

STDF Standards and Trade Development Facility

GUIDELINES FOR THE IMPLEMENTATION OF THE SPECIFIC PHYTOSANITARY SURVEILLANCE SYSTEM CASE STUDY Xanthomonas OTYZAE DV. OTYZAE

Inter-American Institute for Cooperation on Agriculture (IICA), 2018



Guidelines for the implementation of the Specific Phytosanitary Surveillance System: case study: Xanthomonas oryzae pv. oryzae by IICA is published under license Creative Commons Attribution-ShareAlike 3.0 IGO (CC-BY-SA 3.0 IGO) (http://creativecommons.org/licenses/by-sa/3.0/igo/) Based on a work at www.iica.int

IICA encourages the fair use of this document. Proper citation is requested.

This publication is available in electronic (PDF) format from the Institute's Web site: http://www.iica.int

Editorial coordination: Lourdes Fonalleras and Florencia Sanz Translator: Paula Fredes Layout: Victor Hugo Vidart Cover design: Victor Hugo Vidart Digital printing

> Guidelines for the implementation of the Specific Phytosanitary Surveillance System: case study: Xanthomonas oryzae pv. oryzae / Inter-American Institute for Cooperation on Agriculture, Comité Regional de Sanidad Vegetal del Cono Sur; José Manuel Galarza. – Uruguay: IICA, 2018. A4; 21 cm x 29,7 cm.

ISBN: 978-92-9248-787-4 Published also in Spanish

1. Plant diseases 2. Xanthomonas oryzae 3. Crops 4. Rice 5. Disease surveillance 6. Risk management 7. Weeds 8. Environmental factors 9. Cartography I. IICA II. COSAVE III. Title.

AGRIS H20 DEWEY 632.32

Montevideo, Uruguay 2018

Acknowledgments

The Guide for the Implementation of Specific Phytosanitary Surveillance System has been applied through two case studies. Those products were developed as a result of the component aimed at strengthening plant pest surveillance in the framework of STDF / PG / 502 Project "COSAVE: Regional Strengthening of the Implementation of Phytosanitary Measures and Market Access". The beneficiaries are COSAVE and the NPPOs of the seven countries that make up COSAVE. The Standards and Trade Development Facility (STDF) fund it, the Inter-American Institute for Cooperation on Agriculture (IICA) is the implementing organization and the IPPC Secretariat supports the project.

The editorial coordination was in charge of Maria de Lourdes Fonalleras and Florencia Sanz.

Maria de Lourdes Fonalleras, Florencia Sanz y José Manuel Galarza, have defined the original structure of this Guide.

The content development corresponds exclusively to José Manuel Galarza expert contracted especially for the project.

The technical readers that made important contributions to develop the study cases are the specialists of the NNPO's participating in the Project:

Pablo Cortese, Ignacio García Varona, Federico Aguirre, Oscar Von Baczko, Yanina Outi from Servicio Nacional de Sanidad y Calidad Agroalimentaria – SENASA from Argentina;

Luis Sánchez Shimura, Remi Castro Ávila, Gustavo López Zenteno, Edgar Delgado Vargas, Immer Adhemar Mayta Llanos, Geordana Zeballos from Servicio Nacional de Sanidad Agropecuaria e Inocuidad Alimentaria – SENASAG from Bolivia;

Ricardo Kobal Raski, Dalci de Jesus Bagolin, Jesulindo de Souza Junior, Ériko Tadashi Sedoguchi from Secretaria de Defensa Agropecuaria del MAPA from Brasil;

Marco Muñoz, Fernando Torres Parada, Jairo Eladio Alegría Contreras, Carolina Pizarro, Karina Reyes, Ilania Astorga from Servicio Agrícola y Ganadero – SAG from Chile;

Acknowledgments

Cristian Marecos, Katya Bogado, Mariano Franco Aquino, Liz Adriana Ojeda, Rosa Liliana Encina, María Bettina Chaparro from Servicio Nacional de Calidad, Sanidad Vegetal y de Semillas – SENAVE from Paraguay;

Moisés Pacheco Enciso, Johny Naccha Oyola, Cecilia Lévano Stella, Betty Matos Nonogawa, Carmen Oré Vento, Iván Gutiérrez Martínez, Jorge Velapatiño Flores, Percy Alberto Mamani Sánchez from Servicio Nacional de Sanidad Agraria – SENASA from Perú;

Elina Zefferino and Noelia Casco from Dirección General de Servicios Agrícolas – DGSA/ MGAP from Uruguay.

We express special appreciation to all of them.

We also thank the support received from the IPPC Secretariat for the implementation of this component of the project.

Finally, we thanks Victor Vidart by diagramming the document.

Xanthomonas oryzae pv. oryzae

1. PURPOSE

Detection surveillance of *Xanthomonas oryzae pv. oryzae* in rice production and host weeds in the COSAVE region.

2. SCOPE

COSAVE region, considering pest records and suitable environmental conditions for the pest.

3. TARGET PEST

Xanthomonas oryzae pv. oryzae, see the pest datasheet in Annex 1.

4. DURATION AND APPROPRIATE TIMING

The duration is one (1) growing season, during the active growing stage of the crop, with a weekly frequency between surveys.

5. SITE SELECTION

For the area or site selection process, the following information is required in advance:

- Cadastral map of the region
- Hydrography and geographical characteristics (forests, mountains, lakes, rivers, deserts) in the location
- Risk map for the region
- Area and production of the crop at the political and administrative level as detailed as possible
- International transport routes

Xanthomonas oryzae pv. oryzae

5.1. Environmental modeling for the development of risk maps for the region

The environmental niche modeling is commonly used to develop probabilistic maps of species distribution. Among the available modeling techniques, MaxEnt has become one of the most popular tools for modeling species distribution, with hundreds of peer-reviewed articles published each year. The popularity of MaxEnt is mainly due to the short running time, easy operation, small sample size, high simulation precision, the use of a graphical interface and automatic parameter configuration capacities (Morales et. al, 2017; Costa P., Holtz V. 2011; Wang R. et al. 2018).

Risk maps for the target pest can be managed for the risk characterization and the regional prioritization of surveillance activities. In this study case, we use the MaxEnt model, to identify the environmental risk for Xanthomonas oryzae pv. oryzae with worldwide locations that report the pest and their correlation with the bioclimatic variables from the Worldclim database

(http://www.worldclim.org/). The details of the method appear in Annex 2 and the resulting regional environmental risk map in Figure 1. The areas in red and yellow mean higher and medium risk respectively, light blue means lower estimated risk. The risk estimation is based on MaxEnt results and the comparison of the presence of the pest and the bioclimatic variables where the pest is reported.



Fig. 1. Environmental risk map of Xanthomonas oryzae pv. oryzae for the COSAVE region. Higher risk in red, medium risk in yellow and lower risk in light blue. Scale 1:45,000,000. Source: Prepared for STDF/PG/502 COSAVE Project.

Xanthomonas oryzae pv. oryzae

5.2. Host area in the region

Xanthomonas oryzae pv. oryzae hosts belong to the genus Oryza as well as wild species from the Poaceae and Cyperacea family, as described in the datasheet (Annex 1). Rice production is economically important in the region. It accounts for about 214,570 hectares in Argentina; 181,497 in Bolivia; 2,162,178 in Brazil; 20,937 in Chile; 167,088 in Peru; 131,740 in Paraguay, and 164,400 hectares in Uruguay. Based on rice production information at a first administrative-geopolitical level in each COSAVE country, it is possible to develop a host risk map. As Fig. 2 illustrates, the NPPO can determine the levels as high, medium and low based on the importance of production in each identified administrativegeopolitical level. The method for its preparation is discussed in Annex 2.

Fig. 2. Host risk map—rice in the COSAVE region. High risk in red, medium risk in yellow and low risk in light blue. Scale 1:45,000,000. Source: Prepared for STDF/PG/502 COSAVE Project.

5.3. Regional risk for xanthomonas oryzae pv. oryzae

It is possible to integrate the environmental and host risk maps in one regional risk map, as is illustrated in Fig. 3. The method is presented in Annex 2 and is based on the reclassification of highrisk category with a value of two (2), medium with one (1) and low with zero (0); and the use of the raster mathematical multiplication function of a geographic information system like QGIS. The method for its preparation is described in Annex 2.

Fig. 3. Regional risk map of Xanthomonas oryzae pv. oryzae for COSAVE. High risk in red, medium risk in yellow and low risk in light blue. Scale 1:45,000,000. Source: Prepared for STDF/PG/502 COSAVE Project.

5

Xanthomonas oryzae pv. oryzae

5.4. Selected sites for the surveillance

Considering pest reports, it is necessary to identify the potential considerations for the entry of the pest. In this regard, it is important to identify the main transporting routes and the main rivers that can spread the pest with rice seeds, as well as nearby places of production.

