Data Article

Raw data of laboratory toxicity and field control effect of different fungicides on *Colletotrichum fructicola*

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Abstract

Laboratory toxicity test and field control effect test are important experiments to evaluate the effect of pesticides on disease control. The safety of pesticide application depends on whether the pesticide residue on the fruit complies with the limits related to the good agricultural practices which were assessed by the legislative framework. In addition, many factors may affect the control effect of fungicides in the field experiment, among which one of the most important factors is the precipitation during the application process in the growing season. In this study, raw data of the laboratory toxicity of different fungicides to *Colletotrichum fructicola*, disease severity after treatment with different agents, the pesticide residue on the fruit after preharvest application, and the precipitation in the growing season are provided. In addition, this study also introduced the method and calculation process of raw data processing. We hope that these raw data will serve as a reference for other researchers who are

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studying the prevention and control of Glomerella leaf spot (GLS).

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### Specifications Table

| Subject | Agricultural Sciences |
|---------|-----------------------|
| Specific subject area | Agronomy and Crop Science |
| Type of data | Table |
| How data were acquired | Data were acquired from laboratory and field experiment where investigation as well as calculation for EC<sub>50</sub> values and EC<sub>90</sub> values, disease index, area under disease progress curve (AUDPC), disease reduction of disease fruit and control effect were conducted. Statistical analysis was done using IBM SPSS statistics software version 20.0 (IBM, US). |
| Data format | Raw |
| Parameters for data collection | Table 1: Colony diameter and spore germination number were used to calculate mycelial growth inhibition rate and spore germination rate. Table 2: DI, foliar disease index of GLS; AUDPC, the area under foliar diseases progress curves of GLS; N<sub>df</sub>, the number of disease fruit. Table 3: the pesticide residues in Apple fruits. Table 4: Precipitation in experimental orchards during field trials. |
| Description of data collection | Table 1: The data of colony diameter was collected through laboratory experiments by recording the colony diameter. The data of spore germination number was collected by recording the number of germinated spore in laboratory using an optical microscope. Table 2: The data of DI, AUDPC, and N<sub>df</sub> were collected through field experiments by recording the number of diseased leaves. Table 3: The pesticide residues in Apple fruits were entrusted to Fruit Quality and Safety Research Center of Fruit Research Institute of Chinese Academy of Agricultural Science. Table 4: Precipitation was obtained daily from weather stations located at least than 10 km from the experimental orchards. |
| Data source location | Institution: Plant Protection Institute City/Town/Region: Qixia city in Shandong Province Country: China |
| Latitude and longitude (and GPS coordinates, if possible) for collected samples/data | Orchard A (37.25°N, 120.68°E); Orchard B (37.25°N, 120.68°E); Orchard C (37.47°N, 120.46°E); Orchard D (37.25°N, 120.67°E); |
| Data accessibility | Meng, Xianglong (2021), “Raw data of laboratory toxicity and field control effect of different fungicides on Colletotrichum fructicola”, Mendeley Data, V1, doi:10.17632/97bfppx7c2.1 |
| Related research article | Jiang, H., Meng, X., Ma, J., Sun, X., Wang, Y., Hu, T., Cao, K., and Wang, S. Control effect of fungicide pyraclostrobin alternately applied with Bordeaux mixture against apple Glomerella leaf spot and its residue after preharvest application in China, Crop Protection 142 (2021):105,489. https://doi.org/10.1016/j.cropro.2020.105489. |

### Value of the Data

- Colony diameter and spore germination number are used to calculate EC<sub>50</sub> and EC<sub>90</sub>, which are used to evaluate the laboratory toxicity of fungicides. DI, AUDPC and N<sub>df</sub> are used to evaluate the field control effects of fungicides. Pesticide residues are used to evaluate the safety of fungicides. Precipitation directly affects the prevalence of diseases and the field control effect of pesticides.
• These raw data will serve as a reference for other researchers who are studying the prevention and control of GLS.
• We provided the raw data of laboratory toxicity and field control effect of different fungicides on GLS in Shandong province, China, in 2017 and 2018. Other researchers will be able to compare this data with other data in future to assess the susceptibility and resistance of pathogens to fungicides.

1. Data Description

The data presented in this paper were Raw data for a manuscript of “Control effect of fungicide pyraclostrobin alternately applied with Bordeaux mixture against apple Glomerella leaf spot and its residue after preharvest application in China” which will be published on Crop Protection (DOI: https://doi.org/10.1016/j.cropro.2020.105489). Raw Data is contained in four Excel files, whose file names are “Table 1”, “Table 2”, “Table 3”, and “Table 4”.

