INFLUENCE OF IRRIGATION METHOD ON THE OCCURRENCE AND INTENSITY OF THE GRAY MOLD OF LETTUCE

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Abstract

The experiment on fungicide efficiency when controlling lettuce grey mold in dependance of irrigation mode, was made in the greenhouses in 2021. Under conditions of drip irrigation, the lowest percent (1.2%) of the diseased plants was revealed on the variant treated with the fungicide Switch. Of the treated variants, the highest infestation percent was recorded in the variant treated with Folio Gold (3.7%) whereas on the control variant without chemical treatment, 10.5% of the diseased plants was recorded. The disease intensity caused by B. cinerea on the control variant in the greenhouse experimental area with micro sprinkler greenhouse irrigation was 15.7%. The infection intensity with the chemically treated variants was reported to be the strongest on the variant treated with Teldor (7.0%) and the weakest on that treated with the fungicide Switch (3.2%). Thus, the most efficient fungicide for lettuce protection from B. cinerea proved to be Switch (88.1%). Comparatively highly efficient with grey mold control was also Signum (80.1%). Somewhat lower level of efficiency was exhibited by Folio Gold (64.3%) and Teldor (69.1%). The fungicide Switch showed the best results with grey mold control in lettuce (79.4%). Signum was also quite efficient (73.0%), with lower efficiency recorded on the variants treated with Folio Gold (61.9%) and Teldor (55.5%).

Keywords: irrigation, lettuce, *B. cinerea*.

INTRODUCTION

An intensive vegetable production is possible only under irrigation conditions. Thus, the properly chosen irrigation method for lettuce is of paramount importance for achieving an optimal soil moisture, which is the basic precondition for the proper lettuce growth and development. Lettuce has rather shallow root system [1]. Therefore, water is a highly important factor for its optimal growth sustainment during the whole vegetation, both, for germination and sustainment of a high rate of photosynthesis [2].

Irrigation in agriculture will face big challenges in the future. Increase in the world`s food production will primarily depend on the quantity and quality of irrigation water [3]. Drip irrigation system is considered to be a noticeably more advantaged method than the other irrigation methods and, hence, the most efficient mode of plant supply with water and nutrients, which, not only saves water, but also increases crop yield [4]. Thus, an efficient water use through an improved irrigation technique is of prior importance to agriculture [5]. Drip irrigation enables a uniform water distribution and fertilizers uptake by the root system zone, which results in higher crop yields [6]. It is exceptionally significant to determine the time of irrigation in order to utilise the irrigation system most efficiently whereas inadequate irrigation measures may cause stress and lower production [7]. A rational irrigation regime should fulfill the requirements of lettuce for water and thus exclude the potential risks of an excessive soil moisture, which may lead to crop diseases. One of the biggest challenges lettuce producers are facing with is regarded the protection from pests. Thus, the decrease in lettuce yield results most commonly from the destructive crop diseases [8], with the yield losses varying from 1% to nearly 75% [9].

The research goal was, therefore, to establish the impact of lettuce irrigation method on the onset and intensity of *Botrytis cinerea.* In addition, the degree to which the applied fungicides have proved efficient in *B. cinerea* control, will also be determined.

MATERIALS AND METHODS

The experiment on fungicide efficiency when controlling lettuce grey mold in dependance of irrigation mode, was made in the greenhouses in 2021. The greenhouses are situated in the village of Batušinac, the municipality of Merošina (south-east Serbia) (43°26'11" N 21°82'28" E). The lettuce was sown in hotbed greenhouse on the 22nd of January. The seed of Sunny cultivar was used. The lettuce transplant was produced under controlled conditions, the air temperature, soil temperature and a relative air humidity were measured, too. The lettuce was sown on a permanent place in the greenhouse on the 25th of February, sowing spacing of 25×25 cm. Irrigation was done through micro sprinkler and drip irrigation. Tensiometer was used to determine watering time, the irrigation started when the soil moisture capillary potential was 20 kPa. After the soil chemical analysis, the basic fertilisation prior to planting with NPK combination of 8:16:24 in the amount of 50 g/m^2, was performed. Through the irrigation system, the lettuce was fertilised with NPK fertilisers in the ratio of 15:15:35, being: I fertilisation of 10 days upon the planting in the amount of 6 g/m^2 and, II fertilisation, 15 days upon the first fertilisation in the amount of 6 g/m^2. The trial was set up as a block design fitted to the irrigation conditions, 5 variants with 4 replications each. The four variants were treated with chemical means and the fifth one was the control variant. Each replication comprised 100 plants. Intensity assessment of *B. cinerea* onset was made through five categories ranking from 0 to 4 [10].

