Bactrocera (Bactrocera) tryoni

(Queensland Fruit Fly)

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Information Taken From

Yonow, T. and Sutherst, R.W. (1998). The geographical distribution of the Queensland fruit fly, *Bactrocera (Dacus) tryoni*, in relation to climate. *Australian Journal of Agricultural Research* 49: 935–953.

Background Information

Common Names:
Queensland Fruit Fly; QFF, QFly

Scientific Name:
Bactrocera tryoni (Froggatt)

Synonyms:
Bactrocera (Bactrocera) tryoni (Froggatt); *Chaetodacus sarcocephali* Tryon; *Chaetodacus tryoni* (Froggatt); *Dacus ferrugineus tryoni* (Froggatt); *Dacus tryoni* (Froggatt); *Strumeta melas* Perkins & May; *Strumeta tryoni* (Froggatt); *Tephritis tryoni* Froggatt

Taxonomy:
Kingdom: Animalia; Phylum: Arthropoda;
Class: Insecta; Order: Diptera; Family: Tephritidae

Crop Hosts:
An extensive host range, comprised of both native and introduced fruits

Figure 1. Adult Queensland fruit fly, *Bactrocera tryoni* (Froggatt). Photograph by James Niland.

Introduction

Bactrocera tryoni is widely recognised as one of Australia's worst economic pests of fruit (e.g. Clarke et al. 2011). Apart from lowering production and making fruit inedible, it has severe effects on trade to sensitive local and international markets. A number of management zones have been established to protect horticultural production areas from this species.

Known Distribution

Bactrocera tryoni occurs in eastern parts of Australia (http://www.ala.org.au). It also occurs in French Polynesia, New Caledonia, Pacific Islands, and Vanuatu (http://www.spc.int/Pacifly). See also Clarke et al. (2011) and Dominiak and Daniels (2012) for a review of the distribution of *B. tryoni*.

Description and Biology

Adult *B. tryoni* are about 7 mm long and brownish in colour, with distinctive yellow markings (Figure 1). Females lay their eggs into soft and ripening host fruit. Larvae (maggots - up to 10 mm long) emerge from the eggs and cause damage by living and feeding within the fruit, which may appear intact from the outside. However, affected fruit are readily recognised since rots develop rapidly and the skin around the sting marks becomes discoloured.

Bactrocera tryoni activity is greatest in warm humid conditions and is particularly important where tree-ripened fruit are concerned. Damage is more severe during mid and late summer than at other times. Large numbers of flies can be expected after good falls of summer rain; fruit flies become active after periods of rain or high humidity. *Bactrocera tryoni* are spread by the movement of uncertified host fruit out of infested areas.

Bactrocera tryoni development is temperature-dependent, but also requires fruit to be available. Generally the phenology of fruit and *B. tryoni* populations are reasonably well synchronised, so it is highly likely that fruit from an infested area will be infected. Summer is a particularly bad season, but *B. tryoni* can persist year-round in locations with a mild enough climate, making the risk unrelated to season.

Suggested citation: Yonow, T. (2014). *Bactrocera (Bactrocera) tryoni*. HarvestChoice Pest Geography. St. Paul, MN: InSTePP-HarvestChoice.

If infected fruit is imported to a non-infested area at any time of year when it is sufficiently warm for development to occur, then it is likely that an outbreak will result. Summer and the wet season in the tropics are the major risk seasons.

Natural flight of *B. tryoni* rarely exceeds 1 km (Dominiak 2012); however, *B. tryoni* is easily transported in infected fruit and this can result in local and seasonal population outbreaks. Thus, great care must be taken when fruit is transported from one locality to another. *Bactrocera tryoni* is a very serious and major pest of many commercial fruits, and strict management and quarantine practices must be enforced.

