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Investigation of the competitive ability of Different Lentil in the Root

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Abstract
An experiment was conducted to examine the extent of root and canopy interference of lentil (*Lens culinaris* L.) with wild lettuce (*Lactuca serriola* L.). Wild lettuce was surrounded with either two or eight lentil plants. There were different types of competition: no competition, shoot competition, root competition and full competition (root and shoot). The performance of wild lettuce grown in full competition with two lentil plants was the same as that grown with root competition only. Also, there were no significant differences between wild lettuce grown with lentil canopy shade and the control, where there was no competition. On the other hand wild lettuce grown with eight neighbours was significantly suppressed in full, canopy or root competition.
Keywords *Lactuca serriola* L., wild lettuce, lentil, root competition, shoot competition

1. Introduction

Competition can be below-ground and/or above-ground. One mode of competition will always be more important. This depends on the species, environment, and the resource availability. Understanding the mode of competition can help us to manage weeds in crops better. To address this need, different techniques are reviewed by McPhee and Aarssen (2001). The authors proposed that the target techniques in which plants are fully surrounded by competing neighbours is more realistic than the other methods. In this method resource depletion occurs from all directions and there is no way of escaping for the target plant. This is especially more important in shoot competition when the direction of light changes during the day. Mechanism of interference may be dependent on the effect of the plants on resource and their response to changed resources (Day et al. 2003). The aim of this study was to evaluate the influence of four modes of competition on the growth of wild lettuce, to assess the relative importance of root and/or canopy interaction of Lentil with this weed.

2. Materials and Methods

Pots filled with a 1:1:1 mixture of sandy loam clay with 2.5 g of granular 15: 18: 12 NPK fertilizer and placed in a controlled glass-house. Treatments consisted of four types of competition and two levels of competing neighbors surrounded an individual wild lettuce as target (Table 1). Each experiment was completely randomized with four replications.

Table 1.The competition types: no competition (NC), shoot competition (SC), root competition (RC), and full competition (FC) with different number of neighbors surrounded them. The volume of soil available for target plant was equal in all the treatments, V=0.2 m^3

Type of competition	Number of neighbours	Available soil volume for the target plant
No competition	0	V/3 and V/9
Shoot competition	2 and 8	V/3 and V/9
Root competition	2 and 8	V/3 and V/9
Full competition	2 and 8	V/3 and V/9

In root competition treatment (RC), canopy competition was prevented by holding back the neighbours using a wire. For the shoot competition treatment (SC), deep cardboard sheets were used to separate the roots of target plant from those in neighbour plants. In no competition treatment (NC) an individual wild lettuce was planted in the middle of pot placed faraway from the other pots and for full competition (FC) one Wild lettuce was planted with two or eight lentil surrounding it in the same pot (Fig 1).

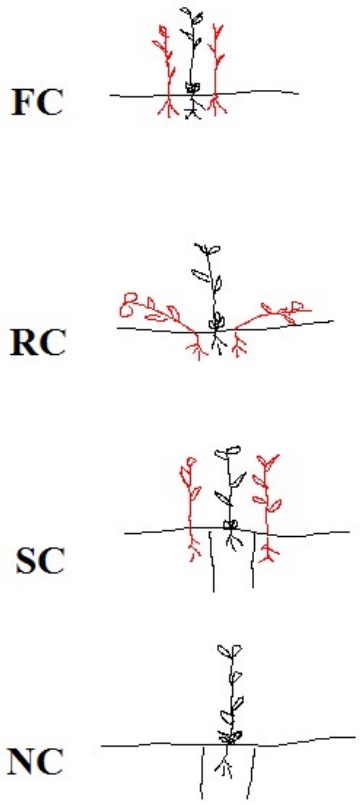

Fig. 1. Protocol for the modes of competition when the number of neighbours was two; for full competition (FC) one wild lettuce was planted with two lentil surrounded it in the same pot. In root competition treatment (RC), canopy competition was prevented by holding back the neighbours using a wire. For the shoot competition treatment (SC), deep cardboard sheets were used to separate the roots of target plant from those in neighbouring plants. In no competition treatment (NC) an individual wild lettuce was planted in the middle of pot located far away from the other pots.

