THREE YEARS OF TRIALS WITH TRIFLOXYSTROBINE FUNGICIDES IN CEREALS IN BELGIUM

J.-M. MOREAU[1], F. VANCUTSEM[2], B. BODSON[2] & P. MEEÙS[1]
[1] Département de Phytopharmacie, Centre de recherches Agronomiques
11, rue du Bordia, B-5030 Gembloux, Belgique
[2] Unité de Phytotechnie des régions tempérées
Faculté Universitaire des Sciences Agronomiques de Gembloux
2, Passage des Déportés, B-5030 Gembloux, Belgique

SUMMARY

Trifloxystrobine-based fungicides were tested for two years in winter barley and three years in winter wheat in Belgium. One or two applications were compared with other strobilurine-based fungicides. The efficacy of the combinations of trifloxystrobine (125 g/ha) + propiconazole (125 g/ha) and trifloxystrobine (125 g/ha) + cyproconazole (80 g/ha) for disease control in winter barley and winter wheat, respectively, was confirmed. They allowed yield increases comparable to those obtained with kresoxim-methyl and azoxystrobine-based fungicides.

INTRODUCTION

Strobilurine fungicides have been officially tested in cereal crops in Belgium since 1993 (Meeùs & Bodson, 1996) and kresoxim-methyl and azoxystrobine have been available to Belgian farmers since 1996 and 1997, respectively. The persistence of action of this chemical class of fungicides, as well as its efficacy against a wide range of cereal pathogens, often results in high yield increases (Meeùs & Bodson, 1996, 1997, 1998). The timing of the application of the two strobilurine fungicides during crop growth, however, appears to work in the same way as for triazole fungicides (Bodson *et al.*, 1997a, 1997b).
In 2000 a third strobilurine fungicide, trifloxystrobine, was registered for use in cereals in Belgium. This paper describes the results obtained with this compound in winter barley trials in 1997 and 1998 and winter wheat trials over a three-year period (1997–99) in Belgium.

MATERIAL AND METHODS

The efficacy of trifloxystrobine-based combinations of fungicides for the control of the main winter barley and winter wheat diseases was tested in fields in a loamy area of central Belgium where good cultural practices prevail in terms of rotation, sowing dates and density, nitrogen fertilisation, herbicides and insecticides (Tables 1 to 5). The trials were

established in six randomised complete blocks and the fungicides were applied using 400 L/ha, as previously described (Meeùs, 1982). In the winter barley, fungicides were applied when the first node was just detectable (GS 31, Zadoks *et al.*, 1974) and/or when the ligule of the flag leaf was just visible (GS 39). In the winter wheat they were applied at GS 39 and/or when at least 80% of ears had emerged (GS 59). Trifloxystrobine was used alone (2 L/ha of trifloxystrobine DC 125 g/L) or with propiconazole or cyproconazole: i) 1L/ha of trifloxystrobine 125 g/L and propiconazole 125 g/L DC; ii) 1L/ha of trifloxystrobine 187.5 g/L and cyproconazole 80 g/L SC; iii) 1.5 L/ha of trifloxystrobine 125 g/L DC + 0.5 L/ha of cyproconazole 160 g/l and propiconazole 250 g/L EC. The trifloxystrobine-based treatments were always compared with one of the following treatments being used as a reference: i) 1L/ha of azoxystrobine 250 g/L SC (Amistar); ii) 2 L/ha of azoxystrobine 100 g/L and fenpropimorphe 280 g/L SE (Amistar pro); iii) 1L/ha of kresoxim-methyl 125 g/L and epoxiconazole 125 g/L SC (Allegro); iv) 1l/ha of propiconazole 125 g/L tebuconazole 125 g/L and fenpropidine 375 g/L SC (Gladio); and v) 1.5 L/ha of epoxiconazole 34 g/L and fenpropimorphe 250 g/L SC (Opus team).

Observations of leaf diseases were made on 25 plants randomly selected in each plot. The percentages of leaf area colonised by the diseases were visually assessed on the different leaf layers. The rates of disease control (RC) by fungicides were calculated in comparison with the disease level observed in the control plots, with an RC of 0% meaning absolutely no control of the disease and an RC of 100% meaning complete control of the disease.

The effect of the timing of the trifloxystrobine application on yield was analysed in trials conducted at the Lonzée experimental site (Table 6). The trials were carried out in latin square and fungicides applications were made using 200 L/ha when the second node was detectable (GS 32), the flag leaf just visible (GS 37), the flag leaf ligule just visible (GS 39), booting (GS 45) and the ears just emerged (GS 59).

