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Host selection behavior by Aphid *Myzus persicae* to different ages of tomato *Solanum lycopersicum*

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الملخص

يعتبر المن الأخضر *Myzus persicia* أحد الآفات الرئيسية في الصوبات الزجاجية. حيث يعتبر متعدد العوائل النباتية وعلى نطاق واسع، حيث يتغذي علي أكثر من مائة عائل نباتي التي تنتمي الي أكثر من 40 عائلة نباتية. يعتبر طماطم *Solanuum lycopersicum* من المحاصيل المهمة في ليبيا. تتعرض هذه المحاصيل للعديد من الآفات، ومن أكثر هذه الآفات ضرراً حشرة المن الأخضر *M. persicia*، والتي تتسبب في خسائر اقتصادية كبيرة. هدفت هذه الدراسة إلى دراسة تأثير عمر النبات وسطح الأوراق وطبقات الأوراق على كثافة مراحل حشرات المن (البيض والحوريات والبالغات). أظهرت النتائج وجود فرق معنوي في كثافة حشرات المن بين أعمار الطماطم المختلفة. كما أظهرت النتائج أن هناك فرقاً معنويا في كثافة حشرات المن بين طبقات الطماطم المختلفة. بالإضافة إلى ذلك، أوضحت النتائج أن هناك فرقاً معنويا في كثافة مراحل حشرة المن بين أسطح الورقة المختلفة حيث كانت أعلى على السطح السفلي مقارنة بالسطح العلوي. لذلك تساعد هذه النتائج في فهم العلاقة بين هذه الآفة والنباتات المضيفة لها وتوفر المعلومات لإيجاد طرق آمنة وصديقة للبيئة لإدارة هذه الآفة.

الكلمات المفتاحية: *Myzus persicea* المن الاخضر Hemiptera, *Solanuum lycopersicum,* عمر Solanaceae , النبات.

ABSTRACT

The green peach aphid (GPA) *Myzus persicea* is considered to be one of the major pests of greenhouse. It is broadly polyphagous, feeding more than one hundred of host plants in over 40 plant families. Tomato *Solanuum lycopersicum*is important crops in Libya. These crops are exposed to many pests, and among the most harmful of these pests is the green peach aphids *M. persicea*, which causes great economic losses. This study was aimed to study the effect of plant age, leaf surface and leaf strata on the density of aphids stages (eggs, nymphs and adults). The results showed there are significant difference on density of aphids between different age of tomato. The findings also showed there was significant difference on density of aphids between different tomato strata. As well as, the results demonstrated that there was significant difference on density of aphid stages between different leaf surface where were higher on abaxial compared to adaxial surface. Therefore these results help in understanding the relationship between this pest and its host plants and provide information to find safe and environmentally friendly ways to manage this pest.

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Keywords: *Myzus persicea,* Hemiptera*, Solanum lycopersicum,* Solanaceae, plant age, اسم المدينة, Libya.

INTRODUCTION

As phloem feeders and major vectors of plant viruses, aphids are important pests of agricultural and horticultural crops worldwide. Aphids are a perennial source of frustration to farmers. The pest status of these small insects is related to several features of their biology that enable them to locate and exploit their host plants (Powell et el 2006). There are about 4500 aphid species that have been characterized (Remaudière and Remaudière. 1997), among these, *Myzus persicae* is the one which has emerged as a threat to agriculture in tropical and subtropical regions. It causes damage to the plants in several ways. For instance, it causes a significant decrease in the longevity and productivity of plants. It can also serve as a vector for transferring plant viruses (Johannes *et al*., 1994; Gatehouse *et al*., 1996). Nymphs and adults of this aphid pierce the leaves and extract phloem sap while feeding. They also release huge quantities of honeydew on the fruits and leaves. Subsequently, sooty molds grow in this honeydew leading to immense damage to the quality of fruits and vegetables (Fiona *et al*., 2001., James, 2004).

