EFFECT OF POTASSIUM NITRATE AND DIFFERENT SALINE CONDITIONS ON GROWTH AND YIELD OF CHILLI

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CERTIFICATE

This is to certify that the thesis entitled **“Effect of Potassium Nitrate and Different Saline Conditions on Growth and Yield of Chilli”** 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 **RESHMA YESMIN**, Registration No. **10-03796** 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.

Dated: June,2016
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Dedicated To

My Beloved Parents

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The Author

EFFECT OF POTASSIUM NITRATE AND DIFFERENT SALINE CONDITIONS ON GROWTH AND YIELD OF CHILLI

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ABSTRACT

The pot experiment was conducted in the "Field Lab of Plant Stress Management",Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka during the period from October, 2015 to March, 2016 to find out the effect of potassium nitrate and different saline conditionson growth and yield of chilli. The experiment consisted of two factors: Factor A: Three levels of potassium nitrate as K_0: 0 mM KNO_3/kg Soil, K_1: 3.5 mM KNO_3/kg Soil, K_2: 7.0 mM KNO_3/kg Soil and Factor B: Four levels of sodium chloride as S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl. The experiment was laid out in Complete Randomized Design with three replications.The maximum number of fruits plant^{-1}(34.91) and fruit yield plant^{-1}(167.70 g) were obtained from K_2 treatment while the minimum was found from control. In case of salinity, the maximum number of fruits plant^{1}(35.33) and fruit yield plant^{-1}(165.00 g) were obtained from S_0 while the minimum results were found from S_3 treatment. Finally this experimental result suggests that, exogenous application of KNO_3 can effectively mitigate the deleterious effect of salinity in chilli production. The present study revealed that increasing level of salinity decreases the crop yield and negatively affects on other reproductive parameters of chilli.The treatment combination S_3K_1(15 ds/m NaCl and 3.5 mM KNO_3/kg soil) had the maximum sodium ion content in the soil (14.56 ds/m) and the yield plant^{-1}was 155.66 (g). The treatment combination S_3K_2 (15 ds/m NaCl and 7mM KNO_3/kg soil) gave higher yield which was 157.66 (g).

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CHAPTER I

INTRODUCTION

Chilli (*Capsicum frutescens*) is an important spice crop belongs to the family Solanaceae. The genus *Capsicum* contains about 20 species and now five domesticated species e.g. *Capsicum annum*, *Capsicum frutescens*, *Capsicum chinense*, *Capsicum baccatum* and *Capsicum pubescens* are only recognized. Chilli grows well in warm and humid climate. Deep, loamy, fertile soils rich in organic matter are preferred by the crop for satisfactory growth. It also needs well drained soil with adequate soil moisture for the growth of the crop. It grows well mostly in the dry and high land of Bangladesh.

Chilli is grown in all parts of tropical and subtropical regions of the world**.** Owing to its high cash value and consumption rate, the annual trade of chilli is approximately 17 per cent of total spice trade in the world (Krishna *et al*., 2007). Chilli is the second most important Solanaceous crop after tomato throughout the world (Souvanalat, 1999). It is a self pollinated crop but a few percentage of cross pollination may happen by insect.

In Bangladesh, the total production of chilli is about 387,368 thousand tons which was produced from 176,015 hectare of land in the year 2014(BBS, 2014). Red chillies contain small amounts of vitamin-C and large amounts of carotene (provitamin-A). Green chillies (unripe fruit) contain a considerably higher amount of vitamin-C and lower amount of carotene. Chillicontain a complex mixture of essential oils, waxes, colored materials (mainly capsanthin, capsorubin, zeaxanthin, cryptoxanthin and lutein), several capsaicinoids and are commonly used as a pungent flavor in food, natural plant color and pharmaceutical ingredient. Chilli (*Capsicum frutescence* L.) are sensitive to drought stress and moderately sensitive to salt stress. Chilli plants grown under water deficit with excess fertilizers accumulate large amounts of sodium (Na), potassium (K) and chloride (Cl) (Hussein *et al.*, 2012). This leads to an excess ion uptake and an imbalance of various mineral elements. Bangladesh is thought to be one of the most vulnerable countries of the world to Climate Change and Sea Level Rise. There are a number of environmental issues and problems that are hindering the development of Bangladesh. Salinity is such an environmental problem which is expected to exacerbate by climate change and sea level rise in the future. The coastal area of the Ganges delta in Bangladesh is characterized by tides and salinity from the Bay of Bengal. Salinity intrusion due to a reduction of fresh water flow from upstream, salinization of groundwater and fluctuation of soil salinity are the major concern of the coastal area of the country. The higher salinity levels have adverse impacts on agriculture, aquaculture, and domestic and industrial water use and so on (IWM, 2014). Plants exposed to high salinity exhibit membrane destabilization and inhibition of exposed photosynthetic capacity. Negative effects of salinity on pepper plants can be overcome to some extent by foliar application of macro and/or micro nutrients. Studies have also shown an increase in pepper yields with foliar application of K (Greenway *et al*., 1980). The physiological effects of interactions between salinity and mineral nutrition in horticultural crops are extremely complex.

Adverse effects of salinity on plant growth are mainly due to metabolic imbalance caused by ion toxicity. The selection of salt tolerant lines continues to challenge plant scientists, especially those working in the field of physiology and genetics. Chilli, being a long duration and energy rich crop, requires proper manuring and balanced fertilization along with secondary nutrients for higher yield and quality produce (Prasad *et al.*, 2009). Nutrient management as split application of fertilizers, use of different sources of fertilizers and their integrated use have proved to be very effective in increasing nutrient use efficiency, crop productivity and reducing nutrient losses (Shafeek*et al.*, 2012).Chilli, being indeterminate in nature, vegetative and reproductive stages overlap and the plants need nutrients even up to maturity and fruit ripening. Mitigation of soil salinity and its impact on plants must therefore be considered somewhat differently in the context of these three scenarios. Salinity is often accompanied by other soil properties, such as sodicity, alkalinity, or boron toxicity, which exert their own specific effects on plant growth.Waterlogging often accompanies salinity due to clearing or to irrigation.Salts in soils are primarily chlorides and sulfates of sodium, calcium, magnesium, and potassium. Symptoms of soil salinity include slow and spotty seed germination, sudden wilting, stunted growth, marginal burn on leaves (especially lower, older leaves), leaf yellowing, leaf fall, restricted root development, and sudden or gradual death of plants. There are commonly two ways in which salinity stress of crops can be mitigated - by changing farm management practices, and by breeding for increased salt tolerance in crops.

Soil salinity in the coastal areas of Bangladesh varies from 12- 16 dS/m depending on the distance from the sea. However, due to saline intrusion, increasingly more lands fall towards the higher end of the range.

SOIL SALINITY CLASSES AND CROP GROWTH IN BANGLADESH

Soil Salinity Class	Conductivity of the Saturation Extract (dS/m)	Effect on Crop Plants
Non saline	0 - 2	Salinity effects negligible
Slightly saline	2 - 4	Yields of sensitive crops may be restricted
Moderately saline	4 - 8	Yields of many crops are restricted
Strongly saline	8 - 16	Only tolerant crops yield satisfactorily
Very strongly saline	> 16	Only a few very tolerant crops yield satisfactorily

Potassium is one of the important macronutrients required for the growth,development, yield, and quality ofplants, and it also plays a key role in thesurvival of plantsunder abiotic stress conditions, as stress negatively affects the physiological processes of plants such as root andshoot elongation, enzyme activity, water and assimilatetransport, synthesis of protein, photosynthetic transport, and chlorophyll content (Yin and Vyn, 2003). Under saline field conditions, plantssuffer a deficiency of potassium mainly because of the excess of Na+ in the rooting medium, which acts as an antagonist and decreases the availability of potassium (Niuet al., 1995; Rodriguez-Navarro, 2000); thus, under salinitystress, plants face the problem of K deficiency. Therefore,under salinity stress, improving the K-nutritional status of plants

alleviates the detrimental effects of Na^+bydifferent mechanisms, including K^+= Na^+discrimination (Rodriguez-Navarro, 2000; Rubio et al., 2009).As higher levels of NaCl cause K-deficiency, this maybe one of the factors of oxidative stress. Hence, under saltstress, improving the K-nutritional status of the plantscould be used as a tool to minimize oxidative cell damage,at least by the reduced formation of reactive oxygenspecies during photosynthesis and by the inhibition of NADPH oxidase generating O2•–(Shen et al., 2000). Previous reports suggest thatunder salinity stress, maintaining a sufficient supply ofpotassium to the plant alleviates the negative effects ofsalinity in different crops like strawberry (Kaya et al., 2003;Khayyat et al., 2009); bell pepper (Kaya et al., 2003); maize,wheat, soybean, and cotton (Pettigrew, 2008); and pepper(Rubio et al., 2009). Donald et al. (1998) reported thatunder water deficit, supplementary potassium via foliarfeeding maximized the yield of cotton. Kaya et al. (2001,2003) reported that foliar application of K fertilizer couldbe effective in correcting salinity-induced K-deficiency, significantly decreasing salinity-induced damage tomembranes and increasing biomass production in tomato, chilli and strawberry.

Considering the above mentioned facts this research work was under taken with the following objectives-

- To determine the effect of KNO_3 on the growth and yield of chilli;
- To investigate the effect of different salinity levels on the growth and yield of chilli; and
- To assess the combined effect of salinity and KNO_3 on the growth and yield of chilli

CHAPTER II

REVIEW OF LITERATURE

Chilli (*Capsicum frutescens*) is one of the popular solanaceous crop cultivated in Bangladesh. Very few research works have been done for the improvement of this crop in Bangladesh and other countries of the world. Soil salinity is one of the most significant abiotic stresses for crop species. Sustainable and equitable global food security is partly dependent on the development of crops and horticultural plants with increased salt tolerance.Increased salt tolerance of perennial species used for fodder or fuel production is also a key component in reducing the spread of secondary salinity in many regions in the world. In the last few years, considerable progress has been made in the analysis of the transcript to study salt stress either alone or in combination with other abiotic stresses. The present review summarizes current research findings for the analysis of plant salt tolerance.

