4 Wingfield, J C. *Avian Endocrinology· Environmental and Ecological Perspective* (eds. Karni, S M., Homma, K. and Wada, M), JSSP, Springer-Verlag, Tokyo and Berlin, 1983, pp. 265–288.
5. Juss, T. S , *Avian Endocrinology* (ed Sharp, P. J), J Endocrinol. Ltd., Bristol, 1993, pp. 47–60.
6. Pyrzak, R. and Siopes, T D., *Poultry Sci* , 1986, **65**, 199–200.
7 Pyrzak, R and Siopes, T. D., *Br. Poultry Sci.*, 1989, **30**, 151–160
8. Scott, H M. and Payne, L. F., *Poultry Sci.*, 1937, **16**, 90–96.
9. Jones, T. E., Hughes, B. L., Thurston, R. T., Hess, R A. and Froman, D P., *Poultry Sci.*, 1982, **61**, 1930–1932
10. Chandola, A. and Thapliyal, J P , Proc. First International Symp on Avian Endocrinology, Calcutta, 1977.
11. Benoit, J., *Ann. NY Acad Sci* , 1964, **117**, 204–216
12. Hartwig, H. G and Van Veen, *J Comp. Physiol.*, 1979, **130**, 277–281.

ACKNOWLEDGEMENT. Financial support from CSIR, New Delhi to A. K. is gratefully acknowledged

Received 11 January 1994; revised accepted 2 March 1994

Colletotrichum falcatum race designation – A methodology

Narendra Singh and Vijai Singh

Indian Institute of Sugarcane Research, Lucknow 226 002, India

On the basis of variation in the reaction of *Colletotrichum falcatum* isolates in the set of 13 differentials, viz. SES 594, BO 91, COS 767, COLK 8002, Baragua, CO 7717, CO 975, CO 419, CO 62399, COJ 64, Khakai, CO 1148 and CO 997, two physiological races were identified. The races were designated on the basis of binary and decanary values of infection (spectrum of pathogenicity). The races designated were (i) 7680 from CO 1148 (Haryana), COJ 64 (Lucknow) and COLK 7701 (Lucknow) and (ii) 5920 from CO 7717 (Haryana). The race of higher aggressive nature could achieve higher value of infection.

COLLETOTRICHUM FALCATUM Went, the causal agent of red rot disease of sugarcane, is one of the most distructive pathogens in India. It is a facultative saprophyte and keeps changing in nature due to factors such as hybridization, mutation, heterokaryosis and adaptation. The phenomenon of physiological specialization in *C. falcatum* has been reported by several workers[1–6]. The races of *C. falcatum* have been reported earlier on the basis of fungus morphology that many times do not agree even with the concept of the physiological race[7]. Recently efforts have been made to identify the races on the basis of reactions on tentative differentials[8–12].

There are several methods of nomenclature and designation of races of fungal pathogens. The methodology utilized where genes for resistance in host and genes for virulence in the pathogen are known is considered different than the unknown gene situation. Habgood[13] reported a system of nomenclature in which the race is derived from the spectrum of pathogenicity in different hosts. Nomenclature is made whether or not the genetic basis of resistance in the host has been elucidated. Since sufficient information on the genes for resistance in sugarcane and genes for virulence in *C. falcatum* is not available Habgood's method[13] is being proposed in the present study.

Several isolates of *C. falcatum* were collected and 4 isolates of COJ 64 (Lucknow), COLK 7701 (Lucknow), CO 1148 (Haryana) and CO 7717 (Haryana) were used in this study. Thirteen differentials, viz. Baragua (*Saccharum officinarum*), Khakai, (*S. sinense*), SES 594 (*S. spontaneum*), COS 767, COJ 64, COLK 8002, BO 91, CO 419, CO 975, CO 1148, CO 7717 and CO 62399, were planted in the field condition at Lucknow during the last week of February. Inoculations were made in the second week of August. Twenty five uniform canes of each differential were inoculated by plug method at the third internode. The maximum temperature range was 31–34°C and the minimum 23–26°C. The field was irrigated at the next day of inoculation. The relative humidity was 75–90% during inoculation. The experiments were repeated thrice.

Observations on the disease symptoms were recorded 30 days after inoculation on the basis of 0–9 scale[14]. The reactions of the isolate were limited to resistant and susceptible categories. The differentials were assigned the following grades for their average value of disease index:

Score	*Reaction*	*Notation*
0–4 (white spot absent)	R (Resistant)	0
4.1–9 (white spot present)	S (Susceptible)	I

The differentials were arranged in the fixed liner order. The reaction of each host to a particular isolate was assigned as 0 and 1 depending on resistant and susceptible category. The resulting series of 0 and 1 notation were then considered as a binary number and converted to decanary notation giving a simple unique number for potential race as illustrated below (Table 1). Isolate R-51 is pathogenic on four of thirteen differential hosts namely 10, 11, 12 and 13.

