Research & Reviews in Biotechnology & Biosciences

Homepage: www.biotechjournal.in

Volume No: 4, Issue No: 1, Year: 2017 PP: 27-30

Published By: National Press Associates in Association with Lyallpur Khalsa College, Jalandhar, Punjab

ISSN No: 2321-8681

Research paper

Interactions Between Fluorescent *Pseudomonads* And Chilli (*Capsicum Annuum* L.) Plants

S. Sundaramoorthy and P. Balabaskar

Department of Plant Pathology, Faculty of Agriculture, Annamalai University, Tamil Nadu, India

Article History

Received: 27/03/2017
Revised: 10/04/2017
Accepted: 28/04/2017

Corresponding Author:
E-Mail: sundardivi@gmail.com

Abstract

Chilli (*Capsicum annuum* L.) is an indispensible vegetable cum spice crop and suffers from several pests and diseases. In recent years, Plant Growth Promoting Rhizobacteria (PGPR) has gained worldwide importance and acceptance for agricultural benefits. These microorganisms have the potential tools for disease control and growth promotion in various crops and patho-systems which involve multidisciplinary approaches to understand adaptation of PGPR to the rhizosphere, mechanisms of root colonization, effects on plant physiology and growth, bio-fertilization, induced systemic resistance, bio-control of plant pathogens etc. Considering the seriousness of diseases in chilli, investigations were carried out to utilize indigenous PGPR strains of Fluorescent *Pseudomonads* for eco-friendly management of diseases of chilli. These strains of Fluorescent *Pseudomonads* were evaluated for bio-control activity and induction of systemic resistance in chilli. Strains with high defence related enzymes (peroxidase, polyphenly oxidase, phenyl alanine lyase) and β-1,3-glucanase as well as production of antibiotics (phenazine), antimicrobial compounds (hydrogen cyanide) and salicylic acid were used in this study. Shelf-life and compatibility of Fluorescent Pseudomonads with other insecticides, fungicides and bio-agents were undertaken before its use as a component in Integrated Pest Management (IPM) trial. The IPM trial was conducted on farmers'field of 25 acres. The IPM strategies were followed by regular monitoring of pests and diseases throughout the chilli growing season. The results showed that the incidence of powdery mildew, leaf spot, wilt, die-back/anthracnose, as well as sucking pest and fruit borer was significantly reduced in IPM plot treated with PGPR compared to control. The number of pesticide sprays was significantly lower (30%) in IPM plots as compared to non IPM plot in adjacent region. Overall, the average yield in IPM plot was 28.52 q/ha compared to 23.84 q/ha in non IPM plot. In terms of monetary value, Rs. 2,03,243 per ha was recorded in IPM plot as against Rs. 1,48,581in non IPM plot, which is a net gain of Rs. 54,662 per ha.

Introduction

India is the largest producer of chilli in the world contributing 28% to the world production. Many factors influence successful production and quality of chilli in which diseases and pests play a very important role. Chilli crop suffers from diseases such as damping-off, leaf spot, powdery mildew, anthracnose, die back, *Fusarium* wilt during growing season and aflatoxin contamination as a post harvest problem. Among the insect pests, sucking pest, defoliator and fruit borer play a crucial role. Farmers were solely dependent on pesticides and often the numbers of sprays exceed 25 to 30 under irrigated conditions which consequently increase the cost of production apart from extreme damage to eco-system. PGPR such as Fluorescent *Pseudomonads* play a crucial choice for its versatility and ability to control large number of plant pathogens in diverse target environments. Hence, we have focused on biological and molecular characterization of indigenous Fluorescent *Pseudomonads,* development of efficient formulation, shelf-life, compatibility to various pesticides and their efficacy at the field level using IPM strategies. In this paper we have presented a series of judicious and supervisory interventions using eco-friendly bioagents such as Fluorescent Pseudomonas and botanicals as well as other pesticides against diseases and pests of chilli.

Material and Methods

Indigenous fluorescent *Pseudomonas* isolates were collected and characterized and then subjected to dual culture technique to determine the wide spectrum of plant pathogens. The selected indigenous PGPR isolate of Fluorescent *Pseudomonads* developed and formulated in talc powder and that was used in IPM trial.

