



## Submissions for Diagnostic Protocols

### I. General information

<b>Submission number</b>	2023-015
<b>Title of Proposal</b>	Diagnostic protocol for <i>Bactrocera correcta</i>
<b>Submitted by</b> (Country or Organization)	IPPC Contracting Party
<b>IPPC Official Contact Point or RPPO</b>	China
<b>Supported by</b>	China Agricultural University

### 2. Contact information

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### 3. Summary of proposal

<b>Summary of justification for the proposal</b>	<p><i>Bactrocera correcta</i> (Bezzi, 1916) is an economically significant pest of international concern, causing severe damage to tropical and subtropical fruit industries. Currently, there is no International Standards for Phytosanitary Measures (ISPM) specifically addressing the identification of <i>B. correcta</i>. Developing such a standard based on morphological and molecular diagnostic methods would effectively address the requirement for accurate and rapid identification of <i>B. correcta</i>, and provide a technical basis for its quarantine and identification. China Agricultural University, in collaboration with the other research institutions, has developed molecular identification techniques for <i>B. correcta</i> including DNA barcoding, PCR, and microfluidic dynamic array. Relevant papers have been published, and these techniques have been extensively applied. It is recommended to establish this standard to provide technical support for global fruit fly management and facilitate trade of tropical and subtropical fruits.</p>
<b>Proposed priority</b>	I (high)

<b>Comments</b>	<p>The proposal highlights the crucial importance of addressing the <i>Bactrocera correcta</i> issue and emphasizes the urgent requirement for an internationally recognized diagnostic protocol. The collaborative efforts of China Agricultural University and other research institutions, along with the successful development and application of molecular identification techniques, demonstrate the readiness and capability to contribute to the establishment of a comprehensive and effective standard. The proposed priority ranking of "Level I" reflects the significance and immediate attention this matter deserves in order to protect the global fruit industry and ensure the safe trade of produce.</p>
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#### 4. Literature review

<b>Literature review</b>	<p><i>Bactrocera correcta</i> belongs to the family Tephritidae and poses significant threat to global agriculture and trade. The adult of <i>B. correcta</i> can be identified using morphological characteristics, however, its egg, larva, pupa stages could but be diagnosed based on molecular techniques. This review summarizes the findings of six key literatures that have made significant contributions to the field of morphological and molecular diagnosis of economically important fruit flies, specifically focusing on the species <i>B. correcta</i>. White et al. (1992) described the morphological identification characteristics of adult <i>B. correcta</i>. Jiang et al. (2013) proposed a rapid diagnostic method for <i>B. correcta</i> based on a species-specific barcoding marker of cytochrome oxidase I (COI). Jiang et al. (2014) investigated the challenges posed by species complexes in DNA barcoding success for <i>Bactrocera</i>, however, <i>B. correcta</i> could be identified successful. Jiang et al. (2016) introduced a high-throughput detection method for 27 fruit fly species based on microfluidic dynamic array technology, the study demonstrated the efficacy of this approach in rapidly identifying and distinguishing different Tephritidae species, including <i>B. correcta</i>. Qin et al. (2016) explored the genetic diversity and population structure of <i>B. correcta</i> in the world using mitochondrial DNA <i>coxI</i> which contributed more DNA barcodes for diagnosis. Recently, Li et al. (2022) used morphology, DNA barcoding, and PCR methods to determine that they had discovered the <i>B. correcta</i> in Sanya City, Hainan Province, China. According to the further increasing international travels and fruit trades, <i>B. correcta</i> has more spread probability in the world and requires more prevention and control measures.</p> <p>The main reference are as follows: (* corresponding author) Jiang, F., Li, Z.H.*, Deng, Y.L., Wu, J.J., Liu, R.S., and Buahom, N. (2013). Rapid diagnosis of the economically important fruit fly, <i>Bactrocera correcta</i> (Diptera: Tephritidae) based on a species-specific barcoding cytochrome oxidase I marker. <i>Bull Entomol Res</i>, 103, 363–371. 10.1017/S0007485312000806. Jiang, F., Jin, Q., Liang, L., Zhang, A.B.*, and Li, Z.H.* (2014). Existence of species complex largely reduced barcoding success</p>
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	<p>for invasive species of Tephritidae: a case study in <i>Bactrocera</i> spp. <i>Mol Ecol Resour</i>, 14, 1114–1128. 10.1111/1755-0998.12259.</p> <p>Jiang, F., Fu, W., Clarke, A.R., Schutze, M.K., Susanto, A., Zhu, S.F.*, and Li, Z.H.* (2016). A high-throughput detection method for invasive fruit fly (Diptera: Tephritidae) species based on microfluidic dynamic array. <i>Mol Ecol Resour</i>, 16, 1378–1388. 10.1111/1755-0998.12542.</p> <p>Li, W.S., Yan, X.R., Yang, W.Z., Yin, C.W., Zeng, Q., Feng, X.D., Wang, X.L., Qin, Y.J., Guo, S.K., Liu, L.J., Zhao, Z.H., Li, Z.H.* (2022). <i>Bactrocera correcta</i> (Diptera: Tephritidae) was found in Yazhou Bay Science and Technology City, Sanya, Hainan Province. <i>Plant Protection</i> (in Chinese), 48, 77-82. 10.16688/j.zwbh.2022418.</p> <p>Qin, Y.J., Buahom, N., Krosch, M.N., Du, Y., Wu, Y., Malacrida, A.R., Deng, Y.L., Liu, J.Q., Jiang, X.L., and Li, Z.H.* (2016). Genetic diversity and population structure in <i>Bactrocera correcta</i> (Diptera: Tephritidae) inferred from mtDNA <i>cox1</i> and microsatellite markers. <i>Sci Rep</i>, 6, 38476. 10.1038/srep38476.</p> <p>White I.M. and Elson-Harris M.M. (1992). <i>Fruit flies of economic significance: their identification and bionomics</i>, Wallingford, UK: CABI.</p>
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## 5. Criteria for prioritization of Diagnostic Protocols

