EFFECT OF NANOPARTICLES OF SUGARCANE (*Saccharum officinarum* L.) WASTE ON GERMINATION OF PEA (*Pisum sativum* L.) IN SALINE CONDITIONS

Mahmoud Moustafa1,2, Hoida Zaki2, Saad Alamri1,3, Ali Shati1, Mohamed Al-Kahtani1 and Sulaiman Alrumman1

1Department of Biology, College of Science, King Khalid University, 9004, Abha, Kingdom of Saudi Arabia (KSA), 2Department of Botany & Microbiology, Faculty of Science, South Valley University, Qena, Egypt, 3Prince Sultan Bin Abdulaziz Center For Environmental and Tourism Research and Studies – King Khalid University (KSA)

*Corresponding author’s e-mail: mmostfa@kku.edu.sa*

In many countries, salinity is one of the most concerning problems causing severe losses in economic crops. Herein, nanoparticles from sugarcane (*Saccharum officinarum* L.) waste were prepared using ball-milling techniques. The impact of these nanoparticles on pea (*Pisum sativum* L.) seedlings was studied by evaluating their growth and biochemical parameters under different salinity levels. The results indicated that treating the pea seedlings with the nanoparticles markedly increased various plant growth parameters. There was a significant association between the ATPase activity and the gene expression of 49 kDa apyrase in the shoot system. The findings also showed that the application of the nanoparticles of sugarcane waste significantly increased the germination rate to 1.96% more than that of the control and that of stressed seedlings between (12.4% and 50%). The fresh weight of the root and shoot systems increased by (24.3%) and (13.4%), respectively. The dry weight of the root and shoot systems increased by (12.7%) and (10.4%), respectively. The root and shoot lengths increased by (5.39%) and (18.29%), respectively. The protein content in the roots and shoots increased by (8.48%) and (10.9%), respectively. The amino acid content in the roots and shoots increased by (34.89%) and (41.18%), respectively. The carbohydrate content in the roots and shoots increased by (30.81%) and (7.75%), respectively, compared with that in the control. The ATPase and amount of 49 kDa were enhanced in the shoots by (32.88% to 30.12%) than those in the control. Applying the nanoparticles to the stressed pea seedlings using 50 mM to 200 mM NaCl could enhance the fresh weight of the root and shoot systems by (1.03% to 16.7%) and (3.70% to 9.11%), respectively; the dry weight of the root and shoot systems by (8.47% to 27.9%) and (1.15% to 45.03%), respectively; the root and shoot lengths by (12.23% to 24.4%) and (5.39% to 10.0%), respectively; the protein content in the root and shoot systems by (0.64% to 9.41%) and (0.92% to 1.20%), respectively; the amino acid content in the root and shoot systems by (0.13% to 3.17%) and (13.9% to 0.125%), respectively; and the carbohydrate content in the root and shoot systems by (4.42% to 1.60%) and (6.28% to 3.20%), respectively. The ATPase activity and the gene expression of 49 kDa apyrase were enhanced in the shoot systems by (1.92% to 4.03%) and (1.94% to 6.77%) than those in the stressed seedlings. Therefore, these nanoparticles, which were prepared from sugarcane waste, could be applied as a promising natural organic bio-fertilizer to combat the saline effect of agricultural lands, which hinders seedling development.

**Keywords:** Nanoparticles, Waste of sugarcane, *Pisum sativum*, NaCl, *Saccharum officinarum*.

INTRODUCTION

Salinity and water logging are considered as the most dangerous soil problems in many countries. Salt-affected soils mostly exist in semi-arid and in arid environmental condition, covering approximately 955 million hectares (Szaszolcs, 1991). Around 20 million of hectares of lands have been reported to be out of yielding (Malcolm, 1993), and almost 10 percent of the total surface of the lands in the world are covered by different types of salt (Passarakli *et al*., 1991). Salinity has been estimated to decrease crop production on about of 40 x 106 hectares, that about one-third of the world's irrigated cultivated land (Mass and Hoffman, 1977), and El-Asbry *et al.* (1985) reported that salinity on 20 x 106 hectares is significantly decreasing crop yield.

