro Phenoxy Acetic Acid (H_1) treated plants whereas the shortest plant (51.02 cm) was scored from control (H_0) treated plants at final harvest.



[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Figure 3: Effect of foliar application of 4-CPA on plant height at different DAT.

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of plant height of capsicum at 40, 60, 80, 100 DAT and final harvest (Appendix III). The tallest plant (21.73, 29.08, 37.23, 46.55 and 61.17cm) was observed from P_3H_1 at 40, 60, 80, 100 DAT and at final harvest respectively. On the other hand, the shortest plant (12.78, 19.31, 22.59, 29.69, and 43.11 cm) was recorded from P_0H_0 at 40, 60, 80, 100 DAT and at final harvest respectively (Table 2). Hasanuzzaman *et al*. (2007) reported that, due to hormonal treatments significant variation exists among the capsicum in respect of morphological characters.

Table 2: Interaction effect of nylon net, kaolin and 4-CPA on plant height at different DAT.

Treatments	Plant Height (cm)				
	40 DAT	60 DAT	80 DAT	100 DAT	At final harvest
P_0H_0	12.78 f	19.31 e	22.59 e	29.69 f	43.11 g
P_0H_1	14.18 e	19.52 e	23.71 e	32.75 e	46.01 f
P_1H_0	16.48 d	21.82 d	29.14 d	37.94 d	50.63 e
P_1H_1	18.73 b	26.78 bc	32.88 c	42.37 b	55.75 c
P_2H_0	17.16 cd	22.56 d	29.42 d	39.52 c	52.62 d
P_2H_1	18.82 b	27.34 ab	32.94 c	42.17 b	56.60 c
P_3H_0	18.06 bc	24.91 c	34.49 b	42.77 b	57.74 b
P_3H_1	21.73 a	29.08 a	37.23 a	46.55 a	61.17 a
CV (%)	9.01	5.93	4.52	4.88	4.76
LSD (0.05)	1.12	2.06	1.28	0.94	0.86
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability					

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

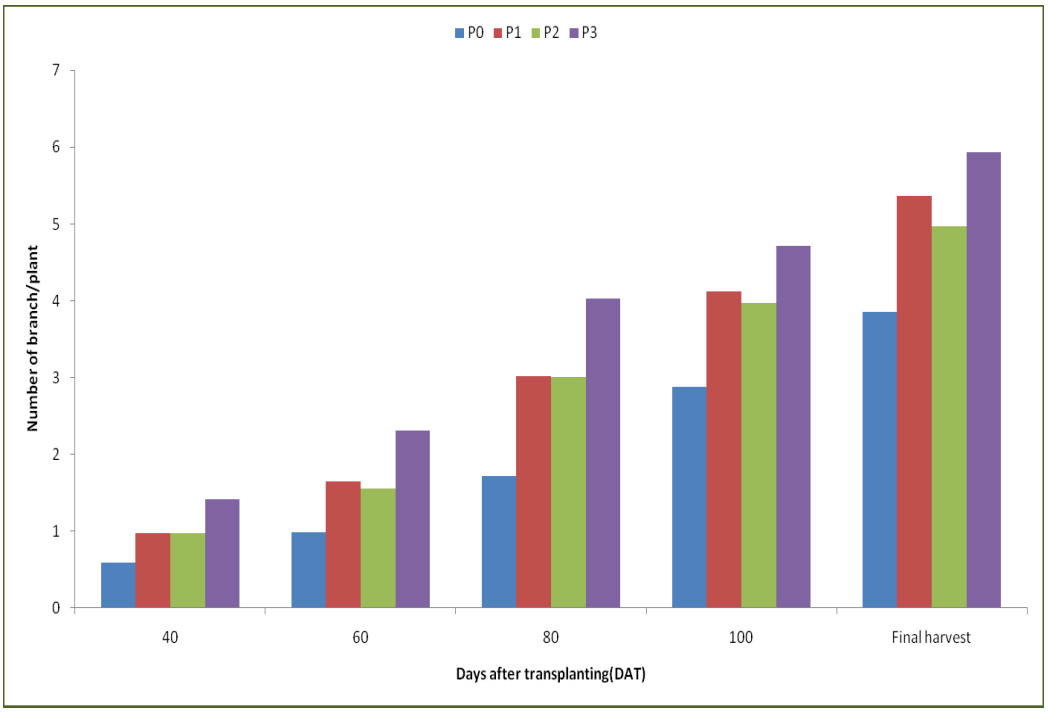
[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

4.2 Number of branches per plant

Significant variation was recorded for nylon net and kaolin on capsicum in terms of number of branches per plant at 40, 60, 80, 100 DAT and at final harvest (Appendix IV). At 40, 60, 80, 100 DAT and final harvest, the maximum number of branches per plant (1.42, 2.31, 4.03, 4.71, and 5.93) was observed from P_3, while the minimum number (0.59, 0.99, 1.72, 2.88 and 3.85) was found from P_0 (Figure 4). Management practices influence the number of branches per plant but different protection measures itself manipulated the number of branches per plant. Sharma *et al*. (2004) reported that capsicum cv.

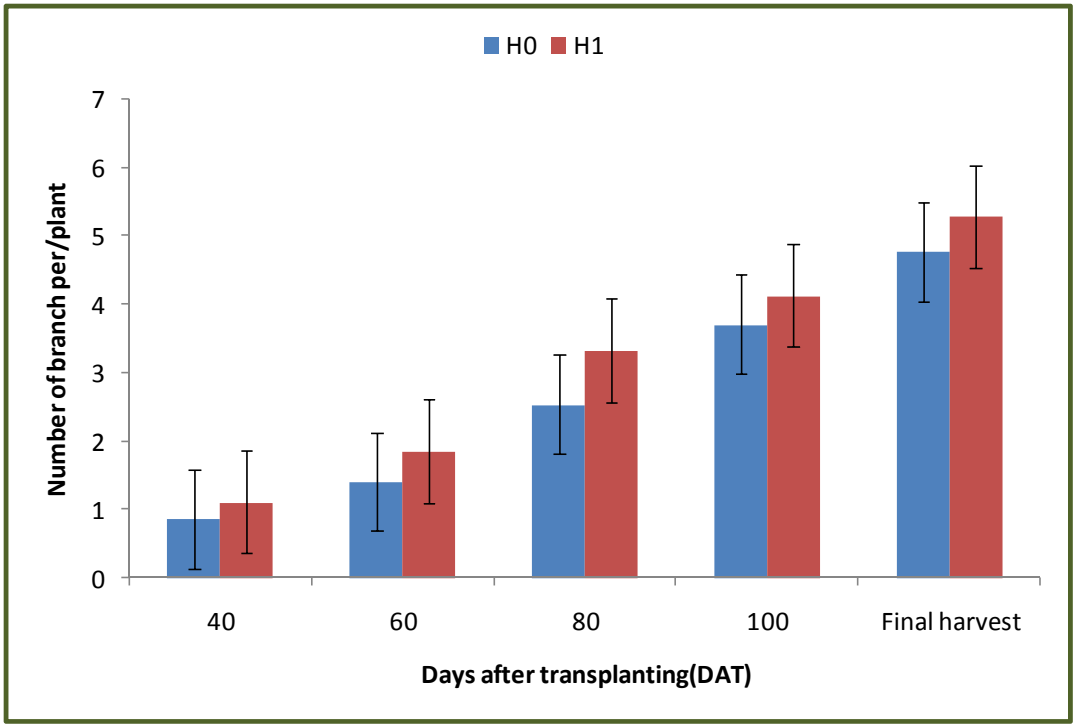
California Wonder under green house produced maximum number of branches (5.86) compared to open field condition.

Number of branches per plant was significantly affected by plant growth regulator (4-CPA) treatments which have been shown (Appendix IV). Number of branches per plant of capsicum varied significantly for different treatments which were control (H_0) and 4-Chloro Phenoxy Acetic Acid (H_1) at 40, 60, 80, 100 DAT and at final harvest (Figure 5). At 40, 60, 80, 100 DAT and final harvest, the maximum number of branches per plant (1.11, 1.85, 3.33, 4.13 and 5.28) was observed from H_1, while the minimum number (0.86, 1.41, 2.55, 3.71 and 4.77) was found from H_0 (Figure 5).



[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

Figure 4: Effect of nylon net and kaolin on Number of branches per plant at different DAT.



[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Figure 5: Effect of application of 4-CPA on Number of branches per plant at different DAT.

