

Northeast Nebraska Helped Greece Fight Weeds

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What the Northeast Nebraska and Greece have in common, what would you say?

Weeds, and more weeds, yes, they both have weed species that interfere with local lives.

Weeds are the specialty of Stevan Knezevic, UNL Weed Scientist. Majority of Stevan's research is conducted at Haskell Ag. However, few years ago Stevan was invited to coordinate non-chemical weed control project in Greece.

The Mediterranean region of Europe (including Greece) gave birth to a number of civilizations and is interspersed by a dense network of cultural heritage sites. Archaeological sites are often large scale open spaces that enclose a variety of monuments, including free spaces between monuments, which are rapidly colonized by herbaceous plants (weeds), especially during rainy season (November –April). Weed presence between the monuments is not desirable because weeds can: (1) conceal the monuments, (2) interfere with regular maintenance and restoration, (3) obstruct the site access to the visitors, (4) impair the aesthetics of the site (appearance of the site neglect), and (5) increase the risk of fire during long hot and dry summer seasons of the Mediterranean region. Typical Mediterranean climate is characterized by mild winters and extended dry periods during the warmest months of the year. The herbaceous vegetation of the archaeological sites in the Mediterranean zone is adapted to such conditions and is dominated by plants with short life cycles that during the warm months (summer) are in a dormant stage.

Currently the Greek national law prohibits the use of herbicides in and around archaeological sites because chemicals can deteriorate and stain the historical monuments due to the acidity of the herbicide and/or herbicide formulations.

Complete eradication of weeds (vegetation) is not the intent at the archaeological sites, but rather the management of vegetation at the desirable level, which can be a challenging task. The most common weed control methods at archaeological sites are string trimming and hand weeding. Mechanical cultivation could

not be adopted for archaeological sites, due to non-uniform landscape, and potential for mechanical damage of unexcavated archaeological monuments. Therefore, there is interest to develop alternative vegetation control methods for archaeological sites. One such method might be a propane fueled flame weeding, as it is becoming popular in organic crop production.

Propane fueled flame weeding is a non-chemical method for weed control adopted by organic cropping systems, which is the method of weed control that Dr. Knezevic studied from 2008-2014 at Haskell Ag Lab. Weed flaming involves exposing plant tissues to heat produced by a propane burner. Flaming differs from burning, as in flaming the plant biomass is not incinerated, but it is rather heated rapidly causing rupturing of the cell membranes. The cell integrity is disrupted due to protein denaturation and cell membrane destruction, hence, flamed weeds die or their growth ability is severely reduced.

Taking into consideration that flaming is a non-chemical method for suppressing weeds it would be beneficial to study its effectiveness in archaeological sites. Therefore, the objective of the study was to determine the effects of propane dose and multiple flaming operations on weed control at several archaeological sites in Greece.

Experiments were conducted over a period of three years (2013-2015) at three archaeological sites in Greece (Kolona, Ancient Messene and Early Christian Amfipolis), representing different bioclimatic types of the Mediterranean climate. Kolona is located at Aegina island, 20miles south of Athens. Ancient Messene is situated in southwestern Greece (western Peloponnese) while Early Christian Amfipolis site is located in Northern Greece, 40 miles east of Thessaloniki. The main growing season for vegetation in this type of climate is from November until April. From practical standpoint, if weeds are managed until end of April, they are not of major concern during dry hot Summer and Fall due to lack of moisture that promotes emergence or growth of new weed flushes.

Dr. Knezevic designed experiments that involved testing various rates of propane (2-15 Gallons per acre) and multiple timing of flaming operations (1-4 times). Flaming was conducted utilizing a custom designed backpack flamer with a single nozzle hooded boom (see photo). Stevan also visited Greece twice a year to train operators and oversee the progress of the project. Project was funded by the European Union Funds for International Collaboration, which also covered Stevan's travel expenses while in Greece.

Results were clearly visible after first season. All flaming treatments reduced weed growth, while the highest level of weed control was achieved by multiple applications of the higher propane dose. Flaming treatments significantly

reduced weed height across all sites and years. In general, average height decreased with increasing propane dose and number of flaming applications. The flaming treatment applied 3-4 times in 3-weeks intervals reduced vegetation height to about 3” compared to 50” height in nontreated control, suggesting that flaming treatments can be utilized effectively to control vegetation height. Vegetation height was identified by the managers of archeological sites as one of the most important factors contributing to the overall enjoyment of the site. Managers agreed that a 2-3” height is an ideal vegetation height at any historical site. Otherwise taller vegetation can interfere with monument restoration projects, and can also visually impair the monuments or obstruct free access to the site. Since the short vegetation presence is very important to provide a ground cover, the results from this study are encouraging as they suggest that multiple flaming with the dose of about 15 gallon per acre has the potential not only to keep vegetation suppressed for the first 2-3 months of the growing season, but also to keep the vegetation at the desirable height (eg. 3”). Flame weeding can be also combined with other weed control tools (hand weeding, or trimming) as part of an integrated weed management program, especially in those years when weather conditions may not be favorable for flaming (eg. rainy or extremely wet or dry periods. Results of this project were also published as scientific manuscript in *Weed Technology*, the official journal of Weed Science Society of America. For reprints of manuscript or additional information contact Stevan Knezevic (sknezevic2@unl.edu, 402-404-0175)