Aphid *Myzuspersicae*is a polyphagous pest, which causes heavy losses in agricultural crops, thus, there is considerable growth in research dedicated to the aphid (Berlandier and Sweetingham, 2003). There are several factors that influence the choice of the pest to the appropriate host plant; such as pH gradients, the concentration of nitrogen and protein contents of cells sap (Nadwodnik and Gertrud, 2008; Torsten *et al*., 2013; Vandermoten *et al*, 2014). It would also be different in the host plant species as well as in the same plant species through different stages (Wearing 1972; Williams 1995; Alvarez 2006).A key factor that determines the selection of the host plant for aphid feeding is plant age (Leite *et al*., 1999). In addition, leaves in different positions relative to the plant apex or plants of different ages can differ in suitability for insects (Willem *et al*., 1997; Chu *et al*., 2000). The aims of this study were to determine the effect of tomato growth stage and different leaf surfaces on the population density of *M. persicae.*

MATERIALS AND METHODS

Study site and Crops used

The study was carried out in a glasshouse at Omar Al-MuktharUniversity, from 1 June to 21 August 2018. Experiments were conducted in cages measuring 1.5×3.0 m and 2.0 m in height, covered by an insect proof screen at the side and top, at 30-36ºC, 80% RH. Tomato (*Solanum lycopersicum*).

Aphid rearing

Aphids were reared on *Cucurbita pepo* to1 month before experiments, in cages measuring 0.5×1.20 m and 1.20 m in height, covered by insect proof screen.

Experiment layout

Seedlings were planted in pots with soil (2:1:1 for clay, sand and Bio-organic fertilizer). After sowing, they were placed under net covers in separate isolated compartments of the glasshouse to reduce infestation. After the plants reached 3-5 leaf stages, they were transferred to experiment cages. Each different plant growth stage species (30 days, 45 days, and 60 days) were placed in the cage separately. A total of 24 plants were used and these experiments were arranged following a Randomized Complete Design (RCD) with 3 replicates, each replicatehaving three rows of 10 cm within and 20 cm between rows with 500 Aphid adults released into it.

Data collection and analysis

After one day of infestation, Aphid adults were randomly counted every two days for 30 days, as three plants per replicate three different levels of plant height; namely, upper, middle, and lower strata, on the underside and upper side of the leaf. Samplings of stages Aphid (eggs and nymphs) were counted every 4 days in 1 cm^2 by using a stamp made on the abaxial surface, which was placed between the central and left lateral leaf veins (3 disks per stratum). The stereoscopic microscope at 40X magnification was used to count the number of eggs and nymphs glasshouse. Data collections were commenced from June to August 2018.

A one-way analysis of variance (ANOVA) was conducted to determine differences in the number of adults, eggs, and nymphs Aphid between different plant growth stages placed in the same experimental arena. Means were separated with Tukey`s Protected Least Significant Difference ($P < 0.05$) when the ANOVA result was significant.The t- test was used to analyze data to determine the difference in the number of adults and the stages of the aphid between abaxial and adaxial. Data was run on Minitab Statistical Package Programme (Minitab version 17).

RESULTS

Population abundance of eggs nymphs and adults GPA on different growth stages of Tomato *S. lycopersicum*.

The results showed (Fig 1), that the mean number of GPA eggs varied significantly ($F=7.77$, $df=2$, $P <0.05$) among plant growth stages, the higher mean number of eggs observed on 60 days compared to other plant growth stages. while, there was no significant difference between 45 days,30 days plant growth stages (Fig 2). Whilst, there was no significant difference between the mean number of GPA nymphs among plant growth stages($F=1.64$, $df=2$, $P >0.05$) (Fig 2).In Figure 3, the results indicated the mean number of adults GPA was no significantly different among tomato growth stages ($F=2.31$, $df=2$, $P >0.05$).

Population abundance of eggs nymphs and adults GPA on different strata of Tomato *S. lycopersicum.*

There was a significantly ($F =7.69$, $df= 2$, $P = 0.00$) The mean number of GPA eggs was significantly different amongst tomato stratum (Fig 4). The results showed that the mean

number of GPA eggs was significantly higher (P< 0.05) on the middle stratum compared to other strata. While, the lowest number of (GPA) eggs was on upper stratum. Similarly, There was a significant difference in the mean number of (GPA) nymphs (F=4.30, df=2, P = 0.014) (Fig 5). According to the different tomato strata. It was found that the mean number of GPA nymphs was the highest on the upper stratum and was significantly different (P<0.05) to other strata .whilst , the lowest number of (GPA) nymphs was on the lower stratum. In contrast, there was no significantly difference in mean number of GPA adults (F=0.81, df=2, P >0.05) among tomato strata (Fig 6).

