Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.4, No.25, 2014 

# Influence of Polyethylene Soil Mulch and Foliar Application of Urea , Complete Fertilizers, Seaweed in Alleviating Salt Stress of Broccoli (*Brassica Oleracea Var.Italica*)

Ali Husain Jasim
Prof. Dr. , Crop Sci. Dept. , Agric. Coll., Babylon Univ., Iraq

Fadia Hameed Moham
Lecturer , Biology Dept., College of Sci. , Babylon Uni. , Iraq

Wasan M. Abo Al-Timman
Lecturer , Biology Dept., College of Sci. , Babylon Uni. , Iraq

**Abstract**
This experiment was carried out to study the effect of soil mulch (with black polyethylene) and foliar application of urea, complete fertilizer and seaweed as well as control) and their interaction in alleviation of salt stress on broccoli which cultivated in salty soil(11.3 $dS.m^{-1}$) under drip irrigation , by estimating of leaf area, SOD and Catalase activity , MDA and Glutathione concentration in both of leaves and flowers. In broccoli leaves, soil mulch gave a significant effect in each of leaf area, SOD activity and non- significant effect in catalase activity, Glutathione and MDA concentration , while in flowers it caused a significant effects on all studied parameters except catalase activity compared to no mulch treatment . Complete fertilizer treatment caused higher effect in all studied parameters than urea and seaweed compared to control treatment . In all studied parameters , the interaction between soil mulch and foliar treatments had high significant effect . complete fertilizer + mulch treatment was the best, which caused increase in leaf area , SOD and Catalase activity in addition of Glutathione concentration compared to control treatment in both leaves and flowers , while it caused the biggest significant decrease in MDA concentration in both of leaves and flowers.
**Keywords**: Broccoli, Foliar fertilizer, seaweed , soil mulch, Urea, complete fertilizer

## Introduction

Broccoli (*Brassica oleracea* L. var italic Plenk) is a unique nutritious vegetables (El-Helaly , 2012) . The commercial product of the broccoli plant is its green inflorescence, which is rich in chlorophyll, , ascorbic acid and good source of vitamins and minerals (Everaats , 1994 ; Fabek et al., 2012) and some bioactive compounds such as phenolics, flavonoids and gluconsinolates that possess antioxidant and anticancer effects (Beecher, 1994) . Salt stress is the main factor that affects vegetables yield, which can inhibit crop growth and development, thus reducing agricultural production. Besides, salinity is the major factor to enhance Na+ uptake ( Abbas et al., 1991 ; Huang et al.,2010), inhibit K+, Ca2+, and NO3− uptake ( Maas ,1986 ; Shao et al ., 2013), damage cells ( Scandalios ,1997), induce oxidative stress (Abdel Latef and Chaoxing ,2011) and inhibit the activity of the key enzymes and photosynthesis (Karlberg et al .,2006 ; He et al ., 2014; ). Efforts have been made to control salinity by various technological means including drip irrigation ( Hanson and May ,2004), subsurface drainage ( Shao et al., 2012 ; Zhang et al ., 2012)., mulching ( Jord´an *et al*., 2010 ; Pang *et al*.,2010), foliar nutrition application ( Asghari et al.,2011 ; Welfare *et al.* ,1996), and seaweed application (Abdel-All and Mohammed , 2014; Aziz et al, 2011).
Therefore, this study was conducted to assess the effect of soil mulch and foliar application of Urea , Complete fertilizer and seaweed on Broccoli growth ( leaf area) and the activity of some enzymatic and non-enzymatic antioxidant systems( SOD, Catalase , Glutathione), as well as the concentration of MDA (to show amount of cell membrane damage by lipid peroxidation) under salt stress condition.

