Interference of Silverleaf Nightshade *(Solanum elaeagnifolium)* on Spanish Peanuts *(Arachis hypogaea)*[1]

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ABSTRACT

Interference of silverleaf nightshade *(Solanum elaeagnifolium* Cav.) with Pronto spanish peanuts *(Arachis hypogaea* L.) was evaluated from 1981 through 1983 in a natural occurring weed population. Treatments consisted of weed-free maintenance or weed interference for 0, 4, 8, 12 weeks and for the full season. Silverleaf nightshade stems were counted as a measure of weed regrowth in treatments maintained weed free for 0, 4, and 8 weeks. Contamination of the harvested in-shell peanuts by silverleaf nightshade berries was determined by counting the number of berries passing through the peanut combine. In-shell peanut yields were reduced by an average of 17% when silverleaf nightshade was allowed to interfere with the crop for 4 weeks. Further yield reductions of 53, 66, and 66% were observed in treatments where interference occurred for 8 and 12 weeks and for the full-season, respectively. Regression analysis conducted on yield data of individual years predicts that each week of weed-free maintenance after crop emergence results in an average of 33 to 38 kg/ha yield increase above the unweeded control. Conversely, analyses of yield data averaged over all years indicated that for each week of weed interference there would be approximately a 103 kg/ha decrease in in-shell yield compared to the weed-free control. When yield data were converted to percent of yield of weed-free controls, there was no interaction among years. Regression analysis of the converted data predicts that for each week of weed-free maintenance after crop emergence there would be a 3.7% yield increase compared to the unweeded control and that for each week of weed interference there would be a corresponding yield loss of 4.5%. Silverleaf nightshade stem counts per plot were reduced an average of 18 and 36 percent for treatments maintained weed free for 4 and 8 weeks, respectively. In 1982 analysis of fruit contamination indicated a significant difference between full-season interference and weed-free maintenance for 4 or more weeks. Differences in fruit contamination between 4, 8, and 12 weeks of weed-free maintenance were not significant. In the second year no differences in fruit contamination were observed between the weedy check and the other treatments; however, fruit production after 4 weeks of weed-free maintenance was significantly higher than after 8 and 12 weeks of weed-free maintenance. Peanut quality, disregarding contamination by silverleaf nightshade berries, was not affected by weed interference.

Key Words: Competition, peanut yield, weed fruit production, weed dry weight.

Silverleaf nightshade is a deep-rooted perennial broadleaf weed capable of propagation by seed, root segments, and creeping lateral roots (3). The main vertical root of the weed can penetrate at least 274 cm into the soil (4).

Silverleaf nightshade is a serious weed infesting more than 800,000 ha of cotton in the Southern High Plains of Texas (1). Cotton *(Gossypium hirsutum L.)* and grain sorghum [*Sorghum bicolor* (L.) Moench] yield reductions were proportional to silverleaf nightshade densities (7). Grain sorghum yields were reduced 12 percent from nine silverleaf nightshade plants per m^2 (3). Silverleaf nightshade reduced yields of low growing crops such as canteloupes *(Cucumis melo* L.), watermelon *(Citullus vulgaris* Schrader ex Ecklon and Zeyher), and perennial pastures (4).