Population abundance of eggs nymphs and adults GPA on leaf surface of Tomato *S. lycopersicum*.

The mean number of GPA eggs was significantly different (T =-4.44, df=568, P <0.05) on the two surfaces of tomato plants leaf (Fig 7). The highest mean number of GPA eggs was found on abaxial compared to adaxial surface. In Figure8, the results also showed that, the mean number of GPA nymphs was significantly different (T=-2.43, df=749, P >0.05) between abaxial and adaxial of tomato plant leaf, the highest mean number of GPA nymphs found on abaxial surface. There was a significant difference in the mean number of adults GPA (T =-1.93, df=782, P >0.05) (Fig 9). between abaxial and adaxial of tomato plant leaf, the mean number of adults was higher on the abaxial compared to adaxail surfaces.

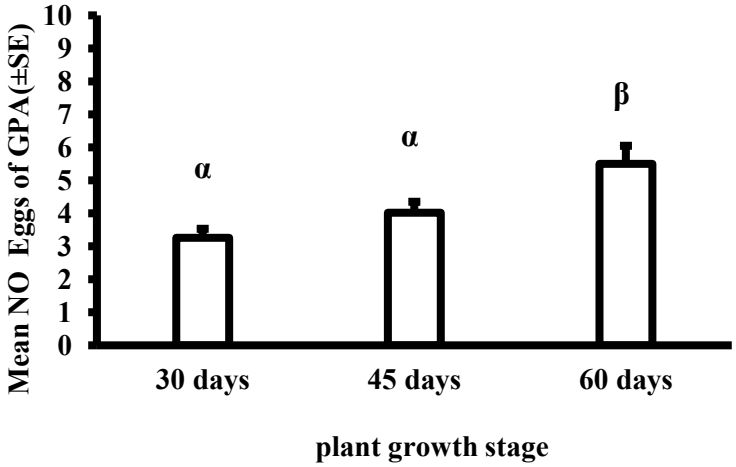

Fig. 1. Mean (±SE) number of eggs *M. perrsicae* on three different growth stages of tomato. Mean with different letters differed significantly from others (P < 0.05).

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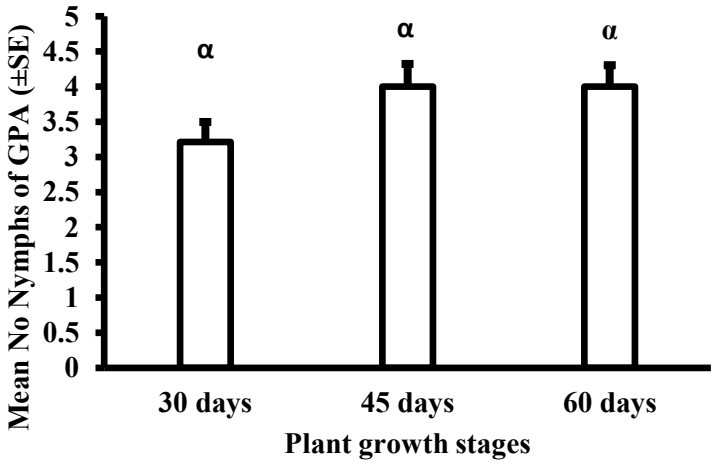

Fig. 2. Mean (±SE) number of nymphs *M. persicae* on three different growth stages of tomato. Mean with different letters differed significantly from others *(P < 0.05)*.

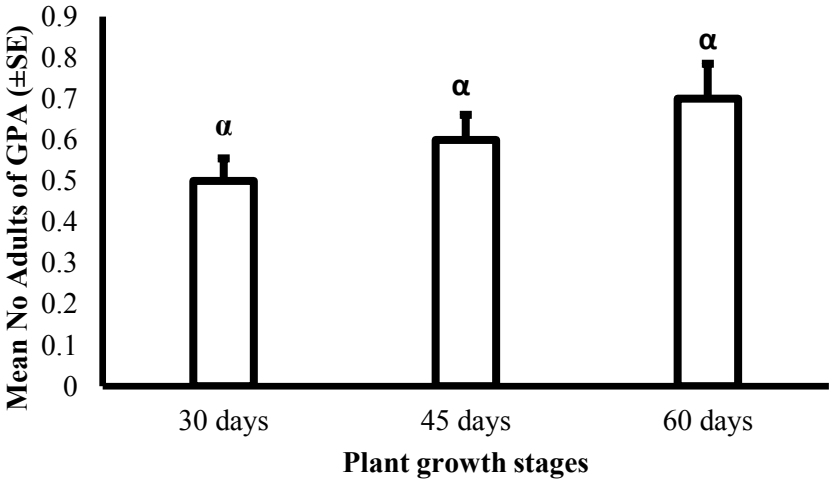

Fig. 3. Mean (±SE) number of adults *M. persicae* on three different growth stages of tomato. Mean with different letters differed significantly from others (P < 0.05).

