Decontamination of wasted plastic pesticide containers

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Introduction

Pesticides are used to fight insects, fungi and weeds. They can be toxic to humans and must be properly and safety managed. Special practices for decontaminating wasted plastic pesticide containers (WPPC) include triple rinsing with tap water, rinsing with tap water under pressure and integrated rinsing and rinsing with an organic solvent.

The objectives of our study were:

a) to determine the residual active substance contained in WPPC
b) to control the effectiveness of triple rinsing of WPPC
c) to classify WPPC as hazardous or no hazardous waste

There seems to exist no residual active substances results of the shredded WPPC in the international literature.

Materials and methods

Figure 1: Cutting mill of WPPC

Fifty six (56) wasted (empty) plastic pesticide containers (WPPC) were randomly collected with the aid of farmers near the city of Drama (North Greece). Thirty one of the sampled WPPC were triple rinsed. Five of the sampled WPPC were shredded before residual analysis. Two analytical techniques were used for residual analysis, High-Performance Liquid Chromatography (HPLC) with Diode array detector (DAD), and Gas chromatography (GC) with flame ionization detector (FID).

Results & Discussion

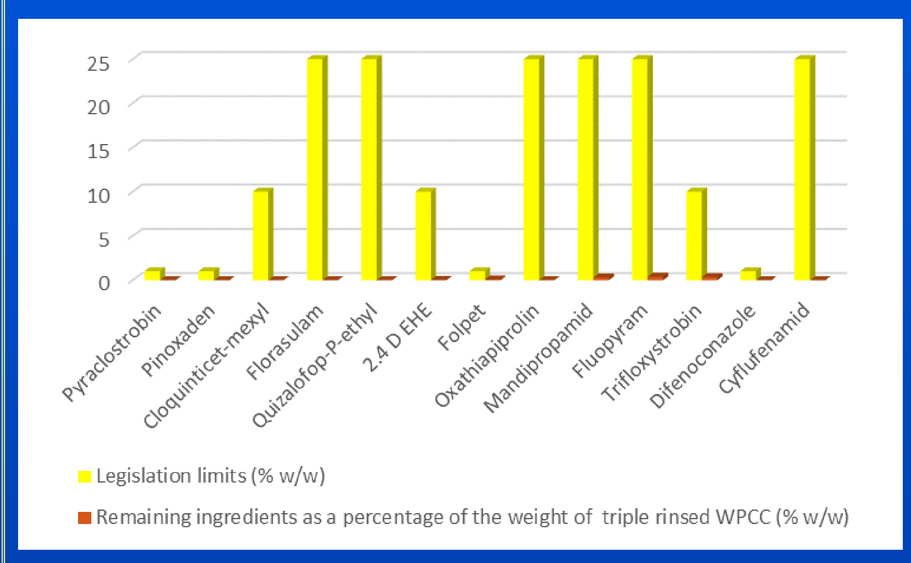

Figure 2: Residual active substances of triple rinsed WPPC and legislation limits

Table 1: Residual active substances of the sampled WPPC that were not triple rinsed.

Active Substance	Mass of WPPC (as Received) (g)	Content of Active Substance[1] (g/L)	Mass of Active Substance Contained in the WPPC (mg)	Remaining Ingredients as a Percentage of the Weight of as Received WPCC (% w/w)	Legislation limits (%w/w)[3]
Pyraclostrobin	112±0.749	198±0.531	4840±300	4.30±0.300	1
Pinoxaden	101±1.70	66.6±0.489	1750±287	1.73±0.27	1
Cloquinticet-mexyl	101±1.70	15.6±0.0152	411±70.6	0.41±0.0700	10
Clopyralid	46.5±1.22	228±103	2050±1790	4.15±3.74	n/a[2]
Florasulam	46.5±1.22	18.7±6.85	164±134	0.350±0.280	25
Quizalofop-P-ethyl	206±0.208	23.4±27.3	78.2±94.2	0.0400±0.0500	25
2.4 D EHE	102±0.545	889±34.4	8870±2020	8.69±1.99	10
Folpet	103±1.25	153±224	612±979	0.580±0.930	1
Oxathiapiprolin	103±1,25	2.98±4.63	11.8±18.5	0.0100±0.0200	25
Mandipropamid	118±0.450	227±11.0	1580±532	1.34±0.450	25
Fluopyram	70.9±2.63	9.27±2.86	44.7±24.0	0.0600±0.0300	25
Trifloxystrobin	70.9±2.63	9.96±2.78	48.4±25.3	0.0700±0.0400	10
Difenoconazole	61.9±0.400	54.8±0.137	387±93.0	0.630±0.150	1
Cyflufenamid	61.9±0.400	27.5±0.435	194±44.1	0.310±0.0700	25

[1]Analyses were performed at the Benakion Phytopathological Institute (BPI), Means ± Standard Deviations are based on n = 3; all values are expressed with a precision of 3 significant digits, [2] not classified, [3] according to the regulation of the European Committee No 1357/2014

According to table 1 residual active substances of Pyraclostrobin, Pinoxaden, 2.4 D EHE and Folpet exceeded hazard threshold limits, and these WPPC are classified as hazardous. All active substances of triple rinsed WPPC were below hazard threshold limits as presented in figure 2 Content of active substances of Fluopyram, Trifloxistrobin and Azoxystrobin in shredded WPPC were below those of rinsed WPPC as concluded in figure 5.

