

Društvo za varstvo rastlin Slovenije
Ljubljana

Plant Protection Society of Slovenia
Ljubljana

ZBORNİK PREDAVANJ IN REFERATOV

11. SLOVENSKEGA POSVETOVANJA O VARSTVU RASTLIN Z
MEDNARODNO UDELEŽBO

(in okrogle mize o zmanjšanju tveganja zaradi rabe FFS v okviru
projekta CropSustaIn)
BLED, 5.-6. MAREC 2013

LECTURES AND PAPERS

PRESENTED AT THE 11TH SLOVENIAN CONFERENCE ON
PLANT PROTECTION WITH INTERNATIONAL
PARTICIPATION

(and the round table of risks reduction in phyto-pharmaceutical
products use in the frame of CropSustaIn project)
BLED, MARCH 5-6 2013

LJUBLJANA, 2013

Vsebina

Uvodni referati

Jürg M. GRUNDER Dosežki in izzivi ekološkega kmetijstva v Švici 1

Bernd HOMMEL, Bernd FREIER, Jörn STRASSEMAYER, Wolfgang ZORNBAACH
Tretji nemški akcijski načrt o trajnostni rabi fitofarmaceutskih sredstev – kontinuiteta in novi izzivi 6

Referati na okrogli mizi o zmanjšanju tveganja zaradi rabe fitofarmaceutskih sredstev

Meta ZEMLJIČ URBANČIČ, Gregor UREK, Matej KNAPIČ, Vojko ŠKERLAVAJ,
Andrej SIMONČIČ, Jolanda PERSOLJA, Magda RAK CIZEJ, Sebastjan RADIŠEK,
Mario LEŠNIK Analiza stanja rabe fitofarmaceutskih sredstev v Sloveniji 11

Matej KNAPIČ, Gregor UREK, Meta ZEMLJIČ URBANČIČ, Vojko ŠKERLAVAJ,
Andrej SIMONČIČ, Jolanda PERSOLJA, Magda RAK CIZEJ, Sebastjan RADIŠEK,
Mario LEŠNIK Primerjava rabe fitofarmaceutskih sredstev v Sloveniji in v izbranih evropskih
državah 16

Gregor UREK, Matej KNAPIČ, Meta ZEMLJIČ URBANČIČ, Vojko ŠKERLAVAJ,
Andrej SIMONČIČ, Jolanda PERSOLJA, Magda RAK CIZEJ, Sebastjan RADIŠEK,
Mario LEŠNIK Pomen kazalnikov za spremljanje rabe fitofarmaceutskih sredstev 22

Gregor UREK, Matej KNAPIČ, Meta ZEMLJIČ URBANČIČ, Vojko ŠKERLAVAJ,
Andrej SIMONČIČ, Jolanda PERSOLJA, Magda RAK CIZEJ, Sebastjan RADIŠEK,
Mario LEŠNIK Možnosti in ukrepi za zmanjšanje tveganja zaradi rabe fitofarmaceutskih
sredstev 27

Peter KOZMUS, Andrej SIMONČIČ Ugotavljanje in ocena vplivov različnih kmetijsko-
pridelovalnih območij na pojavljanje ostankov fitofarmaceutskih sredstev v čebeljih pridelkih ter
njihov vpliv na razvoj in zdravstveno stanje čebel 33

Franci Aco CELAR, Katarina KOS Fungistatični učinek izbranih herbicidov in fungicidov na
entomopatogeno glivo *Beauveria bassiana* 38

Varstvo gozdnega drevja in drugih lesnatih rastlin

Metka Žerjav, Anita BENKO BELOGLAVEC Deset let nadzora fitoftome sušice vejic
(*Phytophthora ramorum*) v Sloveniji 46

Tine HAUPTMAN, Dušan JURC Ogroženost jesenov zaradi jesenovega ožiga v Sloveniji 52

Barbara PIŠKUR, Tine HAUPTMAN, Nikica OGRIS, Dušan JURC Bolezni borovih iglic v
Sloveniji, ki jih povzročajo glive iz rodu *Mycosphaerella* 57

Nikica OGRIS Kratkoročna prognoza pojava pooglenitve bukve (*Biscogniauxia nummularia*) v
Sloveniji 62

Varstvo sadnega drevja in jagodičevja

Maja MIKULIČ-PETKOVŠEK, Valentina SCHMITZER, Fran TAMPAR, Robert
VEBERIČ, Darinka KORON Odziv malin na okužbo z malinovo s. (*Didymella*
applanata in *Leptosphaeria coniothyrium*) 69

