Seasonal incidence and control of white fly (*Dialeurodes pallida* Singh) infestation in betel vine (*Piper betle* L.)

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ABSTRACT

Seasonal incidence, correlation studies and efficacy of some insecticides of white fly (Dialeurodes pallida Singh) *on betel vine were conducted in the Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, West Bengal during November,2005 to April, 2007. the whitefly was found active throughout the year but the maximum population was observed during last week of November to December. Population of whitefly showed negative correlation against maximum & minimum temperature and rainfall while positive correlation to maximum humidity. The R^2 value suggested 72% variation in leaf infestation due to various climatic factors. Out of ten (10) synthetic as well as botanical insecticides, imidachloprid was found to be most effective to suppress the population of whitefly which resulted 89.87%, 73.45% and 60.31% mortality at 3,8 and 14 days after spraying.*

Key words: Betel vine, correlation, efficacy of insecticides, seasonal incidence and whitefly.

Betel vine (*Piper betle* L.) is a highly remunerative crop to the farmers of West Bengal. It has high domestic demand to meet requirement of about 15 to 20 million people consuming betel leaves in our country on a regular basis (Jana, 1996). It plays an important role in the agriculture as well as in economy of West Bengal. It is highly labour intensive and one hectare betel vine can generate 5000 mandays in a year (Acherjee *et al*., 1988). The crop has been cultivated traditionally over the years without any improved package of practices leading to diminishing returns (Guha,2006).

Since the crop is raised under covered structure creating a microclimatic condition that not only favours crop growth but also influence pest incidence. The crop is subjected to attack by large no. of insect- pests causing huge loss in leaf yield (Nikam *et al*., 1958). The white and black fly have been identified as major constraints in increasing the leaf yield of betel vine (Giri, 1995; Jana, 2006). Meager information is available on population build up and efficacy of insecticides against the pest particularly in Terai Region of West Bengal. The present investigation was, therefore, carried out to study the incidence of whitefly and their control under *Terai* Region of West Bengal.

MATERIALS AND METHODS

The experiments were conducted in two years old standing betelvine (cv. *Kali Bangla*) under closed conservatory system of cultivation at the instructional farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during the period from Nov., 2005 to Apr., 2007. Planting was done with a spacing of 50x10cm between the rows and the plants respectively. The crop was raised with recommended package of practices (150 : 100 : 100 kg NPK / ha/ yr). Half of the nitrogen was applied as organic in the form of mustard cake and rest amount in the form of urea in six equal splits at a monthly interval starting from May to October. Phosphatic and potassic fertilizers were applied at a time during onset of monsoon in May (Guha, 2006).

To study the seasonal incidence of white fly population, counting (Eye estimation) on both nymphs and adults population were made at weekly interval. Five rows each having 20 creepers in a plot were considered as one replication to observe the incidence pattern of whitefly. One plant from 20 creepers was selected from each plot and thus 5 plants from 5 rows were taken into consideration for single replication. Counting was made from top five leaves where flies were found to occur. Weekly data of abiotic factors such as maximum and minimum temperature, maximum and minimum relative humidity and rainfall were recorded properly. The data thus obtained were computed and subjected to R.B.D. and correlation analysis.

Ten insecticides (syntyhetic and botanicals) viz., NSKE 5%, Tobacco leaf extracts 2.5%, Azadirachtin 0.0002%, Imidachloprid 0.0023%, Endosulfan 0.07%, Chlorpyriphos + Cypermethrin 0.05%, Cartap hydrochloride 0.05%, Carbaryl 0.13%, Acetamiprid 0.0027% and Quinolphos + Cypermethrin 0.07% were taken into consideration for spraying. Eleven plots each having three rows were selected and ten different insecticides were

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sprayed on ten plots randomly while the remaining one was treated as control plot where only water was applied. The population of whitefly was counted from 3 randomly selected plants in each plot at 3, 8 and 14 days after spraying from all treatments. Data from one plant from each row represented one replication, thus there was three replications for each insecticide-treatment. General formula used for the calculation of per cent mortality of whitefly is presented below-

$$\text{Per cent mortality} = \frac{(\text{Pre- treatment count} - \text{Post- treatment count}) \times 100}{\text{Pre- treatment count}}$$

Data thus obtained were transformed (ARC-SIN) accordingly and subjected to statistical analysis (RBD).

