MERIT RESEARCH JOURNALS
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Merit Research Journal of Microbiology and Biological Sciences (ISSN: 2408-7076) Vol. 9(3) pp. 032-035, June, 2021
Available online http://www.meritresearchjournals.org/mbs/index.htm

DOI: 10.5281/zenodo.5067976

Original Research Article

Plant-Biomedicines Prevent Disease of Tomato and Coronavirus-Like-Pandemic-Diseases: Enriched Agriculture Socio-Economy Science-Technology-Communication-Issues

Dr. Subhas Chandra Datta

Headmaster, Secretary and Researcher, Kanchannagar D.N.Das High School (HS), Kanchannagar, Burdwan Municipality, Purba Bardhaman, Bardhaman-713102, West Bengal, India.

PhD in VisvaBharati, C/O-RajendraNath Nag, House No.-430A, Bajeprotappur (Katwa Road), Burdwan Municipality, Purba Bardhaman, Bardhaman-713101, West Bengal, India

E-mail: dattasubhas@rediffmail.com
Tel.: +91 9832192464
+91 7602303924

Abstract

To avoid traditional control of root-knot disease, there remains a need for developing effective biomedicines of animal origins. The animal biomedicines; Nematode Extract (NE) and Gall Protein (GP) when applied by foliar spray, are highly effective at 1.3mg/plant and 2.01mg/plant, respectively in ameliorating root-knot disease of tomato (*Lycopersicon lycopersicum*, Cv. Pusa Ruby) caused by *Meloidogyne incognita* (Kofoid and White) Chitwood, promoting plant growth and fruit production. The nematode extract (NE) is more effective than the gall protein (GP) in this respect. Both the extract is thought to induce systemic acquired resistance response of the treated plants through the expression of pathogenesis-related proteins, and may prevent 21st –century pandemics COVID-19 like virus diseases by boosting immunity, resisting toxic effects on the environment, and improved agriculture green-socio-economy aquatic-science-technology-communication application issues, and it may also give a good scope for new development and research in the field 'Agricultural and Aquatic Sciences also' in future.

Keywords: Plant-Biomedicines, Disease-Tomato-Coronavirus-Like-Pandemic-Diseases, Enriched Agriculture Socio-Economy Science-Technology-Communication-Issues

INTRODUCTION

Root-knot nematodes infest almost all kinds of crops, mostly vegetables, and in India the amount of damage they inflict on plants, accounts for 10-40% of the total crop losses annually (Sen, 1983). Thus the disease caused by the plant-parasitic nematodes is a serious problem in our country and this indirectly affects our agricultural economy. A number of chemical pesticides have been extensively used by the farmers; nearly 80,000 tons of chemical pesticides are applied on the Indian soil annually (Paul et al., 1995). The safe alternative method to the conventional method of nematode control is to induce the natural defense response of the plants against nematode attack (Datta et al., 1998a; Datta et al., 1998b; Datta, 1999; Mukherjee et al., 2020). In the present study, systemic signaling and induced natural defense in the host plants by applying animal-biomedicines; nematode extract (NE), and gall protein (GP).

MATERIALS AND METHODS

Preparation of Biomedicines

The animal biomedicines; nematode extract (NE) and total gall protein (GP), Meloidogyne incognita females,

Table 1. Effect of the GP and NE on tomato plants[x] growth, development and protein

Treatments[y]	Fresh Biomass (g)[x]			Number of Fruits[x]	Number of Root-Galls[x]	Nematode Population[x]		Protein[x] Content (%)	
	Shoot	Root	Fruits			Root (2g)	Soil (200g)	Root	Fruits
Uninoculated Untreated	206.48b[z]±12.02	30.02d ±1.92	132.16a±10.02	12.32a ±4.04	00			3.94b ±0.22	0.25a ±0.05
Inoculated Untreated	98.03d ±12.01	76.86a ±6.42	43.97c ±4.63	05.97c ±4.03	3500.65a ±196.15	4389a ±265	769a ±49	6.03a ±0.01	0.14c ±0.02
GP-Treated Inoculated	193.31c±6.29	43.28b ±8.02	81.45b ±6.25	08.86b ±4.02	875.11b ±83.71	329b ±32	187b ±29	3.42b ±0.24	0.19b ±0.03
NE-Treated Inoculated	208.02a±4.68	36.02c ±2.04	133.56a ±9.28	13.98a ±3.04	58.65c ±67.35	178c ±22	119c ±29	2.97c ±0.19	0.21b ±0.03

