Irrigation and living mulches for improving the longevity of asparagus plantings

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Drought stress can be an important factor contributing to the decline in asparagus fern health and yield. Although asparagus is deep rooted and relatively drought tolerant, soil water content during fern growth is an important determinant of crop yields (Drost and Wilcox-Lee, 1997; Hartman 1981). Drought stress during fern growth can limit the capacity of plants to produce the soluble carbohydrates in roots necessary for high yields in subsequent seasons (Drost and Wilcox-Lee, 1997). Stressed plants may also be more susceptible to fungal diseases that increasingly plague the asparagus industry. Warmer temperatures and more variable rainfall patterns observed in MI in recent years make irrigation an increasingly important tool for reducing risks of yield loss in asparagus production.

Irrigation may also create opportunities for valuable complementary practices including higher planting densities, cover-cropping, and fertigation. In irrigated systems, cover crops growing below the fern canopy may be established with reduced risk of competition for water with the asparagus crop. These “living mulches” may provide several important benefits including soil protection and weed suppression (Brainard et al. 2012). Carefully selected and managed living mulches may suppress weeds without suppressing the crop. Rye living mulches, sown following asparagus harvest have been recommended (e.g. Kuepper and Thomas, 2001) and tried by growers, but few studies have been conducted to evaluate their impact on asparagus or weeds (Paine et al. 1995). When sown in the summer, winter rye can emerge rapidly and suppress weeds, but does not shade crops due to its short growth habit in the absence of vernalization (Brainard and Bellinder, 2004).

METHODS.

Irrigation and living mulch. A field trial was conducted from 2008-2010 at the Asparagus Research Farm in Hart, MI in asparagus (cultivar “Jersey Giant”) that had been established from crowns in 1999. Following the final asparagus harvest in late June, four experimental treatments were established consisting of two different management systems (conventional vs living mulch), each with two levels of irrigation (no irrigation vs irrigation) (Table 1). The same management systems were maintained in the same plots each year from 2008-2010. Conventional management involved use of pre-emergence residual herbicides after harvest, while the living mulch treatments had no herbicide applications following harvest.

Table 1. Summary of treatments examined

	Irrigation	Cover	Tillage	PRE herbicides
1. Herbicide/No irrigation	No	None	No	Dual/Spartan/Karmex
2. Herbicide/Irrigation	Yes	None	No	Dual/Spartan/Karmex
3. Living Mulch/No irrigation	No	Rye	Yes	None
4. Living Mulch/Irrigation	Yes	Rye	Yes	None

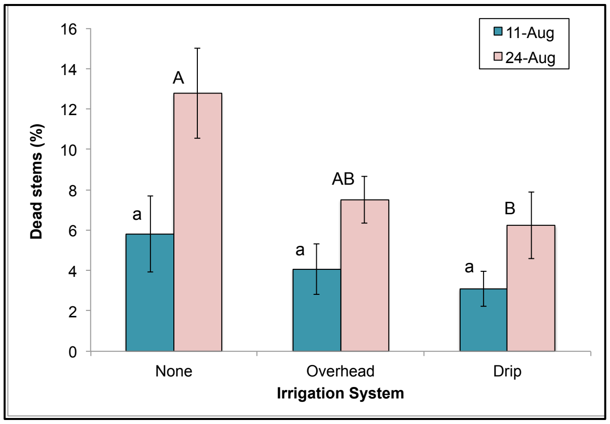
Overhead and sub-surface drip irrigation. A second field experiment was initiated in 2010 in Hart, MI examining irrigation (none, overhead or subs-surface drip) effects on two varieties of asparagus (Guelph Millenium and Jersey Supreme). Crowns were planted at a density of approximately 16,600 per acre in spring 2010. Sub-surface drip tubing was placed below the crowns at planting. In 2011, 0.5"-1" inch of irrigation was applied per event at approximately weekly intervals during dry periods in July and August. Volumetric soil moisture content was monitored at multiple depths with a Diviner 2000 soil moisture probe throughout the summer. In addition, light interception by the developing fern was estimated by measuring photo-synthetically active radiation (PAR) above and below the canopy. Asparagus fern was sampled on 10/4, dried, separated into cladophyll (leaf-like modified petioles) and stem tissue and weighed. A visual rating of purple spot severity and the number of mature marestail (*Conyza canadensis*) plants per plot were assessed in August.