RESULTS AND DISCUSSION

Seasonal incidence of whitefly

From table-1 it is revealed that population build up of whitefly varied significantly over different weeks throughout the period of investigation. A very high level of whitefly population was noticed during 48^{th} to 52^{nd} standard week in 2005; 1^{st}, 2^{nd}, 5^{th}, 50^{th} and 52^{nd} standard week in 2006 and 1^{st} to 4^{th} standard week in 2007. While comparatively lesser population were registered during 18^{th} to 26^{th} and 31^{st} to 37^{th} standard weeks in 2006. Whitefly population was recorded maximum (16.5 nos/leaf) during the 1^{st} week of December (49^{th} SW) in 2005 while the minimum (1.4 nos/leaf) in the end of August (34^{th} SW) in 2006 . Giri (1995) observed highest population of whitefly during early November whereas Jana (2006) recorded higher population during December to January which confirms the results under the present investigation.

Correlation and multiple regression analysis between abiotic factors and whitefly population showed that the population was significantly negatively correlated to maximum temperature, minpmum temperature and rainfall and significantly positive to the gradient of temperature. Maximum relative humidity and relative humidity gradient had non-significant positive relationships with whitefly population while minimum relative humidity showed non-significant negative correlation with them. During higher period of incidence, the maximum temperature, maximum relative humidity and rainfall were 19 °C to 26 °C, 81 to 100% and no or negligible rainfall respectively while during the lower period of incidence, these were 28.9 °C to 33.5 °C, 81 to 95% and 86.07 mm respectively. It indicates that moderate temperature, higher relative humidity and no rainfall favour the activity of the pest which in turn resulted in higher pest infestation during November to January. Thus the data under present investigation can be utilized in predicting the whitefly outbreak. The impact of weather parameters was also collectively measured by multiple regression analysis and the R^2 values suggested 72.73% variation in pest incidence due to various climatic factors studied.

Efficacy of insecticides

It is revealed from the table-3 that all the insecticidal treatments were significantly superior over control in reducing the whitefly infestation. The highest efficacy was found from imidachloprid (0.0023%) followed by Quinolphos + Cypermethrin, Carbaryl, endosulfan and Chlorpyriphos + Cypermethrin. These insecticides were found better and also differed significantly from rest of the insecticides after three (3) days of spraying. Similar trend in efficacy of insecticides was also observed after eight (8) days of spraying. The ranking of these insecticides were found as imidachloprid > Endosulfan > Quinolphos + Cypermethrin > acetamiprid. At the 14 days after spraying, the mortality percentage of whitefly was recorded to be highest from Endosulfan (47.52%) treated plots followed by Quinolphos + Cypermethrin, imidachloprid, Cartap Hydrochloride, however, the difference among the insecticides are negligible and non-significant. As far as overall mortality is concerned, imidachloprid (72.57%) was found to be the best of all other insecticides though it was statistically at par with endosulfan (71.60%), Quinolphos + Cypermethrin (71.24%), Chlorpyriphos + Cypermethrin (70.18%) in relation to the control of whitefly. Although neem based insecticide like Azadirachtin resulted lower mortality (64.28%) over synthetic insecticides against whitefly but had significant importance whenever the residual toxicity in leaf will be taken into account. A very scanty report is available on management of whitefly through insecticides. However, Das and Pandey (1991) reported dichlorophos as the best treatment out of 10 insecticides evaluated including leaf extract of neam, Neem oil (0.05%) + 0.5% teepol on betelvine against whitefly and was recorded lower mortality of whitefly. The findings under present investigation are almost in conformity with the results of Anonymous, 1987).

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Table-1 Variations in white fly population as influenced by weather factors