After the infestation intensity of *B. cinerea* had been classified, the disease index calculated by the formula of Mc Kinney supposed to indicate the mean value of the disease attacking a particular area (Equation 1):

$$I = \frac{\Sigma(n \times k)}{N \times K} \times 100 \qquad (1)$$

was put forward: I – disease index in %, n – plant number within a category, k – number of single categories, N – total plant number and, K – total number of the categories.

The efficiency of fungicides (Table 1) was calculated using the formula of Abbott (Equation 2), being:

$$E = \frac{C - T}{C} \times 100 \quad (2)$$

was put forward: E – efficiency of the fungicide studied, C – plant number on the untreated variant and, T – plant number on the treated variant.

Table 1 *Overview of the fungicides tested*

Fungicide	Formulation	Active substance	Dose
Switch 62.5	WG	Fludioksonil 250 g/kg + Ciprodinil 375 g/kg	0.6 kg/ha
Folio Gold 537.5	SC	Metalaksil–m 37.5 g/l + Hlorotalonil 500 g/l	2.5 l/ha
Signum	WG	Piraklostrobin 67 g/l + Boskalid 267 g/l	1.5 kg/ha
Teldor 500	SC	Fenheksamid 500 g/l	1.0 l/ha

RESULTS AND DISCUSSION

Further, the results obtained for disease intensity of lettuce caused by *B. cinerea* while using drip irrigation, are presented in the Table 2.

Table 2 *Intensity of B. cinerea infection on lettuce drip – irrigation*

Variant	Fungicide	Number of infected plants per repetition				Infected plants (%)
		I	II	III	IV	
V_1	Switch	2	1	1	1	1.2
V_2	Folio Gold	5	4	4	2	3.7
V_3	Signum	2	3	1	2	2.0
V_4	Teldor	3	2	5	3	3.2
V_5	Control	11	12	9	10	10.5

The lowest percent (1.2%) of the diseased plants was revealed on the variant treated with the fungicide Switch. Of the treated variants, the highest infestation percent was recorded in the variant treated with Folio Gold (3.7%) whereas on the control variant without chemical treatment, 10.5% of the diseased plants was recorded.

The disease intensity caused by *B. cinerea* on the control variant in the greenhouse experimental area with micro sprinkler greenhouse irrigation was 15.7% (Table 3). The infection intensity with the chemically treated variants was reported to be the strongest on the variant treated with Teldor (7.0%) and the weakest on that treated with the fungicide Switch

(3.2%). The percent of the diseased lettuce plants was higher with micro sprinkler irrigation in all the variants than being with drip irrigation (Figure 1). It was also found out that the consistently less intensity of the disease onset in lettuce using drip subirrigation could favour the long–term sustainability of this irrigation method in practice when coping with diseases [11]. Lettuce was less affected by this disease with drip irrigation whereas no significant effect of different irrigation methods on the disease onset intensity, was noticed [12].

Table 3 *Intensity of B. cinerea infection on lettuce – micro – sprinkler irrigation*

Variant	Fungicide	Number of infected plants per repetition				Infected plants (%)
		I	II	III	IV	
V_1	Switch	3	4	2	4	3.2
V_2	Folio Gold	6	7	5	6	6.0
V_3	Signum	5	5	3	4	4.2
V_4	Teldor	7	8	7	6	7.0
V_5	Control	16	14	16	17	15.7

