

From Drone Images to Pollination Services: A case study at KBS Long Term Ecological Research Site

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Introduction

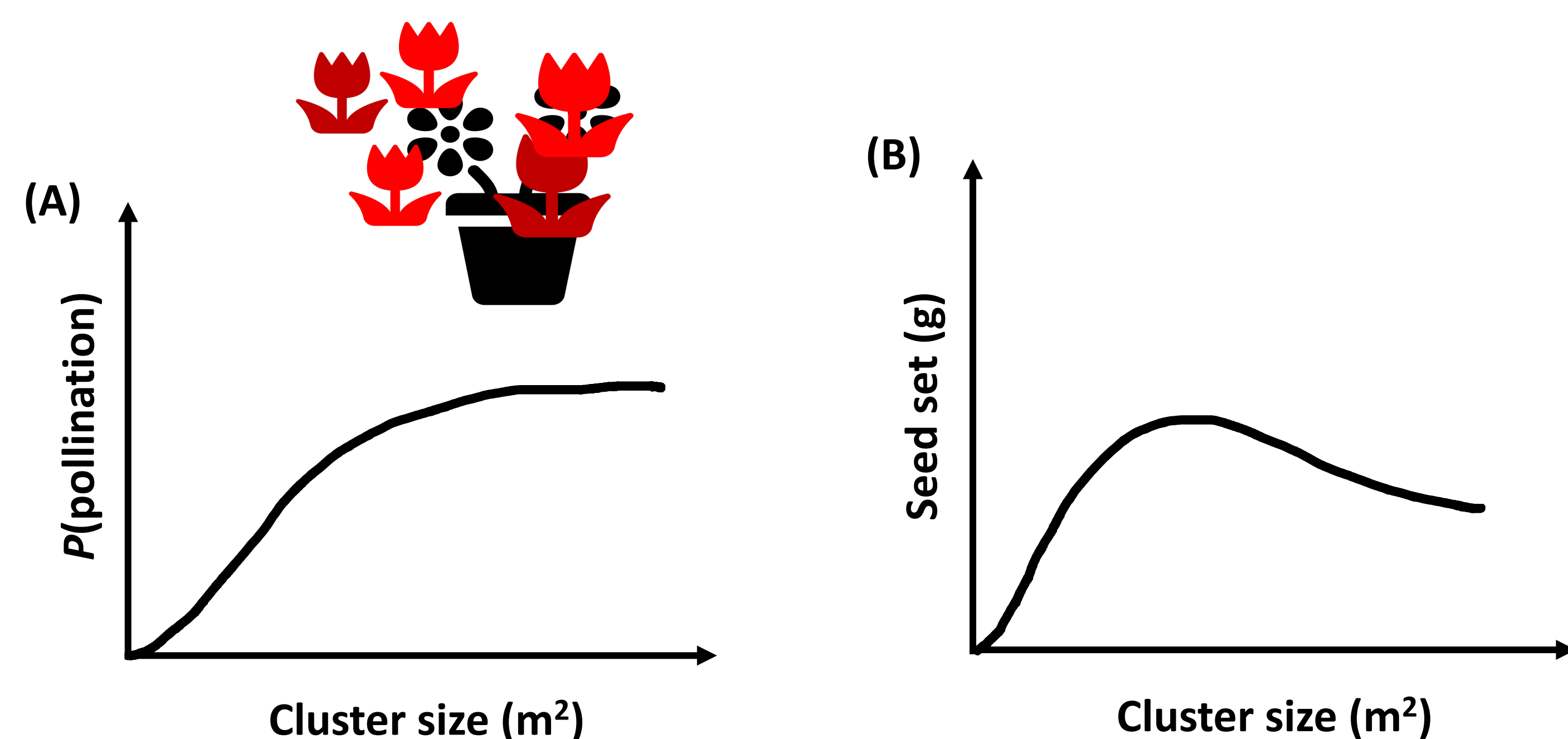
The employment of unmanned aerial vehicles (UAVs) can advance scientific research in multiple aspects. Here we take advantage of the fine resolution that UAV images can achieve to ask how spatial configuration of flowers would affect pollination services.