## Material and methods

Field experiment was conducted in the field of Agriculture college, Babylon University , during the growing season 2013–2014, to study the interaction of soil mulch with foliar application of urea, complete fertilizer and seaweed on alleviating the injury of salt stress on broccoli. The farm soil was sandy loam with pH 7.8 and salinity 11.3 $dS.m^{-1}$. Broccoli seeds were seeded in nursery at 1/10/2013, after 35 days, seedlings were planted on ridges 75 cm apart and 30 cm between plants. DAP (di-ammonium phosphate) at the rate of 200 kg/ ha was added as soil dressing down the plant line 10 cm. Factorial experiment within (R.C.B.D.) with three replicates was adopted. The experiment included two levels of soil mulch (with and without black polyethylene) and four levels of foliar applications : control , urea (i.e. %0.5 at 4 and 6 leaf stage ) , complete fertilizer (13-10-15, +

 

TE) spraying at 4 and 6 leaf stage (i.e.3 mg/l) and seaweed (2 ml.$L^{-1}$ ). The experimental unit included 3 ridges (0.6 m apart and 3 meters long). The data were recorded during the flowering stage , which included leaf area (cm2) , SOD (super oxide dismutase) activity according to (Marklund and Marklund , 1974) , Catalase activity by (Aebi, 1983) , the concentration of Glutathione by using the method of(Ellman, 1959) , the concentration of MDA (malondialdehyde) by ( Zacheo et al 2000) . The data were analyzed and the means were compared according to Least Significant Difference ($LSD_{0.05}$) , (Steel and Torrie, 1981) .

**Results**

Table (1) showed that soil mulch caused significantly increasing in leaf area with a percentage increasing of (26 %) compared to control. All other treatments of urea , complete fertilizer and $GA_3$ caused significant increase in leaf area (100 % , 142.7% ,34.4 %) respectively compared with control . The complete fertilizer treatment had bigger effect than the other treatments. The interaction between mulch and fertilizers caused significantly the bigger increasing effect in leaf area compared to control . Mulch + complete fertilizer had significantly the highest leaf area with a percentage increasing of (207 %) compared to control treatment.

**Table (1) Effect of Soil mulch , treatments and their Interaction in leaves area ($cm^2$ ) .**

| Treatment / Soil mulch | Control | Urea | seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 100 | 207 | 130 | 249 | 171.5 |
| Mulch | 129 | 251 | 178 | 307 | 216.25 |
| Treatment Mean | 114.5 | 229 | 154 | 278 | |
| LSD Value (0.05) | mulch= 17.5976 | Treatment= 24.886 | Interaction= 35.1953 | | |

Table (2 and 3) showed that soil mulch caused a significant increase in (SOD) activity in leaves (table 2) and flowers (table 3)with a percentage increasing of (28.5 %) and (33.9 %) , respectively compared to control. Foliar application of urea or complete fertilizer caused a significant increase in (SOD) activity in both of leaves and flowers compared to control treatment which was (51.9 % ,66.6 %) , respectively in leaves ( table 2) and ( 70%, 98.9%) respectively in flowers ( table 3). While the application of seaweed had no significant effect in (SOD) activity in leaves or flowers compared to control treatment ( table 2 and3). The interaction between soil mulch and others treatments (table 2 and table3) had significantly the bigger effect in increasing SOD activity in both of leaves and flowers compare to each treatment alone. The highest SOD activity in both of leaves (table 2) and flowers (table 3) was recorded in ( complete fertilizer + mulch) with a percentage increasing of ( 134.1% ) in leaves and (177.9 %) in flowers compared to control treatment.

**Table (2) Effect of Soil mulch , treatments and their Interaction in (SOD) activity of broccoli leaves**

| Treatment / Soil mulch | Control | Urea | seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 1.340 | 2.255 | 1.896 | 2.419 | 1.9775 |
| Mulch | 1.994 | 2.811 | 2.223 | 3.138 | 2.5415 |
| Treatment Mean | 1.667 | 2.533 | 2.0595 | 2.7785 | |
| LSD Value (0.05) | mulch= 0.4701 | Treatment= 0.6648 | Interaction= 0.9402 | | |

**Table (3) Effect of Soil mulch , treatments and their Interaction in (SOD) activity of broccoli flowers**

| Treatment / Soil mulch | Control | Urea | seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 1.176 | 2.125 | 1.536 | 2.582 | 1.854 |
| Mulch | 1.765 | 2.876 | 2.026 | 3.269 | 2.484 |
| Treatment Mean | 1.470 | 2.500 | 1.781 | 2.925 | |
| $LSD_{0.05}$ | mulch= 0.5135 | Treatment=0.7262 | Interaction= 1.027 | | |

Table 4 and 5showed that soil mulch had no significant effect on Catalase activity in both of leaves ( table 4) and flowers (table 5) compared to control. (Table 4) showed that the Foliar application of complete fertilizer and urea caused significant increase in Catalase activity in leaves , while the application of seaweed had no significant increase in Catalase activity compared to control . In flowers( table 5), all treatments had no significant effect in catalase activity . The highest Catalase activity in both of leaves (table 4) and flowers (table 5) was recorded in complete fertilizer + mulch , with a percentage increasing of 466.6 % and 666.1 % , respectively compared to control treatment, which was significant in leaves and non-significant in flowers.

