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Recent developments: late blight in Latin America

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Late blight is the most important disease in Latin America causing big productive losses and affecting food security. Therefore a group of researchers have decide to constitute the Tizonlatino network (https://tizonlatino.wordpress.com/), with the objective to share knowledge and protocols about the pathogen, the disease and its management, with the goal to advance in its sustainable control. This group is already performing studies to monitor and characterize the causal agent of late blight in different countries, disease management and control strategies using predictive systems.

Phytophthora infestans was originated in America and co-evolved with its host potato. Today, also new species of Phytophthora have been described in association with Solanaceae, this is the case of *P. andina* (Oliva, et al, 2010, Adler et al, 2004). *P. andina* and *P. infestans* attack potato, tomato and *S. muricatum*, but *S. betaceum* has only been associated with *P. andina* in Ecuador and Perú, while in Colombia, there is a mix of *P. andina, P. infestans* and probably intermediate genotypes (Forbes et al, 2013). On the other hand*, P. infestans* population shows a clonal population in some countries, such us in Colombia, Ecuador, Costa Rica, Peru and Chile, A1 mating type is described associated to potato but in Bolivia and Uruguay, mating type A2 is named. In Argentina, early in the 90's A2 was described in 89% of the population, and later in this decade A2 was the only one detected, but today, A1 is again predominant. Additionally, EC1 are dominant clonal lineage in Colombia, Ecuador and Perú, but in the last one, new lineages have been discovered in very high frequency, while, Chile used to be US1 the main population, but today the predominant is 2-A1, the same genotype described in Argentina. On the other hand, in México many studies has been performed about *P. infestans* characterization, host resistance and control, due to the high variability of pathogen genotypes and the presence of A1 and A2 mating type (Acuña et al, 2016).

Today, much work has been done combining different cultivar resistance and fungicide strategies, suggesting that the use of cultivars with reduced susceptibility to late blight can be managed with reduced fungicide rates and longer application intervals, thus offering more economical control of this disease, saving between 30 to 60% of the fungicide input. Most major genes known until now mainly come from *S. demissum*, however a number of new genes have recently been detected in other *Solanum* spp. such as *S. bulbocastanum*, *S. verucosum, S. stoloniferum, S. papita, S. venturi, S. microdontum, Solanum berthaultii and Solanum*

mochiquense. Much work has been performed introgressing R genes from the Mexican hexaploid species *S. demissum*, however, it is expected that there are more unidentified genes or genes interaction enhancing the resistance, therefore new source of resistance are being studied (Solano, et al., 2016, Solano et al., 2014, Diaz et al., 2003, Gabriel et al., 2007). Moreover, different studies have been developed by CIP about functionality of R genes and effector allele composition in Peruvian populations of *P. infestans* (Lindquist-Kreuzer et al., 2014) and the potato breeding program carried out by INIA Chile, has started a systematic crossing program to develop potato varieties with increased and more durable resistance, using molecular techniques to select segregants carrying multiple genes from crosses using R gene donor genotypes (Muñoz et al., 2015).

In addition, cultural practices are an important part of an integrated management program because it reduces the incidence and severity of the disease epidemic, thereby reducing yield losses and also, sometimes lowering the requirement of fungicides, especially in developing countries, because in these countries both the small scale farming (low yields) and the large scale farming (high yields) coexist (Mizubuti and Forbes, 2002).

Forecasting allows a better control of a disease and a more efficient use of fungicides. Today there is a great amount of weather information available and easy communication systems that makes the forecast an excellent decision support system (DSS) to develop an integrated pest management. These systems use different information and grade of complexity, according to the decisions makers (Acuña, 2007; Perez et al., 2016; Lucca and Rodriguez, 2015, Schepers, 2002, Fry et al., 1983). Some of them do not require technology like Hand-held DSS (HH-DSS) develop by the International Potato Center (CIP) to be used by small farmers in the Andes, which using only observation of the weather by the farmer and management, demonstrated similar performance than Simcast (Perez et al., 2016). Others are slightly sophisticated but easy to use by farmers, such is the case of the ones implemented by Argentina and Chile (Schepers, 2002; Acuña et al, 2007; Lucca and Rodriguez, 2015). In Chile, Late blight DSS is available since 2007, this system, today with 5000 users, utilize only weather information to do the warning, which is delivery to the farmers through a web page, SMS and e-mail (http://tizon.inia.cl). In a survey done about using the system, it shows that 42% of the farmers applied fungicide based on DSS information with 50% less spray compared to a schedule application (Bravo et al, 2016). Similarly, in Argentina an impact study about use DSS demonstrated 33% of monetary saving and spray reduction of 26% (Lucca and Rodriguez, 2015).

Thereby, warning systems are useful tools to develop integrated pest management, but the most important and fundamental is to consider what and how information is delivered to final users, It needs to be simple and easy to understand. Today, Tizon Latino network will start new studies focus in Late blight DSS as a tool to climate change adaptation in Latinoamerica.

REFERENCES

Acuña, I., Restrepo, S., y Gabriel, J. (Eds). Resúmenes del Segundo Taller de la red de Cooperación Latinoamericana sobre el estudio del tizón tardío de las solanáceas. (Agosto 21, 2016, Panamá). Revista Latinoamericana de la papa 20 (1): 45-64. ISNN: 1853-4961.