In the Mediterranean regions, water irrigation is the main problem accompanied with soil salinity (El Lateef *et al.*, 2006; Niu *et al*., 2010). Salt stressed lands is not only the most serious factor limiting the productivity of legumes in arid and semi-arid lands as reported by (Lluch *et al*., 2007; Rozema and Flowers 2008), but also altering the metabolism of plants by reducing available water or imbalance of ion and toxicity, and the rate of assimilating of carbon dioxide (Munns and James 2003).
Soil salinity may affect seed germination either by creating external seed osmotic potential preventing water absorption or by the poisonous effects of Na\(^+\) and Cl\(^-\) ions on seed germination (Munns and Tester 2008). The percentage of germination, vigorous of the seed and seedling growth, shoot or root system length of some cultivated crops has been found to be affected greatly under salt stress (Shitole and Dhumal 2012). Germination and growth rate of seedlings are diminished significantly in saline soils with varied responses for various cultivars and species (R’him et al., 2013). The germination process of seeds is the most crucial stages of seedling that determine crop production subjected to salinity (Ungar 1996). Most legumes are salinity-sensitive species whereas NaCl significantly reduces productivity by interfering with plant metabolic activities (Zribi et al., 2009).

In many regions of the world, pea plants (*Pisum sativum*) are considered as an important economic vegetable crop for its rich protein and carbohydrate content to be main food to the human and fodder to animals (Hussein et al., 2006). Approximately 50% reduction in pea crop yields was recorded at 100 mM NaCl (Subbarao and Johansen 1994) and then reduction in productivity in subjecting to high salinity levels (Najafi et al., 2007). However, pea tolerance to long-term salt stress (70 mM NaCl) is linked with antioxidant defense induction (Hernández et al., 2000). In addition, salinity stress under 80 mM NaCl significantly increased potassium deficiency and accumulation of sodium in pea leaves (Pandolfi et al., 2012).

Nanotechnology is emerging advanced science for the current and next decade to develop and transformation of agri-food systems. Nanoparticles have molecular-level interactions in living cells, with the hope that these fine particles will give the crop some beneficial effects (Kotegooda and Munaweera, 2011). Recent study showed NPs could be used in plant growth and in controlling plant disease control (Zheng et al., 2005; Shah and Belozerova, 2009). The effect of nano SiO\(_2\) and nano TiO\(_2\) mixtures on soybean seed were studied by Lu et al., (2002). They found that the mixture of NPs enhanced the germination rate and the growth of nitrate reductase in soybean.

Brazil is the top country cultivated by sugarcane (39.26 % of the world’s sugarcane area) and the top others five countries include India, China, Thailand, and in Pakistan countries estimated for 71.45 %. In Egypt, the average yield per year of sugarcane (66 tons and 105 tons/has), (World Data Atlas, 2017).

After sugarcane manufactures and producing sugar, there are a lot of wastes that may be used in manufacturing processes such as paper, building materials or may use as an organic fertilizer, etc. However, to the best of authors’ knowledge, no reports available described the effects of waste of sugarcane NPs in ameliorating the salinity effect of NaCl on the growth of pea plants (*Pisum sativum* L.). Therefore, this article designated to study the bio-effect of waste of sugarcane NPs on the seedling growth of *Pisum sativum* L. in a sequential saline conditions from NaCl.

**MATERIALS AND METHODS**

**Synthesis of nanoparticles from waste of Sugarcane:** The nanoparticle waste of sugarcane was synthesized in the Electronics & Nano Devices Lab- Faculty of Science - South Valley University, Egypt, by ball milling technique. A 10 g charge of sugarcane waste was loaded into ball milling vials of ball mills. In our experiments, the ball mills used consist of a stainless-steel vial, which is mounted on a vibrating plate. The zirconium of the 3 cm diameter ball repeatedly collides with the plate and powder inside the vial for 36 hours. 10 g from nanoparticles powder from the waste of sugarcane was boiled in one liter distilled water and then filtered by using Whatman No.1 filter papers.

**Plant growth conditions:** Seeds of pea (*Pisum sativum* L.) were surface-sterilized with 0.1% of mercuric chloride for 5 minutes and rinsed thoroughly using distilled water. Then, washed seeds were germinated using 10 seeds per sterilized Petri dish upon two sheets of Whatman papers No. 1 filter paper applying the following sets: 1) Control (distilled water only); 2) Control with nanoparticles solution of sugarcane waste 1:1 (0.5%); 3) Nanoparticles solution only forming (1%); 4) 50 mM NaCl; 5) 50 mM NaCl + nanoparticles solution 1:1; 6) 100 mM NaCl; 7) 100 mM NaCl + nanoparticles solutions 1:1; 8) 200 mM NaCl; 9) 200 mM NaCl + Nanoparticles solutions 1:1. The Petri dishes were stored in an aerobic condition in shade at 25 °C in triplicates for 10 days. The germination parameters were evaluated including: 1) Germination percent (GP) for each set (number of germinated seeds/total number of seeds); Germination rate (GR) (number of germinated seeds/days). 2) Dry weight of shoot and root systems. 3) Shoot and root lengths (Keys et al., 1984). 4) Soluble protein in the powered tissue of root and shoot (Lowery et al., 1951). 5) Free amino acids in shoot and root according to (Moore and Stein 1948). 6) Soluble carbohydrates in shoot and root (Fales 1951; Schlege 1956; Badour 1959).

