



Aerospace Information Research Institute
Chinese Academy of Sciences

Global Crop Pests and Diseases Monitoring and Forecasting Report



Vegetation Remote Sensing & Pest and Disease Application

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Crop pests and diseases monitoring and forecasting Global April to May 2018

Minor infestation of pests and diseases on wheat

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series and HJ series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, AIR (RADI) constructed the 'Crop pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases in whole China.

During April to May 2018, wheat rust (*Puccinia striiformis*), Fusarium head blight (*Fusarium graminearum*), aphid (*Sitobion avenae* & *Rhopalosiphum padi*) slightly occurred in ten main wheat production countries, including Russia, France, Turkey, China, Pakistan, United States, Germany, Iran, Uzbekistan, and United Kingdom.

Wheat diseases

The distribution of wheat diseases in these ten countries is shown in Figure 1. The total wheat area in Russia is about 31 million hectares, with affected area of rust accounts for 9%, mainly occurred in the Caucasus, and central economic Region. The total wheat area in France is about 8 million hectares, with affected area of rust accounts for 4%, mainly occurred in maize, barley and livestock zone along the English Channel, and mixed maize / barley and repassed zone from the

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center to the Atlantic Ocean. The total wheat area in Turkey is about 8 million hectares, with affected area of rust accounts for 12%, mainly occurred in central Anatolia region, and Marmara, Aegean, Mediterranean lowland region. The total wheat area in China is about 24 million hectares, with affected area of rust in China accounts for 4%, mainly occurred in North China and Central China. The total wheat area in Pakistan is about 14 million hectares, with affected area of rust accounts for 17%, mainly occurred in northern highlands, and northern Punjab. The total wheat area in the United States is about 16 million hectares, with affected area of Fusarium head blight accounts for 5%, mainly occurred in southern plains, California, and northwest. The total wheat area in Iran is about 10 million hectares, with affected area of rust accounts for 10%, mainly occurred in semi-arid to sub-tropical hills of the west and the north. The total wheat area in Uzbekistan is about 2 million hectares, with affected area of rust accounts for 14%, mainly occurred in eastern hilly cereals zone, and Aral Sea cotton zone. The total wheat area in United Kingdom is about 2 million hectares, with affected area of rust accounts for 8%, mainly occurred in south English mixed wheat and barley zone, and sparse crop area of England, Wales and Northern Ireland.

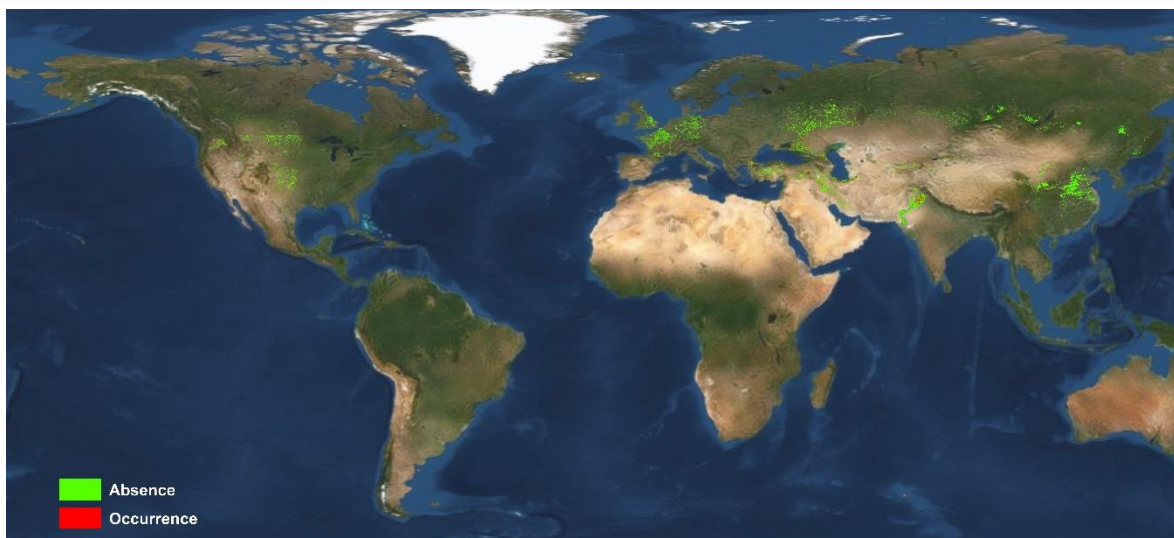


Figure 1 Distribution of wheat disease in ten production countries

Wheat aphid

The affected area of wheat aphid in Russia accounts for 10%, mainly occurred in Volga basin, the Caucasus, and central economic Region. The affected area of wheat aphid in France accounts for 5%, mainly occurred in maize, barley and livestock zone along the English Channel, Southwest maize zone, and mixed maize/barley and repassed zone from the center to the Atlantic Ocean. The affected area of wheat aphid in China accounts for 31%, mainly occurred in North China, Central China and Southwest China. The affected area of wheat aphid in Pakistan accounts for 22%, mainly occurred in northern highlands, northern Punjab, and lower Indus river basin in south Punjab and Sind. The affected area of wheat aphid in the United States accounts for 5%,

mainly occurred in southern plains, and northwest. The total wheat area in Germany is about 5 million hectares, with the affected area of aphid accounts for 9%, mainly occurred in central wheat zone of Saxony and Thuringia, wheat zone of Schleswig- Holstein and the Baltic coast, and mixed wheat and sugar beets zone of the northwest. The affected area of wheat aphid in Iran accounts for 12%, mainly occurred in semi-arid to sub-tropical hills of the west and the north. The affected area of wheat aphid in Uzbekistan accounts for 17%, mainly occurred in eastern hilly cereals zone. The affected area of wheat aphid in the United Kingdom accounts for 11%, mainly occurred in south English mixed wheat and barley zone.

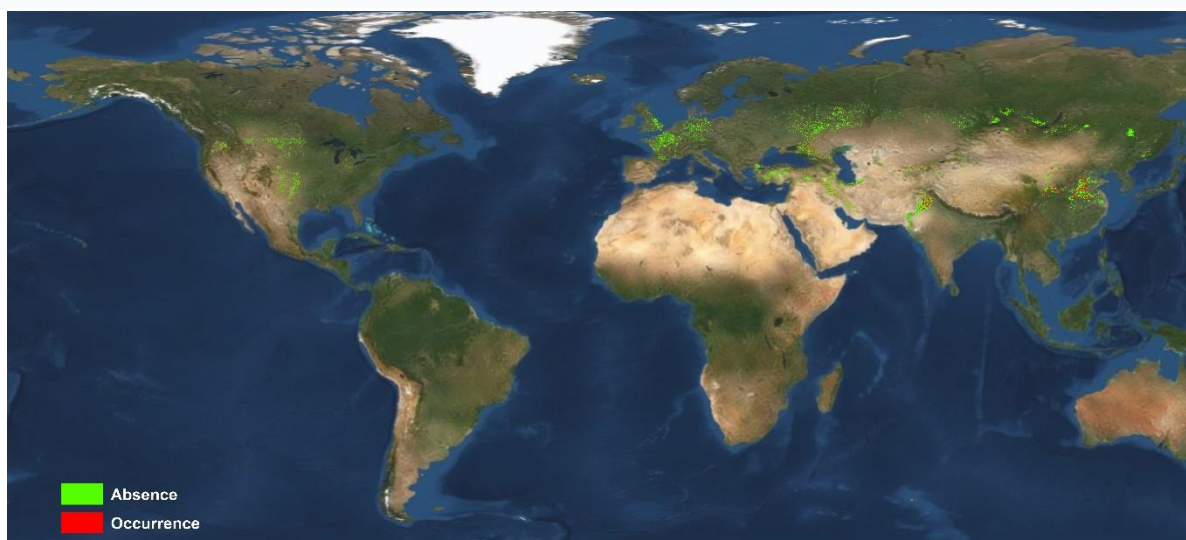


Figure 2 Distribution of wheat pest in ten production countries

Table 1 Statistics of wheat disease and pest in ten production countries

Winter wheat production countries	Disease and pest occurrence ratio / %			Total planting area / million hectares
	Rust	Fusarium head blight	Aphid	
Russia	9	/	10	31
China	4	/	31	24
United States	/	5	5	16
Pakistan	17	/	22	14
Iran	10	/	12	10
France	4	/	5	8
Turkey	12	/	/	8
Germany	/	/	9	5
Uzbekistan	14	/	17	2
United Kingdom	8	/	11	2

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Crop pests and diseases monitoring and forecasting Global China, South and Southeast Asia September 2018

Minor infestation of pest and disease on rice

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series and HJ series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, AIR (RADI) constructed the 'Crop pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases in whole China.

In September 2018, rice blast (*magnaporthe oryzae*) and rice planthopper (*nilaparvata lugens*) slightly occurred in twelve main rice production countries, including China, India, Thailand, Bangladesh, Indonesia, Myanmar, Vietnam, Cambodia, Philippines, Pakistan, Nepal and Laos.

Rice blast

The distribution and statistics of rice blast in China, South and Southeast Asia are shown in Figure 1 and Table 1. The total rice area in China is about 30 million hectares, the area affected by rice blast accounts for 3% of the total rice areas, with the disease mainly occurred in lower Yangtze region and Northeast China. In India, the total rice area is about 44 million hectares, the disease accounts for 10% of total rice area, mainly in Assam and northeastern regions, eastern regions of Gangetic plain, and eastern coastal region. In Thailand, the total rice

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area is about 13 million hectares, 6% of rice areas are infested, mainly in single cropped rice northeastern region, central double and triple cropped rice lowlands, and northern regions of western and southern hill areas. In Bangladesh, the total rice area is about 10 million hectares, the affected areas reach 8%, essentially the Gangetic plain and northwestern regions of Sylhet basin. In Indonesia, the total rice area is about 14 million hectares, the affected areas (9% of cultivated areas) occur mainly in Java and northern regions of Sumatra. In Myanmar, the total rice area is about 7 million hectares, the disease affects 5% of rice areas, mainly in northern regions of hills area and northern regions of Delta and southern coast. In Vietnam, the total rice area is about 7 million hectares, the fungus occurs in 4% of rice growing areas, mainly in Southern zone with Mekong Delta and northern zone with Red river Delta. In Cambodia, the total rice area is about 3 million hectares, the affected areas are 6% of rice areas, mainly in southern regions of upland areas and central Tonle-Sap plain. In Philippines, the total rice area is about 4 million hectares, the disease affects 8% of rice areas, mainly in Lowlands. In Pakistan, the total rice area is about 3 million hectares, the pathogen occurs in 7% of rice areas, mainly in northern Punjab and lower

Indus river basin in south Punjab and Sind. The total rice area in Nepal is about 2 million hectares, the affected area accounts for 5% of rice land, mainly in Central and southeastern

regions. In Laos, the total rice area is about 1 million hectares, the affected areas cover 7% of rice areas mainly in southern regions.

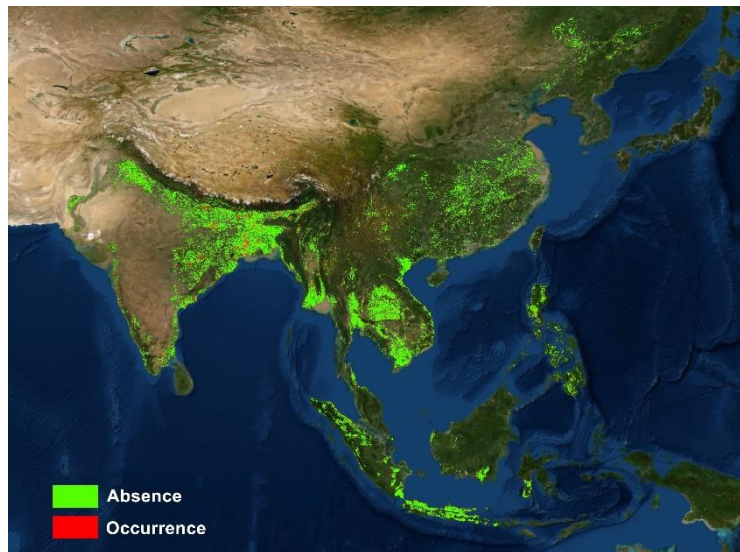


Figure 1 Distribution of rice blast in China, South and Southeast Asia (September 2018)

Rice planthopper

The distribution and statistics of rice planthopper in China, South and Southeast Asia are shown in Figure 2 and Table 1. The area affected by rice planthopper in China accounts for 19% of the total rice area, with the pest mainly occurring in lower Yangtze region, northeast China and southwest China. In India, the pest occurs accounts for 25% of total rice area, mainly in Assam and northeastern regions, Gangetic plain, northern regions of eastern coastal region and western Himalayan region. In Thailand, the insect affects 20% of rice areas, mainly in central double and triple cropped rice lowlands and western regions of southeastern horticulture area. Affected areas in Bangladesh reach 22%, essentially the coastal region, Gangetic plain and Sylhet basin. The affected areas in Indonesia reach 11% of cultivated

areas, mainly in southern regions of Sumatra and Java. In Myanmar the insect affects 23% of rice areas, mainly in central plain, and northern regions of Delta and southern coast. In Vietnam infested areas cover 28% of rice areas mainly in southern zone with Mekong Delta, northern zone with Red river Delta and northern regions of central coastal areas from Thanh Hoa to Khanh Hoa. In Cambodia, the southeastern regions of upland areas and central Tonle-Sap plain are affected, representing 13% of rice areas. In Philippines, 10% of rice areas suffered from rice planthopper, mainly in forest area and lowlands. In Pakistan the pest occurs in 12% of rice areas, mainly in northern Punjab and lower Indus river basin in south Punjab and Sind. The affected area in Nepal accounts for 15% of rice land, mainly in central and southern regions. In Laos, The affected area accounts for 21% of rice land, mainly in southern regions.

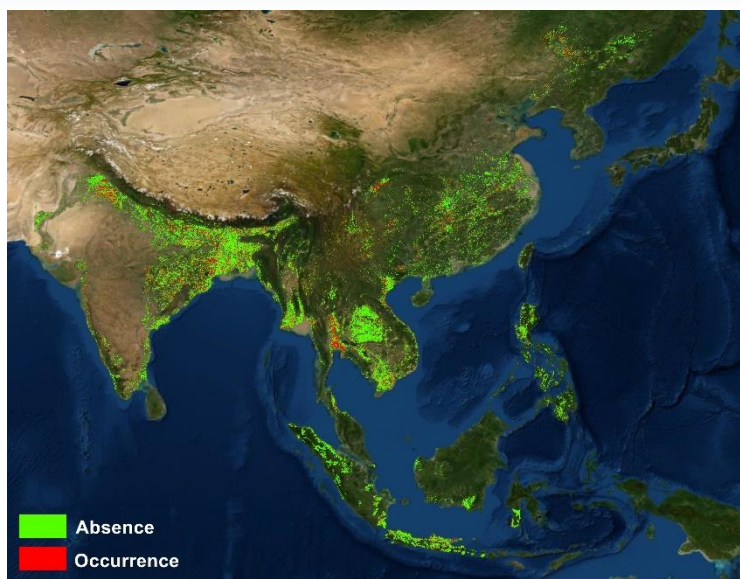


Figure 2 Distribution of rice planthopper in China, South and Southeast Asia (September 2018)

Table 1 Statistics of rice disease and pest in China, South and Southeast Asia (September 2018)

Rice production countries	Disease and pest occurrence ratio / %		Total planted area/ million hectares
	Rice blast	Rice planthopper	
China	3	19	30
India	10	25	44
Thailand	6	20	13
Bangladesh	8	22	10
Indonesia	9	11	14
Myanmar	5	23	7
Vietnam	4	28	7
Cambodia	6	13	3
Philippines	8	10	4
Pakistan	7	12	3
Nepal	5	15	2
Laos	7	21	1

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Crop pests and diseases monitoring and forecasting Global America, Brazil, Argentina, and China 2018

Minor infestation of pest and disease on soybean

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series and HJ series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, AIR (RADI) constructed the 'Crop pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases in whole China.

In 2018, soybean mosaic virus and soybean aphid (*Aphis glycines* Matsumura) slightly occurred in four main soybean production countries, including America, Brazil, Argentina, and China.

Soybean mosaic virus

The total soybean area in America is about 35.7 million hectares, the area affected by soybean mosaic virus accounts for 4.6% of the total soybean areas, with the disease mainly occurred in northwestern and eastern regions of the soybean planting areas. The distribution and

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statistics of soybean mosaic virus in America are shown in Figure 1 and Table 1. In Brazil, the total soybean area is about 35.5 million hectares, the disease accounts for 2.0% of total soybean area, slightly occurred in the whole soybean planting areas. The distribution and statistics of soybean mosaic virus in Brazil are shown in Figure 2 and Table 1. In Argentina, the total soybean area is about 16.5 million hectares, 2.2% of soybean areas are slightly infested, mainly in western and eastern regions of the soybean planting areas. The distribution and statistics of soybean mosaic virus in Argentina are shown in Figure 3 and Table 1. In China, the total soybean area is about 8.3 million hectares, the affected areas reach 2.7%, slightly occurred in the whole soybean planting areas. The distribution and statistics of soybean mosaic virus in China are shown in Figure 4 and Table 1.

