

CONTROL OF *CERCOSPORA BETICOLA* BY COMBINATION OF FUNGICIDES WITH DOUBLE TOLERANT CULTIVARS (*RHIZOMANIA* AND *CERCOSPORA*)

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AIMCRA

1. INTRODUCTION

The disease caused by the fungus *Cercospora beticola* Sacc. (Cb) is widely spread over production regions of sugar beet all over the world. Approximately 34% of the area, namely 2.400.000 ha. parceled out among 33 countries, suffers from moderate to high severity attacks (Holtshulte, 2000) –requiring more than one application to be controlled and causing production losses superior to 10%.

Cb causes the destruction of leaves subsequently resulting in a regrowth, at the expense of the substances stored in the root, and provoking a reduction in sugar production and polarization (Smith and Martin, 1978; Ayala and Gordo, 1998). The impurity content of the juices does also increase and causes difficulties to sugar extraction at the industrial process while the crown of the plant lengthens abnormally and increases the loss of weight in the topping.

Among the control measures proposed to prevent losses we may remark the use of fungicides (Meriggi *et al.*, 2000), the use of tolerant cultivars (Koch, 1970), and some cultivation measures such as rotation.

The development of Cb resistances to fungicides affects to very diverse families. Ionnidis (2000) reports this problem referring to benzimidazoles, tin derivatives (Giannopolitis, 1978) and more recently to EBIs (EBIs: *ergosterol biosynthesis inhibiting*). In order to palliate this phenomenon some anti-resistance strategies are established based in the mixing and alternative use of fungicides from families with different modes of action.

In Spain we find high-risk manifestations of Cb in the Central zone and moderate ones in the North. The health care status of these areas is more complex due to the presence of *Rhizomania* and *Oidium*. It makes necessary the use of varieties tolerant to *Rhizomania* and also a control of foliar diseases by means of fungicides.

In the last two decades the problem posed by Cb changed: after being considered a restrictive disease, now it appears included into health care programs. This has been possible thanks to the coordinated action of sugar beet professionals by the use of the best products and mixtures at the suitable doses and at the right moments. Thanks to this high level of discipline, Cb has not been an obstacle to yield improvement.

At present new challenges arise: European Directive 91/414/EEC meets social worries and urge a growing environmental care by demanding the use of protection products. Its final resonance cannot still be forecast but we already know about the prohibition of active substances, the limitation of accumulated doses in rotation and the probable limitation in the number of applications. Moreover, the farmers' tolerance concerning the presence of diseases in their crops decreases and causes a greater demand of control. Finally we have noticed the presence of Cb strains that were little susceptible to the most frequently used families of fungicides. With regard to this situation, a practical control of Cb is proposed by the combination of different fungicides with double cultivars tolerant to Rhizomania and Cercospora

2. EFFECT OF C. BETICOLA ON YIELDS

In Spanish conditions of spring cultivation early Cb symptoms appear in the first summer month when foliar apparatus is fully developed while the peak growth occurs in late August or early September, persisting in high virulence frequently up to the harvest in October-November.

In order to study the losses we have taken information from control trials performed with fungicides throughout four years. The values of the trials that presented average attacks on the controls (AFA>30%) 30 days before harvest were recorded. The percentage of losses was calculated by taking as a reference the more effective treatment at each trial.

Graphic 1. Influence of cercospora (% Affected Foliar Area) in sugar yields. 6 trials

