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First report of *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) in apaxtleco chili (*Capsicum annuum* L.) cultivated in greenhouse

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ABSTRACT

Objectives: To generate information about a new host of the *Polyphagotarsonemus latus* (Banks) mite, and to understand the damages caused by the cultivation of apatlexco chili pepper (*Capsicum annuum* L.) in the northern region of the state of Guerrero.

Design/Methodology/Approach: The identification of the mite was carried out through taxonomic keys and the damages caused in vegetative shoots, mature leaves and flower buds were described.

Results: The *P. latus* mite was identified as causing important damage to the crops of aplaxtleco chili pepper grown in greenhouses in the state of Guerrero, Mexico, and this is the first report of this mite in the Aplaxtleco chili pepper crop grown in greenhouses in the state of Guerrero, Mexico.

Findings/Conclusions: Economic income is obtained from the cultivation of aplaxtleco chili peppers, a characteristic crop of the municipality of Aplaxtla, in the northern zone of Guerrero; therefore, knowing the identity of the *P. latus* mite in the aplaxtleco chili crop will help to suggest effective control methods to obtain higher yields.

Keywords: *Polyphagotarsonemus latus*, aplaxtleco chili pepper, mite, damage, description.

INTRODUCTION

Chili pepper (*Capsicum annuum* L.) is one of the crops with greatest agricultural importance at the global and national level, due to its high consumption, uses and benefits. Mexico is the second producer of this vegetable in the world, with a cultivated surface of 149 thousand hectares (SIAP, 2019). Additionally, in recent years, chili production in Mexico in its different varieties reached 3,379,289 t in the year 2018 (Panorama Agroalimentario, 2019).

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On the other hand, there are various types of landrace chili peppers that are consumed broadly in different sectors of the Mexican population, and they have the advantage of being accepted by consumers (Mena *et al*., 2007); among the numerous types of landrace chili peppers there is apaxtleco chili, which is characteristic and of great economic importance in the municipality of Apaxtla de Castrejón, in the northern region of the state of Guerrero, México (Moreno *et al*., 2007; Mena *et al*., 2007; Aguilar-Rincón *et al*., 2010). Its traditional cultivation on small surfaces, of which a low percentage of fruits are harvested to be destined to auto-consumption and 90% of the production sold to mole paste makers of the region, representing an important source of income for the producers who grow it (Vázquez-Casarrubias *et al*., 2011).

However, since it is a regional species and of broad use, it is affected by the presence of various pest insects and mites (Aarwe *et al*., 2019, Tirkey *et al*., 2019), harming the development of plants and decreasing production (Patrock and Schuster, 1992; López *et al*., 2003). Among the most important pests there are mites, and among them the white mite (*P. latus*) stands out, which causes severe damages to chili pepper crops (Garza, 2000).

This mite was discovered for the first time in terminal shoots of mango plants in a greenhouse in Washington, USA (Denmark, 1980; Banks, 1904); in addition, it is known as a polyphagous species of temperate and subtropical areas (Fasulo, 2007; Peña and Campbell 2005). *P. latus* has several hosts, among them the chili crop (Garza, 2000; Brown and Jones, 1983). In Mexico it has been reported in serrano and jalapeño chili peppers (Garza, 2000), causing important damages by suctioning the sap; the leaves roll downwards, giving the appearance of "an inverted spoon, a brown cork-like tissue between the nervation is formed on the underside, the leaves and the flowers are deformed causing a reduction in the photosynthesis and instability of the water potential" (Black *et al*., 1993; King and Saunders, 1984; Baker 1997).

Based on the problem described before, the objective of this study was to generate information about a new host of the *P. latus* (Banks) mite, and to understand the symptoms of the damages of the apaxtleco chili pepper (*C. annuum*) grown in greenhouses in the northern region of the state of Guerrero.

