P: ISSN No. 0976-8602 RNI No.UPENG/2012/426228 VOL.-III, ISSUE-IV, October-2014
E: ISSN No. 2349 - 9443
Asian Resonance

Estimation of Economic Decision Levels of Aphid, *Aphis Craccivora* Koch on Indian Bean, *Lablab Purpureus* (Linn.) Sweet

Bhavana Godwal
Department of Entomology,
S. K. N. College of Agriculture
Skrau, Jobner,
Rajasthan.

K.C. Kumawat
Department of Entomology,
S. K. N. College of Agriculture
Skrau, Jobner,
Rajasthan.

S.K. Khinchi
Department of Entomology,
S. K. N. College of Agriculture,
Skrau, Jobner,
Rajasthan.

Abstract

In the present investigation conducted during *Kharif*, 2009, the management cost incurred at highest net return was Rs. 2049.00 ha^{-1}. The gain threshold of 341.5 kg ha^{-1} was computed on the basis of whole sale price of pods of Indian bean (Rs. 6.00 kg^{-1}) and current management cost (Rs. 2049). The corresponding value of economic injury level (EIL) was worked out to be 24.19 aphids per shoot. In the field, the mean aphid population was found to be increased at the rate of 3.09 aphids per day per shoot. Based on economic injury level (EIL), the economic threshold level (ETL) was estimated to be 21.10 aphids per shoot.

Keywords: Economic threshold level, economic injury level, gain threshold, *Aphis craccivora*, Indian bean.

Introduction

The chemical control of aphid, *Aphis craccivora* Koch to suppress its population effectively has been recommended by many workers (Khurana and Kaushik, 1991;Sharma et al.,1991 and Uddin *et al.,* 2002) but the schedules are calendar based, hence would lead to injudicious use of insecticidal treatments, quite harmful to the natural biotic agencies, cause ecological backlash and may not be economical. Therefore, the present study aims to reduce the number of sprays and ultimately reduce the amount of insecticidal pressure in the environment by determining the economic decision levels (threshold levels). There is no doubt that economic decision levels are the key stones of insect pest management programmes. Such levels are indispensable because these indicate the course of action to be taken in any given pest situation. The sensible pesticide use is possible only with an understanding of pest population level that causes economic damage. Indeed, without such knowledge, risk causing absurd economic blunders like spending more to suppress an insect population rather than the value of commodity the pest could destroy is focussed. Conversely, understanding and properly using economic decision levels in dealing with pest can increase producer’s profit and conserve environmental quality.

Materials and Methods

To estimate economic decision levels of aphid on Indian bean, Lablab purpureus (Linn.) Sweet, the local variety (Laxmi) was grown in caged condition in simple Randomized Block Design (RBD) during *Kharif,* 2009, replicated thrice. The individual plot size was 1.5 x 2.25 m^2, keeping row to row and plant to plant distance of 1.5 m x 0.45 m, respectively. Eight arbitrary levels of aphid population (starting from 10 aphids per shoot at an interval of 10 aphids) along with farmers’ practice (spray irrespective of aphid population at fortnightly interval) and an untreated control was maintained. These levels were considered as treatments. There were ten treatments including untreated control. For this purpose, the crop was raised in caged condition to avoid the infestation of other insect pests. As soon as the plants outside the cage were observed to have natural infestation, the aphid population was inoculated on the plants grown in caged conditions. As soon as the plant harboured the arbitrary level of population, they were sprayed alternately with dimethoate 30 EC and endosulfan 35 EC @ 0.03 and 0.05 per cent, respectively. These sprays were repeated as and when the plots acquired the arbitrary level of population again. The pod yield in each plot was recorded at each picking.

The yield per plot was converted into per hectare and was subjected to analysis of variance. The benefit-cost ratio of individual treatment was worked out taking into consideration the cost of treatment and gross return per hectare. The regression coefficient (Ordinary least square estimates) was worked out between the population levels and yield parameter for convenience in further algorithm of EIL (Acharya and Madnani, 1988). Taking into consideration, the reduction in yield due to different levels of aphid density; the gain threshold and economic injury level (EIL) was determined using the method suggested by Johnson and Bishop (1987) and Pedigo (1989).

$$\text{Gain threshold (kg ha}^{-1}) = \frac{\text{Management cost (Rs ha}^{-1})}{\text{Market value of the produce (Rs kg}^{-1})}$$

$$\text{EIL} = \frac{\text{Gain threshold (kg ha}^{-1})}{\text{Regression coefficient}}$$

Results and Discussion

Pod Yield and Economics of Insecticidal Treatments at Various Levels of Aphid Population

The pod yield of Indian bean owing to the different aphid densities (starting from 10 and ending at 80 per shoot at an interval of 10) in different plots exhibited a decreasing pattern of yield with the increased aphid density per shoot (Table-1). The pod yield was maximum, viz., 126.20 q ha^{-1} at the level of 10 aphids per shoot, vis-à-vis, minimum, viz., 116.98 q ha^{-1} in the level of 80 aphids per shoot. However, the pod yield obtained in 20 and 30 aphids per shoot revealed non-significant difference with the yield obtained in 10 aphids per shoot. The pod yield drastically reduced in control (untreated) plots to 46.02 q ha^{-1} which differed significantly with other treatments or levels. In the farmers' practice (insecticide sprays irrespective of pest population), the pod yield of 120.01 q ha^{-1} was obtained.

