



## Effect of agriculturally beneficial microorganisms on feeding and ovipositional preference of bhendi shoot and fruit borer, *Earias vittella* Fab.

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### Abstract

Bhendi is one of the most important vegetable crops grown in India throughout the year. A number of insect pests severely limit the output of bhendi. Among the insect pests, the bhendi Shoot and Fruit Borer, *Earias vittella* Fab. poses a serious threat and ultimately lowers both the output's quality and quantity. The first line of defence against insect pests among the numerous management strategies is the employment of tolerant and/or resistant genotypes. After taking this into account the goal of the current study was to evaluate the induction of resistance by agriculturally beneficial microorganisms in bhendi accessions through feeding and ovipositional preference test at the Department of Entomology, Faculty of Agriculture, Annamalai University, Tamil Nadu, India during 2022. In case of feeding preference, with regard to free choice test, the preference of *E.vittella* larvae to the fruit was minimum towards the accessions Salem Local treated with K-solubilizer and maximum damage recorded in the accession Arka Anamika treated with *Azospirillum*. Whereas in confined condition, the accession Salem Local treated with *Azospirillum*+ Phosphobacteria + K-solubilizer, recorded minimum tunneling of fruit by the larvae even after 8 hours, while the accession Arka Anamika treated with *Azospirillum* recorded maximum tunnelling. In terms of ovipositional preference, the accession Salem Local treated with K-solubilizer produced the minimum number of eggs by the adult moths of *E.vittella*, while the accession Arka Anamika treated with *Azospirillum* produce more number of eggs in both free choice and no choice tests.

**Keywords:** Agriculturally beneficial microorganisms, bhendi, *E.vittella*, Feeding preference, ovipositional preference

### Introduction

Bhendi is a nutrient-rich important crop with commercial value in the world's tropical and subtropical regions. Bhendi is grown primarily for its immature young fruits, which are consumed as a vegetable, raw, cooked, or fried. Bhendi fruit has carbohydrate (5.4%), protein (4%) and a total fat content of 0.5%. In India, the crop is grown on 514 ha with a yield of 6126 MT and a productivity of 12 t/ha (Dhankhar and Koundinya, 2020) [3]. It is also a good source of iodine and can help with goitre treatment. Bhendi Fruit can also help with genitor-urinary problems, spermetorrhoea and chronic dysentery. Insect pests are a significant limiting factor in bhendi cultivation. *Earias vitella* (Fabricius), a shoot and fruit borer are the most feared pest, causing significant reductions in both quality and quantity of produce (Srinivasa Rao and Rajendran, 2003) [10] (Suman *et al.*, 1984) [11]. Borer attacks tender fruits, causing 52 to 71% yield loss in the production of quality fruits (Pareek and Bhargava, 2003) [8]. The larvae of *E. vittella* cause damage to the bhendi during the vegetative and reproductive phases. The larvae penetrate the terminal bud of the vegetable and channel down from the growth site. Severe attack causes top leaves to wilt and the main stem to collapse (Atwal and Dhaliwali, 2005) [1]. The management of *E. vitella* through host-plant resistance has recently gained importance due to increased consumer awareness of the negative effects of

pesticide residues. Taking into account the foregoing information, laboratory studies were conducted to evaluate the induction of resistance by using agriculturally beneficial microorganisms against *E. vittella*.

### Materials and methods

At the Department of Entomology, Faculty of Agriculture, Annamalai University, one bhendi accession, Salem Local, identified earlier (Karthik, 2015) as resistance to bhendi Shoot and Fruit borer, *E. vittella*, was used for studying the resistance potentials as induced by various agriculturally beneficial microorganisms during 2022. A popular cultivar, Arka Anamika, was also used as a comparison.

For seed treatment of bhendi accessions, *Azospirillum* and Phosphobacteria were received from the Department of Agricultural Microbiology at Annamalai University, while K-solubilizer (*Frateria aurentia*) was purchased from Romvijay Biotech Limited in Puducherry, were used to induce resistance in bhendi accessions. To make slurry, the required amount of inoculants for seed treatment is mixed with rice gruel. The required seeds are then mixed into the slurry to ensure that the inoculants are evenly coated over the seeds. The seeds were shade dried for 30 minutes after treatment. Details on the various agriculturally beneficial microorganisms used for this study are provided below (Table 1).

