

SCLEROTINIA SCLEROTIORUM (Lib.) de Bary :
A Study of Fungicides to Control Attacks on Sunflower Heads.

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Summary :

The development of fungicides to control *Sclerotinia sclerotiorum* on sunflower heads carried out for several years by CETIOM has encountered two major difficulties :

- the absence of systemy in fungicides applied to sunflower, and
- the low penetration and quick degradation of these products applied on the flowered head.

The results of important studies carried out in the lab, in the greenhouse and in the field underline the interest of studies dealing with additives and new formulations directly applied on the flowered face of sunflower. Due to specific properties of these products (anti-oxidants, wetting agents, etc...), maximum fungicidal efficacies of 75 to 90% were obtained in experimental micro-plots in the open field in 1990 and 1991.

Regularly for the last three years, two fungicides FG 268 and FG 311 mixed with one or two additives have shown significant efficacies in different contexts of attacks obtained by a well-adapted and performing methodology.

1. INTRODUCTION

Among the four manifestations of *Sclerotinia sclerotiorum* on sunflower (disease on heads, terminal buds, stems and collars), the attack on heads remained the most serious epidemic disease in France considering important damage observed until 1987.

The contamination takes place on the flowered face of sunflower heads (florets) and following a mycelial progress through floral structures for about 20 days, the disease becomes visible at the back of the head with a pale beige soft rot, while a cluster of sclerotia is developing between and under the seeds. The total destruction of tissues leads then to a fall of seeds.

Studies carried out by CETIOM for several years and aiming at finding a chemical answer have never given sufficient efficacies due to characteristics specific to this form of attacks (difficulty of penetration and maintain of products within the flowered face of sunflower-heads. Thus, a study in the greenhouse and in the field based on chemical (Table 1) and biological analyses showed that :

- fungicides do not penetrate, or only little, the inside of the flowered face,

- a quick degradation of the product can be observed on the day following treatment (oxidizing environment)
- adding a wetting agent improves properties of penetration of the fungicidal mixture (PERES et. al. , 1986).

This work on fungicides carried out for 4 years, and which is the focus of the present study, takes into account these difficulties since they are orientated towards the use of additives and new formulations.

2. MATERIAL AND METHODS

7 trials were carried out in micro-plots in the field (24 m²) with a spray irrigated crop in a highly contaminated place between 1988 and 1991.

Products were applied with a back-sprayer with 350 l/ha of mixture with one (early flowering) or two (early flowering + late flowering) application(-s). Spraying is orientated towards the flowered face of sunflower heads.

Artificial contamination took place at early flowering by spraying the flowered face with a contaminated suspension of spores of *Sclerotinia sclerotiorum* (25.000 spores/ml) followed by an encapping of heads for about 30 days.

The experimental device was of the Fischer-block type with 4 or 5 replications.

The efficacy of products was measured by counting attacked sunflower heads at maturity on a sample of 100 plants by elementary plot.

3. RESULTS

The results of both experiments (Tables 2 and 3) are rather representative of all experiments which were carried out. They stress out :

- a good efficacy of the technique of artificial contamination (39,47 % and 77,30 % of attacked sunflower heads on the untreated control),
- a meaningful efficacy of all tested fungicidal formulations.

In best cases, these efficacies reached 75 to 90 % for formulations based on FG 268.

The synthesis of results obtained from the 6 experiments carried out in the field in 1990 and 1991 gives a global insight of product efficacies. They were studied according to the seriousness of attacks, with three different attack-rates : 20 - 50%, 50 - 80 % and > 80 % of attacks (results of 2 experiments for each category).

In the case of one single preventive application (Graph 1), the lower the attack, the more efficient the products. As an example, the efficacy of FG 268 + A + S was 85 % for an attack of about 40 % ; it was only 65 % for attacks of about 75 % and of 30 % for those neighbouring 90 %. The comparison of products underlined that in the case of a low attack-rate, FG 268 + A + S and FG 311 offered the best efficacy. In the case of slightly more serious attacks, FG 268 with or without adding agent was more efficient than FG 311 in two cases out of three. In presence of a very important attack, FG 311 + A appeared to be, on the contrary, appreciably more performing than FG 268 + A + S.

