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Preliminary investigations on biocontrol of sucking pests of okra by plant growth promoting rhizobacteria

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ABSTRACT: **Certain PGPR isolates were tested to study their biocontrol ability against aphid (*Aphis gossypii* Glover) and leafhopper (*Amrasca biguttula biguttula* Ishida) pests of okra. All the four PGPR isolates reduced the incidence of pests remarkably, out of which *Pseudomonas* B 25 was found to be the most efficient biocontrol agent against both pests. The populations of aphids and leafhoppers were reduced by about 79 and 81 per cent, respectively, due to spraying with B 25 isolate. The okra yield was improved by over 53 per cent when compared to the uninoculated control. The mechanisms involved in biocontrol are being investigated.**

KEY WORDS: Aphids, leafhoppers, okra, plant growth promoting rhizobacteria

INTRODUCTION

Okra is an important vegetable crop grown in an area of about 0.4 m ha in the country with a production of 3.5 m tonnes (Shanmugasundaram, 2004). There are several production constraints, of which incidence of insect pests is a major one. Yields are drastically reduced by sucking pests such as aphids (*Aphis gossypii* Glover) and leafhoppers (*Amrasca biguttula biguttula* Ishida).

The estimated yield losses range from 25 to 72 per cent (Narayanaswamy, 1999; Rao and Rajendran, 2002). It is estimated that less than 1% of total applied pesticides generally gets to the target pests and most of the pesticides remain unused and enter into the ecosystem and be toxic to non-target organisms including humans. Hence, there is a need to focus our attention on the use of biocontrol agents for the management of pests. Several rhizobacteria capable of controlling aphids, thrips and whiteflies through induced systemic resistance have been reported (Bharathi *et al*., 2004). In this study, we made an attempt to test the ability of plant growth promoting rhizobacterial isolates to control sucking pests of okra.

MATERIALS AND METHODS

Plant growth promoting rhizobacterial (PGPR) isolates used in the study are from the culture collections of the Department of Agricultural Microbiology, UAS, Dharwad. They were isolated from the rhizosphere of healthy tomato seedlings and they suppressed early blight disease caused by *Alternaria solanacearum* (Ell and Martin) through induction of systemic resistance (Venugopal, 2004).

A field trial was laid out to test the ability of PGPR isolates to control sucking pests under rainfed conditions at Main Agricultural Research Station, UAS, Dharwad during November 2005-February 2005 on okra crop hybrid, Syngenta-152. The crop was raised as per the package of practices. The plot size was 5.0 x 3.6 m and each treatment was replicated six times. After 30 days of sowing, the treatments imposed were a control (water

spraying) and spraying of four *Pseudomonas* isolates namely B15, B21, B25 and B26. For spraying PGPR isolates, lignite based inoculants were used. The seedlings were sprayed with 2 per cent (w/v) solution of the biological control agent (Paul and Sarma, 2003). Five seedlings were tagged in each replication. Aphids and leafhoppers that were present on the two top leaves were counted one day before spraying and at different interval after spraying. The okra fruits were harvested and totally four pickings were made and the yield data pooled. The statistical analysis of the data was carried out for completely randomized design (Panse and Sukhatme, 1985) as well as for Duncan's multiple range test (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

All the PGPR isolates sprayed significantly decreased the number of aphids at all intervals tested (Table 1). The highest decrease in the population was observed on 3 days after spraying. Although all isolates were statistically on par, the isolate B25 was found to be the most superior strain in controlling the insect population. There was 66.8 per cent decrease in aphid population at one day after its spraying. This increased to 78.8 per cent at 3 DAS, which came down to 70.2 per cent at 7 DAS. This isolate was followed by B36 strain with 77.6 per cent reduction in aphid population at 3 DAS.

