# Epidemiology of grey mould (caused by Botrytis cinerea) on sunflower in the UK.

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## Summary

The relationship between the latent period, the time between infection and appearance of symptoms, and growth stage, for Botrytis cinerea infections on sunflower was investigated in controlled environment chambers and in the field. The latent period decreases the later in growth the plants are infected and symptoms appear at about the same time even though infection may have taken place at different growth stages. The implications of this for the control of grey mould on sunflower in the UK are discussed.

## Introduction

When climate and the physiological growth stage are favourable, sunflower can be infected by Botrytis cinerea through conidia deposited on the flower head (Perez,1986). Conidial germination requires relatively high temperatures (18°C-25°C), and the presence of moisture, which must persist long enough for penetration to take place (Ingold,1986), before infection is established. It has been observed, however, that conidia can germinate at temperatures ranging from 7°C-27°C (Perez,1986). Pollen can also stimulate germination of the conidia and the fungus can establish itself as a saprophyte on senescing ray flowers (Lamarque,1975). Alternating periods of high and low humidity further encourage the development of the disease (Lamarque,1979). However, little is known about the effect of timing of infection or the subsequent development of disease on the heads. We report the results of field and controlled environment experiments which studied the development of grey mould on sunflower in relation to timing of infection by B. cinerea.

## Materials and Methods

On 29 April 1991, 16 plots, each 10m x 3.5m, were sown to sunflower cultivars Avante (Sigco S47) and Allegro. Eight plots of each cultivar were sown at 12 seeds/sq m. Nitrogen was applied as Nitram at 145kg/ha. The herbicide trifluralin was incorporated into the seed-bed, folowed by linuron applied pre-emergence. No fungicides or insecticides were used. All plots were covered by bird-proof netting from

emergence to harvest. Ten plants were chosen randomly within each plot and their growth stages and occurrence of grey mould recorded daily from the beginning of flowering. Rainfall and temperature were recorded at a site less than 1 km away. Daily average concentrations of B. cinerea conidia were measured within the plot area from the beginning of flowering to harvest, using a continuously recording spore trap (Burkhard Manufacturing Company, Rickmansworth).

In three controlled environment room experiments plants were inoculated with B. cinerea conidia at different growth stages from the beginning of flowering to near maturity and disease development was monitored. The cultivars used were Avante (Sigco S47) in the first experiment, and Sunbred 246, a later maturing cultivar, in the second and third. In each experiment seed was sown in 18cm diameter pots filled with a soiless compost of peat, sharp sand and a clay fraction, plus a slow release fertilizer. Day and night temperatures were maintained at 20°C and 13°C respectively, with a day length of 16 hours. Light was at 280 microeinsteins/sq m. Liquid fertiliser (Phostrogen) was applied when 4 pairs of leaves were present, and again during bud formation. Growth stages were monitored regularly.

Spore suspensions used to inoculate plants were obtained by washing conidia with distilled water from cultures grown on malt extract agar. Spore numbers were estimated with a haemocytometer and plants inoculated by spraying each flower with 4ml of the suspension (c.600,000 spores/ml) using an aerosol spray-gun. Each head was enclosed in a plastic bag for 48 hours after inoculation, and afterwards sprayed daily with water to maintain conditions favourable for fungal growth (Ladsous et al,1988). In the first two experiments plants were inoculated at CETIOM Growth Stage 4.2, when the first ring of anthers is present, and at all other growth stages until GS 5.1.1, the start of maturation. In the third experiment plants were inoculated at GS 4.3 when 2 rings of anthers are present and stigmas displayed, and at GS 5.1.1.

**Results**

Figure 1 shows that the length of the latent period, from inoculation to symptom development, was greater for plants inoculated during the early stages of flowering than for those inoculated at the end of flowering or the beginning of maturation. The latent period was about 65 days when cv. Sunbred 246 was inoculated at or before GS 4.4, but only 35 days when it was inoculated at GS 5.1.1. Disease symptoms developed more quickly on cv. Avante, but the differences between early and late inoculation were

similar. No symptoms developed on plants inoculated before the production of pollen or towards the end of the maturation period.