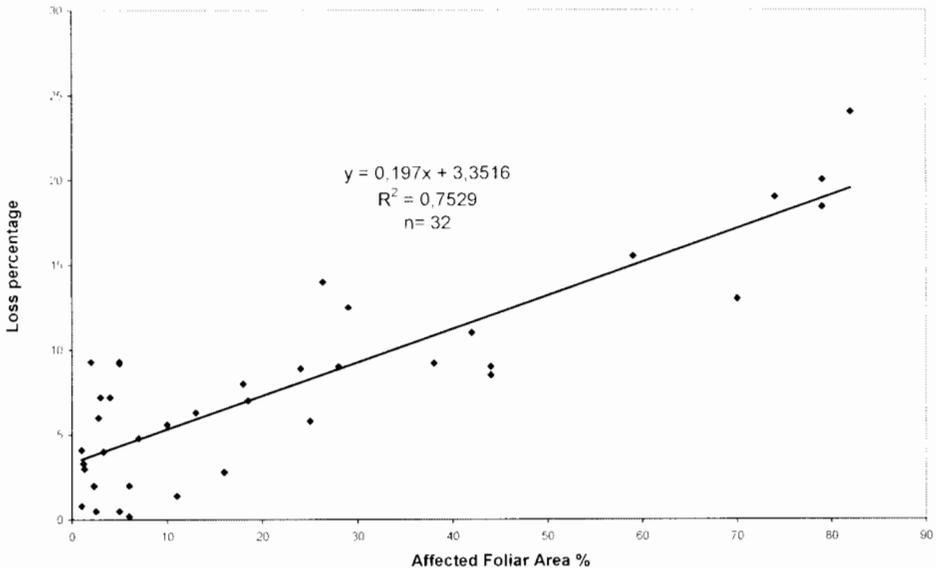


Table 2. Concentration and active substance of the products used

Brand	Active substance (concentration in %)
Impact R	flutriafol (9.4)+ carbendazim (20)
Spyrale	difenoconazole (10)+ fenpropidine (35.5)
Punch CS	flusilazole (25)+ carbendazim (12.5)
Lovit	epoxiconazole (12.5)
Bumper P	procloraz (40)+ propiconazole (9)
Maneb	maneb (80)

ASSESSMENTS

The incidence of the diseases was visually assessed according to the percentage of Affected Foliar Area (AFA).

For the different evaluations 20 sugar beets were taken from the center or the elementary plot, considering the average as final data.

The analysis of the variance was performed after the transformation $y = \text{arc.sen} \sqrt{(x/100)}$, the x being the different percentage estimations (AFA).

The comparison of means was carried out by LSD test. Efficacies were calculated for the date of the highest disease level, according to Abbot's formula.

Table 3. Efficacy of tested treatments, expressed in % \pm E.S., depending on the incidence of *Cercospora* and the days passed since application, expressed in AFA (% Affected Foliar Area).

Treatment ⁽¹⁾	Efficacy depending on attack level			Efficacy depending on ddT	
	AFA > 80 (5 trials)	80 < AFA > 40 (5 trials)	AFA < 40 (3 trials)	12 ddT ₅ ⁽³⁾	33 ddT ₅
AIMCRA	91.1 \pm 3.0	92.1 \pm 3.7	96.0 \pm 0.7	93.6 e	78.8 e
Impact R	79.0 \pm 10.2	87.5 \pm 5.4	95.8 \pm 1.5	58.9 c	51.8 d
Spyrale	92.4 \pm 2.8	95.1 \pm 2.5	97.0 \pm 0.2	93.7 e	78.1 e
Spyrale-10 ⁽²⁾	96.2 \pm 1.9	97.9 \pm 0.4	-	97.9 e	94.1 f
Punch CS	62.9 \pm 15.6	82.5 \pm 7.8	81.4 \pm 5.1	33.4 a	22.0 a
Lovit	78.1 \pm 14.2	92.2 \pm 3.8	91.1 \pm 4.6	50.2 b	42.5 c
Bumper	66.0 \pm 9.3	75.9 \pm 14.4	73.5 \pm 3.2	49.3 b	33.3 b
Control (AFA)	(94.4)	(59.0)	(18.8)	(99.3)	(99.6)

⁽¹⁾ Maneb 80% (2,5) has been added to all treatments.

⁽²⁾ applications every 21 days up to 15/08 and every 10 days from that date

⁽³⁾ ddT₅: days after the 5th application

When the attack reaches a degree of severity superior to 80% in controls (Table 3), only the treatments including Spyrale –in isolation or alternated- obtain sufficient efficacy (>85%). When the period between treatments is shortened to 10 days after August 15, what means 2 more applications in our conditions, the efficacy improves 4 points and persistence to 33 ddT₅ in 16 points. These data are especially important since good efficacy is maintained up to the end of cultivation, when late attacks are still frequent and less attention is paid to growth health care.

