



Institute of Pesticides and Environmental Protection

DEVELOPMENT OF THE ADJUVANTS BASED ON PLANT OILS AND THEIR APPLICATION

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Introduction

Over the last few years the number of adjuvants on the market has been increased because of the interest in the potential benefits of their application. Also in the past the use of adjuvants was concentrated only on herbicides, whereas there is now considerable interest in using adjuvants for fungicides and insecticides to enhance activity and possibly reduce dose rates for applications. Generally it is accepted that there are two main ways in which adjuvants may enhance biological performance of the pesticide products. The first way is increasing amount of retained pesticide active substance and the other way is promoting its uptake. Although pesticide manufacturers generally attempt to build in adjuvant in pesticide formulations it is not always possible. Actually there is no universal adjuvant which will give enhanced effects with all pesticides. Sometimes happens that biological efficacy with adjuvant may be even reduced or in some cases phytotoxicity problems to the crop may be increased. Thus it is necessary to carry out field trials with adjuvants and the pesticide formulations to avoid this problem.

Objectives

The objective of this study was to develop three different adjuvants based on plant oils (sun flower oil, soya bean oil and esterified rape seed oil) in combination with different surfactants. The effects of the herbicide (bentazone) applied alone and in mixture with the adjuvants were compared. In addition, it was also compared the effects of the adjuvants with commercial adjuvant Trend 90 during the application with the same herbicide (bentazone) on two different locations.

Table 4: Efficacy of bentazone alone and with the adjuvants in maize crop

Weeds	I assessment										II assessment									
	Control		Deltazon+Trend 3L/ha + 0.1%		Deltazon+A 1 3 L/ha + 0.1%		Deltazon+A 2 3 L/ha + 0.1%		Deltazon+A 3 3 L/ha + 0.1%		Control		Deltazon+Trend 3L/ha + 0.1%		Deltazon+A 1 3 L/ha + 0.1%		Deltazon+A 2 3 L/ha + 0.1%		Deltazon+A 3 3 L/ha + 0.1%	
	WN	EF	WN	EF	WN	EF	WN	EF	WN	EF	WN	EF	WN	EF	WN	EF	WN	EF	WN	EF
<i>Abutilon theophrasti</i>	9.5	1.0	89.5	0.0	100	0.0	100	0.0	100	9.5	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Chenopodium album</i>	10.3	0.0	100	0.0	100	0.0	100	0.0	100	9.5	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Chenopodium hybridum</i>	4.5	0.0	100	0.0	100	0.0	100	0.0	100	4.0	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Convolvulus arvensis</i>	3.0	0.0	100	0.0	100	0.0	100	0.0	100	4.3	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Datura stramonium</i>	12.8	0.0	100	0.0	100	0.0	100	0.0	100	10.3	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Helianthus annuus</i>	23.0	3.0	86.9	5.0	78.3	1.0	95.6	1.0	95.6	4.3	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Hibiscus trionum</i>	8.3	0.0	100	0.0	100	0.0	100	0.0	100	10.3	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Polygonum aviculare</i>	3.0	0.0	100	0.0	100	0.0	100	0.0	100	11.5	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Polygonum lapathifolium</i>	3.8	0.0	100	0.0	100	0.0	100	0.0	100	16.0	0.0	100	1.0	93.8	0.0	100	0.0	100	0.0	100
<i>Sinapis arvensis</i>	10.5	0.0	100	0.0	100	0.0	100	0.0	100	11.5	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Solanum nigrum</i>	19.5	0.0	100	1.0	94.9	0.0	100	0.0	100	16.0	0.0	100	1.0	93.8	0.0	100	0.0	100	0.0	100
<i>Stachys annua</i>	3.0	0.0	100	0.0	100	0.0	100	0.0	100	3.3	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100
<i>Xanthium strumarium</i>	3.8	0.0	100	0.0	100	0.0	100	0.0	100	3.3	0.0	100	0.0	100	0.0	100	0.0	100	0.0	100

