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Defense Responses of Cotton to *Trichoderma* spp. and Its Influence in Control of Seedling Damping-off by *Rhizocto\nia solani*

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Abstract

Damping-off of seedling is a major disease of cotton in Iran. Disease may become epidemic in soil with low temperature and high moisture if seed treatment isn't done. Recently, *Trichoderma* spp. are considered as one of the biological control methods of seedling Damping-off. One proposed mechanism for biocontrol in *Trichoderma* spp. is stimulation of host defense responses and induction of resistance.In this survey, antagonistic effect of *Trichoderma* spp. on *Rhizoctonia solani* were studied using dual culture test. Nine isolate were selected for greenhouse studies. Results showed that *Trichoderma virens* isolate A224 and *Trichoderma harzianum* isolate A291 had maximum biocontrol effect on seedling Damping-off. Both isolates increased weight of seedling radicles too. Isolate A224 and isolate A229 were applied on enzyme activity in germinator. Experiments were conducted factorial in Completely Randomized design with 4 replications. Peroxidase, β- 1,3 glucanse activity and total phenolic compounds levels were evaluated by colorimetic. Experiments indicated that maximum level of peroxidase activity is induced 12 days after planting and maximum level of peroxidase activity is induced 10 days after planting. *Trichoderma* isolates and *Rhizoctonia solani* individually increased Peroxidase, β- 1,3 glucanase activity and total phenolic compounds levels, but they are more pronounced and more persistent in the case of applying of combination of two fungi(*Trichoderma* and *Rhizoctonia*) in comparision to the control.

Keywords: Biological control, Cotton Seedling Damping-off, Defense Responses, *Rhizoctonia solani*, *Trichoderma.*

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Comparison of Resistance of Seven Cotton Varieties to *Bemisia tabaci* in Kashmar

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Abstract

Bemisia tabaci (Homoptera: Aleyrodidae) is one of the most important pests of cotton in Khorasan which causes crop damage and yield reductions as a result of direct feeding of plant and passing pathogenic viruses. Using resistant varieties is an economic and environmental friendly method for controlling this pest. The resistance of seven cotton varieties (Green leaf okra, Red leaf okra, Mehr, Varamin, Khordad. Sahel and Termus 14) was evaluated against *B. tabaci* in field experiment for the period of 2009 cropping season at Cotton Research Station East Countries of Kashmar**.** This study was done in a complete randomized block design with 7 treatments and 4 replications. Analysis of variance of data showed that there were significant differences among varieties in terms of pest infestation ($P < 0.01$). The result revealed that variety Termus 14 presented the most number of adults (2.74 per leaf), nymph (8.94 per 3.88cm^2 leaf area) and egg (8.81 per 3.88cm^2 leaf area) and Green leaf okra and Red leaf okra varieties presented the lowest number of adult (0.22 and 0.26 per leaf, respectively), nymph (1.16 and 1.27 per 3.88cm^2 leaf area, respectively) and egg (1.34 and 1.67 per 3.88cm^2 leaf area, respectively). It is suggested that more investigations should be carried out on the conventional cotton varieties, green leaf okra and red leaf okra for integrated management of *B. tabaci*.

Keywords: Cotton, *Bemisia tabaci*, Resistance, Varieties

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Effect of Microwave Heating Treatment on Mortality of Indian Meal Moth (*Plodia interpunctella*) in Pistachio

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Abstract

Indian meal moth (*plodia interpunctella*) is the most important stored-product pest, which causes damage to agricultural commodities such as pistachio. Microwave heat treatment method in stored-product pests control is a new way that can be an alternative method to chemical fumigation because of its fast and safe operation. In this research, mortality and quality of infested pistachio was studied when subjected to several microwave treatment times. The mortality of third-fourth and fifth instars Indian meal moth larvae in 20, 30, 40 and 50 (s) microwave treatments and the effect of 30, 50 and 70 (s) microwave treatments on quality properties such as moisture content, peroxide value and free fatty acid value was studied. The results showed that in 20, 30, 40 and 50 (s) the percent mortality of third-fourth instars larvae was 71.66, 90.83, 97.5 and 100 respectively. The percent mortality of fifth instars larvae was 39.11, 62.75, 95.78 and 100 respectively. The moisture content of pistachio significantly decreased when treatment time increased from control to 50 and 70 (s). In contrast, Free fatty acid significantly increased when treatment time increased from control to 70 (s). The results showed that microwave treatment method in disinfestations of Indian meal moth in pistachio, considering mortality and quality of infested pistachio in a microwave treatment time, is effective.

