APPLICATION OF ORGANIC COMPOST FOR RECLAMATION OF SOIL SALINITY FOR APPROPRIATE GROWTH OF *CUCUMIS SATIVUS* SEEDLINGS

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خلاصہ

مرکبات کی موجودہ تحقیق نامیاتی کھاد میں موجود تھور نمکیات کے اثرات کو کم کرنے کی صلاحیت کا جائزہ لینے کے لئے کی گئی ہے۔ یہ تحقیق شعبہ، نصرت جہاں کالج ربوہ، پاکستان میں کی گئی تھی تاکہ نامیاتی کی مختلف ترکیبوں کے اثر کو معلوم کیا گیا ہے مٹی میں نمکیات کو کم کرنے کے لئے کھاد استعمال کیا جاتا ہے۔ "بے نظیر" کی قسم Cucumis sativus NARC پاکستان سے لے جایا گیا. برتنوں میں استعمال شدہ کھاد کی مختلف ترکیبیں ٪2 ، ٪4، ٪6، ٪8 اور ٪10 تھیں اور ہر علاج کے لیئے پانچ نمونے تیار کی گئیں اس سلسلے میں *Cucumis sativus* کے پانچ مختلف بیج ہر ایک برتن میں بویا گیا تھا. برتنوں کو مکمل طور پر بے ترتیب ڈیزائن میں رکھا گیا تھا اور نمی کا مواد ہر روز دیکھا جاتا تھا اور برقرار رکھا جاتا تھا۔ پودوں کی کٹائی 30 دن کے بعد کی گئی، جڑیں، ٹہنیاں اور پتے الگ الگ 50mM پوٹاشیم فاسفیٹ بفر میں محفوظ تھے۔ اس کے بعد محفوظ کردہ نمونے پیسے، سینٹرفیوجڈ اور متعدد بائیو کیمیکل ٹیسٹ (جن میں کل پروٹین، ہائیڈروجن پیروآکسائیڈ، اسکوربیٹ پیروآکسیڈیز سرگرمی اور میلونڈیہائڈ مواد شامل ہیں) کا جائزہ لیا گیا۔ بائیو کیمیکل ٹیسٹ کے نتائج سے معلوم ہوا ہے کہ تھور کے اثرات پر قابو پانے کے لئے اور اچھی پیداوار حاصل کرنے کے لئے 6 فیصد سے زیادہ کھاد استعمال زیادہ فائدہ مند ہے۔

Abstract

The current study was carried out to determine the effect of organic compost to minimize the consequences of salinity in order to promote vegetable cultivation at household. The research was performed at Botany department, Nusrat Jahan College Rabwah, Pakistan in 2019 to evaluate the effect of different compositions of organic compost applied to reduce soil salinity. ”Benazir" variety of *Cucumis sativus* was taken from NARC Pakistan. The different compositions of compost applied in pots were 2%, 4%, 6%, 8% and 10% and five replicates were made for each treatment. Five seeds of *Cucumis sativus* were sown in each pot. The pots were placed in completely randomized design (CRD) and the moisture content was observed every day. The plants were harvested after 30 days, roots, shoots and leaves were preserved in a 50mM potassium phosphate buffer separately. The preserved samples were then ground, centrifuged and subjected to various biochemical tests (including total soluble proteins, hydrogen peroxide determination, ascorbate peroxidase activity and malondialdehyde content). Results of biochemical tests have shown that compost application more than 6% is more beneficial for overcoming salinity effects and growing healthy crops.
Keywords: Cucumber, salinity, compost, biochemical tests.