2.1 Review in relation to the effect of potassium on chilli

Naeem *et al*. (2002) was conducted an experiment the effect of different levels of nitrogen (0, 30, 60, 90 kg ha^{-1}) and phosphorus (0, 30, 60 kg ha^{-1}) with a constant dose of potash (30 kg ha^{-1}) on the growth and yield of chilli cultivar Sanam. Minimum days to flowering (42 days) and days to flowering (54 days) were recorded in plots fertilized with (30-60-30 kg NPK ha^{-1}) and (30-30-30 kg NPK ha^{-1}), respectively. Maximum number of brunches per plant (10.00), plant height (98.27 cm), number of fruits per plant (51.73) and total yield (7679.66 kg ha^{-1}) was recorded in plots fertilized with 90-60-30 kg NPK ha^{-1}. However maximum number of fruits was recorded at fertilized level of 60-30-30 kg NPK ha^{-1}. It is suggested that chilli cv. Sanam should be fertilized with 90-60-30 kg NPK ha^{-1} under the agronomic conditions of Peshawar.

Khan *et al*. (2014)reported that the effect ofdifferent levels of nitrogen (0, 60, 120 and 180 kg ha^{-1}) and potassium (0, 30, 40 and 50 kg ha^{-1}) on all growth and yield parameters. Nitrogen application at the rate of 180 kg ha^{-1} significantly affected plant height (68.3 cm), number of leaves per plant(294), number of branches per plant (18.3), stem thickness (2.43 cm), fruits per plant (59.4), fruit length (6.83 cm), seeds per fruit (152) and yield (8.803 tons ha^{-1}). The maximum number of fruits per plant (47.7), fruit length (5.76 cm), seeds per fruit (109), chlorophyll content (78.02) and higher yield (7.102 tons ha^{-1}) were recorded with 50 kg K ha^{-1} which was statistically at par with 40 kg K ha^{-1} except for fruit length. Application of 180-40 kg N-K_2O are recommended for better growth and yield of chillies under the agro-climatic conditions of Dargai, Malakand Pakistan.

Murugan (2001) observed that nitrogen and phosphorus application increased the ascorbic acid content and capsaicin contentin green, ripe and dry chilli. Sources of phosphorus did not have any significant effect on theascorbic acid content. The maximum ascorbic acid content was recorded in green fruit whichdecreased gradually with maturity of fruit, recording the lowest value in dry pod, while capsaicincontent was lowest in green fruit and maximum in dry pod.

Johnson and Decoteau (1996) reported that the influence of N and K rates in Hoagland’s nutrient solution on Jalapenopepper (*Capsicum annuum*L.) plant growth and pod production was determined ongreenhouse-grown plants in sand culture. Varying the rates of N (1 to 30 mM) and K (1 to12 mM) in Hoagland’s solution identified optimum concentrations for Jalapeno plantgrowth and pod production. Optimum N rate for pod yield was15 mM. Nitrogen rate affected pungency of pods, with 1 mM Nreducing capsaicin levels in fruit compared to other N rates. The optimum K rate for pod yield was6 mM. Potassium rates did not affect pod pungency. Jalapeno peppers grown in sand culture required 15 mM N and at least 3 mM K for optimum pod production.

Medina-Lara*et al*. (2008) conducted an experiment to find out the effect of N or K fertilization on Habanero pepperdevelopment and fruit pungency. Nitrogen fertilization significantly increased plant growthand fruit while maintaining high capsaicin levels. Optimum response was produced with15 mM urea as the N source. Potassium fertilization had no positive effects on growth or productivity. The K: N ratio (specifically in leaves and roots) varied between treatments with values greater than 1 in the K treatments, near 0.5 in the control and less than 0.5 in the N treatments.

Aminifard *et al*. (2012) was carried out an experiment to evaluate response of paprika pepper (*Capsicum annuum* L.) to nitrogen (N) fertilizer under field conditions. Nitrogen was supplied in four levels (0, 50, 100 and 150 kg ha^{-1}). The results showed that plant height, lateral stem length and leaf chlorophyll content were influenced by N fertilizer. Data indicated that fertilization with 50 g N ha^{-1} resulted to the best yield and quality components at ripening stage. Thus, these results showed that fertilization with 50 kg N ha^{-1}hadstrong impact on vegetative and reproductive growth of paprika pepper under field conditions.

Aldana (2005) was evaluated in a preliminary experiment conducted the effects of P and K fertilization on chilli growth and fruit quality; 4 levels of P (0.25, 1.0, 1.75, and 2.5 mM) and 4 levels of K (0.75, 1.75, 2.75, and 3.75 mM) in hydroponic culture with a factor randomized design. The dry root weights of plants grown with the highest K rate (K_4) were significantly higher than the lowest k rate (K_1). Potassium source was changed for the main plant growth experiment. Phosphorus and potassium rates significantly affected plant growth, increasing plant height, weight, stem diameter, leaf area and dry weights of plant sections with increasing ratesin nutrient solution. For the fruit quality experiment, all plants were grown until the flowering stage with the same nutrient solution (2 mM P; and 3.75 mM K). Increasing P and K rates affected plant yield and some fruit quality variables. Results were consistent for most of the variables, suggesting that the 0.25 mM concentration for both P and K was insufficient for pepper production. Concentrations higher than 1.25 mM and close to 2.5 mM are the most appropriate for hydroponic tabasco pepper production.

Bhubaneswar *et al*. (2014) was carried out an experiment to evaluate response of sweet pepper (*Capsicum annuum* L.) to plant density and potassium fertilizer under field conditions. Plant density at four levels (20×50 cm, 30×50 cm, 20×100 cm and 30×100 cm) and nitrogen treatments at four levels (0, 50, 100 and 150 kg K/ha) were applied. The results showed that vegetative growth characteristics (plant height, lateral stem number and leaf dry matter) and reproductive factors (fruit volume, fruit weight and plant yield) decreased with increasing plant density, but total yield (kg/ha) increased with increasing plant density. The highest and lowest total yields were obtained by plant density 20×50 cm and 30×100 cm respectively. Nitrogen fertilizer was significantly affected on plant height, lateral stem number and leaf chlorophyll content. It was observed that fertilization with 50 kg K/ha resulted to the highest fruit volume and plant yield.

Yasuor *et al*. (2013) observed that producers of horticultural products face new and growing standards regarding food quality and safety as well as environmental responsibility and sustainability. Pepper cultivars with different vegetative vigor were drip-irrigated with solutions containing 9.2, 56.2, 102.3 and 158.5 mg L^{-1} nitrogen (N). Maximum yields were found when peppers were irrigated with 56.2 mg·L^{-1} N. Nitrogen concentrations of 102.3 and 158.5 mg L^{-1} N loaded 400 and 800 kg ha^{-1}N into the environment, respectively, whereas for the 56.2 mg L^{-1} N concentration, N was almost completely taken up and used by the plants. Nitrogen treatments had no significant negative effect on pepper fruit physical or chemical quality parameters including sugar content and acidity. Reduced N application did not affect nutritional quality components of the pepper fruit such as b-carotene and lycopene content or total antioxidant activity. The vigorous cultivar used N more efficiently.

Hasan *et al*. (1993) reported that Green pepper (*Capsicum annuum* L. cv. Lady Bell) was grown for 7 weeks and transplanted into the field. The following rates of N were applied: 112, 224, 336 and 448 kg/ha. As N rates increased, plants exhibited poor early growth and produced lower early and total fruit yields. Doubling the N rate from 112 to 224 kg/ha resulted in a 21% increase in flowerbeds, but the percentage of fruit set decreased as N rates increased. Fruit set correlated negatively with total leaf N and positively with plant weight, suggesting that a high leaf N content and a lower plant weight were detrimental to fruit set and yield of green pepper

Mavengahama *et al*. (2003) were conducted an on-farm trials experiment in the Chinyika Resettlement Area of Zimbabwe to study the response of paprika (*Capsicum annuum* L.) to four basal fertilizer treatments [no basal fertilizer, 500 kg/ha cattle manure,200 kg/ha Compound D (7N:14P_2O_5:7K_2O), or 200 kg/ha Compound L (5N:17P_2O_5:10 K_2O)] and three ammonium nitrate (AN) topdressing treatments (no AN application, application of 350 kg/a AN as single dose or 2-split application).The non-application of AN significantly reduced total and marketable yields, pod number per plant and pod mass. However, there were no differences in fruit yields and fruit parameters due to the application of AN either as a single dose or in 2-split application. The concentrations of N, P, K, Ca and Mg in pods were not affected by AN topdressing at both sites. Phosphorus concentration in leaves decreased significantly with the application of AN. There were no significant differences in fruit ASTA content among the treatments.

Haasan *et al*. (1995) was conducted a field experiment 10 study the influence of levels of potassium fertilizer (0, 66 and 132 kg ha^{-1}) and types of mulching (black plastic, reflective plastic and coconut fronds) on growth and yield of chilli. Plant height, yield, fruit number and dry weight of plant increased with increasing K levels and mulching. Yields were increasedby89% and 142% with K levels of66 and 132 kg ha^{-1}, respectively. Highest yield was obtained from plant grown under reflective plastic mulch. Nitrogen, P, K and Ca content in leaf tissues, soil temperature and moisture under mulched conditions were higher than without mulch. There was a positive correlation between plant dry weight with soil temperature and moisture.

Reyes *et al*. (2008) was conducted an experiment to compare different formulations of a slow-release fertilizer with a conventional fertilizer program to determine their impaction yield and growth of bell pepper (*Capsicum annuum*). Treatments were compared with the extension-recommended rate of 200 lb/acre nitrogen (N) (NC-200) and a high-input fertilizer rate of 300 lb/acre N (HI-300) from calcium nitrate injected in 12 weekly applications of drip irrigation. The slow-release granular formulation at 200 lb/acre N produced the highest marketable yield and better canopy quality in eastern soil. Low rates (150 lb/acre N) of one of the liquid formulations performed better in total and marketable NUE thanNC-200 and HI-300. Liquid and dry formulations of slow-release fertilizer showed a potential to be used on bell pepper production across the state at reduced N rates, with greater impact on yield in coarse-textured soils found predominantly in the eastern coastal plain region.

Bahuguna *et al*. (2016) conducted a field experiment at the research farm of Institute of Medicinal and Aromatic Plants, Gainsaid, Uttara hand University of Horticulture and Forestry, to find out the effects of optimum levels of fertilizer on growth and yield attributes of capsicum, consisting four levels of nitrogen (0, 40, 80 & 120 kg ha^{-1}), three levels of phosphorus (0, 40 & 70 kg ha^{-1}), three levels of potash (0, 30 & 60 kg ha^{-1}) and one level of vermin-compost (200 q ha^{-1}) along with control on sweet pepper in randomized block design with three replications. Plant height at harvest, number of fruits per plant, fruits maturity and fruits yield increased significantly with T_{20} treatment (nitrogen, phosphorus, potash and vermin-compost 120:40:60:20000 kg ha^{-1}). However, fruits length, fruits width and fruits weight increased significantly with increasing T_{10} treatment (nitrogen, phosphorus and potash 120:40:60 kg per ha) level.