MATERIALS AND METHODS

This study was carried out in the facilities of the Master's in Agricultural and Livestock Sciences and Local Management of the Universidad Autónoma de Guerrero, located on the Iguala-Tuxpan Highway km 2.5, Iguala de la Independencia, Guerrero, México on geographic coordinates 18° 20' 57'' latitude N and 99° 28' 43'' longitude W, at an altitude of 757 m. Apaxtleco chili pepper seeds were used, from the municipality of Apaxtla de Castrejón, Guerrero, Mexico (18° 8' 00'' N; 99° 56' 05'' W, at 1182 m altitude). Later, the seeds were sown on 10/05/2018 on a propylene tray with 200 cavities filled with moist peat at field capacity, three seeds were placed per cavity and they were covered with the same substrate. Right away the tray was covered with black polyethylene to maintain the moisture and the temperature and to favor germination; then, it was placed in a tunnel-type greenhouse covered with milky white polyethylene plastic of 700 mm and anti-aphid mesh on the sides. Once the seedlings emerged, the first 15 days two watering events were carried out per day with tap water and then Steiner's (1984) universal nutritional solution (SN) was added at 20% of its original concentration, until the seedlings reached an average height of 20 cm and they presented five to six true leaves. At 39 days the transplant was carried out to black polyethylene bags of 12 L, filled with pumice stone with particle size of 1 to 5 mm, placing a seedling per bag (pot), which were distributed inside the greenhouse described previously, with a total of 126 pots. The crop was irrigated manually every day with three watering events per day, the first in the morning (8:00 h) with the indicated nutritional solution for the seedling stage, adjusting it in agreement with the phenological stage of the crop, with pH of 5.5 and electrical conductivity that was modified gradually from 0.5 to 2.0 dS m^{-1} according to the phenological stage of the crop, the second (14:00 h) and third (18:00 h) watering events were done with tap water.

Symptoms of *P. latus* appeared at 144 days, and samples were taken; for this purpose, an identification transect of damage and symptomatology present in the plant's organs was used, to later describe and obtain the mites, cutting three leaves on each cardinal point from ten plants, which were washed under a strong stream of water and sieving with different size meshes, following the methodology described by Southwood (1978). Next, the samples from the specimens collected were processed and mounted

between slides for their taxonomic determination; the mites were identified based on the determination made by Peña and Campbell (2005). Image capture was made with a scanning electron microscope brand JEOL, model IT-300LV, in the Scanning Electron Microscopy and Microanalysis Laboratory of the Earth Sciences School at Universidad Autónoma de Guerrero. The taxonomy of the specimens was determined with images from it, and the identification was made according to the description performed by Peña and Campbell (2005).

RESULTS AND DISCUSSION

According to the taxonomic keys and characteristics mentioned by Brown and Jones (1983), and Peña and Campbell (2005), the *P. latus* mite was determined (Figure 1) which was present in the apaxtleco chili pepper crop (*C. annuum*), and the first report of this species in the crop is reported. This mite has been reported in serrano and jalapeño chili peppers (Garza, 2000, Qureshi and Kostyk, 2020), sweet pepper (Raudez-Centeno and Jiménez-Martínez, 2018, Naituku *et al.*, 2017); however, there is no report in the apaxtleco chili pepper crop.

The characteristics that led us to its identification agree with those described by Peña and Campbell (2005), authors who determined the white mite *P. latus*. The adults were observed with a white to light yellow color, the females and the males had the same color (Figura 1 E, F), but with a clear difference in their morphology (Figure 1 C, D). The male is faster and of smaller size