 

**Table (4) Effect of Soil mulch , treatments and their Interaction in Catalase activity of broccoli leaves**

| Treatment / Soil mulch | Control | Urea | seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 2.04 | 7.48 | 4.76 | 8.16 | 5.61 |
| Mulch | 4.42 | 9.52 | 5.44 | 11.56 | 7.73 |
| Treatment Mean | 3.23 | 8.50 | 5.10 | 9.86 | |
| LSD $_{0.05}$ | mulch= 3.6983 | Treatment= 5.2302 | Interaction= 7.3966 | | |

**Table (5) Effect of Soil mulch , treatments and their Interaction in Catalase activity of flowers**

| Treatment / Soil mulch | Control | Urea | Seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 1.42 | 6.12 | 4.08 | 7.48 | 4.77 |
| Mulch | 3.40 | 8.16 | 5.44 | 10.88 | 6.97 |
| Treatment Mean | 2.41 | 7.14 | 4.76 | 9.18 | |
| LSD $_{0.05}$ | mulch= 5.3329 | Treatment= 7.5418 | Interaction= 10.6658 | | |

Table 6 and 7 showed that soil mulch had no effect in Glutathione concentration of leaves (table 6), while it caused a significant increase in Glutathione concentration in flowers ( table 7) with a percentage increase of (28.9% ) compared to control. application each of urea and complete fertilizer treatment caused a significant increase in Glutathione concentration in leaves (table 6) with a percentage increase of (114.6 %,139.3 %) respectively , while application of seaweed treatment had no significant effect in Glutathione concentration in leaves compare with control treatment . In flowers ( table 7) , the treatments gave similar effected of that in leaves (table 6 ) which showed a significant increase in Glutathione concentration in both of urea and complete fertilizer treatments with a percentage increase of (88.9 % ,136.2 % ) respectively and also seaweed had no significant increase . The interactions between soil mulch and others treatments gave the higher effect in increasing the concentration of Glutathione in both of leaves table(6) and flowers table (7) compared to each alone. The highest Glutathione concentration in both of leaves and flowers was recorded in ( complete fertilizer + mulch) which gave a percentage increasing of ( 213.8%) in leaf (table 6) and (215.8%) in flowers (table 7) compared to control treatment.

**Table (6) Effect of soil mulch , treatments and their Interaction in the concentration of Glutathione mg\g of broccoli leaves**

| Treatment / Soil coverage | Control | Urea | Seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 324 | 784 | 450 | 917 | 618.75 |
| Mulch | 484 | 950 | 520 | 1017 | 742.75 |
| Treatment Mean | 404 | 867 | 485 | 967 | |
| LSD $_{0.05}$ | mulch= 162.05 | Treatment= 229.17 | Interaction= 324.10 | | |

**Table (7) Effect of soil mulch , treatments and their interaction in the concentration of Glutathione mg\g of broccoli flowers**

| Treatment / Soil mulch | Control | Urea | Seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 417 | 794 | 550 | 960 | 680.25 |
| Mulch | 547 | 1027 | 617 | 1317 | 877 |
| Treatment Mean | 482 | 910.5 | 583.5 | 1138.5 | |
| LSD $_{0.05}$ | mulch= 153.99 | Treatment= 217.78 | Interaction= 307.99 | | |

Table ( 8 and 9) showed that soil mulch had no significant effect in decreasing (MDA) concentration in leaves ( table 8), but it had a significant decreasing in flowers (table 9) reached to(57.4%) compared to control treatment. On the other hand , all treatments used (urea , seaweed and complete fertilizer ) caused a significant decreasing in MDA concentration of leaves and flowers and the percentage of decreasing was respectively (73.5 % ,47.8 % ,92.8 %) in leaves (table 8) and (62.2% , 33.3%, 87.9%) in flowers (table 9)compared to control treatment. MDA concentration in both of leaves(table 8) and flowers (table 9) became lower at interaction between soil mulch and treatments and the lowest concentration of (MDA) in both of leaves (table 8) and flowers (table 9) were recorded in ( complete fertilizer + mulch) , which caused the highest decreasing percentage reached to ( %96.3 , 97.3 %) respectively compared to control .

