Potential geographical distribution of fall armyworm (*Spodoptera frugiperda*) in China

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- It prefers **maize**, but can feed on more than 80 additional species of crops, including rice, sorghum, millet, sugarcane, vegetable crops and cotton.
- The moth can fly up to 100 km per night and the female moth can lay up to a total of 1000 eggs in her lifetime.

*(FAO, 2019)*
Distribution and invasion history of FAW
Study object

Publication of Chinese journal of FAW
Future climate scenarios project a decrease in the risk of fall armyworm outbreaks (Ramirez-Cabral et al., 2017)
PGD development of FAW

Pest risk assessment of *Spodoptera frugiperda* for the European Union (EFSA PLH Panel, 2018)
Forecasting the global extent of invasion of the cereal pest *Spodoptera frugiperda*, the fall armyworm (Early et al., 2018)
Global distribution of the fall armyworm (14 provinces occurred in China until 2019.5.21)
Distribution data

Year-round and seasonal distributions of the fall armyworm (divided by 0°C, 1618 year-round, 1217 seasonal distribution points)
<table>
<thead>
<tr>
<th>变量</th>
<th>英文名</th>
<th>中文名</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO1</td>
<td>Annual Mean Temperature</td>
<td>年平均气温</td>
</tr>
<tr>
<td>BIO2</td>
<td>Mean Diurnal Range</td>
<td>月平均昼夜温差</td>
</tr>
<tr>
<td>BIO3</td>
<td>Isothermality</td>
<td>平均日温/年温变化范围</td>
</tr>
<tr>
<td>BIO4</td>
<td>Temperature Seasonality</td>
<td>气温季节性变化</td>
</tr>
<tr>
<td>BIO5</td>
<td>Max Temperature of Warmest Month</td>
<td>最热月的最高温</td>
</tr>
<tr>
<td>BIO6</td>
<td>Min Temperature of Coldest Month</td>
<td>最冷月的最低温</td>
</tr>
<tr>
<td>BIO7</td>
<td>Temperature Annual Range</td>
<td>气温年变化范围</td>
</tr>
<tr>
<td>BIO8</td>
<td>Mean Temperature of Wettest Quarter</td>
<td>最湿月的平均气温</td>
</tr>
<tr>
<td>BIO9</td>
<td>Mean Temperature of Driest Quarter</td>
<td>最干月的平均气温</td>
</tr>
<tr>
<td>BIO10</td>
<td>Mean Temperature of Warmest Quarter</td>
<td>最热季节的平均气温</td>
</tr>
<tr>
<td>BIO11</td>
<td>Mean Temperature of Coldest Quarter</td>
<td>最冷季节的平均气温</td>
</tr>
<tr>
<td>BIO12</td>
<td>Annual Precipitation</td>
<td>年降水量</td>
</tr>
<tr>
<td>BIO13</td>
<td>Precipitation of Wettest Month</td>
<td>最湿月的降水量</td>
</tr>
<tr>
<td>BIO14</td>
<td>Precipitation of Driest Month</td>
<td>最干月的降水量</td>
</tr>
<tr>
<td>BIO15</td>
<td>Precipitation Seasonality</td>
<td>降水的季节变化</td>
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<tr>
<td>BIO16</td>
<td>Precipitation of Wettest Quarter</td>
<td>最湿季节的降水量</td>
</tr>
<tr>
<td>BIO17</td>
<td>Precipitation of Driest Quarter</td>
<td>最干季节的降水量</td>
</tr>
<tr>
<td>BIO18</td>
<td>Precipitation of Warmest Quarter</td>
<td>最暖季节的降水量</td>
</tr>
<tr>
<td>BIO19</td>
<td>Precipitation of Coldest Quarter</td>
<td>最冷季节的降水量</td>
</tr>
</tbody>
</table>
Maxent modelling （version 3.3.3k）

✓ Random test percentage  25
✓ Replicates            10
✓ Replicated run type   subsample
✓ Maximum iterations    5000
✓ Apply threshold rule  10 percentile training presence
Current PGD based on dataset of year-round distribution

Potential geographical distribution of the fall armyworm (based on dataset of year-round distribution)
Potential geographical distribution of the fall armyworm (based on dataset of all distribution)
Model performance and contribution rate of environmental variables. 

- **a,b:** All distribution
- **c,d:** Year-round distribution

The diagrams illustrate the performance and contribution rates of environmental variables, with plots showing sensitivity vs. 1-specificity for FAW and FAW-0. The graphs depict how different environmental variables (e.g., bio10, bio16, bio17, bio5, bio6, bio8) contribute to the model performance across different distribution scenarios.
The results showed that year-round surveillance should be done in Hainan, Yunnan, Guangxi, Guangdong, Fujian, Zhejiang, Jiangxi, Hunan, Guizhou, Sichuan, Chongqing, Hubei, Anhui, Jiangsu provinces.

Seasonal surveillance in spring, summer and autumn should be done in Shandong, Henan, Hebei, Beijing, Tianjin, Shanxi, Shaanxi, Ningxia, Gansu, Qinghai, Inner Mongolia, Xinjiang and Liaoning.

Bio5 (Max temperature of warmest month) and bio7 (Temperature annual range) were the key variables for all distribution model, bio6 (Min temperature of coldest month) was the key variable for year-round distribution model.
Discussion

Time effective of the model?

Currently FAW was occurred in 22 provinces, is the model built on 5.22 (14 provinces) still working?

Not in time to consider Climate change.
PGD of *Bactrocera dorsalis* (Stephens et al. 2007)
PGD of *Bactrocera dorsalis* (De Villiers et al. 2016)
PGD of *Bactrocera dorsalis*  
(Qin et al. 2019)
Distribution density effect on the model?
Global distribution of the fall armyworm (2019.3.20)
Sampling bias correction

Assigned the distribution data to the same Cellsize as the climate data (0.0833, 0.0833)
Potential geographical distribution of the fall armyworm (2019.3.20)
Discussion

Historical PGD or current PGD?

Current distribution vs historical climate data?

1961 - 1990 (30 years centered on 1975)

WorldClim - Global Climate Data
Free climate data for ecological modeling and GIS

• Current conditions (interpolations of observed data, representative of 1960-1990)
College of Plant Protection
Plant Quarantine and Invasion Biology Lab

Thank you for your attention!

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