Manca PIRC, Tanja DREO Izbira metode ekstrakcije DNK za spremljanje organizma za
biotično zatiranje, *Gliocladium catenulatum* J1446

Barbara AMBROŽIČ TURK, Nikita FAJT, Nataša MEHLE, Marina DERMASTIA,
Irena MAVRIČ PLEŠKO Vrednotenje tolerantnosti sort in tipov marelice na leptonekrozo
koščičarjev (ESFY)

Matjaž JANČAR Bakterijski ožig aktinidije, *Pseudomonas syringae* pv. *actinidiae* (Takikawa,
Ichikawa, Serizawa, Tsuyumu in Goto) – Psa, prihajajoča nevarnost za slovensko sadjarstvo

Gabrijel SELJAK, Mojca ROT Preučevanje bionomije češpljeve bolšice (*Cacopsylla pruni*)
na Primorskem

Domen BAJEC, Karmen RODIČ, Andreja PETERLIN Napovedovanje razvoja ameriškega
kapařja (*Diaspidiotus perniciosus* Comst.)

Mario BJELIŠ, Luka POPOVIČ, Suzana DEAK, Ivana BULJUBAŠIČ, Ante IVANOVIČ,
Pero ARNAUT, Rui PEREIRA Zatiranje breskove muhe (*Ceratitidis capitata*) z metodo
sterilnih žuželk (SIT) na več kot 4000 ha sadovnjakov v dolini reke Neretve

Mojca ROT, Gabrijel SELJAK Inventarizacija resarjev v cvetovih koščičarjev na
Primorskem, potencialnih povzročiteljev porjavenja kořice plodov

Jože MIKLAVC, Miro MEŠL, Boštjan MATKO, Anita SOLAR, Stanislav TRDAN
Izkušnje z zatiranjem orehove muhe (*Rhagoletis completa* Cresson) v SV Sloveniji v letih 2011
in 2012

Domen BAJEC, Karmen RODIČ, Andreja BRENCE, Lucija LESKOVŠEK, Andreja
PETERLIN Pojavnost rilčkarjev (Curculionidae) in naraščanje gospodarske škode v ekoloških
sadnih nasadih

Varstvo poljščin

Tanja DREO, Tina NAGLIČ, Matjaž PETERKA, Maja RAVNIKAR Karakterizacija
slovenskih izolatov *Pectobacterium* in *Dickeya* spp. iz krompirja

Jana ERJAVEC, Tanja DREO, Jože BRZIN, Jerica SABOTIČ, Maja RAVNIKAR
Naravne protimikrobne snovi in mikroorganizmi kot sredstva za varstvo rastlin

Igor ZIDARIČ, Peter DOLNIČAR, Gregor UREK Biotična učinkovitost nekaterih
insekticidov za zatiranje strun iz rodu *Agrotis* v krompirju

Barbara GERIČ STARE, Saša ŠIRCA, Gregor UREK Ali smo pripravljeni na nove vrste
ogorčic iz rodu *Globodera*?

Žiga LAZNIK, Matej VIDRIH, Stanislav TRDAN Preučevanje učinkovitosti različnih
biotičnih agensov za zatiranje ogreev (Scarabaeidae) na travinju – izkušnje s Kočevskega

Stanislav TRDAN, Tanja BOHINC Preučevanje insekticidne učinkovitosti samostojne in
kombinirane uporabe različnih naravnih snovi pri zatiranju črnega žitnega žužka (*Sitophilus*
granarius [L.])

Karmen RODIČ, Domen BAJEC, Mateja ŠTEFANČIČ, Matej ŠTEFANČIČ, Peter
ČEBOKLI Daljinsko zaznavanje s feromonsko vabo na zgludu koruzne vešče (*Ostrinia*
nubilalis [Hübner])

Stanislav TRDAN, Mario LEŠNIK, Jože MIKLAVC, Boštjan MATKO, Miroslav MEŠL,
Marjeta MIKLAVC Rezultati preizkušanja herbicidov v koruzi v pridelovalni sezoni 2012

