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COMMON LAMBSQUARTERS (Chenopodium album) AREA OF INFLUENCE ON LETTUCE (Lactuca sativa) UNDER DIFFERENT PHOSPHORUS FERTILITY REGIMES

B. M. Santos, J. P. Morales-Payan, J. A. Dusky and W. M. Stall. Horticultural Sciences Department, University of Florida, PO Box 110690. Gainesville, Florida, USA 32611

ABSTRACT. Area of influence experiments were established on high-organic matter soils to assess the effect of varying common lambsquarters distances on lettuce marketable yield and quality under two phosphorus (P) regimes. Banded (125 Kg/ha) or broadcast (250 Kg/ha) P was applied before lettuce planting. A single 2-week-old common lambsquarters plant was transplanted in the center of each lettuce bed. Lettuce plants were arranged in pairs from the distance to the lambsquarters plant of a given treatment. A weed-free control was also established. Lettuce plants were harvested in pairs at distances of 0, 25, 50, 75, 100 and 125 cm to each side of the lambsquarters plant after season-long interference. Average head fresh weight was collected. Results indicate that lambsquarters severely reduced fresh weight and quality of lettuce plants as spacing decreased. In all cases, banded P diminished the impact of lambsquarters on lettuce. Lettuce pairs grown at 75 cm or more from lambsquarters were apparently not affected by weed interference when P was banded, whereas no effect was present at 100 cm or more when P was broadcast. These data indicates that banding P gives an additional advantage to lettuce within a given distance, reducing the area of influence of lambsquarters.

INTRODUCTION

Lettuce profitability depends on the establishment and maintenance of healthy stands to obtain high quality heads. Among the many pests that could occur in lettuce fields, weeds are the most noxious since they compete with the crop for essential growth elements such as water, light, space and nutrients. Common lambsquarters is a troublesome weed in lettuce fields in southern Florida. Because of its fast growth rate, profuse rooting system and shading ability, this annual species can outcompete lettuce causing significant yield losses. Currently, the most common weed control means used against common lambsquarters are hoeing and cultivation. These methods not only could damage lettuce roots, but also are expensive and time-consuming activities. At the same time, rational decisions have to be made about weed control measurements, since they should not be implemented unless the value of increased yields due to control are greater than the cost of controlling. Therefore, the nature of weed competition and its damages have to be studied.

More than 90% of the lettuce planted in the state of Florida is produced in the histosols of the Everglades Agricultural Area (Dusky and Stall 1995). These soils are naturally deficient in phosphorus (P), an essential element for plant growth, mainly due to the lack of free carbonates, and aluminum and iron oxides that could retain phosphates for further release (Sample et al. 1980). In order to obtain healthy lettuce stands, large amounts of P have to be provided to the crop. However, since common lambsquarters also requires P for growth, competition for this element with lettuce may occur.

Previous studies have demonstrated that nutrients can change the crop/weed relationship in favor of either the weed (Carlson and Hill, 1986; Morales-Payan et al. 1996; Okafor and DeDatta, 1976) or the crop (Santos et al. 1997). In most cases, nitrogen (N) has been the focus of this type of studies (DiTomaso 1995). However, several reports have targeted P as the critical competition factor. Santos et al. (1997) suggested that banding P in lettuce fields can change the population density and initial period of interference necessary for smooth pigweed (Amaranthus hybridus L.) and common purslane (Portulaca oleracea L.) to reduce lettuce yields. Similar findings were obtained by Shrefler et al. (1994) dealing with lettuce-spiny amaranth (A. spinosus) complexes.

The constant search for new production techniques leading to less expensive and more efficient weed management strategies have led researchers to investigate about the nature of weed interference in crops. Among the multiple approaches used in Weed Science to assess the damage of a given weed on a crop, area of influence experiments are seldom understood and utilized. Under this type of studies, the effect of a single weed plant on crop growth is estimated by measuring crop responses at regular intervals from the weed (Oliver and Buchanan 1986). The validity of the information obtained by this methodology is applicable in situations where low weed densities are present and questions about the possible impact of scatter plants on yields are unanswered (Jordan 1989), allowing to estimate distances from where a single weed have an influence on the crop. The main objectives of this research were (1) to determine the zone of common lambsquarters influence on lettuce yields under two different P fertility regimes, and (2) to compare the effect of banded and broadcast P on the zone of influence of common lambsquarters on lettuce fresh weight.

MATERIALS AND METHODS

This research was conducted at the Everglades Research and Education Center of the University of Florida, Belle Glade, Florida., from September 1996 to January 1997. A soil classified as a Pahokee muck (Euic hyperthermic Lithic Medisaprist) was utilized. As revealed by soil tests, soil fertility in terms of P was low (3.0 mg/L water-extractable P) and insufficient for optimum lettuce growth (Hochmuth et al. 1994; Sanchez et al. 1990). Insect and disease control, irrigation and fertilization (nutrients other than P) were achieved by following current recommended management practices.

