Stemphylium forecast with TomCast – an online tool for fungicide timing in asparagus

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Abstract

Starting from the late 70th, TomCast is world wide used successfully for the optimization of fungicide applications in tomatoes and in other crops. In asparagus, HAUSBECK demonstrated that TomCast as software tool of the Spectrum weather stations, could reduce the number of chlorothalonil applications and substantially ensures their efficacy. In Europe experimental work with TomCast has been done in various asparagus growing areas of France by the subsidies of CTIFL.

Also in Germany *Stemphylium* is the most important disease of asparagus, so that additional tools for optimizing the fungicide schedule are welcome. 2007 a trial program in the PASO forecasting model surface started with (i) a "dew model" using measured and calculated "virtual" leaf wetness periods (DSV_S-value) and (ii) the "rain model" (DSV_R-value).

Being an empiric model, TomCast is tested for the sprayings following the Botrytis fungicide measures during flowering, which are predominant during first fern growth. The ontogenetic component (cultivar, year of plantation, green or white spears harvested, end time of harvesting, etc.) is of minor importance; inoculum potential is not limiting disease development. Thus we concentrated on disease severity in relation to basic weather data and choice of the fungicide – protective or curative – according to forecast results and application conditions.

Results obtained in different experiments in 2007 and 2008 revealed, that thresholds around the value of 20 DSV performed much better than those of 30 or 35 DSV. A optimizing of the thresholds is planned in multi site experiments from 2009 on. Observations demonstrate a clear coincidence between *Stemphylium* appearance (symptoms, sporulation) and the cumulated DSV for the last 5 or 10 days. The basic cause therefore is not clear.

As extension service for growers and advisors TomCast forecast for 6 representative agricultural meteorological stations is published on the DLR website www.dlr-rheinpfalz.rlp.de as graphs and Excel files. Though there is still a lot of problems to solve and questions to answer, we feel that TomCast gives an additional help for optimizing fungicide treatments in asparagus crops.

INTRODUCTION

Keeping asparagus ferns healthy as long as possible is the only way for not having yield losses caused by diseases. Fungicide trials have shown that these detrimental effects are not only sizeable in the following first year, but also in the second or third year. In worst cases newly established plantations can be damaged irreversible for their whole life span. Managing purple spot disease *(Stemphylium sp.,* teleomorph *Pleospora herbarum)* with fixed application intervals for fungicides (10 to 14 days) is not only expensive, but in favourable weather conditions for *S. botryosum* these intervals can also be too long and the applications are not effective (Leuprecht, 1990; Leuprecht, 1992). Therefore a forecast model, which delivers the optimal fungicide timing, is the needed possible solution.

It was shown that with TomCast fungicide (chlorothalonil, mancozeb) applications in the USA and in France could be reduced (Meyer et al., 2000; Hausbeck, 2008; Poissonnier, 2003; Garcin et al., 2006). Being an empiric model derived from FAST model for *Alternaria* in tomatoes (Madden et al., 1978; Pitblado, 2000), it still has to be validated for the conditions in south-west Germany. There is little knowledge about the epidemiology of the disease in relation to weather conditions. Therefore a mechanistic model like in apple scab forecast models could not be developed. For example the primary cycle of purple spot disease, the teleomorph *Pleospora*

herbarum, is not known in its quantitative development (maturation and release of ascospores) and so strategies for reducing ascospore infections are not developed or not practicable. In comparison to strategies against apple scab, where principal effort is done for managing successful the primary cycle, the strategy for purple spot assumes the worst case with unlimited inoculum potential and endless secondary cycles, keeping growers in permanent alert.

Newer results for the development of *Pleospora allii* in relation to temperature in the cumulative degree day model PAMcast for brown spot of pear have to be proved for their relevance for *Pleospora herbarum* in asparagus (Llorente and Montesinos, 2006).

The ontogenetic component with different emerging spears, shoots and branches and connected different susceptibilities is a further element complicating the task. Solutions therefore are not obtainable in the next years.

The objective of this work is to validate TomCast in fungicide trials as an effective fungicide timing tool for the conditions in our asparagus growing region.

MATERIALS AND METHODS

The principal element of TomCast, the disease severity value (DSV_S) and the action thresholds for fungicide applications defined as cumulated DSV´s (CS), have been tested in trials in 2007, 2008 and 2009. The tested CS thresholds for the first fungicide application were 25, 30 and 35 for the PASO model and 20 and 25 for the Spectrum model. For the second and following applications we have tested the thresholds of 15, 20, 25, 30 and 35 for the PASO model and 15 and 20 for the Spectrum model.

