THE USE OF THE ADDITIVES IN WEED AND DISEASE CONTROL OF THE SUGAR BEET

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ABSTRACT

Results of the last five years field trials with amino acids, peptides, surfactants and pH stabilizers of the chemical solution employed in weed, Cercospora leaf spot and Oidium control are reported.

The aim was to improve the efficacy, the selectivity, the persistence and reduce environmental impact of the mixture employed in stress condition of the crop too.

Field trials have shown the possibility to replace the higher toxic products and increase the biological activity of some mixtures employed.

ABRÉGÉ

Le document en question indique les résultats des cinq dernières années d'essais expérimentaux avec des additifs, à base d'acides aminés, de peptides, de surfactants et de renforceurs du pH de la solution, utilisés dans le cadre du désherbage et de la défense fongicide contre la cercosporiose et l'oïdium.

Le but consistait à améliorer l'efficacité, la sélectivité, la persistance d'action et à réduire le plus possible l'impact environnemental des mélanges utilisés même dans des conditions de stress de la culture. Des indications positives ont été obtenues sur la possibilité de remplacer les produits les plus toxiques et d'augmenter l'efficacité et la sélectivité de certains mélanges.

KURFASSUNG

Es werden die Resultate der letzten fünf Jahre bezüglich der Experimente mit Additiven auf der Basis von Aminosäuren, Peptiden, Tensiden und Optimierern des pH des Lösungsmittels veröffentlicht, die auf dem Gebiet der chemischen Unkrautvertilgung und des Fungizidschutzes gegen Cercospora (Blattfleckenkrankheit) und Oidium (Mehltau) angewandt werden.

Das Objektiv war es, die Effizienz, die Selektivität und die Wirkungsbeständigkeit zu verbessern und den Umwelteinfluss der eingesetzten Gemische so weit wie möglich zu verringern, auch unter Stressbedingungen des Anbaus. Man gelangte zu positiven Hinweisen hinsichtlich der Möglichkeit, die

Produkte höherer Toxizität durch andere zu ersetzen und die Effizienz so wie die Selektivität einiger Gemische zu erhöhen.

INTRODUCTION

The need to find treatment techniques that have a lower chemical impact has lead to research aimed at examining all the factors that can in some way help improve the effectiveness of active ingredients and their crop selectivity. Among these, the use of adjuvants in herbicides mixtures and in chemical products to prevent Cercospora leaf spots is of great interest.

Such adjuvants or additives are components that can improve or modify the activity of an active ingredient. These substances can guarantee more uniform distribution, reduce drift, improve effectiveness and enhance safety of use. They can also be differentiated by composition and action mechanism as follows: oils (paraffinic and vegetable), surfactants and sprays (anionic, cationic, non ionic, amphoteric), stabilizers (emulsifiers, dispersing agents, anti-flocculation, compatibility enhances), solvents, deposit enhancers (adhesives and film formers), foaming and anti-foaming agents and buffering agents (Meriggi, et al., 1992). In addition, today there is a great deal of experimental evidence on the importance of plant-derived additives, especially esterifiers, as additives in phytotherapy (Mantey et al., 1989; Gauvrit, 1994; Müller et al., 2001).

In order to replace products having a high environmental impact (e.g. white mineral oil in post-emergence herbicide mixtures and tin salts in fungicide mixtures for the treatment of Cercospora) from 1996 to 2002 specific tests were performed to evaluate the effect of different additives on both herbicide and anti-cercospora activity of the active principles in various chemical compositions commonly employed in such treatments.

MATERIALS AND METHODS

The weed control trials were performed in the Italian provinces of Bologna, Rovigo and Ancona while the anti-Cercospora trials were performed in the provinces of Bologna and Ferrara. All field trials were randomized block design, replicated 4 times was adopted. Individual plot size was 27 m^2. The adjuvants (see Table 1) were added at the time of the treatment performed in the field. The treatments were applied during the periods traditionally used in the reference areas. In particular, for weed control the first application was performed at the cotyledonary stage of weed infestation and then continued with 2-3 additional applications at 10-12 day intervals. For protection against Cercospora, application was made when the first leaf spots appeared and were followed up with 2-3 additional applications at 18-20 day intervals. The volumes of water adopted were, respectively, 180-200 l/ha and 400-500 l/ha. To evaluate the effect these additives had on the biological activity of the herbicide mixtures, periodic floristic samples were taken (weed count and classification) while for anti-Cercospora mixtures the Leaf Area Diseased (LAD) was determined. Then, in both cases, production quantity and quality were evaluated. In both experiments treatment selectivity was evaluated with a visual crop estimate using the empirical EWRS 1-9 scale (1=no symptom; 9=total phytotoxicity).

