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Effects of Soil Water Level, Black Dot (*Colletotrichum coccodes*) Infested Soil and Nutrient Depletion on Potato in a Controlled Environment

Thomas F. Cummings, Dennis A. Johnson..... Pages 327-336

Abstract: The effects of soil water level and soil infested or not infested with *Colletotrichum coccodes* were quantified and compared on Umatilla Russet potato in repeated greenhouse trials. Nitrogen levels in leaflets and tuber yield differed significantly for effect of water level but there was no effect for soil infestation in both trials. More leaflet N as measured by chlorophyll and less tuber yield occurred in the low than the medium and high soil water treatments. Number of progeny tubers was not affected by *C. coccodes* but numbers were significantly less for the low water level than the high water level in one trial. Root weight was significantly reduced by *C. coccodes* in both trials and was significantly less in the high than the low and medium soil water levels in one trial. Incidence of infected progeny tubers was significantly reduced in infested soils for the low soil water compared to the medium or high soil water levels in one trial. The effect of increasing levels of water in infested soils had large and significant increases for percentage of stem area with sclerotia in both trials. Managing soil water by not overwatering in irrigated potato fields in the presence of *C. coccodes* may reduce black dot severity and quantity of sclerotia that potentially can overwinter and serve as sources of infection for subsequent crops. Analyses demonstrated a potential for significant associations between plant and disease variables not evidence for cause and effect.

Mineral Oil Inhibits Movement of *Potato Virus Y* in Potato Plants in an Age-Dependent Manner

Fadi Al-Daoud, Manphool S. Fageria, Jianhua Zhang..... Pages 337-345

Abstract: *Potato Virus Y* (PVY) is one of the most devastating pathogens threatening potato production worldwide. It is a RNA virus that is disseminated by aphids in a non-persistent manner. Regular application of mineral oil on potato fields is known to reduce the number of PVY-positive tubers in post-harvest testing. The mechanism of this phenomenon is not well understood, but it is hypothesized to influence the virus-vector-plant relationships. Here, we present data from greenhouse and field trials that shed light on the effect of mineral oil on local and systemic accumulation of PVY⁰ in susceptible Shepody and Russet Burbank. The data suggests that mineral oil did not influence PVY⁰ levels in mechanically-inoculated leaves nor tubers of plants with a secondary infection. However, a reduction in systemic PVY⁰ levels was observed in mineral oil-treated older plants but not in younger plants, suggesting that mineral oil inhibits PVY⁰ movement in an age-dependent manner.

Differential Growth Response and Minituber Production of Three Potato Cultivars Under Aeroponics and Greenhouse Bed Culture

Roberto Tierno, Ana Carrasco, Enrique Ritter..... Pages 346-353

Abstract: We have evaluated and compared different methods and cultivars for the production of quality prebasic seed in potato. Two cultivation systems, aeroponics and greenhouse beds with a peat moss substrate, and three potato cultivars with different vegetative cycle, Agria, Monalisa and Zorba, were assayed. Plants in the aeroponic system showed increased growth and their vegetative cycle extended between 12 and 36 % compared to the plants cultivated in greenhouse beds. Flowering and tuberization dates, Absolute Growth Rates (AGR) during the period of 60 days after planting (DAP) and height presented a wide variation between cultivars. Zorba showed earlier flowering and tuberization, lower AGR and reached a minor height at 60 DAP. Instead the late season cultivar Agria showed later flowering and tuberization, presented higher AGR and reached an increased height at 60 DAP. The total tuber yield per plant was between 34 and 87 % higher in the aeroponic system, with a marked difference for the earlier cultivars Zorba and Monalisa. Tuber numbers increased between 60 and 80 %. Minituber production in aeroponics showed a better size distribution, with a reduction in the percentage of tubers smaller than 12 mm of between 33 and 86 %. In this soil-less culture system average tuber weight increased in Zorba and Monalisa over 60 % but was lower for Agria. Further studies are needed to optimize aeroponics system, which can be considered a high yield potato multiplication system, particularly for early or mid season potato cultivars that may produce best quality minitubers.