Robert LESKOVŠEK, Andrej SIMONČIČ Potencial različnih strniščnih dosevkov za zatiranje plevla	178
Robert LESKOVŠEK, Andrej SIMONČIČ Možnosti uporabe mehanskega zatiranja plevla in sistema reducirajoče obdelave v pridelovanju koruze	184
Splošna sekcija	
Vlasta KNAPIČ Pomen obvladovanja vektorjev v epidemiologiji fitoplazemskih bolezni	190
Matej ŠTEFANČIČ, Mateja ŠTEFANČIČ Novosti pri daljinskem zaznavanju škodljivcev	201
Varstvo vinske trte	
Karmen RODIČ, Andreja PETERLIN, Lucija LESKOVŠEK, Domen BAJEC Ameriški škrtatek (<i>Scaphoideus titanus</i> Ball) v vinorodni deželi Posavje	205
Boštjan MATKO, Jože MIKLAVC, Miro MEŠL Izkušnje z zatiranjem ameriškega škrtatka (<i>Scaphoideus titanus</i> Ball) v obdobju 2008-2012 v severovzhodni Sloveniji	210
Matej KNAPIČ, Rok RUTAR, Uroš ŽIBRAT Uvajanje metode daljinskega zaznavanja pri nadzoru zlate trsne rumenice (Flavescence dorée)	216
Domen BAJEC, Andreja PETERLIN, Karmen RODIČ, Lucija LESKOVŠEK Epidemiologija antraknoze vinske trte s povzročiteljem <i>Elsinoë ampelina</i> (Shear)	222
Stanislav VAJS, Mario LEŠNIK, Jože MIKLAVC, Boštjan MATKO, Miroslav MEŠL, Mojca PUŠNIK Vpliv metode ocenjevanja stopnje okužbe pri določanju učinkovitosti fungicidov za zatiranje oidija vinske trte (<i>Uncinula necator</i>)	228
Domen BAJEC, Karmen RODIČ, Andreja PETERLIN, Lucija LESKOVŠEK Traheomikoze v vinogradih vinorodne dežele Posavje	235
Varstvo poljščin in okrasnih rastlin	
Jaka RAZINGER, Matthias LUTZ, Hans-Josef SCHROERS, Gregor UREK, Jürg GRUNDER Laboratorijski poskusi entomopatogenih ali potencialno rast spodbujajočih gliv za zatiranje kapusove muhe (<i>Delia radicum</i> L.) in njihova rizosferna kompetenca	239
Špela MODIČ, Meta URBANČIČ ZEMLJIČ, Metka ŽERJAV, Mojca ŠKOF, Kristina UGRINOVIČ, Jana BOLČIČ, Jaka RAZINGER Spremljanje pojavljanja in možnosti napovedovanja kapusove muhe (<i>Delia radicum</i>) v Sloveniji	244
Tanja BOHINC, Stanislav TRDAN Je z mešanici križnic kot privabilnimi rastlinami mogoče zmanjšati škodljivost kapusovih bolhačev (<i>Phyllotreta</i> spp.) na zelju?	250
Ivan ŽEŽLINA, Primož PAJK, Branko CARLEVARIS Izsledki ugotavljanja zastopanosti paradiznikovega molja (<i>Tuta absoluta</i> Povolny) v Sloveniji v obdobju 2009-2012	258
Kristina UGRINOVIČ, Mojca ŠKOF, Metka ŽERJAV, Špela MODIČ, Jaka RAZINGER, Meta URBANČIČ-ZEMLJIČ Varstvo kapusnic pred škodljivci – stanje, možnosti in izzivi v integrirani pridelavi v Sloveniji	266
Tina NAGLIČ, Magda TUŠEK ŽNIDARIČ, Maja RAVNIKAR, Matjaž PETERKA, Tanja DREO Bakteriofagi kot alternativni način zatiranja bolezni tlin	273

