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Establishment of Economic Injury Levels for Olive Infestation by *Dacus oleae* in Corfu[1,2]

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ABSTRACT

Economic injury levels for cover sprays and air bait sprays were established for the infestation by *Dacus oleae* (Gmelin) (Diptera: Tephritidae).

For cover sprays, the economic injury levels (expressed as percent infestation by taking 30,000 fruits to represent the average number of fruits per tree) were calculated as 7.59% for infestation laid in late July-August, 6.16% for infestation in September and 10.31% for infestation in October.

For air bait sprays, economic injury levels were calculated for various fruiting conditions (expressed as proportion of trees bearing olive fruits) and they were much lower than for cover sprays due to the lower cost of air treatments. For July-August, they ranged from 5.07% infestation for 25% trees bearing olives to 1.27% for 100% trees with olive fruits. For September they ranged from 4.11% to 1.08% infestation, for October they ranged from 6.88% to 1.72% infestation and for infestation laid in November they ranged from 61.28% to 15.32% infestation, respectively. The economic injury levels for air bait sprays were also expressed as mean weekly number of females per McPhail trap by taking into account the potential fecundity of *D. oleae* and the efficiency of the McPhail trap (baited with protein hydrolysate 2% and borax 1.5%) at different times of the year. For September, they ranged from 16 females per trap for groves with 25% of trees bearing olive fruits, to 4 females per trap for 100% trees with fruits. For October, they ranged from 6 females per trap to 1 female per trap, respectively.

Introduction

The economic injury level is defined as the lowest population density of a pest that causes damage which justifies the cost of control. Intervention threshold (economic threshold) is the population density at which control measures should be carried out to prevent an increasing pest population from reaching the economic injury level (Stern et al. 1959). It is necessary, however, to clarify the meaning of these terms in the case of the olive fly in relation to the two main control methods used: i.e. cover sprays applied from the ground which kill, mainly, the existing infestation within the fruits (curative method) and aerial bait sprays against the adult population before fruits are infested (prophylactic method). In the case of cover sprays it is rather difficult and meaningless to distinguish between the two terms and the term economic injury level will be used to mean the infestation which unless treated will cause economic damage equal to the cost of the spray after progressing to the advanced stages (third stage larvae). Air bait sprays are applied against the adult population and because of this

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it is necessary to express the economic injury level (i.e. the level of infestation which will cause damage equal to the cost of that type of spray) in terms of number of adults per tree capable of producing that infestation. This expression corresponds to the intervention threshold but for reasons of simplicity, the term economic injury level will be used also in that case.

Economic injury levels for *D. oleae* can be calculated for any time during the fruiting season when control measures are likely to be applied (July-October) provided that the necessary parameters (mortality factors, developmental times, potential fecundity, trap efficiency, etc.) can be estimated. However, taking into account the plenology of the pest, the changes in the other parameters affecting the calculations and the period when control is actually applied in Corfu, three economic injury levels were developed for cover sprays. One for the first period of infestation which starts in late July-beginning of August, one for the infestation that starts at the beginning of September and the third at the beginning of October. For aerial bait sprays, an additional economic injury level was calculated for infestation in November but, of course, the actual treatment to prevent this would be applied in late October.

In order to establish economic injury levels for the infestation of olives by *D. oleae* in Corfu it was necessary to obtain an average estimate of the olive oil production of the "Lianolia" variety as this is the predominant variety of the island.

From the components of crop loss due to the infestation of *D. oleae* (Kapatos and Fletcher 1983b), only the preharvest fruit drop and the amount of pulp consumed by the larvae were taken into account in developing the economic injury levels. The effect of *D. oleae* infestation on the acidity of the olive oil was not included because it is negligible at the time when fruits drop and the other factors like harvest and storage conditions are much more important in determining it (Neuenschwander and Michelakis 1978). These factors may interact with *D. oleae* infestation in increasing olive oil acidity, but this interaction cannot be easily quantified and incorporated into the economic thresholds. Also it would be more sensible for the pest management system to include techniques for shortening the harvesting period and to improve storage conditions before milling, instead of "loading" the economic thresholds for *D. oleae* which would mean an increase in the insecticides used.

