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IMPACT OF MIXED POPULATIONS OF YELLOW AND PURPLE NUTSEDGES (*CYPERUS ESCULENTUS* AND *C. ROTUNDUS*) ON EGGPLANT YIELD

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Abstract. **The effects of mixed populations of purple and yellow nutsedges (*Cyperus rotundus* L. *and C. esculentus* L.) on the growth and yield of eggplant (*Solanum melongena* L.) were studied in field experiments conducted in Florida. Tubers of purple and yellow nutsedges were planted onto the eggplant soil beds at a fixed density of 60 plants/m² and were allowed to grow alongside the crop season-long. The percentages of yellow nutsedge:purple nutsedge in the mixed stands were 0:100 (pure purple nutsedge stand), 25:75, 50:50, 75:25, and 100:0 (pure yellow nutsedge stand). Eggplant shoot dry weight, leaf area, concentration of nitrogen in nitrate and potassium in leaf petiole sap, and fruit yield decreased as the number of yellow nutsedge plants in the mixed nutsedge stands increased. Tuber productivity, and thus the potential for high nutsedge population densities in the following season, was higher in yellow nutsedge than in purple nutsedge. This results indicate that the percentage of yellow nutsedge in a mixed stand of purple and yellow nutsedges may significantly influence the growth and yield of eggplant, and that it may be more important to suppress yellow nutsedge than purple nutsedge.**

Florida is the leading state in eggplant production in the US, with approximately 30% the total area dedicated to that crop in the country during 2000-2003. In 2001, Florida harvested about 61,000 metric tons of eggplant in nearly 1600 ha, with a value of approximately $14 million (NASS-USDA, 2003). Yellow and purple nutsedges (*Cyperus esculentus* and *C. rotundus*) are weeds commonly found in many Florida vegetables, including eggplant. Nutsedges are considered troublesome weeds because they are abundant and difficult to control with available herbicides, can penetrate polyethylene mulch, and can cause drastic yield losses when left unchecked (Stall and Gilreath, 2003).

Yield losses caused by pure stands of yellow nutsedge or purple nutsedge in solanaceous crops have been reported. In tomato (*Lycopersicon esculentum* Mill.) purple nutsedge interference caused yield loss by 24% (Morales-Payan and Stall, 2002), whereas yellow nutsedge interference reduced yield by 65% (Morales-Payan and Stall, 2003a). In bell pepper, yield reductions due to yellow and purple nutsedges interference were 74% (Motis et al., 2001) and 70% (Morales-Payan and Stall, 2003b), respectively. In eggplant, yield loss was 28% when purple nutsedge interfered with the crop season-long (Morales-Payan and Stall, 2001).

Because nutsedges reproduce primarily by tubers, growers can readily estimate near-future nutsedge densities in a field (and the percentage of yellow and purple nutsedges in the total density) by sampling the soil prior to planting. If crop yield were influenced by the percentage of one nutsedge species in the mixed stand, growers could make proper decisions regarding nutsedge management based on their assessment of the expected composition of the nutsedge population. The effects of pure yellow nutsedge stands and mixed stands of yellow and purple nutsedges on eggplant yield have not been documented. The objective of this research was to determine the extent of eggplant yield loss caused by season-long interference of pure and mixed stands of yellow and purple nutsedges.

Materials and Methods

Field research was conducted in April-June 2003 at the Plant Science Research and Education Center of the University of Florida near Citra, Fla. The experimental plots were polyethylene-mulched soil beds 3.2 m long and 0.7 m wide. Existing weed propagules and other soil pests were suppressed fumigating the soil with methyl bromide + chlorpricrin 10 d before transplanting. With the natural weed population suppressed, the required nutsedge stand densities and mixtures were established by planting nutsedge tubers onto the soil beds at the fixed a fixed density of 60 tubers per m². Nutsedge tubers were planted the same day the crop was transplanted. The percentages of yellow nutsedge:purple nutsedge in the mixed stands were 0:100 (pure purple nutsedge stand), 25:75, 50:50, 75:25, and 100:0 (pure yellow nutsedge stand). 'Santana' eggplant (approximately 14 cm tall and at the 5 true-leaf stage) was transplanted in single rows at 0.4 m distancing between plants and 1.6 m between row centers. The treatments were eggplant grown weed-free or grown with mixed nutsedge populations ranging from pure yellow nutsedge to pure purple nutsedge stands.

