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Estimation of Economic Injury Levels of *Aphis craccivora* Koch. for IPM in Cowpea in Chittagong, Bangladesh.

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ABSTRACT:

Cowpea aphids *Aphis craccivora* Koch is considered to be one of the major pests of cowpea. To estimation the economic threshold level and economic injury level for *Aphis craccivora* nymph on cowpea crop were worked out. On an average, 20 nymphs per m row reduced the yield to the extent of 49 kg/ha and 79 kg/ha in 2010-2011 and 2011-2012 cropping season, respectively. EILs for *Aphis craccivora* were determined as 20 and 21 per m row and ETLs was at 15 and 15.75 nymphs per m row in 2010-2011 and 2011 -2012, respectively.

Key Words: Economic Threshold Level, Economic Injury Level, IPM, Cowpea, *Aphis craccivora.*

INTRODUCTION:

The knowledge of Economic Threshold Level helps to determine whether an insect is to be classified as a pest or not. Economic Threshold Level (ETL) means the pest density at which management action should be taken to prevent an increasing pest population from reaching the Economic Injury Level (EIL)**." Stem *et al***. **(1959**). **Pierce (1934)** developed the ideas with regard to the assessment of insect damage and the commencement of control measures that became one incentive for the development of a concept of Economic Injury Level (EIL) in the later years. Economic Injury Level actually deals the smallest number of insects (amount of injury) that will cause yield losses which is equal to the insect management costs. The EIL has been taken as the break-even point, the level of pest a plant can tolerate, among other things. The main point is that we like to manage the pest population before it reaches the EIL. That is where the ET comes in. The ET is the practical rule used to determine when to take management action. In fact, some refer to the ET as the action threshold. It is essentially a prediction of when a pest population is going to reach the EIL.

Cowpeas mostly are grown on the African continent, particularly in Nigeria and Niger which account for 66% of world cowpea production. Outside of Africa, the major production areas are Asia, Central America, and South America. Brazil is the world's second-leading producer of cowpea seed, accounting for 17% of annual cowpea production, although most is consumed within the country. Cowpea is the most important pulse in Bangladesh in terms of acreage and production amount (**BBS, 1998**). The 100 g pods contain 84.6 g moisture, 4.3 g protein, 0.9 g minerals (calcium 80 mg, phosphorus 74 mg and iron 2.5 mg) and 13 mg vitamin C **(Dhaliwal, 2008).**

There are many factors responsible for low yield, among which insect pests appear to be the most vital. In bad infestations insect pressure is responsible for over 90% loss in yield. Cowpea is attacked by more than 36 species of insect pests in India **(Nayar *et al*., 1982; Davis and Lateef 1979).** A number of insect pests are associated with cowpea 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 of aphid cause damage by sucking the cell sap specially the tender portions of plants i.e. lower side of the leaves. During severe infestation, all parts of the plants including the pods are covered by aphids. The serious infestation results in stunted plant growth and decreased yield. The honey dew secretion of the aphid provides suitable media for the development of sooty mould which ultimately hampers the process of photosynthesis **(David and Kumarswami, 1982).** In Bangladesh, 30 to 40 percent pods were found to be damaged by this pest **(Rahman, 1990).**

Therefore, the present investigation was aimed to determine the economic injury levels of *Aphis craccivora* Koch infesting cowpea.

MATERIAL AND METHOD:

The experiment was conducted to determine the injury levels and yield loss of Cowpea due to aphid infestation in Chittagong during two rabi seasons 2010-2011 and 2011-2012.

The methods of artificial infestation by different levels of nymph population were followed to establish the economic injury levels of *Aphis craccivora* Koch. The ETL was determined based on the benefit cost ratio as suggested by **Farrington (1977).** There were six treatments consisted of six different nymph densities i.e., 0, 20, 40, 60, 80 and 100 nymphs per m row length, released at flowering stage of the crop. Seeds were sown in row maintaining row to row distance of 30 cm. Spacing between plants was kept 30 cm. The experiment was laid out in The Randomized Complete Block Design (RCBD). The third or fourth instars and nymph adults were used for this purpose. The plants of one meter row length was covered with nylon mesh cages of 1.0 x 0.5 x 1.0m size before flowering to avoid natural infestation. The cages were designed in such a way that they did not interrupt ventilation and aeration to the growing plants inside. The nymphs were released once at the time of flowering and subsequently at 15 days interval to maintain constant population throughout. The population density was maintained till the pod maturation stage. The number of total and damaged pods and weight of grains from all the covered plants of each cage were recorded.