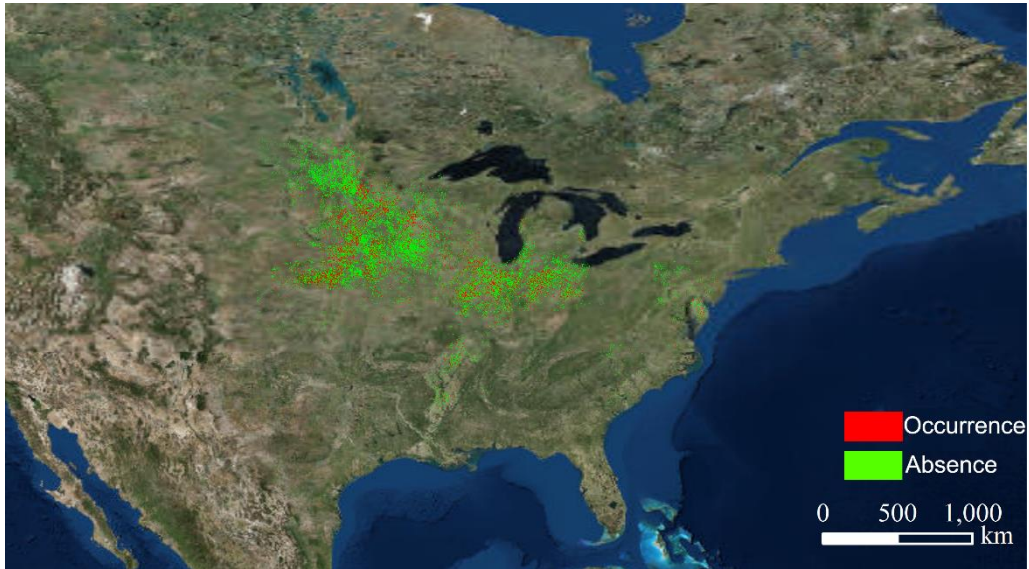


Figure 1 Distribution of soybean mosaic virus in America (2018)

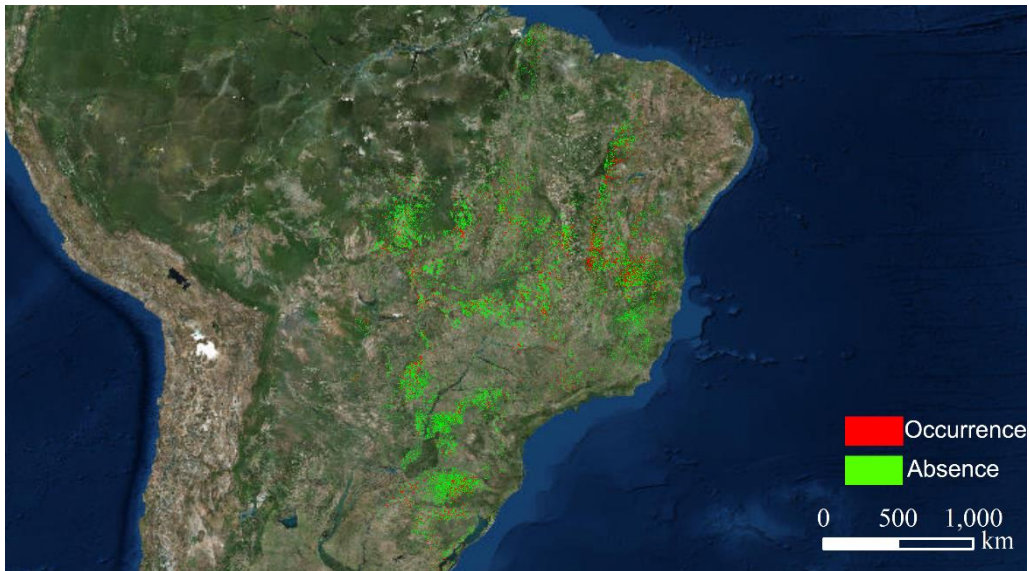


Figure 2 Distribution of soybean mosaic virus in Brazil (2018)



Figure 3 Distribution of soybean mosaic virus in Argentina (2018)

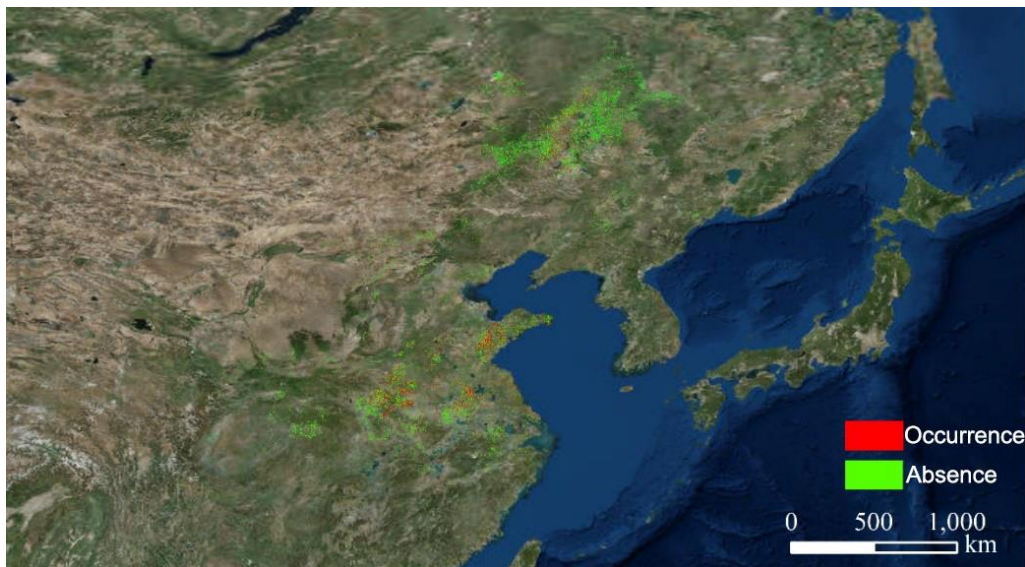


Figure 4 Distribution of soybean mosaic virus in China (2018)

Soybean aphid

The area affected by soybean aphid in America accounts for 2.1% of the total soybean areas, with the disease mainly occurred in eastern region of the soybean planting areas. The distribution and statistics of soybean aphid in America are shown in

Figure 5 and Table 1. The soybean aphid in China accounts for 3.5% of total soybean area, slightly occurred in the whole soybean planting areas. The distribution and statistics of soybean aphid in China are shown in Figure 6 and Table 1.

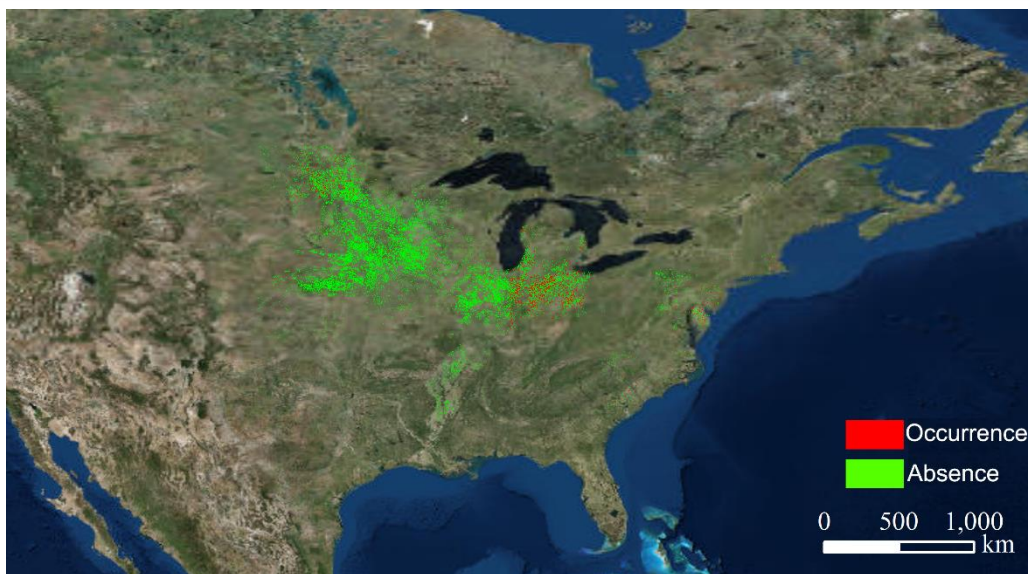


Figure 5 Distribution of soybean aphid in America (2018)

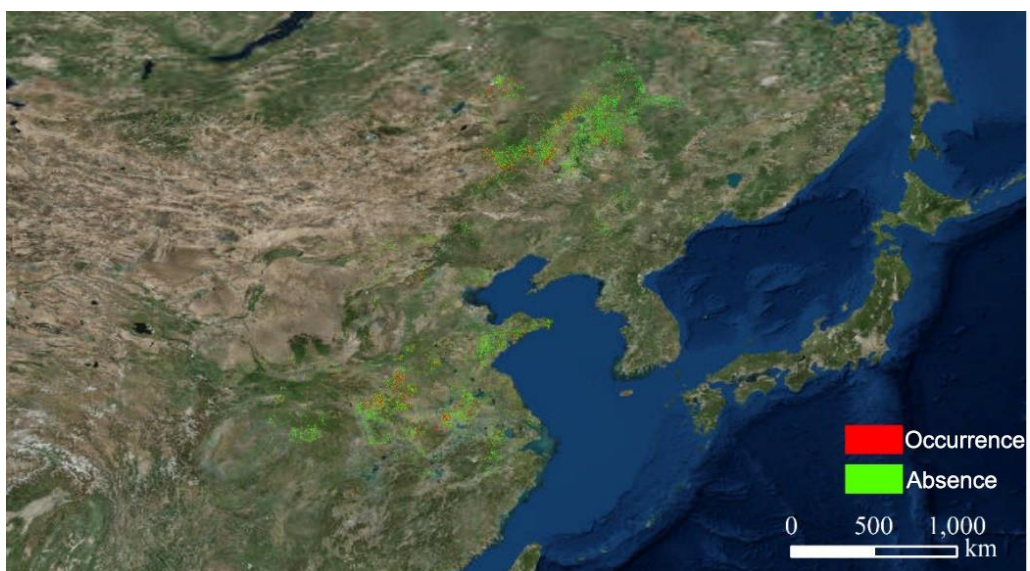


Figure 6 Distribution of soybean aphid in China (2018)

Table 1 Statistics of soybean disease and pest in four main production countries (2018)

Soybean production countries	Disease and pest occurrence ratio / %		Total planted area/ million hectares
	Soybean mosaic virus	Soybean aphid	
America	4.6	2.1	35.7
Brazil	2.0	/	35.5
Argentina	2.2	/	16.5
China	2.7	3.5	8.3

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Crop pests and diseases monitoring and forecasting Global April to May 2019

Pests occurred heavier than diseases on winter wheat Affected area reached 27 million ha Global

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, AIR (RADI) constructed the 'Crop pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases Global.

During April to May 2019, pests occurred heavier than diseases in eleven main winter wheat production countries, including Russia, China, United States, Pakistan, Iran, France, Turkey, Germany, Canada, Uzbekistan and United Kingdom. The total affected area by wheat rust (*Puccinia striiformis*) and aphid (*Sitobion avenae* & *Rhopalosiphum padi*) has reached 27 million hectares.

Wheat rust

The distribution, occurrence area and ratio of wheat rust in these eleven countries is shown in Figure 1 and Table 1. The total wheat area in Russia is about 31 million hectares, the affected area of rust in Russia is about 131 ten thousand hectares, accounting for 4% of the total planting area, mainly occurred in Volga Basin, and the Caucasus. The total wheat area is about 24 million hectares in China, the

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affected area of rust is about 66 ten thousand hectares, accounting for 3% of the total planting area, mainly occurred in Northwest China, North China and Central China. The total wheat area is about 16 million hectares in United States, the affected area of rust in is about 92 ten thousand hectares, accounting for 6% of the total planting area, mainly occurred in Northwest, Northern Plains, and Southern Plains. The total wheat area is about 14 million hectares in Pakistan, the affected area of rust is about 115 ten thousand hectares, accounting for 8% of the total planting area, mainly occurred in northern highlands, northern Punjab, and the northern regions of Lower Indus river basin in south Punjab and Sind. In Iran, the total wheat area is about 10 million hectares, the affected area of rust is about 81 ten thousand hectares, accounting for 8% of the total planting area, mainly occurred in semi-arid to sub-tropical hills of the west and the north. In France, the total wheat area is about 8 million hectares, the affected area of rust is about 30 ten thousand hectares, accounting for 4% of the total planting area, mainly occurred in northern barley zone, rapeseed zone of eastern France, and mixed maize/barley and rapeseed zone from the Centre to the Atlantic Ocean. The total wheat area is about 8 million hectares in Turkey, the

affected area of rust is about 23 ten thousand hectares, accounting for 3% of the total planting area, mainly occurred in eastern Anatolia region. The total wheat area is about 5 million hectares in Germany, the affected area of rust is about 13 ten thousand hectares, accounting for 3% of the total planting area, mainly occurred in wheat zone of Schleswig-Holstein and the Baltic coast, mixed wheat and sugar beets zone of the north-west, western sparse crop area of the Rhenish massif, and central wheat zone of Saxony and Thuringia. The total wheat area is about 4 million hectares in Canada, the affected area of rust is about 22 ten thousand hectares,

accounting for 5% of the total planting area, mainly occur red in the western regions of Prairies. The total wheat area is about 2 million hectares in Uzbekistan, the affected area of rust is about 12 ten thousand hectares, accounting for 6% of the total planting area, mainly occurred in the western regions of eastern hilly cereals zone. The total wheat area is about 2 million hectares in United Kingdom, the affected area of rust is about 14 ten thousand hectares, accounting for 7% of the total planting area, mainly occurred in south English mixed wheat and Barley zone.



Figure 1 Distribution of wheat rust in eleven production countries

Wheat aphid

The distribution, occurrence area and ratio of wheat aphid in these eleven countries is shown in Figure 2 and Table 1. The total affected area of aphid in Russia is about 393 ten thousand hectares, accounting for 13% of the total planting area, mainly occurred in central Economic region, the Caucasus, and Volga Basin. The total affected area of aphid in China is about 648 ten thousand hectares, accounting for 27% of the total planting area, mainly occurred in Northwest China, North China, Central China, and East China. The total affected area of aphid in United States is about 212 ten thousand hectares, accounting for 13% of the total planting area, mainly occurred in Northwest, Northern Plains, and northwestern

regions of Corn Belt. The total affected area of aphid in Pakistan is about 304 ten thousand hectares, accounting for 22% of the total planting area, mainly occurred in northern Punjab, and the northern regions of lower Indus river basin in south Punjab and Sind. The total affected area of aphid in Iran is about 210 ten thousand hectares, accounting for 21% of the total planting area, mainly occurred in semi-arid to sub-tropical hills of the west and the north. The total affected area of aphid in France is about 68 ten thousand hectares, accounting for 8% of the total planting area, mainly occurred in mixed maize/barley and rapeseed zone from the Centre to the Atlantic Ocean, and southwest maize zone. The total affected area of aphid in Turkey is about 93 ten thousand hectares, accounting for 12% of the total planting area,

mainly occurred in central Anatolia region, eastern Anatolia region, and Marmara, Aegean, Mediterranean lowland region. The total affected area of aphid in Germany is about 46 ten thousand hectares, accounting for 9% of the total planting area, mainly occurred in central wheat zone of Saxony and Thuringia, western sparse crop area of the Rhenish massif, and Bavarian Plateau. The total affected area of aphid in Canada is about 46 ten thousand

hectares, accounting for 11% of the total planting area, mainly occurred in Prairies. The total affected area of aphid in Uzbekistan is about 39 ten thousand hectares, accounting for 18% of the total planting area, mainly occurred in eastern hilly cereals zone. The total affected area of aphid in United Kingdom is about 15 ten thousand hectares, accounting for 8% of the total planting area, mainly occurred in south English mixed wheat and Barley zone.

