# OSMOTIC STRESS RESPONSE INDUCED ON EXPOSURE TOENDOSULFAN AND MALATHION IN *LYCOPERSICON ESCULENTUM* MILL.

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**Abstract:** A study was conducted in the field of Department of Botany, D.N. College, Meerut using two crop varieties of Tomato, viz. Pusa Ruby and Pusa Early Dwarf. The plants were exposed to three different concentrations of pesticides namely Malathion and Endosulfan. Proline was estimated for osmotic stress response. It was observed that there was a high accumulation of proline which was concentration dependent. The increase in the values of proline were found to be more in Pusa Ruby than Pusa Early Dwarf which suggests that Pusa Ruby is comparatively a resistant variety. The enhanced accumulation of proline may be supportive to the tomato plants exposed to high concentration of pesticide. It might have helped the test crops under xenobiotic stress, to maintain membrane stability, water relations, and nitrogen and energy metabolism. It might also have helped to maintain the growth and yield of the pesticide treated plants. Proline acts as osmoprotectant under stress conditions. The free radicals are constantly generated under stress conditions that are quenched by an efficient antioxidant network in the plant body which acts as a supportive system in plant defense.

**Keywords:** Endosulfan, Malathion, Xenobiotic Stress and Osmolytes

## INTRODUCTION

With the ever-increasing population and escalating demand for food, scientists are toiling hard to enhance the production level through the introduction of new high yielding cultivars, effective cultural practices and adopting advanced technologies. Pesticides are one of the most essential inputs in modern agriculture for insuring food security particularly in the developing countries where population growth for exceed the agricultural growth. Among the various strategies adopted to combat pest of Tomato, insecticides from the first line of defense. But the indiscriminate use of pesticides, in modern agriculture has led to various negative impacts on the environment. Some of the pesticides remain persistent (Recalcitrant) and more into the environment (Nasrabdi and Dhumal, 2014).

Among pesticides of synthetic origin, Organochlorine and Organophosphate insecticides play an important role in controlling insect pests in agriculture but the farmers usually go for excess application of these pesticides to protect the susceptible vegetables (Nasrabdi and Dhumal, 2014). Previous studies have demonstrated that dimethoate causes a reduction in plant growth, photosynthetic pigments of *Glycine max* L. (Panduranga*et al.*, 2005) and *Vignaunguiculata* L. (Mishra *et al.*, 2008). The blocked growth might have resulted from the inhibition of normal cell division or elongation. Besides, insecticides triggered oxidative stress by producing reactive oxygen species (ROS), e.g. superoxide radical ($O_2^-$) and $H_2O_2$ (Mishra *et al.*, 2008). Insecticide induced oxidative stress was shown to alter the cellular redox balance by altering ascorbate glutathione (ASC-Glu) cycle or damaging other antioxidant defense systems (Bashir *et al.*, 2007).

Plants have multiple strategies to confer their tolerance to insecticide induced toxicity, and prevention of oxidative and osmotic damage to cells has been suggested as one the mechanisms of stress tolerance (Safar and Sood, 2002; Prasad *et al.*, 2005). In most cases, toxic organic compounds can give rise to the increased activities of antioxidant enzymes such as SOD, POD or ascorbate peroxidase (APX), which reflect not only the degree of toxicity but the ability to tolerate the stress as well (Wu and Von Tiedemann 2002; Pelxoto*et al.*, 2006; Song *et al.*, 2007).

Although a number of studies have demonstrated the effect of insecticides on various plants, but surprisingly, little work has been done to find out the effect of widely used insecticides such as Endosulfan and Malathion on different developmental stages of vegetable crop tomato. To the best of our knowledge, there is not much information available so far about the effect of Malathion and Endosulfan on osmotic and antioxidant system of Tomato plant. In this context, present study will explain and elucidate the effects of Malathion and Endosulfan induced osmotic stress in plant cells of Tomato.

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## MATERIAL AND METHOD

For experimentation, seeds were procured from certified seed center of Meerut. Simple randomized block design was followed for growing the crops. For each variety, the field was divided into six plots each being 1×1 meter$^2$ for different pesticide concentrations (0.05%, 0.15% and 0.25%) of both pesticides. For control, 1 plot for each variety of 1×1 m$^2$ size was selected apart from the treatment plot. The three concentrations of pesticides were prepared with double distilled water using Pearson's Square method (Wagner and Stanton, 2006). Tap water was used as control. The plants were treated with different pesticide solutions of different concentration on 15$^{th}$ day of transplantation of seedlings. The pesticide treatments were given with the help of a sprayer. Samples were collected on 30$^{th}$ day after treatment to analyze the effect of Malathion and Enodosulfan treatment on proline contents of both tested varieties of Tomato.

**Estimation of Proline (Bates *et al.*, 1973)**
100mg of fresh leaves were homogenized in 5ml of 3% sulphosalicylic acid. Filter the homogenate through Whatman no. 2 filter paper, 2 ml of filtrate was mixed with 2ml glacial acetic acid and 2 ml of acid ninhydrin and mixture was allowed to heat on water bath for 1 hour. Reaction was then terminated by cooling it in ice. 4 ml of toluene was added to the reaction mixture and mixed vigorously with a test tube stirrer for 12-20 seconds. Then it was transferred into the separating funnel and mixed well. Two layers were formed and out of these two layers, toluene layer was separated. Then OD was taken at 520 nm. Pure proline was used to make calibration curve. Amount of proline was estimated in mg g$^{-1}$f.wt.

