## NUCLEAR POLYHEDROSIS VIRUS OF *AGROTIS IPSILON* (HUFNAGEL) (NOCTUIDAE: LEPIDOPTERA), THE BLACK CUTWORM OF CABBAGE

G. SANTHARAM and T. KUMARASWAMI

*Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore 641 003, India.*

THE black cutworm, *Agrotis ipsilon* is a serious pest having wide geographical distribution and infesting a variety of crop plants causing severe economic losses in many parts of the world. During field surveys in Tamil Nadu for pathogenic micro-organisms associated with crop pests which could be used as bio-control agents in the integrated pest management system, the larvae of *A. ipsilon* infesting cabbage in the Nilgiris (Tamil Nadu) had shown the virosis symptoms. The dead cadavers were brought to the laboratory and the presence of inclusion bodies was confirmed through microscopic examination.

The virus from the dead cadavers was extracted and purified[1]. The pathogenicity of the virus was assessed in the laboratory by feeding healthy, laboratory reared larvae of *A. ipsilon* with cabbage leaf discs contaminated with the viral suspension. The larvae fed for two days and thereafter either ceased to feed or showed diminished feeding rate. The larvae then became sluggish, with flaccid body, changed to pale white in colour and died within 120 hr after ingestion of virus contaminated food. Some of them also showed the typical wipfelkrankheit symptom of viral infection (figure 1). The body wall finally reptured and white liquefied body contents oozed out. The smear prepared with oozing body fluid was stained with azocarmine G and the inclusion body[2] of NPV took brilliant red colour confirming the presence of inclusion body virus. Even though nuclear polyhedrosis of *A. ipsilon* has been reported from China[3], this is the first report from India.


**Figure 1.** Infected (D) and healthy (H) larva of *A. ipsilon*

Further studies on the utility of this virus for the control of *A. ipsilon* in the field are in progress.

27 April 1983; Revised 19 August 1983

1. Smith, K. M., *Outlook Agric.*, 1959, **2**, 178.
2. Palmieri, J. R., Kelderman, W. and Sullivan, J. T., *J. Invertebr. Pathol.*, 1978, **31**, 264.
3. Tsai, S. Y., Hwang, G. H. and Ding, T., *Acta Entomol. Sin.*, 1978, **21**, 101.

## GENETIC MARKERS TO DETECT APOMIXIS IN *SORGHUM BICOLOR* L. MOENCH

U. R. MURTY, P. B. KIRTI, P. SRIDHAR and M. BHARATI

*Indian Agricultural Research Institute, Regional Station, Rajendranagar, Hyderabad 500 030, India.*

FACULTATIVE apomixis resulting from apospory[1], diplospory[2,3] and synkaryogenesis[4] occurs in sorghum, *Sorghum bicolor* (L.) Moench. The existence of these 3 mechanisms was mostly established from embryological studies. Occurrence of apospory and diplospory could also be established through progeny tests using quantitative characters like number of days taken for flowering, compactness of the panicle, awn length and plant height[5,6]. In all these studies, apomixis was difficult to estimate because of the lack of simple genetic markers and the presence of an interfering cross-sterility[7]. In the present study, 2 simple genetic markers tan plant colour and shrivelled seed, were used to detect and estimate apomixis. These two characters are known to be governed by a single recessive gene[8,9].

SPV-232, a tan (*pp*) sorghum line was crossed to R 473, a purple (*PP*) coloured facultative apomict. The $F_1$ was purple (*Pp*) and the $F_2$ segregated into tan and purple plants in 3:1 ratio. Individual tan plants from $F_2$ were screened for the presence of apomixis through ovule squashes and cross-sterility. Out of 124 $F_2$ individuals, 19 were cross-sterile. Of these, 5 plants were tan. Three of them (8, 53 and 122) were apomicts.

