



Wheat rust advisory - risk assessment from surveys and forecasts in Bhutan

Summary period: 12 Apr - 18 Apr 2024

Overall risk level:

Moderate / Caution

Key messages

Surveys and assessment of field trials are now progressing and indicate high levels of both leaf and stripe rust in Punakha. These results would align with previous forecasts indicating increasing risk of infection risk and also the potential for spores to enter Bhutan from Nepal and/or Bangladesh. Current forecasts indicate an increased risk of infection, especially in the main river valley areas. Close monitoring is recommended for the appearance of either stripe or leaf rust in other areas. Crops in the river valleys may see increased levels of disease.

During the entire period 13 – 29 Apr rain is forecast for all of Bhutan. Temperatures are likely to be warming. These weather conditions may be favorable for the development of rusts, especially leaf rust in more southern areas and stripe rust in mid hills and valleys.

Given the continued and increasing infection efficiency risk and weather conditions caution and close monitoring is advised.

Very close monitoring should be undertaken for any appearance of stem rust.

Recommendations

Suitable conditions for leaf rust (lower, warmer areas) and stripe rust (cooler higher areas) are likely to develop due to forecast rain over the next 1-2 weeks. Scouting should be undertaken and farmers informed to be vigilant for the emergence of rust. If rust starts to appear farmers should be advised to undertake control if susceptible cultivars are grown.

The risk however is based on susceptible wheat lines. Different levels of resistance will reduce the risk of the disease at the farmer field. Before the decision on the use of fungicide, pls consider advisory from expert in your area.

- Awareness should be raised amongst stakeholders at all levels, including farmers, to be vigilant for early appearance of rusts. **Early control to stop increased spread and further build-up of disease is very important.**

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- Sampling should be undertaken to determine races of rust present. This is very important as the new, virulent race of stripe rust (PstS16) may be present in Nepal and an incursion into Bhutan is possible. If any stem rust is observed, samples should be collected.

Field surveys

Surveys undertaken Mar 26 2024 - Apr 05 2024. A total of 93 fields surveyed. No stem rust detected.

Legend for severity and incidence intensity: Low: less than 20%; moderate: 20-40%; high: more than 40%.

Leaf Rust reported from 66 out of 93 fields surveyed (71%). Moderate to high incidence of leaf rust has been seen in 33 fields (50% of infected fields). Moderate to high severity of leaf rust has been seen in 26 fields (39% of infected fields).

Stripe Rust reported from 25 out of 93 fields surveyed (27%). Moderate to high incidence of stripe rust has been seen in 17 fields (68% of infected fields). Moderate to high severity of stripe rust has been seen in 16 fields (64% of infected fields).

Table 1: Variety analysis of surveys.

Variety	Number of surveys	Number of surveys reporting infection of		
		stem rust	stripe rust	leaf rust
Bajosokha	2	n/a	0	1
Bumthang ka Drukchu	4	n/a	2	3
CIMMYT line 1	2	n/a	0	1
CIMMYT Line 10	2	n/a	0	1
CIMMYT Line 11	2	n/a	0	1
CIMMYT Line 12	1	n/a	0	1
CIMMYT line 13	3	n/a	0	3
CIMMYT line 14	2	n/a	0	1
CIMMYT Line 15	2	n/a	0	1
CIMMYT line 16	2	n/a	1	2
CIMMYT line 17	2	n/a	0	2
CIMMYT Line 18	3	n/a	0	3
CIMMYT line 19	1	n/a	0	1
CIMMYT Line 2	2	n/a	0	2
CIMMYT line 20	2	n/a	0	2
CIMMYT line 21	2	n/a	0	2
CIMMYT line 22	2	n/a	0	2
CIMMYT line 23	2	n/a	1	2
CIMMYT Line 24	2	n/a	0	2
CIMMYT line 3	2	n/a	0	1
CIMMYT line 4	2	n/a	0	1
CIMMYT Line 5	3	n/a	0	1
CIMMYT line 6	1	n/a	0	1
CIMMYT Line 7	2	n/a	0	2
CIMMYT line 8	2	n/a	0	2
CIMMYT line 9	2	n/a	0	2
Durum	5	n/a	4	2
Durum wheat line imported from Indian market	1	n/a	1	1
Guma Sokha	4	n/a	1	3

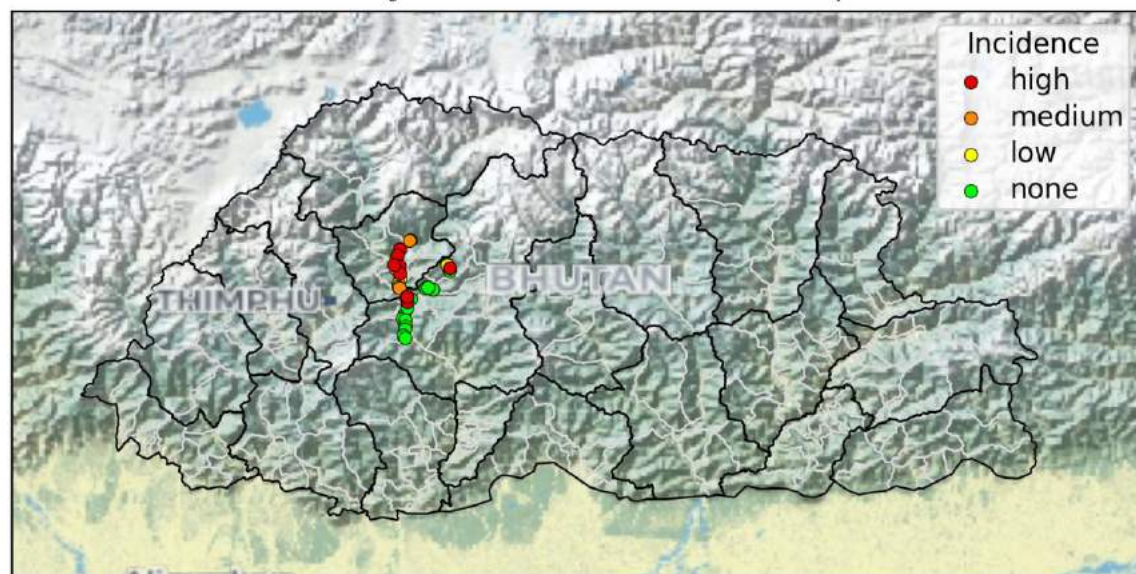
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Guma sokha-kaa	9	n/a	9	9
Improved	1	n/a	0	1
Jaga kaa	1	n/a	1	1
Line from CIMMYT germplasm	1	n/a	1	1
Local	14	n/a	2	4
Zhang ka (improved)	1	n/a	0	0
Zhung kaa	2	n/a	2	0

