



ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE

DEPARTMENT OF ZOOLOGICAL SCIENCE

**The effect of salinity (NaCl) on seedling growth and germination
of Faba bean plants (*Vicia faba* L.)**

Case Study of Oromia Region on the Soil of Farm Land around
Sendafa Town

A thesis Submitted in partial fulfillment of the requirements for the degree of
Master of Science in Biology

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September, 2017

Thesis approval sheet

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Acknowledgment

First of all, I would like to say Alhamdulillah, for giving me the strength and health to do this final year research work until it done.

Next my sincere gratitude goes to my Advisor Dr. Bikila Workineh who was unrelenting in his desire to see me to do quality work.

I am grateful to the Ministry of Education for sponsoring of my graduate study and providing fund for this study. I would like to extend my thanks to the Addis Ababa University Department of Zoological Science, for allowing me to conduct this research.

My sincere thanks also extended to all Wondirad preparatory school laboratory technicians. I specially thank Ato Abera Zegeye for his enormous amount of help during laboratory work.

I would like to thank Wondirad preparatory school for allowing me to conduct this research using school laboratories and instruments.

I am greatly indebted to thanks my parents and my wife Jemila Abdulkadir for their follow up and supporting me in different ways. I have special place for my daughters Hassenat Awel, Nesuha Awel, Mensura Awel and Khayirat Awel for their support. Also my thanks extended to Jibrel Abdulkadir, for his work in reading and editing my research work. Without them I would be nowhere.

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Abbreviations

ANOVA	Analysis of Variance
DNRQ	Department of Natural Resource of Queensland
FAO	Food and Agriculture Organization
ROS	Relative Oxygen Stress
UNESCO	United Nation Educational, Scientific and Cultural Organization

Abstracts

*Salinity is the process by which water soluble salts accumulate in soil. Plants growth can be directly affected by salinity. The overall salinity is one of the main factors that limit the spread of plants in their natural habitat. This study aimed to investigate the effect of salinity and growth and germination of Faba bean. Greenhouse experiment was conducted to assess the effects of soil salinity on germination, seedling emergence, leaf number, stem height, root elongation and biomass of common bean plant. Sodium chloride (NaCl) was dissolved in tap water to saline the soil to 2, 4, 6, and 8dSm⁻¹ electro-conductivity. High level salinity of 6 dSm⁻¹ and 8 dSm⁻¹ caused a significant reduction in stem height, leaf number and biomass and delayed seedling emergence. It also significantly ($P<0.05$) decreased seed germination. The tap-root length significantly increased as soil salinity increased. An increase in elongation of tap root at high soil salinity indicates an adaption of common bean to saline stress. In general high level salinity i.e 6dSm⁻¹ and above is very sensitive to Faba bean (*Vicia faba L.*), and it affects the whole growth of plants.*

Key words: soil salinity, seedling emergency, Faba bean, germination, sodium chloride

1. Introduction

1.1. Background of the study

Salinization is the process by which water soluble salts accumulate in the soil. A soil may be rich in salts because the parent rock from which it was formed contains salt. Irrigation water is a common source of salts in irrigated lands. Most irrigation water contains some salts.

Irrigated agriculture in arid and semi-arid areas is often a source of soluble salt even with water of excellent quality. It is estimated that one third of the irrigated land in the world is affected by salinity problem (UNESCO, 2007)

Every soil contains a certain amount of soluble salts without being saline. Saline soil condition develops only when soluble salts accumulate in the soil and reach a level harmful to plant growth. A soil which is saline and harmful for one crop might be suitable for others and this means that plant tolerance to salinity might vary.

As salts accumulate in saline discharge areas they can reach levels that affect plants in a number of ways. These lead to poor plant health, a loss of productive species and dominance of salt – tolerant species.

Under normal conditions, plants readily obtain water by osmosis. As soil salinity increases this balance shifts making it more difficult for plants to extract water from the soil.

Plant growth can be directly affected by high levels of toxic ions such as sodium and chloride. Excess sodium accumulation in leaves can cause leaf burn (necrotic dead), defoliation. Plants affected by chloride toxicity exhibit similar foliar symptoms, such as leaf bronzing and necrotic spots in some species. Defoliation can occur in some woody species. An excess of some salts can cause an imbalance in the ideal ratio of salts solution and reduce the ability of plants to take up nutrients. For example, relatively high levels of calcium can inhibit the uptake of iron. (Lime induced chlorosis), and high sodium can exclude potassium.

Salt-tolerant plants (halophytes) can tolerate high internal concentration of salts and take up salt with water. Examples include salt bush (*Atriplex species*) and blue bush (*Maireana species*). Most agricultural plants fall into the salt-resistant category of glycophytes. They cannot tolerate salt internally but can maintain growth in mildly saline soil by excluding salts at root (Green way and Munns, 1980). However, in extremely saline soils glycophytes are unable to both exclude salt and obtain sufficient water for maintenance (DNRQ, 1997). The impact of salinity varies with plant species, stage of growth, management practice varieties and soil fertility.

Water logging exacerbates the effect of salinity. Water logged plant roots are unable to exclude sodium and chloride due to the increased rate of transport of these ions, and concentrations in the plant shoot increase. Poor aeration also affects the soil biology responsible for converting nutrients to their part available from causing nutrient deficiencies (Green way and Munns, 1980).

The legume family is the 3rd larger of flowering plants (Morris et al., 2003; Lewis et al., 2005). Economically legumes represent the second most important family of crop plants after (Poaceae; the grass family) account for approximately 27% of the world crop production (Grahamand and Vance, 2003). Legumes in developing countries are largely produced as subsistence crop by small holder farmers. Ethiopia is a good producer of food legumes after Egypt in Africa (Lewis et al., 2005). However, about 10,608 ha of Ethiopian's total land is affected by salinity is Semi-arid and arid regions which may reduce yield (Geressuuz, 2011).

Sound irrigation agriculture contributes towards achieving food security and livelihood improvement for increasing population through enhancement of agricultural productivity. The development of sound irrigated agriculture depends on a chain of related factors, involving soils, water crops, and man. Failure of any one of these links can –bring hardship or even disaster to an irrigation enterprise (Tessema, 2011). Poor irrigation agriculture in arid and semiarid regions results in land degradation through soil salinity and sodic soil developments in different part of the world. Hence, the study of arid lands and salt affected soil has been an important topic for modern agriculture management and particularly for poor countries like Ethiopia where agriculture is the backbone of the economy while arid and Semi-arid climatic zones occupy over 60% of the total land area (Awelachew et al., 2007).