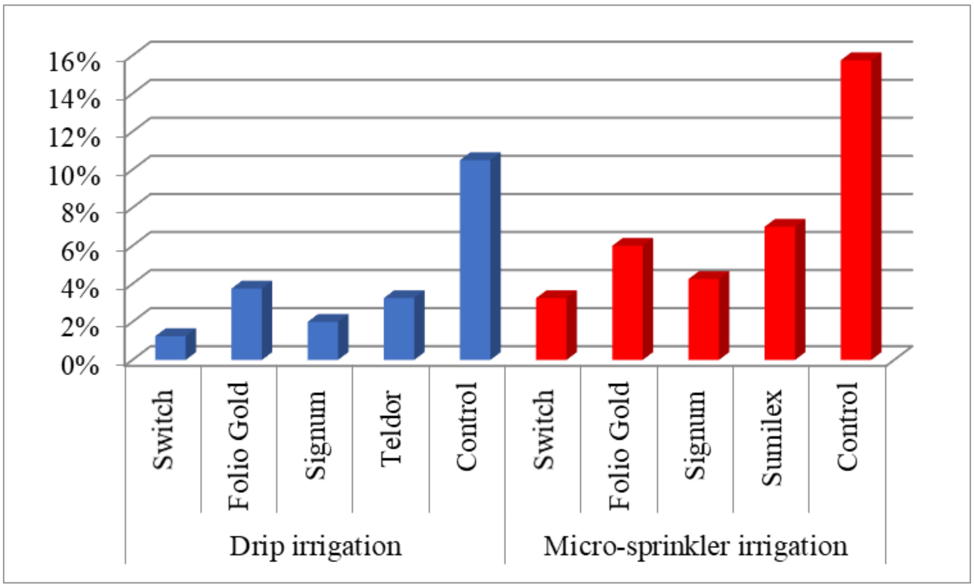

Figure 1 *Intensity of B. cinerea infection on lettuce*

The results of the investigated effciency of the four fungicides on *B. cinerea* control with lettuce under drip irrigation conditions, are given in the Table 4. Thus, the most efficient fungicide for lettuce protection from *B. cinerea* proved to be Switch (88.1%). Comparatively highly efficient with grey mould control was also Signum (80.1%). Somewhat lower level of efficiency was exhibited by Folio Gold (64.3%) and Teldor (69.1%). As regards the fungicide Switch 62.5 WG and the mixture of Switch 62.5 WG + Megafol, they proved efficient from 70.9% to 86.5% in grey mold control from *B. cinerea* [13].

Table 4 *Effectiveness of fungicides in controlling B. cinerea – drip irrigation*

Variant	Fungicide	Infected plants (%)	Efficiency (%)
V_1	Switch	1.2	88.1
V_2	Folio Gold	3.7	64.3
V_3	Signum	2.0	80.1
V_3	Teldor	3.2	69.1
V_5	Control	10.5	–

The assessment of fungicide efficiency with lettuce protection from *B. cinerea* under micro sprinkler irrigation conditions, is presented in the Table 5.

Table 5 *Efficacy of fungicides in controlling B. cinerea – micro – sprinkler irrigation*

Variant	Fungicide	Infected plants (%)	Efficiency (%)
V_1	Switch	3.2	79.4
V_2	Folio Gold	6.0	61.9
V_3	Signum	4.2	73.0
V_4	Teldor	7.0	55.5
V_5	Control	15.7	–

The fungicide Switch showed the best results with grey mold control in lettuce (79.4%). Signum was also quite efficient (73.0%), with lower efficiency recorded on the variants treated with Folio Gold (61.9%) and Teldor (55.5%). On comparing the fungicides sought for protection from lettuce grey mold caused by *B. cinerea*, a weakened disease intensity was spotted on the lettuce plants treated with Switch [14]. It was also established that lettuce control of *B. cinerea* with the fungicides was, on the average, more efficient under drip irrigation (75.4%) than that under the micro sprinkler irrigation (67.45%) (Figure 2).

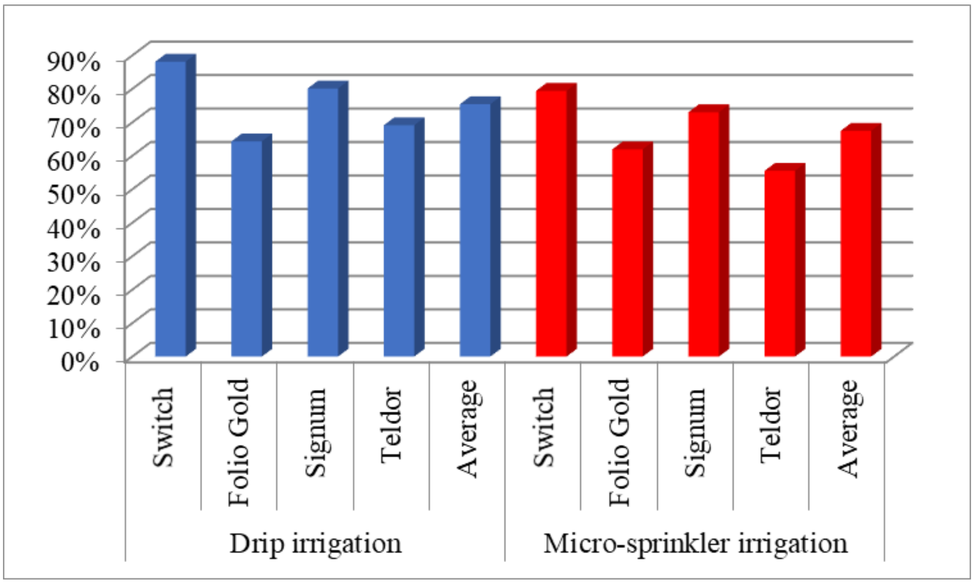

Figure 2 *Efficacy of fungicides in controlling B. cinerea*

CONCLUSION

Throughout the current study, the symptoms of grey mold affecting lettuce were identified in the greenhouse experiment. The percent of the infested lettuce plants was higher with micro sprinkler irrigation in all the variants than it was with drip irrigation. Fungicide control of *B.cinerea* on the lettuce was, on the average, more efficient under drip irrigation (75.4%) than that under micro sprinkler irrigation (67.45%). Therefore, it may be inferred that economic and ecological benefits of the lettuce production with drip irrigation would be higher if the fungicide use was reduced.

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