Annual Research Report

2023-24

Salinity Management and Research Center
Soil Resource Development Institute
Batiaghata, Khulna

Index

EFFECT OF DIFFERENT TYPES OF ORGANIC MATTER ON SOIL SALINITY AND YIELD OF SWEET GOURD IN COASTAL SALINE SOIL

A Biswas, Md. Z Islam

Abstract

Salinity causes serious cellular damage and limits crop productivity. Accumulation of organic matter is one of the best adaptive mechanisms to reduce salinity affect in plants. By reducing soil salinity and for obtaining a better sustainable yield, a low-cost and farmer-ecofriendly method is required for sweet gourd, a well known vegetable. Accordingly, a field experiment was carried out in Salinity Management and Research Center, Soil Resource Development Institute, Batiaghata, Khulna during Kharif-1 season in 03-03-2024 to investigate the effect of different types of organic matter on soil salinity and yield of sweet gourd. The experiment includes five treatments viz. no organic matter (control), cow dung, saw dust, poultry manure and vermi-compost. The experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. Field Soil salinity was recorded at 30 days intervals. Organic matter has showed that this causes effectively reduction the salt accumulation in the plant body and some modification accelerated. After three months of seed sowing, the highest soil salinity (15.8dS/m) and lowest soil salinity (9.4dS/m) were found at no organic matter (control) and poultry manure treatment respectively in the month of May. In the month of June, the experiment shows that, the lowest soil salinity was found at poultry manure (8.7dS/m) in comparison with the highest soil salinity found in control condition (14.3dS/m) (Table 1). Organic matter treatments obviously have increased the growth and yield attributes of sweet gourd. The highest value of four growth parameters i.e., fruit length (19.48 cm), fruit diameter (70.48 cm), fruit weight (3.22 kg) and total yield (25.48 t/h) was found on poultry manure as compared to control. Again, the lowest value of four growth parameters i.e., fruit length (11.47 cm), fruit diameter (33.19 cm), fruit weight (1.91 kg) and total yield (8.54 t/h) were found on saw dust treatment. The results revealed that the use of organic matter decrease soil salinity strength and also increases the yield of sweet gourd in saline soil. These findings suggest that the application of organic matter not only reduces soil salinity but also increases the structure of soil, regulate microbes and yield of sweet gourd.

Keywords: Salinity; cow dung; saw dust; vermi-compost; poultry manure; yield; sweet gourd.

Introduction

Salinity as a whole is very dangerous problem at present situation of crop production of southern part of Bangladesh. Soil salinity stress increases the accumulation of toxic ions such as Na+ and Cl^- in different plant parts, tissues, cells and cell organelles (Gadallah, 1999). Soil salinization is a major process of land degradation that decreases soil fertility and crop productivity. There is a report that coastal regions of Bangladesh are quite lower in soil fertility (Haque, 2006; Kibria et al., 2015). All soils contain a few water-soluble salts, but when these salts happen in sums that are harmful for the germination of seeds and plant development, they are called saline (Conway, 2001). Salt affected soils generally exhibit poor structural stability due to low organic matter content. Many researchers have suggested that the structural stability of soil can be improved by the addition of organic materials (e.g. saw dust, vermin compost, cow dung and poultry manures). Soil salinity is a major barrier to crop production all over theworld that affects probably all plant activities. Million hectares of land throughout the world are too saline to produce economic crops, and more land is becoming nonproductive each year due to salinity build up. Approximately 7% of the world's land area, 20% of the world's cultivated land and nearly half of the irrigated land are affected by soil salinity (Zhu, 2001; FAO, 2008; Mali et al., 2012). In view of another projection, 2.1% of the global dry land agriculture is affected by salinity (FAO, 2008). Besides this, increasing soil salinity of arable land is expected to have devastating global effects, resulting in up to 50% land losses by the middle of the twenty-first century (Mahajan and Tuteja, 2005). Out of total agricultural land about 2.86 million hectares of coastal and offshore lands of Bangladesh , about 10.56 lakh hectares are affected by varying degrees of soil salinity (SRDI, 2010). Among the environmental stresses, soil salinity is the most devastating (Shahbaz and Ashraf, 2013) which not only affect the plant growth and metabolism but also poses a foremost limitation to sustainable agricultural production (Tayyab et al., 2016). Important practice is the application of organic manure which can both ameliorate and increase the fertility of saline soil (Melero et al., 2007). Organic mulches can reduce the effect of salt toxicity on plant growth (Ansari et al., 2001; Landis 1988; Yobterik and Timmer, 1994) or actively accelerate soil desalinization (Dong et al., 1996). Considering the above fact, applying organic matter is one of the suitable technologies for reducing soil salinity, it reduces evapotranspiration and helps soil salinity remains lower in the soil. There are evidences that soil amendments with organic matter reduce the toxic effects of soil salinity in various plant species (Idrees et al., 2004; Abou El-Magd et al., 2008; Leithy et al., 2010; Raafat and Thawrat, 2011). Yield characteristics like diameter of fruit, weight of fruit and fruits per vine showed significant results with black polyethylene mulch in case of different high value vegetables in Bangladesh (Islam, F et al., 2010). Organic matter amendments improve physical, chemical and biological properties of soils under saline conditions. This experiment is designed to find out the effect of different organic matter on soil salinity management and to observe the yield performance of sweet gourd.

Materials and Methods

Study location

This experiment was conducted at the Salinity Management and Research Centre (SMRC), Soil Resource Development Institute, Batiaghata, Khulna, Bangladesh during the Kharif-1 season of 03-03-2024. Geographically, the study site was at 22°46'01.8" N latitude and 89°24'15.2" E longitude and under AEZ-13. With an average yearly temperature of 79.3 °F and monthly mean temperatures ranging from 54.3 °F in January to 93.7°F in May, the area is among the warmest in Bangladesh. Land type of plot was medium high land, Land use was F-KV-TA, Depth of flooding 1.5 to 2.0 feet, duration of flooding was 3-4 months, Soil series was Barisal.

Layout of Experiment and Management of crop

The following expecting experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. Sweet gourd (variety: Maya) was taken as an experimental crop. Five experimental treatments were considered: (T_1) control (no organic matter), (T_1) cow dung, (T_2) vermi-compost, (T_3) saw dust and (T_4) poultry manure with three replication. For gaining good tilt of soil condition, the experiment plot was prepared by several ploughs and cross ploughs followed by laddering and harrowing with tractor and power tiller. Weeds and other stables were removed carefully from the experimental plot and leveled properly. Basal doses of fertilizer were applied during land preparation.

Pit preparation

Total land was designed according to achieving the expected yield. The measurement of pit was One foot length x one foot breadth according to experimental demand. Then five experimental treatments were considered (T_1) control (no organic matter), (T_1) cow dung, (T_2) vermi-compost, (T_3) saw dust and (T_4) poultry manure. Then pit soil and treatments materials were mixed with soil very properly, leveling and marked for data collection. After processing the pit area, sweet gourd seeds were sown in the pit with experimental need. Proper care and management were taken when pit was prepared. Necessary care and other intercultural operations were done when necessary. Data were recorded in accordance with the requirements. Soil salinity was measured by using an EC Meter at 30 days intervals. All the intercultural operations like watering, gap filling, staking, weeding, and plant protection measures were executed carefully.

Measurement of Growth and Yield attributes

Four growth and yield parameters such as fruit length (cm), fruit diameter (cm), fruit weight (kg) and total yield (t/ ha) were taken into consideration to analyze the effect of organic matter on yield of sweet gourd. Total yield (t/ha) was calculated by measuring the total fruit weight of the plot.

Initial Chemical properties of soil s

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				μg/g			
7.5	2.74	0.34	0.16	10.61	14.82	2.89	0.51

Statistical Analysis

The collected data were tabulated and statistically analyzed using Statistix10 software. The treatment means were separated statistically at a 5 % level of significance using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Effects of Different organic matter on Soil Salinity reduction

Salinity controlling in root zone area in saline soil fields is highly considered beneficial to seed emergence and stand establishment. In modern studies has shown that organic matter is a promising technique for salinity control in present agriculture. An upward trend of soil salinity at all treatments was observed from March to June (Table 1). In the month of March, the lowest soil salinity was found at poultry manure (4.2dS/m) while the highest soil salinity was observed at control (7.3dS/m) where no organic matter was used and saw dust (7.2dS/m). In the month of May, the lowest soil salinity was found at poultry manure (9.4dS/m) in comparison with the highest soil salinity found in control condition (15.8dS/m) (Table 1). In the month of June, the experiment shows that, the lowest soil salinity was found at poultry manure (8.7dS/m) in comparison with the highest soil salinity found in control condition (14.3dS/m) (Table 1). This data revealed that soil salinity can be reduced by using different organic matter in which poultry manure has a great significant effect on reducing soil salinity. Some authors emphasized these results and reported that all organic matter effectively reduced salt accumulation in the root zone (Taia, A. et al., 2016).

Table 1:Month wise soil salinity of the experimental plot

Treatment	Month wise Soil salinity (EC: dS/m)			
	March	April	May	June
T_0 (Control)	7.3	11.3	15.8	14.3
T_1 (Cow dung)	6.3	9.4	12.6	11.7
T_2 (Vermi-compost)	5.0	9.1	10.4	9.6
T_3 (Saw dust)	7.2	11.4	15.6	14.2
T_4 (Poultry manure)	4.2	7.7	9.4	8.7

Effects of different organic matter on Yield Attributes of sweet gourd

Fruit length of sweet gourd

This experiment shows that, fruit length and other fruit length related parameters varies a lot that were statistically analyzed as shown in Table 2. They showed a significant variation in relation to different organic matter. The fruit length at control condition was 12.26 cm, at the saw dust treatment it was about 11.47 cm and at treatment with cow dung it was 13.51 cm but at vermi compost treatment it was 18.73 cm of fruit length. The highest fruit length (19.48 cm) was found at poultry manures which was statistically similar to vermi-compost application treatment (18.73 cm), while the lowest (11.47 cm) was found where saw dust was applied. The highest fruit length (19.48 cm) was observed at poultry manure in comparison with the saw dust treatment where the lowest fruit length (11.47 cm) was found (Table 2).

Table 2: Yield and Yield attributes of sweet gourd in saline soil

Treatment	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (kg)	Yield (t/ha)
Control	12.26 b	51.15 b	2.03 b	12.44 c
Cow dung	13.51 b	57.46 b	2.22 b	17.29 b
Vermi- compost	**18.73 a**	**68.54 a**	**3.14 a**	**24.34 a**
Saw dust	11.47 b	33.19 b	1.91 b	8.54 d
Poultry Manure	**19.48 a**	**70.48 a**	**3.22 a**	**25.48 a**
CV (%)	9.70	5.08	7.61	9.49

Fruit Diameter of sweet gourd

Fruit diameter manipulated in accordance with the organic matter treatment at the plot. So that continuing experiment showed that, fruit diameter and other components of creating fruit diameter quality enhance related parameters varies to a wide that were statistically analyzed as shown in Table 2. Those attributes showed a significant variation in relation to different organic matter. The fruit diameter at control condition was 51.15 cm, at the saw dust treatment the diameter was about 33.19 cm and at treatment with cow dung it was 57.46 cm but at vermi-compost treatment, the fruit diameter was 68.54 cm. The highest fruit diameter (70.48 cm) was found at poultry manure which was statistically similar resulted with vermi-compost (68.54 cm). The lowest fruit diameter (33.19 cm) was found where saw dust was applied. The highest fruit diameter (70.48 cm) was observed at poultry manure in comparison with the saw dust treatment where the lowest fruit diameter (33.19 cm) was found (Table 2). It had been observed that fruit diameter (cm) and other fruit diameter contributing characteristics to plant of sweet gourd were significantly superior to poultry manure organic matter while plants without organic matter (control situation) resulted in poor growth and fruit diameter.