Reclaiming salt affected land is always costly and time consuming (Turna et al., 2007). Countries like Ethiopia where legumes cultivated for human food consumption, it is important to identify salt tolerant crops for farmers that use salt affected lands. Therefore, this case study makes investigation on the effect of salinity on germination and seedling growth of Faba bean plant (*Vicia faba* L.).

1.2. Statement of the problem

The over salinity of the soil is one of the main factors that limits the spread of plants in their natural habitat. It is over-increasing problem in arid and semi-arid regions (Shanon, 1986). Fisher and Turner (1978) estimate that arid and semi-arid lands represent around 40% of the earth crust.

Increased salinity of agricultural land is expected to have destructive global effects, resulting in up to 50% loss of cultivable land by the middle of the 21th century. In Africa 1,899 M ha of land is affected by salinity (FAO, 2008). In Ethiopia, salt affected soils are prevalent in the rift valley and lowlands. The Awash Valley in general and the lower plain in particular, are dominated by salt affected soil (Gebreselassie, 1993).

Many authors (Kinfemichael, 2001; Tsige et al., 2000; Fassil, 2009; Taddese and Bekele, 1996; and Haidre et al., 1986) reported that salinity problem escalated and spread to many parts of the country including Melkasa, Melka Sadi, Melka Werer, Abaya state farm and Dams is Mekelle Plateau.

Salinity is one of the factor limiting the productivity because most crop plants are sensitive to salinity caused by high concentration of salts in the soil (Hassen and Uzzaman et al., 2013). According to Brolwer et al. (1985) the highly tolerant crops can withstand a salt concentration of the saturation extract up to 10g L⁻¹ moderately tolerant crops up to 5g L⁻¹ sensitive group about 2.5 gL⁻¹.

The property of salinity tolerance is not simple attribute, but it is an outcome of various features that depend on different physiological interaction, which are difficult to determine. The morphological appearance presented by plant in response to salinity may not be enough to determine its effect, so it is important to recognize other physiological and biochemical factors

including toxic ions, osmotic potential lack of element and other physiological and chemical disorders, as well as the interaction between these various stresses (Munns, 1993; Mannus, 2002; Neumann, 1997; Yao, 1998; and Hasegawa et al., 2000).

Various internal (plant) and external (environmental) factors affect seed germination under saline conditions which includes nature of seed coat, seed dormancy, seed age, seed polymorphism, seedling vigor, temperature, light water and gases (Wahid et al., 2011).

Seed germination is the first step of plant life, which determines when and where seedling growth begins (Jeannette et al., 2002), and it is very sensitive to salt stress. Germination percentage of seeds at a particular time varies considerably among species and cultivators (Hassan Uzzaman et al., 2013). Seedling emergence and early survival are particularly sensitive to substrate salinity (Katemb et al., 1988; Williams et al., 1998). Salt stress affects physiological process (Noreen and Ashraf, 2008). It exerts undesirable effects through osmotic inhibition and ionic toxicity (Munns et al., 2006). Increased salinity causes significant reduction in germination percentage, root, Shoots length, and shoot weight (Jamil et al., 2006).

This case study was, therefore initiated to investigate the impact of salinity on germination and growth of Faba bean (*Vicia faba* L.) Plant.

This research is intended to address the following research questions.

- 1- Does high concentration of NaCl affect germination of Faba bean (*Vicia faba* L.) seeds?
- 2- What concentration of NaCl affects seedling growth of Faba bean (*Vicia faba* L.)?
- 3- Which part of Faba bean (*Vicia faba* L.) is more affected by salinity?

1.3. Objectives of the study

1.3.1. General Objective

This study aimed to investigate the effect of salinity on germination and early seedling growth of Faba bean (*Vicia faba* L.).

1.3.2. Specific objectives

- 1- To investigate the effect of salinity on germination of Faba bean (*Vicia faba* L.).
- 2- To evaluate the degree in which high salt (NaCl) concentration affects germination of Faba bean (*Vicia faba* L.).
- 3- To investigate the part of the plant, either stem, leaf or root more affected by soil salinity.
- 4- To find out the correlation between salt concentration and germination of Faba bean (*Vicia faba* L.).
- 5- To investigate the effect of salinity on early seedling growth of Faba bean (*Vicia faba* L.).

1.4. Significance of the study

The finding of this research will have significance for the cultivators by enabling them to select salt tolerant plants suitable for their farm land. It helps the farmers to improve their soil to enhance the productivity of all crops in general and productivity of Faba bean in particular.

Moreover, the research finding will be significant for other researchers. It may serve as starting point to conduct further research in this area.

1.5. Delimitation of the study

The study was carried out in Wondirad Preparatory School in Addis Ababa Biology laboratory to investigate the impact of salinity on germination and early growth of Faba bean (*Vicia faba* L.) based on the resources available in the school laboratory.

1.6. Limitation of the study

Lack of adequate material in the area of study was one of the problems that the researcher has faced. The absence of standardized measurement and instruments may be the expected problem researcher has faced.

2. Literature Review

2.1. Faba bean (*Vicia faba* L.)

The Faba bean is temperate crop which originated in the Mediterranean region of south western Asia, along with the Garden pea, Lentil, and chick pea. The earliest known archeological Faba bean remains are from veolithic period 6800 to 6500 B.C. from Israel. Around 3000 B.C numerous archeological remains appear in the Mediterranean region of and Central Europe.

Faba bean were a common food for many Mediterranean and near east civilization including Egyptians, Greek and Romans. Faba bean spread along the Nile Valley of Ethiopia, as well as to Northern India and China. The Faba beans wild ancestor is unknown.

Vicia faba, commonly known as Faba bean or broad bean is widely cultivated for its nutritious seeds and pods which are consumed by millions of people throughout the world. It belongs to legume family *Leguminous* also known as *fabacea* and like many legumes it is high in protein due to its ability to fix nitrogen from the air through a symbiotic relationship with bacterial housed in root nodules. Faba bean has a potential of fixing nitrogen up to 300kg N ha.

Species information

Scientific name:- *Vicia faba* L.

Common name: - broad bean, faba bean, horse bean, bell bean

Habitat

Grow best in well - drained soil up to 0.5 meters deep at an optimum pH of 6.0-7.5. Common bean grows optimally at temperature of 18 to 24°C (Teshale et al., 2005). The crop grows well between 1400 and 2000 m above sea level (Vakali, 2009).