Keywords: Heat treatment, Indian meal moth, Microwave, Pistachio

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جلد ۲۷، شماره ۱، بهار ۱۳۹۲، ص. ۴

Investigation of Multiple Competition of Weeds at Different Corn (*Zea mays* L.) Densities

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Abstract

In order to study the weed damage and to determinate the influence of weed species and multiple weed species competition in corn (*Zea mays* L.), a field experiment was conducted based on interval mapping at the Agronomy Research Field of Ferdowsi University of Mashhad during 2009-2010. Treatments consisted of four density level of crop (5, 6, 7 and 9 plant.m^{-2}) and four type of weed management (completely removed weed, broadleaf control, non control, and grass weeds control). Weed samples were taken at harvest time. Dry matters of corn samples were measured. The Density and dry matter of weed samples were recorded separately for each species. Equations were fitted single plant weight ln of each weed species or crop as dependent variable to compare and evaluate the competition coefficient of inter and intra species. Results indicated that single plant weight ln and plant density per m^{-2} had high correlation to evaluate competition coefficient. Considering the coefficients of equation the function of single plant weight ln showed that crab grass and prostrate pigweed had the most stimulation effect on corn. While redroot pigweed prostate common purslane field bindweed black night shade common lambsquars barnyardgrass purple grown nutsedge and Green foxtail had inhibition effect on corn. The positive of the former group on corn were resulted from the inhabitation effect on the latter group of weeds.

Keywords: Multiple linear regression, Crab grass, Prostrate pigweed, Competition coefficient, Single plant weight logarithm

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Investigating Possibility of Tank Mixture of Nicosulfuron+ Rimsulfuron (Ultima) with Bromoxynil+MCPA (Bromicid MA) for Weed Control in Corn in Jiroft

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Abstract

To investigate the possibility of tank-mix application of two herbicides; Nicosulfuron+ Rimsulfuron (Ultima 4% SC) and Bromoxinil+MCPA (Bromicide MA 40 % EC) for control of narrow and broadleaf weeds in corn an experiment was carried out in Jiroft Agricultural Research Centers during 2010. The experiment was conducted in a Rrandomized Complete Block design with two-factors and four replications. The first factor was Nicosulfuron+ Rimsulfuron dosage at four levels; 0, 125, 150 and 175 grams per hectare and the second factor was Bromoxynil +MCPA at 0, 0.5, 1.0 and 1.5 liters per hectare. The results showed that the best combination of tank-mix of the above mentioned herbicides, considering weed control efficiency and percent of corn yield augmentation was 0.5 to 1.0 liters per hectare of Bromoxinil+MCPA and 125 to 150 grams per hectare of Nicosulfuron+ Foramsulfuron. These treatments had the best control of weeds of *Digera muricata, Portulaca oleracea, Convolvulus arvensis, Physalis alkekengi, Amatanthus. Sp, Malva parviflora* and increased seed corn by 6719 kg ha^{-1}

Keywords: Digera muricata, Portulaca oleracea, Amatanthus. Sp, Physalis alkekengi, Malva parviflora, Yield

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Predicting Seedling Emergence of Flixweed (*Descurainia sophia* (L.) Webb.) and Hoary cress (*Cardaria draba* (L.) Desv.) in Rapeseed (*Brassica napus)* Field in Zanjan Conditions

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Abstract

Prediction of weed emergence timing would help to minimize weed–crop competition and reducing herbicide use by facilitating the implementation of more effective weed control strategies through the optimization of the timing of weed control. Therefore, in order to anticipate the of flix weed and hoary cress an experiment was conducted at the Research Farm of University of Zanjan, Zanjan, Iran, in fall planted rapeseed during 2009-2010 to find and develop the best emergence model. The number of, flix weed and hoary cress seedlings was recorded at least weekly and then removed from plots. Emergence for each species was expressed as a cumulative percentage of total emergences. Percentage of cumulative emergence values was compared with thermal time using Logistic,Gompertz and Weibull modified functions. The three models were compared using the Akaike information criterion. The results indicated that Weibull model fits best for both species with 20 to 59 differences in AIC compare with the two other models. Conversely, Logistic model fits worse, with AIC values far higher than Weibull and Gompertz models. The two species showed different patterns of emergence and TT required for 10% emergence in hoary cress was lower than the other, whereas, flix weed reached to 90% emergence faster than hoary cress.