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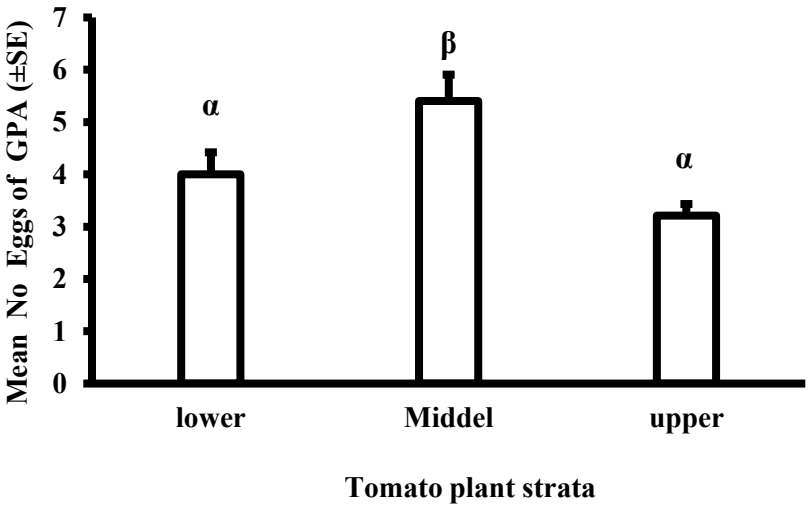

Fig. 4.Mean (±SE) number of eggs *M. persicae* on different tomato strata. Mean with different letters differed significantly at ($P < 0.05$).

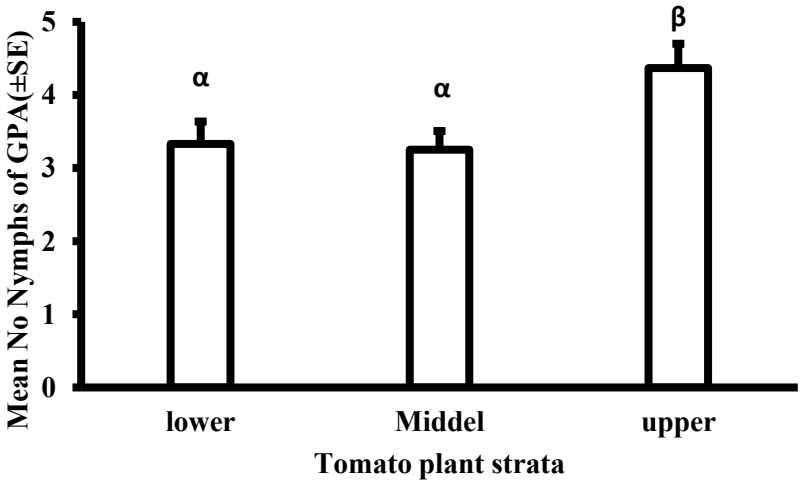

Fig. 5. Mean (±SE) number of nymphs *M. persicae* on different tomato strata. Mean with different letters differed significantly at *($P < 0.05$)*.

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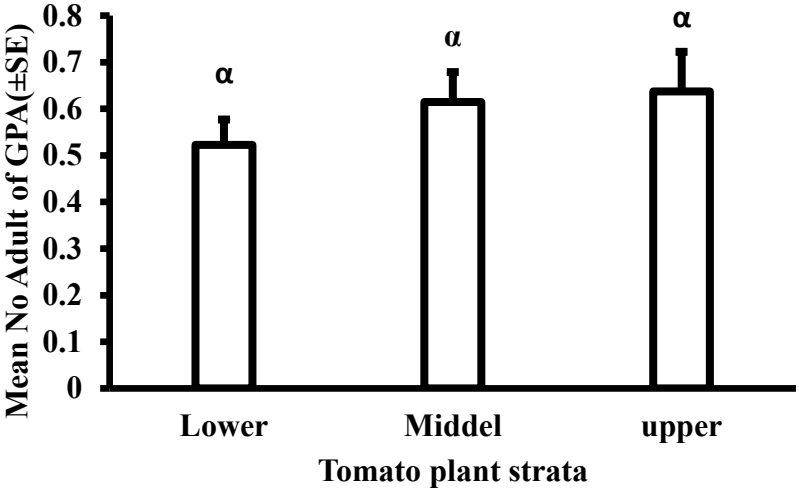

