

Short communication

Note on the efficiency of a miniaturized cyclone spore collector

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Cyclone spore collectors have been recommended for the collection of small particles (Browder, 1968; Owaga and English, 1955; Tervet and Cassell, 1951; Tervet et al., 1951), because they are efficient and easy to handle. Efficiency studies have been made of industrial cyclone collectors (Ter Linden, 1949) but not of the miniaturized cyclone spore collectors which are now generally used in cereal rust work. When the cyclone collector is used as a tool in quantitative studies on spore production (Mehta and Zadoks, 1970), its performance over a wide range of spore quantities must be known.

To investigate the collector's performance, air-dried uredospores of *Puccinia recondita* (Rob. ex Desm.) f. sp. *tritricina* were offered in a glass beaker (weight 19 g) or on a weighing paper (weight 0.4 g). By means of a home-made miniature cyclone collector (Fig. 1 and Table 1) the spores were carefully collected into a glass ampoule. Cyclone efficiency was determined as the weight of the collected spores, expressed as a percentage of the weight of the spores offered (Fig. 2). There are a few technical difficulties: 1. the tools are much heavier than the spore lots to be weighed; extreme care in cleaning and handling tools, and in weighing is imperative; 2. spores may

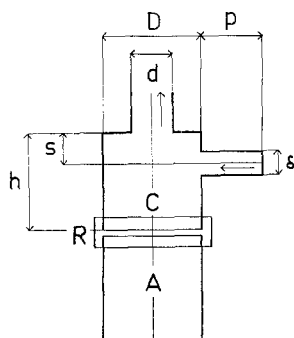


Fig. 1. Schematic representation of a miniaturized cyclone collector with main dimensions. This figure is not drawn on scale, therefore see Table 1 for dimensions.

A - Ampoule
C - Cyclone
R - Rubber sleeve

Fig. 1. Schematische weergave van een geminiaturiseerde cycloonvanger met voornaamste maten. Deze figuur is niet op schaal getekend, zie daarom Tabel 1 voor de maten.

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Table 1. Main dimensions of the miniaturized cyclone spore collector used in this study. Explanation in text and Fig. 1. Dimensions in mm.

Dimension	letter	mm
Length of gas inlet	p	42.0
Diameter of gas inlet	δ	2.0
Height of (cylindrical part of) cyclone	h	28.1
Diameter of cyclone	D	5.8
Diameter of gas exhaust	d	2.4
Distance from top of cyclone to centre of gas inlet	s	2.1

Tabel 1. Voornaamste maten van de geminiaturiseerde cycloonsporenvanger gebruikt in dit onderzoek. Uitleg in tekst en Fig. 1. Maten in mm.

change in weight during processing by the intake or loss of water vapor; all processing was done in one room, where the spores were left for at least 4 hours to equilibrate with the ambient air humidity; 3. spore losses occur at the glass beaker or weighing paper, the cyclone collector, the ampoule, the rubber tube connecting ampoule and collector, and by the way of the collector exhaust; 4. the spore loss may vary in accordance with the spore deposit on each of these tools resulting from preceding measurements; all tools were thoroughly cleaned after each measurement.

When a glass beaker was used to offer spore quantities ranging from 2.5 to 100 mg the spore losses averaged ca. 1 mg (range 0.5 to 2.0 mg). When a weighing paper was used to offer spore lots from 0.5 to 100 mg the average spore loss was 0.3 mg (range + 2.1 to - 0.6). The minus sign is probably due to the fact that the spore losses are nearly within the limits of the accuracy of the balance used (a Mettler B balance with

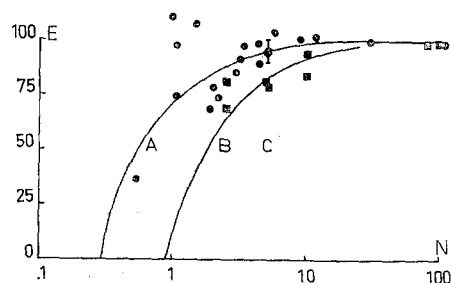


Fig. 2. Efficiency of a miniaturized cyclone collector used in cereal rust work. The dimensions of the collector are given in Fig. 1 and Table 1.

N - Weight in mg of spore lot offered; spores were air-dried uredospores of *Puccinia recondita* f. sp. *trititina*.

E - Efficiency per cent.

Dots - Spores offered on weighing paper.

Squares - Spores offered in glass beaker.

A - Curve A represents the theoretical efficiency calculated for 0.3 mg spore loss, independent of the amount of spores offered; curve A, fitted to the equation $E = 100 - 30/N$ ($0.3 \leq N \leq 100$), divides the swarm of dots in two nearly equal parts.

B - Curve B represents the theoretical efficiency calculated for 0.9 mg spore loss, independent of the amount of spores offered; curve B, fitted to the equation $E = 100 - 90/N$ ($0.9 \leq N \leq 100$), divides the swarm of squares in two nearly equal parts.

C - The dot with vertical bar at the 0.5 mg position represents the average and the range of ten efficiency determinations.

Fig. 2. Efficiëntie van een geminiaturiseerde cycloonvanger gebruikt bij het graanroestonderzoek. De maten van de vanger zijn aangegeven in Fig. 1 en Tabel 1.

a reading accuracy of 0.1 mg). When a Mettler M balance with a reading accuracy of 0.01 mg was used the minus sign did not appear. No significant differences in efficiency were found between the horizontal and the more usual vertical position of the cyclone. With spore lots of ≥ 5 mg offered on weighing paper the cyclone efficiency was invariably over 90%. With spore lots between 1 to 5 mg offered on weighing paper the cyclone efficiency was still high ($> 65\%$) but variable, this being at least partly due to weighing inaccuracy. In Fig. 2 the theoretical efficiency curves, calculated for constant spore losses of 0.3 mg (weighing paper) and 0.9 mg (glass beaker) are shown to divide the swarm of dots and squares respectively in two nearly equal parts.

It is concluded that: 1. the home-made miniaturized cyclone collector is highly efficient in collecting uredospores; 2. weight or form of the vehicle in which the spores are offered affects spore recovery; 3. the position of the cyclone (horizontal or vertical) has little effect on cyclone efficiency; 4. for quantitative studies in which the number or weight of the uredospores is to be determined, cyclones are quite satisfactory for handling spore lots from 100 mg down to 1 mg (1 mg of air-dry uredospores contains about 274,000 spores), though some spore loss occurs at the lower end of the range.

Samenvatting

Opmerking over de efficiëntie van een geminiaturiseerde cycloonsporevanger.

Cycloonstofvangers worden in de industrie gebruikt. Geminiaturiseerde modellen zijn geschikt voor het vangen of verzamelen van schimmelsporen. Een in eigen beheer vervaardigde geminiaturiseerde sporenvanger werd getoetst op zijn efficiëntie, dit is het gewicht van de verzamelde sporen uitgedrukt als percentage van het gewicht van de aangeboden sporen. Hiertoe werden luchtdroge uredosporen van de bruine roest van tarwe gebruikt. Het bleek dat:

1. de geminiaturiseerde cycloonvanger een efficiëntie sporenvanger was;
2. gewicht of vorm van de drager der aangeboden sporen de efficiëntiemeting beïnvloedde;
3. de stand van de cycloonvanger (horizontaal of verticaal) weinig invloed had op de efficiëntie;
4. de cycloonvanger geschikt was voor kwantitatief onderzoek over sporenhoeveelheden vanaf 1 mg tot ten minste 100 mg.

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