Scientific Papers. Series A. Agronomy, Vol. LIX, 2016
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

MINIMIZING OF SIDE EFFECTS OF PESTICIDES ON AGRICULTURAL ENVIRONMENT

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Abstract

Pesticides have negative effects on environment if pesticides are applied in unsuitable conditions such as inappropriate equipment, under unsuitable meteorological conditions, overdose, etc, pesticides can be drifted non-target organisms, and then they are harmful for human health and environment. However, there is a major problem before and after pesticide applications: point source pesticide pollution (PSPP). This pollution occurs during filling before application and cleaning after application. For minimizing of pesticide contamination on agricultural environment, biobed is used in some countries especially Sweden, France, England, Guatemala, and Belgium. Biobed is a biological system for minimizing and degrading of pesticide contamination in agricultural environment. The origin of biobed is Sweden in 1990's. Biobed components are the clay layer, the biomix, and the grass layer. Number of biobeds increases year by year. In some countries, biobed is renamed as biofilter, biomassbed, phytobac, biobac, and biotable that are made some modifications from the original biobed design. In world, approximately 100 researches about biobed were published in several journals, conferences, workshops, etc. In Turkey, totally 6 projects were supported financially by University of Cukurova, and of which 1 by TUBITAK (The Scientific and Technological Research Council of Turkey). For awareness of farmers about biobed, the government agencies, farm associates', and other private sectors related to agriculture environment have to be arranged meetings, workshops, conferences.

Key words*: biobed, pesticide, agriculture, environment, sprayer.*

INTRODUCTION

Generally, in worldwide, pesticide consumption in per year is about two million tonnes, 45% of which is used by Europe (De et al., 2014). In 2013, the amount of pesticides used was approximately 35,000 tonnes for Turkey, and 7,000 tonnes for Romania (FAO, 2016).

In 2010, pesticide active ingredient (a.i.) in arable land and permanent crops was 0.75 kg per ha for Romania, and 1.59 kg per ha for Turkey (FAO, 2016).

In Turkey, total agricultural land is about 40 million ha (TUIK, 2016). In Turkey, the number of sprayers is approximately 1.1 million of which approximately 30% is power take-off (PTO) driven sprayers (TUIK, 2016).

In agriculture, pesticides are important for growing higher quality and quantity crops. Yet, pesticides may contaminate to agricultural environment in three ways: during filling of the sprayer before pesticide applications (Figure 1a), during pesticide applications (Figure 1b), and during cleaning of the sprayers after pesticide applications (Figure 1c) (Castillo et al., 2008).

If pesticides are applied in unsuitable conditions such as inappropriate equipment, under unsuitable meteorological conditions, overdose, etc, pesticides can be drifted non-target organisms, and then they are harmful for human health and environment.

In this contamination, pesticides are generally diluted with water due to make suitable for pesticide application.

Therefore, drifted droplets are diluted (Figure 1b). Yet, there is a major problem for environment before and after pesticide applications: point source pesticide pollution (PSPP) (Figure 1a and c).

Biobed

In general, farmers fill the sprayer near the field, farmyard, water sources, etc. before pesticide application. Also, they generally clean it in same location (Figure 2a and 2b).

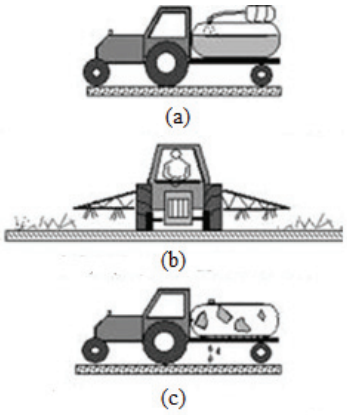

Figure 1. Ways of pesticide contamination into environment (Castillo et al., 2008)

(a)

(b)

Figure 2. Cleaning of sprayer in the farmyard (Photo by Nigar Yarpuz-Bozdogan, 2008)

In these procedures, deposited pesticide a.i. contaminates the environment. Yet, during fill the sprayer with pesticide, if there are leak in sprayer equipment or splash carelessness, pesticide a.i. will be maximum concentration on soil at this point where is filled the sprayer with pesticide. In Turkey, farmers do not take care of location for filling and cleaning of sprayer. Daglioglu (2014) indicated that farmers generally fill pesticides to sprayer in farmyard (41.6%), near field (24.7%) and water bodies (12.8%). They clean the sprayer in farmyard (57.4%), near field (26.7%) and water bodies (8.9%). Researcher determined that only 7.9% of farmers think of pesticide contamination in agricultural environment during filling of the sprayer.

For minimizing and eliminating of this problem, in Sweden, 1993, it is established a construction named as biobed (Figure 3). Biobed is a simple and cheap construction intended to collect and degrade spills of pesticides on farms (Castillo et al., 2008). It consists of clay layer, biomix, and grass.