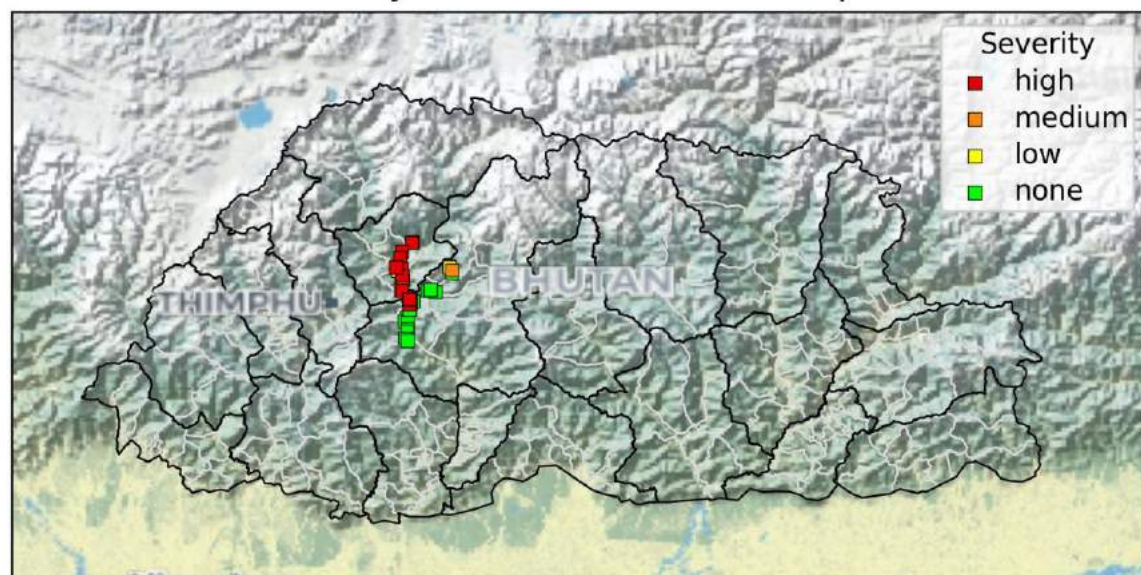
Table 2: Growth stage analysis of surveys conducted in the last week (since Apr 05 2024).

[illegible]