Introduction

Cucumber (*Cucumis sativus*) is one of the popular annual crops in many countries. It belongs to a plant family Cucurbitaceae also known as gourd family. It is an economically important crop ranking fourth in Asia after cabbage, tomatoes and onion. Cucumber possesses characteristics that make it effective against fungal, microbial or bacterial infections (Hina, S. *et al*., 2017). The fruit of cucumber is green in colour, varying in its shape and size. The main component of the crop is up to 96% water. It is a nutritional crop having several minerals, vitamins and organic acids (Mousavizadeh, S. J. *et al*., 2010). High salt concentration in some zones near Kirana Hills of study area is the major problem for the cultivation (Ahmad *et al*., 2016). A study revealed that salinity, unfavorably affects the morphology and physiology of cucumber plants. The results of an experiment revealed that the number of leaves and stem length per plant was considerably reduced at 5 dSm-1 (Khan, M. *et al*., 2013). The main consequences of salinity on plants are ionic toxicity and osmotic effects. Plant processes including cellular metabolism, plant nutrition and photosynthesis are also affected (Safdar, H. *et al*., 2019). Increased salinity in soil effect cucumber plant growth by reducing stomatal conductance, transpiration rate, total yield and water uptake by plant (Al-Harbi, *et al*., 1992). One of the studies revealed that vermicompost is effective in growth and increased dry matter of cucumber seedlings. Furthermore, it was observed that vermicompost allows most nutrients to be available to plants (Pandit, N. P. *et al*., 2012). Similarly treatment of primary saline soil with organic waste (granular corn straw) upgrade soil available nutrients and

diminish salt ion content and soil pH (Chen, X. *et al*., 2020). According to a research use of MSW (microbiologically degraded solid waste) compost after applying gypsum can efficiently re-establish the soil degraded due to high salt content (Hanay, A. *et al*., 2004). Due to high content of organic matter MSW compost enhances physical and chemical characteristics of soil and recovers salt affected soil (Lakhdar, A. *et al.,* 2009). In another study it was observed that application of manure increases water holding capacity of the soil (Eifediyi, E. K. *et al*., 2010). So if plants are grown in saline soil and parallelly treated with compost, the compost will be effective in diminishing the effect of saline soil on growth of plants. Current study was conducted to find whether the addition of compost of different concentrations can neutralize the effect of salinity on the growth of *Cucumis sativus* along with which concentration will be most effective in reducing salinity effect on cucumber.

Materials and Methods

For this research purpose a single variety of cucumber (Benazir) was taken from the National Agriculture and Research Centre (NARC) Pakistan. The experimental design was Completely Randomized Design (CRD). The soil was taken from the local area of Rabwah by zone-based sampling. The compost and soil were screened with the help of strainer before experiment. Chemical analysis of soil was done which included EC and pH. The soil was mixed with five different concentrations of compost i.e. 2%, 4%, 6%, 8% and 10% in 25 pots. Each treatment had five replicates. No treatment of compost was applied to the control group. Quantity of soil mixed with different concentrations of compost was 1000g with 14% water in each pot. Five seeds were sown in each pot Moisture content was observed and maintained in routine. Also the emergence of seedlings was keenly observed. After 30 days emerged seedlings were harvested. Stem, leaves and roots of seedlings were collected, washed with water and preserved in 50mM of Potassium Phosphate buffer separately in labelled sample bottles. Each sample was separately ground in mortar and pestle. The samples were separately centrifuged machine at 14000 rpm for 15 minutes. Supernatant of each sample was separately preserved and palled was discarded. Biochemical tests were conducted for each sample which includes:

Total soluble proteins

Concentration of total soluble protein was examined using the method of (Bradford, M. M. 1976) with few amendments. The 0.5ml of sample was taken in a test tube and then reacted with Bradford reagent and incubated for 15-20 minutes. The absorbance was noted at 595nm via spectrophotometer.

Ascorbate peroxidase (APX) Activity

The APX working was measured using the method demonstrated by (Asada, R. *et al*., 1987). 400 microliter of sample was mixed with 800 microliter of 0.5 mM of Ascorbic acid and 300 microliter of 0.1mM of H_2O_2. The absorbance was taken at 290nm against the blank and readings were noted separately for each sample.