Posterji

Duška INDIČ, Slavica VUKOVIČ, Sonja GVOZDENAC, Tatjana KERESI, Snežana TANASKOVIČ Možnost hitre detekcije občutljivosti koloradskega hrošča (<i>Leptinotarsa decemlineata</i> [Say]) na insecticide
Anka POŽENEL, Mojca BAVCON KRALJ, Mojca ROT, Ivan ŽEŽLINA, Jana ČUK, Branko CARLEVARIS Prvi rezultati ulova poljskega majskega hrošča (<i>Melolontha melolontha</i> L.) s svetlobnimi in alkoholno-feromonskimi vabami
Stanislav TRDAN, Nickolas G. KAVALLIERATOS, Theodoros STATHAKIS, Serge KREITER, Aleksandar STOJANOVIČ, Željko TOMANOVIČ, Tanja BOHINC Prve najdbe treh vrst naravnih sovražnikov v Sloveniji: plenilske pršice <i>Neoseiulus californicus</i> (Arachnida, Acari, Phytoseiidae) in parazitoidnih os <i>Neochrysocharis formosus</i> (Insecta, Hymenoptera, Eulophidae) ter <i>Dibrachys microgastri</i> (Insecta, Hymenoptera: Pteromalidae)
Žiga LAZNIK, Tanja BOHINC, Matej VIDRIH, Filip VUČAJNK, Sebastjan RADIŠEK, Stanislav TRDAN Preučevanje učinkovitosti biofumigacije za zatiranje strun (<i>Agriotes</i> spp., Coleoptera, Elateridae) v krompirju
Iris ŠKERBOT, Matej VIDRIH, Stanislav TRDAN Hrošči iz družin pahljačnikov (Scarabaeidae) in lepenjcev (Chrysomelidae) – vse pomembnejši škodljivci travinja na območju Savinjske in Koroške statistične regije
Andreja PETERLIN, Lucija LESKOVŠEK, Karmen RODIČ, Domen BAJEC Vpliv varstvenih ukrepov proti koruznemu hrošču (<i>Diabrotica virgifera virgifera</i> [LeConte]) na gradacijo strun (Elateridae) in drugih talnih škodljivih vrst v pridelavi koruze
Tanja BOHINC, Stanislav TRDAN Insekticidno delovanje petih eteričnih olj na odrasle osebkke fizolarja (<i>Acanthoscelides obtectus</i> [Say], Coleoptera, Chrysomelidae)
Žiga LAZNIK, Stanislav TRDAN Morfološke karakteristike ogrcev s travinja, potrebne za hitro determinacijo
Žiga LAZNIK, Stanislav TRDAN Preučevanje kompatibilnosti izbranih insekticidov z entomopatogenimi ogorčicami (Nematoda: Rhabditida)
Jaka RAZINGER, Matthias LUTZ, Hans-Josef SCHROERS, Gregor UREK, Jürg GRUNDER Laboratorijski poskusi z entomopatogenimi glivami za zatiranje strun (<i>Agriotes</i> spp. L.)
Jaka RAZINGER, Matthias LUTZ, Hans-Josef SCHROERS, Špela MODIČ, Meta URBANČIČ ZEMLJIČ, Metka ŽERJAV, Kristina UGRINOVIČ, Mojca ŠKOF, Gregor UREK, Jürg GRUNDER Poljski preskus varstva cvetače pred kapusovo muho (<i>Delia radicum</i> L.) z entomopatogenimi ali potencialno rast spodbujajočimi sevi gliv in določanje njihove rizosferne kompetence
Melita ŠTRUKELJ, Irena MAVRIČ PLEŠKO, Mojca VIRŠČEK MARN, Jaka RAZINGER, Gregor UREK Kaparji - prenašalci virusov vinske trte na Primorskem
Igor ZIDARIČ, Jaka RAZINGER, Vojko ŠKERLAVAJ Biotična učinkovitost insekticidov pri zatiranju ameriškega škrtatka <i>Scaphoideus titanus</i> Ball (1932) v vinorodni deželi Dolenjska v letu 2011 in 2012
Mladen ŠTAMALA, Tatjana MASTEN MILEK Prva najdba ščitkarja <i>Aleurocanthus spiniferus</i> Quaintan. 1903 (Hemiptera: Aleyrodidae), na Hrvaškem