Fruit weight of sweet gourd

Different growth stages and developmental indicators of sweet gourd varied at the different plot. It was happened due to application of different organic matter to plants. The fruit weight of different plants of various plot of sweet gourd grown under different organic matter treatments are presented in Table 2. Statistical analysis was carried out on yield and yield attributes which revealed that these were significantly varied due to different organic matter. The fruit weight at control condition was 2.03 kg, at the saw dust treatment the weight was about 1.91 kg and at treatment with cow dung it was 2.22 kg but at vermi-compost treatment, the fruit weight was 3.14 kg which possess the statistically similar result compared to the highest fruit weight (3.22 kg) that was found at poultry manure.The lowest fruit weight (1.91 kg) was found where saw dust was applied. The highest fruit weight (3.22 kg) was recorded in poultry manure whereas the lowest fruit weight (1.91 kg) was found in saw dust treatment (Table 2). That experiment indicated that plants under different organic matter treatment, produce larger fruit and have higher fruit weight per plant because of the better plant growth that is due to a favorable hydrothermal regime of soil and a completely weed free environment. Organic matter changes the micro environment of the plant and thus it enhances plant growth and vigor as well as production and yield. This result may be due to the improvement of soil physical properties as well as increasing soil water holding capacity which gave rise to good aeration and drainage that encourage better root growth and nutrient absorption.

Total yield of sweet gourd

Properly completion of sweet gourd growth stages and developmental process varied at the different plot. It was occurred due to application of different organic matter to plants. The total yield of different plants of various plot of sweet gourd grown under different organic matter treatments are presented in Table 2. Statistical analysis was carried out on yield and yield attributes which revealed that these were significantly varied due to different organic matter. The total yield of sweet gourd at control condition was 12.44 t/ha, at the saw dust treatment the total yield was about 8.54 t/ha and at the treatment with cow dung it was 17.29 t/ha but at vermi-compost treatment, the fruit yield was 24.34 t/ha that shows the similar results to the highest fruit yield (25.48 t/ha) was found at poultry manure. The lowest fruit weight (8.54 t/ha) was found where saw dust was applied (Table 2). The doing experiment showed that plants under different organic matter promotes larger fruit and have higher fruit yield per plant because of the better plant growth that is due to a favorable nutrient channel through the soil and a completely symbiosis environment. This result may be due to the improvement of soil physical properties as well as increasing soil water holding capacity which gave rise to good aeration and drainage that encourage better root growth and nutrient absorption. Organic matter changes the micro environment of the plant and thus it enhances plant growth and vigor as well as production of total yield of sweet gourd.

Conclusion

Sustainable soil management practices and the maintenance of soil salinity are central issues to agricultural sustainability. It may be concluded from that experiment's findings that using organic matter prompt to a noticeable decrease in the accumulation of soil salinity. Maximum soil salinity was reduced by using poultry manure in comparison with the control treatment where no organic matter was applied. This experiments point out that, soil salinity reduce by the following order of treatment: poultry manure > vermi-compost > cow dung > control> saw dust. Different growth and yield attributes were significantly impacted due to different organic matter treatments. This results showed that, poultry manure treatments gave the highest yield (25.48 t/ha) whereas, the lowest yield (8.54 t/ha) was recorded in saw dust treatment. Among five treatment, poultry manure as well as vermin-compost can be used at the farmer’s level to reduce soil salinity strength and increase the yield of sweet gourd. However, further research is still needed to work out a cost effective technology to reduce soil salinity and increase the yield of sweet gourds.

EFFECT OF DIFFERENT SOWING METHOD FOR AVOIDING SOIL SALINITY IN COASTAL SALINE SOIL

A Biswas, Md. Z Islam

Abstract

A field experiment was conducted at Salinity Management and Research Center, Soil Resource Development Institute, Batiaghata, Khulna during 2024 in kharif-1 season to study the impact of saline water in the saline soil on the economics of sweet gourd (*Cucurbita pepo*) yield and soil salinity after the end of the crop. There were three treatments having early pit method, tray seedling transplanting method and conventional method. The design of the experiment was Randomized Complete Block Design (RCBD) with five replications. Every plot received recommended rate of nitrogen, phosphorus and potash fertilizer. The promising text crop was sweet gourd. Field Soil salinity was recorded at 15 days intervals. The treatments were early pit method, tray seedling transplanting and seed sowing directly conventional method. After three months of seed sowing into early pit method, tray seedling transplanting and conventional method the highest soil salinity (14.2dS/m) and the lowest soil salinity (2.9dS/m) were found at conventional method plot and early pit method plot respectively in the month of May. Early pit method treatment obviously has increased the growth and yield attributes of sweet gourd. The highest value of four growth parameters viz., fruit length (18.28 cm), fruit diameter (62.73 cm) , fruit weight (3.32 kg) and total yield (24.62 t/h) were found on early pit method as compared to other method. Again, the lowest value of four growth parameters i.e., fruit length (13.17 cm), fruit diameter (49.44 cm)s, fruit weight (1.98 kg) and total yield (15.55 t/h) were found on conventional method respectively. The changing of crop production time and method has a positive effect on fruit yield. Application of different time of cultivation and method increase soil moisture content and reduce electrical conductivity therefore it is recommended for sustainable yield of sweet gourd in saline soil and reduces soil salinity related land degradation and have a great potential under saline prone areas.

Keywords: salinity; pit method; tray; conventional; potential

Introduction

Limitation in crop productions in south and south western area due to salinity problem in soil and water is a very serious problem. In the coastal saline belt with short winter season timely sowing/planting of Rabi (winter season) crops is essential but this is restricted by late harvest of Aman rice. Rainy water storing in land causes late water recession from the cropping land. This water inundation condition makes the 'Joe' stage occurring in late in soil. And when Joe comes in cropping soil, at the same time salinity starts to increase in soil and water.Evaporation, evapotranspiration, hydrolysis, and leakage are the causes of salt accumulation when mineralized ground water near the ground surface continually evaporates and causes minerals to precipitate and by evapotranspiration where infiltrating recharge water is continually taken up by plants and salt is concentrated in the unsaturated root zone. It is very difficult to control of salinity existing in soil and water. It affects crops depending on degree of salinity at the critical stages of growth, which reduces yield and in severe cases total yield is lost. If planting date or seedling transplantation may change in early or time may convert in different sowing time, it will cause the crop production in early without any damage of yield. It will prohibit salt storing and upward in top soil by breaking down the capillary action that increases starts from last of February. Ground water depth and salinity are affected by the sea and river water level and river water salinity. Since groundwater is the lower boundary condition of surface soil salinity, and also groundwater is closed related to river water, it is the important link between soil and river water. As the river water level and salinity changes, groundwater environment and soil salinity would be affected. Salinity level increases starts from February to May and decrease starts from the starting of rainy season in every year. It has a great effect on crop yield in dry season due to increased salinity level. If fresh water supply may increase in dry season, it reduces the salinity effect in crop production in Khulna. Rainfall also reduces the surfaces soil salinity. Soil salinity adversely influences seed germination, agricultural productivity, and soil and water quality, particularly in semiarid and arid regions, bringing about loss of arable areas and land degradation (Balkanlou et al., 2020; Bennett et al., 2019; Buthelezi dube et al., 2020). Soil salinization is the main reason for land degradation and crop yield reduction (Ivushkin et al., 2019; Makinde & Oyelade, 2019). In dry irrigated regions, the combination of elevated evapotranspiration (ET), little precipitation and soil factors hamper infiltration. Agricultural land use in these areas is very poor, which is much lower than a country's average cropping intensity that cause hydrological situation that restrict the normal crop production throughout the year. The factors which contribute significantly to the development of saline soil are tidal flooding during wet season (June to October), direct inundation by saline water, and upward or lateral movement of saline ground water during dry season (February to May). The severity of salinity problem in Bangladesh increases with the desiccation of the soil. In general, soil salinity is believed to be mainly responsible for low land use as well as low cropping intensity in the area (Rahman & Ahsan, 2001).Salt accumulation in the root zone or soil surface results in loss of soil fertility and alters the soil properties and therefore harmfully impacts soil's environmental functions (Fu et al., 2020). For instance, it restricts water intake and soil water capacity limit to plant uptake, which prompts surface runoff and erosion (Gorji et al., 2020). The occurrence of parent materials and physical or chemical weathering of minerals and seawater intrusion is the leading natural cause of soil salinization (Ramos et al., 2020).Saltwater intrusion is a natural process where seawater mix with coastal groundwater aquifers due to the density difference between saline and fresh waters, creating a barrier that evolves landward (Barlow and Reichard, 2010). Since, soil "joe" condition comes late in coastal area, thus farmer starts cultivation in late and that is why that crop faced high salinity. But if we start cultivation early, then we can avoid salinity. Thus, the study was carried out to find out the yield of sweet gourd by avoiding the soil salinity.

Materials and Methods

Study location

This experiment was conducted at the Salinity Management and Research Centre (SMRC), Soil Resource Development Institute, Batiaghata, Khulna, Bangladesh during the Kharif-1 season of 2024. Geographically, the study site was at 22°46'01.8" N latitude and 89°24'15.2" E longitude and under AEZ-13. With an average yearly temperature of 79.3 °F and monthly mean temperatures ranging from 52.4 °F in January to 99.8°F in May, the area is among the warmest in Bangladesh (AEZ-13).. Land type of plot was medium high land, Land use was F-KV-TA, Depth of flooding 1.5 to 2.0 feet, duration of flooding was 3-4 months, Soil series was Barisal.

Experimental design

The following expecting experiment was carried out in Randomized Complete Block Design (RCBD) with three replications. Sweet gourd (variety: Maya) was taken as an experimental crop. Three experimental treatments were considered: (a) early pit method, (b) Tray seedling transplanting method, (c) Conventional pit preparation method with five replications.

Preparation of early pit

Water recession condition of south west part of Bangladesh is late. Thus "joe" condition comes at first week of February. Before that soil keep moist. In early pit method, pit was prepared in 01-02-2024 in moist soil without plough the land. Then pit was kept fallow in sunshine. The "joe" condition of pit came in 10-02-2024. Then sweet gourd seed was sown in 10-02-2024.

Tray seedling preparation

The second method was transplanting of tray seedling. Seedlings were grown early in tray. Seed was sown in tray in 25-02-2024. 15 days old seedlings were transplanted in main field in 13-03-2024.

Conventional pit preparation

In conventional method land was plough and made pit. Then pit soil and other fertilizer treatments were mixed with soil very properly. After processing the pit area, seeds were sown in the pit in 13-03-2024. Soil salinity was measured by using an EC Meter at 15 days intervals. All the intercultural operations like watering, gap filling, staking, weeding, and plant protection measures were executed very carefully.

Measurement of Growth and Yield attributes

Experiment was carried out for four growth and yield parameters such as fruit length (cm), fruit diameter (cm), single fruit weight (kg) and total yield (t/ha) were taken into consideration to analyze the effect of different pit method on yield of sweet gourd. Total yield (t/ha) was calculated by measuring the total fruit weight of the plot.

Initial Chemical properties of soil

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				µg/g			
7.4	2.69	0.35	0.20	10.35	14.37	2.74	0.49

Statistical Analysis

The collected data were tabulated and statistically analyzed using Statistix10 software. The treatment means were separated statistically at a 5 % level of significance using Duncan's Multiple Range Test (DMRT).

Results and Discussions

Soil salinity condition of different types of pit

When seed was sown (10-02-2024) in pit that made early method, then soil salinity was 2.9dS/m. At the time of tray seedling sowing and normal seed sowing (13-03-2024), then soil salinity was 4.5dS/m (Table 1). Soil salinity of early pit method at harvesting time (28-04-2024) was 8.5 dS/m, whereas other two method pit crops were in growing condition. In 13-05-2024 tray seedling crops were harvested and that time salinity was increasing at that time. Crops grown in conventional method harvested in 28-05-2024, faced long period high salinity. At harvesting time of conventional method the salinity was 14.2dS/m.