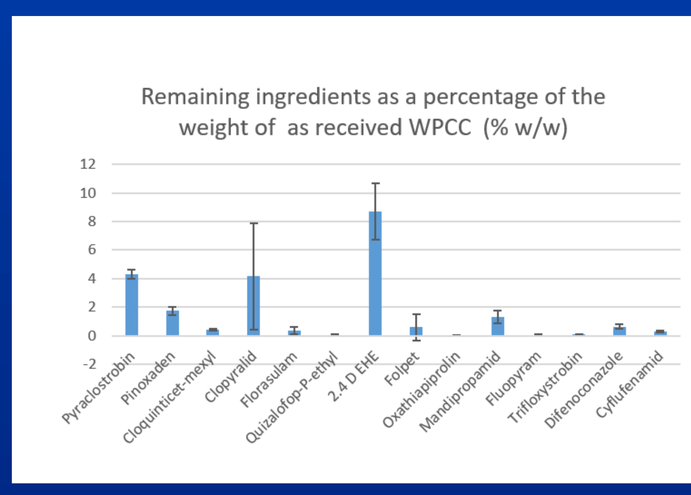

Figure 3: Remaining ingredients of as received WPPC

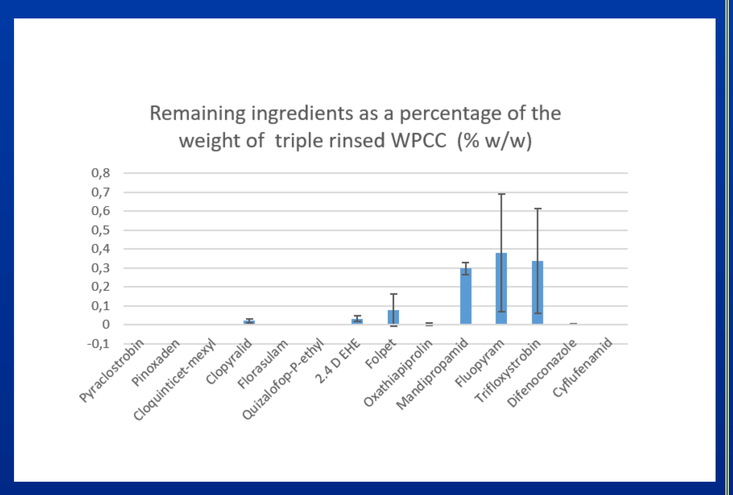

Figure 4: Remaining ingredients of triple rinsed WPPC

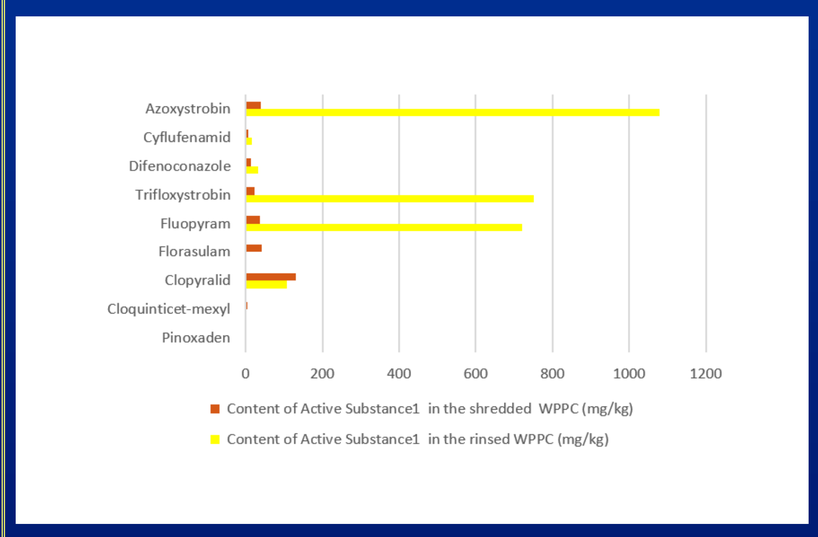

Figure 5: Content of active substances in triple rinsed and shredded WPPC

By comparing figures 3 and 4, it is concluded that triple rinsing can remove up to 99.99% of the liquid residual active substance in WPPC rendering it a necessary practice during WPPC management

Conclusions

The conclusions of this research work are:

1)Triple rinsing removes up to 99.99% of the liquid residual active substances in WPPC and is the most appropriate practice to safely manage WPPC

2) After triple rinsing, however, the residual amount of the active substance that remains adsorbed on the container walls is 10% of the total mass of the residue that remained inside the bottle. This adsorbed amount must be taken into account for proper WPPC management although it is less mobile than the liquid form.

3) Triple rinsed WPPC contain liquid residual active substances below hazard threshold limits and can be classified as non hazardous waste. Thus, they are classified under the 15 01 02 code of the European Waste Catalogue (EWC).