**SDS-PAGE and Western Blotting:** Pea shoots tissues after 10 days of germinating were harvested and 1.7 mg proteins from each sample either treated or non-treated were analyzed by SDS-PAGE (Bradford 1976; Abe and Davies 1991, 1995 Moustafa et al., 2019). Each sample was mixed with 2 x sample loading buffer of 2% LDS, 0.01%M Tris-HCl (pH 6.8), 1% of B- mercaptoethanol, 20% glycerol, and 0.01% bromophenol blue, heated at 95 °C for 5 minutes, afterward separated by SDS-PAGE. Then, the gels were transferred and blotted onto a PVDF membrane (Immobilon1. Transfer Membranes; Millipore, Billerica, MA, USA) and probed with anti-apyrase antibody from rat and biotinylated antirat Ig species-specific whole antibody from sheep. The binding of both antibodies were detected with streptavidin-alkaline phosphatase with 5-bromo-4-chloro-3-indolyl phosphate and
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RESULTS

Effect of nanoparticles on germination parameters: The results of the germination percentage and germination rate of the plants treated with nanoparticles waste of sugarcane are shown in (Fig. 1). It appears there is a general trend for the increase in the germination percentage of the plants using the nanoparticles waste of sugarcane. Germination percentage (GP) also affected by NaCl doses. The highest GP (90%) was recorded in the seedling treated with nanoparticles solution 1%, while the lowest GP (30%) was registered for 200 mM NaCl treatment. The sugarcane waste significantly affected the germination rate (GR) that increased by 1.96% more than control and more than stressed seedlings subjected to the 50 to 200 mM NaCL by (12.4% to 50%).

Fresh weight: The fresh weight of the plants under salt stress and treatment with nanoparticles of sugarcane waste during seedling germination periods are shown in (Fig. 2). It was shown that there are also general trends of increase in the dry weight of both shoot and root system of the plant using 1% sugarcane waste of nanoparticles materials. The plant root treated with 1% nanoparticles increased by 24.33% than control and by 17.95% than 0.5% of nano waste of sugarcane. The plant shoots increased by 13.43% and 9.79% than control and 0.5% nanowaste respectively. Treatment the plant with 50 mM, 100 mM and 200 mM of NaCl could reduce the fresh weight of root by 5.48%, 15.92% and 17.23% than the control respectively. And shoot reduced by 2.05% when treated with 50 mM of NaCl and by 25.18 % in case of 100 mM NaCl and by 28.51% for 200 mM NaCl treatment. Addition of nano sugarcane waste to the stressed seedling could enhance the fresh weight of root by 16.70% (50 mM NaCl), 2.72% (100 mM NaCl) and by 1.03 % for 200 mM NaCl. The pea shoots were also enhanced by 3.70% (50 mM NaCl), 6.09% (100 mM NaCl) and by 9.11% in case of 200 mM NaCl.

Dry weigh: Pea root and shoot dry weight also affected significantly by applying the nanoparticlesof waste of sugarcane as shown in Fig. 3. Root dry weight increased by 12.69% than control and by 9.24% than 0.5% nanoparticles. Also shoots had increased by 10.43% than control and by 5.97% than 0.5% nanoparticles. Dry weight of root had been decreased by applying NaCL by 8.38% for (50 mM), 17.78% for (100 mM) and by 64.44% for (200 mM). The dry weight of pea shoots also affected by 2.96% (50 mM), 30.28% (100 mM) and by 61.62% in case of 200 mM. An application the nano waste of sugarcane could ameliorate the saline effect of NaCL. The roots dry weight were increased by 8.47% (50 mM NaCl), 5.35% (100 mM NaCl) and by 27.92% (200 mM NaCl).

Figure 1. Effects of waste of sugarcane NPs on germination parameters of Pisum sativum L. using NaCl various concentrations. GP, germination percent, GR germination rate. Bars represent standard deviation (±SD) of the means (n = 3). Stars indicate significant differences among the treatments at P< 0.05.

