

Session 7: Modelling and meta-analysis

Session 7-P1:

No further stimulation of wheat yield by CO₂ above 600 ppm?

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We compiled data from 161 exposure experiments (Free-Air Carbon Dioxide Enrichment, FACE; Open-Top Chamber, OTC; closed top-chamber, CTC; field tunnel, FT; greenhouse, GH) where wheat was exposed to different CO₂ concentrations, [CO₂]. Grain yield (GY), yield components (grain mass, GM; grain number, GN; harvest index, HI) and grain protein concentration (GPC) data were included. Data were analysed by meta-analysis and derivation of response functions. HI and GM were largely unaffected by [CO₂]. GY and GN were positively affected and GPC negatively by [CO₂]. Using non-linear (second order polynomial) relationships substantially improved the correlation of GY, GN and GPC with [CO₂] compared to linear functions. The non-linear relationship of these three response variables with [CO₂] suggest that no further stimulation from CO₂ takes place at concentrations above approximately 600 ppm. This result was supported by the meta-analysis, which did not indicate any significant increase in the yield stimulation of wheat at [CO₂]>600 ppm compared to [CO₂]<600 ppm. At both levels of [CO₂] the yield stimulation was around 25%. Extrapolation of the non-linear response function for GY suggests a CO₂ compensation point around 30 ppm, which is more realistic than the large negative compensation points indicated by a linear function. The meta-analysis did not reveal any significant differences in the response of wheat to CO₂ when comparing pot and field experiments. Effects on GY obtained in FACE, OTC and the other exposure systems did not differ significantly. However, CTC and GH experiments exhibited a much larger variability in wheat GY response to CO₂ than the other exposure systems. In conclusion, our results strongly indicate that the CO₂-induced yield stimulation of wheat is saturated at approximately 600 ppm.