ESSENTIAL OIL YIELDS FROM BLIGHTED FENNEL

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SUMMARY

Five fungicide treatments were tested to determine their ability to control blight of fennel (*Foeniculum vulgare*) caused by *Cercosporidium punctum*. Propiconazole plus mancozeb gave the best essential oil yield but the result was not significantly (>0.05) better than all other fungicide treatments. All treatments gave a significant increase in yield over nil treatment, with the best more than doubling the yield. The composition of the distilled oil was not altered by either blight or fungicide treatment. Notes on disease management are also given

INTRODUCTION

Blight or cercosporidiosis of fennel, caused by the fungal pathogen *Cercosporidium punctum* can cause major losses in essential oil production (Deighton 1967; Bougeard and Vegh 1980). During the 1986/87 season in North Canterbury, this seed-borne pathogen, which is newly recorded in New Zealand, caused leaf blight, stem and umbel necrosis, and shedding of seeds from diseased umbels. Since the major source of distilled oil is from the seeds, loss of seeds leads to a direct reduction in oil yield. Efforts were made to control the disease through the management of diseased over-wintering stubble and the timely application of "best bet" fungicides. A fungicide trial was also laid down in a first year crop where the chemicals used were those recommended by the French company of Pernod Ricard, plus others chosen from similar groups and an experimental fungicide. This paper reports on the results of this trial, and implications of the results on future fennel management.

METHODS

The fungicide trial was conducted in a first year crop sown on 14 October 1987, with 850 mm row spacings and with plant spacing varying between 150 and 300 mm. Five fungicides or fungicide mixtures were used (see Table 1).

TABLE 1: Fungicides applied to fennel

Common Name	Trade Name	kg ai/ha
propiconazole	Tilt 25EC	125
propiconazole + mancozeb	—	125/1500
A7491	(experimental)	125
flusilazol	Punch 40EC	160
flusilazol + carbendazim	Punch C	160/150
untreated	—	—

Plots measured 2.5 x 10 m in a four replicate randomized block design, at a minimum of 30 m into the crop from two boundaries.

The first application of fungicide was on 24 January 1988, with the first disease assessment 25 days later (18 February 1988). The second application was on 21 February 1988, followed 21 days later (14 February 1988) by the second disease assessment. Disease assessments were carried out on five leaves from the top down on secondary

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stems, and on the primary umbel of each of 10 plants per plot using the following subjective scale:

- 0 No disease
- 1 Light infection
- 2 Moderate infection
- 3 Heavy infection
- 4 Dead

Fennel plants were harvested for measurement of head weight and percentage oil on 30 March 1988 by cutting 5 m lengths of row from the middle two rows of each plot. Umbels were removed from the harvested plants and weighed. Duplicate 400-500 gm samples were taken from four bulked treatments and steam distilled for 1.5 h. The oil was dried and weighed. Oil contents are expressed as percentage fresh weight. The oil was diluted to 0.5% (v/v) in di-ethyl ether and injected into a 25 m OV101 capillary column for gas chromatographic determination of anethole in the oil. Anethole levels are expressed as percent peak area. All data were subject to analysis of variance.

RESULTS

The results of the field assessments of disease are given in Table 2. Although the experimental fungicide A7491 appeared to give the best control of *C. punctum* on leaves at both assessments, the results were not significantly different ($P > 0.05$) from those provided by the propiconazole/mancozeb mixture. All fungicide treatments gave better disease control than the nil treatment ($P < 0.05$). Again best disease control in the umbels was provided by A7491, but this was not significantly different from any other treatment.

TABLE 2: Mean disease assessment on leaves and umbels of fennel treated with fungicides, and changes in disease scores between assessments.

Treatment	1st Assessment*		2nd Assessment		Differences between assessments	
	Mean all leaves	Mean all umbels	Mean all leaves	Mean all umbels	leaves	umbels
propiconazole	2.00b#	0.95ab	2.86bc	1.5a	0.85a	0.55a
propiconazole + mancozeb	1.62a	0.63a	2.42ab	1.55a	0.80a	0.93a
A7491	1.33a	0.88ab	1.97a	1.3a	0.63a	0.43a
flusilazol	2.18b	0.88ab	3.39de	1.8ab	1.21a	0.90a
flusilazol + carbendazim	2.01b	0.80ab	3.00cd	1.8ab	0.97a	1.00a
untreated	2.82c	1.20b	3.81e	2.25b	0.99a	1.05a
LSD	0.31	0.41	0.52	0.63	0.65	0.76

* Assessed on a 0-4 scale, 0 = healthy, 4 = dead

Means followed by the same letter are not significantly different ($P > 0.05$; Duncan's Multiple Range Test)

Variations in disease scores between assessments on leaves and umbels are also given in Table 2. Although the leaves of plots treated with A7491 had the lowest increase in disease score, and those with flusilazol followed by nil treatment increased the most, the difference between treatments was not significant ($P > 0.05$). In the umbels a similar response occurred where the greatest change was in the untreated and the least was in the A7491 treated plots. Again there were no significant differences between any treatments.

Table 3 gives the harvested umbel weights for each treatment, and percentage oil content for the four bulked treatment samples. Experimental fungicide A7491 gave the highest yield by weight of umbels, but surprisingly did not yield the highest total oil. This was afforded by the propiconazole/mancozeb mixture. All weights of umbels and all oil yields were significantly different ($P < 0.05$) from the nil treatment control, but differences between fungicides were not significant ($P > 0.05$). The treatments did not

affect the anethole content of the oil, which varied between 66.1 and 68.3% (mean 67.3)

TABLE 3: Mean umbel fresh weights and oil yields and contents of fungicide treated fennel.

Treatment	Fresh umbel yield kg/ha	Oil content (%)	Oil yield kg/ha
propiconazole	4269ab#	—	—
propiconazole + mancozeb	4902a	1.27a	62.25a
A7491	5206a	1.13b	58.80a
flusilazol	3927ab	—	—
flusilazol + carbendazim	4389a	1.13b	49.60a
untreated	3088b	1.02b	31.50b
LSD	1634	0.18	15.2

see Table 2

DISCUSSION

The average yield of all first year crops in North Canterbury this season was low, being only 25 kg/ha. This was due in part to blight infection, but also to problems in site selection, weed control and nutrients. At the trial site, blight was well established when the trial was laid down, and the first application was not considered to have been made at an optimal time. Also, only two applications of fungicide were made rather than the three or more that appeared to have been required on a first year crop this season. Despite these shortcomings, a best yield of 62.3 kg/ha was achieved in the trial, compared with 39.7 kg/ha in the surrounding crop. The trial plots were sampled before the umbels had reached normal harvest maturity. This probably depressed oil yield to some extent, but was not likely to have affected greatly the differences between treatments.

Second year crops averaged around 70 kg/ha this season, with blight infection and weeds being the major factors that reduced yields. Much higher yields, about 100-150 kg/ha, can be expected to be achieved in second and third year crops through good over-winter crop management, including trash mulching, inter-row cultivation and herbicide application, coupled with the timely application of appropriate fungicides and fertilisers throughout the growth of the crop.

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