Reviews

Forestry Commission Bulletin, No. 18 (Second Edition). Spring Frosts. London: H.M.S.O. 2/6.

With the widespread havoc wrought in young forest plantations by the frosts of May, 1945, still vivid in the memory of every Irish forester, any work on the subject of Spring Frost is sure to be of interest to the tree planter. The second edition of Bulletin No. 18 has just come to hand and gives one an opportunity of bringing this very valuable publication to the notice of members at an opportune moment.

A similar frost to that of last year occurred in mid-May, 1935. It caused such alarm in Britain that it was decided to study the whole subject in detail. Mr. W. R. Day, B.Sc., M.A., and Mr. T. R. Peace had the task of compiling the information. The Bulletin gives meteorological data from many localities in Great Britain and records of minimum temperatures over the years. From these it appears that May frosts are commonplace in these islands, that they are mainly confined to the first two-thirds of the month and that an appreciable number of them is markedly severe. There are, in fact, places which are specially subject to frosts of sufficient severity to injure all but the hardiest plants. Further it is pointed out that unless trees are always hardy it is an advantage if they come into leaf and flower after the period of spring frost is over. " Our native trees do, in fact, tend to fall into two categories, those not usually injured by frost, even though they leaf and flower early, and those which are usually injured if severe frost comes after their buds are burst. In the first category fall such trees as sallow, common alder, elms, birch and Scots pine; in the second one fall oak, beech and ash."

The several aspects of frost damage and frost occurrence are explained in this Bulletin. Foresters have noted with surprise how ineffectual was the cover of " nurse " trees in the 1945 frost. It appears that there are two types of frosts, advective and radiation frosts. Advective frosts are caused by freezingly cold air coming from regions where winter still prevails. Such frosts cause widespread damage and even plants grown under shelterwood may be burned. The second and more common type of frost, radiation frost, is caused by loss of heat by radiation to the upper air. Such frosts occur on clear, starry, windless nights.

The following conditions are said to accentuate the severity of a radiation frost:

(*a*) Cold, cloudy weather by day followed by clear, cloudless nights,

(*b*) Wet, waterlogged grass covered surfaces which tend to be naturally cold owing to loss of heat by evaporation and transpiration and

(*c*) Flats and hollows which allow cold air to pool.

Records of remarkable differences in temperature at ground level compared with those at different heights show that there is a

sharp rise in temperature even 6″ above grass top level. The depth of freezing air is usually quite shallow, often not more than two or three feet and seldom exceeding 10 feet, hence serious damage is generally confined to young trees in the pre-thicket stage.

Shelter belts or walls if they lie across the hill, will cause cold air moving downhill to pool. Every obstruction crossing a slope acts in this way. It is important, therefore, to remember that if hedges or belts of trees are left for shelter they should run up and down the slope and not across it.

It would be important to be able to recognise frosty sites in advance of planting. The Bulletin is of considerable value to planters in this respect. The severity of the frost in any particular place is very largely determined by the physical aspect of the countryside. Examples of typical frosty sites are given. The plain and the plateau (or elevated plain) provide situations in which severe frost is liable to occur owing to the inability of the cold air, which forms over the surface of the earth on calm nights, to flow away. " This layer of cold air is not usually very deep, but it is usually sufficient to cover the smaller trees." (It is well known that Sitka and Norway spruce are very difficult to raise in the Irish midlands, particularly the former. The moist " bottoms " are notable frost hollows and experiences at Emo, Garryhinch, Durrow and other midland centres have made foresters spruce-shy).

The broad valley is a similar topographical type and, indeed, a broad flat valley bottom is a plain, though sometimes of rather limited extent. It is, however, a plain on to which cold air may drain from the surrounding hills. (In central Wicklow, low ground, even low hills, surrounded by higher mountains are notably subject to frost, while sites in east Wicklow facing the sea are relatively frost-free. Ballyward property near Blessington is a good example of a frosty hill. It is surrounded on all sides by much higher land, and the whole area is liable to lie below the frost level).

