EFFECT OF PURPLE NUTSEDGE (*CYPERUS ROTUNDUS* L.) ON COTTON YIELD IN WET AND DRY SOIL CONDITIONS

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Abstract

Purple nutsedge is the predominant nutsedge species in Arizona cotton fields. It is common to find very high density patches (more than 1000 shoots m^{-2}) of purple nutsedge four weeks after planting. Nutsedges are highly competitive, perennial weeds that reproduce rapidly from tubers and rhizomes. These plant characteristics make purple nutsedge a superior competitor with cotton reducing seed cotton yield and quality. One factor that influences the competitive balance between weeds and crops is soil moisture. Since moisture stress shifts the competitive balance in favor of cotton by reducing the interspecific competition, then it may be possible to hinder purple nutsedge growth with a good water management strategy.

Two additive competition experiments (experiments I and II) were conducted at the University of Arizona, Campus of Agricultural Center (CAC) in 1996 and 1997 and at the Maricopa Agricultural Center in 1995. The experiments were conducted in different soil moisture regimes and with various purple nutsedge densities to determine how these factors affected seed cotton yield and the competitive interaction between the two species. Irrigations were scheduled by monitoring cotton leaf water potential (Ψ_L) of the leaf at the fourth node below the terminal. Each year a DP5415 was planted at density of 400,000 plants ha^{-1} and hand thinned to desired cotton density m^{-1} of row when the plants reached the 2 true leaf stage. In experiment I, wet treatments were irrigated when the Ψ_L reached -1.9 MPa. The dry regime was imposed by delaying the first post-planting irrigation until cotton Ψ_L reached -2.5 MPa. Subsequent irrigations were done when Ψ_L in dry treatment reached -1.9 MPa. Cotton was thinned to 10 plants m^{-1} of row growing in native nutsedge patches of various densities (Table 1). Plots were arranged in a randomized complete block design with six replications. In experiment II, the target Ψ_L levels in the wet and dry treatments were -1.9 and -2.5 MPa, respectively, for the entire season. Cotton was thinned to 9 plants m^{-1} of row and four purple nutsedge densities (0, 3, 9, and 18 tubers $m^{-1}$of row) were planted and arranged in a split-plot, randomized complete block design with 6 blocks.

In the additive competition experiment I, there was a linear decrease in cotton stem dry weight (SDW) as purple nutsedge density increased in both wet and dry soil moisture regimes (Fig. 1). At the highest purple nutsedge density (Table 1), 7±0.45 (mean±std. error) and 7.3±0.33 cotton plants were harvested m^{-1} of row in the wet and dry treatment respectively, compared to 10 plants in the 0 nutsedge density plots. Plant height was reduced about 22 percent at the highest purple nutsedge density in both wet and dry treatments.

Seed cotton yield was reduced as purple nutsedge shoot number increased in both wet and dry regimes (Fig. 2). Yield was reduced because of the total number of harvestable bolls m^{-1} of row was reduced as purple nutsedge shoot number increased (Fig. 3). In addition, due to cotton seedling death at the highest nutsedge density, fewer plants were harvested in this treatment. Seed cotton yield and cotton SDW were not affected by the two different levels of moisture stress that were imposed prior to the first irrigation after planting in experiment I.

In the additive competition experiment II, seed cotton yield was no affected by purple nutsedge density in wet regimes (Fig. 4). In contrast, seed cotton yield was reduced as nutsedge density increased in the dry moisture regime where cotton shoot growth and leaf area were reduced and there was less shading of purple nutsedge. This resulted in a longer period of nutsedge interference with cotton before the cotton began to shade the purple nutsedge. Seed cotton yield was reduced (p=0.05) in water stressed treatments compared to the well watered treatments (Table 2). These results were consistent in all experiments where the same target Ψ_L levels were used in the dry treatment for the entire season.

There was no significant interaction between soil moisture effects and purple nutsedge density effects on seed cotton yield and cotton SDW. Purple nutsedge shoot numbers were reduced by 50 percent when water stress was imposed between irrigations for the entire season. However no increase in seed cotton yield due to a reduction in interspecific competition was observed because of the negative effect of water stress on cotton. This means that the interference of purple nutsedge with cotton cannot be reduced through water management. But, based on the results of experiment I and the growth characteristics of indeterminate cotton varieties, we hypothesize that delaying the first post-planting irrigation of some cotton varieties could reduce the competition of purple nutsedge with cotton without affecting final cotton SDW and yield.

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Table 1. Purple nutsedge shoot density in the additive experiment I in the wet and dry treatments at 4 weeks after planting when cotton was at the two true-leaf growth stage.

Year	Moisture	Number of shoots[1]			
		check	low	medium	high
		---------------------------m^{-2}-------------------------			
1996	wet	0	125±24	320±28	496±40
1997	wet	0	135± 23	317± 25	451± 38
	dry	0	75±10	209±39	319±25

[1] Data are means±standard error of six replications.