Jaka RAZINGER, Metka ŽERJAV, Špela MODIČ Ameriški krek v živih mejah je pogosto gostitelj južnega brinovnega krasnika (<i>Ovalisia festiva</i> L.) v Sloveniji	359
Tatjana MASTEN MILEK, Mladen ŠIMALA Prvi najdbi palmovega rilčkarja, <i>Rhynchophorus ferrugineus</i> (Olivier, 1790) in palmovega vrtača, <i>Paysandisia archon</i> (Burmeister, 1880), na Hrvaškem	366
Jasmina BAČIČ, Barbara GERIČ STARE, Saša ŠIRCA, Gregor UREK Morfometrične in molekulske analize krompirjevih cistotvornih ogorčic iz Srbije	369
Janja LAMOVŠEK, Barbara GERIČ STARE, Gregor UREK Vpliv bakterije <i>Agrobacterium tumefaciens</i> na vstop ličink ogorčice <i>Meloidogyne ethiopica</i> v korenine gostiteljske rastline <i>in vitro</i>	373
Polona STRAJNAR, Saša ŠIRCA, Dominik VODNIK, Barbara GERIČ STARE, Gregor UREK Morfološke in fiziološke spremembe pri paradizniku po napadu ogorčice <i>Meloidogyne ethiopica</i>	378
Mojca VIRŠČEK MARN, Irena MAVRIČ PLEŠKO Raznolikost slovenskih izolatov PPV (<i>Plum pox virus</i>)	384
Tina DEMŠAR, Špela KUBIK, Ana ROTTER, Maja RUPNIK, Maja RAVNIKAR Vpliv rizosfernih bakterij na rast sadik paradiznika (<i>Solanum lycopersicum</i> L.)	391
Alenka MUNDA, Barbara GERIČ STARE Spremljanje gliv iz rodu <i>Monilinia</i> na cvetovih, listih in plodovih breskev in marelic z metodo PCR v realnem času	397
Domen BAJEC, Andreja PETERLIN, Lucija LESKOVŠEK, Karmen RODIČ Praktični vidik aerobiotičnih meritev izbruhov askospor jablanovega škrlupa (<i>Venturia inaequalis</i> [Cooke] Wint.)	401
Maja MIKULIČ-PETKOVŠEK, Nika WEBER, Valentina SCHMITZER, Jerneja JAKOPIČ, Franci ŠTAMPAR, Darinka KORON, Alenka MUNDA, Robert VEBERIČ Spremenjen primarni in sekundarni metabolizem jagod zaradi okužbe z glivo <i>Colletotrichum nymphaeae</i> (Pass.) AA	405
Gabriella KAZINCZI, Ferenc PÁL-FÁM, Erzsébet NÁDASY, András TAKÁCS, József HORVÁTH Alelopatija nekaterih pomembnih plevelov na Madžarskem	410
Robert LESKOVŠEK, Silvo ŽVEPLAN, Andrej SIMONČIČ Učinkovitost bioherbicidov ocetne in pelargonske kisline za zatiranje pelinolistne ambrozije (<i>Ambrosia artemisiifolia</i> L.)	416
Stanislav TRDAN, Žiga LAZNIK Prvi rezultati vzorčenja potencialnih naravnih sovražnikov japonskega dresnika (<i>Fallopia japonica</i> [Houtt.] Ronse Decraene) v Sloveniji	422
Rok LENARČIČ, Polona KOGOVSŠEK, Maja RAVNIKAR Razvoj hitrih in enostavnih diagnostičnih testov za določanje povzročiteljev rastlinskih bolezni na terenu	429
Robert VEBERIČ, Ana SLATNAR, Maja MIKULIČ-PETKOVŠEK, Jerneja JAKOPIČ, Franci ŠTAMPAR, Franci BAVEC, Martina BAVEC Vpliv načina gojenja na kemično sestavo fižola (<i>Phaseolus vulgaris</i> L. cv. Top Crop)	434
Filip VUČAJNK, Alojz SREŠ, Darja KOCJAN AČKO, Gregor LESKOŠEK, Matej VIDRIH, Stanislav TRDAN Vpliv vozne hitrosti pri škropljenju s fungicidi na prekritost klasov ozimne pšenice	439
Tomaž POJE Tehnični ukrepi za zmanjšanje izpostavljenosti traktorista nevarnim snovem	444

Barbara GERIČ STARE, Peter DOLNIČAR, Irena MAVRIČ PLEŠKO, Vladimir MEGLIČ Vpliv izbire metode normalizacije podatkov pri analizi različno izraženih genov z mikromrežami

Sanja LAZIČ, Dragana ŠUNJKA, Nada GRAHOVAC, Snežana JAKŠIČ, Slavica VUKOVIČ Določanje dveh herbicidov v vodi iz drenažnih kanalov

Prispevki sponzorjev

Drago MAJCEN, Primož STEPIC, Andrej KOS, Boris PARADŽIK PALLAS@ 75 WG - novi herbicid za zatiranje plevelov v pšenici, rži in tritikali

Alojz SREŠ Proizvod, rešitev, uspeh - koncept in rezultati Bayerjevih poskusov na koruzi in pšenici

Istok MARIN ADENGO® - najnovejši herbicid za varstvo koruze

Damjan FINŠGAR Insekticidna mreža za zatiranje škodljivcev v gozdarstvu in skladiščih

Kazalo avtorjev

Logotipi sponzorjev

normalization but simultaneously also a background correction. This resulted in underestimation of DE genes as our data had a previous automatic step of background correction.

5 ACKNOWLEDGMENTS

This work was financially supported by the Slovenian Research Agency (ARRS), grant no. L4-2400-0401 and the Ministry of agriculture, forestry and food of Republic of Slovenia (MKGP).