Economic injury levels for *D. oleae* infestation have been established for some varieties in Italy (Pucci et al. 1979) and in Crete (Neuenschwander and Michelakis 1978) although their approach was different from ours.

Materials and Methods

a. Estimation of the olive oil production

The work for estimating the average olive oil production of the trees of the local variety was carried out at four experimental olive orchards in different parts of the island (Xathates, Linia, Kassiopi, Chlomotiana) during the years 1977-1979. All of them received the usual agricultural practices including protection against pests and diseases that induce premature fruit fall. In order to obtain as accurate as possible an estimate of the average olive oil production per tree, additional data which had been obtained by the Olive Institute during 1972 and 1975 (Kassimis, unpublished) were analysed and incorporated in this study. These data were obtained during a study on the rate of fruit fall, fruit weight and oil content at Nissaki which is a village situated in the central eastern part of the island.

To estimate the average olive oil production per tree the following procedure was followed at each of the experimental sites. From the beginning of the season (late July) the number of fruits that fell from a number of trees (12 at Xathates, 8 for the other sites) was measured at regular intervals by using a technique described in a previous paper (Kapatos and Fletcher 1983b). The cumulative totals of these estimates at the end of the season indicated the total number of fruits that were present on each of the trees at the beginning of the season. Thus, the number of fruits present on the tree at any time and the rate of fruit fall during each sampling interval could be easily calculated (Kapatos and Fletcher 1983b). On all sampling dates fruit samples were taken both from the trees and the ground and the mean fruit weight and olive oil content was determined. The determination of the oil content was carried out by the chemistry laboratory of the Institute using standard procedures. Briefly, it was done by drying mashed fruit at 80° until they reach a constant weight. The olive oil was then extracted with benzene for 16 hours in Soxhlet flasks. Moisture content was calculated as a percentage of fresh fruit weight, and oil content both as a percentage of dry weight and fresh fruit weight.

The potential production (P_{max}) of an olive tree available to the farmer is the cumulative totals of the oil content of the fruits at the time they drop assuming that they are all collected. Thus, this value can be obtained by the following formula

$$P_{max} = \Sigma FG_i \times O_i \times W_i \quad (1)$$

where FG_i is the mean number of fruits per tree that fell during the sampling interval i, O_i is the oil content expressed as a proportion of fresh fruit weight and W_i is the mean weight of the fruit at the time they fell.

The total amount of oil produced per fruit (f_{max}) can be obtained by dividing P_{max} by the number of fruits present on the tree before the beginning of infestation in July (FT_o). Thus

$$f_{max} = P_{max}/FT_o \quad (2)$$

Similarly, the contribution to the total oil (i.e. f_{max}) made by the fruits that drop during the ith sampling interval can be estimated as

$$(FG_i/FT_0) \times O_i \times W_i \quad (3)$$

In practice, however, harvesting does not start until mid-November when the oil content of fruits has reached a relatively high level and this results in some loss of production due to the natural fruit fall that occurs before then. Thus, the potential oil production of a tree that the farmer can actually harvest (P_{real}) is less than P_{max} and represents the cumulative totals of the oil content of the fruits that fall after the beginning of harvesting (fruits are harvested from the ground). Consequently, the amount of oil per fruit that is available to the grower (f_{real}) can be obtained by summing the values obtained from calculation (3) from the beginning of harvesting onwards.

b. Calculation of economic injury levels

Assuming that all infested fruits fall, the crop loss due to preharvest fruit drop of a given number of fruits infested by the olive fly (Δ) would be $f_r.\Delta$ where $f_r = f_{real}$ (which is the expected oil production of an individual fruit present on the tree at any time before harvesting). However, it has been shown that only larval stages later than L2 cause preharvest fruit fall. Moreover, only a proportion of the fruits having such stages actually fall before harvesting. The remainder suffer only a 4.48% loss in oil due to the feeding of the larva in the pulp (Kapatos and Fletcher 1983b). Therefore for each major period of infestation (late July-August, September, October) the loss in grams of oil due to infested fruites (D) can be calculated from the equation

$$D = f_r \times \Delta \times S \times P_d + f_r \times \Delta \times S(1-P_d)a \quad (4)$$

where S is the probability of an egg reaching the L3, P_d is the proportion of the fruits containing an L3 or later stage that fall before harvesting and a (= 0.0448) is the proportion of the oil lost in the fruit pulp consumed by a *D. oleae* larva.

