ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 09, pp.57536-57544, September, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EFFECT OF SALINITY STRESS ON PLANT GROWTH, CHLOROPHYLL CONTENT AND CAROTENOIDS OF CORIANDER (*Coriandrum sativum* L.) CULTIVARS

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ARTICLE INFO

Article History:
Received 24th June, 2017
Received in revised form
10th July, 2017
Accepted 23rd August, 2017
Published online 29th September, 2017

Key words:

Coriander,
Chlorophyll Content,
Growth Parameters and salinity levels.

ABSTRACT

Coriander (*Coriandrum sativum*) is an annual herb. It is one of the most commonly used spices. Coriander is moderately tolerant to salinity. Salinity is one of the important abiotic stresses that have adverse effects on plant growth photosynthesis, chlorophyll, fluorescence and their components. Photosynthetic efficiency of a crop species depends upon factors like leaf area, chlorophyll content, stomatal exposure, etc. An experiment was conducted in pots filled with soil at the field temperature. Salinity tolerances of two coriander varieties (P.D 21, and Kalmi) were investigated on growth parameters, chlorophyll and carotenoids and total pigments under salinity stress in forty-five days old plants. For this, aqueous solutions of different concentrations of NaCl salt (viz. 25, 50 and 75 mM) were used. Distilled water served as control. The result showed that increasing salinity levels decrease length and weight of root and shoot, number of leaves, chlorophyll content in leaves in both cultivars when compared with control set. On the basis of above growth parameters, chlorophyll a, b and caretonoids, the present findings revealed that cv. PD-21 performed better as compared to cv. Kalmi.

Citation: Gagandeep Kaur and Ashok Kumar, 2017. "Effect of salinity stress on plant growth, chlorophyll content and Carotenoids of coriander (*Coriandrum sativum* L.) cultivars", *International Journal of Current Research*, 9, (09), 57536-57544.

INTRODUCTION

Salinity is one of the most serious abiotic stress factors that limit crop productivity. It has reached 19.5 % of the irrigated land and 2.1 % of the dry-land agriculture existing on the globe (FAO, 2000). Salinity effects are more conspicuous in arid and semiarid. Salinity affects plant physiology at both the whole plant and cellular levels by causing osmotic and ionic stresses. Salinity generates physiological drought, or osmotic stress (Munns, 2002). In agricultural practice it is not always possible to provide sufficient quantities of irrigation water of good quality. Often more mineralized water and processed waste waters are used (Kalavrouziotis et al., 2010). Therefore, by irrigation the soil can be enriched with useful or harmful salts and various other compounds, depending on water quality. Salinity of arable land is a problem that is becoming more and more important in many areas where irrigation is a regular agro-technical measure, and in semi-arid and arid regions in the world where atmospheric precipitations are not sufficient to flush the salts from the root zone. When irrigation water is of inadequate quality, the occurrence of chlorosis between leaf veins is commonly observed, leaf tissue necrosis often develops and flowering may not happen at all. The osmotic adjustment in both roots and leaves contribute to the maintenance of water uptake and cell turgor, allowing physiological processes, such as stomatal opening, photosynthesis, and cell expansion (Serraj and Sinclair, 2002). Germination is one of the most important stages in plant growth that affected by various stresses. The major effect of salinity on plant growth and development are due to osmotic inhibition of water availability as well as the toxic effect of salt ions responsible for salinization (Hakim *et al.,* 2014). Salinity caused a significant reduction in germination percentage, germination rate, and root and shoots length and weights of four vegetable species Jamil *et al.,* (2006). The salts restrict the plant growth and hence salt stress has become an ever increasing threat to agriculture (Zhu, 2007; Pattanagul and Thitisaksakul, (2008). Salt stress change the morphological, physiological and biochemical responses of plant (Amirjani, 2010). Salinity results in delayed germination, high rate of seedling mortality, stunted growth and reduced yield (Muhammad and Hussain, 2010). Soil salinity may influence the germination of seeds either by creating an osmotic potential external to the seed preventing water uptake, or the toxic effect of Na^+ and Cl^- ions on germination seed. Salt and osmotic stresses are responsible for both inhibition or delayed seed germination and seedling establishment. Seed germination, seedling emergence and early survival are particularly sensitive to substrate salinity (Nasri et al., 2015). Chlorophyll is a green pigment found in plants. This pigment absorbs light energy for use in photosynthesis. There are several different types of chlorophyll including chlorophyll a, chlorophyll b, chlorophyll c, chlorophyll d, chlorophyll e and