Host Crops and Other Plants

Bactrocera tryoni has a very wide host range, comprised of about 250 species of both native and introduced fruits including significant commercial crops such as apple (*Malus*), kiwi fruit (*Actinida*), orange (*Citrus sinensis*), peach (*Prunus persica*), and tomato (*Lycopersicon esculentum*). It has also been recorded on 60 wild hosts, belonging to a number of families. This very wide host range enables *B. tryoni* to build up large populations in forest areas (in its native range), which then act as reservoirs from which to invade crops. Hosts are not perceived to be limiting the distribution of this pest.

Potential Distribution

The CLIMEX model for *B. tryoni* (Yonow and Sutherst 1998, Table 1) was parameterised using a 50 km^2 gridded meteorological dataset for Australia generated from a digital elevation model (Hutchinson and Dowling 1991) and ESOCLIM (Hutchinson 1989).

With the CliMond climate dataset (Kriticos et al. 2012) and using a natural rainfall scenario, the modelled distribution with these parameter values (Figure 2) is somewhat broader than the distribution modelled using Esoclim (Yonow and Sutherst 1998). However, the distribution of *B. tryoni* has also expanded southwards since 1998 (B. Dominiak, pers. comm), and so the distribution modelled using the CliMond dataset is in fact a good fit to the current known distribution. The Western Australian State Government maintains that *B. tryoni* does not occur there, despite all CLIMEX modelling (1998 and current) indicating that parts of this state are in fact suitable, with the northwest of Western Australia being modelled as highly suitable. However, Cameron et al. (2010) conclude that the new pest fruit fly in the northwest of Western Australia is the endemic population of *B. aquilonis*, but that there is no genetic evidence supporting the separation of *B. aquilonis* and *B. tryoni* as distinct species. Blacket et al. (2012) also find that members of the *B. tryoni* complex (*B. tryoni*, *B. aquilonis*, *B. neohumeralis,* and *B. melas*) are genetically indistinguishable from each other. There are two possibilities: both *B. aquilonis* and *B. tryoni* have similar climatic niches, and CLIMEX is modelling the one niche correctly, or CLIMEX is correctly modelling the distribution of *B. tryoni* if *B. aquilonis* is not to be considered a different species.

Table 1. CLIMEX Parameter Values for *Bactrocera tryoni*

Parameter	Description	Value
Moisture		
SM0	lower soil moisture threshold	0.1
SM1	lower optimum soil moisture	0.5
SM2	upper optimum soil moisture	1.75
SM3	upper soil moisture threshold	2
Temperature		
DV0	lower threshold	12 °C
DV1	lower optimum temperature	25 °C
DV2	upper optimum temperature	33 °C
DV3	upper threshold	36 °C
Cold Stress		
TTCS	cold stress temperature threshold	2 °C
THCS	temperature threshold stress accumulation rate	-0.1 $week^{-1}$
DTCS	degree-day threshold (stress accumulates if the number of degree-days above DV0 is below this value)	20 °C days
DHCS	degree-day stress accumulation rate	-0.00025 $week^{-1}$
Heat Stress		
TTHS	heat stress temperature threshold	36 °C
THHS	temperature threshold stress accumulation rate	0.005 $week^{-1}$
or		*or*
DTHS	degree-day threshold (stress accumulates if the number of degree-days above DV3 is above this value)	0.4375 °C days
DHHS	degree-day stress accumulation rate	0.01 $week^{-1}$
Dry Stress		
SMDS	soil moisture dry stress threshold	0.1
HDS	stress accumulation rate	-0.005 $week^{-1}$
Wet Stress		
SMWS	soil moisture wet stress threshold	2
HWS	stress accumulation rate	0.002 $week^{-1}$
Threshold Annual Heat Sum		
PDD	number of degree-days above DV0 needed to complete one generation	380 °C days
Irrigation Scenario		
	2.5 mm day^{-1} as top-up throughout the year	

Independent validation is not really possible, as *B. tryoni* primarily occurs in Australia. However, CLIMEX does indicate that other locations that have populations of *B. tryoni* (French Polynesia, New Caledonia, Pacific Islands and Vanuatu) are all suitable for this species.