Keywords: Winter weed, Weibull model, Gompertz model, Predicting, Weed management

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Biology of Potato Tuberworm, *Phthorimaea operculella* (Lepidoptera: Gelechiidae), on The Leaves of Ten Potato Cultivars Under Laboratory Conditions

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Abstract

The potato tuberworm, *Phthorimaea operculella* (Zeller) (Lepidoptera: Gelechiidae), is one of the most damaging pests of cultivated potato (*Solanum tuberosum* L.) crop, in both field and stores in tropical and subtropical regions. The biological parameters of this pest were evaluated in the growth chamber at 24±1°C, 65±5% RH and photoperiod of 14:10 h (L:D) on leaves of ten potato cultivars, Agria, Agata, Almira, Arinda, Baneba, Fiana, Marfona, Ramus, Satina and Volvox. The mean of total development duration (from egg to adult) of *P. operculella* was significantly different among potato cultivars. The longest immature development time (29.47±0.20 day) was estimated on Marfona leaves. The lowest values of females longevity and life cycle of *P. operculella* was obtained on Fiana and Volvox cultivars leaves, respectively. There was no significant difference among the preoviposition, oviposition periods and daily fecundity value of *P. operculella* females feeding on examined cultivars while its postoviposition period and total fecundity on the different potato cultivars differed significantly. The shortest oviposition period was estimated to be 2.57± 0.35 days on leaves of Marfona cultivar. The average of total fecundity per female was lowest on Marfona cultivar (44.61 ± 4.21 eggs). *P. operculella* has lower performance on leaves of the Marfona cultivar, subsequently, this cultivar was resistant in comparing to other cultivars and can be used in integrated pest management program of potato tuberworm.

Keywords: Biology, Potato cultivars, Potato tuberworm, Resistant cultivars

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Effect of Planting Method, Planting Density and Nicosulforon on Weeds and Corn (*Zea mays* L.) Var. KSC704 Yield and Yield Components

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Abstract

A field study was conducted to determine the effects of planting method, density and nicosulforon on corn (KSC704) and weeds grown in corn at Agricultural and Natural Resources Research Center of Khorasan-Razavi Province, Iran in 2009-2010 growing season. The treatments were: three planting methods (one row, two row and in-row), two planting density (75000 and 90000 plants/ha) and three doses of nicosulforon (Cruz®) (1.5, 2 and 2.5 l/ha) plus weed free and weedy checks. The layout was a split plot by factorial arrangements where planting methods were positioned in main plots while planting density × doses of nicosulforon were positioned as factorial in sub plots. Plot size was 3m×8m. Results showed significant decrease in weed dry matter in nicosulforon treated plots compare to the untreated control. No significant differences were observed between nicosulforon doses (1.5, 2 and 2.5 l/ha). Different planting methods had no significant effect on corn yield. Corn yield at planting density of 90000 plants/ha was significantly more than that of 75000 plants/ha. Corn grain yield, height, stem diameter, number of leaves placed upper the main ear, the height of the main ear, total leaf number, number of grain in ear, grain number in ear row, grain row number in ear in nicosulforon treated plots were significantly more than that of untreated controls. No significant differences were observed between weed free (control) and nicosulforon treated plots. Nicosulforon at doses of 1.5 l/ha and planting density of 90000 plants/ha were the best treatments.

Keywords: Nicosulforon, Planting method, Planting density

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Effects of Integrating Plant Density, Planting Pattern and Nicosulfuron Herbicide on Weed Control in Silage Maize (cv. Sc 704)