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bacterio-chlorophyll. Chlorophyll is an important part of chlorophyll protein complexes on the thylakoid membranes. Chlorophyll's function in plants is to absorb light and transfer it through the plant during photosynthesis. It is the key photosynthetic pigment and its content directly reflects the photosynthetic efficiency and assimilation capacity. As a result, chlorophyll content is an important index in determining salt stress level (Munns, 1993). During long-term exposure to salinity, plants experience ionic stress, which can lead to premature senescence of adult leaves, and thus a reduction in the photosynthetic area available to support continued growth (Sultana *et al.,* 1999). Salt also affects photosynthetic components such as chlorophylls and carotenoids. Saline-alkali stress destroyed the thylakoid membrane structure, lowered the affinity between the chlorophyll and the chloroplast protein, and decreased the activity of the chlorophyll enzyme, which in turn, promoted chlorophyll break down. Measurement of chlorophyll fluorescence is a relatively new technology in recent years to study the impact of various environmental stresses such as drought, salinity and low- or high-temperature on photosynthetic efficiency of leaves in the greenhouse and field conditions has been used (Rizza *et al*., 2001; Rapacz *et al*., 2001; Ort 2002; Baker and Rosenqvist 2004; Zobayed *et al.,* 2005). The reduction of photosynthesis activity is one of the main reasons in salinity influence of plants in which is due to chlorophyll reduction and also reduction of CO_2 absorption and photosynthesis capacity (Fransisco, 2002).

By increasing of salinity, sodium ions change the ratio of K^+: Na^+, which seems to affect the bioenergetic processes of photosynthesis (Sudhir and Murthy, 2004). Ali *et al.* (2004) studied the effect of salinity on chlorophyll concentration, leaf area, yield and yield components of rice genotypes grown under saline environment. They observed that reduction in chlorophyll concentration by NaCl to the inhibitory effect of the accumulated ions of various salts on the biosynthesis of the different chlorophyll fractions. Decrease in chlorophyll content in response to salt stress is a general phenomenon which led to disordering synthesizing chlorophyll and appearing chlorosis in plant (Parida and Das, 2005). Effect of salinity on plant growth may result from impairment of supply of photosynthetic assimilates (Ashraf, 2004) and cell expansion in leaves can be inhibited by salt stress (Chaves *et al*., 2009). As the chlorophyll content changes by saltiness tension would also be meaningfully effected on final photosynthesis level, perspire speed and ostium transaction (Dhanapackiam, 2010).Salinity stress significantly reduced chlorophyll content, photochemical quenching (qP) and Fv/Fm in naked oat (Zhao *et al*., 2007). Salinity reduces photosynthesis, the percentage of seed germination, leaf number, and leaf area and is ultimately reduced leaf area (Sadeghi, 2010). Coriander (*Coriandrum sativum*) which belongs to family Apiaceae (Umbelliferae), is a herb which possesses nutritional and medicinal properties, besides, it is one of the most commonly used spices. The first medicinal uses of the plant were reported by the ancient Egyptians. The plant is native of the Mediterranean region and is extensively grown in Europe, Moroeeo, India and South America. In India, coriander is cultivated in Rajasthan, Madhya Pradesh, Uttar Pradesh and southern states like Andhra Pradesh, Karnataka, and Tamil Nadu. Coriander seeds and leaves are used as common food flavoring agents both sweet and savory dishes, especially in Europe and India. Coriander seeds have medicinal properties too and therefore used as a carminative, and diuretic. It helps to remove toxic mineral residue, such as mercury and lead and excretes them in the urine or faeces (Leena *et al.,* 2012). Both leaves and seeds of the plant are used for medicinal purpose. Oil of coriander is used in medicine and in flavoring beverage , such as gin, whisky and various liqueurs. The extract is a better flavoring substance than either the dried fruit or the oil. It is a tropical crop and can be grown throughout the year (except very hot season i.e. March-May) for leaf purpose, but for higher grain yield it has to be grown in specific season. A dry and cold weather free from frost especially during flowering and fruit setting stage favours good grain production. Coriander is a fast growing annual herb that grows in cooler weather of spring and fall. Coriander grows in sandy-loamy, fertile and humus-rich soil in between October to May month. It performs well at a temperature range of 20-25^{0}C and soil pH is of 6.0-6.7. In general, coriander is known as moderately tolerant to salinity, the effect appears mainly during germination and plant growth (Elouaer and Hannachi, 2013). The objective of present exploration is to study the responses of two cultivars under salinity stress on the basis of growth parameters and photosynthetic pigments.

