Submissions for Diagnostic Protocols

1. General information

Submission number	2021-006
Title of Proposal	Diagnostic protocol for Dickeya spp. on potato
Submitted by	IPPC Contracting Party New Zealand
Submission supported by	Ministry for primary industries, New Zealand

2. Contact information

Name	Lihong Zhu
Position and organization	Portfolio Manager IPPC, Ministry for Primary Industries
Mailing address	Charles Fergusson Building, 34-38 Bowen Street, PO Box 2526, Wellington 6140, New Zealand
Phone	64-4-894 0261
Email	lihong.zhu@mpi.govt.nz

3. Summary of proposal

Summary of justification for the proposal	Dickeya species are an emerging problem for potato production and causes disease on numerous crops and ornamental plants worldwide. Dickeya species have spread across Europe and other parts of the world via trade in potato seed tubers and other plant hosts (e.g. ornamentals) and are causing economic losses. Dickeya spp. can initiate disease from lower inoculum levels, have a greater ability to spread, are considered more aggressive than other soft rotting bacteria, and have higher optimal temperatures for disease development. These higher optimal temperatures may lead to increased disease problems in new areas due to climate change. Dickeya species are seedborne and most new detections are traced back to the movement of latently infected seed. Seed tuber certification and diagnostics play a key role in management and disease control. Disease symptoms are indistinguishable from those caused by other Dickeya/Pectobacterium species and differentiation between these species can be difficult. A number of serological and molecular diagnostic tests are available for detection and a protocol that provides guidance for detection, identification and differentiation from the closely related Dickeya/Pectobacterium species that occur on potato would be beneficial. If it is too challenging to include all 6-7 Dickeya species that occur on potato in a diagnostic protocol it could be restricted to D. solani. Dickeya solani has been shown to cause more severe losses than other Dickeya species on potato.
Proposed priority	2
Comments	The proposed diagnostic protocol meets many of the criteria e.g. pathogen affects an important protocol across many countries.

4. Literature review

Literature review	World-wide, Dickeya are important genera containing several species of plant-pathogenic bacteria that are responsible for soft-rotting diseases on a wide range of plant crops, including potato (Toth et al. 2011). Disease results in the downgrading and rejection of potato seed and imposes significant production constraints to the potato industry. This has resulted in phytosanitary restrictions on potato seed and plants worldwide. There are several important Dickeya species on potato these include D. solani, D. dianthicola, D. dadantii, D. zeae, D. chrysanthemi, D. paradisiaca, and D. dieffenbachiae. Many of these are listed as quarantine organisms (EPPO-A2). Dickeya spp. identified on potato appear to be distinct on

	different continents and have caused disease in temperate, tropical, and subtropical regions. These include D. chrysanthemi in the USA and Taiwan, D. dadantii in Brazil, Peru and Zimbabwe, and D. zeae in Australia and Papua New Guinea (Toth et al. 2011). Dickeya spp. have been spread worldwide via infected vegetative propagating material. The most important means of dissemination is the movement of latently infected seed tubers. The pathogen can be carried on the tuber surface and in lenticels but is also found in the tuber vascular system. The economic impact varies from country to country but yield losses of up to 30 % can occur for Dickeya infections on potato (Toth et al. 2011). Dickeya solani has been shown to cause more severe losses than other Dickeya species on potato (Toth et al. 2011). The main way to control disease is to ensure seed tubers are free of contamination. Detection of Dickeya spp. is challenging due to the genetic heterogeneity observed among strains, and that multiple species are known to cause similar symptoms on one host, and a single species can infect multiple hosts. Detection and identification of Dickeya spp. can be further complicated by its proximity on overlapping hosts to closely related pathogens such as Pectobacterium spp. There are many approaches to the detection and identification of Dickeya species. These include the use of selective plating, biochemical, serological and molecular methods. Isolation of Dickeya species has focused on the use of semi-selective media (Helias et al. 2012). Serological tests have been used to screen seed potatoes for Pectobacterium spp. and Dickeya spp. but have been found to lack specificity and sensitivity (Toth et al. 2011). The main advantages of serology testing are cost efficiency and adaptability for high throughput testing. Several molecular methods have been developed to detect Dickeya spp. or distinguish them from Pectobacterium spp. including a multiplex PCR, real-time quantitative PCR (Czajkowski et al. 2014), and a loop-mediated isothermal amplification method (Yasuhara-Bell et al. 2017). References: • Czajkowski, R., Pérombelon, M.C.M., Jafra, S., Lojkowska, E., Potrykus, M., Van Der Wolf, J.M. and Sledz, W., 2015. Detection, identification and differentiation of Pectobacterium and Dickeya species causing potato blackleg and tuber soft rot: a review. Annals of Applied Biology, 166(1), pp.18-38. • Hélias, V., Hamon, P., Huchet, E., Wolf, J. V. D., & Andrivon, D. (2012). Two new effective semiselective crystal violet pectate media for isolation of Pectobacterium and Dickeya. Plant pathology, 61(2), 339-345. • Toth, I. K., Van Der Wolf, J. M., Saddler, G., LOjkowska, E., Hélias, V., Pirhonen, M., ... & Elphinstone, J. G. (2011). Dickeya species: an emerging problem for potato production in Europe. Plant pathology, 60(3), 385-399. • Yasuhara-Bell, J., Marrero, G., Arif, M., de Silva, A., & Alvarez, A. M. (2017). Development of a loop-mediated isothermal amplification assay for the detection of Dickeya spp. Phytopathology, 107(11), 1339-1345.