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Abstract

In order to investigate the possibility of reducing herbicide usage in combination with plant density and planting pattern, a field experiment was designed in Chenaran, Khorasan Razavi, on 2010. The experiment was split plot treatments based on RCBD with three replications in factorial arragement. The treatments included of 3 level of plant density (100000, 120000 and 140000 plants ha^{-1}) and 2 level of planting pattern (single and double row) as a main plot and Nicosulfuron dosage at four levels[(0), 50% recommended dose (1 l ha^{-1}), 75% recommended dose (1.5 l ha^{-1}) and 100% recommended dose (2 l ha^{-1})] as a sub-plots. The control plots consisted of weedy control and weed free check, respectively. Sampling was done to measure weed density, total dry matter and evaluating herbicide effect on weeds according to the EWRC 20 days after the corn emergence and repeated every 20 days. Corn silage yield was increased due to reduction of double row planting pattern and increasing of planting density significantly in dough seed stage. The results also showed that reduction of the weed density and total dry matter of weeds and desirable weed controls at first stage after the herbicide treatments. Experimental treatments had also a significant effect on weed species diversity according to shannon-winer index,sensitive population such as common purslane (*Portulaca oleracea* L.), buckhorn plantain(*Plantago lanceolata* L.), prostrate knotweed (*Polygonum* aviculare L.), black nightshade (*Solanum nigrum L.*) and Johnson grass (*Sorghum halepens* L.) was reduced and according to simpson diversity index, low population such as redroot pigweed (*Amaranthus retroflexus* L.),common lambsquarters (*Chenopodium album* L.), field bindweed (*Convolvulus arvensis* L.) and Canada thistle (*Circum arvensis* L.) by the end of growth season.

Keywords: Dry weight of weed, Good weed control, Weed diversity, Yield

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Identification of Aphid Parasitoids (Hym., Braconidae, Aphidiinae) and Determination of their Host Relationships in Southern Zagros

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Abstract

Fauna of the the aphid parasitoids at Southern parts of the Zagros submountains, and their host associations have been investigated. A total of 24 parasitoid species were identified in association with 30 aphids on 36 host plant species, representing more than 80 tritrophic associations (Parasitoid-aphid-plant). *Aphidius avenae* Haliday is newly reported from Iran. Generally, the area of southern Zagros representing major components of the central Asian area, including the broadly oligophagous to strictly specific species. Many species were in association with economically important aphid species on alfalfa and cereal fields, as well as fruit orchards.

Keywords: Host association, New record, Biological control, Southern Zagros, Aphids

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Tolerance of Wild Barley (*Hordeum spontaneum*), Wild Oat (*Avena ludoviciana*) and Different Wheat (*Triticum aestivum*) Cultivars to Metribuzin

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Abstract

In order to investigate the tolerance of wild barley (*Hordeum spontaneum*), wild oat (*Avena ludoviciana*) and different wheat (*Triticum aestivum*) cultivars to metribuzin (Sencore®), a completely randomized design experiment was conducted in Ferdowsi university of Mashhad. The treatment were replicated three times and included wheat cultivars (Atila, Chamran, Niknejad, Dorum, Gaskojen), weed species (wild barley, and wild oat), and herbicide doses (0, 100, 200, 400, 800, and 1600 g/ha of commercial formulation). The results demonstrated that wild oat was the most susceptible species to metribuzin, and wild barley (ED_{50}=722) was significantly more tolerance than wild oat (ED_{50}=257). Among wheat cultivars, Niknejad (ED_{50}=1022) and Gaskojen (ED_{50}=958) had more tolerance and Atila (ED_{50}=307) and Dorum (ED_{50}=498) were less tolerance than other cultivars and wild barley, but were significantly more tolerant than wild oat.

Keywords: Herbicide, Sencore, Weed control, Wild oat

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Introducing some Eriophyid Mites (Acari: Prostigmata: Eriophyidae), associated with Weeds in Razavi Khorasan Province

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Abstract

The majority of eriophyid mites are phytophagous and some of them are important pests of plants. However, due to host specificity and other bioecological characteristics seen in members of this family, they are considered as important biocontrol agents of weeds. In order to identify the eriophyid mites associated with important weeds in agroecosystems in Razavi Khorasan province, during 2010 and 2011 different agricultural areas were visited and a variety of broadleaf and gramineous, annual and perennial weeds from orchards, cultivated fields and roadsides were sampled. As a result, 12 species belonging to four genera of the Eriophyidae family were collected from12 different host plants belonging to eight plant families and identified as listed below. In this list, species marked with (*) are new for Iran. *Aceria acroptiloni* Shevchenko & Kovalev, 1974; *A. anthocoptes* (Nalepa, 1892); *A. chenopodia* Xue et al., 2009; *A. lactucae* (Canestrini, 1893); *A.malherbae** Nuzzaci, 1985;*A. mashhadiensis* Xue et al., 2009;*A. pulicaris* Xue et al., 2011; *A.salsolae** de Lillo and Sobhian, 1996; *A. tosichella* Keifer, 1969;*Eriophyes rotundae* Mohanasundaram, 1983;*Aculops maroccensis* Keifer, 1972; *Tetra lycopersici* Xue & Hong, 2005.