The progress of the disease in the field crop, in relation to rainfall, temperature, plant growth and the number of airborne spores during and after flowering is shown in Fig.2. Maximum air temperature ranged beatween 17°C and 27°C with alternating periods of dry and wet weather. Although spore concentrations tended to increase after rainfall, there was a gradual increase from 22 July reaching a maximum on 4 August, and then declining. The highest spore concentrations corresponded with GS 4.5 and 5.0 for most plants. The first symptoms were noted as early as 5 August, but the number of heads with grey mould remained small until about 27 August when the rate of incidence increased rapidly. The rapid increase in disease incidence occurred about 23 days after the peak in spore concentration was measured. No differences were observed between the two cultivars.

## Discussion and Conclusions

Grey mould is potentially the most damaging disease of sunflower crops in the UK, and an understanding of the environmental and biological factors affecting disease development is needed before a practical forecasting system can be produced. The results of controlled environment experiments suggest that the length of the latent period depends on the growth stage at which infection takes place. The reduction in latent period observed when heads were inoculated at the end of flowering or the beginning of maturation may have been due to the presence of senescing material in the form of ray flowers and old pollen which would act as a substrate for fungal growth.

The time between the observation of maximum spore concentrations and the rapid increase in observed symptoms (about 23 days) in the field crop was similar to the latent period found for early maturing plants inoculated at GS 4.5 and 5.0. As the greatest conidial concentrations were found when most of the plants were at GS 4.5 and 5.0 it is probable that most infections took place then. However, some of the late infections may have been caused by conidia deposited at the later growth stages when the latent period is short, or, the late development of symptoms may have been due to the early deposit of conidia followed by a long latent period.

The apparent dependence of latent period on growth stage suggests that, in field crops, symptoms will develop at about the same time irrespective of growth stage at infection (Fig.2). The most damaging symptoms, which cause loss of oil yield and quality,