Figure 2. Effects of waste of sugarcane NPs on a root and shoot fresh weight (mg) of Pisum sativum L. using NaCl various concentrations. Bars represent standard deviation (±SD) of the means (n = 3). Stars indicate significant differences among the treatments at P< 0.05.
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The shoot dry weight increased by 1.15% (50 mM), 10.94% (100 mM) and 45.03% for (200 mM NaCl).

**Figure 3. Effects of waste of sugarcane NPs on a root and shoot dry weight (mg) of Pisum sativum L. using NaCl various concentrations. Bars represent standard deviation (±SD) of the means (n = 3). Stars indicate significant differences among the treatments at P< 0.05.**

**Pea seedlings length:** There are general increases in both shoot and root length by applying nano waste of sugarcane and also significant decrease with NaCl application as shown in Fig. 4. 50 mM of NaCl found to decrease the root length and shoot length by 20.44% and 15.71% respectively, while 100 mM NaCl by 22.71% for roots and by 48.85% for shoots. 200 mM also affected the roots by 53.05% and by 52.76% for the shoots. Nano waste of sugarcane found to enhance the root length by 12.23% for (50 mM NaCl), 9.81% for (100 mM)) and by 24.43% for (200 mM). The shoot length enhanced by 3.196% for (50 mM NaCl), 16.31% for (100 mM) and by 10.00% for (200 mM). Also it enhanced the plant roots length by 5.39% and shoots length by 18.29% than control.

**Figure 4. Effects of waste of sugarcane NPs on a root and shoot lengths (cm) of Pisum sativum L. using NaCl various concentrations. Bars represent standard deviation (±SD) of the means (n = 3). Stars indicate significant differences among the treatments at P< 0.05.**

**Protein content:** The protein content in shoots and roots of pea seedlings were analysed as shown in Fig. 5. There was a significant effect on protein amount on treated sample with 1% nanoparticle of sugarcane waste. 50 mM of NaCl could reduce protein production in roots and shoots system of pea by 1.89% and 2.70%, respectively. And 100 mM NaCl by 23.76% for roots and by 14.57% for shoots. And 200 mM NaCl declined the protein content in the pea roots system by 24.04% and in the shoots by 17.59%. Vice versa nano of sugarcane waste could increase the protein content in the roots by 8.48% and in shoots by 10.94% than the control and by 7.08% and by 5.97% in roots and shoots respectively than 0.5% nanoparticles. The increment was 0.64% for 50 mM of NaCl treated sample and by 3.01% for 100 mM of NaCl and by 9.41% for roots system. And for shoot system increased by 0.92 for 50 mM of NaCl, by 9.09% for 100 mM of NaCl and by 1.20% for 200 mM of NaCl.

**Figure 5. Effects of waste of sugarcane NPs on protein content (mg/g) of Pisum sativum L. using NaCl various concentrations. Bars represent standard deviation (±SD) of the means (n = 3). Stars indicate significant differences among the treatments at P< 0.05.**

**Carbohydrate content:** Carbohydrate content increased at all treatment compared to the control and stressed seedlings by NaCl as shown in Fig. 6. It showed maximum content in case the application of 1% nanoparticle of sugarcane waste as compared to control and other NaCl various concentrations treatment. The carbohydrates increased by 30.81% and 12.04% for the roots system and by 7.75% and 4.00 % to the shoots system than control and 0.5% nano wasate of sugarcane respectively. Addition 50 mM reduced the carbohydrate amount in root and in shoots by 8.47% and 10.19% respectively. 100 mM and 200 mM of NaCl significantly reduced the carbohydrate content by 12.38% to 23.20% in roots and by 25.26% to 40.91% in shoots system respectively. An addition of nanoparticles to the stressed seedlings could ameliorate the salinity effect of 50 mM NaCl to roots and shoots by 4.42% and 6.28% respectively. Adverse effect of 100 mM and 200 mM NaCl to growing seedlings of pea could be altered by 8.19% and 1.60% for roots and by 4.05% and by...
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3.20% for shoots system respectively with application of nanowaste of sugarcane.

**Figure 6.** Effects of waste of sugarcane NPs on sugars content (mg/g) of *Pisum sativum* L. using NaCl various concentrations. Bars represent standard deviation (±SD) of the means (n = 3). Stars indicate significant differences among the treatments at *P* < 0.05.

