Summary

The allelopathy of *Parthenium hysterophorus* may contribute significantly to the invasive potential of the plant. The allelochemical, parthenin, is hypothesized to play a leading role in the allelopathy of the weed and this study was conducted to further investigate the importance of parthenin in *P. hysterophorus* allelopathy; and to investigate the interference potential of the weed with indigenous grass species.

The first trial of the investigation involved a study on the interference of *P. hysterophorus* with three indigenous grass species, namely, *Eragrostis curvula*, *Panicum maximum* and *Digitaria eriantha*, under field conditions. The trial was established on an old dumpsite at Skukuza, in the Kruger National Park, where there is a naturally occurring *P. hysterophorus* infestation. Plots containing one of the grass species planted at a single density (16 tufts m^{-2}), and the weed planted at three different densities (0, 5, 7.5 plants m^{-2}), were first established in the 2003/2004 growth season and observed for two seasons. Grass and *P. hysterophorus* dry mass accumulation was monitored and subjected to statistical analysis. *P. maximum* clearly outperformed the other two grass species from the outset and was observed to be the species most adapted to the environmental conditions of the trial, especially soil pH. In the first growth season (2003/2004), despite considerably greater dry mass accumulation by *P. maximum* relative to the other grass species, significant differences ($P \leq 0.075$) for percentage of control data was only observed between *P. maximum* at both the 5 and 7.5 plants m^{-2} and *D. eriantha* at the 7.5 plants m^{-2} density. For *P. hysterophorus* dry mass data, the main species effect was observed to be significantly different with *P. maximum* significantly inhibiting the growth of *P. hysterophorus*. In the second growth season (2004/2005), *P. maximum* once again displayed the best performance, although the performance of the other two species greatly improved with increased adaptation to the environmental conditions. For percentage of control data, the main species effect was found to be significant ($P \leq 0.05$), with *P. maximum* performing significantly better than *E. curvula* across the two *P. hysterophorus* densities. For the second growth season (2004/2005), *P. hysterophorus* control plots were included in the trial and it was observed that all three grass species were able to interfere significantly with *P. hysterophorus* growth.

As in the previous season, *P. maximum* was observed to interfere with *P. hysterophorus* growth most effectively and weed plants growing on the *P. maximum* plots were observed to produce less seed, and a large number of weed mortalities were observed. It was concluded that *P. maximum* therefore shows high potential for use as an antagonistic species in an integrated programme for control of *P. hysterophorus.*

In the second trial the production dynamics of parthenin over the life-cycle of *P. hysterophorus* was studied. Plants were grown in a greenhouse at the University of Hohenheim in Stuttgart, Germany, and the parthenin content in leaves harvested at different growth stages was monitored. Highly significant differences were observed for parthenin concentration in the leaves at different phenological stages. Highest parthenin concentrations occurred in the final three growth stages of the plant and it was calculated that a single plant can introduce >267.19 mg parthenin into the environment in a single growing season. This build-up of allelochemical (parthenin) content with age in the leaves may indicate that the plant utilizes residual allelopathy in its interference strategy, which may be aimed at limiting the recruitment of other or the same species.

In the third trial, the persistence of pure parthenin in soil was investigated. Four soils with different properties were utilized for the trial, and parthenin DT_{50} values were observed to range from 1.78 to 3.64 days when applied at an initial concentration of 10 μg g^{-1}. Degradation of parthenin was observed to be significantly faster in the loam soil than in the loamy sand or sand. Significant negative correlations were observed between DT_{50} values and the soil characteristics of soil water-holding capacity and soil cation exchange capacity, but not between DT_{50} values and pH and organic carbon percentage. Persistence of parthenin was also investigated in sterile and non-sterile loamy sand placed under different temperature regimes, and it was observed that parthenin degraded significantly faster in the non-sterilized soils, indicating that microbial degradation may play a predominant role in the disappearance of parthenin from soil. A significant correlation between DT_{50} values and temperature was only observed for non-sterilized soils.

In the fourth trial, the sensitivity of the three indigenous grass species used in the field trial to pure parthenin was assessed. Seeds were placed in Petri dishes and exposed to a parthenin concentration range (0-500 µg ml^{-1}). It was observed that *P. maximum* was the most sensitive species regarding germination and early radicle development. *D. eriantha* was the intermediate species, while *E. curvula* was the least sensitive species to pure parthenin. ED_{50} values for radicle length and germination, respectively, were 100.6 and 96.1 µg ml^{-1} for *P. maximum*, 144.7 and 184.2 µg ml^{-1} for *D. eriantha*, and 212.9 and 345.9 µg ml^{-1} *for E. curvula*.

Based on the findings from these trials it was calculated that a naturally occurring *P. hysterophorus* stand in Skukuza could potentially introduce a concentration of 2350 µg ml^{-1} in the top 2 cm layer of the soil. It therefore seems possible that parthenin alone can inhibit or impede the recruitment of indigenous grass species using allelopathy. It is acknowledged that allelochemicals other than parthenin may also be important in the allelopathy displayed by *P. hysterophorus*, and that competition by the weed is probably another important interference mechanism. Considering the sensitivity of *P. maximum* to parthenin, it may prove challenging to establish the grass from seed in *P. hysterophorus* stands when using the grass in an integrated control programme.

This ongoing study will continue to investigate the role of parthenin in *P. hysterophorus* allelopathy. The spread of this invader in the Kruger National Park will also be monitored.