Leaf rust surveys Bhutan Mar 26 2024 - Apr 11 2024

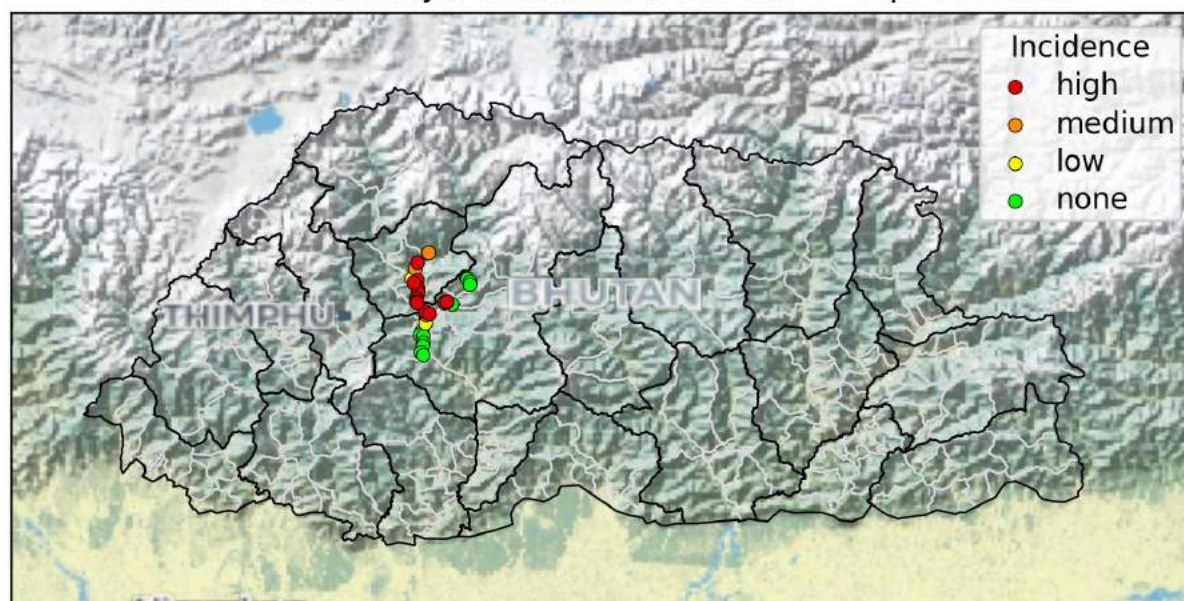


Leaf rust surveys Bhutan Mar 26 2024 - Apr 11 2024

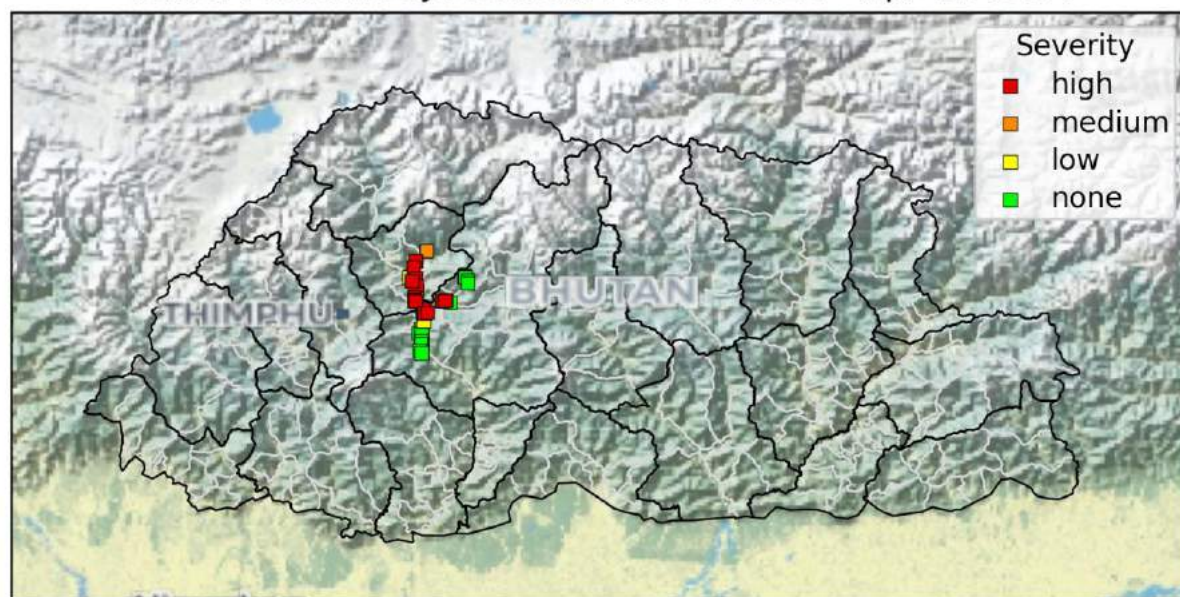


Map 1: Leaf Rust incidence (top) and severity (bottom) in Bhutan field surveys Mar 26 2024 - Apr 11 2024

Yellow rust surveys Bhutan Mar 26 2024 - Apr 11 2024



Yellow rust surveys Bhutan Mar 26 2024 - Apr 11 2024



Map 2: Stripe Rust incidence (top) and severity (bottom) in Bhutan field surveys Mar 26 2024 - Apr 11 2024

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Spore dispersal forecasts

Spore dispersal forecasts run by the UK Met Office and Cambridge University are displayed for stem, stripe and leaf rusts for the forecasted period. Surveys in each district are gathered to provide a single source per administrative area for dispersal forecasts (red dots in figure).

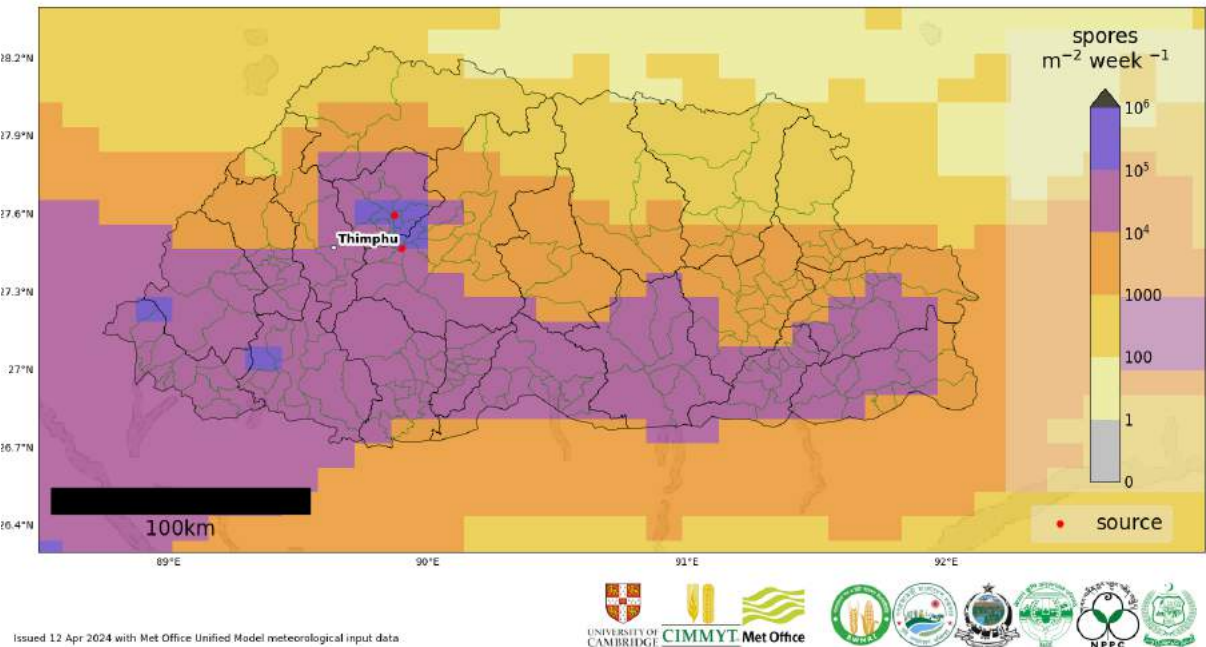
Environmental / climatic suitability for infection forecasts