Fig. 6. Mean (±SE) number of adults *M. persicae* on different tomato strata. Mean with different letters differed significantly at *(P < 0.05)*.

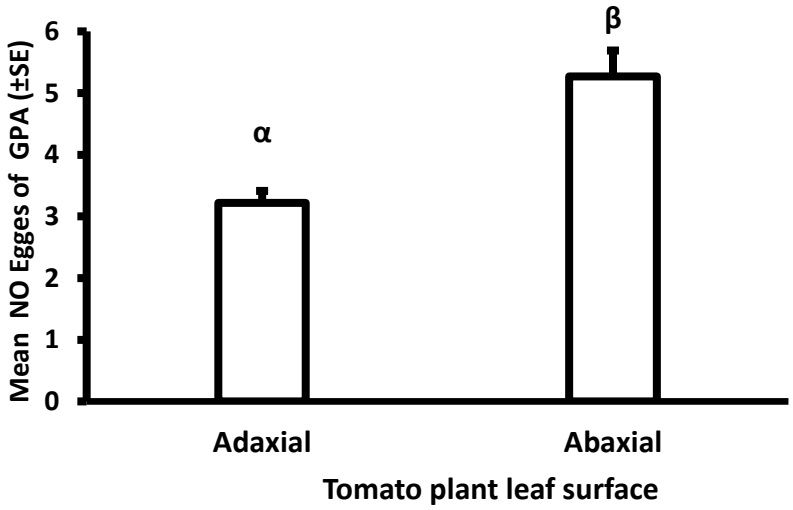

Fig. 7. Mean (±SE) number of eggs *M. persicae* on two leaf surfaces of tomato.Mean with different letters differed significantly at *(P < 0.05)*.

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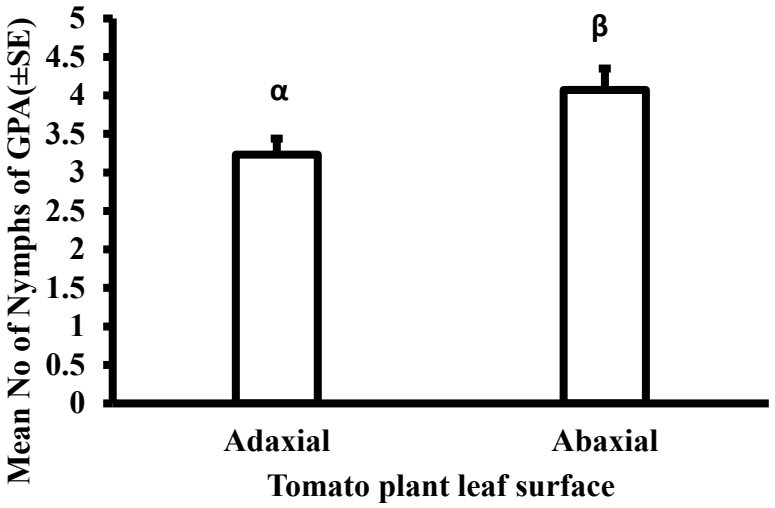

Fig. 8.Mean (±SE) number of nymphs *M. persicae* on two leaf surfaces of tomato. Mean with different letters differed significantly at *(P < 0.05)*.