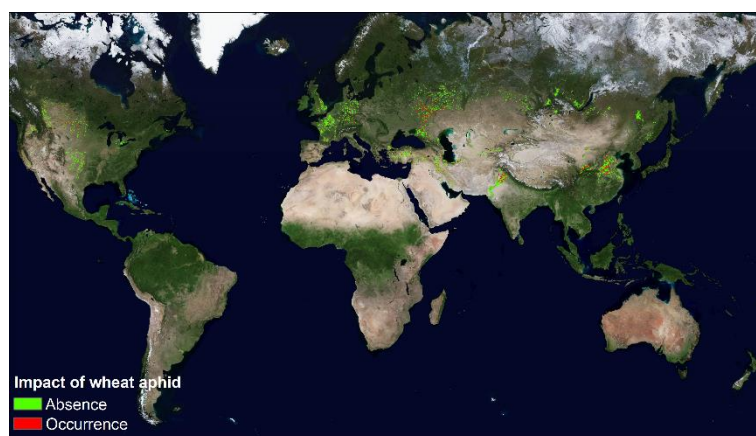


Figure 2 Distribution of wheat aphid in eleven production countries

Table 1 Statistics of wheat diseases and pests in eleven production countries

Winter wheat production countries	Rust occurrence area and ratio		Aphid occurrence area and ratio		Total planting area / million hectares
	Area / ten thousand hectares	Ratio / %	Area / ten thousand hectares	Ratio / %	
Russia	131	4	393	13	31
China	66	3	648	27	24
United States	92	6	212	13	16
Pakistan	115	8	304	22	14
Iran	81	8	210	21	10
France	30	4	68	8	8
Turkey	23	3	93	12	8
Germany	13	3	46	9	5
Canada	22	5	46	11	4
Uzbekistan	12	6	39	18	2
United Kingdom	14	7	15	8	2

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Crop pests and diseases monitoring and forecasting **Global** China, South and Southeast Asia September 2019

Minor infestation of pest and disease on rice

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series and HJ series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, AIR (RADI) constructed the 'Crop pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases in whole China.

In September 2019, rice blast (*magnaporthe oryzae*) and rice planthopper (*nilaparvata lugens*) slightly occurred in twelve main rice production countries, including China, India, Thailand, Bangladesh, Indonesia, Myanmar, Vietnam, Cambodia, Philippines, Pakistan, Nepal and Laos.

Rice blast

The distribution and statistics of rice blast in China, South and Southeast Asia are shown in Figure 1 and Table 1. The total rice area in China is about 30 million hectares, the area affected by rice blast accounts for 4% of the total rice areas, with the disease mainly occurred in Northeast and Central China. In India, the total rice area is about 44 million hectares, the disease accounts for 12% of total rice area, mainly in the Gangetic plain and Northeast India. In Thailand, the total rice area

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is about 13 million hectares, 7% of rice areas are infested, mainly in south and central Chao Phraya Plain, and south Korat plateau. In Bangladesh, the total rice area is about 10 million hectares, the affected areas reach 9%, essentially occurred in Central Gangetic plain. In Indonesia, the total rice area is about 14 million hectares, the affected areas reach 11% of cultivated areas, occurred mainly in North Sumatra, and Java. In Myanmar, the total rice area is about 7 million hectares, the disease affects 6% of rice areas, mainly in northern regions of hills area and Central Irrawaddy delta. In Vietnam, the total rice area is about 7 million hectares, the fungus occurs in 5% of rice growing areas, mainly in South Mekong Delta. In Cambodia, the total rice area is about 3 million hectares, the affected areas are 7% of rice areas, mainly in regions of rice areas. In Philippines, the total rice area is about 4 million hectares, the disease affects 9% of rice areas, mainly occurred in rice growing area of Luzon plain. In Pakistan, the total rice area is about 3 million hectares, the pathogen occurs in 8% of rice areas, mainly occurred in North Punjab. The total rice area in Nepal is about 2 million hectares, the affected area accounts for 6% of rice land, mainly occurred in Central Nepal. In Laos, the total rice area is about 1 million

hectares, the affected areas cover 8% of rice areas mainly occurred in South Laos.

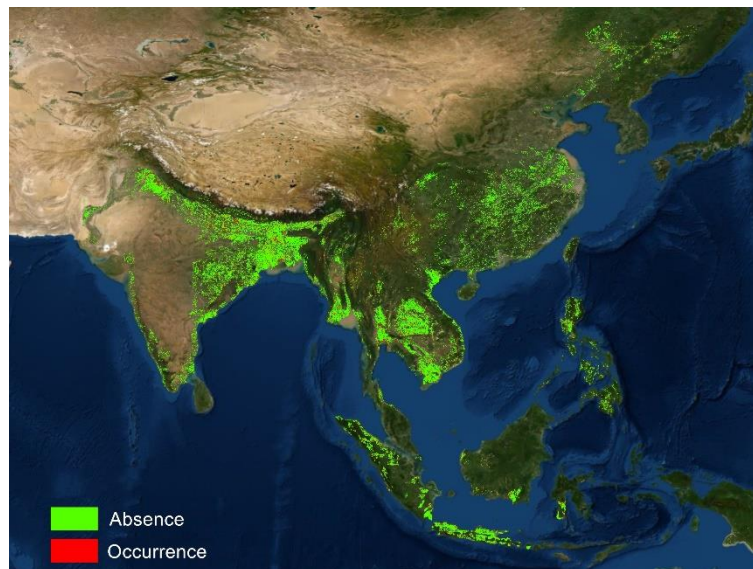


Figure 1 Distribution of rice blast in China, South and Southeast Asia (September 2019)

Rice planthopper

The distribution and statistics of rice planthopper in China, South and Southeast Asia are shown in Figure 2 and Table 1. The area affected by rice planthopper in China accounts for 20% of the total rice area, with the pest mainly occurred in middle and lower Yangtze region, and South China. In India, the pest occurs accounts for 26% of total rice area, mainly occurred in Gangetic plain and eastern coastal areas of India. In Thailand, the insect affects 22% of rice areas, mainly in southern and northern region of the Chao Phraya Plain and western region of the Korat plateau. Affected areas in Bangladesh reach 24%, especially in Central Gangetic plain. The affected areas in Indonesia reach 13% of cultivated areas, mainly occurred in southern

regions of Sumatra, and Central Java. In Myanmar the insect affects 24% of rice areas, mainly in northern regions of hills area and Central Irrawaddy delta. In Vietnam infested areas cover 31% of rice areas mainly in northern regions of the Red River Delta, South Mekong Delta, and eastern regions of coastal areas. In Cambodia, the southern regions of rice areas are affected, representing 15% of rice areas. In Philippines, 12% of rice areas suffered from rice planthopper, mainly in rice growing area of Luzon plain. In Pakistan the pest occurs in 14% of rice areas, mainly in northern Punjab. The affected area in Nepal accounts for 17% of rice land, mainly in central regions. In Laos, The affected area accounts for 23% of rice land, mainly in southern region.



Figure 2 Distribution of rice planthopper in China, South and Southeast Asia (September 2019)

Table 1 Statistics of rice disease and pest in China, South and Southeast Asia (September 2019)

Rice production countries	Disease and pest occurrence ratio / %		Total planted area/ million hectares
	Rice blast	Rice planthopper	
China	4	20	30
India	12	26	44
Thailand	7	22	13
Bangladesh	9	24	10
Indonesia	11	13	14
Myanmar	6	24	7
Vietnam	5	31	7
Cambodia	7	15	3
Philippines	9	12	4
Pakistan	8	14	3
Nepal	6	17	2
Laos	8	23	1

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Crop pests and diseases monitoring and forecasting **Global** China, America, Brazil, Argentina 2019

Minor infestation of pest and disease on soybean

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series and HJ series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, AIR (RADI) constructed the 'Crop pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases Global.

In 2019, soybean cyst nematode (*Heterodera glycines* Ichinohe), soybean rust (*Phakopsora pachyrhizi* Sydow), soybean aphid (*Aphis glycines* Matsumura) and soybean bollworm (*Helicoverpa armigera*) slightly occurred in four main soybean production countries, including America, Brazil, Argentina, and China.

Soybean diseases

The total soybean area in China is about 8.9 million hectares, the area affected by soybean cyst nematode accounts for 8.1% of the total soybean areas, with the disease mainly occurred in northwest Heilongjiang, north Shandong and central Henan. The distribution and statistics of soybean cyst nematode in

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China are shown in Figure 1 and Table 1. In America, the total soybean area is about 30.2 million hectares, the area affected by soybean cyst nematode accounts for 12.3% of total soybean area, mainly occurred in most of Iowa, central and north Nebraska, and south Minnesota. The distribution and statistics of soybean cyst nematode in America are shown in Figure 2 and Table 1. The total soybean area in Brazil is about 36.5 million hectares, the area affected by soybean rust accounts for 3.1% of the total soybean areas, mainly occurred in most parts of Rio Grande do Sul, east and west Santa Catalina, west Parana, and northeast Mato Grosso do Sul. The distribution and statistics of soybean rust in Brazil are shown in Figure 3 and Table 1. The total soybean area in Argentina is about 17.3 million hectares, the area affected by soybean rust accounts for 4.3% of the total soybean areas, mainly occurred in the south and central Buenos Aires, north Cordoba, and central Salta. The distribution and statistics of soybean rust in Argentina are shown in Figure 4 and Table 1.

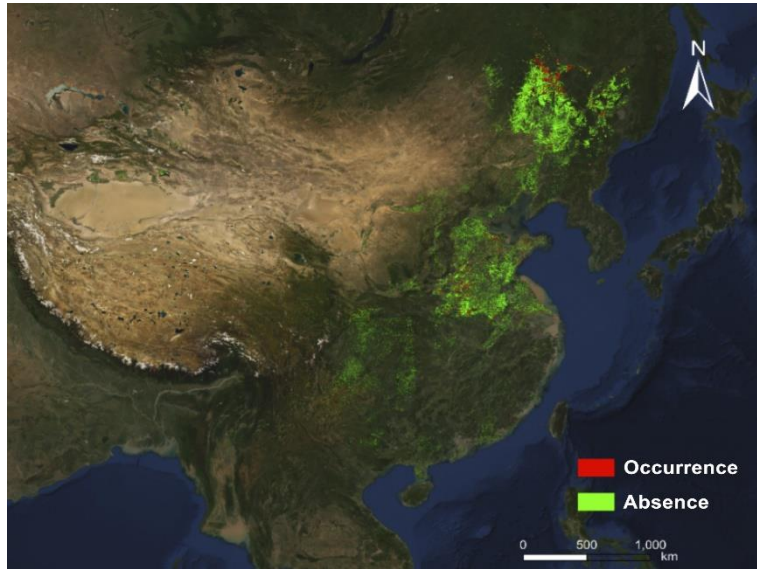


Figure 1 Distribution of soybean cyst nematode in China (2019)

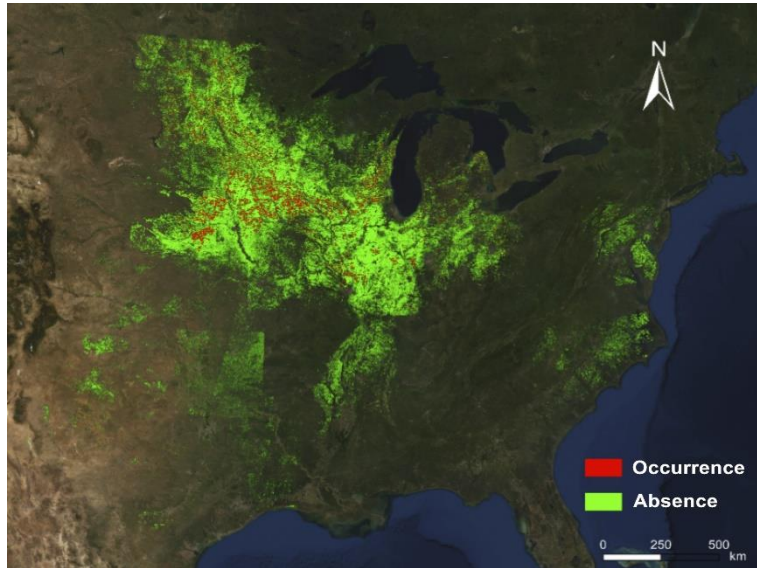


Figure 2 Distribution of soybean cyst nematode in America (2019)

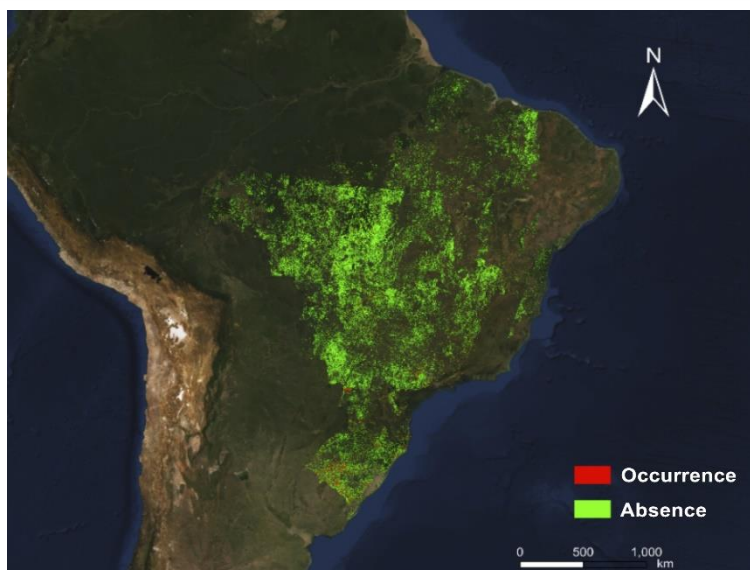


Figure 3 Distribution of soybean rust in Brazil (2019)

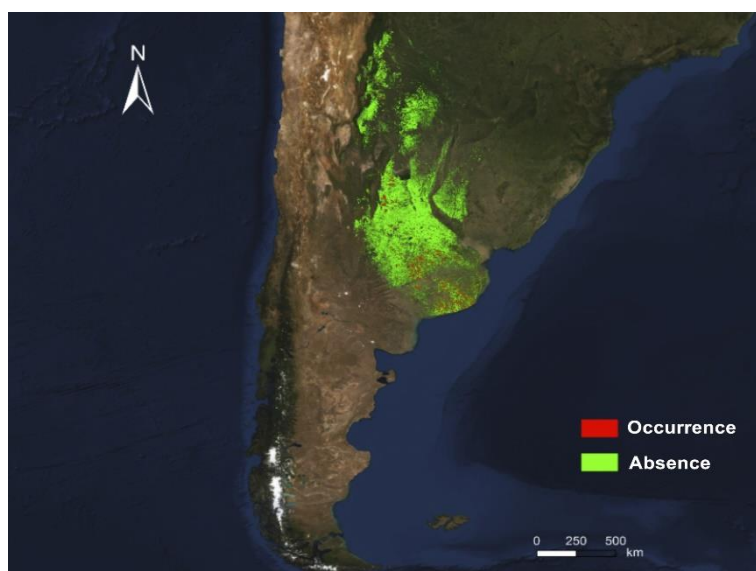


Figure 4 Distribution of soybean rust in Argentina (2019)

Soybean pests

The area affected by soybean aphid accounts for 3.5% of the total soybean areas in China, mainly occurred in west Heilongjiang, north Henan, north Shandong, central Anhui and south Jiangsu. The distribution and statistics of soybean aphid in China are shown in Figure 5 and Table 1. In America, the area affected by soybean aphid accounts for 2.5% of the total soybean areas, mainly occurred in central and southeast Minnesota, central North Dakota, and northeast South Dakota. The

distribution and statistics of soybean aphid in America are shown in Figure 6 and Table 1. In Brazil, the area affected by soybean bollworm accounts for 5.2% of the total soybean areas, mainly occurred in south Mato Grosso do Sul, central and east Mato Grosso and north Paraná. The distribution and statistics of soybean bollworm in Brazil are shown in Figure 7 and Table 1. The area affected by soybean bollworm accounts for 5.9% of the total soybean areas in Argentina, mainly occurred in south and east Cordoba, south Santa Fe, north Buenos Aires and central Entre Rios. The distribution and

statistics of soybean bollworm in Argentina are shown in Figure 8 and Table 1.