Taxonomy

Kingdom –Plantae

Phylum – Tracheophyta

Class – Spermatophytia

Sub class –Magnoliopsida

Order – Rosanae

Sub order – Fabales

Family – Leguminosae (Fabeaceae) Papilionoidae

Genus – Vicia

Species –faba L.

This ancient crop belongs in the legume family and like many other legumes it has the ability to fix nitrogen from the air through a symbiotic relationship with bacteria housed in its root nodules. As a result common bean is high in protein and in many part of the world it is considered the meat of the poor. The impressive diversity of colors, textures and tastes of the common bean make it a popular choice for people everywhere.

2.2. Geographical distribution

Faba bean is ancient crop which is thought to have originated in Western Asia as early as 7000-4000 B.C. From there it was spread by human to Europe, Africa and Central Asia. Today Faba

bean is only known in cultivation and grown in temperate and subtropical regions of the world and at higher altitudes in the tropics.

2.2.1. Description

Vicia faba is an erect robust annual herb growing up to 2 meters tall. It has stout, square stem which is hollow and has additional based branches. The plant has a well-developed tap root with strong lateral roots

Leaves: - The compound leaves are arranged alternately along the stem; each leaf is paripinnate (terminating in leaflet pair), composed of 2-6 leaflet. Faba bean has conspicuous stipules (appendages at the base of the leaf) which are toothed at the margins and vary widely in shape. The leaflets are ovate to elliptical and are up to 10x4 cm in size.

Flower: - The staled flowers are arranged on an un branched axis (a raceme). The racemes are short, 1-6 flowered and axillary (arising) from the point between the main stem and a leaf. The flowers are fragrant, the petals white, the outermost petal (the standard) marked with a central, basal, dark brown, or black blotch, and are pallinnaceous resembling the pea (*Pisum sativum*) flower. Each flower has ten stamens, nine of which are fused into a partial tube, with the tenth stamen free. The ovary is positioned above the sepals, petals and stamens. The style is approximately 3mm long and is abruptly upturned with a tuft of hairs near the stigma.

Seed: - Faba bean seed had short pods containing up to four seeds. The seeds are highly variable in shape and color (white, green, buff brown, purple black) and size (6-20mm) in length.

2.2.2. Status of Faba bean (*Vicia faba* L.) in Ethiopia

Ethiopia is the world's second largest producers of Faba bean next to china. It shares only 6.96% of production and 40.5% in Africa (Chopra et al., 1989). In Ethiopia, the average yield of faba bean under small holder farmers is not more than 1.6% ha (CSA, 2013).

In Ethiopia, the Faba bean production is primary rain fed. Faba bean ranks first in pulse crop in the total area coverage and the total production of Ethiopia. It accounts about 36% of the countries pulse production (IFPRI, 2010). Currently the total area under cultivation with Faba

bean in the country is estimated to be about 0.54 million ha and the total production 696 million kg (NOARD, 2009). Oromia region is the largest 320million Kg followed by Amhara region 250 million Kg (CSA, 2011). The two regions together share about 85% of the countries Faba bean production.

Ethiopia is considered as the secondary center of diversity and also one of the nine major agro geographical production regions of Faba bean (Telaye Bejiga et al., 1994). The production is mainly concentrated in the high altitude of Ethiopia ranging between altitudes 1800-3000 m with annual rainfall range from 700 to 1100 mm and also suitable environment and soil condition for high land pulse crop production.

The productivity of Faba bean in Ethiopia is quite lower 15.2 qt/ha (CSA, 2011). In Ethiopia, there are about 20 improved Faba bean varieties which are adapted to different agro-ecology and have different diseases reaction (IFPRI, 2010).

Faba beans (Amharic; Baqella) are one of the most popular legumes in Ethiopia. Faba bean is highly coupled with every aspect of Ethiopian life. They are mainly used as alternative to peas to prepare flour called “shiro”, which is used to make “shiro” wet (a stew almost ubiquitous in Ethiopian dishes). The two uncooked spicy vegetable dishes are made using broad beans. The first is hilibeta thin white paste of broad bean flour mixed with pieces of onion, green pepper, garlic and other spices based personal taste. The second is “silijo” a fermented, sour, spicy thin yellow paste of broad bean flour. (Helstosky and Carol, 2009).

2.3. What is Salinity?

The term salinity refers to the concentration of salts in water or soil. Salinity can take three forms, classified by their cause. Primary salinity (also called natural salinity), secondary salinity (also called dry land salinity) and tertiary salinity (also called irrigation salinity).

Small amount of dissolved salts in natural water are vital for life of aquatic plant and animals. However –high level of salinity and acidity are harmful to many plants and animals.

Salt in our water resource generally drive from three sources. Firstly, small amount of salt primarily sodium chloride are evaporated from ocean water and are carried in raincloud and deposited across landscape with rainfall.

Secondly, some landscape, may also contain salt that has been released from rocks during weathering (gradual breakdown) and thirdly salt may remain is sediments left be lined. By retreating seas after periods, where ocean level were much higher or the land surface much lower.

2.3.1. Primary Salinity (natural salinity)

Primary salinity is caused by natural process such as the accumulation of salt from rainfall over many thousands of years or from the weathering of rocks. When rainfalls on a landscape, some evaporates from soil vegetation surface and water bodies, some infiltrates into the soil and the ground water, and some enter streams and rivers and flows into lakes or ocean. The small amount of salt brought by the rain can build up in soil over time (especially Daye soils) and can also move into the ground water.

2.3.2. Salinity (dry land salinity)

Secondary salinity is caused where groundwater levels rise, bringing salt accumulated through primary salinity processes to the surface. This is caused by clearing of perennial (long –lived) vegetation in drier areas i.e. areas that tend to accumulate salt is soil profile and groundwater over time. When vegetation cleared the amount of water lost from the landscape through plants is drastically reduced. Instead, more water enters the groundwater and groundwater levels rise.

2.3.3. Tertiary or irrigated salinity

Tertiary salinity occurs when water is reapplied to crops over many cycles either directly or by allowing it to filter into the ground water before pumping it out for re-application. Each time the water is applied, some of it will evaporate and the salts in the water remaining will become concentrated, very high salt concentration can result in multiple cycle of reuse.