5. Criteria for prioritization of Diagnostic Protocols

Criteria	Information provided by Submitter
1. Need for international harmonization of the diagnostic techniques for the pest (e.g. due to difficulties in diagnosis or disputes on methodology)	Detection of Dickeya spp. is challenging due to the genetic diversity observed among strains, multiple species are known to cause similar symptoms on a wide range of hosts. Detection is further complicated by other bacterial pathogens such as closely related Pectobacterium spp., Ralstonia solanaecarum and Clavibacter sepedonicus. There are no current diagnostic protocols for Dickeya species.
2. The relevance of the diagnosis to the protection of plants including measures to	Accurate diagnostic techniques are essential for seed trade. There are several important Dickeya species on potato these include D. solani, D. dianthicola, D. dadantii, D. zeae, D. chrysanthemi, D. paradisiaca, and D. dieffenbachiae. For many countries these are listed as quarantine organisms and there are phytosanitary measures are in place for imported seed and nursery stock consignments.

Criteria	Information provided by Submitter
limit the impact of the pest.	A standardized protocol would be useful to certify seed tubers and nursery stock free of certain Dickeya species. This could also facilitate identification and early detection during incursions for countries that do not have certain species.
3. Importance of the plants protected on the global level (e.g. relevant to many countries or of major importance to a few countries).	Dickeya spp. have been spread worldwide via infected vegetative propagating material. Dickeya are important genera containing several species of plant-pathogenic bacteria that are responsible for soft-rotting diseases on a wide range of plant crops, including potato. Disease results in significant production constraints to the potato industry. Dickeya spp. on potato appear to be distinct on different continents and have caused disease in temperate, tropical, and subtropical regions. These include D. solani and D. chrysanthemi in Northern Europe, D. chrysanthemi in the USA and Taiwan, D. dadantii in Brazil, Peru and Zimbabwe, and D. zeae in Australia and Papua New Guinea.
4. Volume / importance of trade of the commodity that is subjected to the diagnostic procedures (e.g. relevant to many countries or of major importance to a few countries).	Potatoes are the third most important food crop in the world after rice and wheat and is a stable food crop of global importance. Global production exceeds 300 million tonnes. Native to Central and South America but has been introduced to most parts of the world. For example, Europe, North America, Australasia, Asia, Africa and the West Indies. The growth in potato production areas has rapidly overtaken other food crops in developing countries.
5. Other criteria for topics as determined by CPM that are relevant to determining priorities	n/a
6. Th balance between pests of importance in different climatic zones (temperate, tropics etc) and commodity classes.	Dickeya spp. are a problem on potato on many different continents and have caused disease in temperate, tropical, and subtropical regions. This includes Europe, USA, Taiwan, Brazil, Peru, Australia and Papua New Guinea.
7. Number of labs undertaking the diagnosis.	Many quarantine and research laboratories are involved in Dickeyi diagnostics e.g. SASA, James Hutton Institue (Scotland), FERA (United Kingdom), USDA (USA), CFIA (Canada), ANSES (France), NIWA (Netherlands), AgrioBio (Australia) etc.
8. Feasibility of production of a protocol, including availability of knowledge and expertise.	A protocol is feasible as there are publications available that separately cover key aspects of diagnostics that include symptoms, biochemical, serological and molecular methods. Many experts available throughout UK, Europe and North America.