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The influence of climate change on the dates of phenological phenomena in Lithuania

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Climate change research has been relevant on a global scale for several decades. In climatology, they are shown by various climate-related meteorological phenomena, and in phenology, they are shown by changes in living nature, that is, the reaction of plants and animals to changed conditions. In the last 30 years, warm winters have been more frequent in Lithuania. The increase in the average temperature during the winter period disrupts the seasonal rhythm of nature, the cold season of the year is shortened, and spring seasonal phenomena begin earlier. The plants that are most responsive to climate warming are those that express it in their development phases. Changes are also noticeable in insect phenology.

Phenological observations have been carried out since 1961 at the Voke Branch of Institute of Agriculture of Lithuanian Centre for Agriculture and Forestry. The program of phenological observations includes the registration of 75 dates of phenological phenomena, therefore, over a 60 years period, a large database has been accumulated that allows various scientific researches to be carried out.

The purpose of phenological research is to determine the influence of climate change on the occurrence patterns of various phenological phenomena and their interrelationships with environmental conditions.

Due to climate change, deviations of meteorological conditions from the norm have been identified in Lithuania, which have affected the seasonal rhythm of nature. It was found that the starting dates of plant phenophases in spring and summer were strongly correlated with the average air temperature of the two-month period before the occurrence of phenophases ($r = -0.93$). Dependence on precipitation was weaker, but a tendency was observed for phenophases to be delayed in wet spring. Both temperature and precipitation had little influence on the dates of the onset of leaf yellowing. 1961 – 2020 during the period, the dates of plant phenophases were earlier (from -0.05 to -0.43 days per year), but larger-scale earlier trends have been observed since 1981. In the last decade, the occurrence dates of spring phenological phenomena have advanced by 7 – 11 days on average.

Changes in the length of the growing season are also related to climate change. Growing season in Lithuania from 1961 to 2020 lengthened by 0.26 d. per year. Due to climate change, the growing season has become 5 – 6 days longer than the average multi-year growing season in the last two decades.

The appearance of insects (especially honey bees) in spring and their nutritional conditions are related to the timing of the phenophases of entomophilous plants. It was found that the dates of honeybee appearance on the flowers were strongly correlated with the dates of the first phenophases of plants beginning of flowering in spring ($r = 0.73 - 0.80$). In the last decade, climate change has advanced the dates of plant phenophases, resulting in more species of entomophilous plants flowering when the honey bees began to fly than in 1961 – 2010.

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