

REFLECTIVE MULCH AND SHADE CLOTH EFFECTS ON WEED MANAGEMENT IN FIELD-GROWN ZINNIAS IN THE SAN JOAQUIN VALLEY

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Summary

A field experiment near Fresno demonstrated that reflective, silver-over-black polyethylene mulch effectively suppressed weed growth in zinnias (*Zinnia elegans* cv. Dahlia Flowered Blue Point) for cut-flower production. The mulch reduced the time needed to hand-weed plots by 85%, and mean weed biomass per plot by 97%, over the bare soil control. On the other hand, use of polymer shade cloth rated at 30% light reduction had no effect on weed management. Opaque, reflective mulches can be useful for weed management in warm-season ornamental crops in the San Joaquin Valley.

Introduction

Open-field production of ornamental cut flowers in California is concentrated in coastal areas, where moderate temperatures prevail year-around. Cut flower production in the San Joaquin Valley (SJV) is very limited, primarily due to more extreme cold winter and hot summer air temperatures. Zinnias are a heat-loving summer annual valued for use in ornamental borders and beds, and as cut flowers. Due to their environmental preferences, zinnias as a cut-flower crop could be compatible with the hot and dry summer climatic conditions prevalent in the SJV.

Previous studies in the SJV have shown increased flowering and fruiting of a variety of plants as a result of culture under enhanced light conditions using reflective mulches. Some of the benefits have arisen from non-chemical pest management by repulsion of insects (Stapleton and Summers, 2002; Summers et al., 2004) and weed suppression. However, other studies have shown enhanced flowering and fruiting with reflective mulch in the absence of major pests (Mahmoudpour and Stapleton, 1997; Mitchell et al., 2000). In these cases, increased reflected light into the plant canopy has been suggested as the mechanism for the plant responses (Stapleton and Summers, 2002; Summers *et al*, 2004). Apart from numerous pest management benefits, the deployment of mulches and plant coverings provides soil temperature and other micro environmental modifications which may benefit crop growth.

Most of the economically important plants which have been evaluated in conjunction with reflective mulches have been producers of edible products. There is little information available on effects in field-grown ornamental flower or foliage crops. The objectives of these experiments were to evaluate effects of reflective mulch and shade cloth on weed management in zinnias.

Materials and Methods

Zinnia seeds (cv. 'Dahlia Flowered Blue Point') were sown in commercial potting mix and germinated in flats according to standard greenhouse conditions. Plants were transplanted to the field ca. 5 wk after seedling emergence. The reflective mulch treatment consisted of an aluminum metallized over black, reflective polyethylene film placed directly on beds. The low

light treatment beds were tented over the plant canopies with black polymer shade cloth rated at 30% light reduction. The netting was attached to wooden posts ca. 0.91 m (36 in) height above the bed level. A treatment combining the reflective soil mulch and the shade net canopy cover also was done, as was a bare soil control, to give a 2x2 factorial experimental design. Four replicate plots per treatment were used, with each replicate 6 m (20 ft.) long. Guard rows of the zinnia plants were grown around the perimeter and between the replicates of the experimental area. A single flower color series, 'Golden Dawn', was used for all data collection.

Plants were irrigated conventionally using a surface drip system, and received weekly fertigation with 17% calcium-ammonium nitrate (CAN-17) in the irrigation water. Although weed growth was sparse on the planting beds following land preparation, paraquat was applied over the entire experimental area one wk prior to transplanting, followed four days later by hula-hoeing, to eliminate all emergent weeds at the beginning of the field experiment.

Four weeks after transplanting (October 14), a two-man field crew was sent into the experiment to hand-weed each plot. Both men worked together to weed each plot, and they were timed with a stopwatch. Weeds removed from each plot were then loaded into paper bags, screened to remove adherent soil, and placed in a drying oven. Following the drying period, weed masses from each plot were again screened to remove soil, then weighed to determine total weed biomass. Data were analyzed using the GLM procedure in SAS software.

Results and Discussion

The predominant weed taxa in the experimental area were barnyardgrass (*Echinochloa crus-galli*), nutsedge (*Cyperus* spp.), pigweed (*Amaranthus* spp.), and carpetweed (*Molluga verticillata*). The mean time needed by the two field workers to weed each reflective mulch plot was 1.8 minutes, as compared to 11.8 minutes for the bare soil control, 13.1 minutes for the shade cloth, and 2.1 minutes for the combination of the reflective mulch and shade cloth. This translated into an 84.6% time reduction for the reflective mulch over the bare soil control. Factorial ANOVA gave a significant effect of reflective mulch ($P < 0.05$), while the shade cloth factor was insignificant. No significant interaction between the reflective mulch and shade cloth was found.

In terms of total weed dry weight, the reflective plastic mulch was again successful at inhibiting weed growth ($P < 0.05$). The mean dry weed biomass per mulch plot was 8.1 g, compared to 320.6 g per plot for bare soil. This corresponded to a 97.5% reduction in weeds using mulch rather than bare soil. Shade cloth allowed 403.7 g of weed growth per plot, while the combination of mulch and shade cloth allowed 9.8 g. Factorial ANOVA gave no significant effect of shade cloth use, or for the interaction of mulch and shade cloth.

Weed growth on bare soil, whether in open sunlight or under shade cloth, was distributed over the entire bed areas. On the other hand, weed growth in reflective mulch plots was confined to the periphery of the plastic sheets and the planting holes.

Conclusions

This field experiment showed that opaque, reflective polyethylene mulch, but not shade cloth, was effective for managing weeds in zinnias for cut-flower production. The results indicated that reflective mulch can be useful for non-chemical weed management in warm-season ornamental crops in the San Joaquin Valley. Other data not shown here demonstrated that the use of reflective mulch gave increased cut-flower yields, as well.

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References

Mahmoudpour, M.A., Stapleton, J.J. 1997. Influence of sprayable mulch color on yield of eggplant (*Solanum melongena* L. cv. Millionaire). *Scientia Horticulturae* 70:331-338.

Mitchell, J.P., Summers, C.G., and Stapleton, J.J., 2000. Evaluation of reflective and cover crop mulches in fresh-market tomato production systems. *HortScience* 35:392 (abstr.).

Stapleton, J.J., and Summers, C.G. 2002. Reflective mulches for management of aphids and aphid-borne virus diseases in late-season cantaloupe (*Cucumis melo* L. var. *cantalupensis*). *Crop Protection* 21:891-898.

Summers, C.G., Mitchell, J.P., Stapleton, J.J. 2004. Management of aphid-borne viruses and *Bemisia argentifolii* (Homoptera:Aleyrodidae) in zucchini squash by using UV reflective plastic and wheat straw mulches. *Environmental Entomology* 33:1447-1457.