SHORT COMMUNICATION

Enhancement of growth, defense response in brinjal and inhibitory potential of salicylic acid against *Fusarium oxysporum* f. sp. *melongenae*

BANU NAZIYA* and M.S. SHARADA

Department of Studies in Botany, University of Mysore, Manasagangotri, Mysore 570 006, Karnataka, India

Received: 10 May 2017/ Accepted: 18 July 2017/ Published online: 24 July 2017

© Indian Phytopathological Society 2017

ABSTRACT: The study was carried out to evaluate the effects of salicylic acid in enhancement of growth, defense response and inhibition of colony growth of *Fusarium oxysporum* f. sp. *melongenae* under *in vitro* condition. The collected seed samples were primed with different concentrations of salicylic acid for 3 h to assess its effect on brinjal seed germination and seedling vigor using paper towel method. Inhibitory effect of salicylic acid was also tested against *F. oxysporum* f. sp. *melongenae* using poisoned food technique. Hypersensitive response in salicylic acid treated seedlings was also studied. Among salicylic acid treatments, 20 mM for 3 h duration recorded maximum seed germination of 95% and seedling vigour of 874.6 over non-treated control. In addition, the treatment also stood best in inhibiting mycelial growth of the pathogen under *in vitro* condition and showed enhanced hypersensitive response in treated seedlings. Thus, the study suggested that salicylic acid at 20 mM concentration proved to be good in enhancement of seedling growth with significant inhibition of pathogen growth and also enhanced hypersensitive response in brinjal seedlings.

Keywords: *Fusarium* wilt disease, hypersensitive response, pathogen inhibition, seed germination and seedling vigour, *Solanum melongena*

Brinjal (*Solanum melongena* L.) is the most common vegetable crop grown in India. The crop is mainly cultivated for its fruit (purplish in color) which is used as a staple vegetable all over the world. The crop has also got nutritional and medicinal importance which makes it even more important in terms of cultivation, consumption and commercial purposes. The crop suffers from so many fungal diseases and wilt disease caused by *Fusarium oxysporum* f. sp. *melongenae* is common in occurrence which has resulted in severe loss in the productivity of brinjal (Altinok and Dikilitas, 2014). The disease control is cumbersome due to development of fungal resistance. Though chemical fungicides were being applied to manage the disease but these fungicides have adverse effects on soil microflora and environment. Management of plant diseases through induction of resistance is rising. Plants have their own defensive system but sometimes when pathogen is virulent, plants known to get affected by diseases. In such circumstances inducing resistance by artificial means using inducers will be more beneficial and effective in enhancing the defensive capacity of the plant and also promoting plant growth respectively. Plant when comes in contact with pathogen known to produce hypersensitive cell death in the form of brown necrotic spots. This response can be increased with the inducer treatments. Inducer like salicylic acid is appearing to be auspicious in management of fungal diseases due to its

ecofriendly nature (Ali *et al.*, 2009). The reports on bioagents, organic amendments, chemical, microbial and soil amendments have been used to control/ manage the diseases in brinjal (Haseeb and Kumar, 2007; Lal *et al.*, 2017). The work on salicylic acid mediated resistance and enhancement of growth against *Fusarium* wilt of brinjal has not yet been carried out so far. Therefore, the present study was undertaken to evaluate the effect of different concentrations of salicylic acid in enhancement of seedling growth, defense response and inhibition of mycelial growth of *F. oxysporum* f. sp. *melongenae* under *in vitro* conditions.

Susceptible seed samples of *Solanum melongena* cv. Dhenu were collected from different agricultural farms, local seed agencies and APMC of Mysore district. *F. oxysporum* f. sp. *melongenae* (FOM) causative agent of wilt disease was isolated from the infected brinjal plant.

Salicylic acid (SA) was prepared in different concentrations of 10 mM, 20 mM, 40 mM and 80 mM by dissolving 0.138 g, 0.276 g, 0.552 g and 1.049 g of SA with distilled water and the final volume of each solution was made up to 100 mL.

Seed germination test was carried out by paper towel method. The different concentrations of SA treated and untreated brinjal seeds cv. Dhenu soaked for 3 h (four replicates of 100 seeds each) previously sterilized with

*Corresponding author: naziyauom@gmail.com

0.1% sodium hypochlorite for 2 min, rinsed with sterile distilled water (SDW) were placed equidistantly on the moist germination sheets on which extra pre-soaked paper towel was placed, rolled and incubated at $25 \pm 2^\circ\text{C}$ for fourteen days. At fourteen days, seed germination and seedling vigour was calculated (Abdul Baki and Anderson, 1973).

$$\text{Percent germination (PG)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds plated}}$$

$$\text{Vigour Index} = (\text{Mean root length} + \text{Mean Shoot length}) \times \text{Percent germination}$$

About 2 mm FOM mycelia was aseptically inoculated to the center of the PDA plates previously amended with 2 ml of 10 mM, 20 mM, 40 mM and 80 mM concentrations of SA and the plate containing simple PDA media served as control. All the plates were incubated at $25 \pm 2^\circ\text{C}$ for seven days and then the fungal colony diameter in all concentrations of SA was measured. The experiment was repeated thrice. Percent growth inhibition (PGI) was calculated by the formula of Mishra *et al.* (2005).

HR was carried out in sampled seedlings of brinjal by modifying the method of Kumudini *et al.* (2001). The SA treated seedlings inoculated with pathogen and non-treated inoculated seedlings of brinjal were observed at 24 hours after inoculation (h.a.i.) for the external appearance of necrotic streaks on the treated seedlings. Each treatment consisted of four replicates of 25 seedlings and was repeated thrice.

