# Ear Cockle / Tundu Disease of Wheat

**Causal organism:** Combined action by Nematode *Anguina tritici* & Bacteria *Clavibacter tritici* or *Corynebacterium tritici*

**Taxonomic Position:** Phylum- Nematoda, Class- Secernentea, Order- Tylenchida, Family- Anguinidae

**Distribution & Importance:** The disease was first reported and discovered by Needham, 1743, while in India this disease was first reported by Hutchinson (1917) from Punjab. In India it is known as "**Sehun**" disease. This disease has been reported from Punjab, Haryana, U.P. and Rajasthan. It is extinct or rare in most parts of Europe, Australasia, Russia and North America. Up to 30% annual loss in U.P. due to this disease. Besides loss in yield, the disease produces toxic effects on human being and animals when they consume gall-contaminated flour. Ear cockle disease very often occurs in association with "tundu" (yellow ear rot) disease of wheat caused by the bacterium *Clavibacter* (*Corynebacterium*) *tritici*.

**Symptoms:** The characteristics symptoms are yellow slime on stem and inflorescences, which dries up to form sticky yellow layers and cause curling and twisting of spikes. Most of the grains are replaced by galls formed by the nematodes and these galls carry causal bacterium. The nematode alone causes winkling, twisting and various other distortion of the leaves, stem and produce small round galls on the leaves. The infected plants are shorter and thicker than healthy plants. The affected plants look dwarfed with twisted and crinkled leaves. Infected heads are shorter, broader, remain green for longer period, and contain hard, dark-brown or black cockles (also called galls) replacing grains in the ear partially or completely. The cockles remain filled with nematode larvae. When they are soaked in water and then macerated, one can see larvae coming out from them.

**Pathogen:** The *Anguina tritici* males and females are distinguishable morphologically. The males are measures 3-5 mm in length, while the females are 2.0-2.5 mm long and wider than the males. The stylet is relatively short at 8 to 10 µm long. Males are not as robust as the females, curved rather than coiled. The nematode develops larvae showing four distinct stages of growth during the life. The first-stage larvae (juveniles) develop inside the egg laid by female nematode. It undergoes moulting inside the egg and a second-stage larvae (J2s, c. 800 µm long) emerges from the egg which are the survival, dispersal and invasive stage of *Anguina tritici*. The second-stage larva move progressively to the growing tip until they penetrate the floral primordia, where they develop to third-stage and fourth-stage larva are resulted in successively. These are the fourth-stage larvae (adult) which differentiate into male and female nematodes. The female nematodes lay thousands of eggs after copulating with males in developing seed galls and, interestingly, both the adults soon die. However, eggs soon hatch into second-stage larvae, which remain inside the cockle (gall) anhydrobiosis to carry on the life-cycle. There is one generation per year.

**Disease Cycle:** The disease starts from the seeds contaminated with the nematode galls. When such contaminated seeds are sown in the field, they absorb moisture from the soil and break releasing second-stage larvae (juveniles-2). Actually, the time of

larvae release coincides with that of seedling emergence as the moisture required for softening the cockles and for germination of the wheat seed is almost identical. The second-stage larvae now move in soil and reach the growing point of developing underground seedling. The larvae around the growing point feed ecto-parasitically and are carried upwards with the lengthening of the culms. At the time of flowering,they penetrate and enter inside the embryonic floral tissues causing primary infection, wherein they adopt endo-parasitic mode of life and form galls in the ovaries. Symptoms now manifest as a result of primary infection, and the disease develops. Secondary infection does not occurs frequently as the seedlings are available once in a growing season. Nematode carry bacterial cell on their body from germination of seedlings to the inflorescences and thus both appear together. The nematode galls are reported to remain in the soil for 20 years or more and the bacterium can also survive for the same period inside the nematode gall.

**Management:**

1. Healthy seeds should be selected and sown. Selection of healthy seeds from a cockle contaminated lot can be made with the help of sieve.
2. Healthy seeds and cockles (galls) can be better separated by immersing in water or normal salt solution (brine 20%). The cockles come up on the surface and can be collected and destroyed.
3. Early sown crops usually escape infection hence early sowing should be preferred.
4. Affected plants should be uprooted and burnt.
5. In nematode-infested fields, wheat cultivation should be replaced by barley and oats to reduce soil inoculum. It happens so as the barley and oats are not infected by this disease.
6. Spray the crop with streptocycline 1g in 10 liters of water.
7. Nematicides such as D-D Mixture (20-40 gallons/acre), Nemagon (1-2 gallons/acre), Hexanema (10-20 kg/acre), and Nemaphos (10% granular; applied at the rate of 5-10 gallons/acre) have been tested to control disease. Nemaphos proved to be most effective.
8. Varieties like Sonara 63, NP 908, and 227 are preferable against this disease as they show certain degree of resistance.