FIRST REPORT ON INDUCTION OF RESISTANCE TO ROOT KNOT NEMATODE (*MELOIDOGYNE INCOGNITA*) BY DL-BETA AMINO BUTYRIC ACID UNDER ABIOTIC STRESS (FLY ASH)

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Abstract: In our recent study, BABA has been tested to manage *Meloidogyne incognita* under stress conditions due to fly ash. The reduction in the growth of pathogen under abiotic stress is being intensified by DL-β-amino butyric acid (BABA). The combination of abiotic and biotic stress can have a positive effect on the yield of plants by reducing the sensitivity to biotic tension and limiting the crop yield and more priority has been given on the surface of the research table now a days. Therefore this study was carried out observe the effect in combination of Fly ash and BABA in resistance to Root knot nematodes. Results indicate that 30% fly ash in combination with BABA (125 µg/ml) undoubtedly reduced the gall Index by 50% when compared with the control. The interesting thing is that the lower dose of BABA when combined with the abiotic stress was similar to the high dose of BABA efficacy (250 µg / ml).

Keywords: BABA, Fly ash, Nematode, Stress

Abbreviations

BABA- DL-β-amino butyric acid

INTRODUCTION

It is becoming increasingly popular, especially among home gardeners and organic producers, as they produce more interesting and delicious crops at the expense of disease resistance and productivity. An average loss of 19.6 % has been estimated due to plant parasitic nematodes with overall average annual yield loss caused by nematodes goes up to 60% (with Rs.242.1 billion) The global average crop loss of all diseases combined was about 12.8% of potential production, but the tomato only lost 11-35% (Manjunathan et al., 2017). As a strategy to combat these biotic stresses, the particular dependence on fungicides/pesticides has led to many adverse effects such as pesticide contamination, resurgence of secondary pests, resistance to pathogens or pesticides, eradication of beneficial organisms and various risk related to human health. The management of resistance to biological stress in tomato is an important consideration. Among the most common ways to prevent fungicide resistance, reduce the number of applications per season in "at risk" products, using different types of action, using fly Ash and applying them alternately (Rosenzweig et al., 2008;Brent and Holloman, 2007:Ahmad et al., 2017:Shakeel et al., 2019). These effects can have physical and molecular parameters. BABA (N-amino-n-butyric acid), a non-protein amino acid, that can induce plants to sensitize to conditions in which the defence is not expressed, but in which plants can react faster and /or more strongly than other plants, did not experience the earlier stress (Conrath et al., 2006: Cohen et al., 2016). However, its method of action is uncertain because the reaction depends not only on the pathological system, including crosstalk with other defence signalling pathway but also depends on it method of application (Jakab et al., 2001). Previous findings reported that plant cells developed good defense in response to microbial infection and environmental stress after treatment with BABA. (Hamiduzzaman et al., 2005; Jakab et al., 2005;Zimmerli et al., 2000: Pye et al., 2013). The earlier findings have also reported that in recent decades that BABA is used at low and tolerable levels along with salt stress in many other crops against different species of bacteria and fungi (Baysal et al., 2007;Olivieri et al., 2009; Walz and Simon, 2009: Mostek et al., 2016). Although BABA can be one of the important regulators for plant growth along with Fly Ash, no report on this stress combination (role of BABA in combination with fly ash) has been demonstrated on tomato. Depending on the initial pH of the soil, addition of fly ash at a particular conc. can improve the health of status of soil and also neutralize soil acidity to a suitable level for agricultural (Shakeel et al., 2019). Our aim in this study was to induce the resistance of *Meloidogyne incognita* on plants by applying the treatment of BABA and to check its synergistic behaviour under abiotic stress.