These forecasts give the probability of wheat rust infection occurring based on meteorological factors. The maximum infection efficiency that can occur is 100%. This means that 100% of the spores deposited on susceptible wheat plants could complete the infection process. Therefore, a forecast Infection Efficiency of 100% indicates the highest risk of wheat rust infection occurring in susceptible wheat varieties.

Leaf rust

Dispersal: Current forecast (12 Apr - 18 Apr) indicates dispersal in an easterly direction with spore deposition from both local sources and infected sites in Nepal and/or Bangladesh. Highest spore deposition forecast for eastern and southern areas.

NAME dispersion forecast for the number of wheat **Leaf rust** spores deposited
2024-04-12-03:00 - 2024-04-19-00:00 (UTC)



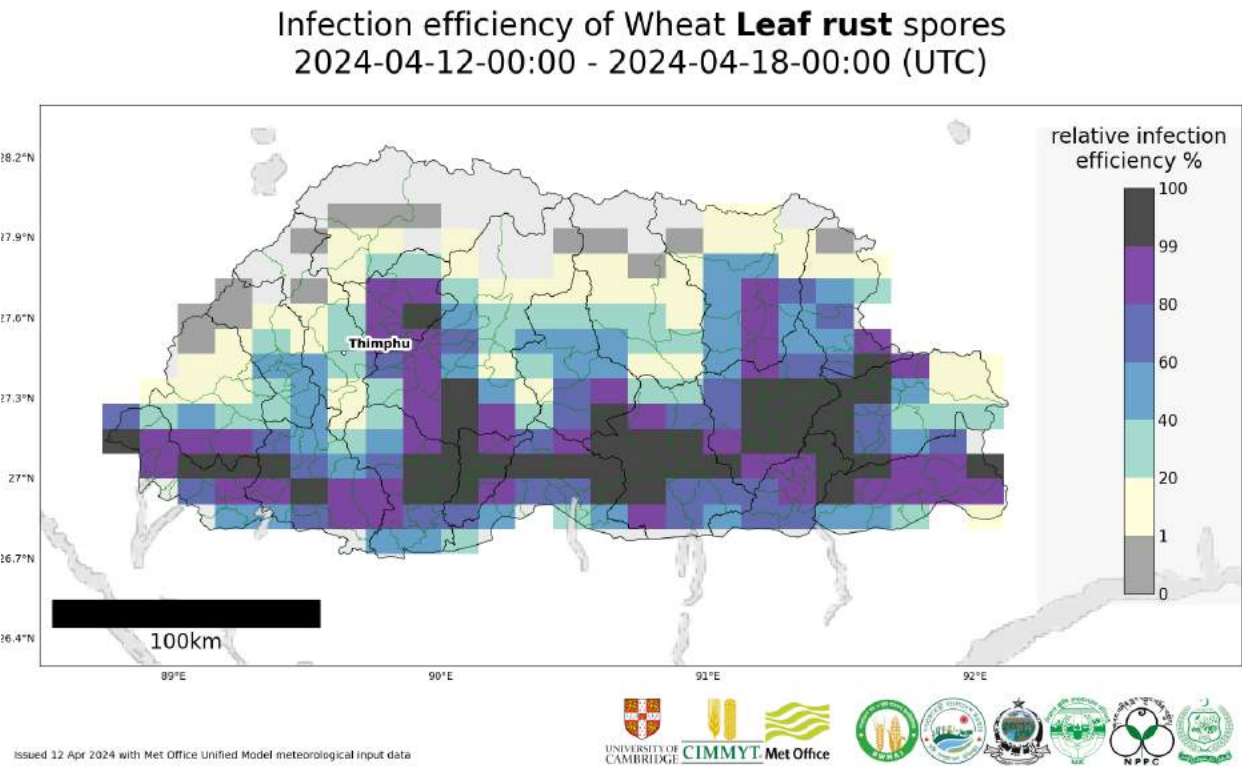
Map 3: Leaf rust spore deposition forecast Bhutan 12 Apr - 18 Apr 2024

The 20 most impacted districts (spore deposition) are presented in the table below.

admin2Name	Leaf rust spores per m ² per week
Dzoma	380000
Lingmukha	380000
Phangyuel	380000
Guma	260000
Shengabjimi	210000
Bapisa	210000
Chhubu	190000
Thedtsho	160000
Talo	140000
Nahi	120000
Bjena	110000
Ruepisa	87000
Logchina	84000
Bara	84000
Denchhukha	80000
Dungtoe	79000
Toepisa	77000
Metap	75000
Nyisho	74000
Kazhi	71000

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Risk of infection: Current forecast (12 – 17 Apr) indicates increased risk of infection to the previous advisory, with high infection efficiency in southern areas and in the main river valleys.