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of branches per plant of capsicum at 40, 60, 80, 100 DAT and final harvest (Appendix III). The highest number of branches per plant (1.68, 2.43, 4.12, 4.96 and 6.11 cm) was observed from P_3H_1 at 40, 60, 80, 100 DAT and final harvest, respectively. On the other hand, the lowest branches per plant (0.49, 0.90, 1.44, 2.58 and 3.73) were recorded from P_0H_0 at 40, 60, 80, 100 DAT and final harvest, respectively (Table 3).

Table 3: Interaction effect nylon net, kaolin and 4-CPA on branches per plant at different DAT.

Treatments	Number of branches per plant at				
	40 DAT	60 DAT	80 DAT	100 DAT	At final harvest
P_0H_0	0.49 g	0.90 f	1.44 h	2.58 e	3.73 c
P_0H_1	0.677 f	1.09 e	1.99 g	3.18 d	3.97 c
P_1H_0	0.87 e	1.23 d	2.30 f	3.85 c	4.80 b
P_1H_1	1.08 bc	2.08 b	3.74 c	4.38 b	5.92 a
P_2H_0	0.92 de	1.32 d	2.53 e	3.93 c	4.83 b
P_2H_1	1.01 cd	1.81 c	3.48 d	4.01 c	5.11 b
P_3H_0	1.17 b	2.18 b	3.92 b	4.47 b	5.74 a
P_3H_1	1.68 a	2.43 a	4.12 a	4.96 a	6.11 a
CV (%)	5.26	6.94	7.47	5.76	7.53
LSD (0.05)	0.095	0.135	0.175	0.246	0.492
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability					

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

4.3 Number of leaves per plant

Number of leaves per plant of capsicum showed statistically significant differences on use of nylon net and kaolin at 40, 60, 80, 100 DAT and final harvest (Appendix V). At 40, 60, 80, 100 DAT and final harvest, the maximum number of leaves per plant (19.43, 32.81, 45.78, 81.21 and 91.40 respectively) was recorded from P_3 treatment while the minimum number (12.99, 18.27, 31.84, 44.53 and 49.60 at same days of observation respectively) was obtained from P_0 (Table 4). Sharma *et al*. (2004) reported that capsicum under green house produced maximum number of leaves (80.76) compared to open field condition.

Table 4: Effect of nylon net and kaolin on number of leaves per plant at different DAT.

Treatments	Number of leaves per plant				
	40 DAT	**60 DAT**	**80 DAT**	**100 DAT**	**At final harvest**
P_0	12.99 b	18.27 c	31.84 b	44.53 c	49.60 b
P_1	17.37 a	28.33 b	41.13 a	68.53 b	86.26 a
P_2	17.34 a	29.02 b	39.34 a	68.92 b	84.23 a
P_3	19.43 a	32.81 a	45.78 a	81.21 a	91.40 a
CV (%)	10.49	10.41	12.73	5.18	8.65
LSD (0.05)	2.18	3.49	7.20	3.40	3.87
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability					

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

Number of leaves per plant was affected by Plant growth regulator (4-CPA) treatments which have been shown (Appendix V). Number of leaves per plant of capsicum varied significantly for different treatments which were control (H_0) and 4-Chloro Phenoxy Acetic Acid (H_1) at 40, 60, 80, 100 DAT and at final harvest (Table 5). The maximum number of leaves (81.80) was recorded from 4-Chloro Phenoxy Acetic Acid (H_1) treated plants whereas the minimum leaves (73.93) were recorded from control (H_0) plants at final harvest.

Table 5: Effect of 4-CPA on number of leaves per plant at different DAT.

Treatments	Number of leaves per plant				
	40 DAT	**60 DAT**	**80 DAT**	**100 DAT**	**At final harvest**
H_0	16.13	25.02	38.03	62.02	73.93
H_1	17.43	29.19	41.06	69.59	81.80
CV%	10.49	10.41	12.73	5.18	8.65
LSD (0.05)	1.01	3.21	2.67	5.23	5.73

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of number of leaves per plant of capsicum at 40, 60, 80, 100 DAT and final harvest (Appendix III). The highest number of leaves per plant (19.59, 33.14, 49.01, 83.92 and 92.78) was observed from P_3H_0 at 40, 60, 80, 100 DAT and final harvest, respectively. On the other hand, the lowest leaves per plant (12.52, 17.36, 31.84, 40.41 and 42.18) were recorded from P_0H_0 at 40, 60, 80, 100 DAT and final harvest respectively (Table 6).

Table 6: Interaction effect of nylon net, kaolin and 4-CPA on number of leaves per plant at different DAT.

Treatments	Number of leaves per plant				
	40 DAT	60 DAT	80 DAT	100 DAT	At final harvest
P_0H_0	12.52 d	17.36 d	31.84 e	40.41 g	42.18 d
P_0H_1	13.46 d	19.18 cd	31.83 e	48.65 f	57.03 c
P_1H_0	15.60 c	23.67 bc	38.24 d	62.05 e	81.95 b
P_1H_1	19.15 a	32.99 a	44.01 b	75.02 bc	90.57 a
P_2H_0	16.84 bc	26.58 b	39.50 cd	67.04 d	81.61 b
P_2H_1	17.84 ab	31.46 a	39.17 cd	70.79 cd	86.85 ab
P_3H_0	19.59 a	32.49 a	42.55 bc	78.51 b	90.01 a
P_3H_1	19.27 a	33.14 a	49.01 a	83.92 a	92.78 a
CV (%)	10.49	10.41	12.73	5.18	8.65
LSD (0.05)	1.92	4.63	4.29	4.81	6.17
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.0 (5%) level of probability					

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

4.4 Foliar coverage

Significant variation was observed among P_0, P_1, P_2 and P_3 treatments in terms of foliar coverage (Appendix VI). Foliar coverage of capsicum statistically significantly varied at 100 DAT (Table 7). The topmost result in terms of foliar coverage (43.33 cm) was recorded from P_3 where as P_0 was scored as the lowest (26.00 cm) at 100 DAT.

At final harvest, statistically significant variation was observed between the control and 4-CPA @ 4000 ppm in terms of foliar coverage (Appendix III). Foliar coverage of capsicum exposed statistically significant variation between

the treatments water (H_0) and 4-CPA @ 4000 ppm at final harvest. The maximum foliar coverage (38.02 cm) was marked at H_1 whereas the minimum (31.63 cm) was scored from water (H_0) treated plants at 100 DAT (Table 8).

Variation was observed due to the interaction effect of p nylon net, kaolin and 4-CPA in terms of foliar coverage of capsicum at final harvest (Appendix VI). The highest foliar coverage (45.22 cm) was observed from P_3H_1 and the lowest foliar coverage (24.89 cm) was recorded from P_0H_0 at 100 DAT (Table 9).

More healthy plants were observed at P_3H_1 and weak plants were observed at P_0H_0 treatment combination. From visual observation it was noticed that P_1 and P_2 treated plants were healthier than P_0 treated plants. So, nylon net and kaolin spray might be protect plants from disease and viral attack of bell pepper.

4.5 Days from transplanting to 1st flowering

Significant variation was observed among P_0, P_1, P_2 and P_3 treatments in terms of Days from transplanting to 1st flowering (Appendix VI). Days from transplanting to 1st flowering of capsicum statistically significantly varied at final harvest (Table 7). The topmost result (57.20 days) was recorded from P_0 whereas P_2 was scored as the lowest (47.33 days) at final harvest.

At final harvest, statistically significant variation was observed between the control and 4-CPA @ 4000 ppm in terms of days from transplanting to 1st flowering (Appendix III). Days from transplanting to 1st flowering of capsicum exposed statistically significant variation between the treatments water (H_0) and 4-CPA @ 4000 ppm (H_1) at final harvest (Table 6). The maximum days from transplanting to 1st flowering (54.10 days) was marked at (H_0) whereas the minimum (48.96 days) was scored from (H_1) treated plants at final harvest (Table 8).

Significant variation was observed due to the interaction effect of plant protection measures and PGR application (4-CPA) in terms of days from

transplanting to 1st flowering of capsicum at final harvest. The highest days from transplanting to 1st flowering (58.41 days) was observed from P_0H_0 and the lowest days from transplanting to 1st flowering (47.92 days) was recorded from P_3H_1 at final harvest (Table 9).

Table 7: Effect of nylon net and kaolin on growth parameters.

Treatments	Foliar coverage (cm)	Days from transplanting to 1st flowering	Days from transplanting to 50% flowering
P_0	26.00 c	57.20 a	97.39 a
P_1	35.39 b	52.53 ab	93.53 b
P_2	34.61 b	47.33 b	94.89 ab
P_3	43.33 a	49.07 b	86.89 c
CV%	9.70	11.14	4.31
LSD (0.05)	4.18	6.58	2.66

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

4.6 Days from transplanting to 50% flowering

Significant variation was observed among P_0, P_1, P_2 and P_3 treatments in terms of Days from transplanting to 50% flowering (Appendix VI). Days from transplanting to 50% flowering of capsicum statistically significantly varied at final harvest (Table 7). The topmost result (97.39 days) was recorded from P_0 whereas P_3 was scored as the lowest (86.89 days) at final harvest.