2.4. Effects of salinity on plant growth

2.4.1. Effect of salinity on germination

Germination is one of the most critical periods of crop subjected to salinity salt stress has been shown to decrease the germination percentage and germination rate of some crops. Soil salinity may influence germination of seeds either by creating osmotic potential external to the seed preventing water uptake, or the toxic effect of Na^+ and Cl^- on germinating seed. Salt and osmotic stresses are responsible for both inhibition or delayed seed germination and seedling establishment.

Germination is the initial stage of plant life cycle and determines where and when a crop is established. It is a complex metabolic process that oxidizes the lipids and carbohydrates within the seed and breaks down storage protein in order to obtain energy and amino- acid necessary for plant development (Alman Souri et al., 2001). Seed germination and early seedling growth under saline conditions are considered as major factor limiting the establishment of crops (Kitajima and Fenner, 2000). Interaction between seed bed environment and seed quality is also important (Khajeh-Hosseni et al., 2003).

Plant available water is restricted in soil containing excess sodium chloride, resulting in partial dehydration of cell cytoplasm, such plasmolysis effects the metabolism of cells and function of macromolecules and ultimately results in cessation of growth (Le Redulier, 2005)

The effect of salinity on germination can be either by creating osmotic potential which prevent the uptake of water by the toxic effect ions on embryo viability (Houle et al., 2001) salts absorb and retain water with such strength that it is not freely available in the soil causing an increase of soil solution osmotic pressure. Salt stress may cause significant reductions in the rate and final germination percentage which in turn may lead to uneven stand establishment and a reduction in yields. Rapid, uniform and high germination percentage for legumes is a prerequisite for successful stand establishment and yields (Demir and Ermis, 2003). The specific ions likely to be most abundant and cause greatest problems are sodium (Na^+) and chloride (Cl^-).

2.4.2. The effect of salinity on metabolism and growth of plants

From the result of the studies, which looked at the effect of salt stress on growth, one can notice a connection between the decrease in plant length and increase in the concentration of sodium chloride (Beltag et al., 2006). Numerous studies showed the effect of leaf area negatively by using different concentrations of NaCl (Raul et al., 2003). The harmful influence of salinity on leaf number also increases with the increase in concentration (Raul et al., 2003).

Many studies have shown that the fresh and dry weight of the shoot system are affected, either negatively or positively, by change in salinity concentration, type of salt present or type of plant species (Jamil et al., 2005).

Change in water relation of plants that are stressed by salinity can be seen in certain studies confirm that many plants undergo osmotic regulation when they are exposed to salt stress by increasing the negativity of osmotic potential of the leaf sap (Kaymakonava and Stoeva et al., 2003).

Many studies confirm the inhibitory effect of salinity on biochemical processes, of which photosynthesis is the most important. The effect on photosynthesis can be gauged from the effect on photosynthetic pigment (Sultana et al., 2000). The specific studies clearly indicate that salinity reduces the content of photosynthetic pigments in treated plants.

Reduction in the growth rate of the leaf can represent an adaptation to salt stress, since increased levels of salts in the soil impede the uptake of water by plant (Carilio et al., 2005) and the reduction in leaf area limits transpiration (Neumann, 1997). Another adaptation to salinity is the increase in succulence, which reduces the concentration of salts in the protoplasm. The greater growth of the roots in comparison with the aerial part is also considered an adaptation to saline streets (Alshamary et al., 2004). Since it causes an increase in surface area for water uptake, thereby preventing dehydration. Salinity reduces the uptake and transport of nitrate and consequently the assimilation of nitrogen necessary for protein synthesis (Silveria et al., 2001).

Plant growth can be directly affected by high levels of toxic ions such as sodium and chloride. Excess sodium accumulation in leaves can cause leaf burn (necrotic dead), patches and even

defoliation. Plants affected by chloride toxicity exhibit similar foliar symptoms, such as leaf bronzing necrotic spots in some species. Defoliation can occur in some woody species.

Growth of *Suaeda nudiflora* tissue was stimulated by salt and optimum growth was at 7.9 dSm⁻¹ salinity. Similar results have been reported for halophytes that have optimal growth in the presence of salt (Tester & Davenport, 2003). The enhanced growth rate of *Suaeda nudiflora* seedlings in the presence of salt evinces that it is a halophytic plant. Root/ shoot dry weight ratios of seedling grown in soil with increasing salinity did not differ because salinity stimulated the growth of shoots and roots equally. Leaves of *Suaeda nudiflora* are small, linear and succulent. It is considered that succulence is a morphological adaptation in salt-tolerant species (Marschner, 1995). Water content in tissues increased and seedlings adjusted water potential of tissues to more negative level until 7.9 dSm⁻¹ salinity. In dicotyledonous halophytes, water relations and ability to adjust osmotically are important determinants of the growth response (Munns et al., 1983). It would appear that the growth response at moderate salinities may be largely the consequence of an increased uptake of solutes that are required to induce cell expansion, since this maintains the pressure potential in plant tissues. Moreover, halophytes effectively compartmentalize salt (Na⁺) into the vacuoles of cells. High sodium concentration may cause a stimulus to the growth of tolerant plants by its effect on generation of turgor and thereby cell expansion (Marschner, 1995). In some plant species, salt tolerance is associated with accumulation of organic solutes in cytoplasm to balance the osmotic pressure of ions in the vacuoles (Hasegawa et al., 2000).

In halophytic plants, Na substitutes potassium in several physiological processes (Marschner, 1995). A greater concentration of Na than that of K in all tissues of plants grown under both control and saline conditions, on the one hand, and increase in growth of seedling with salinity, on the other suggested that *S. nudiflora* is a natrophilic species. It is reported that uptake mechanisms of K and Na are similar (Wataid et al., 1991, Schroeder et al., 1994). Plants utilize two systems for K acquisition, low- and high affinity uptake mechanisms. Na⁺ cannot move through the plasma membrane lipid bilayer, but the ion is transported through both low- and high affinity transport systems, which are necessary for K⁺ acquisition. As a consequence Na⁺ could enter the cell through high affinity K⁺ carriers or through low affinity channels called non selective cation channels. However, the K and Na profiles of *S. nudiflora* in response to

salinity suggested its two distinct traits: (i) high Na⁺ influx and /or low Na efflux on root plasma membrane and (ii) high K⁺/Na⁺ discrimination to select K from soils with high Na concentration.

Increase of Mg²⁺ in tissues may be of importance for plant growth and survival in saline soil. Salinity generates an increase in reactive oxygen species (ROS) which have deleterious effects on cell metabolism (Borsani et al. 2001) superoxide dismutases (SODs) detoxify and may contain Cu, Zn, Mn and Fe as metal components (Slater et al., 2003). Increase in concentration of these trace elements at the whole –plant level might be the requirement of this plant for survival in saline soils.