Much of the Oklahoma cropland infested with silverleaf nightshade is located in the southern portion of the state, an area commonly associated with peanut and cotton culture. To date no published literature has described the effects of silverleaf nightshade interference on peanuts. However, several researchers (2, 5, 6, 8) have reported results from competition of annual weeds with peanuts. Tifspan or Florunner peanuts kept free of sicklepod *(Cassia obtusifolia* L.). or Florida beggarweed *[Desmodium tortuosum* (Siv.) DC.] for 4 weeks after crop emergence showed no yield reduction (5). Competition from either species for 10 weeks was necessary before yeilds were reduced. York and Coble (8) observed a 25 percent yield reduction in Florigiant peanuts from one fall panicum *(Panicum dichotomiflorum* Michx.) per 4.9 m of row. Seed yield was reduced from as little as 2 weeks of fall panicum interference and peanuts kept weed-free for 8 weeks after crop emergence still yielded less than peanuts kept weed-free all season. Hill and Santelmann (6) reported yield reductions in spanish peanuts when smooth pigweed *(Amaranthus hybridus* L.) and large crabgrass *[Digitaria sanguinalis* (L.) Scop.] were allowed to compete for 4 or more weeks. If peanuts were kept weed-free for 6 weeks after crop emergence, yields were not reduced. Chamblee *et al.* (2) reported that natural infestations of broadleaf signalgrass [*Brachiaria platyphylla* (Griseb.) Nash] removed within 6 weeks of planting did not reduce Florigiant peanut yields. These findings demonstrate that weed species affect peanut yields differently.

The use of selective herbicides to replace cultivation has aided the development of perennial broadleaf weeds (7). Several *Solanum* species, including silverleaf nightshade, are tolerant to the dinitroaniline herbicides such as trifluralin [2,6-dinitro-N,N-dipropyl-4-(Tri-fluoromethyl)benzenamine]. Smith and Wiese (7) suggest that perennial weeds including *Solanum* species have increased in weed control systems utilizing extensive and repeated use of dinitroaniline herbicides.

The objective of our research was to determine the critical duration of weed interference and weed-free maintenance for silverleaf nightshade when grown in competition with spanish peanuts.

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Materials and Methods

Field experiments were conducted under dryland conditons during 1981, 1982 and 1983 near Stratford, Oklahoma, on a Bethany loam (fine, mixed, thermic, Pachic Paleustoll). Soil fertility and pH were satisfactory for the production of peanuts; therefore, additions of fertilizer or lime to the soil were not made. Spanish peanuts cv. Pronto were planted in an area naturally infested with silverleaf nightshade. Trifluralin was applied preplant incorporated at 0.56 kg/ha approximately 5 weeks before planting to control annual grasses and pigweed (*Amaranthus* spp.).

Treatments were arranged in a randomized complete block design with four replications. Individual plots were four rows, spaced 91 cm apart and 10 m in length. To measure the duration of early-season weed interference effects, silverleaf nightshade plants were allowed to compete with peanuts for 0, 4, 8, and 12 weeks before being removed by hand hoeing or handpulling or for the full season. After initial weed removal, the plots were maintained weed-free by hoeing or pulling approximately every 10 days until harvest. The duration of weed-free maintenance effect was measured by maintaining peanuts weed-free with hand hoeing or handpulling for 0, 4, 8, 12 weeks, and for the full season before allowing silverleaf nightshade to emerge and grow undisturbed.

Peanuts were planted on May 22, 1981, June 14, 1982, and June 6, 1983. The later planting date in 1982 was due to more than 39 cm of rain in May. Data collected included in-shell peanut yield and quality analysis and silverleaf nightshade stem counts and fruit counts. Fruit contamination was determined by counting the number of berries found in the threshed peanuts. Weed populations of the entire plot were determined by counting the number of above-ground stems 2 weeks prior to harvest in the plots kept weed-free for 0, 4, and 8 weeks after crop emergence. Plots which were kept weed-free for 12 weeks after crop emergence, but were not weeded after 12 weeks, were reinfested by silverleaf nightshade; however, this regrowth was judged too erratic and counts were not made. Harvest dates were October 24, 1981, November 5, 1982, and October 28, 1983. Quality of the harvested peanuts was evaluated by determining the percent sound mature kernels (% SMK) and percent sound splits (% SS).

All data were subjected to analyses of variance and regression analysis to determine the relationship between duration of silverleaf nightshade interference or weed-free maintenance and in-shell yield and quality. When interaction was not significant, data were pooled over years prior to final analysis. Yield data were converted to percent of yield of weed-free control, tested for year interaction, pooled, and regressed.