In the case of attacks with a degree of severity between 40% and 80% AFA, along with the treatments aforementioned, Lovit and Impact R do obtain good efficacy.

The control with fungicides improves the production in FEI (tons of 16°) on the control in 25%, some 23 t/ha in these trials, which are equivalent to 950 €/ha in FNI.

4. STRATEGIES OF CONTROL BASED IN THE COMBINATION OF FUNGICIDES AND DOUBLE CULTIVARS TOLERANT TO RHIZOMANIA AND CERCOSPORA

In the present situation, the degree of satisfaction of Cb control is quite good, but social worries about environmental issues urges farmers and technicians to search for profitable and compatible alternatives to the interests of producers and consumers. In the 2001 campaign some experiences were initiated to evaluate the efficacy and yield obtained by the combination of varieties with tolerance to Cercospora and fungicide treatments (Table 4). In our country it is essential that genetic material may be tolerant to Rhizomania, for what trials are also performed in those conditions.

Table 4. Treatments

Factor 1		2001	2002
Variety	Ramona (tolerante a Rizomania)	+	+
	Flavia (tolerante a Rizomania y Cercospora)	+	+
	África (tolerante a Rizomania y Cercospora)	-	+
	Mondial (tolerante a Rizomania y Cercospora)	-	+
	Adapt (tolerante a Rizomania y Cercospora)	-	+
Factor 2			
Fungicide	Control	+	+
	Spyrale (1) every 21 days starting with 1 st spot	-	+
	Impact R 1.25L/ha every 21 days, starting with 1 st spot	+	-
	Punch CS 0.5 L/ha every 21 days, starting with 1 st spot	+	+
	Spyrale 1L/ha every 21 days, with a delay of 21 days	+	+
	Spyrale 1L/ha every 21 days, with a delay of 42 days	+	-

+ : Tested / - : Npt tested

ASSESSMENT

The incidence of *Cercospora* has been assessed visually depending on the percentage of Affected foliar area (AFA).

For our assessment 20 plants from the centre of each elementary plot were examined and the average results were taken as final record. Analysis of variance was carried out after $y = \arcsin \sqrt{(x/100)}$ transformation, where x stands for the different percentage values (AFA). Comparison of average values was carried out by means of LSD test. As a reference, the tables will show the lowest significant difference at 5%.

YIELDS

The central 10 m² of each elementary plot were harvested, recording root weight and polarization and later estimating the sugar content, the farmer's economic index (FEI= 16° tons) and the industrial quality index ICI.

For statistical purposes variance analysis of absolute data and average values split was carried out following LSD test. As a reference, the tables will show the lowest significant difference at 5%.

The RRP (recommended retail price) for fungicides and a cost of 9.02 € per application, were taken into account in order to calculate the farmer's net index (FNI).

4.1. RESULTS

TRIAL 1-2001

Cercospora (Table 5): The first spray (14/07) was carried out after first symptoms. The disease increased gradually and reached, in mid September, a very low level in Flavia control (4.3 % of AFA) and a severe level in Ramona control (47.5% of AFA). In 23 days, *Cercospora* increased remarkably and reached a severe level in Flavia control (46.3 % of AFA) and very severe in Ramona control (89.8 % of AFA). Fungicide applications on Flavia had considerable success. Even the application with a delay of 41 days had 89.6 % effectiveness on its reference. Fungicide control on Ramona had worse results, and if the applications are delayed effectiveness went down to 79.6 %. Control of *Cercospora* in Ramona with fungicide Punch proved insufficient.

Flavia showed more sensitivity to oidium than Ramona, and a sulphur application to the whole trial was needed to avoid this interference.

Yields (Table 6): There were significant differences at 5% in all parameters. Observing the FEI values, Flavia control proved to be 6% higher than Ramona control due to higher polarization. With the use of fungicides FEI increases 8% in Flavia (on its reference) and 21 % in Ramona (on its reference). Fungicides on Flavia control improved FNI (deducting the cost of applications and the product) at 443 €/ha, and on Ramona improved at 1,050 €/ha.

