Opportunities for potato late blight DSS's in Argentina

G. KESSEL[1], M. HUARTE[2], F. LUCCA[2], M. SANTINI[3], C. RIJZEBOL[4], P. RAATJES[4], J. ROVERS[5], J. DEN BOER[5], AND H. SCHEPERS[6]

[1] Wageningen University and Research Centre, Plant Research International, Biointeractions and Plant Health, P.O. Box 69, 6700 AB Wageningen, The Netherlands.
[2] El Instituto Nacional de Tecnología Agropecuaria (INTA) EEA Balcarce, Ruta Nacional 226, km 73.5, (7620) Balcarce, Argentina.
[3] Farm Frites, Av. Alexander Fleming 2238, B1606DAB, Munro, province of Buenos Aires, Argentina.
[4] Dacom B.V., P.O.Box 2243, NL-7801 CE, Emmen, the Netherlands.
[5] Farm Frites International B.V., Molendijk 108, 3227 CD, Oudenhoorn, the Netherlands.
[6] Wageningen University and Research Centre, Applied Plant Research, P.O. Box 430, 8200 AK Lelystad, The Netherlands.

KEYWORDS
Potato late blight, Argentina, disease management, decision support

INTRODUCTION

Continental Argentina stretches from just North of the Tropic of Capricorn to near the Antarctic Peninsula, resulting in a wide range of available climates. As the largest beef exporter in the world and the third largest producer of soybeans, Argentina has a very strong and significant agricultural sector. Almost 60% of Argentina's total exports are agriculture related. Currently, processing facilities are being updated to meet improved food quality and safety initiatives. Argentina has very good storage, distribution and logistic systems to facilitate the export oriented activities of the sector. Despite consumer hesitation surrounding genetically modified organisms, Argentina is a world leader in bio-technology. Soybeans, Argentina's most prominent commodity, are planted almost entirely with GMO seeds. In addition, approximately 90% of the corn acreage is grown using GMO seeds. At the other end of the spectrum, Argentina is also a strong producer of organic products, which are mostly destined for European markets.
Agriculture accounts for over 11% of Argentine GDP. Top agricultural field crops are soybeans, sunflower seeds, lemons, grapes, corn, tobacco, peanuts, tea and wheat. Top livestock production is in beef, poultry, dairy and some specialty meats such as llama, frog and iguana. Argentina's land base holds approximately 12% arable land, with less than 1% dedicated to permanent crops. Environmental concerns in Argentina include deforestation, soil degradation, desertification, and air and water pollution (1).

Potato is an important staple food and horticultural crop in Argentina. Although the potato area only covers 0,5% of the area covered by soybean, 0.08 mln ha versus 17 mln ha respectively, export of potato and potato products is growing whereas potato imports did not take place since 1984. The

PPO-Special Report no. 14 (2010), 75 - 78

total potato area of Argentina is around 77,000 ha with an average annual yield of around 35 t/ha. The processing industry transforms around 450,000 t of potatoes, of this quantity 70% is being exported. The technology level of potato production varies with the size of the growers potato area and the production goal. Potato production may reach high technology levels with large and medium size growers (from 150 ha up) producing potatoes for the processing industry although smaller growers producing potatoes for the fresh market still use a lot of hand labor, especially for harvest.

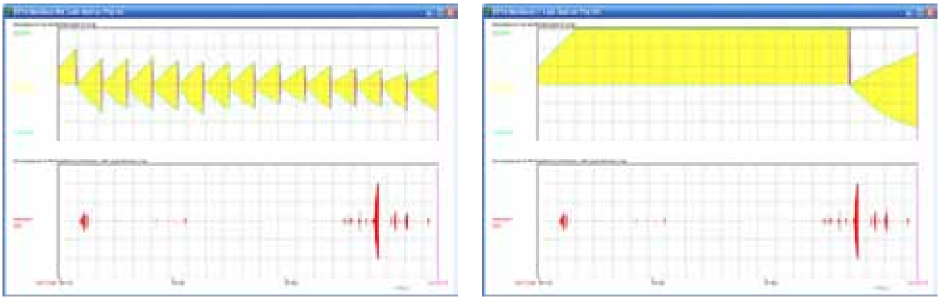

Fig 1. *Analysis of weather data from the 2009 - 2010 growing season in the Mendoza area assuming a weekly spray schedule (left panel) and a calculated optimal spray schedule (right panel). The lower half of the graphs indicate potato late blight infection risks whereas the upper half quantifies the unprotected foliage in the potato crop. Ideally, sprays are applied shortly before an infection event when a significant fraction of the foliage is unprotected.*

