

POTENTIAL FOR WEED MANAGEMENT IN POTATO FIELDS USING GIS TECHNOLOGY

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Introduction

Weed competition decreases the availability of essential elements, necessary for optimum potato growth and yield (Banaras, 1993; Nelson and Thoreson, 1981). Weeds also indirectly hinder potato production by serving as alternate hosts for parasitic pests, increasing tuber damage, and increasing harvest complications (Nowacki, 1983). To combat these negative impacts, herbicides are applied to greater than 90% of the total potato acres in Wisconsin (Wisconsin Pesticide Use Bulletin, 1996). Use of herbicides increases potato production costs and also increases the potential for non-point source water contamination. Non-point water pollution is especially a concern in the Central Sands of Wisconsin where coarse textured soils and shallow water tables are present.

Recent research in corn and soybean cropping systems has confirmed that many weed species are aggregated within fields, and large portions of these fields have low densities of weed species (Gerhards et al. 1997; Johnson et al. 1995; Mortensen et al. 1993). However, a typical herbicide application is a uniform broadcast application of broad-spectrum herbicides to control a diverse group of weed species. This application technique is effective and decreases the risk of weed escapes, but may be an unwarranted expense. One way to reduce weed management costs is by specifically applying herbicides where weed species exist. In order to accomplish the site specific application of herbicides, trustworthy maps of the weed specie density distribution must be created and economically justified. Therefore, research is being conducted to determine weed specie distribution and the potential for site specific management of weeds within production potato fields.

Methods and Materials

This research was initiated in 1998 in cooperation with Coloma Farms and will continue through the year 2000. In 1998 two production fields, 114 and 134 acres, were planted in Russet Burbank and Snowden varieties, respectively. Neither field was fumigated prior to the 1998 potato crop with the exception of the eastern 1/3 of the Russet Burbank field. In 1999, the 114 and 134 acre fields were planted in corn and two additional Russet Burbank potato fields, 80 acres each, were chosen for evaluation. A differential GPS backpack unit was used to create a one-acre, georeferenced, diamond shaped sampling grid system.

Weed specie and densities were quantified (weeds/100 ft²) twice during the growing season, early and late, at each of the georeferenced grid sampling points. Early season measurements occurred one to two days after pre-emergence herbicides (Prowl and Lexone) were applied at labeled rates to the fields. Despite pre-emergence herbicide application, emerging weeds were visible and easily counted and identified. Prior to potato vine desiccation, late season weeds were quantified by specie and maturity. Also the location of the late season weed specie aggregates was identified using a differential

GPS backpack unit which provided a comparative method to determine the accuracy of the GIS surface maps.

Weed distribution surface maps were created with a GIS program (SSToolbox, Stillwater, OK). Geostatistical methods and software (S-PLUS4, Seattle, WA) were used to analyze the spatial data.

Results and Discussion

Early season broadleaf and grass weeds appeared aggregated within all four of the potato fields. The primary grass weed species were foxtail species and field sandbur. Grass weed densities were variable for each of the fields, but the majority of each field had low to moderate weed densities. The primary broadleaf weeds early in the season were common lambsquarters, common ragweed, and redroot pigweed. Other broadleaf weeds, including field bindweed and eastern black nightshade, occurred in very localized areas at high densities. Much like the grass weed distribution, large portions of each field had low to moderate weed densities and were conducive to site specific management of these weeds.

Late season broadleaf and grass weeds densities were sharply reduced from the early season densities by the application of herbicides, crop competition, and tillage. GIS surface maps indicated alterations in weed aggregate location, but aggregates remained relatively stable from the early season to the late season rating. A comparison of GIS surface maps of weed distribution was comparable to the weed distribution maps created with the differential GPS and indicated an adequate representation of weed distribution was accomplished using a one-acre grid system.

The aggregated broadleaf and grass weed distribution indicate the potential to reduce herbicide inputs cost by site specific application. However, incorporating this management technique for weed control may allow a narrow window of opportunity for quantifying and managing emerged weeds.

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