# Rust Disease of Wheat

***Dr. Munesh Lal Meena**
****Karoo Lal Meena**

**Introduction**

Wheat (triticum spp.) constitutes a very important source of food to a vast population of many developing countries. In recent years some of these countries have registered a high growth rate (Rajaram et al 1984). In India no other major crop has achieved a growth tate in production comparable to wheat. In 2021, India produced about 107 million metric tons of wheat. In 2023, India's wheat production was estimated to be over 112 million metric tons. Not only the production but the yield per unit hectare has also increased and today amongst wheat growing countries of the world India ranks 2nd after People Republic of China. However, there is still scope to enhance the productivity as vast areas of the country, suitable for wheat cultivation have not yet been fully exposed to modern wheat improvement technology. Pal (1978) has drawn attention to the fact that the production can be stabilized and increased to a great extent by mitigating the losses caused by diseases and pests. Swaminathan (1978) also felt that major problems faced by the scientists in stabilizing production of the dwarf varieties, is the reduction in genetic vulnerability to the major diseases of wheat in the sub-continent, A major cause of instability of wheat production has been the rusts (stem rust = Puccinia graminis Pers. F. sp tritici Erikss. & Henn. Leaf rust = P. recondita Rob. Ex. Desm. F. sp. Tritici Erikss. & Henn. And stripe rust = P. striiformis West.). Wheat rusts have a long history of epidemics and have attracted the attention of plant scientists for a long time.

**1. Rust disease of wheat and Rust problem in India :-**

There are three types of rust diseases in wheat, which are called Stripe (Yellow), Stem (Black), and Leaf (Brown) rust. These rust types got their names from the colors of the pustules they form by tearing the epidermis of the plants. Rust fungi are seen as obligate parasites in nature.

- ***Stem rust*** **:-** (black rust) (*Puccinia graminis* f.sp. *tritici*)

Stem rust disease is one of the oldest known diseases of wheat and it is also called stem rust because it is usually seen on the stem of the wheat.

In the case of an epidemic, it can cause significant yield and quality losses in grain and hay. Stem rust is the last rust disease seen in wheat. Stem rust disease occurs in all parts of the wheat above-ground.


It changes in size from 3 mm to 1 cm and is mainly seen on the stem of wheat but can also be seen on the other green parts.

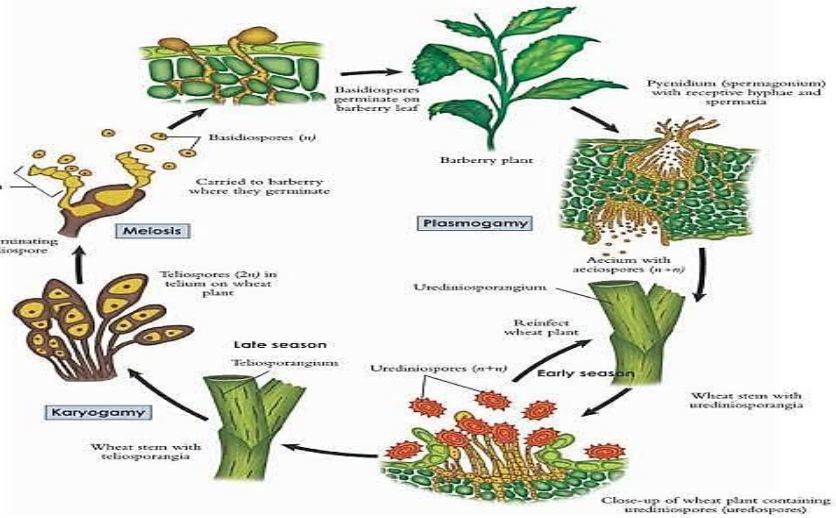
The dark red-brown (tile-colored) pustules may occur on the two sides of the leaf, on the stem, and the head. The pustules on the lower surface of the leaf, which are seen on both sides of the leaf, are larger than those on the upper surface. The pustules are sprinkled on the stem and leaves and are large, oval, long, and darker in color than other rust pustules. Their temperature request is higher. Stem rust disease grows well in the temperature between 20 to 25°C with a proportional humidity of over 96%. If all environmental conditions are suitable for disease development an epidemic occurs. New urediospores occur every 10–15 days. When plants mature black teliospores occur near the harvest .