The maximum increase in yield over control (untreated) was recorded in the level of 10 aphids per shoot (80.18 q ha^{-1}). This level was followed by the 20, 30, 40, 50, 60, 70 and 80 aphids per shoot. However, in farmers' practice, the increase in yield was 73.99 q ha^{-1}. The increase in yield was maximum in 10 aphids per shoot (80.18 q ha^{-1}), whereas, it was minimum in 80 aphids per shoot (70.96 q ha^{-1}). Maximum gross returns (Rs 48,108 ha^{-1}) were obtained when the population of aphids was maintained at 10 per shoot. This treatment was maintained at 10 per shoot. This treatment was followed by 20 aphids per shoot (Rs. 47,700.0 ha^{-1}). The expenditure incurred in maintaining different levels of aphid population ranged from Rs. 1220.5 to 2485.5 ha^{-1}. The minimum expenditure incurred in maintaining 80, 70 and 60 aphids per shoot (Rs. 1250.5 ha^{-1}). Maximum expenditure was incurred in maintaining 10 aphids per shoot (Rs. 2485.5 ha^{-1}).

Ordinary Least Square Estimates (OLS) of Two Variables Simple Linear Regression

The relationship between two variables is linear if the change is constant throughout the whole range under consideration. Similar relationship is evident between the aphid density per shoot and the pod yield of Indian bean (Table-2). The graphical representation of a linear relationship is a straight line, where Y constantly increases for each unit increase in X throughout the whole range of X value. The functional form of linear relationship between a dependent variable Y and independent variable X is represented by the equation:

$$Y = \alpha + \beta x$$

Where,

α = Intercept of the line on the Y axis.

β = Linear regression coefficient, is the slope of the line or the amount of change in Y for each unit change in X.

The correlation analysis indicated that there existed a significant inverse correlation (r = -0.98) between the aphid population and the pod yield of Indian bean (Table-3). However, the simple correlation does not disclose the facts of economic significance, a regression equation Y = 127.39-0.141X was obtained which permitted the amount of resultant yield loss for each unit of aphid density. The equation indicated that 127.38 is the intercept and presence of one aphid per shoot was responsible to cause loss of pod yield of 0.141 q ha^{-1}. The economic analysis showed that highest net return of Rs. 45,651.00 ha^{-1} during the crop season was obtained when aphid density was maintained at 20 per shoot. A decreasing trend was evident when aphid density was increased.

Gain threshold, EIL and ETL

The gain threshold represents the beginning point of economic damage.In the present investigations,the management cost incurred in highest net return was Rs. 2049.00 ha^{-1}.The gain threshold (341.5 kg ha^{-1}) was computed on the basis of whole sale price of pods of Indian bean (Rs. 6.00 kg^{-1}) and current management cost (Rs. 2049) as shown in table-4. The corresponding value of economic injury level (EIL) was worked out to be 24.19 aphids per shoot. In the field, the mean aphid population was found to increase to 3.09 aphids per day per shoot. Based on economic injury level (EIL), the economic threshold level (ETL) was estimated as 21.10 aphids per shoot. Earlier, El-Defrawi et al. (1998) reported EIL of 50.9 aphids per shoot and ETL of 34.3 aphids per shoot on faba bean, *Vicia faba* cultivar Giza-2. The EIL of *A. craccivora* population on green gram was reported to be 10-16 aphids per plant by Sharma et al. (2000). The variation in these decision levels from the present findings might be due to the different crop, varied agro-climatic conditions of the particular locality and variations in the price of inputs like insecticides, labour etc.

The highest Net return (Rs 45,651.0) was obtained from plots where the aphid population was maintained at 20 aphids per shoot followed by 10 aphids per shoot (Rs 45,622.5). The correlation analysis showed a significant inverse correlation between aphid population and the pod yield of Indian bean (r = -0.98). Gain threshold and EIL was found to be 341.5 kg ha^{-1} and 24.19 aphids per shoot, respectively, whereas the ETL was found to be 21.10 aphids per shoot at the current market prices.

Acknowledgements

The authors are highly grateful to the Dean, S.K.N. College of Agriculture, Jobner and Vice-Chancellor, SKNAU for providing necessary facilities to conduct the studies.

