Control of Cherry leaf spot (*Blumeriella jaapii*) and Shot hole disease (*Wylconomyces carpophillus*) with lime sulfur applied before or during rain event

Z. Jelev[1] and M. Marinov[2]

Abstract

Three different strategies of lime sulphur (Curatio®, Biofa AG) application against cherry leaf spot (CLS) and shot hole disease (SH) were tested. Treatments were performed in sweet cherry (cv. Van in orchard without rain shields. First application started during full bloom due to bract leaves appearance and confirmed maturation of the overwintering fruiting bodies. Sprays continued till fruits begin to change colour. All lime sulphur treatments demonstrated substantial control of CLS and good control of SH. Results have shown sprays "during rain and spore germination" provide as efficient control as sprays before rain or within 7 days interval. There was no phytotoxicity registered after lime sulphur application in the used dose (1 l/ha or 0.3 l/1 m high canopy).

Keywords: *Blumeriella jaapii*, *Wylconomyces carpophillus,* lime sulphur, cherry

Introduction

Organic production of sweet and sour cherries in Bulgaria is mostly orientated to the processing industry and due to the low added value it is not economic rain shields to be installed. This predisposes plantations to rain driven diseases unknown in other situations like CLS (caused by *B. jaapii*). Other common for all production systems pathogens are SH caused by *W. carpophyllus,* brown rot and blossom blight (BR) caused by *Monilia laxa.* SH is registered every season, but rarely causes substantial damage. CLS may disappear for 2-3 years, but afterwards suddenly defoliate the trees before July or August. In such cases fruiting buds and whole plants synthesize less nutrients and winter hardiness decreases. After heavy infections by CLS it could take 2 seasons before trees recover to produce normal yields (Eisensmith & Jones, 1981a; Dimova et al., 2014). Recent research indicates visible symptoms by CLS could impair stomatal conductance and photosynthesis in the asymptomatic part of the leaves (Gruber et al., 2009 and 2012). Organic production relies on holistic strategies rather than one single approach. Holb (2013 and 2014) tested the effect of sanitation and leaf litter removal, mulching and autumn sprays on fallen leaves, but none of the methods alone or even in combination resulted in low enough CLS infection. Moreover leave litter remove equipment is often not affordable for most local famers. Fungicides are another option, but the registered ones copper and sulphur have low efficacy and create a risk of phytotoxicity on *Prunus* genera (Gruber et al., 2009, 2012). In addition to this copper is under discussion as a possible soil pollutant in some EU countries. Lime sulfur application during the growth season of cherries is mentioned in the labels of some commercial products like Curatio (Biofa AG) and Polisulfuro (Polisenio s.r.l.), but nowhere CLS is described as a possible target organism.

[1] Z. Jelev, Agricultural University-Plovdiv, Bulgaria-4000, zvezdomir_au@abv.bg
[2] M. Marinov, Agricultural Unversity-Plovdiv, Bulgaria-4000, mmarinov@gmail.com

Material and Methods

Trial was performed during the spring of 2016 in a sweet cherry experimental orchard in Plovdiv, South Bulgaria. Van is highly susceptible variety; trees were 4 years old on Gisela 5 rootstock. Distance between rows was 4 x 2 m. Four variants were tested. Each one consisted of 3 randomized replications, each repl. represented by 4 trees. Three variants were tested and each included different number of sprays: Var. 1 – every 7 days (6 applications); Var. 2 – Before rain (8 appl.), Var. 3 – During rain (4 appl.), Var. 4 – Untreated control.

In 3 out 4 cases natural rain was substituted or continued with above canopy irrigation by microsprinklers. Spraying before rain or at weekly basis has always been applied on dry leaves followed by at least 3 hours without any rain. In variant 2 spraying was like var. 1, but on the same or 1 day before rain/irrigation (table 1). Some small rain events (1-2 mm) were left without special treatment due to short leaf wetness afterwards. Treatment during rain was organized in the following order - 40 min. rain or precipitation, 10 min. spraying on wet leaves (irrigation stopped), 4 hrs. irrigation. There was one early season spray with copper hydroxide (700 g a.i./ha) and all the rest were with Curatio 10 l/ha. Trees canopy was approx. 3 m high and 2 m wide. Spraying was performed with back engine sprayer Solo 451 at drops size controlled by level 3 on the machine with volume dependent on trees growth and approx. 550 l/ha.