It is possible to integrate the regional risk of the pest and the location of routes and rivers consolidated by the Consejo Suramericano de Infraestructura y Planeamiento (COSIPLAN) (Available at:

http://www.sig.cosiplan.unasursg.org/node/15, on January 5, 2018). For a better management of field actions, the NPPO can identify squares (grids), with the appropriate size to describe a uniform population for the sampling, as shown in Fig. 4 and 5, with 100 km grids. The method for preparation is also described in Annex 2.



Fig. 4. 100 km squares used for the integration of main rivers location and the regional risk information of the pest (high risk in red, medium risk in yellow and low risk in light blue. Scale 1:45,000,000. Source: Prepared for STDF/PG/502 COSAVE Project. Fig. 5. 100 km squares used for the integration of main routes location and regional pest risk information (high risk in red, medium risk in yellow and low risk in light blue. Scale 1:45,000,000. Source: Prepared for STDF/PG/502 COSAVE Project.

Xanthomonas oryzae pv. oryzae

The NPPO can identify risk squares (grids) with a code and review it with additional information and then identify the appropriate place for the surveillance.

In addition, with the rivers and transport routes information, the NPPO can identify the high-risk squares (grids). The number of squares (grids) separated by risk category is presented in table 1 and 2. This identification should be complemented with additional information from the NPPO.

Table 1. Number of squares (grids) in major rivers by Xanthomonas oryzae pv. oryzae risk level.

COUNTRY	HIGH	MEDIUM	LOW	TOTAL
ARGENTINA	13	16	84	113
BOLIVIA	12	20	19	51
BRASIL	22	196	131	349
CHILE	1	3	23	27
PERÚ	11	37	28	76
PARAGUAY	1	3	14	18
URUGUAY		10	11	21
	60	285	310	655

Source: Prepared for STDF/PG/502 COSAVE Project.

Table 2. Number of squares (grids) in major routes by Xanthomonas oryzae pv. oryzae risk level.

COUNTRY	HIGH	MEDIUM	LOW	TOTAL
ARGENTINA	15	17	242	274
BOLIVIA	23	24	32	79
BRASIL	38	383	224	645
CHILE	2	4	75	81
PERÚ	3	18	76	97
PARAGUAY	2	9	14	25
URUGUAY	1	11	14	26
	84	466	677	1227

Source: Prepared for STDF/PG/502 COSAVE Project.

This information is available to open with the QGIS, downloading the complete folder "Qxoo" from the link: https://goo.gl/WYFe6a

7

Xanthomonas oryzae pv. oryzae

6. PLANNING

6.1. Preliminary activities

For a better operational organization, it is necessary to recognize the national characteristics of the risk, places and supplies for surveillance implementation. This allows the NPPO to evaluate, manage and systematize the activity. In this regard, it is important to include the following:

- The annual operating plan with the inclusion of the budget, geographical distribution, task schedule and the implementation time.
- Coordination with the diagnostic laboratory, including the protocol and the number of samples to be submitted.
- Cadastral map of the region.
- Hydrography and geographical characteristics (forests, mountains, lakes, rivers or deserts) in the location.
- Hosts area and production at the administrative-geopolitical level as detailed as possible.
- Phenology of the involved hosts.
- Location of rice seedbeds, collection and storage centers, and risk areas.
- International transport routes.
- Collate pest information in a datasheet like Annex 1.
- Manage permissions to enter private property in advance.
- Ensure the required supplies and resources for the surveillance.
- Training for directly involved staff.

Xanthomonas oryzae pv. oryzae

6.2. Surveillance methodology

The visual inspection or survey can be an effective surveillance method when the characteristics or symptoms of the pest enable identification, which can be confirmed with the laboratory diagnosis. Moreover, it is important to consider:

- The surveillance of *Xanthomonas oryzae pv. oryzae* is performed with the visual inspection or survey in production locations, tissue sampling and pest isolation.
- The number of inspections or surveys can follow the recommendations of the "Guidelines for the implementation of the specific phytosanitary surveillance system".
- Identification of the varieties and other pest susceptible species.
- Ecological conditions that encourage the presence of the pest.
- Rice seedbeds.

6.2.1. Required supplies

- Disposable cloths and gloves.
- Field knife for the sampling.
- Alcohol burner.
- Alcohol 70% for hand disinfection.
- Bleach 10% for sample collection.
- Identification labels.
- Plastic and paper bags for sampling.
- Entomological clamps.
- Writing pads.
- Pencil.
- Dishcloth for tool cleaning.
- Devices to capture geo-referenced field data.
- Templates for data collection.

6.2.2. Sample collection and submission

In case that the visual survey (inspection) can identify Xanthomonas, it is necessary to confirm its identification safeguarding its integrity and submitting the sample to the laboratory. This official diagnosis requires prior coordination of the number of the samples that can be identified.

Xanthomonas oryzae pv. oryzae

6.3. Recording surveillance activities

In order to collate and implement automated reports, the activities of the information record for the Surveillance System should be performed in a standardized and integrated manner. In this regard, we present a general template for the identification of the required information to record *Xanthomonas oryzae pv. oryzae* surveillance activities.

	COL	JNTRY A	AND ACTIVITY	PLA	NCE	HOST AN	ID RESULT	S		INCIDEN	ICE AN	D SEV	ERITY
ltem	País	Fecha (dd/mm/aaaa)	Actividad de Vigilancia Inspección, muestreo, trampeo, otro (especificar)	Coordenadas geográficas decimales: LATITUD	Coordenadas geográficas decimales: LONGITUD	Hospedante (Citrus sinensis, Citrus reticulata, Citrus unshiu, Citrus aurantifolia, Oryza sativa, otro(especificar)	Tipo de Predio (Comercial, vivero, traspatio, aislado, otro(especificar)	Resultado (Ausente o Presente)	Incidencia encontrada	Descripción de la incidencia evaluada(% u otro(especificar)	Severidad encontrada	Severidad (Grados u otro (especificar)	Observación
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													

Fig. 6. General template to record Xanthomonas oryzae pv. oryzae surveillance activities. Source: Prepared for STDF/PG/502 COSAVE Project.

In addition, this general template should have modeled fields in order to avoid mistakes in recording information and the use of computing platforms. For example, Open Data Kit is capable of collecting geo-referenced information with Android devices. The details, templates and explanations for its use are available in the ODK folder in the link: https://goo.gl/WYFe6a.

6.4. Biosafety

To achieve biosecurity in surveillance actions, it is necessary to include:

- The use of new disposable cloths during the entry to each surveillance site.
- The handling of plants or samples should be done with gloves to avoid contaminating nearby locations.
- Surveillance waste should be kept in properly closed plastic bags.
- Any waste material should follow NPPO waste recommendations.
- Hand disinfection with approved supplies is required after each activity.

Xanthomonas oryzae pv. oryzae

7. COMMUNICATION

It is important to produce reports with the results of the various level of decision making.

8. AUDIT

Through the central coordination, each NPPO will perform auditing activities at any stage of the process, analyzing the data in the system, and monitoring the quality of the field tasks performance, among others.

9. **REFERENCES**

CABI, 2017. Crop Protection Compendium. Data Base. Wallingford, United Kingdom.

Sheldeman X & van Zonneveld M. 2011. Manual de Capacitación en Análisis Espacial de Diversidad y Distribución de Plantas. Bioversity International, Rome, Italy. 186 pp. Available on October 27, 2017, at:

http://www.bioversityinternational.org/e-library/publications/detail/manual-decapacitacion-en-analisis-espacial-de-diversidad-y-distribucion-de-plantas/

Singh, R.A., and Rao, M.H.S. 1977. A simple technique for detecting Xanthomonas oryzae in rice seeds. Seed Science and Technology 5: 123-127. Available on October 27, 2017, at: http://download.ceris.purdue.edu/file/289

Wang R, Li Q, He S, Liu Y, Wang M, Jiang G. 2018. Modeling and mapping the current and future distribution of Pseudomonas syringae pv. actinidiae under climate change in China. PLoS ONE 13(2): e0192153. Available on February 26, 2018, at: https://doi.org/10.1371/journal.pone.0192153

10. ANNEXES

Annex 1. Data sheet of the pest Annex 2. Modeling for xanthomonas oryzae pv. oryzae

Xanthomonas oryzae pv. oryzae

ANNEX 1

DATA SHEET OF THE PEST

Xanthomonas oryzae pv. oryzae (Ishiyama 1922) Swings et al. 1990

Synonyms:

Bacterium oryzae (Uyeda & Ishiyama) Nak., 1928; Phytomonas oryzae (Ishiyama) Magrou 1937; Pseudomonas oryzae Ishiyama; Xanthomonas campestris pv. oryzae (Ishiyama 1922) Dye 1978; Xanthomonas itoana (Tachinai) Dowson; Xanthomonas kresek Schure 1953; Xanthomonas oryzae (Ishiyama 1922) Swings et al. 1990; Xanthomonas translucens f. sp. oryzae Jones et al; Dowson; Ishiyama; Pordesimo.