'x'-Mean of 10 replicates with S.E.
'y'-Tomato plants inoculated at 8-leaf stage with M. incognita juveniles (2580±55 J_2/pot) and harvested 53 days after sowing of germinated seeds.
'z'-Means carrying the same letters in a column are not significantly different (P≤0.05) by analysis of variance.

and gall roots were collected from roots of the tomato plant grown in the experimental garden of the Department of Zoology, VisvaBharati University, Santiniketan – 731235. They were washed with sterile water, homogenizer and extracted with 90% ethanol at room temperature (25±2°C) for five days and centrifuged at @3500 rpm for 5 minutes. Both the extract supernatant was collected and allowed to evaporate at room temperature (25±2°C) and both the biomedicines residues were kept over anhydrous $CaCl_2$ for dehydration and stored at 4°C. The biomedicines residue was mixed with sterile distilled water just before application on the test plants (Datta et al., 1998a; Datta et al., 1998b; Datta, 1999; Mukherjee et al., 2020; Datta, 2020a).

Pot Test and Inoculation

The aseptically germinated seeds of tomato, *Lycopersicon lycopersicum*, Cv. Pusa Ruby was shown one seed/pot (32 cm diameter) containing a mixture of clay soil and composted manure (2:1v/v and 4.5kg), and the soil-filled were earlier treated with boiling water five times. The pots were divided into four groups of 10 pots each. The groups were: uninoculated untreated, inoculated untreated, GP treated inoculated, and NE treated inoculated. When the plants were at the 8-leaf stage they were inoculated with M. incognita juveniles (J2) @ 2580±55 J2/plant (Datta et al., 1998a; Datta et al., 1998b; Datta, 1999; Mukherjee et al., 2020).

Treatments

All the treatments were applied by foliar spray @ 10ml / plant in five steps spanned with an interval of 1 hr., and the treatments were given three days before inoculation. In the NE treated group 1.3 mg/plant nematode extract and in the gall protein treated group were received 2.01 mg/plant respectively. Control plants were sprayed with an equal amount of sterile distilled water. The plants were irrigated regularly and the experiment was conducted outdoors in the experimental garden of Department of Zoology, Visva-Bharati University, Santiniketan – 731235, West Bengal, India, at an ambient atmospheric temperature (28±5°C) and humidity (80±5%).

RESULT

Harvesting

All the plants were uprooted 53 days after the sowing of seeds. The following measures were taken: biomass of shoot, root, and fruits, root gall number, nematode population in roots (2g) and soil (200g), protein content of root and fruits. Proteins were estimated by the Folin-phenol method [8]. All the data were analyzed by analysis of variance (ANOVA). The experiment was repeated five times with similar results and the data from the third experiment were represented in Table 1.

Pretreatment with NE and GP

The pretreated nematode extract (NE) and gall protein (GP) extract significantly (P≤0.05 by ANOVA) increased plant growth in terms of shoot weight, fruit weight as compared to the inoculated and untreated plants (Table 1). Root galls, nematode population in the root and soil, and root protein content were significantly (P≤0.05 by ANOVA) reduced in pretreated plants as compared to the untreated ones (Table 1). Protein content in green fruit was significantly reduced in inoculated plants as

compared to the uninoculated ones, and both the pretreatments with biomedicines (NE and GP) restored the condition to some extent (Table 1). NE-biomedicine treatment showed better plant growth and lesser intensity 0f root-knot disease as compared to the GP-biomedicine pretreatment (Table 1).