Crisphead lettuce (cv. South Bay) was directly sown in twin rows on top of 0.9-m wide flat beds. Each row was separated at approximately 30 cm. Phosphorus was applied either banded 5 cm beneath each lettuce row at a rate of 125 Kg/ha or broadcast at a rate of 250 Kg/ha. After crop emergence, a single common lambsquarters seedling in the two-true leaf stage was transplanted in the middle of each treatment. Experimental units were approximately 2.7 m^2 (3 m by 0.9 m). Each treatment had 8 experimental units (16 lettuce rows). As indicated by head firmness of control plots, trimmed lettuce heads were harvested in pairs to each side of the common lambsquarters plant and their fresh weights were averaged. Distances studied were 0, 25, 50, 75, 100 and 125 cm from the weed.

Treatments were organized in a randomized complete block design with four replications. Data collected was analyzed for significant P and distance effects (P=0.05) by using multivariate analysis of variance (MANOVA) (Jordan 1989, SAS 1985). Single degree-of-freedom contrasts were calculated to compare treatments.

RESULTS AND DISCUSSION

Symmetric weed effects were observed on lettuce head weight regardless of P fertility utilized, indicating equal interference of the weed to either the left or the right side of each row (data not shown). Therefore, results from only the right side of the weed are presented (Figure 1). Lettuce fresh weight was interactively influenced by lambsquarters distance and P fertility regime. In all cases, lettuce yield increased as distance from the common lambsquarters plant increased. However, when P was banded, lettuce yields were greater within a given distance compared with the broadcast P treatment, except at 0 and 25 cm away from the weed where both fertility regimes had similar impact on lettuce fresh weight (Table 1).

Table 1. Mean comparisons of lettuce head fresh weights at different distances from the weed under two P fertility regimes.

	Lettuce fresh weight per head (Kg)	
Weed distance (cm)	Broadcast P	Banded P
0	0.42	0.42
25	0.42	0.42
50	0.45	0.52
75	0.56	0.76
100	0.67	0.74
125	0.68	0.75
Weed-free control	0.69	0.74
Single degree-of-freedom contrasts		
Control vs.		
All	**	**
0 cm	***	***
25 cm	***	***
50 cm	***	*
75 cm	*	NS
100 cm	NS	NS
125 cm	NS	NS
0 cm vs.		
25 cm	NS	NS
50 cm	NS	*
75 cm	*	***
100 cm	***	***
125 cm	***	***
25 cm vs.		
50 cm	NS	*
75 cm	*	***
100 cm	***	***
125 cm	***	***
50 cm vs.		
75 cm	*	**
100 cm	***	**
125 cm	***	**
75 cm vs.		
100 cm	*	NS
125 cm	*	NS
100 cm vs. 125 cm	NS	NS

*NS, *, **, *** : Nonsignificant or significant at P≤ 0.05, 0.01 and 0.001, respectively.*

When P was banded, no decrease in the crop fresh weight was measured at a distance of 75 cm or further from the common lambsquarters plant. This critical distance increased to 100 cm when P was broadcast. Reductions of 39, 39 and 35 and 19% occurred at distances of 0, 25, 50 and 75 cm with broadcast P respect to the weed-free control, whereas 43, 43 and 30% losses were measured with banded P (Figure 2).

Knowing that broadcasting P increases the opportunities for the weed to uptake P as opposed of banding which concentrates this nutrient around lettuce rooting system, it can be concluded that the area of influence of common lambsquarters on lettuce increases with P supply respect to the weed. These findings show that the presence of common lambsquarters in low densities can impact lettuce yields at distances of up to 100 cm. At the same time, alternative fertilization practices, such as banding, could aim to alter the nature of weed/crop relationships in favor of the crop.

