EFFECTS OF GLASSHOUSE AIR QUALITY ON CROP YIELDS

Effects of NO on the growth of tomato (N. van Berkel and H.G. Wolting) Annual Report, 1986. Naaldwijk, The Netherlands

An experiment was set up to find out whether the NO which enters a glasshouse together with the CO_2 from a burner, causes growth inhibition in a sensitive crop like tomato. On the basis of measurements of NO and NO_2 carried out in 1985 (see Annual Report 1985, p. 35) the expectation was that when maintaining 1000 ppm CO_2 from the central heating system, NO concentrations of 150-200 ppm would occur. From 7 January 1986 onwards CO_2 was applied from the burner in 2 of 4 glasshouse compartments, and the concentration was kept at 1000 ppm. In the 2 other compartments pure CO_2 was applied. The temperatures were maintained as far as possible at 18°C by day and by night. Two cultivars were used, viz. 'Counter' and 'Turbo'. From the 4th week of January onwards NO was measured in the compartments which could not come from the central boiler. When at the end of the afternoon after a short ventilation period the glasshouse was free from all gases and the ventilators were closed the NO concentration began to rise again. Around midnight the highest value was reached. The concentration then remained constant also by day, on days when no ventilation took place. It appeared the NO escaped from the soil.

By far the largest amount of NO was released in the 2 compartments where pure CO_2 was applied. In the compartments with boiler-CO_2 boiler-NO was added by day when CO_2 was applied. The sum of the boiler-NO and the soil-NO, however, remained lower than the NO concentration in the compartments with pure CO_2. The production of soil-NO took place during the entire period when no ventila-

tion took place (until 23 February) and also for a long time afterwards. The picture changed in May. Then the largest amount of soil-NO was released in the compartments where boiler CO_2 was applied.

To find out more the soil air from a number of places in one compartment was studied. Seventy litre barrels were placed on the glasshouse soil with the opening down. In a number of places the soil was pierced to a depth of 20 cm and the released air was collected during one night. With the aid of a measuring station the composition of the collected air was analysed.

It appeared that the amounts of gases released differed strongly from place to place within the compartment. If the upper spit (ca 30 cm) was dug away virtually no NO was released from the underlying soil. Covering the soil with white film, which is also used in rockwool cultivation, prevented the release of NO.

Gases which could be measured, CO_2, NO, NO_2 and SO_2, were all released from the soil.

These gases must have originated from the process of denitrification, in which organic material and nitrates are broken down into, among other compounds, SO_2 and nitrogen oxides (NO_2, NO, N_2O), while even free nitrogen (N_2) may be formed.

The great differences in the amounts of NO released from the soil, either between spots within one compartment or between the various compartments, must be explained by one or more factors affecting denitrification.

Because of the occurrence of the soil NO the original aim, investigating the effect of NO from the boiler, came to nothing. Instead, the effect was studied of high levels of NO released from the soil.

Already in week 4 the NO concentrations in compartments 3 and 4 (with pure CO_2) were much higher (250 ppb) than in the boiler-CO_2 compartments 1 and 2 (150 ppb). The picture was somewhat more pronounced in week 5 when in compartment 3 360 ppb (maximum 560 ppb) was measured, in compartment 4 290 ppb and in compartments 1 and 2 190 ppb. The concentrations were highest in week 8: in compartment 3 580 ppb (max. 1100), in compartment 4 350 ppb and in compartments 1 and 2 340 ppb. From week 9 onwards the concentrations dropped rapidly because of ventilation. Measuring data of weeks 6 and 7 are not available because of calibration of the NO measuring equipment, but the concentrations must have been high because no ventilation took place yet.

In compartment 3 serious damage occurred of the lower leaves, less serious damage in compartment 4 and no appreciable injury occurred in the boiler-CO_2 compartments. Counting the damaged leaflets (7 per leaf) gave the following results (Table 7).

Table 7. Damage leaflets per plant in the 4 compartments.

	compartment			
	1	2	3	4
Counter	0.1	0.2	36.2	9.2
Turbo	0.4	0.6	43.6	14.9

Neither longitudinal growth nor flowering was affected by the high NO concentrations. The growth of the shoots, however, was affected. 'Turbo' remained behind in shoot growth in particular in compartment 3 and to a lesser degree in compartment 4. A similar effect was observed with respect to leaf weight.