Taxonomic rank:

Phylum: Proteobacteria Class: Bacteria Order: Xanthomodales Family: Xanthomonadaceae Genus: Xanthomonas Species: *Xanthomonas oryzae pv. oryzae* (Ishiyama 1922) Swings et al. 1990

Common names:

Enfermedad bacteriana de las hojas del arroz (spanish); maladie bactérienne des feuilles du riz (french); bacterial leaf blight of rice; kresek disease; rice bacterial leaf blight; rice kresek disease (english).

Hosts:

Cenchrus ciliaris, Cynodon dactylon, Cyperus difformis, Cyperus rotundus, Echinochloa crus-galli, Leersia hexandra, Leersia oryzoides, Leptochloa chinensis, Megathyrsus maximus, Oryza spp., Oryza longistaminata, Oryza sativa, Paspalum scrobiculatum, Urochloa mutica, Zizania aquatica, Zizania palustris, Zoysia japonica (CABI, 2017).

Geographic distribution:

America: Mexico, United States, Costa Rica, El Salvador, Honduras, Nicaragua, Panama, Colombia, Ecuador, Venezuela (CABI, 2017).
Asia: Pakistan, Philippines, Sri Lanka, Taiwan, Vietnam (CABI, 2017).
Africa: Burkina Faso, Cameron, Egypt, Gabon, Gambia, Madagascar, Mali, Niger, Nigeria, Tanzania, Togo (CABI, 2017).
Europe: Russia (CABI, 2017).

Oceania: Australia (restricted) (CABI, 2017).

Xanthomonas oryzae pv. oryzae

Biology:

Xanthomonas oryzae pv. oryzae survives during the off-season in seed, weed hosts, rice volunteers and infected rice straw and stubble. The evidence for significant seed transmission is contradictory. Survival in soil is limited to a few months at the most in relatively cool, moist conditions (the bacterium dies rapidly in hot, dry conditions) and is thus of little significance in single-crop rice systems. Transmission in irrigation water and floodwater is important during the cropping period, but survival in water is limited to a few days (CABI, 2017).

The bacterium invades rice plants through hydathodes on leaves, root-growth cracks and wounds. Seedling roots are wounded when pulled from the seedbed; and leaf tips are often cut before transplanting. When inside the plant, the bacterium enters the vascular system in which it spreads. Bacteria eventually ooze out of water pores on hydathodes (CABI, 2017).

Signs and symptoms:

The symptoms known as 'kresek' (wilting, desiccation of leaves and death, characteristic of systemic infection) occur with particular combinations of virulent isolates and susceptible cultivars, probably when the vascular system is blocked by bacterial cells and extracellular polysaccharide. Kresek is associated with tropical storms which spread the pathogen and also wound rice plants. High temperature (30°C) and humidity favor the disease (CABI, 2017).



Fig. 7. Symptoms of *Xanthomonas oryzae pv. oryzae* due to artificial inoculation (Source: Purdue University, 2017).

Symptoms appear on leaves of young plants, after planting out, as pale-green to grey-green, water-soaked streaks near the leaf tip and margins. These lesions coalesce and become yellowish-white with wavy edges. The whole leaf may eventually be affected, becoming whitish or greyish and then dying. Leaf sheaths and culms of more susceptible cultivars may be attacked. Systemic infection, known as kresek, results in wilting, desiccation of leaves and death, particularly of young transplanted plants. In older plants, the leaves become yellow and then die. In later stages, the disease may be difficult to distinguish from bacterial leaf streak (X. oryzae pv. oryzicola) (CABI, 2017).

Xanthomonas oryzae pv. oryzae

Entry pathway:

The bacteria can only move short distances in infected crops. The bacteria can only move long distances in infected rice seeds. The bacteria are usually found in the glumes, but may also penetrate the endosperm (EPPO, 2003).



Survey (inspection) and detection:

Symptoms appear on leaves of young plants, after planting out, as pale-green to grey-green, water-soaked streaks near the leaf tip and margins. These lesions coalesce and become yellowishwhite with wavy edges. The whole leaf may eventually be affected, becoming whitish or greyish and then dying.

Fig. 8. Infected rice seedlings. Infected leaves wilt and roll up, turning grayish-green to yellow, until the whole seedling dies. Plants which have survived the disease are stunted and yellowish (Picture from EPPO, 2017).

Leaf sheaths and culms of more susceptible cultivars may be attacked. Systemic infection, known as kresek, results in wilting, desiccation of leaves and death, particularly of young transplanted plants. In older plants, the leaves become yellow and then die. In later stages, the disease may be difficult to distinguish from X. oryzae pv. oryzicola (CABI, 2017).

Pest impact:

Bacterial leaf blight is the most serious disease of rice in South-East Asia, particularly since the widespread cultivation of dwarf high-yielding cultivars (EPPO, 2003). In Japan, where figures are available, up to 400,000 ha may be affected annually, with losses of 20-30% and up to 50%. In Africa, losses of 2.7-41% in grain yield have been found (CABI, 2017).

In the Philippines, losses are estimated at 22.5% (in wet seasons) and 7.2% (in dry seasons) in susceptible varieties and 9.5 and 1.8%, respectively, in resistant crops (EPPO, 2003).

Pest control and mitigation measures:

Preventive phytosanitary control measures include:

- Use of healthy and treated seeds.
- Resistant varieties.
- Careful attention to crop management (for example, water control, avoidance of damage to seedlings) is very important.
- Restricting nitrogen fertilizer applications to about 80-100 kg N/ha.
- Chemical control is not recommended (CABI, 2017).

Xanthomonas oryzae pv. oryzae

ANNEX 2

Modeling for Xanthomonas oryzae pv. oryzae

A. Data:

This section will discuss the origin and type of data used in the case studies. All the working files, software, references, and other data are available in the link: https://goo.gl/WYFe6a.

A1. Environmental raster data ("*.tif")

For geo-referenced climate data, go to http://www.worldclim.org/ and then click on Version 2 (http://worldclim.org/version2) for updated climate data.

WorldClim

WorldClim is a set of global climate layers (gridded climate data) with a spatial data can be used for mapping and spatial modeling.

The new Version 2.0 is now available (current climate only --- more coming s

The old version is **Version 1.4**. For this version you can get data for past, current and future climates. Below you can download the standard (19) WorldClim Bioelimatic variables for WorldClim version 0. They are the average for the years 1970-2000. Each download is a "zip" file containing 39 GeoTiff (.tif) files, one for each month of the variables. veriable 10 minutes 5 minutes 2.5 minutes 30 seconds Bioclimatic variables 30 seconds bio 2.5m bio 2.5m

Fig. 9. Link to Version 2 of the web page: http://www.wordclim.org.

Fig. 10. Download the 10 minutes data.

NOTE: The folder with this data is named "WC10y1990tiff" and is located in the link: https://goo.gl/WYFe6a.

NOTE: The bioclimatic variables are: BIO1 = Annual Mean Temperature, BIO2 = Mean Diurnal Range (Mean of monthly (max temp - min temp)), BIO3 = Isothermality (BIO2/BIO7) (* 100), BIO4 = Temperature Seasonality (standard deviation *100), BIO5 = Max Temperature of Warmest Month, BIO6 = Min Temperature of Coldest Month, BIO7 = Temperature Annual Range (BIO5-BIO6), BIO8 = Mean Temperature of Wettest Quarter, BIO9 = Mean Temperature of Driest Quarter, BIO10 = Mean Temperature of Warmest Quarter, BIO11 = Mean Temperature of Coldest Quarter, BIO12 = Annual Precipitation, BIO13 = Precipitation of Wettest Month, BIO14 = Precipitation of Driest Month, BIO15 = Precipitation Seasonality (Coefficient of Variation), BIO16 = Precipitation of Wettest Quarter, BIO17 = Precipitation of Driest Quarter, BIO18 = Precipitation of Warmest Quarter, BIO19 = Precipitation of Coldest Quarter, BIO18 = Precipitation of Warmest

NOTE: In the link to Version 1.4, we share access to the projected future data for 2050 and 2070, under four (4) scenarios called RCP ("Representative Concentration Pathways").

Xanthomonas oryzae pv. oryzae

A2. Vector data ("*.shp")

The Consejo Suramericano de Infraestructura y Planeamiento (COSIPLAN) collated cartographic information about the following layers in the region:

Border control (CSP_AH070_N), Populated center (CSP_AL105_N), Railway Line (CSP_AN010_L), Railway station (CSP_AN070_N), Main road (CSP_AP030_L), Port (CSP_BB005_N), Lake (CSP_BH080_P), River (CSP_BH140_L, CSP_BH140_P), Administrative border (CSP_FA000_L), (CSP_FA001_L, CSP_FA001_P), 3er level administrative zone (CSP_FA002_P), Border crossing (CSP_FA125_N), Airport (CSP_GB001_N), and others.