The proportion of the fruits containing an L3 or later stage that fall before harvesting (P_d) has been calculated for each period of infestation (late July-August, September, October) and given in a previous paper (Kapatos and Fletcher 1983b). Also probabilities of survival for the various stages of *D. oleae* have been calculated on both a generation and a monthly basis (Kapatos 1981). For the period July-August these two types of estimates are actually the same because the development of the larval stages of this generation, usually, takes place between the end of July and the middle of August. The estimated probability of survival of the various stages for the second generation of *D. oleae* covers the period September-October and this estimate was used for the calculation of economic injury levels for both the periods because it was considered more accurate than the separate monthly estimates for September and October and because mortality factors have been found to act rather similarly during these two months. The values used, therefore, were 0.49 for July-August and 0.72 for September and October (Kapatos 1981).

Equation (4) assumes that only a single egg is laid in each fruit or at least only one individual of *D. oleae* reaches the L3 stage. This is very close to the truth, especially at low and medium infestation levels, although some exceptions may be observed in the field. The equation also assumes that the infestation is recorded when it is still in the egg stage because the probabilities of this stage surviving to the L3 stage have been used in the calculations. In practice it might not be possible to sample sufficiently frequently to record all eggs before they hatch. However, the equation can be easily modified according to the stages found in the fruit samples and the probabilities of survival for these stages which have been calculated (Kapatos 1981). Another assumption is that crop loss due to consumption of fruit pulp by stages earlier than L3 present in the fruits at the beginning of harvesting is negligible. This seems reasonable when it is considered that the total amount during all three larval stages is only 4.48%. Again it is not difficult to incorporate this component by partitioning the amount of pulp consumed by each larval stage in proportion to weight increase. However, if all these factors are incorporated into the equation, which is possible, this would make it much more complex without very much improvement in precision.

Economic injury levels for the two methods of control used against *D. oleae* can be calculated from equation (4) if the cost of spraying in terms of grams of oil per tree is known and substituted for D. Then the equation can be solved for Δ which represents the number of infested fruits per tree that cause economic damage equal to the cost of spray. The cost of sprays in terms of grams of oil per tree change from year to year and therefore the economic injury levels which are presented in this paper are only meant to be indicative of the general situation as they are based on 1980 prices.

Theoretically, it is possible to express the economic injury levels relating to the use of aerial bait sprays in terms of number of females per tree, capable of producing an infestation at the level determined by the economic injury level, if the potential fecundity for each particular period of infestation is known. However, the adult populations are normally monitored with McPhail traps baited with protein hydrolysate and borax and thus in practice it is more useful if the economic injury levels for air bait sprays are defined in terms of the mean weekly number of females caught per trap. This introduces another variable into the calculations because not only do the values for potential fecundity and economic injury levels change but the relative efficiency of the McPhail trap also changes throughout the year. Thus, even if the actual numbers of females per tree that correspond to the economic injury level are the same at two different times of the year, when expressed in terms of McPhail trap catches the numbers are likely to be quite different from each other.

The McPhail trap baited with protein hydrolysate and borax has been calibrated for the conditions in Corfu by comparing mean weekly trap catches with known absolute densities of flies per tree estimated with mark-recapture techniques. These estimates of trap efficiency were used to develop an equation giving the relationship between trap efficiency and mean weekly temperature (Kapatos and Fletcher 1983a). According to Kapatos and Fletcher (1983a), trap efficiency expressed as a proportion of the adult population within the tree that is trapped by a McPhail trap during a seven-day period (TE_i) is given by

$$TE_i = C_i/Nt_i \qquad (5)$$

where C_i is the mean number of flies per trap during the ith week and Nt_i is the average population per tree estimated for the ith week. TE_i for females can be calculated as

$$\log_e TE_i = -4.794 + 0.223T_i \qquad (6)$$

where T_i is the mean weekly temperature. The average number of females per tree (NtF_i) that are present during a particular week is given by

$$NtF_i = \frac{C_i}{e^{(-4.794 + 0.223T_i)}} \qquad (7)$$

It should be noted, however, that this equation does not apply for the summer period before the beginning of infestation in July, because temperature ceases to be the major factor determining trap efficiency at this time.