Table 1: EC (dS/m) at different sowing/transplanting date in the field

Treatment	EC (dS/m)					
	10-02-2024	13-03-2024	13-04-2024	28-04-2024	13-05-2024	28-05-2024
T_1 (Early pit method)	2.9	4.5	6.6	8.5	-	-
T_2 (Tray seedling method)	-	4.5	6.6	8.5	11.9	-
T_3 (Conventional method)	-	4.5	6.6	8.5	11.9	14.2

EC: Electrical Conductivity

EC determined by 1: 1 extraction Method

Effects of different sowing method on Yield Attributes of sweet gourd

Fruit length of sweet gourd

The research showed that, the fruit length varies to a great extent that was statistically analyzed as shown in Table 2. Fruit length showed a significant variation in relation to different pit method treatment. After production with different pit method, the fruit length at early pit method (seed sown in 10-02-2024) was 18.28 cm, the fruit length at tray seedling method (transplanted at 13-03-2024) was 15.23 cm and the fruit length at conventional method (seed sown in 13-03-

2024) was 13.17 cm. The highest fruit length (18.28 cm) was found at early pit method while the lowest fruit length (13.17 cm) was found where conventional method was followed. It was also found that fruit length (cm), numbers of fruit per plant of sweet gourd were significantly superior in early pit method to other treatments plot. Other planting treatments resulted in poor growth and yield of sweet gourd.

Table 2:Yield and Yield attributes of sweet gourd at different sowing method

Treatment	Fruit Length (cm)	Fruit Diameter (cm)	Fruit weight (kg)	Yield (t/ha)
T_1 (Early pit method)	18.28 a	62.73 a	3.32 a	24.62 a
T_2 (Tray seedling method)	15.23 b	55.64 b	2.45 b	20.45 b
T_3 (Conventional method)	13.17 c	49.44 c	1.98 c	15.55 c
CV (%)	4.56	6.85	7.06	7.33

Fruit Diameter of sweet gourd

Salts affect plant growth due to increasing soil osmotic pressure and to interference with plant nutrition. A high salt concentration in soil solution reduces the ability of plants to acquire water, which is referred to as the osmotic or water deficit effect of salinity. The highest fruit diameter (62.73 cm) was found at early pit method. In case of tray seedling method, the fruit diameter was 55.64 cm and in case of conventional method, the fruit diameter was 49.44 cm. The highest fruit diameter (62.73 cm) was observed at early pit method in comparison with the conventional planting method where the lowest fruit diameter (49.44 cm) was found(Table 2). It is a great sign that shows different pit method cultivation positively affect the soil salinity and manipulates the soil structure, texture, biochemical reaction and soil fertility. It is also found that fruit diameter, numbers of fruits per plant and other growth of sweet gourd were significantly superior in early pit method to other method of another plot. Salinity lowers the total photosynthetic capacity of the plant through decreased leaf growth and inhibited photosynthesis limiting its ability to grow.

Single fruit weight of sweet gourd

Sweet gourd yield parameters and single fruit weight grown under different methods are presented in Table 2. Statistical analysis was carried out on yield and yield attributes which revealed that these are significantly varied due to different planting method. The single fruit weight 3.32 kg was found in early pit method. In case of tray seedling method, the single fruit weight was 2.45 kg and in case of conventional method, the single fruit weight was 1.98 kg. The highest single fruit weight 3.32 kg was observed in early pit method in comparison with the conventional method where the lowest single fruit weight 1.98 kg was found (Table 2). That experiment indicated that plants under different planting method produce larger fruit and have higher single fruit weight per plant because of the better plant growth that is due to a favorable agro climate environment of soil and a completely moderate environment. Different planting method changes the micro environment of the plant and thus it enhances plant growth and vigor as well as production.

Total yield of sweet gourd

Soil salinity works against the growth of plants and developmental structure that varies of sweet gourd due to different planting method at different plot. The total yield and yield attributes grown under different pit method are presented in Table 2. Statistical analysis was carried out on yield and yield attributes which revealed that these are significantly varied due to different pit method. The total yield of fruit (24.62 t/ha) was found in early pit method. In case of tray seedling method, the total yield of fruit was 20.45 t/ha but in case of conventional method, the total yield of fruit was 15.55 t/ha. The highest total fruit yield (24.62 t/ha) was observed in early pit method in comparison with the conventional method where the lowest total fruit yield (15.55 t/ha) was found (Table 2).

Conclusion

Soil salinity is becoming a major constraint to vegetable crop production. This experiments point out that, soil salinity remain by the following order of planting method: early pit method > tray seedling method > conventional method. Different growth and yield attributes were significantly impacted due to different pit method. This results showed that, early pit method gave the highest total yield (24.62 t/ha) whereas, the lowest total yield (15.55 t/ha) was recorded in conventional method. It may be conclude that early pit method may be helpful for avoiding soil salinity.

EFFECT OF DIFFERENT STRENGTH OF SOIL SALINITY ON GROWTH AND YIELD OF CAULIFLOWER

A Biswas, Md. Z Islam

Abstract

Salt concentration in saline soil is a serious agricultural problem in south and south-western part of Bangladesh. This salt intensity creates a vital obstruction for cauliflower (*Brassica oleracea L*.) and other crops production. The experiment was conducted in the Salinity Management and Research Center under Soil Resource Development Institute at Batiaghata, Khulna to observe the effects of soil salinity strength management on growth and yield of cauliflower. The research work was conducted in a completely randomized design (CRD) with three replication of salt concentration (2,4,6,8,10,12 dS/m EC). Result of the experiment showed that the different combinations of soil salinity significantly influenced all the indicators that studied. Yield performance per plant was investigated for Plant height (cm), Numbers of leaves/ plant, Leaf length (cm), Spreading diameter (cm), Curd diameter (cm), Curd yield/plant (gm) and Gross yield/plant (gm). The yield data were recorded at harvest time. The parameters were significantly varied due to soil salinity management. The higher curd yield/plant (741 gm) was found in T_1 treatment (2±0.2 dS/m EC). It was demonstrated that salinity strength affects to decrease all the indicators that impact directly to the cauliflower yield with the increasing salt intensity.

Introduction

Cauliflower (*Brassica oleracea L*.) is one of the popular cole crops (botrytis Group) belonging Brassicaceae family (or Cruciferae) in the world. In the cultivation time excess salt level in saline soil causes serious physiological functional disorders, limiting vegetative and reproductive growth of vegetables and causes fertilization disorders decreases in marketing values, and also causes plant death (Dolarslan and Gul, 2012). Soil Salinity tolerance levels that affect yield are between 1.0-2.5 dS/m EC (Machado and Serralheiro, 2017). Cauliflower is a moderate salt sensitive vegetable, and the soil salinity up taking level of irrigation water yield of cauliflower starts to decline between 1.9 and 2.7 dS/m EC (Snapp et al., 1991; Kotuby et al., 1997). The optimum temperature for cauliflower with stands is 10° to 15°C. Soil salinity strength effect the extensive number of observations on the physiology of plant salt tolerance to a genetic basis and particular modification (Zhu, 2000; Pardo, 2010). Soil salinity is a serious problem in arid and semi-arid region of the world where poor quality water is available for irrigation (Tanji, 1990; Maas and Grattan, 1999). The yield of cauliflower is low due to lack of proper management practices and nutrients deficiency in the saline soil. National production of cauliflower was 268.48 thousand MT from 19.42 thousand ha (BBS, 2016). It was estimated that about 20% (45 million ha) of irrigated land, producing one-third of the world's food, is salt-affected (Shrivastava, P.; Kumar, R., 2015). The amount of world agricultural land destroyed by salt accumulation each year is estimated to be 10 million ha (Pimentel, D et al., 2004). It is estimated that, by 2050, 50% of the world's arable land will be affected by salinity (Bartels, D.; Sunkar, R., 2005). In saline region it is almost impossible to cultivate more than one crop for salt concentration in soil and water. Farmer can not supply fresh and salt free irrigation in their field at crops demand time due to salinity problem in soil and water. The proper management of adequate soil physical, chemical and biological properties in saline environments may be gain by using irrigation water and soil amendments and proper cultural practices (Grattan and Oster, 2003). Short duration vegetables can be introduced in that region of medium high land. There is a huge scope in saline areas for vegetable cultivation through intensification and diversification of technology in the medium high land during winter. The shortage of fresh water and soil salt level, negatively effects on plant growth (Asık et al., 2009). Cauliflower would be a promising crop for that region. After recession of saline water and minimum salt concentration in soil and water, cauliflower and other winter vegetables could be grown easily in south saline area. Soil salinity generally stresses plant growth responses from specific salt tolerance properties (Dalton et al., 2000). Salinity inhibits photosynthesis by decreasing CO_2 availability as a result of diffusion limitation (Flexas, J et al., 2007) and a reduction of the contents of photosynthetic pigments. Salt accumulation in cauliflower inhibits photosynthesis, primarily by decreasing stomatal and mesophyll conductance to CO_2(Di Martino, C.; Delfine, S.; Alvino, A.; Loret, 1999) and reducing chlorophyll content, which can affect light absorbance (Thompson et al., 2007).Appropriate saline water and soil management would play an important role in plant growth and curd formation especially in saline soil in winter crops production. In saline soil condition, Saline water should be used optimally and carefully to get the desire results from the irrigated crops (Alsaadawi and Mohamed , 2000). Research showed that saline soil and water management enhanced curd yield/plant, gross yield/plant and yield attributes substantially. Utilization of saline water has been well documented to improve physical, chemical and biological properties of soil. But the farmers of saline area are not habituated of cauliflower cultivation with proper soil salinity management of the crop. The goal of this study was to test the salt tolerance of cauliflower at different soil salinity level. As a result, the current study was designed to evaluate the impacts of saline soil on cabbage growth and yield.

Materials and methods

The experiment was carried out at the salinity management and research center, under soil resource development institute, Batiaghata, Khulna to test the effect of different strength of saline soil on emergence, growth and yield of cabbage plant. Plastic pots were used in conducting the experiment. The plastic pots were firstly washed and followed by rinsing with distilled water. Then those pots were dried in air. After drying the plastic pots were ready for the experiment. Finely prepared soil was filled of the pot by saline soil. Necessary amount of salt treatment was given to create saline environment by saturating the soil before placing the cabbage seedling. The trial included the following treatments: T_1 = 2±0.2 dS/m EC, T_2 = 4±0.2 dS/m EC, T_3 = 6±0.2 dS/m EC, T_4 = 8±0.2 dS/m EC, T_5 = 10±0.2 dS/m EC and T_6 = 12±0.2 dS/m EC. The single factor experiment used Completely Randomized Design (CRD) with three replications. The experiment was divided into three equal replication blocks, each with six plots.

As a result, the total number of unit plots was 18. The experiment's treatment combinations were randomized at random to 18 plots, each with three replications. Proper management about salinity control over the pot and growth of plants were observed. Time to time weeding, fertilizer application, irrigation, pot checking and special care to plant proper growth were following upto yield harvesting. Every three days later water application, pest controlling chemical and abiotic affect was observed. The data was collected at 60 days after cauliflower was fully matured. Intercultural operations were carried out when needed. The following yield related indicators were measured: Plant height (cm), numbers of leaves/plant, leaf length (cm), Spreading diameter (cm), Curd diameter (cm), Curd yield/plant (gm) and Gross yield/ plant (gm).

Preparation of saline soil

For developing the expected soil salinity of 2 to 12 dS/m EC, salt affected soil was collected from different place of saline affected area. Different concentrations of soil salinity (2, 4, 6, 8, 10 and 12 dS/m EC) was applied to the transplanted seeding on plastic pot. The salinity level was maintained by assessing the salt level from laboratory test.

Initial Chemical properties of soil of pot

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				µg/g			
7.2	1.91	0.24	0.09	17.23	57.51	1.12	1.17

Statistical analysis

The data obtained for different characters were statistically analyzed. The mean values of all the characters were evaluated and analysis of variance was performed by the ‘F’ test by using statistics software, version 10.

Results and discussions

The influence of different saline soil of different strength caused a considerable variation in plant height and numbers of leaves per plants which was statistically significant at different soil salinity strength. Initial Salinity of pot soil was 1.54 dS/m EC. After applying different strength of soil salinity to different pot, the evaluating indicator was different.