Table 1 – Characteristics of the additives used in the field trials

THESIS	GROUP	TYPE OF ADDITIVE	INCLUDED IN FIELD TRIAL
1	Oils	Mineral oil	Weed control
2		"Narrow range" mineral oil	Weed control
3		Seed oil (e.g. rapeseed oil)	Weed and Cercospora control
4	Deposit formers	Adhesives and film formers	Cercospora control
5	Stabilizers	Compatibility enhancers	Weed and Cercospora control
6	Buffering agents	pH optimizers	Weed and Cercospora control
7	Biostimulants	AATC + folic acid	Weed and Cercospora control
8	Fertility integrators	Nitrogen and/or micro-elements	Weed and Cercospora control
9	Phosphorganic agents	Phosethyl-aluminum	Cercospora control
10	Natural agents	Algae	Cercospora control

RESULTS

Weed control. The lands involved in the field trials were of mixed soils and were 82% infested with Polygonacae (Polygonum aviculare 55%, Polygonum persicaria 19% and Fallopia convolvulus 8%) and 15% by Chenopodium album. The results on selectivity and effectiveness of the mixtures with and without triflusulfuron-methyl (Safari) are reported, respectively in Tables 2 and 3.

A significant increase in activity was seen with test products 2 (mineral oil "narrow range") and 3 (seed oil) both in the absence (+7.1% and +6.2%) and in the presence (+3.9% and +4.2%) of sulphonilurea. The mixtures with Safari also proved significantly more effective with the addition of adjuvant 6 (pH enhancer) showing a 3.6% increase vs. the test with white mineral oil. Crop selectivity was on the whole respected with a slight increase in phytotoxicity in the cases of test products 5 and 6. The best additive with the highest effectiveness/selectivity ratio proved to be the seed oil (thesis 3).

Cercospora. The field trials were performed in Northern Italy where this diseases is highly present. The appearance of the first spots normally occurred during the middle of June. The selectivity and effectiveness of the results obtained by comparing a mixture of a triazolic fungicide containing different additives and with tin salts (TPTA) are expressed as Leaf Area Diseased (LAD) and yield production. These results are shown in Table 4. Analysis of the biological activity of the mixtures e.g. disease reduction (LAD values) have shown that the only test product significantly better than the standard TPTA product was seed oil which reduced the disease by approximately 38%. Moreover the test products showing the lowest (but not significantly different) LAD values vs. the standard product were, in order: phosethyl-aluminum, pH optimizers and film formers. The production data, Gross Saleable Product (GSP), confirm good performance of the thesis with seed oil, film formers and phosethyl-aluminum with a significant increase ranging from 7.5% to 6.4%. There were no significant differences in the values for quality, Dense Juice Purity (DJP), and crop selectivity.

CONCLUSIONS

In post-emergence weed control of infestations (predominantly Polygonacae), the results showed that:

- in the absence of triflusulfuron-methyl significant increases were seen in mixture efficacy when white mineral oil was replaced with "narrow range" mineral oil (+7.1%) and with seed oil (+6.2%);

- in mixtures containing triflusulfuron-methyl, there was generally a more limited increase in activity. In particular, the test products which proved significantly better than white mineral oil were: seed oil (+4.2%), "narrow range" mineral oil (+3.9%) and pH optimizers (+3.6%);

- in cercospora control a significant increase in biological activity vs. the standard TPTA product was achieved with mixtures containing seed oil, with a 38% reduction in Leaf Area Diseased. As regards GSP, the most significant results were obtained with the seed oil, phosethyl-aluminum and film formers, with increases between 6.4 and 7.5%;

- both in chemical weed control and anti-Cercospora treatments the best additive with the highest effectiveness/selectivity ratio was the seed oil (test product 3).

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Tab. 2 - Post-emergence weed control without triflusulfuron-methyl (Safari): comparison of additives, average of 5 field trials 1998-2001 (Indices, 100=thesis with white mineral oil)

Additive used[1]	Selectivity (EWRS)[2]		Increase in efficacy performance (%) *
	T1 + 9	T2 + 10	
1. Mineral oil	1.9 R,M	1.7 R	100.0 b
2. "Narrow range" mineral oil	1.2 R	1.3 R	107.1 a
3. Seed oil	1	1.4 R	106.2 a
5. Compatibility enhancer	2.3 R,M	2.2 R,M	100.6 b
6. pH optimizer	2.5 R,M	2.2 R,M	104.2 b
7. Biostimulant	1.5 R	1.8 R	103.4 b
8. Fertility integrator	1.4 R	1.8 R	91.9 c

Note:

[1]The mixture was composed of: (fen+des+eto) 0.7-1 + metamitron 0.5-0.7 + lenacil 0.1 l or Kg/ha of c.f.