Abstract: [ELISA \(enzyme-linked immunosorbent assay\)](#) is a sensitive and reliable method of plant virus detection. It is commonly used in daily research carried out by scientific institutions and laboratories working on the certification of potato tubers. The key stage in this method is a 3–4-h-long incubation of microtiter plates with IgG and with a conjugate in an incubator at a temperature of 37 °C. The aim of the research was to replace this type of incubation process with a technique of mechanically shaking the plates using a shaker to induce a vibrating movement. Three durations of shaking, performed at room temperature, were adopted: 30, 60 and 90 min with two incubation periods at a temperature of 37 °C: 60 and 180 min which were applied at the stage of coating the IgG plates, following addition of the conjugate. The assessment was made for three dilutions of lyophilized sap from leaf of potatoes (1:10, 1:100, 1:1,000). Replacing the stages of plates incubation with IgG and conjugate at 37 °C with mechanical shaking allowed the whole process of DAS-ELISA to be reduced below 3–4 h without any significant impact on its quality. The process turned out to be equally efficient as the 3-h-long incubation in an incubator for PVY, PVM and PLRV detection by means of DAS ELISA. Applying the 90-min-long incubation on a shaker in comparison to a 3-h-long incubation in an incubator gave comparable or even slightly improved results. The reaction background, i.e. the value of absorbance for sap from healthy plants (negative control) was very low in all the combinations irrespective of the time of reading after the substrate was placed. No significant differences for this parameter were found between the combinations and times of reading. Only in the case of PLRV was a clearly visible decrease in test sensitivity found (no positive reactions) at diluted sap over 1:10. Moreover, it was observed that an increase in dilutions impacted the length of reaction. The dilution 1:10 seemed to be the most favorable (maximum 1:100 for PVY and PVM), wherein the sensitivity and pace of staining the substrate for each of the methods did not provoke any doubts regarding the reliability of the test.

[Resistance of Selected Potato Genotypes to the Potato Psyllid \(Hemiptera: Trioziidae\)](#)

John Diaz-Montano, Beatriz G. Vindiola, Nichole Drew..... Pages 363-367

Abstract: The characterization of resistance of selected potato, *Solanum tuberosum* L., breeding clones to the potato psyllid, *Bactericera cockerelli* (Sulc) (Hemiptera: Trioziidae) was investigated. Antixenosis was assessed in choice tests in which a single plant of each genotype was placed inside a rearing cage, where 60 female psyllid adults were released and the number of adults and eggs on each genotype was counted 24 h later. Antibiosis was evaluated in no-choice tests in which adults (five males and five females) were confined in a cage fixed to the upper side of leaves. After 4 h of exposure, adults were removed and the number of eggs counted. The developmental time and survival of offspring were recorded until all insects became adults. All the resistant genotypes showed strong antibiotic effects to *B. cockerelli*. These results show promise for incorporation into an IPM program against *B. cockerelli*.

[Selection and Validation of an AFLP Marker Core Collection for the Wild Potato *Solanum microdontum*](#)

John Bamberg, Alfonso del Rio..... Pages 368-375

Abstract: *Solanum microdontum* is a diploid potato species with features that make it a good model for research into management and use of germplasm in the genebank. Its taxonomic status is unambiguous and it is in the taxonomic series of wild species closest to cultivated forms. It is represented by about 100 populations in the genebank—not too many for comprehensive evaluation, yet not too few to make prioritization of the most valuable populations worthwhile. This species is also particularly rich in desirable traits, often exhibiting very broad segregation. We here report use of DNA markers for selection of a core set of populations, and assessing whether that core captures populations with the most desirable evaluation results for economic traits. DNA was extracted from bulks of 27 plants from each of 94 populations to generate AFLPs. A total of 1,741 informative loci were detected. AFLP loci were treated as though they were traits, with the banded condition considered to be the desired state to include in a core set. At least one band unique to a population was present in 45 populations, and these 45 populations together captured 98 % of all bands. Adding another 14 populations for a core of 59 populations captured 100 % of bands. This core set was assessed for whether it encompassed those populations known to have useful traits, including nutritional and quality components; and disease, stress and pest resistances. As with AFLP bands, 25 of 26 of the most desirable phenotypic traits were also found in populations in the core set of 59 populations. The most desirable status of 3 traits is lost by selecting a core of 45

populations. We conclude that these core sets would be a rational starting point when prospecting for new useful traits in *microdontum*.

