Precision Fumigation Technologies for Use in Strawberry

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Summary

Dr. Boyd's research team is developing technologies to map common pests in strawberry fields. Recent findings show their methods can effectively identify nutsedge and, through spatial statistical analysis, locate persistent high-density hot spots within fields. These persistent nutsedge hot spots offer opportunities to focus management efforts where patches are predicted to occur during the strawberry season. Additionally, preliminary research has shown the potential of satellite imagery to identify sting nematode damage hot spots in strawberry fields. Ongoing research is focused on validating this approach with the goal of utilizing pest maps to enhance management and facilitate targeted fumigation.

Purple Nutsedge Patch Persistence

An Artificial Intelligence (AI)-based weed surveying system was developed by integrating digital cameras, GPS, and other components. The system is mounted to a tractor and captures video imagery as it moves across the field. The videos are processed through AI programs trained in the Weed Science lab to accurately detect and localize each purple nutsedge, generating a precise map of all purple nutsedge in the field (Figure 1).

Density maps are created to evaluate the spread of nutsedge across the field, identifying areas with the greatest weed pressure (Figure 2). The surveying system was used to map fallow fields in August 2023 and 2024, and during the 2023 strawberry season, Mapping efforts will continue during the 2024-2025 season. Directional patterns of higher weed pressure are observed in fallow fields, aligning with the rows where the sprinklers are located, likely due to reduced management in these zones.

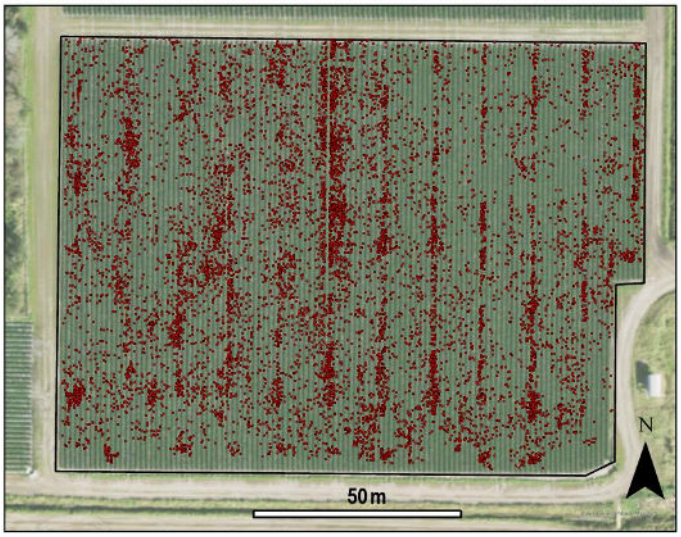

Figure 1. Population map of a commercial strawberry field during the fallow period, August 28th, 2024. Each red dot represents one purple nutsedge plant.

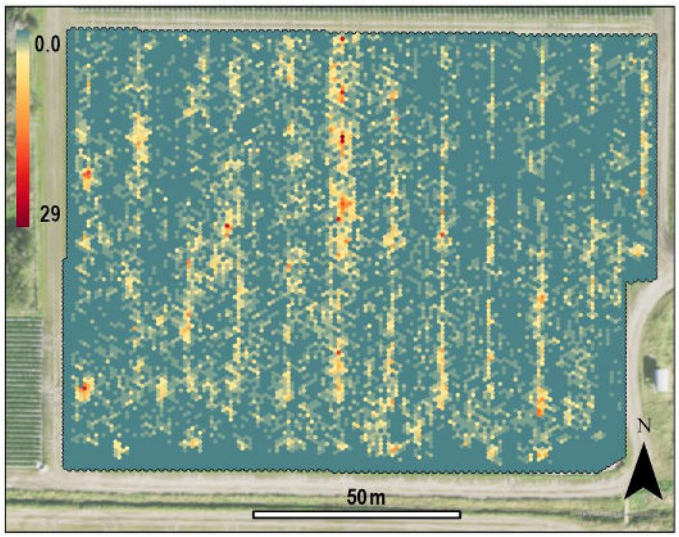

Figure 2. Density map of a commercial strawberry field during the fallow period, August 28th,2024.

Spatial statistical methods, used to analyze weed distribution patterns, identified areas with significantly higher concentrations of nutsedge, or "hot spots", during both fallow conditions and strawberry season (Figure 3). This confirms that

nutsedge is concentrated in patches rather than uniformly spread across the field.

