Developing Spring Dead Spot Maps Across Entire Golf Holes Using Aerial Imagery

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Rationale

- Spring dead spot (SDS) is a disease which causes damage to warm-season turfgrass as *Ophiosphaerella spp.* fungi infect root tissues (Tredway, 2008)
- Recent research has automated SDS detection (Booth, 2018), but not at the scale of a full 18-hole course
- Turfgrass managers aim to minimize SDS in the most cost-effective way, but are reluctant to implement unproven technologies
- Drone image processing can be more time efficient and as accurate as traditional SDS identification practices

Figure 1. Flight test of Mavic 2 Enterprise Advanced Edition, UAV used in orthomosaic imagery capture

Methods

- Imagery captured over Independence Golf Club in June 2022
- Flight plans built with DJI Pilot (Shenzhen, China) and DroneDeploy (San Francisco, CA)
- DJI Mavic 2 Enterprise Advanced Edition and DJI Phantom 4 Pro were flown
- Images for each hole were georeferenced with ground control points and orthomosaicked in Pix4D
- Orthomosaics processed using previously developed python script
- Holes treated in October 2022 with John Deere ProGator Precision sprayer (Moline, IL)

Figure 2. Precision fungicide application on Independence Golf Club using John Deere ProGator Precision Sprayer

Disease Map Generation

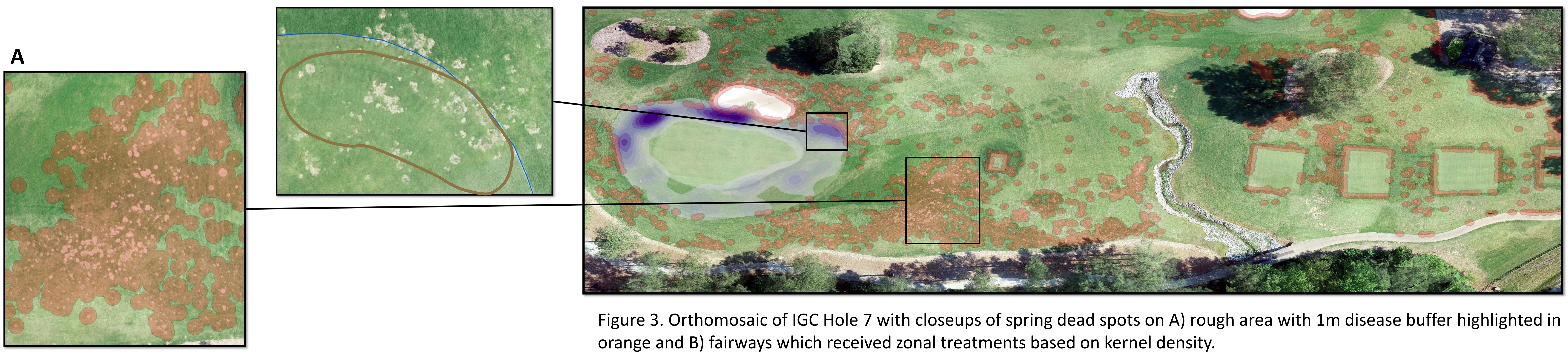

Figure 3. Orthomosaic of IGC Hole 7 with closeups of spring dead spots on A) rough area with 1m disease buffer highlighted in orange and B) fairways which received zonal treatments based on kernel density.

Image Processing

Bilateral Filter → Edge Detection → Contour Drawing → Coordinate Transfer

Figure 4. Orthomosaics were processed in a custom python script (Henderson, 2021). A bilateral filter removed edges while maintaining color boundaries, and canny edge detection identified circular contours. Contours were filtered for typical disease patch size and labeled as SDS. GPS coordinates of centers were overlaid on the mosaics. For the fairways, kernel density analysis was used to identify site specific management units (SSMU). For the rough areas, a 1m dissolved buffer with 2m gap fills was employed to highlight SDS infection areas.

Spray Area Reduction

Method	Area Treated (Ha)	Fungicide Needed (kg ai)	Cost
Blanket	36.08	145.42	**$85,864.23**
Precision	7.24	17.69	**$10,444.96**

Table 1. Comparison of cost between conventional blanket applications of fungicide compared to precision showing a reduction in area sprayed of approximately 80%.

- Methods required spraying of 14.41% of fairway acreage and 22.45% of roughs
- Only 20% of entire course was targeted with the disease maps
- Treated acreage reduction equates to savings of $75,000 of isofetamid fungicide
- Savings based on Kabuto fungicide blanket application at 4.03 Kg ai/hectare

Practical Implications

- Optimization of custom script used to identify fairway SDS would yield refined spray blocks and greater fungicide savings.
- Upfront investment in drone training and image processing for a course employee would quickly be remade.
- Autosteer GPS sprayer could complete 18 holes in a fraction of the time it would take an attendant by hand.
- Discrete coordinate data generated can provide insights into adjustment of cultural practices.
- For only one course, aerial imagery disease maps have resulted in savings over $75,000, these savings could be reinvested in higher quality pest control practices.
- Course should be re-flown in late spring to assess percent control of SDS to justify savings to date.

References

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