The timing of *Echinochloa spp*. and *Cyperus difformis* emergence in alternative stand establishment rice systems depends the year, flooding date, and location within the Sacramento Valley

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Objective:

The overarching goal of this research is to develop decision support tools that assist rice growers in planning for and implementing alternative stand establishment systems for weed control.

Hypothesis:

If early-season temperatures are heterogeneous across space and time in the Sacramento Valley, site-specific, real-time temperatures will improve the precision of weed emergence predictions.

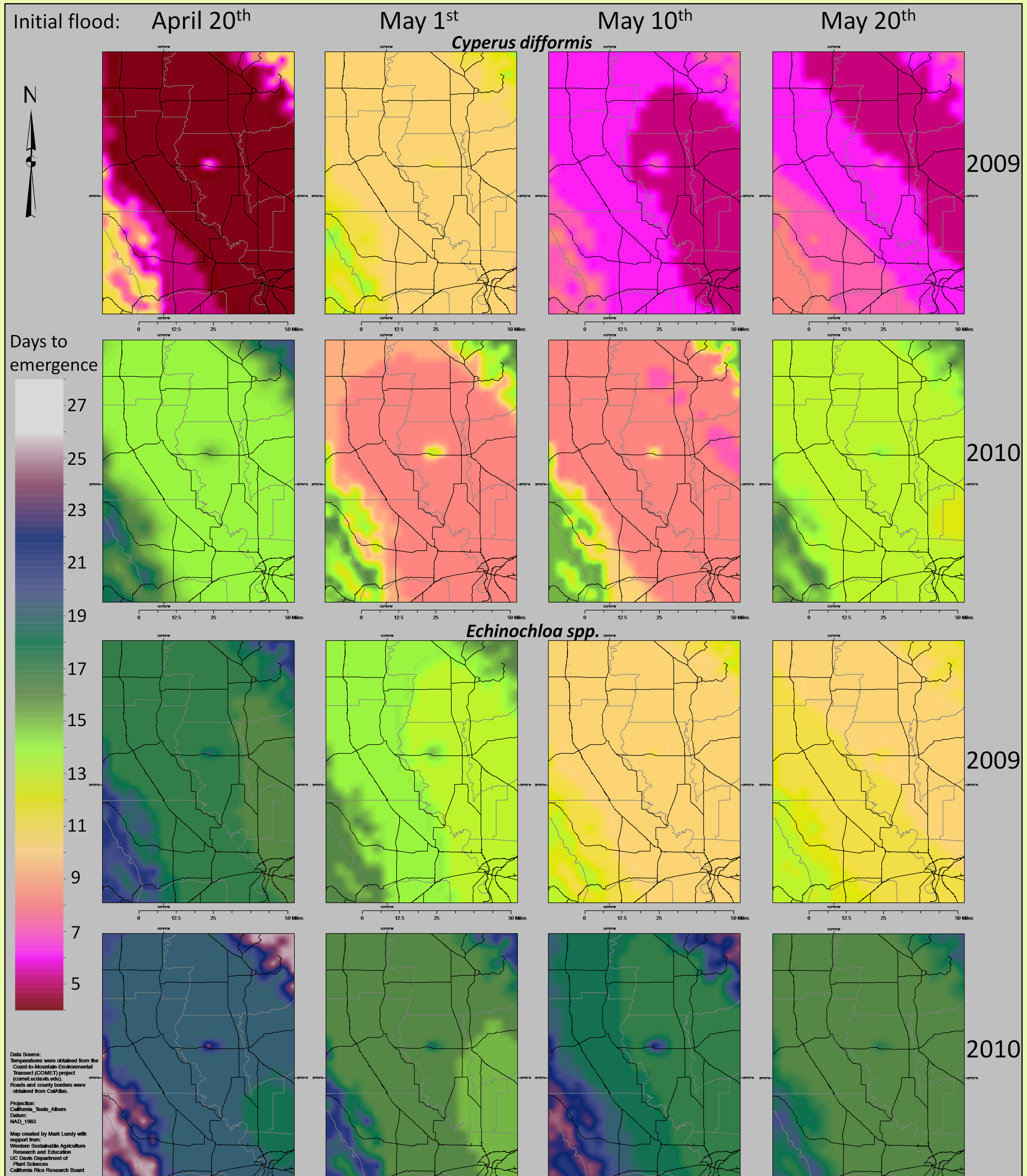

Figure 2.
Spatial distribution of emergence predictions for *C. difformis* and *Echinochloa spp.* for selected initial flooding dates in flushed fields for the 2009 and 2010 seasons projected using kriging interpolation.