MATERIALS AND METHODS

For present study two varieties (PD-21 and Kalmi) of coriander were raised in plastic pots filled with soil under salt stress condition. The plastic pots (60-dm) were sterilized and filled with 1kg of oven dried soil. Consequently, solutions of different concentration (25, 50, and 75 mM) were prepared by dissolving NaCl salt in distilled water. Now pots were irrigated with 100 ml of each of saline water separately and distilled water was used as control. Healthy and uniform sized seeds were sterilized with 0.01% $HgCl_2$ for a minute and washed thoroughly in distilled water. Fifteen seeds were sown in the depth of 2cm in each plastic pot. These plastic pots were moistened with 300 ml of different NaCl solution respectively. Scheduled routine of irrigation was practiced for both control and treated pots throughout the crop growth period. After forty-five days of sowing, plants were collected from each treatment in three replicates. The root and shoot were separated with the help sharpened knife. The root and shoot length were measured with scale (cm). Number of leaves per plant was also measured. Then fresh weight of root and shoot was measured on electric balance. There after roots and shoots collected from respective treatments were dried in hot air oven at 60^0 C tempreture for 48 hours. Now, dry weights of roots and shoots were taken with the help of electronic balance.

Chlorphyll Estimation

Chlorophyll estimation was carried out in forty-four days old fresh leaves, collected from different salinity treatment including control using the method of Duxbury and Yentsch (1956). The collected leaves were washed separately to eliminate the traces of contamination deposited on the leaves. A quantity of 1 g of fresh leaf sample was ground using mortar and pestle in 3 ml of 80% acetone (w/v). Then the homogenate was centrifuged at 5000 rpm for 10 minutes and the supernatant was collected. The residue was again washed with 80% acetone and centrifuged. The process was repeated till the pellet became colourless. The final volume of the pooled supernatant was noted. The absorbance was read at 662 nm, 644 nm and 440 nm against the solvent blank (80% acetone). Then the amount of chlorophyll present in the extract was calculated as mg per gram fresh weight using the following formulae:

Chl a = (9.784 * E662-0.99 * E644) * V/m
Chl b = (21.462 * E644 - 4.65 * E662) *V/m
Carotenoids = (4.695 * E440 – 0.268 * (5.134 * E662 + 20.436 * E644) V/m

Where E662, E644, E440 denote the absorbance, V is the volume of the solvent and m is the tissue mass.

Data analysis

Statistical analysis and plotting of graphs were done by Excel software. A critical difference (CD) was computed when F-test indicated statistically significant differences between genotypes using the method described by Bruning and Kintz, (1997) at P=0.05.

RESULTS AND DISCUSSION

Root and shoot length (cm): Root and shoot lengths are the most important parameters for studying salt tolerance as roots are in direct contact with soil and absorb water from the soil and store it in the plant. Figure – 1.1 and 1.2 showed that, the root length and as well as shoot length decreases with increasing concentration of salt. At 25 to 75 mM salinity levels, 21.57-76.00% reductions in root length and 20.12-52.95% reductions in shoot length were recorded in Kalmi. The cultivar P D-21 showed minimum reduction 17.00-48.62% in root length and 15.98-46.14% in shoot lenghth at these levels of salinity when it was compared with control set. A decrease in plant growth in salinity soils is caused by the osmotic and water potential of soil, specific toxicity, and nutritional deficit. After these primaries effects, secondary stresses happen as the oxidative damage. The present findings indicate that length and dry weight of shoot and root significantly reduced at higher salinity levels. These findings are in agreements with Yan-bing Wu et al., (2010) who found the decrease in plumule length and radical length as the concentration of NaCl increases; and an increase in inhibition rate as the NaCl concentration increased in wheat cultivars. Similarly, Papedo and Redman (2007) also reported inhibitory effect of salinity on different bean cultivars. Byrordi and Tabatabaei (2009) reported that such a decrease in root length and shoot length may be due to salt toxicity and disproportion in nutrient absorption by the seedling as suggested by. Sarkar *et al.,* (2014) also observed that salinity stress significantly rediced germination and growth parameters of seedlings of four vegetable crops including radish (*Raphanus sativus* L.), cabbage (*Brassica oleracea capitata* L.), mustard (*Brassica juncea*) and water spinach (*Ipomoea aquatica*). The major inhibitory effect of salinity on plant growth and development has been attributed to osmotic inhibition of water availability as well as the toxic effect of salt ions responsible for salinization (Hakim *et al.,* 2009).