This information is packed in a zip file, available on October 27, 2017 in the link http://www.sig.cosiplan.unasursg.org/node/15, unzip and save the file in a separated folder like DATA in the link: https://goo.gl/WYFe6a.

rchivo Edición Ver I	Herramientas Ayuda			
Irganizar 👻 🔚 Abrir	▼ Compartir con ▼ Grabar N	lueva carpeta		
🔆 Favoritos	Nombre	Fecha de modifica	Tipo	Tamaño
👪 Descargas	CSPAdmN1	07/06/2017 11:39 a	Archivo WinRAR Z	59,958 KB
Escritorio	CSPAdmN2I	07/06/2017 11:39 a	Archivo WinRAR Z	70,820 KB
🖳 Sitios recientes	CSPAdmN2p	07/06/2017 11:47 a	Archivo WinRAR Z	76,863 KB
💱 Dropbox	CSPAdmN3	07/06/2017 02:12	Archivo WinRAR Z	195,754 KB
沾 Google Drive	CSPa Abrir	11:34 a	Archivo WinRAR Z	34 KB
Box Sync	CSPa 📜 Extraer ficheros	.2:52	Archivo WinRAR Z	67,790 KB
🕲 MEGAsync	CSPo Extraer aquí	.2:02	Archivo WinRAR Z	30 KB
a OneDrive	CSPf Extraer en CSPAdmN3	.2:31	Archivo WinRAR Z	139 KB
		2:36	Archivo WinRAR 7	92 551 KB

Figura 11. Descargar las capas vectoriales y descomprimirlas haciendo un clic con el botón izquierdo del mouse.

A3. Geo-referenced data of pests (use of geographic coordinates as an example)

In the CABI Invasive Species Compendium webpage, refer to: *Xanthomonas oryzae pv. oryzae* or go to the link: http://www.cabi.org/isc/datasheet/56956

17

Xanthomonas oryzae pv. oryzae

Go to the lower part of the world distribution map and to the link "Download CSV file" or "Comma separated values" that can be opened with Microsoft Excel.



Fig. 12. Download the CSV ("Comma separated values") files.

	А	В	С	[
1	species	Longitude	Latitude	
2	Xoryzaeoryza	93	10	
3	Xoryzaeoryza	79	16	
4	Xoryzaeoryza	117	32	
5	Xoryzaeoryza	93	26	
6	Xoryzaeoryza	134	-20	
7	Xoryzaeoryza	90	24	
8	Xoryzaeoryza	2.25	9.5	
9	Xoryzaeoryza	85.75	25.75	

Fig. 13. Delete the data with the "Absend" or "Restricted distribution" pest situation and arrange the elements as is shown.

Open the data in Microsoft Excel, delete the reports of the pest with the situation label as "Absent" or "Restricted distribution" and include first the column species, then longitude and after latitude. Delete the other columns.

Double-check the existence of the species column first, then the longitude and latitude columns respectively and save it as "Xoo.csv" ("Comma separated value"). This data is available in the "cXanthomonasoryzaoryzae" folder in the link: https://goo.gl/WYFe6a.

Xanthomonas oryzae pv. oryzae

B. Software:

B1. QGIS

QGIS (previously called Quantum GIS) is an open source Geographic Information System (GIS) for the GNU/Linux, Unix, Mac OS and Microsoft platforms, it supports many formats and functions for shapefiles, raster files and databases. In addition, it has defined extensions

(http://plugins.qgis.org/plugins/) that make it one of the best of its kind and is in continuous development.



Fig. 14. Webpage to download QGIS 3.0.0 "Girona". Available on February 23, 2018 in: https://www.qgis.org/es/site/forusers/download.htmlNote. We reco

NOTE: We recommend reading and practicing with the training manual of the software. This is available on January 19, 2018, at: https://www.qgis.org/en/site/forusers/index.html#download and tutorial videos available on the Internet.

B2. MaxEnt

B2.1. Installing Java, if not already installed To verify if Java is installed on your computer, go to the link: https://www.java.com/es/download/installed.jsp with Internet Explorer

To install Java in Internet Explorer, go to the link: http://www.java.com/es/download/help/ie_online_install.xml

Xanthomonas oryzae pv. oryzae

To install Java in Mozilla Firefox, go to the link: http://www.java.com/en/download/help/firefox_online_install.xml

NOTE: Java is not supported in Google Chrome

B.2.2. Installing MaxEnt

The MaxEnt software is available on January 19, 2018, at: https://biodiversityinformatics.amnh.org/open_source/maxent/ (with small letters and a lower hyphen between open and source).

a Cathol Vers Las 🔛 Hess Franzisten 🕜 Hess Hermanner 🙆 mehtine songels 🛛 関 Franziskon sel Kes	Called No. 619 🖉 Hystorywyklik 🔅 Dans manuena 💩 unikawionych 🛛 👹 Parasitek a
Main changes in Version 3.4.1 • Minor hug from to the 3.40 melesse Main changes in Version 3.4.0 • Released where AVT is more? • Think for functions are now model of a default • A clogor functions has been acted and new constitutions the default transformation for made upput thereau the logor, burghteen.	Main changes in Version 3.4.1 • Virus hay from to the 3.4 therease Main changes in Version 3.4.0 • Related to the a NT format" • Therebook losters are not under of by default • Therebook losters in the best folded and mar constitutes the celebrat trends in the celebratic sectors.
Download	Download
Current version 3.4.1 Process follow a lifetimeter strengthere service and the service	Current Version 3.4.1 Citation Pryculates the application for analysiss that result in a publication, report, or testing the software states, herease. Data R. Retard E. Scharper (Internet) Monet advance Prevents 4.1.9. Analysis for an utility and versions of the states for a state Prevents 4.1.9. Analysis for an utility and versions of the states for a state Prevents 4.1.9. Analysis for an utility and versions of the states for a state of the states for an utility and the states for an utility and the states for an utility of the states of the states for an utility of the states of the states for an utility of the states of the states for an utility of the states of the states for an utility of the states of the st

Fig. 15. Link to download MaxEnt software and optional requirement of user personal data.

Fig. 16. Download Version 3.4.1. and the cited reference of the MaxEnt software.

g species inches and distribute. Accented on 2011.4-15

C. Activities

C1. Opening a shapefile (or vector layer) and converting the raster data files ("*.tiff" to "*.asc") for the use of MaxEnt software in the modeling.

C1.1. Opening a shapefile in QGIS:

A shapefile has (at least) three files with the same name but with a different extension. The file with the SHP ("*.shp") extension is the main file and includes spatial features.

Open the QGIS with the short option: add vector layer (left margin) or the "Layer" tab, as shown in the below figure:

Xanthomonas oryzae pv. oryzae

Project Edit View	Loyer Settings Plugins Vector Raster	Database Web MMQGIS SCP Processing
	Create Layer	* 10 0 0 0 0 A A A
the state of the s	edd tayer	Add Vector Layers - Ctri + Shift
1. 1 13 15	Embed Layers and Groups	Add Raster Layer Ctrl+Shift
and highlighter	Add from Layer Definition File	Restance State Carl+Shift Ctrl+Shift
Vi 🤇 🖕	Copy style	Add SpatiaLite Layer Ctrl+Shift
M. P. A. I	Paste style	Add M55QL Spatial Layer Ctrl+Shift
10	E Open Attribute Table	Add Oracle Spatial Layer Ctri+Shift
u	/ Toggle Editing	Add WMS/WMTS Laver Ctrl+Shift
-	He Save Layer Edits	Add WCS Laver
P	/ Ourrent Edits	* V Add WFS Laver
	Save As	 Add Delmited Text Laver
100	Save As Layer Definition File	
940	🔤 Remove Layer/Group Ctrl +D	
C61	Duplicate Layer(s)	
NA.	Set Scale Visibility of Laver(s)	

Source t	уре		
• File	O Directory	O Database	O Protoco
Encoding	System		
Source			
Dataset	ra\Desktop\TallerJun	2017\Data\CSPAdmN1\CSP	_FA000_L.shp

Fig. 17. Search for the DATA folder and unzip *.shp files.

Fig. 18. Locate the shapefile (*.shp) and click on "Open".

In the "Project" tab in QGIS, select "Save as" to save the project.

NOTE: Check the right lower edge for the CRS "Coordinate Reference System" in World Geodetic System 1984 - WGS84 with the code: 4326, recommended because is a world-standardized system.

C.1.2. Converting raster data ("*.tif" to "*.asc"):

A raster is a set of pixels with the same size; each pixel has a different value for a variable (including temperature, type of soil). The size of the pixel is called "resolution", and its selection depends on the geographical scope and the objective of the project. To open the raster file, choose the "Add Raster Layer" option on the left side, as shown in the figure below. Locate, select and open files like "bio10m01.tif" from the "WC10y1990tiff" file.

Approximate size ((at the Equator),	of geographic units rounded (in km)
Degrees	Size
1 degree	111 km
10 minutes	18 km
5 minutes	9 km
2.5 minutes	5 km
30 seconds	1 km

Fig. 19. Correspondencia aproximada entre grados y kilómetros en el Ecuador (de: Sheldeman X. & van Zonneveld M. 2011).

