DIGITAL GOVERNMENT: NEW TOOLS TO DEFINE TERROIRS AND VITICULTURAL AREAS IN THE NORTHERN GREAT PLAINS

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Introduction

Terroir embodies a defined geographic place, integrating soils, geology, climate, the cultivar (variety), and the role of cultivation, culture, and history in producing wine (White, 2003). It captures the concept of "genotype x environment", integrates the human dimensions of vineyard management, and builds a "sense of place" from landscape and climate characteristics. The understated topographic changes, broad thick mantles of loess, subtle changes in large agronomic fields, diffuse climatic and ecological boundaries, and brief viticulture history contribute to a misperception that terroir may not be applicable or that niche microclimates for vineyards may not exist in the Northern Great Plains. Compared to New York and the Great Lakes vineyard traditions, our history is brief and our knowledge of growing environments is only now evolving. The lack of viticulture history in the Northern Great Plains is a real constraint to new growers, wineries, crop insurance companies, USDA, and the Alcohol and Tobacco Tax and Trade Bureau (TTB; formerly ATF). Although the growing season characteristics of the Northern Great Plains are very suitable to producing high quality winegrapes, it is the dormancy period and the inherent extreme temperature variability that challenges the sustainability of the vineyards.

With many new hybrids available through university research and private breeders, new cultivars are adapted to growing environments once considered marginal vineyard settings. Similarly, with the wealth of geospatial natural resource (soils, climate, and topography) databases available in the Northern Great Plains, it becomes possible to develop and map inference spaces from existing variety field trials and identify regions of similar viticulture behavior. For growers in our region, a vineyard decision support system that can test, match, and map cultivars to the landscape before planting could avoid vineyard failures, provide a better understanding of vineyard site suitability, and lead to a more sustainable winegrape industry in a region known for highly variable climates. Our initial goal is to overcome poor selection of varieties, especially in marginal environments, and identify the niche environments that will lead to sustainable vineyards of the higher quality winegrape cultivars.

Objectives

- Integrate georeferenced observations ("rules of thumb") from existing growers and university research sites to construct inference spaces of similar viticultural behavior, as part of a vineyard decision support system,
- Match winegrape cultivars to the microclimates and landscapes of the Northern Great Plains through terrain-modeling of climate data, and
- Develop the biogeoinformatics characterizing the growing regions for winegrape cultivars that can eventually lead to the recognition of terroirs and development of American Viticultural Areas (AVAs).

Developing a Geospatial Context to Genotype x Environment Interactions

Currently, there are four locations in Nebraska for viticulture research--Kimmel Education & Research Center, Nebraska City, on-farm sites near Peru and Nemaha, and the Panhandle Research and Extension Center, Scottsbluff, Nebraska (Fig. 1a and 1b). Unfortunately, universities and USDA researchers cannot test and validate new cultivars in all possible environments. Therefore, we need to explore new geospatial algorithms to project adaptations across untested terrains and climates, based upon the plant traits, phenology, and biophysical constraints. Winter hardiness and susceptibility to premature bud break are the controlling factors of winegrape cultivar adaptation, which translates into developing new approaches to geospatial analysis of growing environments with high variability of extreme events, thermal buffers and islands, and benign climates.

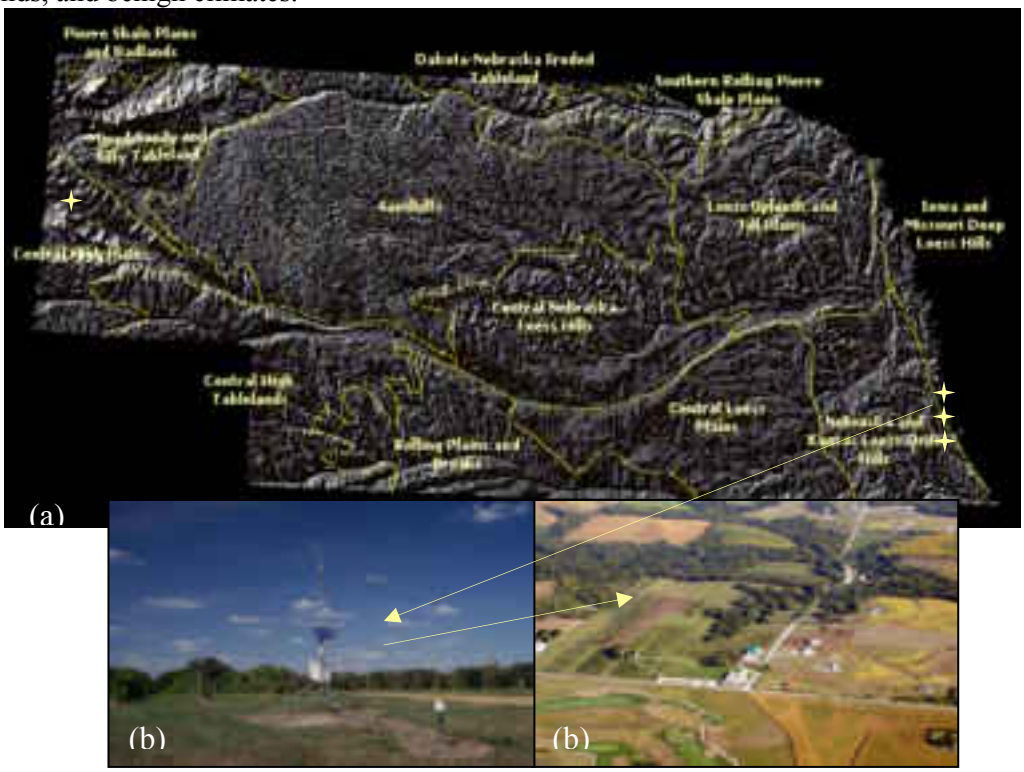

Figure 1. (a) Existing (stars) viticulture research sites relative to Major Land Resource Areas (MLRAs; USDA Soil Conservation Service, 1981). (1b) The Kimmel Orchard research variety trial site located at Nebraska City.

Research Significance

Our research tests the following hypotheses:

- Do lakes and reservoirs in the Northern Great Plains follow a "Finger Lakes" model of buffering winter temperature minima extremes and slow warm-up in the spring?
- Are extreme temperature minima (Tminimum) not reaching the lows of past decades? Climate changes in the Northern Great Plains may provide the opportunity for expansion of *V. vinifera* and cold sensitive French-American hybrids into Nebraska. Vineyards in the rural-urban fringe areas may sustain cold sensitive and later maturing cultivars within thermal islands.

New "GxE" tools will become the foundation for a vineyard decision support system that can provide interactive geospatial data mining and geovisualization of cultivar adaptation, searching for favored environments. We believe that the biogeoinformatics of alternative crops at the whole plant scale will complement future discoveries in plant genomics.