odology adopted by Baldwin is worth special attention, especially for younger persons embarking on new techniques. He started with experimenting on a few masks placed over a single telescope and gradually worked his way up to the current achievement. The paper which reported this achievement has a large number of authors from several institutions – a model for successful cooperation that merits special mention. We can expect several new discoveries when the sensitivity and resolution of this technique improve, and when the several other contenders in this game achieve similar successes.

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Volatile oil constituents and wilt resistance in cumin (*Cuminum cyminum* L.)

Cumin cultivation has received a serious threat from wilt disease which devastates the total standing crop. Screening of lines against cumin wilt under artificial/field conditions indicated that UC-198, UC-199 and RZ-19 have shown fairly good tolerance to wilt[1]. Different entries of cumin were evaluated for volatile oil contents and correlated with wilt incidence. To understand the role of volatile oil in disease resistance at the molecular level, the volatile oil was fractionated on GLC and correlation between volatile oil constituents and wilt resistance was determined.

Fourteen entries of cumin were grown at Agriculture Farm of S.K.N. College of Agriculture, Jobner under All India Coordinated Varietal trial. The volatile oil contents from these entries were evaluated using Clevenger apparatus[2]. The volatile oil was made moisture-free by using anhydrous sodium sulphate and stored in a glass vial. These samples were subjected to gas chromatographic examination as described earlier[3]. The identity of the constituents was ascertained by comparison of relative retention time with authentic standards. The percentage of oxygenated compound and hydrocarbons was recorded.

The negative correlation between volatile oil contents and wilt incidence (Figure 1) suggests that the variety with high volatile oil contents is less prone to wilt which was not true in all cases. The anti-microbial property of volatile oil was also reported by other workers[4,5]. Earlier we reported that the growth of wilt pathogen, *Fusarium oxysporum* was inhibited in presence of volatile oil of cumin. The effectiveness of inhibition varies from variety to variety[6]. To understand it at the molecular level, the main components of volatile oil of some varieties of cumin were determined. Volatile oil of cumin consists of a mixture of hydrocarbons (terpenes, sesquiterpenes, etc.) and oxygenated compounds (alcohols, ester, ether, aldehydes, ketones, lactones, phenols, etc.). Of these, the oxygenated compounds are the principal odour carriers, although the terpenes and sesquiterpenes too contribute to some degree to total odour and flavour. These components are separated on GLC on the basis of their partition coefficient. The hydrocarbon components and oxygenated compounds are having marked difference in the retention time due to polarity differences. The main constituents of volatile oil of cumin are cuminaldehyde, cuminyl alcohol, terpenes, p-cymenes, pinenes, etc. The first two components are oxygenated compounds and the last three are hydrocarbon compounds. So cumin oil has two types of

Table 1. Volatile oil constituents of cumin and relative wilt resistance

Entry	Volatile oil constituents (%) a	b	Ratio of a : b	Relative wilt resistance (0–9 scale)
UC-199	76	21	3.61	1–2 (R)
UC-198	55	38	1.44	1–2 (R)
UC-19 mnt	42	54	0.77	2–4 (MR)
UC-218	34	61	0.55	4–5 (MR)
RZ-19	30	67	0.44	4–5 (MR)
RS-1	30	68	0.44	7–8 (HS)
UC-208	28.4	71.5	0.397	4–6 (MR)
Local	16	82	0.19	9 (HS)

a = oxygenated components; b = hydrocarbon components. R = resistance; MR = moderately resistance; HS = highly susceptible.

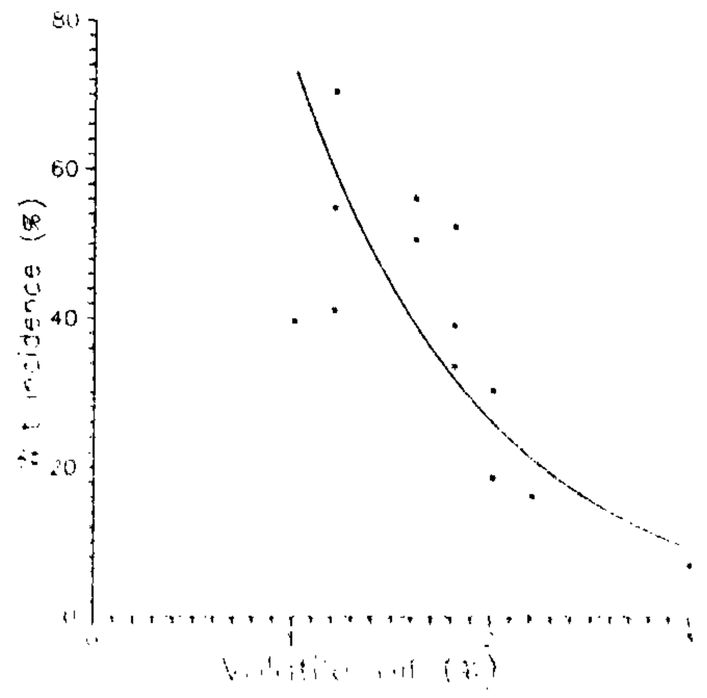

Figure 1. Relation between volatile oil and wilt incidence in cumin. The line represents the regression line ($Y = \exp(-1.03164x)$ 205.276).

components, i.e. oxygenated compound and hydrocarbon compound. The percentage of volatile oil constituents and the ratio of oxygenated components : hydrocarbons were found correlated with wilt resistance (Table 1); the varieties having high ratio of oxygenated components : hydrocarbons are more resistant to wilt compared to those with lower ratio. Thus oxygenated compounds, i.e. cuminaldehyde and cuminyl alcohol appear responsible for resistance to wilt.

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