Both nutsedge species emerged approximately 4 d after planting the tubers, and were allowed to grow with the crop for the remainder of the season. Aside from nutsedge management, eggplant was managed according to University of Florida recommendations for North-Central Florida (Maynard et al., 2003).

In purple and yellow nutsedges, the variables measured were shoot height, shoot dry weight, tuber number, and tuber dry weight. Shoot height was determined at 2-week intervals after eggplant transplanting. Shoot dry weight was determined by cutting the plants at soil level at the end of the experiment and drying them in an oven for 36 h at 90 °C. Tuber number was determined at the end of the experiment by collecting the tubers in a 30 × 30 cm square towards the center of each plot, within a depth of 20 cm from the soil surface. Tuber dry weight was determined by drying them in an oven for 36 h at 90 °C.

In eggplant, the variables measured shoot height and dry weight, leaf area, concentration of nitrogen in nitrate ([NO_3]) and potassium ([K]) in leaf petiole sap, and fruit yield. Shoot height was determined at 2-week intervals after trans-

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planting. Shoot dry weight was determined at the end of the experiment, by cutting the shoots at soil level and drying them in an oven for 48 h at 90 °C. [N-NO_3] and [K] in leaf petiole sap were determined using ion-specific meters (Spectrum technologies, Plainfield, Ill.). Leaf area was determined detaching the leaves at final harvest and using a scanner equipped with the ASSESS software (APS Press, St. Paul, Minn.). Eggplants were harvested four times when fruits reached commercial maturity. The yield of nutsedge-infested eggplant was compared to the yield of weed-free eggplant. The data were submitted to analysis of variance and regression (5% significance level).

Results and Discussion

The shoot heights of eggplant and purple and yellow nutsedges were not affected by the percentage of purple and yellow nutsedges in the weed stand. Throughout the season, purple nutsedge was shorter than yellow nutsedge and eggplant. In contrast, yellow nutsedge was as tall as eggplant from two weeks after transplanting the crop trough the end of the season (Fig. 1).

Eggplant leaf area at final harvest tended to decrease linearly as the percentage of yellow nutsedge in the weed stand increased. When eggplant competed season-long with pure purple nutsedge stands, eggplant leaf area was reduced by approximately 10% as compared to weed-free eggplant, whereas the reduction in eggplant leaf area was approximately 20% when eggplant competed the entire season with yellow nutsedge (Fig. 2). The effect of purple and yellow nutsedge pure and mixed stands on eggplant shoot dry weight at final harvest was the same as on eggplant leaf area (data not shown).

Eggplant [N-NO_3] and [K^+] in leaf petiole sap tended to decline as the percentage of yellow nutsedge in the weed stand increased. [N-NO_3] and [K^+] in eggplant petiole sap were reduced by approximately 11 and 17% as a result of interference from pure purple nutsedge stands, as compared to weed-free eggplant. In contrast, when pure yellow nutsedge stands interfered with eggplant, [N-NO_3] and [K^+] in eggplant leaf petiole sap were reduced by approximately 25 and 32% (Figs. 3 and 4).

When eggplant competed with pure stands of purple nutsedge, the crop yield was approximately 10% lower than in weed-free eggplant. In contrast, when competing with pure stands of yellow nutsedge, eggplant yield was approximately 20% lower than in control plants. Eggplant yield tended to decrease as the percentage of yellow nutsedge increased and the percentage of purple nutsedge decreased in the mixed nutsedge stand (Fig. 5). Previous reports on the effects of purple nutsedge interference with eggplant indicate that season-long interference from 60 purple nutsedge plants per m^2 reduced 'Jira' eggplant yield by approximately 19% (Morales-Payan and Stall, 1997 and 2001), but no prior references to yellow nutsedge effects on eggplant yield were found.

The shoot dry weight accumulation in the shoots of purple and yellow nutsedge competing with eggplant was significantly affected by the percentage of yellow and purple nutsedge in the weed stand. In pure stands, yellow nutsedge accumulated more shoot dry weight (approximately 1700 g m^{-2}) than purple nutsedge (approximately 500 g m^{-2}) (Fig. 6).