At final harvest, statistically significant variation was observed between the control and 4-CPA @ 4000 ppm in terms of days from transplanting to 50% flowering (Appendix VI). Days from transplanting to 50% flowering of capsicum exposed statistically significant variation between the treatments water (H_0) and 4-CPA @ 4000 ppm (H_1) at final harvest (Table 6). The maximum days from transplanting to 50% flowering (94.38 days) was marked

at (H_0) whereas the minimum (91.96 days) was scored from (H_1) treated plants at final harvest (Table 8).

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of days from transplanting to 50% flowering of capsicum at final harvest. The highest days from transplanting to 50% flowering (98.06 days) was observed from P_0H_0 and the lowest days from transplanting to 50% flowering (85.16 days) was recorded from P_3H_1 at final harvest (Table 9).

Table 8: Effect of foliar application of 4-CPA on growth parameters.

Treatments	Foliar coverage (cm)	Days from transplanting to 1st flowering	Days from transplanting to 50% flowering
H_0	31.63 b	54.10	94.38
H_1	38.02 a	48.96	91.96
CV%	9.70	11.14	4.31
LSD (0.05)	4.41	3.42	2.17

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Table 9: Interaction effect of nylon net, kaolin and 4-CPA on growth parameters.

Treatments	Foliar coverage	Days from transplanting to 1st flowering	Days from transplanting to 50% flowering
P_0H_0	24.89 d	58.41a	98.06 a
P_0H_1	27.11 cd	56.00 ab	96.71 b
P_1H_0	30.00 c	54.24 abc	94.79 c
P_1H_1	40.78 ab	50.82 bcd	92.27 e
P_2H_0	30.22 c	53.57 abc	96.06 b
P_2H_1	39.00 b	41.10 e	93.72 d
P_3H_0	41.44 ab	50.22 cd	88.62 f
P_3H_1	45.22 a	47.92 d	85.16 g
CV (%)	9.70	11.14	4.31
LSD (0.05)	4.77	5.24	1.01
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability			

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

4.7 Number of flowers per plant

Significant variation was observed among P_0, P_1, P_2 and P_3 treatments in terms of number of flowers per plant (Appendix VI). Number of flowers per plant of capsicum statistically significantly varied at final harvest. The topmost result (31.08) was recorded from P_3 where as P_0 was scored as the lowest (21.45) at final harvest (Table 10).

At final harvest, statistically significant variation was observed between the control and 4-CPA @ 4000 ppm in terms of number of flowers per plant. Number of flowers per plant of capsicum exposed statistically significant

variation between the treatments water (H_0) and 4-CPA @ 4000 ppm at final harvest (Table 11). The maximum number of flowers per plant (28.03) was marked at H_1whereas the minimum (25.21) was scored from water (H_0) treated plants at final harvest (Table 11).

Variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of number of flowers per plant of capsicum at final harvest. The highest number of flowers per plant (32.18) was observed from P_3H_1 and the lowest number of flowers per plant (20.90) was recorded from P_0H_0 at final harvest (Table 12).

4.8 Days from transplanting to 1st harvest

Different plant protection measures of capsicum showed significant effect on days from transplanting to 1st harvest (Appendix VI). However, minimum days from transplanting to 1st harvest (104.7) were attained from P_2, while the maximum days (111.3) were found from P_0 (Table 10).

Days from transplanting to 1st harvest of capsicum varied significantly due to plant growth regulator. The minimum days from transplanting to 1st harvest (101.45) were found from H_1 and the maximum days (113.07) were recorded from H_0 at control condition (Table 11).

Variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of number of days from transplanting to 1st harvest of capsicum at final harvest. The highest days from transplanting to 1st harvest (118.4) were observed from P_0H_0 and the lowest result (99.10) was recorded from P_3H_1 at final harvest (Table 12).

4.9 Number of fruits per plant

Significant variation was observed among P_0, P_1, P_2 and P_3 treatments in terms of number of fruits per plant (Appendix VI). Number of fruits per plant of

capsicum statistically significantly varied at final harvest (Table 10). The topmost result (8.32) was recorded from P_3 where as P_0 was scored as the lowest (4.49) at final harvest.

At final harvest, statistically significant variation was observed between the control and 4-CPA @ 4000 ppm in terms of number of fruits per plant. Number of fruits per plant of capsicum exposed statistically significant variation between the treatments water (H_0) and 4-CPA @ 4000 ppm (H_1) at final harvest (Table 11). The maximum number of fruits per plant (7.09) was marked at H_1 whereas the minimum (6.08) was scored from water (H_0) treated plants at final harvest.

Variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of number of fruits per plant of capsicum at final harvest. The highest number of fruits per plant (8.61) was observed from P_3H_1 and the lowest number of fruits per plant (4.03) was recorded from P_0H_0 at final harvest (Table 12).

4.10 Fruit setting

Fruit setting of capsicum showed significant variation due to the effect of nylon net and kaolin (Appendix VII). The maximum fruit setting (26.81%) was found from P_3, while the minimum (21.05 %) was attained from P_0 (Table 10). Sharma *et al*. (2006) reported that fruit set percent varied significantly with the average of 18.81% for different cultural practices.

Fruit setting of capsicum varied significantly for different plant growth regulators. The maximum fruit setting (25.33%) was found from H_1 while the minimum fruit setting (23.87%) was recorded from H_0 i.e. control condition (Table 11). Deka and Shadeque (1996) obtained the fruit set of capsicum with 4-CPA at 500, 1000 of 1500 ppm. Rajmani *et al*. (1990) reported that increased

percentage of fruit set with 2, 4-D (2-5ppm) and tricontanol (1.25-5 ppm) and with chorflurenol on capsicum, respectively.

Interaction effect of nylon net, kaolin and 4-CPA showed significant variation in terms of fruit setting. The maximum fruit setting (26.86%) was observed from P_3H_0 which was statistically similar with the treatments P_2H_1 (26.38%) and P_3H_1 (26.76%) while the minimum (19.44%) was found from P_0H_0 (Table 12).

Table 10: Effect of nylon net and kaolin on growth parameters.

Treatments	Number of flowers per plant	Days from transplanting to 1st harvest	Number of fruits per plant	Fruit setting (%)
P_0	21.45 c	111.3 a	4.49 c	21.05 b
P_1	27.32 b	108.0 ab	6.796 b	24.99 a
P_2	26.64 b	104.7 b	6.73 b	25.56 a
P_3	31.08 a	104.9 b	8.32 a	26.81 a
CV%	8.55	6.97	4.12	8.81
LSD (0.05)	2.79	3.94	0.087	2.03

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

Table 11: Effect of application of 4-CPA on growth parameters.

Treatments	Number of flowers per plant	Days from transplanting to 1st harvest	Number of fruits per plant	Fruit setting (%)
H_0	25.21	113.07	6.08	23.87
H_1	28.03	101.45	7.09	25.33
CV%	8.55	6.97	4.12	8.81
LSD (0.05)	1.98	08.56	0.92	1.19

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Table 12: Interaction effect of nylon net, kaolin and 4-CPA on growth parameters.

Treatments	Number of flowers per plant	Days from transplanting to 1st harvest	Number of fruits per plant	Fruit setting (%)
P_0H_0	20.90 f	118.4 a	4.03 h	19.44 d
P_0H_1	22.01 ef	104.2 d	4.96 g	22.66 c
P_1H_0	24.27 de	113.4 b	5.93 f	24.45 b
P_1H_1	30.37 a	102.6 d	7.66 c	25.53 ab
P_2H_0	25.69 cd	109.6 c	6.33 e	24.74 b
P_2H_1	27.59 bc	99.89 e	7.15 d	26.38 a
P_3H_0	29.98 ab	110.6 c	8.03 b	26.86 a
P_3H_1	32.18 a	99.10 e	8.61 a	26.76 a
CV (%)	8.55	6.97	4.12	8.81
LSD (0.05)	2.54	2.1	0.123	1.53
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability				

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

4.11 Individual fruit weight

Significant variation was observed among P_0, P_1, P_2 and P_3 treatments in terms of individual fruit weight (Appendix VII). The topmost result (115.4g) was recorded from P_3 where as P_0 was scored as the lowest (85.30 g) record (Table 13).