While the pustules are dispersed in low infections, it can be seen that the pustules may merge in severe infections. The urediospores that form the pustules tear the epidermis and the plant surface takes the form of a whitish collar. These torn pieces of the epidermis are seen very clearly.

Stem rust spends the winter on infected plant parts. Spores are found on the underside of the leaves of Berberis and Mahonia plants, which are alternate hosts in the spring. Then they form rust pustules on the leaves and stems of the wheat by being carried by air and wind. Spores reproduce in suitable conditions and cause great damage to the crop.

Stem rust creates new races where Berberis plant is present. Thus stem rust can infect wheat varieties that were previously known to be resistant. As a result, new epidemics can occur. Stem rust reduces tillering and decreases grain weight and quality. The whole product can be lost when the appropriate conditions for the disease are formed. Crop loss can change depending on the

susceptible varieties, environmental conditions, races of stem rust and it differs from year to year, from region to region .



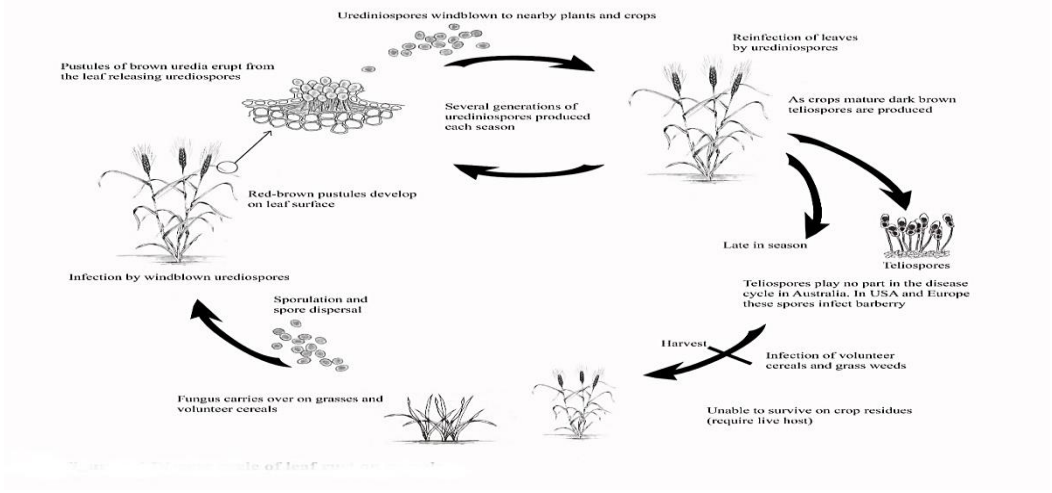

Mehta (1929, 1940, 1952) showed that stem rust can over summers in the uredial stage on wheat either on the cultivated crop in Nilgiri and Pulney hills or self sown (volunteer) plants in the sub-Himalayan ranges, mainly in central Nepal. He considered Northern bilis, particularly central Nepal as "the most dangerous foci of infection". Recent investigations, however, are at variance with Mehta's conclusŸ about stem rust. It is now established that in case of stem rust, "the South Indian hills are the Foci of infection and that the hills in North India contribute little, ifat a[l, to stem rust epidemic in the main wheat belt" (Joshi et al 1971, 1974).

Butler (1918) recorded that stem rust in North India does not appear on wheat until late in season. According to him it is often not seen until March, a time when wheat is in ears.

- ***Leaf rust*** **:-** (brown rust) (*Puccinia triticina*)

It is usually seen on the leaves, so it is also called Leaf Rust. The orange-yellow or burnt brown color pustules are in the form of large and small dots randomly scattered on the leaf surface. Leaf rust can be seen on the upper surface of leaf. The characteristic of this rust is to form smaller pustules in one or two circles around the pustule. This symptom distinguishes brown rust from other types of rust.

This rust usually appears on the wheat after the stripe rust before the stem rust. In the spring, summer spores cause infection at 10–18°C and high humidity. The temperature and humidity requirements for the development of leaf rust disease have the ability to spread more easily than stem rust. Thus damage to the product can be very severe. The damage of leaf rust has recently coincided with the maturity period of wheat.



Leaf rust disease infects other crops besides wheat. They are barley, triticale, and many other related wild wheat crops. The disease is in the form of uredospores in temperate winter regions. In spring, spores exist on the surface of alternate hosts (Thalictrum spp. And Isopyrum spp.) leaves. Then they are carried on the leaves of the wheat by the wind and form pustules of rust. It causes significant yield losses by decreasing the number of grains, hectoliter weight, and grain quality in the head. The severity of the damage caused by the rust disease changes according to the development periods of the plants. Flowering and earlier periods are the most damaging period. The late period is the least damaging period.