Materials And Methods

For conducting this experiment, commercial tomato variety K-21 (procured from authorized Chola Beej Bhandar, Aligarh, India) with four true leaves was used. Seedlings were grown in earthen pots (15cm) containing sandy soil under Net house conditioned at 28°C with 60% humidity during a 16:8 h photoperiod. From time to time the plants were watered. BABA was processed in the form of an aqueous solution with the final concentration of 125, 250 and 500 μg/ml 24hr prior to application, the adjusted BABA solution was applied as soaking through the roots (ca. 50 ml per plant). Control plants were treated with water. For stress plantlets were soaked in 30% solution of fly ash solution (filter separated, 0.45µm). For 10 minute plantlets without treatment were treated with sterile distilled water for the same time as treated plants. Application of BABA (125μg/ml) was also done at 24hr after treatment as indicated above. Susceptible tomato cultivar K-21 was used for the rearing of *M. incognita*. At the four true leaf stage the plant were inoculated with 1000s stage juveniles of *M. incognita*. Plants were organized in randomized block design with 10 replicates. All experiments were done under the condition of net house at 28 °C. The experiments were completed 8 weeks after inoculation and every plant was collected and the root system was carefully washed under running tap water.

In each root system, the egg mass were counted under the stereo telescope microscope and the root galling index rate in each root was determined using the scale of the gall index from 0 to 10 (Barker 1985). The number of egg masses in the roots and the rates of root gall index in each pot were analyzed in order to determine the effects of BABA and its combination with abiotic stress by using analysis of variance. The significance of the differences between experiments was tested by the Tukey test at the level of importance of $P < 0.05$ with the statistical program SPSS (SPSS, 16.0).

Results And Discussions

All the treatments showed a significant difference in the number of eggs masses and roots galling index according to the index of irritation (Table 1). The results showed a harmonious effect of low dose combined with abiotic stress (Fly Ash) on *M. incognita*. Our findings suggested that combination of Fly ash stress (30%) with four-fold less BABA (125 µg/ml) had hindrance effect as achieved with application of 500 µg/ml BABA alone. It can greatly reduce the galling index rate in tomato roots (Fig.1).

Table 1

Effects of treatments on *Meloidogyne incognita*

Applications	Number of egg masses	Galling index
BABA (500µg/ml)	93.3±10.3^{ab}	4.5±0.2^{ab}
BABA (250µg/ml)	46.5±6.5^{a}	3.2±0.2^{a}
30% Fly Ash	70.1±6.5^{ab}	3.6±0.2^{a}
BABA (125µg/ml) + 30% Fly Ash	52.5±11.2^{a}	3.3±0.2^{a}
Control	240±80^{b}	6.1±0.2^{b}

Means in columns followed by the same letter are not significantly different ($P \leq 0.05$) according to Tukey test

Fig.1. Effect of BABA (125µg/ml + 30% Fly Ash) in comparison with Healthy and Nematode infected (positive) tomato roots.

The utilization of Fly ash (30%) alone resulted in a more meaningful effect than BABA (500 µg/ml) alone against *M. incognita* (Table 1) (Ahmad et al., 2017: Shakeel et al., 2019). In previous findings, the inducer effect of BABA has been shown for fungal and bacterial pathogens on tomatoes (Lee et al., 2000; Cohen 2002; Baysal et al., 2007: Bai et al., 2018). BABA has also been used as a plant inducer against root-knot nematodes in tomatoes (Oka et al. 1999). Sahebani et al., (2011) investigated the effects of BABA on cucumbers infected with *M. javanica* and the accumulation of total phenolic compounds, hydrogen peroxide and the activity of some enzymes related to plant defense mechanisms. He showed that the treatment of cucumber transplantation seedlings with BABA can reduced nematode galls, the number of eggs per plant and the number of eggs per individual egg masses in comparison to control. As mentioned in previous reports, defense activating molecules BABA induced a significant increase in callose deposition in rice roots by *M. graminicola* (Ji et al., 2015), also by Absicis acid (Mauchi-Mani et al., 2015). In our research study, we proved the effect of BABA against *M. incognita* on tomatoes, Therefore our new findings were in accordance with previous studies (Sahebani et al., 2011; Oka et al., 1999; Ji et al., 2015) in this first report findings.

In conclusion, our findings indicate that the induction of the plant's resistance was done through the combine application of BABA and fly ash together. With low dose of fly ash and BABA treatment alone, its combination with coactive effect on tomato plants against *M. incognita.* Tomato plants showed synergistic effects against the *M.incognita.* Fly ash has a rapid synergistic effect on the effectiveness of BABA. Fly ash stress has an increasingly synergistic effect on BABA’s efficacy.

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