Plausible weather data is available from a network with DIN-conform weather stations allowing a representative grid of 10 km in the area. This data are used for the PASO model. For the Spectrum model Specware Spec 9 Pro, a WatchDog weather station recorded temperature and leaf wetness in the asparagus canopy.

The programming of TomCast under the PASO surface, which was done by ZEPP, enables us to incorporate additional overhead irrigation, which is interpreted as natural rain. The model calculates the daily DSV with (i) a "dew model" using measured and calculated "virtual" leaf wetness periods (DSV_S-value) and (ii) the "rain model" (DSV_R-value).

Three rows of asparagus, 10 m long defined the plot size of the cultivar Gijnlim. Applications were done by a commercial sprayer in accordance to the recorded CS thresholds.

The CS threshold for the first application was irrelevant in 2009 because fungicide application against Botrytis was of primary interest; the asparagus plantation was full flowering. The following thresholds were CS 20 and CS 30 for the PASO forecast (V2 and V3) and CS 15 and CS 20 for the Spectrum forecast (V4, V5 and V6).

The fungicides for the strategies V2, V3, V4 and V5: the first application was Score (difenoconazole, 0,4 l/ha) + Switch (fludioxonil + cyprodinil, 1,0 l/ha), followed by AmistarOpti (azoxystrobin + chlorothalonil, 2,5 l/ha). The timing strategy for V6 was identical with V4, but differed for the fungicides: the first applications were Score (difenoconazole, 0,4 l/ha) + Switch (fludioxonil + cyprodinil, 1,0 l/ha), followed by Rovral WG (iprodione, 0,75 kg/ha) + Polyram WG (metiram, 1,2 kg/ha) + Score (difenoconazole, 0,4 l/ha) alternating with AmistarOpti (azoxystrobin + chlorothalonil, 2,5 l/ha). This strategy is in accordance to the legal regulations in Germany. The surrounding commercial plantation has nearly similar fungicides like V6.

Purple spot severity was assessed weekly as the percent green remaining phylloclades, branches and stems in a representative area in the middle row of the plot starting from end of August to the mid of October.

RESULTS AND DISCUSSION

The two different forecast models showed us in several calculations, that the DSV values of the Spectrum model were nearly always 30 % lower, than the values of the PASO model. The differences were caused by different basic weather data of the different weather stations, but also by the different algorithm. The Spectrum model subdivides the daily leaf wetness time in more than one wetness periods, if there is an interruption of the wetness time. So our CS thresholds for the Spectrum strategy were different.

As an example for the achieved results the trial Speyer 2009 is presented in the following table and figures.

The TomCast season started with the first 2 decades of June being not very significant concerning the daily DSV and the DSV sum of the last 5 and last 10 days. On June 25 the beginning of a period of 8 weeks with a lot of rain and daily mean temperatures around 20 °C was remarkable. Just a couple of days in the second half of August with no rain were cause of some relaxation regarding the DSV. So there were optimal conditions for the testing of the strategies. The heavy rains sometimes did not allow making the applications at the planned CS value, so small deviations of the strategies had to be taken into account.

The differences between the strategies for the assessed percent green phylloclades can only be described in a dynamic way in respect of the critical points in their DSV history. The speculative moment of this interpretation is dominant, but causal reflections regarding every infection time and the following apparition of symptoms are not possible at this level of the trials. So the development of every strategy is done chronological.

Assessment 8/27. Strategy V3 is damaged in comparison to the other strategies. Causes therefore are the high CS values of 35 on 7/28 resp. 37 on 8/20. In these weeks the DSV sum of the last 10 days was nearly constant around 20, so that the efficacy of the applied AmistarOpti was exhausted.

Assessment 9/2. Strategy V2 shows some damage in comparison to V4, V5 and V6. With high probability the strong rising of the DSV sum of last 10 days starting on 8/6 was critical for this strategy having a CS of more than 20 at this time. V4 and V6 get an application on 8/7.

Assessment 9/14. V6 shows positive effects in comparison to V4 and V5, mainly due to the additional curative Score effect with the applications on 7/15 and 8/20.