Map 4: Leaf rust suitability for infection forecast Bhutan 12 Apr - 17 Apr 2024

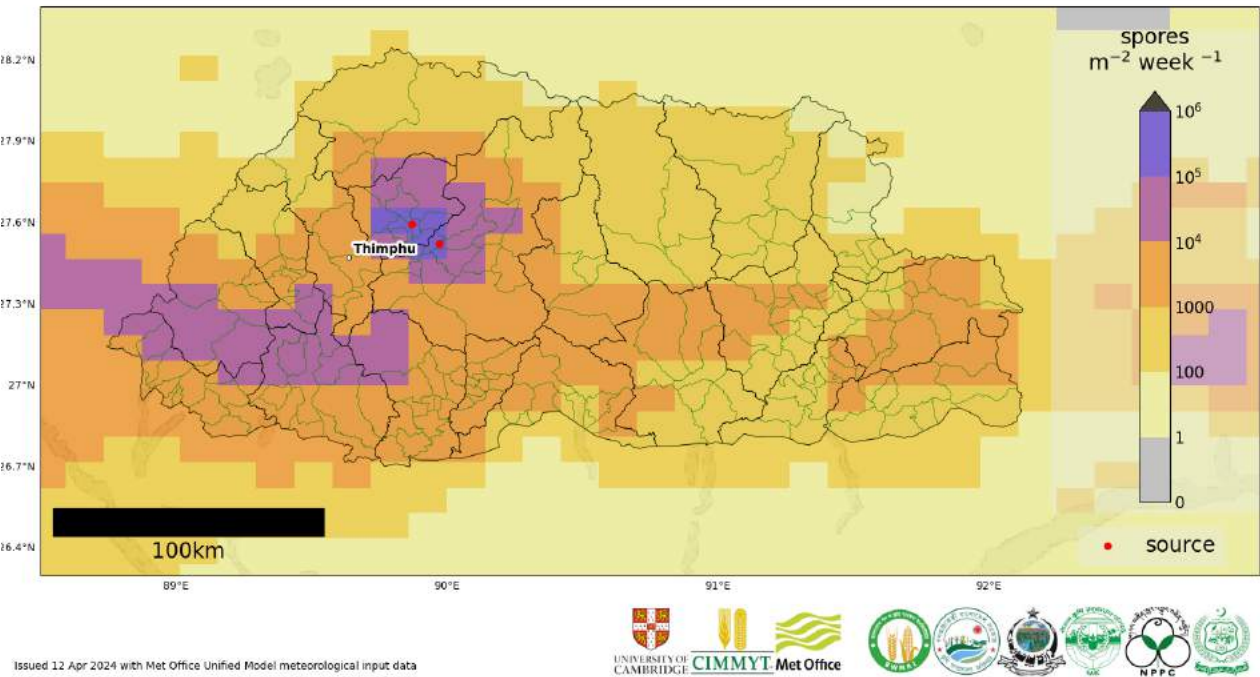
The 20 most impacted districts (infection efficiency) are presented in the table below.

admin2Name	RIE_leaf_rust_%
Tsholingkhori	100
Shemjong	100
Chaskhar	100
Gosarling	100
Tsangkhā	100
Dungtoe	100
Chhali	100
Drugyelgang	100
Udzorong	100
Drepung	100
Ramjar	100
Mongar	100
Bartsham	100
Nanong	100
Narang	100
Tsirangtoe	100
Thangrong	100
Dzoma	99
Zobel	99
Toetsho	99

Stripe rust

Dispersal: Current forecast (12 Apr - 18 Apr) indicates dispersal in an easterly direction with spore deposition from local sources and from infected sites in Nepal. Highest forecast spore deposition in eastern areas.

NAME dispersion forecast for the number of wheat **Stripe rust** spores deposited
2024-04-12-03:00 - 2024-04-19-00:00 (UTC)



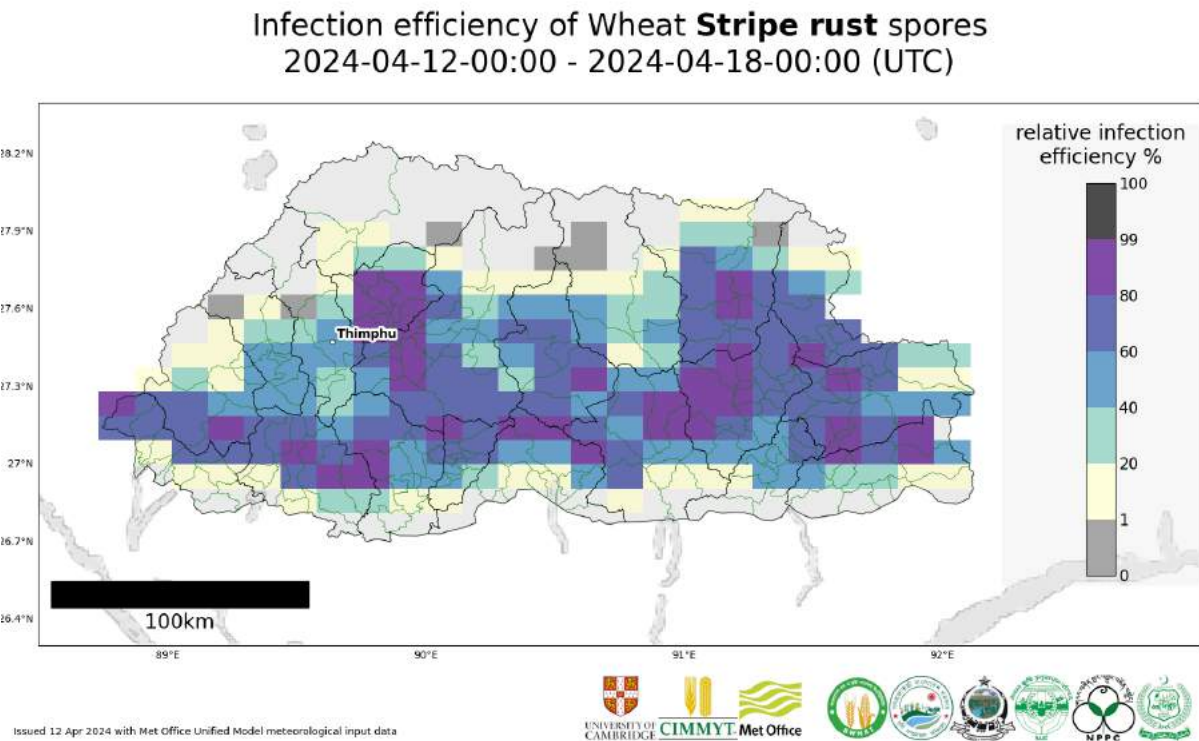
Map 5: Stripe rust spore deposition forecast Bhutan 12 Apr - 18 Apr 2024