Similar findings are recorded by De and Kar (1995) in vetch, Turk *et al.,* (2004) in lentil, and Netondo *et al.,* (2004) in pea for seedling parameters, Assadi (2009) in fenugreek, Jaleel (2008) in *Catharanthus roseus* and Foolad (1996) in tomato, Naseer, (2001) in barley for root length, Ghanbari *et al.,* (2013) in basil for shoot length and Mensah *et al.* 2006 in groundnut and Afkari (2010) in sunflower for number of leaves. Keshavarzi *et al.,* (2011) suggested that salinity leads to reduce water uptake which interferes with cell division and differentiation thereby affecting the root length and shoot length. Number of leaves per plant: The number of the leaves showed significant diminishing by increasing the salinity amount in comparison with control. Figure-2 showed that, the number of leaves per plant in both varieties decreased with increasing salt levels. The lowest number of leaves in both varieties (PD-21 and Kalmi) was noted at 75 mM salinity levels. The cultivar Kalmi showed maximum reduction 18.33-36.67%. The minimum reduction 16.67-22.83% was recorded in PD-21 when it was compared with control set. Generally a reduction in plant growth evident by a reduction in plant height or in the number of leaves or shoots is the plants first response to salinity. Grieve and Francois (1992) reported that salinity stress decrease leaf number in wheat during the early vegetative stage of growth. These results are agreements with the findings of Mass and Grieve (1990) in wheat, Yadao *et al.* (1998) in onion and Ali *et al.,* (2004) in rice. Salt induced leaf damages are considered to reduce the photosynthetic leaf area and hence yield potential in oat (Kumar, 2010).

Fresh weight of root and shoot (mg): It is cleared from the figure-3.1 and 3.2 that shoot and root fresh weights have significantly decreased with increasing NaCl concentration. Abbass and Latif, (2005) have also found a trend in fresh weight and dry weight of jute seedlings under NaCl stress. Salinity stress significantly affected root and shoot fresh weight as the salt concentration increased. Reduction in shoot fresh weight 49.12-72.05% and root fresh weight 63.39-88.33% was recorded in cultivar Kalmi. The cultivar PD-21 showed minimum reduction 41.68-62.19% in shoot fresh weight and 56.59-82.06% in root fresh weight at 25, 50 and 75 mM when it was compared with control. The decrement was related to the concentrations of NaCl. These results are similar to the findings of Fortmeier and Schubert, 1995 (maize), Harris *et al.* 2001 (farm seed) and Basra *et al.* 2003 (canola), Okcu *et al.,* 2005 (*pea*), Farhoudi and Tafti, 2011 (soybean), Khan *et al.,* 2009 (wheat), Keshavarzi, 2011 (savory), Abbaspour, 2010 (*Carthamus*), Banakar and Ranjbar, 2010 (*Pistachio*) and Zhani *et al.,* 2012a (pepper). Shoot and root dry weight (mg): The figure- showed a declining trend in dry weight of shoot and root with increasing salinity levels. Cv. Kalmi showed maximum reductions (50.71-77.99% and 62.96-88.71%) in dry weights of shoot and root respectively at 25, 50 and 75mM salinity levels when compared with control. The minimum reductions (45.07-64.06% and 57.59-83.25%) in shoot and root dry weights were recorded by PD-21 at these salinity levels. Statistical analysis revealed that dry weights of shoot and root of both cultivars were significantly decreased as the concentration of NaCl increased. Salt stress decreased root and shoot growth of the seedling. These findings are agreed with the those obtained by Khajeh- Hosseini *et al.,* 2003 (soybean) Pessarakli and kopec, 2009 (ryegrass), Turan *et al.,* 2009 (maize), Ratnakar and Rai, 2013 (fenugreek), Yan-Bing Wu *et al.,* 2010 (wheat), Hakim *et al.,* 2014 (rice). Reduction in the weight of shoot and root may be due to toxic effects of salt as well as unbalanced nutrient uptake by the pinching. Dadkhah and Grifiths (2006) attributed such a decrease in dry weight to greater reduction in uptake and utilization of mineral nutrients by plants under salt stress.

Total seedling dry weight (mg): Data on the effect of salinity on total seedling dry weight in both varieties have been shown in figure -5. Dry weights of seedlings in both cultivars were significantly reduced with increasing concentration of saline water. Maximum reduction (52.44-76.08%) in total seeding dry weight was recorded by cv. Kalmi whereas cv. PD-21 showed minimum (46.75-66.64%) in total seeding dry weight at 25 to 75mM when it was compared with control.

