Plant Growth Speed, Photosynthetically Active Radiation Utilization and Association of them with Grain Yield in Winter Wheat in Multilocation.

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Global warming has significantly influenced plant phenology, including winter wheat, affecting developmental stages from germination to maturity. Winters are becoming milder, and spring precipitation is shifting toward later growth stages of winter wheat across the northern hemisphere, particularly in West and Central Asia. Vernalization (Vrn), photoperiod sensitivity (Ppd), and intrinsic earliness genes play an important role in the environmental adaptation of winter wheat. It has been observed that genotypes exhibiting rapid early spring growth and ground coverage, thereby minimizing soil evaporation, demonstrate better adaptation to winter wheat-growing regions. Although early-maturing genotypes can escape terminal drought stress, they may not benefit from precipitation occurring during later growth stages.

The objectives of this study were to assess growth speed (GS), ground coverage, and the efficiency of Photosynthetically Active Radiation (PAR) utilization during the growth of winter wheat. A total of 825 entries, including five check varieties, were evaluated in Eskişehir, Ankara, and İzmir, Türkiye. The germplasm originated from more than 80 crosses made among diverse germplasm pools; all genotypes were in the F6 generation. The experimental design was augmented design, with plots consisting of 1 m × 1 row in İzmir and Ankara, and 4 m × 6 rows in Eskişehir. The check varieties (Gerek, Karahan, Sönmez, Taner, and Bayraktar) were sequentially repeated as every 20th entry in the trial.

The traits measured were Days to Heading (DH) and Plant Height (PH), measured at weekly intervals across all locations. In Eskişehir, Normalized Difference Vegetation Index (NDVI) and chlorophyll content with Chlorophyl Meter were also measured at the same time with PH measurements. Daily meteorological data, along with solar radiation and PAR, were determined at each site.

Significant differences were observed among genotypes for all measured traits. As expected, plant development was earliest in İzmir. Growth speed varied across environments: initial growth was most rapid in Izmir, slowest in Ankara, and intermediate in Eskişehir. In Ankara, growth speed (GS) followed a bell-shaped pattern, beginning slowly, increasing during the mid-growing stage, and declining toward maturity. Although initial GS was high in both Eskişehir and Izmir, it showed a steady decline in İzmir, while in Eskişehir it fluctuated in response to changing weather conditions. Significant genotype × environment interactions were observed for all traits. Genotypes demonstrated differential responses in PAR utilization across growth stages and environments, suggesting that yield potential could be enhanced by exploiting the most efficient performers under specific environmental conditions.

Keywords: Winter Wheat, Growth Speed, NDVI, PAR