Criteria	Information provided by Submitter
<b>1. Need for international harmonization of the diagnostic techniques for the pest (e.g. due to difficulties in diagnosis or disputes on methodology)</b>	<p><i>Bactrocera correcta</i> is economically important fruit fly causing issue to fruits production and international trade. In recent decade, the morphological and molecular identification techniques for <i>B. correcta</i> has been studied and applied. Within this protocol, we propose a series of diagnostic methods particularly the molecular techniques for eggs, larvae and pupae. First, DNA barcoding is a molecular technique that involves sequencing a short segment of DNA to identify and distinguish different species. DNA barcoding is of great significance in international pest quarantine identification as it enables rapid and accurate identification of invasive species, aiding in pest control, and safeguarding agriculture and ecosystems. Building upon DNA barcoding technology, we have further streamlined the identification process, increased detection throughput, and reduced testing costs, making this standard applicable to the vast majority of countries and regions worldwide.</p>
<b>2. The relevance of the diagnosis to the protection of plants including measures to limit the impact of the pest.</b>	<p>The relevance of diagnosis to the protection of plants lies in its vital role in mitigating the impact of pests and implementing effective measures for plant protection. Accurate diagnosis enables the early detection and identification of pests, facilitating timely and targeted interventions to control their spread and minimize damage to crops and plant populations. By diagnosing plant pests, we gain valuable insights into their biology, behavior, and patterns of infestation. This knowledge helps develop appropriate and sustainable pest management</p>

	<p>strategies, including integrated pest management (IPM) approaches that focus on biological and chemical control methods. Furthermore, diagnosis plays a crucial role in quarantine and biosecurity measures. It allows for the identification of invasive pests, enabling the implementation of strict surveillance, monitoring, and control measures to prevent their establishment and spread into new areas.</p>
<p><b>3. Importance of the plants protected on the global level (e.g. relevant to many countries or of major importance to a few countries).</b></p>	<p>Tropical and subtropical fruits have global significance, being relevant to many countries and holding significant importance for a few nations. Firstly, these fruits play a crucial role in the economies of many countries. They are among the primary agricultural exports, bringing substantial economic benefits and promoting agricultural and rural development. Secondly, tropical and subtropical fruits are vital for global food supply and diversity. These fruits are highly valued by consumers worldwide due to their rich nutritional value and unique flavors. They provide essential vitamins, minerals, and fiber, contributing to a healthy and balanced diet. Moreover, the diversity of tropical and subtropical fruits, with various colors, shapes, textures, and flavors, enriches people's dietary choices. Lastly, these fruits are crucial for the livelihoods of local farmers and community development. Many farmers in tropical regions rely on fruit cultivation for their livelihoods, generating income through fruit sales. The cultivation and processing industries of these fruits create employment opportunities and drive economic growth in rural areas. Additionally, fruit cultivation and exportation promote technology transfer and knowledge sharing among farmers, enhancing agricultural productivity and sustainability. In summary, tropical and subtropical fruits are relevant to many countries globally and hold significant importance for a few nations. They contribute to economies, food supply, and rural development while providing diverse and nutritious food options.</p>
<p><b>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).</b></p>	<p>The trade volume and importance of tropical and subtropical fruits that undergo pest diagnostic procedures can vary, with relevance to many countries or significant importance to a few countries. Tropical and subtropical fruits, such as bananas, pineapples, mangoes, papayas, and coconuts, are widely traded and have substantial importance for many countries. These fruits are exported globally and consumed in various markets due to their popularity and demand. As a result, the trade volume of these fruits is significant, and they are relevant to numerous countries involved in both production and consumption. Pest diagnostic procedures play a crucial role in ensuring the quality, safety, and compliance of these fruits for international trade. These procedures help detect and prevent the spread of pests and diseases that could harm the fruit crops and impact trade. Moreover, certain countries may have a particular significance in the trade of specific tropical and subtropical fruits due to their unique production capabilities, geographic advantages, or specialization in certain varieties. These countries may be major exporters of these fruits and have a significant impact on the global trade dynamics for these</p>

