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INFLUENCE OF MIXED POPULATION DENSITIES OF SMOOTH PIGWEED (*Amaranthus hybridus*) AND COMMON PURSLANE (*Portulaca oleracea*) ON LETTUCE (*Lactuca sativa*) DRY MATTER ACCUMULATION

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ABSTRACT. Interference trials were conducted under greenhouse conditions to determine the effects of mixed densities of smooth pigweed and common purslane on the initial growth of lettuce. Weeds were allowed to interfere with lettuce for 30 days before collecting plant dry matter of each species growing in the containers. Densities used were 1, 2, 4, 6 and 8 weeds per container, along with the weed-free control. Monocultures of each weed were established along with the 50:50 proportion within each density, except for 1 plant per container. Interference of monostands of common purslane reduced lettuce dry matter accumulation more than smooth pigweed monostands within each density. Four common purslane plants per container reduced dry matter in as much as 6 or 8 smooth pigweed plants per container. In all cases, within a given density, 50:50 mixture treatments produced more lettuce dry matter than common purslane monocultures.

INTRODUCTION

Lettuce is the most important leafy vegetable crop, based on its market value and surface area planted. Management of this crop requires clean field exempt of insects, diseases and weeds for maximum head marketability. Unfortunately, even though insecticides and fungicides are currently available for controlling insect and diseases, few herbicides are selective for weed control in lettuce allowing naturally occurring weeds to grow practically unchecked. Hoeing and cultivation are frequently used to control most species in lettuce fields. However, these practices could harm lettuce rooting system and be expensive for farmers.

Smooth pigweed and common purslane are among the most noxious weeds in lettuce stands. Previous studies have estimated that about 24 and 48% yield losses can be obtained due to season-long interference of smooth pigweed and common purslane when allowed to interfere individually at a density of 16 plants per 5.4 m^2 (Santos et al. 1997). However, these weeds are commonly found in mixed populations. Because single weed stands are rarely found in agricultural settings, the importance of studying multiweed complexes is emphasized (Sims and Oliver 1990; Street et al. 1985). This type of study would help researchers to devise new management alternatives in terms of predicting economic threshold levels, especially in low-infestation fields (Toler et al. 1996).

Two possible weed associations respecting to the crop can be assessed from these studies: a) non-interactive (neutral), where the expected joint response of one species in mixture with another is equal to the individual responses of both species, and b) interactive, where the expected joint response is not equal to individual responses (Fisher and MacKenzie 1923; Gilbert 1963). Usually, in the latter model joint responses are less than individual.

Additive studies are a valuable tool to study these weed relationships respecting to the crop, because crop density can be maintained constant, a series of weed densities are changed

(Radosevich 1987). In this case, within each total weed density, varying proportions of each weed will be established to assess the mixture effect on lettuce biomass accumulation. The objective of this research was to determine the impact of mixed weed species on head lettuce dry biomass.

MATERIALS AND METHODS

Multiweed species trials were conducted under greenhouse conditions during spring and summer 1997 at the University of Florida, Gainesville. 'South Bay' crisphead lettuce, smooth pigweed and common purslane seeds was planted in multicell flats (3 cm^3/cell), filled with a potting medium composed of 50% vermiculite, 30% perlite and 20% spaghnum peat. Once seedlings reached the two-true leaf stage, they were transplanted to 2.5 l plastic containers filled with the same potting medium described above.

One lettuce plant was transplanted in the center of each pot, while 0, 1, 2, 4, 6 or 8 weeds per container were also transplanted in a circular pattern around each lettuce plant. Three smooth pigweed to common purslane proportions were established within each weed density (100:0, 50:50 and 0:100), where 100:0 and 0:100 indicated smooth pigweed and common purslane monocultures, respectively. When weed density was 1 plant per container only monocultures were planted. An example of a given treatment would be if a density of 8 weeds per pot is chosen in a 50:50 ratio, then a lettuce plant will be at the center with 4 plants of each weed surrounding it. Weeds were allowed to interfere for 30 days.

Fifteen treatments were arranged in a completely randomized design with four replications. Shoot dry weights of each species involved were collected 30 days after transplanting and subjected to analysis of variance (ANOVA) at the 5% significance level to test for weed density effects. Standard error bars were calculated to separate treatment means, if differences were found. Percentage of lettuce dry weight reductions due to weed interference was also calculated and submitted to analysis as outlined above.