The 20 most impacted districts (spore deposition) are presented in the table below.

admin2Name	Stripe rust spores per m ² per week
Lingmukha	530000
Phangyuel	530000
Dzoma	530000
Guma	310000
Shengabjimi	310000
Bapisa	270000
Chhubu	210000
Thedtsho	180000
Bjena	160000
Nyisho	140000
Nahi	140000
Kazhi	110000
Ruepisa	110000
Talo	90000
Toewang	85000
Toepisa	48000
Kabjisa	44000
Dangchhu	41000
Goenshari	30000
Gangte	29000

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Risk of infection: Current forecast (12 – 17 Apr) indicates an increased risk of infection, with high infection efficiency in central areas and also the main valleys.



Map 6: Stripe rust suitability for infection forecast Bhutan 12 Apr - 17 Apr 2024

The 20 most impacted districts (infection efficiency) are presented in the table below.

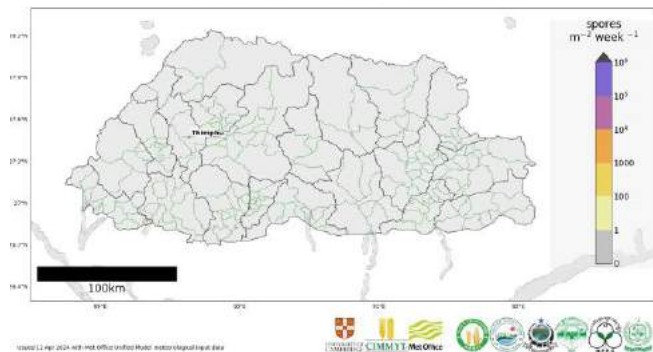
admin2Name	RIE_stripe_rust_%
Bapisa	88
Phangyuel	88
Thedtsho	88
Dzoma	88
Lingmukha	88
Guma	87
Chhubu	86
Talo	86
Nahi	85
Ruepisa	84
Tsamang	82
Gasetsho Gom	81
Jamkhar	80
Shengabjimi	79
Yangnyer	79
Menbi	79
Tsakaling	79
Drametse	79
Bjena	78
Kanglung	78

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Stem rust

Dispersal: Current forecast (12 Apr - 18 Apr) indicates no dispersal as no reports of stem rust.

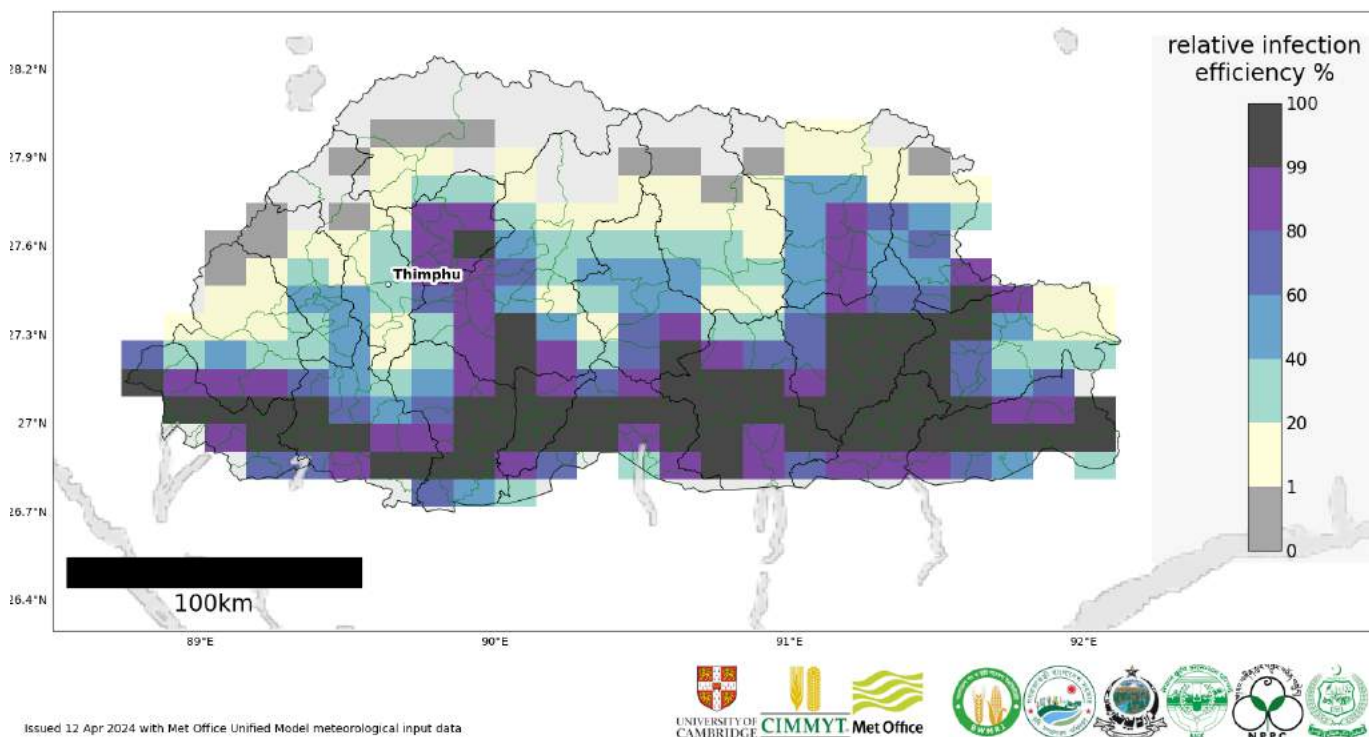
NAME dispersion forecast for the number of wheat **Stem rust** spores deposited
2024-04-12-03:00 - 2024-04-19-00:00 (UTC)