**Table 1:** List of agriculturally beneficial microorganisms for the induction of resistance in bhendi accessions against *E. vittella*

Sl. No.	Treatments	Dosage	Day of application	Method of application
1.	<i>Azospirillum</i>	3ml/ kg of seed	Day before sowing	Seed treatment
2.	Phosphobacteria	3ml/ kg of seed	Day before sowing	Seed treatment
3.	K – Solubilizer	3ml/kg of seed	Day before sowing	Seed treatment
4.	<i>Azospirillum</i> + Phosphobacteria	1.5ml+1.5ml/ kg of seed	Day before sowing	Seed treatment
5.	Phosphobacteria + K – Solubilizer	1.5ml+1.5ml/ kg of seed	Day before sowing	Seed treatment
6.	<i>Azospirillum</i> + K – Solubilizer	1.5ml+1.5ml/ kg of seed	Day before sowing	Seed treatment
7.	<i>Azospirillum</i> + Phosphobacteria + K – Solubilizer	1ml+1ml+1ml /kg of seed	Day before sowing	Seed treatment
8.	Control	-	-	-

**Feeding Preference of *E. vittella***

**Relative Fruit Damage by Free Choice**

A feeding preference assay with a free choice test was performed to identify the promising treatments. Tender fruits from the accessions were kept at equal distances in a circular pattern and after four hours of starvation, 15 numbers of pre-starved third instar larvae were released at the centre. The number of larvae settled on the respective

accessions was counted after 2, 4, 6, and 8 hours of release. This was replicated three times.

**Relative Fruit Damage by Confined Feeding**

In this experiment, a four-hour pre-starved third instar larva was placed in a separate container with a fruit from the respective accessions. After 8 hours, the length of the fruit devoured (tunnelling) by the larva was measured. This was replicated three times (Table 2).

**Table 2:** Feeding preference of *E. vittella* larvae towards the fruit of bhendi accessions as influenced by agriculturally beneficial microorganisms

Sl. No.	Treatments	Larval feeding preference			
		No. of larva preferred after 8 hr (free choice)		Tunnel length in 8 hr (cm) (no choice)	
		Salem Local	Arka Anamika	Salem Local	Arka Anamika
1.	<i>Azospirillum</i>	2 (1.65)	2 (1.71)	4.2 (2.26)	4.8 (2.40)
2.	Phosphobacteria	1 (1.38)	2 (1.66)	2.9 (1.96)	3.1 (2.02)
3.	K – Solubilizer	0 (1.00)	0 (1.00)	2.3 (1.81)	2.7 (1.92)
4.	<i>Azospirillum</i> + Phosphobacteria	2 (1.71)	2 (1.71)	2.9 (1.97)	3.3 (2.07)
5.	Phosphobacteria + K – Solubilizer	1 (1.33)	1 (1.38)	2.6 (1.89)	2.7 (1.92)
6.	<i>Azospirillum</i> + K – Solubilizer	1 (1.38)	2 (1.65)	2.7 (1.92)	3.5 (2.12)
7.	<i>Azospirillum</i> + Phosphobacteria + K Solubilizer	0 (1.00)	1 (1.38)	2.1 (1.76)	2.6 (1.89)
8.	Control	4 (2.22)	4 (2.20)	4.9 (2.42)	5.4 (2.52)
CD (P= 0.05)		0.65	0.61	0.62	0.15

Each value is a mean of three replications Values in parentheses are square root transformed values

**Oviposition Preference of *E. vittella***

**Relative oviposition preference by free choice method**

45 days old potted plants inoculated with various agriculturally beneficial microorganisms were placed in a single oviposition cage (175 x 175 x 175 cm) made of net to perform a free choice test to determine *E. vittella* ovipositional preference. Ten newly emerged adult pairs were placed in the cage. Number of eggs laid by adults per accession was calculated and then most preferred accession for oviposition was identified. This was replicated three times (Table 3).

**Relative oviposition preference by no choice method**

To determine *E. vittella* ovipositional preference, 45-day-old potted plants treated with various agriculturally beneficial microorganisms were placed individually in an oviposition cage (175 x 175 x 175 cm) made of net to perform a no-choice test. A pair of adults were released into the cage. The plants in the oviposition cage were checked for eggs and recorded once every 24 hours. The number of eggs per accession was calculated, and the most preferred accession for oviposition was determined. This was replicated three times.