Analysed organs	Treatments	Quantity of procymidone in organs (ppm)			
		at 1 day	at 2 days	at 8 days	average
Floret	Untreated	0,1	-	-	0,1
	Procymidone	205	132	164	167
	Procymidone + triton CS 7	156	112	113	127
Kernel	Untreated	0,04	-	-	0,04
	Procymidone	0,85	0,48	0,90	0,74
	Procymidone + triton CS 7	58	28	20	35,3
Medulla	Untreated	0,06	-	-	0,06
	Procymidone	0,26	0,33	0,08	0,22
	Procymidone + triton CS 7	31	4,7	1,8	12,5

Table 1
QUANTITY OF PROCYMIDONE CONTAINED IN ANALYSED ORGANS
(PROCYMIDONE : 750 g/ha)

Fungicides + additives (1)	Number of treatments	% attacked heads	% of efficacy	Yield q/ha
FG 268 + E + S	2	5,95 e	84,9	37,01
FG 268 + A + S + T	2	9,75 de	75,3	38,89
FG 311 + A	1	13,27 cd	66,4	38,23
FG 259 + A	1	15,50 bcd	60,7	37,69
VINCHLOZOLIN + A + B	1	17,22 bcd	56,4	37,01
FG 268 + A + S	1	17,50 bcd	55,7	35,52
FG 268 + E + S	1	19,01 bcd	51,8	37,14
FG 304	1	19,59 bcd	50,4	34,90
TEBUCONAZOLE + A	1	20,80 bc	47,3	36,66
FG 268 + A + S + T	1	25,88 b	34,4	34,93
UNTREATED		39,47 a		33,94

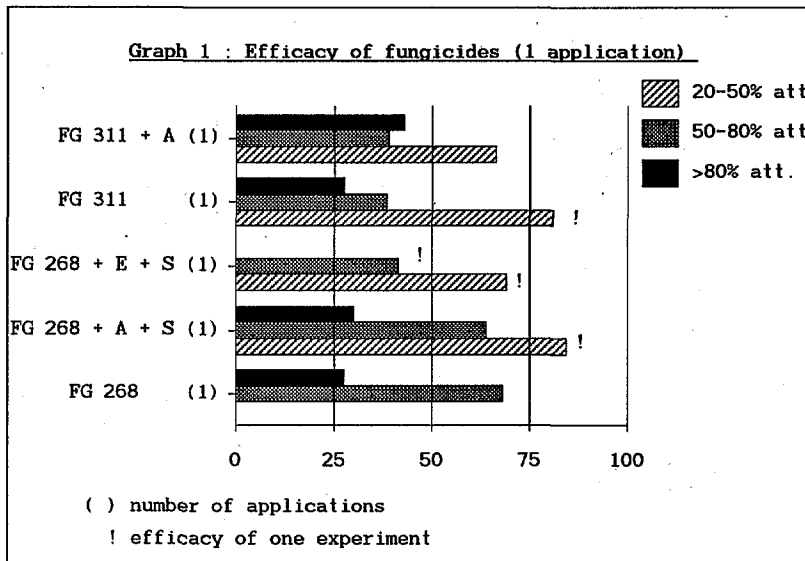
(1) : Fungicide (FG...) + additive (A,B,E,S,T)