Map 7: Stem rust spore deposition forecast Bhutan 12 Apr - 18 Apr 2024

Risk of infection: Current forecast (12 – 17 Apr) indicates an increased risk of infection to the previous advisory, with high infection efficiency in southern areas and in the main river valleys.

Infection efficiency of Wheat **Stem rust** spores 2024-04-12-00:00 - 2024-04-18-00:00 (UTC)



Map 8: Stem rust suitability for infection forecast Bhutan 12 Apr - 17 Apr 2024

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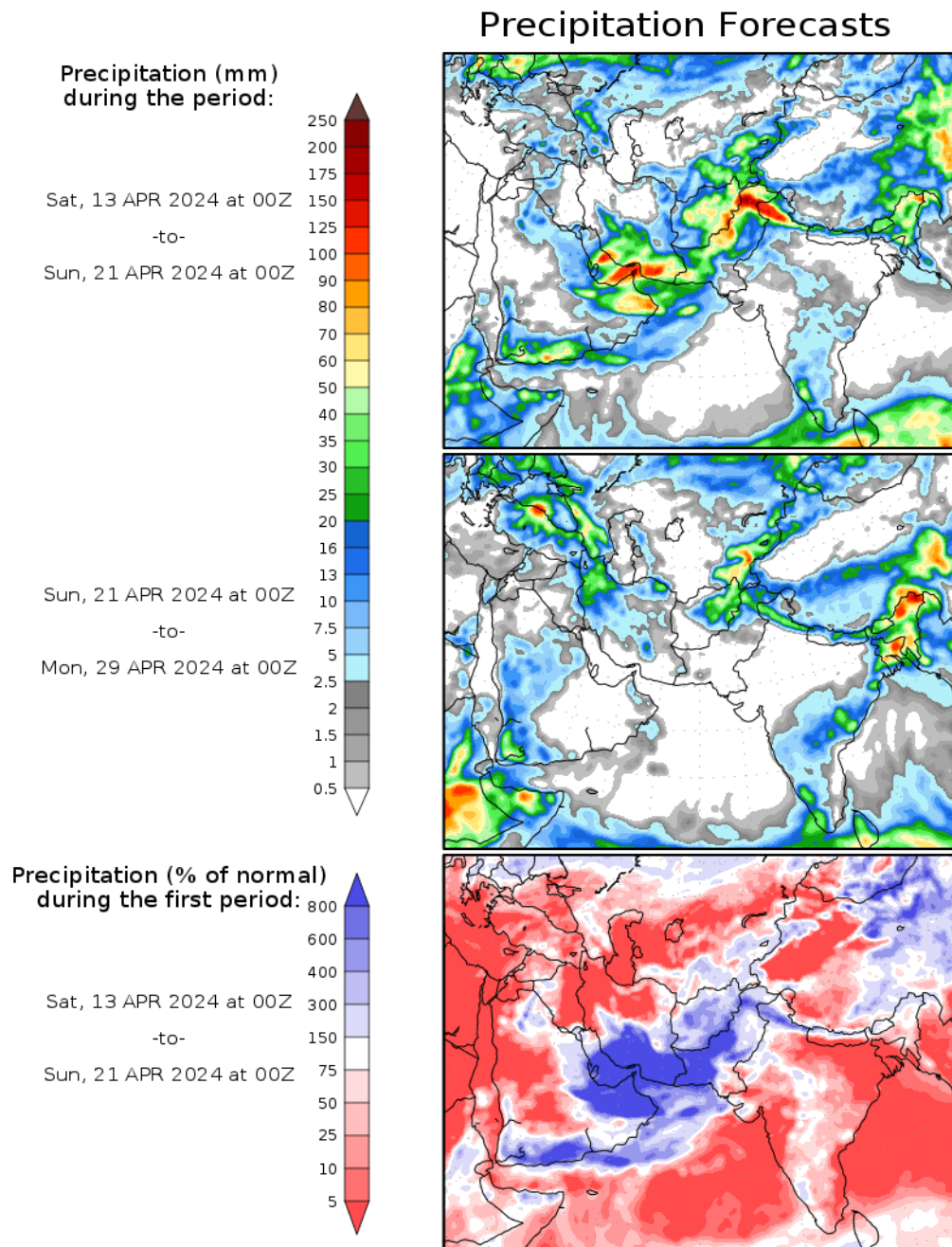
The 20 most impacted districts (infection efficiency) are presented in the table below.

admin2Name	RIE_stem_rust_%
Zobel	100
Gozhi	100
Tsholingkhoh	100
Denchhukha	100
Tsangkhah	100
Drepung	100
Drugyelgang	100
Dunglegang	100
Dungmin	100
Dungtoe	100
Thangrong	100
Gomdar	100
Gosarling	100
Sipsu	100
Chongshing	100
Jurmey	100
Shumer	100
Shemjong	100
Kengkhar	100
Kikorthang	100

Regional Forecasts – Precipitation & Temperature

Forecasts from the National Centers for Environmental Prediction (NCEP)[<http://wxmaps.org/pix/clim>]
These indicate possible general conditions across South Asia, with likely decreasing prediction accuracy in the second forecast period.