2.5. Salinity tolerance in plants

Salt – tolerant plants (halophytes) can tolerate high internal concentrations of salts and take up salt with water. Examples include saltbush (*Atriplex species*) and blue bush (*Maireana species*). Most agricultural plants fall into the salt – resistant category of glycophytes. They cannot tolerate salt internally but can maintain growth in mildly saline soil by excluding salts at the roots (Greenway and Munns, 1980). However, in extremely saline soils glycophytes are unable to both exclude salt and obtain sufficient water for maintenance (DNRQ, 1997). The impact of salinity varies with plant species, stage of growth, management practices, varieties and soil fertility.

Water logging exacerbates the effect of salinity. Waterlogged plant roots are unable to exclude sodium and chloride due to the increased rates of transport of these ions, and concentrations in the plant shoot increase. Poor aeration also affects the soil biology responsible for converting nutrients to their plants available form, causing nutrient deficiencies.

3. Materials and Methods

3.1. Study area

The study was conducted in laboratory of Wondirad Preparatory School in Addis Ababa (for seed germination experiment). The school lies (Latitude 9° 02' N and longitude 38° 42' E). The Faba bean (*Vicia faba* L.) seeds were collected from the market of Bereh Aleltu Woreda particularly (Sandafa), Oromia region, Ethiopia. It lies with Latitude 9° 09' 07 N and Longitude 39° 01' 24' elevation above sea level (2560m).

The soil sample used for the study of seedling growth was collected from farm land around Sendafa town. The black soil (koticha) mixed with compost in a ratio of 24:1. Due to lack of budget and lab facilities, we were not able to determine the chemical and physical properties of the soil before the experiment. The seedling was grown in homemade plastic room with 4m² widths to substitute greenhouse.

3.2. Climate

According to hold ridge life zones system bioclimate classification, Addis Ababa is situated in or near the subtropical moist forest biome. Average annual temperature is 13.9°C. Average monthly temperature varies by 3°C. This indicates that the continentality type is hyper oceanic.

3.3. Plant materials preparation

The seeds obtained from local market were homogenous, identical seeds in size, and free from wrinkles was chosen and sterilized with 5% of sodium hyperochlorate solution for 10 minutes.

3.4. Seed germination

Before beginning of the experiment of seed germination, solution were made by dissolving sodium chloride in distilled water at 5 different concentrations (0, 2, 4, 6, and 8 dsm⁻¹ and left for 2 days until it dissolved completely. The salt solutions were prepared every 3 days to use relatively fresh solution for germination of seeds. After the solution was prepared, Petri-dishes were washed and disinfected with alcohol and dried. The dishes were bedded with filter paper and fifty seeds were sown on each Petri-dish.

The counting of germinated seeds began 24 hours after sowing for 12 days. A seed was considered to be germinated when the plumule and radical emerges from seeds.

3.5. Seedling Emergence

Five polyethylene bags were filled with 2 kg of soil. Tap water was added to each bag and allowed to dry for 10 days. The bags were labeled and one seed sown at the surface of soil in each bag on Yekatit 5/2009 E.C. The seed of of Faba bean (*Vicia faba L.*) was collected from Sendafa market. Immediately after sowing, the soil was watered with the salt solution with different concentrations. Watering was carried out in every other day. Emergence of seedling was recorded weekly over a period of 30 days. The recording included shoot emergence, leaf growth and number of leaves grown at the end of the month and the length of the shoot and root. The dry biomass of root, leaf, and stem were weighed.

3.6. Germination Analysis

All the germination and early seeding growth parameters were evaluated using the method used by Li (2008) by counting germinating seeds starting after 24 hours of sowing every day for 7 days. In all treatments, a continuous assessment in seedling growth was carried out during the subsequent days until 12 days.

Germination index (GI) was calculated as described in association of official seeds analysis (AOSA, 1983) by the following equation:

$$GI \text{ (germination index)} = \frac{\text{No of germinating seeds}}{\text{days of the first count}} + \dots + \frac{\text{No of germinating seeds}}{\text{days of the first count}}$$

$$\text{Germination percentage (GP \%)} = \text{GI} \times 100$$

3.7. Seedling growth Analysis

The seedling growth was evaluated at the end of the month. Fresh and dry weight (biomass) of leaves, stem, and tap root were evaluated. The sum of leaf and stem, weight considered as shoot weight. Dry weight (biomass) of different component was analyzed to assess the effect of salinity on plant growth.

3.8. Statistical Data Analysis

All the parameters were determined in triplicates and the results obtained from each determination are presented as mean \pm standard deviation (SD). Tests for significance in variations were conducted by one-way analysis of variance (ANOVA). Variations were considered significant at $p < 0.05$. The analysis of ANOVA is depicted in Appendices.

4. Results

4.1. Effect of salinity on seedling emergence

Seedlings began to emerge 7 days after sowing and only 35.5% of seedling emergence was achieved over a period of 10 days (Table: 1). Seedling emergence in saline soil was recorded 7-12 days after sowing. Negative relationship was observed between seedling emergence and concentration of salt. As salt concentration increased seedling emergency became delayed. At the end of 12 days from all seeds sown 56% of seedling emergence was achieved.

The high level salinities of 6 dSm⁻¹ and 8 dSm⁻¹ started emerging on 12 day when compared with control that emerged on the 7th day. The record indicates 5 days difference. The early seedling emergence in saline soil achieved 7% in the soil at 2dSm⁻¹. The delayed seedling emergence was achieved 14% at 12 days in 6 dSm⁻¹ and 8 dSm⁻¹ salinization (Table: 1).

Table: 1. The effect of salinity on seedling emergence of Faba bean (*Vicia faba* L.).

Salinity (dsm-1)	Days					
	7	8	9	10	11	12
control	14.5%			7%		
2		7%	7%	7%		
4			14.5%	14.5%		
6					7%	7%
8					14.5%	7%

4.2. Effect of salinity on stem and tap root elongation and leaf number

The result shows, as salinity increased the stem height and leaf number decreased when compared to control group. High salt concentration (6dSm⁻¹ and 8dSm⁻¹) significantly decreased the stem height (p<0.01). However, tap root elongation increased with increasing salinity. Root elongation significantly increased at 6dsm⁻¹ and 8 dSm⁻¹ salinization, but at 2dSm⁻¹ and 4 dSm⁻¹ salinization the root elongation decreased (Table: 2) when compared to control group (tap water).