Plant height

The highest cauliflower plant height was found at T_1 (2±0.2 dS/m EC) treatment. The highest plant height at T_1 (2±0.2 dS/m EC) was 43.13 cm. The plant height at T_2 (4±0.2 dS/m EC) treatment was also the highest and that was 41.40 cm. In T_3 (6±0.2 dS/m EC) treatment, the plant height was 37.53 cm. At the T_4 (8±0.2 dS/m EC) treatment, plant height was 34.96 cm. The plant height at T_5 (10±0.2 dS/m EC) was 32.60 cm and the lowest plant height was at T_6 (12±0.2 dS/m EC) treatment that was 30.70 cm. So, the highest plant height at T_1 (2±0.2 dS/m EC) was 43.13 cm & T_2 (4±0.2 dS/m EC) was 41.40 cm and the lowest plant height was at T_6 (12±0.2 dS/m EC) treatment was 30.70 cm respectively (shown in table No. 1). The main causes of above result are the presence of available salinity strength of soil in sole application to pot for plant growth.

Table 1: Different plants parameter of different growth stages at different Soil salinity strength.

Treatment	Plant height (cm)	Number of leaves/plant	Leaf length (cm)	Spreading Diameter (cm)
T_1 (2±0.2 dS/m EC)	43.13 a	24.33 a	36.83a	66.61 a
T_2 (4±0.2 dS/m EC)	41.40 a	20.00 b	33.36	63.59 ab
T_3 (6±0.2 dS/m EC)	37.53 b	17.66 c	32.56	61.37 b
T_4 (8±0.2 dS/m EC)	34.96 c	17.00 cd	28.00	56.50 c
T_5 (10±0.2 dS/m EC)	32.60 cd	16.00cd	24.66	53.38 cd
T_6 (12±0.2 dS/m EC)	30.70 d	15.00 d	23.33	50.06 d
CV (%)	3.59	6.90	2.85	3.63

*EC determined by 1: 1 extraction Method

Number of leaves per plant

Number of leaves per plant for every cauliflower plants at different for soil salinity that has been shown in Table 1, because of the influence of different salinity strength of soil, a significant difference in number of leaves per plant was observed that was statistically significant at different level of salinity strength.The plants treated with T_1(2±0.2 dS/m EC) had the highest number of leaves per plant (24.33), at T_2 (4±0.2 dS/m EC) treatment, the plants had 20.00 number of leaves per plant, the plants treated with T_3(6±0.2 dS/m EC) had the 17.66 number of leaves per plant. But the number of leaves per plant (17.00) treated with T_4(8±0.2 dS/m EC) treatment. The plant treated with T_5 (10±0.2 dS/m EC) treatment has given 16.00 no. of leaves /plant. The lowest number of leaves per plant (15.00) treated with T_6(12±0.2 dS/m EC). Effect of saline soil showed significant variations in leaves number to every plant.

Leaf length

Cauliflower plant showed significant variations in leaf length at 2, 4, 6, 8, 10 and 12 (±0.2 dS/m EC) of soil salinity strength (Table 1). Significant variation on leaf length was found due to application of different saline water strength. The maximum length of leaf (36.83 cm) was found in T_1(2±0.2 dS/m EC) treatment. But the lowest number of leaf length (23.33 cm) treated with T_6(12±0.2 dS/m EC). Due to different soil salinity preparation, the increase salt concentration hit to cell elongation and cell division probably influenced the leaf growth of cauliflower.

Spreading diameter

The Higher spreading diameter of cauliflower was observed at T_1 (2±0.2 dS/m EC) treatment that is 66.61 cm which was statistically similar to T_2 (4±0.2 dS/m EC) that was of 63.59 cm respectively (shown Table 1). The lowest spreading diameter was 50.06 cm at T_6(12±0.2 dS/m EC). The interaction effects of cauliflower and saline soil showed significant variation in spreading diameter.

Yield contributing characters of cauliflower

Curd diameter

The maximum curd diameter was recorded at T_1(2±0.2 dS/m EC) treatment and it was 19.33 cm shown (Table 2) while the lowest curd diameter (7.00 cm) was recorded with the T_6 (12±0.2 dS/m EC)with recommended saline soil management, Curd size has a positive response towards the proper irrigation and salt management. It is a mass message that, at 6, 8, 10 dS/m EC facing cauliflower has given salinity result based curd formation due to high soil salinity.

Table 2: Showing of different plant parameter of different growth stages for different Soil salinity strength.

Treatment	Curd Diameter (cm)	Curd yield (gm)	Biological yield (gm)
T_1(2±0.2 dS/m EC)	19.33 a	741.00 a	1208.7 a
T_2(4±0.2 dS/m EC)	16.83 b	622.33 b	1012.0 b
T_3(6±0.2 dS/m EC)	14.16 c	464.67 c	838.7 c
T_4(8±0.2 dS/m EC)	12.23 d	345.67 d	535.3 d
T_5(10±0.2 dS/m EC)	11.00 d	246.67 e	394.3e
T_6(12±0.2 dS/m EC)	7.00 e	98.33 f	286.0 e
CV (%)	7.46	3.66	9.73

*EC determined by 1: 1 extraction Method

Curd yield

Curd yield of cauliflower drastically affected by soil salinity. When the soil and water becomes saline then curd production get seriously low. The highest curd yield was recorded (shown table 2) at T_1(2±0.2 dS/m EC) treatment that was 741gm and the lowest curd yield was recorded at T_6(12±0.2 dS/m EC) of 98.33 gm. Combination of different saline soil gives result to curd yield goes down due to higher strength of saline soil.

Biological yield per plant

Saline soil hardly performs for plant growth. The gross yield per plant was significantly influenced by different soil salinity strength (Table 2). The maximum gross yield/plant (1208.70 gm) was observed inT_1(2±0.2 dS/m EC) treatment, while the lowest gross yield/plant (286 gm) was observed in the plants treated with T_6 (12±0.2 dS/m EC). It is a clear message that, at 6, 8, 10 dS/m EC facing cauliflower plant has given salinity result based gross yield due to high soil salinity that is very drastically different to other plants yield.

Conclusion

This research results revealed that the cauliflower plants grow better withT_1(2±0.2 dS/m EC) soil salinity strength condition. The objective of the experiment was to determine the influence of different levels of soil salinity strength performance on cauliflower growth and production. From the results, it can be concluded that applying different levels of saline soil have a significant effects on cauliflower growth and yields. The highest gross obtained yield from lower level of soil salinity and gives the maximum gross yield (1208.70 sgm) per plant is helpful for increasing the growth and yield of cauliflower. The findings of the research may be applicable to other region of the southern area of the country. However, further research work at different doses of salinity strength of saline soil on the growth and yield of cauliflower will need to be performed in different saline area of Bangladesh to suggest specific conclusions and recommendations.

EFFECT OF DIFFERENT STRENGTH OF SOIL SALINITY ON GROWTH AND YIELD OF CABBAGE

A Biswas, Md. Z Islam

Abstract

Salinity of soil is a major problem in south and south-western part of Bangladesh. An investigation was made on growth and yield performance of cabbage (*Brassica sa* var. *capitata L.*) under different soil salinity strength to plants by saline soil at salinity management and research center. The experiment was laid out in a completely randomized design (CRD) with three replications of salt concentration (2, 4, 6, 8, 10, 12 dS/m EC). Result of the experiment revealed that the different combinations of saline soil significantly influenced all the parameters that studied. Yield performance per plant was investigated for Plant Height (cm), numbers of leaves/plant, fresh weight of loose leaves/plant (gm), diameter of head (cm), thickness of head (cm), fresh weight of head/plant (gm), numbers of folded leaves/plant and gross yield/ plant. It was proved that soil having salinity 2 dS/m gives the best result for all parameter of cabbage.

Introduction

Continuous rising of global temperature and associated climate changes are creating severe abiotic stresses that are seriously hampering crop yields and quality in many salt affected areas. Among those sufferings, major is soil salinity. Yield and quality traits of vegetable crops are adversely affected by environmental factors such as drought and/or high salinity of the root zone (Goyal et al., 2003). It is recognized that water and ions are the main physiological catalogue of processing plants physiology that need to optimize to resume growth in saline environments (Lauchli and Luttge, 2002). Over 9% of the world's total land and approximately 20% of irrigated land is affected by high salinity barrier. The problem is particularly severe in the Mediterranean, semi-arid and arid areas (Zhang et al., 2014; Munns and Gilliham, 2015). Cabbage (*Brassica oleracea var. capitata L.*) is a popular green leafy vegetable of the family Brassicaceae. It is an herbaceous, biennial, dicotyledonous flowering plant distinguished by a short stem crowned with a mass of leaves, typically green but in some varieties red or purple, which while immature form a characteristic compact, globular cluster (cabbage head). Photosystem II (PSII) is the most sensitive part of the apparatus to salt stress (Kalaji et al., 2011; Jajoo, 2014; Oukarroum et al., 2015). Cabbage is a great source of vitamin C, with a moisture content of 60.6%. It also contains vitamin B complex, potassium, and calcium (Haque KMF, 2006). Soil contributes to the maintenance of cells' redox systems and the regulation of stomatal aperture in drought and salinity responses (Sharma et al., 2017). Saline soil play crucial roles in plants' physiological responses and adaptation to salinity stress (Fahad et al., 2015). Cabbage ranks second in terms of production and area among all vegetables grown in Bangladesh. It is grown on an 18 thousand hectares area with a total production of 312 thousand tons (BBS, 2017), but the yield is poor. In south and south-western part of Bangladesh is facing a huge constraint of salt problem. Every year farmers are losing their hope for cabbage cultivation for soil salinity. The main reason is NaCl toxicity in soil (Almeida et al., 2017). The reason for such low cabbage production is due to a lack of fresh water for cultivation. This low cabbage yield could be increased by adopting improved saline soil management research. It is very important to determine the limit of soil salinity that crops can tolerate and determine if they can uptake and accumulate salts to use them for soil desalination. This may encourage and motivate farmers to introduce cabbage plants into their cropping system. The goal of this study was to test the salt tolerance of Cabbage (*Brassica oleracea var*. *Capitata L*.) at different soil salinity level. As a result, the current study was designed to evaluate the impacts of saline soil on cabbage growth and yield.

Materials and methods

The experiment was carried out at the salinity management and research center, under soil resource development institute, Batiaghata, Khulna to test the effect of different strength of saline soil on emergence, growth and yield of cabbage plant. Plastic pots were used in conducting the experiment. The plastic pots were firstly washed and followed by rinsing with distilled water. Then those pots were dried in air. After drying the plastic pots were ready for the experiment. Finely prepared soil was filled of the pot by saline soil. Necessary amount of salt treatment was given to create saline environment by saturating the soil before placing the cabbage seedling. The trial included the following treatments: T_1 = 2±0.2 dS/m EC, T_2 = 4±0.2 dS/m EC, T_3 = 6±0.2 dS/m EC, T_4 = 8±0.2 dS/m EC, T_5 = 10±0.2 dS/m EC and T_6 = 12±0.2dS/m EC. The single factor experiment used completely Randomized design (CRD) with three replications. The experiment was divided into three equal replication blocks, each with six plots. As a result, the total number of unit plots was 18. 30 days cabbage seedlings were transplanted. The experiment's treatment combinations were randomized at random to 18 plots, each with three replications. Proper management about salinity control over the pot and growth of plants were observed. Time to time weeding, fertilizer application, irrigation, pot checking and special care to plant proper growth were following upto yield harvesting. Every three days later water application, pest controlling chemical and abiotic affect was observed. The data was collected at 60 days after cabbage transplanting. Intercultural operations were carried out when needed. The following parameters were measured: plant height (cm), numbers of leaves/plant, fresh weight of loose leaves/plant (gm), diameter of head (cm), thickness of head (cm), fresh weight of head/plant (gm), numbers of folded leaves/plant and gross yield/ plant (gm).