The superior performing Fluorescens *Pseudomonas* isolates (Pf1 and TDK1) were used for the study of induction of systemic resistance in chilli crop and these were integrated in IPM schedule. The IPM trial was conducted on 25 acres of farmers'field for three consecutive seasons from 2008～2010 in Chathrapatti area of dindigul district. The selected farmer beneficiaries from the region were provided with bio-inputs and other IPM interventions as and when necessary. The team of entomologists and plant pathologists supervised the IPM demonstrations by regular visit and intervened judiciously with bio-agents, fungicides, insecticides and plant products wherever required. The observations on incidence of diseases such as leaf spot, powdery mildew, anthracnose, wilt and rot and insect pests such as thrips, mites, borer, aphids and foliage and fruit damage.

Results and Discussion

A total of 65 isolates of *Pseudomonas fluorescens* were collected and evaluated for bio-control and growth promotion activity. Among them two most promising strains *Pseudomonas fluorescens* (Pf1 and TDK1) were identified on the basis of dual culture test and induction of systemic resistance. The isolates were tested against broad spectrum of pathogens such as *Macrophomina phaseolina , Rhizoctonia bataticola, Rhizoctonia solani, Fusarium solani, Colletotrichum gleosporioides, Fusarium solani, Sclerotium rolfsii, Cercospora capsici, Alternaria sesami,* and a bacterial pathogen, *Xanthomonas axonopodis* pv. *punicae.*

The PGPR isolates were evaluated for formulation and carrier material. Out of three carrier materials studied for survival, talc maintained the highest population of PGPR even after 365 days of storage. Vidyasekaran and Muthamilan (1995) observed the shelf life of talc based formulation up to eight months after storage. Talc being inert material having more surface area with neutral pH will help for the survival of *Pseudomonas fluorescens* than any other carrier material like farm yard manure (FYM) and vermicompost. Talc based formulation has been used and tested against fusarium wilt of chilli (Sundaramoorthy *et al.,* 2012) and *Alternaria* blight of sesame (Naik *et al*., 2009). *Pseudomonas fluorescens* was compatible with carbendizm and thiram among fungicides, imidacholoroprid, choloropyriphos, carbofuron and endosulfan among insecticides , neem seed kernel extract (NSKE), garlic extract and nimbicidine among plant products.The compatibility of *Pseudomonas fluorescens* with imidacholoroprid, carbofuron and neem cake have been reported by Kumar *et al*., (2008).

Among 65 fluorescent pseudomonads, six isolates produced higher siderophore production. Siderophores chelate with the ferric ion and serve as vehicle for transport of ferric ion into the cells (Neilland, 1981). The siderophore production has been determined by Sharma *et al*., (2007) in Fluorescent *Pseudomonads*. The potential strain was used as one of the bio-control and PGPR input in the series of IPM

interventions made in chilli fields to manage diseases and pests, during IPM demonstrations. Along with a series of IPM interventions made in farmers'field, a regular monitoring of pests and diseases by team of plant pathologists and entomologist throughout the season was conducted for three years. The judicious use of pesticides, bio-agents, botanicals and other IPM inputs helped to reduce the indiscriminate use of pesticides significantly in the last three years.

In the IPM demonstration trial, the average per cent incidence of leaf spot, powdery mildew, and fruit rot/wilt and also aflatoxin contamination came down from 26.16 to 8.95, 17.25 to 15.95, 14.32 to 9.65, and 17.91 to 11.89 respectively in the three years trials conducted (Table 1). The damage caused by insect pests such as sucking pests, defoliators and fruit borer also came down (Table 2) significantly. As a result, the number of pesticides sprays and the cost of protection was reduced significantly by 25% to 30% with an average net profit of Rs 2, 03,243/- per ha in IPM plot as against Non-IPM plot with a net profit of Rs 1,48,581 per ha which is a gain of Rs.54,6620 per ha (Table 3). In addition, untold ecological damage which is inevitable in Non-IPM practice, as a result of indiscriminate use of pesticides was minimized in IPM practice. There is need to expand the IPM practices with bio-agent and PGPR as major input for realizing India's vision of 2020 for sustainable food and nutritional security.