Figure: 1 Faba bean (*Vicia faba* L.) growth at different salinities

Generally the result shows a negative relationship between salinity and stem height, and positive relation with tap root elongation. The leaf number irregularly decreased in all saline group when compared to control group (tap water) (Table 2).

Table: 2 Effect of soil salinity on stem leaf and root characteristic of Faba bean (*Vicia faba* L.) by mean \pm SEM regression equation constant

Salinity in (dSm ⁻¹)	Stem height (cm)	Leaf number	Root length (Cm)
Control	27.20 \pm 6.90 ^a	15.00 \pm 7.8 ^a	19.30 \pm 7.50 ^a
2	23.50 \pm 5.70 ^a	12.00 \pm . ^{00b}	19.00 \pm 1.40 ^b
4	19.40 \pm 4.40 ^{ab}	10.50 \pm 1.90 ^a	18.50 \pm 5.20 ^{ab}
6	16.30 \pm 9.50 ^a	12.50 \pm 2.10 ^a	25.00 \pm 1.40 ^a
8	12.80 \pm 2.90 ^b	10.70 \pm 1.50 ^{ab}	27.00 \pm 3.00 ^a

Mean with same letters within columns are not significantly different at 5% probability

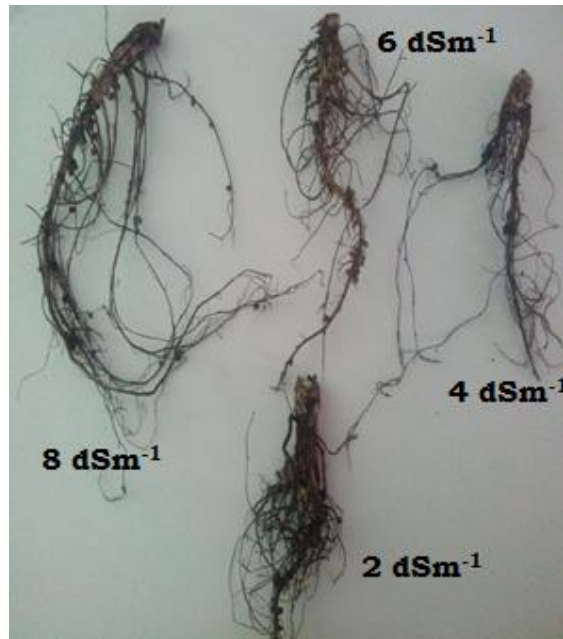


Figure: 2 Effects of salinity on tap root elongation of Faba bean (*Vicia faba* L.)

4.3. Effect of salinity on dry weight of leaf, stem and root

Dry weight significantly decreased for root and stem. Dry weight of leaf increased in 2dSm⁻¹, 6dSm⁻¹ and 8 dSm⁻¹ compared to control group. However, dry weight of stem and root decreased when compared to control. The least dry weight of stem and root achieved at salination of 8 dSm⁻¹ and the least dry weight of leaf obtained at 4 dsm⁻¹ (Table 2). As salination increased dry weight of root and stem decreased (Table 3).

Table: 3 Effect of soil salinity on root, leaf and stem dry weight (biomass) of Faba bean (*Vicia faba* L.) by mean \pm SEM and regression equation constant.

Salinity (dSm ⁻¹)	Dry weight of root in g	Dry weight of leaf in g	Dry weight of stem in g
0	0.64 \pm 0.21 ^a	0.15 \pm 0.07 ^{ab}	2.26 \pm 0.94 ^a
2	0.30 \pm 0.08 ^{ab}	0.25 \pm 0.07 ^a	1.98 \pm 0.62 ^a
4	0.40 \pm 0.00 ^a	0.12 \pm 0.05 ^b	1.65 \pm 1.06 ^a
6	0.55 \pm 0.07 ^a	0.28 \pm 0.04 ^a	2.00 \pm 0.14 ^{ab}
8	0.23 \pm 0.03 ^b	0.20 \pm 0.02 ^a	0.93 \pm 0.21 ^b

Mean with same letters within columns are not significantly different at 5% probability

4.4. The effect of salinity on germination

Germination percentage (GP) decreased with increasing salinity. The highest GP (96%) was observed for control. The lowest GP i.e 34% was observed in highest level salinization (8dSm⁻¹). Germination index decreased with increasing salinity. The highest germination index (9.16) was observed for control group. However, the lowest germination index was achieved at highest level salinization i.e GI (P<0.05). GI increased when NaCl osmotic potential decreased. Increasing in salinity induced both percentage of germination and index of germination. (Table: 4)

Table: 4 Effect of salinity on germination index and cumulative germination percentage of Faba bean (*Vicia faba* L.)

Salinity (dSm ⁻¹)	Germination index	Cumulative percentage	germinations
0	9.16	96%	
2	8.13	92%	
4	7.13	84%	
6	6.64	82%	
8	2.77	34%	

Table: 5 Germination percentage of Faba bean (*Vicia faba* L.) in response to soil salinity in days after sowing up to harvesting.

Salinity (dSm ⁻¹)		Days of count							Cumulative percentage
		4	5	6	7	8	9	10	
control	No of seed germinated	13	16	7	6	3	2	1	
	Germination percentages	26%	32%	14%	12%	6%	4%	2%	96%
2	No of seed germinated	10	8	12	8	2	4	2	
	Germination percentages	20%	16%	24%	16%	4%	8%	4%	92%
4	No of seed germinated	8	6	11	5	5	6	1	
	Germination percentages	16%	12%	22%	10%	10%	12%	2%	84%
6	No of seed germinated	6	4	13	4	6	6	2	82%
	Germination percentage	12%	8%	26%	8%	12%	12%	4%	
8	No of seed germinated	2	5	3	1	0	3	3	
	Germination percentages	44%	10%	6%	2%	0	6%	6%	34%

5. Discussion

From the result of the studies, which looked at the effect of salt stress on growth, one can notice a connection between the decrease in plant length and increase in the concentration of sodium chloride (Beltag et al., 2006). Numerous studies showed its effect on leaf area by using different concentration of NaCl (Raul et al., 2003).

The result of study of Faba bean (*Vicia faba* L.) shows that salinity significantly affect the growth of Faba bean by affecting the height of stem at high level salinization i.e 6 dSms⁻¹ and 8 dSm⁻¹. The elongation of tap root also increased with increasing in salinization. As salinity increased the leaf number was reduced in high level salinization at 8dSm⁻¹. The harmful influence of salinity on leaf number also increased with the increase in concentration, (Raul et al., 2003).

