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Estimation of Economic Decision Levels of Aphid, *Aphis craccivora* Koch on Cowpea, *Vigna unguiculata* (Linn.) Walp. (Grown for Vegetable)

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Abstract

The study on estimation of economic decision levels of aphid, *Aphis craccivora* Koch on cowpea, *Vigna unguiculata* (Linn.) Walp. (grown for vegetable) was conducted at SKN College of Agriculture, Jobner. The highest net return (Rs. 11044 ha-1) was obtained from the plots where the aphid population was at 7.71 aphids per central shoot followed by 27.02 aphids per central shoot (Rs. 9674 ha-1). The correlation analysis showed a significant inverse correlation between aphid population and the pod yield of cowpea (r = -0.98). The gain threshold and EIL was found to be 213.60 kg ha-1 and 16.18 aphids per central shoot, respectively. The ETL was worked out to be 14.63 aphids per central shoot at the current market prices.

Keywords: Economic Threshold Level, Economic Injury Level, Gain Threshold, *Aphis craccivora*, Cowpea.

Introduction

The cowpea [*Vigna unguiculata* (Linn.)] Walp.(family: Leguminosae), whether utilized for green pods as vegetable or dry seed as pluse, forms an important component of farming systems from the arid to the humid tropics covering parts of Asia, Middle East, Southern Europe, Africa, Southern USA and Central and South America.

Cowpea cultivars with long pods grown as vegetable. Vegetable are variously known as asparagus bean, snake bean, Chinese long bean and yard long bean; when grown for medium-long immature pods for vegetable are known as cowpea, snap bean etc. Insect pests are major constraints in enhancing the productivity of cowpea. A very little work has been carried out on the cowpea grown as vegetable crop.

Comparatively a number of insect pests are associated with this crop, viz., aphid, *Aphis craccivora* Koch; pod borer, Maruca testulalis (Geyer); galerucid beetle, Madurasia obscurella (Jacoby); cowpea curculio, Chalcodermus aeneus (Boheman) etc. Among these, the aphid A. craccivora (Hemiptera: Aphididae) has been reported as major insect pest of cowpea (Attia et al. 1986, Dhaliwal 2008). Both nymphs and adults cause damage by sucking the cell sap on the tender portions of plants including lower side of the leaves. The chemical control of aphid, A. craccivora has been recommended by many workers to suppress its population effectively (Khurana and Kaushik, 1991; Sharma et al., 1991 and Uddin et al., 2002) but the schedules are calendar based. This would lead to injudicious use of insecticidal treatments, harmful to the natural biotic agencies and not economical. Therefore, the present study aims to use the insecticides in a judicious manner, ultimately reducing the amount of insecticides by determining the economic decision levels (threshold levels). Such levels are indispensable because they indicate the course of action to be taken in any given pest situation. The sensible pesticide use is possible only with an understanding of the pest population level that causes economic damage. Indeed, without such knowledge, people risk making absurd economic blunders like spending more to suppress an insect pest than the value of the commodity the insect pest could destroy. 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 aphids on cowpea, the variety Pusa Komal was grown in caged condition in simple Randomized Block Design (RBD) with eight treatments including untreated, replicated thrice. The individual plot size was 2.40 x 1.5 m2, keeping row to row and plant to plant distance of 30 cm x 20 cm, respectively. The crop was sown on 7th July, 2013. Eight treatments comprising spray of dimethoate 30 EC @ 0.03 per cent and malation 50 EC @ 0.05 per cent at different crop phenology as mentioned in table-1 were kept in this study.The sprays of insecticides were done alternately with these insecticides. In the treatments, wherever single spray is mentioned, it was done with dimethoate 30 EC. The sprays were repeated at a definite interval as mentioned in the individual treatment.

Table 1

Insecticidal Spray Interventions at Different Crop Phenology of Cowpea to Study Economic Decision Levels

S.No.	Treatments
1.	T_1 – One spray at commencement of aphid population with dimethoate 0.03%
2.	T_2 – Two sprays (T_1 + malathion 0.05% after 15 days of T_1)
3.	T_3 - Three sprays (T_1 + malathion 0.05% + dimethoate 0.03% at 15 days interval)
4.	T_4 – Four sprays (T_1 + malathion 0.05% + dimethoate 0.03% + malathion 0.05% at 10 days interval)
5.	T_5 – Three sprays (As in the T_4 except T_1)
6.	T_6 – Two sprays (Last two sprays of T_4)
7.	T_7 – One spray (Last spray of T_4)
8.	T_8 - Untreated

The first spray was applied as soon as the population of aphid appeared. The data on population of aphid was recorded one day before application of treatments on five randomly selected and tagged plants, thereafter; the population was recorded at weekly interval. The pod yield of cowpea in each treatment was recorded after every harvesting of the crop. The pod yield per plot was converted into per hectare and was subjected to analysis of variance.