The total number of eggs (NtE_i) likely to be laid by females present in a tree during a particular week (NtF_i) as defined in formula (7),can be obtained from the formula

$$NtE_i = PF_i \times NtF_i \qquad (8)$$

where PF_i is the potential fecundity for a particular period. Then, assuming that only one egg is laid in each fruit (a close approximation to the real situation) NtE_i should be equal to the number of fruits these females will infest. Although females may move from tree to tree, because NtF_i is an estimate of the mean density of females per tree, NtE_i should represent an estimate of the total number of fruits infested per tree. Thus ,using the relationship in equation (7) it is possible to redefine NtE_i as

$$NtE_i = \frac{C_i \; PF_i}{e^{(-4.794 + 0.223T_i)}} \qquad (9)$$

If the calculated economic injury level for the appropriate period (i.e.the minimum number of fruits infested per tree that cause economic damage) is substituted for NtE_i, then by solving equation (9) for C_i, that is

$$C_i = \frac{NtE_i \; e^{(-4.794 + 0.223T_i)}}{PF_i} \qquad (10)$$

the weekly catch of females in McPhail traps that corresponds to the economic injury level for that period can be calculated.

Results and Discussion

a. Estimation of the olive oil production

The mean fruit weight, oil content and rate of fruit fall throughout the fruiting season estimated at one of the experimental sites (Xathates 1978) are given in Table 1, where also the calculations of f_{max} and f_{real} are also shown. For convenience, the data on oil content and rate of fruit fall are presented as percentages rather than as proportions. The estimates of fruit weight, oil content and rate of fruit fall obtained at the other experimental sites show the same general trends as those for Xathates in 1978.

Fruit weight increases continuously from August onwards especially after the first rains in September. During winter it remains relatively constant and then increases again the following spring. Percent oil content also increases gradually and by late November/beginning of

TABLE 1. Estimates of the mean fruit weight (W), oil content of the fruit (0, in %) and rates of fruit-fall (FG/FT_o) at Xathates during the 1978/9 season. The calculation of f_{real} and f_{max} are also shown.

Date	W (in g)	O (%)	Fruit-fall FG/FT_o	$\frac{FG}{FT_o} \times W \times O$ (in mg)	Cumulative product $\frac{FG}{FT_o} \times W \times O$ (in mg)
29/7	0.625	2.06	0.38	0.0	
12/8	0.672	3.22	0.36	0.1	
26/8	0.734	4.30	0.83	0.3	
24/9	0.823	9.81	1.46	1.2	
14/10	0.920	15.51	1.06	1.5	
4/11	0.970	16.17	1.29	2.0	
18/11	1.032	16.89	1.89	3.3	0.9*
25/11	1.065	17.93	0.62	1.2	2.1
9/12	1.089	18.92	4.52	9.3	11.4
30/12	1.169	20.26	19.34	45.8	57.2
13/1	1.190	21.02	10.74	26.9	84.1
27/1	1.162	21.52	6.01	15.0	99.1
10/2	1.214	21.40	10.67	27.7	126.8
24/2	1.275	22.26	10.65	30.2	157.0
17/3	1.319	23.72	9.52	29.8	186.8
2/4	1.378	25.11	5.48	19.0	205.8
17/4	1.414	25.92	5.99	22.0	227.8
3/5	1.430	26.37	4.77	18.0	245.8
10/5	1.476	26.58	2.11	8.3	254.1
20/5	1.312	29.02	2.30	8.7	262.8
				f_{max} = 270.3	f_{real} = 262.8

* Calculated proportionally from 15 November.

