Ascophyllum nodosum extract use on plant parasitic nematode abundance and diversity on a golf green

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Introduction

Seaweed extracts are often used in integrated turf management programs as a soil fertilizer and conditioner. Many of the seaweed products sold commercially utilise *Ascophyllum nodosum*; a brown bladder wrack found on the shores of the North Atlantic Ocean. As these seaweeds occupy the intertidal range, they have evolved to survive both in and out of the water meaning they contain unique compounds such as fucoidan and alginate. It is this unique profile of compounds that allows seaweed extracts to have a bio-stimulant effect in soils and possibly infer plant protection against pests and diseases. The effect of *A. nodosum* extracts against plant parasitic nematodes (PPN) has not been widely documented in turf grass systems. While previous work has shown that seaweed extracts may reduce the incidence of root knot nematode infection in tomato, it has only been suggested that the same may be seen in turf[1,2]. Much of the previous work has found it hard to translate significant PPN reduction found in laboratory studies to the field[3,4]. The objective of this research was to see if the use of an alkaline extracted *A. nodosum* solution could reduce plant parasitic nematode abundances on a golf green, compared to an untreated control, following some positive results seen in laboratory trials.

Materials and Methods

A 20 m^2 plot was marked out on a golf green consisting of a *Poa annua* and *Agrostis stolonifera* mix (approximately 70:30) on a medium sand loam soil in the south of England. Within the 20 m^2 plot individual 1 m^2 plots were marked, totaling five replicates (1 m^2 plots) per treatment arranged in a randomized block design. To each 1 m^2 an alkaline extracted *Ascophyllum nodosum* solution (Acadian marine plant extract powder, Acadian Seaplants Nova Scotia) was applied at three rates; 0.5 kg/ha, 1 kg/ha (the recommended dosage rate) and 2 kg/ha in 600 L water, control plots received water only application. *A. nodosum* was applied every 21 days over three months (four applications). At the trial start and after final seaweed applications, three soil cores were taken from each 1 m^2 plot and pooled, totaling in approximately 200 g of soil per plot. The soil was then placed in a modified whitehead tray in tap water for 17 hours[5]. The resulting nematode suspension was centrifuged and siphoned down to 10 ml, before killing the nematodes in a 90 °C water bath. To preserve the nematodes, 10 ml of double strength TAF (Triethnaolamine, formaldehyde and sterile distilled water) was added to each suspension. Nematode counts and taxa were recorded from 1 ml aliquots. The proportion of plant parasitic nematodes per sample, Simpson's diversity index and nematode percentage prevalence were calculated. The results were assessed firstly for normality using Shapiro Wilk test and differences in the abundance per 100ml of each nematode taxa, the proportion of PPN's, and the maximum abundance per 100 ml of each taxa between treatments were examined with the Kruskal Wallis test.

Results and Discussion

The main taxa of nematodes found in order of prevalence were *Helicotylenchus, Pratylenchus, Tylenchulus* and *Criconema*. The most prevalent nematode genus *Helicotylenchus* reduced in mean and maximum abundance after applications with all seaweed treatments, compared to the water only control (Table 1, Figure 1), but there was no increased effect with higher application rates. After four applications of seaweed a decrease of 11 percentage points in the mean proportion of PPN's within the total nematode population, was observed when using the recommended rate of *A. nodosum* extract. However these reductions in *Helicotylenchus* abundance when using the recommended rate of alkaline extracted seaweed (1 kg/ha) were found to be non-significant from a Kruskal Wallis test (at p=0.05), due mainly to high variability of numbers within each treatment (Figure 1).

This trial has clearly illustrated that nematode populations are highly variable, even across a single golf green,

[1] WU, Y., T. JENKINS, G. BLUNDEN, N. Von MENDE and S.D. HANKINS, 1998: Suppression of fecundity of the root-knot nematode, Meloidogyne javanica, in monoxenic cultures of *Arabidopsis thaliana* treated with an alkaline extract of *Ascophyllum nodosum*. J Appl Phycol 10:91–94.

[2] FLEMING, C.C., S.J. TURNER and M. HUNT, 2006: Management of root knot nematodes in turfgrass using mustard formulations and biostimulants. Com Agri Appl Biol Sci 71:653–6583.

