both reached their potential size with six achenes/cm², and their weights are proportional to the total number of achenes on each. If berry C, with twelve achenes/cm², had expanded to the same extent as *A* it would have been of equal size because it has the same total number of achenes.

It is thus possible, using achene spacing measurements, to calculate the shortfall in yield resulting from sub-maximal receptacle development. The percentage shortfall in berry weight has been determined for achene spacings in the range 6–10 achenes/cm² (Table 1). Other experimental plants, yielding well by accepted standards, appear to have been capable of producing a 50–100 per cent greater yield of berries; and yields from a local commercial strawberry holding suggest that the crop could have been doubled if conditions had been more favourable to berry expansion. A large gap thus clearly exists between present yields and what could be achieved by manipulation of the environment (for example, irrigation, or better nutrition) during the final phase of development alone. A similar approach to the calculation of potential yield and the theoretical shortfall it reveals may be possible for other fruits, such as the raspberry, pineapple, blackcurrant and gooseberry.

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Non-biological Reduction of Nitrite in Soil

Chemical decomposition of nitrite in soil[1-7] resembles microbial denitrification by producing gaseous end-products, N_2 and N_2O (refs. 8–11). NO and N_2 are formed in sterile soil over a wide *p*H range[12], and N_2 is also formed in sterile aqueous solutions containing nitrite and iron[13,14]. We show here that NO, N_2 and N_2O are products of non-biological nitrite decomposition in soil.

Soil was sterilized by autoclaving, brought to 60 per cent water-holding capacity with sterilized distilled water, and equal amounts of membrane-filtered $Na^{15}NO_2$ (60·019 atom per cent ^{15}N) and $Na^{14}NO_2$ were added. Final concentration was 250 μg N/g dry soil. The soil was incubated in respirometer flasks[15] at 25° C in an oxygen-free helium atmosphere for 168 h. Flask atmospheres were analysed by mass spectrometry. Atom per cent of ^{15}N in excess of normal was determined from isotope beam ratios. Quantitative analysis of respirometer gases was done by gas chromatography, using commercially available columns. Soil *p*H was measured at the sticky point with a glass electrode.

Table 1. ^{15}N ENRICHED GASES EVOLVED FROM SOILS AMENDED WITH NITRITE-^{15}N*

Soil	Per cent ^{15}N excess† NO	N_2	N_2O
Amity silty clay loam	29·40	4·10	5·22
Cove clay	14·70	3·13	11·70
Chehalis silty clay loam	19·40	2·94	14·20
Cloquato silt loam	14·60	2·48	9·70
Willamette silty clay loam	14·80	2·09	11·80

* Equal amounts of $Na^{15}NO_2$ (60·019 atom per cent ^{15}N) and $Na^{14}NO_2$ added to soil respirometer flasks to give a final concentration of 250 μg N/g dry soil.

† Excess ^{15}N in normal abundance determined from isotope beam ratios obtained by mass spectrometric analysis of flask atmospheres.

Soil containing added nitrite–^{15}N produced NO and N_2O heavily enriched with ^{15}N (Table 1). No microbial growth occurred in soil extracts incubated for 3 weeks in a variety of media and environmental conditions. The relative proportion of gases evolved from Amity, Cove and Cloquato soils was $NO > N_2 > N_2O$; whereas, for Chehalis and Willamette soils the order was $N_2 > NO > N_2O$. Gas analyses of many other soil systems in similar conditions revealed NO, N_2 and occasional small quantities of N_2O. Formation of N_2 and N_2O in sterile soil together with NO, a gas which is not usually associated with microbial denitrification, provides strong evidence for non-biological mechanism(s).

Table 2. PATTERN OF GAS PRODUCTION IN SEVERAL SOIL TYPES AMENDED WITH NITRITE*

		Per cent nitrite–nitrogen converted to gas†					
		Autoclaved			Non-autoclaved		
Soil	*p*H	N_2	N_2O	NO	N_2	N_2O	NO
Astoria silt loam	4·8	7	0	71	9	0	68
Cove clay	5·8	14	0	37	17	0	41
Chalis silty clay loam	6·1	23	0	33	25	0	34
Willamette silty clay loam	6·2	26	0	63	28	0	60
Walla Walla silt loam	7·3	14	0	7	17	0	7
Corvallis sandy loam	8·9	1	0	11	1	0	10

* Nitrite-nitrogen added as $Na^{14}NO_2$ to give a final concentration of 200 μg N/g dry soil.

† Quantitative analysis of gases in respirometer atmospheres by gas chromatography.

The pattern of gas production in several soil types with added $Na^{14}NO_2$ is presented in Table 2. Evolution of N_2 and NO from both alkaline and acid soil indicates that *p*H is not the only factor involved in converting nitrite–N to gases[16]. Additional evidence, not presented here, suggests that organic matter and clay also affect the stability of nitrite in sterile soil systems. Autoclaving did not alter those soil properties which affect nitrite decomposition.

Copper, iron, manganese and certain aluminium salts may promote non-enzymatic decomposition of nitrite[13,14]. Metal ions can be reduced by metabolic intermediates and end-products of anaerobiosis[17] and then combine with nitrite, organic matter and colloidal clay. Such a complex could become reactive and liberate N_2 and other gases which are significant in soil denitrifying systems[11].

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