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Short communication:

An evaluation of cadusafos against *Pratylenchus* sp. and *Paratylenchus* sp. on chrysanthemums in Cameron Highlands

(Penilaian terhadap kadusafos dalam kawalan *Pratylenchus* sp. dan *Paratylenchus* sp. pada tanaman kekwa di Cameron Highlands)

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Abstrak

Dalam ujikaji terhadap *Chrysanthemum morifolium* (varieti Reagan Yellow) di ladang selama semusim, *Rugby* (10% kadusafos) diuji pada kadar 5, 10 dan 15 g/m^2 dan dibandingkan dengan *Furadan* (3% karbofuran) pada 5 g/m^2 sebagai piawai. Nematod yang menyerang tanaman kekwa ialah *Pratylenchus* sp. dan *Paratylenchus* sp. Karbofuran gagal mengawal nematod pada kadar yang diuji. Kadusafos pada semua kadar mengurangkan (tetapi tidak menghapuskan semuanya) populasi nematod dalam akar dan tanah dengan ketara. Tanaman di petak yang diperlakukan dengan racun nematod menghasilkan lebih banyak bunga yang boleh dijual berbanding dengan tanaman di petak bandingan yang tidak dibubuh racun nematod walaupun tidak ketara. Hal ini disebabkan oleh serangan nematod di petak tersebut sedikit dan tidak berupaya mencapai aras kerosakan.

Abstract

In a single season field trial on *Chrysanthemum morifolium* (variety Reagan Yellow), *Rugby* (10% cadusafos) was tested at 5, 10 and 15 g/m^2 and compared with *Furadan* (3% carbofuran) at 5 g/m^2 as a standard. Nematodes infesting the crop were *Pratylenchus* sp. and *Paratylenchus* sp. Carbofuran failed to control the nematodes at the tested rate. Cadusafos at all rates significantly reduced (but did not eliminate completely) nematode populations in roots and soil. The number of marketable flowers produced in treated plots was higher than those in the untreated controls although this was not significantly so. This is attributed to low nematode infestations in the plot which were unable to reach damaging levels.

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Introduction

Chrysanthemum (*Chrysanthemum morifolium* Ramat.) is one of the most popular cut flowers grown in the Cameron Highlands. Currently, the area planted with chrysanthemums is about 150 ha and this comprises some 50% of the total area under cut flower cultivation in the Cameron Highlands (Ahmad et al. 1993). It is popular probably due to its fast turnover with a short growing period of 4 months (Safruddin 1989) and the high annual capital returns of more than RM100 000/ha (Noor Auni et al. 1990). To ensure high productivity and quality flowers, the farmers usually need to apply stringent pest and disease control measures. Among the pests being treated are nematodes. Yuen and Yau (1996) found that the predominant nematode pest on chrysanthemums in the Cameron Highlands is *Pratylenchus* sp., with lesser populations of *Rotylenchulus reniformis, Paratylenchus* sp., *Helicotylenchus* sp. and *Meloidogyne* sp. As there are no published local data on yield loss of chrysanthemums caused by nematodes, a study on yield loss was made via the evaluation of two nematicides.

Field experimentation

A nematode-infested field of a commercial flower grower at Kuala Terla, Cameron Highlands, Pahang was selected for the trial. Three rates of a nematicide, *Rugby 10G* (10% cadusafos), were tested as a preplant soil treatment. *Furadan 3G* (3% carbofuran), was used as a standard comparison. Both nematicides were granular formulations. The experimental design was randomised complete block with five treatments and four replications. Plot size of each replication was 2 m x 1 m. The treatments were A = control (untreated), B = *Rugby* 5 g/m^2, C = *Rugby* 10 g/m^2, D = *Rugby* 15 g/m^2, E = *Furadan* 5 g/m^2. Rates used were based on the manufacturer's recommendations (Anon. 1983, 1986). The nematicides were broadcast on the surface of the prepared planting beds and raked into the top 10 cm layer of the soil. The chrysanthemum was planted 3 days later.

The experimental area had been cultivated with chrysanthemum for the past year and, from a preliminary survey, was known to be infested with phytoparasitic nematodes. Before nematicide application, composite soil samples were taken from every replicate to determine the initial nematode population in the soil. To obtain a composite sample of approximately 1 litre, soil was taken with a trowel to a depth of 15 cm randomly from eight points within each plot. In the nematology laboratory at MARDI, Serdang, each composite soil sample was thoroughly mixed and two 200 mL sub-samples taken for nematode extraction with the Oostenbrink elutriator (Flegg and Hooper 1970).

The chrysanthemum variety grown was Reagan Yellow (spray type) and was planted directly as cuttings. At the end of the trial after 4 months, the final soil population of nematodes was determined through soil sampling as described earlier. In addition, root samples were also taken from each plot in a similar manner. Roots were obtained at random from eight points in each treatment plot to make a composite sample of about 200 g. In the laboratory, two sub-samples of 5 g roots were macerated for determination of endoparasitic nematodes via the technique described by Hooper (1970). In sampling of soil and roots, no samples were taken from a 15 cm wide band around the edge of each plot so as to minimise errors due to border effects. Analyses of variance were carried out on square root transformed data due to the large variation among the samples collected.

In addition, the yield of blooms was determined in each plot by counting the number of floral cuttings within a one square metre area in the centre of each plot and grading them into three categories. The specification of each grade according to the farmer's standard is shown in *Table 1*.