Assessment 9/21. Clear differentiation between V4, V5 and V6, which is in accordance to the expectations. V2 and V3 did not recover from the damages received in the first decade of August.

The **following assessments** on 9/30, 10/9 and 10/15 are continuing the former trend with the additional aging of the plantation.

CONCLUSIONS

In comparison to other validation trials for forecast models, where there is the possibility to record disease symptoms in their apparition date and quantitative dimension to a defined infection date with favourable infection conditions, the validation of TomCast for Stemphylium in asparagus in our region is very difficult and will take some more years. But for extension purposes the following elements for decision setting can be used at the moment:

i) CS values around 20 for the recommended protective fungicides;
ii) if this CS value is surpassed additional curative fungicide is necessary;
iii) DSV sum of the last 10 days around 20 is marking periods with high infection conditions; during this period the CS threshold 20 should not be surpassed;
iv) before expected heavy rains or intended irrigations the probable rise of the CS value has to be taken into account;
v) obtainable knowledge about the efficacy and working modus of fungicides has to be implemented.

Starting from 2009 the TomCast forecast for *Stemphylium* in asparagus is published online for 6 representative agricultural meteorological stations on the DLR website www.dlr-rheinpfalz.rlp.de as graphs and Excel files and gives the necessary information for the timing decision. There is a lot of information, which needs some experience in the interpretation, so in most cases it is used by consultants. Interested growers with larger asparagus plantations and need of logistic timing of the sprayings can get the training in one to two seasons and use TomCast as an economically important tool.

The general measures of reducing infection potential of *Stemphylium*, mainly for the primary cycle are of high importance. Orientation of the rows to wind direction, chopping of the stems and shallow incorporation in the soil and/or additional spraying of the stems with urea may enhance the degradation process of the organic matter.

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Table

Table 1: Date of the different applications for the fungicide timing strategies

Strategy / date	**V2**. TomCast PASO 35*-20 ff.	**V3**. TomCast PASO 35*-30 ff.	**V4**. TomCast Spectrum 25*-15 ff.	**V5**. TomCast Spectrum 25*-20 ff.	**V6**. TomCast Spectrum 25*-15 ff. legal	Commercial
	(PASO model; CS)		*(Spectrum model; CS)*			
T1	6/5					
T2	7/2	7/7	7/2	7/7	7/2	6/18
T3	7/15	7/28	7/15	7/27	7/15	7/3
T4	7/28	8/20	8/7	8/20	8/7	7/17
T5	8/14	9/15	8/20	9/15	8/20	8/1
T6	9/5		9/5		9/5	8/14
T7						9/5
* CS, if not in full flower						

