

ECONOMIC INJURY LEVEL OF *Helicoverpa armigera* ON BEAN *Phaseolus vulgaris* L. SEEDLINGS

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SAP 21783 Data do envio: 19/02/2019 Data do aceite: 25/04/2019
Sci. Agrar. Parana., Marechal Cândido Rondon, v. 18, n. 3, jul./set., p. 308-312, 2019

RESUMO - A lagarta *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) chegou ao Brasil em 2012 e vem causando prejuízos severos aos agricultores, especialmente nas culturas do algodão, feijão, milho, soja e tomate nas regiões Norte, Nordeste e Centro-Oeste. Pouco se conhece sobre seus danos às culturas no país e o feijoeiro é uma das culturas menos estudadas dentre as citadas. Portanto, esse trabalho objetivou-se avaliar o nível de dano causado pela lagarta *H. armigera* de 3^o ínstar em plântulas de feijão cv. BRS-Estilo. O ensaio foi semeado em 10/04/2014, em Ribeirão Preto, SP, com espaçamento de 0,5 m e 12 plantas por metro. Em um delineamento em blocos casualizados, as infestações (18/04) de 0 (testemunha), 0,1, 0,2, 0,5 e 1 lagarta por planta foram repetidas quatro vezes, em parcelas de 0,5 m² cercadas por barreiras de PVC de 20 cm de altura e com bordadura de 1 m. Após 1, 3, 7 e 14 dias após a infestação foi avaliada a porcentagem de desfolha. A porcentagem média de desfolha foi proporcional à densidade de lagartas. O nível de dano de lagartas de 3^o ínstar de *H. armigera* é de 1,4 lagartas por planta e, dessa forma, o nível de controle deve ser de 0,7 lagartas por planta de feijoeiro.

Palavras-chave: Lepidoptera, lagarta desfolhadora, praga agrícola, entomologia econômica, biologia.

NÍVEL DE DANO ECONÔMICO DE *Helicoverpa armigera* EM PLÂNTULAS DE FEIJOEIRO

ABSTRACT - *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) arrived in Brazil in 2012 and has caused severe losses to farmers, especially in cotton, beans, corn, soybean and tomato, in North, Northeast and Midwest regions. Little is known about their damage to crops in the country and the bean is one of the least studied among the crops mentioned. Therefore, this study aimed to assess the economic injury level of 3rd instar *H. armigera* larvae to bean seedlings cv. BRS-Estilo. The assay was sown on April 10, 2014, in Ribeirão Preto, São Paulo, Brazil, at spacing of 0.5 m and 12 plants per meter. In a randomized block design, infestations (April 18) of 0 (control), 0.1, 0.2, 0.5 and 1 larvae per plant were repeated four times in plots of 0.5 m² surrounded by plastic barriers of 20 cm and 1 m boundary. After 1, 3, 7 and 14 days after infestation were evaluable percent defoliations. The average percentage of defoliation was proportional to the density of caterpillars. The economic injury level of 3rd instar larvae of *H. armigera* for common bean is 1.4 caterpillar per plant and thus the economic threshold should be 0.7 caterpillar for bean plant.

Keywords: Lepidoptera, defoliator caterpillar, crop pest, economic entomology, biology.

INTRODUCTION

In recent years, the cotton bollworm moth *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae), was introduced and spread throughout South America, especially in Brazil, that have suffered greatly in recent years from the damage caused by caterpillars of the subfamily Heliiothinae, regardless of whether these plants are transgenic or conventional (JONES et al., 2019). Three species of caterpillars of the subfamily Heliiothinae have been observed to cause damage to many crops: *Heliothis virescens* (Fabricius), *Helicoverpa zea* (Boddie) and *H. armigera*, the most economically damaging of all heliothine species (CUNNINGHAM and ZALUCKI, 2014).

The caterpillar *H. armigera* is a specie that was recently considered as a quarantine pest A1 in Brazil, and

was recently detected in three central Brazilian states (Goiás, Bahia and Mato Grosso), associated mainly with cotton, maize, sunflower and soybean crops (CZEPAK et al., 2013). This caterpillar specie is an extremely polyphagous, whose larvae have been recorded in more than 60 species of cultivated and wild plants and in more than 60 host families, including Asteraceae, Fabaceae, Malvaceae, Poaceae and Solanaceae (CUNNINGHAM and ZALUCKI, 2014; KRITICOS et al., 2015; SOSA-GOMEZ et al., 2016).

This pest, besides being very polyphagous and voracious develops very fast, completing its life cycle in four to six weeks, reaching several generations in one year, giving the species a great capacity of dispersion (CZEPAK et al., 2013). In addition, it is a pest with several records of insecticide resistance (MAELZER and ZALUCKI, 2000).

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Fazolin and Estrela (2003) verified that 33% of defoliation are already harmful to plants in the V3 stage of development. At 24 days of germination, defoliation of 25% can cause about 20% decrease in productivity (SILVA et al., 2003).

Pratissoli et al. (2012) and Schimldt et al. (2019) observed a decrease of bean yield for all defoliation levels (33, 67 and 100%) considering all development stages, except for dried pods.

The developed bean plant supports 30% in the vegetative stage V3-4 and 15% in the R6-8, with losses of more than 50% defoliation in the production, being the stage with more suffering by the increasing defoliation (SCHIMLDT et al., 2010). In this context, this study aimed to assess the damage caused by *H. armigera* caterpillars to BRS-Estilo bean seedlings.

MATERIAL AND METHODS

Location

The bioassays were conducted at the campus of the Moura Lacerda University Center in Ribeirão Preto, São Paulo State (Brazil), situated 620 m of altitude, located at 21°12'43" South latitude and 47°46'23" West longitude.

Caterpillar infestation and bioassay assembly

The *H. armigera* caterpillars used in the artificial infestations assays were provided by the Bug biological agents S/A, from Piracicaba, SP. The caterpillars were kept in artificial diets adapted to this specie. The experiment was sown on 04/10/2014, the sowing being carried out with the aid of a ratchet. Conventional non-transgenic beans of the carioca type, cultivar BRS-Estilo were used, with spacing of 50 cm between rows and maintaining 12 plants per meter, being pruned for this. The experimental design was did with a randomized block design, where each experimental plot consisted of a 1 m line, with 12 plants, and the 1.0 m border was maintained in the clean. A barrier with PVC plaques 20 cm high were mounted around each plot.

After the establishment of the barriers and when the seedlings were three days after the emergence (04/18), the plots were artificially infested with different amounts of caterpillars (treatments), with four replicates, being: 0, 1, 2, 6 and 12 caterpillars of 3rd instar by 12 plants (0.0, 0.1, 0.2, 0.5 and 1 caterpillar per plant). Fertilization was based on soil analysis and sprinkler irrigation. After the infestation with the caterpillars, evaluations were performed at 1, 3, 7 and 14 days, where the percentage of defoliation of each plant was recorded.

Statistical analysis

All data were submitted to analysis of variance (ANOVA). However, the homogeneity test of Levene and

normality test When the F-test of ANOVA indicated a significance of 5% of error probability, the complementary analyzes were carried out using the Tukey test at 5% of probability, where the averages were compared. Correlations were made between the caterpillar density and the mean defoliation percentage, graphs and the determination coefficients (r) were obtained. The calculated averages were also submitted to regression analysis, at the 5% level, to verify correlations. All statistical calculations were performed by Statistical program for Windows (STATSOFT, 1996).

RESULTS AND DISCUSSION

In the experimental plots, in spite of the barriers placed to avoid the escape of the inoculated caterpillars or the entrance of caterpillars in the units, there was a natural occurrence of other species, that defoliated the seedlings bean plants, and after the third day, there was migration of *H. armigera* caterpillars from barrier to barrier. Even so, the results can be discussed, especially until the 3rd day of the infestation, when migratory caterpillars had not yet been found.

After one day of infestation, a higher percentage of defoliation in a caterpillar per plant was observed, differing significantly from the control and infestation of 0.1 caterpillar's per plant. In the control treatment, there was defoliation of $2.50 \pm 1.06\%$ caused by other natural defoliant of the locality, but the defoliation in the highest density of caterpillars per plant reached $7.00 \pm 1.27\%$. After three days, the treatment of greater density of caterpillars per plant differed statistically from all other treatments, with a mean percentage of defoliation of $21.50 \pm 2.72\%$. The control group had the lowest defoliation rate ($2.88 \pm 1.01\%$), differing from the other treatments, which did not differ among them, because this caterpillar feeds fast and in large quantities (Figure 1).

At seven days of infestation, there were significant differences between treatments, similar to the previous evaluation. However, at 14 days of infestation, probably due to migration of caterpillars from one plot to another and the possible presence of natural field pests, the control did not differ from treatments with 0.1 to 0.5 caterpillar's per plant, which in turn did not differ from the higher density treatment, to the mean percentage of defoliation (Figure 1).

