

Possibilities of integrated management of onion downy mildew

Gunita Bimsteine¹, Līga Lepse², Biruta Bankina¹

¹ Institute of Soil and Plant Sciences, Latvia University of Agriculture,
Liela Street 2, Jelgava, LV-3004, e-mail Biruta.Bankina@llu.lv

² Pūre Horticultural Research Center, Abavas Street 2, Pūre, Tukums district,
LV-3124 Latvia, e-mail liga.lepse@puresdis.lv

Onion downy mildew caused by *Peronospora destructor* is one of the most important onion diseases that require fungicide application. The aim of the research was to find out methods of integrated control of downy mildew in onion.

Investigation was carried out in Pūre Horticultural Research Center in 2008. Three onion hybrids were included in the investigation: 'Safrane' F₁, 'Hypark' F₁ and 'Alonso' F₁. There were investigated three plant protection variants: 1) fungicide applied according to the DACOM Plant Plus decision support system; 2) fungicide used according to spraying scheme; 3) no fungicide was used. Fungicide with active ingredients Metalaxyl and Mankoceb were used in the trials.

The first symptoms of the disease were observed only on 30 July. Differences in development of the disease between hybrids were detected. Severity of downy mildew achieved 1.6 % ('Alonso' F₁), 3.1 % ('Hypark' F₁) and 4.5 % ('Safrane' F₁).

Technical effectiveness of fungicide application fluctuated depending on varieties and spraying variant: 18.8–93.5 % for DACOM Plant Plus and 62.5–83.9 % for schematic spraying.

The most effective disease control was achieved by application of DACOM programme. Further investigations are necessary to obtain consistent results.

Key words: forecast, fungicides, *Peronospora destructor*, spraying.

Introduction. Onion downy mildew caused by *Peronospora destructor* (Berk.) Casp. is an economically important disease causing losses both in the yield and quality of onion (*Allium cepa* L.). Infection in onion causes early defoliation, reduced size and poor storage ability of bulbs (Peter et al., 2004, Surviliene et al., 2008).

The disease symptoms vary with the type of infection. Systemic infection occurs when plants are grown from infected bulbs, but local infection partly is caused by air-borne conidia. Onion bulbs with systemic infection are damaged faster and during moist weather all the leaf surface on infected plants is covered by grayish violet sporulation of *P. destructor*. In case of local infection, oval to cylindrical spots

(3–30 mm in size) slightly paler than the rest of foliage are apparent on the leaves. Older leaves are attacked first and infection spreads to other leaves and plants (Peter et al., 2004; Palti, 1989).

Without fungicide treatment economically significant onion production would not be possible. Onion downy mildew is a disease, which is effectively controlled with fungicide application (Whiteman, Beresford, 1998). Planting time, resistant cultivars, soil drainage and healthy seed or bulb material are also included in the management of this disease. The fungicide efficiency depends on the time of application and developmental stage of the disease. It is very important to notice the first symptoms of the disease in sufficient plant protection system (Buloviene, Surviliene, 2006; Whiteman, Beresford, 1998).

Development of mildew epidemics depends primarily on moisture, but temperature and light also are important factors, which influence different stages of *P. destructor* (Palti, 1989, Buloviene, Surviliene, 2006). Cool temperatures (10–12 °C), moderate relative humidity and low solar irradiance are more favorable conditions for spore survival. Sporangia of *P. destructor* disperse mainly during the morning and early afternoon and they can survive in the field for several hours until the conditions are more suitable for infection, such as those at night (Palti, 1989; Bashi, Aylor, 1983). Knowledge of the relationships between weather factors and pathogen sporulation is important for developing predictive models of downy mildew epidemics (Palti, 1989; Buloviene, Surviliene, 2006).

Different forecast models (ZWIREPO, DOWNCAST, ONIMIL and others) were made to improve schemes of fungicide application (Friedrich et al., 2003). Dutch farmers used weather based Decision support systems against diseases of field vegetables since the middle of the 1980 (Bouma, 2004). The Agri Yield Management system developed by DACOM provides growers around the world with practical solutions for profitable and sustainable agriculture. By combining sensor technology, internet and scientific knowledge, growers can continuously monitor and fine-tune their production process throughout the growing season (<http://www.dacom.nl>). It was found to be usable to introduce DACOM Plant Plus decision support system in the onion growing system in Latvia. Evaluation of the system efficiency under Latvia conditions in integrated plant protection system becomes interesting.