Assuming a pollinator can freely move from one flower to another given two flowers are within the foraging distance of a pollinator, we create flower networks and study how spatial effects, including cluster size of flowers and distance to closest cluster of flowers, would affect pollination probability and seed set weight.

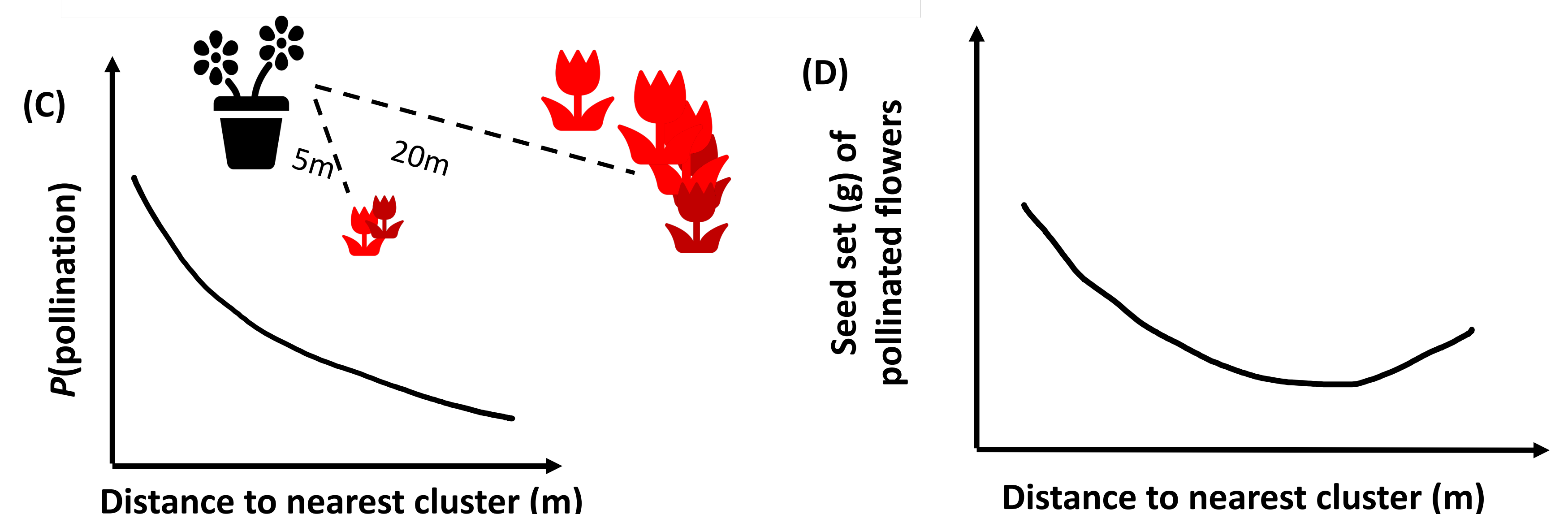
Methods

In summer 2019, pots of greenhouse blooming Black-eyed Susans were deployed for pollination in LTER MCSE T1 (conventional wheat), T2 (reduced input wheat), T3 (no-till wheat), T4 (organic wheat) and T7 (early successional) treatment plots. We took drone images of plots, and created orthomosaics of 2.6 cm/pixel resolution. By using 5 band values (Red, Green, Blue, Red-Infrared, Red-Edge) and several derived ratios of these values (*e.g.* NDVI, EVI, SAVI), we distilled floral resources with the application of semi-automatic classification plugin in QGIS. We also conducted post-processing to increase accuracy rate of classification to be above ~93%. In PostGIS, we created edges between flowers within a distance of 5m and generated a flower network for each plot.

Hypotheses



Probability of pollination increases with flower cluster size. Seed set weight increases with flower cluster size but decreases as the cluster size is so large that pollinators spend less time foraging on each flower and thus decreases the *per flower* pollination service.