Hydrogen Peroxide Determination

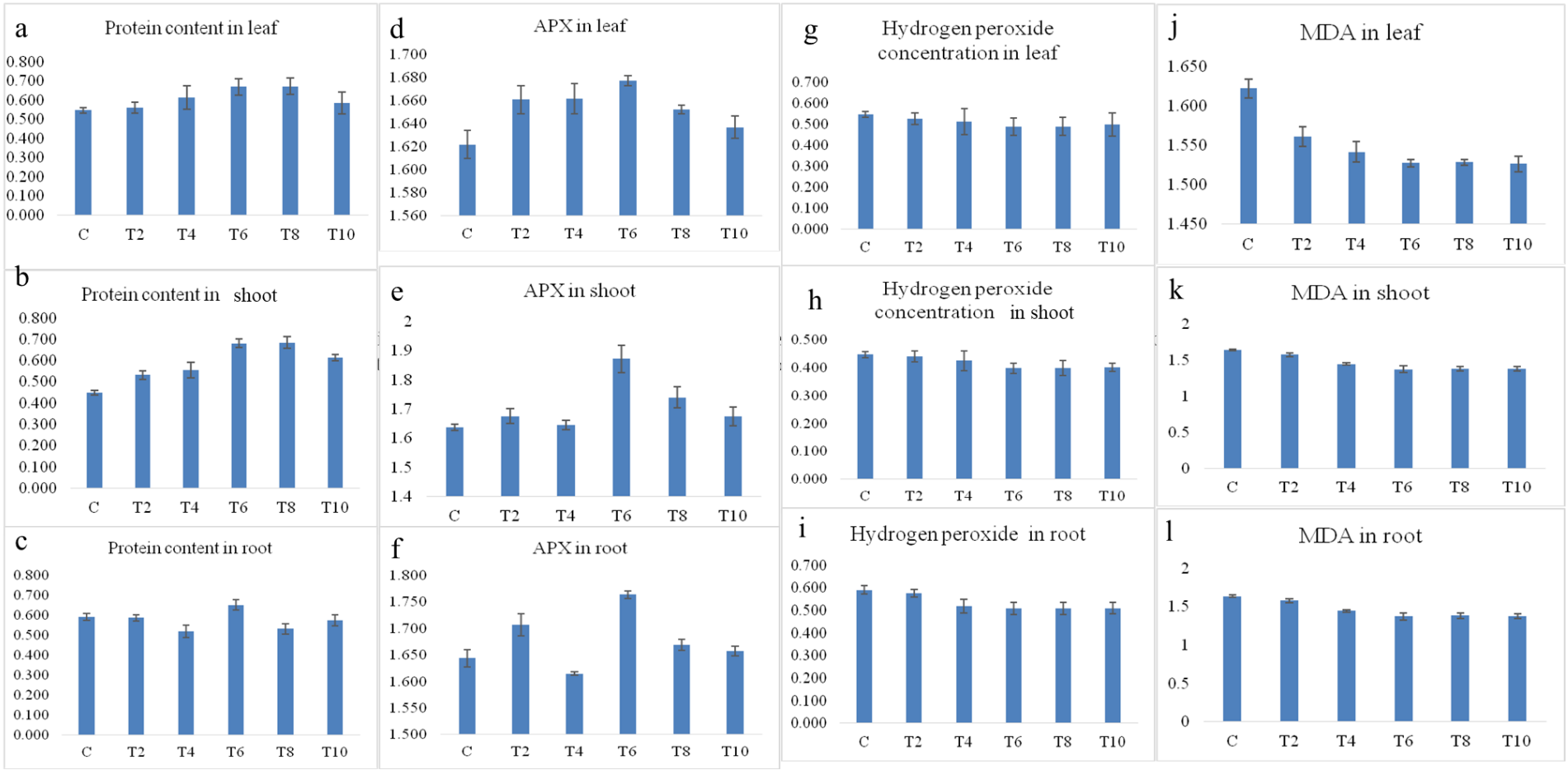
H_2O_2 concentration was determined according to the protocol of (Velikova, V. *et al*., 2000). 0.1ml of supernatant was added to 0.1ml of 0.1% Trichloroacetic acid (TCA) and 0.1ml of 1M Iodine potassium iodide (IKI). The absorbance was taken at 390 nm for each sample separately.

Malondialdehyde Contents

Malondialdehyde (MDA) was determined in accordance with a method proposed by (Dhindsa, R. S. *et al*., 1981) . In 1ml sample of TCA 0.6% of thiobarbituric acid was added. It was heated at 100˚C for 20 mins in a water bath and after heating, immediately cooled for 20 mins. The resultant colour was analyzed at 532nm on a spectrophotometer for each sample separately.