Therefore in 2008 investigation was carried out attaining to find out the most effective methods of integrated control of downy mildew in onion.

Object, methods and conditions. Investigations were carried out in Pūre Horticultural Research Center in 2008. Three onion hybrids were included in the investigation: ‘Safrane’ F₁, ‘Hypark’ F₁ and ‘Alonso’ F₁. There were investigated three plant protection variants: 1) fungicide treatment was performed according to the DACOM Plant Plus decision support system; 2) fungicide used according to experts’ estimation based on experience; 3) no fungicide was used.

Investigation was arranged in 4 replications, each plot – 10 m². Onion seeds were sown by a precise sowing-machine “Robin Stanhay” in loamy soil on 23 April, in three-row beds on plane surface. Cultivation that followed was performed according to agro-ecological requirements of onions.

Peronospora destructor control was performed with the following treatments:
Variant 1 – Ridomil Gold MZ 68 WG (metalaxyl) 2.5 kg ha⁻¹ on 08.07 and 14.07, and Penncozeb 75 DG (mankoceb) 2 kg ha⁻¹ on 29.07.

Variant 2 – Ridomil Gold MZ 68 WG (metalaxyl) 2.5 kg ha⁻¹ on 14.07 and Penncozeb 75 DG (mankoceb) 2 kg ha⁻¹ on 29.07.

Onion hybrids used in the trial were characterized as follows:

‘Safrane’ F₁ – vegetation period in the investigation was observed shorter than it was given in the hybrid description – 135 days. Leaves mid-waxed, grey-green and slightly hanging down, average height of foliage 80 cm;

‘Hypark’ F₁ – vegetation period 150 days. Leaves mid-strong waxed, grey-green, almost upstanding, average height of foliage 78 cm;

‘Alonso’ F₁ – vegetation period 130 days. Leaves mid-strong waxed, green, almost upstanding, average height of foliage 73 cm. Resistance to *Peronospora destructor* is indicated in the description of hybrid.

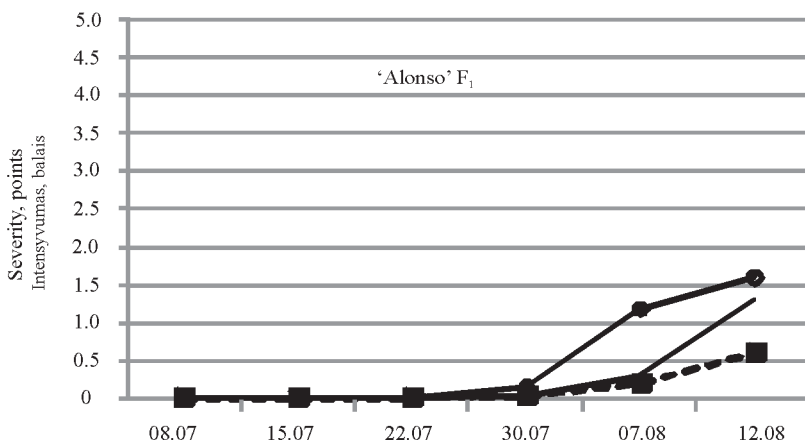
The severity of downy mildew was evaluated each week and was scored using 5 point system: 0 – no disease symptoms; 1 – some spots of disease; 2 – damaged 1/3 of a plant; 3 – damaged 1/2 of a plant; 4 – damaged 2/3 of a plant; 5 – all leaves damaged.

Onion bulbs were harvested on the 3rd decade of August. Yield was weighted in the field directly after harvest, dried in a plastic tunnel, cleaned and placed for storage.

Meteorological data were recorded by “Lufft” automatic meteorological station. Air temperature, precipitation, air humidity, solar irradiation, wind and dry leaf measurements were recorded.

ANOVA procedures were used for experimental data processing.