December has reached relatively high values. During January-February it remains relatively constant and increases again slightly the following spring.

The rate of fruit fall appears to be very low until November but from then onwards fruit maturation proceeds quickly and large numbers of fruits become mature and fall to the ground. Some fruits remain on the tree until the following May but the proportion varies from situation to situation depending upon many factors, including crop management systems and climatic conditions.

Fruit weight, oil content and rate of fruit fall are parameters reflecting fruit maturity and they are likely to interact with each other and to be affected by the total number of fruits present on the tree at any time. However, this aspect of the physiology of the olive tree has not been studied.

The estimates of the olive oil production per single fruit (f_{real}) obtained at the various experimental sites and the mean estimate for all sites are given in Table 2. The average production of olive oil per fruit of the "Lianolia" variety was estimated to be 0.2926 grams. Using this estimate, the total production of olive oil per tree can be calculated at any time before harvesting if the total number of fruits present on the trees is known. It also represents the expected loss in olive oil production of individual fruits that fall before harvesting due to *D. oleae* infestation.

TABLE 2. The average olive-oil production per fruit estimated at various experimental sites during the years 1977-1979 in Corfu.

Year	Experimental site	Olive-oil production (g)
1972	Nissaki	0.3206
1975	Nissaki	0.3332
1977	Linia	0.3399
1977	Kassiopi	0.2782
1977	Xathates	0.3054
1978	Xathates	0.2628
1979	Chlomotiana	0.2083
Mean		0.2926
Standard deviation		0.0466

b. Establishment of economic injury levels for cover sprays

The cost of a cover spray applied from the ground was estimated to be approximately equivalent to 300 grams of olive oil per tree based on the price of good quality oil (at 1980 prices). Using this figure and equation (4), the number of infested fruits per tree that cause economic damage was calculated for each period of infestation and the values are given in Table 3. In order to express these numbers as percentages of infestation, the total number of fruits per tree must be known. However, crop size varies from tree to tree and from year to year. Therefore, 30,000 fruits which represent the average number of fruits per tree in a year of good production was chosen to represent the

TABLE 3. Calculated economic injury levels for *D. oleae* infestation, expressed both as number of infested fruits per tree and percentage infestation, in relation to the cost of cover sprays for late July-August, September and October, the periods when these control measures would be normally carried out. The calculations refer to trees bearing an average of 30,000 olive fruits each.

Late July-August		September		October	
Number fruits infested	% infestation	Number fruits infested	% infestation	Number fruits infested	% infestation
2277	7.59	1848	6.16	30.94	10.31

typical situation. Using this figure the economic injury levels with regard to cover sprays applied from the ground, expressed as percentages of infestation, are also given in Table 3.

The economic injury levels for July-August and September are relatively similar, because although a greater proportion of the fruits infested in September remain on the tree until harvest, compared with the ones infested in July-August (Kapatos and Fletcher 1983b), the survival rate of the early stages is higher in September due to lower temperatures in this month. The economic injury level for October is slightly higher than for the two earlier periods because in October only 43,5% of the fruits infested with an L3, or later stage, fall before harvesting.

Interestingly, the calculated economic injury levels of 7,59% infestation in July-August, 6.16% in September and 10,31% in October, although higher, are not all that different from the empirically determined threshold of 5% living infestation which is used by the Ministry of Agriculture.

c. Establishment of economic injury levels for air bait sprays

Air bait sprays are applied against the adult population before fruits are infested. Therefore, the term economic injury level in this case means the "expected" infestation that is going to be produced by the presence of a certain number of flies.

The cost of treatment is an essential component in determining economic injury levels and the lower the cost the lower the threshold becomes. Because aerial bait sprays in Corfu like in the rest of Greece are organized by the Ministry of Agriculture and applied to large areas, the apparent cost per tree is considerably less than for cover sprays and it was estimated to be approximately equivalent to 50 grams of olive oil (at 1980 prices). Air bait sprays are applied over a relatively large area and because of this the calculation of economic injury levels present an additional problem. This problem is that only a proportion of the olive trees within the area are likely to have fruits in a particular year and these trees are usually dispersed throughout the area. Therefore, equation (4) for the calculation of the expected number of infested fruits per tree equal to the economic injury level becomes

$$D/A = f_r \times \Delta \times S \times P_d + f_r \times \Delta \times S(1-P_d)a \quad (11)$$

where A is the proportion of the trees in the area which bear olive fruits in a particular year.