In all cases, least significant difference (0.05) was calculated without data from control plots and after transformation arc sin $\sqrt{x}$.

RESULTS

Background

Over three successive winters (1996–97, 1997–98 and 1998–99) the main winter barley and winter wheat diseases established themselves before the cereals reached GS 31.

In winter barley the normal rainfall and temperature in the spring of 1996–97 and 1997–98 created good conditions for the development *Rhynchosporium secalis* and *Pyrenophora teres* during stem elongation. In 1998,

however, the weather conditions after ear emergence were drier than in 1997, and the diseases progressed more slowly on the upper leaves than in 1997.
In winter wheat the weather conditions during the three successive winters were especially favourable for *Septoria tritici*. In 1997, the low rainfall in April prevented the progression of the disease during stem elongation, but in June, after ear emergence, the weather conditions allowed the disease to reach the upper leaves. In 1998, the dry and warm conditions during May prevented the evolution of *Septoria* during stem elongation. However, a lot of rainfall during the first part of June allowed the disease to progress on the upper leaves and made sprayings very difficult at ear emergence. In 1999, rainfall was not particularly frequent during stem elongation and *Septoria* reached the upper leaves only later in the season. Powdery mildew developed in only a few trials in 1997 and 1998, while brown and yellow rust developed only in 1999.

Winter barley

The combination of trifloxystrobine + propiconazole allowed good control of *P. teres*, *R. secalis* and *E. graminis* f. sp. *hordei* (Tables 1 and 2). This combination was often equivalent to strobilurine-based reference combinations applied at the same time. Where differences were observed the combination of trifloxystrobine + propiconazole was sometimes more effective (trial 98/4, Table 2) and sometimes less effective (trial 97/5, Table 1) than the reference combinations.
When applied at GS 39, the combination of trifloxystrobine + propiconazole showed good control of the different diseases on the three last leaf layers of the cereal. In plots treated at the GS 31 stage, diseases were also controlled on leaf F2 and the flag leaf, but often to a lesser extent than for treatment at GS 39. As for the reference combinations, two applications of trifloxystrobine + propiconazole at GS 31 and GS 39 sometimes significantly improved disease control compared with a single treatment at GS 39.
In the trials in which treatments at GS 31, 39 and 31 + 39 were compared (Tables 1 and 2), on average the yield increases were 904 and 1364 kg/ha when trifloxystrobine + propiconazole was applied at GS 31 and GS 39, respectively, and 765 and 1329 kg/ha for reference combinations under the same conditions. Two applications of trifloxystrobine + propiconazole at GS 31 and GS 39 gave a mean yield increase of 413 kg/ha compared with a single application at GS 39.

Winter wheat

The combination of trifloxystrobine (187.5 g/ha) + cyproconazole (80 g/ha) was tested in four trials in 1997 and four trials in 1998 (Tables 3 and 4). This combination allowed good control of *S. tritici* and *E. graminis*, which was at least equivalent to the control obtained using reference

combinations (Tables 3 and 4), except for trial 98/16. The application of this combination at GS 39 and/or GS 59 in 1997 (4 trials, Table 3) and 1998 (3 trials, Table 4) always resulted in better control of *S. tritici* and *E. graminis* in plots treated at GS 39 than in plots treated at GS 59. These differences had no repercussions with regard to yield. On average the yield increase in the trials where the applications were made at GS 39 and GS 59 was 1499 and 1415 kg/ha, respectively, for the combination of trifloxystrobine + cyproconazole and 1317 and 1142, respectively, for the reference combinations. Two applications, at GS 39 and GS 59, resulted in yield increases of 587 kg/ha and 511 kg/ha, respectively, for the combination of trifloxystrobine + cyproconazole and for references, in comparison with a single application at GS 39.

The combinations of trifloxystrobine + cyproconazole and trifloxystrobine + propiconazole were compared in five trials (97/14, 97/19, 97/21, 98/10, 98/16). Significant differences were often observed for disease control and yield increase. Trifloxystrobine + cyproconazole was always the better combination. In four of the trials the applications of trifloxystrobine + propiconazole and trifloxystrobine + cyproconazole gave a mean yield increase of 1092 and 1510 kg/ha, respectively, when applied at GS 59, and 1782 and 2113 kg/ha, respectively, when applied twice at GS 39 and GS 59. In 1999 the application at GS 59 of trifloxystrobine (187.5 g/ha) + cyproconazole (80g/ha) + propiconazole (125 g/ha) gave also good control of *S. tritici*, *P. recondita* and *P. striiformis*. On average this combination and a reference combination applied at the same time gave yield increases of 915 and 957 kg/ha, respectively.