Table 5. *Cercospora* levels, expressed in terms of diseased foliage area percentages (AFA), depending on treatments and timetables, at a fungicide x variety trial 1, La Gineta (Albacete). Year 2001. 4 replications.

Application dates: 14/07; 03/08; 25/08; 15/09

	Treatment		Evaluation dates			Efficacy of fungicides on its reference
	Variety	Fungicide	31/08	18/09	11/10	
1	Flavia	Control	1.5 bc	4.3 c	46.3 b	-
2	Flavia	Spyrale	0.3 d	0.8 e	1.5 e	98.5
3	Flavia	Impact	0.5 d	1.3 e	2.3 de	95.0
4	Flavia	Punch	0.3 d	1.3 e	4.8 de	89.6
5	Flavia	Sp T1+21	0.3 d	1.0 e	2.8 de	94.0
6	Flavia	Sp T1+42	0.8 cd	1.8 de	4.8 de	89.6
7	Ramona	Control	8.0 a	47.5 a	89.8 a	-
8	Ramona	Spyrale	0.5 d	1.3 e	3.5 de	96.1
9	Ramona	Impact	0.8 cd	3.5 cd	14.8 c	83.5
10	Ramona	Punch	2.5 b	9.0 b	40.8 b	54.6
11	Ramona	Sp T1+21	1.8 bc	4.5 c	6.5 d	92.8
12	Ramona	Sp T1+42	3.8 b	9.8 b	18.3 c	79.6
Lsd (5%)			2.9	4.8	9.3	
Variety			**	**	**	
Fungicide			**	**	**	
Variety x Fungicide			ns	**	**	

Effectiveness of *Cercospora* treatment on trial varieties.

Variety	Spyrale	Impact	Punch	SpT1+21	SpT1+42	Average
Flavia	98.5	95.0	89.6	94.0	89.6	93.3
Ramona	96.1	83.5	54.6	92.8	79.6	81.3

Table 6. Yields in absolute values of root weight, sugar content, sugar yield, FEI, ICI and FNI at trial 1, La Gineta (Albacete), depending on treatments. 4 replications.

Year 2001

Sowing date: 20/03 Harvest date: 08/11

Treatment			Root weight (t/ha)	Sugar content (°)	Sugar yield (t/ha)	I.E.A. (t/ha 16°)	I.C.I.
	Variety	Fungicide					
1	Flavia	Control	105.4 c	16.1 ab	16.93 d	106.0 cd	84.9 ab
2	Flavia	Spyrale	106.5 c	16.3 ab	17.59 cd	111.5 bcd	85.6 a
3	Flavia	Impact	116.0 abc	16.2 ab	18.83 abcd	118.4 abc	85.4 a
4	Flavia	Punch	111.3 bc	16.6 ab	18.44 abcd	117.0 abc	85.9 a
5	Flavia	Sp T1+21	105.3 c	16.9 a	17.81 bcd	113.9 abc	86.3 a
6	Flavia	Sp T1+42	110.8 bc	16.3 ab	18.06 abcd	113.7 abc	85.3 a
7	Ramona	Control	115.7 abc	14.8 c	17.13 cd	100.6 d	83.9 b
8	Ramona	Spyrale	124.3 a	16.0 b	19.85 a	123.8 ab	85.6 a
9	Ramona	Impact	121.6 ab	16.3 b	19.71 ab	123.9 ab	85.9 a
10	Ramona	Punch	114.3 abc	16.1 ab	18.47 abcd	116.0 abc	85.3 a
11	Ramona	Sp T1+21	119.2 ab	16.6 ab	19.80 a	125.7 a	86.0 a
12	Ramona	Sp T1+42	117.9 abc	16.0 b	18.99 abc	118.9 abc	85.4 a
C.V.(%)			6.7	2.3	6.3	6.7	1.0
Isd(5%)			11.0	0.7	1.68	11.2	1.2
Variety			ns	ns	ns	ns	ns
Fungicide			ns	**	*	**	**
Variety x Fungicide			ns	ns	ns	ns	ns

FEI

Variety	Control	Spyrale	Impact	Punch	SpT1+21	SpT1+42	Average
Flavia	106.0	111.5	118.4	117.0	113.9	113.7	113.4
Ramona	100.6	123.8	123.9	116.0	125.7	118.9	118.1

