Do glyphosate-resistant feral plants and hay fields spread the transgene to conventional alfalfa seed fields?

Sandya Kesoju[1], Stephanie Greene[2], Ruth Martin[3], Matthew Kramer[4], Doug Walsh[1], and Rick Boydston[5]

[1]Washington State University, Prosser, WA; [2] USDA-ARS, Fort Collins, CO; [3]USDA, ARS Corvallis, OR; [4]USDA, ARS Beltsville, MD; [5]USDA-ARS, Prosser, WA

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Introduction

Alfalfa is an outcrossing, insect-pollinated crop and readily naturalizes along roadsides, irrigation ditches, and unmanaged habitats. Genetically-engineered (GE) glyphosate resistant varieties are available, and GE low-lignin varieties are entering the market place. These GE varieties are being adopted by alfalfa producers, especially in the western US, a major production area for both alfalfa forage and seed. However, western producers also export a large amount of alfalfa seed and hay to countries that prohibit GE traits. The US National Organic Standards also specify livestock feed be free of GE traits. Therefore seed and pollen flow that results in the contamination of conventional alfalfa with GE traits (also termed adventitious presence or AP) is a concern for producers serving export and organic markets. Transgene flow can be mediated by seed or pollen and very little research has been done on the landscape-level to assess the risk of AP from GE hay field and GE feral plant pollen flow.

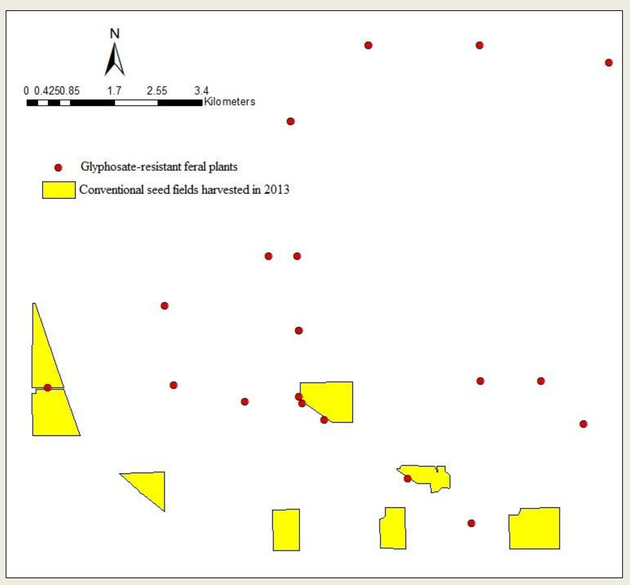
Objective

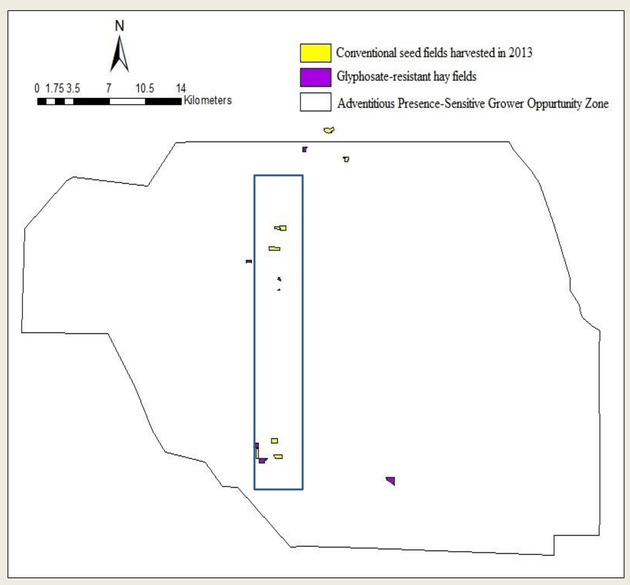
Our objective was to examine transgene flow from glyphosate-resistant (GR) feral plants to conventional seed fields in Fresno County, CA and GR hay fields to conventional seed fields in Canyon County, ID to better understand the AP risk these GE sources impose on conventional seed fields.