Table 1 is the raw data of laboratory toxicity test. This file has two sheets. One is the raw data of the mycelial growth, and the other is the raw data of conidia germination. The experiments of fungicides against mycelium growth were performed in triplicate and conducted independently two times. The experiments of fungicides against fungicides against conidia germination were performed in triplicate and conducted independently two times.

Table 2 is the raw data of field control effect experiment, including foliar disease index of GLS (DI), the area under foliar diseases progress curves of GLS (AUDPC), foliar control effect of different fungicides against GLS (CE), Percentage of disease fruit (PF) and disease reduction of disease fruit after different fungicides treatment (DF).

This file has five sheets, which are the raw data of five field experiments. To measure the foliar disease severity, five branches were randomly selected in an apple tree at five directions (from the east, west, south, north, and central portions). The leaves of each branch were used to evaluate the disease severity, and the classification standards of disease severity level of a single leaf are as follows (Dang et al.): level 0, no lesion; level 1, 0 ≤ lesion area < 10%; level 2, 10% ≤ lesion area < 25%; level 5, 25% ≤ lesion area < 40%; level 7, 40% ≤ lesion area ≤ 65%; and level 9, lesion area ≥ 65% or fallen leaves. The foliar disease index (DI) of GLS was calculated as an equation of previous report (Ligia et al.). Area under disease progress curve (AUDPC) was calculated for the assessment period as described in a previous method [1, 2]. A total of 800 fruits per treatment were examined.

Table 3 is the raw data of different pesticide residue in five field experiment. Five apple fruits were sampled in each plot at 10 and 15 d after the last application before harvest in orchard A, B and D. In orchard C, the interval time between sample collection and the last application before harvest was 16 and 21 d All apple samples were stored at −20 °C. The terminal residual levels of pyraclostrobin, tebuconazole, prochloraz, chlorpyrifos and cypermethrin in apple fruits was measured in 2017 and 2018, except tebuconazole that did not measured in 2018. Measurements of terminal residues of the target agents were entrusted to Fruit Quality and Safety Research Center of Fruit Research Institute of Chinese Academy of Agricultural Science.

Table 4 is the raw data of precipitation in apple growing season. Weather data (per hour temperature, precipitation and relative humidity) was obtained daily from weather stations located at less than 10 km from the experimental orchards.

2. Experimental Design, Materials and Methods

2.1. Mycelial culture and conidia suspension

Strain QX16–3 was isolated from Qixia city of Shandong province in China and identified as C. fructicola. Mycelial culture of QX16–3 grown on potato dextrose agar (PDA, 200 g of peeled
potato, 5 g of dextrose and 15 g of agar per liter of distilled water) was incubated at 25 °C in the dark for 10 days until conidia were produced. Conidia were harvested from PDA plates by adding 20 ml sterile distilled water to each plate and gently rubbing the mycelial mass with a bent glass rod. The suspension was filtrated by four layers sterilized gauze, and the filtrate was centrifuged at 10,000 r/min for 5 min to precipitate the conidia in the solution. Conidia concentration was adjusted to 1 × 10^5 conidia ml^{-1} using sterilized water by a haemocytometer under an optical microscope (AX10, Zeiss, Germany).

2.2. In vitro toxicity of three fungicides

Technical-grade pyraclostrobin (99.95% active ingredient (ai); TK; Germany Dr. Ehrenstorfer Co., Ltd.), prochloraz (98% ai; TK; Shanghai Jingchun Biochemical Technology Co., Ltd.), and tebuconazole (97% ai; TK; Shanghai Jingchun Biochemical Technology Co., Ltd.) were dissolved in acetone to produce their respectively 1000 μg ml^{-1} stock solution. All of these stock solutions were stored at 4 °C for no more than two weeks before being serially diluted for subsequent experiments.

PDA medium at about 55 °C were amended with pyraclostrobin at final concentration of 0.20, 0.40, 0.80, 1.60, 3.20 mg ai L^{-1}; prochloraz at 1.56, 3.13, 6.25, 12.50, 25.00 μg ai L^{-1}; tebuconazole at 0.15, 0.30, 0.60, 1.20, 2.40 mg ai L^{-1}. PDA media supplemented with only acetone at concentration of 0.10 to 0.50% by volume were used as the negative control (CK). Mycelial plugs (5 mm in diameter) cut from the periphery of 7-day-old colonies of C. fructicola were placed upside down onto the center of fungicide-supplemented PDA plates. PDA plates were incubated at 25 °C in the dark for 6 days. The diameter of each colony was measured twice at right angles. The experiments were performed in triplicate and conducted independently two times.

