Predictions Of Optimal Chickpea Flowering Time For Better Yield

muhuddin Anwar[1]
Yashvir Chauhan[2], Mark Richards[3], David Luckett[4], Rosy Raman[3] and Neroli Graham[3]

[1] NSW Department of Primary Industries and Graham Centre for Agricultural Innovation (an alliance between NSW DPI and Charles Sturt University)
[2] Department of Agriculture and Fisheries (DAF)
[3] NSW DPI
[4] Graham Centre for Agricultural Innovation (an alliance between NSW Department of Primary Industries and Charles Sturt University)

Chickpea yields are often constrained by miss-match of crop duration with the environment in which it is grown leading to its exposure to frost, drought and heat stress. For achieving higher and reliable production, its duration therefore needs to be optimised for individual environments. We tried to achieve this through a modelling approach. A factorial simulation study was conducted across important chickpea growing regions in Australia, to determine how differences in crop phenology across these regions can affect yield in current and future environments. Based on temperature and photoperiod as the main drivers of flowering time, significant differences in floral initiation (date of first flower) were observed among the sites and between sowing dates. Flowering was earliest at Biloela and Theodore, situated at relatively low latitudes in Queensland, in contrast to Roma, Dalby and Goondiwindi (at higher latitudes in Queensland). Some sites exhibited a wide range in flowering characteristics (e.g. Wagga Wagga (NSW) and Dalby) which may be due to greater fluctuations in seasonal conditions. It is also possible that at these sites, the Agricultural Production Systems sIMulator (APSIM) was not adequately able to account for variation in flowering and pod set due to failure to reconcile with production of sterile (pseudo) flowers in cooler environments which seems to occur due to interactions between soil moisture and temperature. There was a strong latitudinal phenology gradient in flowering, with southern sites being better-suited to earliness to facilitate drought escape during grain-fill, and northern sites better-suited to lateness to maximize biomass production and avoid the fitness penalty associated with the species' lack of reproductive chilling tolerance. Indeed, across all sites, yield was most strongly influenced by soil water supply (in-season rainfall) and sowing date. The follow-on challenge from this work is to identify the levels and duration of chilling stress responsible for observed yields that depart from the simulated yields, and to determine how those chilling indices might be incorporated into the chickpea growth model in future versions of APSIM.