6 REFERENCES

- Bolstad, B.M., Irizarry R.A., Astrand, M., Speed, T. P. 2003. A comparison of normalization methods for high density oligonucleotide array data based on bias and variance. *Bioinformatics*, 19: 185-193.
- Dolničar, P., Mavrič Pleško, I., Meglič, V. 2011. Long-term cold storage suppress the development of tuber necrosis caused by PVY-NTN. *American journal of potato research*, 4, 88: 318-323.
- Huber, W., von Heydebreck, A., Sülthmann, H., Poustka, A., Vingron, M. 2002. Variance stabilization applied to microarray data calibration and to the quantification of differential expression. *Bioinformatics*, 18 Supplement 1: S96-S104.
- Smyth, G.K., Speed, T.P. 2003. Normalization of cDNA microarray data. *Methods*, 31: 265-273.
- Yang, Y.H., Dudoit, S., Luu, P., Speed, T.P. 2001. Normalization for cDNA microarray data. In: Bittner, M.L., Chen, Y., Dorsel, A.N., Dougherty E.R. (eds.). *Microarrays: Optical Technologies and Informatics*, Proceedings of SPIE, 4266: 141-152.
- Yang, Y.H., Dudoit, S., Luu, P., Lin, D.M., Peng, V., Ngai, J., Speed, T.P. 2002. Normalization for cDNA microarray data: a robust composite method addressing single and multiple slide systematic variation. *Nucleic Acids Research*, 30,4: e15.
- Yang, Y.H., Thorne, N.P. 2003. Normalization for two-color cDNA microarray data. In: Goldstein D.R. (ed.). *Science and Statistics: A Festschrift for Terry Speed*, IMS Lecture Notes - Monograph Series, 40: 403-418.

453

DETERMINATION OF TWO HERBICIDES IN DRAINAGE WATER

Sanja LAZIĆ¹, Dragana ŠUNJKA^{2*}, Nada GRAHOVAC³, Snežana JAKŠIĆ⁴,
Slavica VUKOVIĆ⁵

^{1,2,5} University of Novi Sad, Faculty of Agriculture, Department for Environmental and Plan
Protection, Novi Sad, Serbia

^{3,4} Institute of Field and Vegetable Crops, Novi Sad, Serbia

ABSTRACT

Pesticides used in agricultural production for weeds and pests control can migrate to surface and ground water after application. Their presence in water used for irrigation can cause yield reduction and decrease product quality. This is very important considering importance of water quality for agricultural production, especially organic. Some of commonly detected pesticides in surface water are chloracetanilide herbicides, acetochlor and alachlor. They are herbicides widely used for control of broadleaf weeds and annual grasses in row crops. This study was carried out to evaluate the content of acetochlor and alachlor in drainage water which is widely used in agricultural production for irrigation. Water samples were collected from drainage canals in agricultural fields in the region of Vojvodina Province, Serbia. This part of Serbia is well-known as region with intensive agricultural production. The sampling was performed during June 2012, on twelve potential risk sites. Solid-phase extraction on C₁₈ ENVITM SP disc (47 mm) was used for isolation of the investigated pesticides, acetochlor and alachlor, from water samples. Prior to extraction disc was conditioned with 5 ml of methanol and 5 ml of deionized water. Afterward, water sample was filtered through the disc. After drying the disc, acetochlor and alachlor were eluted with mixture of dichloromethane and n-hexane (40/60, v/v) and evaporated to dryness. Finally, the extract was diluted in 1 ml methanol and analyzed. Analysis was performed with a Hewlett-Packard (HP) model 5890 Series II gas chromatograph with EC Ni⁶³ detector (GC/ECD). Most of the analyzed water samples were found to be contaminated. Content of acetochlor and alachlor were ranged from 0.02-0.41 µg/l and 0.05-0.78 µg/l, respectively. This could be due to the frequent usage of the above-mentioned herbicides in these localities.

Key words: acetochlor, alachlor, drainage water, residues

1 INTRODUCTION

Contamination of surface water with pesticides may be due to drift or runoff from areas where they were applied, while the result of contamination of groundwater leaching into deeper soil layers under the influence of precipitation. This is particularly obvious in areas with sandy soil and intensive pesticide application. The European Union by Framework Directive 2000/60/EC defined the guidelines in protecting and improving the quality of all water resources - rivers, lakes, groundwater, coastal water, etc. Directive 2008/105/EC updates the Directive 2000/60/EC and by Annex X defines the List of priority substances in the field of water policy. List includes 33 pollutants - 9 are pesticides, including alachlor.

¹ PhD, Trg Dositeja Obradovića 8, Novi sad, Serbia

² PhD, *ibid.*, e-mail: draganas@polj.uns.ac.rs

³ MSc, Maksima Gorkog 30, Novi sad, Serbia

⁴ BSc *ibid.*

454



Figure 1: Structure of acetochlor and alachlor

Alachlor [2-chloro-2,6-diethyl-N-(methoxymethyl)acetanilide] (Fig. 1) has been registered since 1969 as a preemergence, early postemergence, or preplant incorporated herbicide for control of most annual grasses or certain broadleaf species. Alachlor is most heavily used on corn, soybeans, and grain sorghum (Schwab *et al.*, 2005).