[3] CROUCH, I.J., J. Van STADEN, 1993: Effect of seaweed concentrate from Ecklonia maxima (Osbeck) Papenfuss on Meloidogyne incognita infestation on tomato. J Appl Phycol 5:37–43.

[4] MARTIN, T.J.G., S.J. TURNER and C.C. FLEMING, 2007: Management of the potato cyst nematode (*Globodera pallida*) with bio-fumigants/stimulants. Comm Agri Appl Biol Sci 72:671–675.

[5] WHITEHEAD, A.G. and J.R. HEMMING, 1965: A comparison of some quantitative methods of extracting small vermiform nematodes from soil. Ann of Appl Biol 55:25-38.

Treatment	Mean proportion of PPN %	*Helicotylenchus* spp		
		Maximum abundance per 100 ml	Mean abundance per 100 ml	Coefficient of variation %
0 kg/ha	22.96	54000	2540	86.0
0.5 kg/ha	21.95	2100	1440	40.4
1.0 kg/ha	12.31	2000	1120	51.1
1.5 kg/ha	23.91	3200	1780	70.6

Tab. 1: The mean proportion of plant parasitic nematodes (PPN) compared to non-PPN in the sample (%). Mean abundance and maximum abundance per 100 ml of *Helicotylenchus spp* found from golf green after four applications of seaweed. The coefficients of variation for *Helicotylenchus spp* after seaweed applications.

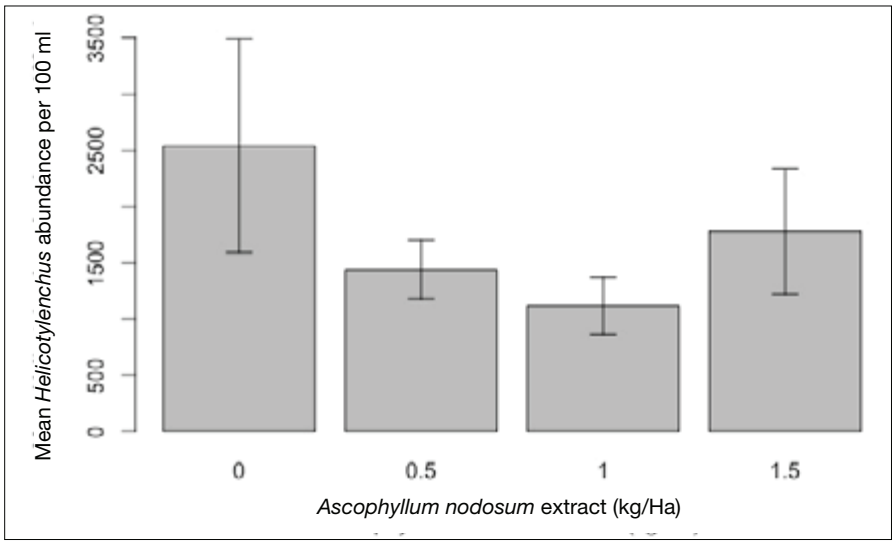

Fig. 1: The mean abundances of *Helicotylenchus spp* found in 1oo ml of a nematode suspension extracted from soil cores from a golf green in the south of England. Each nematode population was taken from three soil cores from each 1 m2 plots after treatment with 0 kg/ha, 0.5 kg/ha, 1 kg/ha and 1.5 kg/ha of an *Ascophyllum nodosum* extract every three weeks for approximately three months. Error bars = standard error of the mean.

despite samples being pooled per plot to overcome the spatial heterogeneity. The trial does demonstrate that seaweeds can be used to reduce this variability that is illustrated when comparing coefficients of variation (CV) between treatment groups. The highest CV *Helicotylenchus* spp was in control plots at 86%, compared to 40.4% when 0.5 kg/ha of seaweed was applied (Table 1).

The findings from this trial support research showing how difficult it is to replicate laboratory results in the field, as the complexity of soil communities are difficult to account for. It appears that with some fine-tuning and further research, *A. nodosum* extracts could be used to reduce variability and numbers of the most prevalent taxa of PPN in nematode populations. Less spatial variability may result in a reduction in visual symptoms for the course manager and potentially improve the use of available nematocides as part of an integrated pest management scheme. It is necessary that more field trials and research is needed, particularly using the recommended rate and higher replication, however the initial results are promising.

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