In 1999 the application of trifloxystrobine alone (250 g/ha) at GS 59 gave good disease control, equivalent to the control by reference combinations. The results from the trifloxystrobine + cyproconazole + propiconazole combination, however, was usually slightly better, although no significant effect on yield was observed.

Over the three years (12 trials), on average the application of trifloxystrobine + cyproconazole (and + propiconazole in 1999) and of reference combinations at GS 59 gave yield increases of 1197 and 1124 kg/ha, respectively.

When a single application of trifloxystrobine (187.5 g/ha) + cyproconazole (80 g/ha) was applied, the increased yields could not be clearly related to the time of application between the second node growth stage and ear emergence (Table 6). As for the two strobilurine-based references, such treatments gave yield increases of at least 627 kg/ha, except when applied at GS 59 in 1999. It should be pointed out, however, that a greyish discoloration of the ears was always observed in plots treated before ear emergence.

DISCUSSION

The trials conducted between 1997 and 1999 show the potential of trifloxystrobine for disease control in winter wheat and winter barley. When applied using the crop protection practices prevalent in Belgium this compound led to increases in yield and improvement in yield quality (data not shown) comparable with the results obtained using kresoxim-methyl or azoxystrobine-base fungicides.

In winter barley the association of trifloxystrobine + propiconazole (125 g/ha each) gave very good results. As demonstrated for triazole fungicides (Meeùs, 1993), the present results show that the application of trifloxystrobine-based combinations applied at GS 31 can limit disease progression in winter barley fields so that leaves not yet emerged can develop in a cleaner environment. When applied at GS 39 such treatments are still effective on F2 and F3, probably partially due to the curative effect of the associated triazole.

In winter wheat, when a single application was made at ear emergence, the results show that trifloxystrobine combined with a triazole gives better protection than trifloxystrobine applied alone at 250 g/ha. Moreover, the combination of trifloxystrobine (187.5 g/ha) + cyproconazole (80 g/ha) gives more protection than trifloxystrobine (125 g/ha) + propiconazole (125 g/ha). This suggests that the persistence and curative action of the triazole associated trifloxystrobine remains important. In 1998 and 1999 the effect on yield of a single treatment in winter wheat with trifloxystrobine (187.5 g/L) + cyproconazole (80 g/L) could not be clearly related to the growth stage at which products were applied. The results observed for Sphère when the treatment was applied at GS 59 in 1999 remain unexplained. Nevertheless, observations of the plots treated before ear emergence suggest that there was insufficient fungicide distribution to the ears.

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Table 1: Rate of disease control (i=percentage of leaf area colonised in control plots) for *Pyrenophora teres*. *Rhynchosporium secalis* and *Erysiphe graminis* f.sp. *hordei* on different leaf layers (F1=flag leaf; dates of observation are in brackets) and yield in plots treated with trifloxystrobine or with reference combinations in four winter barley trials in 1997.

	Trial 97/5 (CV Krimhild)					**Trial 97/7** (CV Krimhild)					
	GS (dates) of treatments	*P. teres* F 3 (30-05)	*P. teres* F 2 (30-05)	*P. teres* F 1 (20-06)	Yield (23-07) kg/ha	GS (dates) of treatments	*P. teres* F 3 (09-06)	*P. teres* F2 (09-06)	*R. secalis* F 3 (09-06)	*R. secalis* F 2 (09-06)	Yield (24-07) kg/ha
1 L/ha of trifloxystrobine	31 (07-04)	53.8 gh	57.7 ef	36.8 gh	7866 bc	31 (10-04)	67.8 bcde	59.8 abcde	79.9 bc	74	7959 abc
125 g/L + propiconazole	39 (08-05)	89.7 bcd	94.7 abc	88.4 cd	8534 a	39 (10-05)	85.3 abc	77.6 ab	79.7 bc	83.7	8011 abc
125 g/L D.C.	31 and 39	97.1 ab	97.6 ab	85.7 d	8645 a	31 and 39	92.4 a	89.7 a	97 a	98.2	8547 a
	Reference = Amistar					**Reference** = Allegro					
	31 (07-04)	81.9 cde	89.6 cd	53.9 ef	7784 bc	31 (10-04)	35.2 de	28.2 cde	88 ab	88.3	8041 abc
Reference :	39 (08-05)	90.5 bcd	90.7 abc	93.8 ab	8364 ab	39 (10-05)	84.2 abc	64.4 abcde	79.9 bc	83.3	8266 ab
	31 and 39	96.9 ab	94.6 abc	96.5 a	8815 a	31 and 39	84.2 abc	85.6 ab	93.7 ab	97.1	8457 a
Control	-	i = 17.9	i = 9.1	i = 37.1	6978 d	-	i = 7	i = 2.9	i = 15	i = 7.4	7001 d