Appropriate volumes of stock solutions of pyraclostrobin, prochloraz and tebuconazole were added into molten PDA plates at about 55 °C to achieve final concentrations of 0.31, 0.63, 1.25, 2.50 and 5.00 μg ai ml^{-1} respectively. The fungicide-free PDA media supplemented with appropriate concentrations of organic solvents were used as the negative controls. Conidia suspensions (30 mL) with 1 × 10^5 conidia ml^{-1} prepared by sterile distilled water were spread on fungicide-supplemented PDA plates. PDA plates were incubated at 25 °C in the dark for 24 h. When the germ tube length exceeded half the conidia length, conidia were considered as germination. For each plate, the number of the germinated conidia was determined by a haemocytometer. For each fungicide, three replicates per concentration were used, and the experiment was performed two times.

2.3. Field area

Field experiments were conducted for two years (from late-June to mid-August in 2017 and 2018) at four nearby commercial apple orchards of Qixia city in Shandong Province, China (orchard A, B, C and D; 37°05’ N to 37°32’ N, 120°33’ E to 121°15’ E). The susceptible apple cultivar ‘Gala’ trees in orchard A, C and D were planted in 2009 grafted onto Malus hupehensis Rehd. The apple tree spaces were 4 × 3 m at these three orchards with a training system of slender pyramid training system (SP). The ‘Gala’ trees in orchard B was planted in 2012 grafted onto M9 rootstock. The apple tree spaces were 4 × 2 m at this orchard with a training system of slender spindle training system (SS).

The climate is typical continental monsoon climate characterized by hot and rainy summers, cold and dry winters. The average annual precipitation ranged from 640 to 846 mm, 70% of which is concentrated from June to September. The annual average frost-free period is 209 days and occurs from spring to late autumn. The soils of all experimental orchards are loam soil (soil organic matter, 9.15 g kg^{-1}; N, 628.00 mg kg^{-1}; P, 35.10 mg kg^{-1}; K, 92.00 mg kg^{-1}; B, 0.25 mg kg^{-1}; Zn, 2.41 mg kg^{-1}; Cu, 5.75 mg kg^{-1}; Mn, 24.49 mg kg^{-1}; Fe, 61.57 mg kg^{-1};
pH, 4.40–6.70). During two years experiment, in addition to the fungicide treatment used in this experiment, the conventional and identical pest control measures were also carried out in the four experimental apple orchards. Fertilization, irrigation and other cultural practices were as recommended to commercial growers. Weather data (per hour temperature, precipitation and relative humidity) was obtained daily from weather stations located at less than 10 km from the experimental orchards.

2.4. Field experiment design

Five field experiments were carried out to investigate the efficacy of pyraclostrobin (30% ai; SC; Qingdao Star Crop Science Co., Ltd.), prochloraz (45% ai; EW; Qingdao Star Crop Science Co., Ltd.) and tebuconazole (43% ai; SC; Qingdao Star Crop Science Co., Ltd.) against GLS. This experiment was arranged in a split-plot design. Experiments were designed as randomized block of four replicates. To avoid cross contamination, one plant was left as interval between different treatments. The sprayer was calibrated to deliver 2700 L ha\(^{-1}\) of water at 280 kPa pressure to minimize the drift of fungicides from one plot to another. Spray the whole plant evenly with sprayer (Golden ball 3WBD-20 L type). No artificial inoculation was applied.

2.4.1. Experiment 1

This experiment was arranged in a split-plot design with five foliar treatments at orchard A (37.25°N, 120.68°E) in 2017. Five foliar treatments were applied as single applications [pyraclostrobin at 810.00, 405.00, and 202.50 g ai ha\(^{-1}\), tebuconazole at 580.50 g ai ha\(^{-1}\) and a control group sprayed with tap water] on June 13, July 21 and July 26, respectively. Besides the target fungicides, Bordeaux mixture (80% ai; WP; Qingdao Star Crop Science Co., Ltd.) at 1080.00 g ai ha\(^{-1}\) and a combined application [pyraclostrobin at 405.00 g ai ha\(^{-1}\) combined with prochloraz at 911.25 g ai ha\(^{-1}\)] were sprayed at the whole plot on July 5 and August 18 respectively.

