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### THE EFFECT OF HERBICIDES ON THEIR ACTIVE INGREDIENT RESIDUES IN SOYBEAN SEEDS

#### ABSTRACT

Experimental material consisted of the seeds of Polan, Aldana and Dornburg soybean cultivars harvested from the field experiments in 1990-92 at Sandomierz with the following herbicides and doses: Sencor 75 WP (1.0 and 2.0 kg/ha), Tribunil 70 WP (1.0 and 2.0 kg/ha), Azogard 50 WP (1.5 and 3.0 kg/ha), Afalon 50 WP (1.0 and 2.0 kg/ha). Seeds from plots treated with a single dose of some herbicides (Tribunil 70 WP, Afalon 50 WP) did not exhibit any herbicide active residues or in case of other herbicides their level were far below permissible limits (0.1 mg/kg).

The use of double doses, resulted in accumulation of the active remnants in soybean seeds but still their level did not exceed permissible limits. Differences in the level of herbicide active substances in soybean seed were found to depend on season conditions.

*Key words:* soybean seed, herbicide residues

#### INTRODUCTION

Residues of active herbicide components in seed, soil and water are the side effect of herbicide application (Rola et al. 1971). Their content in agricultural products has been extensively tested in recent years. Poland is a country where crops exhibit one of the lowest amount of pesticides. In 1986-1990 only in 0.2% of tested samples the active residues were found comparing to 2-4% in the samples from developed, industrial countries (Dąbrowski 1992). In Poland first tests for residues were started in sixties and in seventies tests were performed on a wide scale in cooperation with FAO Dąbrowski 1992).

The aim of this study was to evaluate the level of herbicides remained on three soybean cultivars following their application at low and high doses

## MATERIALS AND METHODS

Experimental material consisted of the seeds of Polan, Aldana and Dornburg soybean cultivars harvested from field experiments in 1990-92 at Sandomierz with the following herbicides and doses: Sencor 70 WP (70% metribuzin, 1.0 and 2.0 kg/ha), Tribunil 70 WP (70% metabenzthiazuron, 1.0 and 2.0 kg/ha), Azogard 50 WP (50% prometryn, 1.5 and 3.0 kg/ha), Afalon 50 WP (50% linuron, 1.0 and 2.0 kg/ha). The plots with no weed control (control – C<sub>1</sub>) and some hand weeded throughout the entire growing season (control - C<sub>2</sub>) served as controls.

The experiment was carried out on chernozem soil developed from loess (very good wheat complex), pH – 5.9, humus content – 2.72%. The experiment was conducted within 4 replicates in randomized block, the plot size was 10 m<sup>2</sup>. Each year cereals were consisted a forecrop. Soybean was sprayed with herbicides (2 days after sowing: 26.04.1990, 02.05.1991, 04.05.1992). Seed analyses for herbicides contamination were made each year 2 months after seed harvest (on 20 g sample from each plot). Determination of active herbicide residues in seeds was performed according to Polish Standards Anon. (1997, 1999), and Kostowska et al. (1993).

Statistical assessments were made by analysis of variance, differences of the means were assessed by Tukey's test.

## RESULTS

The seeds of Aldana and Polan cvs. submitted to a single dose of Sencor 70 WP contained 0.0019 and 0.0054 mg/kg of metribuzin residues respectively. A double dose resulted in a two-fold increase of metribuzin in the seeds of these cultivars but as much as fifteen-fold higher in Dornburg cv. However, still this concentration was below permissible limits (Table 1, Fig. 1).

No metabenzthiazuron residues were detected in the seeds of all cultivars in each experimental year when a single dose of Tribunil 70 WP was applied (Fig. 1). The seeds of Aldana and Dornburg cvs. from the plots treated with double doses of Tribunil 70 WP contained trace amount of metabenzthiazuron.

When a single dose of Azogard 50 WP was applied prometryn, an active substance of this herbicide, was detected only in the seeds of Polan cv. Besides prometryn below permissible level was found in the seeds of all cultivars with a double dose of Azogard 50 WP each year of testing (Table 1).

Linuron, an active substance of Afalon 50 WP applied in a single dose was only detected in Polan seeds (0.001 mg/kg) while in the seeds of all cultivars from the plots controlled with a double dose of Afalon 50 WP

The content of herbicide residues in soybean seeds (mean for cultivars)

Table 1

Active of herbicide	Residues [mg per kg]					
	Year*			Mean	Dose**	
	1990	1991	1992		Single	Double
Metribuzin	0.0000	0.0004	0.0267	0.0090	0.0031	0.0150
Metabenzthiazuron	0.0065	0.0000	0.0000	0.0022	0.0000	0.0044
Prometryn	0.0116	0.0400	0.0122	0.0213	0.0027	0.0399
Linuron	0.0015	0.0366	0.0030	0.0137	0.0004	0.0269

LSD<sub>0.05</sub> for years = 0.0090; for doses = 0.0113. \* average for cultivars and doses, \*\* average for cultivars and years

