

**DISTRIBUTION OF *Helicoverpa armigera* (HUBNER),
(LEPIDOPTERA:NOCTUIDAE) EGGS AND LARVAE ON
COTTON PLANT IN PAKISTAN**

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ABSTRACT

Females of *H. armigera* laid eggs on all parts of the cotton plant including terminal buds, leaves, fruiting parts and internodes. Approximately 70% of the eggs were found on the upper followed by the middle and lower parts of the plant. Main stem and branch leaves were more preferred for oviposition. At low infestation rates, 71% of the eggs were found on the main stem leaves but at medium and high levels of infestation, 51-54% of the eggs were found on side branches. Minimum eggs were found on fruiting parts at all levels of infestation. On the main stem, more eggs were laid on leaves up to the seventh node, the highest being on the first and second fully developed leaves. On the side branches, maximum eggs were laid on the first fully expanded leaves and the oviposition decreased towards the main stem. More eggs were found on squares near the tips of branches than flowers and bolls.

Larvae were recorded from all parts of the cotton plant

Maximum young larvae were on top (57.0 %), half -grown on the middle (69.4%) and full-grown on the lower parts of the plant(65 .0%). The highest young larvae were found on squares (48.2%) followed by flowers(23.5%) and vegetative parts (28.3%). Half-grown larvae preferred flowers(42.4%) and full-grown bolls(58.6%). No young larva was found on bolls.

Key words: cotton, eggs and larvae distribution , *Helicoverpa armigera*, lepidoptera, noctuidae.

1. INTRODUCTION

In Pakistan, the American bollworm , *Helicoverpa armigera* (Hubner) (Noctuidae: Lepidoptera) is an important pest of cotton and has been recorded feeding on 65 plant species under a variety of climatic conditions from 20 to 2500 m altitude(Mohyuddin, 1989). In 1967, a severe attack was recorded in some areas of the Punjab, Pakistan , on delta pine cotton varieties resulting in complete cotton failure. In the early 1980s, it became a serious pest of maize, gram, tobacco and cucurbits but remained sporadic on cotton. From 1989 onwards, it became the major pest of cotton and caused considerable damage in 1994 and 1997 because of resistance to the major groups of insecticides (Ahmad *et al.*, 1995 and 1997).

The eggs of this pest were distributed all over the cotton plant but the oviposition pattern was not consistent on cotton (Wilson *et al.*, 1980, Bernhardt and Phillips, 1982, Fitt,1990, Hassan *et al.*,1990).Egg distribution differs significantly between cotton varieties depending on leaf characteristics (Fitt,1987,1988 and 1990). Farrar and Bradley (1985) reported that the distribution of *H. armigera* eggs on cotton can differ, not only from one geographical region to another, but between years also and is influenced by rainfall and pest species composition.Egg distribution had a little effect on the subsequent establishment of the larvae.

For effective control of *H. armigera* with minimum insecticides by targeting the parts of the plant that had maximum eggs and small larvae, the knowledge of their distribution is important . This study reports the distribution of eggs and larvae of *H. armigera* on cotton

cultivar CIM-240.

2.MATERIALS AND METHODS

Distribution of *Helicoverpa armigera* eggs was studied on the cotton cultivar, CIM-240 at three locations during 1994 and 1995 crop seasons. The crop was planted in the first week of June at all the locations. First location was the riverain area about 30 km away from Multan. Second location was about 15 km away from Multan and surrounded by canals and water channels. Third location was near the city at the experimental area of the Central Cotton Research Institute, Multan. These locations varied in the initial level of pest infestation estimated in late August. Therefore, studies were carried out at three levels of natural infestation viz, high, medium and low (where mean numbers of eggs were 15 and 18, 8 and 10 and 3 and 5/plant during 1994 and 1995, respectively). Regular egg counting started in September when pest's activity was at its peak. Randomly selected five plants examined daily up to 25 days each year and in all 150 plants, 75 per year were examined from each location. Eggs deposited on all plant structures were recorded individually on a plant map and were calculated as percentages of total eggs deposited per plant. Egg population on these structures was summarized and is presented on top (from terminal bud to the 10th main stem nodes) middle (from 11th to the 20th main stem nodes) and bottom (from the 21st to cotyledonous nodes) portions of the plant. Eggs recorded on the main stem leaves, side branch leaves and fruiting parts as well as on the terminal bud, unexpanded leaf, expanded leaves, squares, flowers and bolls were summarized separately and presented as percentage of total eggs per plant. To determine the larval distribution of *H. armigera*, the same fields were used where egg distribution study was carried out. Larval population in these locations was almost according to the number of eggs per plant. Larvae in all developmental stage were recorded from all plant parts separately and categorized small (as first and second instars), medium (third and fourth instars) and large (fifth and sixth instars). Data on each larval category on top, middle, bottom portions, reproductive and vegetative parts were summarized separately and presented as percentage of total larvae/plant.