 

**Table (8) Effect of Soil mulch , treatments and their Interaction in the concentration of (MDA) µmol\gm of broccoli leaves**

| Treatment / Soil coverage | Control | Urea | Seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 0.2123 | 0.0855 | 0.1038 | 0.0197 | 0.1053 |
| Mulch | 0.1695 | 0.0153 | 0.0955 | 0.0078 | 0.0720 |
| Treatment Mean | 0.1909 | 0.0504 | 0.0996 | 0.0137 | |
| LSD $_{0.05}$ | mulch= 0.0450 | Treatment= 0.0637 | Interaction= 0.0901 | | |

**Table (9) Effect of Soil mulch , treatments and their Interaction in the concentration of (MDA) µmol\gm of broccoli flowers .**

| reatment / Soil coverage | Control | Urea | Seaweed | Complete fertilizer | Coverage Mean |
|---|---|---|---|---|---|
| Without Mulch | 0.3594 | 0.1520 | 0.2338 | 0.0537 | 0.1997 |
| Mulch | 0.1669 | 0.0464 | 0.1170 | 0.0097 | 0.085 |
| Treatment Mean | 0.2631 | 0.0992 | 0.1754 | 0.0317 | |
| LSD $_{0.05}$ | mulch= 0.0390 | Treatment= 0.0552 | Interaction= 0.0780 | | |

**Discussion**

Plant growth is a series processes ,which correlated with plant nutrition , hormones and environmental condition (Mckersie and Leshen, 1994 , De Pascale *et al* ., 2005 ) .

Salinity is an environmental stress that limits growth and development of plant. The response of plants to excess NaCl is complex and involves changes in their morphology, physiology and metabolism (Hilal *et al* ., 1998 ; Jamil *et al* , 2005) . Tables (1 - 9) showed that the interaction between mulch and other applied treatment ( urea , complete fertilizer , seaweed) had better effect in improving the ability of broccoli to tolerate salt stress than each factor alone . The interaction of complete fertilizer + mulch gave the highest effective, which caused significantly the highest increasing in the leaf area (table 1) from 100 $cm^2$ in control treatment to 307 $cm^2$ . Many of researchers (Savant *et al* ., 1991; Jasim and Merhij , 2013) refers to the role of mulch and fertilizers in plant growth improvement . The effect of mulch in saving soil moisture and reduce the accumulation of salt( Romic *et al* ., 2003 ; Yamanaka *et al* ., 2004 ) , in addition of supplying broccoli plant with all macro and micro nutrients by complete fertilizer (Kirthisinghe , 2006 ) made their best effected on all studied parameters .Some of macro and micro nutrients have direct or indirect role in increasing the activity of many enzymes and others act as a precursors to some hormones , enzymes and others plant cells component (Cakmak ,2005 ; Fageira *et al* ., 2011 ), thus complete fertilizer + mulch treatment had the highest effect not only in increasing broccoli leaf area , but also in improving the action of antioxidant system by increasing the enzymatic activity of SOD in leaves (table 2) and flowers (table 3) and Catalase activity in leaves (tables 4 ) and flowers (tables 5) as well as increase the concentration of Glutathione in leaves (table 6) and flowers (table 7). All that increased the ability of broccoli to tolerate salt stress and reduce troubles and decline processes , which caused by free radicals under salt stress (Scandalios ,1997) . The results refer that the concentration of ( MDA) decreased to the lowest level in leaves (table 8) and flowers (table 9) by this treatment.

**References**

Abbas M. A. ; Younis M. E. and Shukry W. M. (1991) "Plant growth, metabolism and adaptation in relation to stress conditions. III. Effect of salinity on the internal solute concentrations in Phaseolus vulgaris," J. Pl. Physiol., vol. 138, pp. 722–729.