The intensive use of alachlor herbicides in contemporary agricultural production during previous decades, has led to the accumulation of residues of alachlor and its metabolites in the environment, which endangers surface and ground water.

In order to replace the more widely used corn herbicides alachlor, atrazine, etc., acetochlor was registered for use, first in the USA. Acetochlor is a selective preemergent herbicide used to control broadleaf weeds and annual grasses in corn (Fig. 1). During the first season it was used, acetochlor was detected in rain and surface water in Minnesota at concentration of 0.01-0.25 µg/l. It was predictable, considering that acetochlor has a water solubility of 223 mg/l and it is moderately to very mobile in soil.

Besides the occurrence of pesticide residues in drinking water, control of their presence in drainage water used in agricultural production is very important. This primarily refers to the river water and groundwater, considering that the water and land quality in conventional production, but especially in organic agriculture, are extremely important. The presence of pesticide residues in these matrices may cause yield reduction and decrease product quality, due to its uptake.

This research was carried out to evaluate the content of chloroacetanilide pesticides, acetochlor and alachlor, in drainage water in the region of Vojvodina.

2 MATERIALS AND METHODS

2.1 Sampling area

Water samples were collected from drainage canals in agricultural fields in the region of Vojvodina Province, Serbia. This part of Serbia is well-known as region with intensive agricultural production. The sampling was performed during June 2012, on twelve potential risk sites (Fig. 2).

2.2 Analytical procedure

The standard solution of acetochlor and alachlor were prepared in mixture of ACN/methanol (50/50, v/v) in concentration interval of 0.01 – 2 µg/ml. For the recovery test model solution (500 ml of tap water enriched with 1 ml of acetochlor and alachlor standard solution in concentration 0.01 µg/ml, 0.1 µg/ml and 1 µg/ml) was used.

2.3 SP extraction

The extraction of pesticide from water was performed using ENVITM-C18 DSK 47 mm

455

extraction for disc of 47 mm. Prior to extraction disc was preconditioned with 5 ml methanol, followed by 5 ml of ultrapure water, at a rate of 2 ml/min. Then model solution filtered through the disc under vacuum at rate of 10 ml/min. After the disc was pesticides eluted from disc with 6 ml of dichloromethane/n-hexane (40/60, v/v) evaporated to dryness. The extract was dissolved in 1 ml of methanol, ultrasonically homogenized and analyzed by GC-ECD. Injecting volume was 3 µl. Quantification performed using external standard method. The calibration solutions were analyzed before and after each water samples.



Figure 2: The geographic position of drainage water samples in the area of Vojvodina

456

2.4 GC-ECD analysis

Content of acetochlor and alachlor was determined using a Hewlett-Packard model 5 Series II gas chromatograph equipped with Supelco column 24048 (SPBTM-5, 30 m × mm id, film thickness 0.25 µm) and an electron capture detector Ni⁶³ (ECD) (Table 1). He was used as the carrier gas at a flow rate of 1 ml/min. The splitless injection was applied.

Table 1: GC/ECD conditions for acetochlor and alachlor determination

	Temperature
Inlet column temperature	100 °C
Rate	9 °C/min
Final column temperature	250 °C
Injector	250 °C
EC Detector	300 °C

Definition of chromatographic conditions was performed by determining the following chromatographic parameters – linearity, repeatability of the peak area and limit of quantification (LOQ). Linearity of detector response was determined by injecting standard acetochlor and alachlor at concentrations of 0.01 to 2 µg/ml. Standard solution for calibration curve was defined as the dependence of the peak area and concentration and expressed as the correlation coefficient (R²). Repeatability of detector response was determined by injecting chlorpyrifos standard solution (0.1 µg/ml) five times and tested by calculating the variation coefficient. LOQ was calculated using the formula $10 \times Sa/a$, where the Sa is standard deviation and a is the slope of the calibration curve.

3 RESULTS AND DISCUSSIONS

3.1 Method validation

Using the presented conditions, the obtained value of correlation coefficient (Table 1) and coefficient of variation (CV=2.62%) for acetochlor and alachlor indicating that achieved good linearity and high reproducibility and LOQ was 0.01 µg/ml. These data are within the accepted range for determination of pesticide residue in matrices such as water.