Statistically significant variation was observed between the control and 4-CPA @ 4000 ppm in terms of individual fruit weight. Individual fruit weight of capsicum exposed statistically significant variation between the treatments water (H_0) and 4-CPA @ 4000 ppm (H_1) (Table 3). The maximum fruit weight

(97.97g) was marked at H_1 whereas the minimum (94.17g) was scored from water (H_0) treated plants (Table 14).

Variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of individual fruit weight of capsicum at final harvest. The highest number of fruits per plant (118.0g) was observed from P_3H_1 and the lowest number of fruits per plant (83.93g) was recorded from P_0H_0 (Table 15).

4.12 Length of fruit

Different plant protection measures of capsicum showed significant variation for length of fruit (Appendix VII). The maximum length of fruit (7.11 cm) was recorded from P_3, while the minimum length (4.40 cm) was found from P_0 (Table 13).

Control and 4-CPA @ 4000 ppm showed significant variation on length of fruits (Appendix VII). The maximum length of fruit (6.03 cm) was found from H_1 and minimum length (5.35 cm) was observed from H_0 i.e. control condition (Table 14).

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of length of fruit. The maximum length of fruit (7.59 cm) was found from P_3H_1, while the minimum length (4.33 cm) was observed from P_0H_0 (Table 15).

4.13 Diameter of fruit

Different plant protection measures of capsicum showed significant variation for diameter of fruit (Appendix VII). The maximum diameter of fruit (6.91 cm) was recorded from P_3, while the minimum diameter (4.02 cm) was found from P_0 (Table 13).

Control and 4-CPA @ 4000 ppm showed significant variation on diameter of fruits. The maximum diameter of fruit (5.66 cm) was found from H_1 and minimum diameter (5.12 cm) was observed from H_0 i.e. control condition (Table 14).

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of diameter of fruit. The maximum diameter of fruit (7.15 cm) was found from P_3H_1, while the minimum diameter (4.01 cm) was observed from P_0H_0 (Table 15).

4.14 Pericarp thickness

Different plant protection measures of capsicum showed significant variation for pericarp thickness of fruit (Appendix VII). The maximum pericarp thickness of fruit (1.44 cm) was recorded from P_3, while the minimum pericarp thickness (0.55 cm) was found from P_0 (Table 13).

Control and 4-CPA @4000 ppm showed significant variation on pericarp thickness of fruits. The maximum pericarp thickness of fruit (1.09 cm) was found from H_1 and minimum pericarp thickness (0.89 cm) was observed from H_0 i.e. control condition (Table 14).

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of pericarp thickness of fruit (Appendix VII). The maximum pericarp thickness of fruit (1.49 cm) was found from P_3H_1, while the minimum pericarp thickness (0.49 cm) was observed from P_0H_0 (Table 15).

Table 13: Effect of nylon net and kaolin on growth parameters.

Treatments	Individual fruit weight (g)	Length of fruit (cm)	Diameter of fruit (cm)	Pericarp thickness (cm)
P_0	85.30 c	4.40 c	4.02 d	0.55 c
P_1	91.22 b	5.63 b	5.40 b	0.99 b
P_2	92.34 b	5.64 b	5.2 c	0.98 b
P_3	115.4 a	7.11 a	6.91 a	1.44 a
CV%	3.09	5.78	6.49	4.07
LSD (0.05)	3.67	1.010	0.095	0.553

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

Table 14: Effect of 4-CPA on growth parameters.

Treatments	Individual fruit weight (g)	Length of fruit (cm)	Diameter of fruit (cm)	Pericarp thickness (cm)
H_0	94.17	5.354	5.12	0.898
H_1	97.97	6.033	5.66	1.083
CV%	3.09	5.78	6.49	4.07
LSD (0.05)	2.68	0.582	0.485	0.164

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Table 15: Interaction effect of nylon net, kaolin and 4-CPA on growth parameters.

Treatments	Individual fruit weight (g)	Length of fruit (cm)	Diameter of fruit (cm)	Pericarp thickness (cm)
P_0H_0	83.93 e	4.33 h	4.01 g	0.49 h
P_0H_1	86.68 d	4.47 g	4.03 g	0.61 g
P_1H_0	88.11 d	5.11 f	4.71 f	0.80 f
P_1H_1	94.33 c	6.15 c	6.09 c	1.18 c
P_2H_0	91.80 c	5.35 e	5.09 e	0.91 e
P_2H_1	92.88 c	5.93 d	5.35 d	1.04 d
P_3H_0	112.9 b	6.6 b	6.66 b	1.38 b
P_3H_1	118.0 a	7.59 a	7.15 a	1.49 a
CV (%)	3.09	5.78	6.49	4.07
LSD (0.05)	2.54	0.078	0.135	0.078
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability				

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

4.15 Plant dry weight

Use of nylon net and kaolin on capsicum showed significant variation for plant dry weight (Appendix VII). The maximum plant dry weight (49.67 g) was recorded from P_3, while the minimum plant dry weight (32.45 g) was found from P_0 (Table 16).

Control and 4-CPA @4000 ppm showed significant variation on plant dry weight (Appendix VII). The maximum plant dry weight (43.16 g) was found from H_1 and minimum plant dry weight (38.94 g) was observed from H_0 i.e. control condition (Table 17).

Significant variation was observed due to the nylon net, kaolin and 4-CPA in terms of plant dry weight. The maximum plant dry weight (51.41 g) was found from P_3H_1, while the minimum plant dry weight (31.28 g) was observed from P_0H_0 (Table 18).

4.16 Plant fresh weight

Use of nylon net and kaolin on capsicum showed significant variation for plant fresh weight (Appendix VIII). The maximum plant fresh weight (343.8 g) was recorded from P_3, while the minimum plant fresh weight (219.5 g) was found from P_0 (Table 16).

Control and 4-CPA @4000 ppm showed little variation on plant fresh weight (Appendix VIII). The maximum plant fresh weight (278.2 g) was found from H_0 and minimum plant fresh weight (277.7 g) was observed from H_1 (Table 17).

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of plant fresh weight. The maximum plant fresh weight (347.7 g) was found from P_3H_0, which is statistically similar to P_3H_1 while the minimum plant fresh weight (211.1 g) was observed from P_0H_0 (Table 18).

4.17 Chlorophyll content

Use of nylon net and kaolin on capsicum showed significant variation for chlorophyll content (Appendix VIII). The maximum chlorophyll content (70.70%) was recorded from P_3, while the minimum chlorophyll content (30.19%) was found from P_0 (Table 16).

Control and 4-CPA@ 4000 ppm showed significant variation on chlorophyll content (Appendix VIII) of plant. The maximum chlorophyll content (62.71%)

was found from H_1 and minimum chlorophyll content (44.49 %) was observed from H_0 i.e. control condition (Table 17).

Significant variation was observed due to the interaction effect nylon net, kaolin and 4-CPA in terms of chlorophyll content (Appendix VIII). The maximum chlorophyll content (80.36%) was found from P_3H_1, while the minimum chlorophyll content (26.83%) was observed from P_0H_0 (Table 18).

Table 16: Effect of nylon net and kaolin on growth parameters.

Treatments	Plant dry weight (g)	Plant fresh weight (g)	Chlorophyll content (%)
P_0	32.45 c	219.5 c	30.19 c
P_1	41.07 b	258.9 bc	59.09 ab
P_2	41.03 b	289.7 b	54.45 b
P_3	49.67 a	343.8 a	70.70 a
CV%	6.15	12.92	12.03
LSD (0.05)	2.60	51.34	15.95

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

Table 17: Effect of 4-CPA on growth parameters.

Treatments	Plant dry weight (g)	Plant fresh weight (g)	Chlorophyll content (%)
H_0	38.94	278.2	44.49
H_1	43.16	277.7	62.71
CV%	6.15	12.92	12.03
LSD (0.05)	3.34	0.4	14.46

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Table 18: Interaction effect of nylon net, kaolin and 4-CPA on growth parameters.

Treatments	Plant dry weight (g)	Plant fresh weight (g)	Chlorophyll content (%)
P_0H_0	31.28 f	211.1 f	26.83 d
P_0H_1	33.62 e	227.9 e	33.54 cd
P_1H_0	36.44 d	267.4 c	39.91 cd
P_1H_1	45.71 b	250.3 d	78.27 a
P_2H_0	40.14 c	286.6 b	50.21 bc
P_2H_1	41.91 c	292.7 b	58.70 b
P_3H_0	47.94 b	347.7 a	61.04 b
P_3H_1	51.41 a	340.0 a	80.36 a
CV (%)	6.15	12.92	12.03
LSD (0.05)	2.26	16.64	16.68
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability			

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

4.18 Yield per plant

Use of nylon net and kaolin on capsicum showed significant variation for yield per plant (Appendix VIII). The maximum yield per plant (966.1 g) was recorded from P_3, while the minimum yield per plant (379.3 g) was found from P_0 (Table 19). Yield varied for different varieties might be due to genetical and environmental influences as well as management practices.

