

Frost on Wheat

During the middle of July in Zimbabwe there has been a lot of frost, with numerous reports of wheat being affected. How serious is this?



Types of Frost:

There are two kinds of frost – white and black.

White frost occurs when the air temperature drops below the dew point temperature **and** below freezing. Thus, the dew forms as temperature drops and then turns to ice on leaf and soil surfaces, resulting in the white crystal-like appearance, especially in the early morning in low-lying areas. This kind of frost may or may not kill plants, depending on the sensitivity of the plant and how far temperatures drop below freezing. The formation of ice, especially with irrigation water on plant parts can protect the plant from damage because there is energy release during ice formation. So the ice acts like an insulation. However, the below-freezing temperatures may cause water in cells to freeze in sensitive plant parts, like pollen or young kernels, and therefore cause death, and yield loss on wheat.

Black frost occurs when the air temperature drops below freezing **but** is above the dew-point temperature. This usually occurs around dawn during dry clear nights. No dew forms but it is freezing. Hence, there is no surface ice, but because the temperature is below freezing, the water in plant cells freezes and kills the cells. This is therefore the most damaging type of frost.

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The most vulnerable time for frost damage on wheat is during flowering and early grain formation. During flowering, the pollen sacks may be killed resulting in poor or no fertilisation and therefore no grain. During early grain formation, the young kernels are mostly composed of water and sugars and so are more prone to freezing than later when the kernels have greater starch content. The frozen young kernels will shrivel and either die, or, if partially frozen, may form small shrunken grain.

Usually, when a field is exposed to a light white frost, damage will be minimal. Sometimes, along the sprinkler line or below the operating pivot there may be icicle formation on the ears and flag leaves, but this is more dramatic than deleterious. Even light white frost over the plants may not cause much damage, especially if the air temperature is only just below freezing, like -1 or -2°C . If air temperatures are below -5°C , damage will be more severe.

As indicated above, the black frost scenario will have the most severe effect on wheat. Usually, in this situation, death of leaves and ears will be noted. The impact on yield will be in direct proportion to the extent of death of kernels, ears and leaves. The flag leaf contributes about 75% of carbs to the kernels, so death of leaves will reduce yields. The ears also contribute carbs to kernels. But worse is the failure to pollinate and death of kernels. Assessing the impact of frost is best done 7 to 10 days after the event so as to be able to see the extent of pollen-failure and kernel death. Also, an estimate would need to be made of the area affected. Following this, a decision can be made as to what to do with the crop. Abandoning a crop is not an easy decision at this stage, so a good evaluation needs to be made. Unless the whole field is killed, which is unlikely, it is probably best to take the loss and manage the remaining yield as best as possible. Usually, flowering occurs about 60% of the way through the crop cycle, so from flowering to physiological maturity is 40 to 60 days, depending on altitude. Flowering and early grain-fill has the highest water demand, but this decreases from mid-grain-fill onwards. Furthermore, most of the costs have been borne on the crop at this stage, what remains is irrigation and harvest. So, it is probably prudent to see the crop through to harvest and get what can be salvaged to cover as much of the costs, and even make a profit, if possible. However, there is one further issue to consider, and that is the effect of shrivelled grains on quality. The proportion of the crop that is damaged by frost in the early grain-fill period causing shrivelled grain will reduce quality. Therefore, using an air-cleaner (aspirator) after harvesting will help to eliminate this problem and improve quality.