Xanthomonas oryzae pv. oryzae

Project Edit View	Layer Settings Plugins Vector Raster	Di	atabase Web MMQGIS SCP	Processing Help
	Create Layer	۲	00000	an 🛲 🚓
	Add Layer		Va Add Vector Layer	Ctrl+Shift+V
. / B 'S	Embed Layers and Groups		Add Raster Laye	Ctrl+Shift+R
nonen hennennenn	Add from Layer Definition File	_	Read PostGIS Layers	Ctrl+Shift+D
Vo A T	Copy style		🔏 Add SpatiaLite Layer	Ctrl+Shift+L
K.	Paste style		Madd MSSQL Spatial Layer	Ctrl+Shift+M
	Open Attribute Table		Add Oracle Spatial Layer	Ctrl+Shift+O
	🥖 Toggle Editing		Add WMS/WMTS Layer	Ctrl+Shift+W

Fig. 20. Command to open raster ("*.tif") files, indicated with the red arrows in the Layer/Add layer/Add Raster Layer tab.

For the conversion, select the "Raster/Conversion/Translate" option, as shown in Fig. 20, in the box "Input Layer" select each file "*.tif" and in the box "Output file" the location of the "*.asc" files in a folder like WC10y1990asc (not the WC10y1990tiff folder) and select the Spatial Reference System (SRS) EPSG:4326, as illustrated in Fig. 22.

= 🖪 🛃 🖓 🔍 🔿 🗑 💆	💡 🏪 Raster Calculator	月 22 43 日 28 43			
	Georeferencer + Heatmap + MOLUSCE +	🗏 🛱 Σ 🚔 🗭 📬	Batch mode ((for processing whole directory)	
	Projections +	Provide State	Input Layer	bio 10m0 1	Select
III - 1 100 100 100	Conversion 1	"> Rasterize (Vector to Raster)			
CSP FA000 L	Extraction	er Polygonize (Raster to Vector)	Output file	C10y1990asc/bio10m01.asc	Select
bio10m01	Analysis	🐁 Translate (Convert Formal) 🥌	Trust con	(
28.5646	GdalTagle Settinger	RGB to PCT	A larget SKS	EPSG:4326	Select
0.000 (HE K)	duanous settings	PCT to RGB	Outriza	(new	

Fig. 21. Command "Translate" to convert raster "*.tif" files to "*.asc".

Fig. 22. Details of the conversion, specifying the "*.asc" extension.

Double check extension "*.asc" in the output file and the selection of the Spatial Reference System.

Repeat the same procedure with the 19 layer of the bioclimatic variables downloaded in the section A1, which are available in the link: https://goo.gl/WYFe6a and the WC10y1990tiff folder.

NOTE: The raster "*.asc" files are also available in the WC10y1990asc folder in the link: https://goo.gl/WYFe6a.

Xanthomonas oryzae pv. oryzae

C2. Using MaxEnt for the modeling.

To open the MaxEnt software, click on the "maxent.jar" file. Then open the "Settings" option, select "Basic" and include the standard option and the box "Random test percentage" write 25 for an additional software test with 25% of the samples. Then close the window.

Maximur	n Entropy Parameters – – 🖉					
Basic Advanced Experimen	itaf	Samplus FilepioidBactroceradorsalisiBdorsalis.csv B	rowse Directory/File isEne2017/12	vironmental layers vilerJun2017W/C10y1990aac jookinine.oo.a	WC10y1990asc Browse	
Random saod Give visuel warnings Show toolfips Ask bofore overwriting Skip if output exists Remove duplicate presence records Write clamp grid when projecting z) Do MESS analysis when projecting		⊻ Bdorsells	bio10m09 bio10m10 bio10m11 bio10m12 bio10m13 bio10m13 bio10m14 bio10m14	Continuous Continuous Continuous Continuous Continuous Continuous Continuous	* * * *	
			Dip10m15	Continuous Continuous Continuous	•	
Random test percentage Regularization multiplier Max number of background points Replicates Roplicated run type	25 1 10000 1 Crossvalidate	Guatrance features Guatrance features Product features Threaded features Threaded features	Junici i m Do jaci	Create respon Make pictures of p kkelle to measure variable in Output format Output file type	e curves redictions nportance ogistic sc 7	
Test sample file	Browse	E Hings features Or Setures Pr	atpat directory insiCOSAVE2017/GuiaEn ojection layers directory/file	a2017(Tail er Jun2017)Proce 4	Browse Browse	
		Ran	Settings	Help		

Fig. 23. In "Settings" and "Basic", include the standard options, as illustrated here.

Fig. 24. Main screen where geo-referenced data and bioclimatic variables are included in "*.asc" format.

In the main screen, in the samples option, select the "*.csv" ("Comma separated values" not "*.xls") file with the geo-referenced pest data. This was discussed in section A3.

Next, select "Auto features", "Create response curves", "Make pictures of predictions", "Do jackknife to measure variable importance", "Logistic format" and "asc file type", and select a folder for the output of the files, thus ordering a complete modeling, with figures like "Do jackknife" that visually describe the contribution of each bioclimatic variable to the final model. In the other part with the environmental layers option, choose the folder with the converted variables to the "*. asc" format, i.e. a raster file like the one described in section A1.

For practical purposes, record warning messages like "Unused field" or "Missing environmental data" and click "Ok".

/ is missing some environmental data (e.g. bio10m01)
Suppress similar visual warnings

Xanthomonas oryzae pv. oryzae

Unused field in	n Bdorsalis.cs	sv		Sample at	24.0, 16.0 in Bdorsalis.cs
OK		Suppress similar visual warning	3		OK

Fig. 25. Record messages like: "Unused field" o "Missing environmental data".

Fig. 26. After checking the repetition of messages, you can select the "Suppress similar visual warnings" option.

The results of the environmental modeling are available in the Xoryzaeoryzae.html file, which can be opened with any web browser. The raster file of the map is available in the Xoryzaeoryzae.asc file, as illustrated in the figure below.

Nombre	Fecha de modifica	Tipo
🕌 plots	17/06/2017 04:06	Carpeta de a
maxent.log	17/06/2017 04:06	Documento
maxentResults.csv	17/06/2017 04:06	Archivo de v
Xoryzaeoryzae.asc	17/06/2017 03:52	Archivo ASC
Xoryzaeoryzae.asc.aux.xml	19/06/2017 06:55 a	Archivo XM
Xoryzaeoryzae.html	17/06/2017 04:06	Archivo HT
Xoryzaeoryzae.lambdas	17/06/2017 03:52	Archivo LAM
📓 Xoryzaeoryzae_explain.bat	17/06/2017 03:52	Archivo por
Xoryzaeoryzae_omission.csv	17/06/2017 03:52	Archivo de s
Xoryzaeoryzae_sampleAverages.csv	17/06/2017 03:52	Archivo de v
Koryzaeoryzae_samplePredictions.csv	17/05/2017 03:52	Archivo de v



Fig. 27. File with the results of the MaxEnt modeling.

Fig. 28. Opening the "*.html" file with the modeling. The "*.asc" file is a raster, as those described in section A1.

C3. Open a map in geographical coordinates, creating a 100 km reference grid, and a centroid in each grid.

Develop a grid with a reference size of 100 Km or 0.9 decimal degrees, based on the equivalences of grades and kilometers from Sheldeman X. & van Zonneveld M. 2011, shown in the Fig. 19.

First, open a shape vector layer from COSIPLAN (http://www.sig.cosiplan.unasursg.org/node/15).

Xanthomonas oryzae pv. oryzae



NOTE: If the Processing toolbox is not available, please select it in tab "View", "Panels" and then "Processing toolbox".

In the "Grid type" choose the "Rectangle (polygon)" option in the "Grid extent" choose "select extent on canvas" dragging the mouse on the map to create the grid. Complete "Vertical spacing" and "Horizontal spacing" with the 0.9 data. Check that EPSG 4326 – WGS84 is in "Grid CRS" and provide a route to save the grid file. Finally, click on "Run in Background" as illustrated in the figure below.

G	ear cuadricula		*		
Parámetros Registro					
Fper de suastricula					Establecer SRC del provecto a partir de ca
Recisiogola (esilgana)					
Sistensión de la cuadricula (umin, umáx, ymáx, ymáx)					Estilos
88.09651940288059, 31.19663140496588, 55.17389879	660758, 4.649169513372563 [EPOCHODE]			100	Abele table de stributer
specialo horizontal				1993	Abiii tabia de adibutos
0,900000			41 Q	1	Conmutar edición
Special vertical					
e.scccoc			fil 🔹		Guardar como
Supergealción hankantal					Guardar como archivo de definición de car
6,000000			ŧ		
Aperposición vertical					Filtrar.
e,000000			\$		Mostrar número de objetos espaciales
ados				as anomana 🖁 🛄	mostrar numero de objetos espaciales
1P52-418 - 1625 84			× @	H 10 EL	Propiedades
Duetricue				10 14 14 14	Combios combro
Culusers/Juse/AcoDeta/Roaming/Q605/Q6033/profiles/defi	wit/processing/suburts/110kpid.shp		100		Campiar nombre
Aber el archeve de salida después de ejacutar el algorite	0			P	
		0%	Desile		
ton an Batch Process	Pur in Badground	Clase	Hep		

Fig. 31. Details included in the "Create grid" function.