Year	Standard week	Whitefly (Nos./ leaf)	Temperature (^{0}c)			Relative humidity (%)			Rainfall (mm)
			Max.	Min.	Gradient	Max.	Min.	Gradient	
2005	48th	14.60	26.70	14.70	12.00	95.00	82.00	13.00	0.00
	49th	16.50	26.40	14.40	12.00	92.00	81.00	11.00	0.00
	50th	13.40	26.30	13.50	12.80	88.00	75.00	13.00	0.00
	51th	13.20	25.90	13.40	12.50	87.00	75.00	12.00	0.00
	52th	12.01	25.30	10.90	14.40	89.00	78.00	11.00	0.00
2006	1st	10.80	21.40	9.40	12.00	86.00	62.00	24.00	0.00
	2nd	12.90	21.30	9.30	12.00	87.00	63.00	24.00	0.00
	3rd	7.90	22.10	10.10	12.00	83.00	58.00	25.00	0.00
	4th	6.80	21.90	10.20	11.70	82.00	57.00	25.00	0.00
	5th	12.30	21.80	10.10	11.70	81.00	62.00	19.00	0.00
	6th	9.80	27.20	12.90	14.30	79.00	53.00	26.00	0.00
	7th	8.10	29.10	16.80	12.30	78.00	52.00	26.00	0.00
	8th	6.40	32.50	17.00	15.50	79.00	51.00	28.00	0.00
	9th	5.80	30.20	16.90	13.30	78.00	51.00	27.00	0.00
	10th	8.70	29.40	16.30	13.10	88.00	65.00	23.00	0.30
	11th	5.00	32.20	18.40	13.80	79.00	53.00	26.00	0.00
	12th	5.50	33.50	17.90	15.60	79.00	55.00	24.00	0.00
	13th	7.00	34.10	18.50	15.60	75.00	62.00	13.00	0.60
	14th	6.80	34.70	18.10	16.60	94.00	84.00	10.00	2.10
	15th	4.70	34.30	18.20	16.10	94.00	82.00	12.00	21.30
	16th	4.20	30.10	21.00	9.10	89.00	85.00	4.00	36.00
	17th	5.30	29.60	21.00	9.10	86.00	64.00	22.00	7.10
	18th	2.30	33.00	21.00	11.70	87.00	65.00	22.00	99.70
	19th	5.80	29.50	22.00	7.20	91.00	75.00	16.00	33.00
	20th	2.80	31.60	22.00	9.80	81.00	68.00	13.00	27.80
	21st	7.30	33.50	25.00	8.90	84.00	76.00	8.00	17.00
	22nd	2.90	29.00	24.00	5.20	95.00	85.00	10.00	243.00
	23rd	3.20	31.50	25.00	6.10	91.00	81.00	10.00	123.00
	24th	5.60	30.90	24.00	7.20	94.00	83.00	11.00	49.40
	25th	4.30	32.10	25.00	7.50	94.00	82.00	12.00	85.20

Year	Standard week	Whitefly	Temperature (^{0}c)			Relative Humidity (%)			Rainfall (mm)
			Max.	Min.	Gradient	Max.	Min.	Gradient	
2006	26th	2.90	30.40	25.00	5.70	94.00	82.00	12.00	237.30
	27th	3.20	33.00	26.00	7.20	93.00	79.00	14.00	106.10
	28th	3.80	31.40	26.00	5.70	95.00	79.00	16.00	109.30
	29th	5.70	32.60	26.00	6.40	93.00	80.00	13.00	0.20
	30th	3.10	31.20	25.00	6.30	92.00	79.00	13.00	113.60
	31st	1.80	33.20	26.00	7.60	90.00	70.00	20.00	33.60
	32nd	2.10	33.10	26.00	7.20	92.00	73.00	19.00	11.60
	33rd	1.80	33.30	26.00	7.40	88.00	72.00	16.00	25.20
	34th	1.40	32.10	25.00	6.90	96.00	72.00	24.00	68.40
	35th	2.90	32.40	25.00	7.10	94.00	71.00	23.00	13.90
	36th	2.40	33.00	25.00	8.20	93.00	76.00	17.00	142.70
	37th	2.00	28.90	24.00	5.10	98.00	76.00	22.00	166.30
	38th	4.30	31.00	24.00	7.10	96.00	77.00	19.00	61.80
	39th	3.80	30.10	24.00	5.80	96.00	77.00	19.00	90.90
	40th	2.30	31.20	23.00	7.80	98.00	78.00	20.00	89.40
	41st	2.60	32.00	23.00	8.80	94.00	69.00	25.00	83.20
	42nd	4.00	30.90	22.00	9.40	96.00	72.00	24.00	39.40
	43rd	5.80	30.00	18.00	11.60	84.00	65.00	19.00	0.00
	44th	4.70	29.70	18.00	11.40	93.00	67.00	26.00	0.00
	45th	6.00	27.80	19.00	8.90	94.00	72.00	22.00	0.00
	46th	5.80	27.90	17.00	10.90	97.00	59.00	38.00	1.00
	47th	9.60	24.90	16.00	9.00	97.00	74.00	23.00	1.00
	48th	9.60	24.30	11.40	12.90	97.00	77.00	20.00	0.00
	49th	8.80	25.30	13.00	12.80	95.00	78.00	17.00	0.00
2007	50th	14.20	23.90	13.00	10.80	98.00	85.00	13.00	0.00
	51th	8.00	25.50	13.00	12.20	95.00	70.00	25.00	0.00
	52nd	14.20	13.50	11.00	13.00	100.00	82.00	18.00	0.00
	1st	16.40	19.10	9.90	9.20	95.00	79.00	16.00	0.00
	2nd	13.20	23.00	8.00	15.00	99.00	58.00	41.00	0.00
	3rd	11.30	21.20	7.10	14.10	99.00	55.00	44.00	0.00
	4th	15.70	23.10	9.50	13.60	100.00	57.00	43.00	0.00
	5th	9.60	25.50	13.30	12.20	98.00	64.00	34.00	0.00
	6th	4.00	21.90	14.30	7.60	98.00	73.00	25.00	43.70
	7th	4.20	21.30	12.30	9.00	96.00	74.00	22.00	28.30
	8th	7.20	25.70	12.10	13.60	96.00	52.00	44.00	0.00

