PLASTIC MULCH COLOR EFFECTS ON ECHINACEA GROWTH, SURVIVAL, AND ROOT PHENOLIC MARKER COMPOUNDS

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ABSTRACT

Colored plastic mulches have been shown to affect growth as well as chemical composition of a number of herbaceous plant species. We tested the effects of blue, dark green (IRT), and red plastic mulches on growth of *Echinacea angustifolia* in a three-year field experiment. Plant survival in the second and third years was significantly higher in the red-mulch treatment compared to the other two colors. There were no significant detectable treatment effects on flower number, leafspot disease incidence, shoot weight, root dry weight, or root phenolic composition.

Keywords

Medicinal herb, coneflower, plasticulture

INTRODUCTION

Many herbaceous plant species have been shown to respond to various colors of plastic mulches with differences in plant growth, form, yield, or even chemical content. For example, basil *(Ocimum basilicum)* grown over yellow and green surfaces produced significantly higher concentrations of aroma compounds and phenolics compared to white, red, black, or blue surfaces. In the same experiment, basil leaves grown over red surfaces had greater area and fresh weight than those developing over black surfaces (Loughrin, 2001). Kasperbauer, et. al. (2001) found that strawberries had different concentrations of aroma compounds and organic acids when grown over red vs. black mulches. Carrot root phenolic concentrations were highest under yellow- or black-covered plots compared to those grown with red, white, blue, or green soil covers, while roots from yellow- and white-covered plots had highest concenterations of b-carotene and ascorbic acid (Antonius and Kasperbauer, 2002). *Echinacea angustifolia* showed

higher second year plant weights when grown on black plastic rather than white or on bare soil in the mountains of North Carolina (Davis and Cox, 2004).

Our objective was to test whether different colored mulches would affect production of medicinal components of *E. angustifolia*, as measured by total phenolic concentration. We also monitored effects of the mulch color on other plant growth parameters, including survival.

MATERIALS AND METHODS

Transplants. Plant material was from two sources: seedlings from locally collected seed, and root cuttings from six mature plants that had been started from seed. The cuttings and seedling plants were started and grown in the greenhouse for eight and twelve weeks, respectively, hardened off for one week, and planted in the field plots in early July, 2002.

Experimental design. The research was carried out at the N.E. Hansen research farm near Brookings, South Dakota. Soil type is Vienna Brookings Complex, silty loam with a pH of 7.6, and organic matter 3.1%. Plots were laid out in a randomized complete block design, with four blocks. The three treatments (blue, dark green (IRT), or red plastic mulch) were applied to 3.2 m x 1 m plots, separated by 1.5 m between plots. Each plot was planted with 9 plants spaced 30 cm apart; there were five seedlings and four clonal plants in each plot. Drip irrigation was laid under the mulch and used only during plant establishment.

Figure 1. Experimental layout of Echinacea plots.

The plots were maintained for three years. Survival and flowering data was collected in early summer and fall of 2003 and 2004, leafspot intensity was visually rated on a 0-5 scale in July 2004, and plants were harvested in Sept. 2004. Whole plants were dug to a depth of 30 cm., which included the majority of the roots, and placed into paper bags for further processing. After recording stem and flower numbers, the shoots were separated from roots, dried, and weighed. Roots were gently washed to remove adhering soil, air-dried for 14 days, and weighed prior to grinding for further analyses. Total phenolic concentrations were spectrophotometrically determined on acetone/water/acetic acid extracts of the ground Echinacea roots using the Folin-Ciocalteu method of Slinkard and Singleton (1977). Phenolic concentrations were expressed as gallic acid equivalents.

Results were analyzed by analysis of variance (MSUSTAT) and means separated by Fisher's Protected Least Significant Difference at p=0.05. Chi-square analyses were used to test for differences across treatments by clone, and Pearson correlations were used to examine relationships between phenolic content and other variables across and within treatments.

RESULTS AND CONCLUSIONS

Plant survival in the second and third years was significantly higher in the plots with red mulch compared to the IRT (dark green) and blue mulches (Fig. 1) We observed no significant treatment differences in early or late-season flower numbers either year, or in leafspot intensity (data not shown). Although root dry weights of surviving plants (Fig. 2) followed the same trend as the plant survival,

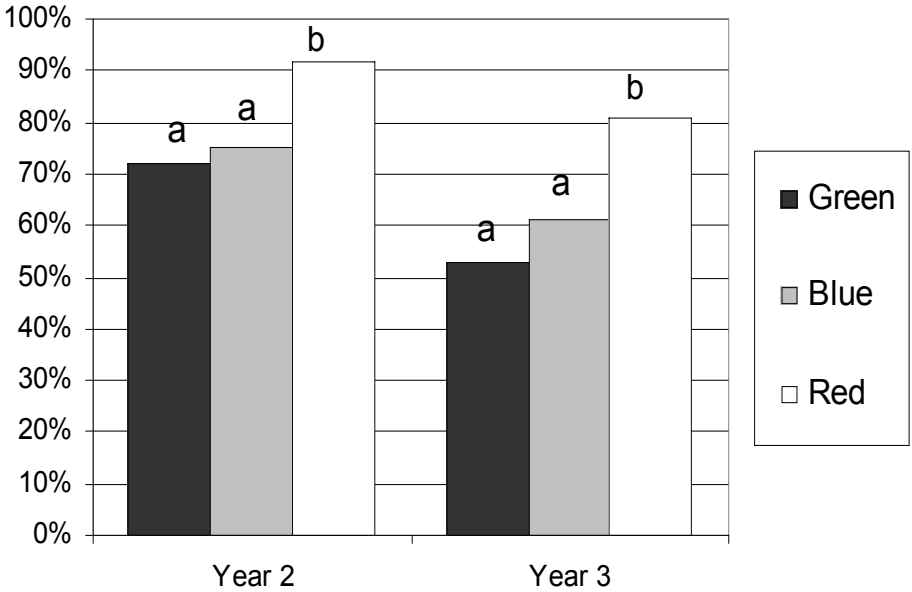

Figure 2. Plant survival.

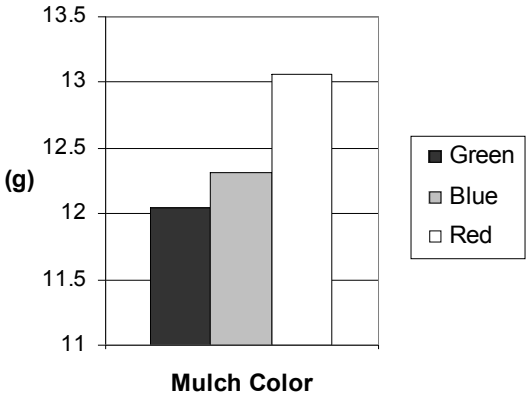

Figure 3. Root dry weight.

differences were not statistically significant. There were also no detectable significant treatment differences in other harvested plant data: stem and flower number, shoot weight, or total phenolic content of the roots, whether across all plants or within clones or treatments (data not shown). Leafspot was negatively correlated (r=-0.335; p=0.006) with root dry weight, suggesting that this disease can significantly impact root yields, and control measures should be considered by growers.

From our results, it appears that growers should consider using the red mulch, as it gave the highest plant survival, and there is no evidence it impacted phenolic concentrations differently than other mulch colors.

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