Roy*et al*. (2011) conducted a field experiment to study the effects of nitrogen and phosphorus on the fruit size and yield of Capsicum. The treatments comprised 4 levels of N (0, 50, 100 & 150 kg ha^{-1}) and 3levels of P (0, 30 & 60 kg ha^{-1}). Length and breadth of fruit and number of fruits per plant increased significantly with increasing nitrogen doses up to 100 kg N ha^{-1}. However, average weight of fruit content increased significantly up to 150 kg N ha^{-1}. On the other hand, average weight of fruit and yield increased significantly with the increasing levels of P up to the treatment 30 kg P ha^{-1}, whereas length of fruit and number fruits per plant was increased significantly up to the 60 kg P ha^{-1}. Considering the combined effect of nitrogen and phosphorus, the maximum significant length of capsicum, breadth of capsicum, number of fruits per plant and, average weight of fruit as well as yield were found in the treatment combination of 150 kg N and 30 kg P ha^{-1}.

Silva *et al*. (1999) was conducted an experiment to evaluate the effect N and K_2O on the production and yield of sweet pepper plants, related to the characteristics of growth (weight, length and diameter) and total number of fruits per plant, per area. The experiment was conducted with the following treatments: control and combination of three rates of N (13.3, 26.6, and 39.9 g m^{-2}) and three rates of K_2O (13.3, 26.6 and 39.9 g m^{-2}). Nitrogen fertilizer increased the maximum dry matter of the stem, leaves and roots, but not of fruit dry matter production. The optimal rate for maximum dry matter accumulation of N was 27.0 g m^{-2}.

2.1 Review in relation to the effect of salinity on chilli

Kaveh *et al.* (2011) carried out an experiment on the effect of high salt concentrations in soil and irrigation water which restricted establishment and growth of tomato (*Solanumlycopersicum*). Correcting saline condition in field and greenhouse would be expensive and temporary while selection and breeding for salt tolerance can be a wise solution to minimize salinity effects as well as to improve production efficiency. In order to find any kind of tolerance to saline condition, effects of four salinity levels in irrigation water (0.5, 2.5, 5, and 10 dsm^{-1}) on seed germination and seedling emergence, and growth of tomato lines LA3770, R205, CT6, Fla, and ME were investigated in a greenhouse. They found that germination percentage and rate, emergence percentage and rate of all tomato lines were delayed and decreased by salinity. All seedling growth characters, except seedling height were decreased with increasing salinity levels. At germination and emergence stage, LA 3770 were more tolerant to salinity than others.

Ghorbanpour *et al*. (2011) investigated the effect of salinity and drought stress on fenugreek germination indices. To create salinity stress, sodium chloride (NaCl) at the levels of 0 (as control), -3, -6 and -9 bar, and for drought stress, polyethylene glycol 6000 (PEG 6000) in osmotic levels at 0 (as control), -3, -6 and -9 bar were used. Result showed significant difference between evaluated indices. They found that increasing of stress levels led to reduction of germination and epicotyls and hypocotyls length. Also, both salinity and drought cause reduction in germination and growth indices, however, a few of the seeds conserved germination viability. Therefore, Fenugreeks have relative resistance to salinity and drought stress in germination stage. Seeds of four spinach cultivars were used by Turhan *et al.* (2011) to investigate the effects of different NaCl concentrations on their germination percentage, germination index, relative germination rate and germination time. The results showed that different treatments of salinity had statistically considerable effects on the germination percentage, germination index relative germination rate and germination time.

Salt tolerance of five cultivars of *Capsicum annuum* L. were evaluated by Niu*et al.* (2010). Seedlings were transplanted in late May to field raised beds containing loamy sand soils in a semi-arid environment. Plants were well irrigated throughout the experiment. Three saline solution treatments, prepared by adding NaCl, $MgSO_4$ and $CaCl_2$ to tap water at different amounts to create three salinity levels of 0.82 dS m^{-1} (control, tap water), 2.5 dS m^{-1}, and 4.1 dS m^{-1} electrical conductivity (EC), were initiated on 15th June and ended in late August. The most tolerant to salinity had the lowest leaf Na^+ accumulation while the most sensitive to salinity had the highest Na^+ in the leaves.

Bybordi (2010) conducted an experiment to study the salinity stress effects resulted from sodium chloride on germination, vegetative growth, elements concentration and proline accumulation in five canola cultivars. The results showed that different salinity stress levels had significant effect on germination percentage, germination speed, shoot and root length. In the pot experiment, there was a significant effect on plant height, leaf area, dry matter, elements concentration, proline accumulation and seed yield due to salinity stress.

Nawaz *et al.* (2010) carried out a study of salt tolerance induction in two cultivars of sorghum by exogenous application of different levels (0, 50 mM and 100 mM) of proline. Salt treatments (100 mM) adversely affected the germination percentage, growth and chlorophyll contents of both cultivars. However, applications of proline alleviated the adverse effects of salt stress. However, high concentration of proline (100 mM) was not as much effective as compared to low concentration i.e. 50 mM in both cultivars.

Khan *et al*. (2009) conducted an experiment on the effect of seed priming with salicylic acid (SA) and acetylsalicylic acid (ASA) in improving seed vigor and salt tolerance of hot pepper. They found that hormonal priming, especially with acetylsalicylic acid, can be a good treatment for hot pepper to enhance uniformity of emergence and seedling establishment under normal as well as saline conditions.

Cho and Chung (1997) illustrated that fruit size, fresh and fruit dry weight of chill decreased with increased salinity. They also stated that the percentage of puffy fruits was reduced higher salinity.

Houimli *et al*. (2008) investigated the inhibitory effect of salinity on pepper plants. A short-term experiment was conducted in greenhouse to test different concentrations of 24-epibrassinolide by foliar application on growth and development. They found that its effects were more pronounced on the shoot than root growth. An exogenous supply of24-epibrassinolide was found to be successful in alleviating of the inhibitory effects of salt stress on shoot growth parameters and the leaf relative water contents. Regarding biochemical analysis the sugar; praline content increased with increasing salinity level where as protein content decreased in the physiologically active leaves of different treatments for all the varieties of wheat.

An experiment was conducted by Bajehbaj (2010) to evaluate the effects of NaCl priming with KNO_3 on the germination traits and seedling growth of four chill cultivars under salinity conditions. Experiment was conducted using various osmotic pressures induced by NaCl (5, 10, 15, 20 and 25 dS/m). Results showed that germination percentage of primed seeds was greater than that of un-primed seeds. Radicle length, seedling height and dry weight and leaf number of plants derived from primed seeds were higher compared with un-primed seeds. Na content of plants derived from primed seeds was higher than that of un-primed ones. In contrast, K content of priming resulted plantlets was comparatively higher compared with un-primed counterparts.

Khan *et al*. (2009) conducted an experiment on the effect of seed priming with salicylic acid (SA) and acetylsalicylic acid (ASA) in improving seed vigour and salt tolerance of hot pepper. They found that hormonal priming, especially with acetylsalicylic acid, can be a good treatment for hot pepper to enhance uniformity of emergence and seedling establishment under normal as well as saline conditions

Golezanik and Esmaeilpour (2008) investigated the influence of salt priming (3% KNO_3 for 3 days and 1% NaCl for 2 days at 20˚C) on germination, seedling emergence and seedling dry weight of two Iranian chilli cultivars viz. Basmenj and Varamin harvested at 25, 35 and 45 days after anthesis (DAA) in an unheated glasshouse. Maximum advantage of priming seedling vigour was observed in seeds harvested at 25 DAA. Smaller effects of priming were also seen in the decreased mean germination and emergence times and increased seedling dry weight of seeds harvested at 35 and 45 DAA. In all cases, KNO_3 priming was more effective than NaCl priming. Therefore, KNO_3 priming can be used to improve chilli seedling emergence and establishment, particularly in early spring sowings at low temperatures.

Cho *et al.* (1996) indicated that total fresh, dry weight, length of fruit, and yield of chilli fruits decreased with increasing salinity.

Jamil *et al.* (2006) conducted an experiment where four *Capsicum* species were treated with different concentrations of salt solution to study their response to salinity. Results indicated that salinity caused significant reduction in germination percentage, germination rate, root and shoot lengths and fresh root and shoot weights.

Hajer *et al.* (2006) conducted an experiment on effect of sea water salinity (1500, 2500 and 3500 ppm) on the growth of pepper (*Capsicum frutescence*) cultivars. They found that sea water salinity delayed seed germination and reduced germination percentage especially with increasing salinity level. Chlorophyll b content was higher than chlorophyll a, and both of them decreased with increasing salinity. The seedling height increased with time but decreased with increasing salinity in all cultivars. Seedlings fresh and dry shoot and root weights were decreased with increasing salinity. The growth of stem, leave and root after over 80 days of exposure to sea water salinity was affected by sea water dilution.

Midan *et al.* (1985) conducted an experiment to study the effects salinity on chilli yield. The weight of individual fruit decreased with the increased salinity levels.

CHAPTER III

MATERIALS AND METHODS

This chapter deals with the materials and methods that were used in carrying out the experiment.

3.1 Location of the experiment field

The experiment was conducted at the field Laboratory of plant stress management, Horticultural farm, Department of Horticulture, Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka 1207, Bangladesh during the period from October, 2015 to March, 2016. The location of the experimental site was at 23°75′ N latitude and 90°34′ E longitudes with an elevation of 8.45 meter from sea level.

3.2 Climate of the experimental area

The experimental area is characterized by subtropical rainfall during the month of May to September (Anonymous, 1988) and scattered rainfall during the rest of the year. Information regarding average monthly temperature as recorded by Bangladesh Meteorological Department (climate division) during the period of study has been presented in Appendix III.

3.3 Soil of the experimental field

Soil of the study site was silty clay loam in texture belonging to series. The area represents the Agro-Ecological Zone of Madhupur tract (AEZ No. 28) with pH 5.8-6.5, ECE-25.28 (Haider *et al*., 1991). The analytical data of the soil sample collected from the experimental area were determined in the Soil Resources Development Institute (SRDI), Soil Testing Laboratory, Khamarbari, Dhaka and have been presented in Appendix IV.