Preparation of saline soil

For developing the expected soil salinity of 2 to 12 dS/m EC, salt affected soil was collected from different place of saline affected area. Different concentrations of soil salinity (2, 4, 6, 8, 10 and 12 dS/m) was applied to the transplanted seeding on plastic pot. The salinity level was maintained by assessing the salt level from laboratory test.

Initial Chemical properties of soil of pot

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				μg/g			
7.2	1.91	0.24	0.09	17.23	57.51	1.12	1.17

Statistical analysis

The data obtained for different characters were statistically analyzed. The mean values of all the characters were evaluated and analysis of variance was performed by the 'F' test by using statistics software, version 10.

Results and Discussions

All the contributing parameters at different soil salinity strength have been shown. The influence of different saline soil of different strength caused a considerable variation in plant height and numbers of leaves per plants which was statistically significant at different soil salinity strength. Initial Salinity of pot soil was 1.54 dS/m EC. After applying different strength of soil salinity to different pot, the evaluating indicator was different.

Plant height

The highest plant height was found from T_1 (2±0.2 dS/m EC) treatment. The highest plant height at T_1 (2±0.2 dS/m EC) was 23.00 cm. The plant height at T_2 (4±0.2 dS/m EC) was 20.00cm. In T_3 (6±0.2 dS/m EC) the plant height was 17.66 cm. At the T_4 (8±0.2 dS/m EC) treatment, plant height was 15.33 cm. The plant height at T_5 (10±0.2 dS/m EC) was 13.66 and the lowest plant height was at T_6 (12±0.2 dS/m EC) that was 13.33 cm. So, the highest plant height at T_1 (2±0.2 dS/m EC) was 23.00 cm and the lowest plant height was at T_6 (12±0.2 dS/m EC) that was 13.33 cm respectively (shown in table No. 1).

Number of leaves per plant

Number of leaves per plant at different soil salinity strength has been shown in Table 1. Due to the influence of different soil saline strength, a significant difference in Number of leaves per plant was observed that was statistically significant at different soil salinity. The plants treated with T_1(2±0.2 dS/m EC) had the highest number of leaves per plant (54.00), at T_2 (4±0.2 dS/m EC) treatment, the plants had the 51.33 number of leaves per plant, the plants treated with T_3(6±0.2 dS/m EC) had the 46.66 number of leaves per plant. Numbers of leaves at T_4(8±0.2 dS/m EC) was at 45.00. Treatment with T_5 (10±0.2 dS/m EC), the no. of leaves was 42.00. But the lowest number of leaves per plant (39.00) given by treated with T_6 (12±0.2 dS/m EC) treatment.

Table 1: Different plant parameters shown at different Soil salinity strength.

Treatment	Plant height(cm)	No of leaves/ plant	Fresh weight of loose leaves (gm)	Diameter of head (cm)	Thickness of head(cm)
T_1(2±0.2 dS/m EC)	23.00 a	54.00 a	332.00 a	16.66 a	9.23 a
T_2(4±0.2 dS/m EC)	20.00 b	51.33 b	325.67 ab	15.00 ab	7.66 b
T_3(6±0.2 dS/m EC)	17.66 c	46.66 c	312.67 b	13.33 bc	7.63 b
T_4(8±0.2 dS/m EC)	15.33 d	45.00 d	247.33 c	11.33 c	6.83 bc
T_5(10±0.2 dS/m EC)	13.66 e	42.00 e	230.33 d	8.83 d	6.00 c
T_6(12±0.2 dS/m EC)	13.33 e	39.00 f	218.67 d	8.16 d	5.76 c
CV (%)	5.32	2.19	3.33	11.07	8.44

*EC determined by 1: 1 extraction Method

Fresh wt. of loose leaves (gm)

The effects of different saline strength of soil on fresh weight of loose leaves were significant (Table 1). The plants grown under the soil saline treatment of T_1(2±0.2 dS/m EC) had the highest fresh weight of loose leaves (332 gm), however the plants grown under the treatment of T_6(12±0.2 dS/m EC) had the lowest fresh weight of loose leaves (218.67 gm).

Diameter of head (cm)

Different saline strength of soil of pot culture and management had a significant effect on head diameter (Table 1). The plants with the largest diameter of head (16.66 cm) were grown with T_1(2±0.2 dS/m EC) treatment while the plants with the smallest diameter of head (8.16 cm) were grown with the treatment of T_6(12±0.2 dS/m EC). It is noticed that at 8, 10, 12 dS/m EC of soil, Cabbage crop has response salinity level related result based with poor growth of head formation due to soil salinity.

Thickness of head

It would appear that the various soil saline conditions had a significant effect on the thickness of the head (Table 1). The T_1(2±0.2 dS/m EC) treatment showed the highest thickness of head (9.23 cm), where as the T_6(12±0.2 dS/m EC) gave the lowest thickness of head (5.76 cm). It is noticed that, at 6, 8,10, dS/m EC of soil tolerant cabbage has response very lightly with poor growth of thickness of head formation due to soil salinity.

Table 2: Different plants parameter shown at different Soil salinity strength.

Treatment	Fresh weight of head (gm)	Number of folded leaves/plant	Gross yield (gm)
T_1 (2±0.2 dS/m EC)	954.33 a	39.00a	1258.3 a
T_2 (4±0.2 dS/m EC)	853.67 b	34.33	1168.0 b
T_3 (6±0.2 dS/m EC)	777.33 c	32.33	1054.3 c
T_4 (8±0.2 dS/m EC)	723.67 d	28.10	922.7 d
T_5 (10±0.2 dS/m EC)	374.00 e	24.00	585.3 e
T_6 (12±0.2 dS/m EC)	310.67 f	22.66	555.3 e
CV (%)	2.64	4.77	2.14

*EC determined by 1: 1 extraction Method

Fresh weight of head/plant (gm)

The highest fresh weight of head (954.33gm) was found in plants grown with T_1 treatment (2±0.2 dS/m EC) (Table 2), while the lowest fresh weight of head (310.67gm) was found in plants grown with T_6(12±0.2 dS/m EC) treatment and this difference were statistically significant. At different soil saline strength of 6, 8, 10, dS/m EC, any cabbage plants has given small significant responded salinity level related result based thickness of head.

Number of folded leaves/plant

The highest number of folded leaves/plant (39.00) was found in plants grown under treatment T_1(2±0.2 dS/m EC) (Table 2), while the lowest number of folded leaves/plant (22.66) was found in plants grown under treatment T_6 (12±0.2 dS/m EC) and the significant difference was found. At different soil salinity strength of 6, 8, 10, dS/m EC, any cabbage plants has given very salinity level related result based folded leaves per plant.

Gross yield per/plant

The gross yield per plant was significantly affected by different saline soil intensity (Table 2). The maximum gross yield (1258.30gm) per plant was observed in T_1 treatment (2±0.2 dS/m EC), while the lowest gross yield/plant (555.30gm) was observed in the plants treated with T_6(12±0.2 dS/m EC). At 6, 8,10 dS/m EC of soil saline condition has formed salinity level related result based gross yield per plant.

Conclusion

The purpose of the experiment was to determine the influence of different levels of soil saline strength effect on cabbage growth and production. From the results, it can be concluded that management of different levels of saline soil have a significant effects on cabbage growth and yields. The highest gross and marketable yield were obtained at the combination from the application of T_1 treatment (2±0.2 dS/m EC) of soil and gives the maximum fresh weight of head

(954.33gm) per plant and gross yield (1258.30gm) per plant is helpful for increasing the growth and yield of cabbage. The findings of the study may be applicable to other locations of the southern region of the country as well. However, further research work at different cultivated land of different soil salinity strength on the growth and yield of cabbage will need to be performed in different saline area of Bangladesh to reach a specific conclusions and recommendations.

EFFECT OF DIFFERENT STRENGTH OF SOIL SALINITY ON GROWTH AND YIELD OF KNOL KHOL

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Abstract

Salinity is a crucial agricultural constraint for crops production in saline area. In south and south-western area of Bangladesh is overcoming a huge barrier of salt accumulation to soil and problematic condition for different agricultural activities. So for solving such a curse a field experiment was carried out to investigate the effect of different soil salinity strength on the growth and yield of knol khol (*Brassica* *oleracea* var. *caulorapa L.)* during Rabi season. The experiment was laid out in Completely Randomized Design (CRD) comprising of 18 treatments viz., T_1- 2±0.2 dS/m EC, T_2 -4±0.2 dS/m EC,T_3 –6±0.2 dS/m EC, T_4 –8±0.2 dS/m EC, T_5 –10±0.2 dS/m EC, T_6 - 12±0.2 dS/m EC. Each replication was three times repeated. Treatments were randomly arranged in each replication that divided into 18 pots. The results revealed that the application of T_1- 2±0.2 dS/m EC gave the maximum plant height, highest number of leaves per plant, Diameter of stem/plant, diameter of knob, Fresh weight of knob/plant and Gross yield/plant. So, we can consider 2 dS/m EC (2±0.2 dS/m) for our soil health, environmental benefits and ecological safety.

Keywords: Knol khol, Growth, saline water, diameter of knob, knob yield.

Introduction

Soil salinity problem is the most abiotic barrier for crop production for arid and semi-arid region in the world now a days. Soil salinity has great detrimental effects on crop production, especially in arid and semi-arid regions (Moud and Maghsoudi 2008; Keshavarzi 2011). High soil salinity is deleterious to most knol khol (*Brassica* *oleracea* *var*. *caulorapa L*.), as it is a cole crop that produced worldwide, but very popular in Bangladesh also. The soil salinity of coastal saline soil is sometimes high, and with the same ion composition compared to sea water (Khan et al., 1996). In the other hand, the groundwater table of that saline region is quite shallow and the soil salinity changes seasonally (Shi et al., 2005).Different soil salinization process causes soil erosion on a global scale and reduces crop productivity (Acosta JA, Boris J, Karsten K, Martínez, S. M., 2011). Salt accumulation in soil is one of the most destructive environmental pressures in the uncultivated area, crop production and quality cause deficit (Yamaguchi, T., Blumwald, E., 2005;Lugtenberg et al.,2002). There are long light green colored round shape structures, which come out as its shoots. Knolkhol (*Brassica oleracea* var. *caulorapa L*.) also is known as kohlrabi belongs to the family cruciferae. It is a cold, hardy crop and can tolerate well in extremely cold weather and saline condition also. The fleshy portion of the stem develops entirely above the ground, called knob and is used as a vegetable (Raj et al., 2014). It is an excellent vegetable if it is used before it becomes tough and fibrous. It is high in minerals and vitamins A and C. It contains adequate amount of water (85.9 g), calories (28.5.0 g), protein (2.10 g), carbohydrate

(7.6 g), fibers(1.0 g)) per 100 g of edible stem (Kamal et al., 2013). It also contains satisfactory amount of calcium, phosphorus, iron, sodium, potassium and vitamin A and C (Dadhich et al., 2015). Basically edible part of knol khol is knob, which is form swelling of the stem tissue above the plants. The crop has miracle medicinal value like, acidosis, asthma, cancer, cholesterol level, heart problems, indigestion, muscle and nerve functions, prostate and colon cancer, skin problems, weight loss etc. The fleshy turnip like portion of the stem develops entirely above the ground. The modern nutrient management policy has changed its focus towards the concept of sustainability and eco-friendliness and productivity (N and P Mehta et al.,2015). The increasing use of chemical fertilizers and soil saline condition in Bangladesh has a great impact to increase vegetable production. Plant growth decreases significantly under the influence of salt stress however the plants differ considerably in their sensitivity and ability to tolerate salinity stress (Amzallag et al., 1993). For irrigation purposes, saline water should be used optimally and carefully to get the desire results from the irrigated crops (Alsaadawi and Mohamed, 2000). It has been widely recognized but its long run impact on soil health, ecology and other natural resources are detrimental which affect living organisms including beneficial soil microorganism for crop production. However, at high level of crop production, those saline environmentsare not congenial to plant growth and yield. Ground soil salinity is known to inhibit plant growth (Paul, D., 2012). Soil salinity strength has a negative effect on the yield and quality of beet crops like sugar beet,turnip, knol khol etc especially from the excessive absorption of sodium (Mekki and El Gazaar 1999; Cheggour and Fares 2002).This saline movement can also hamper soil physical and biological fertility, making it non ideal for land application as a working microclimate. Soil salinity is also a major problem in areas where high ground salt water is used for irrigation (Rausch, T., at all, 1996). The agricultural practices in saline soil is considered as a bad management practice in any agricultural production system because of its negatively stimulation of soil microbial growth and activity, subsequent conversion of plant nutrients, and promote to loss soil fertility and quality for any types of crops production. Bangladesh is a developing country. Most of the people living here are suffering from nutrient deficit i.e., malnutrition. Fresh knol khol can be a cheap and safe vegetable for health and that is our ultimate destination to produce crop. So, cultivation of knol khol in saline soil deserves great importance. In fine, the studied was undertaken to observe the evaluation of comparative effects of different soil salinity strength on growth and yield of knol khol and to find out best intensity of soil salinity strength for obtaining higher economic yield.