**Amino acids:** The comparative analyses of amino acids in the root and shoot parts in pea seedlings either treated or not treated with nanoparticles waste of sugarcane are shown in (Fig. 7). It was evident that the treated sample also with 1% nanoparticles waste of sugarcane found to be significantly affected the amount of amino acids by 34.89% and by 12.99% in roots more than control and 0.5% nanoparticles respectively. In the shoot system increased by 41.18% and 23.36% than control and 0.5% nanoparticles respectively.

**Figure 7.** Effects of waste of sugarcane NPs on free amino acids content (mg/g) of *Pisum sativum* L. using NaCl various concentrations. Bars represent standard deviation (±SD) of the means (n = 3). Stars indicate significant differences among the treatments at *P* < 0.05.

There was negative effect of NaCl on the amount of free amino acids that compensated by the addition of nanoparticles waste of sugarcane. It was found that 50 mM NaCl had a negative effect on the production of free amino acids by 3.29% for roots and compensated by 0.13% and in shoots reduced by 15.79% compensated by 13.9% by using nanoparticles waste of sugarcane. 100 and 200 mM NaCl had reduced the amount of amino acid in roots by 3.29% and 22.15.5% that compensated by 3.26% and 3.17% respectively. In shoot also 100 and 200 mM NaCl had diminished the amount of amino acid by 23.60% and 15.91% that compensated by 15.0% and 0.13% respectively.

**ATPase and gene expression of 49 kDa APY:** Response ATPase activity and 49 kDa apyrase of untreated and treated samples of pea seedlings with nanoparticles of sugarcane waste are shown in Fig. 8. Similar to fresh weight, dry weight, length, protein, amino acid and carbohydrates content, the activity of ATP and amount of 49 kDa apyrase were positively affected during treatments. It was evident that application of nanoparticles of sugarcane waste increased the rate of ATPase activity by 32.88% and amount of 49 kDa by 30.12% than control in the shoot system. And by 15.21% for ATPase and 15.52% for 49 kDa apyrase than 0.5% nanoparticles. ATPase activity and amount of 49 kDa apyrase also greatly affected by the addition of various concentrations of NaCl. ATPase activity and amount of 49 kDa apyrase found to be diminished by 4.78% and by 7.08% respectively in case of 50 mM NaCl. In case of 100 mM and 200 mM NaCl, the rate had been decreased between 12.12% to 14.70 for ATPase and by 16.74% to 22.15% for expression of 49 kDa apyrase, respectively. *Vice versa*, an application the nanoparticles of sugarcane waste could diminish the harmful effect of various concentration of NaCl. ATPase activity and amount of 49 kDa apyrase had been raised by 1.92% and 1.94% for 50 mM of NaCl. And also ATPase activity and amount of 49 kDa apyrase had been raised by 0.39% and 0.72% (100 mM NaCl) and by 4.03% and by 6.76% (200 mM NaCl) in the plant shoot system respectively.

**DISCUSSION**

The most salinity problems in plant metabolism is seed germination that is necessary for the plant survival. NaCl stress is considered as the main cause of abnormalities in plant growth due to water deficiency leading to malformations in plant morphology (Jiang *et al*., 2014). Osmotic stress, nutritional disturbances, physiological and biochemical imbalances also considered as a results of NaCl accumulation in the soils (Soliman *et al*., 2015; Ahmad *et al*., 2016). Our results showed that pea seeds germinated in 1% nanoparticles...
solution gained form sugarcane waste positively affect all the growth parameters. The positive affect of nanoparticles waste of sugarcane might be plays a vital role in the followings; accelerate the cell division causing increase in the length of root and shoot systems (Ali and Mahmoud 2013). Also the nanoparticles might have some function in maintaining the biomembrane structural integrity so why numbers of germinated seeds increased positively about 90% than 30% of stresses germinated seeds (Weisany et al., 2012). Also the nanoparticle could have a role in accumulation of phospholipids (Jiang et al., 2014). Amount of protein in treated sample with nanoparticles more than that control or seeds germinated in NaCl, so that it enhanced protein synthesis (Ebrahimian and Bybordi 2011). Also, it may have a role in nutrient translocation from older cells to newborn cells (Rockenfeller and Madeo 2008; Jiang and others 2014). And this in accordance with our finding whereas amount of carbohydrates recorded in the sample treated with nanoparticle higher than other untreated samples. Nanoparticles could decreased take-up the excess of Na\(^+\) and Cl\(^-\), therefore the peas seedling could tolerate up to 200 mM NaCl (Weisany et al., 2012; Ibrahim and Faryal 2014; Jiang et al., 2014). Our findings are consistent with the results obtained by Prasad (2012) reported that treatment of groundnut seeds with nanoscale ZnO particles at a concentration of 1000 ppm has a substantial increase in germination percent, in root and shoot length and the vigour traits of the Peanut plants. The main reason for the influences of ZnO particles on plant germination was not explained but they suggested that due to the higher level of zinc in the seed when treated with nanoscale particles. Our finding revealed that all tested parameters were significantly diminished accompanied with the increment of NaCl concentration. As the NaCl level increased, the germination characteristics were indirectly affected, i.e. the germination rate, fresh weight, dry weight, length, protein content, carbohydrate content, ATPase and amount of 49 kDa apyrase, all were influenced particularly under 200 mM of NaCl. In accordance with the results by (Ouerghi et al., 2016) reported that germination index, germination percentage, seed vigor index and the coefficient of germination velocity decreased as the concentration of NaCl increased. Similar studies also reported by Okçu et al., (2005) on pea cultivars and Bayuela- Jiménez et al., (2002) on bean, they demonstrated that mean germination time increase with the addition of higher concentration of NaCl.