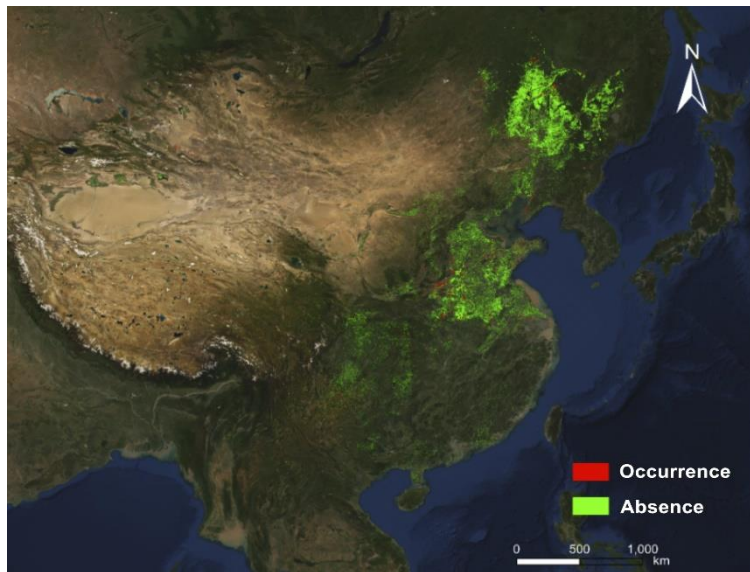


Figure 5 Distribution of soybean aphid in China (2019)

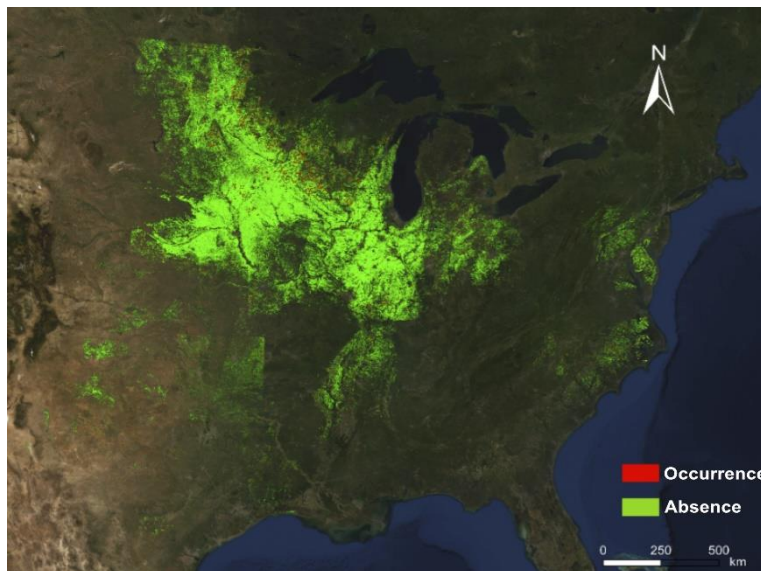


Figure 6 Distribution of soybean aphid in America (2019)

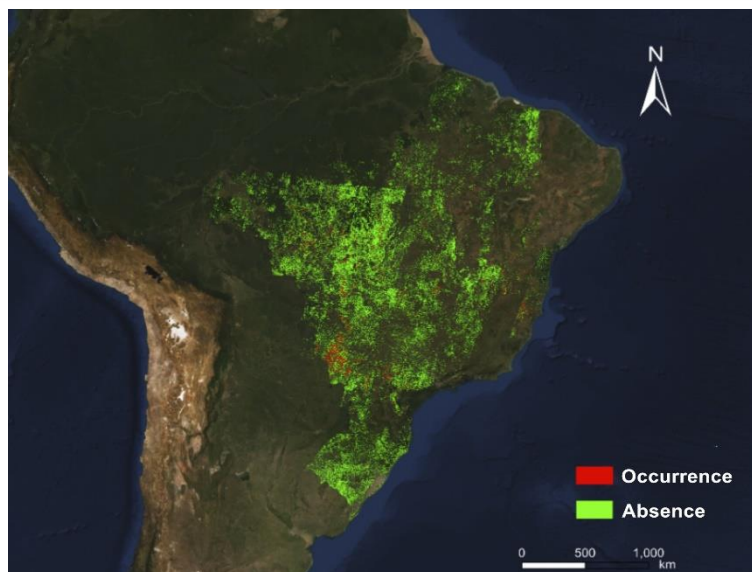


Figure 7 Distribution of soybean bollworm in Brazil (2019)

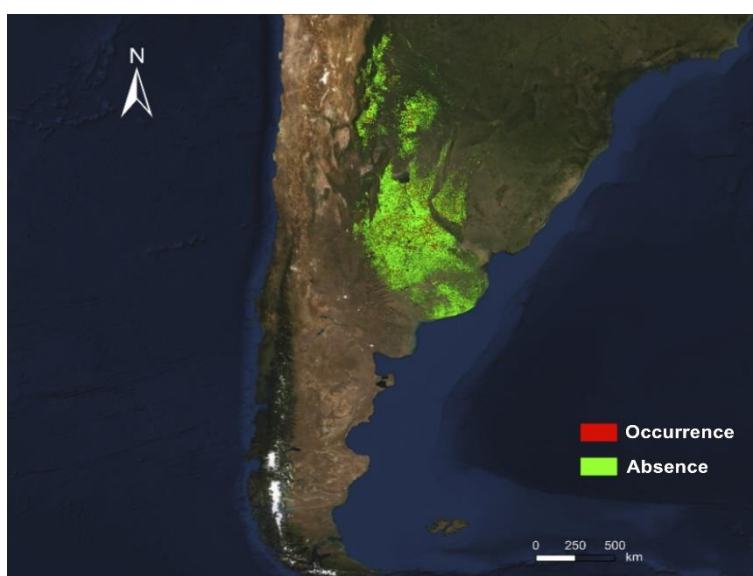


Figure 8 Distribution of soybean bollworm in Argentina (2019)

Table 1 Statistics of soybean diseases and pests in China, America, Brazil and Argentina (2019)

Rice production countries	Disease and pest occurrence ratio / %				Total planted area/ million hectares
	Soybean cyst nematode	Soybean aphid	Soybean rust	Soybean bollworm	
China	8.1	3.5	/	/	8.9
America	12.3	2.5	/	/	30.2
Brazil	/	/	3.1	5.2	36.5
Argentina	/	/	4.3	5.9	17.3

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Crop pests and diseases monitoring and forecasting Global April to May 2020

Pests will occur heavier than diseases on winter wheat Affected areas are estimated to reach 30 million ha

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, the research team constructed the 'Vegetation pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases at global scale.

During April to May 2020, pest will occur heavier than disease in eleven main winter wheat production countries, including Russia, China, United States, Pakistan, France, Turkey, Iran, Germany, Canada, Uzbekistan and United Kingdom. The total areas affected by wheat rust (*Puccinia striiformis*) and aphid (*Sitobion avenae* & *Rhopalosiphum padi*) are estimated to reach 30 million hectares.

Wheat rust

The distribution, occurrence area and ratio of wheat rust in eleven main wheat production countries is shown in Figure 1 and Table 1. The wheat planted area of Russia is 27 million hectares, the total affected areas of rust are estimated to reach 232 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in Caucasus and central region. The wheat planted area of China is 24 million hectares, the total affected areas of rust are estimated to reach 243 ten thousand hectares,

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accounting for 10% of the total planting area, will mainly occur in southwest, northwest and central China. The wheat planted area of the United States is 18 million hectares, the total affected areas of rust are estimated to reach 41 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in the northwest of the United States and the west of the Great Plains. The wheat planted area of Pakistan is 9 million hectares, the total affected areas of rust are estimated to reach 69 ten thousand hectares, accounting for 8% of the total planting area, will mainly occur in northern plateau and northern Punjab. The wheat planted area of France is 7 million hectares, the total affected areas of rust are estimated to reach 80 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in mixed maize/barley and rapeseed zone of southwest region. The wheat planted area of Turkey is 7 million hectares, the total affected areas of rust are estimated to reach 35 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in eastern region. The wheat planted area of Iran is 7 million hectares, the total affected areas of rust are estimated to reach 68 ten thousand hectares, accounting for 10% of the total planting area, will mainly occur in central and southern region. The wheat planted area of

Germany is 5 million hectares, the total affected areas of rust are estimated to reach 88 ten thousand hectares, accounting for 18% of the total planting area, will mainly occur in wheat zone of mixed wheat and sugar beets zone of the north-west, western sparse crop area of the Rhenish massif, and central wheat zone of Saxony and Thuringia. The wheat planted area of Canada is 4 million hectares, the total affected areas of rust are estimated to reach 33 ten thousand hectares, accounting for 8% of the total planting area, will mainly occur in southern

region. The wheat planted area of Uzbekistan is 2 million hectares, the total affected areas of rust are estimated to reach 26 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in the western regions of eastern hilly cereals zone. The wheat planted area of United Kingdom is 2 million hectares, the total affected areas of rust are estimated to reach 16 ten thousand hectares, accounting for 8% of the total planting area, will mainly occur in south English mixed wheat and Barley zone.

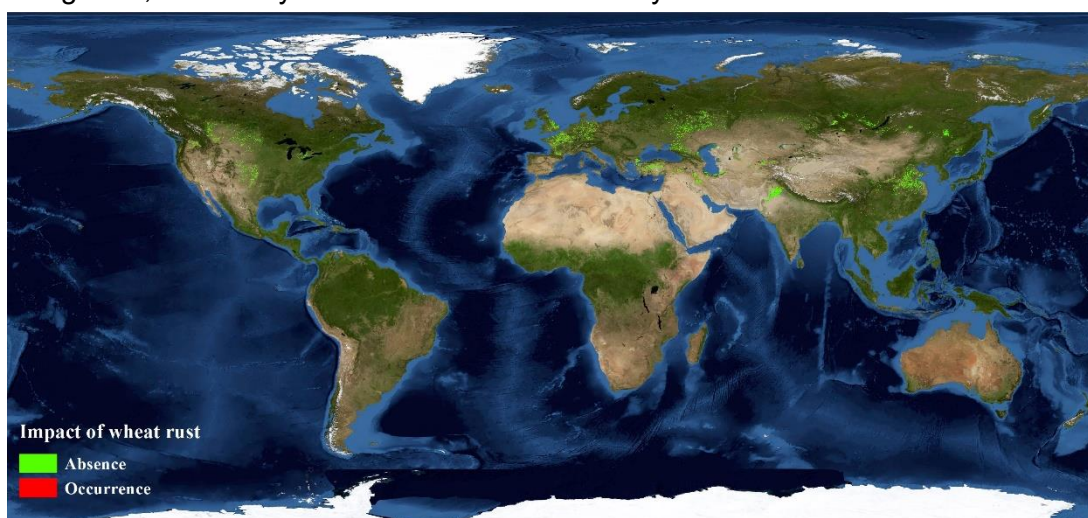


Figure 1 Spatial distribution of wheat rust in eleven winter wheat production countries

Wheat aphid

The distribution, occurrence area and ratio of wheat aphid in eleven main wheat production countries is shown in Figure 2 and Table 1. The total affected areas of aphid in Russia are estimated to reach 358 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in the Caucasus and Volga Basin. The total affected areas of aphid in China are estimated to reach 755 ten thousand hectares, accounting for 31% of the total planting area, will mainly occur in north China and central China. The total affected areas of aphid in United States are estimated to reach 285 ten thousand hectares, accounting for 16% of the total planting area, will mainly occur in northwest of the Great Plain. The total affected areas of aphid in Pakistan are estimated to

reach 230 ten thousand hectares, accounting for 26% of the total planting area, will mainly occur in northern plateau, northern Punjab and lower Indus. The total affected areas of aphid in France are estimated to reach 68 ten thousand hectares, accounting for 10% of the total planting area, will mainly occur in mixed maize/barley and rapeseed zone of northwest region. The total affected areas of aphid in Turkey are estimated to reach 88 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in northwest region close to Marmara Sea. The total affected areas of aphid in Iran are estimated to reach 174 ten thousand hectares, accounting for 25% of the total planting area, will mainly occur in southeast and central region. The total affected areas of aphid in Germany are estimated to

reach 53 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in central wheat zone of Saxony and Thuringia. The total affected areas of aphid in Canada are estimated to reach 45 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in southern region. The total affected areas of aphid in Uzbekistan are

estimated to reach 40 ten thousand hectares, accounting for 20% of the total planting area, will mainly occur in eastern hilly cereals zone. The total affected areas of aphid in United Kingdom are estimated to reach 14 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in south English mixed wheat and Barley zone.

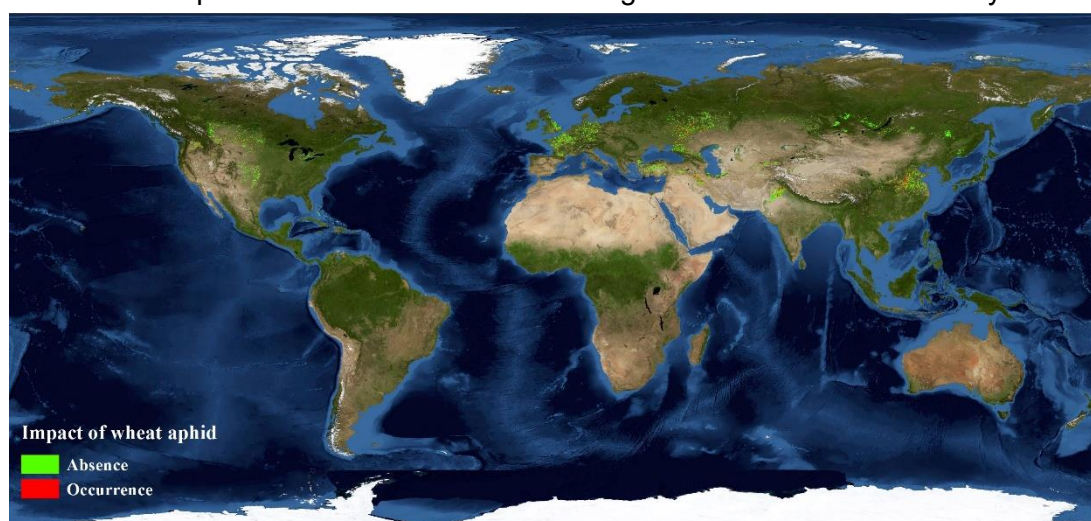


Figure 2 Spatial distribution of wheat aphid in eleven winter wheat production countries

Table 1 Statistics of wheat rust and aphid in eleven winter wheat production countries

Winter wheat production countries	Rust occurrence area and ratio		Aphid occurrence area and ratio		Total planting area / million hectares
	Area / ten thousand hectares	Ratio / %	Area / ten thousand hectares	Ratio / %	
Russia	232	9	358	13	27
China	243	10	755	31	24
United States	41	2	285	16	18
Pakistan	69	8	230	26	9
France	80	11	68	10	7
Turkey	35	5	88	13	7
Iran	68	10	174	25	7
Germany	88	18	53	11	5
Canada	33	8	45	11	4
Uzbekistan	26	13	40	20	2
United Kingdom	16	8	14	7	2

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Crop pests and diseases monitoring and forecasting Global September 2020

Pests will occur heavier than diseases on rice
 Affected areas are estimated to reach 20.1 million ha

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, the research team constructed the 'Vegetation pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases at global scale.

During September 2020, pest will occur heavier than disease in main rice production countries, the total damaged areas are estimated to reach 20.1 million hectares, mainly occurred in India, Thailand, Bangladesh, Myanmar, Vietnam, Philippines, Cambodia, Pakistan, Nepal, Japan, United States, South Korea, Laos and Iran. The areas affected by rice blast (*Magnaporthe oryzae*) are estimated to reach 5.3 million hectares, accounting for 5% of the total planting area. The areas affected by rice planthopper (*Nilaparvata lugens*) are estimated to reach 14.8 million hectares, accounting for 13% of the total planting area.

Rice blast

The distribution, occurrence area and ratio of rice blast in rice production countries is shown in Figure 1 and Table 1. The rice planted area of India is 44 million hectares, the total

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affected areas of blast are estimated to reach 208 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in Assam and north-eastern regions, Gangatic plain and Western coastal region. The rice planted area of the Thailand is 12.7 million hectares, the total affected areas of blast are estimated to reach 68 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in South-eastern horticulture area and Central double and triple-cropped rice lowlands. The rice planted area of Bangladesh is 10.0 million hectares, the total affected areas of blast are estimated to reach 41 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in Coastal region, central Gangetic plain and southern Sylhet basin. The rice planted area of Myanmar is 7.3 million hectares, the total affected areas of blast are estimated to reach 29 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in Central plain and southern Hills. The rice planted area of Vietnam is 7.3 million hectares, the total affected areas of blast are estimated to reach 53 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in Southern zone with Mekong Delta. The rice planted area of Philippines is 4.0

million hectares, the total affected areas of blast are estimated to reach 6 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in Forest area and Hills. The rice planted area of Cambodia is 3.3 million hectares, the total affected areas of blast are estimated to reach 36 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in Central Tonle-Sap plain and southern Upland areas. The rice planted area of Pakistan is 2.7 million hectares, the total affected areas of blast are estimated to reach 23 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in Northern Punjab and Lower Indus river basin in south Punjab and Sind. The rice planted area of Nepal is 2.0 million hectares, the total affected areas of blast are estimated to reach 3 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in eastern region. The rice planted area of Japan is 1.5 million hectares, the total affected areas of blast are estimated to reach 17 ten thousand hectares, accounting for 11% of

the total planting area, will mainly occur in central region. The rice planted area of United States is 1.1 million hectares, the total affected areas of blast are estimated to reach 13 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in Lower Mississippi. The rice planted area of South Korea is 0.8 million hectares, the total affected areas of blast are estimated to reach 3 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in western regions. The rice planted area of Laos is 0.7 million hectares, the total affected areas of blast are estimated to reach 2 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in Attapu and Champassak. The rice planted area of Iran is 0.6 million hectares, the total affected areas of blast are estimated to reach 6 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in Semi-arid to sub-tropical hills of the west and the north.

