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Insecticides authorized for use on olive trees and the relationship between their registration and residues in olive oil

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RESUMEN

Insecticidas autorizados para su uso en olivos y la relación entre sus registros y los residuos en el aceite de oliva.

Diversos insecticidas son usados para eliminar las pérdidas debidas al ataque de insectos en olivos. Sus residuos en el aceite de oliva constituyen un parámetro importante de su calidad y deben ser controlados con regularidad y mantenidos tan bajos como sea posible en orden a asegurar la protección del consumidor. En este artículo se incluyen los distintos insecticidas autorizados para su uso en olivos así como los valores de ingesta diaria aceptable para el hombre y los límites máximos autorizados de los mismos. Los registros existentes se discuten desde el punto de vista de sus residuos en el aceite.

PALABRAS-CLAVE: Aceite de oliva – Insecticida autorizado – Olivo – Residuo.

SUMMARY

Insecticides authorized for use on olive trees and the relationship between their registration and residues in olive oil.

In order to eliminate losses due to insect attack, several insecticides are used on olive trees. Their residues in olive oil constitute an important parameter of its quality and must be monitored regularly and kept as low possible in order to ensure consumer protection. In this paper the insecticides authorized for use on olive trees are listed and their ADIs and Codex Alimentarius MRLs reported. The existing registrations are discussed from the point of view of their residues in oil.

KEY-WORDS: Insecticide authorized – Olive oil – Olive tree – Residue.

The attacks of insects and other pests make it necessary to treat olive trees with various chemicals in order to eliminate losses and improve the quality of the produce. Chemical pesticides are known to possess acute and long-term toxicity, therefore their residues in olives and olive oil should be monitored and assessed from the point of view of consumer protection.

The first point of interest to the analytical laboratory is the identity of the pesticides that are usually used on olive trees, so that suitable methods of analysis can be developed, adapted and validated. However, data are not always available. In most olive-producing countries the registration (or authorization or approval) of pesticides is to a certain degree an administrative procedure which leads to the granting of a general liscence for its use. In this paper, the insecticides authorized in Greece for use on olive trees are presented in a concise manner and the existing registrations are discussed.

To this end, the labels of all the insecticides for which an authorization for sale exists in the country were examined, and the compounds for which a specific recommendation for use on olive trees exists or derives from the instructions were identified. The latter means that when a general approval for «arboriculture» is stated, we have tried to deduce the probability of its eventual use on olive trees from the insects included in the spectrum of activity of this compound. All these active ingredients are reported in the table. The formulation types, recommended application rates and preharvest intervals (PHIs) are also given. Although the table represents the situation in Greece, considerable differences between Greece and other olive growing countries of the Mediterranean region are not expected. The Maximum Residue Limits (MRLs) for olive and oil, established by FAO/WHO Codex Alimentarius Commission, and information about the Acceptable Daily Intake for Man (ADI) of these compounds, are also reported. Only the Codex MRLs are given, because some limits are set by the Codex committee for pesticide residues, whereas in the European Union no MRL 's have been established for olives for the compounds evaluated, up to now due to the inadequacy of data. The requirements for establishing EU MRLs are very demanding (at least 8 trials representative of the most critical GAP must be available in other to permit the fixing of an MRL) (Lundehn, 1993).

The ADI values are those established by the joint meetings of FAO and WHO experts (JMPR). However, if such ADIs are not yet established, ADIs reported in the latest edition of «The Pesticide Manual» (1994) are given, although the body issuing the ADI is not indicated.