The lengths and weights of both shoot and root systems of pea seedlings were significantly affected by NaCl treatments. Previous researches also showed that morphological parameters greatly affected with increasing NaCl levels in different species like Pisum sativum plants (Cokkizgin and Colkesen 2012) and in Durum wheat (Ayed et al., 2014). The highest growth parameters were observed with the addition of nanoparticles of waste sugarcane either individually or mixed with NaCl. This indicate that nanoparticles have some chemicals especially sucrose that might diminish the NaCl harmful effect. Also, Pisum sativum seedling fresh and dry weights showed significant reduction in their biomass treated with various level with NaCl. And the biomass of fresh and dry weigh of pea seedlings was higher than for treated ones by nanoparticle of waste of sugarcane at different levels of NaCl. The same results had been found by Fortmeier and Schubert (Fortmeier and Schubert 1995) in barley and in safflower seedling (Kaya and Day 2008).

Protein synthesis turnover in growing plants is a basic component of metabolic regulation which provides a way to vary the enzyme complement to environmental conditions (Huffaker and Peterson 1974). Amino acids are phytohormone precursors and growth substances which can play some roles in plants; as a nitrogen source and act as stress-reducing agents, (Zhao 2010; DeLille et al., 2011; Maeda and Dudareva 2012). Protein, free amino acids and carbohydrate content increased at every treatment with nanoparticles waste of sugarcane compared to the others treatment, especially to those stressed by NaCl. Previous results showed that free amino acid levels in Glycine max plants (Queiroz et al., 2012), protein in Plocamopherus imperialis (Ayala-Astorga and Alcaraz-Meléndez 2010) and soluble sugar in Suaeda salsa (Duan et al., 2007) were reduced through salt treatment. ATPase and ADPase activities are considered as measuring tools of plant metabolic activities (Palmgren, 2001). Moustafa et al., (2003; 2019) found that there was an association between amount of 49 kDa apyrase and the rate of various nucleotides hydrolysis including ATP, ADP, UTP, GTP etc. It showed that under osmotic stress and due to salinity there was an improve of hydrolysis of ATP and considerable decrease (about 45%) in shoot PM-ATPase activity (Ayala et al., 1997; Babakov et al., 2000; Kerkeb et al., 2002; Shanko et al., 2003). This again ensure our results that salinity found to had an adverse effect upon ATPase activity and the rate of 49 kDa APY expression in shoot system of pea seedlings. What the functions of nanoparticles of waste of sugarcane might be in pea seedlings during the initial course of germination under salty conditions? In addition to what mentioned above, nanoparticles of waste of sugarcane might play a role in ionic balance and compensate the nutrient deficiency in pea seedlings. Nanoparticles of waste of sugarcane probably having compatible solutes which was regarded as an important osmotic adjustment mechanism in plants (Strange 2004). These nanoparticles may also help controlling the pH in the cytosol or/and amino acid accumulation during salinity stress (Gilbert et al., 1998). Also, it may play a role in removing free radicals generated by stress (Smirnoff and Cumbes 1989). Therefore, it is necessary to evaluate the active chemicals found in the nanoparticles of sugarcane waste and determine the mode of
action of these chemical to determine how these nanoparticles could ameliorate the salinity stress of pea seedlings.

**Conclusion:** Nanoparticles from waste of sugarcane could be applied as a promising bio-fertilizers and to combat the salinity effect of the land against germinating pea seeds and to other crop seeds.

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