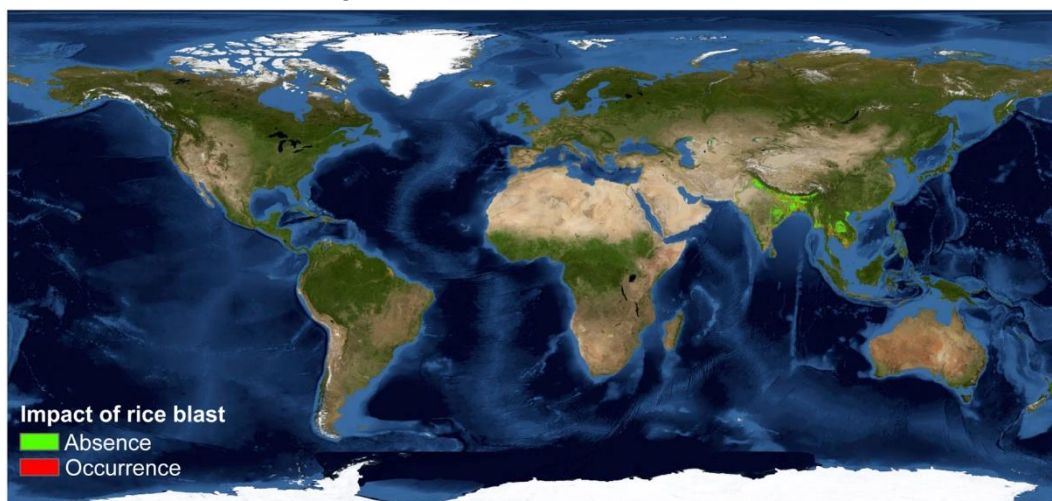


Figure 1 Spatial distribution of rice blast

Rice planthopper

The distribution, occurrence area and ratio of rice planthopper in rice production countries is shown in Figure 2 and Table 1. The total affected areas of planthopper in India are estimated to reach 907 ten thousand hectares, accounting for 21% of the total planting area,

will mainly occur in Assam and north-eastern regions and Gangatic plain. The total affected areas of planthopper in Thailand are estimated to reach 161 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in Single-cropped rice north-eastern region and Central double and triple-cropped rice lowlands. The total affected areas of

planthopper in Bangladesh are estimated to reach 41 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in western Gangetic plain. The total affected areas of planthopper in Myanmar are estimated to reach 37 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in Central plain and western Hills. The total affected areas of planthopper in Vietnam are estimated to reach 165 ten thousand hectares, accounting for 23% of the total planting area, will mainly occur in Northern zone Red river Delta, central coastal area and the southernmost region. The total affected areas of planthopper in Philippines are estimated to reach 23 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in northern Lowlands. The total affected areas of planthopper in Cambodia are estimated to reach 66 ten thousand hectares, accounting for 20% of the total planting area, will mainly occur in southern Upland areas. The total affected

areas of planthopper in Pakistan are estimated to reach 33 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in Northern Punjab. The total affected areas of planthopper in Nepal are estimated to reach 4 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in central region. The total affected areas of planthopper in Japan are estimated to reach 13 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in central region and southern region. The total affected areas of planthopper in South Korea are estimated to reach 8 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in central regions and southern regions. The total affected areas of planthopper in Laos are estimated to reach 23 ten thousand hectares, accounting for 35% of the total planting area, will mainly occur in southern regions.

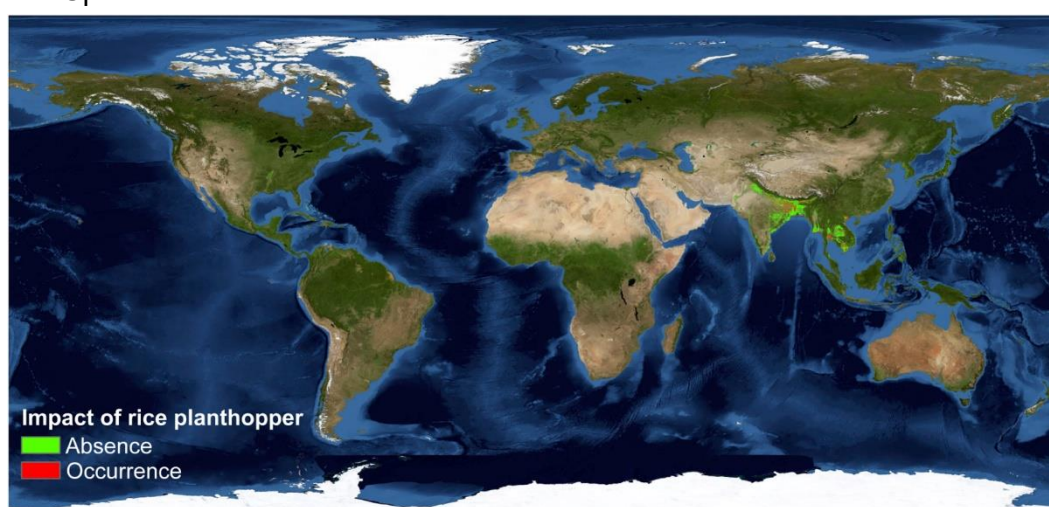


Figure 2 Spatial distribution of rice planthopper

Table 1 Statistics of rice blast and planthopper

Rice production countries	Blast occurrence area and ratio		Planthopper occurrence area and ratio		Total planting area / million hectares
	Area / ten thousand hectares	Ratio / %	Area / ten thousand hectares	Ratio / %	
India	208	5	907	21	44
Thailand	68	5	161	13	12.7
Bangladesh	41	4	41	4	10
Myanmar	29	4	37	5	7.3

Vietnam	53	7	165	23	7.3
Philippines	6	2	23	6	4
Cambodia	36	11	66	20	3.3
Pakistan	23	9	33	12	2.7
Nepal	3	2	4	2	2
Japan	17	11	13	9	1.5
United States	13	12	0	0	1.1
South Korea	3	4	8	10	0.8
Laos	2	3	23	34	0.7
Iran	6	11	0	0	0.6

Note: Please refer to China chapter of the report for China's rice pests and diseases results.

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National Engineering Research Center for Agro-Ecological Big Data Analysis & Application

Crop pests and diseases monitoring and forecasting Global America, Brazil, Argentina 2020

Minor infestation of pests and diseases on soybean

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for crop pest and disease monitoring and forecasting, the research team constructed the 'Vegetation pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main crop pests and diseases at global scale.

In 2020, soybean cyst nematode (*Heterodera glycines* Ichinohe), soybean rust (*Phakopsora pachyrhizi* Sydow), soybean aphid (*Aphis glycines* Matsumura) and soybean bollworm (*Helicoverpa armigera*) slightly occurred in three main soybean production countries, including America, Brazil, and Argentina.

Soybean diseases

In America, the total soybean area is about

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33.5 million hectares, the area affected by soybean cyst nematode accounts for 12.8% of total soybean area, mainly occurred in Corn Belt, Middle Atlantic and Northeast. The distribution and statistics of soybean cyst nematode in America are shown in Figure 1 and Table 1. The total soybean area in Brazil is about 37.1 million hectares, the area affected by soybean rust accounts for 2.8% of the total soybean areas, mainly occurred in Parana basin and Southern subtropical rangelands. The distribution and statistics of soybean rust in Brazil are shown in Figure 2 and Table 1. The total soybean area in Argentina is about 17.1 million hectares, the area affected by soybean rust accounts for 3.9% of the total soybean areas, mainly occurred in Pampas. The distribution and statistics of soybean rust in Argentina are shown in Figure 4 and Table 1.

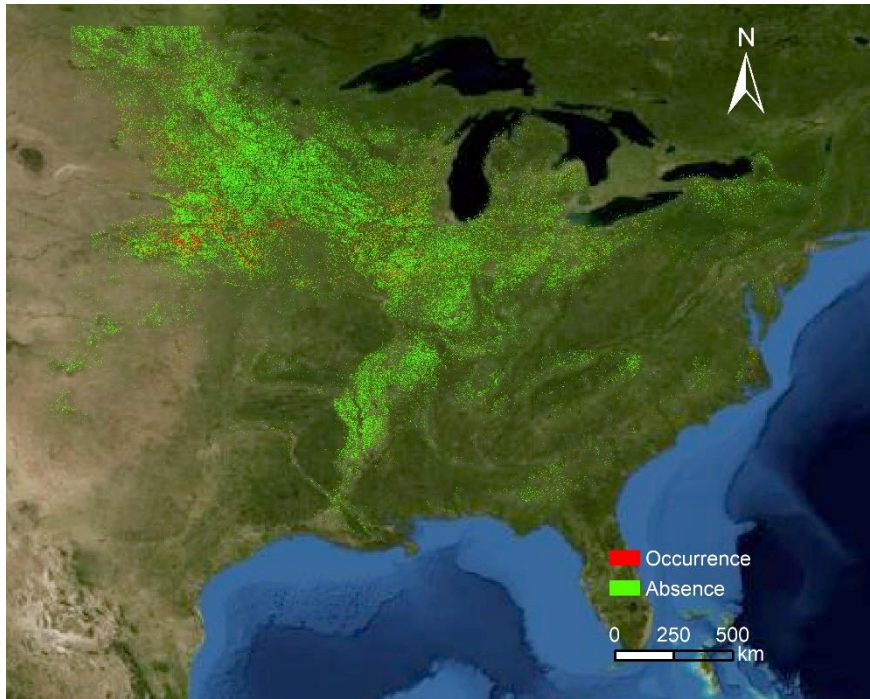


Figure 1 Distribution of soybean cyst nematode in America (2020)

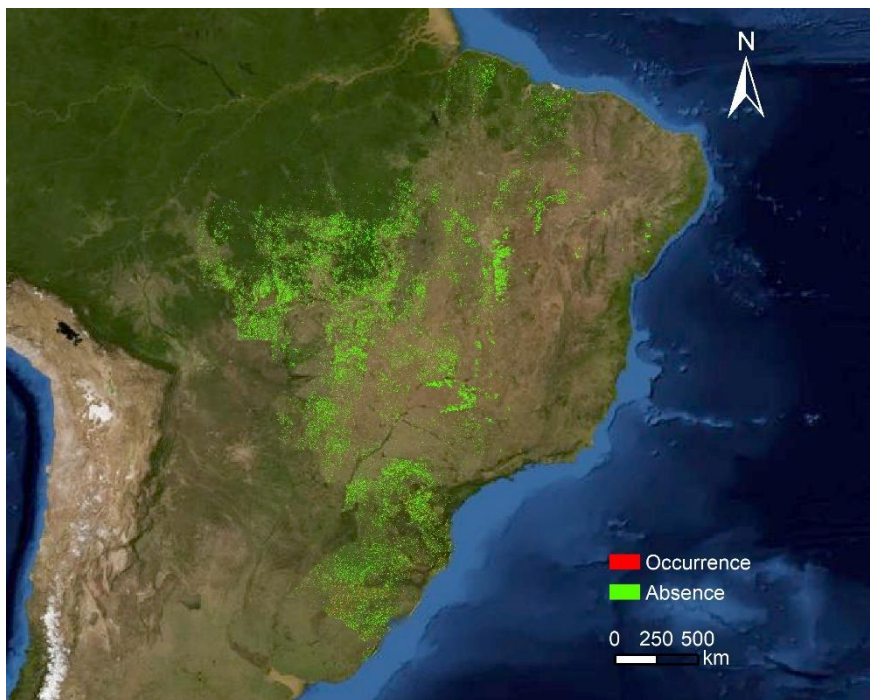


Figure 2 Distribution of soybean rust in Brazil (2020)

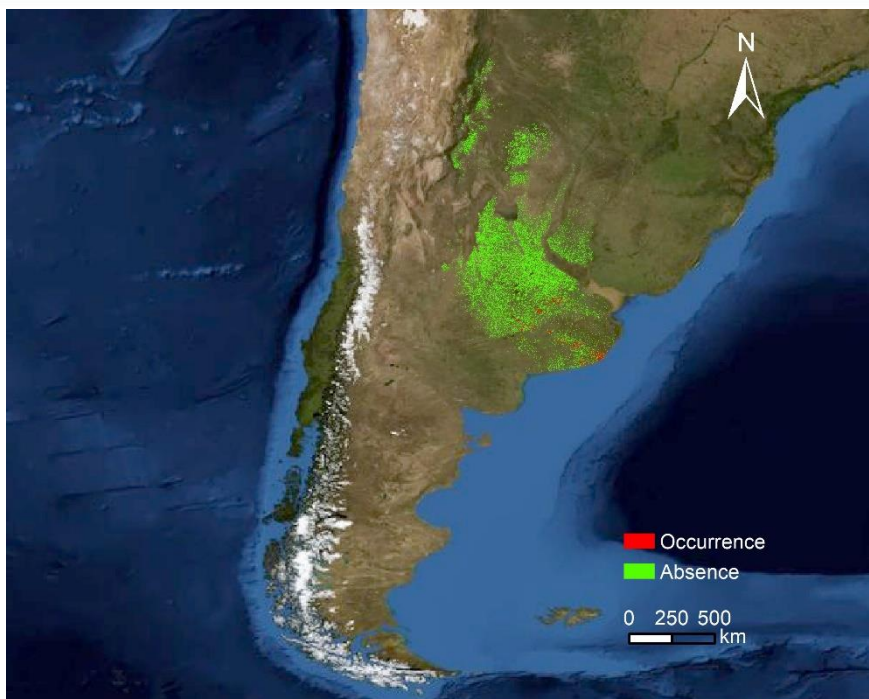


Figure 3 Distribution of soybean rust in Argentina (2020)

Soybean pests

In America, the area affected by soybean aphid accounts for 2.1% of the total soybean areas, mainly occurred in Corn Belt. The distribution and statistics of soybean aphid in America are shown in Figure 4 and Table 1. In Brazil, the area affected by soybean bollworm accounts for 2.6% of the total soybean areas,

mainly occurred in Parana basin and Mato Grosso. The distribution and statistics of soybean bollworm in Brazil are shown in Figure 5 and Table 1. The area affected by soybean bollworm accounts for 5.3% of the total soybean areas in Argentina, mainly occurred in Chaco, Pampas, and Subtropical highlands. The distribution and statistics of soybean bollworm in Argentina are shown in Figure 6 and Table 1.