Materials and Methods

The experiment was carried out at the salinity management and research center, under soil resource development institute, Batiaghata, Khulna to test the effect of different strength of saline soil on emergence, growth and yield of knol khol plant. Plastic pots were used in conducting the experiment. The plastic pots were firstly washed and followed by rinsing with distilled water. Then those pots were dried in air. After drying the plastic pots were ready for the experiment. Finely prepared soil was filled of the pot by saline soil. Necessary amount of salt treatment was given to create saline environment by saturating the soil before placing the knol khol seedling. The trial included the following treatments: T_1 = 2±0.2 dS/m EC, T_2 = 4±0.2 dS/m EC, T_3 = 6±0.2 dS/m EC, T_4 = 8±0.2 dS/m EC, T_5 = 10±0.2 dS/m EC and T_6 = 12±0.2 dS/m EC. The single factor experiment used completely Randomized design (CRD) with three replications. The experiment was divided into three equal replication blocks, each with six plots. As a result, the total number of unit plots was 18. The experiment's treatment combinations were randomized at random to 18 plots, each with three replications. 25 days knol khol seedlings were transplanted. Proper management about salinity control over the pot and growth of plants were observed. Time to time weeding, fertilizer application, irrigation, pot checking and special care to plant proper growth were following upto yield harvesting. Every three days later water application, pest controlling chemical and abiotic affect was observed. The data was collected at 60 days after knol khol transplanting. Intercultural operations were carried out when needed. The following parameters were measured: Plant height (cm), number of leaves/plant, diameter of stem (cm) at 60 days, diameter of knob (cm), fresh weight of knob/plant (gm) and gross yield/plant (gm).

Preparation of saline soil

For developing the expected soil salinity of 2 to 12 (±0.2 dS/m) EC of salinity strength, salt affected soil was collected from different place of saline affected area. Different concentrations of soil salinity (2, 4, 6, 8, 10 and 12 ds/m EC) was applied to the transplanted seeding on plastic pot. The salinity level was maintained by assessing the salt level from laboratory test.

Initial Chemical properties of soil of pot

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				μg/g			
7.2	1.91	0.24	0.09	17.23	57.51	1.12	1.17

Statistical analysis

The data obtained for different characters were statistically analyzed. The mean values of all the characters were evaluated and analysis of variance was performed by the 'F' test by using statistics software, version 10.

Results and Discussions

All the characters of promoting vegetative growth and yield performance parameters at different DAT have been shown (table 1). Results on main and combined effect of different soil salinity strength and fertilizer management practices and their interactions have been presented and discussed here. The influence of different soil salinity caused a considerable variation in plant growth, production of yield and economic benefits of plants which was statistically significant at

60 DAT. After applying different strength of soil salinity in different pot, the expected parameters were changed.

Table 1: Showing result of different plantsof different growth stages at different soil salinity strength.

Treatment	Plant height (cm)	Number of leaves/plant	Diameter of Stem (cm) 60 DAT	Diameter of knob (cm)	Fresh weight of knob (gm)	Gross Yield (gm)
T_1 (2±0.2 dS/m EC)	46.63 a	20.00 a	2.03 a	13.80 a	796.00 a	994.33 a
T_2 (4±0.2 dS/m EC)	39.33 b	16.66 b	1.83 b	11.90 b	592.33 b	823.33 b
T_3 (6±0.2 dS/m EC)	37.46 bc	16.00 b	1.63 c	10.80 c	525.33 bc	778.00 bc
T_4 (8±0.2 dS/m EC)	34.80 cd	15.66 b	1.56 cd	10.20de	506.33 c	702.33 cd
T_5 (10±0.2 dS/m EC)	33.73 de	15.00 b	1.50 d	9.60 e	463.33 c	645.33 d
T_6 (12±0.2 dS/m EC)	32.00 e	13.00 c	1.30 e	8.33	373.67 d	473.67 e
CV (%)	4.10	5.76	4.39	4.82	6.98	8.72

*EC determined by 1: 1 extraction Method

Plant height

The outside variation in plant height due to different soil salinity strength was statistically significant in knol khol at different strength of soil salinity after transplanting (DAT) (Table 1). At T_1 (2±0.2 dS/m EC) treatment the maximum plant height was 46.63 cm. In the T_2 (4±0.2 dS/m EC) treatment it was found the plant height was 39.33 cm. At the T_3(6±0.2 dS/m EC) treatment, the plant height was 37.46 cm and for T_4(8±0.2 dS/m EC) treatment plant height resulted in 34.80 cm.The minimum plant height was found in the treatment T_6 (12±0.2 dS/m EC) and it was 32 cm. It is stated that 12±0.2 dS/m of soil salinity strength knol khol plant had given very lowest plant growth at all.

Number of leaves per plant

A lots of ingredients helps to produce plant leaves. The production of different number of leaves per plant at different DAT has been shown in Table 1. Due to the influence of different soil salinity strength, a significant difference in number of leaves per plant was observed that was statistically significant at different DAT. The plant irrigated with T_1 (2±0.2 dS/m EC) had the highest number of leaves per plant (20). At T_2 (4±0.2 dS/m EC) the numbers of leaves per plant was 16.66.The plants treated with T_3 (6±0.2 dS/m EC) had 16.00 number of leaves per plant and the lowest numbers of leaves per plant (13) for treatment of T_6 (12±0.2 dS/m EC). The plants treated with T_1 (2±0.2 dS/m EC) had the highest number of leaves per plant (20) but the lowest number of leaves per plant (13) treated with T_6 (12±0.2 dS/m EC).

Diameter of stem (cm)

Soil salinity strength has a profound effect on plant canopy and yield production characters and management had a significant effect on stem diameter (Table 1). The plants with the largest diameter of stem (2.03 cm) was grown with T_1 (2±0.2 dS/m EC) treatment. In the T_2 (4±0.2 dS/m EC) treatment, diameter of stem resulted at 1.83 cm. At T_3 (6±0.2 dS/m EC) treatment, the diameter of stem was 1.63 cm while the plants with the smallest diameter of stem (1.30 cm) was grown with the treatment of T_6(12±0.2 dS/m EC). It is shown that at 8,10dS/m EC of salinity strength tolerant knol khol had given the smallest stem formation due to soil salinity.

Diameter of knob (cm)

Effect of different soil salinity strength had a great significant influence on the diameter of knob (Table 1). The maximum diameter of knob (13.80 cm) was found with the treatment T_1 (2±0.2 dS/m EC) and the minimum diameter of knob (8.33 cm) was obtained from T_6 (12±0.2 dS/m EC) treatment. As knol khol is a short duration crops and highly feeding crops it was affected when grown under saline condition.

Fresh weight of knob/plant (gm)

Different intensity of saline soil salinity had a great significant effect on fresh weight of knob per plant (Table 1). The maximum fresh weight of knob per plant (796.00 gm) was obtained from the treatment T_1 (2±0.2 dS/m EC) and the minimum fresh weight of knob (373.67gm) was found from the T_6 (12±0.2 dS/m EC) treatment. The maximum weight of single tuber might be due to soil salinity effect and plant growth resistant. Interaction effects of different strength of soil salinity treatment were significant on fresh weight of knob.

Gross yield/plant (gm)

Application of different strength of saline soil to knol khol plant contributes on economic yields per plant. It reveals that variation among different soil salinity strength was statistically significant. It is obvious from the present study that the maximum marketable gross yield (994.33gm) resulted from T_1 (2±0.2 dS/m EC) and the lowest marketable gross yield (473.67 gm) was found from treatment T_6 (12±0.2 dS/m EC)treatment. It was observed that the interaction effect of different soil salinity strength on economic yield per plant was statistically significant.

Conclusion

From the above discussion it is clear that, higher yield could be obtained by cultivating the knol khol variety early in different saline prone area under saline region of Bangladesh. Recommended soil salinity strength T_1 (2±0.2 dS/m EC) produced maximum vegetative gross yield s(994.33 gm) and economic yield. So, we can consider the treatment T_1 (2±0.2 dS/m EC) of soil salinity for our soil health, environmental benefits and crops production. Further experiment may be carried out before giving final recommendation.

EFFECT OF DIFFERENT STRENGTH OF SOIL SALINITY ON GROWTH AND YIELD OF RED BEET

A Biswas, Md. Z Islam

Abstract

Salinity is a crucial agricultural constraint for crops production in saline area. In south and south-western area of Bangladesh is overcoming a huge barrier of salt accumulation to soil and problematic condition for different agricultural activities. So for solving such a curse a field experiment was carried out to investigate the effect of different soil salinity strength on the growth and yield of Red beet (*Beta vulgaris subsp. vulgaris*) during Rabi season. The experiment was laid out in Completely Randomized Design (CRD) comprising of 18 treatments viz., T_1-2±0.2 dS/m EC, T_2 -4±0.2 dS/m EC, T_3 –6±0.2 dS/m EC, T_4 –8±0.2 dS/m EC, T_5 –10±0.2 dS/m EC, T_6 - 12±0.2 dS/m EC. Each replication was three times repeated. Treatments were randomly arranged in each replication that divided into 18 pots. The results revealed that the application of T_1- 2±0.2 dS/m EC gave the maximum plant height, leaf length, leaf width, highest number of leaves/plant, Beet root length, Diameter of beet root/plant, Fresh weight of beet root/plant and Gross yield/plant. So, we can consider 2 dS/m EC (2±0.2 dS/m) for our soil health, environmental benefits and ecological safety.

Keywords: Red beet, Growth, saline water, diameter of root, beet root yield.