**Table 3:** Ovipositional preference of *E. vittella* adult towards the fruits of bhendi accessions as influenced by agriculturally beneficial microorganisms

Sl. No.	Treatments	Adult ovipositional preference			
		Free choice		No choice	
		Salem Local	Arka Anamika	Salem Local	Arka Anamika
1.	<i>Azospirillum</i>	33 (5.82)	47 (6.92)	47 (6.92)	53 (7.34)
2.	Phosphobacteria	17 (4.23)	35 (6.00)	33 (5.82)	39 (6.32)
3.	K – Solubilizer	16 (4.11)	26 (5.19)	17 (4.23)	22 (4.79)
4.	<i>Azospirillum</i> + Phosphobacteria	19(4.45)	31 (5.65)	36 (6.08)	27 (5.29)
5.	Phosphobacteria + K – Solubilizer	16 (4.11)	28 (5.38)	25 (5.09)	42 (6.55)
6.	<i>Azospirillum</i> + K – Solubilizer	24 (4.99)	43 (6.63)	43 (6.63)	51 (7.20)
7.	<i>Azospirillum</i> + Phosphobacteria + K – Solubilizer	11 (3.46)	22(4.77)	21 (4.68)	23 (4.89)
8.	Control	51 (7.20)	65 (8.12)	53 (7.34)	64 (8.06)
CD (P= 0.05)		0.49	0.43	0.39	0.32

Each value is a mean of three replications Values in parentheses are square root transformed values

## Result and discussion

When *E. vittella* larvae were fed with Bhendi accessions in a free choice test, it was clear that the maximum damage occurred in Arka Anamika rather than Salem Local, irrespective of treatments. Even after 8 hours, plants treated with K- Solubilizer were the least preferred by the larvae. In contrast to the treatment, plants treated with *Azospirillum* were highly preferred by the larvae for up to 8 hours. According to the current findings Perrenoud (1990) [9] reported that adequate potassium supply hardens plant structures, including a tougher cuticle, a stronger epidermal outer wall, stronger cell walls and enhanced sclerenchymatous tissue development. Plant hardening is supposed to improve mechanical resistance to insect feeding. Microbes induced insect pest resistance through phytohormone synthesis, increased potassium and phosphorus uptake, and increased iron and mineral solubility through chelation growth. Microbial inoculants, particularly *Bacillus* and *Pseudomonas* strains, are also used as biofertilizers, with direct and indirect effects on insect resistance. A diverse range of beneficial microbes also provide plants with important capabilities such as enhanced nutrient uptake, growth promotion and pathogen and insect defence (Lareen *et al.*, 2016) [5].

Unlike the previous method, confining the larva on the fruits individually treated with agriculturally beneficial microorganisms and forcing them to feed only on specific accession. The length of fruit bored (tunnelled) by a third instar larvae to various agriculturally beneficial microorganisms treated accessions was measured. According to the results, the accession with consortium (*Azospirillum* + Phosphobacteria + K- solubilizer) followed by K- solubilizer resulted in the shortest length of fruit damage by the larvae in 8 hours. Bantoto and Danilo (2013) [2] reported that feeding disruption, morphological abnormalities and mortality are common responses in insects when fed the plants have higher K content.

In terms of oviposition preference, the accession Salem Local was observed with the lowest eggs (16 eggs) and was least preferred by the adults of *E. vittella* in a free choice test. On the other hand, Arka Anamika ranked first in terms of ovipositional preference for adults, with the highest egg deposition of 65 eggs on the plants. Those findings are in accordance with the results of Muthukumar and Ganesan (2017) [7] who found that the accession Arka Anamika was most preferred for oviposition. Adults of *E. vittella* least preferred the agriculturally beneficial microorganisms consortium (*Azospirillum* + Phosphobacteria + K- solubilizer) enriched plants followed by K- solubilizer and Phosphobacteria + K- solubilizer treated plants. This is consistent with Hassan Etesami's findings (2017) [4] Potassium (K) is the most significant plant nutrient, influencing plant growth, metabolism, and development. In addition to increasing plant resistance to insect pests.

In the no-choice test for ovipositional preference, 45-day-old Bhendi accessions were individually placed in the oviposition cage and newly emerged adults were released into the cage for oviposition. It was found that the lowest number of eggs (17 eggs) were deposited in Salem Local enriched with K-solubilizer and accession, Arka Anamika was observed with the highest number of egg deposition (64 eggs), indicating that Arka Anamika was highly preferred

by the adults of *E. vittella*. The K-solubilizer is effective at releasing K from inorganic and insoluble pools of total soil K through solubilisation (Meena *et al.*, 2014) [6]. Also it has been reported that inoculation with K- Solubilizer increased resistance to various insects (Xiao *et al.*, 2017) [12].

## Conclusion

As a result of feeding and ovipositional preference of okra shoot and fruit borer in both free choice and confinement test, the accession Salem Local enriched with K- solubilizer preferred less by the larvae than other treatments of bhendi. But it is also essential to evaluate the various biophysical and biochemical factors that contribute to resistance as influenced by agriculturally beneficial microorganisms and the promising treatments may be used in future breeding programmes to develop resistant varieties.

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