The degree to which cold air fills up a valley depends chiefly on the width, straightness and steepness of the valley. It is also much influenced by the sort of place on to which the valley debouches. Thus a wide straight, steep mountain valley which opens into the sea, or a wide plain, is much less likely to suffer from frost than one which is narrower, more crooked, flat bottomed and opens into another narrow valley. (The Glens of the Slieve Blooms debouching on the central plain are notably frost free, as are also the east Wicklow Glens which face the sea. In the central Wicklow glens the frost risk is high. Glenmalure has a noted frost flat, as has the Liffey valley all the way to Poulaphuca and beyond).

" The height to which trees are liable to be injured depends on the height to which cold air is able to accumulate at night. Thus on a wide plain it will be comparatively shallow, while in a deep narrow valley it may rise much higher than the tallest tree." Where the cold air is shallow it is often possible to create a favourable climate for the growth of small trees by regeneration under shelter, whereas when the cold air is very deep, as in a narrow valley, this becomes

difficult or impossible. (It is probable that frost tender species such as spruces and hardwoods might be successfully raised on the frosty midland flats and cut away bog under a shelter wood of S. pine, Japanese larch, birch, alder or white poplar).

The injury caused by frost on trees and shrubs is considered under four headings according to the parts damaged, namely leaves, young shoots, buds and old wood. Another interesting phenomenon—that of a tree flushing normally and dying later in the season for some unknown reason is explained. While trees are usually frosted from the top backwards and while buds, leaves, young shoots or recently formed shoots are more liable to damage, very low temperatures often occur at grass-top level sufficient to kill the cambial layer at this point while not affecting the top of the young tree. The tree has reserves sufficient for the flushing of leaves and shoots but later dies, as surely as if it were ring barked and for no apparent visible reason.

Trees frosted in one year usually recover extremely well, trees frosted repeatedly become progressively enfeebled and eventually die.

With regard to damage in conifers, leaders are less susceptible to damage than side shoots and when leaders escape the damage is not reckoned as serious. If the leader is injured the shape of the tree is bound to be affected even though only one shoot is allowed to get away. With certain hardwoods, oak, beech, etc., damage to leading shoots is not considered serious as there is often no definite leading bud or shoot. Ash on the other hand can be seriously affected by the loss of the terminal bud or shoot.

Particulars, obtained from reports after the 1935 frost, of the susceptibility to damage of a great range of trees and shrubs planted commercially or for ornament are given. Among forest trees Sitka spruce suffered worst. Further Sitka spruce is remarkably even in its time of flushing, so that in any given place most of the trees flush within a comparatively limited period. There is, therefore, no chance with this species, as there is with Norway spruce, of selecting a late flushing race for use in frosty localities.

Norway spruce differs from Sitka spruce in possessing well defined early and late flushing races. Usually in any normal lot of plants these occur mixed, with a tendency for the early flushing to outnumber the late flushing trees. The early flushing trees are quite as susceptible to frost as Sitka spruce, but the late ones are more resistant. In really frosty places the early flushing plants tend to get killed out, and a pure stand of the late flushing race remains. (A remarkable case of this natural selection of an ecotype can be seen here at Durrow in a bog at Castle Durrow, where scattered, late flushing Norway spruce are flourishing amid the general ruin, and promise eventually to form a crop).

Scots pine appears to be the best frost resistant species among the commonly planted forest trees followed closely by Contorta. The conifers are ranked in the order of susceptibility to frost damage as follows: Abies grandis, Sitka spruce, Norway spruce, Douglas fir, Japanese larch, common larch, Contorta pine, Corsican and Scots

pine. It is interesting to learn that Picea omorika is frost hardy and would seem to have possibilities as a forest tree for frosty localities.

Among hardwoods commonly planted, walnut, ash, Spanish chestnut, oak and beech are recorded as frost tender, poplars, lime, birch and elm are listed as hardy.

The controversial question of the value of shelter against frost is fully discussed. It appears that low shrubs or scattered small trees or belts of low coppice giving low side shelter are pretty well useless in staving off frost damage. The taller the shelter trees and the more complete the canopy the more effective the protection. Of course the shade required for full protection may be too heavy for satisfactory growth of the young plants. It seems that while too much must not be expected of overhead cover, it is plain that it can be of great silvicultural value in creating a micro-climate specially suited to the growth of small, tender trees. The value of shelter should not be judged on the effects during an abnormal frost but rather at a time when a degree or two makes all the difference.

T. C.