Table 1: Detailed information about treatments

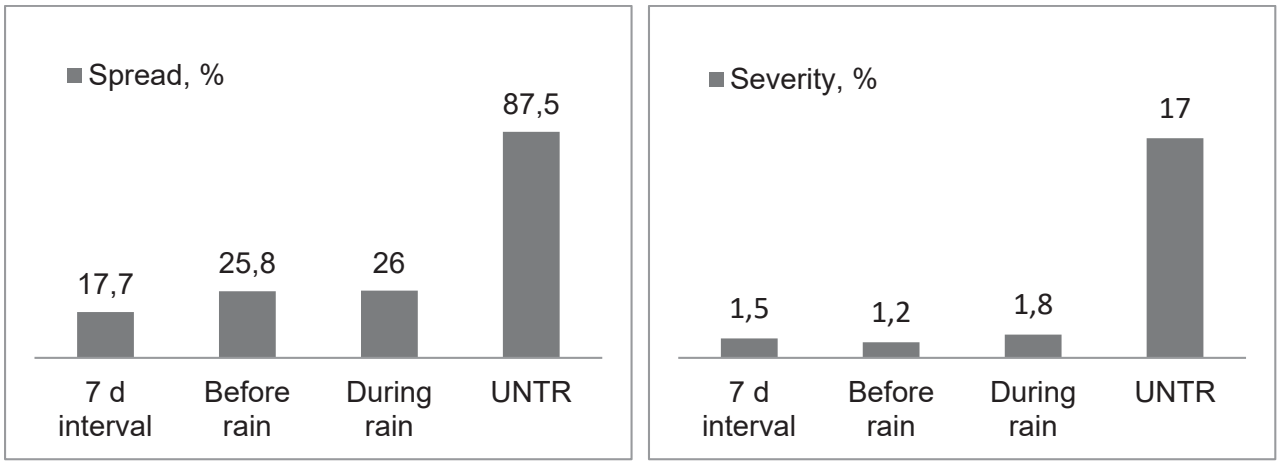
Variant, N:	Date	Cherry, BBCH	Fungicide	Rain/irrigation		
				Amount, mm	Type	Duration, hrs
1,2,3,4	01.03	01	Copper hydroxide			
1, 2	16.04	65	Curatio			
1, 2	23.04	71	Curatio			
3	24.04	72	Curatio	15	rain	8
1, 2	28.04	75	Curatio			
1, 2, 3	03.05	77	Curatio	18	irrigation	4
2, 3	05.05	77	Curatio	18	irrigation	4
2	07.05	78	Curatio			
1, 2	09.05	79	Curatio			
1, 2, 3	14.05	81	Curatio	18	irrigation	4

Scouting of CLS and SH was done three times on 8.05, 17.05 and 28.05. Disease spread and severity have been scouted on 10 randomly chosen and not higher than 1.5 m shoots (5 at each side of the row) in 1 tree. On every observed shoot 20 leaves (counted from the basis to the top) were categorized infected if at least 1 single spot resp. by CLS or SH was detected. Severity on each single leaf has been estimated as percent of the symptomatic compared to the whole leaf surface. One single person was involved in monitoring; he was