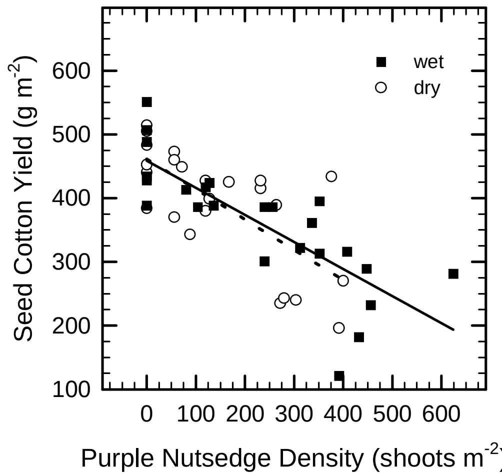

Table 2. Seed cotton yield in plots containing 9 cottons m^{-2} in wet and dry soil moisture conditions in the additive experiment II.

Moisture level	Seed cotton yield		
	1995	1996	1997
	--------------------g m^{-2}--------------------		
wet	568 a[1]	480 a	447 a
dry	442 b	394 b	315 b

[1] Means within a data column followed by same letter are not significantly ($p<0.05$) different using the Tukey HSD test.

Figure 2. Effect of purple nutsedge density on seed cotton yield in wet and dry soil moisture regimes in experiment I. Wet regime is solid line, Y = 458 -0.42X (R^2=0.63, p=0.0001). Dry regime is dotted line, Y = 461 - 0.48X (R^2=0.51, p=0.0001).

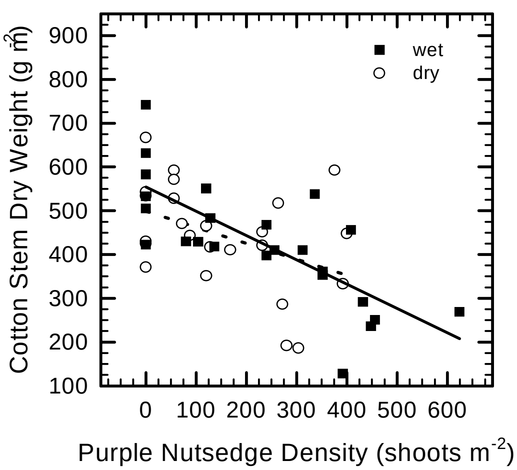

Figure 1. Effect of purple nutsedge density on stem dry weight in wet and dry soil moisture regimes in experiment I. Wet regime is solid line, Y = 554 -0.55X (R^2=0.57, p=0.0001). Dry regime is dotted line, Y = 498 - 0.36X (R^2=0.18, p=0.04).

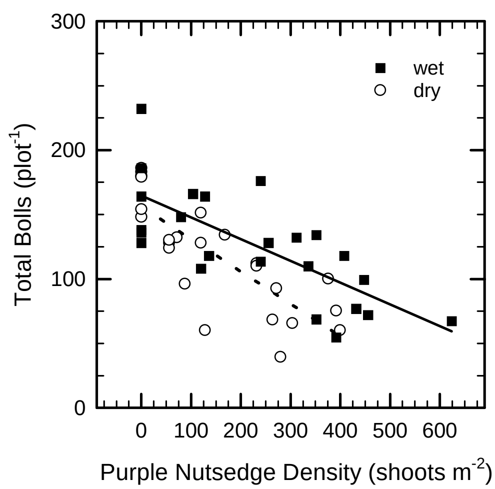

Figure 3. Effect of purple nutsedge density on number of cotton bolls m^{-2} in wet and dry soil moisture regimes in experiment I. Wet regime is solid line, Y = 164 -0.17X (R^2=0.54, p=0.0001). Dry regime is dotted line, Y = 156 -0.25X (R^2=0.64, p=0.0001).

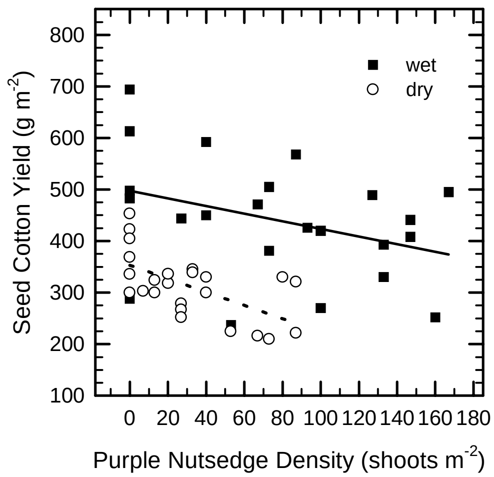

Figure 4. Effect of purple nutsedge density on seed cotton yield in wet and dry soil moisture regimes in experiment II. Wet regime is solid line, Y = 497 -0.74X (R^2=0.14, p=0.07). Dry regime is dotted line, Y = 353 -1.3X (R^2=0.37, p=0.002).