Irrigation is a key factor in allowing *B. tryoni* to survive and persist in locations that are otherwise too dry. As per Yonow and Sutherst (1988), an irrigation scenario was used to show the suitability of areas for *B. tryoni* globally. For this analysis, 2.5 mm per day as top-up irrigation was applied throughout the year. A composite climate suitability map was created by combining the

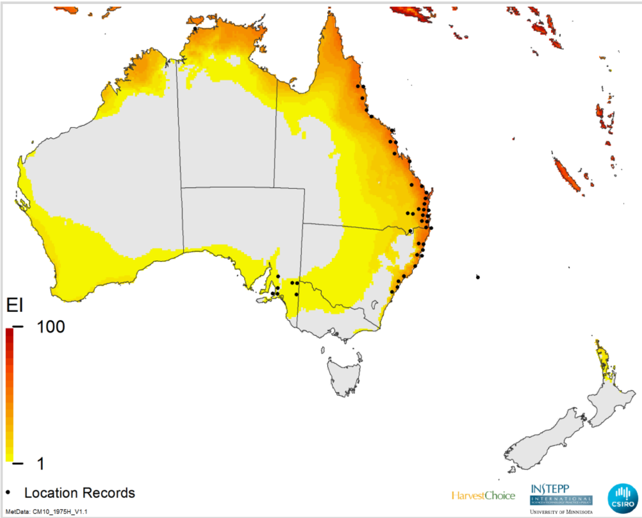

Figure 2. Modelled climate suitability of Australia for *Bactrocera tryoni* under natural rainfall conditions. Location records for *B. tryoni* obtained from the Atlas of Living Australia (http://www.ala.org.au).

natural rainfall and irrigation scenario results using the data from Siebert et al. (2005) (Figure 3). This map clearly shows that many regions of the world are climatically suitable for *B. tryoni*. In fact, many of these areas are even more suitable than the native range in Australia.

Potential Impact in Africa

The simulated distribution of *B. tryoni* in Africa (Figure 4) would put much of sub-Saharan horticultural production at risk. Among the listed host crops for *B. tryoni*, avocado, banana, coffee, guava, mango, papaya, passion-fruit, and tomato are all grown in Africa, and would potentially be at risk. The major production regions for both banana and coffee (You et al. 2012) coincide with regions of high EI values for *B. tryoni* in Africa. Production maps are not currently available for the other hosts that could be affected, and it is not yet known whether any other local fruit species would also be attacked by *B. tryoni*. Nonetheless, it can be expected that the impact of this species in Africa would be fairly high.