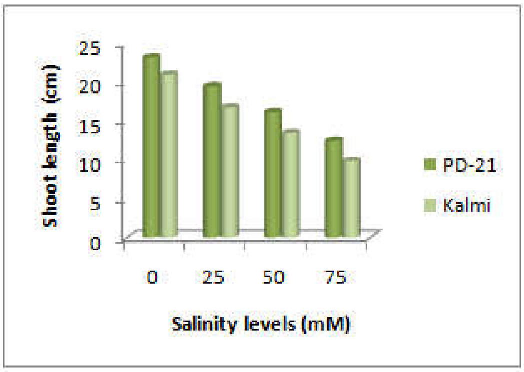

Fig-1.1 Effect of salinity on shoot length of two coriander cultivars

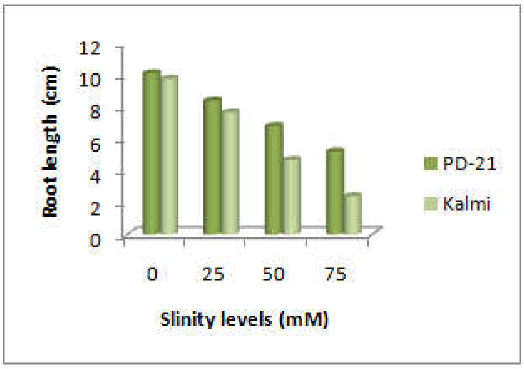

Fig-1.2 Effect of salinity on root length of two coriander cultivars

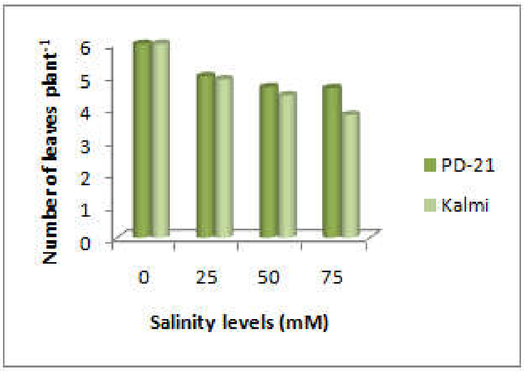

Fig-2. Effect of salinity on number of leaves per plant of two coriander cultivars

