Preliminary results on the action of a plant growth regulator (Ethrel) in reducing the attack of *Prays oleae* Bern. on olive fruits

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Summary. Preliminary experiments carried out in the Granada province of Southern Spain over three years and in three different habitats have shown that a single application of Ethrel (2 chloro-ethyl phosphonic acid) to the olive tree at the beginning of fruit formation is sufficient to reduce significantly attack by *Prays oleae* Bern. and subsequent damage to the fruit. At the same time the treatment did not cause any detrimental change to the trees and had no measurable effect on the activity of beneficial insects such as Chrysopids (*Neuroptera*), which are known to be important *P. oleae* egg predators in the study area.
Key words. Lepidoptera; *Prays oleae*; plant growth regulator; fruit infestation reduction.

Since 1970 extensive bio-ecological studies have been carried out in the Granada province of Southern Spain on the Olive Moth, *Prays oleae* Bern. (*Lepidoptera : Hyponomeutidae*) an important economic pest of the olive in the Mediterranean basin [1]. The most interesting insight achieved in recent years in the dynamics of *P. oleae* populations and the damage caused to the fruits has been the phenological coincidence between the flight of adult females and the necessity of 'suitable' fruits being available on the olive tree for oviposition [2]. The degree of synchrony can vary greatly from year to year and can in some occasions result in very low fruit attack despite the presence of large adult populations if these happen to be flying before the fruits have become 'suitable' for oviposition [3]. Some authors [4] have suggested that fruits have to have a minimum diameter in order to be 'suitable' for oviposition. However, later studies on fruit diameter, color, texture and lipid biosynthesis showed that none of these factors significantly influenced fruit susceptibility, while certain volatile substances emanating from the fruit could on the other hand provoke or inhibit the arrival of the female on the olive fruit for oviposition. Amongst the volatiles which are emitted naturally by the fruit, ethylene stands out as being one of the most important. Ethylene is known to be a plant hormone which modulates all other plant growth substances [5]. It is released in very high amounts by the olive plant when it undergoes developmental changes such as flowering or fruit formation [6], and could be the factor which inhibits the attraction of females to the fruits when it is present at high levels. If this were the case, raising the level of ethylene artificially for a sufficiently long time might diminish the moths' oviposition period.

Material and methods

A single application of Ethrel (2 chloro-ethyl phosphonic acid) was made every year over three consecutive years (1986, 1987 and 1988) to the experimental trees. Ethrel produces a burst of ethylene from the fruit; the latter then continue to produce ethylene for up to one month, unlike the untreated fruits which produce ethylene at a comparatively low level after two or three days. The Ethrel formulation was used at a concentration of 0.12% [7] and applied at the start of fruit formation to five olive trees, leaving five other trees as controls. The treatment was applied to trees in three distinct zones within the province of Granada, at different altitudes; Parque Invierno, 835 m, Alfacar, 930 m and Quentar, 1000 m. All the experiments were carried out on trees of the 'Picual' variety, 50–60 years old, grown under non-irrigated conditions, with 10×10 m spacing and without insecticide treatment for at least ten years. From the date of application, weekly samples of fruits were taken from the ten olive trees on each site, until the point was reached when 100% of the eggs had hatched. The total number of fruits observed was around 5000 per biotope and year, corresponding to almost 8000 eggs laid on them. From each sample the following parameters were obtained relating to the attack by *P. oleae* and subsequent egg predation [8]: Population intensity (POP), an index of *P. oleae* population expressed as the total number of eggs laid per 100 fruits; Potential Infestation (PI%), the percentage of fruits with eggs laid on them; Final Infestation (FI%), the percentage of fruits with eclosed eggs (larvae having entered the fruit), which would eventually fall off the tree; Predatory Activity (PA%), the percentage of *P. oleae* eggs destroyed by egg predators from the total number of eggs observed.

Preliminary results

The table shows the mean values of the measured parameters at or about 100% egg eclosion. The results obtained show quite clearly that a single application of Ethrel in almost all cases produced a significant reduction of all parameters measuring *P. oleae* attack when compared with controls. The means of total levels of reduction in attack were about 56% in POP, 15% in PI% and 13% in FI%. At the same time, no significant differences were observed in the activity of beneficial insects such as egg predators between the treated and

Means of parameters measuring *Prays oleae* fruit attack and egg predators' activity (100% of hatched eggs)

Biotope	Year	Treatment	POP	PI%	FI%	PA%
Parque Invierno	1986	Control	288.0a	98.7a	21.3a	93.4a
		Ethrel	137.1b	77.1b	15.7b	87.3a
	1987	Control	218.2a	88.0a	56.6a	57.0a
		Ethrel	185.0b	85.0a	48.8b	65.4a
	1988	Control	326.5a	99.5a	60.9a	71.4a
		Ethrel	289.6b	89.2b	40.8b	79.2a
Alfacar	1987	Control	264.1a	93.3a	52.5a	75.8a
		Ethrel	103.6b	67.4b	35.1b	58.5b
	1988	Control	372.0a	100.0a	41.2a	86.3a
		Ethrel	239.9b	96.3a	28.8b	82.4a
Quentar	1987	Control	158.9a	81.8a	39.8a	69.8a
		Ethrel	85.9b	55.3b	23.4b	66.7a
Mean of totals		Control	271.3a	93.6a	45.4a	75.6a
		Ethrel	173.5b	78.4b	32.1b	73.3a

Means followed by different letters within each column and year/site differ significantly (least significant differences test $p = 0.01$) POP, population; PI%, potential infestation %; FI%, final infestation %; PA%, predatory activity %.

control trees. There is, however, an indication from some sets of data which could indicate that when there is a drastic reduction in the attack of *P. oleae* (Alfacar 1987, 150% reduction in POP and 26% reduction in PI%) there can also be a certain reduction (13%) in the activity of the egg predators. This phenomenon can be explained in part by the observations made in earlier studies[8] that the lower the attack of *P. oleae*, the lower the egg predator activity; this relationship can be roughly described by the linear relationship between PI% and PA% ($r = 0.50$).

Conclusions

By means of a single application of Ethrel, it has been possible to reduce the final attack level (FI%) of *Prays oleae* in olive fruits and in turn the dropping of those fruits from the olive trees, by about 13% with a range of values between 6% and 20% according to the experimental zone and year concerned. In practice, the greatest problem encountered in the field application of this technique is determination of the optimal time of treatment, since fruit formation is not chronologically homogeneous in any zone and not even in a single tree, depending on the geographical orientation and the height of the fruit upon the tree. It is therefore improbable that a single application of Ethrel would be certain to hit all the developing fruits at the right point in their physiological development, and repeated treatments with Ethrel could result in significant hormonal imbalance with detrimental changes to the tree[9]; such detrimental changes were not observed when only one physiologically active dose was applied. It may be possible to overcome the problems cited by applying Ethrel on each occasion only to those fruits which are at the correct stage of development to respond to the treatment, but the need to visit the same trees repeatedly would argue against this practice. However, continuing research by the present authors will be directed towards overcoming these inconveniences and it is hoped that a technique can be developed which artificially produces a lack of synchrony of 15–20 days between *P. oleae* emergence and its host plant, such that 50% of females will have flown without ovipositing[10]. This should lead to major reduction in *P. oleae* attack and avoid negative effects on its natural enemies.

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