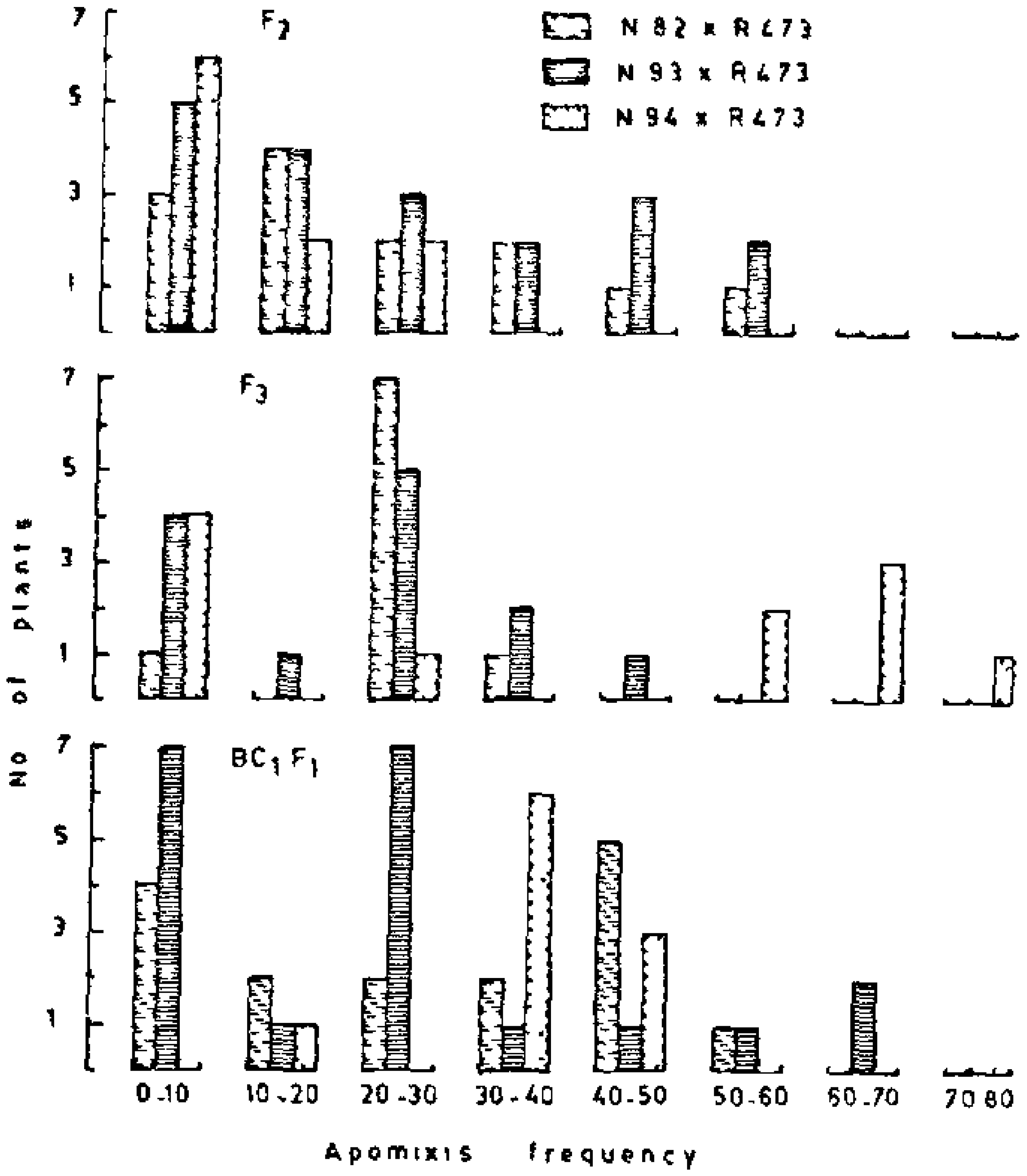



**Figure 1.** Frequency distribution of plants with varying degrees of apomixis in the different crosses and generations.