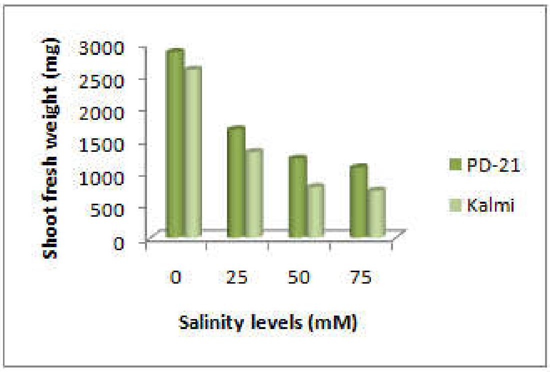

Fig-3.1 Effect of salinity on shoot fresh weight of two coriander cultivars

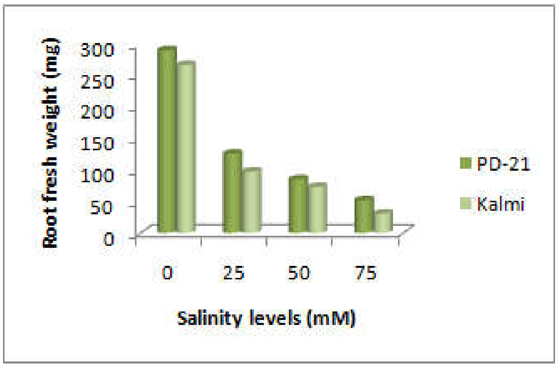

Fig-3.2 Effect of salinity on root fresh weight of two coriander cultivars

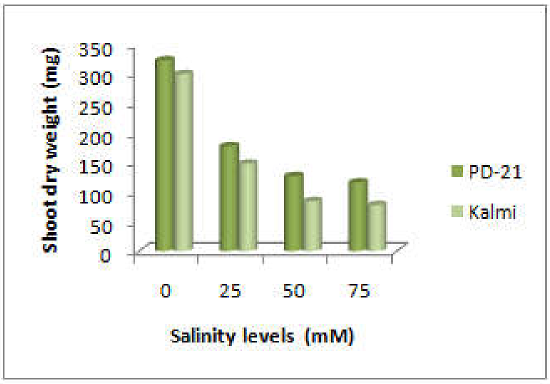

Fig-4.1. Effect of salinity on shoot dry weight of two coriander cultivars

Similar observations were reported by (Rastegar and Kandi, 2011) in soybean and (Hoque *et al.,* 2014) in maize. Jafari *et al.,* (2009) reported that decrease in dry weight of plants under saline conditions can be attributed to reduced rate of photosynthesis. These results are agreements with the findings ofDegar (2004) in *Salvadora persica*, Jaleel (2008) in *Withania somnifera,* Afzal *et al.,* (2005) *Triticum aestivum,* Jamil *et al.,* (2006) in sugarbeet, cabbage, amaranth, and pak-choi, Asfew (2011) in *Sorghum biolor* L. Moench, Agarwal *et al.,* (2011) in finger millet, and Agarwal *et al.,* (2015) in soybean. Ashraf *et al*., (2002) reported that the reduction in seedling fresh and dry weight is due to decreasing water uptake by seedling in salt stress presence. The reduction in seedling dry weight under salt stress may be attributed to the inhibited hydrolysis of reserved food and its translocation to the growing shoots. Croser *et al.,* (2001) reported that an increase in salt levels caused a reduction in seedling dry weight of *Picea mariana, Picea glauca* and *Pinus banksiana*. In general, there is a decrease in dry weight of plants under saline conditions which can be attributed to reduced rate of photosynthesis, as suggested by (Jafari *et al.,* 2009).

Photosynthetic Pigments

Chlorophyll a

Photosynthesis is one of the most important metabolic processes in plants and its performance is greatly affected under stress conditions (Mehta *et al.,* 2011). NaCl stress decreases chlorophyll content even at the lowest concentration (Santos, 2004). Data on chl a under saline condition in both varieties have shown in figure -6.1. Chlorophyll percentage decreases significantly when salinity levels increase from 25 to 75 mM as compared to control. The maximum reduction (24.66-68.16 %) in chlorophyll a was recorded in cultivar cv. Kalmi whereas in cv. PD-21 minimum reduction (20.38-63.02 %) was observed. These results are similar with the findings of Nazir *et al.,* (2001) who reported the reduction in rate of

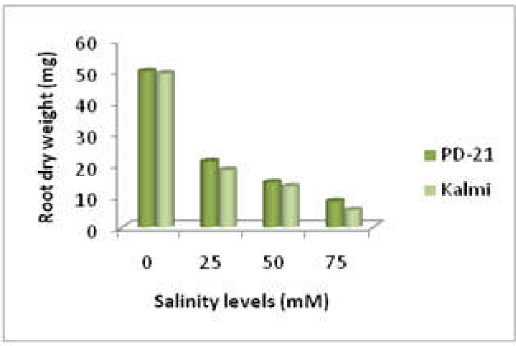

Fig-4.2. Effect of salinity on root dry weight of two coriander cultivars

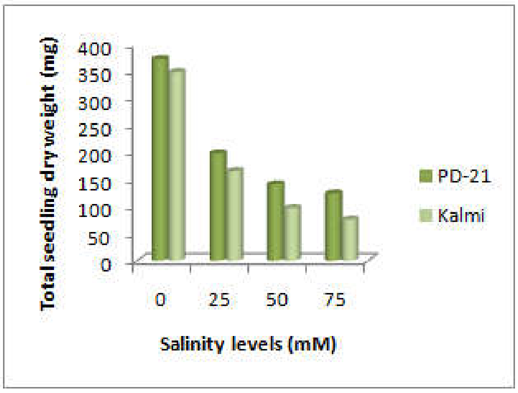

Fig-5. Effect of salinity on total seedling dry weight of two coriander cultivars