Number of treatments performed: 2. Stage of infestation development: (T1) cotyledonary - 2 true leaves.

[2] Description of symptoms: R=reduced development: Y=yellowing: M=malformations. Stage of sugar beet development: 4 true leaves.

* Expressed as a percentage reduction of overall infestation vs. untreated test: thesis with white mineral oil is set to 100.

Percentage of weeds present in untreated plots: Polav 55. Polpe. 19. Cheal 15. Polco 8. Alomy 3 (tot pl/m^2 24)

ANOVA and separation of averages performed on $\sqrt{\ }$ n+1 of plants/m^2 with the Skott-Knott test (p=0.05).

Tab. 3 - Post-emergence weed control with triflusulfuron-methyl (Safari): comparison of additives, average of 5 field trials 1998-2001 (Indices, 100=thesis with white mineral oil)

Additive used[1]	Selectivity (EWRS)[2]		Increase in efficacy performance (%) *
	T1 + 9	T2 + 10	
1. Mineral oil	3.0 R,Y	2.7 R,Y,M	100.0 b
2. "Narrow range" mineral oil	2.5 R,Y	2.5 R,Y	103.9 a
3. Seed oil	1.9 R	1.8 R	104.2 a
5. Compatibility enhancer	3.3 R,Y,M	2.9 R,Y,M	100.6 b
6. pH optimizer	3.5 R,Y,M	2.9 R,Y,M	103.6 a
7. Biostimulant	2.5 R,Y	2.2 R,Y,M	100.3 b
8. Fertility integrator	2.1 R,Y	2 R,Y	98.9 b

Note:

[1]The mixture was composed of: (fen+des+eto) 0.7-1 + metamitron 0.5-0.7 + lenacil 0.4 l or Kg/ha of c.f.

Number of treatments performed: 2. Stage of infestation development: (T1) cotyledonary - 2 true leaves.

[2] Description of symptoms: R=reduced development: Y=yellowing: M=malformations. Stage of sugar beet development: 4 true leaves.

* Expressed as a percentage reduction of overall infestation vs. untreated test: thesis with white mineral oil is set to 100.

Percentage of weeds present in untreated plots: Polav 55. Polpe. 19. Cheal 15. Polco 8. Alomy 3 (tot pl/m^2 = 24)

ANOVA and separation of verages performed on $\sqrt{n+1}$ of plants/m^2 with the Skott-Knott test (p=0.05).

Tab. 4 - Cercospora control: comparison of additives, average of 5 field trials 1996-2002
(Indices 100=standard test product with TPTA)

Additive Used[1]	Selectivity (EWRS)[2]			Cercospora (LAD)*	GSP*	DJP*
	T1+15	T2+15	T3+15	T3 + 25	Indices	Indices
TPTA (standard)	1.0	1.1	1.0	87 a	100.0 b	100.0 a
3. Seed oil	1.0	1.2	1.1	54 b	107.5 a	100.8 a
4. Film formers	1.0	1.0	1.0	85 a	106.4 a	100.1 a
5. Compatibility enhancers	1.3	1.0	1.0	91 a	99.8 b	99.2 a
6. pH optimizers	1.7 D	1.5 D	1.8 D	79 a	102.7 b	100.1 a
7. Biostimulants	1.2	1.0	1.0	92 a	98.3 b	99.7 a
8. Fertility Integrators	1.5 D	1.3	1.7 D	94 a	101.1 b	99.4 a
9. Phosethyl-aluminum	1.3	1.0	1.1	71 a	106.5 a	100.7 a
10. Algae	1.0	1.0	1.0	94 a	96.8 b	100.0 a

[1] see Table 1. The base mixture was made up of : tetraconazole 1.1 (+ TPTA 0.8 in the standard thesis) l or Kg/ha of c.f.
Variety used: sensitive to Cercospora, tolerant to Rhizomania.
Number of treatments performed: 3. Starting when the first Cercospora spots appeared and then following at 18-20 day intervals.
[2] Values of 1= no symptom to 9=total phytotoxicity. Description of the symptoms: D=drying.
*ANOVA and separation of the averages performed on real and normalized values N+1 for LAD using the Skott-Knott test (p=0.05).