Table I

Insecticides authorised for use on olive trees

Common name/ ADI (mg/kg b.w/day)	Formulation	Pests controlled	Application rate (g a.i./hl)	Application time	Preharvest interval(days)	log K o/w	MRL
azinphos-ethyl/ not cleared toxicologically by JMPR - 0.00025	EC WP	Prays oleae Rhynchites cribripennis Hylesinus oleiperda Phloeotribus scarabeoides Palpita unionalis Euphyllura olivina Saissetia oleae Aspidiotus nerii Pollinia pollini Parlatoria olea Lepidosaphes ulmi	32-40 40-48 40-48 50-60	To be applied only until 31 of August	-	3.18	-
buprofezin/0.01 JMPR (1991)	WP	Saissetia oleae	18.75-25	mobile first-instar larvae (August)	40	4.30	-
carbaryl/0.01 JMPR (1973)	WP SL dust	Prays oleae Rhynchites cribripennis Calocoris trivialis Liothrips oleae Saissetia oleae Parlatoria oleae Aspidiotus nerii Euphyllura divina	60-255	May to end of September	7	1.59	raw olives 10 processed olives 1
chlorpyriphos/0.01 JMPR (1982)	EC	Prays oleae Aspidiotus nerii Parlatoria oleae Saissetia oleae Pollinia pollini Liothrips oleae Euphyllura olivina	40-75	March to August	30	4.69	-
cypermethrin/0.05 JMPR (1981)	EC	Saissetia oleae Lepidosaphes ulmi soluble	1.6-3.2		Not stated	6.60	-
deltamethrin/0.01 JMPR (1982)	EC FL ULV	Prays oleae Bactrocera (Dacus) oleae Saissetia oleae Liothrips oleae Zeuzera pyrina Cossus cossus	1-2.5		15	4.60	olives 0.1
diazinon/0.002 JMPR (1993)	EC WP	Prays oleae Phynchites cribripennis Bactrocera (Dacus) oleae Liothrips oleae Euphyllura olivina Calocoris trivialis	30-60	To be applied only until mid-July	-	3.30	withdrawn
diflulenzuron/0.02 JMPR (1985)	WP	Prays oleae	10-20	beginning of blossom	30	3.89	-
dimethoate/0.01 JMPR (1987) 0.0008 Scientific Committee for Pesticides of the EU	EC	Bactrocera (Dacus) oleae	a) Full cover rage sprays 30 b) Bait sprays (in mixture with hydrolysed proteins) – from the ground (Low Volume) 300 apply 30 litters per hectare – from the air (Very Low Volumen) 900 apply 10 litters bait per hectare		20 15 15	0.70	raw olives 1 processed olives 0.05 (LOD) refined olive oil 0.05 (LOD)
		Prays oleae Phloeotribus scarabeoides Hylesinus oleiperda Rhynchites cribripennis Liothrips oleae	32-60		20		

Common name/ ADI (mg/kg b.w/day)	Formulation	Pests controlled	Application rate (g a.i./hl)	Application time	Preharvest interval(days)	log K o/w	MRL
endosulfan/0.006 JMPR(1989)	EC WP	Prays oleae Euphyllura olivina Calocoris trivialis Rhynchites cribripennis	50-100	To be applied only until blossom	Not applicable	for α=4.74 β=4.79 (both at pH 5)	
ethion/0.002 JMPR (1990)	EC	Prays oleae Saissetia oleae Aspidiotus nerii Pollinia pollini Calocoris trivialis Euphyllura olivina	50-75		28	Not available	
etrimfos/0.003	EC	Prays oleae Scale insects	37.5-50		21	Not available (Fat soluble)	Superseded compound
fenoxycarb/0.04	WP	Saissetia oleae	10	when 65% of the scale population are at mobile stages	60	4.07	-
fenthion/0.001 JMPR (1980) 0.007 JMPR (1995)	EC	Bactrocera (Dacus) oleae	a) Full coverage sprays 50 b) Bait sprays (in mixture with hydrolysed proteins) – from the ground (L V) 250-300 apply 100 litters bait per hectare – from the air (Very Low Volume) 900 apply 10 litters bait per hectare	September-October	30	4.84	olives 1 olive oil 1
formothion/0.02 JMPR (1973)	EC	Bactrocera (Dacus) oleae Prays oleae	33		20	Not available (cannot be determined accurately because of decomposition)	-
heptenophos/not established by JMPR/0.005	EC	Bactrocera (Dacus) oleae Euphyllura olivina	27.5-55		3	2.32	-
λ-cyhalothrin/0.02 for cyhalothrin (sum of all isomers) JMPR (1984)	EC	Prays oleae	0.5 for anthophagous generation 1 for carpophagous generation	to be applied only till 15 July	-	7.00 (20°C)	-
malathion/0.02 JMPR (1966)	EC Dust	Prays oleae Rhynchites cribripennis Liothrips oleae	50-100		20	2.75	-
mephosfolan/not established	EC	Saissetia oleae Prays oleae	42-50	end of May and end of July before blossom and just after fruit setting	30	1.04	-
methidathion/ 0.001 JMPR (1992) 0.004	EC WP	Prays oleae Calocoris trivialis Euphyllura olivina oil Rhynchites cribripennis Liothrips oleae Parlatoria oleae Aspidiotus nerii Saissetia oleae Palpita unionalis Mites	30 50	to be applied till end of August	-	2.20	olives 1 virgin olive oil 2
methomyl/0.03 JMPR(1989)	L SP WSP SL	Prays oleae Scale insects Phyllophagous insects	36-90		20	0.09	-
parathion or parathion ethyl/ 0.005 JMPR (1967)	EC	Prays oleae Saissetia oleae Rhynchites cribripennis Scale insects Euphyllura olivina	16-24	60 or until end of August	-	3.83	Olives 0.5 virgin olive oil 2