[Varietal Differences in Minituber Production Costs](#)

Joseph F. Guenther, Amy Charkowski, Ruth Genger..... Pages 376-379

Abstract: Minitubers have become important components of seed potato production systems. Minituber production methods and yields affect costs. We used data from the University of Wisconsin seed potato program to estimate minituber production costs by variety in 2009, 2010, and 2011. Labor is identified as the most significant operating cost, while salaries represent the greatest fixed cost. The 3 year average total cost per minituber across all varieties was estimated at \$0.47. Of the varieties grown in all 3 years of analysis Langlade had the highest average yield and lowest cost. Yukon Gold and Pike had the lowest yields and highest costs.

[Teton Russet: An Early-Maturing, Dual-Purpose Potato Cultivar Having Higher Protein and Vitamin C Content, Low Asparagine, and Resistances to Common Scab and *Fusarium* Dry Rot](#)

R. G. Novy, J. L. Whitworth, J. C. Stark..... Pages 380-393

Abstract: Teton Russet is an early-maturing, medium-russeted, potato cultivar with high merit for both fresh-pack and processing. In early harvest trials in the Pacific Northwest, Teton Russet had total yields similar to Russet Norkotah, and higher than Ranger Russet and Russet Burbank. Marketable yield of Teton Russet in the early harvest trials was also comparable to or higher than Russet Norkotah in Washington and Oregon, and higher than Ranger Russet and Russet Burbank at these sites, as well as in Idaho. In full-season trials, while total yield of the earlier-maturing Teton Russet tended to be lower than Ranger Russet and Russet Burbank, marketable yield was generally higher than Russet Burbank across the majority of sites due to its higher percentage of U.S. No. 1 tubers. Teton Russet is suitable for processing, with acceptable fry color following up to 8 months of storage at 8.9 °C. Uniformity of fry color was also very consistent. Teton Russet has shown lower levels of the amino acid asparagine relative to Ranger Russet and Russet Burbank which may contribute to lower acrylamide levels in French fries and other processed potato products. Teton Russet is notable for having resistance to common scab (*Streptomyces* spp.) and *Fusarium* dry rot, and is moderately resistant to tuber net necrosis. Analyses have also shown Teton Russet to have significantly higher protein levels than Russet Norkotah, Ranger Russet, and Russet Burbank, as well as higher vitamin C content than Russet Norkotah and Russet Burbank. Teton Russet was released in 2011 by the USDA-ARS and the Agricultural Experiment Stations of Idaho, Oregon, and Washington, and is a product of the Pacific Northwest Potato Variety (Tri-State) Development Program.

[Glyphosate Carryover in Seed Potato: Effects on Mother Crop and Daughter Tubers](#)

Pamela J. S. Hutchinson, Joel Felix, Rick BoydstonPages..... Pages 394-403

Abstract: Field studies were conducted in 2008 and 2009 in Aberdeen, ID, Ontario, OR, and Paterson, WA to determine the effect of simulated glyphosate drift on 'Ranger Russet' potato during the application year and the crop growing the next year from the daughter tubers. Glyphosate was applied at 8.5, 54, 107, 215, and 423 g ae ha⁻¹ which corresponds to 1/00, 1/16, 1/8, ¼, and 1/2 of the lowest recommended single-application rate for glyphosate-resistant corn and sugar beet of 846 g ha⁻¹. Glyphosate was applied when potato plants were at 10 to 15 cm tall (Early), or at stolon hooking (H), tuber initiation (TI), or during mid-bulking (MB). In general, the MB applications caused less visual foliar injury to the mother crop than earlier applications at ID or OR, and H applications at WA. Mother crop injury increased as glyphosate rate increased regardless of location, application timing, and rating date. U.S. No.1 and total tuber yields were usually related to the injury level resulting from glyphosate application timings and rates. Although injury to the mother crop from glyphosate applied at MB usually was the lowest compared to injury from other application timings, when daughter tubers from that timing were planted the following year, emergence, plant vigor, and yield was most detrimentally impacted compared with that of daughter tubers from other timing treatments. MB daughter tuber emergence was less than 30 % of the nontreated control tuber emergence while emergence of daughter tubers from the other treatments was 60 to 95 %. As rate of glyphosate applied to the mother crop increased, daughter tuber emergence decreased. When MB daughter tubers did emerge, plants were chlorotic and stunted as if the plants had been directly sprayed with glyphosate. Regardless of whether the daughter tubers had defects or not, results the following year were the same. Implications are that if a mother seed crop encounters glyphosate during