The spectrum of pathogenicity of race 7680 can be simply obtained from its designation. Thus race 7680 $(4096+2048+1024+512) = 2^{12}+2^{11}+2^{10}+2^{9}$ attacks host 13, 12, 11 and 10 only.

The race number of each of the four isolates was calculated on the basis of their reaction on 13 differentials (Table 2). The isolates from CO 1148 (Haryana),

Table 1. Key for designation of race

Differential hosts	13	12	11	10	9	8	7	6	5	4	3	2	1
Isolate no 51	S	S	S	S	R	R	R	R	R	R	R	R	R
Binary value	1	1	1	1	0	0	0	0	0	0	0	0	0
	12 (2)	11 (2)	10 (2)	9 (2)	8 (2)	7 (2)	6 (2)	5 (2)	4 (2)	3 (2)	2 (2)	1 (2)	0 (2)
Decanary value	4096	2048	1024	512									

Designation of isolate No. 51 = 4096 + 2048 + 1024 + 512 = 7680

Table 2. Reaction of *C. falcatum* isolates on different hosts

Isolate no. and source	13 CO 997	12 CO 1148	11 Khakai	10 COJ 64	9 CO 62399	8 CO 419	7 CO 975	6 CO 7717	5 Bara-gua	4 COLK 8002	3 COS 767	2 BO 91	1 SES 594	Race Number
R-4(COJ 64) Lucknow	S	S	S	S	R	R	R	R	R	R	R	R	R	7680
R-5 (COLK 7701) Lucknow	S	S	S	S	R	R	R	R	R	R	R	R	R	7680
R-51 (CO 1148) Haryana	S	S	S	S	R	R	R	R	R	R	R	R	R	7680
R-52 (CO 7717) Haryana	S	R	S	S	S	R	R	S	R	R	R	R	R	5920

COLK 7701 (Lucknow) and COJ 64 (Lucknow) acquired the same value 7680. The other race designated was 5920 from CO 7717 (R-52, Haryana).

The race 7680 was comparatively more aggressive on the differentials as it acquired the higher value than race 5920.

The findings clearly indicate that isolates of CO 1148 (R-51, Haryana), COJ 64 (R-4, Lucknow) and COLK 7701 (R-5, Lucknow) belong to race-1 (7680). Isolate of CO 7717 (R-52, Haryana) designated race 2 (5920) was quite distinct from race 1 (7680). The reaction of the two isolates on certain commercial varieties was earlier established[8, 11] and two distinct races (CO 1148 and CO 7717) were identified.

The environmental conditions were optimum for the red rot development from August to September because of favourable temperature range 23–34°C (weekly mean) and the average relative humidity more than 75%. The relative humidity at 7 a.m. was generally 90%. Beniwal and Satyavir[15] also found that the temperature range of 21–31°C was suitable for red rot development in Haryana.

The important methods[16] for race nomenclature and designation were (i) arbitrary number method (ii) Black's method based on virulence on a particular gene for resistance (iii) virulence formulae method (iv) virulence analysis based on certain critical genes for virulence and (v) Habgood's method. Considering the limitation of genetic information on sugarcane for resistance, Habgood's method has been utilized for designating the races of red rot.

In case there is a need to add some new additional hosts in original series, these can be done to the left end of the host series at a later stage. Thus the old race that do not attack these hosts can retain the same number. The new race will then acquire a new number.

The system can be used for designating and ascertaining the existence of races of *C. falcatum* in different varieties and various locations.

1 Abbott, E. V., *Int. Soc. Sug. Tech. Congr*, 1935, **5**, 730–736.
2. Rafay, S. A. and Padmanabhan, S. Y, *Curr Sci.*, 1941, **10**, 25–26.
3. Rafay, S A. and Singh, V. B, *Curr. Sci.*, 1957, **26**, 19–20
4 Chattopadhyay, S E. and Sarkar, A., *J. Mycol. Res.*, 1957, **3**, 25–28.
5. Kirtikar, *Proc Bien Conf. Sug. Dev. Workers*, 1961, **4**, 583–589.
6. Chona, B L. and Srivastava, D. N., *Indian Phytopathol*, 1960, **5**, 158–160.
7. Stakman, E. C., Mayo Foundation Lecture, 1926.
8. Khirbat, S. K., Satyavir, and Beniwal, M. S., *Indian Phytopathol.*, 1980, **33**, 296–299.
9. Satyanarayana, Y. and Achuta Rama Rao, M, *Sugarcane*, 1984, **3**, 6
10. Waraitch, K. S, *Bhartiya Sugar*, 1986, **11**, 24–25
11. Beniwal, M S., Satyavir and Virk, K. S., *Indian Phytopathol*, 1989, **42**, 95–98.
12. Ramapandu, S. and Sarma, M. N., *Indian Phytopathol*, 1991, 339–344.
13. Habgood, R. M., *Nature*, 1970, **227**, 1268–1269
14. Srinivasan, K. V. and Bhat, N. R, *J. Indian Bot Soc.*, 1961, **11**, 566–577
15. Beniwal, M S. and Satyavir, *Indian Phytopathol.*, 1991, **44**, 333–338