There was no incidence of *Amrasca devastans*, *Thrips tabaci* and *Bemisia tabaci* up to the fifth week after plant emergence at all the locations. These pests were observed from the sixth to the tenth week (from early-July to mid -August) and were controlled with imidacloprid. Bollworms, especially *Earias* spp. were controlled with deltamethrin and *H. armigera* with chlorpyrifos and thiodicarb.

3. RESULTS

3.1. Distribution of *H. armigera* eggs on cotton plant

Number of eggs on the first expanded leaf of the main stem was significantly higher (26.5%) at the low infestation level and on the first two fully expanded leaves at medium and high levels of infestation when individual structures were taken into account. At all levels of infestation, eggs were found consistently on seven expanded leaves and the differences were significant. After this, egg laying was irregular. Minimum eggs were laid on the lower leaves of the plant at all levels of pest infestation (Table 1).

Table (1): Distribution of *Helicoverpa armigera* eggs on the main stem of the cotton plants under different levels of infestation.

Main stem	Levels of pest infestation		
	5 eggs/plant	10 eggs/plant	18 eggs/plant
Terminal bud	10.3 ^{gh}	4.2 ⁱ	9.2 ^{hi}
Unexpanded Leaf	15.6 ^c	7.9 ^{ij}	12.7 ^{dci}
Expanded leaf1	26.5 ^a	19.3 ^b	14.0 ^{cde}
Expanded leaf2	24.1 ^a	24.7 ^a	14.3 ^{cd}
Expanded leaf3	14.7 ^{cd}	18.0 ^b	14.7 ^{cd}
Expanded leaf4	5.8 ^k	12.2 ^{sf}	11.3 ^{fg}
Expanded leaf5	1.8 ⁿ	8.3 ^{ij}	7.4 ^j
Expanded leaf6	0.5 ^{op}	4.2 ⁱ	7.5 ^j
Expanded leaf7	0.2 ^{pq}	0.4 ^{opq}	2.9 ^m
Expanded leaf8-16	0.5 ^{op}	0.8 ^o	2.6 ^{mn}
Internodes	0.0 ^q	0.0 ^q	3.4 ^{im}

Means followed by the same letter are not significantly different (P 0.05).

Oviposition on the main stem and side branch leaves showed preference for main stem leaves at low infestation level. However, at medium levels of infestation, the highest number of eggs was laid on side branch leaves and the differences were significant. Statistically, lower number of eggs was found on fruiting parts at all levels of pest infestation (Table 2).

Table (2): Distribution of *Helicoverpa armigera* eggs on different parts of the cotton plant at different levels of infestation.

Plant parts	Levels of pest infestation		
	5 eggs/plant	10 eggs/plant	18 eggs/plant
Main stem leaves	7.2 ^a	39.1 ^d	39.5 ^d
Branch leaves	25.6 ^c	51.5 ^e	54.4 ^b
Fruiting parts	3.2 ^h	9.4 ⁱ	6.1 ^j

Mean followed by the same letter are not significantly different (P 0.05)

When eggs of all structures of top, middle and bottom portions were added separately, maximum (70-81 %) eggs were found on the top followed by middle (12-20%) and lower parts (7-10%) of the plant at all levels of infestation and the differences of egg distribution between plant portions were significant (Table.3).

Table (3): Distribution of *Helicoverpa armigera* eggs(%) on different portions of the cotton plant at three levels of infestation.

