Frost damage to crops can be financially devastating for farmers the world over. In California, USA alone, estimated losses to fruit and vegetable crops sometimes run into millions of dollars. This has resulted in the adoption of various methods of frost protection. Oil for the traditional heaters is expensive, and their use demands much labor. Wind machines represent a large investment. Surface methods of irrigation have been utilized in frost protection for many years, but their application is limited. Perhaps for these reasons, in the last decade sprinklers have come into quite widespread use for frost protection in parts of the USA, Europe, and elsewhere. Protection is normally profitable only where frosts in the growing season are infrequent—winter frosts in Mediterranean climates, spring and autumn frosts in more temperate regions.

Ice formation in the intercellular spaces is lethal to plant tissues. This is the normal cause of frost damage in plants; the affected parts take on a wilted appearance and often become black in color. Less frequently, intracellular ice formation may also have the same effect.

I. FROST TYPES AND FORMATION

Radiation and advection frosts are distinguished by the circumstances which produce them. A common feature of both is the local influx of a relatively cold and dry polar air mass. The difference is in the degree of coldness and the speed with which the new air is entering the local area.

A. Advection Frost

This type of frost is accompanied by a wind below 0°C which may be in excess of 15 miles/hour. Consequently, it is not limited to nighttime as radiation frosts generally are. Since protection from windborne frost has generally proved to be of little value, the physical conditions of its microclimate will not be discussed in detail.

B. Radiation Frost

The ideal meteorological condition for a radiation frost is a clear, cold, dry, and calm atmosphere with the temperature of the invading air mass above freez-