These plants were crossed as females to R 473. The resulting progeny was either completely tan (12 out of 12 in the case of 8 × R 473 and 6 out of 6 in the case of 53) or a mixture of tan and purple (7 out of 8 in the case of 122 × R 473). The tan plants could have arisen only through apomixis. Accidental selfing was ruled out since in none of the controls (crosses of tan sexual × R 473), tan plants could be recovered.

In another study three high lysine shrivelled (*su su*) endosperm sorghum lines N 82, N 93, and N 94 were crossed as females to R 473 (*Su Su*). $F_2$, $F_3$ and BC $F_1$ progenies were built up. Seeds with the genotype (*su su*) will be shrivelled. The $F_0$ (crossed) seed was plump. The seed on the $F_1$ plant itself segregated into shrivelled and plump. The segregation of shrivelled and plump seeds was tested using chi-square values in the $F_2$ (on the $F_1$ plant), $F_3$ (on the $F_2$ plant) and in the BC $F_1$ generations during the *rabi* and/or *kharif* season. A sexual cross *P* 721 (plump) × N 84 was used as a control. Normal 3:1 segregation occurred in this cross. However, in the sexual × facultative apomictic crosses significant deviations occurred indicating the occurrence of apomixis. The frequency $x$ of apomixis was calculated as

$$x = 1 - 4y$$

where $y$ is the frequency of observed shrivelled seed.

The mean frequency of apomixis in the various generations and occurrence of plants with a high frequency (50 %) of apomixis are given in table 1. The more or less continuous distribution of apomictic plants shows that it is under complex genetic control.

The present study shows that either of these two

**Table 1.** *Frequency of apomixis and facultative apomicts in various generations*

| No. | Cross | Generation | Season | Shrivelled | Plump | Apomixis frequency Range | Apomixis frequency Mean | No. of plants with more than 50 % apomixis |
|---|---|---|---|---|---|---|---|---|
| 1. | N 82 × R 473 | $F_2$ | *Rabi* | 331 | 1161 | 0–90 | 11.26 | 16.67 |
| | | | *Kharif* | 4790 | 18060 | 0–70 | 14.99 | 11.76 |
| | | $F_3$ | *Rabi* | 3584 | 10291 | 0–75 | * | 12.5 |
| | | | *Kharif* | 2171 | 8529 | 0–40 | 18.84 | 0 |
| | | BC$_1$ $F_1$ | *Kharif* | 2968 | 13392 | 0–60 | 27.6 | 6.25 |
| 2. | N 93 × R 473 | $F_2$ | *Rabi* | 753 | 2549 | 0–30 | 8.8 | 0 |
| | | | *Kharif* | 3352 | 14889 | 0–70 | 26.49 | 22.73 |
| | | $F_3$ | *Rabi* | 2455 | 6227 | 0–45 | * | 0 |
| | | | *Kharif* | 3493 | 13832 | 0–50 | 19.35 | 0 |
| | | BC$_1$ $F_1$ | *Kharif* | 3793 | 15319 | 0–70 | 20.61 | 15.79 |
| 3. | N 94 × R 473 | $F_2$ | *Rabi* | 39 | 142 | 0 | 13.81 | 0 |
| | | | *Kharif* | 2654 | 8614 | 0–40 | 5.78 | 0 |
| | | $F_3$ | *Rabi* | 4 | 112 | – | 86.2 | – |
| | | | *Kharif* | 1858 | 8549 | 0–80 | 28.59 | 54.55 |
| | | BC$_1$ $F_1$ | *Kharif* | 1395 | 7329 | 0–50 | 36.04 | 0 |
| 4. | Control: P 721 × N 94 | | *Kharif* | 2129 | 6624 | 0 | 0 | 0 |

* Grand mean became negative because of greater frequency of shrivelled grains.

characters can be used to detect and estimate apomixis. But both characters have their own advantages and disadvantages. With the tan plant character, one has to grow the plants for making a progeny test. In the case of shrivelled-seed character, apomixis frequency can be estimated from the crossed seed itself. However, shrivelled seeded lines are useless as breeding lines, while tan plants lines are much more desirable than purple plants. Further, earhead diseases result in improperly filled grains simulating the shrivelled character. It is therefore suggested that tan plant character is used in estimations of apomixis in breeding experiments and the shrivelled grain character in quick estimations in basic studies aimed at achieving obligate apomixis.