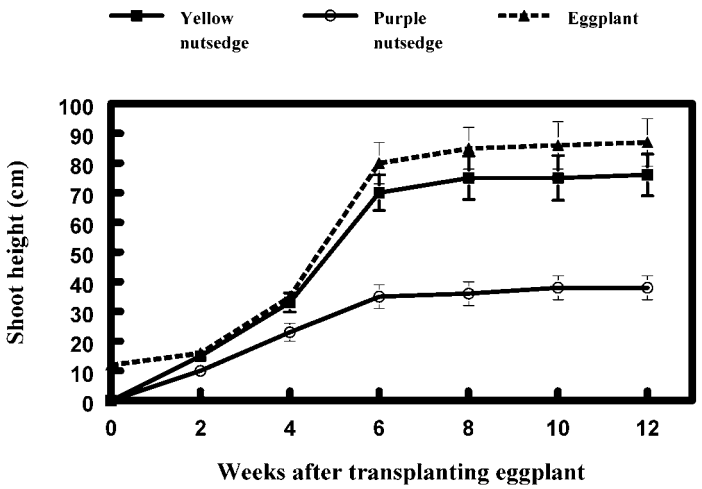

Fig. 1. Shoot height of eggplant and purple and yellow nutsedges during the season.

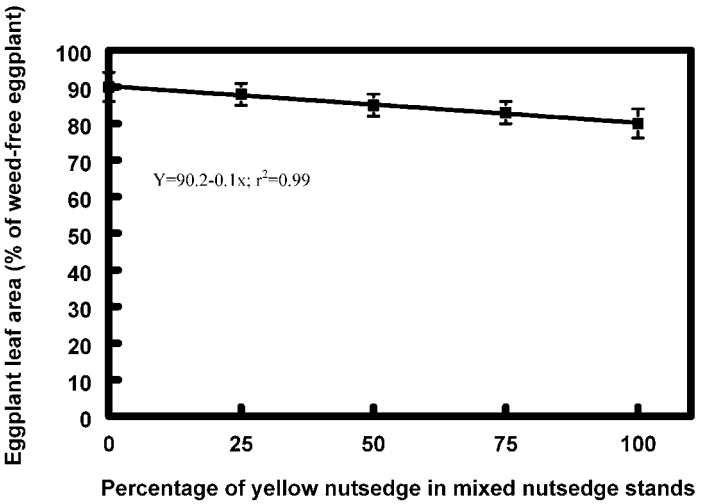

Fig. 2. Eggplant leaf area at final harvest as affected by increasing the percentage of yellow nutsedge in purple and yellow nutsedge stands.

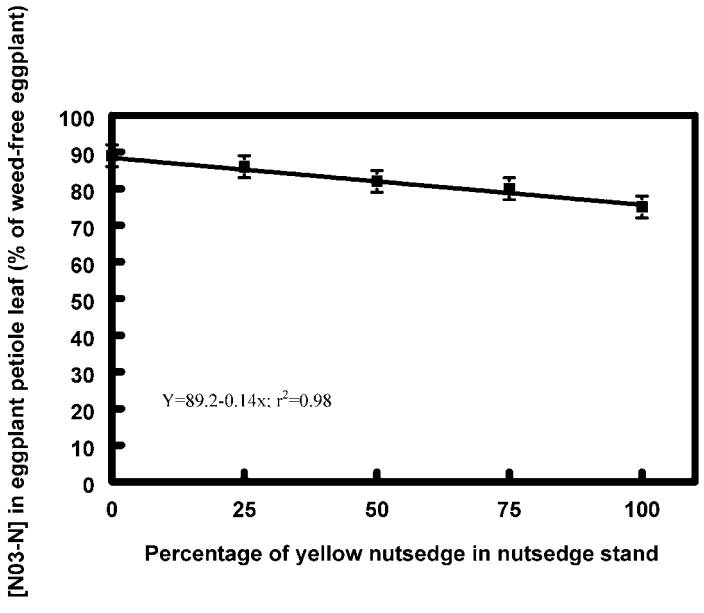

Fig. 3. Eggplant nitrogen in nitrate concentration in petiole leaf sap as affected by increasing the percentage of yellow nutsedge in purple and yellow nutsedge stands.