3.4 Plant materials collection

The seeds of chilli (Variety: Lalon) were collected from seed market, Siddique bazar, Gulistan, Dhaka, Bangladesh.

3.5 Treatments to individual plant

The experiment was consisted of two factors:

Factor A: Different levels of KNO_3

i. K_0: 0 mM/kg soil

ii. K_1: 3.5 mM/kg soil and

iii. K_2: 7.0 mM/kg soil

Factor B: Different levels of NaCl

i. S_0: 0 ds/m

ii. S_1: 5.0 ds/m

iii. S_2: 10.0 ds/m

iv. S_3: 15.0 ds/m.

There were in total 12 (3×4) treatment combinations such as: S_0K_0, S_0K_1, S_0K_2, S_1K_0, S_1K_1, S_1K_2, S_2K_0, S_2K_1, S_2K_2, S_3K_0, S_3K_1, S_3K_2.

3.6 Design and layout of the experiment

The experiment was laid out in Completely Randomized Design (CRD) having two factors with three replications. The experimental area was divided into three equal blocks. Each block was covered by 12 pots and 3 pots for each replication. Therefore, total number of pot was 108 (3×12×3) where 12 treatment combinations were applied. The size of each pot was 1.2 ft diameter and x 1.2 ft height. The distance maintained between three blocks and two pots were 1.0 m and 0.5 m respectively.

3.7 Preparation of seedling

Chilli seedlings were raised in four plastic pots. Before the soil was well prepared and converted into loose friable and dried mass by spading. All weeds and stubbles were removed and 5 kg well rotten cow dung was mixed with the soil. The seed were dipped in water for whole night before sowing for better germination. Seeds were sown on each plastic pots on 21 October, 2015. After sowing, seeds were covered with light soil. The emergence of the seedlings took place within 5 to 6 days after sowing. Weeding, mulching and irrigation were done as and when required. After 30 days of seed sowing they are ready for transplanting to the pot.

3.8 Preparation of the pot

The experimental pots were first filled with soil at 14th November, 2015. Plastic pots were used in this experiment. The height and width of each pot was 35 and 30 cm respectively. Two holes were made in the middle of the bottom of each pot and holes were covered by the broken pieces of earthen pot. All the pots were washed with ash and tap water by rubbing and sun dried. The fertilizer mixed soil was made well pulverized and dried in the sun. Final check was made to remove plant propagates, inert materials, visible insect and pests.

3.8.1 Manure and fertilizers and its methods of application

Manures and fertilizers have been applied to the pot soil by following doses

Fertilizer	Quantity	Application method
Cow dung	10 t/ha	Basal dose
Urea	210 kg/ha	15,30 and 45 DAT
TSP	330 kg/ha	Basal dose
MoP	200 kg/ha	15,30 and 45 DAT mixed with urea
Borax	5 kg/ha	Basal dose

Source: Razzak *et al.* (2011).

The entire amount of cowdung, TSP and Borax were applied as basal dose during pot preparation. Urea and MoP were used as top dressing in equal splits at 15, 30 and 45 days after transplanting.

3.9 Transplanting of seedlings to the pot

Healthy and uniform 30 days old seedlings were uprooted separately from the seed bed and were transplanted in the experimental pots in the afternoon on 22 November 2015. This allowed an accommodation of 02 plants in each pot. The seed bed was watered before uprooting the seedlings from the seed bed so as to minimum damage to the roots. The seedlings were watered after transplanting. Shading was provided using banana leaf sheath for three days to protect the seedling from the hot sun and removed after seedlings were established. They (transplants) were kept open at night to allow them receiving dew. Each pot allowed two seedlings in the pot and one seedling is removed from pot after healthy establishment of seedlings.

3.10 Application of KNO_3 and NaCl solutions

As per treatment the required amount of KNO_3 and NaCl solution were applied. A tray was used in the bottom of each pot to collect the water and different nutrient. KNO_3 and NaCl solution were applied in the pot soil at 20DAT ,50DATand 80DAT (days after transplanting).

3.11 Intercultural operations

After transplanting the seedlings to the pot, various intercultural operations such as weeding, earthing up, irrigation, pest and diseases control etc. were accomplished for better growth and development of the chilli seedlings.

3.11.1 Weeding

The hand weeding operation was done as when necessary to keep the pot weed free condition.

3.11.2 Earthing up

The earthing up at 20 and 30 days after transplanting on the basement of the plant by taking the soils from the boundary side of the pots by hands.

3.11.3 Irrigation

Number of irrigations were given throughout the growing period by using watering cane. The first irrigation was given immediate after the transplantation whereas others were applied depending upon the condition of soil.

3.11.4 Plant protection

Chilli plants infected with anthracnose and die back were controlled by spraying cupravit (3g/L) at 15 days interval. Few plants found to be infected by bacterial wilt were uprooted. The established plants were affected by aphids. Diazinon 60EC (15cc/10 L) was applied against aphids and other insects.

3.12 Harvesting

Fruits were harvested at 6 to 7 days intervals during early ripe stage when they attained marketable size. Harvesting was started from 10th March, 2016 and was continued up to 25th of March 2016.

3.13 Data collection

Data on the following parameters were recorded from the plant of each pot during the course of the experiment.

3.13.1 Plant height

The plant height was measured in centimeters from the base of plant to the terminal growth point of main stem at 25, 50, 75 and 100 days after transplanting to observe the growth rate of plants.

3.13.2 Measurement of sodium ion (Na^+) and potassium ion (K^+)

Sodium and potassium ions were determined by the EC meter and Flame photometer respectively at Department of Agricultural Chemistry, SAU. Two separate meters (EC meter for Na^+ and Flame photometer for K^+) were used for a quick and reliable measurement of sodium and potassium ions at the scene using ion selective membrane and results were calculated at ds/m and mM/kg units respectively. The measurements of sodium ion (Na^+) and potassium ion (K^+) were done at 85 DAT.

3.13.3 Days required to first flowering

Days required for transplanting to first flower initiation was counted from the date of transplanting to the blooming of first flower in the cluster and it recorded in the note book.

3.13.4 No. of primary branches

The number of primary branches was measured from the growing point of main stem at 25, 50, 75 and 100 days after transplanting to observe the growth rate of plants.

3.13.5 Length of fruit with pedicel

The length of fruit was measured with a meter scale from the tip of the fruit to the point of pedicel attached to the plant of plants from each pot.

3.13.6 Individual fruit weight

Among the total number of fruits during the period from first to final harvest the fruits, except the first and final harvest, was considered for determining the individual fruit weight. The weight of individual fruit was measured with a digital weighting machine from each pot and calculated by the following formula and expressed in gram.

$$\text{Weight of individual fruit (g)} = \frac{\text{Total weight of fruit (g)}}{\text{Total number of fruits (g)}}$$

3.13.7 Number of fruits plant^{-1}

The number of fruits per plant was counted from the plant of each pot and the number of fruits per plant was recorded.

3.13.8 Fruit yield plant^{-1}

Yield of chilli per plant was recorded as the whole harvesting period and calculated and expressed in grams.

3.13.9 Chlorophyll content

SPAD value or chlorophyll content was determined from the plant's leaves by using an automatic SPAD meter (KONIKA MINOLTA SPAD-502 plus), a product of Japan. SPAD value was recorded at flowering stage.

3.13.10 Dry matter of plant

After harvesting, 150g plant sample previously sliced into very thin pieces were put into envelop and placed in oven maintained at 70^0C for 72 hours. The sample was the transferred into the desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. The dry matter contents of plant were computed by simple calculation from the weight recorded by the following formula:

$$\% \text{ Dry matter content of plant} = \frac{\text{Dry weight of plant}}{\text{Fresh weight of plant}} \times 100$$

3.13.11 Dry matter of fruit

After harvesting, randomly selected 150g fruit sample previously sliced into very thin pieces were put into envelop and placed in oven maintained at 60^0C for 72 hours. The sample was the transferred into the desiccators and allowed to cool down at room temperature. The final weight of the sample was taken. The dry matter contents of plant were computed by simple calculation from the weight recorded by the following formula:

$$\% \text{ Dry matter content of fruit} = \frac{\text{Dry weight of fruit}}{\text{Fresh weight of fruit}} \times 100$$

An electric balance was used to measure the weight of fruits per plant. The total fruit yield of each plant measured separately during the harvest period and was expressed in gram (g).

3.14 Statistical analysis

The recorded data on various parameters were statistically analyzed using MSTAT-C statistical package program. The mean for all the treatments was calculated and analysis of variance for all the characters were performed by F- Difference between treatment means were determined by LSD method according to Gomez and Gomez, (1984) at 5% level of significance.

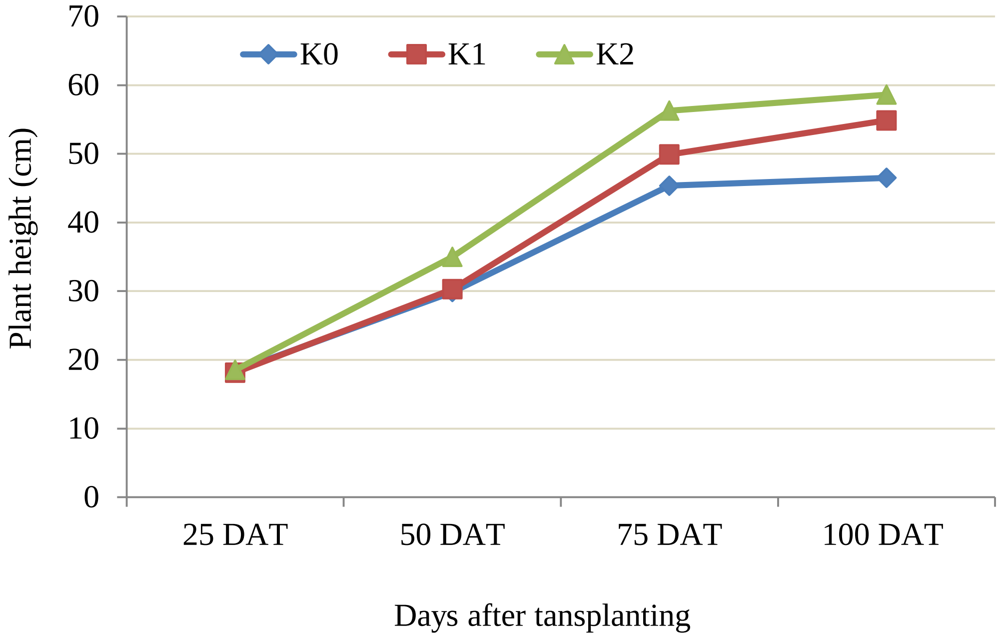
CHAPTER IV
RESULTS AND DISCUSSION

The present study was conducted to find out the effect of potassium nitrate on chilli at different saline conditions at the "Field Lab of Plant Stress Management", Horticultural Farm, Sher-e-Bangla Agricultural University (SAU), Dhaka.Data on different growth and yield contributing parameters were recorded. The analysis of variance (ANOVA) of the data on different growth and yield parameters are given in Appendix IV-VII. The results have been presented and discussed with the help of tables and graphs and possible interpretations were given under the following headings:

4.1 Plant height

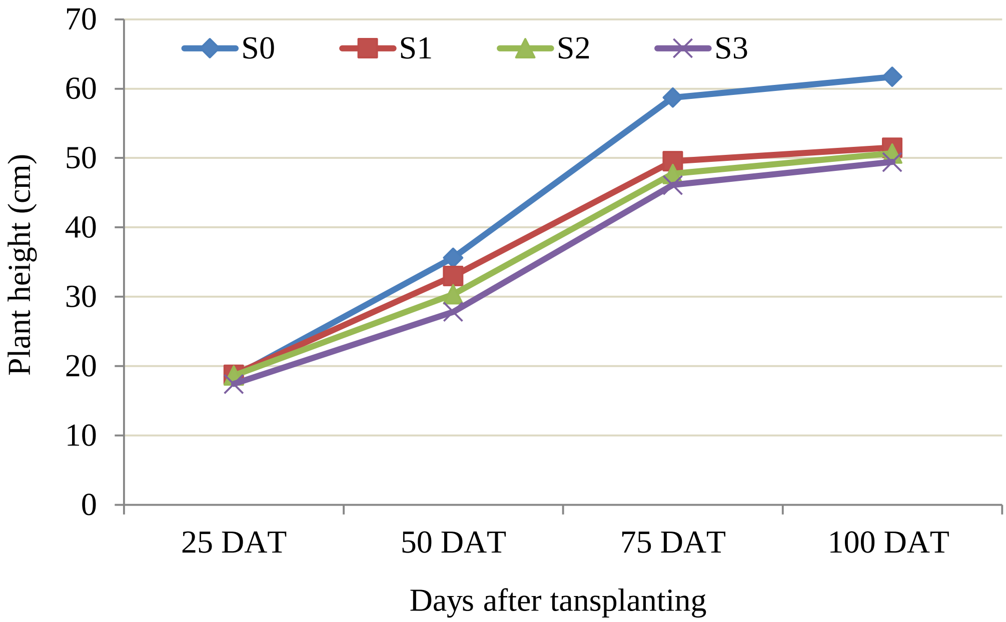
Significant difference was observed due to the application of different levels ofpotassium nitrate on plant height at 50, 75 and 100 DAT.At 50, 75 and 100 DAT, the tallest plant height (35.00, 56.29 and 58.62) was recorded from K_2treatmentwhich was closely followed (30.29, 49.91 and 54.87) by K_1treatment whereas the shortest plant (29.87, 45.37 and 46.50) was recorded from K_0treatment (Figure 1). Khan *et al*. (2014) reported the similar results in his experiment on chilli. Bhuvaneswari *et al*. (2014) carried out an experiment to evaluate response of sweet pepper (*Capsicum annuum* L.) to plant density and potassium fertilizer under field conditions. He also reported the similar results.

Significant difference was observed due to the application of different levels sodium chlorideon plant heightat 50, 75 and 100 DAT.At 50, 75 and 100 DAT, the tallest plant height (35.66, 58.72 and 61.72) was recorded from S_0 (control) treatmentwhich was closely followed (33.00, 49.55 and 51.50) by S_1treatment whereas the shortest plant(27.83, 46.11 and 45.33) was



K_0: 0 mM/kg Soil KNO_3, K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

Figure 1: Effect of potassium nitrate on plant height of chilli



S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Figure2: Effect of sodium chloride on plant height of chilli

recorded from S_3 treatment (Figure 2). Ghorbanpour *et al*. (2011) investigated the effect of salinity on chilli and reported the similar results.

Table 1: Combined effect of potassium nitrate and sodium chloride on plant height of chilli

Treatment	Plant height (cm)			
	25 DAT	**50 DAT**	**75 DAT**	**100 DAT**
S_0K_0	19.83 a	28.16 cd	44.33bc	49.16 cd
S_0K_1	16.83 bc	29.16 bcd	53.50 b	61.17 b
S_0K_2	20.16 a	43.33 a	71.66 a	75.16 a
S_1K_0	19.00 abc	37.16 ab	53.83 b	55.00 bc
S_1K_1	18.16 abc	29.66 bcd	47.16 bc	53.00 bcd
S_1K_2	19.16 ab	32.16 bcd	50.33 bc	46.50 cd
S_2K_0	17.83 abc	34.33 bc	49.33 bc	51.50 cd
S_2K_1	18.50 abc	28.66 bcd	55.00 b	55.16 bc
S_2K_2	18.33 abc	34.50 abc	51.00 bc	48.83 cd
S_3K_0	16.33 c	25.16 d	42.16 c	45.33 d
S_3K_1	17.83 abc	32.00 bcd	44.00 bc	50.16 cd
S_3K_2	18.16 abc	26.33 cd	44.00 bc	52.83 bcd
LSD $_{(0.05)}$	2.71	8.95	11.17	9.47
CV %	8.75	16.67	13.06	10.49

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3, K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at 25, 50, 75 and 100 DAT on plant height (Appendix IV). At 25, 50, 75 and 100 DAT, the tallest plant height (20.16, 43.33, 71.66 and 75.16) was recorded from S_0K_2 treatment combination whereas the shortest plant (16.33 cm, 25.16, 42.16 and 45.33) was recorded from S_3K_0 treatment combination (Table 1).

4.2Number of branches plant^{-1}

Significant difference was observed due to the application of different levels potassium nitrate on number of branches plant^{-1}at flowering stage (Appendix V).The maximum number of branches plant^{-1} (6.75) was recorded from K_2treatmentwhich was closely followed (5.08) by K_1 treatment whereas the minimum number of branches plant^{-1} (4.20) was recorded from K_0treatment (Table2). Khan *et al.* (2014)reported the similar results in his experiment on chilli.

Table 2: Effect of potassium nitrate and sodium chlorideon growth and yield characteristics of chilli

Treatment	Number of Branches Plant^{-1}	Days required to first flowering	Dry matter content of plant (%)	Dry matter content of Fruit (%)
K_0	4.20 c	48.00 a	44.98 c	3.31 b
K_1	5.08 b	46.91 a	46.82 b	3.35 b
K_2	6.75 a	45.16 b	48.37 a	3.55 a
LSD $_{(0.05)}$	0.49	1.16	0.83	0.22
S_0	6.27 a	44.00 c	48.24 a	3.40 a
S_1	5.27 b	46.44 b	47.17 b	3.37 a
S_2	5.44 b	47.44 b	46.48 b	3.33 a
S_3	4.38 c	48.88 a	45.01 c	3.01 b
LSD $_{(0.05)}$	0.57	1.34	0.96	0.26
CV %	10.91	2.96	2.11	8.17

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.
K_0: 0 mM/kg Soil KNO_3, K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3
S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences on dry matter content of plant (Appendix V). The maximum dry matter content of plant (50.23 %) was recorded from S_0K_2 treatment combination whereas the minimum dry matter content of plant (44.60 %) was recorded from S_3K_0treatment combination which is statistically identical to S_3K_1treatment combination (Table 3).

Significant difference was observed due to the application of different levels of sodium chlorideon number of branches plant^{-1} at flowering stage (Appendix V). The maximum number of branches plant^{-1}(6.27) was recorded from S_0 (control) treatmentwhich was closely followed (5.27) by S_1treatment whereas the minimum number of branches plant^{-1} (4.38) was recorded from S_3treatment (Table2). Niu *et al,* (2010) observed the similar kinds of results.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stageon number of branches plant^{-1} (Appendix V). The maximum number of branches plant^{-1}(8.66) was recorded from S_0K_2treatment combination whereas the minimum number of branches plant^{-1}(3.66) was recorded from S_3K_0treatment combination (Table 3).

4.3 Days required to first flowering

Significant difference was observed due to the application of different levels of potassium nitrate on days required to first flowering (Appendix V).The minimumdays required to first flowering(45.16 days) was recorded from K_2 treatmentwhich was closely followed (46.91 days) by K_1 treatment whereas the maximum days required to first flowering(48.00 days) was recorded from K_0 treatment (Table 2).

Significant difference was observed due to the application of different levels sodium chlorideon days required to first flowering (Appendix IV).The minimum days required to first flowering(44.00 days) was recorded from S_0 (control) treatmentwhich was closely followed (46.44 days) by S_1 treatment whereas the maximum days required to first flowering(48.88 days) was recorded from S_3treatment (Table 2)..

Combined effect of potassium nitrate and sodium chloride application showed the significant differences on days required to first flowering (Appendix V). The minimum days required to first flowering (42.01 days) was recorded from S_0K_2 treatment combination whereas the maximumdays required to first flowering (50.33

days) was recorded from S_3K_0 treatment combination which is statistically identical to S_3K_1 treatment combination (Table 3).

4.4 Dry matter content of plant

Significant difference was observed due to the application of different levels of potassium nitrate on dry matter content of plant (Appendix V). The maximum dry matter content of plant (48.37 %) was recorded from K_2treatmentwhich was closely followed (46.82 %) by K_1 treatment whereas the minimum dry matter content of plant (44.98 %) was recorded from K_0treatment (Table 2). Murugan (2001) observed that nitrogen and phosphorus application increased amount of dry matter content. Aldana (2005) was evaluated in a preliminary experiment conducted the effects of P and K fertilization on chilli growth and found similar results.

Significant difference was observed due to the application of different levels sodium chlorideon dry matter content of plant (Appendix V). The maximum dry matter content of plant (48.24 %) was recorded from S_0 (control) treatmentwhich was closely followed (47.17 %) by S_1 treatment whereas the minimum dry matter content of plant (45.01 %) was recorded from S_3treatment (Table 2). Bybordi (2010) conducted an experiment to study the salinity stress and suggested similar results. Khan *et al*. (2009) conducted an experiment on the effect of seed priming and similar results were found.