Mehta (1940, 1952) has shown that leaf rust spreads both from South and North Indian hills. First build up of leaf rust like stem rust takes place in the plains of Karnataka in South India, generally in the last week of December. At the same time the infection is also established in the foot hills of Bihar and eastern part of Uttar Pradesh. The rust population from southern foci moves Northwards towards Maharashtra and Madhya pradesh and another population moves from the northern foot hills towards the South and finally both the populations, moving in opposite directions merge into each other (Joshi et al 1974).

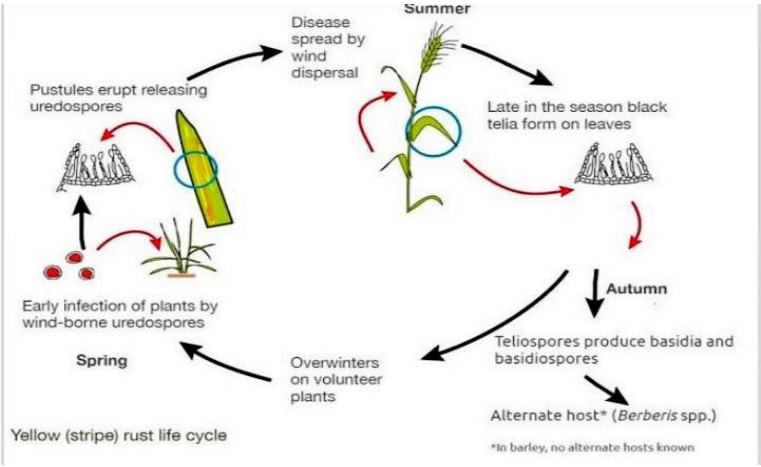
***Stripe rust*** **:-** (Yellow rust) (*Puccinia striiformis*)

It is the earliest and most important rust disease of wheat. Especially in the spring months, there is an increase or decrease in the intensity of the stripe rust disease depending on the climate structure. In the case of abundant and long-term spring rains, it appears suddenly and causes significant yield and quality losses by causing diseases primarily in the leaves. It has been noted that rust diseases are observed even in the early stages with the increase in temperature. Although it is usually seen on the leaves of wheat, it can also occasionally be seen on stems and heads. It can be easily distinguished from other types of rust due to the symptoms it shows on the leaf. It occurs on

the upper surface of the leaves, on the leaf sheath, on the head, and even inside the husks. The rust symptoms on the leaves cover the whole leaf and kill the leaf when the disease Is .

Stripe rust disease is named after the color of the disease spores (pustules), which are like a powder of orange-yellow (golden yellow) color.

Stripe rust, especially on the upper surface of the leaf, creates yellow pustules like machine stitches. Since the arrangement of these pustules resembles a line, it is also called Line Rust. Summer spores occur inside these pustules which have the form of dots arranged in rows and intra row.



In the development of the disease, the first infections occurred by urediospores, which can be carried by the wind from long distances. Because rust spores are light they can be spread around even with very little wind and can be drift to the next fields. Millions of summer spores formed from pustules are dispersed by the wind in the spring. The initial infection is initiated by very few spores and is seen in the early stages when plants are just starting to develop. After that, new spores occur every 12 to 15 days, and then every 8 to 10 days, the disease rate increases, and stripe rust disease is suddenly seen everywhere. At the end of the season, winter teliospores are formed from the same pustules. The disease is carried out on wild wheat crops on the edges of the field, which remain alive during the summer, and on the wheat planted in autumn for the winter.

With the increase of rust disease, the use of nutrients and water increases, as well as the photosynthesis area of the plant narrows. As a result, the amount of nutrients that will produce grains decreases. It has been determined that rust prevents normal root development and nutrient uptake in the plant to a certain extent. In addition, since rust infection causes plants to reach maturity earlier than usual, it also causes the grain filling period to be shortened thus the damage increases. The severity of the damage caused by the rust disease changes according to the development periods of the plants. Flowering and earlier periods are the most damaging period. The late period is the least damaging period. If the heads are infected with stripe rust, no matter how little rust is on the leaf, the grain yield is greatly reduced. As a result of rust infection, losses occur in the yield and quality of the grain, as well as in the quantity and quality of hay.