Abd El-All , H.M. and Mohammed, Y.A. , (2014) . Improvement salt tolerance of broccoli and cauliflower by adding magnetic Iron and seamino and the reflection of this on yield and sulforaphane content under sinai conditions. J. App. Sci. Res. 10(1), : 22-31.

Abdel-Aziz, N.A. ; Mahgoub, M.A. and Siam H.S. (2011). Growth, flowering and chemical constituents performance of amaranthus tricolor plants as influenced by seaweed extract application under salt stress conditions. J. App. Sci. Res., 7(11): 1472-1484

Abdel Latef A. A. H. and Chaoxing H.(2011). "Effect of arbuscular mycorrhizal fungi on growth, mineral nutrition, antioxidant enzymes activity and fruit yield of tomato grown under salinity stress," Scientia Horticulturae, 127(3): 228–233.

Aebi H. (1983) Catalase *in vitro* . Methods Enzymol., 105: 121- 126.

Asghari S.; Abbasi F. and Neyshabouri M.R.(2011) "Effects of soil conditioners on physical quality and bromide transport properties in a sandy loam soil," Bio systems Engineering, vol. 109, no. 1, pp. 90–

 

97.
Beecher, C. ( 1994). Cancer preventive properties of varieties of Brassica oleracea. A Review, Amer. J. Clin. Nutr., 59: 1166-1170.
Cakmak I. (2005). The role of potassium in alleviating detrimental effects of abiotic stresses in plants . J. Plants . Nutr. Soil Sci., 168: 521 – 530
De Pascale, S., A. Maggio and G. Barbieri, (2005). Soil Salinization affects growth, yield and mineral composition of cauliflower and broccoli. Euro. J. Agronomy, 23(3): 254-264.
El-Helaly , M A .(2012). Effect Of Nitrogen Fertilization Rates And Potassium Sources On Broccoli Yield, Quality And Storability. Research Journal of Agriculture and Biological Sciences, 8(4): 385-394.
Ellman, G. , (1959). Tissue sulfhydryl groups. *Archives of Biochemist. and Biophysics* 32, 70- 77.
Everaats, A.P.( 1994). Nitrogen fertilization and head rot in broccoli. Netherlands journal of Agricultural Science., 42: 195-201.
Fabek, S., N. Toth I.R. Redovnikovic, M.H. Custic, B. Benko and I. Zutic,( 2012). The effect of nitrogen fertilization on nitrate accumulation, and the content of minerals and glucosinolates in broccoli cultivars. Food Technology Biotechnology, 50(2): 183-1.
Fageira, N.K.; Gheyi, H.R. and Moreira, A. (2011). Nutrient bioavailability in salt affected soils. J. Plant Nutrition ; 34: 945-962.
Hanson B. and May D. (2004). "Effect of subsurface drip irrigation on processing tomato yield, water table depth, soil salinity, and profitability," Agricultural Water Management, vol. 68, no. 1, pp. 1–17.
He Y. ; Yang J.; Zhu B. and Zhu Z.-J. (2014). "Low root zone temperature exacerbates the ion imbalance and photosynthesis inhibition and induces antioxidant responses in tomato plants under salinity," Journal of Integrative Agriculture, vol. 13, pp. 89–99.
Hilal, M., A.M. Zenoff, G. Ponessa, H. Moreno and E.D. Massa, (1998). Saline stress alters the temporal patterns of xylem differentiation and alternative oxidative expression in developing soybean roots. Plant Physiol., 117: 695-701.
Huang Z. ; He C. ; He Z. ; Zou Z., and Zhang Z. (2010) "The effects of arbuscular mycorrhizal fungi on reactive oxy-radical scavenging system of tomato under salt tolerance," *Agri. Sci. in China*, 9( 8) : 1150–1159.
Jamil, M., C.C. Lee, S. Ur Rehaman, D.B. Lee, M. Ashraf and E.S. Rha, (2005). Salinity (NaCl) tolerance of Brassica species at germination and early seedling growth. EJEAF Che., 4(4): 970-976
Jasim A.H. and E .I. Merhij.( 2013). Effect of soil mulch and fertilizers on alleviating of salt stress of chlorophyll, leaf area and hormones content of Broccoli plants (*Brassica oleracea var. Italica*). Euphrates J. Agric. Sci.., 5 (4): 48-58.
Jord´an A.; Zavala L. M. and Gil J. (2010). "Effects of mulching on soil physical properties and runoff under semi-arid conditions in southern Spain. Catena, 81(1): 77–85.
Karlberg L.; Ben-Gal A.; Jansson P.-E. and Shani U. (2006). "Modeling transpiration and growth in salinity-stressed tomato under different climatic conditions," Ecological Modeling, 190( 1-2) : 15–40.
Kaya C , Tuna AL, Yokas I( 2009) The role of plant hormones in plants under salinity stress. Book salinity and water stress 44: 45-50.
Kirthisinghe J. P. (2006). A complete and balanced fertilizer recommendation based on a systemic approach for Cauliflower (*Brassica oleracea L. Var. Botrytis*). PhD thesis PGIA, University of Peradeniya, Peradeniya.
Maas E. V. (1986). "Crop tolerance to saline soil and water," in *Prospects for Biosaline Research*, pp. 205–219, Bot. Dept., University of Karachi, Karachi, Pakistan.
Marklund S. and Marklund G. ( 1974). Involvement of the Superoxide Anion Radical in the Autoxidation of Pyrogallol and a Convenient Assay for Superoxide Dismutase. Eur. J. Biochem. 47, 469-474.
Pang H. C.; Li Y. Y.; Yang J. S. and Liang Y. S.(2010)., "Effect of brackish water irrigation and straw mulching on soil salinity and crop yields under monsoonal climatic conditions," Agricultural Water Management, vol. 97, no. 12, pp. 1971–1977.
Romic, D., Romic, M., Borosic, J. and Poljak, M.( 2003). Mulch decreases nitrate leaching in bell pepper (*Capsicum annuum* L.) cultivation. Agric. Water Manage. 60:87-97.
Savant N. K., S. S. Dhane and S. Talashilkar, (1991). Fertilizer News. International Fertilizer Development Center, Muscle Sholas, Alabama and 1.S.A. 36(3): 19-25.
Scandalios J. G. (1997). Oxidative Stress and the Molecular Biology of Antioxidant Defenses, Cold Spring Harbor Laboratory Press, Plainview, NY, USA .
Shao X. H. ; Hou M.M. and Chen J. N. (2013). "Effects of EM-calcium spray on Ca uptake, blossom-end rot incidence and yield of greenhouse tomatoes (*Lycopersicon esculentum*)," *Research on Crops*, vol. 14, pp. 1159–1166 .
Shao X. H. ; Hou M. M. ; Chen L. H.; Chang T. T. and Wang W.N. (2012) "Evaluation of subsurface

