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Susceptibility of Cowpea varieties to infestation by Pea blue Butterfly, *Lampides boeticus* (Linnaeus) (Lepidoptera: Lycaenidae)

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ABSTRACT

A field experiment was conducted in the Grdarasha Research Station-College of Agricultural Engineering Sciences- Salahaddin University-Erbil-Iraq, to evaluate the susceptibility of four varieties of cowpea crop to infestation by pea blue butterfly, *Lampides boeticus* L. based on the infestation percentage on different growth stages of the plant including flowering stage, pod stage and the number of holes made by the pest larvae also were calculated. As well as estimating the nature and extent of damages due to pest insect were described. The varieties of cowpea used in this study were Polaris, Japan cowpea, Italy cowpea, and Safal variety. The RCBD design was used for implementing the experiment. The results showed that, the highest percentages of infestation, on the flower stage and pod stage were recorded on the cowpea variety Italy which reached 46.33% and 51.30%, while the lowest percentages were on the Safal variety which were 18.52% and 24.86%, respectively, more over the highest number of holes made by the larval stage of the pest insect was recorded on variety Italy 1.99 holes/ pod, and the lowest number was recorded on variety Japan which was 1.24 holes/ pod.

حساسية أصناف اللوبيا للإصابة بحشرة دودة قرون البقوليات *Lampides boeticus* (Linnaeus) (Lepidoptera: Lycaenidae)

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الخلاصة

اجريت التجربة الحقلية في محطة بحوث كرده ره ش التابعه إلى كلية علوم الهندسة الزراعية، جامعة صلاح الدين – أربيل- العراق، لتقويم حساسية أربعة أصناف من محصول اللوبيا للإصابة بالحشرة دودة قرون البقوليات (*Lampides boeticus* L.). اجري التقييم على أساس حساب النسبة المئوية للإصابة بالحشرة في المراحل المختلفة لنمو النبات والتي شملت كل من مرحلة التزهير ومرحلة تكوين القرينات وأيضاً تضمنت دراسة حساب عدد الثقوب المتكونة بواسطة يرقات الحشرة أنفة الذكر، على قرون اللوبيا، وكذلك تم وصف طبيعة ومستوى الأضرار الناجمة بواسطة الحشرة على محصول اللوبيا. أصناف اللوبيا المستخدمة في الدراسة كانت (بولاريس، الياباني، ايطالي، و صنف السافال) ونفذ تصميم القطاعات العشوائية كاملة في الدراسة، اوضحت نتائج الدراسة هذه بأن اعلى نسبة مئوية للإصابة بالحشرة في مرحلتي التزهير وتكوين القرينات كانت على الصنف الايطالي (Italy) والتي وصلت الى 46.33% و 51.30% على التوالي، بينما أدنى نسبة للإصابة في مرحلتي التزهير وتكوين القرينات لمحصول اللوبيا سجلت على صنف السافال (Safal) والتي وصلت الى 18.51% و 24.86% على التوالي. وكذلك سجلت اعلى عدد ثقوب المتكونة من قبل يرقات الحشرة المذكوره اعلاه على قرينات اللوبيا كانت على قرينات الصنف الايطالي (1.99) ثقب / القرنة، بينما أدنى عدد الثقوب المسجلة كانت على قرينات الصنف الياباني (Japan cowpea) والتي وصل الى (1.24) ثقب/ القرن

INTRODUCTION

Cowpea, *Vigna unguiculata* L. Walp., is a member of the plant family Fabaceae, its common name probably originated from the fact that the plant was a significant source of food for animals especially cows in some parts of the world. Cowpea is a priceless component of agricultural systems in many areas because of its ability to restore soil fertility for succeeding cereal crops grown rotating with it (Carsky, Vanlauwe, & Lyasse, 2002; Sangina, 2003). Dry grains of cowpea are consumed as human food (Ahenkora et al., 1998), and animals feed (B. Singh & Tarawali, 1997). The constraints in front of cowpea production and good quality are many, including insect pests (A. Singh, Santosh, Pankaj, & Maurya, 2012), sometimes causing over 90% loss in yield (Jackai & Daoust, 1986). Damages of insects are changing from variety to another (Doss & Faris, 1989) and season to season (Jagginavar, Kulkarni, & Lingappa, 1990; Raina, 2016) and the population density also depends on environmental conditions (A. Singh et al., 2012)

Pea blue butterfly, *Lampides boeticus* (L.) is a major lepidopteron insect pest of cowpea which belongs to Lycaenidae family (Jagginavar, 1988; Jagginavar et al., 1990; Mavi, 1992), and it is responsible for infestation and injuries on various plant families (Mavi, 1992), and leguminous crops, in particular, including cowpea (A. Singh et al.,

2012), this insect pest starts infesting crops from flowering to the Pod maturity (Sekhar, Singh, Singh, & Singh, 1991). In addition, larvae of pea blue butterfly feed on flower buds, flowers and Pods causing a 26.92-31.88% loss of crops yield (Al-Karboli & AL-Janabi, 2017).

Many management and control methods have been attempted against Pea blue butterfly, *Lampides boeticus* (L.), ranging from cultural methods (Al-Karboli & AL-Janabi, 2017) to using Insecticide (Anusha, Balikai, & Patil, 2014; Sontakke & Amrita, 2022).

Globally, to our knowledge, a few studies (Doss and Faris, 1989; Anusha *et al.*, 2013), have been performed on the varietal susceptibility against infestation and damages of *L. boeticus* (L.) on cowpea plants. However, in the Kurdistan region of Iraq, no comprehensive research has been performed on the pea blue butterfly on cowpea, therefore, this study aims to investigate the seasonal abundance of pea blue butterfly in relation to weather parameters and estimation of the susceptibility of varieties of cowpea based on the population density and pest damages in the Erbil city.

MATERIALS AND METHODS

Study design, cultivation and sampling

The present study was carried out in the Grdarasha research station field belonging to College of Agricultural Engineering Sciences, Salahaddin University-Erbil-Iraq during cowpea growing season, 20/ 6 - 20/ 10/ 2022. For this study, the Seeds for four varieties of cowpea including Safal, Japan, Italian, and Polaris cowpea were sown at 20/6/2022, and the treatments were allocated on lines (plots) and blocks randomly using R.C.B.D. design (Randomized Complete Block Design).

Table (1) information on cowpea varieties used in the present study- Erbil city

Variety	Characteristics		
	Age of flowering(days)	Flower color	Pod Color
Polaris	41 - 45	yellow	green
Safal	50 - 55	yellow	green
Japan	45- 50	purple	Light green
Italy	40 - 45	yellow	Light green

Sampling for infestation percentages was taken place starting from the first appear of the insect on the crop in the experimental field and continued weekly until maturity of the cowpea pods. The infestation ratio sampling depended on the presence of damaging stage (Larva) or its damages on the flower buds and the presence of Larvae and the number

Holes on the pods also were estimated, for this, ten flowers in each variety and replication were checked for infestation percentage. Infestation percentage on each variety and replication were calculated by using the following Formula (1).

$$\% \text{ infestation/Flower} = \frac{\text{no.of infested flower}}{\text{total number of sampled flowers}} \times 100 \text{ (1)}$$

For the estimation of damages on pods of cowpea crop plants caused by Pea blue butterfly larvae, at the pod formation stage, a total of 100 randomly selected cowpea pods of each cowpea variety were brought to the laboratory, and then they were checked, in addition, the damaged pods (those with holes caused by larvae of the pest insect) isolated and were counted on each variety according to the following formula (2):

$$\text{Pod infestation}\% = \frac{\text{No.of damaged pods for each variety}}{\text{Total number of sampled pods for each variety}} \times 100 \text{ (2)}$$

Identification of insect sample

The samples of the pest insect were collected and brought to the Agricultural Research Center of Erbil- Plant Protection Department –Insects Museum, for Identification by comparing with those Identified samples preserved in the museum.

Statistical Analysis

The obtained data from the current study were tabulated and entered into Excel program and means were worked out and compared with each other using SPSS Program version 26(SPSS, 2018).

RESULTS AND DISCUSSIONS

The infestation appears on the pink buds when they are formed (flower buds), then the adult females were hovering on the cowpea plants and laid eggs on the flower buds and rarely on the leaf were buds seen during the current study (Figure 1).After the eggs hatches and the first larval instar appears, which burrows into the flower bud and started feeding inside the flower (Figure 2-A and B). Feeding on the flower buds continue in the first and second instars until the small formed pod inside the flower was completely consumed, in the third and fourth instars, the larva progressed to devouring the flowers, and also made holes in the pods of cowpea and fed on the seeds within (Figure 3.A and B), consequently, infested pods and flowers were contaminated with feces of the larva and infected with some types of fungi. These observations reflect the results obtained in the study conducted by Al-Karboli and AL-Janabi (2017), they noticed that the larva of the pea blue butterfly feeds on each of the floral buds, flowers, and pods of cowpea plants. They also stated that, these damages lead to losses of the crop yield qualitatively and quantitatively.

The data provided in table (2) shows infestation percentages by larval stage of pea blue butterfly on flowers of cowpea at flower stage in summer growing season-2022. According to the data (table 2), the highest percentage of infestation caused by larvae of *Lampedis boeticus* L. at the flowering stage ranged between 25.67 – 70.33% and averaged 46.33% flower damage/ Plot on cowpea crop, variety Italy followed by variety Polaris of the same crop which occupied 16.67 - 60.00% and averaged 39.61 % flower infestation / plot, while the lowest percentage of infestation caused by pea blue butterfly larvae was on cowpea variety Safal, which ranged from 9.00–33.33% and averaged 18.52% flower infestation/ plot, whereas, cowpea variety Japan, located in the middle rank, the infestation percentage of flowers was ranged from 14.33 – 36.00% and averaged 24.23 %, flower infestation / plot.



Figure (1) Egg of the pea blue butterfly on cowpea plant



Figure (2) larval damage; A- holed flowers and B- larva inside the flower of cowpea



Figure (3) larval damage on yield; A- holes on pods and B- larval damages on seeds of cowpea

According to statistical analysis, Duncan test at 0.05 significant level, there are differences among tested cowpea crop varieties regarding the infestation percentage due to pea butterfly larvae on flower at the flower stage, especially both cowpea varieties Italy and Polaris showed a significant difference with other two cowpea varieties including Safal and Japan varieties, however, there are no significant differences between Safal and Japan in one hand, and between Italy and Polaris variety on the other hand, the results indicated that there is no effect of flower color on the infestations of flowers, while the increased infestation of flowers in both Italy and the Polaris variety may belong to age of flowering which shorter in these two varieties than others, the outcomes of this study are in conformity with those of Anusha *et al.* (2013) who stated that the in resistance of cowpea varieties has a positive correlation with days taken to the flowering time, also they found the colors of cowpea cultivars did not have any effect on the level of the damage and infestation caused by the pest.

Table (2) Percentage of Infestation caused by insect pest on cultivated cowpea cultivars at flowering stage- Erbil city, 2022

No.	Cowpea varieties	Infestation percentage % / plot		
		At Flower stage		
		No. of samples	Range	Mean ± SE
1	Polaris	70	16.67 - 60.00	39.61 ± 3.1 a
2	Safal	70	9.00 – 33.33	18.52 ±3.1 b
3	Japan	70	14.33 – 36.00	24.23 ± 3.1 b
4	Italy	70	25.67 – 70.33	46.33 ± 3.1 a

Different letters in the same column are significantly different from each other at 0.05 of significant level

The data provided in table (3) explains infestation percentages by larval stage of pea blue butterfly on pods of cow pea at flower stage in summer growing season-2022. According to the data shown in table (3), the highest percentage of infestation caused by larvae of *Lampedis boeticus* L., at the pod stage ranged between 37.33-59.47% and averaged 51.30 % pod infestation/ Plot on cowpea crop, variety Italy followed by variety Polaris of the same crop which occupied 34.33 – 54.50% and averaged 46.02% pod infestation/ plot, while the lowest percentage of infestation caused by pea blue butterfly larvae was on cowpea variety Safal, which ranged from 12.83–32.30% , and averaged 24.86 % pod infestation/ plot, whereas, cowpea variety Japan, located in the middle rank, the infestation percentage on pods was ranged from 25.00 – 46.10% and averaged 32.27 % pod infestation/ plot. According to statistical analysis, Duncan test at 0.05 of significant level, there are significant differences among tested cowpea crop varieties regarding the infestation percentage due to pea butterfly larvae on pods at pod stage, at this growing stage data, especially both cowpea varieties Italy and Polaris differed significantly with other cowpea varieties (Safal and Japan variety), also between Safal and Japan. However, there are no significant differences between Italy and Polaris varieties regarding pod

infestation. The results of this study are in agreement with those of Anusha, Balikai, and Deshpande (2013) who mentioned that the early maturing varieties are more vulnerable to infestations and damage than those late maturing varieties, and also Al-Jorany and Al-Cerrawi (2009) said that the infestation ratio among early maturing varieties is higher than the infestation in late maturing varieties.

Table (3) Infestation of various cowpea varieties by larvae of *Lampides boeticus* L. at pod stage- Erbil city

No.	Cowpea varieties	Infestation percentage %		
		pod stage		
		No. of samples	Range	Mean \pm SE
1	Polaris	600	34.33 – 54.50	46.02 \pm 2.1a
2	Safal	600	12.83 – 32.30	24.86 \pm 2.1c
3	Japan	600	25.00 – 46.10	32.27 \pm 2.1 b
4	Italy	600	37.33 -59.47	51.30 \pm 2.1a

Different letters in the same column means significant difference from each other at 0.05 significant level.

The data provided in the table (4) demonstrates the number of holes made by larval stage of pea blue butterfly on pods of cowpea at pod formation stages in summer growing season-2022. According to the data in the table (4), the highest number of holes made by larvae of *Lampides boeticus* L. at the pod stage ranged between (1-5) and averaged 1.99 \pm 1.26 holes/ pod of cowpea crop, variety Italy followed by variety Polaris in which the number of holes ranged from 1–5 holes/ pod and averaged 1.82 holes/ pod, while the lowest number of holes caused by pea blue butterfly larvae was ranged from 1-4 holes/ pod and averaged 1.52 holes/ pod, on cowpea variety Safal, however, variety Japan, located in the middle rank, on which the number of holes bored by the larval stage of the pea blue butterfly was ranged from 1-3 holes/ pod and averaged 1.24 holes/ pod. According to statistical analysis, Duncan test at 0.05 of significant level, there are significant differences among tested cowpea crop varieties regarding the infestation percentage due to pea butterfly larvae on pods at pod stage, at this growing stage data, especially both cowpea varieties Italy and Polaris differed significantly with other cowpea varieties (Safal and Japan variety) , however, there are no significant differences between Safal and Japan, as well as between Italy and Polaris variety. The findings of this study could not be discussed because there have no previous studies conducted on the cowpea varieties regarding the difference in the number of holes bored by larvae of *Lampides boeticus* L. on the pods of the crop. However, there is no relationship between pod color and number of holes among varieties and this supported by (Anusha et al., 2013) who showed that the correlation between pod color and infestation among varieties of cowpea is absent.

Table (3) The number of holes made by larvae of *Lampides boeticus* L. on cowpea pods, at pod stage- Erbil city

No.	Cowpea varieties	Number of holes /pod	
		At pod stage	
		Range	Mean ± SE
1	Polaris	1 - 5	1.82 ± 0.1 ab
2	Safal	1 - 4	1.52 ± 0.1 bc
3	Japan	1 - 3	1.24 ± 0.1 c
4	Italy	1 - 5	1.99 ± 0.1 a

Different letters in the same column means significant difference from each other at 0.05 significant levels

CONCLUSIONS

The Pea blue butterfly, *Lampides boeticus* L., is considered a key insect pest that infests the cowpea and other pulse crops in the plant family Fabaceae causing significant damage to different plant parts such as flower buds, flowers, pods, and cowpea seeds. In the current study, it has been noticed that, the infestation by pea blue butterfly larvae occurs mainly in flower and pod stages. Moreover, the study also indicated that early maturing varieties had a higher percentage of infestation on flowers, pods, and the number of holes per pod of cowpea crops. However, morphological Characteristics have no effects on the infestation and damage ratio.

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