Results. First symptoms of downy mildew on the leaves of plants were noticed on 15 July in hybrid ‘Safrane’, but sharp development of this disease was observed after 30 July. Differences of downy mildew development were observed depending on hybrids (Fig. 1). The most susceptible hybrid was ‘Safrane’ – the severity of disease achieved 4.5 points.



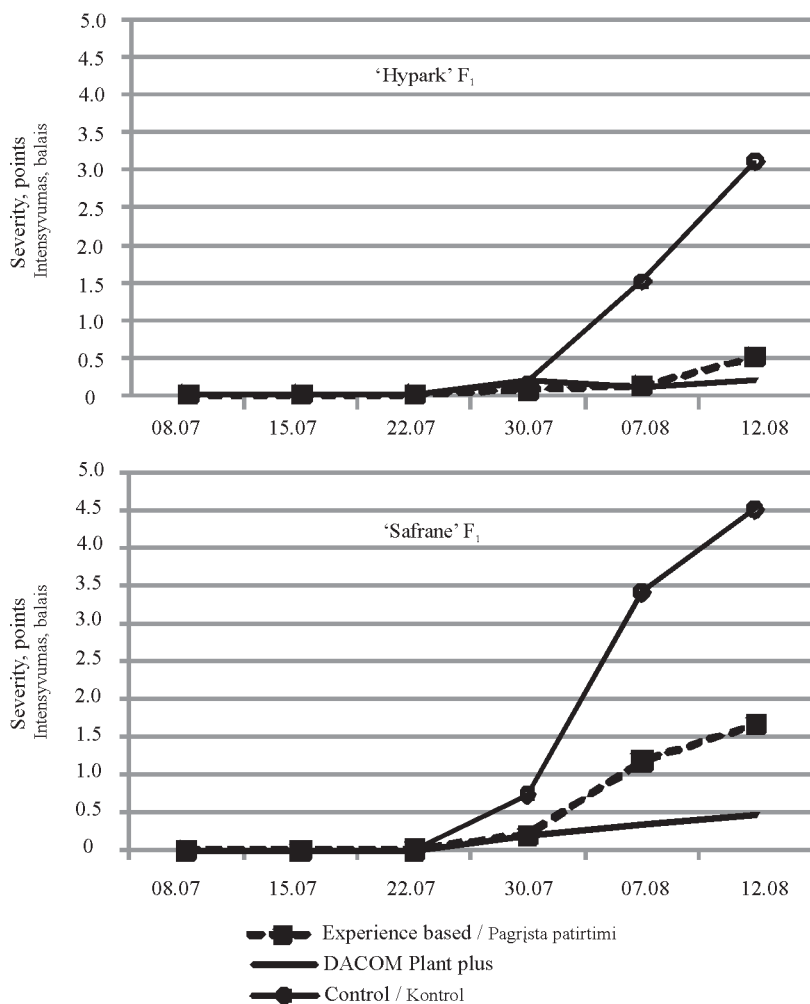


Fig. 1. Development of disease depending on fungicide application scheme
1 pav. Ligos eiga priklausomai nuo fungicidų naudojimo schemos

The first fungicide treatment was performed on 8 July according to DACOM Plant Plus decision support system, but on experience-based spraying – a week later. At this time disease symptoms were not observed. In total, during vegetation period DACOM Plant Plus recommended three applications of fungicides (Fig. 1). Treatments of fungicides significantly reduced the severity of downy mildew in planting, but efficiency was depending on hybrids as well.

Hybrid and fungicide application scheme influenced yield. Onion yield was significantly higher, if scheme of DACOM Plant Plus was used (Fig. 2). Routine or experience-based variant did not give sufficient results.

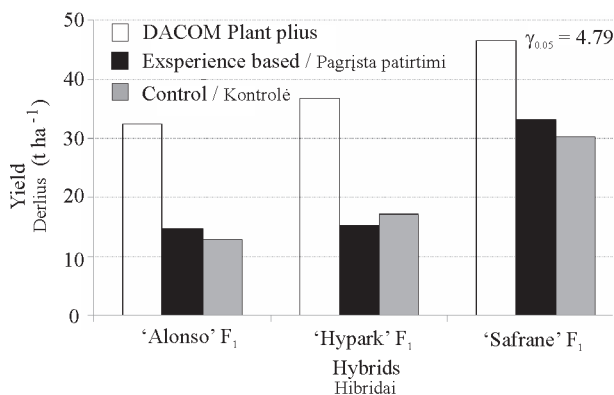


Fig. 2. Onion yield depending on hybrid and schemes of fungicide application
2 pav. Svogūnų derliaus priklausomybė nuo hibridų ir fungicidų naudojimo schemas