In order to arrive at actual figures, A must be known and in practice it would be possible to estimate A early in the season (late June-early July). For the present estimates, 4 values of A were used (0.25, 0.5, 0.75, 1.0) so that economic injury levels could be calculated for a wide range of situations with regard to the fruiting conditions of the trees. As in the case of cover sprays, in order to express the economic injury levels as percentages of infestation, the figure of 30,000 fruits was used as the average production of olive trees bearing crop. The economic injury levels calculated in this way, both as expected number of infested fruits per tree and as percent infestation, are given in Table 4. It can be seen that the calculated economic injury levels for the aerial application of bait sprays are much lower than the ones for cover sprays for the period July-October. Therefore, it appears that on a cost basis

TABLE 4. Calculated economic injury levels for *D. oleae* infestation, expressed both as number of infested fruits per tree and percentage infestation, in relation to the cost of the spray and the proportion of trees with fruits in the area, for late July-beginning August, September, October and November (the periods when air bait sprays would be carried out).

Proportion of trees with fruits (A)	July-August		September		October		November	
	Number fruits infestation	% infestation	Number fruits infestation	% infestation	Number fruits infestation	% infestation	Number fruits infestation	% infestation
0.25	1520	5.07	1332	4.11	2064	6.88	18384	61.28
0.50	760	2.53	616	2.05	1032	3.44	9192	30.64
0.75	507	1.69	411	1.37	688	2.29	6128	20.43
1.00	380	1.27	308	1.08	516	1.72	4596	15.32

more treatments can be applied during this period by plane. It is also clear from the results that the higher the value of A (proportion of the trees in the area that have fruits) the lower the economic injury levels. The calculated economic injury levels for infestation in November are very high. The fruits that are infested in November drop after harvesting has begun and at that time oil content and fruit weight has reached relatively high values. As these fruits suffer only a 4.48% loss in fruit pulp due to the feeding by the larva the loss of oil due to infestation is relatively low. For these reasons, air treatments at the end of October can be avoided unless it is predicted that very high infestation will occur.

When establishing economic injury levels on a regional basis it is important to bear in mind that the cost of treatment is not the only component to be considered (Southwood and Norton 1973). To obtain a true picture of the cost of control against *D. oleae*, other factors like environmental pollution and harmful effects on beneficial organisms, particularly the parasites of *Saissetia oleae*, should be taken into account. These, however, are outside the scope of this study.

Economic injury levels for air sprays expressed as number of flies caught in McPhail traps were calculated for air bait sprays carried out in September and October for various levels of fruiting conditions of the tree (i.e. proportion of trees with fruits A = 0.25, 0.5, 0.75, 1.00). For September, the estimate of potential fecundity was 107 eggs per female but for October the average values of the estimates for October and November-December was used (186 eggs per female) because although the treatment is carried out in October, the infestation may occur from October to December (Kapatos 1981). Trap efficiency in September and October was estimated using the average mean temperature of the last 15 years for these months (i.e. 23° and 19° respectively). The thresholds calculated in this manner are given in Table 5. The economic injury level for October is lower than that for September because trap efficiency decreases as temperature drops. Also the economic injury level increases as the proportion of trees with fruits within the sprayed area decreases because the real cost of control per tree increases.

Economic injury levels have not been calculated for the period in July prior to the initial infestation of new season's fruit crop because, as mentioned earlier, trap-efficiency during this period is not so directly related to temperature and therefore cannot be estimated with any reliability. In Corfu, however, the application of an aerial bait spray in July just prior to the start of the infestation is carried out as a routine procedure because it is highly effective

TABLE 5. Calculated economic injury levels for air bait sprays, expressed as weekly number of females caught per McPhail trap, in relation to the cost of the spray and the proportion of trees with fruits in the area, for September and October.