Figures

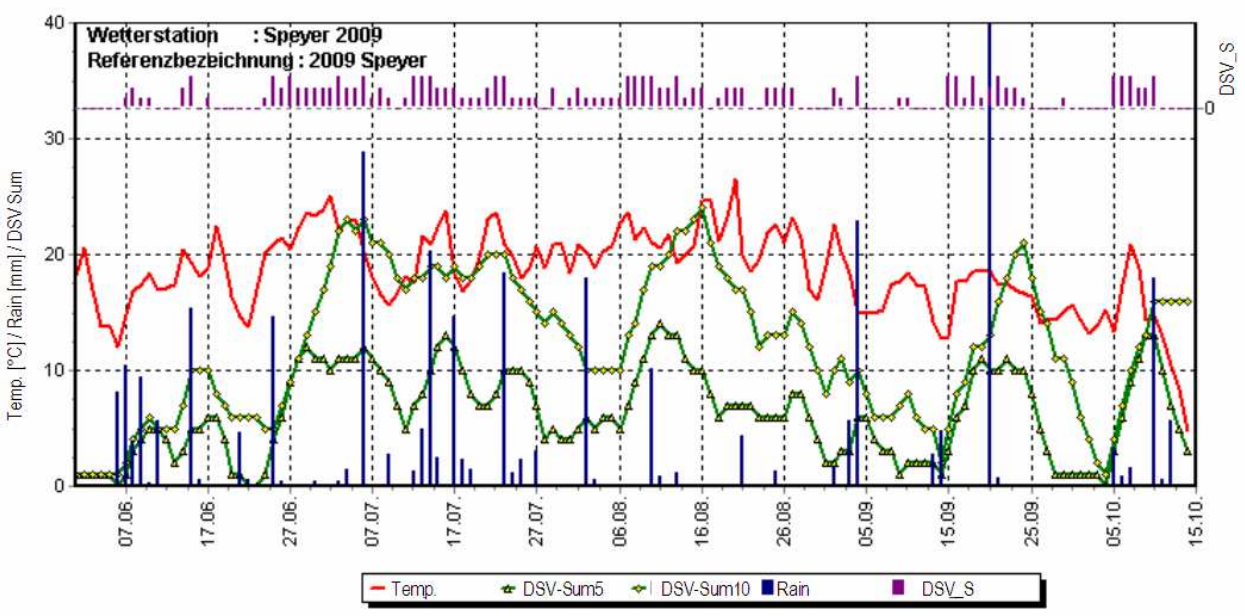

Figure 1: TomCast forecast (daily DSV_S, cumulated DSV for the last 5 and last 10 days) and the basic weather data (temperature, rain) for Speyer 2009

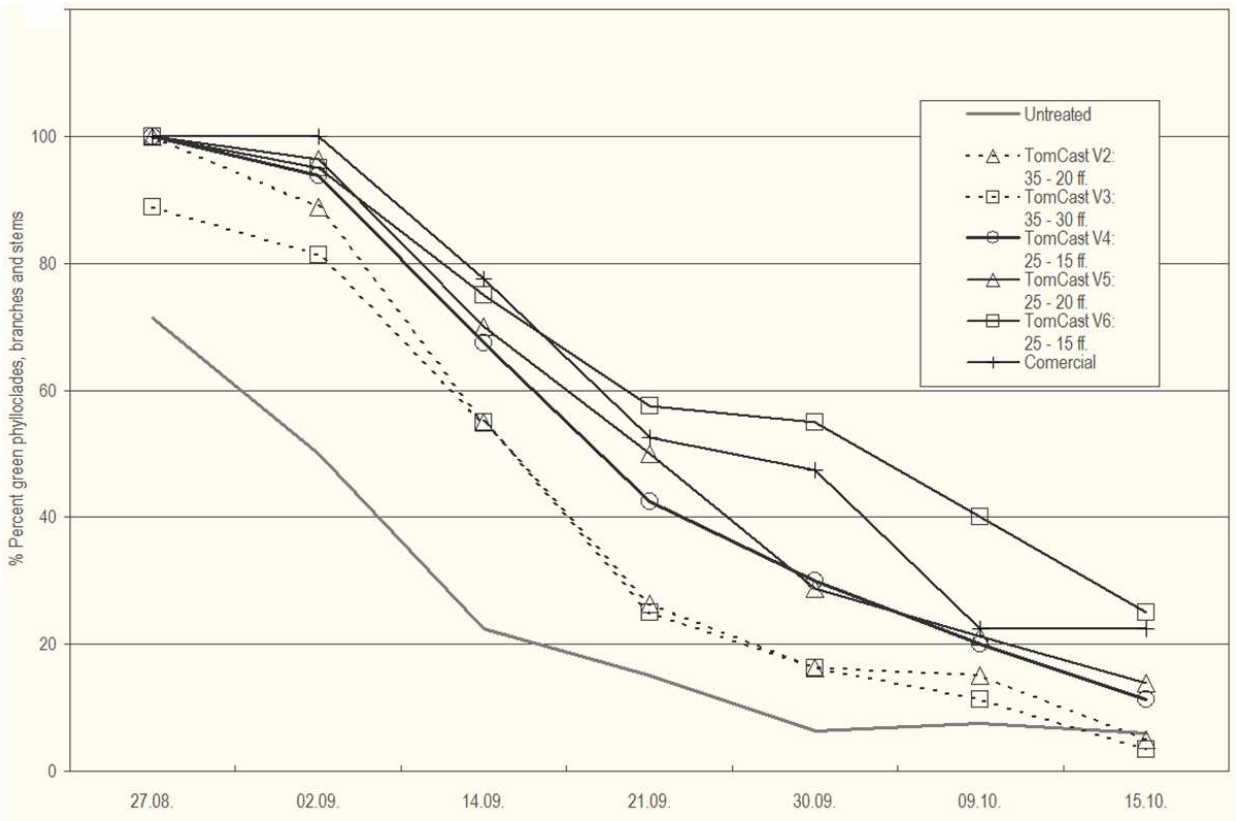

Figure 2: Percent green phylloclades, branches and stems for the different timing strategies in Speyer 2009