Introduction

The largest abiotic obstacle to crop development in arid and semi-arid regions of the world today is the problem of salinity in the soil. Particularly in dry and semi-arid areas, soil salinity has a significant negative impact on agricultural productivity (Moud and Maghsoudi, 2008; Keshavarzi, 2011). Most Red beet (*Beta vulgaris* subsp. *vulgaris*) which is a cole crop that is grown all over the world but is particularly well-liked in Bangladesh as well, suffers from high soil salinity. The soil salinity of coastal saline soil is sometimes high, and with the same ion composition compared to sea water (Khan et al., 1996). In the other hand, the groundwater table of that saline region is quite shallow and the soil salinity changes seasonally (Shi et al., 2005).Different soil salinization process causes soil erosion on a global scale and reduces crop productivity (Acosta, J. A., Boris, J., Karsten, K., Martínez, S. M., 2011). Salt accumulation in soil is one of the most destructive environmental pressures in the uncultivated area, crop production and quality cause deficit (Yamaguchi, T., Blumwald, E., 2005; Lugtenberg et al., 2002). There are long light green colored round shape structures, which come out as its shoots. Red beet (*Beta vulgaris* subsp. *vulgaris*) also is also known as the table beet, garden beet, red beet, dinner beet or golden beet. Beet root can be eaten raw, roasted, or boiled. Beetroot can also be canned, either whole or cut up, and often are pickled, spiced, or served in a sweet-and-sour sauce. It is one of several cultivated varieties of *B.vulgaris* grown for their edible taproots and leaves (called beet greens) they have been classified as *B.vulgaris* subsp. *Vulgaris* conditiva group. Other cultivars of the same species include the sugar beet, the leaf vegetable known as chard or spinach beet which is a fodder crop. Three subspecies are typically recognized. It is a cold, hardy crop and can tolerate well in extremely cold weather and saline condition also. The fleshy portion of the stem develops entirely above the ground, called knob and is used as a vegetable (Raj et al., 2014). It is an excellent vegetable if it is used before it becomes tough and fibrous. It is high in minerals and vitamins A and C. It contains adequate amount of water (85.9 g), calories (28.5.0 g), protein (2.10 g), carbohydrate (7.6 g), fibre (1.0 g)) per 100 g of edible stem andRaw beet root is 88% water, 10% carbohydrates, 2% protein, and less than 1% fat. In a 100-gram (3+1⁄2-ounce) amount providing 180 kilojoules (43 kilocalories) of food energy, raw beetroot is a rich source (27% of the Daily Value - DV) of folate and a moderate source (16% DV) of manganese, with other nutrients having insignificant content. A clinical trial review reported that consumption of beetroot juice modestly reduced systolic blood pressure but not diastolic blood pressure (Kamal et al., 2013). It also contains satisfactory amount of calcium, phosphorus, iron, sodium, potassium and vitamin A and C (Dadhich et al., 2015). Basically edible part of Red beet is root, which is form swelling of the stem tissue above the plants. The crop has miracle medicinal value like, acidosis, asthma, cancer, cholesterol level, heart problems, indigestion, muscle and nerve functions, prostate and colon cancer, skin problems, weight loss etc. The fleshy turnip like portion of the stem develops entirely above the ground. The modern nutrient management policy has changed its focus towards the concept of sustainability and eco-friendliness and productivity (N and P Mehta et al., 2015). The increasing use of chemical fertilizers and soil saline condition in Bangladesh has a great impact to increase vegetable production. Plant growth decreases significantly under the influence of salt stress however the plants differ considerably in their sensitivity and ability to tolerate salinity stress (Amzallag et al., 1993). For irrigation purposes, saline water should be used optimally and carefully to get the desire results from the irrigated crops (Alsaadawi and Mohamed, 2000). It has been widely recognized but its long run impact on soil health, ecology and other natural resources are detrimental which affect living organisms including beneficial soil microorganism for crop production. However, at high level of crop production, those saline environments are not congenial to plant growth and yield. Ground soil salinity is known to inhibit plant growth (Paul, D., 2012). Soil salinity strength has a negative effect on the yield and quality of beet crops like sugar beet, turnip etc especially from the excessive absorption of sodium (Mekki and El Gazaar 1999; Cheggour and Fares, 2002).This saline movement can also hamper soil physical and biological fertility, making it non ideal for land application as a working microclimate. Soil salinity is also a major problem in areas where high ground salt water is used for irrigation (Rausch, T. et al., 1996). The agricultural practices in saline soil is considered as a bad management practice in any agricultural production system because of its negatively stimulation of soil microbial growth and activity, subsequent conversion of plant nutrients, and promote to loss soil fertility and quality for any types of crops production. Bangladesh is a developing country. Most of the people living here are suffering from nutrient deficit i.e., malnutrition. Fresh Red beet root can be a cheap and safe vegetable for health and that is our ultimate destination to produce crop. So, cultivation of Red beet root in saline soil deserves great importance. In fine, the studied was undertaken to observe the evaluation of comparative effects of different soil salinity strength on growth and yield of Red beet root and to find out best intensity of soil salinity strength for obtaining higher economic yield.

Materials and Methods

The experiment was carried out at the salinity management and research center, under soil resource development institute, Batiaghata, Khulna to test the effect of different strength of saline soil on emergence, growth and yield of Red beet plant. Plastic pots were used in conducting the experiment. The plastic pots were firstly washed and followed by rinsing with distilled water. Then those pots were dried in air. After drying the plastic pots were ready for the experiment. Finely prepared soil was filled of the pot by saline soil. Necessary amount of salt treatment was given to create saline environment by saturating the soil before placing the red beet seedling. The trial included the following treatments: T_1 = 2±0.2 dS/m EC, T_2 = 4±0.2 dS/m EC, T_3 = 6±0.2 dS/m EC, T_4 = 8±0.2 dS/m EC, T_5 = 10±0.2 dS/m EC and T_6 = 12±0.2 dS/m EC. The single factor experiment used Completely Randomized Design (CRD) with three replications. The experiment was divided into three equal replication blocks, each with six plots. As a result, the total number of unit plots was 18. The experiment's treatment combinations were randomized at random to 18 plots, each with three replications. 25 days Red beet seedlings were transplanted. Proper management about salinity control over the pot and growth of plants were observed. Time to time weeding, fertilizer application, irrigation, pot checking and special care to plant proper growth were following up to yield harvesting. Every three days later water application, pest controlling chemical and abiotic affect was observed. The data was collected at 60 days after Red beet transplanting. Intercultural operations were carried out when needed. The following parameters were measured: Plant height (cm), leaf length (cm), leaf width (cm), number of leaves/plant, Red beet root length (cm), diameter of root (cm) at 60 days, fresh weight of root/plant (gm) and gross yield/plant (gm).

Preparation of saline soil

For developing the expected soil salinity of 2 to 12 (±0.2 dS/m) EC of salinity strength, salt affected soil was collected from different place of saline affected area. Different concentrations of soil salinity (2, 4, 6, 8, 10 and 12 ds/m EC) was applied to the transplanted seeding on plastic pot. The salinity level was maintained by assessing the salt level from laboratory test.

Initial Chemical properties of soil of pot

pH	OM (%)	K meq/100 gm soil	Total N (%)	P	S	Zn	B
				µg/g			
7.2	1.91	0.24	0.09	17.23	57.51	1.12	1.17

Statistical analysis

The data obtained for different characters were statistically analyzed. The mean values of all the characters were evaluated and analysis of variance was performed by the 'F' test by using statistics software, version 10.

Results and Discussions

All the characters of promoting vegetative growth and yield performance parameters at different strength of salinity have been shown (table 1). Results on main and combined effect of different soil salinity strength and fertilizer management practices and their interactions have been presented and discussed here. The influence of different soil salinity caused a considerable variation in plant growth, production of yield and economic benefits of plants which was statistically significant at 60 DAT. After applying different strength of soil salinity in different pot, the expected parameters were changed.

Table 1: Showing result of different plantsof different growth stages at different soil salinity strength

Treatment (dS/m)	Plant height (cm)	Leaf length (cm)	Leaf width (cm)	Leaves numbers	Beet Root length (cm)	Diameter of beet root (cm)	Beet root fresh weight (gm)	Gross yield (gm)
T_1 (2±0.2 dS/m EC)	55.73 a	51.83 a	18.46 a	28.33 a	12.26 a	10.53 a	527.00 a	726.67 a
T_2 (4±0.2 dS/m EC)	48.06 b	45.76 b	13.96 b	24.33 b	10.33 b	10.13 ab	401.33 b	601.67 b
T_3 (6±0.2 dS/m EC)	43.10 c	40.23 c	12.56 bc	22.66 bc	9.80 bc	9.43 bc	303.00 c	446.33 c
T_4 (8±0.2 dS/m EC)	39.80 cd	37.53 cd	10.03 bcd	22.00 bc	8.83 bcd	8.93 c	247.33 d	362.00 cd
T_5 (10±0.2 dS/m EC)	37.16 d	34.50 d	9.43 cd	19.66 c	8.33 cd	7.80 d	196.00 e	302.00 d
T_6 (12±0.2 dS/m EC)	31.26 e	29.90 e	8.36 d	16.33 d	7.20 d	6.43 e	115.67 f	167.33 e
CV (%)	5.04	4.48	18.28	7.78	9.66	5.96	9.24	11.40

*EC determined by 1: 1 extraction Method

Plant height

The outside variation in plant height due to different soil salinity strength was statistically significant in Red beet at different strength of soil salinity after transplanting (DAT) (Table 1). At T_1 (2±0.2 dS/m EC) treatment the maximum plant height was 55.73 cm. In the T_2 (4±0.2 dS/m EC) treatment it was found the plant height was 48.06 cm. At the T_3(6±0.2 dS/m EC) treatment, the plant height was 43.10 cm and for T_4(8±0.2 dS/m EC) treatment plant height resulted in 39.80 cm. The minimum plant height was found in the treatment T_6 (12±0.2 dS/m EC) and it was 31.26 cm. It is stated that 12±0.2 dS/m of soil salinity strength Red beet plant had given very lowest plant growth at all.

Leaf length

Red beet plant showed significant variations in leaf length at 2, 4, 6, 8, 10 and 12 (±0.2 dS/m EC) of soil salinity strength (Table 1). Significant variation on leaf length was found due to application of different saline water strength. The maximum length of leaf (51.83 cm) was found in T_1 (2±0.2 dS/m EC) treatment. But the lowest number of leaf length (29.90 cm) treated with T_6 (12±0.2 dS/m EC). Due to different soil salinity preparation, the increase salt concentration hit to cell elongation and cell division probably influenced the leaf growth of Red beet plant.

Leaf width

Red beet plant revealed significant variations in leaf width at 2, 4, 6, 8, 10 and 12 (±0.2 dS/m EC) of soil salinity strength (Table 1). Very notable variation on leaf width was found due to application of different saline water strength. The maximum width of leaf (18.46 cm) was found in T_1 (2±0.2 dS/m EC) treatment. The lowest number of leaf width (8.36 cm) treated with T_6 (12±0.2 dS/m EC). Due to different soil salinity preparation, the increase salt concentration hit to cell elongation and cell division probably influenced the leaf growth of Red beet plant.

Number of leaves per plant

A lots of ingredients helps to produce plant leaves. The production of different number of leaves per plant at different DAT has been shown in Table 1. Due to the influence of different soil salinity strength, a significant difference in number of leaves per plant was observed that was statistically significant at different DAT. The plant irrigated with T_1 (2±0.2 dS/m EC) had the highest number of leaves per plant (28.33). At T_2 (4±0.2 dS/m EC) the numbers of leaves per plant was 24.33. The plants treated with T_3 (6±0.2 dS/m EC) had 22.66 number of leaves per plant and the lowest numbers of leaves per plant (16.33) for treatment of T_6 (12±0.2 dS/m EC). The plants treated with T_1 (2±0.2 dS/m EC) had the highest number of leaves per plant (28.33) but the lowest number of leaves per plant (16.33) treated with T_6 (12±0.2 dS/m EC).

Beet root length

Red beet plants possess very crucial variations in root length at 2, 4, 6, 8, 10 and 12 (±0.2 dS/m EC) of soil salinity strength (Table 1). Very notable variation on leaf width was found due to application of different saline water strength. The maximum beet root length (12.26 cm) was found in T_1 (2±0.2 dS/m EC) treatment. The lowest beet root length was pointed (7.20 cm) where treated with T_6 (12±0.2 dS/m EC) treatment. Due to different soil salinity preparation, the increase salt concentration hit to cell elongation and cell division probably influenced the leaf growth of Red beet plant.

Diameter of red beet root

Soil salinity strength has a profound effect on plant canopy and yield production characters and management had a significant effect on red beet root diameter (Table 1). The plants with the largest diameter of red beet root (10.53 cm) was grown with T_1 (2±0.2 dS/m EC) treatment. In the T_2 (4±0.2 dS/m EC) treatment, diameter of red beet root resulted at 10.13 cm. At T_3 (6±0.2 dS/m EC) treatment, the diameter of red beet root was 9.43 cm while the plants with the smallest diameter of red beet root (6.43 cm) was grown with the treatment of T_6(12±0.2 dS/m EC). It is shown that at 8, 10 dS/m EC of salinity strength tolerant red beet root had given the smallest stem formation due to soil salinity.