The amount of soil availability for the target plant was the same in all the treatments (Table 1). Plants were grown under natural day-length at 17 ± 2 and 14 ± 1 ºC during day and night, respectively. There was no limitation in the amount of water. In both experiments wild lettuce plants were grown till senescence and then harvested. Before the harvest, the heights of plants were measured and the numbers of lateral branches were counted then plants removed from the pots and the soil from the roots was washed. Above ground and below ground parts of the plants were dried and the resulting data was analysed using one way ANOVA.

3. **Results**

There were no significant differences ($P > 0.05$) between no competition (NC) and shoot competition (SC) or root competition (RC) and full competition (FC) treatments in performance of wild lettuce grown in the presence of two Lentil plants (Table 2). The canopy and root biomass,

height and number of branches were decreased significantly ($P < 0.05$) in both RC and FC in comparison with those in NC and SC. However, the growth and development of wild lettuce was extremely sensitive to high population of Lentil (8 plants). The canopy biomass, root biomass, height and number of branches of wild lettuce were significantly decreased in SC, RC and FC (Table 3). For example, the canopy biomass was approximately decreased 64.8, 77, and 82% in SC, RC, and FC, respectively, in comparison with the one in NC.

Table 2. Wild lettuce responses[&] to low population of lentil (2 plants) in different types of competition; NC: no competition (control), SC: shoot competition, RC: root competition and FC: full competition

Type of competition	Canopy biomass (gr/plant)	Root biomass (gr/plant)	Height (cm)	Number of branches per plant
NC	30 (3.6) a	5.6 (0.4) a	101 (8.5) a	13 (1) a
SC	27.5 (0.5) a	5 (0.4) a	104 (7) a	7 (1) b
RC	15 (0.8) b	3.2 (0.5) b	84 (2) b	1 c
FC	13 (0.5) b	3 (0.1) b	83 (3) b	0 c

[&]Means (SE) within the same column followed by the same letter are not significantly different

Table 3. Wild lettuce responses[&] to high population of lentil (8 plants) in different types of competition; NC: no competition (control), SC: shoot competition, RC: root competition and FC: full competition

Type of competition	Canopy biomass (gr/plant)	Root biomass (gr/plant)	Height (cm)	Number of branches per plant
NC	27 (0.6) a	5 (0.05) a	103 (2.5) a	10 (2) a
SC	9.5 (0.5) b	3 (0.1) b	58.9 (1) b	0 b
RC	6 (0.8) c	2 (0.2)c	17.8 (4) c	0 b
FC	4.7 (0.9) c	1.8 (0.3) c	11.6 (3.7) c	0 b

[&]Means (SE) within the same column followed by the same letter are not significantly different

In both low and high populations of lentil, number of branches in wild lettuce expressed high plasticity in response to all modes of competition. In most of the treatments, plant allocations to branch outgrowth decreased up to 100%.

4. Discussion

In this study, the dry weight of wild lettuce was reduced more by root interference than canopy interference from Lentil. Canopy interference could only be significant when the population of lentil was fairy high (Table 3). This suggests the root of Lentil has more potential to control the growth and development of wild lettuce than the shoot. Such a result was reported by Bauer et al. (2004) examining the importance of shoot and root competition in 23 cases. He found that in 70% of published literature, root competition is more intense than shoot competition. In my study, lentil

has the ability to fix the nitrogen and this may be one of the reasons that why is more successful in below-ground competitive ability with wild lettuce (Johnston and Pickering, 2007). Number of branches was highly affected in wild lettuce by all the modes of competition. It indicates the high plasticity of this weed in response to stress and resource availability.

5. Conclusion

In summary, it was concluded that the potential of the root of lentil is sufficient to suppress the performance of wild lettuce, whereas canopy interference from lentil is insufficient to suppress wild lettuce growth. Canopy manipulation of Lentil therefore needs to be examined as a means to improve the competitive ability of lentil with weeds.

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