Table 1: Analytical parameters for GC-ECD determination of acetochlor and alachlor

Parameter	Concentration interval	Retention time	Correlation coefficient	LOQ	Recovery
Analit	µg/ml	Min		µg/ml	%
Acetochlor	0.01-2	10.955	0.993	0.01	97±1.9
Alachlor		10.737	0.975		96±2.5

For the extraction of pesticides from water C₁₈ solid phase in the form of columns is mostly used. (Kolpin *et al.*, 1996; Louter *et al.*, 1992). This study used a C₁₈ solid phase in the form of disc. Activation and conditioning of the disk is carried out by applying methanol. Otherwise, the hydrophobic C₁₈ ligands are entangled and reduce the active surface interaction with the analytes from the water. Average value of the recoveries for acetochlor and alachlor at three fortification levels was 97% and 96%, with associated relative standard deviations (RSDs) of 1.9 and 2.5%, respectively.

3.2 Monitoring

The European Union (Council Directive 98/83/EC of 3 November 1998) specifies a limit (MRL) of 0.1 µg/l for individual pesticides in water intended for human consumption, while the total concentration of pesticides should not exceed 0.5 µg/l.

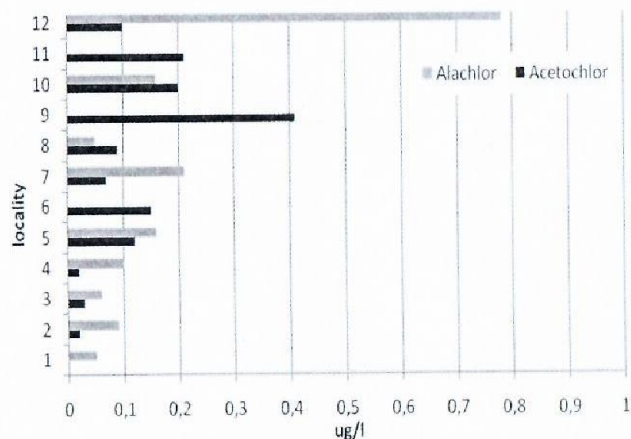


Figure 2: Content of acetochlor and alachlor in drainage water samples in the Vojvodina region

Obtained results show that the extraction and analysis procedures are efficient for determination of acetochlor and alachlor in water samples, considering that the EU MRL for

applied to real water samples. Drainage water samples were taken from several locations in the territory of Vojvodina during 2012. The presence of acetochlor was detected in 92% of analyzed drainage water samples, while alachlor was found in 75% samples. The corresponding range of acetochlor concentrations was 0.02-0.41 µg/l and 0.05-0.78 µg/l for alachlor. Pollution of surface waters by tested pesticides may be the result of drift or runoff from fields that have been applied. In this sampling program content of acetochlor and alachlor and their metabolites were analyzed. Some investigators (Kalkhoff *et al.*, 1998) reported that metabolites of acetochlor and alachlor were detected much more frequently than the respective parent compounds. This is probably because the metabolites have higher water solubility than the parent compounds.

4 CONCLUSIONS

In this work SPE-GC-ECD method for determination of acetochlor and alachlor in water samples was developed. High values of the recovery suggested the possible use of this method for acetochlor and alachlor extraction from different types of water, especially bearing in mind that the described method does not use large amounts of toxic organic solvents. The optimized method was applied for analysis of drainage water samples from the Vojvodina region. The corresponding range of acetochlor and alachlor content in water samples was 0.02-0.41 µg/l and 0.05-0.78 µg/l, respectively.

5 ACKNOWLEDGEMENT

The authors acknowledge financial support from the Ministry of Education and Science, Republic of Serbia, grant III43005.

6 REFERENCES

- Kalkhoff, S.J., Kolpin, D.W., Thurman, E.M., Ferrer, J., Barcelo, D. 1998. Environmental science and technology, 32:1738-1740.
- Kolpin, D.W., Thurman, E.M., Goolsby, D.A. 1996. Occurrence of selected pesticides and their metabolites in near-surface aquifers of the Midwestern United States. Environmental science and technology, 30:335-340.
- Louter, H.J.A., Van Beekvelt, A.C., Cid Montanes, P., Slobodnik, J., Vreuis, J.J., Brinkman, Th.U.A. 1996. Analysis of microcontaminants in aqueous samples by fully automated on-line solid-phase extraction-gas chromatography-mass selective detection. Journal of Chromatography A, 725:61-83.
- Official Journal of the EC L327/1, 23 October 2000, Directive 2000/60/EC.
- Official Journal of the EC L3487/84, 24 December 2008, Directive 2008/105/EC.
- Schwab, A.P., Splichal, P.A., Banks, M.K., 2006. Persistence of atrazine and alachlor in groundwater aquifers and soil. Water, air and soil pollution, 171: 203–235.