Fig. 32. This is the grid file in the "Layers" panel. To make it transparent, select "Properties" with the right button.

NOTE: If the Processing toolbox is not available, please select it in tab "View", "Panels" and then "Processing toolbox".

In the "Layers" panel, you can change the grid file appearance and its location in the map with a right click on its name. To make it transparent, select "Options", "Style", "Single symbol", "Fill", "Simple fill", and in "Fill style" select "No Brush". Front or background movement on the map is commanded with a change in file position in the "Layers" panel.

Xanthomonas oryzae pv. oryzae

2 Dirgle synthet	-	Caja de heiranientas de Procesos	U ?
• 📕 Release		🏘 🛃 🕓 🖹 🗞	
Back R		centrai	6
		Creación de vectores	
		denerar puntos (centroide	s de píxel) a lo largo de línea
an de cons de al mais facale 18		de Cenerar puntos (centroide	s de pivel) deptro de políconos
Color densitiere	• C.		s de pries de la o de polígorios
Srib demilers 🔤 Silds	- C.	a Geometria vectoriai	
Oler de naria sel refero	- C+	Strate Centroides	
Anthons de marca	6	Polo de inaccesibilidad	
Sinse shite Dagona/Racia abile	- G-	🔺 🕹 GRASS	
Della da drigolari Della da drigolari Degona 1	6.	 Vectorial (v.*) 	
Depleuments		🤘 v.delaunay - Crea un t	riangulación de Delaunay a par
* 0.0000 E)		🕺 v.what.rast - Uploads	raster values at positions of ve
		A S FACA	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1
E Artiver report (🖕 🗌 è tectore da ja 👘		4 Vector polycom tools	
• Reproduction de Capan		Polycop centroids	
Easts * OC Canal	Auto Nuto	Polygor Centrolda	

Fig. 33. To make the grid transparent, select "Single symbol", "Fill Style", then "No brush".

Fig. 34. To obtain centroids in each grid, look for the "Centroids" function ("Vector geometry" set) in "Processing Toolbox".

NOTE: If the Processing toolbox is not available, please select it in tab "View", "Panels" and then "Processing toolbox".

Using this vector "*.shp" file of centroids, you can extract values from the modeling.

ardmetros	Security.	Ejecular cono proceso por lotes	Polygon centrolds
			i orgon consolus
spa de entr	103 40-4041	1. () () ()	points again the presenting the central of polygons of an
interiden	anarnat		Plan while the interval and to mark restat to the
Users/Ges	/Cantacta/Documenta/COSAVE2017/Gu	aEne 2017/Taller Jun 2017/Proce 7/2004 gridCentre 1. shp	output layer are the same ones associated to the



Fig. 35. Details in of the use of the "Centroids" function ("Vector geometry").

Fig. 36. Results of the "Centroids" functions.

Xanthomonas oryzae pv. oryzae

C4. Integrating information with QGIS

C4.1. Development a vector shapefile with the crop production information in the geo administrative geopolitical units of each co Develop a vector shapefile with crop production information in the administrative geopolitical units of each country:

First, open the file for the second level administrative geopolitical unit "CSP_FA001_P.shp" downloaded in section A2. Then with the right click on the file, select "Open attribute table" and "Toggle edition tool" by clicking on the pencil in the top left corner of the screen.

1000	ten 1 Ann	1.64			-	2 400.00	1 440.00	and in.	Dec.
111 200	96.26	L'Merin-saise	1	Departments		Date	Intelli	and an an	Diad - Midate
No 1999	M + M) -	1 Artan	1.0	NEATUNET		form	Settion	047	(mail-induced
101-1240	N2:40.	L Detteres		Septement	- 10	Dente	(et-m	301	the star
840 12000	NO.M	1 Caretage		best and		Buick	Lebox	184	Trail Value
100-10000	24.01	1.5804	19	nextman.		Decis	patters.	97	star-wake
672 1600	se al	i Seere		System		Inch	Lebin.	in/	Red Values
Ani (1900)	94.01	1 Hett		lenisterio	- 1	tieb	iebm	101	10119-101010
90712204	87.00	1 Maria	(13	hatness	- 11	5 bitte	t-Ann	are .	Stad - William
80.1000	86.0	1 Location		lipstanet		tien	(#9400	-87	(itsel-Witter
ell upor	16.AL	1. Hallerater	- 0	Spelaretie	14	Bark	arbin.	str.	What-seldent
80013800	10.00	1 Areante	1	>polarere:	. 1	Exhibit	(rfsik	181	10104-201408
ant uples	N.546.	1 Rachegin		System		back	t-bits	199	that which
804 (1980)	04.04	Laves		liquitamente		barb	(abox	100	Unix - olimes
4. 401.14100	N340.	1 Setter	1.14	banteren.	.14	Coards .	Bellete	WY.	Stal-Mass
a 64115300	14.01	1.646		Separation of the second secon	11	NAS-	Entrate	184	intra-veloce
8011800	x1/4	1341208	1.4	NUMBER	1.0	tsida .	avhva.	WF .	the state
* #A11000	sa at	1 Seiner		Lastencia	1	. Justic	Labore	inv.	Shed Milete
99813200	aites:	1.15(48960		Distanto:	1	FairGe	petosis	301	information
80012800	x8.00.	1 Novie i Nei	1.0	Systems		Link	Infrom-	1497	that which
1040 2000	otal.	Contra	- 24	inerentie .	1.1	Everly	(1994)	240	Ohod-Witten
1010 1000	10.140	1.Dec		Provincian .	2.1	- Loose	Sellins.	JPG .	- Ohid Wilson

9. //		fi 8 🚍	N . 7 X	8 1 0 8 1		
6	onmutar el modo edición	(Ctrl+E)	NAM	RPC		
1	16011000000.00	1	Montevideo			
2	16011000001.00	1	Artigas	2		
3	16011000002.00	1	Canelones	2		
4	16011000003.00	1	Cerro Largo	2		

Fig. 37. Open the "CSP_FA001_P.shp" shapefile downloaded in section A2 and with a right click on the "Open attribute table" option".

Fig. 38. Select the "Conmutar edición" with the pencil in the top left corner of the screen.

The vector file "CSP_FA001_P.shp" can include an additional column, where you can record the host area or a host risk index value like 0, 1 or 2 (2 as the maximum value). The host area can be also a "Whole number (Integer)" having as many digits as the largest production area record. Both files are available in the https://goo.gl/WYFe6a folder.

1_P : Obj	CSP_FA00																
8	16 16 11	13	8	P	-	I	٣	٩,	6		8	0	13	3	-	1	1
(Ctrl+W)	Campo nuevo											C	3	-	co •	IDUS	1.2
ZPP	230		5	RPO			AM	N			ACC			CO	IDUS	L	
	Departamento	21						gas	I Ar	1				001.0	11000	150	1

Nombre	HospIndice	
Comentario		
Тіро	Número entero (entero)	•
Tipo de provee	dor integer	
Longitud	1	\$

Fig. 39. With the "New field" option you can include a column with the host area or a host risk index 0, 1 or 2; where 2 is the maximum value.

Fig. 40. Select the name, the "Whole number (Integer)" type, the "Length" of 1 and a click "Ok".

Xanthomonas oryzae pv. oryzae

C4.2. Converting a vector shapefile in a raster.

In order to integrate the host risk index, first convert the vector "*.shp" file to raster with a function in the tap "Raster", "Conversions" and then "Rasterize (vector to raster)". To do this, use the column with the host risk index for the value of the raster. The illustration of this function is shown in the figure below.

For a better view of model raster values, with a right click on the layer, open the "Properties" then "Style", "Singleband pseudocolor" with the "Spectral" option. Include the modification of the label as HIGH, MEDIUM or LOW, as illustrated in the figure below.

rchivo de entra	da (archivo shape)		COSAVECItrus		Selectionar
ampo de atribut	los		RiesgoHosp		+
rchivo de salida	para los vectoriales ra	sterizados (ráster)	17/Proce7/SupC	WrRast11.tf	Selectionar
Mantener el I	tamaño y resolución de	råster existente			
Tamaño del n	áster en pixeles				
Anchura [3000	A	Altura 3000	12	
Resolución de	al räster en unidades d	le mapa por píxel			
Horizontal	1.00000000	*	Vertical 1.0	0000000	÷
Cargar en la vie al_resteriae -a ¡Users/Jose/Co	sta del mapa cuando si RiesgoHosp -1 COSAVE ntacts/Documents/CO	e termine Citrus SAVE2017/GuiøEne	2017/Taller Jun 20	17/DataSHP/Su	perficie5H
COSAVECItrus.s /Users/Jose/Co	hp ntacts/Documents/CO	SAVE2017/GuiaEne	2017/TallerJun20	17/Proce 7/Supl	CitriRast11



Fig. 41. With the "Rasterize" function, convert the "CSP_FA001_P.shp" file using the host risk index as a value.