FNI (€/ha)

Variety	Control	Spyrale	Impact	Punch	SpT1+21	SpT1+42	Average
Flavia	5.287	5.559	5.905	5.834	5.679	5.671	5.656
Ramona	5.016	6.172	6.177	5.786	6.269	5.929	5.892

TRIAL 2- 2001

Cercospora (Table 7): The first spray (03/08) was carried out after first symptoms. The disease increased gradually and reached, in early October, a low level in Flavia control (7.0 % of AFA) and a severe level in Ramona control (64.3% of AFA). In 17 days, Cercospora increased reaching a moderate level in Flavia control (28.5 % of AFA) and very severe in Ramona control (94.0% of AFA). Fungicide applications on Flavia had considerable success, except for the application with a delay of 41 days. Fungicide control on Ramona had worse results, and if the applications were delayed 21 days, effectiveness fell to 68.1 %. If there was 41 days delay, effectiveness fell to 47.3%.

Flavia showed more sensitivity to oidium than Ramona, and a sulphur application to the whole trial was needed to avoid this interference.

Yields (Table 8): There were significant differences at 5% in all parameters. Observing the FEI values, Flavia control again proved to be 6% higher than Ramona control due to higher polarization. With the use of fungicides FEI increases 7% in Flavia (on its reference) and a 22.9% on Ramona (on its reference). Fungicides on Flavia control improved FNI (deducting the cost of applications and the product) at 320 €/ha, and on Ramona improved at 985 €/ha.

Table 7. Cercospora levels, expressed in terms of diseased foliage area percentages (AFA), depending on treatments and timetables, at a fungicide x variety trial 2, at Casablanca (Albacete). Year 2001. 4 replications.

Application dates: 03/08; 23/08; 13/09; 04/10

Treatment			Evaluation dates				Efficacy of fungicides on its reference
Variety	Fungicide	24/08	13/09	01/10	17/10		
1	Flavia	Control	1.0 bc	3.3 b	7.0 d	28.5 c	-
2	Flavia	Spyrale	0.5 c	1.0 b	1.3 f	1.8 f	93.7
3	Flavia	Impact	0.8 c	1.5 b	2.0 ef	3.3 f	88.4
4	Flavia	Punch	0.8 c	1.3 b	2.8 def	4.5 ef	84.2
5	Flavia	Sp T1+21	0.8 c	2.0 b	2.3 ef	3.8 f	86.7
6	Flavia	Sp T1+42	0.5 c	3.5 b	4.3 def	7.0 ef	75.4
7	Ramona	Control	2.5 a	14.3 a	64.3 a	94.0 a	-
8	Ramona	Spyrale	0.8 c	2.5 b	3.3 def	4.8 ef	94.9
9	Ramona	Impact	0.8 c	3.8 b	5.8 de	12.5 de	86.7
10	Ramona	Punch	1.0 bc	3.5 b	6.8 d	22.3 cd	76.3
11	Ramona	Sp T1+21	2.8 a	11.8 a	14.5 c	30.0 c	68.1
12	Ramona	Sp T1+42	2.3ab	15.5 a	30.8 b	49.5 b	47.3
lsd (5 %)			0.9	6.3	7.5	36.6	
Variety			**	**	**	**	
Fungicide			**	**	**	**	
Variety x Fungicide			ns	**	**	**	

Effectiveness of Cercospora treatment on trial varieties.

Variety	Spyrale	Impact	Punch	SpT1+21	SpT1+42	Average
Flavia	93.7	88.4	84.2	86.7	75.4	85.7
Ramona	94.9	86.7	76.3	68.1	47.3	74.7

Table 8. Yields in absolute values of root weight, sugar content, sugar yield, FEI, ICI and FNI at trial 2, Casablanca (Albacete), depending on treatments. 4 replications.