Keywords: Eriophyidae, Weeds, Biological control, Herbivore mites

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Germination of two Rumex Species in Response to Light and Soil Moisture Conditions

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Abstract

Photocontrol is a preventive method in weed management which aims to reduce the germination of photoblastic weed seeds. One of the basic researches in photocontrol is, identifying these species and their germination behavior in various environmental conditions. In this study, germination behavior of two Rumex species were investigated under two different soil moistures during nine months of burying in soil, in response to three different light conditions. Results showed both species are positively photoblastic but their response to soil moisture environment were different. Under the natural circumstances *Rumex crispus* showed a peak of germination in autumn and one in late spring, while *R.obtosifolius* seeds germinated greatly in late autumn, winter and spring, both in presence of light. *R.crispus* seeds became more sensitive to light when buried in dry soil and germination increased in full light condition. Dormancy of *R.obtosifolius* seeds seemed to alleviate more slowly in dry soil. Our results indicate that seasonal dormancy cycle would occur in both species under natural moisture conditions, and also there is a possibility of environmental factors replacing each other to satisfy germination requirements.

Keywords: Seed dormancy, Germination, Sensitive to light, Seasonal dormancy cycle, Chilling requirement, Rumex

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Determination of Spatial Distribution Pattern of *Alhagi pseudalhagi* (M.B) Desv. Population Using Learning Vector Quantization Neural Network Model (LVQ4)

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Abstract

Mapping of weeds distribution patterns for using in site-specific weed management has been favored by researchers. In this study, a learning vector quantization neural network (LVQ4) model was developed to predict and classify the spatial distribution patterns of *Alhagi pseudalhagi*. This method was evaluated on data of weed density counted at 550 points of a fallow field located in Faculty of Agriculture, Shahrood University of Technology, Semnan, Iran, in 2010. Some statistical tests, such as comparisions of the means, variance, statistical distribution as well as coefficient of determination in linear regression were used between the observed point sample data and the estimated weed seedling density surfaces to evaluate the performance of the pattern recognition method. Results showed that in training LVQ4, test and total phase P-value was greater than 0.7, 0.2 and 1.000 percent respectively, indicating that there was no significant ($p<0.05$) difference between statsitcal parameters such as average, variance, statistical distribution and also coefficient of determination in the observed and the estimated weed seedling density. This results suggest that LVQ4 neural network can learn weed density model very well. In addition, results indicated that trained LVQ4 neural network has a high capability in predicting weed density with recognition accuracy less than 0.9 percent at unsampled points. The technique showed that the LVQ4 could classify and map *A. pseudalhagi* spatial variability on the field. Our map showed that patchy weed distribution offers large potential for using site-specific weed control on this field.

Keywords: Patchy distribution, Precision farming, Classification, Weed map

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جلد ۲۷، شماره ۱، بهار ۱۳۹۲، ص. ۱۵

Brief report

Effects of Different Treatments on Breaking of Dormancy and Seed Germination of Littleseed Canarygrass (*Phalaris minor* Retz.)

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Abstract

To study the effects of different treatments on breaking seed dormancy on Littleseed Canarygrass a factorial experiment based on RCBD with 4 replications was conducted at the Weeds Science Laboratory Ferdowsi University of Mashhad.19 treatments were selected for this experiment. Treatments include: Hot water treatment (50°c for 2, 4 and 6 minutes), treated with sand paper for 5 minutes, concentrated sulfuric acid (3, 6 and 9 minutes), stratification at (5 and 10 °c) for 5 days, concentrated sulfuric acid for 3, 6 and 9 minutes+5 days of stratification, soaking treatments 24, 48, 72 and 96 hours, treatment with potassium nitrate , potassium nitrate+ stratification treatment and control were used for this experiment. The results showed that the effect of light conditions (light / dark and constant darkness) and the effect of different treatments on seed dormancy and two light regimes on the littleseed Canary grass seed germination, but the study of treatments for the seeds to sleep Canarygrass was observed a significant difference at $p<0.01$ level. Results showed that had (96%) sulfuric acid 6 min at two levels of continuous darkness and light / dark had the greatest effect that respectively, were 93 and 98% percent. The lowest germination percentage was observed in control treatments and moist chilling for 10 days, respectively, 16.5 at light/ dark condition and 11 percent at continuous darkness condition in breaking dormancy of littleseed canary grass seeds indicating that likely hard seed coat in the primary mechanism of seed dormancy in littleseed canary grass.