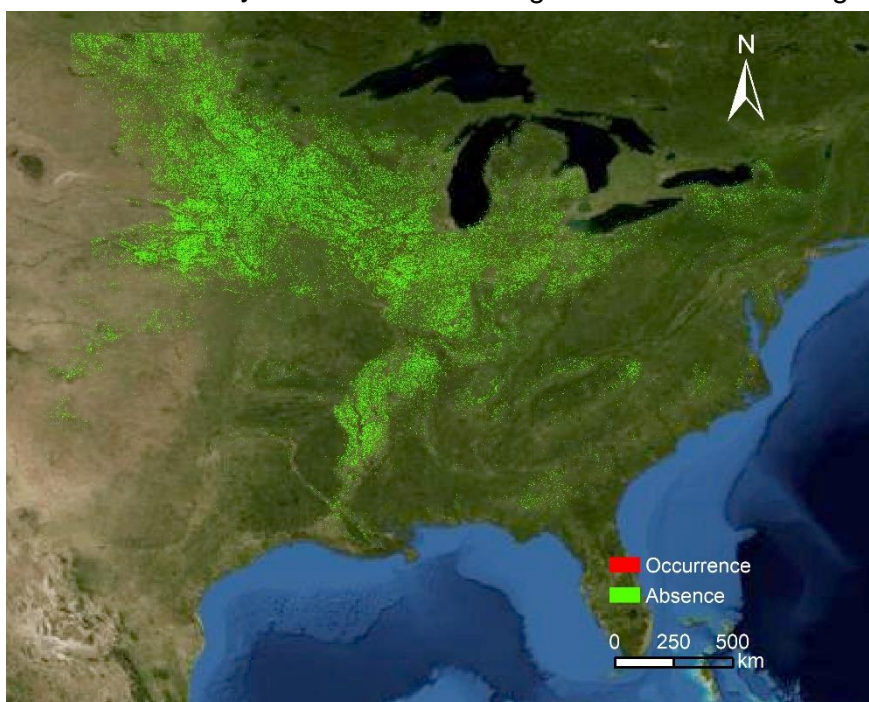


Figure 4 Distribution of soybean aphid in America (2020)

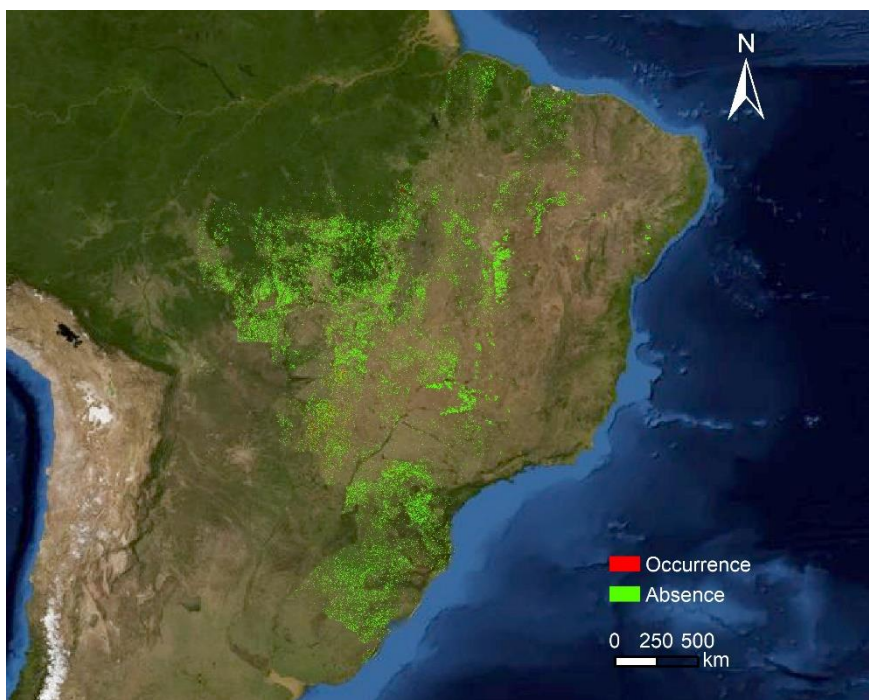


Figure 5 Distribution of soybean bollworm in Brazil (2020)

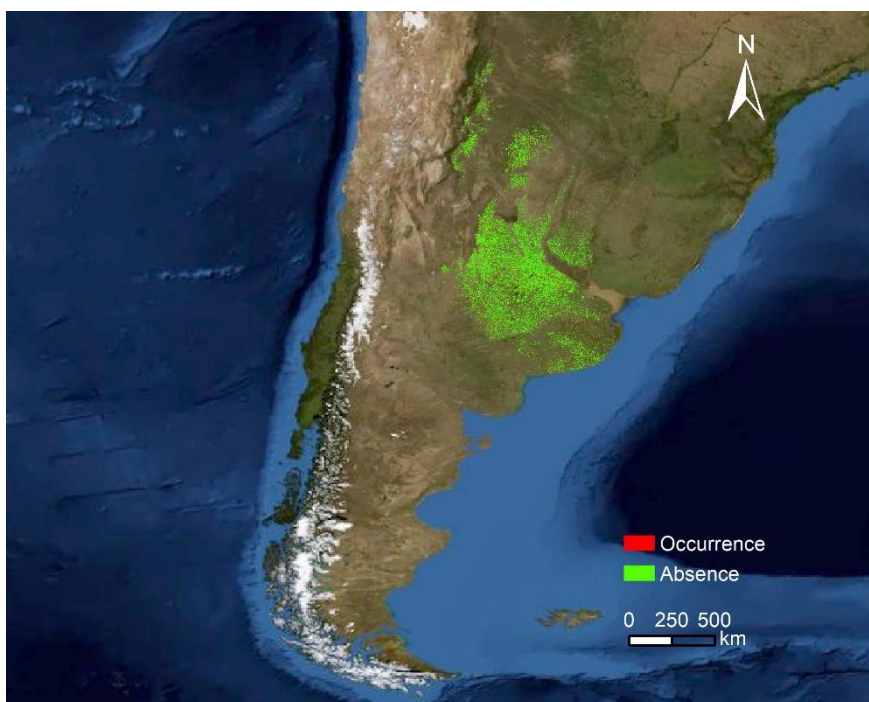


Figure 8 Distribution of soybean bollworm in Argentina (2020)

Table 1 Statistics of soybean diseases and pests in China, America, Brazil and Argentina (2020)

Soybean production countries	Pest and disease occurrence ratio / %				Total planted area/ million hectares
	Soybean cyst nematode	Soybean aphid	Soybean rust	Soybean bollworm	
America	12.8	2.1	/	/	33.5
Brazil	/	/	2.8	2.6	37.1
Argentina	/	/	3.9	5.3	17.1

Note: Please refer to China chapter of the report for China's soybean pests and diseases results.

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Vegetation pests and diseases monitoring and forecasting Global April to May 2021

Pests will occur heavier than diseases on winter wheat
Affected areas are estimated to reach 23 million ha

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for vegetation pest and disease monitoring and forecasting, the research team constructed the 'Vegetation pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main vegetation pests and diseases at global scale.

This report focuses on remote sensing monitoring and forecasting of pest and disease occurrence in the main producing countries entering the middle and late growth stage of wheat during April to May 2021. The results showed that from April to May 2021, the total occurrence areas of rust and aphid are estimated to reach 23 million hectares, will mainly occur in India, Russia, United States, Kazakhstan, Canada, Pakistan, Turkey, Iran, Ukraine, France, Germany, Morocco, Poland, Afghanistan, Romania, Spain, Italy, United Kingdom, Iraq and Uzbekistan. Among them, the total affected areas of rust are estimated to reach 7 million hectares, accounting for 4% of the total planting area, and the total affected areas of aphid are estimated to reach 16 million hectares, accounting for 10% of the total planting area. Overall, pest will occur heavier

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than disease. The specific research results are as follows.

Wheat rust

The distribution, occurrence area and ratio of wheat rust in main wheat production countries is shown in Figure 1 and Table 1. The wheat planted area of India is 29 million hectares, the total affected areas of rust are estimated to reach 94 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in Gangatic plain, North-western dry region or Rajasthan and Gujarat, and Western Himalayan region. The wheat planted area of Russia is 27 million hectares, the total affected areas of rust are estimated to reach 81 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in the Caucasus. The wheat planted area of the United States is 15 million hectares, the total affected areas of rust are estimated to reach 87 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in Corn Belt, Northern Plains, Southern Plains, and Lower Mississippi. The wheat planted area of Kazakhstan is 11 million hectares, the total affected areas of rust are estimated to reach 12

ten thousand hectares, accounting for 1% of the total planting area, will mainly occur in northern zone. The wheat planted area of Canada is 10 million hectares, the total affected areas of rust are estimated to reach 49 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in Prairies. The wheat planted area of Pakistan is 9 million hectares, the total affected areas of rust are estimated to reach 79 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in Northern Punjab, and Lower Indus river basin in south Punjab and Sind. The wheat planted area of Turkey is 7 million hectares, the total affected areas of rust are estimated to reach 21 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in Eastern Anatolia region. The wheat planted area of Iran is 7 million hectares, the total affected areas of rust are estimated to reach 81 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in Semi-arid to sub-tropical hills of the west and the north. The wheat planted area of Ukraine is 7 million hectares, the total affected areas of rust are estimated to reach 17 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in Southern wheat and maize area. The wheat planted area of France is 5 million hectares, the total affected areas of rust are estimated to reach 29 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in Northern barley zone, Mixed maize/barley and rapeseed zone from the Centre to the Atlantic Ocean, and Rapeseed zone of eastern France. The wheat planted area of Germany is 3 million hectares, the total affected areas of rust are estimated to reach 11 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in Central wheat zone of Saxony and Thuringia, Western sparse crop area of the Rhenish massif, and Bavarian Plateau. The wheat planted area of Morocco is 3 million hectares, the total affected

areas of rust are estimated to reach 5 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in northwestern region. The wheat planted area of Poland is 2 million hectares, the total affected areas of rust are estimated to reach 6 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in Central rye and potatoes area. The wheat planted area of Afghanistan is 2 million hectares, the total affected areas of rust are estimated to reach 20 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in eastern region. The wheat planted area of Romania is 2 million hectares, the total affected areas of rust are estimated to reach 3 ten thousand hectares, accounting for 1% of the total planting area, will mainly occur in Western and central maize, wheat and sugar beet plateau, and Eastern and southern maize, wheat and sugar beet plains. The wheat planted area of Spain is 2 million hectares, the total affected areas of rust are estimated to reach 6 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in northern and central regions. The wheat planted area of Italy is 2 million hectares, the total affected areas of rust are estimated to reach 5 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in central region. The wheat planted area of United Kingdom is 2 million hectares, the total affected areas of rust are estimated to reach 13 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in South English mixed wheat and Barley zone, and Sparse crop area of N England, Wales and N. Ireland. The wheat planted area of Iraq is 2 million hectares, the total affected areas of rust are estimated to reach 12 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in northern region. The wheat planted area of Uzbekistan is 1 million hectares, the total affected areas of rust are estimated to reach 9

ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in Eastern

hilly cereals zone.

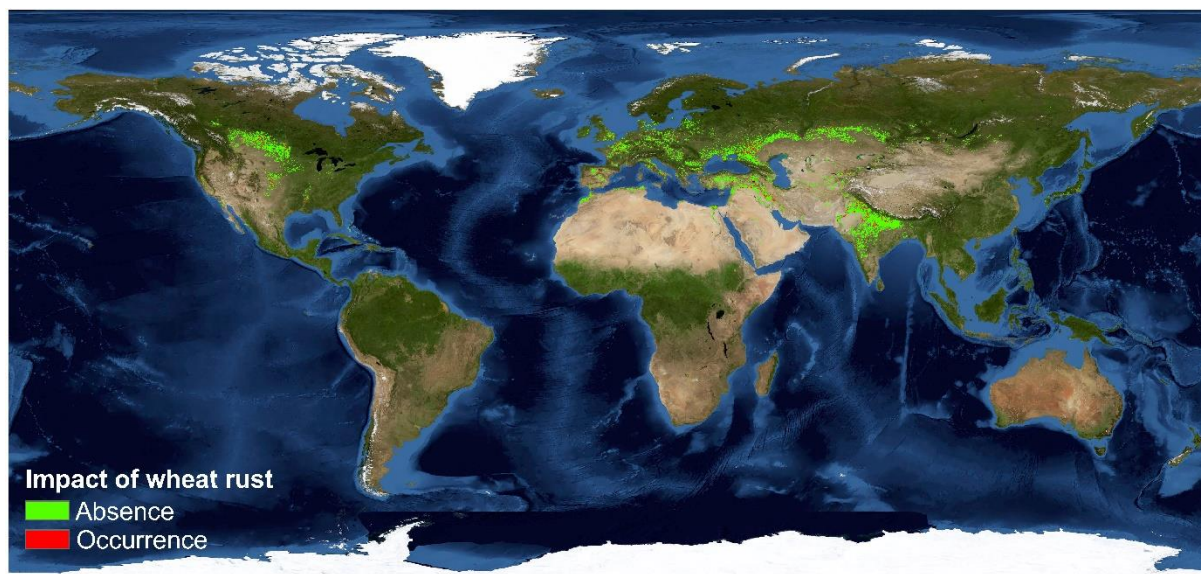


Figure 1 Spatial distribution of wheat rust in winter wheat production countries

Wheat aphid

The distribution, occurrence area and ratio of wheat aphid in main wheat production countries is shown in Figure 1 and Table 1. The total affected areas of aphid in India are estimated to reach 79 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in North-western dry region or Rajasthan and Gujarat, and Western coastal region. The total affected areas of aphid in Russia are estimated to reach 291 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in the Caucasus, and Volga Basin. The total affected areas of aphid in United States are estimated to reach 169 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in Southern Plains. The total affected areas of aphid in Kazakhstan are estimated to reach 28 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in Eastern plateau and southeastern zone. The total affected areas of aphid in Canada are estimated to reach 48 ten thousand hectares, accounting for 5% of the total planting area, will mainly

occur in Prairies. The total affected areas of aphid in Pakistan are estimated to reach 52 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in Northern highlands, and Northern Punjab. The total affected areas of aphid in Turkey are estimated to reach 125 ten thousand hectares, accounting for 17% of the total planting area, will mainly occur in Central Anatolia region. The total affected areas of aphid in Iran are estimated to reach 186 ten thousand hectares, accounting for 28% of the total planting area, will mainly occur in Semi-arid to sub-tropical hills of the west and the north. The total affected areas of aphid in Ukraine are estimated to reach 90 ten thousand hectares, accounting for 14% of the total planting area, will mainly occur in Southern wheat and maize area. The total affected areas of aphid in France are estimated to reach 62 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in Mixed maize/barley and rapeseed zone from the Centre to the Atlantic Ocean, Southwest maize zone. The total affected areas of aphid in Germany are estimated to reach 16 ten thousand hectares, accounting for 6% of the

total planting area, will mainly occur in Central wheat zone of Saxony and Thuringia, Western sparse crop area of the Rhenish massif, and Bavarian Plateau. The total affected areas of aphid in Morocco are estimated to reach 63 ten thousand hectares, accounting for 24% of the total planting area, will mainly occur in northwestern region. The total affected areas of aphid in Poland are estimated to reach 11 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in Central rye and potatoes area, and Southern wheat and sugarbeet area. The total affected areas of aphid in Afghanistan are estimated to reach 50 ten thousand hectares, accounting for 21% of the total planting area, will mainly occur in northeastern region. The total affected areas of aphid in Romania are estimated to reach 33 ten thousand hectares, accounting for 15% of the total planting area, will mainly occur in Eastern and southern maize, wheat and sugar beet plains, and Western and central maize, wheat

and sugar beet plateau. The total affected areas of aphid in Spain are estimated to reach 44 ten thousand hectares, accounting for 23% of the total planting area, will mainly occur in northern and eastern regions. The total affected areas of aphid in Italy are estimated to reach 38 ten thousand hectares, accounting for 21% of the total planting area, will mainly occur in central and southern regions. The total affected areas of aphid in United Kingdom are estimated to reach 7 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in South English mixed wheat and Barley zone. The total affected areas of aphid in Iraq are estimated to reach 9 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in eastern region. The total affected areas of aphid in Uzbekistan are estimated to reach 16 ten thousand hectares, accounting for 11% of the total planting area, will mainly occur in eastern region of Eastern hilly cereals zone.

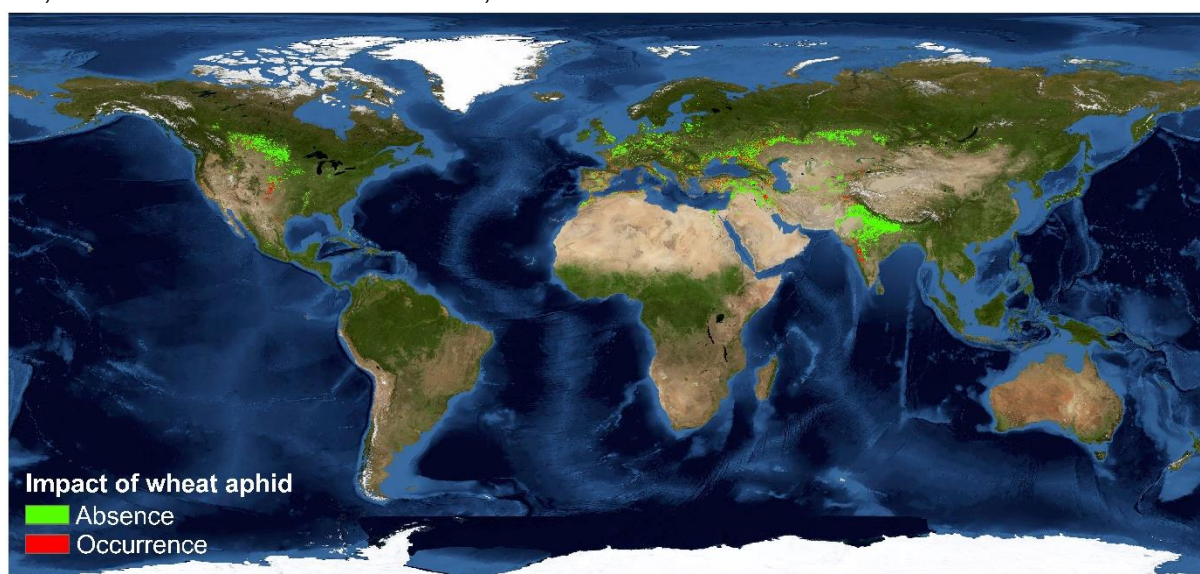


Figure 2 Spatial distribution of wheat aphid in winter wheat production countries

Table 1 Statistics of wheat rust and aphid in main winter wheat production countries

Winter wheat production countries	Rust occurrence area and ratio		Aphid occurrence area and ratio		Total planting area / million hectares
	Area / ten thousand hectares	Ratio / %	Area / ten thousand hectares	Ratio / %	
India	94	3	79	3	29
Russia	81	3	291	11	27
United States	87	6	169	11	15

Kazakhstan	12	1	28	2	11
Canada	49	5	48	5	10
Pakistan	79	9	52	6	9
Turkey	21	3	125	17	7
Iran	81	12	186	28	7
Ukraine	17	3	90	14	7
France	29	6	62	13	5
Germany	11	4	16	6	3
Morocco	5	2	63	24	3
Poland	6	3	11	5	2
Afghanistan	20	9	50	21	2
Romania	3	1	33	15	2
Spain	6	3	44	23	2
Italy	5	3	38	21	2
United Kingdom	13	7	7	4	2
Iraq	12	7	9	6	2
Uzbekistan	9	6	16	11	1

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Mission statements: As the science and knowledge service, the Sino-UK Crop Pest and Disease Forecasting & Management Joint Laboratory is to support independent evidence for crop monitoring.