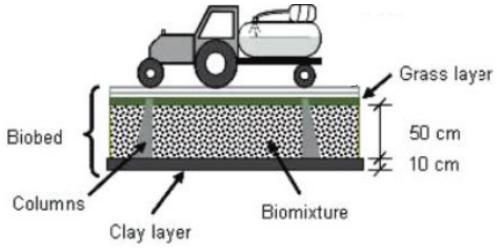

Figure 3. Biobed (Castillo et al., 2008)

Clay layer helps to decrease the water flow downward, and to increase the pesticide retention time in the biobed (Castillo et al., 2008).

Biomix composes of straw (50% v.), peat (25%v.), and soil (25%v.). The straw is used for pesticide degradation and microbial activity, especially from lignin-degrading fungi (such as white rot fungi), which produce phenoloxidases (peroxidases and laccases). The broad specificity of these enzymes makes them suitable for degradation of mixtures of pesticides. The agricultural soil is used for sorption capacity (Castillo et al., 2008). The peat helps to sorption capacity, moisture control, and degradation of pesticides. The peat is expensive material especially southern European countries such as Italy, France, Greece and Turkey. Therefore, in these countries, many experiments are made on organic materials instead of peat.

The grass layer helps to regulate the moisture of the biobed by creating an upward transport of water (Castillo et al., 2008).

Biobed in the World

Biobed number was 1,682 in 2004, and 6,604 in 2012 (Figure 4a, b). It means that biobed number has increased approximately 4 times in 8 years.

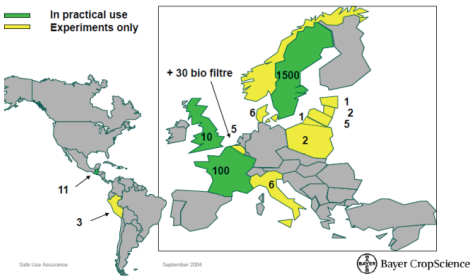

Figure 4a. Biobed number in world in 2004 (Husby and Börgartz, 2004)

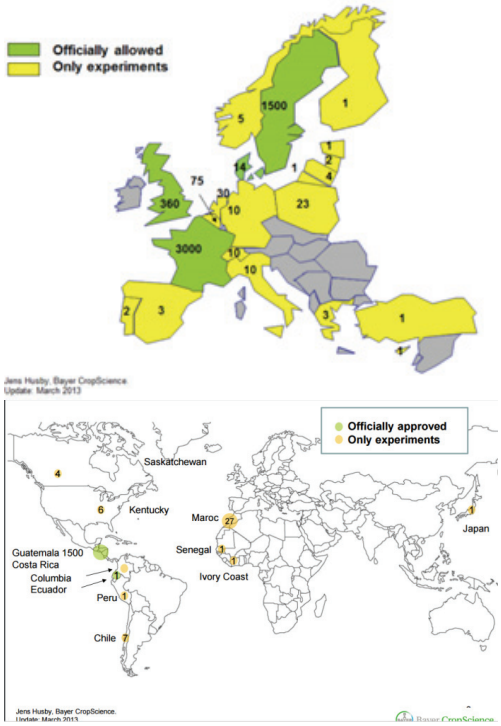

Figure 4b. Biobed number in world in 2012 (Husby, 2013)

In some countries, biobed is renamed as biofilter, biomassbed, phytobac, biobac, and biotable that are made some modifications from the original biobed design.

The European Biobed Workshops were held in Malmö (Sweden, 2004), Ghent (Belgium, 2007), Piacenza (Italy, 2010), and Wageningen (The Netherlands, 2013). In the four workshops, number of participants is 14 in 2004, 41 in 2007, 45 in 2010, and 42 in 2013. They were from 6, 12, 16, and 19 different countries. Moreover, two workshops were organized as Latin-American Biobed Workshop in Chile-2012 and Guatemala-2014 (Anonymous, 2016).

In world, approximately 100 researches about biobed were published in several journals, conferences, workshops, etc. In Turkey, totally 6 projects were supported financially by University of Cukurova, and of which 1 by TUBITAK (The Scientific and Technological Research Council of Turkey). Also, 10 papers about biobed were presented in journals, congress, workshops, etc (Bozdogan and Yarpuz Bozdogan, 2007a; Bozdogan and Yarpuz Bozdogan, 2007b; Bozdogan et al., 2009; Bozdogan et al., 2010; Bozdogan, et al., 2013; Berçik and Bozdogan, 2013; Bozdogan et al., 2014; Daglioglu, 2014; Bozdogan and Yarpuz Bozdogan, 2015a; Bozdogan and Yarpuz Bozdogan, 2015b).

CONCLUSIONS

Biobed is a simple and easy way to minimize pesticide contamination in agricultural environment. For this reason, farmers should be educated about biobed, and importance of agricultural environment. For awareness of farmers about biobed, the government agencies, farm associates', and other private sectors related to agriculture environment have to be arranged meetings, workshops, conferences.

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