Proportion of trees with fruits (A)	Number of females per trap	
	September	October
0.25	16	6
0.50	8	3
0.75	5	2
1.00	4	1

in suppressing the adult population and minimises the need for control later in the season. At that time, therefore, the most important decision is exactly when to apply the spray rather than whether to spray or not, and this depends on a totally different set of criteria (Kapatos and Fletcher 1982).

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Προσδιορισμός Επιπέδων Οικονομικής Ζημιάς για τις Προσβολές του Δάκου της Ελιάς στην Κέρκυρα

Ε.Θ. ΚΑΠΑΤΟΣ και B.S. FLETCHER

Ινστιτούτο Ελιάς Κερκύρας

ΠΕΡΙΛΗΨΗ

Στη μελέτη αυτή προσδιορίζονται επίπεδα οικονομικής ζημίας για ψεκασμούς καλύψεως και δολωματικούς αεροψεκασμούς εναντίον του δάκου της ελιάς, στήν Κέρκυρα. Τα επίπεδα οικονομικής ζημίας υπολογίστηκαν με βάση το προφανές κόστος της κάθε μεθόδου, το ποσοστό επιβιώσεως των σταδίων του δάκου που προκαλούν πρώϊμη καρπόπτωση, το ποσοστό των προσβεβλημένων καρπών που πέφτουν πριν απ' την ελαιοσυλλογή και το ποσοστό της σάρκας του καρπού που καταναλίσκεται απ' τις προνύμφες του δάκου για τον προσβεβλημένο καρπό που συλλέγεται.

Για ψεκασμούς καλύψεως, τα επίπεδα οικονομικής ζημίας (*εκφραζόμενα σε ποσοστό* προσβεβλημένων καρπών θεωρώντας ότι 30.000 καρποί είναι το μέσο φορτίο ενός δένδρου) υπολογίστηκαν σε 7,6% για προσβολή τον Ιούλιο και Αύγουστο, 6,2% για προσβολή τον Σεπτέμβριο και 10,3 για προσβολή τον Οκτώβριο. Για δολωματικούς αεροψεκασμούς τα

επίπεδα οικονομικής ζημίας υπολογίστηκαν ανάλογα και με το ποσοστό των καρποφορούντων δένδρων στην περιοχή που πρόκειται να ψεκαστεί. Αυτά, εκφρασμένα σε αναμενόμενο ποσοστό προσβεβλημένων καρπών, κυμαίνονται για την περίοδο Ιουλίου-Αυγούστου από 5% (για 25% καρποφορούντα δένδρα) μέχρι 1,3% (για 100% καρποφορούντα δένδρα). Για την περίοδο Σεπτεμβρίου από 4,1% μέχρι 1,1%,για την περίοδο Οκτωβρίου από 6,9% μέχρι 1,7% και για αναμενόμενες προσβολές το Νοέμβριο από 61,3% μέχρι 15,3%, αντίστοιχα.

Τα επίπεδα οικονομικής ζημίας για δολωματικούς αεροψεκασμούς εκφρασμένα σε αριθμό συλληφθέντων θηλυκών δάκων ανά παγίδα McPhail (με υδρολυμένη πρωτεΐνη 2% και βόρακα 1,5%) και εβδομάδα, υπολογίστηκαν με βάση το αναπαραγωγικό δυναμικό του δάκου, την αποτελεσματικότητα της παγίδας McPhail και το ποσοστό της αναμενόμενης προσβολής που καλύπτει το κόστος της επεμβάσεως. Για τον Σεπτέμβριο, τα επίπεδα οικονομικής ζημίας εκφρασμένα με τον τρόπο αυτό, κυμαίνονται από 16 θηλυκά ανά παγίδα (για 25% καρποφορούντα δένδρα) μέχρι 4 θηλυκά ανά παγίδα (100% καρποφορούντα δένδρα). Για τον Οκτώβριο,κυμαίνονται από 6 θηλυκά μέχρι 1 θηλυκό ανά παγίδα, αντίστοιχα.