Most parts of Europe were affected by unusually early, and intense, heatwaves during June 2019. Spain, eastern France, Czechia, Germany, Poland, Lithuania and Latvia suffered the greatest impact of the heatwave on annual crops. At EU level, the yield impacts of the heatwaves - compared to the June issue of the MARS Bulletin - are expected to be of little or no significance for winter barley, durum wheat and rapeseed; and relatively small for winter soft wheat, sunflower and grain maize. The yield potential for spring barley and spring wheat is expected to be more significantly reduced. The outlook for sugar beet and potatoes has also weakened but overall good yields are still possible depending on thermal conditions and water availability in the coming months.

Agro-meteorological conditions

In most of central and eastern Europe, considering daily maximum temperatures, June 2019 was either the hottest or amongst the hottest months of June in our weather archive (since 1979). These regions experienced above-average temperatures throughout the month, with the warmest period around mid-June. The last week of June was the hottest in our archive in large parts of western, central and southern Europe. In western Europe these unusually hot conditions arrived very suddenly, contrasting strongly with the average or below-average temperatures in the preceding weeks. All affected regions experienced periods of several days where maximum temperatures exceeded 30°C. Such high temperatures are considered suboptimal for most crops and are in fact damaging during the sensitive periods around flowering. In large parts of France, Germany, Poland and northern Italy, maximum temperatures exceeded 35°C during one or more days during the last week of June. Such high temperatures in June normally occur only in the southern Mediterranean region. Only Ireland, Portugal, the United Kingdom, and northern parts of Finland, Sweden and Norway escaped the unusually warm June conditions.
Crop impacts

Spain, eastern France, Germany, Czechia, Poland, Lithuania and Latvia suffered the greatest impact of the heatwave on annual crops. This mainly concerns regions where crops had already been weakened in earlier stages and/or where the effects of below-average water supply were exacerbated by the high temperatures.

In Spain, extremely high temperatures only persisted for a relatively short period of time, but this was combined with dry soil conditions, and thus significant impacts are expected on flowering grain maize and sunflower crops. In some regions, winter and spring cereals were still in grain filling stage and were also impacted, especially because soil moisture levels were already below average. Water levels in several reservoirs used for irrigation have decreased to further below average levels for this period of the year.

Annual crops in France are most affected where hot conditions coincided with suboptimal water supply. However here, impacts on winter cereal yields are expected to be limited because most crops were reaching the end of the grain filling stage at the onset of the heatwave.

In Germany, Czechia, Poland, Lithuania and Latvia, the yield potentials of spring cereals are negatively affected as these were still in an early grain filling (or flowering in northern regions) phase during the onset of the heatwave. Winter cereals were more advanced but significant impacts are still likely to have occurred in some of these regions. Sugar beet and potato crops are also negatively affected.

In other EU regions, impacts are expected to be less or non-significant, because:

- The heat wave was not very severe (e.g. most parts of the Netherlands, Belgium and northern France) and/or
- Winter crops were already in the final phase of development, close to ripening (central France, southern Europe),
- Maize crops were mostly still in vegetative phase, and favourable soil water conditions mitigated the negative effects of the high temperatures (large parts of France, Italy, and most of southern central and eastern Europe.

Effects of high temperatures on crop growth and development

- Damage around flowering of grain crops, with negative effects on grain numbers.
- Reduced photosynthesis of C3 crops (i.e most common field crops in Europe, except maize).
- Increased respiration to maintain plant functioning (especially when night temperatures are high), which means that less assimilates are available for growth.
- Accelerated phenological development, shortening the growth cycle, with negative effects on yield during the grain filling stage.
- Increased evaporative demand, meaning more rapidly depleting soil moisture reserves; increased water demand for irrigation; and more severe stress when soil moisture is below critical levels.

The combination of hot and dry conditions can be seen as a stress multiplier:

- stress symptoms are more acute leading to irreversible damage to leaves
- canopy temperatures increase well-above air temperatures due to the absence of the cooling effect from leaf evaporation, thus exacerbating high-temperature damage

High temperatures can also affect grain quality. For example, very high temperatures during grain filling can cause shrinkage of the grains, and high temperatures combined with high humidity are favourable for the proliferation of fungal diseases.
Country analysis

France

In France, the last week of June was the hottest in our archive, but preceding weeks were mild, and even cooler-than-usual in the west. During the heat wave, maximum temperatures exceeding 35°C occurred for several days in most parts of the country, and in some parts in central and southern France, maximum temperatures exceeding 40°C were recorded on one or two days.