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Vegetation pests and diseases monitoring and forecasting

Global
September 2021

Pests will occur heavier than diseases on rice
Affected areas are estimated to reach 20 million ha

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for vegetation pest and disease monitoring and forecasting, the research team constructed the 'Vegetation pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main vegetation pests and diseases at global scale.

This report focuses on remote sensing forecasting of pest and disease occurrence in 38 Asian, European and North American countries that entered the mid-to-late growth stage of rice during September 2021. The results showed that the rice planting area in above countries is about 1 billion hectares, rice planthopper (*Nilaparvata lugens*) and rice blast (*Magnaporthe oryzae*) are the main types of rice pests and diseases, the cumulative occurrence areas of the pest and disease reach 20 million hectares. Of which, the affected areas of rice planthopper are estimated to reach 14.7 million hectares, accounting for 15% of the total planting area, and the total affected areas of rice blast are estimated to reach 5.3 million hectares, accounting for 5% of the total planting area. Overall, pest will occur heavier than disease. The analyses of specific forecasting results of accounting for 4% of the total planting area, will

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the spatial distribution and occurrence area of the main pest and disease in 14 major rice producing and pest and disease occurrence countries (India, Thailand, Bangladesh, Myanmar, Vietnam, Philippines, Cambodia, Pakistan, Nepal, Japan, the United States, South Korea, Laos and Iran) are as follows.

Rice planthopper

The distribution, occurrence area and ratio of rice planthopper in main rice production countries is shown in Figure 1 and Table 1. The rice planted area of India is 44 million hectares, the total affected areas of planthopper are estimated to reach 894 ten thousand hectares, accounting for 20% of the total planting area, will mainly occur in central region of India and Ganges Plain. The rice planted area of Thailand is 12.7 million hectares, the total affected areas of planthopper are estimated to reach 156 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in single-season rice planting area. The rice planted area of Bangladesh is 10 million hectares, the total affected areas of planthopper are estimated to reach 42 ten thousand hectares,

mainly occur in the western region of the

Ganges Plain. The rice planted area of Myanmar is 7.3 million hectares, the total affected areas of planthopper are estimated to reach 38 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in the central plains. The rice planted area of Vietnam is 7.3 million hectares, the total affected areas of planthopper are estimated to reach 161 ten thousand hectares, accounting for 22% of the total planting area, will mainly occur northern and southern Vietnam. The rice planted area of Philippines is 4 million hectares, the total affected areas of planthopper are estimated to reach 22 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in the northern lowland agricultural area. The rice planted area of Cambodia is 3.3 million hectares, the total affected areas of planthopper are estimated to reach 67 ten thousand hectares, accounting for 20% of the total planting area, will mainly occur in the main crop producing area and the Tonle Sap Lake area. The rice planted area of Pakistan is 2.7 million hectares, the total affected areas of

planthopper are estimated to reach 33 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in northern Punjab. The rice planted area of Nepal is 2 million hectares, the total affected areas of planthopper are estimated to reach 4 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in central Nepal. The rice planted area of Japan is 1.5 million hectares, the total affected areas of planthopper are estimated to reach 12 ten thousand hectares, accounting for 8% of the total planting area, will mainly occur in central and southern Japan. The rice planted area of South Korea is 0.8 million hectares, the total affected areas of planthopper are estimated to reach 7 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in western South Korea. The rice planted area of Laos is 0.7 million hectares, the total affected areas of planthopper are estimated to reach 24 ten thousand hectares, accounting for 35% of the total planting area, will mainly occur in southern Laos.

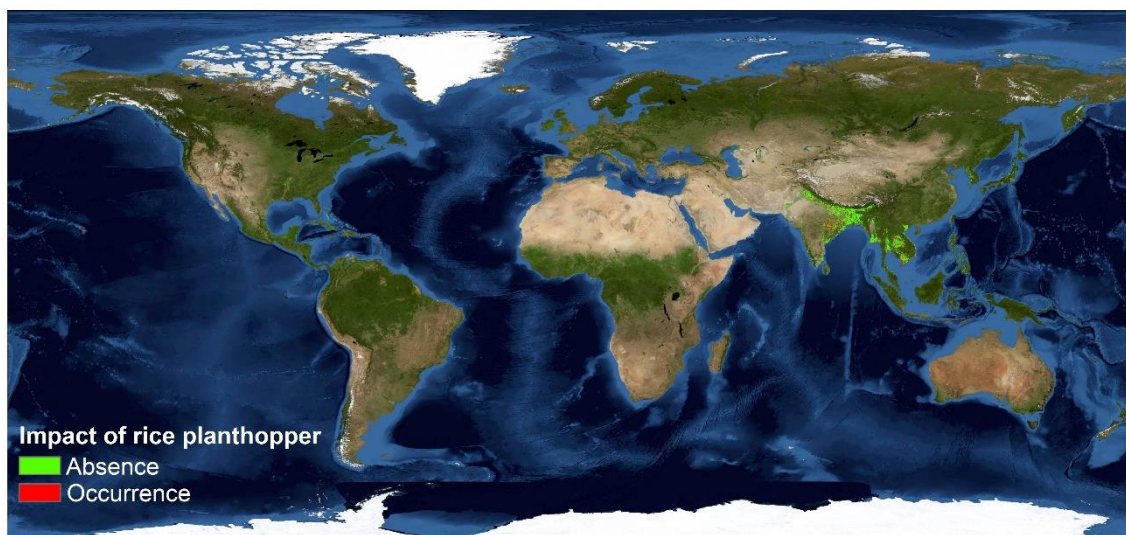


Figure 1 Spatial distribution of rice planthopper in rice production countries

Rice blast

The distribution, occurrence area and ratio of rice blast in main rice production countries is shown in Figure 2 and Table 1. The total

affected areas of blast in India are estimated to reach 197 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in the central region of India, the Ganges Plain and eastern coastal area. The total

affected areas of blast in Thailand are estimated to reach 53 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in single-season rice planting area. The total affected areas of blast in Bangladesh are estimated to reach 39 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in coastal area, southern Ganges Plain and Sylhet Basin. The total affected areas of blast in Myanmar are estimated to reach 36 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in coastal area. The total affected areas of blast in Vietnam are estimated to reach 66 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in southern Vietnam. The total affected areas of blast in Philippines are estimated to reach 6 ten thousand hectares, accounting for 1% of the total planting area, will mainly occur in agroforestry ecotone area and hilly agricultural area. The total affected areas of blast in Cambodia are estimated to reach 41 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in Tonle Sap Lake area and southern part of the main crop production area. The total affected areas of blast in Pakistan are estimated to reach 29 ten thousand hectares, accounting for 11% of the

total planting area, will mainly occur in north Punjab. The total affected areas of blast are in Nepal estimated to reach 5 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in central and eastern Nepal. The total affected areas of blast in Japan are estimated to reach 15 ten thousand hectares, accounting for 10% of the total planting area, will mainly occur in northern Japan. The rice planted area of the United States is 1.1 million hectares, the total affected areas of blast are estimated to reach 13 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in lower Mississippi. The total affected areas of blast in South Korea are estimated to reach 3 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in western South Korea. The total affected areas of blast in Laos are estimated to reach 3 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in southern Laos. The rice planted area of Iran is 0.6 million hectares, the total affected areas of blast are estimated to reach 5 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in western and northern regions of Iran.

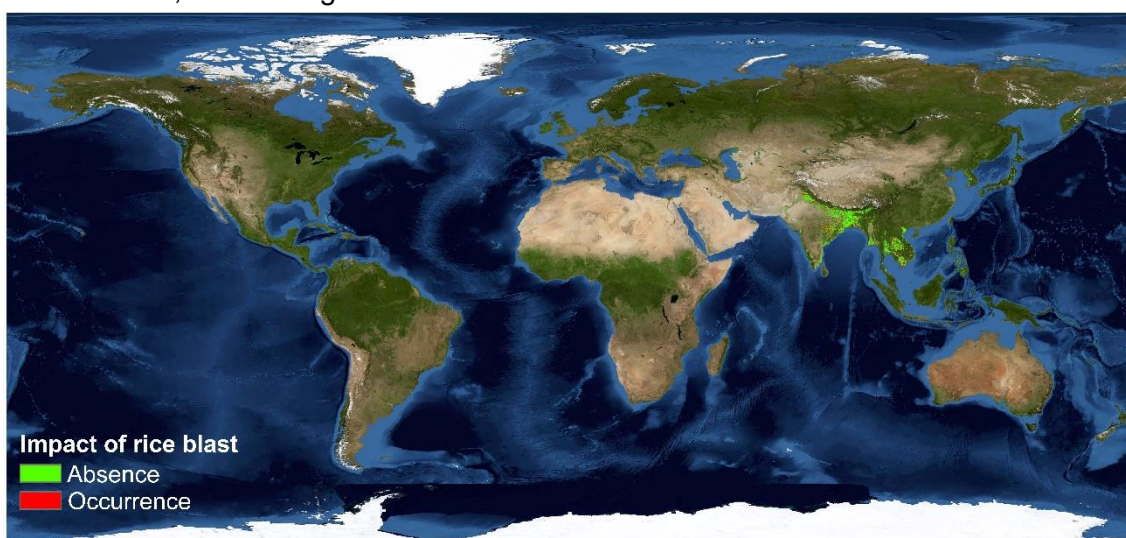


Figure 2 Spatial distribution of rice blast in rice production countries

Table 1 Statistics of rice blast and planthopper in main rice production countries

Rice production countries	Planthopper occurrence area and ratio		Blast occurrence area and ratio		Total planting area / million hectares
	Area / ten thousand hectares	Ratio / %	Area / ten thousand hectares	Ratio / %	
India	894	20	197	4	44
Thailand	156	12	53	4	12.7
Bangladesh	42	4	39	4	10
Myanmar	38	5	36	5	7.3
Vietnam	161	22	66	9	7.3
Philippines	22	5	6	1	4
Cambodia	67	20	41	12	3.3
Pakistan	33	12	29	11	2.7
Nepal	4	2	5	3	2
Japan	12	8	15	10	1.5
United States	/	/	13	12	1.1
South Korea	7	9	3	4	0.8
Laos	24	35	3	4	0.7
Iran	/	/	5	9	0.6

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Mission statements: As the science and knowledge service, the Sino-UK Crop Pest and Disease Forecasting & Management Joint Laboratory is to support independent evidence for crop monitoring.

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Vegetation pests and diseases monitoring and forecasting Global

May 2022

Pests will occur heavier than diseases on winter wheat Affected areas are estimated to reach 25 million ha

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for vegetation pest and disease monitoring and forecasting, the research team constructed the 'Vegetation Pests and Diseases Monitoring and Forecasting System', which could regularly release thematical maps and reports on main vegetation pests and diseases at global scale.

This report focuses on remote sensing monitoring and forecasting of pest and disease occurrence in the main producing countries entering the middle and late growth stage of wheat during May 2022. The results showed that occurrence areas of rust and aphid are estimated to reach 25 million hectares, will mainly occur in India, Russia, United States,

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Kazakhstan, Canada, Pakistan, Turkey, Iran, Ukraine, France, Germany, Morocco, Poland, Afghanistan, Romania, Spain, Italy, United Kingdom, Iraq and Uzbekistan. Among them, the total affected areas of rust are estimated to reach 8 million hectares, accounting for 5% of the total planting area, and the total affected areas of aphid are estimated to reach 17 million hectares, accounting for 11% of the total planting area during May 2022. Overall, pest will occur heavier than disease. The specific research results of spatial distribution and occurrence area are as follows.

Wheat rust

The distribution, occurrence area and ratio

of wheat rust in main wheat production countries is shown in Figure 1 and Table 1. The wheat planted area of India is 29 million hectares, the total affected areas of rust are estimated to reach 111 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in Gangatic plain and Western Himalayan region. The wheat planted area of Russia is 27 million hectares, the total affected areas of rust are estimated to reach 112 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in the Caucasus. The wheat planted area of the United States is 15 million hectares, the total affected areas of rust are estimated to reach 135 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in Corn Belt, Northern Plains, Southern Plains, and Northwest. The wheat planted area of Kazakhstan is 11 million hectares, the total affected areas of rust are estimated to reach 36 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in northern zone. The wheat planted area of Canada is 10 million hectares, the total affected areas of rust are estimated to reach 60 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in Prairies. The wheat planted area of Pakistan is 9 million hectares, the total affected areas of rust are estimated to reach 83 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in Northern Punjab, and Lower Indus River basin in south Punjab and Sind. The wheat planted area of Turkey is 7 million hectares, the total affected areas of rust are estimated to reach 28 ten thousand hectares,

accounting for 4% of the total planting area, will mainly occur in Central Anatolia region. The wheat planted area of Iran is 7 million hectares, the total affected areas of rust are estimated to reach 79 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in Semi-arid to sub-tropical hills of the west and the north. The wheat planted area of Ukraine is 7 million hectares, the total affected areas of rust are estimated to reach 27 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in Southern wheat and maize area. The wheat planted area of France is 5 million hectares, the total affected areas of rust are estimated to reach 32 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in Northern barley zone, Mixed maize/barley and rapeseed zone from the Centre to the Atlantic Ocean, and Rapeseed zone of eastern France. The wheat planted area of Germany is 3 million hectares, the total affected areas of rust are estimated to reach 14 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in Central wheat zone of Saxony and Thuringia, Sparse crop area of the east-German lake and Heathland, and Bavarian Plateau. The wheat planted area of Morocco is 3 million hectares, the total affected areas of rust are estimated to reach 8 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in northwestern region. The wheat planted area of Poland is 3 million hectares, the total affected areas of rust are estimated to reach 10 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in Central rye and potatoes area and Southern

wheat and sugar beet area. The wheat planted area of Afghanistan is 3 million hectares, the total affected areas of rust are estimated to reach 22 ten thousand hectares, accounting for 8% of the total planting area, will mainly occur in eastern region. The wheat planted area of Romania is 2 million hectares, the total affected areas of rust are estimated to reach 3 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in Western and central maize, wheat and sugar beet plateau, and Eastern and southern maize, wheat and sugar beet plains. The wheat planted area of Spain is 2 million hectares, the total affected areas of rust are estimated to reach 8 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in northern and eastern regions. The wheat planted area of Italy is 2 million hectares, the

total affected areas of rust are estimated to reach 7 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in central region. The wheat planted area of United Kingdom is 2 million hectares, the total affected areas of rust are estimated to reach 13 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in South English mixed wheat and Barley zone. The wheat planted area of Iraq is 2 million hectares, the total affected areas of rust are estimated to reach 14 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in northern region. The wheat planted area of Uzbekistan is 1 million hectares, the total affected areas of rust are estimated to reach 10 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in Eastern hilly cereals zone.