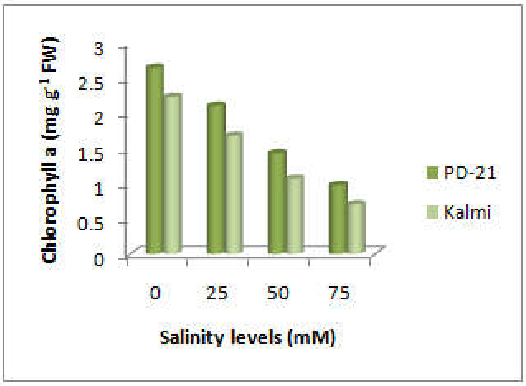

Fig-6.1. Effect of salinity on chlorophyll a of two coriander cultivars

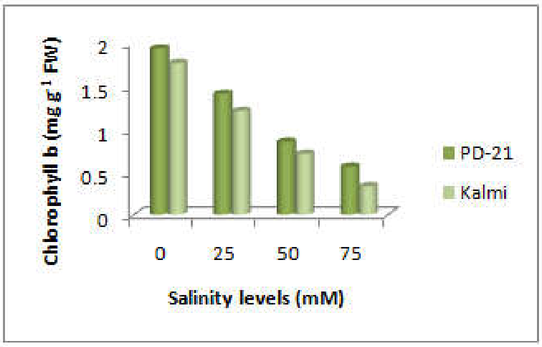

Fig-6.2. Effect of salinity on chlorophyll b of two coriander cultivars

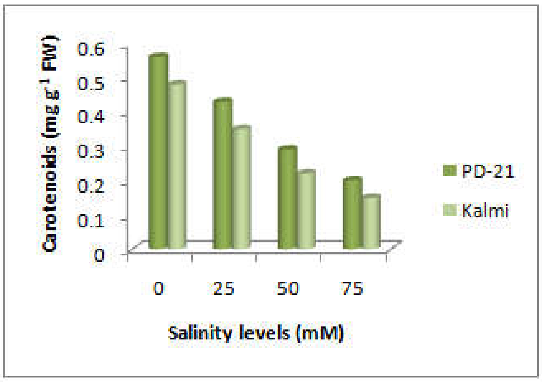

Fig-6.3. Effect of salinity on carotenoids of two coriander cultivars

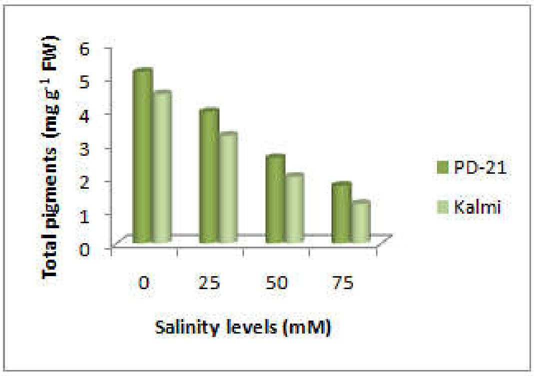

Fig -6.4 Effect of salinity on total pigments of two coriander cultivars

photosynthesis, chlorophyll percentage of coriander when salinity levels increased. Similar results were observed by various researchers who reported that leaf chlorophyll content was affected by salinity in *Brassica juncea* (Qasim, 1998), rice (Sultana *et al*., 1999), tetraploid wheat (Munns and James, 2003), *Brassica oleracea* (Bhattacharya *et al*., 2004), wheat (El-Hendawy *et al.* 2005) and radish (Jamil *et al.,* 2007). This Reduction in chlorophyll concentrations is probably due to the inhibitory effect of the accumulated ions of various salts on the biosynthesis of the different chlorophyll fractions (Raza *et al.,* 2006). Salinity can affect chlorophyll content through inhibition of chlorophyll synthesis or an acceleration of its degradation (Zhao *et al*., 2007).

Chlorophyll b

Photosynthesis is one of the main factors determining the plant biomass. NaCl salinity reduced chlorophyll content in leaves (Kaya *et al.,* 2002). The chlorophyll a and chlorophyll b ratio showed significant differences between various levels of salt. Chlorophyll b showed a higher percentage of reduction when compared to chlorophyll a. Percentage of reduction increased proportionate to increase in salt concentration. Djanaguiraman and Ramadas (2004) have reported that Chlorophyll b showed higher level of reduction in comparison to chlorophyll a. Figure-6.2 showed that, the chlorophyll b percentage decreases with increasing concentration of salt. Minimum reduction (26.18-70.68%) in chl b was recorded in cv. PD-21 at 25 to 75 mM salinity levels. The maximum reduction (31.64-81.36 %) in chlorophyll b was recorded in cv. Kalmi. The cultivar PD-21 showed minimum reduction (26.18-70.68 %) at these levels of salinity when it was compared with control set. The lowest amount of chlorophyll was obtained in 75 mM salinity that had significant differences with others. Khayyat *et al.* (2009) observed a decrease in chl b and dry weight in strawberry under NaCl salinity stress. According to them salinity can reduced the rate of photosynthesis and chlorophyll content in leaves. Effects of sodium chloride (NaCl) stress on chl fluorescence have been studied by various researchers in different plants such as Belkhodja *et al*., (1994) in barely, Zair *et al*., (2003) in wheat Netondo *et al*., (2004) in sorghum, Moradi and Ismail, (2007) in rice Zhao *et al*., (2007) in naked oat, Stepien and Johnson, (2009) in *Arabidopsis and Thellungiella*, Chaum *et al.,* (2009) in *Zea mays*, Dhanapackinm, (2010) in *Paulowina imperialis*, Grewall, (2010) in *Hordeum vulgare* L., Amirjani, (2010) in *Oriza sativa* L. and Desingh *et al.,* (2007) in *Gossypium hirsutum* L.. Beinsan (2009) reported that decrease in leaf's chlorophyll content was due to increase in activity of chlorophyll destroying enzyme named chlorophylls enzyme that would lead to destruction in chlorosplast and instability of protein complexity of pigments.