	commodities. In summary, the trade volume and importance of tropical and subtropical fruits that undergo pest diagnostic procedures can be substantial. These fruits are relevant to many countries involved in production and consumption, while specific countries may play a vital role in the trade of particular fruit varieties.
<b>5. Other criteria for topics as determined by CPM that are relevant to determining priorities</b>	ISPM 27 Diagnostic protocols for regulated pests DP 09: Genus <i>Anastrepha</i> Schiner DP 29: <i>Bactrocera dorsalis</i>
<b>6. The balance between pests of importance in different climatic zones (temperate, tropics etc) and commodity classes.</b>	Firstly, understanding the specific pests that affect each climatic zone and commodity class is crucial. This requires comprehensive research and monitoring programs to identify and prioritize the most significant pests in each region. Secondly, implementing integrated pest management (IPM) strategies tailored to the specific climatic zone and commodity class is essential. IPM involves combining multiple pest control approaches, such as biological control, cultural practices, and targeted pesticide use, to minimize the impact on the environment and non-target organisms. Thirdly, promoting international collaboration and knowledge sharing is vital. Different regions face unique pest challenges, and sharing experiences, best practices, and research findings can help develop effective pest management strategies across climatic zones and commodity classes. Additionally, continuous research and innovation are necessary to develop sustainable and environmentally friendly pest control methods. This includes exploring alternative approaches, such as biological control agents or the use of resistant crop varieties, to reduce reliance on chemical pesticides. Overall, achieving a balance between pests of importance in different climatic zones and commodity classes requires a multidisciplinary and collaborative approach, customized to the specific challenges and characteristics of each region and crop type.
<b>7. Number of labs undertaking the diagnosis.</b>	Most laboratories are able to undertake the diagnosis of <i>B. correcta</i> , as the DNA barcoding, PCR, and other related methods mentioned in the protocol is suitable for use in the vast majority of national and regional laboratories, and have very high application value.
<b>8. Feasibility of production of a protocol, including availability of knowledge and expertise.</b>	Knowledge and Expertise: The studies demonstrate a solid understanding of the genetic markers and detection methods for <i>B. correcta</i> . The authors have expertise in the field of entomology, genetic analysis, and molecular biology, which is essential for developing an execution standard. Existing Research: The referenced articles provide a foundation for the development of an execution standard by outlining the species-specific barcoding marker, rapid detection methods, and genetic diversity analysis. These studies contribute to the existing knowledge and can serve as a basis for the development of standardized protocols. Relevance and Importance: The economic significance of <i>B. correcta</i> and its invasive nature highlight the need for an execution standard to

	<p>facilitate accurate and efficient identification and monitoring. This further emphasizes the relevance and importance of developing a standardized protocol. Practical Implementation: The studies propose practical methods for rapid diagnosis and detection, including the use of microfluidic dynamic arrays and genetic markers. These techniques can potentially be translated into an execution standard that provides specific instructions and guidelines for practitioners in the field. Based on the above analysis, it appears feasible to develop an execution standard for the rapid diagnosis and detection of <i>B. correcta</i>. The existing knowledge, expertise, and practical implementation methods described in the referenced studies provide a strong foundation for the development of standardized protocols in this area.</p>
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