In the last evaluation, the average percentage of defoliation varied from $10.43 \pm 1.78\%$, in the control, to $30.25 \pm 4.32\%$, in the density of one caterpillar per plant, being this result considered by Silva et al. (2003) like harmful to bean culture, which found that a defoliation of 25% at 24 days after germination causes an average reduction of 21.7% in bean productivity.

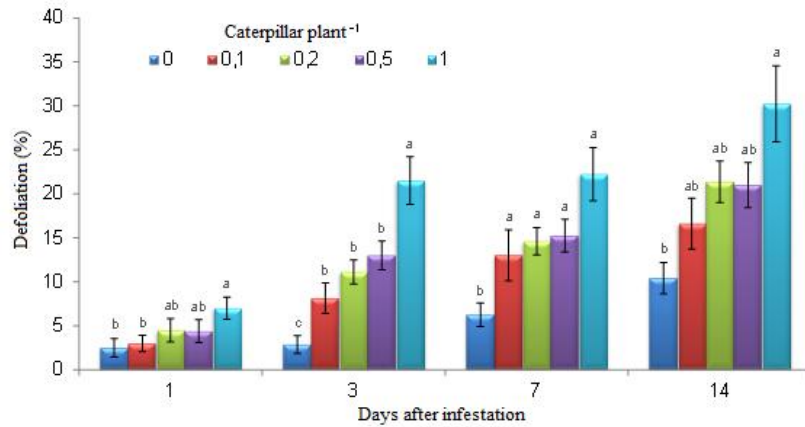


FIGURE 1 - Percentage of defoliation in bean plants artificially infested in the seedling phase with different amounts of *Helicoverpa armigera* larvae of 3rd instar. Columns followed by the same letters, in each date, do not differ among themselves by the Tukey test ($p \leq 0.05$).

Analyzing the graphs of the linear regression analysis, where in all dates the correlations between caterpillar density per plant and average percentage of defoliation were positive and significant (Figure 2), it can be seen that for 3rd instar *H. armigera* be harmful to the bean crop after three days of infestation, it would be enough around 1.2 caterpillars per plant (Figure 2B),

according to Silva et al. (2003), the yield of common bean was reduced with defoliation of more than 50%, regardless plant age. After 14 days of infestation, only 0.7 caterpillar's plant⁻¹ would suffice to reach a crop defoliation, because below this value, was not enough to reach a high defoliation and differ from the natural defoliation caused by other pests in the field (Figure 2D).