	Trial 97/8 (CV Majestic)					**Trial 97/9** (CV Marilor)					
	GS (dates) of treatments	*R. secalis* F 3 (03-06)	*R. secalis* F 2 (03-06)	*R. secalis* F 1 (17-06)	Yield (27-07) kg/ha	GS (dates) of treatments	*E. graminis* F 2 (18-06)	*E. graminis* F1 (18-06)	*P. teres* F 2 (18-06)	*P. teres* F 1 (18-06)	Yield (22-07) kg/ha
1 L/ha of trifloxystrobine	31 (07-04)	74.4 ab	82.6 ab	64.2 fgh	9577 defg	31 (11-04)	13.1 c	34 c	31.8 h	40.8 h	9454 bcde
125 g/L + propiconazole	39 (07-05)	59.4 bcd	51.6 cd	74.2 cdef	9851 cde	39 (12-05)	78.3 abc	92 ab	74.9 de	88.4 bcde	9903 a
125 g/L D.C.	31 and 39	87.7 a	88.3 a	95.2 a	10472 a	31 and 39	64.3 abcd	90 ab	77.2 cd	85.8 def	9865 ab
	Reference = Allegro					**Reference** = Amistar pro					
	-	-	-	-	-	31 (11-04)	11.8 de	48.6 c	41.8 gh	52.4 gh	9177 def
Reference :	39 (07-05)	53.5 bcd	58 cd	80.3 cd	9652 cdefg	39 (12-05)	16.2 de	86.9 ab	76.1 cde	89.1 cde	9551 abcd
	-	-	-	-	-	31 and 39	83.1 ab	93.7 ab	92.7 a	98.7 ab	9725 ab
Control	-	i = 19.9	i = 14.2	i = 27.6	8822 h	-	i = 7.8	i = 8.7	i = 25.4	i = 9.7	8526 g

Means followed by the same letter are not significantly different at P=0.05 within the same column of an experiment

and *Erysiphe graminis* f. sp. *hordei* on different leaf layers (F1 = flag leaf; dates of observation are in brackets) and yield in plots treated with trifloxystrobine or with reference combinations in four winter barley trials in 1998.

	Trial 98/4 (CV Krimhild)						**Trial 98/6** (CV Majestic)			
	GS (dates) of treatments	*R. secalis* F 3 (04-06)	*R. secalis* F 2 (04-06)	*P. teres* F 3 (04-06)	*P. teres* F 2 (04-06)	Yield (20-07) kg/ha	GS (dates) of treatments	*R. secalis* F 2 (17-06)	*R. secalis* F 1 (17-06)	Yield (23-07) kg/ha
1 L/ha of trifloxystrobine	31 (11-04)	88.9 def	89.2 cde	48.8 h	46.8 g	7272 b	-	-	-	-
125 g/L + propiconazole	39 (09-05)	96 abcde	97.5 abc	82.2 de	90.9 bcd	8400 fg	39 (04-05)	20.9 bcde	17 de	9437 bcd
125 g/L D.C.	31 and 39	96.7 abcd	94.7 abcde	93.6 ab	95.5ab	8301 fg	31 and 39	58.8abc	67.8 abcd	9764 bcdef
	Reference = Allegro						**Reference** = Allegro			
Reference :	31 (11-04)	88 def	91 bcde	26.7 i	22.7 g	6563 a	31 (09-04)	23.4 bcde	20.2 de	9120 bc
	39 (09-05)	81.3 f	89.2 bcde	68.7 f	82.2 cde	7987 cdefg	39 (04-05)	18.9 cde	32.8 cde	9802 cdef
	31 and 39	96.3abc	97.8 ab	83.7 cde	90.6 bcd	7532 bcd	31 and 39	52.2 abcd	64.2 abcd	9497 bcde
Control	-	i = 11.3	i = 10	i = 51.5	i = 39.9	6375 a	-	i = 22.2	i = 14.1	8383 a