Plant portion	Levels of pest infestation		
	5 eggs/plant	10 eggs/plant	18 eggs/plant
Top	74.5 ^b	70.4 ^c	81.3 ^a
Middle	15.3 ^e	19.4 ^d	11.5 ^f
Bottom	10.2 ^g	10.2 ^g	7.2 ^h

Means followed by the same letter are not significantly different (P 0.05).

When leaves at different positions of all the branches were compared, significantly more eggs were laid on the first expanded leaf both at low(46.6%) and medium (41.3%) levels of pest infestation. At high level of infestation more eggs were laid on unexpanded leaf and first fully expanded leaf but the differences between these two were not

signifiant. Oviposition decreased significantly towards the main stem at all levels of pest infestation (Table 4).

Table (4): Distribution of *Helicoverpa armigera* eggs on the leaves of side branches of the cotton plant at different levels of infestation.

Side Branch	Levels of pest infestation		
	5 eggs/plant	10 eggs/plant	18 eggs/plant
Terminal bud	11.1 ^h	4.6 ^j	13.8 ^g
Unexpanded Leaf	34.3 ^c	23.3 ^e	34.4 ^c
Expanded leaf1	46.6 ^a	41.3 ^b	32.7 ^c
Expanded leaf2	6.1 ⁱ	25.4 ^d	17.2 ^f
Expanded leaf3	1.2 ⁱ	5.4 ⁱ	1.8 ^k
Expanded leaf4 -7	0.7 ^m	0.0 ⁿ	0.1 ^m

Means followed by the same letter are not significantly different (P 0.05)

Among the fruiting structures at different poitions of side branches, maximum eggs were laid on the first fruiting point immediately after branch terminal and it decreased towards the main stem (Table 5). Significantly high number of eggs was laid on squares (78-88%) follwed by flowers (8-17%) and bolls (3-4%) at all levels of pest infestation (Table 6).

Table (5): Distribution of *Helicoverpa armigera* eggs on fruiting bodies at different levels of infestation.

Fruiting Points	Levels of pest infestation		
	5 eggs/plant	10 eggs/plant	18 eggs/plant
Fruiting point 1	55.0 ^b	58.3 ^a	41.7 ^c
Fruiting point2	44.0 ^c	30.4 ^e	39.1 ^d
Fruiting point3	1.0 ^h	11.3 ^g	18.2 ^f
Fruiting point 4-6	0.00 ⁱ	0.00 ⁱ	0.00 ^h

Means followed by the same letter are not significantly different (P 0.05)

Table(6): Distribution of *Helicoverpa armigera* eggs on squares, flowers and bolls of cotton plant at different levels of infestation.

Fruiting Parts	Levels of pest infestation		
	5 eggs/plant	10 eggs/plant	18 eggs/plant
Squares	86.7 ^a	88.3 ^a	78.8 ^b
Flowers	8.9 ^d	8.2 ^d	17.7 ^c
Bolls	4.4 ^e	3.5 ^e	3.5 ^c

Means followed by the same letter are not significantly different (P 0.05)

3.2.Larval distribution

Significantly a large number of small larvae was on the top portion of the plant where squares were relatively more followed by middle but no small larva was found on the lower part. Significantly a higher number of medium-sized larvae was found on the middle portion of the plant as compared with the lower part, where less number of squares and more hard bolls were available. Maximum larvae were found in the bolls. The differences in the distribution of larvae on different plant portions were significant (Table 7).

Table (7): Distribution of *Helicoverpa armigera* larvae on different portions of the cotton plant.

Plant portion	Larval stage %		
	Small	Medium	Large
Top	57.0 ^a	29.0 ^e	14.0 ^g
Middle	20.9 ^d	69.4 ^a	9.7 ^g
Bollom	0.0 ^e	35.0 ^d	65.0 ^b

Means followed by same letter are not significantly different (P 0.05).

Feeding preference of the larvae for vegetative and reproductive parts indicated that maximum small larvae were found on the squares (48.2%) followed by the flowers (23.5%), terminal buds (22.4%), leaves(5.9%) and no small larva was found in bolls. Maximum medium-sized larvae were found in flowers (42.4%) followed by squares (35.0%) and bolls (15.2%), however, a small number of these larvae was found on the vegetative structures, and the

highest number was found in bolls (58.6%) followed by flowers (25.8%) and squares (15.6%) during this period (Table 8).