Relationship between the larval density and the percentage of pod damaged were worked out by correlation coefficient and regression equations. Yield data were converted into kg/ha. Yield losses due to different treatments were derived by deducting the yield of the respective treatment from the yield of control (where no larvae was released). The value of yield loss was determined according to the wholesale market price of cowpea grains prevailing at Chittagong just after harvest during the season. Eighty percent of the yield loss was considered to be avoided with insecticidal treatment, hence was taken as avoidable loss or yield saved. Benefit cost ratio (BCR) was worked out as the ratio of the value of yield saved to the cost of insecticidal application. Malathion 57 EC was considered for calculating the cost of insecticidal application. Finally, the economic injury level for aphid was calculated by fitting regression equation Y= a+bx, between larval population levels and BCR. The insect density corresponding to unit benefit cost ratio was the economic injury level and economic threshold level was set at 75% of EIL **(Pedigo, 1991).**

RESULTS AND DISCUSSION:

Total number of pods per plant ranged from 45.56 to 55.12 during 2010 -2011 and 42.26 to 56.11 during 2011-2012. The percent pod damage increased significantly with rise in larval density per plant during the two seasons (Table 1 and 2). A density of 20 nymph per plant caused about 15 percent pod damage (15.12% during 2010 - 2011 and 16.12% during 2011 - 2012). However, increase in larval population per meter row did not show proportionate increase in pod damage. **Sharma (1985), Prabhakar *et al*. (1998) and Reddy et al. (2001**) also found in-proportionate increase in the damage of chickpea pods with increase in the larval population levels. A strong positive correlation was found (r^2 = 0.84) during 2010 - 2011 and (r^2 = 0.68) during 2011 - 2012, between larval density and pod damage (Fig. 1).

The grain yield per plant varied from 5.14g to 10.45g during 2010 - 2011 (Table-1) and from 6.13g to 11.43g during 2011 - 2012 (Table-2) corresponding to larval densities of 100 and 0 per meter row length respectively. Twenty nymphs were found to cause 11.89 and 12.99 percent loss in grain yield during 2010 - 2011 and 2011 - 2012 which represent 49 and 79 kg yield loss per hectare respectively (Table 3 and 4). The ratio of the value of yield saved to the cost of insecticide application at one larva per m row was 1.51 and 2.22 during 2010 - 2011 and 2011-2012 respectively.

EIL lies at the pest population density where BCR would be 1.5 and 2.2. In order to calculate the exact nymph density at which BCR would be 1.5, the correlation of nymph density (X) with the BCR (Y) was calculated. There was a strong positive correlation and linear relationship between those two variables (Fig. 2 and 3). The regression equations derived were y = 0.0954x (during 2010 - 2011), y = 0.1062x (during 2011-2012) where, X =Nymph density per m row and Y= BCR.

From the above equations the EILs of *Aphis craccivora* nymphs determined as 20 and 21 nymphs per m row during 2010 - 2011 and 2011 – 2012, respectively. On the basis of means of two years, the EIL value was 20.5 nymphs per m row in cowpea.

Economic threshold level indicates the population density at which control measures should be initiated in order to prevent the population in reaching EIL. According to **Pedigo (1991)-**"we may choose to set ETL conservatively below EIL, say at 75 percent of EIL". Accordingly in the present study ET values were determined from EILs and they were 15 and 15.75 nymphs per m row during 2010 - 2011 and 2011 - 2012, respectively. So on the basis of means of two years, the ETLs value was 15.37 nymphs per m row in cowpea.

Table-1. Effect of insect densities of *Aphis craccivora* on pod damage and yield loss of cowpea at Chittagong during 2010-2011.				
No. of nymphs/m row	Pods/plant (Average of 10 plants)	Pod damage (%)	Yield/plant (g) (Average of 10 plants)	*Yield loss (%)
00	55.12	00.00	10.45	00.00
20	51.23	15.12	9.25	11.89
40	50.56	20.15	7.65	30.25
60	49.25	25.32	6.98	36.45
80	47.15	29.25	6.10	45.16
100	45.56	48.65	5.14	55.12

Table-2. Effect of insect densities of *Aphis craccivora* on pod damage and yield loss of cowpea at Chittagong during 2011-2012.				
No. of nymphs/m row	Pods/plant (Average of 10 plants)	Pod damage (%)	Yield/plant (g) (Average of 10 plants)	*Yield loss (%)
00	56.11	00.00	11.43	00.00
20	50.63	16.12	10.25	12.99
40	49.66	21.18	8.69	29.25
60	48.27	24.33	7.58	39.55
80	46.85	28.28	7.11	45.86
100	42.26	40.25	6.13	59.13

Table-3. Economic analysis of *Aphis craccivora* management of Cowpea at Chittagong during 2010-2011.