Results and Discussion

The pH and EC of soil analyzed before the experiment is 7.5 and 4920 µS/cm respectively. Salinity is the major problem that effect the growth and development of plants. Plants produce and regulate hormonal production to mediate the harmful effect of higher concentration of salts (Yu *et al*., 2015). In current study production of different concentrations of stress hormones were observed under various composition of organic composts. The results of the biochemical tests performed for total protein content are shown in the graphs below. According to the figures 1a and 1b the protein content of leaves and shoot in the pots with 6% and 8% compost is more than other treatments. The protein content in roots (fig 1c) is in higher % in pots with 6 % and 10% compost concentration. This claims that under 6% and 8% compost treatment, the plants cope up with the salinity effects and enhance its protein content and tend to be healthier than other plants with different compost


a
Protein content in leaf
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
C T2 T4 T6 T8 T10
b
Protein content in shoot
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
C T2 T4 T6 T8 T10
c
Protein content in root
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
C T2 T4 T6 T8 T10
d
APX in leaf
1.700
1.680
1.660
1.640
1.620
1.600
1.580
1.560
C T2 T4 T6 T8 T10
e
APX in shoot
2
1.9
1.8
1.7
1.6
1.5
1.4
C T2 T4 T6 T8 T10
f
APX in root
1.800
1.750
1.700
1.650
1.600
1.550
1.500
C T2 T4 T6 T8 T10
g
Hydrogen peroxide concentration in leaf
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
C T2 T4 T6 T8 T10
h
Hydrogen peroxide concentration in shoot
0.500
0.400
0.300
0.200
0.100
0.000
C T2 T4 T6 T8 T10
i
Hydrogen peroxide in root
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
C T2 T4 T6 T8 T10
j
MDA in leaf
1.650
1.600
1.550
1.500
1.450
C T2 T4 T6 T8 T10
k
MDA in shoot
2
1.5
1
0.5
0
C T2 T4 T6 T8 T10
l
MDA in root
2
1.5
1
0.5
0
C T2 T4 T6 T8 T10

concentrations and the plants with no treatment. Results of total protein content are in accordance with work done by (Pandit, N. *et al*., 2012) according to which it has been reported that organic compost increases plant mass and nutrient availability to plants.

The APX content in leaf, stem and roots in the pots with 6% compost concentration is maximum according to the figure 1d, 1e and 1f. The APX content increases in the root, shoot and leaf of cucumber with elevated compost concentration. APX content actually activates the proteins which are responsible for deterioration of reactive oxygen species which may evolve under salt stress conditions. So, at 6% treatment with compost the APX content is found to be highest in leaf, shoot and root which claims to be most favorable concentration to carry out physiological responses to reduce the salinity effect while more than 6 % increase of compost alters the stress reducing effect, it may be because compost particles get bind with roots hindering water passage.

In the figures 1g, 1h, 1i it is shown that the concentration of hydrogen peroxide reduces at 6% compost treatment in stems, roots and leaf. Above 6% compost concentration the hydrogen peroxide content does not change significantly. Hydrogen peroxide concentration is basically a stress indicator i.e. it is more pronounced in stress conditions and negatively affects the growth of plants. Under treatment of 6% compost concentration, hydrogen peroxides are relatively lower than other treatments and control group, which determines that 6% compost concentration is the optimum concentration to decrease the effect of salinity and paved the way for plants to uptake water at healthy rate without binding of salts to root cells and thus hydrogen peroxide concentrations are observed to appear at lower rates. Compost increases water holding capacity of soil (Eifediyi, E. K. *et al*., 2010) by recovering the soil physical and chemical structure (Lakhdar, A. *et al.,* 2009) due to which growth of plant is enhanced.

The graphs 1j, 1k and 1l are showing that MDA content has fallen at 6 % compost treatment. The control treatment has the highest MDA concentration. The MDA content is normally increased in plants under stress conditions and it results in osmotic lysis of plant cells thus affecting the plant growth and morphology. But under treatment of 6% compost concentration the MDA content is significantly reduced in leaf, shoot and root thus justifying the reduction of salinity effects. Application of compost decreases effect of salts in soil as previously described by (Chen, X. *et al*., 2020). As a result seedlings growth is enhanced.

Conclusion

Salinity is the major issue of current study area that hinders the cultivation of vegetables at household. Use of organic compost can be an effective and affordable solution. From the above results it is inferred that 6% organic compost treatment can reduce the effects of salinity on plants and thus allowing the plant to grow normally in salt stress soils. In nutshell 6% organic compost level is ideal for reducing salinity harms on plants because below this percentage low organic matter will be available for hindering salt particles from binding with plant roots while percentages of organic compost more than 6% have chances of binding themselves with roots and reduce water and nutrients availability to plants.

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