16 Singh, B M and Chand, J. N., in *Phytopathological Techniques* (eds Chand, J. N. and Saharan, G. S.), HAU Press, Hissar, 1980, 116–121.

ACKNOWLEDGEMENT. We thank Dr K. S. Virk, HAU, Haryana for supplying fresh cultures of two isolates

Received 21 April 1993; revised accepted 23 February 1994

Sex modification in Kartoli (*Momordica dioica* Roxb.) by foliar sprays of silver nitrate ($AgNO_3$)

J. C. Rajput, Y. R. Parulekar, S. S. Sawant and B. M. Jamadagni

Central Experiment Station, Konkan Krishi Vidyapeeth, Wakawali 415 711, India.

Foliar sprays with $AgNO_3$ at preflowering stage induced hermaphrodite flowers on strictly gynoecious vines of Kartoli (*Momordica dioica*) Roxb.) The androecious vines were insensitive to the $AgNO_3$ sprays. Application of 400 ppm $AgNO_3$ could induce 70 to 90 per cent hermaphrodite flowers. Higher concentration caused wilting and senescence, whereas lower level showed less proportion of bisexual flowers.

KARTOLI is a nutritionally rich perennial dioecious cucurbit having a wide range of adaptability. However, its cultivation has several restrictions like unavailability of improved varieties, difficulties in propagation by seeds due to dormancy, low multiplication rate and dormancy of tubers and unpredictable sex ratio in seedling progenies[1].

Being a dioecious crop, planting of 10% male plants in the field is imperative for a good fruitset. This leads to reduction in number of female plants per unit area and thereby the yield. This investigation considers the possibility of inducing hermaphrodite flowers on female vines so as to avoid the planting of male vines[2].

The experiment was conducted at CES, Wakawali during the rainy season of 1992 and 1993. The male and female vines were sprayed with $AgNO_3$ at 400, 500 and 600 ppm in 1992 and with 200, 300 and 400 ppm in 1993 at preflowering stage.

It is revealed that only female vines produced hermaphrodite flowers when treated with $AgNO_3$ (Figure 1), whereas the male vines were insensitive to the chemical treatment. More important, the proportion of hermaphrodite flowers on female vines was the highest due to 400 ppm $AgNO_3$ in both the years. With increase in concentration, there was a sharp fall in the proportion of bisexual flowers (Table 1). The higher concentration of $AgNO_3$ also exhibited senescence and wilting of vine. Spraying with $AgNO_3$ below 400 ppm also reduced the production of bisexual flowers slightly (Table 2). The chemically induced bisexual flowers on female vine could also set fruits even after enclosing them with perforated paper bags. The results indicate that $AgNO_3$ at 400 ppm favours production of hermaphrodite flowers.

Figure 1. Induction of hermaphoditism in female flower by foliar application of $AgNO_3$. **1**, Normal ♂: **2**, Normal ♀. **3**, ♀♂ by 200 ppm $AgNO_3$; **4**, ♀♂ by 300 ppm $AgNO_3$; **5**, ♀♂ by 400 ppm $AgNO_3$.

Table 1. Effect of silver nitrate on production of bisexual flowers in Kartoli during 1992 (No of vines treated: female 7; male 3)

$AgNO_3$ conc. (mg/l)	No. of vines producing bisexual flowers		% of bisexual flowers	
	Female	Male	Female	Male
400	5	–	71.42	–
500	2	–	28.57	–
600	1	–	14.28	–
Control	–	–	–	–

Table 2. Effect of silver nitrate on production of bisexual flowers in Kartoli in 1993 (No. of vines treated: female 10; male 5)

$AgNO_3$ conc. (mg/l)	No. of vines producing bisexual flowers		% of bisexual flowers	
	Female	Male	Female	Male
200	8	–	80	–
300	8	–	80	–
400	9	–	90	–
Control	–	–	–	–

1. Ali, M., Okubo, H., Fuji, T. and Fujiedan, K., *Sciential Hortic.*, 1991, **47**, 335–343.
2 Rashid, M. M. (ed.), *Vegetables of Bangladesh*, BARI, Joydebpur, Gazipur, 1976, p 494.

Received 29 January 1993; revised accepted 1 December 1993