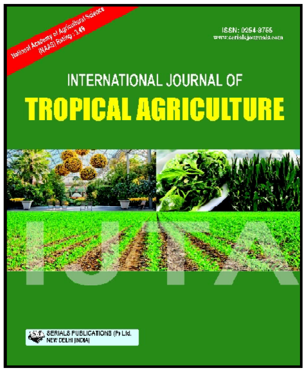

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Induction of Resistance By Organic and Inorganic Nutrients against Bhendi Shoot and Fruit Borer *Earias vittella* FAB.

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Abstract: The influence of organic and inorganic sources of nutrients on the bhendi accessions against shoot and fruit borer *Earias vittella* (Fab.) in an already identified insect tolerant bhendi accession Salem Local in comparison with a susceptible check, Arka Anamika was studied under glasshouse conditions at Department of Entomology, Annamalai University, Tamil Nadu. On studying the feeding preference of *E. vittella* larvae, the damage was maximum in the accession Arka Anamika than Salem Local. Among the treatments, plants supplied with vermicompost were less preferred by *E. vittella* larvae, followed by plants supplied with K. In confining the larva on the accessions, among the treatments, plants supplied with vermicompost recorded lowest length of fruit damage by the larvae. On estimating the antibiosis, among the accessions, Salem Local was found to possess higher antibiosis against *E.vittella*. Among the treatments, vermicompost applied plants exerted higher antibiosis effect on *E. vittella,* followed by plants supplied with poultry manure. Larval feeding on vermicompost applied plants caused maximum larval mortality and minimum pupation rate and higher malformed adults. Minimum larval, pupal and adult duration were recorded on vermicompost applied plants.

Key words: Bhendi, *Earias*, Induced resistance, organic and inorganic nutrients

INTRODUCTION

Bhendi *Abelmoschus esculentus* L. (Moench) is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. Bhendi provides an important source of vitamins, calcium, potassium and other mineral matters which are often lacking in the diet of developing countries (IBPGR, 1990). Bhendi shoot and fruit borer, *Earias vittella* is the most serious pest which cause direct damage to tender shoots and fruits. It is reported that about

69% losses in marketable yield due to attack of this insect pest (Suman *et al.,* 1984). Host plant resistance is the main basic component of IPM, and the utilization of resistant plants has long been considered as one of the most effective components of insect control. In the absence of natural resistance in the gene pool of crop plants or lack of desirable yield attributes in the identified insect tolerant/ resistant crop varieties, inducing resistance by manipulation of plant nutrients may be attempted (Muthukumaran and Selvanarayanan, 2010).

MATERIALS AND METHODS

One bhendi accession Salem Local identified earlier (Karthik, 2015) as tolerant to shoot and fruit borer, *Earias vittella* at the Department of Entomology, Annamalai University was used for studying the resistance potentials as induced by various inorganic and inorganic nutrients. For comparison, a popular cultivar, Arka Anamika was also used. For studying the induction of resistance, preference of *E. vittella* larvae for feeding on the fruits and also antibiosis effects of the bhendi accessions were evaluated. The details on various external inputs used in the present study are furnished hereunder.