4.5 Dry matter content of plant

Significant difference was observed due to the application of different levels potassium nitrate on dry matter content of fruit (Appendix V). The maximum dry matter content of fruit (3.55 %) was recorded from K_2treatmentwhereas the minimum dry matter content of fruit (3.31 %) was recorded from K_0treatment which is statistically identical (3.35 %) to K_1 treatment (Table 2). Bhubaneswar *et al*. (2014) was carried out an experiment to evaluate response of sweet pepper (*Capsicum annuum* L.) to plant density and potassium fertilizer under field conditions. He also reported the similar results. Murugan (2001) observed that nitrogen and phosphorus application increased amount of dry matter content. Aldana (2005) was evaluated in a preliminary experiment conducted the effects of P and K fertilization on chilli growth and found similar results.

Significant difference was observed due to the application of different levels ofsodium chlorideon dry matter content of fruit (Appendix V). The maximum dry matter content of fruit (3.40 %) was recorded from S_0 (control) treatmentwhich is statistically identical to S_1(3.35 %) and S_2 (3.33 %) treatment whereasthe minimum dry matter content of fruit (3.01 %) was recorded from S_3treatment (Table 2). Bybordi (2010) conducted an experiment to study the salinity stress and suggested similar results. Khan *et al*. (2009) conducted an experiment on the effect of seed priming and similar results were found). Hajer *et al.* (2006) conducted an experiment on effect of sea water salinity (1500, 2500 and 3500 ppm) on the growth of pepper (*Capsicum frutescence*) cultivars. He supported the similar results. Cho *et al.* (1996) indicated that dry weight of chilli fruits decreased with increasing salinity. Cho and Chung (1997) illustrated that fruit dry weight of chill decreased with increased salinity.

Table 3: Combined effect of potassium nitrate and sodium chloride on growth and yield characteristics of chilli

Treatment	Number of Branches Plant^{-1}	Days required to first flowering	Dry matter content of plant (%)	Dry matter content of Fruit (%)
S_0K_0	4.66 def	46.66 bc	44.33 g	3.40 a-d
S_0K_1	4.50 efg	49.00 ab	45.00 fg	3.53 ab
S_0K_2	8.66 a	42.01 e	50.23 a	3.56 a
S_1K_0	3.83 fg	48.00 abc	46.00 efg	3.26 a-d
S_1K_1	5.01 de	48.00 abc	47.30 cde	3.50 abc
S_1K_2	7.01 b	44.00 de	49.63 ab	3.06 cde
S_2K_0	4.66 def	46.00 cd	45.00 fg	3.46 abc
S_2K_1	5.50 cd	44.00 de	46.50 def	3.43 a-d
S_2K_2	5.00 de	46.00 cd	47.96 cd	3.10 b-e
S_3K_0	3.66 g	50.33 a	44.60 g	2.80 e
S_3K_1	5.33 de	49.66 a	48.50 bc	3.00 de
S_3K_2	6.33 bc	46.66 bc	45.66 efg	3.20 a-e
LSD $_{(0.05)}$	0.98	2.33	1.66	0.45
CV %	10.91	2.96	2.11	8.17

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3,K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences on dry matter content of fruit (Appendix V). The maximum dry matter content of fruit (3.56 %) was recorded from S_0K_2 (control NaCl + 7.0 mM/kg Soil KNO_3) treatment combination whereas the minimum dry matter content of fruit (2.80 %) was recorded from S_3K_0 (15.0 ds/m NaCl + control KNO_3) treatment combination (Table 3).

4.6 Number of fruits plant^{-1}

Significant difference was observed due to the application of different levels of potassium nitrate on number of fruits plant^{-1} (Appendix VI).The maximum number of fruits plant^{-1}(34.91) was recorded from K_2treatmentwhereas the minimum number of fruits plant^{-1}(32.41) was recorded from $k_0$treatment which is closely followed to (33.66) to K_1 treatment (Table 4).

Table 4: Effect of potassium nitrate and sodium chlorideongrowth and yield characteristics of chili

Treatment	Number of fruits plant^{-1}	Length of fruit (cm)	Weight ofindividual fruit (g)	Chlorophyll content
K_0	32.41 c	8.80 b	5.02 b	65.96 b
K_1	33.66 b	8.87 b	5.10 b	75.70 a
K_2	34.91 a	9.30 a	5.52 a	76.43 a
LSD $_{(0.05)}$	1.06	0.28	0.30	2.17
S_0	35.33 a	9.73 a	5.41 a	76.90 a
S_1	33.11 bc	9.08 b	5.06 bc	76.13 a
S_2	34.00 b	8.61 c	5.25 ab	70.80 b
S_3	32.22 c	8.53 c	4.80 c	66.96 c
LSD $_{(0.05)}$	1.22	0.33	0.26	2.51
CV %	9.19	3.76	6.01	3.53

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3,K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Significant difference was observed due to the application of different levels ofsodium chlorideon number of fruits plant^{-1} (Appendix VI).The maximum number of fruits plant^{-1}(35.33) was recorded from S_0 (control) treatment whereas the minimum number of fruits plant^{-1}(32.22) was recorded from S_3treatment (Table 4).Cho and Chung (1997) illustrated that the percentage of puffy fruits was reduced higher salinity.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stageon number of fruits plant^{-1}(Appendix VI).The maximumnumber of fruits plant^{-1}(37.00) was recorded from S_0K_2 (control NaCl + 7.0 mM/kg Soil KNO_3) treatment combination whereas the minimum number of fruits plant^{-1}(31.00) was recorded from S_3K_0 (15.0 ds/m NaCl + control KNO_3)treatment combination (Table 5).

4.7 Length of fruit

Significant difference was observed due to the application of different levels of potassium nitrate on length of fruit (Appendix VI).The maximumlength of fruit (9.30 cm) was recorded from K_2treatmentwhereas the minimum length of fruit (8.80 cm) was recorded from K_0 treatment which is statistically identical(8.87 cm) to K_1 treatment (Table4). Roy*et al*. (2011) conducted a field experiment to study the effects of nitrogen and phosphorus on the fruit size and yield of Capsicum. He reported the similar result. Bahuguna *et al*. (2016) and Silva *et al*. (1999) also found the similar result.

Significant difference was observed due to the application of different levels of sodium chlorideon length of fruit (Appendix VI). The maximum length of fruit (9.73 cm) was recorded from S_0 (control) treatment whereas the minimum length of fruit (8.53 cm) was recorded from S_3treatment which is statistically identical to S_2 treatment (Table 4). Cho *et al.* (1996) indicated that total length of fruit of chilli fruits decreased with increasing salinity. Cho and Chung (1997) illustrated that fruit size of chill decreased with increased salinity.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stageon length of fruit (Appendix VI).The maximumlength of fruit (10.50 cm) was recorded from S_0K_2treatment combination whereas the minimum length of fruit (8.40 cm) was recorded from S_3K_0treatment combination which is statistically identical to S_3K_1(Table 5).

4.8 Individual weight of fruit

Significant difference was observed due to the application of different levels potassium nitrate on individual weight of fruit (Appendix VI).The maximumindividual weight of fruit (5.52 g) was recorded from K_2treatmentwhereas the minimum individual weight of fruit (5.02 g) was recorded from K_0 treatment which is statistically identical to (5.10 g) to K_1treatment (Table 4). Bahuguna *et al*. (2016) and Silva *et al.* (1999) found the similar result. Yasuor*et al*. (2013) observed that producers of horticultural products get better chilli by potassium application.

Significant difference was observed due to the application of different levels of sodium chlorideon individual weight of fruit (Appendix VI).The maximum individual weight of fruit (5.41 g) was recorded from S_0 (control) treatment whereas the minimum individual weight of fruit (4.80 g) was recorded from S_3treatment which is statistically similar to S_1 treatment (Table 4). Midan *et al.* (1985) conducted an experiment to study the effects salinity on chilli yield. The weight of individual fruit decreased with the increased salinity levels. Cho *et al.* (1996) indicated that total fresh, length of fruit, and yield of chilli fruits decreased with increasing salinity. Cho and Chung (1997) illustrated that fruit size, fresh and fruit dry weight of chill decreased with increased salinity. They also stated that the percentage of puffy fruits was reduced at higher salinity.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stageon individual weight of fruit (Appendix VI).The maximumindividual weight of fruit (6.16 g) was recorded from S_0K_2treatment combination whereas the minimum individual weight of fruit (4.63 g) was recorded from S_3K_0treatment combination (Table 5).

4.9 Chlorophyll content

Significant difference was observed due to the application of different levels of potassium nitrate on chlorophyll content (Appendix VI).The maximumchlorophyll content (76.43) was recorded from K_2treatmentwhich is statistically identical to (75.70) to K_1 treatment whereas the minimum chlorophyll content (65.96) was recorded from K_0treatment (Table 4). Khan *et al.* (2014)reported that chlorophyll content increases with the increasing amount of potassium.

Table 5: Combined effect of potassium nitrate and sodium chlorideon growth and yield characteristics of chilli

Treatment	Number of fruits plant^{-1}	Length of fruit (cm)	Individual fruit weight (g)	Chlorophyll content
S_0K_0	31.66 de	8.60 d	5.43 b	62.86 h
S_0K_1	32.33 cde	8.60 d	5.06 bcd	70.30 fg
S_0K_2	37.00 a	10.50 a	6.16 a	85.01 a
S_1K_0	33.00 b-e	8.70 cd	5.06 bcd	81.40 ab
S_1K_1	33.33 bcd	8.90 cd	4.96 bcd	73.40 def
S_1K_2	35.00 ab	9.66 b	5.16 bc	78.01 bc
S_2K_0	34.00 bc	9.20 bc	4.96 bcd	68.01 g
S_2K_1	35.00 ab	9.50 b	5.10 bcd	77.70 bcd
S_2K_2	32.66 cde	8.63 cd	4.70 cd	75.00 cde
S_3K_0	31.00 e	8.40 d	4.63 d	61.02 h
S_3K_1	34.01 bc	8.50 d	5.26 b	72.00 efg
S_3K_2	35.00 ab	8.70 cd	5.06 bcd	67.73 g
LSD $_{(0.05)}$	2.12	0.57	0.52	4.34
CV %	9.19	3.76	6.01	3.53

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3, K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Significant difference was observed due to the application of different levels ofsodium chlorideon chlorophyll content (Appendix VI).The maximum chlorophyll content (76.90) was recorded from S_0 (control) treatment which is statistically identical to

(76.13) to S_1 treatment whereas the minimum chlorophyll content (66.96) was recorded from S_3 treatment(Table 4). Hajer *et al.* (2006) conducted an experiment on effect of sea water salinity (1500, 2500 and 3500 ppm) on the growth of pepper (*Capsicum frutescence*) cultivars. Chlorophyll b content was higher than chlorophyll a, and both of them decreased with increasing salinity.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stageon chlorophyll content (Appendix VI).The maximumchlorophyll content (85.01) was recorded from S_0K_2 (control NaCl + 7.0 mM/kg Soil KNO_3) treatment combination whereas the minimum chlorophyll content (61.02) was recorded from S_3K_0 (15.0 ds/m NaCl + control KNO_3)treatment combination (Table 5).