No. of larvae per m row	Grain yield (kg/ha)	Yield loss (kg/ha)	Value of yield loss (Tk/ha)	Value of yield loss saved (Tk/ha)	Cost of insecticide application (Tk.)			BCR
					Cost of insecticide (Tk.)	Labour charges (Tk.)	Total cost (Tk)	
00	1612	00	00					
20	1563	49	4900	4100	1500	1200	2700	1.51
40	1450	162	16200	12040	1500	1200	2700	4.45
60	1354	258	25800	18020	1500	1200	2700	6.68
80	1390	222	22200	19023	1500	1200	2700	7.04
100	1245	367	36700	25060	1500	1200	2700	9.28

Price: Cowpea grain = 100 Tk./kg.

Malathion = 1000 Tk./lit. 1.5 Litter Malathion was used.

Table-4. Economic analysis of *Aphis craccivora* management of cowpea at Chittagong during 2011-2012.

No. of larvae per m row	Grain yield (kg/ha)	Yield loss (kg/ha)	Value of yield loss (Tk/ha)	Value yield loss saved (Tk/ha)	Cost of insecticide application (Tk.)			BCR
					Cost of insecticide (Tk.)	Labour charges (Tk.)	Total cost (Tk)	
00	1512	00	00					
20	1433	79	7900	6005	1500	1200	2700	2.22
40	1380	132	13200	11040	1500	1200	2700	4.08
60	1294	258	21800	16027	1500	1200	2700	5.93
80	1198	314	31400	26023	1500	1200	2700	9.63
100	1047	465	46500	27060	1500	1200	2700	10.02

Price: Cowpea grain = 100 Tk./kg.

Malathion = 1000 Tk./lit. 1.5 Litter Malathion was used.

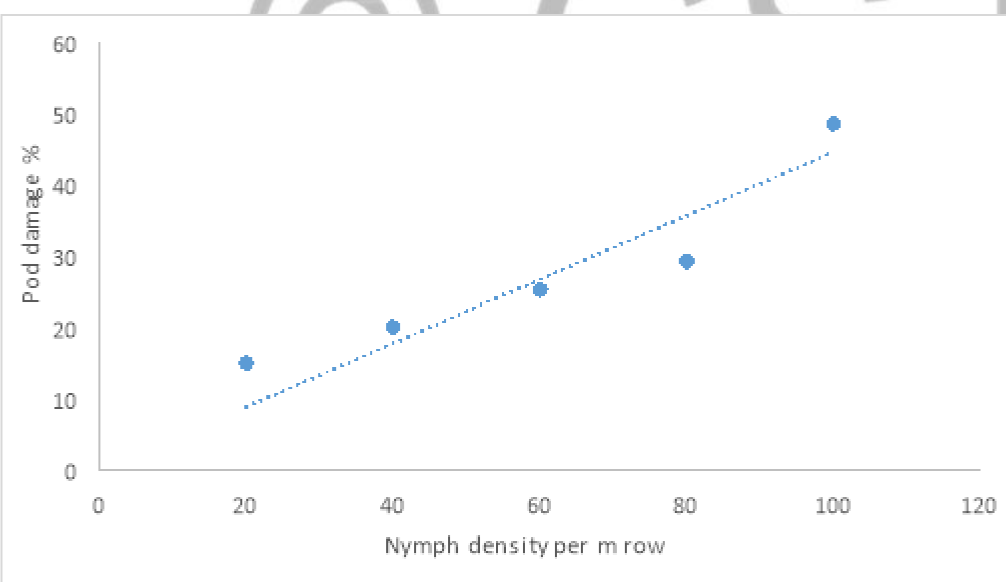

Fig. 1. Relationship between larval densities and pod damage of *Aphis craccivora* in cowpea correlation coefficient at Chittagong during 2010-2011.

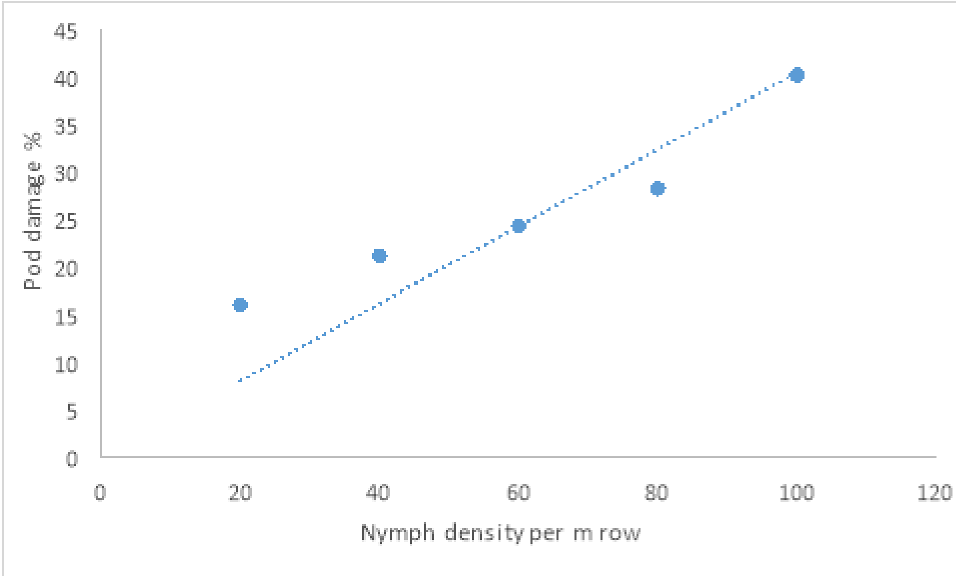

Fig. 2. Relationship between larval densities and pod damage of *Aphis craccivora* in Cowpea correlation coefficient at Chittagong during 2011-2012.