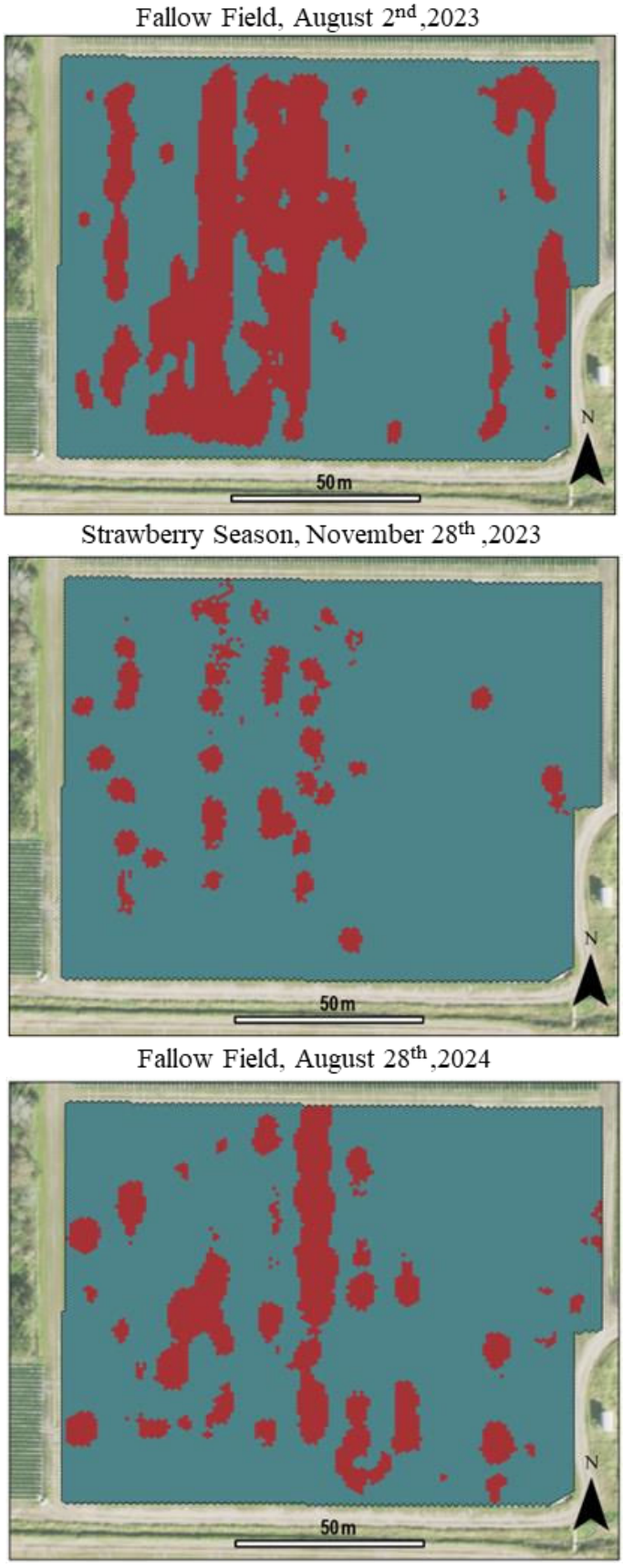

Figure 3. Hot spots, shown in red, represent areas with significantly higher concentrations of purple nutsedge plants across the field.

Despite changes in the number and size of hot spots over time, consistent patterns were observed across different time points (Figure 4). In 2023, 76% of hot spots during the strawberry season aligned with those from the prior fallow period, indicating patch persistence from fallow to in-season populations.

In 2024, 55% of fallow period hot spots overlapped with those from the previous year's fallow period, suggesting some stability in nutsedge patches year to year. However, the lower overlap indicates an expansion of areas with recurring hot spots, reflecting shifts in nutsedge distribution from one year to the next. Similar results were observed in another commercial field.