Table 1. Grades of chrysanthemum floral sprays (cuttings)

Grade	No. blooms/cutting	Price (RM/dozen)	Stem diameter (mm) 60 cm from apex
A	11–12	6.00	7.4
B	6–8	3.50	6.2
C	3–4	rejected	5.8

Table 2. Pre- and postharvest nematode population in soil and chrysanthemum roots, and flower number of various grades

Treatment	Nematode no./ 200 mL soil+			Prat. per 5 g roots+	No. of flower cuttings/m^2		
	Prat.	Para.	Total		Grade A	Grade B	Grade C
Pre-treatment							
Control	40.6a	36.9a	44.9a				
Rugby 5 g/m^2	41.5a	38.9a	47.4a				
Rugby 10 g/m^2	40.4a	35.5a	43.9a				
Rugby 15 g/m^2	42.5a	37.1a	46.9a				
Furadan 5 g/m^2	39.7a	36.9a	44.0a				
Post-treatment							
Control	80.8a	33.2a	81.6a	231.2a	36.8a	19.8a	13.8a
Rugby 5 g/m^2	40.5b	33.7a	42.2b	97.2b	44.8a	16.8ab	10.5a
Rugby 10 g/m^2	32.5b	32.0a	32.9b	39.5c	45.0a	12.0b	8.8a
Rugby 15 g/m^2	31.7b	31.8a	31.9b	33.9c	45.0a	14.3ab	14.5a
Furadan 5g/m^2	80.8a	34.5a	84.5a	214.0a	43.3a	19.5a	8.5a

Prat. = *Pratylenchus* sp. +data transformed: sq. root (X + 1000)
Para. = *Paratylenchus* sp. Mean values with same letter are not significantly different ($p < 0.05$)
Total = *Pratylenchus* + *Paratylenchus*

Effects of treatments

The pre-treatment soil counts *(Table 2)* show that there were no significant differences in nematode numbers between the various treatment plots, indicating that the nematodes had been well distributed during bed preparation. The nematodes present in the plot were *Pratylenchus* sp. and *Paratylenchus* sp., the former an endoparasite and the latter an ectoparasite of chrysanthemum roots.

At the end of the trial, the total nematode counts (*Pratylenchus* sp. and *Paratylenchus* sp.) in the soil were not significantly different between the control plots and those treated with carbofuran *(Table 2)*. However, breakdown of the counts into their components showed that *Paratylenchus* sp. populations were not affected by nematicide treatment, indicating that this nematode was either tolerant to the nematicides or that the levels applied were too low to be lethal. On the other hand, *Pratylenchus* sp. counts showed that although carbofuran did not affect population levels significantly, there were statistically significant differences in the plots treated with cadusafos – the numbers of *Pratylenchus* sp. declined more (though not significantly so) as dosage of this nematicide was increased, and the levels were also lower than that in the control plots. This showed that cadusafos was effective in reducing the *Pratylenchus* sp. population although not eliminating it entirely. The final total nematode counts showed a decreasing trend as the dosage of cadusafos increased though this was not statistically significant.

Evaluation of the nematodes within the roots showed only the presence of *Pratylenchus* sp. This is due to the fact that *Paratylenchus* sp. is essentially an ectoparasite. The nematode population in the roots showed a similar trend as the soil counts, i.e. no significant difference between controls and carbofuran-treated plots; and significantly lesser nematodes in cadusafos-treated plots. The plots treated with the lowest dose of cadusafos had significantly more nematodes than the higher rates while there were no such differences between the two higher rates *(Table 2)*.

The number of cuttings with the best flowers (Grade A) was the least in the untreated control plots (mean of 36.8) compared with more than 43 cuttings in the nematicide-treated plots *(Table 2)*. Although this was not statistically significant, it does indicate that nematode infestation can lower the yield and quality of flowers in an affected crop. The low nematode infestations in the field were probably not high enough to reach damaging levels. For the lesser Grade B, cadusafos-treated plots yielded less blooms than other treatments. This was expected since such plots already had produced more Grade As. There were no differences in the number of Grade C flowers (not marketable) among all treatments. The application of carbofuran (a systemic nematicide) is known to increase crop yields in rice, sugar cane and coffee (Anon. 1983). This stimulatory action could explain the larger number of Grade A blooms over those of the controls, though this was still smaller than the cadusafos-treated plots, in the trial *(Table 2)*. Cadusafos, on the other hand, is a non-systemic nematicide and therefore has no such phyto-stimulatory effect (Anon. 1986).

This field trial demonstrates that *Pratylenchus* sp. and *Paratylenchus* sp. can multiply rapidly when left uncontrolled. The root counts showed that untreated plots had seven times more infestation than nematicide-treated plots. No phytotoxicity effects on chrysanthemum were observed at all dosages of the nematicides tested. *Pratylenchus* sp. has been recorded locally on a wide range of crops including banana (Abdul Karim and Mohd. Zaidun 1983), coffee and eight other hosts (Winoto Suatmadji and Sauer 1982). As *Pratylenchus* sp. is widespread on chrysanthemums in the Cameron Highlands (Yuen and Yau 1996), it would be of interest in future trials to study the deleterious effects of this nematode on chrysanthemum over two or more consecutive seasons in comparison with treatments using chemical and other novel methods of control.

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