The allelopathic nature of parthenium weed leaf litter: Will this change under a changed climate of CO_2 enrichment?

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Parthenium (*Parthenium hysterophorus* L.) is a highly suppressive weed species displacing many other plants, including native and introduced grass and broad-leaf pasture species (Adkins and Shabbir, 2014). Allelopathy is believed to play a key role in this growth suppression enabling the weed to quickly spread in to new habitats and gain dominance over native vegetation. This weed has been accidently introduced into Australia on two different occasions. The first introduction was at Toogoolawah in about 1945, but this biotype has not spread and remains restricted to only area few km^2. The second introduction was at Clermont in 1958, and this biotype has spread rapidly and now occupies over 600,000 km^2.Thus, the aims of the study were to 1) determine if the greater invasiveness of the Clermont biotype was due to a greater ability of its leaf litter to inhibit the growth of neighbouring plants and 2) whether this ability to suppress neighbouring plant growth may increase in the future under a changing climate of CO_2 enrichment.

METHODOLOGY

Seeds of two *parthenium* biotypes (Clermont and Toogoolawah) were germinated and when 2 cm tall transplanted into 14 cm diameter pots, containing UC potting compost. The pots were then watered daily to field capacity and growth took place under a 25/20°C (day/night) thermo-period with a 12/12 hour photoperiod (ca.800 ìmol/m^2/s), and either under an ambient CO_2 concentration of 380 ìmol/mol or an elevated CO_2 concentration of 550 ìmol/mol. After 50 days of growth leaves were collected from the two environments and biotypes, and dried in an oven at 35 ± 1°C for 4 days. The dried leaf samples were then broken into small pieces, well mixed and stored at 15 ± 1°C and 15 ± 3% relative humidity before being used 15 days later.

Autoclaved agar (0.75%; w/v; 5 mL) was added to the six wells of a series of multi-dish plastic plates (Coring Incorporated, USA). The dried *parthenium* leaf material (50 mg) was then added to the agar surface of three wells in each plate. On to these three wells, and the other three wells, was added a further 5 mL of liquid agar to form a sandwich (Fujii *et al.* 2003). Seven seeds of the various test species were placed onto the agar surface of each of the six wells per plate. After germination the seedlings were thinned to five and a second plate inverted over the first to provide a chamber into which the seedlings could grow. All plates were then incubated as described above. This sandwich box method (Fujii *et al.*, 2003) was replicated three times and in turn used to test four species [Curly windmill (*Enteropogon acicularis* L.) native, Cotton panic (*Digitaria brownii* L.) native, Lambs quarters (*Chenopodium album* L.) introduced and Liverseed grass (*Urochloa panicoides* P. Beauv.) introduced]. After 7 days of germination, the length of the seedling shoots and roots were measured. All data sets were then subjected to a general linear model with all species with a Minitab statistical package.

RESULTS

The root growth of all species was inhibited more than the shoot growth indicating a greater sensitivity of the roots to the presence of the leaf litter (Fig. 1). In addition, there was no significant difference between the impact of the two different biotypes and CO_2 concentrations on the level of inhibition (Fig. 1).

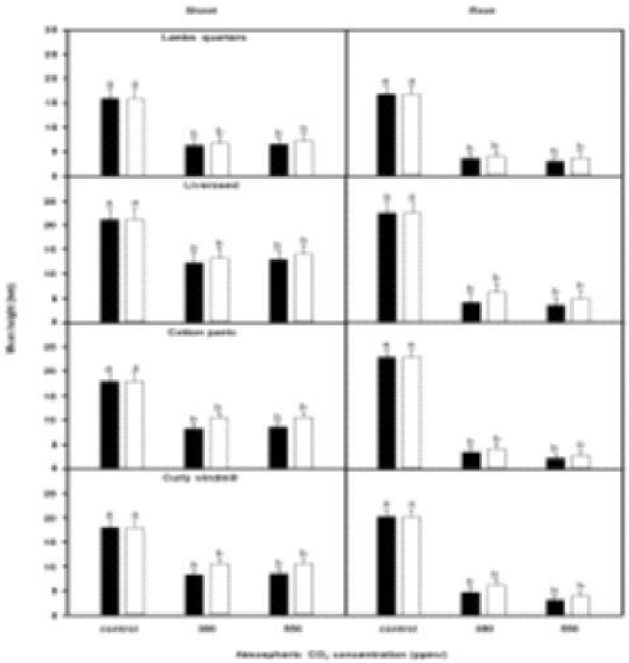

Fig. 1. The root and shoot growth of two introduced species (lambs quarters, liverseed) and two native species (cotton panic and curly windmill) when growing with 50 mg parthenium weed leaf litter produced by two biotypes(Clermont, Toogoolawah) under two CO2 atmospheres. Bars represent two standard errors of the mean. Means within species that do not share the same letter are significantly different from one another at *P > 0.05* level.

CONCLUSION

Seedlings of all species were significantly inhibited by the presence of small amounts of dried leaf material of *parthenium* weed indicating a strong allelopathic activity. There were no significant differences in the observed growth inhibition caused by litter from plants grown under an ambient as compared to an elevated CO_2 concentration, and there were no significant differences seen between the two biotypes indicating that the more invasive nature of Clermont was not due to its capacity of its litter to inhibit the growth of neighbouring plants.

REFERENCES

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