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Length and Shift of Growing Season as Affected by Climate Change: Promises of Artificial Intelligence

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Opinion

Current and projected climate trends provide insight into regional fluctuations in temperature and rainfall in Europe, including Türkiye. According to the recent IPCC AR6 Synthesis Report, more intense and frequent weather extremes should be expected, while water scarcity in Southeastern Europe is adversely affecting daily life and agriculture [1,2]. Anatolia by itself may serve as a laboratory to make projections in a broader sense to larger geographies, considering a dynamic alteration of the climatic pattern is evidenced by diverse agroecological conditions. The increased temperature and the decreased precipitation affected considerably the Turkish agricultural sector for the 1961-2013 period in regions with agricultural intensity [3]. While from one site the recent weather extremes lead to prolonged fires (Southern and Western regions), destructive flood events simultaneously occur at close proximities (Northern and Southeastern regions), while the Central Anatolian Region, known as the cereal storehouse, is more or less stable [4]. Yet, as a result of climate change, the growing season is influenced by air temperatures throughout Türkiye, including Central Anatolia.

Compared to other seasons, Türkiye's winter mean temperature anomaly is much more pronounced, followed by that of the autumn. The winter temperatures of all the years following 2009 (but 2012 and 2017) were above long-term averages, while almost a similar pattern was detected for the autumn mean temperature anomalies. Likewise, abnormalities at the mean areal precipitation were also reported. For instance, the recorded 2022 mean areal precipitation in Türkiye (503.8 mm) was 12.1% below that of the last 30 years' average [4]. These altered climatic conditions make winter wheat, the major crop of Central Anatolia, especially vulnerable during the germination and early growth periods.

The 10th month of the Gregorian calendar is October, which means 'the eighth month' since in ancient Rome the year had only 10 months (from March to December) before January and February were added to the calendar, where October became the tenth month but its old name remained. In Turkish, the word 'Ekim' has a dual meaning, yet both meanings are intermingled. While its primary meaning was given to the month of 'October', its secondary meaning, used as commonly as the first one, is 'sowing'. Speaking for a land with a wheat production tradition of decamillennium [5], sowing in Central Anatolia means sowing cereals, more specifically winter wheat. Yet, during the last few decades, global climate change has equally affected Anatolia, and a gradual warming of the winter has shifted the season for weeks, if not months, with more pronounced effects experienced during recent years. Sowing is not an exclusive October activity in the region anymore. Should we follow the Latin tradition and keep on calling October 'Ekim' reminding sowing activity? During 2022, sowing was possible in Central Anatolia until November 30th, while in 2023, students of Selcuk University (Konya) sown wheat at the end of the 1st week of December, with meteorological conditions still suitable. In its crop calendar, the International Production Assessment Division (IPAD) of the USDA suggests November and December as the sowing times for winter wheat in Türkiye [6]. It is scary to experience shiny spring weather in the first week of January 2024 while still waiting for the winter to appear. Translating it to agricultural language, it means the growing threat of biotic and abiotic stresses to follow, topics of another discussion.

Some crops require a long growing season, while others mature in a shorter period of time. Hence, the extent of the growing season determines the crop species to be grown in an

area. However, numerous factors determine the length of the growing season. The temperature of the air and precipitation play major roles in association with frost days and/or daylight hours, all of them directly associated with climate and the pronto-direct effects of climate change. If, due to seasonal shifts, adequate soil moisture is not met, the first irrigation after sowing becomes crucial for ensuring proper germination and rooting. Considering phenological growth phases (jointing, heading, maturity, etc.) are correlated with grain yield, healthy seedling growth impacts the overall crop quality and yield.

A delayed winter with a warmer and drier climate is a real challenge for the sustainability of wheat supply for decades to follow, where at least a 50% wheat production increase requirement is estimated. Simply stated, humanity needs a new green revolution, and it needs it quite quickly. Classical breeding efforts will not satisfy this requirement, even when heavily supported by the efforts of geneticists. With the turn of the century, genotyping and sequencing technologies accelerated the generation of high-throughput data that also started to be shared extensively. The new breeder should also be empowered with mathematical methods and artificial intelligence (AI) to tackle the enormous data sets while choosing the best combinations of lines with the most proper crossing order. That will be the way the breeding efforts will rapidly benefit from the yield and grain quality increases, while they will also protect the new varieties against all kinds of stress factors. The length of the growing season with a gradual shift as a direct effect of climate change necessitates handling tremendous amounts of data to be carefully processed through the decision pipeline. Not only the big data generated by advanced omics technologies but also the equally enormous climatic data will need to be similarly undertaken. Pilot studies and appropriate simulations will be of utmost importance. Using machine learning (ML) algorithms and training the computer power will determine the best-responding genotypes with perfect gene combinations for a specific location and deteriorate the negative effects generated by climate change. Anatolia, as the center of the origin of wheat, is not only a reservoir of precious agricultural characters but, with a great history in the establishment of wheat agriculture [7], and being one of the most important current producer and consumer State, is a dynamic candidate to provide this service. Not to mention, one of the prominent research universities in Türkiye, The Selçuk University, at the heart of Central Anatolia, has already been officially tagged with the priority of digital farming. A perfect fit for the future of food sustainability and quality of life via developing climate-smart farm practices for a greener and healthier planet.

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References

1. IPCC (2023) Sections. In: Lee H, Romero J (eds.), Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, Geneva, Switzerland, pp. 35-115.
2. Kovats RS, Valentini R, Bouwer LM, Georgopoulou E, Jacob D, et al. (2014) Europe. In: Barros VR, Field CB, Dokken DJ, Mastrandrea KJ, Mach KJ (Eds.)., Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1267-1326.
3. Dumrul Y, Kilicarslan Z (2017) Economic impacts of climate change on agriculture: empirical evidence from the ARDL approach for Turkey. J Bus Econ Manag 6(4): 336-347.
4. (2023) The State of the Türkiye's Climate in 2022. Republıc of Türkiye Ministry of Environment, Urbanization and Climate Change Turkish State Meteorological Service, Ankara.
5. Bilgic H, Hakki EE, Pandey A, Khan M.K, Akkaya MS (2016) Ancient DNA from 8400 Year-Old Çatalhöyük Wheat: Implications for the Origin of Neolithic Agriculture. PLoS ONE 11(3): e0151974.
6. (2020) IPAD.
7. Andrew F (2005) A history of agricultural production at Neolithic Çatalhöyük East, Turkey. World Archaeology 37(2): 197-210.

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