The main production areas can be found in the Provinces of Buenos Aires (Processing/Fresh, 26000 ha; November - March/May), Cordoba (Fresh/Processing, 36000 ha; August – November), Mendoza (Fresh/Processing, 7500 ha; November – March) and Tucumán (Fresh, 6000 ha June – October).
Bulk cold storage of ware potatoes is almost non existing considering that the country produces fresh potatoes all year round. Ware potatoes are therefore mostly stored on the fields for short periods prior to shipping for the market, with the exception of warm areas as Córdoba where some cold storage is used.
The Argentine potato sector may however benefit from the introduction of new technologies to boost yields and quality and to lower losses (1). The main crop protection problems are mostly shared between the growing areas and encompass thrips and related viral infections (Tomato Spotted Wilt Virus, TSWV), early blight (Alternaria spp.) and late blight (*Phytophthora infestans*). When possible and feasible, these threats are controlled with pesticide applications against the causal organisms. On the other hand, the Argentine potato sector benefits from absence of the Golden Nematode and an established commercial seed production system with post production quality control systems, in vitro multiplication and mini tuber production. Argentina has not imported seed for commercial production since 1984 with the exception of small quantities of new varieties.

Currently the first internet based decision support systems to control potato diseases have been introduced and the first farm managers are adapting from fixed (weekly) spray schedules to dynamic, DSS guided, spray schedules. Farm Frites and Dacom have introduced Dacom system in the Mendoza area and, following in the footsteps of an earlier DSS operational in the 1960's and 1970's, INTA and McCain are cooperating in the development of a potato late blight DSS for the South East region of the Buenos Aires Province (3, 4).
Mendoza's climate can be characterized as arid with Mediterranean influences. Average temperatures

for January (summer) are 32 °C during daytime, and 18.4 °C at night. In July (winter) average temperatures are 14.7 °C and 2.4 °C, day and night respectively. Mendoza's annual rainfall is only 223.2 mm. Intensive agriculture, including potato production, is made possible due to (continuous) irrigation. In contrast, Balcarce has a humid-temperate climate with an average annual temperature of 14°C and 890 mm average annual rainfall.
For the purpose of this paper, weather data from these two, climatologically very different, regions were analyzed to evaluate the opportunities and added value of decision support systems for potato late blight control in local potato production.

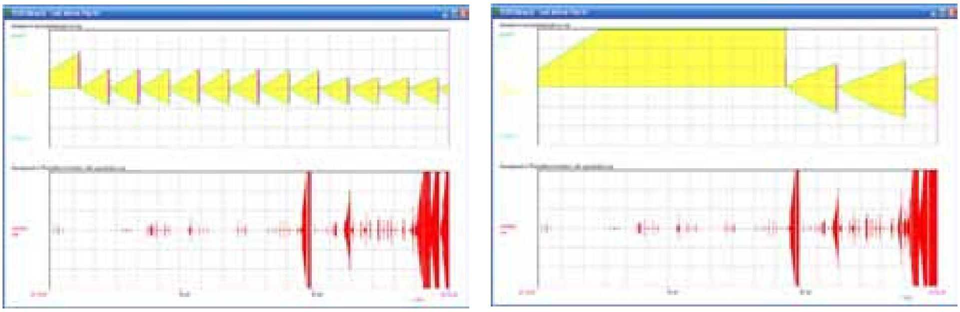

Fig 2. *Analysis of weather data from the 2007 - 2008 growing season in the Balcarce area assuming a weekly spray schedule (left panel) resulting in 13 applications and a calculated optimal spray schedule (right panel) resulting in 3 spray applications. The lower half of the graphs indicate potato late blight infection risks whereas the upper half quantifies the unprotected foliage in the potato crop.*