Control and 4-CPA @4000 ppm showed significant variation on yield per plant (Appendix VIII). The maximum yield per plant (706.6 g) was found from H_1 and minimum yield per plant (585.4 g) was observed from H_0 i.e. control condition (Table 20).

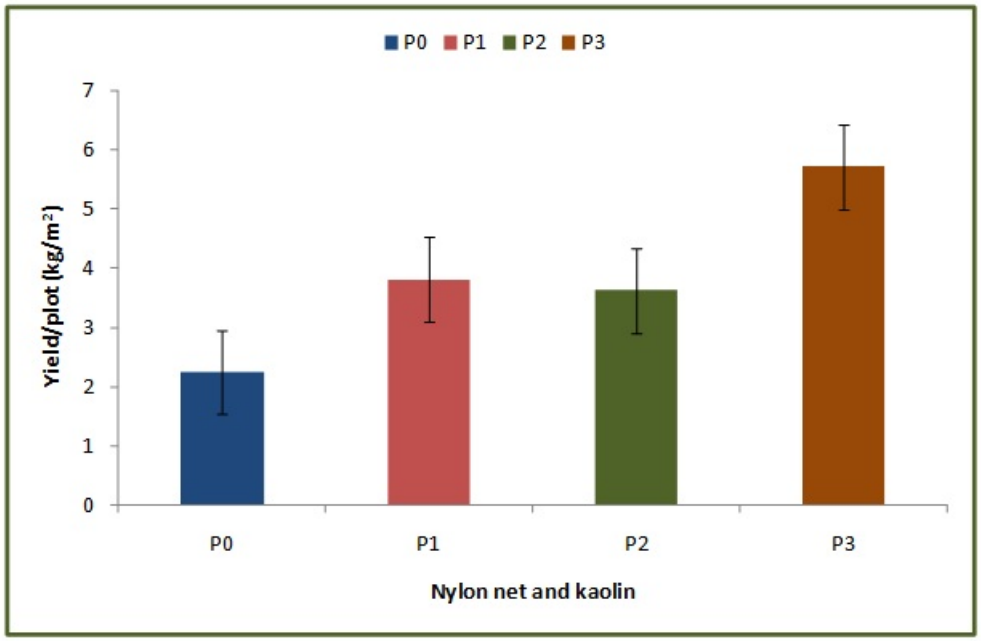
Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of yield per plant (Appendix VIII). The maximum yield per plant (1023 g) was found from P_3H_1, while the minimum yield per plant (334.6 g) was observed from P_0H_0 (Table 21).

4.19 Yield per plot

Use of nylon net and kaolin on capsicum showed significant variation for yield per plot (Appendix VIII). The maximum yield per plot (5.72 kg) was recorded from P_3, while the minimum yield per plot (2.25 kg) was found from P_0 (Figure 6).

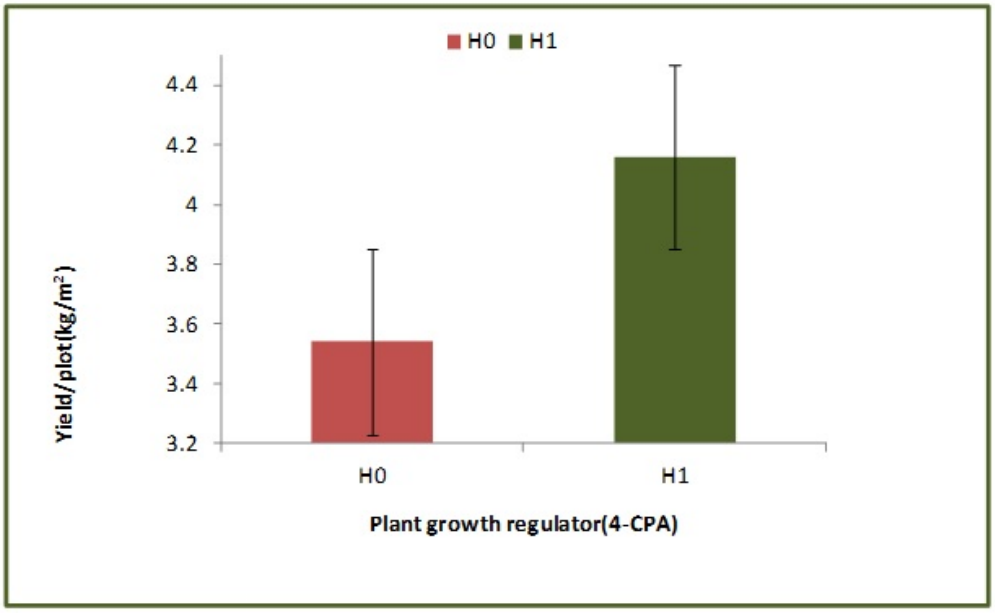
Control and 4-CPA @ 4000 ppm showed significant variation on yield per plot (Appendix VIII). The maximum yield per plot (4.16 kg) was found from H_1 and minimum yield per plot (3.54 kg) was observed from H_0 i.e. control condition (Figure 7).

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of yield per plot (Appendix VIII). The maximum yield per plot (5.97 kg) was found from P_3H_1, while the minimum yield per plot (2.02 kg) was observed from P_0H_0 (Table 21).



[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

Figure 6: Effect of nylon net and kaolin on yield per plot.



[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Figure 7: Effect of 4-CPA on yield per plot.

4.20 Yield per hectare

Use of nylon net and kaolin on capsicum showed significant variation for yield per hectare (Appendix VIII). The maximum yield per hectare (48.06 ton) was recorded from P3, while the minimum yield per hectare (18.58 ton) was found from P0 (Table 19). Yield varied for different varieties might be due to genetical and environmental influences as well as management practices.

Control and 4-CPA @4000 ppm showed significant variation on yield per hectare (Appendix VIII). The maximum yield per hectare (34.80 ton) was found from H_1 and minimum yield per hectare (29.20 ton) was observed from H_0 i.e. control condition (Table 20).

Table 19: Effect of nylon net and kaolin on yield parameters.

Treatments	Yield per plant (g)	Yield per hectare (ton)
P_0	379.3 d	18.58 c
P_1	624.0 b	31.76 b
P_2	612.8 c	29.61 b
P_3	966.1 a	48.06 a
CV%	7.70	6.68
LSD (0.05)	5.59	2.88

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

Table 20: Effect of application of 4-CPA on yield parameters.

Treatments	Yield per plant (g)	Yield per hectare (ton)
H_0	585.4	29.20
H_1	706.6	34.80
CV%	7.70	6.68
LSD (0.05)	110.3	4.62

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

Significant variation was observed due to the interaction effect of nylon net, kaolin and 4-CPA in terms of yield per hectare (Appendix VIII). The maximum yield per hectare (50.55 ton) was found from P_3H_1, while the minimum yield per hectare (16.89 ton) was observed from P_0H_0 (Table 21).

Table 21: Interaction effect of nylon net, kaolin and 4-CPA on yield parameters.

Treatments	Yield per plant (g)	Yield per plot (kg)	Yield per hectare (ton)
P_0H_0	334.6 h	2.02 g	16.89 g
P_0H_1	423.9 g	2.47 f	20.28 f
P_1H_0	522.6 f	3.33 e	27.80 e
P_1H_1	725.4 c	4.287 c	35.72 c
P_2H_0	574.2 e	3.35 e	26.56 e
P_2H_1	651.5 d	3.92 d	32.67 d
P_3H_0	908.8 b	5.48 b	45.56 b
P_3H_1	1023 a	5.97 a	50.55 a
CV (%)	7.70	6.15	6.68
LSD (0.05)	7.91	0.259	1.84
In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly as per 0.05 (5%) level of probability			

[P_0: Open Condition; P_1: Kaolin Spray P_2: Nylon net condition and P_3: Use of Nylon net+Kaolin]

[H_0: Control; H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm]

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the Horticultural Farm of Sher-e-Bangla Agricultural University (SAU), Dhaka, Bangladesh to determine the response of nylon net and kaolin on capsicum to plant growth regulator 4-CPA. The experiment consisted of two factors: Factor A: Use of nylon net and kaolin as P_0: Open Condition (control); P_1: Kaolin Spray; P_2: Nylon net condition; P_3: Use of Nylon net+Kaolin and Factor B: Plant growth regulator (4-CPA) (two levels) as H_0: Control (water spray), H_1: 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm. There were 8 (4 × 2) treatments combination. Two factorial experiments were laid out in a Randomized Complete Block Design (RCBD) with four replications. Data on growth, yield contributing characters and yields were recorded and significant variation was observed.