Year	Standard week	Whitefly	Temperature (^{0}c)			Relative Humidity (%)			Rainfall (mm)
			Max.	Min.	Gradient	Max.	Min.	Gradient	
	9th	4.40	24.60	14.30	10.30	95.00	66.00	29.00	10.30
	10th	7.30	27.10	12.60	14.50	97.00	41.00	56.00	0.00
	11th	6.00	28.10	14.90	13.20	87.00	46.00	41.00	0.00
	12th	5.00	29.30	16.90	12.40	87.00	53.00	87.00	3.30
	13th	5.80	32.20	17.80	14.40	85.00	44.00	41.00	0.00
	14th	4.50	30.50	20.30	10.20	88.00	66.00	22.00	18.70
	15th	4.00	26.70	18.90	7.80	84.00	66.00	18.00	23.20
	16th	3.90	31.90	20.50	11.40	97.00	62.00	35.00	98.80
S Em (±)		**1.95**							
LSD(0.05%)		**5.46**							

Table 2:Correlation co-efficient and multiple regression between whitefly and environmental parameters.

Environmental parameters		Correlation co-efficient (r)	Co-efficient of determination (R^2)	Regression Equation
Temperature	Maximum	-0.681**		
	Minimum	-0.783**		
	Gradient	0.531**		Y=9.906 – $1.361X_1$+
Relative Humidity	Maximum	0.479**	0.7273*	$0.793X_2$+
	Minimum	-0.051		$1.433X_3$ - $0.016X_4$ + $0.122X_5$ –
	Gradient	0.045		$0.014X_6$ - $0.013X_7$
Rainfall		-0.538**		

** Significant at 1% level of significance * Significant at 5% level of significance

Table-3 Efficacy of insecticides against whitefly

Treatment	Concentration	Mean percent Mortality			Overall mortality
		3 D.A.S.	8 D.A.S.	14 D.A.S.	
N.S.K.E.	5%	78.56	65.66	41.88	62.03
		(62.47)	(54.14)	(40.30)	(51.97)
Tobacco leaf extract	2.5%	74.20	61.88	34.67	56.92
		(59.82)	(51.90)	(36.03)	(48.98)
Imidachloprid	0.0023%	96.53	76.08	45.09	72.57
		(75.44)	(59.26)	(42.54)	(57.42)
Azadirachtin	0.00015%	81.09	67.37	44.39	64.28
		(64.43)	(55.22)	(41.77)	(53.30)
Endosulfan	0.07%	92.59	74.69	47.52	71.60
		(75.59)	(59.87)	(43.58)	(57.80)
Chlorpyriphos + Cypermethrin	0.05%	93.06	72.07	45.40	70.18
		(78.78)	(60.43)	(42.54)	(57.92)
Cartap Hydrochloride	0.05%	88.65	72.12	44.92	68.56
		(70.65)	(58.21)	(42.08)	(55.91)
Carbaryl	0.13%	93.35	72.03	43.20	69.53
		(75.23)	(58.21)	(41.08)	(56.52)
Acetamiprid	0.0027%	91.92	72.41	43.97	69.43
		(74.08)	(58.43)	(41.53)	(56.45)
Quinolphos + Cypermethrin	0.07%	94.37	73.57	45.78	71.24
		(76.66)	(59.16)	(42.56)	(57.57)
Control	-	0.00	0.00	0.00	0.00
		(4.05)	(4.05)	(4.05)	(4.05)
S. Em (±)		**2.72**	**1.73**	**1.78**	**0.77**
C.D. (0.05%)		**8.01**	**5.12**	**5.26**	**2.26**

Figures in the parenthesis are angular (ARC SIN)transformed value.