Fresh weight of beet root/plant (gm)

Different intensity of saline soil salinity had a great significant effect on fresh weight of beet root per plant(Table 1). The maximum fresh weight of beet root per plant (527gm) was obtained from the treatment T_1 (2±0.2 dS/m EC) and the minimum fresh weight of beet root (115.67gm) was found from the T_6 (12±0.2 dS/m EC) treatment. The maximum weight of single beet root might be due to soil salinity effect and plant growth resistant. Interaction effects of different strength of soil salinity treatment were significant on fresh weight of beet root.

Gross yield/plant (gm)

Application of different strength of saline soil to Red beet plant contributes on economic yields per plant. It reveals that variation among different soil salinity strength were statistically significant. It is obvious from the present study that the maximum marketable gross yield (726.67gm) resulted from T_1 (2±0.2 dS/m EC) and the lowest marketable gross yield (167.33gm) was found from treatment T_6 (12±0.2 dS/m EC)treatment. It was observed that the interaction effect of different soil salinity strength on economic yield per plant was statistically significant.

Conclusion

From the above discussion it is clear that, higher yield could be obtained by cultivating the Red beet variety early in different saline prone area under saline region of Bangladesh. Recommended soil salinity strength T_1 (2±0.2 dS/m EC) produced maximum vegetative gross yield (726.67gm) and economic yield. So, we can consider the treatment T_1 (2±0.2 dS/m EC) of soil salinity for our soil health, environmental benefits and crops production. Further experiment may be carried out before giving final recommendation.

EFFECT OF GROUND WATER TABLE & SALT CONCENTRATION ON TOP SOIL SALINITY

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Abstract

The process of soil and water salinization that occurs in different geological, hydro-geo-morphological, agricultural, and climatic environment is very complex reaction by various mechanisms. Specifically, the objective is to characterize and find out the groundwater conditions contributing to existing salinity problems. The salinization of land and water is brought about by physical and chemical processes that increase salt concentrations in soil ground water. The process responsible for the development of salinity in soil and water is intimately related to the transport of dissolved salt ion mass in groundwater flow systems. According to the experiment, when ground water level starts to down and the same time salinity in soil and water starts increase. In February, the ground water level was 5 feet 8 inch, the salinity in ground water was 2.5dS/m, at single layer mulching, the salinity in soil was 2.6dS/m and the highest soil salinity was 3.8dS/m in open soil and the lowest salinity was in double layer mulching soil (2.2dS/m). In June, the ground water level was in down at 10 feet 6 inch, salinity at water was 8.5dS/m, in single layer mulching, the salinity was 13.4dS/m and the lowest salinity was in double mulching covered top soil (10.0dS/m), the salinity level was very high in open top soil (19.8dS/m). This experiment shows that soil water level starts to decrease from February month to June (early dry season to early rainy season). It is very much significant that salinity increase relation has simultaneously corelation with the decreasing of ground water level in soil.

Introduction

Crop production in saline area is highly limited because of salinity in ground water. During kharif-1 season, salinity starts to increase from the January and it ranges to November. Saline water from the river water and seawater moves vertically and horizontally to other cropping area. This saline particle and mineral co-exist with other yield beneficial uptaking nutrient and those create a bilateral saline solution. This saline solution directly moves to ground water and turns the soil micro water into saline. Salinity increases very rapidly when evaporation of water from the top soil get started by sun rays. It influences the vertical upward of saline water at the root zone of plant. The main obstacle to intensification of crop production in the coastal areas is seasonally high content of salts at the root zone of the soil. The salts enter inland through rivers and channels, especially during the early part of the dry (winter) season, when the downstream flow of fresh water becomes very low. During this period, the salinity of the river water increases. The salts enter into the soil by flooding with saline river water or by seepage from the rivers, and the salts become concentrated in the surface water layers through evaporation and evapo-transpiration. The saline water may also cause an increase in salinity of the ground water and make it unsuitable for irrigation. The increase in water salinity in ground water of these areas has created a limitation for cultivation. Utilization of low quality ground water for crop irrigation because of prolonged dry spells in conjunction with heavy salt minerals is the principal source bringing about soil salinization.Scarcity of quality irrigation water during dry season limits cultivation of Rabi (winter) crops and kharif-1 (March-July) season. Variability of rainfall, uncertain dates of onset and recession of seasonal floods and risk of drought restrict cultivation. Uncertain rainfall delays sowing/transplanting and flood damages of crops. The texture of most of the saline soils varies silt clay to clay. Land preparation becomes very difficult as the soil dries out. Deep and wide cracks develop and surface soil becomes very hard. These also necessitate deep and rapid tillage operations. Presence of saline ground water table throughout the year within top soil depth is another factor affecting crop production in the saline belt.Sea level rise and reduction of fresh ground water reservoirs due to changes in rainfall patterns are the two major climate change induced hydrological variables that can severely affect saltwater intrusion in coastal water bank.Tidal flooding occurs during wet season (June to October), direct inundation by saline water and upward on lateral movement of saline ground water during the dry season (February to May). In addition, cyclone and tidal surge is accelerating this problem. In the coastal areas of Bangladesh, salinization is one of the most serious types of land degradation as well as a major obstacle to the optimal utilization of ground water resources.The salinization is the process where the concentration of dissolved salts in water and soil is increased due to natural or human induced processes. Fresh water is lost through evapo-transpiration and hydrolysis. Arid and semiarid climates are associated with water logging and ground water access. In all represented cases, ground water is the main geological agent for transmitting, accumulating, and discharging salt.The salinization in land and water is brought by physical and chemical processes that increase concentrations of salt in soil and water. The processes that responsible for the development of saline land and water is very complex and intimately related to the transport of dissolved salt mass in groundwater flow systems. The redistribution of soluble salts accumulated in a soil micro pore is evident mainly in topographically lower areas by terminal salt water in river, dry area and sea water. Evaporation, evapo-transpiration, hydrolysis, and leakage leads salt accumulation in water. When mineralized groundwater near the ground surface continually evaporates and causes minerals to precipitate, it increases the salt concentration in root zone. This process involve the mineralization of the groundwater, the physical transport of dissolved salts, the discharge of saline base flow into streams and river and the precipitation of salts within the soil cropping zone. Most of the salt in the groundwater system comes from micro pore, which includes parent materials structures, salt dissolved in the water recharging system and salt contributed from mineral dissolution within the groundwater flow system. The most important process that adds salt to groundwater is mineral dissolution reactions in the subsoil and to a lesser extent along the entire bilateral movement of saline water flow system. The land geography is low lying land, down ward movement of fresh water and inland along the sea coastal part of Bangladesh. According to salinity survey findings and salinity monitoring information about 1.02 million ha (about 70%) of the cultivated lands are affected by varying degrees of soil salinity. Million hectares of lands is affected by very slight,

slight, moderate, strong and very strong salinity respectively. Cropping intensity may be increased from very slight to slightly in saline areas by adopting proper soil and water management practices with introduction of salt tolerant varieties of different crops. To mitigate the salt water for fill up the demand of fresh water for irrigation, especial emphasis may be given to adopt ground water reservoir technology.

Materials and Methods

This experiment was conducted at the Salinity Management and Research Centre (SMRC), Soil Resource Development Institute, Batiaghata, Khulna, Bangladesh during the Kharif-1 season of 2024. Ground water depletion is a serious problem for irrigation in crop production. A deep 45 feet pipe was installed directly into the soil vertically in the field at 10-02-2024. It was used for checking the ground water level measurement. Three beds were made for salinity level correction. One bed was open soil condition where no mulch was used, another one was made by single layer mulching bed where mulch was spread under the top soil and third one was double layer mulching bed where two layers of mulch was used. In double layer mulching bed, two layers of mulch was spread out, one was under the soil and another one was upper the top soil. Those three beds were made for measurement of soil salinity in every 15 days later.

Results and Discussions

Every 15 days later, the ground water layer depletion was measured through the deep pipe. This collected water and soil salinity were measured and salinity level was recorded (table 1). In 15-02-2024, the ground water depth was 5 feet 8 inch, ground water salinity was 2.5dS/m, at open soil layer, the highest soil salinity was 3.8dS/m, at single mulching layer the salinity was 2.6dS/m and at double mulching layer, the lowest soil salinity was 2.2dS/m.

Table 1: Different Salinity level at different dates of water and soil salinity

Parameter	15-02-2024	01-03-2024	16-03-2024	01-04-2024	16-04-2024	01-05-2024	16-05-24	01-06-24
Water depth	5′8′′	6′1′′	6′8′′	7′3"	7′9"	8′3"	9"3"	10′6"
Ground Water salinity (dS/m)	2.5	3.1	3.9	5.8	6.5	8.4	8.9	8.5
Soil salinity dS/m (open)	3.8	5.2	6.5	8.8	11.3	12.1	14.9	19.8
Soil salinity dS/m (SLM)	2.6	4.3	5.8	6.2	7.8	9.4	11.2	13.4
Soil salinity dS/m (DLM)	2.2	3.8	4.9	5.9	7.0	7.3	8.6	10.0

SLM- Single Layer Mulching
DLM - Double Layer Mulching

In 01-03-2024, the ground water depth was 6 feet 1 inch, water salinity was increased to 3.1dS/m, at open soil layer soil, the highest soil salinity was 5.2dS/m, at single mulching layer, the soil salinity was 4.3dS/m but at double mulching layer, it was the lowest soil salinity was 3.8dS/m.After 15 days later in 16-03-2024, the ground water depth was down to 6 feet 8 inch, water salinity was raised to 3.9dS/m, at open soil layer soil, the highest soil salinity was 6.5dS/m, at single mulching layer, the soil salinity was 5.8dS/m and at double mulching layer,the lowest soil salinity down to 4.9dS/m. Again 15 days later, in 01-04-2024, the ground water depth was measured at 7 feet 3 inch, water salinity was 5.8dS/m, at open soil layer soil, the highest soil salinity ranged at 8.8dS/m, at single mulching layer, the soil salinity was 6.2dS/m and at double mulching layer, the lowest soil salinity was gained 5.9dS/m.In 16-04-2024, the ground water depth was recorded at 7 feet 9 inch, water salinity was 6.5dS/m, at open soil layer soil, the highest soil salinity was 11.3dS/m, at single mulching layer, the soil salinity was 7.8dS/m but at double mulching layer, the lowest soil salinity was found 7.0dS/m. About 15 days later, in 01-05-2024, the ground water depth was measured at 8 feet 3 inch, water salinity was 8.4dS/m, at open soil layer soil, the highest soil salinity was 12.1dS/m, at single mulching layer, the soil salinity was 9.4dS/m but at double mulching layer, the lowest soil salinity was 7.3dS/m. In 16-05-2024, the ground water depth was decreased to 9 feet 3 inch, water salinity was 8.9dS/m, at open soil layer soil,the highest soil salinity was calculated at 14.9dS/m, at single mulching layer, the soil salinity was 11.2dS/m and at double mulching layer, the lowest soil salinity was gone down at 8.6dS/m. At the date of 01-06-2024, the ground water depth was reached at 10 feet 6 inch, water salinity was touched at 8.5dS/m, at open soil layer soil, the highest soil salinity was 19.8dS/m, at single mulching layer, the soil salinity was 13.4dS/m and at double mulching layer, the lowest soil salinity was recorded at 10.0dS/m. In seepage areas dry spell and waterlogging induces clay eluviation near the surface and salinization at water depth in present day that reducing environments. When the water table rises to the surface, seepage areas are flushed by fresh water and salinization takes place. The resulting disequilibrium develops severe salinity environment land and degradation problems as a result of rising saline groundwater tables particularly when they act together in down surface positions of the land.

Conclusion

Groundwater plays a major role in the mobilization, accumulation, and discharge of salts into the root zone plant. Salinity increases during these periods of low recharge where only deep water resources are present and the groundwater flows are insufficient. Saline groundwater flows along the vertical and horizontal streams and is accumulated in the soil system acts as a salt depository. This ground water store directly influence the upper soil surface layer salinity range and water uptake by plants. However, ground water is the critical geological agent in the development of the salinization.