INITIAL WEED-FREE PERIOD AND SUBSEQUENT YELLOW NUTSEDGE POPULATIONS DENSITY AFFECT TOMATO YIELD

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Abstract. **An experiment was conducted to determine the effect of yellow nutsedge (*Cyperus esculentus* L.) times of emergence and densities on tomato (*Lycopersicon esculentum* Mill.). Densities of 0, 25, 50, and 100 yellow nutsedges per m^2 were planted in tomato plots at 0, 1, 3, 5, 7, 9, 11, and 13 weeks after transplanting the crop (WAT). Tomato yield decreased as yellow nutsedge emerged earlier in the season and as nutsedge density increased. Large and extra large fruit yield was reduced by 50% when yellow nutsedge emerged at densities between 50 and 100 plants per m^2 and interfered with tomato season-long. Total marketable yield loss was 25, 55, and 65% when yellow nutsedge emerged at the densities of 25, 50, and 100 plants per m^2, respectively, and interfered with the crop during the entire season. At densities of 25 to 50 yellow nutsedges per m^2, yellow nutsedge suppression for the first 8 WAT would be necessary to prevent >5% total marketable yield loss.**

Yellow nutsedge (*Cyperus esculentus*) is a common weed in Florida (Stall and Gilreath, 2003) known to cause tomato (*Lycopersicon esculentum* Mill.) yield losses >20% when growing unchecked season-long with the crop (Morales-Payan and Stall, 2002). In Florida, tomato is the most important vegetable crop, with an annual worth over $500 million (Florida Agriculture Statistics, 2001). Because of its high produce value, tomato yield reductions are very costly to growers.

The effect of weed interference on crop yield is usually time- and density-dependent, with yield declining as weeds emerge earlier and as density increases (Cousens, 1991). Models estimating the yield reductions caused by yellow nutsedge interference at different densities and times of emergence would be valuable in designing yellow nutsedge management strategies in tomato. The objective of this study was to determine the effect of yellow nutsedge densities and times of emergence on tomato growth and yield.

Materials and Methods

A field experiment was conducted in April-June 1997 at the Suwannee Valley Research and Education Center of the University of Florida near Live Oak, Fla. The experimental units were soil beds 0.7 m wide and 3 m long, mulched with black polyethylene. The soil was fumigated with methyl bromide 10 d before planting, in order to suppress existing weed propagules and other soil pests. 'Solimar' tomato (13 cm tall, 3-4 true leaf stage) was transplanted in single rows at 0.5 m distancing. Yellow nutsedge tubers from Gainesville, Fla., were planted in the tomato beds at 0, 1, 3, 5, 7, 9, 11, and 13 weeks after transplanting the crop (WAT), at densities of 0, 25, 50, and 100 tubers per m^2. The combinations of yellow nutsedge densities and times of emergence were a factorial of additive series (Radosevich, 1997) established in randomized complete blocks with four replications. Yellow nutsedge emerged 3-4 d after planting the tubers, and grew with tomato the rest of the season. Except for yellow nutsedge management, tomato was managed according to University of Florida recommendations for north-central Florida (Hochmuth et al., 1995).

The variables measured in tomato were shoot height and dry weight, concentration of nitrogen (N), phosphorus (P), and potassium (K) in shoot dry matter, and fruit yield. Shoot height was determined 1 WAT and every 2 weeks thereafter. Shoot dry weight was determined at the end of the experiment (13 WAT), cutting the shoots at soil level and drying them in an oven for 48 h at 90 °C. N, P, and K concentrations were determined from the dry matter of tomato shoots collected at harvest; N concentration was determined by the Kjeldhal method (Jones and Case, 1990), whereas P and K concentrations were determined by coupled plasma emission spectrometry (Jarvis et al., 1991). Tomatoes were harvested three times at the mature green or breaker stages, and classified by grades according to USDA standards (Extra large: diameter >7 cm; Large: diameter 6.4-7 cm; Medium: diameter 5.3-6.3 cm (USDA, 1991).