Carotenoids

Data on carotenoids under saline condition in both varieties have shown in figure -6.3. Carotenoids percentage decreases significantly when salinity levels increase from 25 to 75 mM. The maximum reduction (27.08-68.75 %) in carotenoids was recorded in cv. Kalmi. The cultivar PD-21 showed minimum reduction (23.21-64.29 %) at 25, 50 and 75 mM when it was compared with control set. The decrement was related to the concentrations of NaCl. These results are agreements with the findings of Ratnakar and Rai (2013) in the leaves of *Amaranthus polygamous* under NaCl salinity. They reported that the β-carotene, a precursor of vitamin A, thiamine, riboflavin and ascorbic acid content were found to decrease gradually with increase in the concentrations of NaCl. In leaves of tomato, the contents of total chlorophyll (Chla+b), Chl a, and Chl b, carotene decreased due to NaCl stress (Khavarinejad and Mostofi, 1998). Similar findings are recorded by Pisal and Lele (2005) and Sarmad *et al.* (2007) in *Dunaliella salina,* Ayala-Astorga and Alcaraz-Melendez (2010) in *Paulownia imperialis* and *P. fortune*, Rad *et al.* (2011) in *Dunaliella microalga*.

Total pigments

Photosynthetic efficiency depends upon factors like leaf area, chlorophyll content, stomatal exposure, etc. Reduction in total pigments is relatively dependent on the decrease in chlorophyll a, b and carotenoids. The reduction in leaf area, yield and yield components under saline conditions were also due to reduced growth as a result of decreased water uptake, toxicity of sodium and chloride in the shoot cell as well as reduced photosynthesis and value of pigments in leaves. Under increasing stress percentage of total pigments significantly decreased in both cultivars. Data on total pigments under saline condition in both varieties have shown in figure -6.4. Total pigments percentage decreases significantly when salinity levels increase from 25 to 75 mM. The maximum reduction in total pigments was recorded in cultivar Kalmi (27.68-73.44 %). The cultivar PD-21 showed minimum reduction (23.30-66.21 %) at 25, 50 and 75 mM when it was compared with control set. Ciobanu and Sumalan (2009) reported that chl content per unit of leaf area decreased with increasing salinity and the changes in the chl content of leaves occurred after six weeks when leaves intensified their green color. Under abiotic stress, such as metal (Patsikka *et al.,* 2002), salt (Stępien and Klobus, 2006) and water stresses (Jeyaramraja *et al*., 2005), the damage of photosystem leads to decrease of photosystem II (PSII) efficiency and decline of photosynthesis resulting in the inhibition of plant growth (Zhang *et al.,* 2009). Atlassi Pak *et al*., (2009) studied the effect of salt stress on chlorophyll content, fluorescence, Na^+ and K^+ ions content in rape plants (*Brassica napus* L.). Similar findings are recorded by Jamil *et al*. (2007) in redish and Akram *et al.* (2009) in sunflower.

Conclusion

It is concluded from this exploration that cv. PD-21 proved better as compare to cv. Kalmi on the basis of growth parameters and photosynthetic pigments. This study will help to understand the salinity tolerance of coriander genotypes and better use of such salt affect land.

Acknowledgement

The authors are highly thankful to Professor R. M. Dubey, the Hon'ble Vice Chancellor of IFTM University, Moradabad-244001 for providing all necessary facilities in research lab. They are also thankful to Prof. J. S. Verma, Senior Plant Breeder, Genetics and Plant Breeding Department, G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand for giving valuable suggestions during research work.

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