RESULTS AND DISCUSSION

Significant differences among treatments were found to influence lettuce shoot dry weight. With only one weed growing per container, common purslane reduced lettuce biomass in 38%, whereas smooth pigweed reduced it in only 4% respecting to the weed-free control (Figure 1). As weed density increased to 2 plants per container, lettuce yield reductions reached 85, 50 and 65% with 2 common purslane, 2 smooth pigweed plants and 1 of each species (50:50 mixture). Maximum lettuce biomass reductions (-90%) occurred at a density of 4 and 6 common purslane and smooth pigweed per container, respectively. As shown in Figure 1, 50:50 mixtures produced intermediate lettuce biomass reductions respecting to weed monocultures.

Based on these findings, common purslane seemed to be the dominant species in weed mixtures, since it took 6 smooth pigweed plants to equal the amount of lettuce dry biomass reductions achieved by only 4 common purslane plants (-90%). This occurrence is reflected on the weed mixture at 4 plants per container, where apparently common purslane contributes more to the overall extent of interference, since smooth pigweed values (-75%) were smaller than the mixture (-85%).

From the data presented herein, it is obvious that the non-interactive (additive) model does not apply to the relationships between smooth pigweed and common purslane. Instead, interactions between the weed species occurred, since lettuce dry shoot biomass in mixtures was less than the combined effect of individual densities. For instance, in the 50:50 mixture at 4 plants per container (2 plants of each species), reductions of 85% were obtained, whereas individually 2 plants of smooth pigweed and common purslane each reduced in 50 and 85%, respectively. A possible explanation for this negative interaction can be that once weeds are outcompeted lettuce, they start interfering with each other for exploitation of common resources, such as water and space. Once a density of 6 plants was reached a plateau for lettuce reductions was attained, where further weed density increases will not decrease lettuce biomass even further.

This type of results are useful in low-density field situations where initial weed populations of smooth pigweed and common purslane can occur early during crop establishment, causing irreversible yield reductions. Further research is needed to determine the effect of season-long interference of mixed populations of these weed species under field conditions, and how growing factors (i.e. nutrients and water) can alter these relationships.

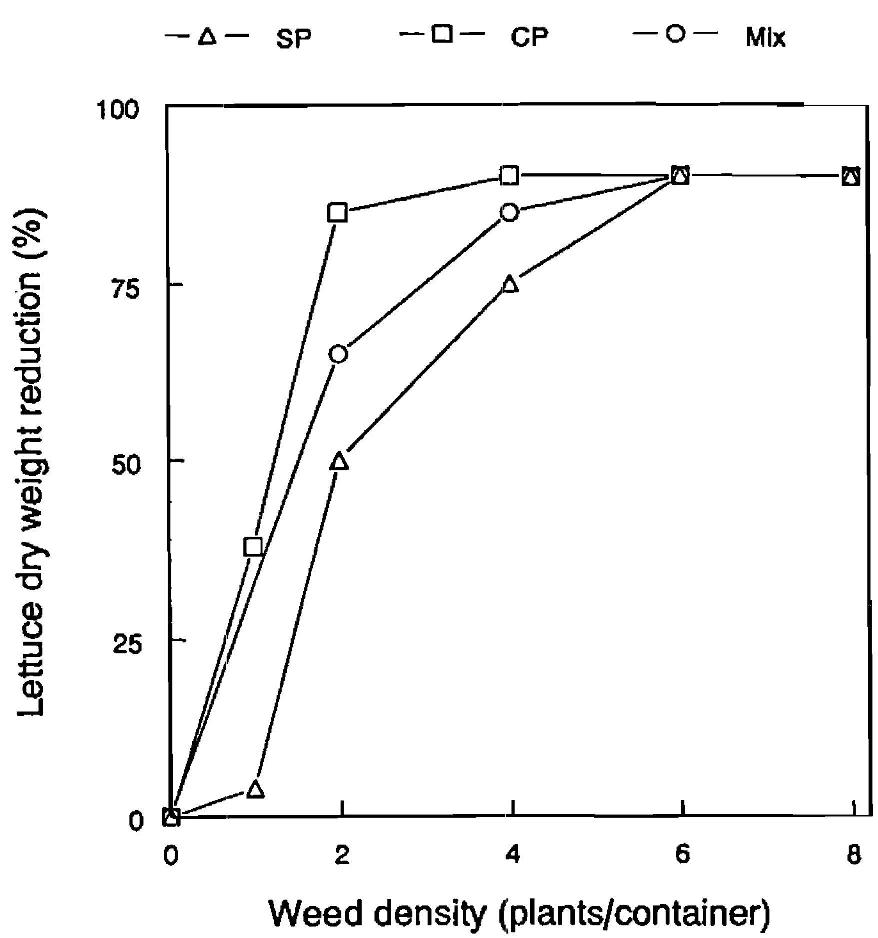

Figure 1. Percentages of lettuce dry weight reduction caused by varying smooth pigweed (SP) and common purslane (CP) densities in monocultures and 50:50 mixtures (Mix).

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