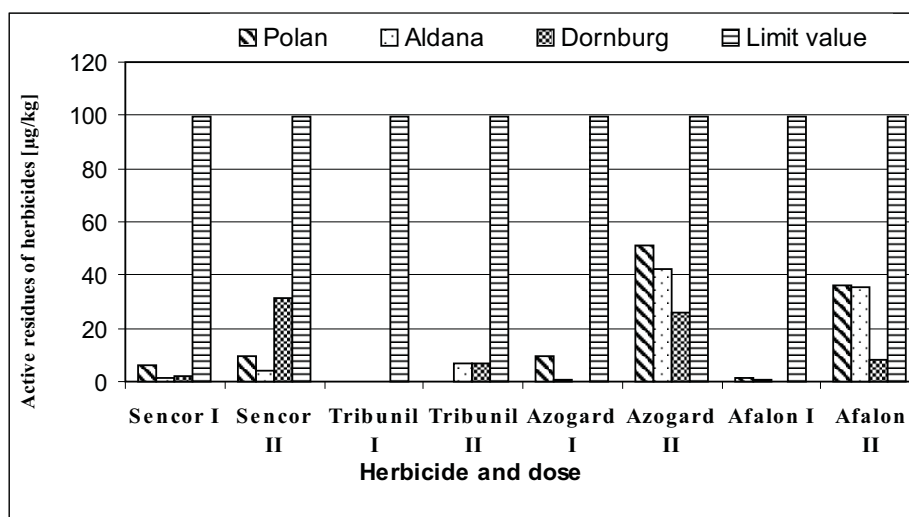


Fig. 1 Active residues of herbicides in seeds of three soybean cultivars (mean of the years 1990-1992). I, II - doses of herbicides. Active substances: metribuzin - in Sencor, metabenzthiazuron - in Tribunil, prometryn - in Azogard and linuron - in Afalon

the presence of the active ingredient residue was detected in all varieties, but still below the limits.

Prometryn - the most highly cumulating component of Afalon 50 WP reached in soybean seeds only 40% of its permissible level when a double dose was applied (Fig. 1). Different amounts of herbicide active substances in soybean seeds were found depending on climatic conditions (Table 1).

Weather condition during cropping seasons could affect the amount of herbicide residues in the seeds (Table 1, Fig. 2). The highest amount of herbicide residues in the seed was found in moderate season of 1991 with the average amount of 0.0192 mg/kg, less in the warm and dry 1992

with the average amount of 0.0105 mg/kg and the lowest amount of 0.0049 mg/kg in the cool and wet 1990 (Table 1., Fig.2.).

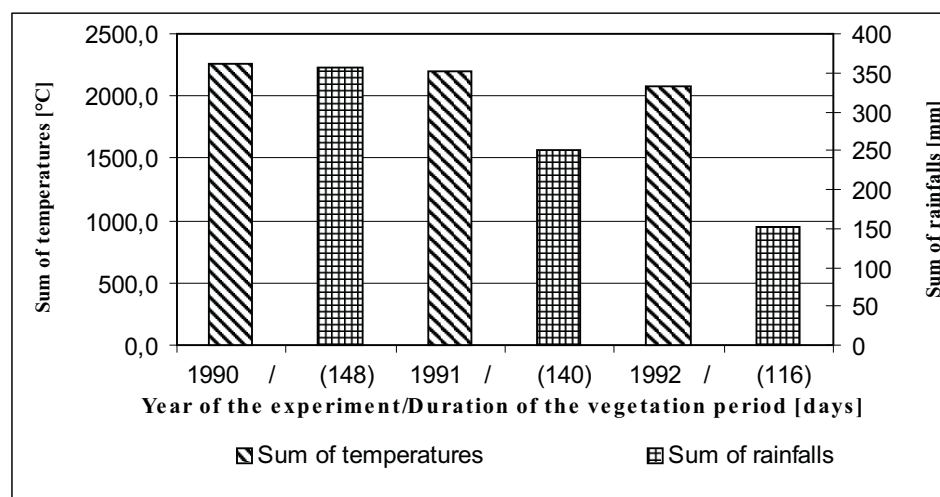


Fig. 2 The amount of rainfalls and sum of temperatures during the vegetation period of three soybean cultivars within the years 1990 - 1992.

Mean temperatures: 15.3°C in 1990, 15.8°C in 1991, 17.9°C in 1992.  
 Mean rainfalls: 2.45, 1.80, 1.38 mm respectively in 1990, 1991 and 1992

Generally, higher quantities of active herbicide were found when double doses were applied (Table 1), but it should be underlined that even in these cases the amount of herbicide residues in the seeds was fairly below the accepted limits irrespective by of the environmental factors.

#### DISCUSSION

We have found that herbicide active remanents were either non detected in the soybean seeds or their amounts were below the level given in Polish, German, Belgian and Swiss regulations Anon. (1969a, 1969b, 1989, 1993). Our results are consistent with those reported by other authors. According to Kampe (1979) and Briggs (1984) the level of herbicides remaining in the seeds is determined by the type of their active component, their physicochemical properties, weather, soil conditions and time of application.

Precipitation and temperature affect soil moisture and it is known (Sheets and Crafts 1958; Gissbuhler 1963; Bailey and White 1964) that both low and high moisture confine absorption of herbicide by plants.

In our study 1992 was very dry in contrast to 1990 that was rainy and soil was soggy. Under these conditions herbicides were restrained. In

1991 with moderate and evenly distributed rain fall during the season, soil was properly moist and herbicide were easily taken by soybean plants. Similar observations were made by Lambert (1966) and Kozaczenko (1974).

In conclusion it could be stated that herbicides Tribunil 70 WP and Afalon 50 WP used for weed control of soybean applied at recommended doses did not leave any active substance residues in the seeds which are completely safe and can be used for human nutrition and animal feeding.

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