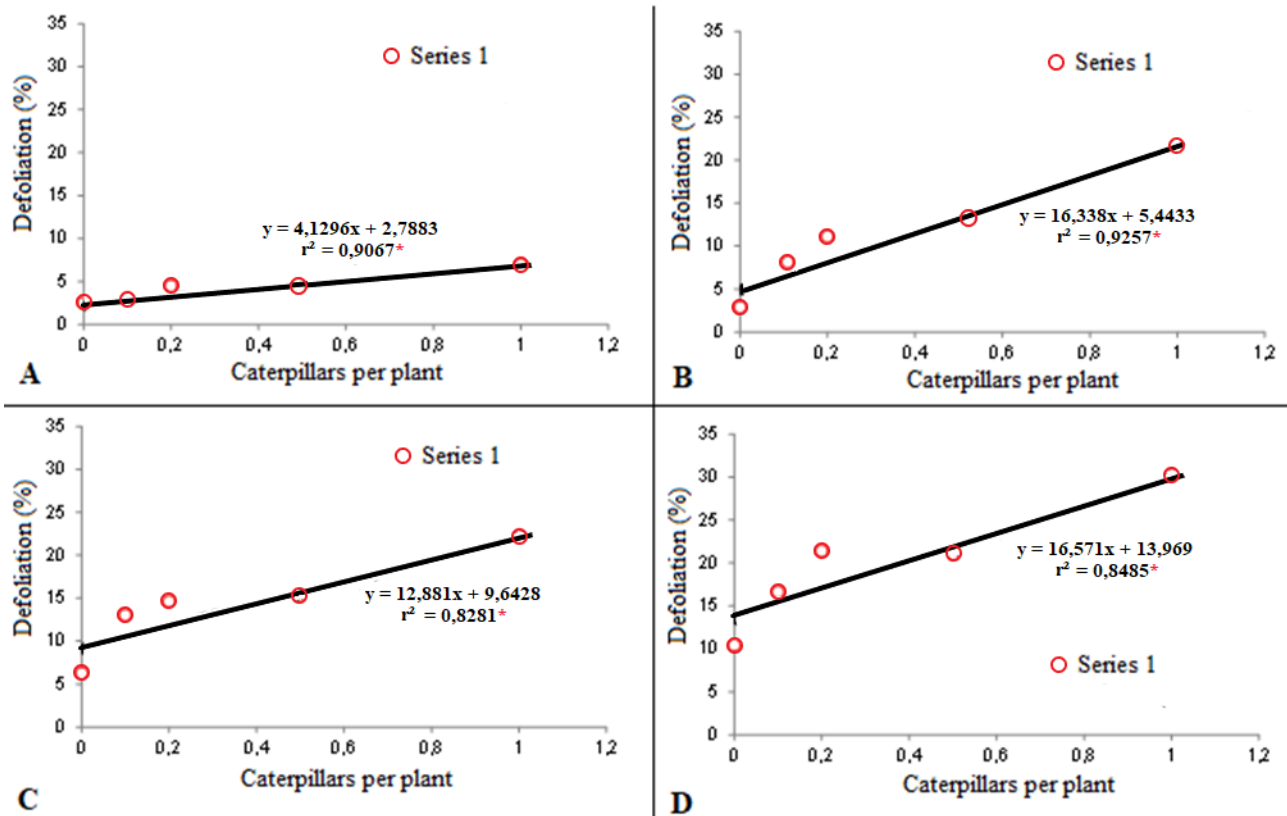


FIGURE 2 - Correlation between the number of *Helicoverpa armigera* larvae of 3rd instar per plant and the percentage of defoliation in bean plants after 1 (A), 3 (B), 7 (C) and 14 (D) days of artificial infestation in the seedling phase. Significant correlation (*) ($p \leq 0.05$).

However, in the average of the periods allowed to defoliation, we have that 1.4 caterpillars of 3rd instar *H. armigera* per plants are sufficient to cause damages in the

productivity of the bean cultivar Carioca, because the defoliation was higher than 30% , according to Pomari-Fernandes et al. (2015), the major economic thresholds

should be when defoliation is equal or higher than 30% at crop vegetative stage or 4 or more caterpillars/meter (ground cloth) at crop vegetative stage (Figure 3).

This estimate of the damage caused by the pest also corroborates with Fazolin and Estrela (2003), who verified a tolerance of the bean in the V3-4 stage of up to

30% of defoliation. Further studies should be planned to better define these levels, including different instars of the caterpillars, environmental factors should be taken into account, as well as the action of natural enemies and the bean genotype.

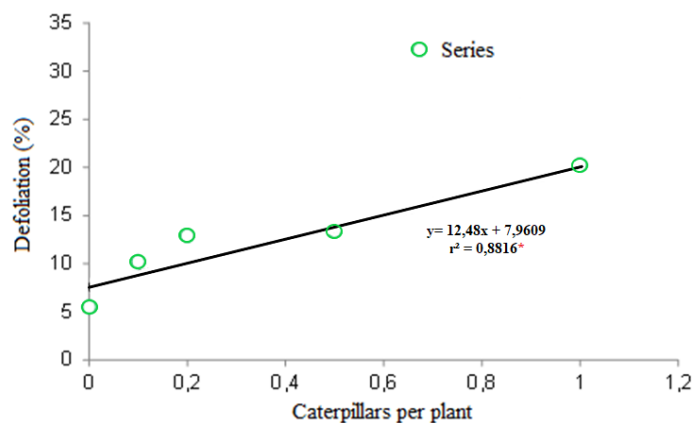


FIGURE 3 - Correlation between the number of 3rd instar *Helicoverpa armigera* larvae per plant and the percentage of defoliation in bean plants in the average of all the days after the artificial infestation in the seedling phase. Significant correlation (*) ($p \leq 0.05$).

This study allows an overview of the potential damage of *H. armigera* caterpillars to the bean, indicating the need to take some control measures before the defoliation reaches 30%, and according to Pomari-Fernandes et al. (2015), when more than 50% of the caterpillars are smaller than 1.5 cm, the use of virus, bacteria or insecticide of the growth regulator group (IGR) should be favored.

But if insecticides are needed, always favor the use of mild insecticides in order to preserve natural biological control agents.

CONCLUSIONS

The 3rd instar larvae of *H. armigera* caused damage to the bean (*P. vulgaris* L.) cultivar BRS-Estilo, the level of damage for new bean plants is 1.4 caterpillar's per plant and the control level in common bean on vegetative period should be 0.7 caterpillar's per plant.

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