During the period 13 – 21 Apr, rain is forecast for Pakistan (heaviest in north and west), northwest India, central and southern India (light rain), high hills of Nepal (especially western hill areas), Bhutan and eastern Bangladesh. During the period 21 – 29 Apr, increased rain is forecast for Bangladesh, and continuing rain for Bhutan, Nepal hills, northern Pakistan, north west India, central / southern peninsula India.



Precipitation forecasts from the National Centers for Environmental Prediction.
Normal rainfall derived from Xie-Arkin (CMAP) Monthly Climatology for 1979-2003.
Forecast Initialization Time: 00Z13APR2024

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Temperature: During the period 13 – 21 Apr, very warm temperatures across India and southern / eastern parts of Pakistan and most of Bangladesh. Also increasing temperatures in the Terai of Nepal. Warmer than normal in the Terai/mid hills of Nepal and Bangladesh. Cooler than normal conditions across most of Pakistan and northwest India. Similar conditions for 21 – 29 Apr.

Temperature Forecasts

Mean Surface Temperature (°C)
during the period:

Sat, 13 APR 2024 at 00Z

-to-

Sun, 21 APR 2024 at 00Z

Sun, 21 APR 2024 at 00Z

-to-

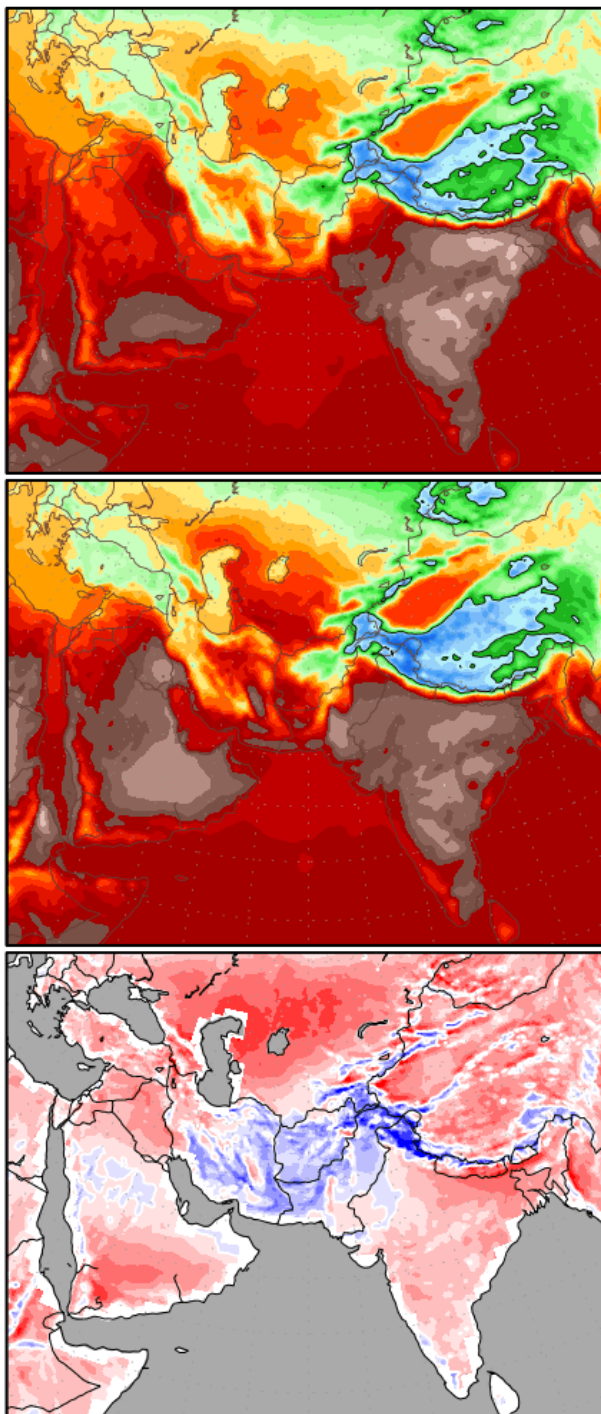
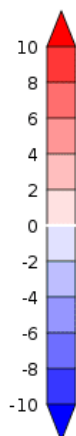
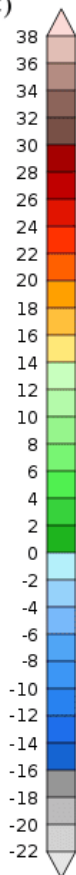
Mon, 29 APR 2024 at 00Z

Temperature Anomaly
during the first period:

Sat, 13 APR 2024 at 00Z

-to-

Sun, 21 APR 2024 at 00Z



Temperature forecasts from the National Centers for Environmental Prediction.
Normal Temperature derived from CRU monthly climatology for 1901-2000
Forecast Initialization Time: 00Z13APR2024