Year 2001

Sowing date: 16/03 Harvest date: 02/11

Treatment							
	Variety	Fungicide	Root weight (t/ha)	Sugar content (%)	Sugar yield (t/ha)	I.E.A. (t/ha 16°)	I.C.I.
1	Flavia	Control	82.0 e	17.3 ab	14.17 c	91.4 ef	85.8 abc
2	Flavia	Spyrale	87.3 cde	17.3 ab	15.12 bc	97.6 cdef	87.0 ab
3	Flavia	Impact	86.9 cde	17.7 ab	15.33 bc	99.7 bcde	86.6 ab
4	Flavia	Punch	84.5 de	18.0 a	15.23 bc	99.6 bcde	86.8 ab
5	Flavia	Sp T1+21	87.2 cde	17.3 ab	15.09 bc	97.5 cdef	87.3 a
6	Flavia	Sp T1+42	84.6 de	17.3 ab	14.67 c	94.8 def	86.4 abc
7	Ramona	Control	91.8 bcd	15.4 d	14.10 c	86.3 f	85.3 bc
8	Ramona	Spyrale	104.5 a	17.1 abc	17.86 a	114.8 a	86.2 abc
9	Ramona	Impact	98.5 ab	17.3 ab	17.08 a	110.3 ab	86.4 abc
10	Ramona	Punch	92.9 bc	17.7 ab	16.48 ab	107.4 abc	86.5 ab
11	Ramona	Sp T1+21	99.1 ab	16.7 bc	16.51 ab	105.1 abcd	86.8 ab
12	Ramona	Sp T1+42	91.6 bcd	16.2 cd	14.78 c	92.5 def	84.6 c
C.V.(%)			5.8	4.3	6.7	7.7	1.5
Isd(5%)			7.6	1.1	1.49	11.0	1.9
Variety			*	*	*	ns	*
Fungicide			**	**	**	**	ns
Variety x Fungicide			ns	ns	ns	ns	ns

FEI

Variety	Control	Spyrale	Impact	Punch	SpT1+21	SpT1+42	Average
Flavia	91.4	97.6	99.7	99.6	97.5	94.8	99.8
Ramona	86.3	114.8	110.3	107.4	105.1	92.5	102.7

FNI (€/ha)

Variety	Control	Spyrale	Impact	Punch	SpT1+21	SpT1+42	Average
Flavia	4.559	4.868	4.971	4.969	4.860	4.725	4.825
Ramona	4.301	5.723	5.503	5.356	5.239	4.613	5.123

TRIAL 3-2002Cercospora (Table 9)

Three applications were performed, one less in Sp T1+21, because the first spot of cercospora appeared late in relation to other years. The first application (05/08) occurred with the first symptoms and, from that date up to mid September, the disease hardly increased. Ramona-control presented a very low level (3.7% of AFA), while double tolerant varieties presented levels inferior to 2% of AFA. Since then to harvest (14/10) the disease increased moderately, Ramona-control reaching 24.5 % of AFA and double tolerant varieties reaching levels under 10% of AFA; Flavia-control (10%), Africa-control (2.4%), Mondial-control (3.8%) and Adapt-control (5.5%). In all varieties the treatments with Spyrale obtained the best efficacy. Due to the low levels and slow involution of Cb, the delayed application of Spyrale+21 reached acceptable efficacies (superior to 75%).

Flavia variety showed greater sensitivity to oidium than the rest of varieties, for what two applications with sulphur 6 Kg/Ha were performed to the whole trial in order to avoid this interference.

Yields (Table 10):

In all productive parameters significant differences were found at 5% among the average of the varieties; a tendency to a higher productivity can be shown among fungicides in FEI with Spyrale; the interaction variety x fungicide is not significant.

With levels of cercospora (24.5% AFA), double tolerant varieties Africa, Mondial and Adapt tend to reach higher FEI than Ramona and Flavia when neither of them is treated. Response to fungicide treatments with Spyrale, depending on the FEI increment, is higher in Ramona (31.1%) and Flavia (21.6%) than in the rest of varieties. The less productive variety has been Flavia, in all fungicide treatments.

In FNI (net €/ha, after discounting the cost of fungicides) significant differences only appear between the average of the varieties (all treatments are included in the average), Flavia being the worst productive variety and the average of the rest of varieties being statistically the same. When not treated, Africa, Mondial and Adapt varieties tend to produce more than Ramona and Flavia. When treated with Spyrale the FNI of all varieties is similar (around 5000 €/ha), except for Flavia, which is remarkably lower (3848.1 €/ha).