bulking, injury may not even be noticeable on the foliage or the tubers, however, emergence, vigor, and yield of the crop growing the following year from the daughter tubers could be greatly impacted.

[Stability Analysis of Agronomic Traits in Potato Cultivars of Different Origin](#)

Bogdan Flis, Leszek Domański, Ewa Zimnoch-Guzowska..... Pages 404-413

Abstract: Potato (*Solanum tuberosum* ssp. *tuberosum*) cultivars are expected to express a stable level for traits important for growers and consumers. To investigate how this expectation was met by a set of 21 cultivars bred in Hungary, Poland and Spain, 2-year field experiments were carried out in these countries for the evaluation of tuber yield, starch content and yield, and occurrence of secondary growth of tubers. Stability in an agronomic sense was evaluated by the analysis of genotype by environment interaction (GE) using the Scheffé-Caliński mixed model. Unstable trait expression was indicated by the statistically significant share of GE in the variability contributed by a specific cultivar. This instability could lead to either complete or partial unpredictability. Stable trait expression was observed for 6–11 cultivars, depending on the trait. A significant genetic factor, which indicates broad adaptation, was rarely found. Stable expression of tuber yield occurred together with stable or predictable expression of both starch content and yield. Unstable expressions of tuber and starch yield were also associated. The stability or instability of secondary growth was not associated with stability or instability of the other measured traits. Analysis of GE interaction was useful for identifying stable or unstable responses and revealed the presence of incomplete stability or partial unpredictability as intermediate types of reaction.

[Potato Early Dying and Yield Responses to Compost, Green Manures, Seed Meal and Chemical Treatments](#)

Oscar I. Molina, Mario Tenuta..... Pages 414-428

Abstract: *Verticillium dahliae* Kleb. is a soilborne fungal pathogen of many crops. In potato, it is the major causal agent of Early Dying. In Manitoba, potato fields planted with cv. Russet Burbank are infested with highly pathogenic *V. dahliae* isolates, which can produce up to 90 % disease severity. The objective of the study was to evaluate selected compost, green manure, and seed-meal treatments, in comparison with the soil fumigant Vapam, for their ability to reduce propagule density of *V. dahliae* in soil and decrease disease, and to enhance potato yield. Select green manure crops (oriental and white mustard, Canada milk vetch, sorghum-sudangrass, rye, alfalfa, oat/pea mixture), organic amendments (composted cattle manure and mustard seed-meal), and Vapam, and crop sequences that contribute to the suppression of *Verticillium*, or the improvement of potato yield were used in a 3-year field study initiated in 2006. Survival in soil of microsclerotia was evaluated as a measure of treatments' success in potentially reducing Early Dying. Compost and seed-meal treatments, compared to an untreated control, reduced incidence to 30 and 40 %, respectively, but only seed-meal reduced *V. dahliae* propagule density. Overall, green manures over 1 or 2-years were ineffective in reducing propagule density or improving potato yield. Vapam was partially effective in reducing the propagule density only at the beginning of the potato season, but it did not reduce disease incidence compared to the control. Compost and seed-meal are promising as alternative control of *V. dahliae*. Only compost reduced disease and increased potato yield, which was associated with improved nutrient availability (phosphorus and sulfate) in soil.