2.4.2. Experiment 2

This experiment was arranged in a split-plot design with five foliar treatments at orchard C (37.47°N, 120.46°E) in 2017. At all sites, Bordeaux mixture at 1080.00 g ai ha\(^{-1}\) was applied to the entire plot area on July 5 prior to applying the target agents. Five foliar treatments were applied as single applications as described in experiment 1 on July 21 and July 26, respectively. Besides the fungicides described above, pyraclostrobin at 405.00 g ai ha\(^{-1}\) were sprayed at the whole plot on August 9 and August 14. In addition, the whole plot was sprayed with cypermethrin (60.75 g ai ha\(^{-1}\)) to control pests.

2.4.3. Experiment 3

This experiment was arranged in a split-plot design with five foliar treatments at orchard A in 2018. Five foliar treatments were applied as single applications [pyraclostrobin at 810.00, 405.00, and 303.75 g ai ha\(^{-1}\), prochloraz at 911.25 g ai ha\(^{-1}\) and a control group sprayed with tap water] on June 26, July 30 and August 10. Bordeaux mixture (1080.00 g ai ha\(^{-1}\)) and cypermethrin (60.75 g ai ha\(^{-1}\)) was applied to the entire plot area on July 8 and August 10, respectively.

2.4.4. Experiment 4

This experiment was arranged in a split-plot design with five foliar treatments at orchard B (37.25°N, 120.68°E) in 2018. Five foliar treatments were applied as single applications as described in experiment 3 on July 16 and August 11, respectively. Bordeaux mixture (1080.00 g ai ha\(^{-1}\)) was applied to the entire plot area on July 30.
2.4.5. Experiment 5

This experiment was arranged in a split-plot design with five foliar treatments at orchard D (37.25°N, 120.67°E) in 2018. Five foliar treatments were applied as single applications as described in experiment 3 on June 26, July 30, and August 10, respectively. Besides the fungicides described above, Bordeaux mixture (1080.00 g ai ha$^{-1}$) and cypermethrin (60.75 g ai ha$^{-1}$) was applied to the entire plot area on July 8 and August 10, respectively.

2.5. Disease assessment

To measure the foliar disease severity (DI), five branches were randomly selected in an apple tree at five directions (from the east, west, south, north, and central portions). The leaves of each branch were used to evaluate the disease severity, and the classification standards of disease severity level of a single leaf were as follows (Dang et al.): level 0, no lesion; level 1, 0 ≤ lesion area ≤ 10%; level 3, 10% < lesion area ≤ 25%; level 5, 25% < lesion area ≤ 40%; level 7, 40% < lesion area ≤ 65%; and level 9, lesion area > 65% or fallen leaves. The DI of GLS was calculated as an equation of previous report (Ligia et al.). Area under disease progress curve (AUDPC) was calculated for the assessment period as described in a previous method [1,2]. Diseased fruits numbers were investigated on 24 August in 2017 and 14 August in 2018. A total of 800 fruits per treatment were examined.

2.6. Pesticide residues detection

Apple fruits were collected to evaluate the terminal residue of the major fungicides and pesticides used in the experimental orchards. Five apple fruits were sampled in each plot at 10 and 15 d after the last application before harvest in orchard A, B and D. In orchard C, the interval time between sample collection and the last application before harvest was 16 and 21 d. All apple samples were stored at −20 °C until analysis [3]. The terminal residual levels of pyraclostrobin, tebuconazole, prochloraz, chlorpyrifos and cypermethrin in apple fruits was measured in 2017 and 2018, except tebuconazole that did not measured in 2018. Measurements of terminal residues of the target agents were entrusted to Fruit Quality and Safety Research Center of Fruit Research Institute of Chinese Academy of Agricultural Science.

Ethics Statement

No conflict of interest exists in this submission. The authors declare that the work described in this paper is original and not under consideration for publication elsewhere, in whole or in part. Its publication is approved by all the authors listed.

CRediT Author Statement

He Jiang: Writing - Original Draft; Xiang-long Meng: Methodology, Writing - Review & Editing, Visualization; Jie Ma: Investigation, Resources; Xiaonuo Sun: Data Curation; Yanan Wang: Conceptualization; Tongle Hu: Supervision; Keqiang Cao: Project administration, Funding acquisition; Shu-tong Wang: Funding acquisition, Term, Conceptualization, Methodology, Writing - Original Draft.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have, or could be perceived to have, influenced the work reported in this article.
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Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:doi:10.1016/j.dib.2021.107000.

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