Table 1. Effect of PGPR isolates on population of aphids in okra

Treatments	No. of Aphids / 2 top leaves				Mean
	1 DBS	1 DAS	3 DAS	7 DAS	
T_1 Spraying with (B-15)	46.4	18.5[a]	12.8[a]	16.4[a]	15.9[a]
T_2 Spraying with (B-21)	49.2	18.4[a]	12.3[a]	15.7[a]	15.5[a]
T_3 Spraying with (B-25)	49.7	15.9[a]	10.7[a]	13.1[a]	13.2[a]
T_4 Spraying with (B-36)	50.7	17.0[a]	11.3[a]	14.0[a]	14.1[a]
T_5 Untreated check	50.4	47.9[b]	50.3[b]	44.0[b]	47.5[b]
C. D. (P = 0.05)	NS	6.4	5.1	5.3	5.2
C.V (%)	15.92	14.6	13.8	13.7	14.8
SEM ±	4.47	1.9	1.5	1.65	1.6

Means followed by the same alphabet do not differ significantly by DMRT (0.05); DAS- Days after sowing

Table 2. Leafhoppers as influenced by spraying with PGPR isolates on okra

Treatments	No. of leafhoppers / 2 top leaves					Good Fruit
	1 DBS	1 DAS	3 DAS	7 DAS	Mean	Yield (Kg / ha)
T_1 (Spraying with B-15)	16.4	9.6	5.5	7.6	7.6	7.77
T_2 (Spraying with B-21)	14.5	8.9	5.3	7.0	7.1	8.33
T_3 (Spraying with B-25)	16.1	7.1	3.5	6.7	5.7	11.05
T_4 (Spraying with B-36)	15.5	7.5	5.6	5.7	6.3	9.49
T_5 (Untreated check)	15.6	15.9	18.53	17.6	17.3	7.2
C. D. (P = 0.05)	NS	2.52	2.31	2.45	2.53	NS
C.V. (%)	18.9	13.7	15.9	14.87	15.6	16.83
SEM ±	0.1	0.7	0.70	0.77	0.71	0.15

DAS - Days after sowing; Means followed by the same alphabet do not differ significantly by DMRT (0.05)

Table 3. Influence of application of PGPR isolates on fruit yield of okra

Treatment	Fruit Yield(kg / plot)	Per cent increase in fruit yield over untreated check
T_1 (Spraying with B-15)	1.4	07.9
T_2 (Spraying with B-21)	1.5	15.7
T_3 (Spraying with B-25)	1.9	53.4
T_4 (Spraying with B-36)	1.7	31.8
T_5 (Untreated check)	1.3	-
C. D. (P = 0.05)	0.52	
C.V. (%)	17.58	
SEM ±	0.16	

The isolate B25 was also efficient in controlling leafhoppers (Table 2). It controlled the population by about 81 per cent at 3 DAS. This increased the fruit yields with 53 per cent higher marketable fruit yields when compared to the untreated check (Table 3). There were significantly higher okra fruit yields due to PGPR sprayings. Similarly, Bharathi *et al.*, (2001) also reported several rhizobacteria capable of controlling aphids, thrips and whiteflies through induced systemic resistance. Vasanthi *et al.* (2001) observed biocontrol of thrips and whiteflies in tomato when *Pseudomonas fluorescens* and *P. putida* were inoculated on tomato. Field experiments in cucumber demonstrated that plants grown from seed treated with PGPR strains sustained significantly lower populations of cucumber beetles, *Diabrotica undecimpunctata howardi* and *Acalymma vittatum* when compared with untreated control plants and plants sprayed with esfenvalerate (Zehnder *et al.* 1997). Most of the plants possess defense mechanisms, which can be induced upon treatment with a variety of microorganisms and compounds, a phenomenon called induced systemic resistance (ISR). ISR operates on the timely accumulation of multiple gene products. For example, defense genes such as chitinase, peroxidase, phenyl alanine ammonia lyase (PALase) and polyphenol oxidase were found to be expressed in the treated plants. Investigations are being carried out to study if similar kind of mechanism is exhibited by our isolates.

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