 

drainage design based on projection pursuit," *Energy Procedia B*, vol. 16,pp. 747–752.

Steel, R.G.D. and J.H. Torrie (1981). Principles and producers of statistics: A Biometrical Approach, 2nd ed. McGraw-Hill, New York.

Welfare K.; Flowers T. J.; Taylor G. and Yeo A.R.(1996) "Additive and antagonistic effects of ozone and salinity on the growth, ion contents and gas exchange of five varieties of rice (*Oryza sativa* L.)," *Environmental Pollution*, 92(3) : 257–266.

Yamanaka, T., Inoue, M. and Kaihotsu, I. (2004). Effects of gravel mulch on water vapor transfer above and below the soil surface. Agric. Water Manage. 67:145-155

Yoldas, F., S. Ceylan, B. Yagmur, and N. Mordogan.( 2008). Effect of nitrogen fertilizer on yield quality and nutrient content in broccoli. Journal of Plant Nutrition., 31: 1333-1343.

Zacheo,G.,Cappello, M.S., Gallo, A., Santino, A. & Cappelo, A.R.(2000). Changes associated with post-harvest ageing in Almond seeds. Lebensm-Wiss U. Technol.,33; 415-423.

Zhang J.; Chang T. and Shao X. (2012). "Improvement effect of subsurface drainage on secondary salinization of greenhouse soil and tomato yield," Transactions of the Chinese Society of Agricultural Engineering, vol. 28, no. 3, pp. 81–86.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

## CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

**Prospective authors of journals can find the submission instruction on the following page:** http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

## MORE RESOURCES

Book publication information: http://www.iiste.org/book/

### IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar