



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

Summary period: 18 Apr - 24 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. Surveys in eastern areas indicate only very low levels of leaf rust and an absence of stripe rust. Current forecasts indicate a similar, but slightly decreased risk of infection compared to the previous advisory. Risk of infection remains high, especially in the main river valley areas. Close monitoring is recommended for the appearance of either stripe or leaf rust. Crops in the river valleys may see increased levels of disease.

During the entire period 18 Apr – 4 May rain is forecast for all of Bhutan. Temperatures are likely to be warming but close to normal. 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 forecast weather conditions caution and close monitoring is advised.

Very close monitoring should be undertaken for any appearance of stem rust. There is some very low risk that spores may be deposited from Nepal (but it should be noted that very low levels of stem rust were observed in Nepal and control was undertaken immediately. Deposition in Bhutan is therefore considered very unlikely).

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. Close monitoring for any appearance of stem rust is advised.

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.

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- 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.**
- 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.
- For any detection of stem rust, samples should be collected.
- If stem rust does start to appear, quick control to prevent any disease build up is recommended.

Field surveys

Surveys undertaken Mar 26 2024 - Apr 16 2024. A total of 122 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 71 out of 122 fields surveyed (58%). Moderate to high incidence of leaf rust has been seen in 34 fields (48% of infected fields). Moderate to high severity of leaf rust has been seen in 26 fields (37% of infected fields).

Stripe Rust reported from 25 out of 122 fields surveyed (21%). 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
Bajo Sokha kaa	3	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	2	n/a	0	2
CIMMYT line 19	2	n/a	0	2
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	2	n/a	0	1
CIMMYT line 6	2	n/a	0	2
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 wheat	19	n/a	5	5
Guma Sokha	13	n/a	10	12
Improved	1	n/a	0	1
Jaga kaa	1	n/a	1	1

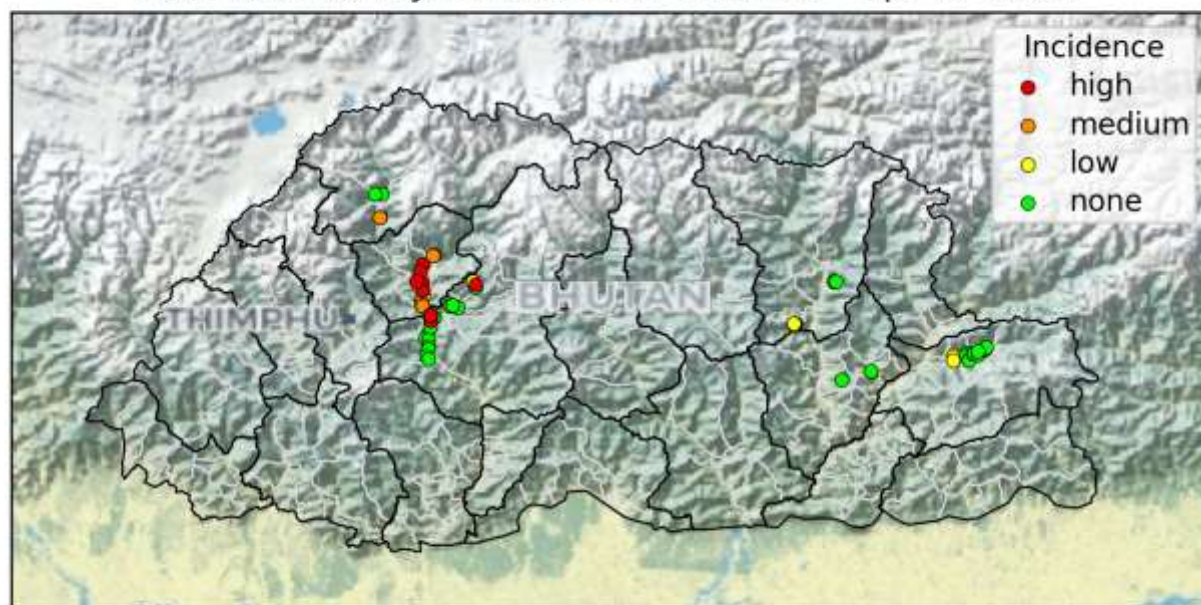
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Line from CIMMYT germplasm	1	n/a	1	1
Local	26	n/a	2	7
Oats	1	n/a	0	0
Zhang ka (improved)	1	n/a	0	0
Zhung kaa	4	n/a	2	0

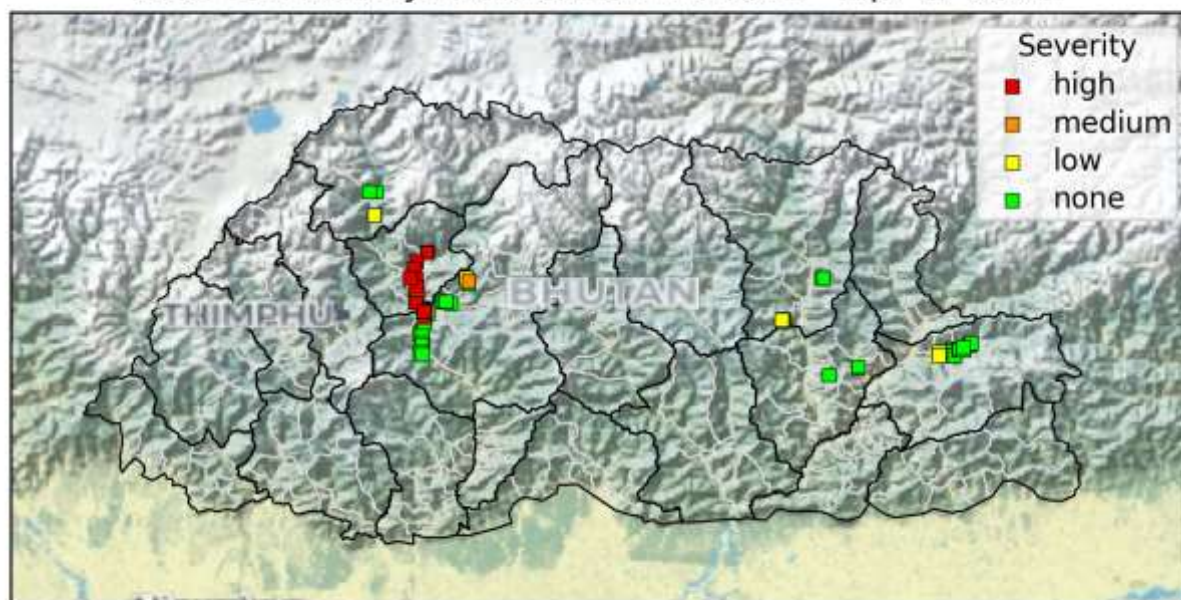
Table 2: Growth stage analysis of surveys conducted in the last week (since Apr 11 2024).

Country	Number of surveys in the last week that observed wheat growth stage:									
	tillering	boot	heading	flowering	milk	dough	maturity	NA	na	n/a
Bhutan	2	1	2	13	1	7	2	0	0	0

Leaf rust surveys Bhutan Mar 26 2024 - Apr 17 2024

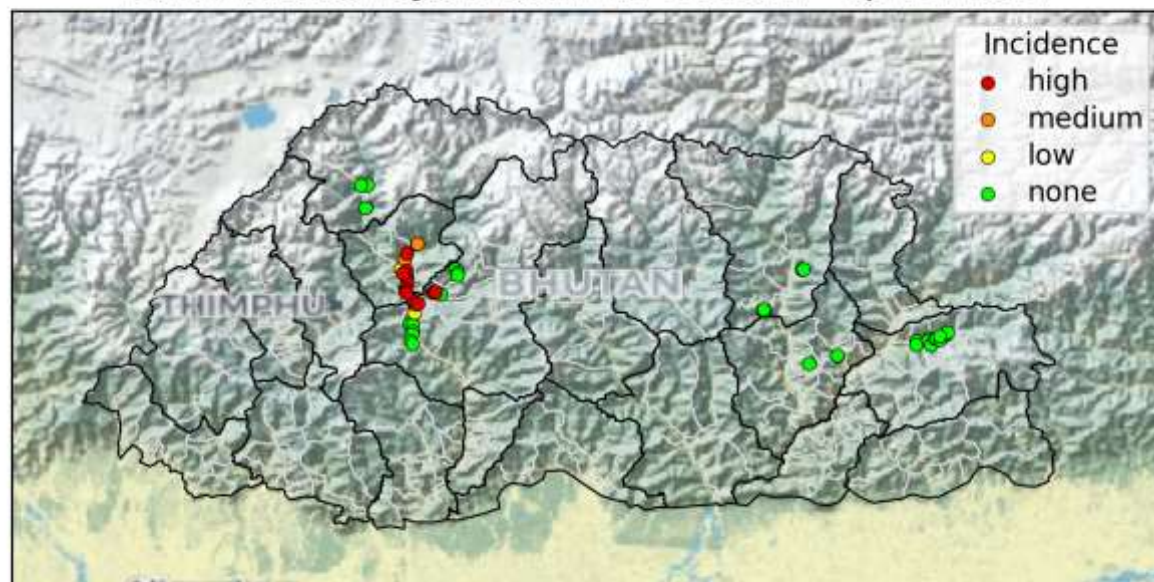


Leaf rust surveys Bhutan Mar 26 2024 - Apr 17 2024

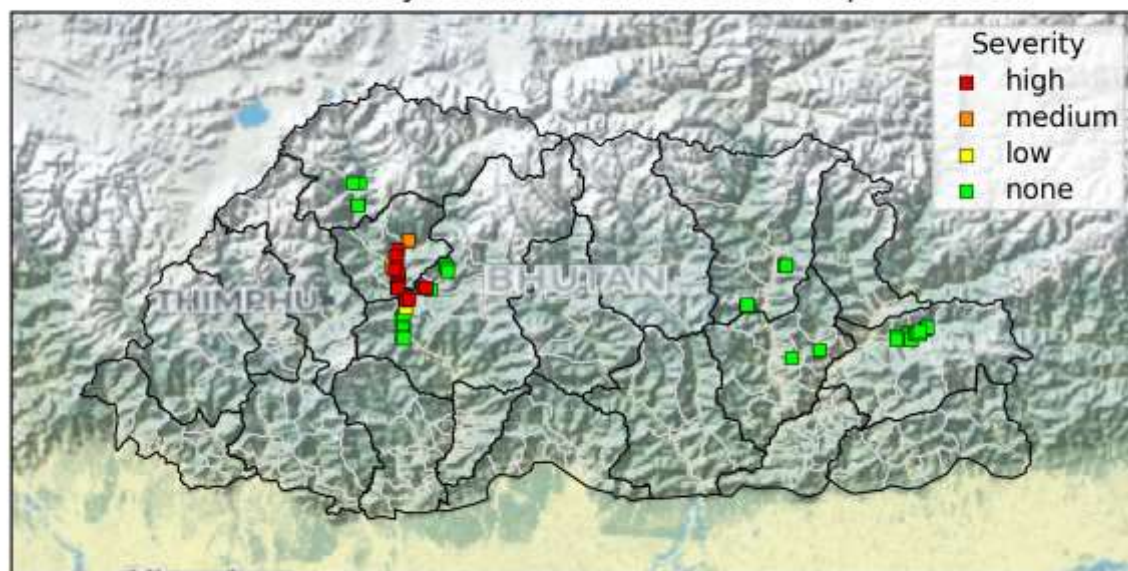


Map 1: Leaf Rust incidence (top) and severity (bottom) in Bhutan field surveys Mar 26 2024 - Apr 17 2024

Yellow rust surveys Bhutan Mar 26 2024 - Apr 17 2024



Yellow rust surveys Bhutan Mar 26 2024 - Apr 17 2024



Map 2: Stripe Rust incidence (top) and severity (bottom) in Bhutan field surveys Mar 26 2024 - Apr 17 2024

Spore dispersal forecasts

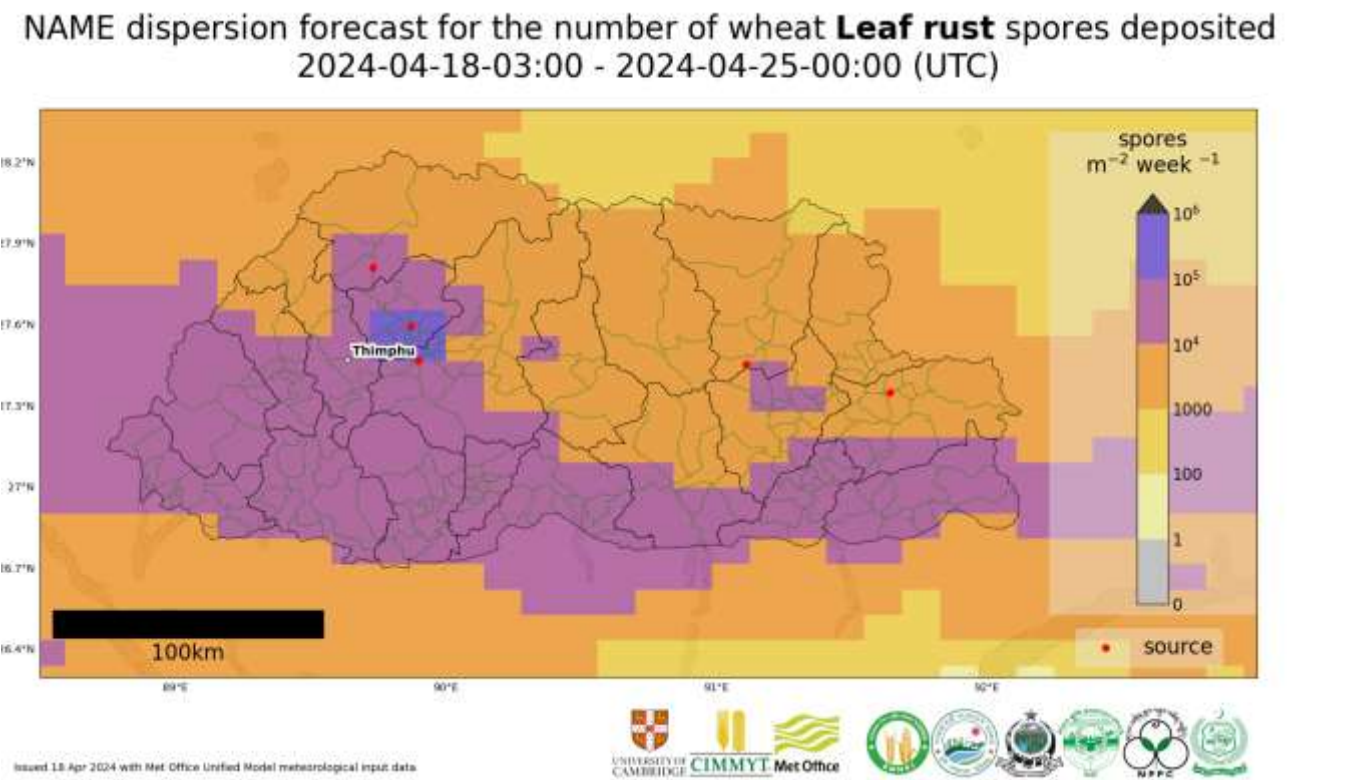
Spore dispersal forecasts run by the UK Met Office and Cambridge University are displayed for stem, stripe and leaf rusts for the forecasted period. Surveys in each district are gathered to provide a single source per administrative area for dispersal forecasts (red dots in figure).

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 (18 Apr - 24 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.



Map 3: Leaf rust spore deposition forecast Bhutan 18 Apr - 24 Apr 2024

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

admin2Name	Leaf rust spores per m ² per week
Lingmukha	490000
Dzoma	490000
Phangyuel	490000
Guma	350000
Bapisa	290000
Shengabjimi	270000
Chhubu	240000
Thedtsho	220000
Talo	210000
Nahi	170000
Bjena	130000
Toepisa	120000
Ruepisa	110000
Nyisho	100000
Kabjisa	100000
Kazhi	93000
Toewang	79000
Gelephu	64000
Chhuzagang	64000
Bhur	60000

Risk of infection: Current forecast (18 – 23 Apr) indicates a similar, but slightly decreased, risk of infection to the previous advisory, with high infection efficiency in southern areas and in the main river valleys.

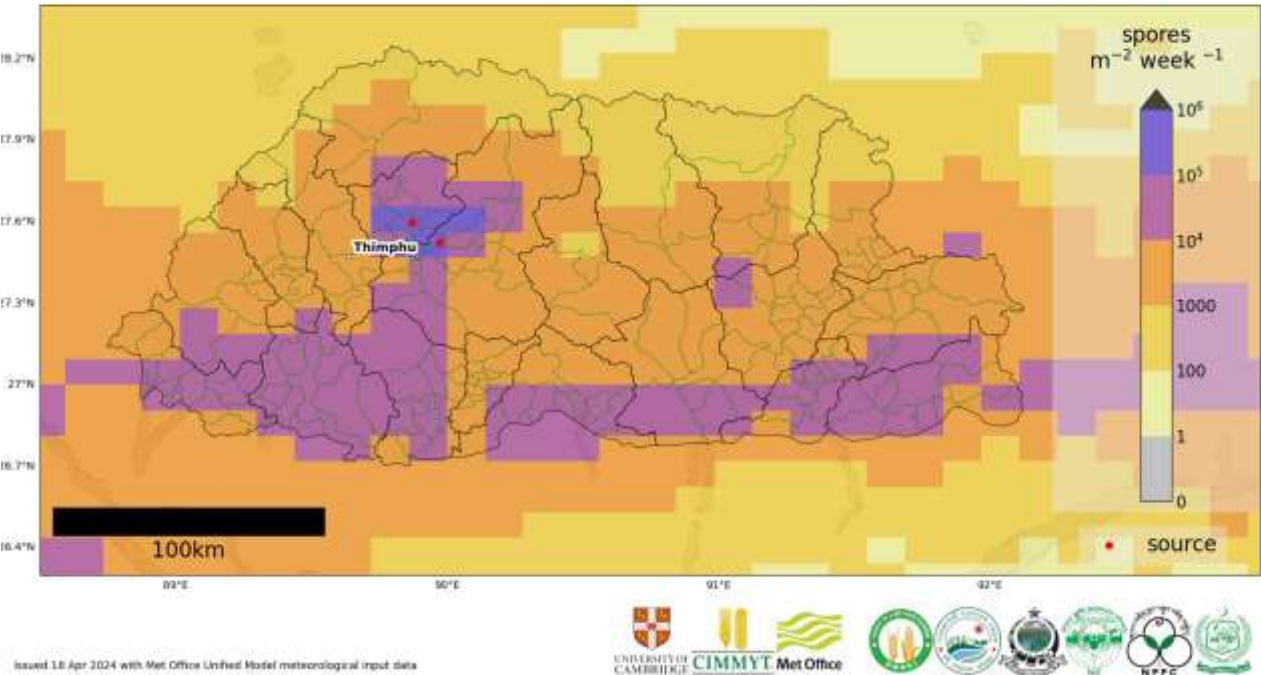


admin2Name	RIE_leaf_rust_%
Chhubu	95
Phangyuel	94
Dzoma	94
Lingmukha	94
Talo	93
Guma	93
Bapisa	92
Thedtsho	91
Tsamang	86
Lajab	84
Tsholingkhor	83
Barzhong	83
Tsakaling	83
Tsangkha	83
Nahi	82
Rangthangling	81
Patakla	81
Drugyelgang	79
Mendrelgang	79
Chhali	78

Stripe rust

Dispersal: Current forecast (18 Apr - 24 Apr) indicates dispersal in an easterly direction with spore deposition from local sources (in east) 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
2024-04-18-03:00 - 2024-04-25-00:00 (UTC)



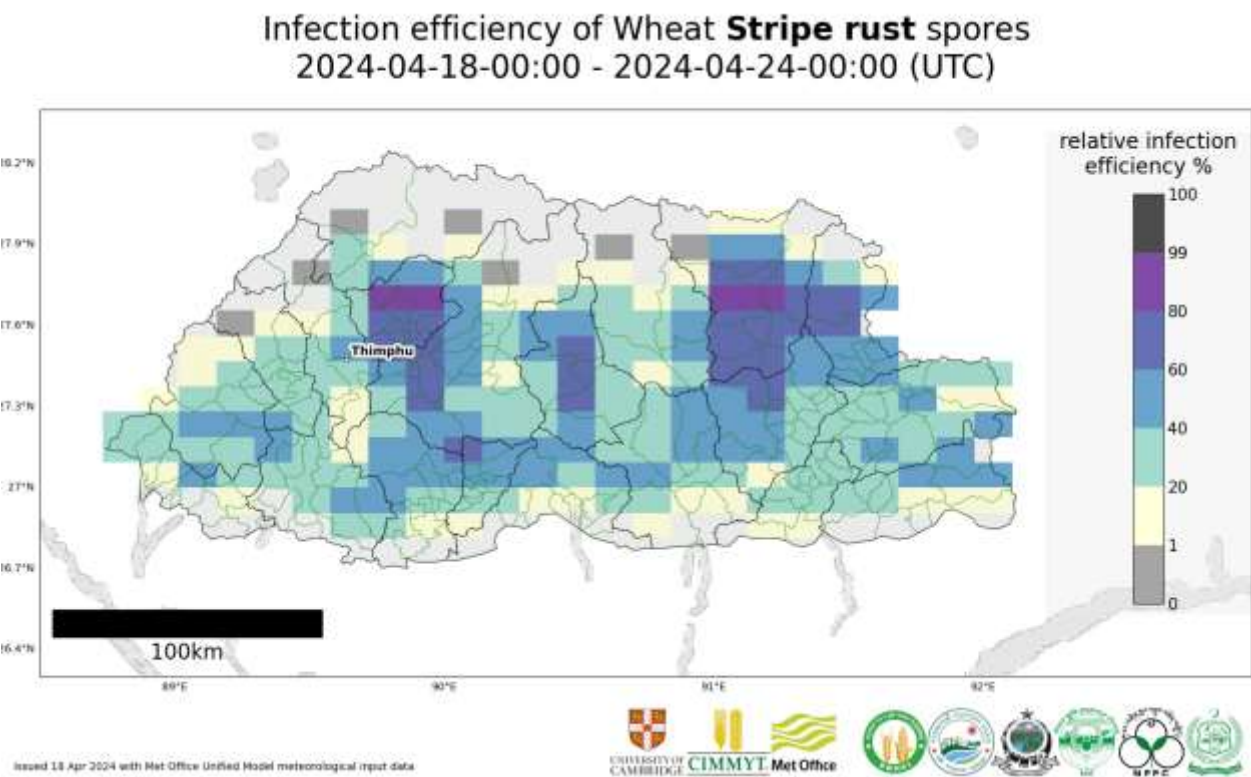
Map 5: Stripe rust spore deposition forecast Bhutan 18 Apr - 24 Apr 2024

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

admin2Name	Stripe rust spores per m ² per week
Lingmukha	630000
Phangyuel	630000
Dzoma	630000
Guma	380000
Shengabjimi	380000
Bapisa	330000
Chhubu	240000
Thedtsho	230000
Bjena	180000
Nahi	170000
Nyisho	170000
Kazhi	140000
Ruepisa	140000
Talo	120000
Toewang	99000
Toepisa	64000
Kabjisa	54000
Dangchhu	46000
Gelephu	38000
Chhuzagang	38000

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Risk of infection: Current forecast (18 – 23 Apr) indicates a similar, but slightly decreased risk of infection, to the previous advisory. Areas with higher infection efficiency now forecast in the hill areas and also the main valleys.



Map 6: Stripe rust suitability for infection forecast Bhutan 18 Apr - 23 Apr 2024

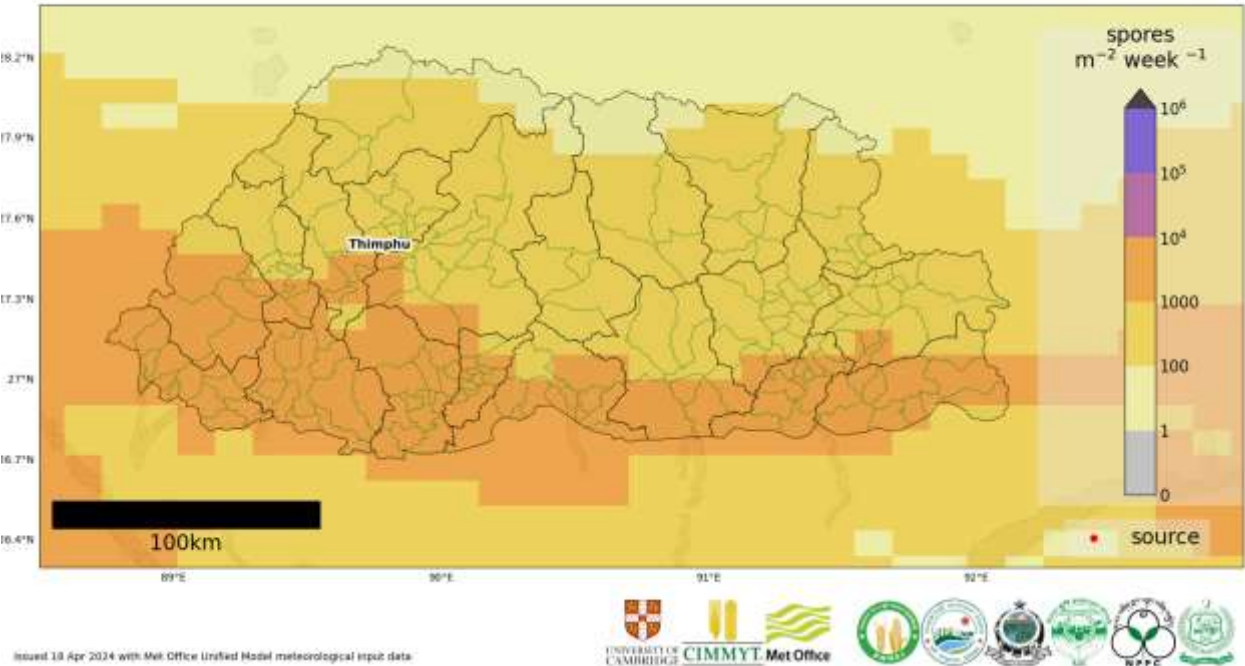
The 20 most impacted districts (infection efficiency) are presented in the table below. The information however should be considered along with presence of wheat, growth stage and resistance level of the host.

admin2Name	RIE_stripe_rust_%
Menbi	77
Dzoma	77
Lingmukha	77
Phangyuel	77
Chhubu	76
Thedtsho	74
Bapisa	71
Guma	70
Minjay	68
Nahi	68
Tsamang	65
Gasetsho Gom	64
Tsenkhar	64
Talo	64
Metsho	64
Bjena	64
Ruepisa	62
Jaray	62
Shengabjimi	60
Trashiyangtse	56

Stem rust

Dispersal: Current forecast (18 Apr - 24 Apr) indicates some possibility of spore deposition from sites in Nepal, highest in eastern and southern areas. But given the very low stem levels detected in Nepal and immediate control undertaken in Nepal, risks of dispersal/deposition are considered very low.

NAME dispersion forecast for the number of wheat **Stem rust** spores deposited
2024-04-18-03:00 - 2024-04-25-00:00 (UTC)



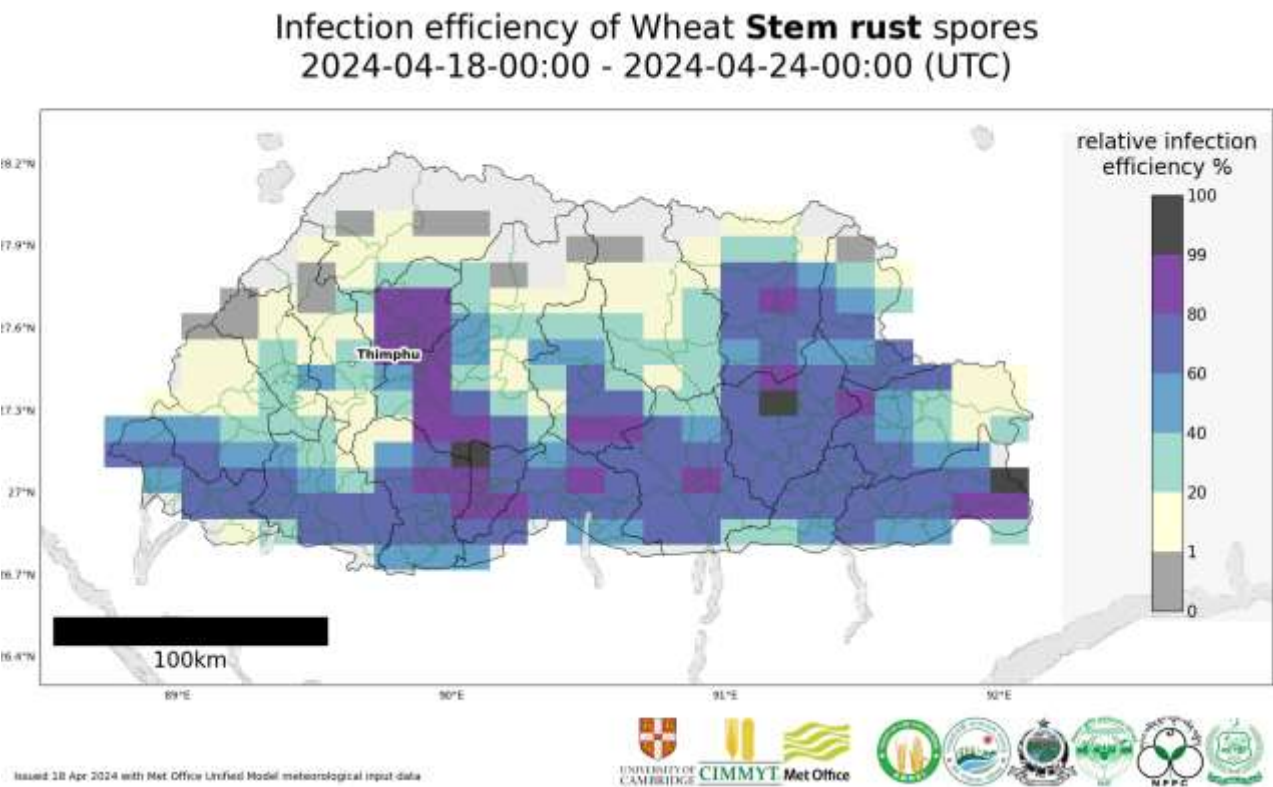
Map 7: Stem rust spore deposition forecast Bhutan 18 Apr - 24 Apr 2024

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

admin2Name	Stem rust spores per m^2 per week
Gelephu	4300
Chhuzagang	4300
Umling	4300
Sherzhong	3900
Taklai	3400
Chongshing	3200
Bhur	3200
Dechhenling	3000
Logchina	2900
Dekiling	2800
Khar	2800
Chhimung	2600
Dungmin	2600
Denchhukha	2600
Tading	2500
Phuentsholing	2500
Pangkhar	2400
Jangchhubling	2400
Shompangkha	2300
Chokhorling	2300

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Risk of infection: Current forecast (12 – 17 Apr) indicates a similar, but slightly decreased risk of infection, to the previous advisory. High infection efficiency in southern areas and in the main river valleys.



Map 8: Stem rust suitability for infection forecast Bhutan 18 Apr - 23 Apr 2024

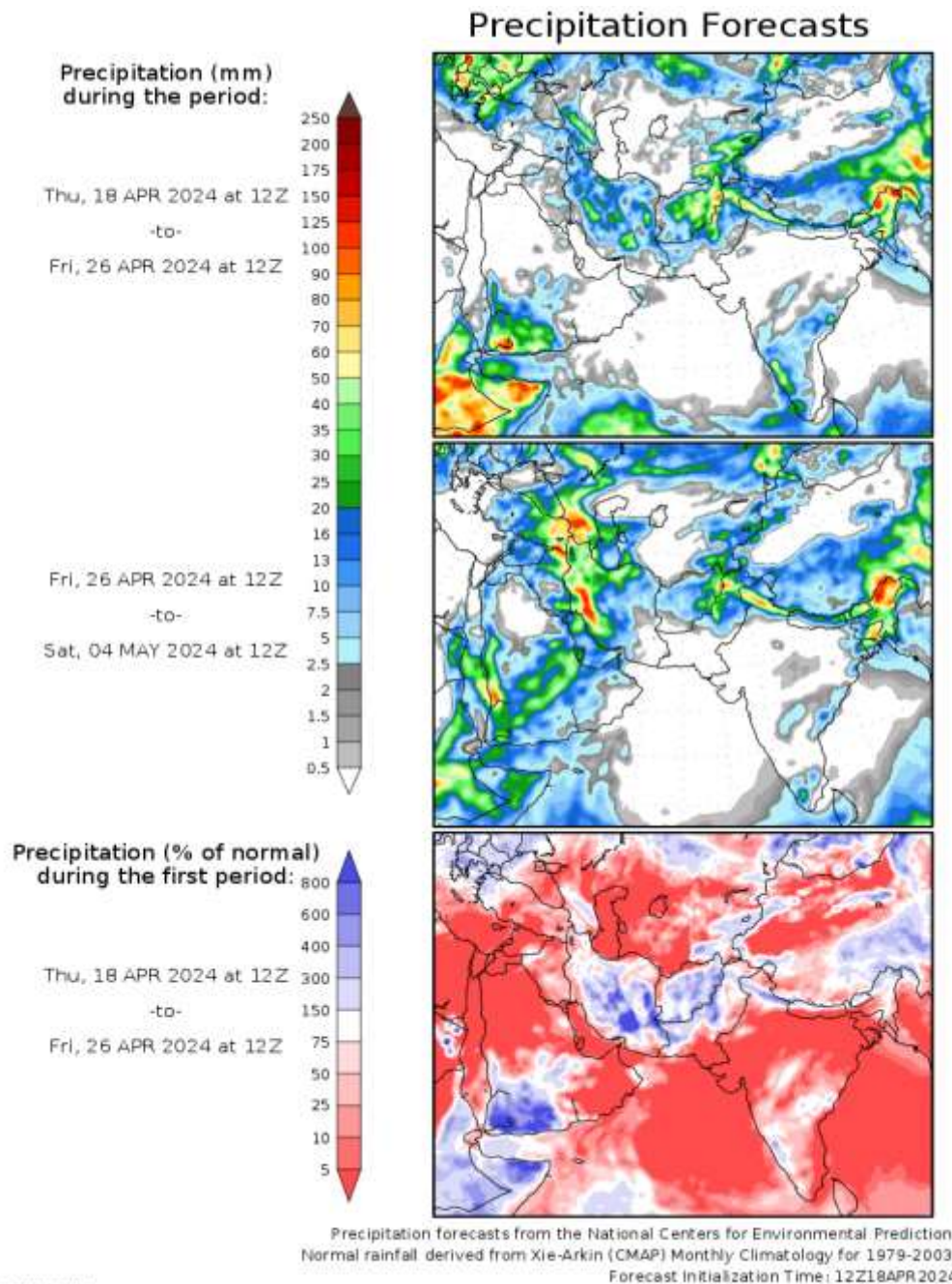
The 20 most impacted districts (infection efficiency) are presented in the table below. The information however should be considered along with presence of wheat, growth stage and resistance level of the host.

admin2Name	RIE_stem_rust_%
Chhubu	95
Phangyuel	94
Lingmukha	94
Dzoma	94
Talo	93
Guma	93
Bapisa	92
Thedtsho	91
Lajab	87
Tsamang	86
Tsholingkhori	83
Rangthangling	83
Patakla	83
Tsakaling	83
Chhali	83
Tsangkha	83
Mendrelgang	83
Barzhong	83
Mongar	83
Nahi	82

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 18 – 26 Apr, rain is forecast for most of Pakistan (heaviest in north and west), northwest India, central and southern India, high hills of Nepal (light rain), Bhutan and eastern Bangladesh. During the period 26 Apr – 4 May, increased rain is forecast for Bangladesh, and continuing rain for Bhutan, Nepal hills, northern Pakistan, north west India.



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Temperature: During the period 18 – 23 Apr, very warm temperatures across India and southern / eastern parts of Pakistan and most of Bangladesh. Warmer than normal in the Terai/mid hills of Nepal (especially the east) and Bangladesh. Cooler than normal conditions across the north and some western parts of Pakistan and northwest India. Similar conditions for 26 Apr – 4 May.

Temperature Forecasts

Mean Surface Temperature (°C)
during the period:

Thu, 18 APR 2024 at 12Z

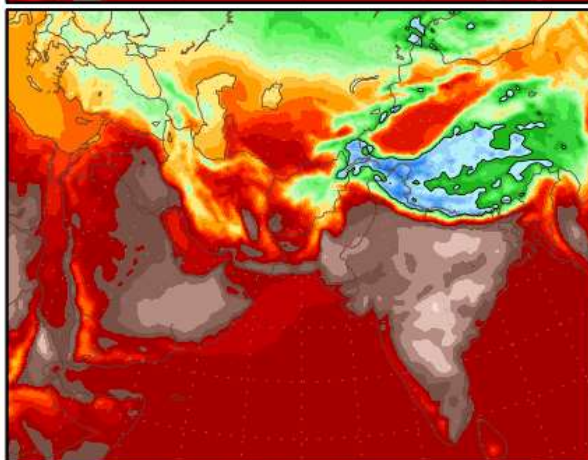
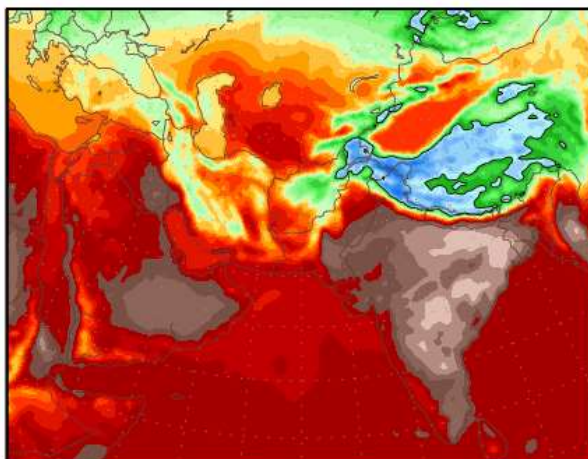
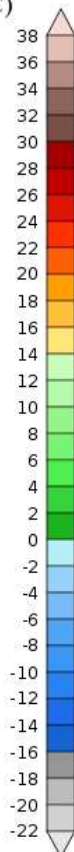
-to-

Fri, 26 APR 2024 at 12Z

Fri, 26 APR 2024 at 12Z

-to-

Sat, 04 MAY 2024 at 12Z

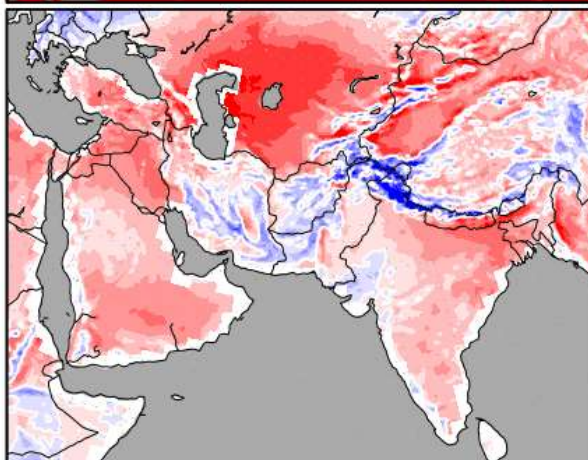


Temperature Anomaly
during the first period:

Thu, 18 APR 2024 at 12Z

-to-

Fri, 26 APR 2024 at 12Z



Temperature forecasts from the National Centers for Environmental Prediction.
Normal Temperature derived from CRU monthly climatology for 1901-2000
Forecast Initialization Time: 12Z18APR2024