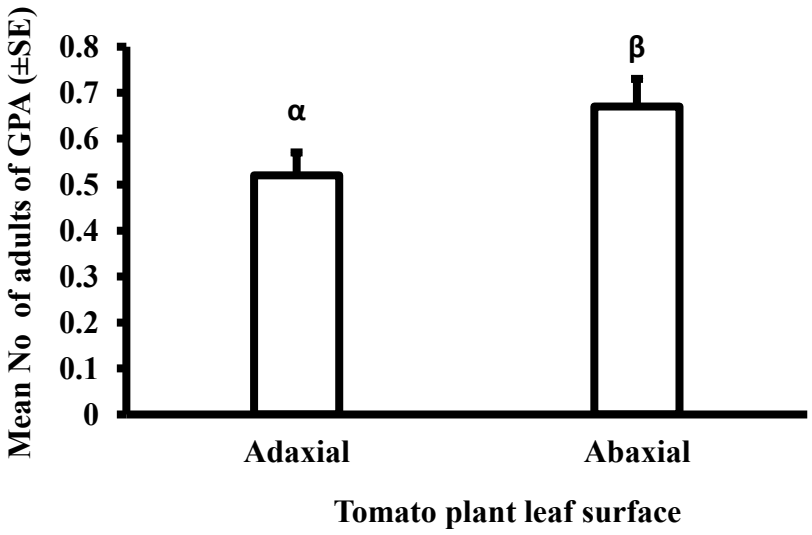

Fig.9. Mean (±SE) number of adults *M. persicae* on two leaf surfaces of tomato. Mean with different letters differed significantly at *(P < 0.05)*.

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DISCUSSION

The present results showed that the density of eggs green peach aphids *M. persicae* was significantly different ($P < 0.05$) among different tomato growth stages. The density of eggs was highest at the 60 days growth stage, compared to other stages (30 and 45 days), whereas, there was no significant difference between 45 days, 30 days plant growth stages. However, the abundance of nymphs and adults were no significant difference ($P< 0.05$) between 30, 45 and 60 days growth stages. This indicates that *M. persicae* generally preferred for tomato older growth stages to lays their eggs . There are several factors might be responsible for Aphid density at older growth stages compared to other stages, such as pH gradients, concentration of nitrogen and protein contents of cells sap (Avila *et al*,. 2019; Awmack and Leather, 2002), which could be different between and within a plant growth stage for each species (Paschalidis and Roubelakis-Angelakis, 2005). In contrast, the density of nymphs and adults *M. persicae* was no significantly different ($P< 0.05$) at all of the tomato stages. This may be due to movement of nymphs and adults within different plant stages. These results were in agreement with (Mansour *et al*., 2013) who found that the population of whitefly *Bemisa tabaci* (adults and nymphs) were not significant on different chilli strata.

Also, the results revealed that the eggs of Aphid were higher at the middle stratum than other stratum, the good explanation for that due to the adults of Aphid lays their eggs on the young leave while the plant continues to grow. The present findings agree with (Mansour *et al*., 2013), who revealed that a higher density of *Bemisia tabaci* eggs was observed at the middle stratum compared to the other strata on the several vegetables crops such as chilli, tomato and okra. Also the different trichomes density between tomato leaves may affect the preferring laying the eggs between strata (Schröder and Krüger, 2014). In opposite, the mean number of nymphs was higher on upper stratum compared with other stratum, this because young leaves at the upper plant stratum provided optimal nutrient requirements for the development of immature stages of Aphids. Nutritional status of a plant has been considered as the most important factors by several workers (Jansson and Smilowitz, 1986; Slosser *et al*., 1992; Slosser *et al*., 1997; Slosser *et al*., 1998; Slosser *et al*., 2004). Moreover, the adults were no significantly different ($P< 0.05$) among different tomato strata, this might be due to movement the adults within plant strata to avoid the food competition (Tilmon *et al*., 2011).

The present results showed that the density of eggs green peach aphids *M. persicae* was significantly different ($P< 0.05$) among different leaves surfaces of tomato. The highest mean number of GPA eggs was found on abaxial compared to adaxial. the results also showed that, the mean number of GPA nymphs and adults were significantly different between abaxial and adaxial, the highest mean number of GPA nymphs and adults found on abaxial. This may appear to give the eggs, nymphs and adults little hope of survival by avoiding predators and parasites, also another hypothesis suggested that the high moisture in abaxial compared to adaxial side could be providing good environment preferred to laying eggs and other stages of aphids, these results agreed with (Saad *et al*., 2019). Additionally, the most important of these differences due to the thickness of the cuticle layers between abaxial and adaxial, which are thicker in adaxial compared to abaxial, which could have acted as a barrier to Aphids feeding (Walker and Zareh, 1990).

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