Results

Analysis of variance for the treatments designed to measure the effects of duration of weed interference on peanut yield indicated that the treatment by year interaction term was not significant; therefore, the data presented are pooled over years (Table 1). In-shell peanut yield was reduced 17% after 4 weeks of silverleaf nightshade interference, compared to the weed-free check. Further yield reductions were noted when silverleaf nightshade was allowed to interfere for 8 or 12 weeks for the full season; however, statistically significant differences among these treatments were not observed. Regression analysis of the combined data revealed that a curvilinear equation best described the relationship between duration of interference and crop yield. The regression equation predicted approximately a 103 kg/ha reduction in in-shell peanut yield for each week of weed interference. This prediction equation accounted for 68% of the variability in yield.

There was a significant treatment by year interaction for effects of duration of weed-free maintenance; therefore, data for each year is shown separately. Generally, in-shell peanut yield increased as the weed-free period lengthened (Table 1). Significant in-shell yield increases, when compared to the weedy check, were observed at 8, 12, and 4 weeks of weed-free maintenance in 1981, 1982, and 1983, respectively. Linear regression models fit to the data predicted that for each week of weed-free maintenance, after crop emergence, a 38, 33, and 35 kg/ha increase occurred in in-shell peanut yield for 1981, 1982, and 1983, respectively. These equations accounted for 60 to 91% of the variability. The extremely low in-shell yields reported for 1982 were due to a 45-day period from August 1 to September 15 when the experimental area received no precipitation.

When yield data from weed-free maintenance treatments were converted to percent of the weed-free check, the interaction was not significant at the 0.05 probability level. Regression analysis predicted that for each week of weed-free maintenance after crop emergence there would be a 3.7% yield increase compared to the unweeded control (Fig. 1). Regression analysis also predicted that for each week of weed interference there would be a corresponding yield loss of 4.5%. When data were analyzed and presented as yield/ha, there were treatment by year interactions with the weed-free maintenance treatments. Yields from year to year varied; therefore, predictions of future results are difficult if not impossible to make. When these data were converted to yield as a percent of check, the treatment by year interaction was not observed. Even though the actual yields varied from year to year, the percent yield reduction caused by specific interval of interference did not vary from year to year. Therefore, estimates made from percent yield reductions should be a better estimate of weed interference than yield values.

Weed-free maintenance for 4 weeks after crop emergence significantly reduced the number of above-ground silverleaf nightshade stems present when compared to the weedy check for data averaged over all years (Table 2). Further reductions in above-ground stems were observed when plots were kept weed-free for 8 weeks after crop emergence. Regression analysis predicted a decrease of 11 above-ground stems/plot for each week of weed-free maintenance after crop emergence.

Fruit contamination as determined by removing silverleaf nightshade berries from the harvested in-shell peanuts, was obtained in 1981 and 1983. No data were obtained in 1982 since fruit production was very erratic. In 1981 weed-free maintenance for 4 weeks after crop emergence significantly reduced the number of berries recovered in the threshed peanuts (Table 2). Significant differences between 4, 8, and 12 weeks of weed-free maintenance were not observed in 1981. In 1983 no significant differences in fruit production were observed between the check and weed-free maintenance for 4, 8, and 12 weeks. The curvilinear equations predicted that for each week of weed-free maintenance in 1981 and 1983 the silverleaf nightshade berry count could be reduced by 8 and 24 berries, respectively.

Quality analyses determined by the Oklahoma State University Peanut Quality Laboratory in 1981 and 1982 showed that percent SMK and percent SS were not affected by silverleaf nightshade interference.