Despite the intensity of the heatwave, impacts on annual crops are expected to be limited. At national level, the wheat yield is expected to be slightly impacted. In the main production regions, the heat wave accelerated the last grain filling stages just before ripening. Summer crops were still at the vegetative stage and in most regions favourable soil water conditions mitigated the impacts of the heat wave; any damage incurred during its short duration is likely to be limited and reversible. Rain is currently needed to restore the below-average soil water contents that resulted after the heatwave, particularly in eastern parts of the country.

Germany

June was the warmest or second warmest month of June in our records, with the most distinct anomalies (4-6 °C above the LTA) in eastern parts of the country. Nighttime temperatures were generally less extreme, but still 2-4 °C above the LTA in the warmest regions. In several parts of the country, maximum temperature extremes, reached close to 40°C on the hottest day towards the end of the month. The first half of June experienced significant rainfall, but for the month as whole, rainfall was distinctly below the LTA in large parts of the country, resulting in low soil moisture levels, particularly in the northern half.

Winter cereals and rapeseed are generally ahead of the usual development, and the harvest of winter barley has started. Thanks to rainfall in the first half of June (and previously May) and the already advanced development, yield reductions will be limited compared to the forecast of June.

Yields of spring crops, such as spring barley, are potentially most affected by the dry and hot conditions, as they have typically a less developed root system than winter crops and enter the grain-filling period later. Maize has not yet reached the most sensitive stages around flowering, when heat stress would seriously diminish yields; potato and sugar beet crops are in the yield formation phase. All summer crops became heat-stressed in this period but depending on weather conditions in the coming weeks and months, good yields are still possible.

Poland

In Poland, temperatures were well above the long-term average throughout June, with the highest anomalies in the second dekad of the month, and up to 10 more days above 30 degrees compared to the LTA. These exceptional thermal conditions, combined with below-average rainfall, resulted in deterioration of soil water conditions, and affected crops, especially on light (sandy) soils.

In the case of winter wheat, the grain filling phase was accelerated due to the hot temperatures (lower grain
mass expected); and an early harvest (by approximately 2 weeks) is anticipated. In the most affected areas, hot and dry conditions during grain filling resulted in grains that are thin and dry. Nevertheless, overall, winter wheat still looks better than last year according to local contacts. Spring cereals are more affected than winter crops. The yields of maize may also be affected by the dry conditions; strong variability of conditions is present depending on soil type.

In case of sugar beet, impacts of the June heat wave add to the adverse conditions in the beginning of the season; however currently most of plantations are in fair conditions; sugar beet yields will be determined based on meteorological conditions in July and August.

Spain

Considering the month of June as a whole, average temperatures were not particularly unusual. However, very hot temperatures were recorded during the last 4 days of the month. This short heatwave particularly hit the eastern regions, which are usually cooler compared to the south and southwest. Above-average night time temperatures affected a wider area of Spain, including the region of Castilla y Leon, Madrid and Castilla La Mancha, where minimum temperatures of the last 4 days of June were 4-6 °C warmer than usual. Rainfall was below average in the southern half of the Peninsula.

Impacts of the heatwave on winter and spring cereals are expected to have been limited to the late ripening eastern areas (e.g. La Rioja, parts of Aragón and Cataluña, the eastern provinces of Castilla y Leon), where winter crops were still in the grain filling phase. Impacts on the yield potential of irrigated summer crops are expected to be limited, due to the short duration of the heat wave. In some parts, grain maize was in the flowering phase, when impacts may have been more significant. A limited reduction of yield is expected also for sunflower in the hottest regions (Aragón, Castilla La Mancha). Sunflowers are in most areas of the Iberian Peninsula at flowering, and in the south and some areas in the Ebro valley at early grain filling, both of which are sensitive stages for yield formation.

The situation of the water reservoirs has further weakened (source: www.embalses.net, 1.7.2019). Water reservoirs in the Guadiana watershed are at much lower level than in the drought year 2017, while Guadalquivir and Tajo are approaching this benchmark. The Ebro and Duero basins are in a fair state.

Italy

Northern and central-western Italy experienced a heatwave since the second dekad of June, with maximum temperatures that exceeded 35°C for 8 consecutive days. At national level, no significant impacts on crop yield potentials are expected.

Winter crops did not suffer damages as the heat wave occurred during ripening, when yields were already formed.

Summer crops are resisting the high temperature thanks to the surplus of precipitation registered up to the first ten days of June that maintained soil moisture at favourable levels and contributed to refill irrigation reservoirs. Despite the recent high temperatures, overall water demand, especially for maize, has been lower than usual due to the below-average biomass accumulation as a result of the combination of late sowing and cold spring. Conditions are less favourable in the north-eastern and central regions where the deficit in the climatic water balance has been stronger than average and may have reduced leaf area expansion of not-irrigated soybean, maize (in north-eastern regions) and sunflower (in central regions) crops.

