

# Mechanistic Evaluation of Allelopathic Potential of *Nyctanthes Arbor – Tristis* on Cell Division and Growth of Onion Root Bulb (*Allium cepa* L.)

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**Abstract:** -- Our previous studies have reported the allelopathic potential of *Nyctanthes arbor – tristis* leaves (Antony S. and P.J. Benny, 2017) and isolated a semi-purified fraction MN F10 with very significant allelopathic activity (Antony S. et al., 2018). Different concentrations of MN F10 were used to determine its allelopathic potential in relation to the cell division and root growth of *Allium cepa* L. The allelochemical present in this fraction induced a considerable reduction in growth and cell division of roots of the treated onions. The mitotic index was also found to be very low. The results revealed the mechanism of action of allelochemical present in *Nyctanthes arbor –tristis*, which necessitates further studies to test its allelopathic effect under field condition and efficacy in the soil.

## 1. INTRODUCTION

Allelopathy is a process in which the secondary metabolites of plants and microorganisms positively or negatively affects the growth and development of neighboring biological systems (Narwal et al., 2005). These plant derived secondary metabolites are termed as allelochemicals and are released into the surrounding environment through leaching, root exudation, volatilization or decaying of plant residues (Whittaker and Fenny, 1971). Allelochemicals obstruct many processes of target organisms such as cell division, photosynthesis, pollen germination, protein & hormone synthesis, nutrient uptake and enzymatic activity (Yarnia et al., 2009). *Nyctanthes arbor-tristis*, a night flowering small tree having wide variety of biological properties. (Rani et al., 2012). Various phytochemicals in this plants exhibit different medicinal and physiological functions. (Thangavelu and Thomas, 2010; Devasagayam and Sainis, 2002; Chatterjee et al., 2007). Our previous studies have already reported the allelopathic potential of leaves of *Nyctanthes arbor-tristis* (Antony S. and P.J. Benny, 2017) and further attempts has led to the isolation of a very potent, semi-purified allelopathic fraction MN F-10 (Antony S. and P.J. Benny, 2018). The present study investigated the allelopathic effect of MN F-10 on cell division and growth of onion root bulbs.

## II. MATERIALS AND METHODS

This study was conducted in the Microbiology and Biochemistry laboratory of St. Thomas College, Pala. The plant was collected from Athirampuzha village in Kottayam District. For elucidating the effect of purified fraction separated from the leaves of *Nyctanthes arbor-tristis* on cell

division, the onion root bulbs were treated with different concentrations of purified fraction (1mg, 2mg, 3mg, and 4mg/ml) and allowed the roots to grow for two days. A control treatment was also maintained to compare the result. Growth rate of these roots were analyzed and recorded. Mitotic index was also calculated to study its effect on the process cell division.

## MITOTIC INDEX

Mitotic index is one of the methods to quantify cell division (Darbelley et al., 1989). Small pieces of MN F10 treated onion root tips were kept in 1:1 mixture of ethanol and conc. HCl. After a few minutes, the root tips were washed in distilled water and stained with acetocarmine. Prepare temporary mount of these specimens with glycerol and observed under high power objective of the microscope (Swarup et al., 1981).

Mitotic Index can be calculated after counting the number of dividing cells out of 100 cells (Arthur C. Giese, 1973). It is the ratio of the number of cells in division to the total number of cells.

$$\text{Mitotic Index} = \frac{\text{No. of dividing cells}}{\text{Total no. of cells observed}} \times 100$$

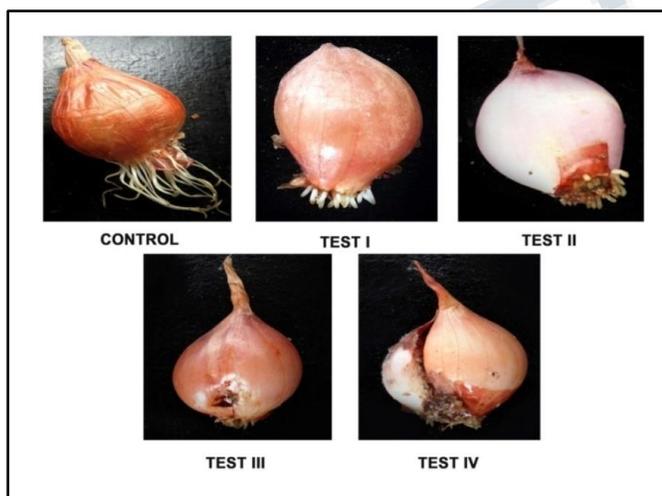
## III. RESULTS AND DISCUSSION

The present study revealed that the mechanism of allelopathic activity displayed by this purified fraction isolated from *Nyctanthes arbor-tristis* is through the inhibition of cell division, as observed by a significant

reduction in the root growth of onion bulbs and the accompanying decaying of its basal portion in treated onions when compared to the control ones [Fig.1]. The mitotic index of the treated root tips was also significantly reduced in a concentration dependent manner [Table 1].

| Parameter studied | Concentration of the test solutions(mg/ml) |     |     |     |    |
|-------------------|--|-----|-----|-----|----|
|                   | 0  | 1   | 2   | 3   | 4  |
| Mitotic index (%) | 65%  | 27% | 21% | 11% | 7% |

**Table 1:** Effect of different concentrations of purified fraction from *Nyctanthes arbor-tristis* on mitotic index of onion root bulbs.



**Figure 1:** MN – F10 induced a dose dependent inhibition in cell division of onion root bulbs. I = 1mg/ml, II = 2mg/ml, III = 3mg/ml, IV = 4mg/ml.

Levizou et al., observed a considerable decrease in the mitosis of the root apex of lettuce after treating with leaf extract of *Dittrichia viscosa*. The growth inhibition of root when compared to shoots, induced by allelochemicals may be because the roots absorb allelochemicals from the environment firstly and the permeability of allelochemicals into root is more than the shoot (Salam et al., 2010; Nishida et al., 2005). The present study has identified that MN F-10 exerted its allelopathic property through cell division

inhibition in plants. Similarly, the allelopathicity of sunflower extracts on germination and growth of wild barley (*Hordeum spontaneum*) was also reported to be due to a reduction in cell division (Gholami et al., 2011).

Other studies proved that the allelochemicals inhibited the growth of target plants by interfering the cell division (Rice, 1984; Einhellig, 1996). Several reports has revealed that the allelopathic substances delay and retard cell division and elongation of meristematic tissues in the growing root tips (Rietjens & Alink, 2003; Dos Santos et al., 2004; Hussain & Ilahi, 2009).

#### IV. CONCLUSION

The present study suggested that the methanol extract of *N. arbor-tristis* exhibits strong phytotoxicity and possesses a semi-purified fraction MN F-10 containing allelochemicals to suppress the cell division and growth of onion root bulbs. A significant reduction in the growth of onion roots along with decaying of its basal portion is observed. However more studies are required for the development of a potential bioherbicide from this fraction, which could be used as an environmental friendly agent against weeds.

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