S. No	*Treatments*	*Dosage/Pot*	*Day of application*	*Method of application*
1	Farm Yard Manure (FYM)	50 g	ODS	Soil
2	Vermicompost (VC)	40 g	ODS	Soil
3	Vermiwash (VW)	3%	30 DAS	Foliar spray
4	Poultry manure (PM)	25 g	ODS	Soil
5	Nitrogen (N) alone (split dose application)	0.45 g (50%)	ODS	Soil
		0.225g (25%)	30 DAS	Soil
		0.225g (25%)	60 DAS	Soil
6	Phosphorus (P) alone	1.25 g	ODS	Soil
7	Potash (K) alone	0.33 g	ODS	Soil
8	Combination of NP N (split dose application)	0.45 g (50%)	ODS	Soil
		0.225g (25%)	30 DAS	Soil
		0.225 g (25%)	60 DAS	Soil
	P	1.25 g	ODS	Soil
9	Combination of PK P	1.25 g	ODS	Soil
	K	0.33 g	ODS	Soil
10	Combination of NK N (split dose application)	0.50 g (50%)	ODS	Soil
		0.25 g (25%)	30 DAS	Soil
		0.25 g (25%)	60 DAS	Soil
	K	0.33 g	ODS	Soil
11	Combination of NPK N (split dose application)	0.50 g (50%)	ODS	Soil
		0.25 g (25%)	30 DAS	Soil
		0.25 g (25%)	60 DAS	Soil
	P	1.25 g	ODS	Soil
	K	0.33 g	ODS	Soil

ODS – On te day of sowing, DAS- Days after sowing

Studies on Antixenosis on Bhendi accassions against *E. vittella*

Feeding Preference of *E. vittella*

To find out susceptible and resistant accessions a feeding preference assay was conducted with free choice test. Promising treatments were identified and tender fruits of the accessions were kept at equal distance in circular manner, in a metal container (36 x 15 cm) and 15 numbers of four hours pre - starved third instar larvae were released at the centre. After 8 h of release, the numbers of larvae settled on the respective accessions was recorded. This was replicated five times. Further a no- choice test was also conducted with four hours pre - starved third instar larvae. In this experiment a larva was introduced and a fruit of respective accessions in individual container. The length of the fruit eaten (tunneling) by the larva was measured after 8h. This was replicated five times.

Studies on Antibiosis of Bhendi Accessions against *E. vittella*

Antibiosis studies were conducted in the laboratory on each accession. The experiments were conducted under controlled conditions of temperature viz., 27 ± 2^{0}C and relative humidity 75-85 percent. The susceptible accession Arka Anamika used as a susceptible check. Ten neonate larvae were released individually in the cage. The larvae were observed once in two days and supplied with fresh leaves and fruits whenever needed and larval mortality, pupation rate, adult emergence, Larval, pupal & adult longevity were recorded.

RESULTS AND DISCUSSION

On studying the feeding preference of *E. vittella* larvae towards the bhendi accessions, it was observed that the damage was maximum in the accession Arka Anamika than Salem Local, irrespective of the organic and inorganic nutrients. The accession Salem Local was collected from a hilly terrain in Salem district. Wild relatives or their derivatives have been reported to possess resistance against shoot and fruit borer, *E.vittella* (Sankhyan and Verma, 1997).

Among the treatments, plants supplied with vermicompost were less preferred by *E. vittella* larvae, this is in line with the findings of Arancon *et al.* (2007) who observed that vermicompost application increased resistance to arthropod herbivores and suppressed the population of mealy bug on tomato significantly. Yardim *et al.* (2006) also observed that field cucumber beetle population was suppressed significantly on cucumber plants treated with vermicompost. In contrast to the above method, the length of fruit bored (tunneling) by a third instar *E. vittella* larvae measured in treated accessions. Among the treatments, plants supplied with vermicompost recorded lowest length of fruit damage by the larvae in 8hours (Table 1). Similarly, Rao Rajasekhara (2002) reported that, organic manures induced the resistance against jassids and aphids in groundnut plants.

On estimating the antibiosis effect of the bhendi accessions on the various life stages of *E. vittella,* Salem Local was found to possess higher antibiosis against *E.vittella* than Arka Anamika irrespective of the organic and inorganic nutrient sources. This may possibly be due to the blood of many wild species that possess insect and disease resistance (Kalloo, 1991). Among the treatments, vermicompost applied plants exerted higher antibiosis effect on *E. vittella,* followed by plants supplied with poultry manure and PK.