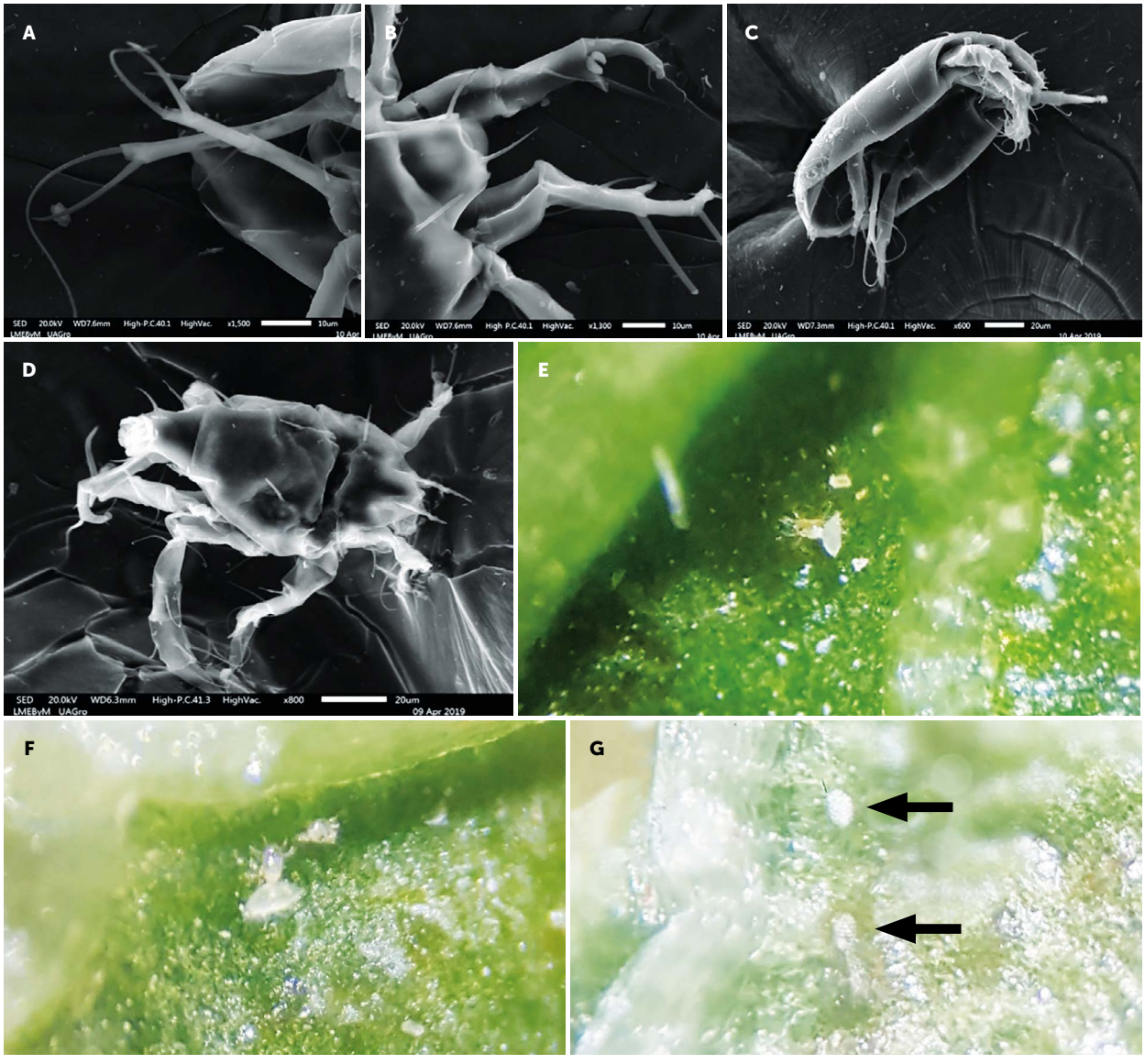

Figure 1. IV pair of legs from the female of *P. latus* (A), IV pair of legs from the male of *P. latus* (B), lateral female view (C), and dorsal male view (D) of *P. latus* in the scanning electron microscope. Male and female (E, F), eggs (G) of *P. latus* in stereoscopic microscope. (Initials based on Spanish terms).

compared to the female. The male, with robust back legs used to lift and carry the female in nymph state for their later mating (Figure 1 B, D, E, F). The back legs of the female were smaller in size, assimilating the shape of whips (Figure 1 A, C) present a very thin white line longitudinally and on the posterior part it forks close to the end (Brown and Jones, 1983; Peña and Campbell 2005). The eggs are transparent and slightly flattened (Baker 1997), the surface with five to six lines of tubers, which make it different from other mite eggs (Lavoipierre, 1940) (Figure 1 G).

Symptoms caused by the attack from *P. latus* on the apaxtleco chili pepper crop

The presence of damage to the crop from the high impact of pests was observed at 144 days after transplant (dat). The most severe symptoms were observed in the vegetative shoots and young leaves, which did not develop normally, becoming irregular and distorted in shape, the same as was described by Baker (1997), except contrary to what Garza (2000) mentions, where it is indicated that the leaves of tender shoots remain narrow and threadlike, some shoots present downward rolled leaves giving the shape of inverted spoon, as mentioned by Black (1993), in addition to finding some withering on the new leaves that did not allow them to reach maturity, but rather that lasted very few days adhered to the bud and fell after a few days, in the same way that Garza (2000) observed (Figure 2 A, B). The attacks were also seen in mature leaves, where they reached high populations of the white mite, which caused withering, rolling in leaves, and falling in few days; however, they did not have cork-like appearance as mentioned by Garza (2000).

An increase in the populations was seen when the flowering period took place, which caused abortion or falling, and in severe attacks the whole inflorescence withered and fell, in addition to atrophy in the development of the plant as mentioned by Denmark (1980), Gerson (1992), and Rai *et al*. (2007) (Figure 2 C).

CONCLUSIONS

The *P. latus* mite was found in the apaxtleco chili pepper; this mite is considered of great agronomic and economic importance because of the damages that it causes this crop, reducing the production. The apaxtleco chili pepper is endemic and characteristic of the region of Apaxtla de Castrejon, in the northern region of the state of Guerrero, which demands more research to maintain the production and to propose effective control methods that will help them to obtain a higher yield.

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Figure 2. Symptoms of damage in vegetative shoots (A), mature leaves (B) and flower buds (C) in apaxtleco chili pepper.

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