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A SURVEY OF MEALYBUGS (HEMIPTERA: COCCOIDEA: PSEUDOCOCCIDAE) IN CITRUS GROVES IN CONTINENTAL PORTUGAL.

ABSTRACT

A SURVEY OF MEALYBUGS (HEMIPTERA: COCCOIDEA: PSEUDOCOCCIDAE) IN CITRUS GROVES IN CONTINENTAL PORTUGAL.

A survey of mealybugs living in citrus groves was carried out in order to elucidate the identity and relative importance of the species associated with this crop in Continental Portugal. Samples were collected in 76 citrus groves from the districts of Beja, Coimbra, Évora, Faro, Lisboa, Porto, Santarém, Setúbal and Viseu. The presence of mealybugs was detected in 93% of the citrus groves studied. Four species were identified, i.e. *Planococcus citri* (Risso), *Pseudococcus calceolariae* (Maskell), *P. viburni* (Signoret) and *P. longispinus* (Targioni Tozzetti). *P. citri* and *P. calceolariae* were the most frequent species, present in 66% and 63% of the citrus groves, respectively. *P. viburni* and *P. longispinus* were identified in 29% and 14% of the sites, respectively. Apparently, *P. calceolariae* has the widest geographical distribution on citrus in Portugal. The co-existence of at least two species in the same citrus grove was found in 59% of the cases. *P. citri* and *P. calceolariae* were found associated in 37% of the citrus groves; *P. viburni* was always found associated with at least one of the three other species.

Key words: Universal Transverse Mercator, *Citrus sinensis*, *C. limon*, *C. reticulata*.

INTRODUCTION

Sixty-one species of mealybugs belonging to 19 genera are listed on *Citrus* spp. in Ben-Dov's (1994) Systematic Catalogue, but only a few are actually considered major pests. *Planococcus citri* (Risso) is probably the most important and cosmopolitan species.

However, pest status may change with pest management systems. Mealybug outbreaks were recently reported from Southern Africa (Hatting & Tate, 1997), where they had been considered relatively minor pests on citrus prior to 1990. Therefore, minor mealybug pests could be considered potential major pests. Furthermore, when more than one species is present, damage may occur as the result of the activity of the phloem-feeding guild of mealybugs, independent of the pest status of individual species.

Prior to the end of 1980 s, *P. citri* and *Pseudococcus longispinus* (Targioni Tozzetti) were the only mealybugs known from citrus in Portugal. Preliminary

studies conducted in Algarve suggested the existence of other species of Pseudococcidae (Carvalho, 1988) and these were subsequently identified as *Pseudococcus calceolariae* (Maskell) and *P. viburni* (Signoret) (= *P. affinis* Maskell) (Franco & Carvalho, 1990).

In order to know whether other mealybugs were associated with citrus and to elucidate their relative importance, a survey was conducted in nine regions of Continental Portugal and the results of this study are presented here and discussed.

MATERIALS AND METHODS

Samples were collected in 76 citrus groves from the districts of Beja, Coimbra, Évora, Faro, Lisboa, Porto, Santarém, Setúbal and Viseu. Each citrus grove was labelled according to the Universal Transverse Mercator (UTM) system of co-ordinates (Rasmont & Andre, 1989). A total of 41 10km² UTM squares were sampled.

Most of the samples were collected in sweet orange (*Citrus sinensis* (L.) Osbeck) groves, but other citrus species were also considered in a few regions. For instance, in Mafra (Lisbon district), all the samples were collected from lemon (*C. limon* Burmann), the only citrus species growing in the region, while in Ribatejo-Oeste Region, where the citrus groves are traditional mixed citrus groves of *C. sinensis*, *C. limon* and *C. reticulata* Blanco, collections were made on all three species.

Samples were mainly collected between 1991 and 1994 from July to September, i.e. the period when mealybug populations are usually at their greatest. Each sample was obtained by observing mainly fruits on trees which had been randomly selected. When the mealybug population was low, particular attention was paid to the space between the sepals and the fruit, where the probability of detecting mealybugs is greatest (e.g., Meyerdirk *et al.*, 1981).

Each grove was studied for 30 to 60 minutes, depending on the size of the grove and the frequency and abundance of the mealybugs.

When available, at least five adult females of each species were collected in each grove. In some groves, only immature stages were found. These specimens were identified using the keys in Panis (1969).