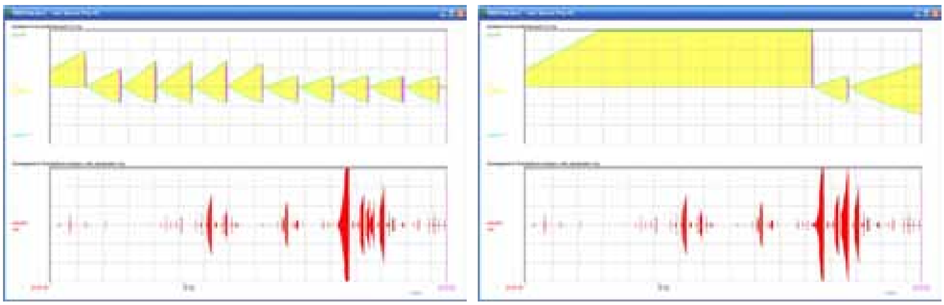

Fig 3. *Analysis of weather data from second half of the 2008 - 2009 growing season in the Balcarce area assuming a weekly spray schedule (left panel) and a calculated optimal spray schedule (right panel). The lower half of the graphs indicate potato late blight infection risks.*

RESULTS

Mendoza

Weather data were measured on farm during the 2009- 2010 growing season and analyzed for potato late blight infection risks using the Dacom system. As an approximation of the situation at San Fili farm, a weekly spray schedule (Figure 1, left panel) was assumed to provide reference data and an optimal spray schedule was generated by Dacom (Figure 1, right panel). The virtual weekly spray schedule for San Fili Farm resulted in 15 spray applications over the season whereas other growers in the same area would cover the season with around 10 applications. In contrast, the calculated (!)

optimal spray schedule suggests only one (1) spray application was needed. A difference of 9 - 14, potentially unnecessary, spray applications providing ample opportunity for DSS's to improve spray timing and efficacy while at the same time a reduction of production costs and emission to the environment can be achieved.

Balcarce

Weather data from the 2007 – 2008 (Figure 2) growing season and the second half of the 2008 – 2009 (Figure 3) growing season were also analyzed by Dacom for potato late blight infection risks. During the 2007 – 2008 growing season, a virtual weekly spray schedule would have resulted in 13 spray applications. Farmers in the Balcarce area generally cover the season with around 15 applications. The calculated (!) optimal spray schedule would have resulted in only three spray applications, a difference of 10, potentially unnecessary, spray applications. Also during the second half of the 2008 – 2009 growing season a weekly spray schedule would have resulted in around nine unnecessary spray applications: a weekly spray schedule during this period would have resulted in 11 applications whereas only 2 applications were necessary according to the Dacom system.

Despite the climatological differences between the Mendoza and the Balcarce area, the analysis of measured weather data gave similar results with respect to the potato late blight control strategy. In both areas, ample opportunities exist for application of DSS guided disease control, providing optimal spray timing, as related to the actual disease cycle and a reduction of the production costs and environmental side effects.

DISCUSSION

DSS's integrate available information on the (measured and forecasted) weather, the disease cycle, the crop and previous spray applications to generate an optimal spray schedule. Spray applications are matched with high risk periods thus providing optimal protection when necessary while at the same time the crop is left unprotected when infection risks are negligible. DSS's thus avoid unnecessary spray applications and provide an optimal timing for the remaining applications. The general result is an equal or improved control efficacy as compared to (nearly) weekly spray schedules, a reduction of the number of applications and thus a reduction of the production costs (e.g. Hansen *et al.*, 2002). Results from both, climatologically very different, regions in Argentina clearly illustrate the potential for introduction of DSS guided control strategies.

REFERENCES

Anonymous, 2008. Potato production in Argentina. Report for the Netherlands ministry of agriculture, nature and food quality, prepared by the bureau of the Netherlands agricultural council in Buenos Aires, Argentina.

Hansen, J.G., B. Kleinhenz, E. Jorg, J.G.N. Wander, H.G. Spits, L.J. Dowley, E. Rauscher, D. Michelante, L. Dubois, T. Steenblock, 2002. Results of validation trials of Phytophthora DSSs in Europe, 2001. Proceedings of the Sixth Workshop of an European Network for development of an Integrated Control Strategy of potato late blight, Edinburgh, Scotland, 26-30 September 2001. PPO-Special Report no. 8, pp 231 – 242.

Lucca, M. F., S. de Gerónimo, S. Capezio and M. Huarte, 2008. Validation of Late Blight forecasting models and development of an extension service in Argentina. III International Late Blight Conference, Beijing, Abril 3-6, 2008.

Lucca, F., Mujica, N., Capezio, S. and Huarte, M, 2008. Estrategias para el control del Tizón Tardío en Argentina. In: Memorias del XXIV Congreso de la Asociación Latinoamericana de la Papa - ALAP2010 y I Simposium Internacional de Recursos Genéticos de la Papa. May 2010, Cusco, Perú. Editor: INIA Perú.