High humidity or precipitation in the spring in wheat fields induces the occurrence of the disease. The optimum temperature for the formation and development of the disease is 10–15°C. If the host-pathogen relationship is suitable with the proper environmental conditions for the development of the disease, an epidemic occurs.

Mehta (1929, 1940, 1952) showed that stem rust can oversummers in the uredial stage on heat either on the cultivated crop in Nilgiri and Pulney hills or self sown (volunteer) plants in the sub-Himalayan ranges, mainly in central Nepal. He considered Northern bilis, particularly central Nepal as “the most dangerous foci of infection”. Recent investigations, however, are at variance with Mehta’s conclusŸ about stem rust. It is now established that in case of stem rust, “the South Indian hiUs are the foci of infection and that the hills in North India contribute little, ifat a[l, to stem rust epidermic in the main wheat belt” (Joshi et al 1971, 1974

Therefore, the stripe rust remains essentially a major disease problem of North and North-western region. Sometimes it also appears in Bihar, eastern Uttar Pradesh and even in central India (Joshi 1978). Very often these infections remain isolated and seldom become serious threat to wheat. The limited spread in South-central and eastern parts of the country is due to the prevalence of high temperature quite uncongenial for stripe rust development. The disease can survive in Nilgiri and Pulney hills but it cannot spread even to the foot hills of Nilgiris due to unfavourable weather.

**2. Management of wheat rust disease :-**

The cultural precautions to be taken to prevent rust disease are as follows-

- Frequent planting should not be done because it prevents ventilation and causes an increase in humidity.
- Weed control should be done on time and with suitable techniques.
- Fertilization should be done according to the results of soil analysis.
- Excessive nitrogen fertilizer should not be given to the field.
- Activities such as irrigation that will increase the humidity of the air should be avoided .
- It is important to control weeds and alternate host plants on time.
- Alternate hosts of rust diseases in the surrounding or on the field edges should be destroyed.
- The destruction of alternate host plants provides a decrease in the amount of inoculum which causes the first infections in rust disease.
- Also, the destruction of alternate host plants leads to a decrease in the number of new races that may emerge due to the limited sexual reproduction in rust disease.
- Resistant cultivars should be used for rust disease.
- It is of great importance to monitor the races of rust in order to develop resistant varieties for the management of rust disease.
- In order to determine virulence in rust disease, it is necessary to develop monitoring and prediction warning systems which also include survey studies.
- With the use of genetic resistance successful progress has been made in the control of wheat stem rust disease in recent years. Resistant varieties can be preferred more reliably because they are economical and environmentally friendly

**3. Conclusion :-**

It is known that climate change causes an increase in disease. It is difficult to predict when and where diseases will spread. With the changing ecosystem the effectiveness of biological factors changes, the distribution of pathogens is affected and the entry of new pathogens is enabled. With climate change, differences can be seen in plant-pathogen systems. Disease development is the result of factors influencing the host and pathogen.Changes in wind direction and speed affect the spread of rust spores. Therefore, the monitoring of rust diseases is important. Care should be taken against new races, disease surveys and breed analyzes should be done, and identification of the rust races is necessary. Molecular research should be carried out in a variety of breeding studies against the aggressive/virulence of rust diseases that may occur with increasing temperature and other parameters. The pathogen forms new races and these races may overcome the resistance present in

wheat cultivars. Besides the increase in the spread of rust diseases is largely due to the widespread of varieties that are susceptible. In addition to this, there may be changes in the number of fungicide applications and doses.

***Associate Professor**
****Assistant Professor**
**Govt. College, Karuali (Raj.)**

**4. References :-**

1. Monitoring of wheat rusts in the lndian sub-continent – (L M JOSHI, K D SRIVASTAVA and D V SINGH) Division of Mycology and Ptant Pathology, Indian Agricultural Research Instimte, New Delhi
   Proc. Lndian Acad. Sci. Iplant Sci.), Vol. 94, Nos 2 & 3, April & May 1985, pp. 387-406 .
   ©Printed in India
2. Mahmood-ur-Rasmaan Ansari :- Book-Wheat (Published in 2022)
3. Further Studies on Cereal Rusts in India, K. C. Mehta Volume 14; Volume 18 of Research monograph Issue 14 of Scientific monograph, Indian Council of Agricultural Research1(952)