FNI increment when treating with Spyrale is higher in Ramona (26.5 %) and the response to treatments is lower whenever less AFA in control is present in the variety.

Table 9. *Cercospora* levels, expressed in terms of diseased foliage area percentages (AFA), depending on treatments and timetables, at a fungicide x variety trial 3, at Villalgordo del Júcar (Albacete). Year 2002. 4 replications.

Application dates: 05/08; 29/08; 20/09; (Sp T1+21: 29/08 y 20/09)

Analysis of the variance has been performed after carrying out the transformation $y = \text{arc.sen } \sqrt{AFA/100}$.

	Treatment		Evaluation dates		Efficacy of fungicides on its reference 14/10
	Variety	Fungicide	20/09	14/10	
1	Ramona	Control	3.7 a	24.5 a	-
2	Ramona	Spyrale	0.9 bc	2.5 bcd	89.9
3	Ramona	Punch	1.2 bc	5.9 bc	75.9
4	Ramona	Sp T1+21	0.6 bc	4.2 bcd	84.5
5	Flavia	Control	1.8 ab	10.0 b	-
6	Flavia	Spyrale	0.6 bc	1.5 bcd	85.6
7	Flavia	Punch	0.6 bc	2.0 bcd	80.5
8	Flavia	Sp T1+21	1.2 bc	2.7 bcd	73.6
9	África	Control	1.2 bc	2.4 bcd	-
10	África	Spyrale	0.2 c	0.6 cd	77.5
11	África	Punch	0.6 bc	0.9 cd	64.8
12	África	Sp T1+21	0.2 c	0.6 cd	77.5
13	Mondial	Control	1.9 ab	3.8 bcd	-
14	Mondial	Spyrale	0.2 c	0.2 d	95.7
15	Mondial	Punch	0.2 c	0.6 cd	86.1
16	Mondial	Sp T1+21	0.9 bc	0.9 cd	76.6
17	Adapt	Control	1.2 bc	5.5 bc	-
18	Adapt	Spyrale	0.6 bc	0.9 cd	83.9
19	Adapt	Punch	0.6 bc	2.9 bcd	47.7
20	Adapt	Sp T1+21	0.6 bc	0.6 cd	90.5
variety					
	Ramona		1.6	9.3	
	Flavia		1.1	4.1	
	África		0.6	1.1	
	Mondial		0.8	1.4	
	Adapt		0.8	2.5	
fungicide					
	Control		2.0	9.2	
	Spyrale		0.5	1.1	
	Punch		0.6	2.5	
	Sp T1+21		0.7	1.8	
	mds (5%)		0.07	0.18	
	CV(%)		26.0	51.3	
	Variety		ns	***	
	Fungicide		***	**	
	Variety x Fungicide		ns	ns	

Table 10. Yields in absolute values of root weight, sugar content, sugar yield, FEI, ICI and FNI at trial 3, Villalgordo del Júcar (Albacete), depending on treatments. 4 replications.