	Trial 98/7 (CV Nickel)							**Trial 98/11** (CV Krimhild)			
	GS (dates) of treatments	*R. secalis* F 3 (29-05)	*R. secalis* F 2 (29-05)	*E. graminis* F 3 (29-05)	*E. graminis* F 2 (29-05)	*P. teres* F 1 (24-06)	Yield (25-07) kg/ha	GS (dates) of treatments	*P. teres* F 3 (27-05)	*P. teres* F 2 (27-05)	Yield (21-07) kg/ha
1 L/ha of trifloxystrobine	31 (06-04)	70.1 bcde	85.1 cd	82.3 bc	84.1 fg	35 e	7699 bcd	31 (12-04)	84.1 b	82 bcd	7232 ab
125 g/L + propiconazole	39 (07-05)	58.1 cde	76.7 d	90.4 ab	96.9 abc	75.8 cd	7896 bcde	39 (09-05)	72.2 bcd	84.6 bcd	7497 bc
125 g/L D.C.	31 and 39	92.6 a	98.2 a	97.8 a	99.6 a	82.5 bc	8802 f	31 and 39	96.1 a	96 a	8439 f
	Reference = Allegro							**Reference** = Amistar pro			
Reference :	31	71.1 bcde	83.5 cd	89.7 ab	82.3 efg	25.1 e	7614 bc	31 (12-04)	83.3 b	80.8 bcd	7468 bc
	39	50.8 c	74.4 d	92.3 ab	97.8 abc	81.5 bc	8199 cdef	39 (09-05)	71.1 cd	84.9 bcd	7669 bcd
	31 and 39	73.6 abc	82.6 cd	97.9 a	99.6 a	80.1 bc	8507 ef	31 and 39	96.8 a	97.8 a	8420 ef
Control	-	i = 20.6	i = 13.6	i = 20.2	i = 22.5	i = 13.9	6531 a	-	i = 36.3	i = 14.6	6646 a

Means followed by the same letter are not significantly different at P=0.05 within the same column of an experiment

Table 3: Rate of disease control (i = % of leaf area in control plots) for *Septoria tritici* and *Erysiphe graminis* on different leaf layers (F1 = flag leaf; dates of observation are in brackets) and yield in plots treated with trifloxystrobine-based combinations or with references in five winter wheat trials in 1997.

	Trial 97/14 (CV Ritmo)					**Trial 97/17** (CV Oracle)						
	GS (dates) of treatments	*S. tritici* F 2 (04-07)	*S. tritici* F 1 (14-07)	*E.gram..* F 2 (04-07)	Yield (13-08) kg/ha	GS (dates) of treatments	*S. tritici* F 3 (27-06)	*S. tritici* F 2 (27-06)	*S. tritici* F 1 (10-07)	*E. graminis* F 3 (27-06)	*E. graminis* F 2 (27-06)	Yield (14-08) Kg/ha
1 L/ha of trifloxystrobine	39 (26-05)	83.4 bc	95.4 bcde	97.3 ab	9001 cdef	39 (16-05)	70 bcde	94.2 abc	89.9 bcde	71.3 def	74.9 def	10415 defg
125 g/L + propiconazole	59 (13-06)	52.1 f	84.5 fgh	41.3 d	8537 fg	59 (03-06)	68.2 cdef	77.4 de	91.9 abcd	67.4 ef	60.6 fg	10686 bcde
125 g/L D.C.	39 and 59	86.6 bc	99 ab	95.8 ab	9589 abc	31 and 39	68.3 cde	95.4 ab	95.9 a	81.9 bcde	89.9 abcde	11100 ab
1.5 L/ha of trifloxystrobine	39 (26-05)	93.2 ab	95.9 abcde	96.4 ab	9063 cdef	-	-	-	-	-	-	-
125 g/L E.C. + 0.8 L/ha of	59 (13-06)	64.5 ef	95.6 abcde	66.2 cd	9224 bcde	-	-	-	-	-	-	-
cyproconazole 100 g/l S.L.	39 and 59	96.8 a	98.1 abc	100 a	9956 a	-	-	-	-	-	-	-
	Reference = Allegro					**Reference** = Allegro						
	39 (26-05)	86.1 bc	94.2 cde	94.6 ab	8607 efg	31 (11-04)	78.8 abc	94.7 ab	81.5 ef	89.6 abc	91.7 abc	10426 defg
Reference	59 (13-06)	61.2 ef	89.9 cfg	61.1 cd	8651 efg	39 (09-05)	51.4 def	62.4 e	91.6 abcd	68.6 ef	74.2 def	10631 cde
	39 and 59	89.7 abc	98.8 abc	97 ab	9792 ab	31 and 39	89.4 a	95.5 ab	93.3 ab	90.2 ab	94.8 ab	11179 a
Control	-	i = 19.7	i = 1.7	i = 5.6	6588 i	-	i = 38.6	i = 21.5	i = 43.6	i = 38.8	i = 10.9	8792 h

