# Dealing with drought

This year's unprecedented drought has placed enormous pressure on farmers in Ireland. Whether the extended dry weather is an anomaly or a sign of things to come, TEAGASC researchers have been working to better understand and prepare for future drought events.

## Grassland mixture diversity for yield stability

John Finn is an environmental researcher in the Teagasc, Crops, Environment and Land Use Programme, Johnstown Castle. John explains: "As part of the EU AnimalChange experiment, we tested whether diversity in grassland mixtures could improve yield resilience when challenged with an experimental nine-week drought (see experimental rain shelters in the main article picture; Finn *et al.*, 2018). We sowed one-, two- and four-species combinations of perennial ryegrass, chicory, red clover and white clover". The four-species mixtures in this study were designed to contain a mix of functional traits related to nitrogen (N) acquisition and rooting depth, with the aim of improving access of the vegetation to utilisable N and soil water during drought events. Yield was harvested by cutting, and N was applied at 150kg/ha/year and 200kg/ha/year at two sites, respectively.

Overall, plant diversity was related to increased yield stability; as diversity increased from one to four species, there were higher yields, and lower variation in yields. Across all of the grassland plots, the experimental drought had a severe effect on yield (-87%) on the individual harvest at the end of the drought event. In contrast, drought effects on annual yields (the sum of yields before, during and after the drought period) of averaged monocultures and the four-species mixture were only -9% and -12%, respectively. This showed a remarkable ability of the total annual yield to be resilient to short-term weather events. These losses were much smaller than the yield advantage due to mixtures, which were 31% under drought and 34% under rainfed conditions (compared to the average yields of the four monocultures); thus, the benefit of mixtures was maintained despite the drought. Importantly, once soil moisture levels were restored, we observed an immediate recovery in harvest yields, e.g., we observed few to no negative drought effects in the first harvest after the removal of the drought shelters. Within this two-year study, there was no indication of an increasing susceptibility to drought from one year to the next (Finn *et al.*, 2018). Further work on the potential role of multi-species grassland mixtures is currently underway at Johnstown Castle.

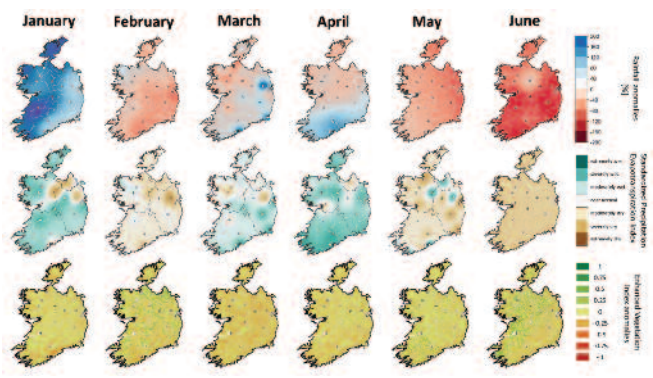


*FIGURE 1: The Standard Precipitation Evapotranspiration Index.*

## Space technology for monitoring drought

Stuart Green and Simone Falzoi in the Agrifood Business and Spatial Analysis Department, Teagasc Ashtown are using meteorological indicators and satellites to monitor the progress of the current drought. Stuart explains: "Monitoring conditions across the country shows us that, while the drought affects the whole country, its impact varies from place to place". The drought can first be seen in the rainfall record and when we compare rainfall totals in a month with average values, we see that while January was very wet, the following months had low rainfall. We can model the impact of reduced rainfall using one of many weather indices. The index shown in **Figure 1** is the Standardised Precipitation Evapotranspiration Index (SPEI). The SPEI looks at long-term rainfall at different timescales and compares it with expected demand as indicated by normal evapotranspiration – giving a single number indicating conditions. The images show that this year, up to June, every month was either drier or wetter than normal and that June was "severely dry". NASA's MODIS satellite can calculate the impact by measuring the greenness of the country, expressed as an "Enhanced Vegetation Index" - ranging from 1-0, 1 being very lush green pasture and 0 being completely barren. By comparing the index each month with the average, we can see how the landscape is coping. And now we can see some regional variability, with vegetation growth well below normal in the south and east (well-drained soils) in June but above normal in the north and west (poorly drained soils).

This is because the heavy soils in the north and west are at an advantage in that they hold moisture for much longer, allowing plants to take advantage of the higher temperatures. However, these soils can't hold out continually and, as the drought progresses, we shall see growth impacted in these regions too.

## Getting the MoSt from grass

Elodie Ruelle, a postdoctoral researcher at Teagasc Moorepark, is working on the Moorepark St Gilles (MoSt) grass growth model (Ruelle *et al.*, 2018), which was developed at Teagasc, Moorepark in conjunction with the INRA, France. Elodie explains: "The model takes into account historical weather, soil type and grass management (such as post-grazing height, stocking rate and N fertilisation) to predict grass growth, grass N content and grass N leaching. The model can accurately forecast grass growth and simulate grass growth when the model outputs are compared to outputs from PastureBaseIreland (PBI), a grassland measurement database developed by Teagasc". Currently, the model is being live tested on the well-drained Curtins (Co. Cork) and poorly drained Ballyhaise (Co. Cavan) research farms. Every Monday, the model is used to predict the grass growth for each paddock for each farm for the next seven days using weather forecast data supplied by Met Éireann and farm management information available in PBI (e.g., N fertiliser application, rotation length, post-grazing sward height). The model can simulate soil moisture deficit due to its dynamic and mechanistic aspect and so it has been able to accurately predict the reduced grass growth as a result of the drought that the country is currently experiencing. It has also been able to predict the latency of the severity of the drought between Ballyhaise and Curtins due to the differences in weather and soil types between the two locations. The consequences of the drought have been more severe at Curtins, where a reduction in growth rate was experienced two weeks earlier than at Ballyhaise. The model also predicted that growth would stabilise at around 15-20kg DM/ha/day at Curtins and at 40-50kg DM/ha/day at Ballyhaise farm. We are currently beginning the process of incorporating the MoSt grass growth model into PBI. When it is incorporated, the model will allow every farmer using PBI to better predict the impact of weather events on their farm based on their location, soil type and grassland management.

For more details on how to deal with the summer drought conditions, Teagasc has prepared advice for farmers: https://www.teagasc.ie/rural-economy/farm-management/farming-in-difficult-weather-conditions/summer-drought-conditions/.

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## References

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