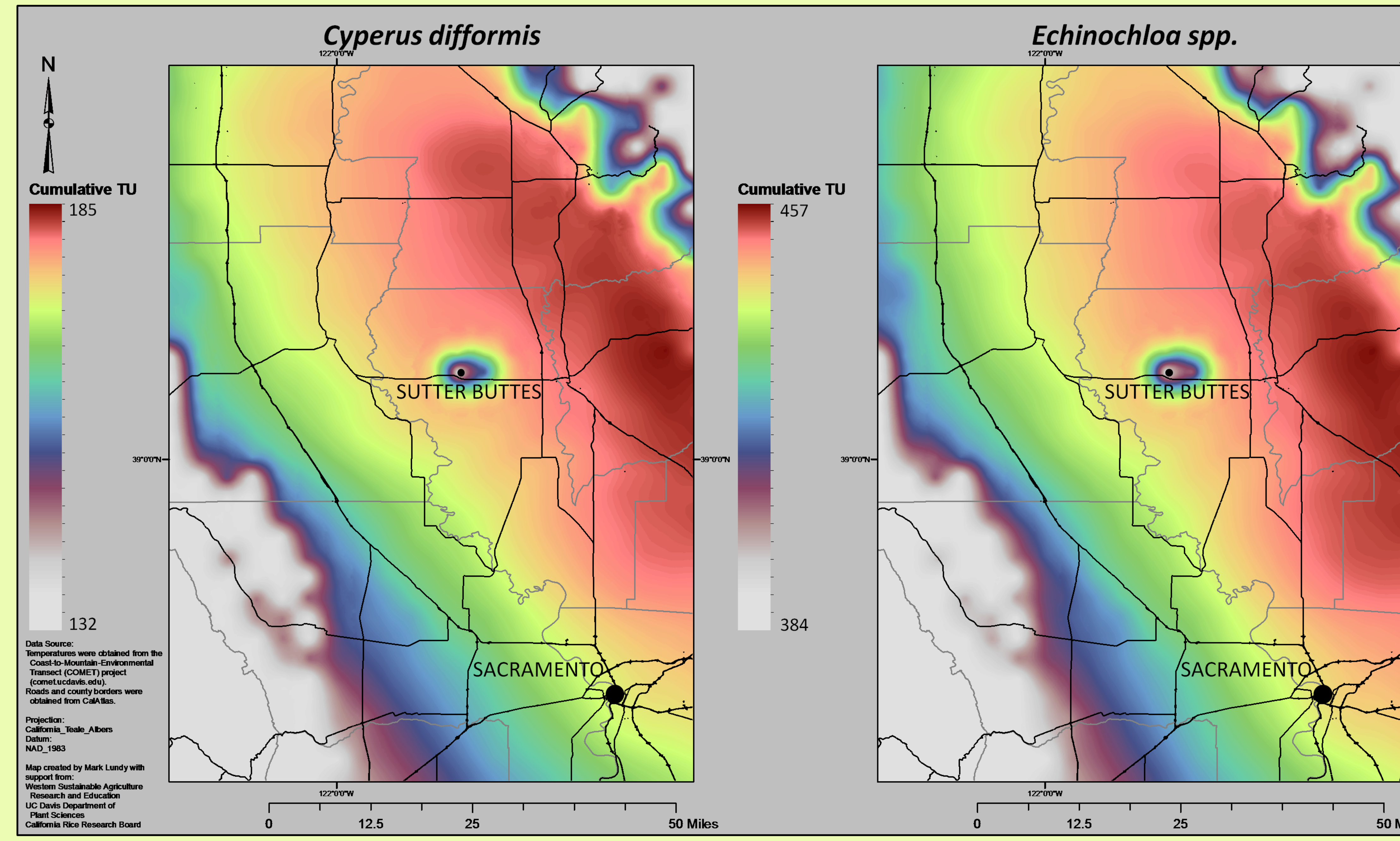

Figure 1.
Distribution of average cumulative temperatures above a physiological base for *C. difformis* and *E. spp.* between April 15th and May 31st for the years 2004-2010 based on kriging interpolation.

Methodology:

We observed early-season emergence of *Echinochloa spp*. and *Cyperus difformis* (smallflower umbrellasedge) over two years (2010 and 2011) at three locations in the Sacramento Valley where growers implemented either spring-till-stale-seedbeds or spring-till-drilled-seedbeds. The fields were flushed repeatedly early in the season to ensure saturated but mostly aerobic conditions. Therefore, temperature was the predominant limiting factor to weed emergence during the observation period. The sigmoidal function [$E = 1 / (1 + \exp[-E_{rate} * [\log(TU_x) - \log(TU_{50})]])$, where E is the cumulative proportional emergence at cumulative thermal time x (TU_x), TU_{50} is the cumulative thermal time required to reach 0.5 of emergence, and E_{rate} is the slope at TU_{50} was fit to our observations iteratively to minimize sums of squares. Base temperatures used (59F for *C. difformis* and 46F for *E. spp.*) were developed at the laboratory scale with seeds collected throughout the Sacramento Valley, and cumulative thermal time was calculated as the area above the predicted physiological base temperature.

These empirical emergence models were then combined with a data source that interpolates temperatures across the Sacramento Valley on a daily basis at a resolution of approximately one square mile (Coast-to-Mountain-Environmental-Transect, COMET; http://comet.ucdavis.edu/). Combining the weather and plant growth models enabled the visualization of early-season weed emergence predictions across space and time and between species for the alternative stand establishment systems.

Results & Discussion:

In spring-tilled fields with early season flushes, the first day of flooding, the year, and the location within the Sacramento Valley all influenced the length of time to emergence for both *Echinochloa spp*. and *C. difformis* (smallflower) populations. For both *C. difformis* and *E. spp*., average cumulative thermal time from 4/15 to 5/31 between the years 2004 and 2010 was spatially dependent based on a kriging interpolation (Figure 1). Though, in general, fewer days to emergence were predicted for later versus earlier flooding dates, exceptions did exist (eg. *C. difformis*, 4/20/2009 v 5/1/2009; *E spp*., 5/1/2010 v 5/10/2010). Likewise, emergence predictions varied between years (Figure 2), with slower emergence predicted in 2010, when average temperatures during the period modeled were 59F compared to 66F in 2009. Additionally, though not yet tested statistically, the degree of spatial dependency of emergence predictions appears to change over time (Figure 2). Finally, with a lower base temperature and greater cumulative thermal time requirement to achieve full emergence, *E. spp.* was predicted to require more time for emergence than *C. difformis* during like periods *(*Figure 2*)*.

The emergence models used to make these predictions are preliminary and need to be further refined and validated. In addition, it is important to emphasize that the model predictions are specific to the water management conditions under which they were developed, and may not be accurate for flooded, water-seeded fields. Further, these models observe and predict emergence for the first cohort only. Although subsequent cohorts may emergence, we did not observe or model season-long emergence because weeds emerging in subsequent cohorts would be outside of a reasonable window for control using an alternative stand establishment technique such as the stale seedbed.

Conclusion:

Predicted time to emergence for *Echinochloa spp*. and *Cyperus difformis* in alternative stand establishment systems varies by location, year and initial flooding date. Although our predictive models require further refinement and validation, they argue for weed management and decision support tools that are site-specific and temporally sensitive.

Acknowledgements:

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