Common name/ ADI (mg/kg b.w/day)	Formulation	Pests controlled	Application rate (g a.i./hl)	Application time	Preharvest interval(days)	log K o/w	MRL
parathion methyl/ 0.02 JMPR (1984)	EC	Prays oleae Rhynchites cribripennis Phloeotribus scarabeoides Hylesinus oleiperda Calocoris trivialis Euphyllura olivina	32-48	60 or until end of August	-	3.00	-
permethrin/0.05 JMPR (1987) for nominal cis-trans 40:60 and 25:75 isomers only	EC	Prays oleae Scale insects Bactrocera (Dacus) oleae Euphyllura olivina Liothrips oleae	7-12		14	6.10 (20°C)	olives 1
phenthoate/0.003 JMPR (1984)	L	Liothrips oleae Scale insects	40-60		21	3.69	-
phosalone/0.001 JMPR (1993)	EC WP	Saissetia oleae Aspidiotus nerii Calocoris trivialis	61	end of July	15	4.30	-
phosphamidon/ 0.0005 JMPR (1986)	SCW	Prays oleae Bactrocera (Dacus) oleae	40-50		21	0.79	-
pirimiphos-methyl/ 0.03 JMPR (1992)	EC	Liothrips oleae Mites Scale insects	50		7	4.20 (20°C)	olives 5
quinalphos/not established	EC	Saissetia oleae Aspidiotus nerii Euphyllura olivina Liothrips oleae	42		28	4.43 (23°C, 10-100 ppm level)	-
teflubenzuron/0.01 JMPR (1994)	SC	Prays oleae	10	to be applied till 15 July	-	4.30 (20°C)	-
triazophos/0.001 JMPR (1993)	EC	Aspidiotus nerii Zeuzera pyrina Other pests and mites	42-63		30	3.34	-
trichlorfon/0.01 JMPR (1978)	WP	Bactrocera (Dacus) oleae Prays oleae	75-125		4	0.43	-
triflumuron/ 0.0072	WP	Prays oleae	10	beginning of oviposition till 15 July	-	4.91	-

Note: The authorisations for mecarbam and monocrotophos have been withdrawn.