In case of factor A (use of nylon net and kaolin) at 40, 60, 80, 100 DAT and final harvest, the longer plant (19.9 cm, 26.99 cm, 35.86 cm, 44.66 cm and 59.45 cm) was recorded from P_3, while the shorter plant (13.48 cm, 19.41 cm, 23.15 cm, 31.22 cm and 44.56 cm) from P_0. At 40, 60, 80, 100 DAT and harvest, the maximum number of branches per plant (1.42, 2.31, 4.03, 4.71 and 5.93) was observed from P_3, while the minimum number (0.59, 0.99, 1.72, 2.88 and 3.85) from P_0. At 40, 60, 80, 100 DAT and harvest, the maximum number of leaves per plant (19.43, 32.81, 45.78, 81.21 and 91.4) was recorded from P_3, while the minimum number (12.99, 18.27, 31.84, 44.53 and 49.6) from P_0. The maximum foliar coverage (43.33) was recorded from P_3, while the minimum number (26) from P_0. The minimum days from transplanting to 1st flowering (47.33) were found from P_2, while the maximum days (57.20) from P_0. The minimum days from transplanting to 50% flowering (86.89) was found from P_3, while the maximum days (97.39) from P_0. The maximum number of flowers per plant (31.08) was recorded from P_3, while the minimum number (21.45)

from P_0. The minimum days from transplanting to 1st harvest (104.7) were found from P2, while the maximum days (111.3) from P_0. The maximum number of fruits per plant (8.32) was recorded from P_3, while the minimum number (4.49) from P_0. The maximum fruit setting (26.81 %) was found from P_3, while the minimum (21.05%) from P_0. The maximum weight of individual fruit (115.4 g) was observed from P_3, while the minimum weight (85.30 g) was found from P_0. The maximum length of fruit (7.11 cm) was recorded from P_3, while the minimum length (4.40 cm) was found from P_0. The maximum diameter of fruit (6.90 cm) was recorded from P_3, while the minimum diameter (4.02 cm) was obtained from P_0. The maximum pericarp thickness (1.44 cm) was observed from P_3, while the minimum thickness (0.56 cm) was found from P_0. The maximum plant dry weight (49.67 g) was observed from P_3, while the minimum plant dry weight (32.45 g) was found from P_0. The maximum plant fresh weight (343.8 g) was observed from P_3, while the minimum plant fresh weight (219.5 g) was found from P_0. The maximum chlorophyll content (70.70 %) was observed from P_3, while the minimum chlorophyll content (30.19 %) was found from P_0. The maximum yield per plant (966.1 g) was found from P_3, while the minimum yield per plant (379.3 g) was observed from P_0. The maximum yield per plot (5.72 kg) was recorded from P_3, while the minimum yield per plot (2.25 kg) was found from P_0. The maximum yield per hectare (48.06 ton) was attained from P_3, while the minimum yield per hectare (18.58 ton) from P_0.

In case of plant growth regulator 4-CPA, at 40, 60, 80, 100 DAT and harvest, the longer plant (18.36 cm, 25.67 cm, 31.69 cm, 40.96 cm and 54.88 cm) was recorded from H_1, while the shorter plant (16.12 cm, 22.15 cm, 28.91 cm, 37.48 cm and 51.02 cm) from H_0. At 40, 60, 80, 100 DAT and harvest, the maximum number of branches per plant (1.11, 1.85, 3.33, 4.13 and 5.28) was observed from H_1, while the minimum number (0.87, 1.41, 2.55, 3.71 and 4.78) from H_0. At 40, 60, 80, 100 DAT and harvest, the maximum number of leaves per plant (17.43, 29.19, 41.06, 69.59 and 81.80) was recorded from H_1, while

the minimum number (16.13, 25.02, 38.03, 62.02 and 73.93) from H_0. The maximum foliar coverage (38.02) was recorded from H_1, while the minimum number (31.63) from H_0. The minimum days from transplanting to 1st flowering (48.96) were found from H_1, while the maximum days (54.10) from H_0. The minimum days from transplanting to 50% flowering (91.96) was found from H_1, while the maximum days (94.38) from H_0. The maximum number of flowers per plant (28.03) was recorded from H_1, while the minimum number (25.21) from H_0. The minimum days from transplanting to 1st harvest (101.45) were found from H_1, while the maximum days (113.07) from H_0. The maximum number of fruits per plant (7.09) was recorded from H_1, while the minimum number (6.08) from H_0. The maximum fruit setting (25.33%) was found from P_3, while the minimum (23.87 %) from H_0. The maximum weight of individual fruit (97.97 g) was observed from H_1, while the minimum weight (94.17 g) was found from H_0. The maximum length of fruit (6.03 cm) was recorded from H_1, while the minimum length (5.35 cm) was found from H_0. The maximum diameter of fruit (5.66 cm) was recorded from H_1, while the minimum diameter (5.12 cm) was obtained from H_0. The maximum pericarp thickness (1.08 cm) was observed from H_1, while the minimum thickness (0.89 cm) was found from H_0. The maximum plant dry weight (43.16 g) was observed from H_1, while the minimum plant dry weight (38.94 g) was found from H_0. The maximum plant fresh weight (278.2 g) was observed from H_0, while the minimum plant fresh weight (277.7 g) was found from H_1. The maximum chlorophyll content (62.71 %) was observed from H_1, while the minimum chlorophyll content (44.49 %) was found from H_0. The maximum yield per plant (706.6 g) was found from H_1, while the minimum yield per plant (585.4 g) was observed from H_0. The maximum yield per plot (4.16 kg) was recorded from H_1, while the minimum yield per plot (3.54 kg) was found from H_0. The maximum yield per hectare (34.80 ton) was attained from H_1, while the minimum yield per hectare (29.20 ton) from H_0.

Due to the interaction effect of nylon net, kaolin and plant growth regulator 4-CPA, at 40, 60, 80, 100 DAT and harvest, the longer plant (21.73 cm, 29.08 cm, 37.23 cm, 46.55 cm and 61.17 cm) was recorded from P_3H_1, while the shorter plant (12.78 cm, 19.31 cm, 22.59 cm, 29.69 cm and 43.11 cm) from P_0H_0. At 40, 60, 80, 100 DAT and harvest, the maximum number of branches per plant (1.68, 2.43, 4.12, 4.96 and 6.11) was observed from P_3H_1, while the minimum number (0.49, 0.89, 1.44, 2.58 and3.73) from P_0H_0. At 40, 60, 80, 100 DAT and harvest, the maximum number of leaves per plant (19.27, 33.14, 49.01, 83.92 and 92.78) was recorded from P_3H_1, while the minimum number (12.52, 17.36, 31.84, 40.41 and 42.18) from P_0H_0. The maximum foliar coverage (45.22cm) was recorded from P_3H_1, while the minimum number (24.89 cm) from P_0H_0. The minimum days from transplanting to 1st flowering (47.92) were found from P_3H_1, while the maximum days (58.41) from P_0H_0. The minimum days from transplanting to 50% flowering (85.16) was found from P_3H_1, while the maximum days (98.06) from P_0H_0. The maximum number of flowers per plant (32.18) was recorded from P_3H_1, while the minimum number (20.90) from P_0H_0. The minimum days from transplanting to 1st harvest (99.10) were found from P_3H_1, while the maximum days (118.4) from P_0H_0. The maximum number of fruits per plant (8.61) was recorded from P_3H_1, while the minimum number (4.03) from P_0H_0. The maximum fruit setting (26.76 %) was found from P_3H_1, while the minimum (19.44 %) from P_0H_0. The maximum weight of individual fruit (118 g) was observed from P_3H_1, while the minimum weight (83.93 g) was found from P_0H_0. The maximum length of fruit (7.59 cm) was recorded from P_3H_1, while the minimum length (4.33 cm) was found from P_0H_0. The maximum diameter of fruit (7.15 cm) was recorded from P_3H_1, while the minimum diameter (4.01 cm) was obtained from P_0H_0. The maximum pericarp thickness (1.49 cm) was observed from P_3H_1, while the minimum thickness (0.49 cm) was found from P_0H_0. The maximum plant dry weight (51.41 g) was observed from P_3H_1, while the minimum plant dry weight (31.28 g) was found from P_0H_0. The maximum plant fresh weight (347.7 g) was

observed from P_3H_0, while the minimum plant fresh weight (211.1 g) was found from P_0H_0. The maximum chlorophyll content (80.36 %) was observed from P_3H_1, while the minimum chlorophyll content (26.83 %) was found from P_0H_0. The maximum yield per plant (1023 g) was found from P_3H_1, while the minimum yield per plant (334.6 g) was observed from P_0H_0. The maximum yield per plot (5.97 kg) was recorded from P_3H_1, while the minimum yield per plot (2.02 kg) was found from P_0H_0. The maximum yield per hectare (50.55 ton) was attained from P_3H_1, while the minimum yield per hectare (16.89 ton) from P_0H_0.