RESULTS AND DISCUSSION

Mealybugs occurred in 93% of the investigated citrus groves, including some commercial groves intensively sprayed with insecticides. Mealybugs were not detected in two citrus groves in the district of Beja, nor in three groves in the district of Évora.

Four mealybug species were identified from the 500 specimens collected (*P. citri*, *P. calceolariae*, *P. longispinus* and *P. viburni*), including 407 adult females and 93 young stages. *P. citri* was the most frequent species, present in 66% of the groves (Table 1). It was followed by *P. calceolariae*, *P. viburni* and *P. longispinus*, present in 63%, 29% and 14% of the groves respectively. However, the relative frequency of the four species was variable from region to region. For example, *P. citri* was collected in 96% of groves in the province of

Table 1. Number of citrus groves by district where the presence of mealybugs was detected. Where - = species not found.

District	Number of groves studied	<i>Planococcus citri</i>		<i>Pseudococcus calceolariae</i>		<i>Pseudococcus longispinus</i>		<i>Pseudococcus viburni</i>	
		N	%	N	%	N	%	N	%
Beja	3	1	33	-	-	-	-	-	-
Coimbra	10	7	70	9	90	3	30	7	70
Évora	5	1	20	1	20	-	-	-	-
Faro	23	22	96	9	39	8	35	4	17
Lisboa	11	7	64	7	64	-	-	5	45
Porto	2	-	-	2	100	-	-	2	100
Santarém	7	4	57	6	86	-	-	-	-
Setúbal	14	8	57	13	93	-	-	4	29
Viseu	1	-	-	1	100	-	-	-	-
Total	76	50	66	48	63	11	14	22	29

Table 2. Frequency distribution of the number of citrus groves and UTM squares as a function of the number of mealybug species identified.

		Number of species				
		0	1	2	3	4
Groves	N	5	26	30	15	0
	%	7	34	39	20	0
UTM squares	N	2	10	15	10	4
	%	5	24	37	24	10