Abbreviations:
ADI = Acceptable Daily Intake for Man.
mg/kg b.w./day = miligram per kilogram body weight per day.
g.a.i./hl = grams active ingredient per hectoliter.
log k o/w = log P = logarithm of the partition coefficient between octanol and water.
MRL = Maximum Residue Limit.
EC = Emulsifiable Concentrate.
WP = Wettable Power.
SL = Soluble Concentrate.
FL = Flowable.
ULV = Ultra Low Volume liquid.
L = Liquid.
SP = Soluble Powder.
WSP = Water Soluble Powder.
SCW = Suspension Water Soluble Concentrate.
SC = Suspension Concentrate (=flowable concentrate).
JMPR = FAO/OMS Joint Meetings for Pesticide Residues.

CONCLUSIONS

From the data presented, several useful conclusions can be drawn. Firstly, many preharvest intervals (PHIs) are established as an administrative tool and reflect only the basic concept that it is the minimum time between pesticide treatment and harvest, necessary to reduce the residues below acceptable limits. The new approach that PHIs should also have a close relationship to the agronomic situation, namely the recommended time of application, is not taken into consideration. For instance, insecticides such as chlorpyrifos and carbaryl, recommended for use against scales and prays oleae, have a PHI of 30 and 7 days, respectively, although there is no need to apply them so close to the harvest of the fruits, given that treatments against scales are effective only in June-August and those against *prays oleae* only if carried out in late spring or early summer (before blossom and just after fruit setting). The PHIs are an essential part of the so-called Good Agricultural Practice, GAP, which is basic requirement for the establishment of Maximum Residue Limits (MRLs). They should be justified first from the agronomic point of view, in order to be accepted for evaluation from the toxicological point of view. Secondly, although treatments against most insects and scales are normally carried out in late spring and in summer, leaving sufficient time before harvest for residues to dissipate, *Bactrocera (Dacus) oleae*, the olive fly, which is the most serious pest (Katsoyannos, 1992), has multiple generations and proliferates until late in the autumn. Therefore, for effective control, and increased number of applications is necessary between June and the end of October. These are the treatments which are most likely to give rise to toxic residues. For this reason, considerable effort has gone into developing alternative control measures. Integrated pest management (IPM) is a strategy combining various approaches to pest control within a system that maximizes the advantages of each particular method while minimizing its disadvantages (Katsoyannos, 1992). In olive IPM considerable progress has already been made, especially in the Mediterranean countries of the European Union (EEC), as the result of the coordinated activities of several international organizations. Bait sprays (a mixture of insecticide and protein hydrolysate solution) aim to reduce the quantity of toxic substances applied, thus minimizing their concentration in the oil. However, they require close adherence to the recommended volume of spraying mixture applied per hectare. If it is not observed, there is a greater risk of residues arising, given the higher –in comparison to that of full coverage treatments– concentration of active ingredient (a.i.) per hectoliter spraying mixture.

The fat-solubility of insecticides is an important parameter that must be considered when they are applied to olives intended for oil production. Indeed, it has been demonstrated that fat-soluble pesticides tend to concentrate in the oil during its extraction from the olives at concentration factors ranging from 1.5 to 5 (Lentza-Rizos and E. Avramides, 1995). Therefore, much higher concentrations of fat-soluble insecticides are expected in the oil than in the olives from which the oil was produced. As an indication of fat-solubility, the logarithm of the partition coefficient between octanol and water (logK o/w) is used. Compounds with logK o/w greater than 4 are considered as fat-soluble, while those with logK o/w between 3-4 are borderline cases. Information concerning the fat-solubility of compounds is included in the table where available and comes from «The Pesticide Manual».

In conclusion, there is clear evidence that the registrations or authorizations should be reviewed and rationalized in order to be considered as Good Agricultural Practices (GAPs). Each preharvest interval should be established after consideration of the recommended time of application optimised from the point of view of efficacy (when the pests are more vulnerable and the treatment more effective), the long-term toxicity of each compound, as expressed by its acceptable daily intake for man, and its fat solubility. The necessity for rationalization of the national registrations of the member-states has been recognised by the Commission of the European Union and the revaluation of all the compounds already marketed in the Member-States began this year, according to the provisions of 91/414 /EEC directive (EEC, 1991).

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