The net return 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 pod yield due to different levels of aphid density; the gain threshold and economic injury level (EIL) was determined using the method suggested by Pedigo (1989), and Johnson and Bishop (1987).

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

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

Results and Discussion

1 **Yield and Net Return**

In the present study, the maximum increase in yield over control (untreated) was recorded at 7.71 aphids per central shoot (13.18 q ha-1) as revealed in table-2. This level was followed by the 27.02, 30.20, 35.73, 57.20 and 79.11 aphids per central shoot. The increase in yield was minimum in 88.08 aphids/ central shoot (3.72 q ha-1). The present data showed that increase in aphid population was responsible for decreasing the pod yield. The gross return was found maximum when the population of aphids was at 7.71 per central shoot (Rs. 13,180 ha-1) followed by 27.02 aphids per central shoot (Rs. 11,330 ha-1). The expenditure incurred in maintaining the various levels of aphid population ranged from Rs. 480 to 2136 ha-1, the maximum in 7.71 aphids/ central shoot and minimum in 88.08 aphids per central shoot. The maximum net return was obtained when the population level of 7.71 aphids/ central shoot was observed (Rs. 11,044) which was followed by Rs. 9,674 ha-1 at 27.02 aphids per central shoot. The minimum net return, viz., Rs. 3240 ha-1 was obtained while the population level was maintained at 88.08 aphids per central shoot.

2 **Ordinary least square estimates (OLS) of two variables simple linear regression**

The OLS is presented in table-3. 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 central shoot and the pod yield of cowpea. The graphical representation of a linear relationship is a straight line. Here, 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 was a significant negative correlation (r = -0.98) between the aphid population and the pod yield of cowpea (Table-4). However, the simple correlation does not disclose the facts of economic significance, a regression equitation Y = 98.43 – 0.1320 X was obtained which permitted the amount of resultant yield loss for each unit of aphid density. The graphical representation of a linear relationship is a straight line. The equation indicated that 98.43 is the intercept and presence of one aphid per central shoot was responsible to cause loss of pod yield @ 0.1320 q ha-1.The economic analysis showed that highest net return of Rs 11,044 ha-1 during the crop season was obtained when aphid density was maintained at 7.71 per central shoot. A decreasing trend was evident when aphid density increased. Similar trend was observed by earlier workers such as Sharma et al. (2000).

3 **Gain threshold, EIL and ETL**

The management cost incurred at highest net return (Rs. 11044 ha-1) was Rs. 2136.00 The gain threshold was computed on the basis of whole sale price of pods of cowpea (Rs.10.00 kg-1) and current management cost (Rs 2136.00) which come to be 213.60 kg ha-1 (Table-5). The corresponding value of economic injury level (EIL) was worked out to be 16.18 aphids per central shoot. In the field, the mean aphid population was found to be increased to 1.55 aphids per day per central shoot. Based on economic injury level (EIL), the economic threshold level (ETL) was estimated as 14.63 aphids per central shoot. Earlier, Godwal (2010) reported EIL of 24.9 aphids per central shoot and ETL of 21.10 aphids per central shoot on Indian bean. The EIL of A. craccivora population on green gram was reported as 10-16 aphids per plant by Sharma et al. (2000). A slight variation in these decision levels from the present findings might be due to the different crops, varied agro-climatic conditions of the particular locality and variations in prices of inputs like insecticides, labour etc.

Conclusion

The study on estimation of economic decision levels of aphid*, Aphis craccivora* Koch on cowpea, *Vigna unguiculata* (Linn.) Walp. (grown for vegetable) revealed the EIL as 16.18 aphids per central shoot and ETL as 14.63 aphids per central shoot at the current market prices.