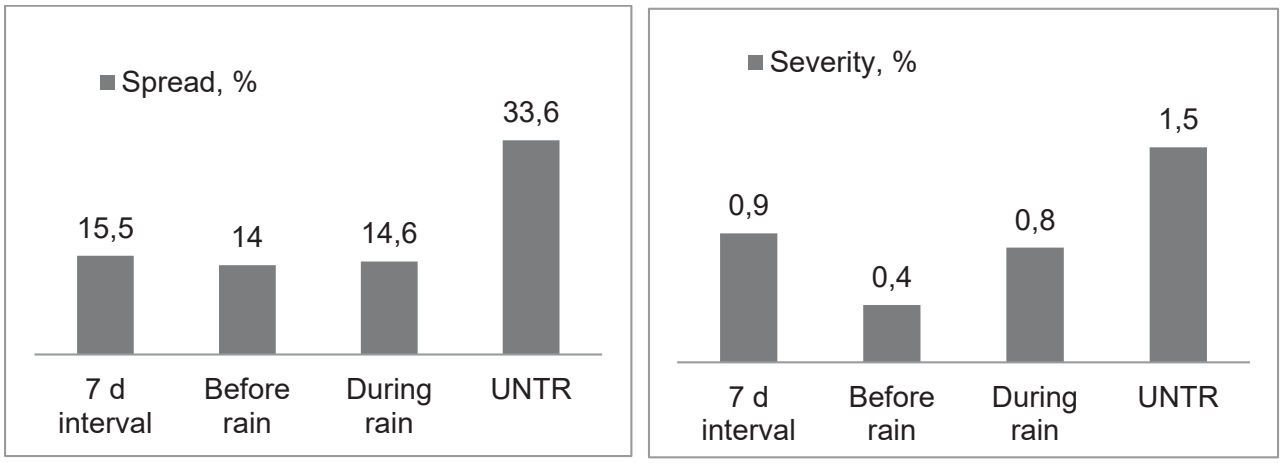
trained with pictures of infected by the diseases of interest leaves. Pictures have been evaluated in terms of severity by special software Assess 2.0 (L. Lamari).

Results

The first CLS symptoms were observed about 10-14 days after conditions for infection were available – thoroughly open leaves, mature apothecia, leaf wetness and air temperature were favourable (estimated by the table of Eisensmith and Jones). First two records however have shown very low levels of disease just to prove its development. On 28.05 the values about both diseases were high and informative enough in order variants of study to be evaluated (fig. 1-4).



Figures 1 and 2: CLS spread and severity in leaves, %



Figures 3 and 4: SH spread and severity in leaves, %

Symptoms of CLS on very limited number of fruit stalks have been found. Number of infected by SH fruits was also insignificant. There were no other widely spread symptoms of other diseases to be recorded. *Monilia spp*. and *Alternaria app*. fruit rots developed to low extent in cracked fruits. As a result of all the treatments no symptoms of phytotoxicity in flowers, leaves or fruits have been observed just very slight brightness reduction on some mature fruits due to fungicide left over.

Discussion

Results demonstrate lime sulphur could be reliable and nontoxic fungicide in sweet and maybe sour cherry production. However preliminary tests with different varieties, doses and trade products based on lime sulphur should be checked before the fungicide is more widely used. The dose mentioned above seems low, but due to much focused spray it could be equal to slightly higher dose applied by tractor mounted sprayer with more drifts. This trial is to show disease like CLS and to some extent SH could be controlled by lime sulphur. The issue about focused sprays during rain event is even more interesting, because as it seems the number of sprays could decrease in comparison with calendar based treatments (4 vs. 6). If infection events could be better forecasted even more flexible and efficient applications could be performed. Spraying on wet leaves during rain and “germination window” could help farmers to protect not only apples from scab (Laurent, 2011), but also cherries from CLS in long rainy periods. Explanation could be germinated spores are fast inhibited by the contact product. We also suspect redistribution within canopy of lime sulphur takes place, which could extend exposition of spores to the product. Spraying on wet leaves results in product dilution and improved coating of large plant surface. Extra benefit could be risky products like lime sulphur does not accumulate and create specific zones of high concentration resp. phytotoxicity.

In *W. carpophillus* there is no spores ejection and well defined infection events. Actually this pathogen can infect without leaf wetness only at high relative humidity (Yousefi, 2014). This is why it is slightly surprising sprayig during rain or on wet leaves is effective too. This short study brings forward additional ideas for subsequent trials of the kind and indicate new useful practices implemntation in organic stonefruits production.

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