Acuña, I., Sagredo, B., Bravo, R., Gutiérrez, M., Maldonado, I., Gaete, N., Inostroza, J., Secor, G., Rivera, V., Kalazich, J., Solano J. and y Rojas, J. (2007). Using a forecasting system to develop integrated pest management strategies for control of late blight in southern Chile. Proceedings of the Tenth Workshop of European network for development

of an integrated control strategy of potato late blight. Bologna, Italy, 2nd - 5th May 2007. PPO Special report N° 12: 237-249.

Adler, N.E., L.J. Erselius, M.G. Chacón, W.G. Flier, M.E. Ordoñez, L.P.N.M. Kroon and G.A. Forbes (2004). Genetic diversity of *Phytophthora infestans* sensu lato in Ecuador provides new insight into the origin of this important plant pathogen. Phytopathology, 94(2), pp.154–162.

Bravo, R. (2016). Sistema de alerta temprana para Tizón tardío de la papa: Experiencia aplicada en Chile. Pages 15-18. In: Compendio de resúmenes XXVII Congreso Asociación Latinoamericana de la papa ALAP. 22 al 26 de agosto 2016. Ciudad de Panamá, Panamá. 236 pp. ISBN: 978-9962-677-43-7.

Díaz, M., Fajardo, D., Dilmer, J., García, C. and Núñez, V. (2003). Identificación de genes R1 y R2 que confieren resistencia a *Phytophthora infestans* en genotipos colombianos de papa. Revista Colombiana de Biotecnología, 5, 40-50.

Forbes, G.A., Morales, J.G., Restrepo, S., Pérez, W., Gamboa, S., Ruiz, R., Cedeño, L., Fermin, G., Andreu, A., Acuña, I., and Oliva, R. (2013). *Phytophthora infestans* and *P. andina* on solanaceous hosts in South America. In: K. Lamour (Ed.). *Phytophthora*: A global perspective. CABI Plant Protection series 2. CABI International. 244 p. ISBN 978-1-78064-093-8.

Fry, W.E.; Apple A.E. and Bruhn, J.A. (1983). Evaluation of potato late blight forecasts modified to incorporate host resistance and fungicide weathering. Phytopathology 73:1054-1059.

Gabriel, A., Coca, G., Plata, J. and Parlevliet, J. (2007). Characterization of the Resistance to *Phytophthora infestans* in Local Potato Cultivars in Bolivia. Euphytica, 153, 321-328. http://dx.doi.org/10.1007/s10681-006-9237-x

Lindqvist-Kreuze, H., Gastelo, M., Perez, W., Forbes, G., de Koeyer, D and Bonierbale, M. (2014). Phenotypic Stability and Genome-Wide Association Study of Late Blight Resistance in Potato Genotypes Adapted to the Tropical Highlands. Phytopathology. 104: 624 -633.

Lucca, M.F. and Rodriguez, J. (2015). Phytoalert: when less is more. Proceeding of the fifteenth Euroblight Workshop, 13-15 May 2015. Brasov, Romania. PPO Special report N°17:243-248.

Mizubuti, E. and Forbes, G. (2002). Potato Late Blight IPM in the Developing Countries. Global Initiative in Late Blight Conference. Late blight: Managing the global threat. March 11-13, 2002. Hamburg, Germany. Pages 93-97.

Muñoz, M., Folch, C., Uribe, M., Kalazich, J. and Orena, S. (2015). Using the MaR8 and MaR9 genotypes as sources of resistance to late blight in the Chilean Potato Breeding program. Page 27. In: Proceedings of First Latin American Conference on Phenotyping and Phenomics for Plant Breeding November, 30, December 1 and 2. Universidad de Talca. Talca, Chile.

Oliva, R.F., Kroon, L.P.N., Chacón, G., Flier, W.G., Ristaino, J.B. and Forbes, G.A. (2010). *Phytophthora andina* sp. nov., a newly identified heterothallic pathogen of solanaceous hosts in the Andean highlands. Plant Pathology, 59(4), pp.613–625.

Perez, W., Andrade J., Ortiz, O and Forbes, G. (2016). Page 59. In: Acuña, I., Restrepo, S., y Gabriel, J. (Eds). Resúmenes del Segundo Taller de la red de Cooperación Latinoamericana sobre el estudio del tizón tardío de las solanáceas. (Agosto 21, 2016, Panamá). Revista Latinoamericana de la papa 20 (1): 45-64. ISNN: 1853-4961.

Schepers, H. (2002). Potato late blight IPM in the industrialized countries. Global Initiative in Late Blight Conference. Late blight: Managing the global threat. March 11-13, 2002. Hamburg, Germany. Pages 89-92.

Solano, J., Acuña, I., Chauvin, J. and Brabant, P. (2016). In-Vitro Evaluation of Resistance to Late Blight (*Phytophthora infestans* Mont. De Bary.) in Solanum Accessions Native to Chile, by Inoculation of Detached Leaflets. American Journal of Plant Sciences, 7, 581-589. doi: 10.4236/ajps.2016.73051

Solano, J., Acuña, I., Esnault, F. and Brabant, P. (2014). Resistance to *Phytophthora infestans* in *Solanum tuberosum* Landraces in Southern Chile. Tropical Plant Pathology, 39, 307-315. http://dx.www.scielo.br/pdf/tpp/v39n4/v39n4a05.pdf http://dx.doi.org/10.1590/S1982-56762014000400005