The authors are thankful to Drs N. G. P. Rao and V. Jaya Mohan Rao for supplying the seed of N 82, N 93 and N 94. This investigation forms part of a National Project supported by the Indian Council of Agricultural Research. The authors are thankful to Dr H. K. Jain for his interest in this work.

21 February 1983; Revised 30 June 1983

1. Rao, N. G. P. and Narayana, L. L., *Indian J. Genet.*, 1968, **28**, 121.
2. Murty, U. R., Schertz., K. F. and Bashaw, E. C., *Indian J. Genet.*, 1979, **39**, 271.
3. Murty, U. R., Kirti, P. B., Bharathi, M. and Rao, N. G. P., *Sorghum in the Eighties. Proc. Int. Symp. ICRISAT*, 1981.
4. Murty, U. R., Rao, N. G. P., Kirti, P. B. and Bharathi, M., *Curr. Sci.*, 1981, **50**, 142.
5. Murty, U. R. and Rao, N. G. P., *Curr. Sci.*, 1979, **48**, 1041.
6. Murty, U. R., Rao, N. G. P., Kirti, P. B. and Bharathi, M., *Cereal Res. Commun.* 1981, **9**, 239.
7. Murty, U. R. and Rao, N. G. P., *Indian J. Genet.* 1981, **41**, 561.
8. Ayyangar, G. N. R., Ayyar, M. B. S., Rao, V. P. and Nambiar, A. K., *Indian J. Agric. Sci.* 1936, **6**, 938.
9. Schertz, K. F. and Stephens, J. C., Compilation of gene symbols, recommended revision and summary of linkage for inherited characters of *Sorghum vulgare* Pers. Tech. Monogr. 3. *Texas Agri. Exp. Stn.* 1966.

