SUNFLOWER YIELD RESPONSE TO CROP DENSITY UNDER CLIMATIC UNCERTAINTY: COUPLING AN EXPERIMENTAL AND A SIMULATION APPROACH.

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ABSTRACT

Crop establishment is a critical step for optimal agronomic and economic crop performances. In sunflower, average emergence rate stands between 70-85% in France, with a tendency to decrease because of increasing bird predation. Consequently, farmers have to sow again the crop in about 8% of the situations. But obtaining a successful plant stand depends not only on the crop emergence rate but also on the initial sowing density. Currently, the practical recommendation for sowing density is between 65-70k seeds per ha (target of 50-60k plants/ha) which should be increased (70-75k seeds/ha) in case of minimum tillage, because of lower crop emergence risk. Ideally sowing density should also be adapted to expected soil water resources, pathogen pressure in the growing area, and cultivar. Our study aims to refine the current sowing recommendations from *Terres Innovia* by providing site-specific decisions based on climate, soil, and cultivar. We used field experiments (multi-environment trials) to assess yield and oil concentration response to plant density, soil type, and cultivar in French growing conditions. We then extended this dataset with numerical experiments (simulations from *SUNFLO* crop model) to evaluate how climatic uncertainty and crop management were impacting or not current sowing recommendations. Datasets were analyzed with linear and quantile regressions both globally and for subsets of the studied population of crops. We found that crop yield variance was mainly explained by farm location (soil and soil x climate interactions), with a weak average impact of plant density (<= 5%); the hierarchy of factors was similar with field or simulated dataset. When refining practical recommendations to account for available soil water content (AWC), adjustment of plant density had a greater impact on crop performance. In deep (AWC > 200 mm) and intermediate (100mm < AWC < 200mm) soils, optimal density range was around 50-60k plants/ha, with important yield loss (10-30%) below this level in deep soils and above it for intermediate soils. In shallow soils (AWC < 100 mm), sparse plant stands were more adequate, given low water available for growth. From the exploration of unexperienced climatic conditions with simulation, we concluded that sowing density recommendations should be adapted to climatic conditions, to better account for soil x climate interactions. Finally, our method coupling field and simulation experiments contributed to adapt more efficiently the crop water demand (through plant population) to available soil water ressources, hence refining the scope of technical support.

Key Words : crop density, simulation, crop model, yield, sunflower