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Photosynthesis and chlorophyll fluorescence: response to high temperature stress in soybean

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High temperature stress is becoming a serious constraint to productivity of soybean as temperature variability is increasing due to climate change. Screening for high temperature tolerance in soybean is often a bottleneck in plant breeding programs. Twelve soybean genotypes were grown in pots at day/night temperatures of 30/22, 34/24, 38/26 and 42/28°C with an average temperature of 26, 29, 32 and 35°C, respectively under greenhouse conditions. One set was also grown under ambient temperature conditions where crop season average maximum and minimum temperatures were 28.0 and 22.4°C, respectively. The objectives of present study were to quantify the effect of high temperature on changes in leaf area, specific leaf weight, above and below ground biomass, number of stomata on adaxial and abaxial leaf surfaces, gas exchange, chlorophyll fluorescence parameters, pollen germination, reproductive efficiency and seed yield in soybean. Significant negative effect of temperature was observed on specific leaf weight, leaf thickness, above and below ground biomass, pollen germination, reproductive efficiency, photosynthesis, stomatal conductance, water use efficiency and seed yield as the growing temperatures increased; whereas, intercellular CO_2 and transpiration rate were increased. With the increase in temperature chlorophyll fluorescence parameters such as Fv/Fm, qP and PhiPSII declined while there was increase in qN. Number of stomata on both abaxial and adaxial surface of leaf increased significantly with increase in temperatures. The total stress response index, in 12 genotypes over the temperature treatments ranged from -1068 (JS 95-60) to -333 (EC 538828). These findings suggest that there exists a genetic variability for high temperature response and there is an urgent need to evaluate large number of soybean genotypes having higher degree of tolerance to elevated temperature conditions which will help in improving the soybean productivity under current climatic variability and future climatic scenario.