	Trial 97/18 (CV Tilbury)			**Trial 97/19** (CV Trémie)				**Trial 97/21** (CV Vivant)			
	GS (dates) of treatments	*S. tritici* F 2 (08-07)	Yield (08-08) kg/ha	GS (dates) of treatments	*S. tritici* F 2 (07-07)	*E.graminis* F 2 (07-07)	Yield (07-08) kg/ha	GS (dates) of treatments	*S. tritici* F 2 (02-07)	*S. tritici* F 1 (11-07)	Yield (13-08) kg/ha
1 L/ha of trifloxystrobine	-	-	-	39 (22-05)	84.4 ab	81.5 bc	10113 bc	39 (23-05)	83.6 d	96.1 bcd	10530 abcde
125 g/L + propiconazole	-	-	-	59 (05-06)	64.1 de	68.9 cdef	10030 bc	59 (09-06)	61.1 g	92 d	10019 efg
125 g/L D.C.	-	-	-	39 and 59	87.3 ab	92.5 a	10129 bc	39 and 59	88.5 cd	98.7 ab	10923 abc
1.5 L/ha of trifloxystrobine	39 (23-05)	82.7 bcde	9892 ab	39 (22-05)	88.8 abc	94.7 a	10191 abc	39 (23-05)	90.8 bc	97.3 abc	10707 abcd
125 g/L E.C. + 0.8 L/ha of	59 (07-06)	62.8 gh	9480 bcd	59 (05-06)	76.4 abcd	71.7 bcde	10247 abc	59 (09-06)	72.4 f	98.2 ab	10490 bcde
cyproconazole 100 g/l S.L.	39 and 59	92.2 a	10115 a	39 and 59	88.4 ab	97.2 a	10657 a	39 and 59	96 a	98.5 ab	11038 a
	Reference = Gladio			**Reference** = Opus team				**Reference** = Opus team			
	39 (23-05)	86.8 abc	9383 bcd	39 (22-05)	61.6 de	70.8 cde	10123 bc	39 (23-05)	94.4 ab	97 abc	10328 def
Reference	59 (07-06)	62.6 h	9128 d	59 (05-06)	50.7 e	67.7 def	9972 bc	59 (09-06)	74.2 f	94.3 cd	9950 fg
	39 and 59	86.2 abcd	9701 abcd	39 and 59	84.4 abc	84 b	9861 cd	39 and 59	95.9 a	98.7 a	10465 cdef
Control	-	i = 38.2	8390 c	-	i = 4.6	i = 7.8	9401 d	-	i = 41.8	i = 66.3	8161 h

Means followed by the same letter are not significantly different at P=0.05 within the same column of an experiment

layers (F1 = flag leaf; dates of observation are in brackets) and yield in plots treated with trifloxystrobine-based combinations or with references in six winter wheat trials in 1998.