Table 1. In-shell peanut yield as affected by duration of silverleaf nightshade interference or duration of weed-free maintenance after crop emergence.[a]

Duration of weed-free maintenance or weed interference	Weed interference	Weed-free maintenance		
	all years	1981	1982	1983
(weeks)	(kg/ha)			
0	1213 a	519 a	259 a	451 a
4	1007 b	920 ab	311 ab	1113 b
8	568 c	1137 bc	332 ab	1211 b
12	411 c	941 b	544 b	1227 b
Full season	409 c	1413 c	913 c	1313 b

Regression equations[b]:

Duration of weed interference

(all years) $\hat{y} = 1265 - 103x^c + 3x^2$ ($R^2 = 0.68$)

Duration of weed-free maintenance

(1981) $\hat{y} = 653 + 38x$ ($R^2 = 0.79$)

(1982) $\hat{y} = 177 + 33x$ ($R^2 = 0.91$)

(1983 $\hat{y} = 752 + 35x$ ($R^2 = 0.60$)

[a]Means within a column followed by the same letter are not significantly different at the 0.05 probability level using the LSD.

[b]Regression values were significantly different from zero at the 0.05 probability level. y is an estimate of the dependent variable.

[c]x is equal to the number of weeks of weed-free maintenance or weed interference after crop emergence.

Table 2. Silverleaf nightshade above-ground stem counts and fruit production following a schedule of weed-free maintenance after crop emergence.

Duration of weed-free maintenance following crop emergence	Above-ground stem count	Fruit contamination	
	all years	1981	1983
(weeks)	(stems/plot)	(berries/plot)	
0	245 a	35 a	78 ab
4	201 b	5 b	237 a
8	158 c	3 b	45 b
12	-	1 b	7 b

Regression equations[b]:

Above ground stem count

(all years) $\hat{y} = 245 - 11x^c$ ($R^2 = 0.68$)

Fruit production

(1981) $\hat{y} = 34 - 8x + 0.5x^2$ ($R^2 = 0.97$)

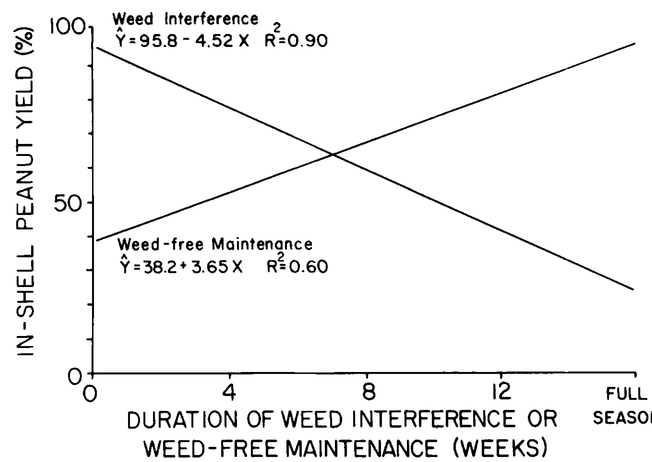
(1983) $\hat{y} = 103 + 27x - 3x^2$ ($R^2 = 0.58$)

[c]Means within a column followed by the same letter are not significantly different at the 0.05 probability level.

[b]All regression values were significantly different from zero at the 0.05 probability level. y is an estimate of the dependent variable.

[c]x is equal to weeks of weed-free maintenance after crop emergence.

Fig. 1. In-shell yields (expressed as a percentage of the weed-free treatments) as effected by duration of silverleaf nightshade interference or duration of silverleaf nightshade weed-free maintenance.



Under nonirrigated conditions, natural infestations of silverleaf nightshade severely reduced in-shell peanut yield from as little as 4 weeks of weed interference. Weed-free maintenance from 4 to 12 weeks was necessary to significantly increase in-shell yield over the weedy check.

In-shell yields reported in this paper were influenced by environmental conditions. In a 41 day span, from June 16 to July 27, 1981, the experimental area received 0.4 cm of precipitation. Similar drought periods occurred from July 29 to September 14, 1982, and from July 5 to August 18, 1983, when the experimental area received 0.9 cm and 3.9 cm of precipitation, respectively.

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