Conclusion:

Considering the findings of the experiment, it may be concluded that:

1. Plant growth hormone 4-Chloro Phenoxy Acetic Acid (4-CPA) @ 4000 ppm was very effective for growth and development of capsicum.

2. Farmers can get more yields by using kaolin based particle film instead of nylon net.

3. The treatment combination of P_3H_1 (Use of Nylon net+Kaolin (Aluminosilicate" $Al_4Si_4O_{10}(OH)_8$) @ 4% solution) and 4-CPA @ 4000 ppm showed best potentiality.

REFERENCES

Anonymous. 1989. Annual Report 1987-88. Bangladesh Agricultural Research Council. p. 45.

AVRDC.1989. Tomato and the pepper production in the tropics. AVRDC., Taiwan. 585p.

Baliyan, S.P., Madhava rao, K. S and Mahabile, M. (2013). the effects of 4-chlorophenoxyacetic acid plant growth regulator on the fruit set, yield and economic bene fit of growing tomatoes in high temperatures. Int. J. Agric. Sci., 3: 29-36.

Bennett, C. W. 1971. The curly top disease of sugarbeet and other plants. American Phytopathological Soc. Monograph No. 7

Bhosle, A. B., Khrbhade, S. B., Sanap, P. B and Gorad, M. K. (2002). Effect of growth hormones on growth, yield of summer tomato. *Orissal of Hort*., 30(2): 63-65.

Cgsar, I., Ozgun, O., Sener, H. R and Carkac, N. (1995). Effects of vibrator and 4-CPA on fruitfulness of tomato plants in unheated greenhouse and determination of residue levels of 4-CPA at marketing stage. *Bitki-Koruma-Bulteni*, 35(1/2): 93-112.

Chaudhary, B. R., Sharma, M.D., Shakya S.M. and Gautam, D.M. 2006. Effect of plant growth regulators on growth, yield and quality of chilly (*Capsicum annuum* L.) at Rampur, Chitwan. *J. Inst. Agric. Anim. Sci.*, 27: 65-68.

Choudhury, S., Islam, N., Sarker, M.D. and Ali, M.A. (2013). Growth and yield of summer tomato as influenced by plant growth regulators. *Int. J. Sustain. Agric*., 5(1):25-28.

Cottrell, T. E., B. W. Wood, and C. C. Reilly. 2002. Particle film affects black pecan aphid (Homoptera: Aphididae) on pecan. J. Econ. Entomol. 95:782-788.

Creamer, R., J. Carpenter, and J. Rascon. 2005. Incidence of the beet leafhopper, *Circulifer tenellus* (Homoptera: Cicadellidae) in New Mexico chile. Southwest. Entomol. 28:177-182.

Deka, P.C. and Shadeque, A. 1996. Effect offoliar sprays of cycocel (CCC) on the growth andyield of bell pepper. *Hort. J*., 9(2): [4]-147.

Edris, K. M., Islam, A. T. M. T., Chowdhury, M. S. and Haque, A. K. M. M. 1979. Detailed Soil Survey of Bangladesh, Dept. Soil Survey, Govt. People's Republic of Bangladesh. 118 p.

FAO. 1988. Production Year Book. Food and Agriculture Organizations of the United Nations. Rome, Italy. 190-193.

Glenn, D.M. and G.J. Puterka (2005). Particle films: a new technology for agriculture. *Hortic. Rev*., 31: 1-44.

Glenn, D. M., G. J. Puterka, T. Vanderzwet, R. E. Byers, and C. Feldhake. 1999. Hydrophobic particle films: a new paradigm for suppression of arthropod pests and plant diseases. J. Econ. Entomol. 92:759-771.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedure for Agricultural Research (2nd edn.). *Int. Rice Res. Inst., A Willey Int. Sci*., pp. 28-192.

Gupta, P. K., Gupta, A. K. and Reddy, S. (1999). Efficacy of PGR (IAA and NAA) and micronutrient (multiplex and humaur) on mineral composition of tomato fruits. *Advances in Plant Sci*., 15(2): 483-485.

Han, J.-S. 1990. Use of antitranspirant epidermal coatings for plant protection in China. Plant Dis. 74:263-266.

Hasanuzzaman , S.M., Hossain, S.M.M., Ali , M. O., Hossain, M.A. and Hannan, A. 2007. Performance of Different Bell Pepper (*Capsicum annuum* L.) Genotypes in Response to Synthetic Hormones. *Int. J. Sustain. Crop Prod*., 2(5): 78-84.

Hasanuzzaman, S.M. 1999. Effect of hormone on yield of bell pepper (*Capsicum annum* L.) MS thesis, BAU, Mymensingh.

Joshi, M.C. and Singh, D.P.1975. Chemical composition in bell pepper. *Indian Hort*., 20: 19-21.

Jifon, J. L. and J. P. Syvertsen. 2003. Kaolin particle film applications can increase photosynthesis and water use efficiency of 'Ruby Red' grapefruit leaves. J. Amer. Soc. Hort. Sci. 128:107-112.

Kamp, M. 1985. Control of *Erysiphe cichoracearum* on *Zinnia elegans*, with a polymer-based antitranspirant. HortScience 20:879-881.

Kannan, K., Jawaharlal, M. and Prabhu, M. 2009. Effect of growth regulators on physiological parameters in paprika cv. Ktpl-19. *American Eurasian J. Sustainable Agri*., 3(4): 732-736.

Karakurt, R. (2000). Effects of 4-CPA applications and inflorescence pruning on the yield of hybrid tomato in greenhouse conditions. *Bahce*., 29(1/2): 45-48.

Leclerc, M., Caldwell, C. and Lada, R. 2006. Effect of plant growth regulators on propaguleformation in *Hemerocallis* spp., and *Hosta* spp. *Hort Sci.,* 41: 651-653.

Liang, G. and T.-X Liu. 2002. Repellency of a kaolin particle film, Surround, and a mineral oil, Sunspray Oil, to silverleaf whitefly (Homoptera: Aleyrodidae) on melon in the laboratory. J. Econ. Entomol. 95:317-324.

Marco, S. 1993. Incidence of nonpersistently transmitted viruses of pepper sprayed with whitewash, oil, and insecticide, alone or combined. Plant Dis. 77:1119-1122.

Nakano, A. and Uehara, Y. (1996).The effect of kaolin clay on cuticle transpiration in tomato. *Acta Hort*., 440: 233-238.

Ouzounidou, G., Ilias, I., Giannakoula, A. and Papadopoulou, P. 2010. Comparative study on the effects of various plant growth regulators on growth, quality and physiology of *Capsicum annuum* L. *Pak. J. Bot*., 42(2): 805-814.

Ouzounidou, G., P. Papadopoulou, A. Giannakoula and I. Ilias. 2008. Plant growth regulators treatments modulate growth, physiology and quality characteristics of *Cucumis melo* L. plants. *Pak. J. Bot.,* 40: 1185-1193.

Panajotov, N.D. 1998. Sweet Pepper response to the application of the plant growth regulator a tonic. *New Zealand J. crop & Hort. Sci*., 26(2): 34-39.

Puterka, G. J., D. M. Glenn, D. G. Sekutowski, T. R. Unruh, and S. K. Jones. 2000. Progress toward liquid formulations of particle films for insect and disease control in pear. Environ. Entomol.29:329-339.

Rajmani, K., Sundararajan, S.and Veeraravathatham, D. 1990. Effect of triacontanol, 2, 4-D and boron on yield of certain chilli cultivar. *South India Hort*., 38 (5): 253-257.

Randolph, T., Wedding, Bernarr, J., Hall, Morries, J., Garber and Frank, H. (1959). Effect of fruit- setting plant hormones and nitrogen level in relation to quality and storage life of tomatoes. *Randolph, T. and Wedding Associate Plant Physiologist in Plant Biochemistry, University of California, Riverside*.

Schon, M. K. 1993. Effects of foliar antitranspirant or calcium nitrate applications on yield and blossom-end rot occurrence in greenhouse-grown peppers. J. Plant Nutrit. 16:1137-1149.

Saha, S.R. 2001. Heat tolerance in sweet pepper. PhD thesis, BSMRAU, Gazipur.

Sasaki, H., Yano, T. and Yamasaki, A. (2005). Reduction of high temperature inhibition in tomato fruit set by plant growth regulators.JARQ, 39:135-138.