Larval feeding on vermicompost applied plants caused maximum larval mortality and minimum pupation rate. Many larvae on pupation become malformed indicating larval-pupal mosaics and also malformed adult percentage was higher in case of larvae that fed on the plants supplied with vermicompost (Table 2). In regard to the tenure of the *E. vittella,* minimum larval pupal & adult duration were recorded on vermicompost supplied plants

Table 1
Feeding preference of *E. vittella* larvae towards the fruits of bhendi accessions as influenced by organic & inorganic nutrients

S.No	*Treatments*	*Number of larvae preferred after 8h (Free choice test)*		*Tunnel length in 8 hours (cm) (No choice test)**	
		SL	*AA*	*SL*	*AA*
1	Farm yard manure (FYM)	2(8.13)	1(5.74)	3.1±0.1	3.8±0.1
2	Vermicompost (VC)	0(0.00)	0(0.00)	0.2±0.1	0.6±0.2
3	Vermiwash (VW)	1(5.74)	1(5.74)	3.4±0.2	4.3±0.1
4	Poultry Manure (PM)	0(0.00)	1(5.74)	1.5±0.1	1.8±0.2
5	N	3(9.98)	2(8.13)	4.2±0.2	4.7±0.1
6	P	2(8.13)	2(8.13)	3.7±0.1	4.5±0.1
7	K	1(5.74)	0(0.00)	0.8±0.1	1.3±0.1
8	NP	2(8.13)	1(5.74)	2.7±0.2	3.5±0.2
9	PK	0(0.00)	1(5.74)	1.8±0.2	2.3±0.1
10	NK	1(5.74)	3(9.98)	2.5±0.1	3.3±0.1
11	NPK	0(0.00)	1(5.74)	2.3±0.2	2.8±0.2
12	Control	3(9.98)	2(8.13)	4.4±0.1	5.2±0.1
	CD (p=0.05)	**0.287**	**0.406**	**0.88**	**1.04**

Each value is a mean of five replications.
Values in parentheses are arc sine transformed.
*Mean value is followed by standard deviation.

Table 2
Antibiosis effects of the bhendi accessions on *E. vittella* as influenced by organic & inorganic nutrients

S.No	*Treatments*	*Antibiosis Characters*					
		Larval mortality		*Pupation %*		*Adult emergence*	
		SL	*AA*	*SL*	*AA*	*SL*	*AA*
1	Farm yard manure (FYM)	60.00 (50.77)	50.00 (45.00)	30.00 (33.21)	40.00 (39.23)	40.00 (39.23)	60.00 (50.77)
2	Vermicompost (VC)	90.00 (71.56)	70.00 (56.79)	20.00 (26.56)	40.00 (39.23)	30.00 (33.21)	40.00 (39.23)
3	Vermiwash (VW)	60.00 (50.77)	40.00 (39.23)	40.00 (39.23)	40.00 (39.23)	40.00 (39.23)	50.00 (45.00)
4	Poultry Manure (PM)	80.00 (63.44)	50.00 (45.00)	30.00 (33.21)	30.00 (33.21)	30.00 (33.21)	60.00 (50.77)
5	N	40.00 (39.23)	20.00 (26.56)	40.00 (39.23)	60.00 (50.77)	40.00 (39.23)	70.00 (56.79)

contd. table 2

S.No	*Treatments*	*Antibiosis Characters*					
		Larval mortality		*Pupation %*		*Adult emergence*	
		SL	*AA*	*SL*	*AA*	*SL*	*AA*
6	P	50.00 (45.00)	20.00 (26.56)	40.00 (39.23)	50.00 (45.00)	20.00 (26.56)	60.00 (50.77)
7	K	80.00 (63.44)	60.00 (50.77)	0.0 (0.0)	40.00 (39.23)	40.00 (39.23)	40.00 (39.23)
8	NP	60.00 (50.77)	40.00 (39.23)	60.00 (50.77)	70.00 (56.79)	60.00 (50.77)	60.00 (50.77)
9	PK	70.00 (56.79)	50.00 (45.00)	40.00 (39.23)	60.00 (50.77)	50.00 (45.00)	70.00 (56.79)
10	NK	50.00 (45.00)	40.00 (39.23)	50.00 (45.00)	70.00 (56.79)	50.00 (45.00)	60.00 (50.77)
11	NPK	70.00 (56.79)	30.00 (33.21)	30.00 (33.21)	40.00 (39.23)	60.00 (50.77)	70.00 (56.79)
12	Control	0.00 (0.00)	20.00 (26.56)	70.00 (56.79)	100.0 (90.00)	80.00 (63.44)	100.0 (90.00)