## A SPONTANEOUS MUTANT WITH THREE-STYLE PISTILS IN *AVENA SATIVA* L.

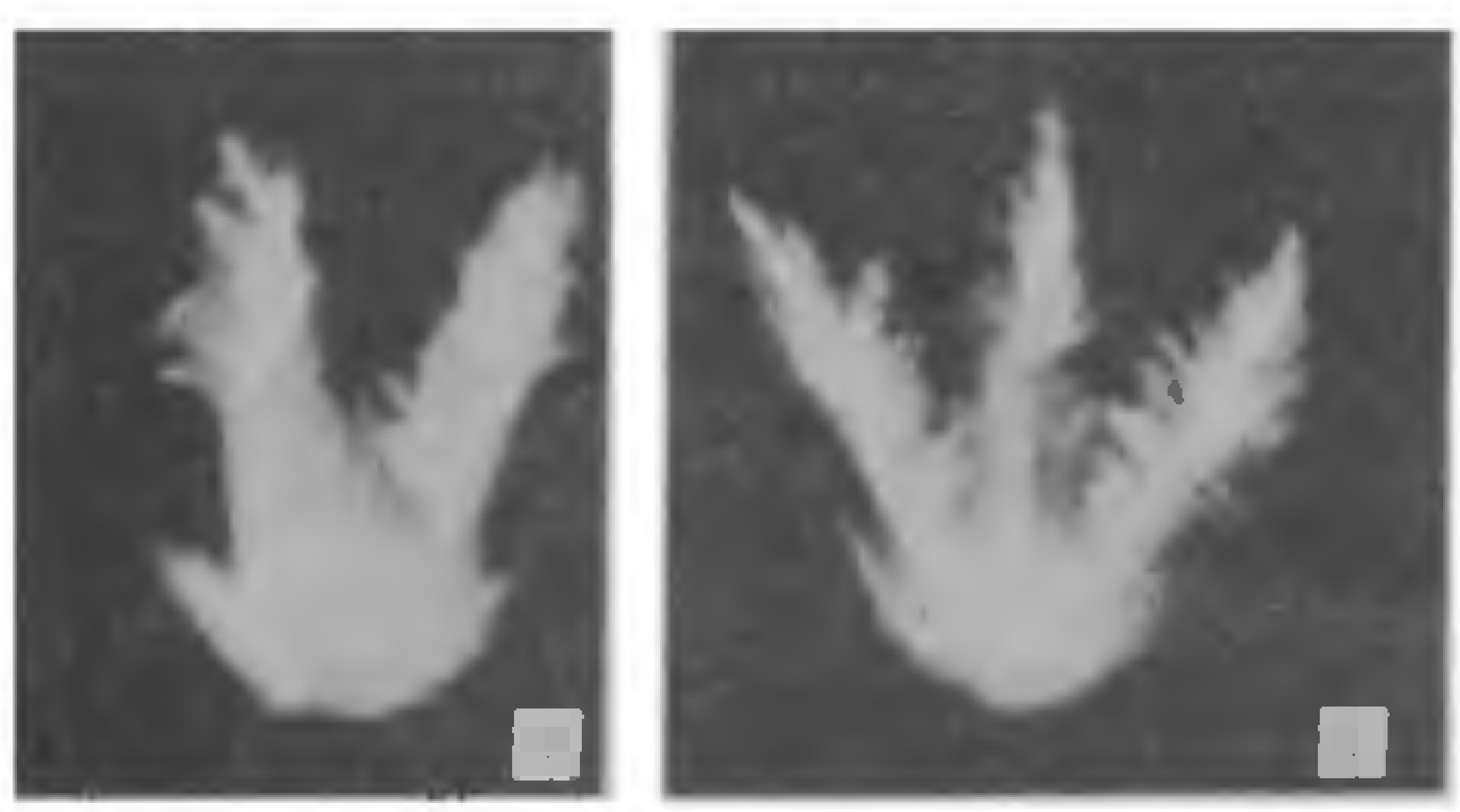
M. N. PREMACHANDRAN, R. N. CHOUBEY and S. K. GUPTA

*Indian Grassland and Fodder Research Institute Jhansi 284 003 India.*

THE grasses are characterized with pistil consisting of a one-loculate ovary having a single ovule and usually two styles bearing feathery stigmas[1]. Robbins[2] pointed out that in all grasses the pistil contains three fibrovascular bundles, with two extending into stylar branches and the third continuing into either the dorsal lobe or a stylar branch. In the genus *Avena*, the ovary invariably at its apex, bears two whitish feathery stigmas on very short styles (figure 1).

While emasculating the florets of various *Avena sativa* L. genotypes raised in the 1981–1982 crossing block at this Institute, the florets of one plant of the strain 'OS-8' were found to possess three styles. The progeny of this plant was raised during *rabi* 1982–'83 along with normal parental line. No differences in the morphological plant attributes and flowering time were found. However, all the plants in the progeny of the mutant were found to possess three styles and stigmas in many florets (figure 2). Cytological observations on pollen mother cells of these plants exhibited normal meiosis with 21 bivalents at metaphase I.

It was found that 111 out of the 316 mature florets from 17 panicles taken at random possessed three styles. Since all the plants in the progeny were characterised by the presence of such florets, the penetrance of the three-style pistil character appeared to be complete. However, the expressivity of this trait varied from 12.5–60% with an average value of



**Figures 1 & 2. 1.** Pistil of normal *A. sativa* with two styles. **2.** Pistil of the spontaneous mutant with three styles.