Sharma, H.G., Narendra-Agarwal., Dubey, P. and Dixit, A, 2004. Comparative performance of capsicum under controlled environment and open field condition. *Ann. Agric. Res*., 25(4): 638-640.

Shoemaker, J.S. and Teskey, B.J.E.1995. Practical Horticulture. John Willy and Sons, Inc. New York. p. 371.

Showler, A. T. 2002. Effects of kaolin-based particle film application on boll weevil (Coleoptera: Curculionidae) injury to cotton. J. Econ. Entomol. 95:754-762.

Teshm Tadesse Michael, A., Thomas, J.R. and Heilmn, M.D. 1999. Nutrient conductivity effects on sweet pepper plants grown using a nutrient technique. *New Zealand J. crop & Hort. Sci*., 5(1): 45-49.

Thomas AL, Muller ME, Dodson BR, Ellersieck MR, Kamps M(2004) A kaolin based particle film suppressed certain insect and fungal pests while reducing heat stress in apple, Journal of the American pomological Societu 58, 42-51.

Tworkoski T. J., D. M. Glen, and G. J. Puterka. 2002. Response of bean to applications of hydrophobic mineral particles. Can. J. Plant Sci. 82:217-219.

UNDP. 1988. Land Resources Appraisal of Bangladesh for Agricultural Development. Report 2: Agro-ecological Regions of Bangladesh, FAO, Rome. pp. 212.

Unruh, T.R., A.L. Knight, J. Upton, D.M. Glenn, and G.J. Puterka. 2000. Particle films for suppression of the codling moth (Lepidoptera: Tottricidae) in apple and pear orchards. J. Econ. Entomol. 93:737-743.

Wiinsche JN, Lombardini L and Green DH(2004) Surround particle film application- effect on whole canopy physiology of apple. Acta Horticulture 636, 565-571.

Ziv, O. and R. A. Frederiksen. 1986. The effect of film-forming anti-transpirants on leaf rust and powdery mildew incidence on wheat. Plant Pathol. 36:242-245.

APPENDICES

Appendix I. Characteristics of the soil of experimental field analyzed by Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka

A. Morphological characteristics of the soil of experimental field

Morphological features	Characteristics
Location	Horticultural Farm, SAU, Dhaka
AEZ	Madhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained

B. Physical and chemical properties of the initial soil

Characteristics	Value
% Sand	27
% Silt	43
% Clay	30
Textural class	Silty-clay
pH	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20.00
Exchangeable K (me/100 g soil)	0.10
Available S (ppm)	45

Source: SRDI, 2012

Appendix II. Monthly record of air temperature, rainfall, relative humidity, rainfall and Sunshine of the experimental site during the period from October 2012 to March 2013

Month (2012)	*Air temperature (^{o}c)		*Relative humidity (%)	*Rainfall (mm)	*Sunshine (hr)
	Maximum		Minimum		
October, 2012	24.32	17.22	75	13	7.2
November, 2012	25.82	16.04	78	00	6.8
December, 2012	22.40	13.50	74	00	6.3
January, 2013	24.50	12.40	68	00	5.7
February, 2013	27.10	16.70	67	30	6.7
March. 2013	31.40	19.60	54	11	8.2

* Monthly average,

Source: Bangladesh Meteorological Department (Climate & weather division) Agargoan, Dhaka – 1212

Appendix III. Analysis of variance of the data on plant height at different DAT of bell pepper as influenced by nylon net, kaolin and 4-CPA.

Source of variation	Degrees of freedom (df)	Mean Square of plant height at				
		40 DAT	60 DAT	80 DAT	100 DAT	Final harvest
Replication	2	1.34 ^{NS}	1.58 ^{NS}	0.43 ^{NS}	1.74 ^{NS}	2.98 ^{NS}
Nylon net and kaolin(A)	3	43.77**	61.93**	66.56**	94.26**	30.94**
4-CPA(B)	1	30.28**	74.73**	46.34**	72.73**	22.39**
Interaction (A x B)	3	8.41**	7.53**	12.11*	14.93*	10.35**
Error	14	1.58	1.39	3.13	3.67	2.36

* Significant at 0.05 level of probability; **Significant at 0.01 level of probability and ^{NS} Non-significant

Appendix IV. Analysis of variance of the data on number of branches per plant at different DAT of bell pepper as influenced by nylon net, kaolin and 4-CPA.

Source of variation	Degrees of freedom (df)	Mean Square of number of branches per plant at				
		40 DAT	60 DAT	80 DAT	100 DAT	Final harvest
Replication	2	0.001 ^{NS}	0.007 ^{NS}	0.009 ^{NS}	0.04 ^{NS}	0.034^{NS}
Nylon net and kaolin(A)	3	0.70**	1.75**	5.37**	3.48**	4.64**
4-CPA(B)	1	0.3**	1.19**	3.71**	1.08**	1.51**
Interaction (A x B)	3	0.16**	0.13**	0.43**	0.089*	0.24*
Error	14	0.04	0.006	0.01	0.02	0.06

* Significant at 0.05 level of probability; **Significant at 0.01 level of probability and ^{NS} Non-significant

Appendix V. Analysis of variance of the data on number of leaves per plant at different DAT of bell pepper as influenced by nylon net, kaolin and 4-CPA.

Source of variation	Degrees of freedom (df)	Mean Square of number of leaves per plant at				
		40 DAT	60 DAT	80 DAT	100 DAT	Final harvest
Replication	2	1.289 ^{NS}	1.253 ^{NS}	2.069 ^{NS}	3.857 ^{NS}	3.329 ^{NS}
Nylon net and kaolin(A)	3	44.122**	51.730**	88.619**	75.213**	85.522**
4-CPA(B)	1	21.049**	30.125**	53.015**	43.649**	53.621**
Interaction (A x B)	3	10.959*	19.453*	33.876*	24.440*	23.145*
Error	14	3.100	5.960	8.917	7.557	6.378

* Significant at 0.05 level of probability; **Significant at 0.01 level of probability and ^{NS} Non-significant

Appendix VI. Analysis of variance of the data on yield contributing character of bell pepper as influenced by nylon net, kaolin and 4-CPA.

Source of variation	Degrees of freedom (df)	Mean Square of					
		Foliar coverage	Days from transplanting to 1st flowering	Days from transplanting to 50% flowering	Number of flowers/plant	Days from transplanting to 1st harvest	Number of fruits/plant
Replication	2	4.303 NS	1.755 NS	2.695 NS	1.673 NS	2.565 NS	0.004 NS
Nylon net and kaolin(A)	3	39.220**	59.702**	120.594**	94.139**	58.426**	14.901**
4-CPA(B)	1	24.865**	36.112**	35.018**	47.912**	41.224**	6.161**
Interaction (A x B)	3	13.593*	13.032*	15.114*	21.462*	18.555*	1.386**
Error	14	4.121	3.117	4.646	5.186	4.135	0.005

* Significant at 0.05 level of probability; **Significant at 0.01 level of probability and NS Non-significant

Appendix VII. Analysis of variance of the data on yield contributing character of bell pepper as influenced by nylon net, kaolin and 4-CPA.

Source of variation	Degrees of freedom (df)	Mean Square of					
		Fruit setting (%)	Individual fruit weight	Length of fruit	Diameter of fruit	Pericarp thickness	Plant dry weight
Replication	2	0.715 NS	5.006 NS	0.003 NS	0.002 NS	0.003 NS	1.426 NS
Nylon net and kaolin(A)	3	37.176**	96.655**	7.348**	8.385**	0.781**	96.828**
4-CPA(B)	1	17.819**	86.602**	2.768**	1.744**	0.207**	60.597**
Interaction (A x B)	3	9.849*	38.075*	0.254**	0.534**	0.025**	17.813**
Error	14	2.697	10.804	0.002	0.006	0.002	1.669

* Significant at 0.05 level of probability; **Significant at 0.01 level of probability and NS Non-significant

Appendix VIII. Analysis of variance of the data on yield contributing character of bell pepper as influenced by nylon net, kaolin and 4-CPA.

Source of variation	Degrees of freedom (df)	Mean Square of				
		Plant fresh weight	Chlorophyll content	yield/plant	yield/plot	yield/ hectare
Replication	2	22.753 ^{NS}	32.227 ^{NS}	11.013 ^{NS}	0.030 ^{NS}	1.894 ^{NS}
Nylon net and kaolin(A)	3	523.066**	742.768**	429.444**	12.243**	88.15**
4-CPA(B)	1	344.426**	443.264**	867.795**	2.294**	41.38**
Interaction (A x B)	3	189.422**	217.016*	822.406**	1.077**	19.43**
Error	14	31.247	49.958	20.452	0.189	2.98

* Significant at 0.05 level of probability; **Significant at 0.01 level of probability and ^{NS} Non-significant.