Fig. 42. For a better presentation of the bioclimatic risk model, change the properties with a right click on the layer.

C4.3. Reclassifying the raster of the model for its integration.

Similarly to the host risk index, index 0, 1 or 2 is required in the environmental modeling. For this purpose, use the "Reclassify values (simple)" function from SAGA (System for Automated Geoscientific Analysis) in the "Processing toolbox" on the right side of QGIS. In the function, select the "Fixed Table 3x3" option with the values 0, 1 or 2. These details are illustrated in the figures below.

Xanthomonas oryzae pv. oryzae

A N		4	Reclass	ify values (simple)	·	Contraction of the local division of the loc	rortage			
		Bertenberg	1	First day come or	transmithten il	9		Tabla fija		1 🔜
Caga da hemamentas de procesado		Parametros	Registro	Lifethia control	read for soles of	17	I con Malana	Black Malue	Benham	Afarte file
0000	-	Grid					LOW VOIC	nigh value	Acpute	
 Agontmos usados recentamente 6. reclass - Crea una capa de mapa nueva cuvos valores de categoría están bi 		6dorsals.Log	[EPSG:4326]			1	2	0,22	0	Elminar fila()
Ordenes de GRASS GES 7 [314 geoalgoritmos]		Replace Cond	Rion			2	0.22	0.44	1	Elminar todo
 Kinum (r.) creciaso - Crea una capa de maca nueva cuyos valores de categoría esti 	6.	[2] Low value	e <= grict value < hig	ph value	(•)	3	144	0.7	2	
🚽 r.reclass.area.greater - Reclasifica una capa raster, seleccionando áreas	m	Lookup Table	Lookup Table			101			10	Aceptar
 Freidass area lesser - Reclasifica una capa raster, seleccionando áreas m - vactorial (v. *) 	*	Flami table 3	ha3							Cancelar
🚽 v.redass - Cambia valores de categoría vectorial para un mapa vectorial	e	Changed Grid								
SAGA (2, 1, 2) [235 geoalgoritmos]		(Giuertlar ett.	(include territors)							
Rester tools Rester tools Rester tools		X Ant el archeo de valós después de spectar el algoritmo								
Terran Analyss - Norphonetry Curvature dassfication							1.00	1	14143	

Fig. 43. Location of the "Reclassify values (simple)" function in SAGA.

Fig. 44. Details of the "Reclassify values" function and the "Fix table 3x3".

Moreover, it is possible to integrate the environmental risk with the host risk index or others with the "Raster calculator" function, which develops math between raster layers. With this tool, you can also integrate information on land cover or Normalized Vegetation Index (NDVI), which are raster files too. When raster layers are multiplied, the grids with a lower value are integrated with the zero (0) value, while higher categories are integrated with maximum values, as shown in Table 3.

Table 3. Integrating raster files with the reclassification of the value in the grid and the multiplication function in the "Raster calculator".

RASTER INTEGRATION	LOW INDEX B = 0	MEDIUM INDEX B = 1	HIGH INDEX B = 2
LOW INDEX A = 0	LOW = 0	LOW = 0	LOW = 0
MEDIUM INDEX A = 1	LOW = 0	MEDIUM = 1	MEDIUM = 2
HIGH INDEX A = 2	LOW = 0	MEDIUM = 2	HIGH = 4

Source: Prepared for STDF/PG/502 COSAVE Project.

Xanthomonas oryzae pv. oryzae

The figure below illustrates the use and results of the "Raster calculator" function:

Bondas ráste				Capa de l	resultad	0					
Bdorsels Logi	\$1 1			Capa de salida Formato de salida			017/Proce 7/8dorsalisGloba 31 tif				
Changed Grid SupCIMPatTL	101 101						GesTIFF				
bia 10m 1491	bic 10# 14# 1			Extensión de la capa actual							
				X mln -180.00000 V min -50.00000		•	X PR2H	180.00000	1		
			100			٠	Y máx	90.00000	\$		
				Columnas	6 2180		٢	Flas	1080		
				SPIC de salida			SRC selecciarado (EPSG: 4326, WGS 84 -				
				# Añedir resultados el proyecto							
Operadore											
Operadore +		reiz cuedrada	C95		87.	lan		log 10	¢		
Operadore + -	* /	reiz cuedrada	096 #(096	NC NC	en sen	lan arcta		log 10 In	¢ S		
Operadore + -	* 	raiz cuadrada	cos arcos te	e No No	en sen	lan arcta		log tð In	() 0		
• Operadore + - c tapresión de	n / 	reiz cuedrada	cos arcos te	e See	er sen	lan arcta 3=	n.] [log tð In 7	۲ ۲		
Operadore + - c Expression de Changed Grid:	* / 3 In colcolado #1" * SupOtri	reiz cuedrede	cos arcos 1=	ж () (en sen	lan arcta) n.]]	log tð In T	() 0		
Operandiore + - c Expression de Changed Grid	* / S In calculado #1" * "SupOtri	rsk cuedrada 	cos arcos 1=	ж сњ. с	er	lan arcta 3=) n:] [] [log 10 In Y	() a		
Operandiore + - c Expressión de Thanged Gridt	s / s In calculado #1" * SupOtri	rsk cuedrada 	cos arcos 1=	ж ма с	eri seti	lan arcta 3=) n:]]	log tð In T	۲ ۵		
Operadore + - c Expression de Thanged Grid	s / / s s colcolado #1" * "SupOtri	rair cuadrada	cos afcos 1±) ac	en seh	lan arcta) , n:]]	log1ð In F	() 0		



Fig. 45. Details in the "Raster calculator" function for the integration of raster layers.

Fig. 46. Regional Risk map. Higher risk in red, medium risk in yellow and lower risk in light blue. Scale 1:45,000,000.

C4.4. Obtaining risk values with a vector shapefile

Open the centroid layer developed in section C3 to extract risk values to a vector (point) layer.

To include geographical coordinates, make a right click on the vector file and select "Open attributes table". Then use the "Field calculator" as shown with the red arrow in the figure below and the "Geometry" option selecting \$x for the field "longitude" and \$y for the field "latitude". It is important to check that the format of the field is "Decimal number (real)" and with 5 decimals of precision.

9		Aeropuer	to :: Objetos to	tales: 976, filtr	ados: 976, selecc	ionado
1	2801	8 8 8		\$ P 8) 语
	IDUSCO	NAM	ACC_LBL	ATV_LBL	FUC_LBL	OP
1	20002000034.00	Fernando De Nor	Exacta	Nacional	Transporte	En Oper
2	20002000084.00	Internacional Do	Exacta	Internacional	Transporte	En Oper
3	20002000049.00	Internacional Pre	Exacta	Internacional	Transporte	En Oper
4	20002000070.00	Internacional Au	Exacta	Internacional	Transporte	En Oper
5	20002000218.00	Internacional Zu	Exacta	Internacional	Transporte	En Oper
6	20002000183.00	Presidente Joao	Exacta	Nacional	Transporte	En Oper



Fig. 47. With a right click on the vector shapefile, open the "Attributes table" and the "Field calculator", as indicated with the red arrow.

Fig. 48. Create a field called "longitude" as "Decimal number (real) with 5 decimals and the "Geometry" function, then "\$x" and similarly with "\$y" for the "latitude".

Xanthomonas oryzae pv. oryzae

In the "Processing toolbox" on the right side, find the "v.sample" function and obtain raster values from the results of sections C2 or C4.3, as illustrated in the figures below.

Reductor Laboration Laboration	Planing many approximit and inter-
and the second second	
Arrison to 10900-4000	- 0
Vector larver of trial to calarm to care for comparison	
D	
Nantor musito be sensied	
Rdvsula (PEG+IDI)	
tempted ractor values will be realisted by this factor	
1.000000	1 - C
Sanding everyolation method	
reweit	
Enternation die fair-engelien also SEASCO GBU 7 (annum, unmain, u	nir, ymax)
Den et Bass pas au hestenis le che tra	110d (=)
Parametros arangados	
Semiler	
C. Abers Date Contexts Documents/COEA/E2017/0	ab e2017 fale 3x 2017 Procei Alexificialia
* Abre el aufreca de antida desaura de rescutar el al	arba
-	(Film

	Layer Preparties	Plettoliant Lywoolspy		1 🔜
a Graduateri				
Colem	1.1 industrial		+ 6	
timbol		A dargo -		
Legend Parint	51-52			Permet 2 2 10
Period	Enter			Accession and the second
Collecterp:	Statement and and the second second			
Cheers. 1	tutogram			
97 . 0.00 197 & 0.15 197 ▲ 0.45	9-63, May 9-64, Mada 9-64, Mada			
	Paulouri *			
Muit Qaartik				General a
Muic Quartic Quarty	le zárd			Advenued
Murie Quantile Quanty (2) Link Hass be	(biks d			Advenuel
Morie Quantie Quanty (Chanty Continues be Distance more	interest () pairs at ()			Advenued

Fig. 49. Sampling risk values with a vector shapefile in a new file "Sampled" in a new route for the file.