Discussion. Development of downy mildew has strong correlation with weather conditions. The first decade of June in 2008 was extremely dry (amount of precipitation only 0.1 mm), relative humidity (RH) exceeded 90 % only in some cases, but mostly fluctuated from 50–80 %. The most important factor for development of onion downy mildew is high RH, the greatest number of sporangia was produced at 100 % (Gilles et al., 2004), but the peak dispersal of spores coincided with drying of the leaves. Infection is not possible if leaves are dry (Hildebrand, Sutton, 1982). Abundant rainfall (60 mm) was observed in the second decade of June, but RH > 95 % only in July. These observations explained sharp development of the disease at the end of July.

Our investigations confirm characterization of varieties according to which 'Alonso' is more resistant comparing to 'Safrane'.

It is difficult to explain the obtained data about disease development and obtained yield. Significant difference between hybrids 'Alonso' and 'Hypark' in downy mildew severity was not observed at the end of vegetation period (12.08) depending on scheme of fungicide application. Visible effect of three applications of fungicide (recommended by DACOM Plant Plus) was noted only for hybrid 'Safrane'. These results were different comparing with the other investigations. Buloviene and Surviliene observed high biological efficacy (74.38 % to 89.36 %) of all the used fungicides (Buloviene, Surviliene, 2006).

Nevertheless, in all cases significant increase in yield was determined in trials with three applications of fungicide. Importance of the necessity to control the first symptoms of the disease (could be latent), as described by other authors (Buloviene, Surviliene, 2006; Battilani et al., 1996), is one of possible reasons of efficiency of DACOM Plant Plus recommendations.

Conclusions. Results of one-year investigations confirmed possible effectiveness of DACOM Plant Plus decision support system in improvement of downy mildew control. Investigations are continued in 2009.

Acknowledgements. Financial support from the Ministry of Agriculture of Latvia is gratefully acknowledged.

Gauta 2009 06 22
Parengta spausdinti 2009 08 03

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Svogūnų netikrosios miltligės integruotos kontrolės galimybės

G. Bimsteine, L. Lapse, B. Bankina

Santrauka

Svogūnų netikroji miltligė, sukeliama *Peronospora destructor*, yra viena iš svarbiausių svogūnų ligų, nuo kurios būtina naudoti fungicidus. Šio tyrimo tikslas ir buvo surasti svogūnų netikrosios miltligės integruotos kontrolės būdus. Tyrimai atlikti Pūre sodininkystės tyrimų centre 2008 metais. Tyrime panaudoti trys svogūnų hibridai: 'Safrane' F₁, 'Hypark' F₁ ir 'Alonso' F₁. Tirti trys augalų apsaugos variantai: 1) fungicidai naudoti pagal „DACOM Plant Plus“ sistemą; 2) fungicidai naudoti pagal purškimo schemą; 3) fungicidai nenaudoti. Bandymuose naudoti fungicidai su veikliosiomis medžiagomis metalaksilu ir mankocebu. Pirmieji ligos simptomai pastebėti liepos 30 dieną. Skirtingiems hibridams liga vystėsi nevienodai. 'Alonso' F₁ netikrosios miltligės intensyvumas siekė 1,6 %, 'Hypark' F₁ – 3,1 %, o 'Safrane' F₁ – 4,5 %. Techninis fungicido naudojimo veiksmingumas priklausė nuo veislių ir purškimo varianto: purškiant pagal „DACOM Plant Plus“ sistemą, jis siekė 18,8–93,5 %, o schematinio purškimo atveju – 62,5–83,9 %. Veiksmingiausiai kelias ligai buvo užkirstas taikant DACOM programą. Siekiant išsamesnių rezultatų reikalingi tolimesni tyrimai.

Reikšminiai žodžiai: fungicidai, *Peronospora destructor*, prognozės, purškimas.