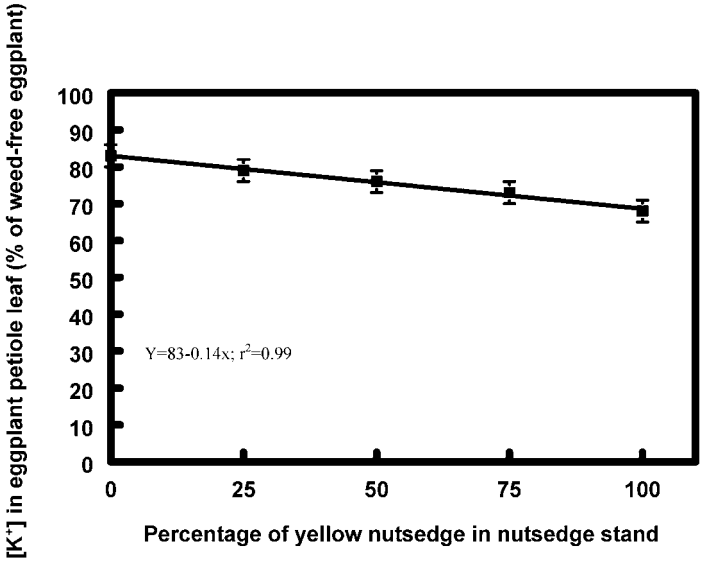

Fig. 4. Eggplant potassium concentration in petiole leaf sap as affected by increasing the percentage of yellow nutsedge in purple and yellow nutsedge stands.

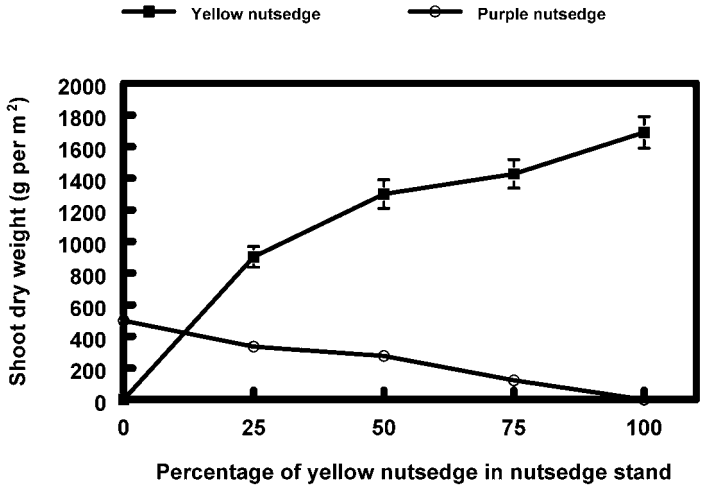

Fig. 6. Purple and yellow nutsedge shoot dry weight at final eggplant harvest as affected by increasing the percentage of yellow nutsedge in purple and yellow nutsedge stands.

Shoot dry weight accumulation in purple nutsedge increased as its percentage in the weed stand increased and that of yellow nutsedge decreased, and vice versa (Fig. 6). If purple and yellow nutsedge were equally aggressive among themselves while competing with eggplant, both nutsedge species would accumulate the same amount of shoot dry weight per area when each were grown as 50% of the weed stand. However, the substitution of one nutsedge species for another in the stand did not result in proportional changes in shoot dry weight accumulation in the yellow and purple nutsedge. Yellow nutsedge seemed to be more aggressive than purple nutsedge, as both species would accumulate the same amount of shoot dry weight when growing in a 13:87 yellow nutsedge to purple nutsedge ratio (or 13% of yellow nutsedge in the mixed weed stand) (Fig. 6). Similarly, yellow nutsedge seemed to be more aggressive than purple nutsedge in terms of tuber production. In pure stands, yellow nutsedge produced approximately 1200 tuber per m^2 by the time of final eggplant harvest, as compared to approximately 500 tubers per m^2 produced by purple nutsedge pure stands in the same time period. In stands with equal number of purple and yellow nutsedges, tuber production was approximately 950 and 200 yellow nutsedge and purple nutsedge tubers per m^2, respectively. Equal tuber productivity (approximately 300 purple nutsedge tubers and 300 yellow nutsedge tubers per m^2) would be reached when yellow nutsedge comprised approximately 20% of the mixed stand and purple nutsedge comprised the other 80% of the stand (Fig. 7).