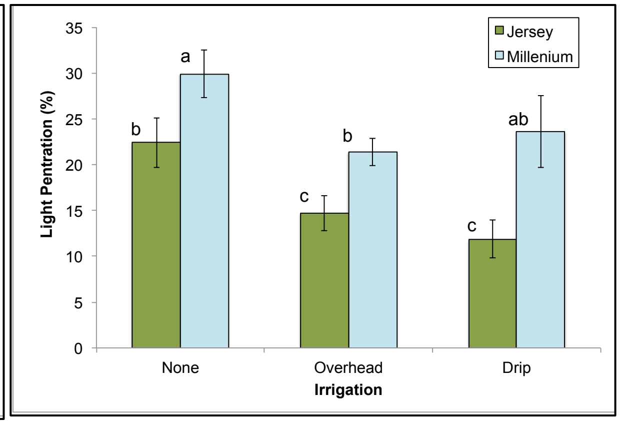
RESULTS

Living mulch effects on soil moisture and weeds. Rye living mulches were effective at suppressing establishment of several fall germinating weeds, including dandelion and horseweed. Under cool conditions rye living mulch also suppressed summer annuals as effectively as residual herbicides. However, under the unusually warm conditions of 2010, rye living mulch failed to effectively suppress either Powell amaranth (*Amaranthus powellii*) or sandbur (*Cenchrus longispinus*). Although Powell amaranth could have been controlled with an application of a post-emergence herbicide like Sandea, grasses like sandbur pose a challenge in fields where rye living mulches are used, since graminicides that kill sandbur, would also likely kill the rye living mulch. In the absence of irrigation, rye living mulches reduced soil available water in early August by 26-52% compared to herbicide treatments. Overall, our results suggest that rye living mulches used in combination with irrigation may benefit asparagus through increases in soil organic matter and reductions in soil erosion while contributing to weed management. However, complementary weed management practices may be needed to avoid buildup of summer annual weeds in rye living mulch systems.

Overhead and sub-surface drip irrigation effects. Soil volumetric water content in irrigated treatments was significantly higher than in the un-irrigated control due to extensive dry periods during much of August. Both forms of irrigation reduced the number of dead stems in asparagus for both varieties during that period (Fig. 1). By the end of August, approximately 13% of stems in non-irrigated controls had died, compared to approximately 7% in irrigated treatments. Not surprisingly, overhead irrigation resulted in higher soil moisture at the soil surface, but lower soil moisture at depth compared to sub-surface drip irrigation. Sub-surface drip irrigation increased cladophyll dry weight of Jersey Supreme. Irrigation also increased overall fern growth and reduced light penetration below the fern (Fig. 2). Trends in both fern dry weight and light penetration suggest that Jersey Supreme fern growth may be more responsive to sub-surface drip irrigation compared to overhead irrigation, and vice-versa for Guelph Millenium. Differences in the rooting patterns of these varieties may explain their varied response to irrigation method.

We had anticipated that overhead irrigation might increase purple spot severity by increasing leaf wetness relative to sub-surface drip and non-irrigated treatments. However, no detectable effect of irrigation on purple spot was detected for either variety in 2011. We also anticipated that overhead irrigation might promote weed growth by increasing moisture availability at the soil surface. However, no effect of irrigation on weeds was detected. Interestingly, marestail density was higher in Guelph Millenium treatments relative to Jersey Supreme treatments, presumably due to greater light penetration under the smaller Millenium fern.





Figures 1 and 2. Effects of irrigation on fern stem death (Fig. 1 L) and light penetration below the fern (Fig. 2 R), 2011.

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