Seeds treated with different concentrations of SA (10 mM, 20 mM, 40 mM and 80 mM) for 3 h duration showed enhanced seed germination and seedling vigour in comparison to non-treated control. Among the different

concentrations of SA tested, 20 mM concentration for 3 h duration recorded the highest seed germination and seedling vigor followed by 40 mM SA. The minimum seed germination and seedling vigor was recorded at 10 mM SA. The untreated control seedlings showed seed germination of 69.5% and seedling vigour of 416.5 (Table 1). Similar observations of SA seed treatment at two different concentrations (5 mM and 1 mM) enhanced seed germination and seedling vigor in wheat plants (Dolatabadian *et al.*, 2009).

The efficiency of SA in inhibiting the colony growth of the FOM under *in vitro* conditions was also tested in the present study and the results indicated that SA reduces the growth of the FOM at very significant level. Among the salicylic acid treatments, the maximum growth inhibition was noticed at 20 mM concentration followed by 40 mM and 80 mM SA. The minimum growth inhibition was noticed at 10 mM SA (Table 1, Fig. 1). The parallel study on inhibitory effect of SA reported to exhibit good antifungal activity against *Colletotrichum orbiculare* and *Phytophthora capsici* (Park *et al.*, 2007). The present study also reported to increase the hypersensitive response in SA treated inoculated brinjal seedlings when compared to non-treated control inoculated seedlings at 24 h.a.i. The maximum appearance of HR (72.3%) was noticed in 20 mM SA treated inoculated seedlings followed by 63% HR response in 40 mM SA treated inoculated seedlings and the susceptible inoculated control seedlings recorded poor HR of 13% at the same time interval (Fig. 2). Similarly, pretreatments with Acibenzolar-S-methyl induced hypersensitive reaction in brinjal plants (Altinok and Dikilitas, 2014).

The significance of the study includes, salicylic acid which is one of the important biochemical elicitor gaining attention due to its unique properties in enhancement of

Table 1. Effect of salicylic acid treatments on brinjal seed germination and seedling vigour at 3 h duration and its inhibition potential against FOM under *in vitro* conditions

Elicitor/inducer	Concentration/control	% seed germination	Seedling vigour index	Colony diameter (mm)	Percent growth inhibition (PGI)
Salicylic acid	Control (SDW)	69.5	416.5	9.00	-
	10 mM	51.3	244.0	6.33	29.6%
	20 mM	95.0	874.6	2.05	77.2%
	40 mM	85.0	633.0	3.49	61.2%
	80 mM	78.3	514.5	4.73	47.4%

Each value is a mean of four replicates (% germination and vigour) and three replicates (PGI). The values are separated by Tukey HSD (One way Anova ver. 11.5)

Fig. 1. Effect of salicylic acid treatments on mycelial growth inhibition of FOM (A-Control, B-10 mM SA, C- 20 mM SA, D- 40 mM SA, E- 80 mM SA)

Fig. 2. Hypersensitive reaction (HR) in salicylic acid treated brinjal seedlings inoculated with FOM at 24 h.a.i. Each value is the mean of three replicates and bars sharing different letters are significantly different ($p \leq 0.05$) according to Tukey's HSD (honest significant difference). The vertical bars indicates the standard errors

defense mechanism in plants against disease causing micro-organisms. In the present study, low concentration of salicylic acid particularly 20 mM was found to be efficient over non-treated control. SA can be used as potential inducer in plant growth promotion and defense response in brinjal.

ACKNOWLEDGEMENTS

The authors are thankful to Department of Studies in Botany, DST-FIST and University of Mysore, Manasagangotri, Mysore for giving all the necessary facilities to carry out the research.

REFERENCES

- Abdul-Baki and Anderson JD (1973). Vigour determination in soybean seed by multiple criteria. *Crop Sci.* 13: 630-633.
- Ali AA, Ghoneem KM, El-Metwally MA and Abd EHKM (2009). Induce systemic resistance in lupine against root rot diseases. *Pak. J. Biol. Sci.* 12: 213-221.
- Altinok H and Dikilitas M (2014). Antioxydant response to biotic and abiotic inducers for the resistance against *Fusarium* wilt disease in eggplant (*Solanum melongena* L.). *Acta Bot. Croat.* 73: 79-92.
- Dolatabadian A, Modarres Sanavy SAM and Sharifi M (2009). Effect of salicylic acid and salt on wheat seed germination. *Acta Agric. Scand., Sect. B.* 59: 456-464.
- Haseeb A and Kumar V (2007). Efficacy of bioagents and organic amendment materials against *Fusarium oxysporum* causing brinjal wilt. *Indian Phytopath.* 60: 108-111.
- Kumudini BS, Vasanthi NS and Shetty HS (2001). Hypersensitive response, cell death and histochemical localization of hydrogen peroxide in host and non host seedlings infected with the downy mildew pathogen *Sclerospora graminicola*. *Ann. Appl. Biol.* 139: 217-225.
- Lal HC, Radha M, Praveen K, Savita E, Binay K and Niraj K (2017). Management of wilt complex in brinjal using chemical, biocontrol agent and soil amendment alone and in combinations. *Indian Phytopath.* 70: 220-223.
- Mishra BD, Sahoo KC, Ghose S and Rout MK (2005). *In vitro* evaluation of plant extracts, oilcakes and agrochemicals against web blight of green gram caused by *Rhizoctonia solani*. *J. Mycopathol. Res.* 43: 255-257.
- Park CN, Lee D, Kim W, Hong Y, Ahn JS and Kim BS (2007). Antifungal activity of salicetin-A against *Colletotrichum orbiculare* and *Phytophthora capsici*. *J. Basic Microbiol.* 47: 332-339.