Probability of pollination decreases with distance to the closest flower cluster. Seed set weight decreases with distance to the closest flower cluster. Nevertheless, while the flower set is very remotely isolated, the flowers get more pollinated if they were to be pollinated, as the pollinator would 'work harder' on these flowers.

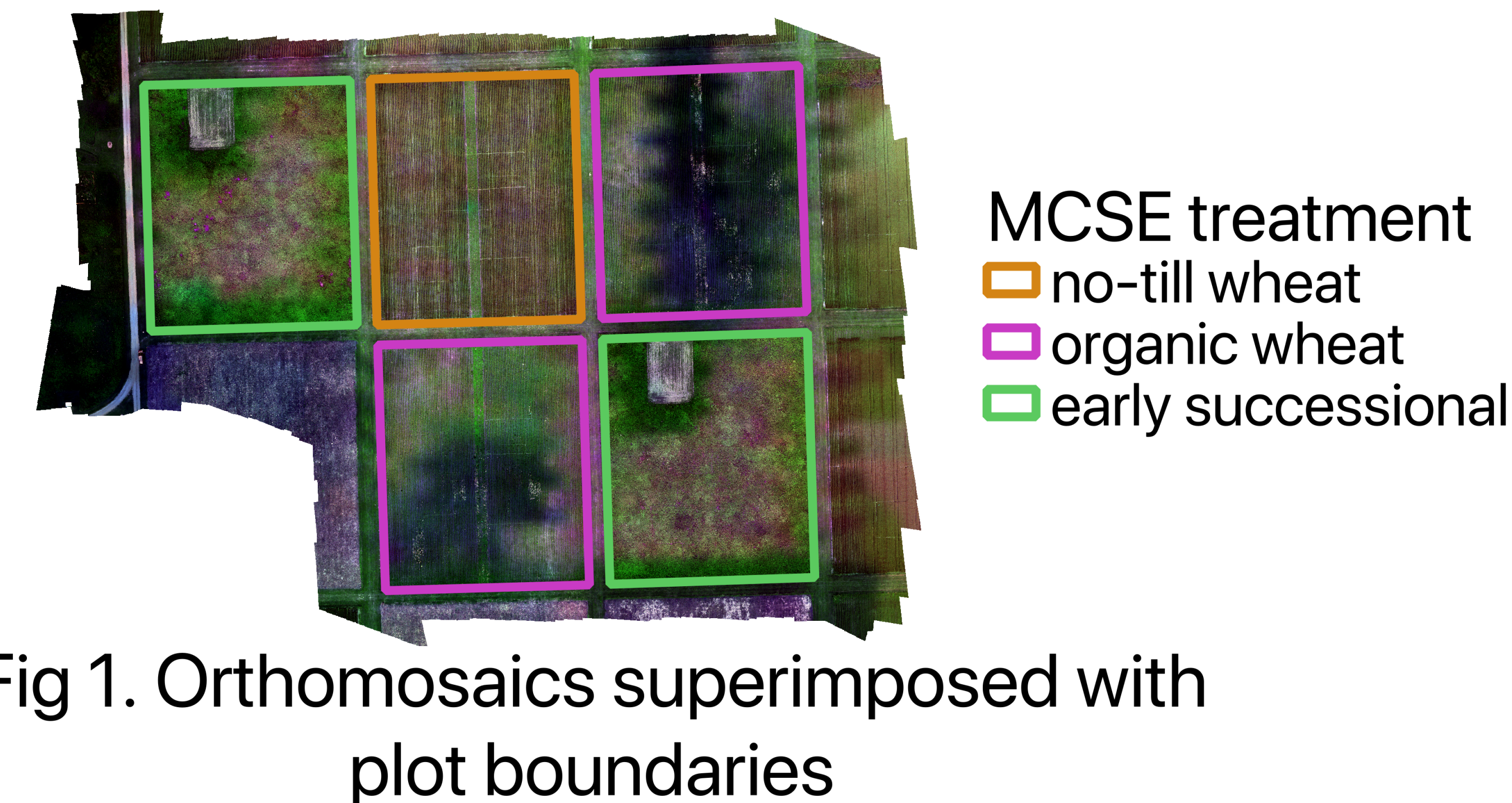


Fig 1. Orthomosaics superimposed with plot boundaries

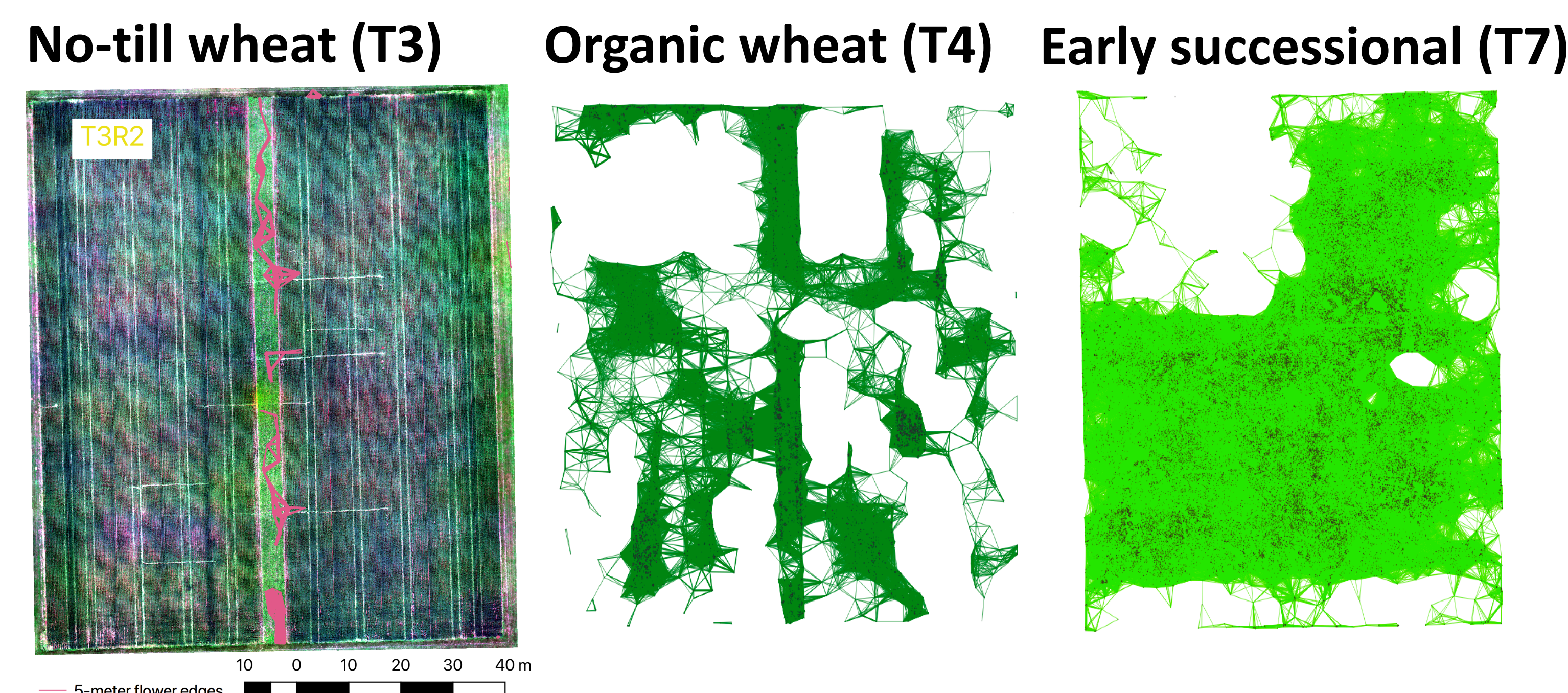


Fig 2. Five-meter edges of T3, T4 and T7 plots