## RESULT AND DISCUSSION

An attempt was made to study the effect of various concentrations of Malathion and Endosulfan on *Lycopersiconesculentum* (Mill.). Final results are represented in the figures 1 and 2. Insecticide exposure can lead to various physiological and biochemical changes within the plant cells causing numerous changes in the cell structure and function. With the onset of chemical stress caused by the pesticide, plant initially tried to mitigate the effect of chemical exposure by optimal resources utilization, nutrient management, alterations in biomass allocation, etc. The complex network of adaptive mechanisms in plants cause changes in the synthesis and accumulation of various osmolytes and antioxidants which provide stress tolerance to the plants. Pesticide treatment affected the accumulation of foliar proline traits in both varieties and caused them to alter to a great extent (Figure 1 and 2). It is clear from the data that in both varieties, a progressive enhancement in foliar proline level were recorded with increased concentration of pesticide. In Pusa Ruby percent increase in Proline content content at 0.25% concentration of endosulfan was 25.21 where as the corresponding value for Pusa Early Dwarf was 19.70. Enhancement in Proline content of Pusa Ruby was more than that of Pusa Early Dwarf with reference of both pesticides.

It has been well known, that small metabolite like proline accumulate to a high level in plants when they are under stress (Kovacik*et al.*, 2009). Over-generation of ROS is a rapid and sensitive response of plants to environmental stresses. Amongst ROS, $O_2^-$and $H_2O_2$ was used to illustrate the degree of oxidative injury to cells (Elhami*et al.*, 2015). The aromatic amino acid proline acts as a free radical scavenger to overcome the oxidative stress by preventing the membrane damage and protein denaturation (Reddy *et al.*, 2004). In this way it would be responsible to maintain the osmotic balance. Enhanced proline content has been reported under insecticide stress (Bashir *et al.*, 2007) in *Glycine. max* L., suggesting that it might prevent chlorophyrifos-induced production of ROS and protect plants from the oxidation damage. These biochemical results can be interpreted as internal tolerance mechanisms and may allow us to develop strategies for reducing the risks of the insecticide contamination in the crop production. The increase in the values of proline were found to be more in Pusa Ruby than Pusa Early Dwarf which suggests that Pusa Ruby is comparatively a resistant variety. The enhanced accumulation of proline may be supportive to the tomato plants exposed to high concentration of pesticide. It might have helped the test crops under xenobiotic stress, to maintain membrane stability, water relations, and nitrogen and energy metabolism.

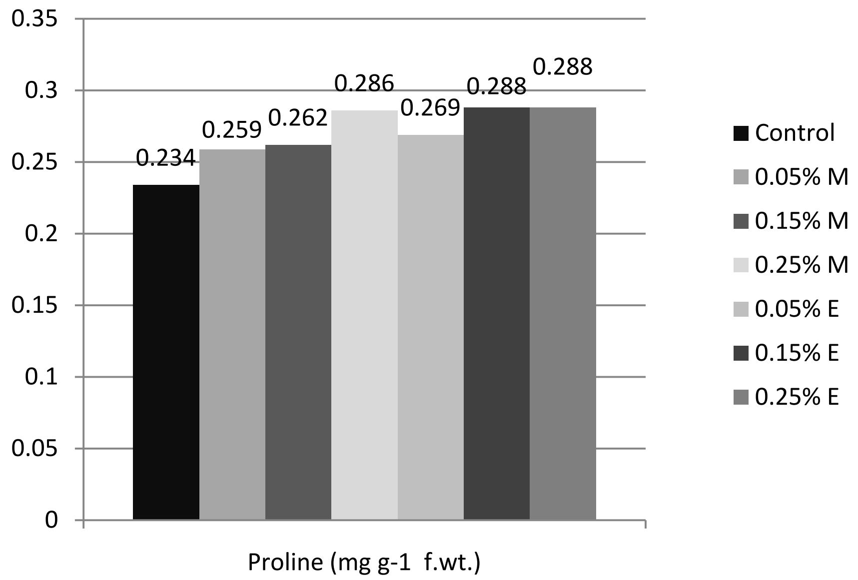


**Fig. 1.** Effect of Malathion and Endosulfan on Proline content of leaves of *Lycopersiconesculentum* var. Pusa Ruby at the age of 30 days

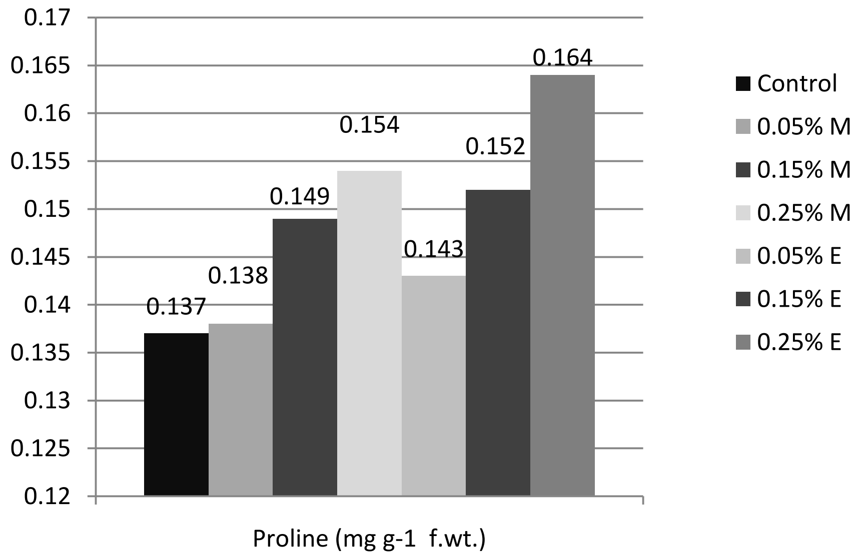


**Fig. 2.** Effect of Malathion and Endosulfan on Proline content of leaves of *Lycopersiconesculentum* var. Pusa Early Dwarf at the age of 30 days

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