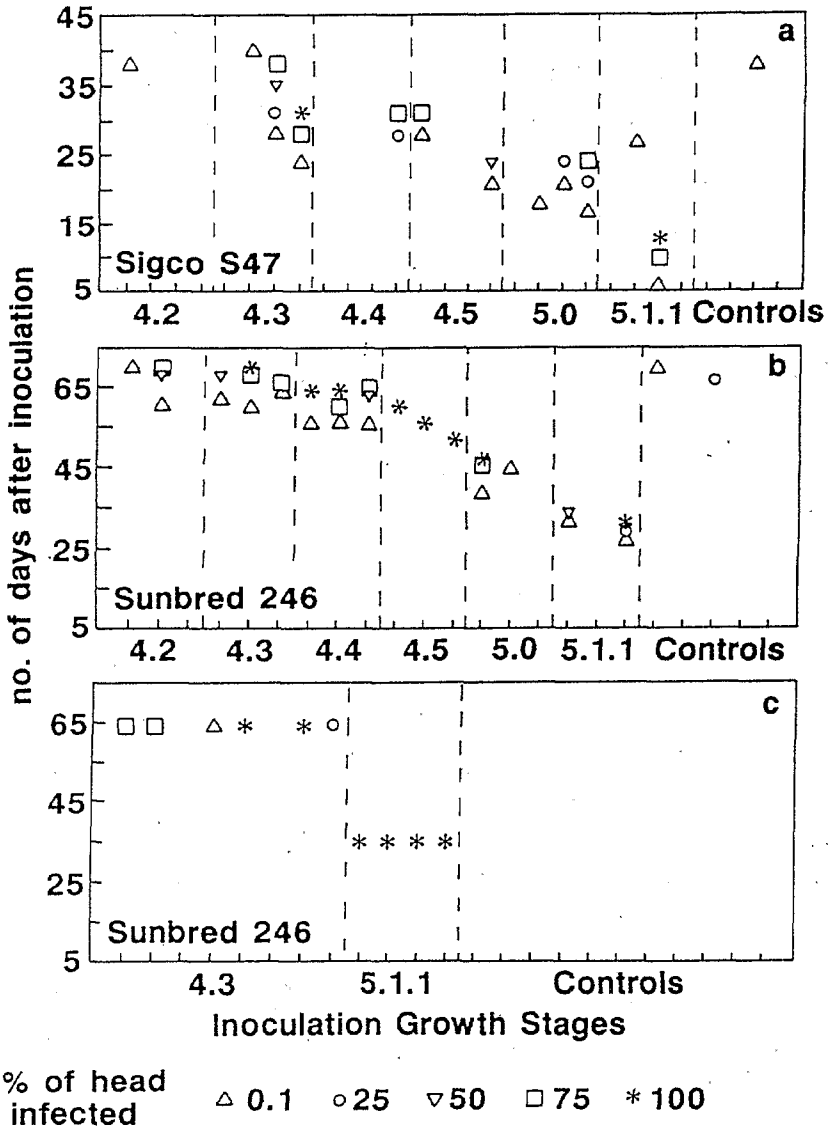


Figure 1. Progress of Botrytis after inoculation

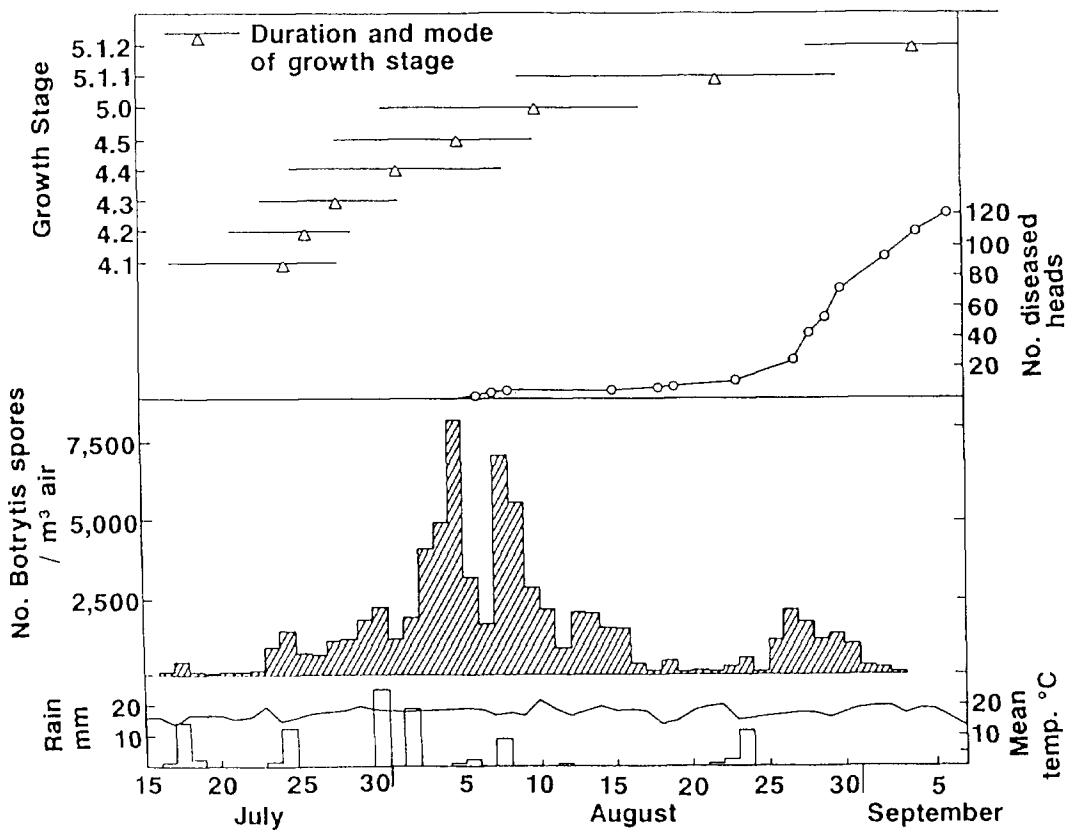


Figure 2. Progress of Botrytis in the field crop in 1991

appear to develop only after physiological maturity (Lamarque,1985). Systemic fungicides have no effect; they are either absorbed or rapidly degraded before reaching the sites of infection (Perez,1986). As the crop is susceptible to infection over the whole of the flowering period, forecasting the timing of control measures may be difficult. However, if a desiccant is applied when seed moisture is ç.30% the effect of the disease can be decreased by advancing the harvest date by up to 7 days. Early desiccation does not result in loss of oil yield since oil content increases until physiological maturity, and then declines (Church and Rawlinson,1990).

Further field studies are needed to identify more closely the relationships between conidia production and time of infection and to confirm that between growth stage and latent period.

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