Many studies have shown that the fresh and dry weight of the shoot system are affected, either negatively or positively, by change in salinity concentration, type of salt present or type of plant species (Jamil et al., 2005).

Change in water relation of plants that are stressed by salinity can be seen in certain studies confirm that many plants undergo osmotic regulation when they are exposed to salt stress by increasing the negativity of osmotic potential of the leaf sap (Kaymakonava and Stoeva et al., 2003).

Some studies confirm the inhibitory effect of salinity on biochemical processes of which photosynthesis is the most important. The effect on photosynthesis can be gauged from the effect on photosynthetic pigment (Sultana et al., 2000). This study clearly indicates that salinity reduces the content of photosynthetic pigments in treated plants.

Reduction in the growth rate of the leaf can represent an adaption to salt stress since increased levels of salts in the soil impedes the uptake of water by plant (Carilio et al., 2005) and the reduction in leaf area limits transpiration (Neumann, 1997). Another adaptation to salinity is the increase in succulence, which reduces the concentration of salts in the protoplasm. The greater growth of the roots in comparison with the aerial part is also considered an adaption to saline stress (Alshamary et al., 2004). It results in increased surface area for water uptake thereby preventing dehydration.

Salinity reduces the uptake and transport of nitrate and consequently the assimilation of nitrogen necessary for protein synthesis (Silveria et al., 2001). Salt stress can provoke several metabolic alterations in plants such as the preoxidation of lipid and reduction in chlorophyll content.

Plant growth can be directly affected by high levels of toxic ions such as sodium and chloride. Excess sodium accumulation in leaves can cause leaf burn (necrotic dead), and defoliation. Plants affected by chloride toxicity exhibit similar foliar symptoms, such as leaf bronzing necrotic spots in some species. Defoliation can occur in some woody species.

The dry weight (biomass) of stem decreased with increasing salinity. The effect of salinity on germination can be either by creating osmotic potential which prevents the uptake of water by the toxic effect of ions on embryo viability (Houle et al., 2001) salt absorb and retain water with strength that it is not freely available in the soil causing an increase of soil solution osmotic pressure. Salt stress may cause significant reduction in the rate and final germination percentage which in turn may lead to uneven stand establishment and a reduction in yields. Rapid, uniform and high germination percentage for legumes, is a prerequisite for successful stand establishment and reduction in yield (Demir and Ermis, 2003) the specific ion likely to be most abundant and cause greatest problems are sodium (Na) and chloride

The specific study on Faba bean (*Vicia faba* L.) indicates that germination is affected by high level salinization i.e both germination percentage and Germination index became decreased with increasing salinization.

6. Conclusion

This study showed the effect of soil salinity on the growth of Faba bean (*Vicia faba* L.). The high level salinity reduces the growth of stem and leaf. Also it delays seedling emergence of Faba bean. The root elongation was not affected at low level salinization, but higher level salinization promotes tap root elongation.

This study also demonstrated that Faba bean (*Vicia faba* L.) seed germination varied according to the change in NaCl osmotic potential i.e NaCl has direct harmful effects on Faba bean (*Vicia faba* L.).

Generally high level salinity is very sensitive to Faba bean (*Vicia faba* L.), and affect its metabolic activity particularly affects osmotic potential of soil that is affects the root to uptake water and in turn affect other metabolic activities, such as photosynthesis finally affects the whole growth of plants (stem, root and leaf).

7. Recommendation

The Faba bean plant (*Vicia faba* L.) is one of legume plants which tolerate salinity at low level but affected as soil salinity increases. The level of salinity must be checked before cultivation, and chemicals or materials like compost which reduce soil salinity must be added to overcome the effects and increase the production of Faba bean (*Vicia faba* L.)

8. References

- Aleman Souri Mg- Kinet, Lutta (2001) *Effect of salt and osmotic stresses on germination in durum wheat (Triticum durum Desf)*. Plant soil 231:-254.
- Alshamary SF, Lian YI, Waliner Sj.(2004) *Growth response of four turfgrass species to salinity*. Agr- water Mana-v66: pp97-111.
- Bailey. (1976), *FADSTAT(2012)*, *USDS(2012)*, *Van Wyk (2005)*.FAOSTAT Ktt/faostat3. fao org/browse/Q/Qc/E Accessed on June 2016.
- Barrett Lennar Eg (2003).*The interaction between water logging and salinity in higher plants; causes consequences and implication plant and soil* vol. 253 PP 35-34.
- Beltagel , M.S Beltagl, M.A Ismail, F.H Mohammed (2006). *Induced salt tolerance in common bean (Phaseolus Vulgaris L.) by Gamma irradiation* Pak, Birl. Sli, Volume 6
- Bernstein L (1975) *Effects of Salinity and Solidity on plant growth Annual Review of phay to pathology* v13,pp295-312.
- Borsani O, Valpuesta V & Botella MA. (2001). *Evidence for a role of salicylic acid in the oxidative damage generated by NaCl and osmotic stress in Arabidopsis seedlings*. Plant Physiology v126:pp1024-1330.
- Borsani O, Valpuesta V and Botella MA (2001), *Evidence for a role of salicylic acid in the oxidative damage generated by Nacl and osmotic stress in Arabiocloopsis seedling*. Plant physic.

Brower .C. Coffeau A. Heliboem M(1985) *Irrigation water management training manual*

No-1 Introduction to irrigation food and agriculture organization of
united Kingdom Rome, Italy.

Chopra VL Singh RB and varma A. (1989) Crop productivity and sustainability shaping
the future proceeding of 2nd international crop science congress oxford and
IBH publishing New Dehi P-11.

CSA(central stactical agency) (2011). The federal democratic republic of Ethiopia,
Agricultural samples survey volume I.

CSA(central stactical agency) (2013) report in the area and production of major crops
(private pesant holding meher seson) statistical bulletin ,!: pp10-14

DCUH DM and Nilsen ET (2000). *The physiology of plant under stress =soil and biotic*
factors. (John Wiley and Sons, Inc; New York)

Demir I, Ermis S(2003) *Effect of controlled hydration treatment on germination and*
seedling growth under salt strees during development in tomato seeds. Euro.
Of Hortic sci. v68:pp53-58.