NW – weeds number (plants number/m²), EF – Efficacy (%)

Table 1: Physical properties of Adjuvant with soya oil, before and after stability tests (adjuvant 1)

Temperature	0°C (7 days)	20°C	54°C (14 days)
Density (g/cm ³)	0.933	0.929	0.928
pH value	5.03	5.61	5.39
Stability of Emulsion and Reemulsification (cm ³)	0.5h 0/0 1h 0/0 2h 0/0 24h 1/0 REE 0/0	0.5h 0/0 1h 0/0 2h 0/0 24h 0/0 REE 0/0	0.5h 0/0 1h 0/0 2h 0/0 24h 0/0 REE 0/0

Table 2: Physical properties of Adjuvant with esterified rape seed oil, before and after stability tests (adjuvant 2)

Temperature	0°C (7 days)	20°C	54°C (14 days)
Density (g/cm ³)	0.932	0.891	0.890
pH value	5.23	5.10	4.94
Stability of Emulsion and Reemulsification (cm ³)	0.5h 0/0 1h 0/0 2h 0/0 24h 2/0 REE 0/0	0.5h 0/0 1h 0/0 2h 0/0 24h 1/0 REE 0/0	0.5h 0/0 1h 0/0 2h 0/0 24h 4/0 REE 0/0

Table 3: Physical properties of Adjuvant with sun flower oil, before and after stability tests (adjuvant 3)

Temperature	0°C (7 days)	20°C	54°C (14 days)
Density (g/cm ³)	0.934	0.929	0.929
pH value	4.94	5.26	5.22
Stability of Emulsion and Reemulsification (cm ³)	0.5h 0/0 1h 0/0 2h 0/0 24h 1/0 REE 0/0	0.5h 0/0 1h 0/0 2h 0/0 24h 0/0 REE 0/0	0.5h 0/0 1h 0/0 2h 0/0 24h 3/0 REE 0/0

Materials and Methods

Adjuvants were obtained by mixing oil phases (sun flower oil, soya bean oil and esterified rape seed oil) with emulsifiers. For homogenization magnetic stirrer (IKA, RH basic 2, duration time 30 minutes, temperature 40°C) was used. In this way the all adjuvants were prepared: soya bean oil with 15% of emulsifiers (adjuvant 1-A1), esterified rape seed oil with 10% of emulsifiers (adjuvant 2-A2) and sun flower oil with 15% of emulsifiers (Adjuvant 3-A3). After formulating, the accelerated storage tests (storage stability) were done (CIPAC method MT 39 and 46). After stability tests the same characteristics were checked according standard CIPAC methods: pH MT 75, density MT 3, and emulsion stability and re-emulsification MT 36.1 and compare (CIPAC, 1995).

Field trials were carried out on maize crops in 2011, on two locations: Putinci (JPC coordinates: w: 7421521, e: 4983507, elevation: 105m a.s.l.) and Glogonjski Rit (JPC coordinates: 7461181, 4981089, elevation: 60m a.s.l.).

The herbicide efficacy was evaluated by OEPP/EPPO method (2004). Efficacy percentage for each weed species was calculated.

Results

Stability and physical properties of the developed adjuvants had been checked and the results confirmed that the adjuvants were stable enough to be used (Tab. 1-3).

From the results given in the Table 4 can be seen that mixing each adjuvant with bentazone generally enhanced efficiency of active substance to weeds. The adjuvants developed by us enhanced the efficiency more or less equal as commercial adjuvant Trend 90. The results we got at both locations were in accordance. It should be point out that at the location of Glogonjski rit adjuvants 2 and 3 in combination with bentazone enhanced efficacy to weed species *Heliathus annuus* which is dominate at that area even more than commercial adjuvant Trend 90 and adjuvant 1. It is worth to mention that the adjuvants formulated in this way leading to the use of safer and more environmentally friendly products with good biodegradability and low toxicity. With the many pressures on product performance, adjuvants are becoming a way by which the pesticide products could add significant value.

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