Year 2002

Sowing date 12/03 Harvest date: 15/10

Treatment			Root weight (t/ha)	Sugar content (°)	Sugar yield (t/ha)	I.E.A. (t/ha 16°)	I.N.A. (€/ha)	I.C.I.
	Variety	Fungicide						
1	Ramona	Control	126.8 a	13.4 b	17.2	81.8	3941.2	83.8
2	Ramona	Spyrale	127.8 a	14.6 ab	18.6	107.2	4985.9	85.9
3	Ramona	Punch	128.6 a	14.1 ab	18.1	99.2	4628.8	84.4
4	Ramona	Sp T1+21	109.2 abc	14.7 ab	16.1	94.9	4451.3	86.9
5	Flavia	Control	86.7 bc	14.7 ab	12.8	68.7	3312.6	85.9
6	Flavia	Spyrale	91.5 bc	15.1 ab	13.8	83.6	3848.1	86.5
7	Flavia	Punch	92.9 bc	14.4 ab	13.4	77.3	3574.4	84.9
8	Flavia	Sp T1+21	83.9 c	14.6 ab	12.3	73.3	3413.0	85.7
9	África	Control	109.1 abc	14.9 ab	16.3	94.0	4530.6	85.5
10	África	Spyrale	116.3 abc	15.2 ab	17.6	107.1	4981.3	85.5
11	África	Punch	117.4 ab	14.7 ab	17.3	102.8	4801.6	84.6
12	África	Sp T1+21	105.0 abc	14.5 ab	15.2	86.1	4028.6	85.0
13	Mondial	Control	130.4 a	14.4 ab	18.8	104.0	5013.2	82.6
14	Mondial	Spyrale	128.1 a	14.7 ab	18.8	107.4	4995.8	83.5
15	Mondial	Punch	129.3 a	14.2 ab	18.3	100.8	4706.2	82.8
16	Mondial	Sp T1+21	130.1 a	14.3 ab	18.6	105.8	4980.0	83.7
17	Adapt	Control	109.2 abc	15.4 ab	16.9	101.7	4900.9	84.8
18	Adapt	Spyrale	116.7 abc	15.9 a	18.5	114.7	5347.6	85.5
19	Adapt	Punch	102.7 abc	15.5 ab	15.9	97.6	4551.2	85.1
20	Adapt	Sp T1+21	107.1 abc	15.3 ab	16.3	99.6	4678.2	85.5
C.V.(%)			13.8	6.8	19.1	29.1	29.8	1.0
mds(5%)			33.07	2.14	6.73	59.17	2851.0	1.81
Variety			*	*	*	**	**	ns
Fungicide			ns	ns	ns	ns	ns	*
Variety x Fungicide			ns	ns	ns	ns	ns	ns

FEI					
	Ramona	Flavia	Africa	Mondial	Adapt
Control (t/ha)	81.8	68.7	94.0	104.0	101.7
Fungicides (t/ha)	100.4	78.1	98.7	104.7	104.0
Increment of FEI with fungicides (%)	22.7	13.7	5.0	0.7	2.3
FNI					
	Ramona	Flavia	Africa	Mondial	Adapt
Control (€/ha)	3941	3313	4531	5013	4901
Fungicides (€/ha)	4689	3612	4604	4894	4859
Increment of FNI with fungicides (%)	19.0	9.0	1.6	-2.5	-1.0

5. CONCLUSION

With fungicide treatments according to anti-resistance strategies, efficacies superior to 90% can be obtained. In conditions of extremely serious attacks the fundamental product is Spyrale; in extreme conditions, efficacy may be maintained by shortening the period between applications. When the intensity of the attacks decreases, the list of effective products enlarges by including Impact R and Lovit.

In 2001, the *Cercospora* level reached at the end of the crop is very high, but it presents a very long-term evolution. The symptoms increase a month later than usual near harvest time. Thus, Flavia proves to be less susceptible to *Cercospora* if compared to Ramona: Ramona control reaches 91.9% AFA while Flavia control reaches 37.4% AFA (the average value in both trials). After fungicide treatments on Flavia, the development of the disease stops at less than 6.0% AFA, being effective even when the applications are delayed. Only Spyrale and Impact proved to be successful on Ramona with satisfactory and regular effectiveness.

The disease levels reached present a clear incidence on yields. Comparing FNI of these varieties after different treatments, Flavia, without fungicide, proves to be more profitable. Applying fungicides, Flavia increases about 8% and Ramona increases about 22%; their final profitability is therefore higher using fungicides.

In 2002 the level reached by Cb has been moderate, and its occurrence and evolution delayed. The lower sensitivity of double tolerant varieties is remarkable compared to Ramona. There is no interaction variety x fungicide neither in Cb control or in yield parameters. The FNI of Mondial and Adapt-control varieties tend to be higher than that of Ramona with protection of fungicides.

It would be desirable to have further trials with more virulent *Cercospora* attacks presenting its peak growth at earlier and more usual timing, at the beginning of September.

If for environmental issues the number of applications has to be reduced, the combination of these fighting measures may coexist with *Cercospora*. It would be therefore very interesting to continue with this research.

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