DNRQ (1997) *Salinity management Handbook*. Department of Natural Resources Queensland.

Etan FE (1966) Chlorine, *In Diagnostic Criteria for plants and soils (Eds, Hp Champ man)*
PP. Division of Agricultural Science, University of California.

FAO (2008) *land and plant nutrition management service* <http://www> Fao Orga/ag/ag/s/Spush.

Gebreselassie T (1998) *Degradation problem of irrigated agriculture A review soil the*

resource Base for survival proceeding of second conference of Esss, 23-24

AA Ethiopia pp199-206.

Greenway H. Munn R. 1980, *Mechanism of salt tolerance in non halophytes*. Annu. Rev.

Plant physiol. v31:pp1 149-190.

Grundon N (1987), *Hugry Crops: a guide to nutrient deficiencies in field crops*

(Queensland. Department of primary Industries; Brisbane).

Hasegawa PM, Bressan RA, Zhu JK & Bohnert HJ (2000). *Plant Cellular and*

molecular responses to high salinity. Annual Review of Plant Physiology and

Plant Molecular Biology v51: pp468-499.

Helstosky, carol (2009) *food culture in the medtranian*. Green wood publishing group.

P.7, ISBN 03133462667.

IFPRI(international food policy research institute(2010) *pulses value chain potential*

in Ethiopia constriants and apportunities for enhancing exports.

Hingston F and Gailitis (1976). *The geographic variation of salt precipitated*. Over

western Australia in Australian Journal of soil Research, Vol. 14 pp 319-335

Jamil M, Lee BD, Jung YK, Ashraf. M. Lee Cs, Rhase (2006) *Effect of salt (Nacl)*

strees on germination and early seedling growth g four vegetables species central

Eur. Agric -v7 (2) pp273-282.

Jamil, Jamil, M-Lee, C.C., Rehman, S.u, Lee D,B, Ashraf, M. Rha E.S (2005)

salinity (Nael) tolerance of brassica species at germination and early

seedling growth Electronic J. Environment. Agric –Food Chem –Iss N-pp
1579-4377.

Kagamaka nova and stoeva, (2008) *physiological reaction of bean plants (phaseolus
Vulgaris L.) to salinity stresses* Gen. Appl- plant physiol. Issue 3-4, 2008 pp. 177-188.

Katembe Wj. Ungar IA, Mitchell Jp (1998) *Effect of salinity on germination and seedling
growth of two Afriplex species, (Chenopodiaceae)* Annal of Botany v82pp167-175.

Kitajima K, Fernner M(2000). *Ecology of seedling regeneration, plant cell.*
Environment v 25 pp239-250.

Krishnamurthy R, Abazhagan M and Bhagwat, K.A (1987) *Effect of Nacl toxicity
of chlorophyll, breakdown in rice.* Indian Journal of Agricultural.
Science v57,pp 567-570.

Kristin A, Schneider, Regoberto, Rosels Francisco IP, Benito CE, Jorge A, Porifrio
RV, Nasrat W, James or (1977) *Improving common bean performance
under drought stresses crop* Sci, v37pp43-50.

Kurniadie D and Redmann RE (1999) *Growth and Z.cl accumulation in soybean
cultivars treated with excess Kd.* in solution culture communication is soil
science and plant Analysis v30,pp669-709.

L Ruduier D (2005) *Osmo regulation in Rhizobia; The key role of compatible solutes.*
Grain legume v42: pp18-19.

Lewis Gischrine B. Makinder B (2005) *Legumes of the world; Royal Botanical Gardens.*

Kew, Uk;

Manschner H (1995) *Mineral nutrition of higher plants* (Academic press Landon)

Marschner H. (1995). *Mineral Nutrition of Higher Plants*. London: Academic Press, PP 889.

Mekibib F (1997) *Farmer participation in common bean genotype evaluation, the case of Eastern Ethiopia experimental Agriculture*, v33pp399-408.

MOARD (ministry of agriculture and rural development (2009), animal and plant health regulatory directorate crop variety register no. 12 june,2009 addis ababa , Ethiopia.

Mordi P, Zavareh M(2013) *Effect of salinity on germination and early seedling growth of Chizpea (Cicer arietinum L.)* *Cultivators Int. Farming Allied Sci.* v2(3) pp70-40.

Munns R, Greenway H& Krist GO. 1983. *Halotolerant eukaryotes In: Lange OL, Nobel PS, Osmond CB& Zeigler HH. (eds), Physiological Plant Ecology, III. Response to the Chemical and Biological Environment. Encyclopedia of Plant Physiology. New Series, Vol. 12c. Berlin: Springer: pp 59-135.*

Munns R, Jamel KA Lauchi A (2006) *Approaches to increasing salt tolerance of wheat and other cereals* *exp Biol.* v97 pp1025.

Neumann P. (1997); *Salinity resistance and plant growth revisited cell Environ.* v20 pp1193-1198.

Raul et.al (2003) O. Andres, L. Armado, M Bernardo, T. Enrique *Response to salinity*

of three grain legumes for potential cultivation in arid area (plant nutrition) soil.

Sli –plant Nutr, Volume 49 Issue 3, 2003, pp 329-336.

Schroeder JI, Ward JM & Gassmann W. (1994). *Perspective on the physiology and structure of inward rectifying K channels in higher plants, biophysical Implications for K uptake.* Annual Review of Biophysics Bimolecular structure v23 pp 441-471.

Silveria JAG, Melo, ARB, Viegas RA, Oliver, JTA (2001). *Salinity induced effect on nitrogen assimilation related to growth in coulpea plants.* Environ –Exp. Bot; v46: pp171-179

Slater A, Scott N & Fowler M. (2003). Plant Biotechnology. *The genetic manipulation of plants.* New York: Oxford University Press Inc.

Sultana, T, Ikeda, R. Itoh (2000) *Effect of Nacl Salinity on photosynthesis and dry matter accumulation in developing rice grains environ.*
Exp. Bot Volum 42. Issue 3.

Telaye , A. Bejiga , G. (1994) role of cool season food legumes and their production constaraints in ethioipa agriculture 1,national cool season food legume review conference, addis ababa (Ethiopia)

Tester M& Davenport R. (2003). *Na+ tolerance and Na+ transport in higher plants.* Annals of Botany v 91 pp503-527.

www.kew.org/science -conservation plant and Fungi.

Xu Gmagen H Turchitzky and Kafkafi U (2000) *Advances in chloride nutrition of plants*, Advances in Agronomy v68 pp97-150.