Fig. 50. The developed shapefile has points and values that can be graphically shown, changing layer properties.

This layer "Sampled" can be integrated with another vector shapefile, like the 100 km grid that created the centroids. For this, find the "Join attributes by location" function in the "Processing toolbox". Select the "Sampled" layers and the "Grid" shapefile and save it, as illustrated in the figure below.

		Reserved Segure	Tyrate sets process an lites	Join attributes by
Caia de herrami	ientas de procesado 🗗 🗙	Cape - accord opphine		
		American Brook Gall	0	ensert of the mediane, with
1.1.1.1	472	les and writed		The minister of strain or other
unir	129 E.S.	Tampini (KMD-1526)	• 9	taken Pare a residue reptact
		Arcitivato georefinos		love that are atted to early
Algoritmos usados r	recientemente	C retens	and the second se	
		E manual Co	antre	
👘 🔏 Unir tabla d	de atributos	C gain (C)	14,50	
		Pressler		
Geoalgoritmos	de OGIS [116 geoalgoritmos]	A: 000000	4	
		Transver in ordering		
🖃 Herramientas g	enerales vectoriales	Terar atrilados defarros dente apasco "acalizado	•	
		fitnedistics are rearrant (appendix to unus) (appoint)		
Unir at	tributos por iocalización	And the second se		
		Personal tasks for minimum final size on one on another or	- internet	
🖉 🖉 Unir ta	bla de atributos	Cale Line a	N975-17	
مغيثات بعجاله مراجع والمعر بالأبد		O Laws/Dev/Omix/s/DecommuCCSVH211164a89w1	17546(3r2).0Ptc#563882.dtg	
atributtoe por localization				

Fig. 51. Find the "Join attributes by location" function in order to integrate vector shapefiles.

Fig. 52. Select the layers to integrate with the "intercept" option and name this integrated layer.

Xanthomonas oryzae pv. oryzae

This integrated information can be shown in a map, selecting with a right click the "Layer properties", "Style" and "Categorize" in reference to the values of the modeling, as shown in the figures below.

It is also feasible to integrate other geo-referenced information, like the river layer "CSP_BH140_L.shp", available in https://goo.gl/WYFe6a using the "Intersection" function in the "Vector" tab and "Geoprocessing tools" group.





Fig. 53. With the "Layer properties" function you can change the style display of the 100 km grid for risk value (high risk in red, medium risk in yellow and low risk in light blue). Fig. 54. With the tool "Intersection", located in the "Vector" tab, "Geoprocessing tools", you can integrate vector shapefile information from the river layers.

The vector shapefile resulting layer contains origin and modeled risk information. This information can be exported with the right click on the layer, as illustrated in the figures below:

💭 Zum a la capa		.0	Geaiche	capa vectoria: con
Mostrar en la vista general		Farmers	Weres separados per carnas (CD)	М
1 Eliminar		Fierane	 InterCOSA/82017/SullEne2017/Seller Am2017/3/2017 	
🚽 Duplicar		the lane	52/C adaptionada (5750) 4336, W	105 84
Establecer visibilidad de escal	a de capas	Colificació		System
Establecer SRC de la capa	CC-	1. Garde	e officility objector experiator activity	rote
Establecer SRC del provecto a	partir de capa	► Selec	clicks to export and their exp	eri uplices
Fetilos		H Mas	archivo guardado ni nepe e de solicitade	for and solution
LSUIDS		Taxas		23070
Abrir tabla de atributos		* Crea	antata	
Conmutar edición		Type day	puncts/a	fatemalic
Guardar como		C reto	znach tepa de znamerszwi	
Guardar como archivo de def	inición de capa	• 🗆 •	terosin (echast urpo)	
Filtrar	2/242	- Operation	nes de copo	
	12	CREWE	COT NO	
Mostrar número de objetos es	spaciales	16.0	ETHY AS JY	
Propiedades		The.	unur (Preiztenmalis)	
Contraction of the second second		L.L., OFWI	CONTRACTOR OF CONTRACTOR	1000

Fig. 55. To collect the information in another format, you can select the layer with a right click and choose "Save as".

Fig. 56. Save the information in CSV ("Comma separated values") format, which can be opened in Microsoft Excel.

31

Xanthomonas oryzae pv. oryzae

In Microsoft Excel, the NPPO can assess the risk parameters in based on expert criteria. The figure below provides an example.

ARC		10) INSE	RTA	r diseño	DE PÁGINA FÓRM	/ULAS	DATOS REVISA	AR	VIST	A	CON	1PLE	MEN
1	۳× ا	Ca	indile		~ 11 ~ A	· _ = = = ?	87-	🖹 Ajustar texto		Gen	eral	ĺ		
Pe	igar 💉	N	к <u></u> .		🗉 • 🔷 • ,	<u>∧</u> + = = = .	e 42	🛱 Combinar y centra	ar 🔻	5	-	% 000	€ 0 00	00 •0
ort	apapeles 🕞			Fue	ente	Es.	Alinea	sción	rs.		p	lumero		Fa
M	18 .		\pm ×		√ fx	Departamento								
4	A		G		к	М		р		Q		S		
1	id 🔹	-	rast_val	+1	NAM 👻	ZJD	*	RPC_LBL	ZPP_	LBL	Ţ,	Riesgo		•
4	124	3	0.6710	59	Tumbes	Región Y/o Departa	amento	Información No D	PER			ALTO		
6	277	3	0.6394	101	Jujuy	Provincia		Definido	ARG			ALTO		
7	306	1	0.6370	055	Santiago De	Provincia		Definido	ARG			ALTO		
8	298	9	0.634	188	Santiago De	Provincia		Definido	ARG			ALTO		
9	284	5	0.6293	884	Jujuy	Provincia		Definido	ARG			ALTO		
10	277	4	0.627	704	Salta	Provincia		Definido	ARG			ALTO		
11	270	2	0.6197	45	Boqueron	Departamento		Información No D	PRY			ALTO		
12	284	6	0.6071	73	Chaco	Provincia		Definido	ARG			ALTO		
13	291	7	0.6061	.77	Santiago De	Provincia		Definido	ARG			ALTO		
15	263	0	0.5933	801	Boqueron	Departamento		Información No D	PRY			ALTO		
16	284	4	0.589	926	Jujuy	Provincia		Definido	ARG			ALTO		
17	306	0	0.5882	295	Santiago De	Provincia		Definido	ARG			ALTO		
18	270	1	0.5881	12	Tarija	Departamento		Información No D	BOL			ALTO		

Fig. 57. Raster risk value and the identification ID of each generated grid.

NOTE: All this case study information is available in the cXanthomonasoryzaeoryzae folder in the link: https://goo.gl/WYFe6a.

NOTE: The QGIS generated map, "Bdorsalis.qgs", is available in the "QBdorsalis" folder in the link: https://goo.gl/WYFe6a. To use it, download the "QBdorsalis" folder containing all the involved layers.



Xanthomonas oryzae pv. oryzae

References

Costa P., Holtz V. 2011. Impacto das mudancas climáticas globais sobre a distribuicao geográfica da soja Brs valiosa RR no Brasil central. Anais do IX Seminário de Iniciação Científica, VI Jornada de Pesquisa e Pós-Graduação e Semana Nacional de Ciência e Tecnologia. Universidad Estadual de Goias. Available on January, 2018.

EPPO, 2003. Data Sheets on Quarantine Pests. Xanthomonas oryzae. European and Mediterranean Plant Protection Organization (EPPO), P Scott, CAB International. Available on October 27, 2017, at:

https://www.eppo.int/QUARANTINE/data_sheets/bacteria/XANTOR_ds.pdf

EPPO, 2017. EPPO Global Database: Xanthomonas oryzae pv. oryzae. Available on October 27, 2017, at: https://gd.eppo.int/taxon/XANTOR/photos

Morales N., Fernandez I., Baca-Gonzales V. 2017. MaxEnt's parameter configuration and small samples: are we paying attention to recommendations? A systematic review. PeerJ 5:e3093; DOI 10.7717/peerj.3093. Available on October 27, 2017, at: https://peerj.com/articles/3093/

Purdue University. 2017. Bacterial blight - Xanthomonas oryzae pv. oryzae. Available on October 27, 2017, at:

http://pest.ceris.purdue.edu/services/approvedmethods/sheet.php?v=681 http://download.ceris.purdue.edu/file/3055 http://pest.ceris.purdue.edu/pest.php?code=FBZAXBM







STDF Standards and Trade Development Facility