References

1. Acharya and Madnani, 1988. Applied Econometrics for Agricultural Economists. Himanshu Publication, Udaipur, pp. 50-53.
2. El-Defrawi, G.M., Emam, A.K. and Shalaby, F.H., 1998. Economic injury levels and economic thresholds of Aphis craccivora Koch on fababean in Egypt (Homoptera: Aphididae). Ann. agric. Sci. 43: 289-298.
3. Johnson, R.L. and Bishop, G.W. 1987. Economic injury levels and economic threshold for cereal aphids on spring planted wheat. J. econ. Ent. 80: 478-482.
4. Khurana, A.D. and Kaushik, H.D. 1991. Bioefficacy of insecticides against Aphis craccivora Koch and Agrotis ipsilon (Hufn.) on chickpea. J. Insect Sci. 4: 193-194.
5. Pedigo, L.P. 1989. Economic Decision Levels for Pest Population. In Entomology and Pest Management. Prentice Hall Englewood Cliff, New Jersey, pp. 243-269.
6. Sharma, R.P., Yadav, R.P. and Singh. R. 1991. Relative efficacy of some insecticides against the field population of bean aphid, Aphis craccivora Koch and safety to the associated aphidophagous coccinellid complex occurring on Lathyrus, lentil and chickpea crops. J. Ent. Res. 15: 251-259.
7. Sharma, K.K., Dutta, S.K. and Borah, B.K. 2000. Economic injury level of Aphis craccivora Koch in green gram var. AAU-34. Crop Res. 23: 463-468.
8. Uddin, M.N., Islam, K.S. and Das, G. 2002. Effect of malathion on bean aphid, Aphis craccivora Koch and its predator, Menochilus sexmaculatus (Fab.). Bangladesh J. Training and Dev. 15: 211-214.

Table 1. Net Return and Benefit-Cost Ratio of Different Population Density of Aphid, *Aphis Craccivora* Koch on Indian Bean, *Lablab Purpureus* During *Kharif*, 2009

S. No.	Population densities of aphid / shoot	Number of sprays	Yield (q ha^{-1})	Increase in yield (q ha^{-1})	Gross return (Rs ha^{-1})	Expenditure (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
1.	10	6	126.2	80.18	48108	2485.5	45622.5	19.36
2.	20	5	125.52	79.50	47700	2049	45651	23.28
3.	30	4	123.05	77.03	46218	1657	44561	27.89
4.	40	4	121.11	75.09	45054	1657	43397	27.19
5.	50	4	119.16	73.14	43884	1657	42227	26.48
6.	60	3	118.51	72.49	43494	1220.5	42273.5	35.64
7.	70	3	117.82	71.80	43080	1220.5	41859.5	35.30
8.	80	3	116.98	70.96	42576	1220.5	41355.5	34.88
9.	Farmers' practice	4	120.01	73.99	44394	1657	42737	26.79
10	Untreated (control)	0	46.02	-	-	-	-	-

Table 2. Ordinary Least Square (OLS) Estimates of Parameters of Two Variable Simple Linear Regression
(Y = α + βX)

S.No.	Y	X_1	Y^2	X^2	$Y.X_1$	y (y -Y)	x (x-X)	y^2	x^2	xy	Y	e (Y- Y)
1	2	3	4	5	6	7	8	9	10	11	12	13
1	126.2	10	15926.44	100	1262.0	5.16	-35	26.63	1225	-180.6	125.98	0.22
2	125.52	20	15755.27	400	2510.4	4.48	-25	20.07	625	-112	124.57	0.95
3	123.05	30	15141.30	900	3691.5	2.01	-15	4.04	225	-30.15	123.16	-0.11
4	121.11	40	14667.63	1600	4844.4	0.07	-5	0.005	25	-0.35	121.75	-0.64
5	119.16	50	14199.11	2500	5958.0	-1.88	5	3.53	25	-9.4	120.34	-1.18
6	118.51	60	14044.62	3600	7110.6	-2.53	15	6.40	225	-37.95	118.93	-0.42
7	117.82	70	13881.55	4900	8247.4	-3.22	25	10.37	625	-80.50	117.52	0.30
8	116.98	80	13684.32	6400	9358.4	-4.06	35	16.48	1225	-142.1	116.11	0.87
Total	968.35	360	117300.24	20400	42982.7	-3.15	0	87.52	4200	-593.05	938.36	0.01

Table 3. Correlation and Regression Coefficient Between Aphid Population and Pod Yield of Indian Bean, *L. Purpureus* During *Kharif,* 2009

S.No.	Aspect	Correlation coefficient (r value)*	Regression equation (y = α + βx)**	Coefficient of determination (R^2)
1	Aphid population vs pod yield	-0.98	Y= 127.39 -0.141 X (0.012)	0.96

* Significant at 5 per cent level
** Significant at 1 per cent level

Table 4. Gain Threshold, Economic Injury Level (EIL) and Economic Threshold Level (ETL) of Aphid, Aphis Craccivora Koch on Indian Bean, L. Purpureus During Kharif, 2009

S. No.	Treatments	Management cost of varying prices (Rs/ha)	Gain threshold (kg/ha)	EIL (aphids /shoot)	Increase rate of population of aphids /days	Economic threshold levels (aphids/ shoot)
1.	Alternate sprays of dimethaote 30 Ec and endosulfan 35 Ec	2049	341.50	24.19	3.09	21.10*
2.	”	2253.9	375.65	26.64	3.09	23.55**
3.	”	2458.8	409.80	29.06	3.09	25.97**

* ETL calculated at current prices of insecticides and labour cost
** ETL calculated at 10 and 20 per cent higher prices of insecticides and labour cost