In yellow nutsedge, the variables measured were shoot height and dry weight, as well as tuber number and dry weight. Shoot height was determined weekly after emergence. Shoot dry weight, tuber number, and dry weight were determined at the time of final tomato harvest. Analysis of variance and regression (5% significance level) were conducted with the data.

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Results and Discussion

Yellow nutsedge shoot dry weight decreased sharply as yellow nutsedge emerged later in the season and as density was lower (Fig. 1). Maximum shoot dry weight accumulation at 13 WAT (3 $kg \cdot m^{-2}$) occurred when 100 yellow nutsedge plants per m^2 grew with tomato season-long. In comparison, shoot dry weight accumulation in yellow nutsedge emerging after 7 WAT was reduced approximately 90%.

Tuber number and dry weight accumulation followed the same pattern as yellow nutsedge shoot dry weight (data not shown). At harvest (13 WAT), yellow nutsedge emerging after 7 WAT had not produced tubers, whereas yellow nutsedge emerging 1 WAT at the densities of 25, 50, and 100 plants per m^2 had produced 2150, 2400, and 2900 tubers per m^2, respectively.

Time of emergence, but not density, affected yellow nutsedge shoot height (data not shown). Yellow nutsedge emerging 1-3 WAT was about 65 cm by 13 WAT, but was shorter if emerging later. For example, yellow nutsedge emerging 6 WAT was approximately 33 cm tall by 13 WAT. In contrast, tomato shoot height was not affected by yellow nutsedge interference. Tomato plants reached a maximum height of 67 cm at 5 WAT. Thus, yellow nutsedge emerging 1-3 WAT was about the same height as tomato for most of the season, and competition for light between tomato and yellow nutsedge was likely to occur. Conversely, when yellow nutsedge emerged >3WAT tomato was taller than yellow nutsedge throughout the season, and there would have been less competition for light between tomato and yellow nutsedge.

Tomato shoot dry weight, macronutrient accumulation, and fruit yield decreased as yellow nutsedge emerged earlier in the season and as density increased. In tomato competing with 50 yellow nutsedges per m^2, crop shoot dry weight was reduced by 40% after season-long competition, by 10% when yellow nutsedge emerged later than 7 WAT, and was not affected when yellow nutsedge emerged after 9 WAT. For the yellow nutsedge density of 100 plants per m^2, tomato shoot dry weight was reduced approximately 65% after season-long interference (data not shown).

N, P, and K concentrations in the shoot dry matter of weed-free tomato were adequate for Florida tomato (Hochmuth et al., 1995). Yellow nutsedge interference did not significantly affect N, P, and K concentrations in tomato shoot dry matter (data not shown). However, because yellow nutsedge interference reduced shoot dry weight accumulation in tomato, the amounts of N, P, and K that accumulated in tomato shoot dry matter was reduced proportionally.

Tomato yield was affected by yellow nutsedge interference. Tomato total marketable yield (TMY) decreased sharply as yellow nutsedge density increased and as the initial weed-free period was shorter (Fig. 2). TMY was reduced by 25, 55, and 65% when yellow nutsedge emerged in tomato <2 WAT at the densities of 25, 50, and 100 per m^2, respectively. TMY loss was >10% when yellow nutsedge emerged during the first 3 WAT (25 nutsedges per m^2), 7 WAT (50 nutsedges per m^2), and 8 WAT (100 nutsedges per m^2). The relationship between TMY and time of yellow nutsedge emergence was characterized by the sigmoidal equations $TMY = -8.6 + 44.8/(1+e(-(x-8.5)/-2.5))$, $r^2 = 0.98$ (25 yellow nutsedges per m^2), $TMY = 1.6 + 84.1/(1+e(-(x-1.8)/-2.6))$, $r^2 = 0.98$ (50 yellow nutsedges per m^2), and $TMY = -4.7 + 85.7/(1+e(-(x-3.7)/-2.8))$, $r^2 = 0.97$ (100 yellow nutsedges per m^2). If <5% TMY loss were acceptable, yellow nutsedge densities <25 plants per m^2 could be allowed to emerge in tomato >6 WAT (flowering/fruit set stage). If yellow nutsedge densities of 25 to 50 plants per m^2 were expected, yellow nutsedge would have to be suppressed for the first 8 WAT to prevent TMY >5%. At yellow nutsedge densities >50 plants per m^2, the crop would need to be weed-free for almost 10 WAT (until first fruit harvest) to avoid 5% TMY loss.