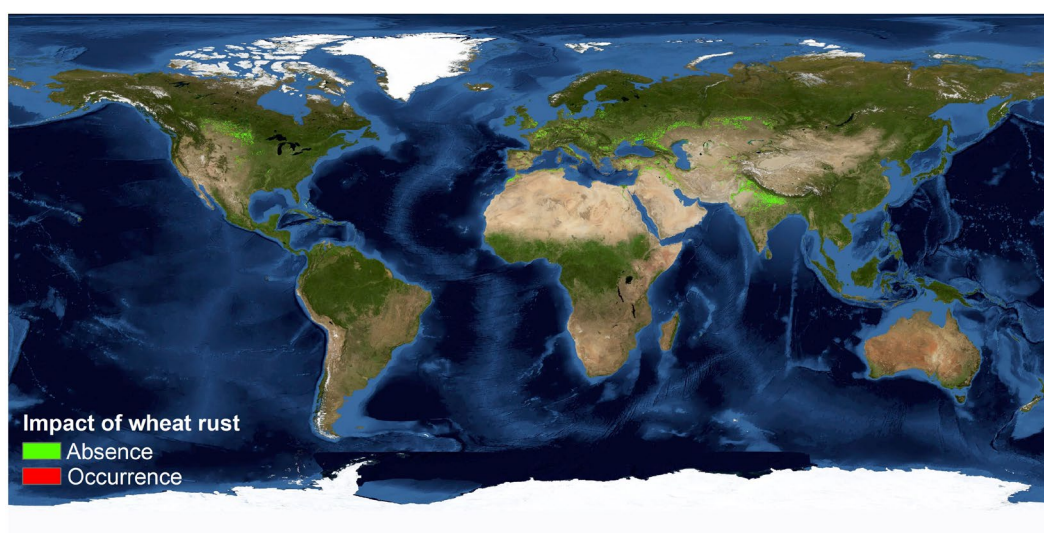


Figure 1 Spatial distribution of wheat rust in winter wheat production countries

Wheat aphid

The distribution, occurrence area and ratio of wheat aphid in main wheat production countries is shown in Figure 2 and Table 1. The

total affected areas of aphid in India are estimated to reach 122 ten thousand hectares, accounting for 4% of the total planting area, will

mainly occur in Western Himalayan region, and Gangatic plain. The total affected areas of aphid in Russia are estimated to reach 325 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in the Caucasus, and Volga Basin. The total affected areas of aphid in United States are estimated to reach 202 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in Northern and Southern Plains. The total affected areas of aphid in Kazakhstan are estimated to reach 58 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in Eastern plateau and southeastern zone, and Northern zone. The total affected areas of aphid in Canada are estimated to reach 77 ten thousand hectares, accounting for 8% of the total planting area, will mainly occur in Prairies. The total affected areas of aphid in Pakistan are estimated to reach 58 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in Lower Indus River basin in south Punjab and Sind, and Northern Punjab. The total affected areas of aphid in Turkey are estimated to reach 143 ten thousand hectares, accounting for 20% of the total planting area, will mainly occur in Central Anatolia region. The total affected areas of aphid in Iran are estimated to reach 204 ten thousand hectares, accounting for 31% of the total planting area, will mainly occur in semi-arid to sub-tropical hills of the west and the north. The total affected areas of aphid in Ukraine are estimated to reach 107 ten thousand hectares, accounting for 16% of the total planting area, will mainly occur in Southern wheat and maize area. The total

affected areas of aphid in France are estimated to reach 58 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in Mixed maize/barley and rapeseed zone from the Centre to the Atlantic Ocean, Southwest maize zone. The total affected areas of aphid in Germany are estimated to reach 20 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in Central wheat zone of Saxony and Thuringia, Sparse crop area of the east-German lake and Heathland, and Bavarian Plateau. The total affected areas of aphid in Morocco are estimated to reach 70 ten thousand hectares, accounting for 26% of the total planting area, will mainly occur in northwestern region. The total affected areas of aphid in Poland are estimated to reach 17 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in Central rye and potatoes area, and Southern wheat and sugar beet area. The total affected areas of aphid in Afghanistan are estimated to reach 49 ten thousand hectares, accounting for 18% of the total planting area, will mainly occur in northeastern region. The total affected areas of aphid in Romania are estimated to reach 37 ten thousand hectares, accounting for 18% of the total planting area, will mainly occur in Eastern and southern maize, wheat and sugar beet plains, and Western and central maize, wheat and sugar beet plateau. The total affected areas of aphid in Spain are estimated to reach 47 ten thousand hectares, accounting for 24% of the total planting area, will mainly occur in northern and eastern regions. The total affected areas of aphid in Italy are estimated to reach 40 ten thousand

hectares, accounting for 20% of the total planting area, will mainly occur in central and southern regions. The total affected areas of aphid in United Kingdom are estimated to reach 7 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in South English mixed wheat and Barley zone. The total affected areas of aphid in Iraq are

estimated to reach 10 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in eastern region. The total affected areas of aphid in Uzbekistan are estimated to reach 17 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in eastern region of Eastern hilly cereals zone.

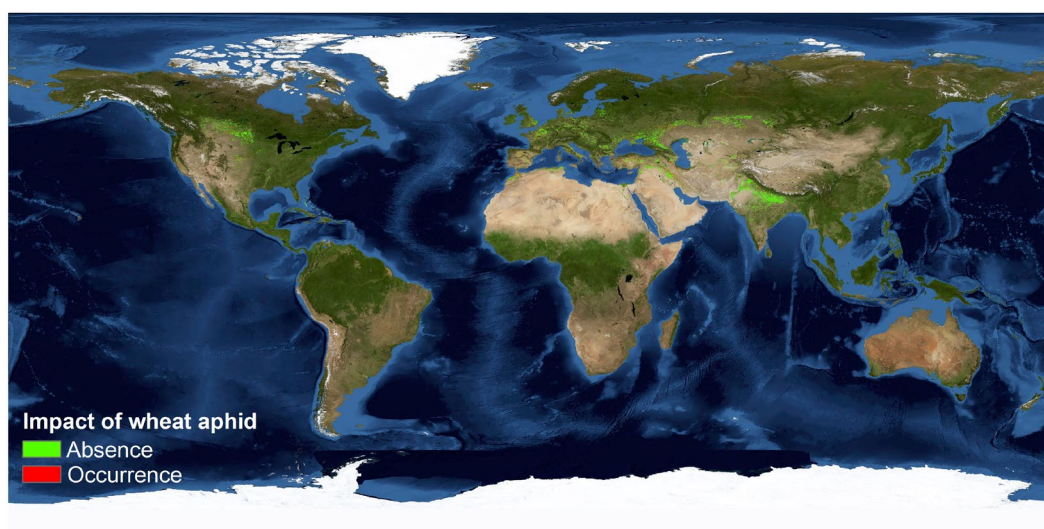


Figure 2 Spatial distribution of wheat aphid in winter wheat production countries

Table 1 Statistics of wheat rust and aphid in main winter wheat production countries

Winter wheat production countries	Rust occurrence area and ratio		Aphid occurrence area and ratio		Total planting area / million hectares
	Area / ten thousand hectares	Ratio / %	Area / ten thousand hectares	Ratio / %	
India	111	4	122	4	29
Russia	112	4	325	12	27
United States	135	9	202	13	15
Kazakhstan	36	3	58	5	11
Canada	60	6	77	8	10
Pakistan	83	9	58	6	9
Turkey	28	4	143	20	7
Iran	79	12	204	31	7
Ukraine	27	4	107	16	7
France	32	7	58	13	5
Germany	14	5	20	7	3
Morocco	8	3	70	26	3
Poland	10	4	17	7	3
Afghanistan	22	8	49	18	3

Romania	3	2	37	18	2
Spain	8	4	47	24	2
Italy	7	4	40	20	2
United Kingdom	13	7	7	4	2
Iraq	14	7	10	5	2
Uzbekistan	10	7	17	13	1

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Mission statements: As the science and knowledge service, the Sino-UK Crop Pest and Disease Forecasting & Management Joint Laboratory is to support independent evidence for crop monitoring.

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Vegetation pests and diseases monitoring and forecasting Global

October 2022

Pests will occur heavier than diseases on rice

Affected areas are estimated to reach 20.7 million ha

Overview

Integrated with multi-source Earth Observation data, e.g. meteorological data, field data, and remote sensing data (such as GF series in China, MODIS and Landsat series in US, Sentinel series in EU), and self-developed models and algorithms for vegetation pest and disease monitoring and forecasting, the research team constructed the 'Vegetation pests and diseases monitoring and forecasting system', which could regularly release thematical maps and reports on main vegetation pests and diseases at global scale.

This report focuses on remote sensing forecasting of pest and disease occurrence in 38 Asian, European and North American countries that entered the mid-to-late growth stage of rice during October 2022. The results showed that rice planthopper (*Nilaparvata lugens*) and rice blast (*Magnaporthe oryzae*) are the main types of rice pests and diseases, the cumulative occurrence areas of the pest and disease reach 20.7 million hectares, yield

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loss up to 3.4%. Of which, the affected areas of rice planthopper are estimated to reach 15.3 million hectares, accounting for 15% of the total planting area, and the total affected areas of rice blast are estimated to reach 5.3 million hectares, accounting for 5% of the total planting area. Overall, pest will occur heavier than disease. The analyses of specific forecasting results of the spatial distribution and occurrence area of the main pest and disease in 14 major rice producing and pest and disease occurrence countries (India, Thailand, Bangladesh, Myanmar, Vietnam, Philippines, Cambodia, Pakistan, Nepal, Japan, the United States, South Korea, Laos and Iran) are as follows.

Rice planthopper

The distribution, occurrence area and ratio of rice planthopper in main rice production countries is shown in Figure 1 and Table 1. The rice planted area of India is 46 million hectares, the total affected areas of planthopper are estimated to reach 933.3 ten thousand hectares, accounting for 21% of the total planting area, will mainly occur in deccan plateau, gangatic plain, eastern coastal region, and western coastal region. The rice planted area of Bangladesh is 11.3 million hectares, the total affected areas of planthopper are estimated to reach 54.1 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in gangetic plain and sylhet basin. The rice planted area of Thailand is 10 million hectares, the total affected areas of planthopper are estimated to reach 132.3 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in single-cropped rice north-eastern region. The rice planted area of Vietnam is 7.3 million hectares, the total affected areas of planthopper are estimated to reach 158.8 ten thousand hectares, accounting for 22% of the total planting area, will mainly occur in northern and southern zone. The rice planted area of Myanmar is 6.7 million hectares, the total affected areas of planthopper are estimated to reach 39 ten thousand hectares, accounting for 6% of the total planting area, will mainly occur in the central plains. The rice planted area of Philippines is 4.7 million hectares, the total affected areas of planthopper are estimated to reach 21.2 ten thousand hectares, accounting

for 5% of the total planting area, will mainly occur in the northern lowland agricultural area. The rice planted area of Cambodia is 3.3 million hectares, the total affected areas of planthopper are estimated to reach 67.3 ten thousand hectares, accounting for 20% of the total planting area, will mainly occur in the main crop producing area. The rice planted area of Pakistan is 3.3 million hectares, the total affected areas of planthopper are estimated to reach 43.7 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in northern Punjab. The rice planted area of Nepal is 1.3 million hectares, the total affected areas of planthopper are estimated to reach 3.5 ten thousand hectares, accounting for 3% of the total planting area, will mainly occur in the junction of Nepal and the gangatic plain. The rice planted area of Japan is 1.3 million hectares, the total affected areas of planthopper are estimated to reach 13.8 ten thousand hectares, accounting for 10% of the total planting area, will mainly occur in central zone. The rice planted area of South Korea is 0.7 million hectares, the total affected areas of planthopper are estimated to reach 12.1 ten thousand hectares, accounting for 18% of the total planting area, will mainly occur in southern zone. The rice planted area of Laos is 0.7 million hectares, the total affected areas of planthopper are estimated to reach 33.9 ten thousand hectares, accounting for 51% of the total planting area, will mainly occur in central zone and southern zone.

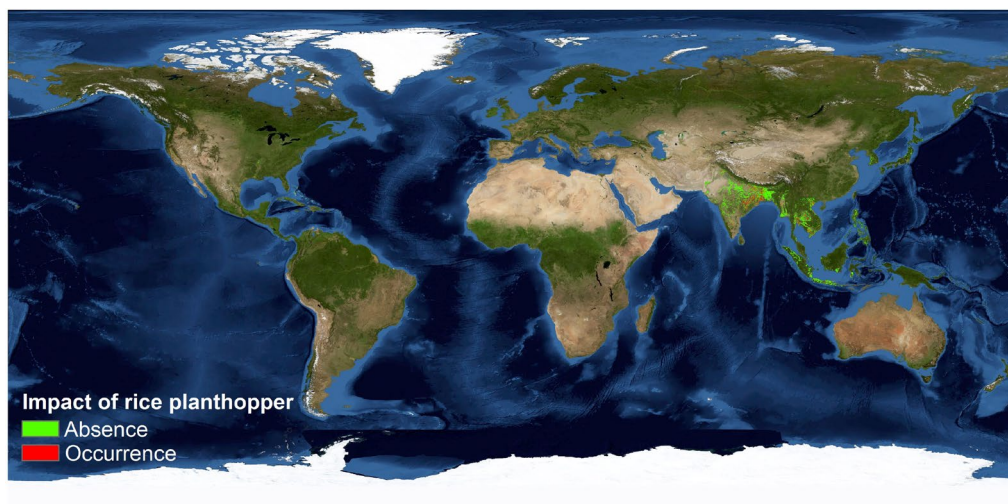


Figure 1 Spatial distribution of rice planthopper in rice production countries

Rice blast

The distribution, occurrence area and ratio of rice blast in main rice production countries is shown in Figure 2 and Table 1. The total affected areas of blast in India are estimated to reach 202 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in the gangatic plain. The total affected areas of blast in Bangladesh are estimated to reach 49.6 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in coastal region and gangetic plain. The total affected areas of blast in Thailand are estimated to reach 43.5 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in central double and triple-cropped rice lowlands, south-eastern horticulture area and central tonle-sap plain. The total affected areas of blast in Vietnam are estimated to reach 68.4 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in northern and southern zone. The total affected areas of blast in Myanmar are estimated to reach 37.3 ten thousand

hectares, accounting for 6% of the total planting area, will mainly occur in central plain and delta and southern-coast. The total affected areas of blast in Philippines are estimated to reach 7.4 ten thousand hectares, accounting for 2% of the total planting area, will mainly occur in lowlands and hills. The total affected areas of blast in Cambodia are estimated to reach 42.3 ten thousand hectares, accounting for 13% of the total planting area, will mainly occur in central tonle-sap plain and upland areas. The total affected areas of blast in Pakistan are estimated to reach 38.9 ten thousand hectares, accounting for 12% of the total planting area, will mainly occur in north Punjab. The total affected areas of blast are in Nepal estimated to reach 4.8 ten thousand hectares, accounting for 4% of the total planting area, will mainly occur in central and eastern zone. The total affected areas of blast in Japan are estimated to reach 18.2 ten thousand hectares, accounting for 14% of the total planting area, will mainly occur in central zone. The rice

planted area of the United States is 0.7 million hectares, the total affected areas of blast are estimated to reach 11.9 ten thousand hectares, accounting for 18% of the total planting area, will mainly occur in lower Mississippi. The total affected areas of blast in South Korea are estimated to reach 5.8 ten thousand hectares, accounting for 9% of the total planting area, will mainly occur in southern zone. The total

affected areas of blast in Laos are estimated to reach 3.3 ten thousand hectares, accounting for 5% of the total planting area, will mainly occur in southern Laos. The rice planted area of Iran is 0.7 million hectares, the total affected areas of blast are estimated to reach 4.7 ten thousand hectares, accounting for 7% of the total planting area, will mainly occur in western and northern regions of Iran.

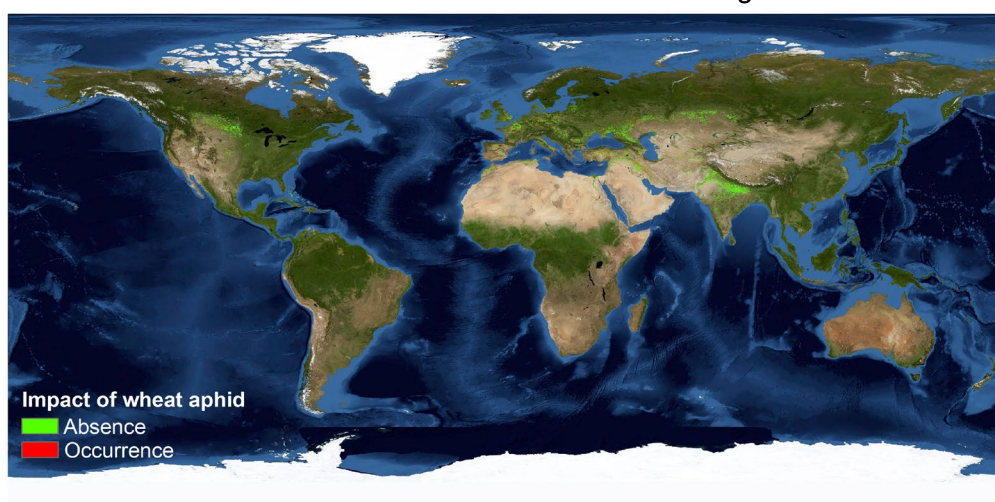


Figure 2 Spatial distribution of rice blast in rice production countries

Table 1 Statistics of rice blast and planthopper in main rice production countries

Rice production countries	Planthopper occurrence area and ratio		Blast occurrence area and ratio		Total planting area / million hectares
	Area / ten thousand hectares	Ratio / %	Area / ten thousand hectares	Ratio / %	
India	933.3	21	202	4	46
Bangladesh	54.1	5	49.6	4	11.3
Thailand	132.3	13	43.5	4	10
Vietnam	158.8	22	68.4	9	7.3
Myanmar	39	6	37.3	6	6.7
Philippines	21.2	5	7.4	2	4.7
Cambodia	67.3	20	42.3	13	3.3
Pakistan	43.7	13	38.9	12	3.3
Nepal	3.5	3	4.8	4	1.3
Japan	13.8	10	18.2	14	1.3
United States	/	/	11.9	18	0.7
South Korea	12.1	18	5.8	9	0.7
Laos	33.9	51	3.3	5	0.7
Iran	/	/	4.7	7	0.7

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