Materials and Method

Fresno Co., California Alfalfa feral plants, seed and hay fields were mapped and tested for GE trait in in spring 2013. Eight conventional seed fields (sink fields), located at various distances from GR feral plant sources were identified.

Canyon Co., Idaho A part of Canyon Co, Idaho has been designated as an Adventitious Presence-Sensitive Grower Opportunity Zone (i.e. no GE alfalfa seed is produced, but GE hay is allowed). Seed and hay fields were mapped in spring 2013 and 8 conventional fields were selected as sink fields (we report on only 5 fields).





Sink fields were hand or combine harvested every 30 m along field edges closest to GR source. Original seedlots (used to plant sink fields) or field plants were assessed for baseline AP. Leaf samples were tested using AgraStrip® RUR Leaf TraitChek™ test strips. Harvested seed samples were threshed, cleaned, scarified, and tested using a seedling germination assay (Kesoju et al., 2016).

The only explanatory variable considered for the results reported here was distance to the closest GR source (either hay or feral plant). Logit transformed AP was kriged to develop maps using ARCGIS 10.2.

Results and Discussion

AP was not detected in the original seed lots used to plant the sink fields sampled in both the counties.

In Fresno Co., out of 64 samples tested from 8 sink fields located near GR feral plants, we detected AP in only two samples (both had 0.02% AP). This suggested that transgene flow was occurring, but at a level that was insufficient to result in a level of AP that would have an economic impact (industry has established < 0.1% AP as a non-detect threshold).

In Canyon Co., AP was found in sink fields located near GR hay fields. The AP ranged from 0.02 to 0.73% in our sink fields. Our spatial prediction map suggested that GE hay fields may contribute to an AP of 0.01% in conventional seed fields located an average distance of 1.7 km away. This distance is well within the current AOSCA Alfalfa Seed Stewardship Program isolation distance of 3.2 km that is required to separate AP-sensitive seed production from GR alfalfa hay production.

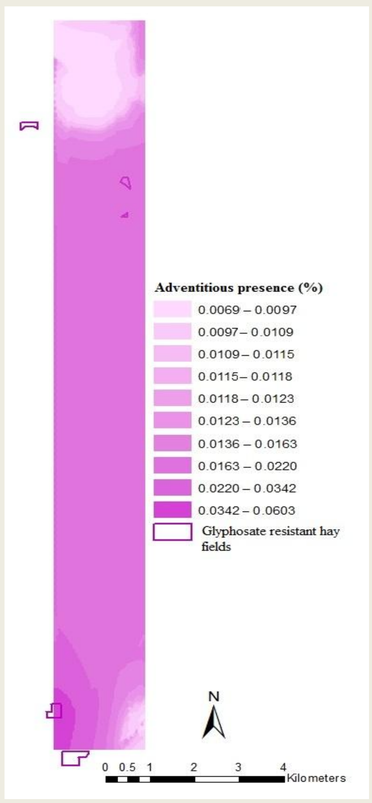


Fig 1. Spatial prediction map with AP% near Canyon County, ID.

Conclusion

Although transgene flow from hay-to-seed fields was low, the AP we found was slightly higher than previous studies (Teuber et al., 2007) and probably reflects the inherent differences between landscape and research scales in assessing transgene flow (St Amand et al., 2000)

The results from our study confirmed that transgene flow occurs from GE hay fields and GE feral plants into conventional seed fields, but in our study areas, was at a very low level and not likely to have an economic consequence. Feral plant populations in our study area consisted of < 16 plants. We would expect AP to increase as feral population size increases, so feral plant control is a prudent management practice. For producers of AP-sensitive seed, use of ASSP AOSCA isolation distances (3.2 km) from GE alfalfa hay fields or unmanaged alfalfa feral plants will ensure seed purity. For producers of non-APS seed, level of AP attributed to GE hay fields will depend upon hay field size, distance and timing of cutting- all factors that influence the amount of GE pollen available to foraging bees.

References

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