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Optimizing the use of aerial photography to map leafy spurge

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Introduction

Leafy spurge occurrence is a well known and pervasive problem throughout the Northern Great Plains. As a noxious weed, most states require landowners to undertake control of the spurge, generally through application of herbicides.

The acreage of spurge by state is summarized annually. The methods of providing these acreage figures vary according to thoroughness of the county-based ground survey; additional data used in the estimation of acreage may include acres sprayed, acres observed during representative transects and landowner participation in supplying data. Understandably, the county estimations of spurge acres can fluctuate in accuracy due to variability in the data collection methods and due to lack of funding and time to complete systematic ground surveys.

The spurge acreage appears to be expanding. It is therefore imperative that accurate estimations of spurge acreage are compiled. This information can then be used to identify “hot spots” and secure additional action, especially intensified state and federal commitments to research and control programs.

Aerial photography offers a timely and cost-effective means of surveying vegetation types. A spurge mapping project in Crook County, Wyoming provided accurate mapping of leafy spurge over 36 square miles through a computer-based analysis of color infrared aerial photography taken at 6,000 feet above mean ground (AGL) elevation. The cost however, was prohibitive at 40 cents per acre (personal communication with Roeland Eliston, supervisor, Crook County Weed & Pest).

The Nebraska Leafy Spurge Task Force expressed an interest in a similar aerial photography approach to leafy spurge mapping, but at an optimal intersection of cost and accuracy. Consequently, this project was undertaken to address the following questions:

- (1) can leafy spurge be identified on aerial photography,
- (2) if yes to (1), which film/altitude gives optimal results, and

(3) what factors are important in detection of leafy spurge on the various film/altitudes?

Study Area

The main site within Rock County, Nebraska was selected by the personnel at the North Central Nebraska RC & D and Planning Council. Rainfall was near normal in May and cool season grasses were actively growing throughout the site. Figure 1. Location of the test site within Rock County, Nebraska. (unavailable)

Methods

A given variable is that data collection during spurge bloom provides the best opportunity to distinguish the affected areas.

To evaluate the aerial photography variables, the following data collection parameters were selected:

- (1) 70 mm aerial films--color, color infrared (CIR), and CIR with enhanced processing, and
- (2) four flight altitudes—1,500 ft., 3,000 ft., 4,500 ft., and 6,000 ft. AGL.

The aerial flight took place under clear sky conditions on May 24, 1988.

Coincident with the aerial overflights, the following ground activities took place at the main site (the control site):

- (1) four-4x4 ft. resolution panels were placed near a spurge patch,
- (2) 8 spurge stands were identified within the site and measured for dimension (shape and area),
- (3) general observations by stand included range of plant height, average plant densities (plants/square foot), and other descriptive factors (as relevant), and
- (4) representative ground photographs (color and CIR photography) were taken.

Results and discussion

The ground data are denoted by 8 spurge stands (Figure 2 - unavailable). The characterizing data by stand are shown in Table 1.

The aerial photography over the site was evaluated by an aerial photo interpreter who had not been involved in the ground data collection. The CIR photography did not adequately portray the spurge stands due to confusion with other light-colored objects. The spurge stands appeared on the aerial color photography in yellowish colors and were distinct from other objects on the 1,500 and 3,000 ft AGL color photography.

Table 1. Characterization of eight leafy spurge stands within the Rock County test site.

<u>Site</u>	<u>Dimension</u> feet	Estimated Range of Plant Height <u>Distribution</u> (inches)	<u>Plant Density</u> (plants/ft ²)	<u>Notes</u>
1	33x34 (1,122 ft ²)	12-20	1-3	patch continued outside defined site
2	10x18 (180 ft ²)	14-20	4-6	lower densities at NE and SW edges
3	14x20 (280 ft ²)	16-22	1-3 NE 4-8 SW	density is variable as indicated
4	10x12 (120 ft ²)	16-22	6-10	denser in center and eastern side with circular shape
5	30x36 (1,080x ft ²)	14-20	2-4	mixture of other weeds and occurs on well-rotted manure mounds
6	20x30 (600 ft ²)	20-24	6-10	(same notes as for #5)
7	96x115 (11,040ft ²)	16-20	5-8	plant height had extremes of 12 to 26 inches and density was as high as 30 plants/ft ² some areas with non-blooming spurge
8	4x4 (16ft ²)	12-20	3-6	nearly circular “control plot”, density lower on edges, density peaked at 8 plants/ft ²)

The results accomplished from evaluation of the color aerial photography are shown in Table 2. Only stand 7 was visible on the 4,500 ft and 6,000 ft AGL color photography.

The interpretation of the 1,500 ft color photography provided 80% accuracy of the spurge area without any misidentification. Low density of spurge (viz., fewer plants than 4 plants per square foot) was the main contributor to not being able to delineate spurge stands on the 1,500 ft color photography. One exception to the density consideration was other weeds and growth on old manure piles (a rare site factor in relation to overall spurge occurrence); size and shape were also factors on the 3,000 color photography. A 4×4 foot patch was visible on the 1,500 ft photography, but overlooked by the aerial photographic interpreter, since it was at the edge of the site and was a small point.

Color enhancements are possible and could potentially allow for better results in the 3,000 ft and possibly 4,500 ft color photography. Since this was an experiment with limited data collection, exact costs could not be estimated per unit area. A comparison of the costs for collecting photography at 1,500 ft AGL versus 3,000 ft is listed as follows:

- (1) flying time--doubled
- (2) aerial photography (film length, processing, and printing) 4× increase, and
- (3) aerial photographic interpretation 4× increase.

Table 2. Results of color aerial photographic interpretation.

Site	Correction Identification (Yes or No)		Mitigating Factors/Comments
	1,500 ft	3,000 ft	
1	N	N	low density stand
2	Y	N	small size
3	Y	Y	
4	Y	N	small size
5	N	N	low density and other weeds
6	N	N	other weeds
7	Y	Y	density differences were apparent across the stand
8	N(Y)	N	Interpreter overlooked this stand on the 1,500 ft photography, but could see it on photography when the ground verification map was later examined.

Conclusions and recommendations

The following conclusions were reached:

- (1) a high percentage of leafy spurge area can be accurately delineated on 1,500 ft AGL color photography, if plant densities are >4 plants/ft² under blooming condition,
- (2) 3,000 ft AGL color photography can be used to delineate the larger plant with stated density, as above, and
- (3) color infrared photography did not record leafy spurge stands such that accurate identification could take place, the spurge bloom was confused with bare ground and other areas that also appeared in whitish colors.

We recommend that further photographic enhancement be evaluated to bring out the color associated with the spurge stands, especially on the 3000 ft and the 4500 ft AGL color photography. The 1500 ft AGL color photography would appear to be too costly for full area surveys. This photography could, however, be a useful tool for trend evaluation and limited surveys over known problem areas.

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