Keywords: Germination, Hard seed coat, Littleseed carnarygrass, Seed dormancy

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نشریه حفاظت گیاهان (علوم و صنایع کشاورزی)
جلد ۲۷، شماره ۱، بهار ۱۳۹۲، ص. ۱۶

Brief report

Detection of Plum Pox Virus (PPV) from Stone Fruits in Khorasan Razavi Province, Iran

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Abstract

Plum pox virus (PPV), the causal agent of Sharka disease, belongs to the genus *Potyvirus* in the family *Potyviridae* and has been reported from some regions of Iran. Surveys were conducted to determine the incidence of the virus in Khorasan Razavi province in 2010 and 2011 and 553 samples of stone fruit trees were collected and tested by DAS-ELISA. In this method 12 samples were infected with PPV. RT-PCR with specific primers amplified 467bp band in 3 samples. DNA fragment of Kadkan region was sequenced after purification from gel. The determined sequence of IRN-KDN isolate were compared with previously reported 29 PPV isolates, using ClustalW2. In phylogenetic analyses based on ClustalW multiple alignment and MEGA 5.1, IRN KDN displayed the highest (98% and 96%) identity with two Japanese isolates and the lowest (95% and 90%) identity with isolate of Slovakia at nucleotide and amino acid sequence levels, respectively.

Keywords: *Plum pox virus* (PPV), DAS-ELISA, RT-PCR, Khorasan Razavi, Iran

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Brief report

Report of New Collembola (Arthropoda: Hexapoda) Species from Kermanshah

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Abstract

In order to investigation of Collembola fauna, several soil and leaf litter sampling were carried out during 2011 in Kermanshah regions and species were extracted by Berlise funnel. In sum, eight species from eight genera from seven families were collected and identified. The species characterized by one star (*) are new for Kermanshah fauna. The species characterized by two star (**) are reported for the first time for Iran fauna. The species are listed as below:

Family Tullbergiidae: *Metaphorura affinis* (Boerner, 1902)*
Family Hypogastruridae: *Ceratophysella denticulata* Bagnall, 1941*
Family Isotomidae: *Isotomiella minor* Schaeffer, 1896* and *Folsomia binoculata* (Wahlgren 1899)**
Family Entomobryidae: *Pseudosinella sexoculata* (Schoet,1902)**
Family Sminthuridae: *Sminthurus cf. nigromaculatus* (Tullberg, 1872)**
Family Katiannidae: *Sminthurinus elegans* Fitch, 1863*
Family Arrhopalitidae: *Arrhopalites caecus* (Tullberg, 1871)*

Keywords: Arthropleona, Entomobryomorpha, Podumorpha, Symphypleona

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جلد ۲۷، شماره ۱، بهار ۱۳۹۲، ص. ۱۸

Brief report

Molecular Diagnosis of *Spiroplasma citri* in Citrus Cultivars, Using PCR-based Assay in Compare with DAS-ELISA

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Abstract

Spiroplasma citri, the causal agent of stubborn disease has become one of the destructive pathogen of citrus industry in Iran. One of the most important strategies for control of stubborn disease is using *S. citri*-free mother trees, propagative material and citrus nurseries and disease avoidance in new orchards. In this way, the efficiency of the standardized ELISA with poly clonal antibody and PCR protocol with three different primer pairs was assessed. The results revealed that ELISA was not able to detect low titre of infection (in symptomless samples) so using ELISA techniques in certification system was not recommended and has significant problem such as false negative reaction. PCR method and specially P89f/r primers in compare with two other primers P58-1f/5r and P58-6f/4r was able to detect low titre of north and south strains of pathogen in moderate seasons. Out of a total 350 samples screened for presence of *S. citri* by the PCR method only 4/6 % showing positive results in symptomless samples.

Keywords: *Spiroplasma citri*, Detection, PCR, ELISA, Citrus

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