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1.LC-IMPACT (Life Cycle Impact assessment Methods for imProved sustAinability Characterisation of Technologies) is supported by the European Commission under the Seventh Framework Programme. See: www.lc-impact.eu

European Commission

Science for Environment Policy

Should critical levels of plant ozone exposure be lower?

'Critical levels' of ozone exposure for plants, above which significant adverse effects may occur, are currently calculated by examining ozone's impacts on only a small number of species. However, researchers have now compared this measure with a new approach which examines all species in a group, and defines the critical levels as the concentration at which 5% of species are affected. These critical levels, which may be more suitable for semi-natural ecosystems, are stricter than current standards.

Ground-level ozone gas is a toxic air pollutant and background levels have been steadily rising in recent years. As well as having damaging effects on human health, ozone can also affect plants by reducing growth and seed production, and increases their vulnerability to stresses such as drought.

The current 'critical levels' of ozone for plant species, which are often used in environmental policy assessment for ozone exposure, describe the level above which adverse effects may occur. They are based on how much yield and growth rates are reduced in a few 'indicator' species.

Therefore, when ozone reaches a concentration that significantly reduces the growth rate of the indicator species it is assumed that a whole group of related species will also show the same response. Although this may be suitable when measuring effects on arable crops or forest plantations, which contain only a few or a single species, many semi-natural ecosystems contain a wide variety of plants with very different sensitivities to ozone.

In this study, conducted under the EU LC-IMPACT project[1], researchers assessed ozone levels using a measure common in other areas of ecotoxicology, which gives a broader view of the ecosystem: the 'HC_5 level'. This is the concentration of a pollutant at which 5% of species are affected. In contrast to the current methods of obtaining critical levels, based on a few species, this method incorporates all species and ascertains the percentage of species that suffer significant reductions in growth or yield.

Researchers first analysed data from 980 previously published studies on the effects of ozone on 96 plants. These included three main species groups: 25 annual (single-year life-cycle) grassland species, 62 perennial (over two-year life-cycle) grassland species, and 9 tree species.

The results demonstrate that potentially 20% of annual grassland species, 17% of perennial grassland species and 8% of tree species suffer a significant growth reduction under the current critical level. Therefore the HC_5 level, which would result in significant growth reduction impacts on only 5% of the species in each group, falls beneath the current critical levels, especially for grassland species.

The researchers conclude that the methods used to calculate critical levels need to be carefully selected and their approach of examining the proportion of all species affected, rather than basing levels on a few indicator species, may be more apt for diverse, semi-natural ecosystems.