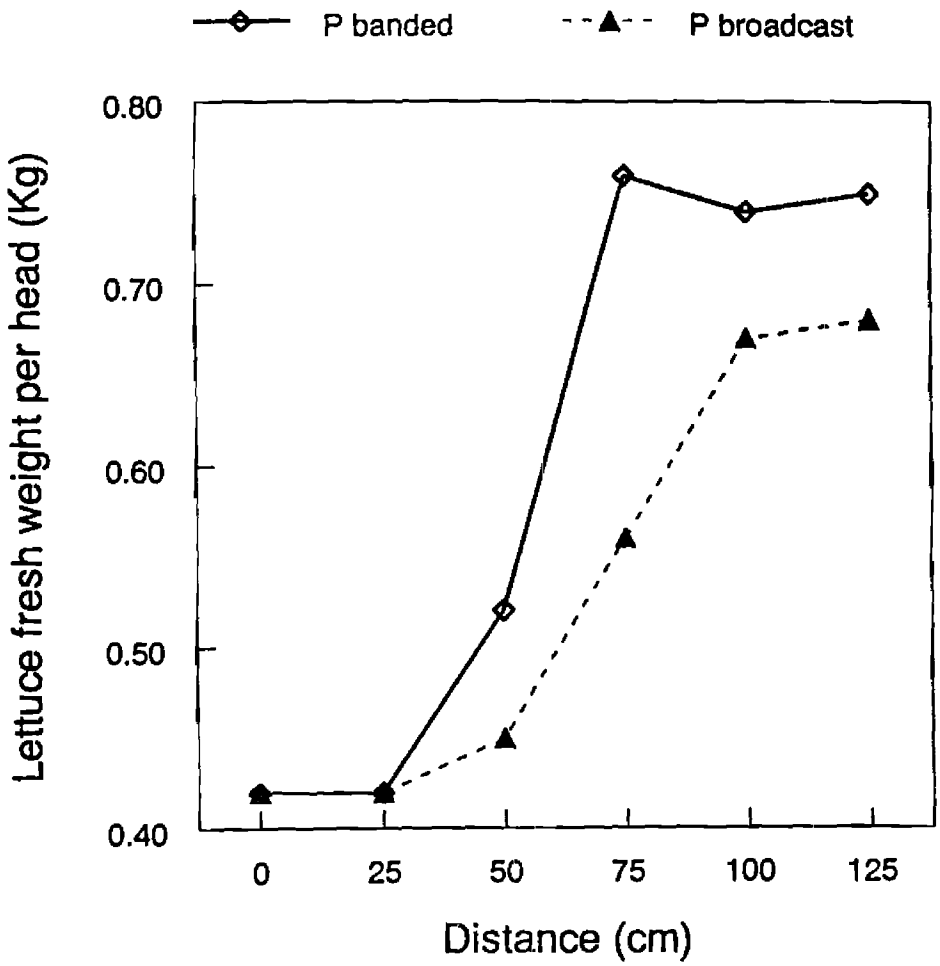

Figure 1. Effects of common lambsquarters distances on lettuce head fresh weight under two different phosphorus regimes.

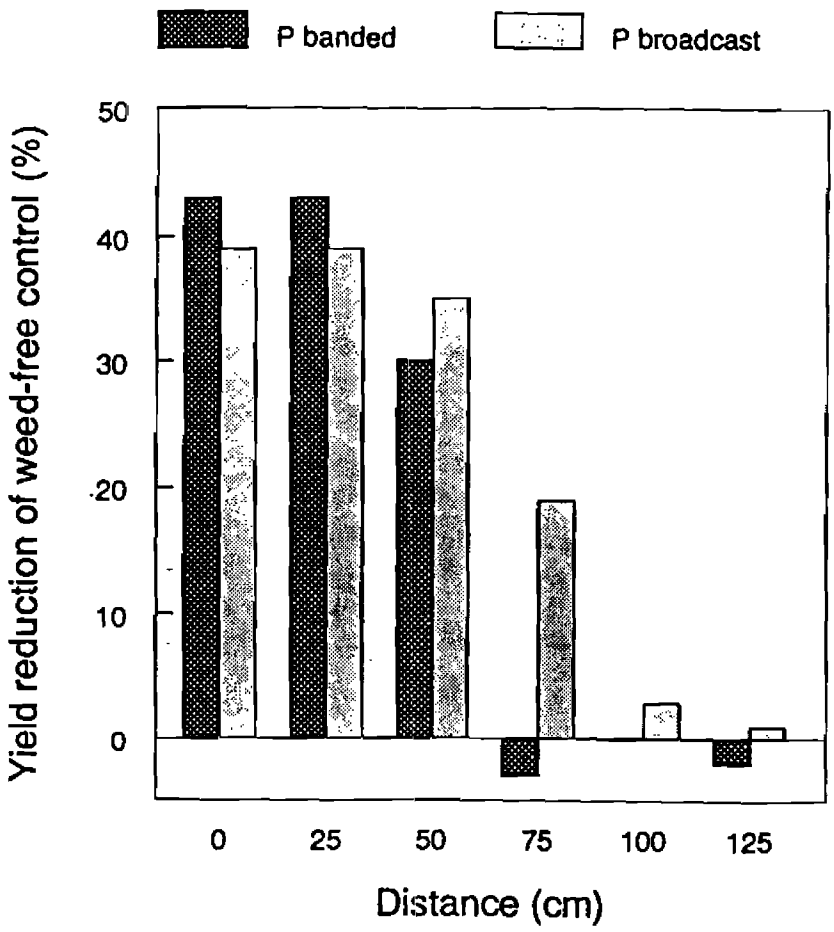

Figure 2. Lettuce yield reductions compared to the weed-free control as affected by common lambsquarters distances and phosphorus fertility regimes.

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