DISCUSSION

The present study very clearly shows that the NE and GP could induce some resistance in tomato to *M. incognita* infection, and NE treatment was more effective than GP treatment. Results of the pot test further indicate that both the treatments (NE and GP) could promote the growth of the plants and the resistance induced by NE and GP were systematic. It is reported that nematode extract had no toxic direct effects on nematodes (Datta et al., 1998a; Datta et al., 1998b; Datta, 1999; Mukherjee et al., 2020). It can be assumed that NE and GP could induce the synthesis of some antagonistic substances. Lectin accumulated in galled regions of root of *Hibiscus esculentus* infected with M. incognita [9]. Systemic acquired resistance can be induced in different crop plants by localized virus infection, non-pathogenic and pathogenic microorganisms or their culture filtrates, or by salicylic acid and this form of resistance protects plants from a broad spectrum of pathogens and work systematically in many cases (Datta et al., 1998a; Datta et al., 1998b; Datta, 1999; Mukherjee et al., 2020; (Kiessig and Malamy, 1994; Kiessig et al., 2000; Descalzo et al., 1990; Kuc and Strobel, 1992; Mauch-Mani and Metraux, 1998; Merra et al., 1994; Nandi et al., 2002; Nandi et al., 2003; Ross, 1961; Schneider et al., 1996; Sukul, 1970). M. incognita is known to share common antigens with its host plants (McClure et al., 1973). It appears that during natural infection with the nematode, host plants show minimal defense responses to the nematode because of this antigenic similarity. NE and GP containing various antigens may induce defense responses involving a number of pathogenesis-related proteins (PR-proteins) which the nematode fails to tolerate (Datta, 2020b; Datta, 2020c). It is primarily observed that in lady's finger disease treated with NE, showed the highest number of root protein (13 and 24) but in inoculated untreated root was 18 numbers and in uninoculated root was 11 numbers. Those showed that NE served as the stimulus for the expression of many proteins particularly the defense-related proteins which later provide resistance to nematode infection (Datta, 1999; Datta, 2020b; Datta, 2020c).

Thus, nematode extract and gall protein will serve as very effective biomedicines which would be cheap, non-phytotoxic, non-pollutant, and conserve our biodiversity, and scholars which give a good scope for new development and future research in the field 'Agri-cultural and Aquatic Sciences' also (Datta, 2020d; Datta, 2020e; Datta, 2020f; Datta, 2020g; Datta, 2020b; Datta, 2021a).

Future Research

The nematode extract and gall protein could induce the production of new defense-related genes in the test plant may be confirmed by further biochemical analysis (Datta et al., 1998a; Datta et al., 1998b; Datta, 1999; Mukherjee et al., 2020), and in near future, synthetic production of both the biomedicines; NE and GP will be the potential cost-effective personalized-biomedicine OR social vaccine OR vaccine against coronavirus-2 like pandemic diseases by boosting immunity, and helping policy initiative clinical research in all areas in the field of agricultural and aquatic Sciences also.

CONCLUSION

The animal biomedicines; nematode extract (NE) and gall protein (GP), boosted the growth of tomato plants by inducing defense-resistance PR-proteins and may prevent 21st –century pandemics like virus diseases by increasing immunity, resisting toxic effects, and improved potential animal-biomedicines, advanced in agriculture, aquaculture, clinical toxicology, green-socio-economy, aquatic-science technology, and communication application issues, and it may also give a good scope for new development and research in the field 'Agricultural and Aquatic Sciences' in future.

ACKNOWLEDGEMENTS

The work described here is part of the UGC and CSB project, Government of India to NCS. I thank Ex- Prof. Dr. N.C. Sukul, Parasitology Laboratory, Department of Zoology, Visva-Bharati, Santiniketan-731235, and West Bengal, India for all kinds of support. I am also thankful to Prof. Dr. N. Banerjee and Dr. K. Ghosh, Plant Biotechnology Laboratory, Department of Botany, Visva-Bharati University, Santiniketan for needful help.

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