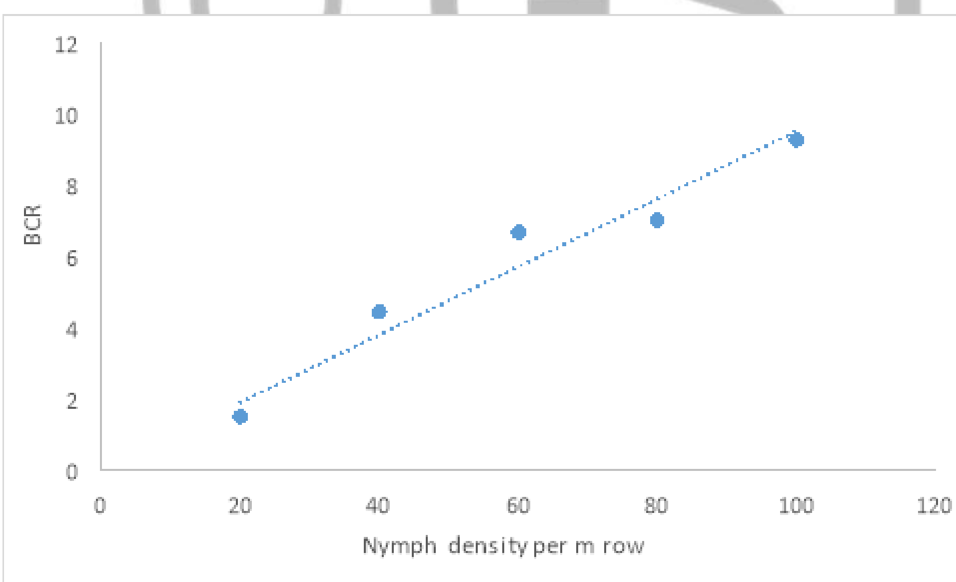

Fig. 3. Relationship between nymph densities (per m row) and BCR during 2010-2011.

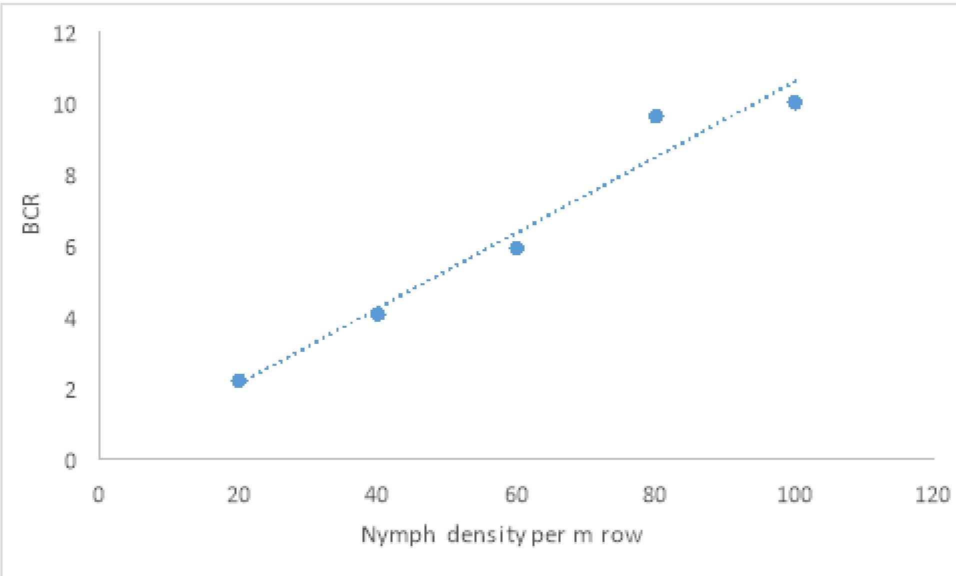

Fig. 4. Relationship between nymph densities (per m row) and BCR during 2011-2012.

CONCLUSION: Results of the present study showed that the control measures should be initiated when the *Aphis* nymph population reaches 20 nymphs per m row length in Cowpea plants in order to prevent the population in reaching economic injury levels because the EIL value was 20.5 nymphs per m row in Cowpea to establish IPM.

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