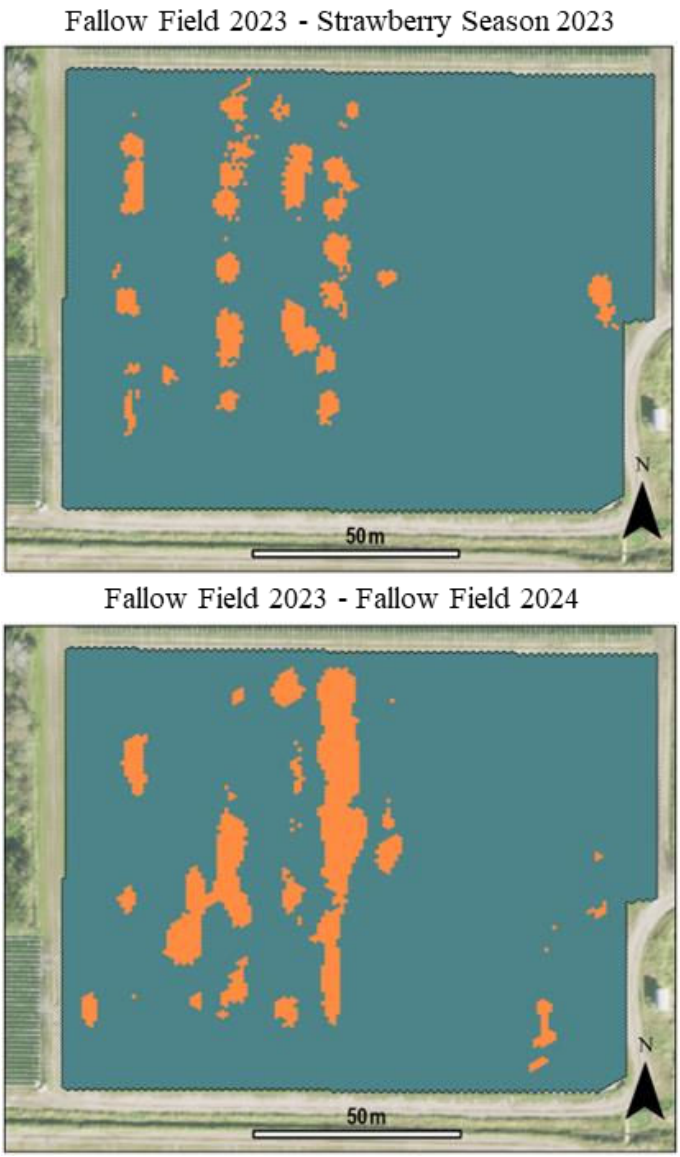

Figure 4. Hot spot association between two maps illustrates where patches are persistent across seasons.

The findings suggest that persistent nutsedge hot spots could allow for more efficient, targeted management in strawberry fields. Growers could focus management areas by identifying areas with high weed pressure that remain consistent between fallow periods and the strawberry season. This targeted approach could consist of variable-rate fumigant applications, supplemental fumigation with K-Pam based on patch locations, targeted preemergence herbicides under the plastic mulch, or targeted herbicide applications during the fallow period. The maps could also be used to track if management efforts are effective. Mapping will be repeated this season to confirm if these patterns consistently reoccur.

Sting Nematode Damage Hot Spots

Preliminary results showed that high-resolution satellite imagery can identify symptoms corresponding to sting nematode infestations using vegetation indices derived from NDVI (Figure 5). While the image resolution does not permit individual plant assessment, it enables the identification of sting nematode damage hot spots, facilitating efficient monitoring of hot spot persistence across years with historical satellite imagery data.

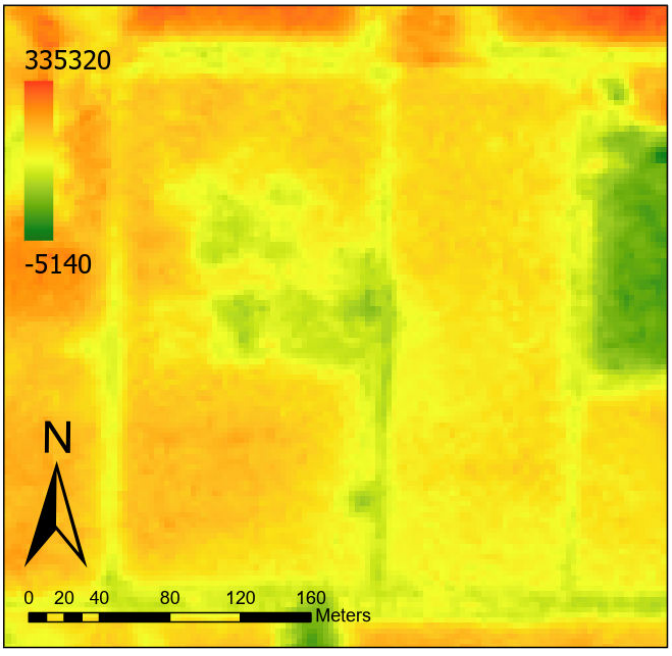

Figure 5. Sting nematode damage hot spot in a commercial strawberry farm, end of season. The green areas are sting nematode hotspots.

This season, sting nematode infestations will be confirmed through laboratory analysis across various farms, and satellite imagery will be used to identify damage areas and evaluate the persistence of these hot spots over the years with historical satellite data.

If sting nematode damage hot spots are found to persist over multiple seasons, targeted management strategies can be implemented to reduce nematode populations in these areas. This could include variable-rate applications during field set up or deep shank telone applications during the fallow period to the problem areas rather than the entire field. Focused control efforts should improving overall nematode management efficiency and reduce input costs.

Takeaways

Dr. Boyd's team has developed an AI-based mapping system for nutsedge in strawberry fields that is being used to demonstrate that nutsedge occurs in persistent patches between the fallow period and the strawberry season, creating opportunities for targeted management in recurrent high-density zones. Preliminary satellite imagery results indicate potential for identifying sting nematode damage hot spots, supporting monitoring and potentially enabling targeted management strategies. Continued research will confirm the stability of these hot spots, allowing for targeted pest control approaches to improve efficiency in strawberry production.

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