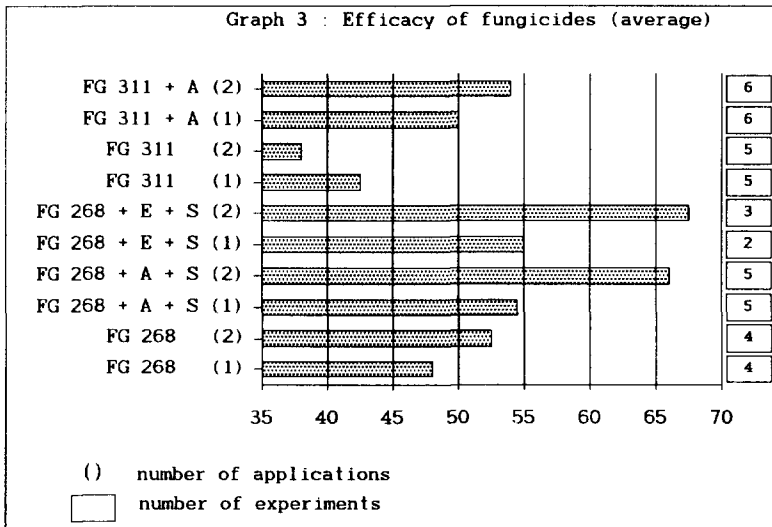
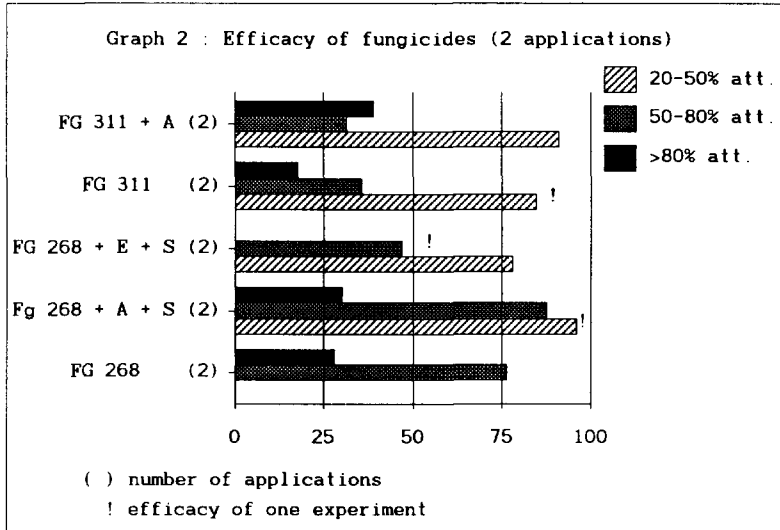
Table 2 : Experiment 1
SCLEROTINIA SCLEROTIORUM ON SUNFLOWER HEADS (1991)
% OF ATTACKED HEADS AND EFFICACIES

Fungicides + additives (1)	Number of treatments	% attacked heads	% of efficacy
FG 268 + S + A	2	7,5 d	90,3
FG 268	2	12,5 c	83,8
FG 268	1	13,8 c	82,1
FG 268 + S + A	1	15,0 c	80,6
FG 311	2	32,5 b	57,9
FG 311	1	33,8 b	56,3
FG 311 + A	2	35,0 b	54,7
FG 311 + A	1	36,3 b	53,0
UNTREATED		77,3 a	

(1) : Fungicide (FG...) + additive (A,S)

Table 3 : Experiment 2
SCLEROTINIA SCLEROTIUM ON SUNFLOWER HEADS (1991)
% OF ATTACKED HEADS AND EFFICACIES





As in the case of unique applications, the lower the attack, the higher the efficacy of doubled applications, and this was particularly pronounced (see Graph 2). Thus, for the category 20 - 50 %, all tested products had at least 80 % of efficacy. In the category 50 to 80 %, only FG 268 and FG 268 + A + S had an efficacy higher than 75 %. For the category > 80 %, efficacies were lower than 40 %, except for FG 311 + A, which was the most performing.

To conclude, if we compare the results given by an average efficacy by treatment, it appeared that (Graph 3) :

- mixtures with additives are more efficient than the fungicide used alone,
- double applications give better results than simple applications (in particular in the case of FG 268),
- FG 268 is more efficient than FG 311 (except in the case of a very high attack).

4. CONCLUSION AND DISCUSSION.

The study of fungicides against *Sclerotinia sclerotiorum* on sunflower heads carried out for several years by CETIOM enabled us to make significant progress :

thanks to a work on new active matters which has confirmed the significant efficacy of both products, FG 268 and to a lesser extent FG 311 for the last three years,

and thanks to a work on additives, which have a globally positive effect on the improvement of efficacies.

Two applications have to be carried out, the first one at early flowering, and the other at late flowering, to reach efficacies with a sufficient level (> 75 %), and the stream must be orientated towards the flowered head of sunflower.

Considering technical constraints linked to the application of products at the time of flowering (high-clearance tractor, adjustment of pendant lances on the ramps, choice of nozzles, etc...), the elaboration of a control strategy has not been possible until now. A work aiming at developing application techniques is in progress, and at the same time, the study of new active matters to widen the range of available products is still under way.

5. BIBLIOGRAPHY.

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