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References

1. Acharya, S.S. and Madnani, G.M.K. 1988. *Applied Econometrics for Agricultural Economists,* Himanshu Publication, Udaipur, pp. 50-53.
2. Attia, A.A.; El-Heneidy, A.H and El-Kady, E.A. 1986. Studies on the aphid, *A. craccivora* Koch (Homoptera : Aphididae) in Egypt*. Bulletin de la Societe Entomologique d' Egypt,* 66: 319 - 324.
3. Dhaliwal, G.S. 2008. Cowpea. *Handbook of Vegetable Crops*, Kalyani Publisher, New Delhi, pp. 67.
4. Godwal, B. 2010. Population dynamics and varietal preference of aphid, *Aphis craccivora* Koch on Indian bean, *Lalab purpureus* (Linn.) Sweet. M. Sc. (Ag.) thesis submitted to the SK Rajasthan Agricultural University, Bikaner, Campus - Jobner.
5. Johnson, R.L. and Bishop, G.W. 1987. Economic injury levels and economic threshold for cereal aphids on spring planted wheat. *Journal of Economic Entomology*, 80 (2): 478-482.
6. Khurana, A.D. and Kaushik, H.D. 1991. Bio-efficacy of insecticides against *Aphis craccivira* Koch and *Agrotis ipsilon* (Hufn.) on chickpea. *Journal of Insect Science*, 4: 193-194.
7. Pedigo, L.P. 1989. Economic decision levels for pest population*. Entomology and Pest Management.* Prentice Hall Englewood Cliff, New Jersey, pp. 243-269.
8. 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 Research*, 23: 463-468.
9. Sharma, R.P.; Yadav, R.P. and Singh. R. 1991. Relative efficacy of some insecticides against the population of bean aphid (*Aphis craccivora* Koch) and safety to the associated aphidophagous coccinellid complex occurring on *Lathyrus*, lentil and chickpea crops. *Journal of Entomological Research,*15: 251-252.
10. 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 Journal of Training and Development*,15 : 211-214.

Table 2.

Net Return in Management of aphid, *Aphis craccivora* Koch at different population densities

S. No.	Population densities of aphid/ central shoot	Number of sprays	Yield (q ha^{-1})	Increase in yield over untreated control (q ha^{-1})	Gross return over untreated control (Rs ha^{-1})	Expenditure (Rs ha^{-1})	Net return (Rs ha^{-1})
1	79.11	1	88.11	4.11	4110.00	588.00	3522.00
2	35.73	2	93.06	9.06	9060.00	1068.00	7992.00
3	27.02	3	95.33	11.33	11330.00	1656.00	9674.00
4	7.71	4	97.18	13.18	13180.00	2136.00	11044.00
5	30.20	3	94.00	10.00	10000.00	1548.00	8452.00
6	57.20	2	92.05	8.05	8050.00	1068.00	6982.00
7	88.08	1	87.72	3.72	3720.00	480.00	3240.00
8	99.56	Untreated	84.00	-	-	-	-

Table 3. Ordinary least square (OLS) estimates of two variable simple linear regression (Y = α + βX)

S. No.	X	Y	X^2	Y^2	Y.X	$x(X-\bar{X})$	$y(Y-\bar{Y})$	x^2	y^2	xy	$\hat{Y}$	$e(Y-\hat{Y})$
1	2	3	4	5	6	7	8	9	10	11	12	13
T1	79.11	88.110	6258.234	7763.372	6970.294	26.034	-3.321	677.769	11.031	-86.465	87.995	0.115
T2	35.73	93.060	1276.633	8660.164	3325.034	-17.345	1.629	300.849	2.653	-28.251	93.721	-0.661
T3	27.02	95.330	729.918	9087.809	2575.531	-26.058	3.899	679.019	15.200	-101.594	94.871	0.459
T4	7.71	97.180	59.413	9443.952	749.063	-45.367	5.749	2058.165	33.048	-260.804	97.419	-0.239
T5	30.20	94.000	911.798	8836.000	2838.424	-22.879	2.569	523.449	6.598	-58.770	94.451	-0.451
T6	57.20	92.050	3272.069	8473.203	5265.444	4.127	0.619	17.032	0.383	2.554	90.887	1.163
T7	88.08	87.720	7757.206	7694.798	7725.939	35.000	-3.711	1225.000	13.773	-129.894	86.812	0.908
T8	99.56	84.000	9912.791	7056.000	8363.292	46.488	-7.431	2161.134	55.223	-345.464	85.296	-1.296
Total	424.600	731.450	30178.062	67015.298	37813.021	0.000	0.000	7642.417	137.910	-1008.688	731.450	0.000
Mean	53.075	91.431										

Table 4. Correlation and Regression Coefficient Between Aphid Population and Pod Yield of Cowpea

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 = 98.43 - 0.1320X (0.009)	0.97

*Significant at 5 per cent, **Significant at 1 per cent

Table 5
Gain threshold, Economic Injury level (EIL) and Economic threshold Level (ETL) of Aphid, Aphis Craccivora Koch

S. No.	Treatments	Management cost at varying price ($Rs\ ha^{-1}$)	Gain threshold ($Kg\ ha^{-1}$)	EIL(aphids/ central shoot)	Increase in rate of aphid/ day	Economic threshold level (aphids/ shoot)
1	Alternate spray of Dimethoate 30 EC and Malathion 50 EC	2136.00	213.60	16.18	1.55	14.63
2	“	2349.6	234.96	17.80	1.55	16.25
3	“	2563.2	256.32	19.42	1.55	17.87

EIL calculated at current price of insecticide and labour cost
EIL calculated at 10 and 20 per cent higher price of insecticide and labour cost