The effects of purple and yellow nutsedge mixed stands on eggplant leaf area, [N-NO_3] and [K^+], and yield also indicated that yellow nutsedge had a stronger influence than purple nutsedge on all the eggplant variables, since increasing the percentage of yellow nutsedge in mixed weed stands resulted in increased reductions in all the eggplant variables (Figs. 2-5). Although the objective of this research was not to determine the mechanisms of nutsedge interference with eggplant, some inferences on said mechanisms can be made from the results. Eggplant and yellow nutsedge were approx-

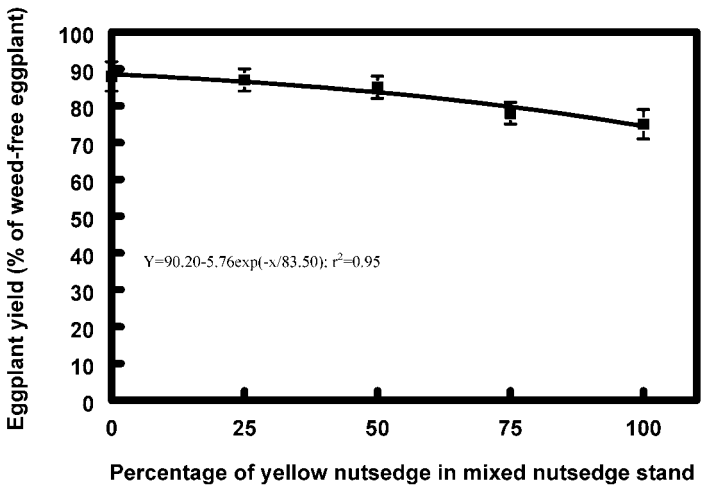

Fig. 5. Eggplant yield as affected by increasing the percentage of yellow nutsedge in purple and yellow nutsedge stands.

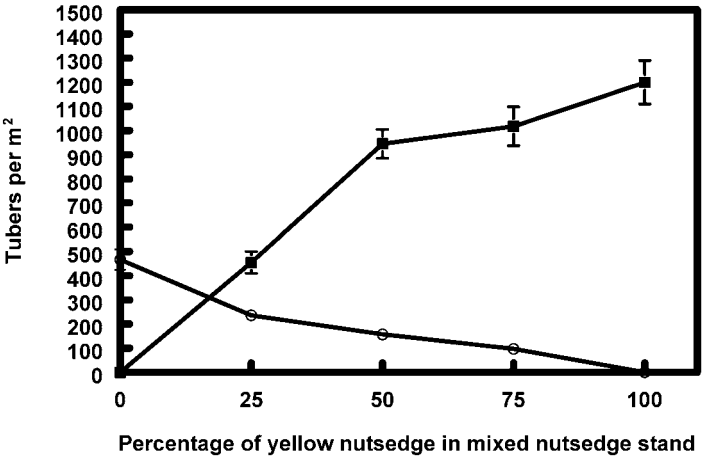

Fig. 7. Purple and yellow nutsedge tuber production by final eggplant harvest as affected by increasing the percentage of yellow nutsedge in purple and yellow nutsedge stands.

imately the same height during most of the season, which may have resulted in mutual competition for light between yellow nutsedge and eggplant. In addition, eggplant leaf area was lower when the crop competed with nutsedge stands having higher percentages of yellow nutsedge, which may have reduced the ability of eggplant to compete for light. In contrast, purple nutsedge was shorter than eggplant throughout the season, and thus it is unlikely that purple nutsedge was a strong competitor for light with eggplant. Our results showed that both purple and yellow nutsedge affected N and K accumulation in eggplant petiole sap, and that in that regard yellow nutsedge exerted a stronger influence than purple nutsedge. Other potential mechanisms of nutsedge interference with eggplant, but cannot be assessed from our results, are allelopathy and competition for water (Carvalho et al., 2002; Mulligan and Jenkins, 1976). Because the crop was adequately irrigated throughout the season, competition for water was probably a minor factor in the overall interference between purple and yellow nutsedges with eggplant. The potential impact of nutsedge allelopathy on eggplant cannot be ascertained from the results of this study.

This research showed that both purple and yellow nutsedges, in pure stands or mixed, may significantly reduce eggplant yield when emerging at an initial density of 60 tubers per m^2 and growing unchecked with the crop during the entire season. Moreover, yellow nutsedge had a stronger impact than purple nutsedge on eggplant growth and yield. Thus, in eggplant fields with mixed stands of purple and yellow nutsedges, the suppression of yellow nutsedge may prove more important than the suppression of purple nutsedge to alleviate potential yield losses. Our results also show that the percentage of yellow and purple nutsedges in mixed nutsedge stands may have implications in terms of nutsedge tuber production, and in turn on nutsedge population build-up for the following season. In that regard, the higher tuber productivity of yellow nutsedge in pure and mixed stands suggests that yellow nutsedge may be more important to suppress than purple nutsedge.

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