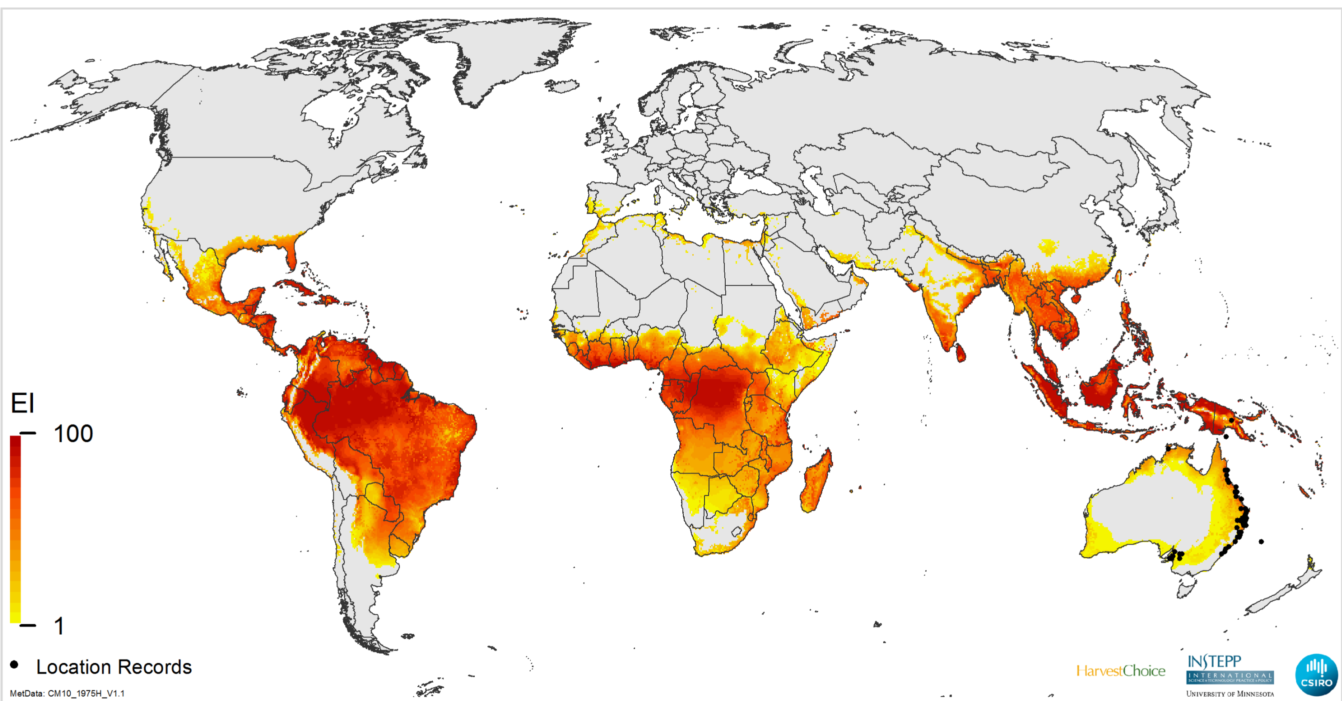

Figure 3. Modelled global climate suitability for *Bactocera tryoni* as a composite of natural rainfall and irrigation based on the irrigation areas identified in Siebert et al. (2005). Location records for *B. tryoni* obtained from the Atlas of Living Australia (http://www.ala.org.au).

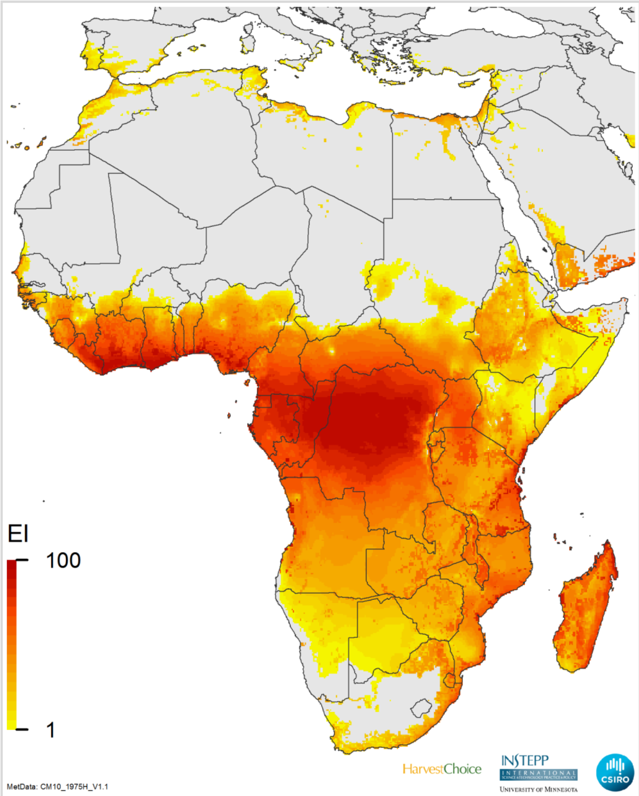

Figure 4. Modelled climate suitability of Africa for *Bactrocera tryoni* as a composite of natural rainfall and irrigation based on the irrigation areas identified in Siebert et al. (2005).

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ACKNOWLEDGEMENTS

HarvestChoice would like to acknowledge Noboru Ota for spatial data analysis and the production of all maps. This brief was prepared with support from the Bill and Melinda Gates Foundation by way of the HarvestChoice project with additional support from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and The International Science and Technology Practice and Policy Center (InSTePP), University of Minnesota.

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