	Trial 98/8 (CV Hynoprecia)					**Trial 98/9** (CV Rialto)				**Trial 98/10** (CV Tremie)				
	GS (dates) of treatments	*S. tritici* F 2 (26-06)	*S. tritici* F 1 (17-07)	*E.grami.* F 2 (26-06)	Yield (12-08) kg/ha	GS (dates) of treatments	*S. tritici* F 2 (14-07)	*S. tritici* F 1 (14-07)	Yield (14-08) kg/ha	GS (dates) of treatments	*S. tritici* F 3 (26-06)	*S. tritici* F 2 (26-06)	*S. tritici* F 1 (24-07)	Yield (10-08) kg/ha
1 L/ha of trifloxystrobine	39 (15-05)	90.9 ab	94.2 ab	78.3 ab	9480 bc	-	-	-	-	39 (14-05)	56.5 ef	75.1 ef	83.4 fg	10021 b
125 g/L + propiconazole	59 (03-06)	60 c	79.9 d	43.7 cd	9969 c	-	-	-	-	59 (28-05)	30.4 g	47.2 g	79.6 g	10148 bc
125 g/L D.C.	39 and 59	92.8 ab	98.2 ab	90.8 a	9682 bc	-	-	-	-	39 and 59	69.3 de	84.1 cde	91.3 cd	10599 bcd
1 L/ha of trifloxystrobine	-	-	-	-	-	-	-	-	-	39 (14-05)	81.1 bcd	88.5 cd	86 defg	10120 bc
187.5 g/L + cyproconazole	-	-	-	-	-	59 (12-06)	82.2 def	86 efg	8623 b	59 (28-05)	36.8 g	63.8 fg	85 efg	10788 def
80 g/L E.C.	-	-	-	-	-	39 and 59	92.1 ab	94.7 ab	9034 cd	39 and 59	85.6 bc	92 bc	92.1 bc	10821 ef
	Reference = Amistar					**Reference** = Allegro				**Reference** = Allegro				
	39 (15-05)	84.5 b	80.4 cd	43.7 cd	9216 b	39 (25-05)	88.1 bcde	92.3 bcd	8597 b	39 (14-05)	79 bcd	89.4 bcd	88.4 cdef	10183 bcd
Reference	59 (03-06)	66.8 c	85.2 cd	9.4 e	9371 bc	59 (12-06)	77.7 fg	84.4 fg	8743 bc	59 (28-05)	43.2 fg	57.1 g	86.9 defg	9958 ab
	39 and 59	86.7 b	96.9 ab	50.6 c	9535 bc	39 and 59	91.2 ab	94.7 ab	8716 bc	39 and 59	82.6 bcd	88.8 bcd	90.5 cd	10475 bcde
Control	-	i = 21.2	i = 68.7	i = 5.6	8479 a	-	i = 34.7	i = 14.6	7838 a	-	i = 76.1	i = 18.3	i = 100	9387 a

	Trial 98/14 (CV Rialto)				**Trial 98/16** (CV Vivant)					**Trial 98/19** (CV Record)			
	GS (dates) of treatments	*S. tritici* F 2 (01-07)	*S. tritici* F 1 (16-07)	Yield (12-08) Kg/ha	GS (dates) of treatments	*S. tritici* F 2 (30-06)	*S. tritici* F 1 (16-07)	*E.graminis* F 2 (30-06)	Yield (17-08) kg/ha	GS (dates) Of treatments	*S. tritici* F 2 (10-07)	*S. tritici* F 1 (10-07)	Yield (12-08) kg/ha
1 L/ha of trifloxystrobine	-	-	-	-	39 (20-05)	-	-	-		39 (15-05)	52.9 ef	90.2 f	9550 bc
125 g/L + propiconazole	-	-	-	-	59 (08-06)	51.8 hij	66.7 j	30.8 fg	6012 ab	59 (08-06)	16 g	71.4 g	9348 b
125 g/L D.C.	-	-	-	-	39 and 59	82.6 cdef	84.9 bcdef	54.9 bcdef	6958 cde	39 and 59	61.3 de	95.8 def	10155 e
1 L/ha of trifloxystrobine	39 (18-05)	93.9 a	96.4 ab	8996 ef	39 (20-05)	77.5 defg	76.8 fghi	49.7 cdef	6483 bc	-	-	-	-
187.5 g/L + cyproconazole	59 (11-06)	4.8 c	88.8 bcd	8547 de	59 (08-06)	34.6 j	76 ghi	26.1 g	6090 ab	-	-	-	-
80 g/L E.C.	39 and 59	92.2 ab	98.1 a	9591 g	39 and 59	89.9 abcd	83.7 cdefg	74.1 abc	7383 ef	-	-	-	-
	Reference = Opus team				**Reference** = Amistar pro					**Reference** = Allegro			
	39 (18-05)	88.2 ab	94 abc	8632 de	39 (20-05)	68.1 fgh	80.1 efgh	21.6 g	6921 cde	39 (15-05)	62.7 de	93.1 ef	9760 cd
Reference	59 (11-06)	53.3 cd	91.6 abcd	8677 de	59 (08-06)	61.4 ghi	84.3 cdef	32.5 efg	6612 bcd	59 (08-06)	13 g	74.5 g	9571 bcd
	39 and 59	86.9 ab	96.4 ab	8985 de	39 and 59	86.3 bcde	91.1 ab	61.6 abcd	7249 def	39 and 59	84.3 bc	99.2 abc	10596 gh
Control	-	i = 17.2	i = 55.6	7282 a	-	i = 41.6	i = 59.5	i = 17.7	5749 a	-	i = 95.5	i = 77.6	8161 a

Means followed by the same letter are not significantly different at P=0.05 within the same column of an experiment

Table 5: Rate of disease control (i = percentage of leaf area colonised in control plots) for *Septoria tritici*. *Puccinia recondita* and *Puccinia striiformis* on different leaf layers (F1 = flag leaf; dates of observation are in brackets) and yield in plots treated with trifloxystrobine-based combinations or with references in four winter wheat trials in 1999.