4.10 Sodium ion content in soil

Significant difference was observed due to the application of different levels of potassium nitrate on sodium ion content in soil (Appendix VII).The maximumsodium ion content in soil (7.27) was recorded from K_2treatmentwhereas the minimum sodium ion content in soil (7.03) was recorded from K_0 treatment which is statistically identical to (7.14) to K_1 treatment (Table 6).

Significant difference was observed due to the application of different levels of sodium chlorideon sodium ion content in soil (Appendix VII).The maximum sodium ion content in soil (14.43) was recorded from S_3treatment whereas the minimum sodium ion content in soil (0.04) was recorded from S_0 (control) treatment(Table 6).

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stageon sodium ion content in soil (Appendix VII).The maximumsodium ion content in soil (14.56) was recorded from S_3K_1treatment combination which is statistically identical to $S_3K_0$and S_3K_2treatment combination. On the other hand the minimum sodium ion content (0.04) in soil was recorded from S_0K_1treatment combination which is statistically identical to $S_0K_0$and S_0K_2treatment combination (Table 7).

4.11 Potassium ion content in soil

Significant difference was observed due to the application of different levels ofpotassium nitrate on potassium ion content in soil (Appendix VII).The maximumpotassium ion content in soil (6.96) was recorded from K_2 treatmentwhereas the minimum potassium ion content in soil (0.06) was recorded from K_0treatment (Table 6).

Table 6: Effect of potassium nitrate and sodium chlorideon potassium ion and sodium ion content of pot soil

Treatment	Sodium ion (Na^+) content in soil (ds/m)	Potassium ion(K^+) content in soil (mM/kg)
K_0	7.03 b	0.06 c
K_1	7.14 b	3.07 b
K_2	7.27 a	6.96 a
LSD $_{(0.05)}$	0.11	0.09
S_0	0.04 d	3.44 a
S_1	4.41 c	3.42 ab
S_2	9.45 b	3.32 bc
S_3	14.43 a	3.28 c
LSD $_{(0.05)}$	0.13	0.10
CV %	3.26	3.91

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3,K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Significant difference was observed due to the application of different levels ofsodium chlorideon potassium ion content in soil (Appendix VII).The maximum potassium ion content in soil (3.44) was recorded from S_0 (control) treatment whereas the minimum potassium ion content in soil (3.28) was recorded from S_3 treatmentwhich is statistically similar to S_2 treatment (Table 6).

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stageon potassium ion content in soil (Appendix VII).The maximumpotassium ion content in soil (7.20) was recorded from S_0K_2 (control + 7mM/kg Soil KNO_3) treatment combination which is statistically identical to S_1K_2treatment combination. On the other hand the minimum potassium ion content (0.05) in soil was recorded from S_3K_0treatment combination which is statistically identical to S_0K_0, $S_1K_0$and S_2K_0treatment combination (Table 7).

Table 7: Combined effect of potassium nitrate and sodium chloride on potassium ion and sodium ion content of pot soil

Treatment	Sodium ion (Na^+) content in soil (ds/m)	Potassium ion (K^+) content in soil (mM/kg)
S_0K_0	0.05 e	0.07 d
S_0K_1	0.04 e	3.05 c
S_0K_2	0.04 e	7.20 a
S_1K_0	4.23 d	0.06 d
S_1K_1	4.50 c	3.06 c
S_1K_2	4.50 c	7.13 a
S_2K_0	9.50 b	0.06 d
S_2K_1	9.46 b	3.06 c
S_2K_2	9.40 b	6.83 b
S_3K_0	14.36 a	0.05 d
S_3K_1	14.56 a	3.10 c
S_3K_2	14.36 a	6.70 b
LSD $_{(0.05)}$	0.22	0.18
CV %	3.26	3.91

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3,K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

4.12 Yield plant

Significant difference was observed due to the application of different levels potassium nitrate on yield plant^{-1} (Appendix VII). The maximum yield plant^{-1} (167.70 g) was recorded from K_2 treatmentwhereas the minimum yield plant^{-1} (153.58 g) was recorded from K_0 treatment (Table 8). Bhubaneswar *et al*. (2014) was carried out an experiment and got highest fruit volume and plant yield by potassium application. Haasan *et al*, (1995) Aldana (2005) reported the similar results. Mavengahama *et al*. (2003) were conducted an on-farm on chilli and got the maximum yield by potassium application. Silva *et al*. (1999) was conducted an experiment to evaluate the effect N and K_2O on the production and yield of pepper plants. He also supported the results.

Table 8: Effect of potassium nitrate and sodium chlorideon yield of chili

Treatment	Yield plant^{-1} (g)
K_0	153.58 c
K_1	156.58 b
K_2	167.70 a
LSD $_{(0.05)}$	2.01
S_0	165.00 a
S_1	159.55 b
S_2	157.88 b
S_3	154.77 c
LSD $_{(0.05)}$	2.32
CV %	4.01

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3,K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Significant difference was observed due to the application of different levels of sodium chlorideon yield plant^{-1} (Appendix VII).The maximum yield plant^{-1} (165.00 g) was recorded from S_0 (control) treatment followed (159.55 g) by S_1 treatment which is statistically similar (157.88 g) to S_2 treatment whereas the minimum yield plant^{-1}(154.77 g) was recorded from S_3treatment(Table 8). Midan *et al.* (1985) conducted an experiment to study the effects salinity on chilli yield. The weight of individual fruit decreased with the increased salinity levels. Cho *et al.* (1996) indicated that total yield of chilli fruits decreased with increasing salinity.

Table 9: Combined effect of potassium nitrate and sodium chloride on yield of chilli

Treatment	Yield plant^{-1} (g)
S_0K_0	152.67 gh
S_0K_1	153.66 fgh
S_0K_2	179.00 a
S_1K_0	154.66 e-h
S_1K_1	157.01 def
S_1K_2	162.00 c
S_2K_0	156.00 d-g
S_2K_1	160.01 cd
S_2K_2	158.00 cde
S_3K_0	151.00 h
S_3K_1	155.66 efg
S_3K_2	157.66 efg
LSD $_{(0.05)}$	4.02
CV %	4.01

In a column, means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability.

K_0: 0 mM/kg Soil KNO_3,K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil KNO_3

S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl.

Cho and Chung (1997) illustrated that fruit size and yield of chill decreased with increased salinity. They also stated that the percentage of puffy fruits was reduced higher salinity. Bybordi (2010) conducted an experiment on chili and found the similar results.

Combined effect of potassium nitrate and sodium chloride application showed the significant differences at flowering stage on yield plant^{-1}(Appendix VII). The maximum yield plant^{-1}(179.00 g) was recorded from S_0K_2 (control + 7mM/kg Soil KNO_3) treatment combination. On the other hand the minimum yield plant^{-1} (151.00 g) was recorded from S_3K_0treatment combination (Table 9).

CHAPTER V
SUMMARY AND CONCLUSION

The experiment was conducted in the Horticultural Farm of Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka during the period from October, 2015 to March, 2016 to find out the effect of potassium nitrate and sodium chloride on growth and yield of chilli. The experiment consisted of two factors: Factor A: Three levels of potassium nitrate as K_0: 0 mM/kg Soil KNO_3, K_1: 3.5 mM/kg Soil KNO_3, K_2: 7.0 mM/kg Soil $KNO_3$and Factor B: Four levels of sodium nitrate as S_0: 0 ds/m NaCl, S_1: 5.0 ds/m NaCl, S_2: 10.0 ds/m NaCl, S_3: 15.0 ds/m NaCl. There were 12 treatment combinations. The experiment was laid out in Complete Randomized Design (CRD) with three replications. Data on different growth and yield contributing characters and yield were recorded to find out the optimum level of potassium nitrate and sodium chloride on chilli production.

At 100 DAT, the tallest plant (58.62 cm), maximum number of branches (6.75), minimum days required to first flowering (45.16), maximum dry matter content of plant (48.37 %), maximum dry matter content of fruit (3.55 %), maximum number of fruits plant^{-1}(34.91), maximum length of fruit (9.30 cm), maximum weight of individual fruit (5.52 g), maximum chlorophyll content (76.43), maximum sodium ion content in the soil (7.27 ds/m), maximum potassium ion content in the soil (6.96 ds/m) and maximum fruit yield plant^{-1} (167.70 g) were recorded from K_2treatment that is 7.0 mM/kg soil KNO_3. On the other hand at 100 DAT, the shortest plant (46.50 cm), minimum number of branches (4.20), maximum days required to first flowering (48.00), minimum dry matter content of plant (44.98 %), minimum dry matter content of fruit (3.31 %), minimum number of fruits plant^{-1}(32.41), minimum length of fruit (8.80 cm), minimum weight of individual fruit (5.02 g), minimum chlorophyll content (65.96), minimum sodium ion content in the soil (7.03 ds/m), minimum potassium ion content in the soil (0.06 ds/m) and minimum fruit yield plant^{-1} (153.58 g) were recorded from K_0 treatment that is control treatment.