Table (8): Distribution of *Helicoverpa armigera* larvae on different parts of cotton plant.

Plant part	Larval stage %		
	Small	Medium	Large
Terminal buds	22.4 ^f	1.7 ^f	0.0 ^j
Leaves	5.9 ^h	5.7 ^h	0.0 ^j
Squares	48.2 ^b	35.0 ^d	15.6 ^g
Flowers	23.5 ^f	42.4 ^e	25.8 ^e
Bolls	0.0 ^j	15.2 ^g	58.6 ^a

Means followed by the same letter are not significantly different (P 0.05).

4. DISCUSSION

Oviposition pattern of *H.armigera* on cotton variety CIM-240 showed that females lay eggs on all parts but maximum eggs were laid on the upper 22-30 cm parts of the plant. Moth preference for oviposition changed slightly even within the variety at different levels of eggs per plant. In all cases, a large number of eggs was laid on vegetative parts of the main stem and branches. Only 3.2-9.4% eggs were laid on fruiting parts at the three levels of infestations. However, Farrar and Bradley (1985) in the U.S.A., reported that one third of the eggs of *Heliothis* spp. are generally found on flower buds and the rest are scattered all over the plant.

Almost 95% of the eggs were laid on the upper surface of the leaves and the results are in agreement with Beeden (1974), Mabbett and Nachapong (1984) and Fitt (1990) who mentioned that the upper surface is preferred. The results are not in agreement with those of Uthamasamy (1992) who reported that *H.armigera* females prefer lower surface for oviposition. It is not certain whether these changes were influenced by leaf characteristics, age of the crop or environmental factors singly or in combination.

Neonates generally feed on the leaves for a short period and shift to the reproductive parts. About 28% of the small larvae were found feeding on the terminal buds and leaves but the preference was

for the squares (48.0%.) The differences in the egg deposition and larval feeding sites probably had no or very little influence on the larval feeding preference. Similar behaviour of *Heliothis* spp. in the USA was reported by Farrar and Bradley (1985).

Medium-sized larvae showed preference for reproductive parts and their large proportion was found on flowers (42.4%), squares (35.0%) and bolls (15.2%) and only a small proportion was seen on the vegetative parts like terminal buds and leaves. In contrast, large larvae were found mainly on the lower part of the plant. This may explain the reasons why most efficient insecticides fail to control this pest, mainly because of poor coverage of lower canopy.

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توزيع بيض ويرقات حشرة دودة اللوز الأمريكية *Helicoverpa armigera* على نبات القطن فى باكستان

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ملخص

تضع اناث حشرة دودة اللوز الامريكية *Helicoverpa armigera* البيض على جميع اجزاء نبات القطن (يشمل ذلك البراعم الطرفية، الاوراق، الاجزاء الزهرية وغيرها) وقد وجد أن حوالى ٧٠% من البيض يوضع على الاجزاء العلوية من النبات، بلى ذلك الأجزاء الوسطية ثم السفلية. كما تفضل الاناث وضع البيض على الساق الرئيسى واوراق الأفرع. عند مستوى الإصابة المنخفضة فلان حوالى ٧١,٢% من البيض يوضع على أوراق الساق الرئيسية، ولكن عند مستوى الإصابة المتوسطة او المرتفعة فان حوالى ٥١,٥-٥٤,٤% من البيض يوضع على الافرع الجانبية.

تنتشر اليرقات على جميع أجزاء نبات القطن حيث وجد أن اقصى عدد لليرقات الصغيرة كان على قمة النبات (حوالى ٥٧%) اما اليرقات المتوسطة فقد وجدت على المنطقة الوسطية من النبات (حوالى ٦٩,٤%) بينما وجدت اليرقات الكبيرة على الأجزاء السفلية من النبات (٦٥%). كما وجد ان اليرقات متوسطة العمر تفضل الأزهار (٤٢,٤%) اما اليرقات الكبيرة فانها تفضل إصابة اللوز (٥٨,٦%) ولم يلاحظ وجود اى يرقة صغيرة على لوز القطن.

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