Table 1. The Incidence of Various diseases of chilli in IPM plots compared to Non-IPM plots during 2008-2011

Sl. No	Diseases	Range of incidence	
		IPM (%)	Non –IPM (%)
1	Leaf Spot	08.95～26.16	10.62～36.73
2	Powdery Mildew	15.95～17.25	18.58～28.00
3	Fruit Rot	09.65～14.32	16.69～17.48
4	*Fusarium* wilt	11.89 ～17.91	13.40～26.33

Table 2. Incidence of insect Pests of chilli in IPM plots compared to non IPM plots during 2008-2011

Sl. No	Insect Pests	Range of incidence	
		IPM	Non IPM
1	Thrips/ Leaf	1.77～2.20	2.59～3.18
2	Mites/ Plant	1.16～1.61	1.79～2.06
3	Aphids/ Plant	0.00～ 0.00	0.41～1.81
4	*S. litura*	0.35～0.73	0.62～1.50
5	*H. armigera*	0.29～0.41	0.63～0.93
6	Foliage damage (%)	2.29～2.66	5.89～5.73
7	Fruit damage (%)	1.63～1.92	5.17～7.65

Table 3. Economics of chilli production in IPM and Non IPM plots during 2008-2011

Location	Dry chilli yield* (qt/ha)	Total income (Rs/ha)	Cost of cultivation (Rs/ha)		Total cost (Rs/ha)	Net Profit (Rs/ha)
			Production cost	Protection cost		
Chathrapatti village						
IPM plots	28.52	236797	20950/-	12604/-	33554/-	203243/-
Non IPM plots	23.84	186941	18950/-	16410/-	38360/-	148581/-

REFERENCES

1. Anith, K. N., Tilak, K. V. B. R. and Manmohandas, T. P. 1999. Analysis of mutation affecting antifungal property of a fluorescent *Pseudomonas* sp. during cotton *Rhizoctonia* interaction. *Indian Phytopath.*, 52(4): 366-369.

2. Kumar, S., 2008. Compatibility of *Pasteuria penetrans* with bio-control agents against root knot nematode in tomato. *Annu. Pl. Protec. Sci*., 16(1): 262-263.

3. Manjunatha, H. Naik, M. K., Rangeshvaran, S. V. and Vagid, N. V. 2011, Deposition of sequences of *Pseudomonas putida.* in NCBI, Gen Bank Maryland, USA. *www.ncbi.nlm.nih.gov*

4. Naik, M. K., Madhukar, H. M. and Devika Rani, G. S. 2009. Evaluation of biocontrol efficacy of *Trichoderma* isolates and methods of its application against wilt of chilli (*Capsicum Annum* L.) caused by *Fusarium solani* (Mart) Sacc. *J. Biol. Control*., 23(1): 31-36.

5. Rosales, A. M., Thomashow, L., Cook, R. J. and Mew, L. W. 1995. Isolation and identification of antifungal metabolites produced by rice associated antagonistic *Pseudomonas* spp. *Phytopathol*., 85(9): 1029-1032.

6. Schwyn, B. and Nielands, J. B.1987. Universal chemical assay for the detection and determination of siderophore. *Annu. Biochem*., **160**: 47-56.

7. Sharma, K., Sexena, A., Dak, G., Sharma, R. and Agarwal, A. 2007. Isolation and assay of antifungal activity of siderophore producing *Pseudomonas aeruginosa*. *J. Mycol. Pl. Pathol*., 37: 251-253.

8. Sundaramoorthy, S., Raguchander, T., Ragupathi, N. and Samiyappan, R. 2012. Combinatorial effect of endophytic and plant growth promoting rhizobacteria against wilt disease of *Capsicum annum* L. caused by *Fusarium solani*. *Biol Control* 60 (1): 59–67

9. Velusamy, P., Immanuel, J. E., Gnanamanickam, S. S. and Thomashow, L. 2006. Biological control of rice bacterial blight by plant associated bacteria diacetylphloroglucinol. *Canadian J. Microbial.,* 52(1): 56-65.

10. Vidhyasekaran, P. and Muthamilan, M., 1995. Development of formulations *Pseudomonas fluorescens* for control of chickpea wilt. *Pl. Dis*., 79: 782- 786. 163