Each value is a mean of ten replications.

Values in parentheses are arc sine transformed.

Table 3

Tenure of bio stages of *E. vittella* as influenced by organic & inorganic nutrients

S.No	*Treatments*	*Mean tenure of*							
		Larva		*Pupa*		*Adult*			
						Male		*Female*	
		SL	*AA*	*SL*	*AA*	*SL*	*AA*	*SL*	*AA*
1	FYM	13.33±0.24	14.00±026	12.2±1.8	13.2±1.2	5.8±1.6	5.4±1.1	5.6±1.4	5.9± 1.1
2	VC	12.22±0.21	13.33±0.24	10.2±1.0	9.8±1.5	4.2±1.0	4.7±1.2	4.5±1.0	5.3± 1.3
3	VW	12.33±0.34	13.12±0.14	12.4±1.3	12.6±1.2	5.4±1.2	5.8±1.6	5.4±1.1	6.2± 2.1
4	PM	14.00±0.26	18.00±0.24	12.4±1.4	11.5±1.8	5.0±1.5	5.8±1.4	5.6±1.3	5.7± 1.3
5	N	18.44±0.22	19.21±0.14	13.5±1.2	12.5±1.4	6.4±1.1	7.4±2.1	6.9±1.4	7.4± 1.4
6	P	17.33±0.26	18.46±0.32	11.3±1.3	10.9±1.2	5.4±1.1	6.2±2.1	5.8±1.4	6.2± 1.4
7	K	12.66±0.18	14.66±0.18	12.6±1.2	12.0±1.0	4.3±1.2	4.9±1.0	4.5±1.2	5.3±1.2
8	NP	17.33±0.26	19.56±0.22	11.9±1.2	9.6±1.4	5.9±1.4	6.4±1.2	6.1±1.2	6.9± 2.2
9	PK	15.00±0.21	19.33±0.21	12.2±1.7	10.5±1.8	5.5±1.6	6.4±1.2	6.1±1.0	6.0± 1.1
10	NK	15.31±0.14	15.44±0.24	11.0±1.5	10.2±1.6	6.2±1.4	6.6±1.2	6.8±1.1	7.1± 2.4
11	NPK	15.66±0.13	19.66±0.13	12.0±1.5	9.8±1.3	5.8±1.4	6.5±1.4	6.2±1.1	6.7± 1.5
12	Control	17.33±0.26	22.33±0.26	11.2±1.8	6.4±2.0	6.4±1.1	7.8±2.1	6.2±1.4	6.9± 1.4

Each value is a mean of ten replications.

Mean value is followed by standard deviation

(Table 3). This confirms the finding that the fertilizers can affect the relative growth rate, development time, and survival of a range of phytophagous species (Awmack and Leather, 2002). In the present study, plants applied with potassium also exerted significant antibiosis effects on *E. vittella*. Similar negative influence of potassium on certain insect pests was reported by Marwat *et al.* (1985) who found the population of cabbage aphid to have negative correlation with increasing level of potassium. On the other hand, Inayatullah (1987) concluded that potassium had positive correlation with the sugarcane borer infestation.

Hence, application of vermicompost, poultry manure and recommended dose of K may be recommended as suitable practices in the integrated pest management module for bhendi shoot and fruit borer.

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