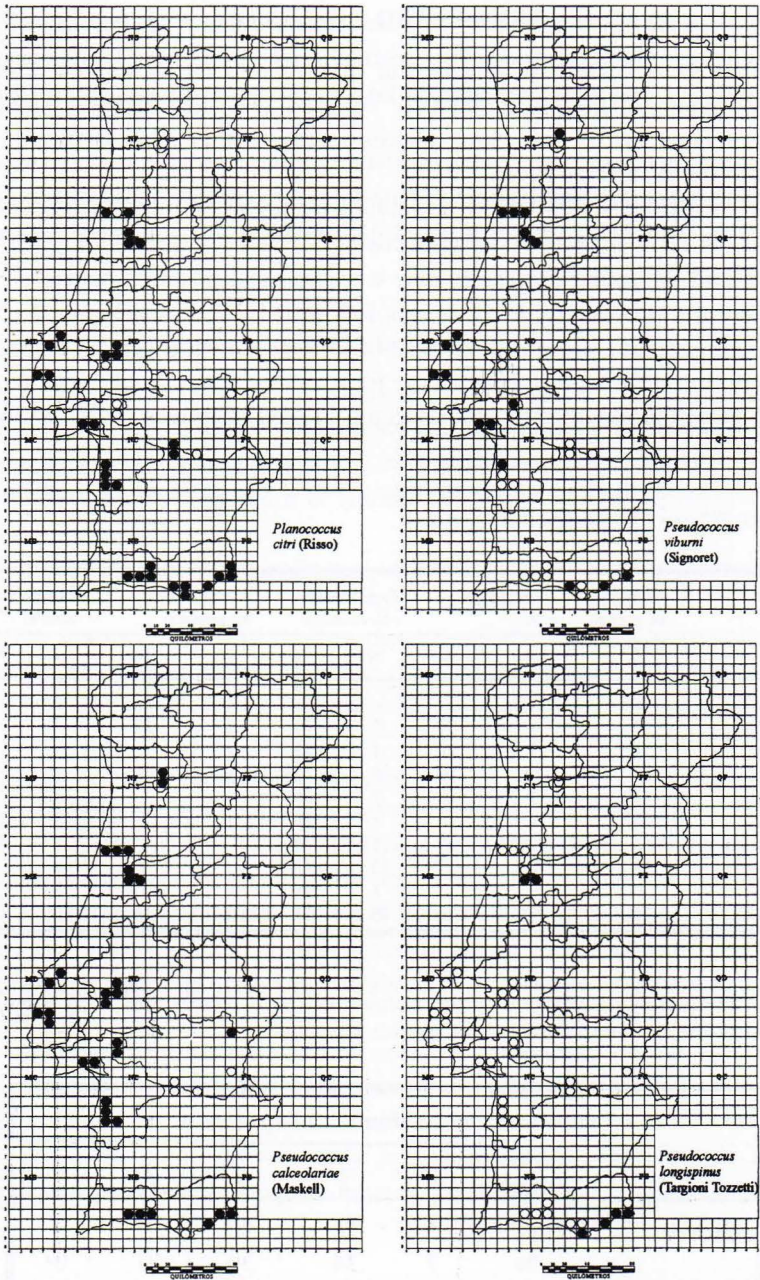


Fig. 1. Geographical distribution of the four mealybug species identified from citrus groves in Continental Portugal. The sampled UTM squares (10km x 10km) are shown as circles, black when a species was present and white when absent.

Algarve (district of Faro), against less than 40% for the other three mealybug species in the same area. *P. calceolariae* was the most frequent species in the districts of Setúbal, Santarém and Coimbra, where it was present in between 86% and 93% of the groves. *P. longispinus* was collected in only two of the nine districts studied, namely Coimbra and Faro. For *P. viburni*, it seems that there is a frequency gradient, increasing from south to north, i.e. Faro (17%), Setúbal (29%), Lisboa (45%), Coimbra (70%) and Porto (100%).

Based on the UTM system (Fig. 1), the most frequent species was *P. calceolariae*, present in 78% of the UTM squares studied. It was followed by *P. citri* (76%), *P. viburni* (41%) and *P. longispinus* (15%). Thus, although *P. citri* was the most common species in the citrus groves studied, *P. calceolariae* had a wider geographical distribution in citrus in Continental Portugal.

The results also showed that it was common to find two or more mealybug species co-existing in the same grove or in different groves in the same geographic region. In fact, this co-existence was detected in 59% of citrus groves and 71% of UTM squares (Table 2). *P. citri* and *P. calceolariae* were found alone in only 17% and 16% of the groves respectively, and co-existing in 37%. *P. viburni* was always associated with at least one of the other three mealybug species, while *P. longispinus* was alone in one citrus grove only.

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REFERENCES

- BEN-DOV, Y., 1994 - A Systematic Catalogue of the Mealybugs of the World (Insecta: Homoptera: Coccoidea: Pseudococcidae and Putoidae), with Data on Geographical Distribution, Host Plants, Biology and Economic Importance. Intercept, Andover. 686pp.
- CARVALHO, J.P., 1988 - Programa de entomologia para a citricultura do Algarve. Programa de Investigação para Concurso a Investigador Coordenador. INIA/EAN, Oeiras. 97pp.
- FRANCO, J.C., CARVALHO J.P., 1990 - As cochonilhas-algodão dos citrinos (Homoptera: Pseudococcidae) em Portugal. In: APHF/SECH (eds) I Congresso Ibérico de Ciências Hortícolas, Lisboa, 1990. *Actas de Horticultura*, 6: 75-81.
- HATTING, V., TATE, B.A., 1997 - The pest status of mealybugs on citrus in Southern Africa. Pp 560-563 in Manicom, B, Robinson, J., du Plessis, S.F., Joubert, P., van Zyl, J.L., du Preez, S. (eds) Proceedings of the International Society of Citriculture. Sun City Resort, 1996. 1311pp.

- MEYERDIRK, D.E., CHANDLER, L.D., SUMMY, K.R., HART, W.G., 1981 - Spatial distribution of the citrus mealybug on grapefruit trees. *Journal of Economic Entomology*, 74: 662-664.
- PANIS, A., 1969 - Observations faunistiques et biologiques sur quelques Pseudococcidae (Homoptera, Coccoidea) vivant dans le midi de la France. *Annales de Zoologie et Ecologie Animale*, 1(3): 211-244.
- RASMONT, P., ANDRE, J., 1989 - Applications d'un logiciel de projection UTM a la surveillance des Invertébrés. Pp 227-240 *in*: De Beauford, J., Maurin, H., (eds) L'utilisation des Inventaires Informatisés d'Invertébrés pour l'Identification et la Surveillance d'Espaces de Grand Intérêt Faunistique. Paris, Secrétariat de la Faune e de la Flore.