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Assessment of the impact of meteorological factors and bulb planting date on flowering and yielding of tulips (*Tulipa gesneriana* L.) cultivated in Haplic Luvisol soil

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In the last quarter of the century there has been observed a progressive global warming. This is manifested by the prolonged vegetation period in autumn and late beginning of the thermal winter, which is also getting shorter and milder, with little snow cover. Soil thaws earlier in spring and tulips begin vegetation even at the end of February and the beginning of March. The term of blooming of the majority of tulips cultivars in the region of Lubelszczyzna is even two weeks earlier, in comparison to previous years. Climatic changes also cause an increase in the occurrence of drought periods, heat waves as well as extreme rainfalls in spring and early summer. As flowering of tulips and bulbs yield are mainly influenced by climatic conditions, it is important and necessary for horticultural practice to estimate what extent present climatic changes affect growth and development of these geophytes.

The aim of the research was the evaluation of flowering and yielding of two tulips varieties: 'Parade' and 'Van Eijk' belonging to Darwin Group, in relation to the climatic conditions of Lubelszczyzna region (central-eastern part of Poland) in the years 2009–2018. Plants were cultivated in Haplic Luvisol soil which characterizes with high fertility and good water capacity. Mother bulbs were planted in the mid October, 45 pcs per 1 m² plot in 5 replications. Plots were not irrigated. Correlation coefficient was calculated between flowering date, flower shoots length, total and commercial bulb yields and average temperatures of air and soil, sum of precipitation for each month. The relationships between the flowering and bulb yield and sum of precipitation and sums of air and soil temperatures calculated from its thawing till flowering and from flowering till 10th of June.

The following climate factors were analysed: mean air and soil temperatures, precipitation per vegetation month, the term of soil freezing and thawing and total insolation.

The second part of the research conducted in the years 2013–2017 included analysis of the effect of the mother bulb planting date, from the beginning of October till the half of November, on the flower shoot length, total and commercial bulb yield, content of dry weight and soluble solids in bulbs. Fifteen tulips cultivars were tested: 'Apricot Parrot', 'Erna Lindgreen', 'Libretto Parrot' (Parrot Group); 'Jimmy', 'Negrita', 'Synaeda Blue', 'White Liberstar' (Triumph Group); 'American Eagle', 'Arma', 'Black Jewel', 'Fancy Frills' (Crispa Group); 'Doll's Minuet', 'Golden Artist', 'Hollywood Star' i 'Spring Green' (Viridiflora Group). Tulip bulbs were planted on: 1 X, 15 X, 30 X and 15 XI. The contents of dry weight and soluble solid were measured (with the use of electronic refractometer) in daughter bulbs after a summer dormancy.

The air and soil temperature, as well as the term of soil thawing influenced highly the length of the tulips flower shoots and the term of flowering. Precipitation, especially during autumn, decided about the daughter bulbs yield. A strong negative effect of an excessive moisture content in soil during November, March and April was recorded, on weight of commercial and first class bulbs. Periodic droughts or high air and the soil temperatures noted in April, May and the beginning of June, had lower negative effect on tulips.

The flowering time of tulips depended mainly on the air temperature in December, March and April. High average temperatures and high precipitation in those months caused that tulips bloomed earlier and formed shorter flower stems. In case of 'Parade', the length of flower stems depended on the sum of soil temperature, counted from the date of thawing until the beginning of flowering. Lower soil warming in the second half of May and beginning of June favoured higher weight of commercial bulbs. A practical indicator to predict estimate the yield of commercial bulbs might be the date of soil thawing, as well as the date of flowering. In case of 'Parade' tulips, the term of flowering was positively correlated with the yield of commercial bulbs and bulbs with circumference of above 12 cm. In case of 'Van Eijk' the commercial and first class bulbs yield was positively correlated with the length of flower shoots.

Tulips belonging to the Triumph Group produced commercial bulbs of higher weight when mother bulbs had been planted in the beginning of October, in comparison to later terms. In case of tulips belonging to Parrot or Viridiflora Groups, high yield of commercial bulbs was obtained when the mother bulbs had been planted from the beginning till the half of October, however, higher bulb masses were recorded when the mother bulb had been planted at the beginning of the month. High yield of commercial bulbs of tulips belonging to the Crispa Group was obtained when mother bulbs had been planted till the half of October. The content of bulb dry mass depended on the cultivar and climatic factors during the years of study. Tulips belonging to the Triumph and Viridiflora Groups characterized with similar contents of dry mass when the mother bulbs had been planted at the beginning of October, while bulbs belonging to the Crispa and Parrot Groups accumulated the most dry mass when mother bulbs had been planted in the last decade of the month. The soluble solid content in daughter bulbs depended mainly on vegetation season and cultivar. Higher content of soluble solid was recorded in daughter bulbs, when there were stress conditions noted during vegetation season (excess of precipitation or drought), in comparison to years with favourable climatic conditions. High yield of bulbs in the region of Lubelszczyzna is obtained, when soil freezes in the second decade of December and thaws in the first decade of March. The sum of precipitation in March and April is 40–65 mm and the precipitation during daughter bulbs growth (mainly in May) ranges from 40 to 100 mm, while precipitation during a whole vegetation period (from the 1st of October till 10th of June) is 300–380 mm.