In case of sodium chloride application at 100 DAT, the tallest plant (61.72 cm), maximum number of branches (6.27), minimum days required to first flowering (44.00), maximum dry matter content of plant (48.24 %), maximum dry matter content of fruit (3.40 %), maximum number of fruits plant^{-1}(35.33), maximum length of fruit (9.73 cm), maximum weight of individual fruit (5.41 g), maximum chlorophyll content (76.90), minimum sodium ion content in the soil (0.04 ds/m), maximum potassium ion content in the soil (3.44 ds/m) and maximum fruit yield plant^{-1}(165.00 g) were recorded from S_0 treatment that is control treatment. On the other hand at 100 DAT, the shortest plant (49.44 cm), minimum number of branches (5.44), maximum days required to first flowering (48.88), minimum dry matter content of plant (45.01 %), minimum dry matter content of fruit (3.01 %), minimum number of fruits plant^{-1}(32.22), minimum length of fruit (8.53 cm), minimum weight of individual fruit (4.80 g), minimum chlorophyll content (66.96), maximum sodium ion content in the soil (14.43 ds/m), minimum potassium ion content in the soil (3.28 ds/m) and minimum fruit yield plant^{-1}(154.77 g) were recorded from S_3 treatment that is 15.0 ds/m NaCl treatment.

In case of combine treatment at 100 DAT, the tallest plant (75.16 cm), maximum number of branches (8.66), minimum days required to first flowering (42.01), maximum dry matter content of plant (50.23 %), maximum dry matter content of fruit (3.56 %), maximum number of fruits plant^{-1}(37.00), maximum length of fruit (10.50 cm), maximum weight of individual fruit (6.16 g), maximum chlorophyll content (85.01), minimum sodium ion content in the soil (0.04 ds/m), maximum potassium ion content in the soil (7.20 ds/m) and maximum fruit yield plant^{-1}(179.00 g) were recorded from S_0K_2 treatment combination. On the other hand at 100 DAT, the shortest plant (45.33 cm), minimum number of branches (3.66), maximum days required to first flowering (50.33), minimum dry matter content of plant (44.60 %), minimum dry matter content of fruit (2.80 %), minimum number of fruits plant^{-1}(31.00), minimum length of fruit (8.40 cm), minimum weight of individual fruit (4.63g), minimum chlorophyll content (61.02), minimum potassium ion content in the soil (0.05 ds/m) and minimum fruit yield plant^{-1}(151.00 g) were recorded from S_3K_0

treatment combination. Maximum sodium ion content in the soil (14.56 ds/m) was obtained from S_3K_1 treatment combination.

Conclusion:

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

1.Potassiun Nitrate (KNO_3) was very positively effective on the growth and yield of chilli by mitigating the salinity levels.

2.The treatment combination S_3K_1 (15ds/m NaCl and 3.5 mM/kg soil KNO_3) had the maximum sodium ion content in the soil (14.56 ds/m) and the yield per plant was 155.66 (g).

3.The treatment combination S_3k_2 (15ds/m NaCl and 7mM/kg soil KNO_3) gave higher yield which was 157.66(g).

Therefore, S_3k_2 can be better for those farmers who are living under saline belt areas for the cultivation of chilli.

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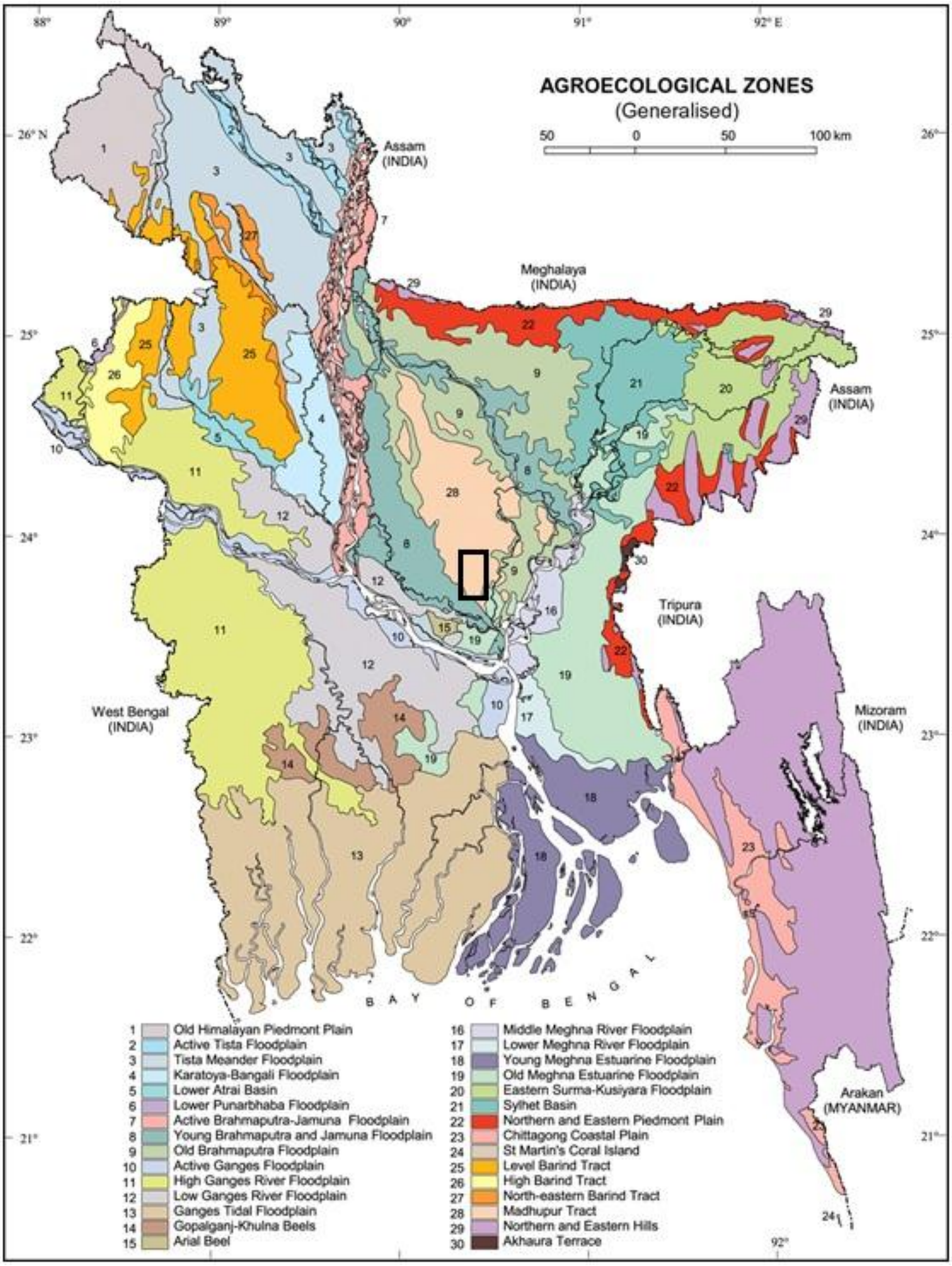
APPENDICES

Appendix I: Map showing the experimental sites under study



e experimental site under study

Appendix II. Monthly average temperature, relative humidity and total rainfall of the experimental site during the period from October 2015 to April, 2016

Month	Air temperature (^0C)		R. H. (%)	Total rainfall (mm)
	Maximum	Minimum		
October,15	32.18	21.26	76	134
November,15	29.82	14.04	81	24
December,15	26.40	13.50	87	5
January,16	28.51	11.40	74	8
February,16	28.10	12.70	79	32
March,16	34.40	17.60	70	61
April, 16	37.30	21.40	66	137

Source: Bangladesh Metrological Department (Climate and weather division) Agargaon, Dhaka

Appendix III. Results of morphological, mechanical and chemical analysis of soil of the experimental plot

A. Morphological Characteristics

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

B. Mechanical analysis

Constituents	Percentage (%)
Sand	28.78
Silt	42.12
Clay	29.1

C. Chemical analysis

Soil properties	Amount
Soil pH	5.8
Organic carbon (%)	0.95
Organic matter (%)	0.77
Total nitrogen (%)	0.075
Available P (ppm)	12.78
Exchangeable K (%)	0.32
Available K (ppm)	43.29
Available S (ppm)	16.17

Source: Soil Resource Development Institute (SRDI)

Appendix-IV. Analysis of variance of data on plant height of chili

Source of variation	Degrees of freedom (df)	Mean square of plant height at			
		25 DAT	50 DAT	75 DAT	100 DAT
Replication	2	1.715	3.174	36.757	44.333
Factor A: Potassium nitrate	2	0.423	97.215*	360.882*	462.437*
Factor B: Sodium chloride	3	3.377	102.278*	286.417*	287.907*
Interaction (A × B)	6	4.960	58.465*	83.049**	78.345**
Error	22	2.578	27.969	43.530	31.280
** : Significant at 1% level of probability; * : Significant at 5% level of probability					

Appendix-V. Analysis of variance of data on growth and yield characteristics of chili

Source of variation	Degrees of freedom (df)	Mean square of			
		Number of branches plant^{-1}	Days required to first flowering	Dry matter content of plant	Dry matter content of fruit
Replication	2	0.340	1.361	4.730	0.060
Factor A: Potassium nitrate	2	20.006*	24.527*	34.529*	0.133*
Factor B: Sodium chloride	3	5.395*	38.101*	16.625**	0.315*
Interaction (A × B)	6	1.506**	6.935*	1.984**	0.128**
Error	22	0.340	1.906	0.969	0.071
** : Significant at 1% level of probability; * : Significant at 5% level of probability					

Appendix-VI. Analysis of variance of data on growth and yield characteristics of chili

Source of variation	Degrees of freedom (df)	Mean square of			
		Number of fruits plant^{-1}	Length of fruit (cm)	Individual weight of fruit (g)	Chloro-phyll content
Replication	2	6.350	0.122	0.025	1.321
Factor A: Potassium nitrate	2	18.750*	0.872*	0.197*	409.653*
Factor B: Sodium chloride	3	15.851*	2.743**	0.622*	197.727*
Interaction (A × B)	6	1.379*	0.456*	0.464**	50.806*
Error	22	1.575	0.114	0.095	6.591
** : Significant at 1% level of probability; * : Significant at 5% level of probability					

Appendix-VII. Analysis of variance of data on sodium, potassium content and yield plant^{-1}

Source of variation	Degrees of freedom (df)	Mean square of		
		Sodium ion content in soil	Potassium ion content in soil	Yield plant $^{-1}$
Replication	2	0.016	0.034	0.260
Factor A: Potassium nitrate	2	0.034*	143.823**	8.232*
Factor B: Sodium chloride	3	348.822**	0.051*	2.038**
Interaction (A × B)	6	0.028**	0.061*	0.887**
Error	22	0.018	0.012	0.069
** : Significant at 1% level of probability; * : Significant at 5% level of probability				