Hungary, Romania, Bulgaria

This June was the hottest in Hungary and Romania and the second hottest in Bulgaria since 1979. The positive thermal anomaly of June reached 2-4°C compared to the LTA and the number of days with maximum temperature above 30°C exceeded the average by 5-15 days. Precipitation in June was mostly average or exceeded the average.

Winter crops (winter wheat, winter barley and rape-seed) were in mid- or late ripening phase, therefore the negative effect of the heatwave on yield potential was mostly small. Combined with high moisture levels, negative effects on grain quality may have been more significant, however.

Some decrease in yield potential can be expected for spring barley, which is less advanced. The vegetative development of summer crops was favourably accelerated by the heat-wave and grain maize and sunflower caught up after the colder-than-usual May. Flowering just starting in late June, early July. In spite of the high evaporative demand, water supply is still adequate except on poor (sandy or shallow) soils.

In summary, the crops are generally in good shape so far
and the expected yield losses are small.

Czechia, Austria, Slovakia

Czechia, Austria and Slovakia experienced two hot spells in June: a milder around mid-June and a more extreme one during the last week of June. Maximum daily temperatures exceeded 35°C on the hottest days in the main agricultural regions of Czechia, Austria and southwestern Slovakia. Yield potentials of winter cereals are likely to be somewhat affected, especially in Czechia, where crop development is relatively behind (in the second half of grain filling) and soil moisture contents have been below average.

Summer crops were delayed; still in vegetative phase of development. Therefore this heat-wave has not affected flowering and no significant losses are expected.

Spring barley crops were exposed to the hot temperatures during the early phase of the grain filling period and yield formation is likely to have been negatively affected, especially in the areas where crop water supply has been limited.

Estonia, Latvia, Lithuania and Finland

In Estonia and Finland, the above average temperatures accelerated crop development without affecting yield potentials. Maximum temperatures remained below 31°C.

Water supply to crops has generally not been limiting in Estonia, but in Finland, crops have started to experience water stress. Rain in the coming days (as forecasted) will be welcomed to support the currently positive yield forecast.

In Latvia (especially southern parts) and Lithuania, model indicators show an early senescence for spring and winter cereals due to the combined effect of persistently above-average temperatures (with maximum temperatures exceeding 31°C in Lithuania in mid-June) and limited water supply around flowering. These conditions are expected to have negative effects on the final yields.

Belgium, Luxembourg, the Netherlands

In western parts of Belgium and the Netherlands, even though temperatures during the last week of June were exceptionally high for this period of the year, the duration and intensity of the heatwave, combined with the mitigating effect of adequate water supply, was insufficient to cause serious damage. However, in Luxembourg and eastern parts of Belgium and the Netherlands, bordering Germany, temperatures tended to be higher and soil water contents have been below average. Moreover groundwater levels are still below average, as a legacy of last year’s drought, and irrigation restrictions have already been put in place in some areas. In these regions, the yield outlook of winter cereals has been somewhat reduced, and growth of maize crops, sugar beet and potatoes has been seriously affected where water supply was insufficient. In the most affected regions, above-average rainfall in the coming weeks and months will be required to sustain fair yields of these last three crops.

Croatia, Slovenia

Maximum temperatures, up to 37°C were experienced during the last week of June and the first day of July, but no persistent hot spell, since some milder days occurred during the same period.

Winter cereals are close to maturity, therefore no significant impacts are expected. In case of summer crops, grain maize is before flowering or flowering has just started; therefore the effect of high temperatures is limited. Sunflowers, which reached flowering in some regions, could be more affected; however, given the limited duration and intensity of the heat-wave the yield decrease is expected to be small. Meanwhile, soil water contents have dropped to below-average levels and temperatures and water supply/precipitation in the next 2-3 weeks could be critical for the yield formation of summer crops.
Weather forecast for the coming days (3 to 10 July 2019)

North-easterly/easterly air flow will bring cooler temperature conditions in northern/north-eastern Europe, with daily maximum temperatures forecast to remain below 26 °C. This atmospheric circulation will also favour precipitation events, with accumulated values below 40mm (60mm locally).

Warmer-than-usual temperatures are expected to continue in other parts of Europe. Daily maximum temperatures are expected to remain above 30 °C throughout Mediterranean region, with highest values above 34 °C (reaching 36 °C in some areas). Atmospheric instabilities will trigger precipitation events (locally even thunderstorms and intense precipitation events) in many regions of a zonal band extending from the Gulf of Biscay to the Balkan region.
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