	Trial 99/9 (CV beaufort)			**Trial 99/10** (CV Igor)						
	S. tritici		Yield	*S. tritici*		*P. striiformis*		*P. recondita*		Yield
	F 2 (08-07)	F 1 (08-07)	(03-08) Kg/ha	F 2 (15-07)	F 1 (15-07)	F 2 (15-07)	F 1 (15-07)	F 2 (15-07)	F 1 (15-07)	(06-08) Kg/ha
2 L/ha of trifloxystrobine 125 g/L D.C.	80 g	92.2 efg	9792 bc	70.2 efg	93.5 de	74 ef	81.4 fg	97.3	98.6	10822 b
1.5 L/ha of trifloxystrobine 125 g/L D.C. + 0.5 L/ha of cyproconazole 160 g/l + propiconazole 250 g/L E.C.	84.2 efg	95.4 bcdef	9947 bcd	81.8 cdef	94.7 bcde	88.3 abcde	94.9 cde	99.9	99.6	10995 b
	Reference = Amistar			**Reference** = Allegro						
Reference	67.2 h	89.7 fg	9711 b	68.9 fg	95.9 abcde	87.5 bcdef	90.3 efg	100.0	100.0	11112 b
Control	i = 54.3	i = 11.9	9320 a	i = 52.4	i = 23.4	i = 17.7	i = 27.2	i = 9.2	i = 11.8	9698 a

	Trial 99/11 (CV Sponsor)					**Trial 99/16** (CV Cadenza)				
	S. tritici		*P. recondita*		Yield	*S. tritici*		*P. recondita*		Yield
	F 2 (19-07)	F 1 (19-07)	F 2 (19-07)	F 1 (19-07)	(04-08) Kg/ha	F 2 (20-07)	F 1 (20-07)	F 2 (20-07)	F 1 (20-07)	(07-08) Kg/ha
2 L/ha of trifloxystrobine 125 g/L D.C.	73.4 cd	94.1 a	99.9 ab	99.5 a	10314 bcde	77.5 bc	87.4 ef	86.8 def	89 cd	9520 bc
1.5 L/ha of trifloxystrobine 125 g/L D.C. + 0.5 L/ha of cyproconazole 160 g/l + propiconazole 250 g/L E.C.	81.8 bc	95.7 a	99.8 ab	99.8 a	10171 bc	79.5 b	92.1 cde	99 abc	99.7 ab	9678 cd
	Reference = Allegro					**Reference** = Amistar				
Reference	68.2 d	89.9 abc	99.7 ab	99.9 a	10397 cdef	78.5 b	90.2 cde	91.5 bcde	96.6 abc	9723 cd
Control	i = 58.8	i = 33.5	i = 40.2	i = 39.5	9147 a	i = 36.8	i = 9	i = 14.5	i = 6.5	8952 a

Means followed by the same letter are not significantly different at P=0.05 within the same column of an experiment

Table 6: Yield increase (kg/ha) compared with control when 1L/ha of azoxystrobine 250 g/L SC (Amistar), 1L/ha of kresoxim-methyl 125 g/L + epoxiconazole 125 g/L SC (Allegro) and 1l/ha of trifloxystrobine 187.5 g/L + cyproconazole 80 g/L DC (Sphère) were applied at different growth stages in 1998 and 1999 at the Lonzée experimental site

Year of trial	Fungicides applied	Yield increase compared with control for application at GS				
		32	37	39	45	59
1998	Amistar 1l/ha	763 a	627 a	747 a	812 a	972 a
	Allegro 1l/ha	923 a	769 a	931 a	1007 a	771 a
	Sphère 1l/ha	730 a	865 a	902 a	930 a	946 a
1999	Amistar 1l/ha	860 a	713 a	1195 b	898 a	899 a
	Allegro 1l/ha	1064 c	930 bc	747 ab	884 ab	694 a
	Sphère 1l/ha	727 b	712 b	810 b	642 b	400 a
Average	Amistar 1l/ha	812	670	971	855	936
	Allegro 1l/ha	994	850	839	946	733
	Sphère 1l/ha	729	789	856	786	673

Means followed by the same letter are not significantly different at P=0.05 within the same line of an experiment