Yellow nutsedge interference also affected tomato fruit grade (data not shown). At densities of 50 to 100 yellow nutsedges per m^2, season-long interference reduced large and extra large fruit yield by 50%, whereas at a density of 25 plants per m^2 the large and extra large fruit yield was reduced approximately 30%. To prevent a ≥10% reduction in large and extra large yield, tomato would have to be yellow nutsedge-free at least until the flowering/fruit set stage.

This study showed that yellow nutsedge interference caused increasingly larger tomato yield losses as the initial yellow nutsedge-free period was shorter and as nutsedge densities increased. In this study, yellow nutsedge emerging early in the season competed with tomato for N, P, K, and light. In order to prevent yield loss >5%, yellow nutsedge suppression should last at least until flowering (<25 yellow nutsedges per m^2) or fruit enlargement (<50 yellow nutsedges per m^2).

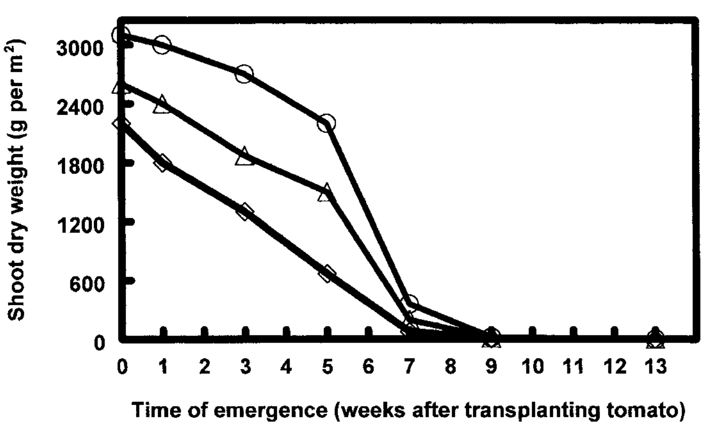

Fig. 1. Yellow nutsedge (yn) shoot dry weight as affected by yellow nutsedge density and time of emergence.

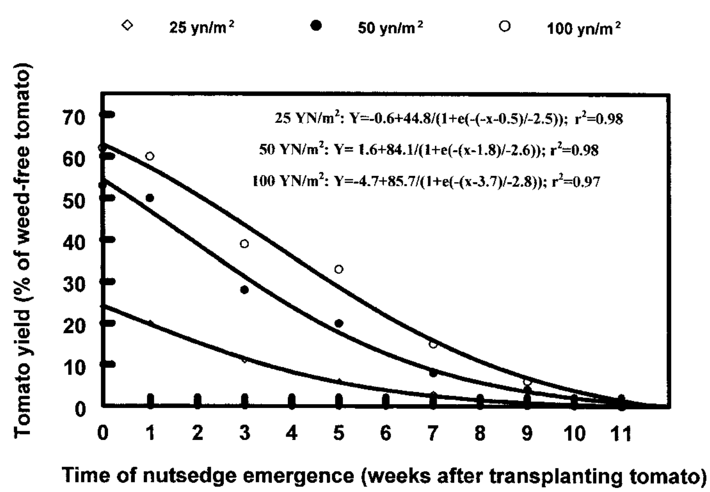

Fig. 2. Tomato yield as affected by yellow nutsedge (yn) density and time of emergence.

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