A NEW STRAIN OF TOBACCO MOSAIC VIRUS CAUSING MOSAIC DISEASE IN PIGEON PEA

PIGEON pea (*Cajanus cajan* L. Millsp.) is an important pulse crop in this country. Recently some plants of pigeon pea in Poona Agricultural College farm showed symptoms of virus infection. Infected pigeon pea plants showed mild mosaic and slight puckering in the interveinal regions of leaves (Fig. 1) and bore smaller leaves and fruits than those of healthy ones. The virus obtained is henceforth referred to as Arhar Mosaic Virus (AMV) and the experimental results are presented in this report.

FIG. 1. Healthy (right) and AMV-infected (left) leaves of Pigeon pea plant showing mild mosaic symptoms.

AMV was easily sap transmitted but could not be transmitted through seed or any of the six aphids tested, *viz.*, *Myzus persicae* Sulz., *Aphis craccivora* Koch., *A. gossypii* Glove., *A. neri* Boyen., *Lipaphis pseudobrassicae* Davis., and *Rhopalosiphum maidis* Fitch. Dilution end point, thermal inactivation point and longevity *in vitro* of AMV were $10^{-7} - 10^{-8}$, 80–85° C and 30–31 days at room temperatures (21 to 35° C) respectively.

AMV produced mild mosaic symptoms on the leaves of *Glycine soja* (L.) Sieb. and Zuec., *Phaseolus vulgaris* L., *P. lunatus* L., *P. aureus* Roxb., *Desmodium gyrans* D.C., *Cajanus cajan* L. Millsp., and local lesions on *Nicotiana glutinosa* L., *Chenopodium amaranticolor* L., *N. tabacum* L. W.B., *N. rustica* L., *N. glauca* L. whereas, *Pisum sativum* L. and *Dolichos lablab* L. were found to be symptomless carrier. Serological tests revealed that AMV is a strain of TMV.

Symptoms produced on different hosts and physical properties of AMV are quite different from those of other pigeon pea infecting viruses, *viz.*, cowpea mosaic virus, yellow and pale mosaic virus and common bean mosaic virus. AMV differs from pigeon pea mosaic virus[1] and the virus causing pigeon pea sterility disease[3] in method of transmission, host range and symptomatology. Also the present virus differs from legume viruses limited to leguminosae[2] in its host range, physical properties and insect transmission.

Host range and physical properties of AMV are in general agreement with tobacco mosaic virus (TMV). TMV and AMV are also serologically related. Thus the above study revealed that the virus reported is a strain of TMV and is also related to arhar mild mosaic virus (AMMV)[4] from which it differs in physical properties and host range. Thus the present virus is identified as a new strain of TMV infecting pigeon pea.

Division of Mycology and Plant Pathology,
I.A.R.I., New Delhi 110 012,
August 23, 1978.

A. B. SINGH.
P. K. PANDEY.*

* I.A.R.I. Regional Station, Agricultural College Estate, Poona 411 005.

1. Bist, N. S. and Banerjee, A. K., *Labdev J. Sci. Technol.*, 1962, **3**, 271.
2. Bose, L., *Neth. J. Plant Path.*, 1964, **70**, 161.
3. Capoor, S. P., *Indian J. agric. Sci.*, 1952, **22**, 271.
4. Singh, R. and Mall, T. P., *Curr. Sci.*, 1976, **45**, 635.

STUDIES ON FLORAL BIOLOGY IN *PLANTAGO OVATA* FORSK AND OTHER SPECIES

Introduction

Plantago ovara Forsk. yielding *Sat Isabgole* of commerse is well known for its medicinal properties. It hae captured the world market fetching about 165·31 million rupees worth foreign exchange in 1976–77. It is mainly cultivated in Mehsana and Banaskantha Districts of North Gujarat in an area of about 20,000 hectares. Its dried seeds are boat-shaped (*Isabgole* literally means "horse's ear") and contain about 30% mucilage. It is used as a mild laxative, emollient and demulcent. In many ways, it is superior to the commonly used laxatives based on magnesium and other salts.

In spite of its unique position in the agricultural economy of the country, *P. ovata* has not received adequate attention of the breeders and geneticists. Available information on flower structure, floral biology and nature of pollination being meagre, investigations on these important aspects of *Plantago* were undertaken as an ancilliary to its improvement programme. Some observations are reported here.

Materials and Methods

Seeds of eight *Plantago* species, *viz.*, *ovata* (IC 7739), *psyllium*, *lanceolata*, *pumilla*, *albicans*, *coronopus*, *argentea* and *lagopus*, were field-planted during

TABLE I

Diurnal variation for flower opening in Plantago ovata

	Number of flowers opened in a spike				Number of flowers in a spike
	9·00 A.M.	11·00 A.M.	1·00 P·M.	5·00 P.M.	
Mean	2·72	1·76	0·01	0·01	55·60
Range	2·1–3·6	1·0–2·5	..	..	45·5–69·0
S.D.*	0·56	0·51	..	..	8·36

TABLE II

Flowering period in a spike and delay of anther dehiscence after stigma emergence in Plantago *species*

Species	Number of days for completion of flowering in a spike			Delay of anther dehiscence after stigma emergence (in hrs.)
	Mean	Range	S.D.*	
P. pumilla	7·00	..	..	Nil
P. argentea	4·28	4–6	0·81	Nil
P. ovata	13·40	8–17	2·69	Nil in short styled flower
				48·0 in long styled flowers
P. psyllium	7·25	5–8	1·41	43·2
P. coronopus	20·0	12–25	5·56	40·8
P. lagopus	23·20	22–25	0·52	48·0
P. lanceolata	21·75	17–23	2·07	50·4
P. albicans	15·17	13–16	1·81	76·8

* Standard deviation.

November, 1974 using usual agronomic practices. In *P. ovata*, observation on 2 spikes per plant from 10 plants selected, at random, were taken during February. Averages for number of flowers opened from 7·00 A.M. to 5·00 P.M., number of days for completion of flower opening and number of flowers per spike were computed. Time gap between anther dehiscence and stigma emergence was recorded from one flower per spike per plant. Similarly, in other species, observations were made in respect of days to completion of flower opening and timings of anther dehiscence and stigma emergence.

Results and Discussion

Average weekly temperature (maximum and minimum) during the flowering period extending from February 1st week to March 2nd week is given in Table III.

1. *Flower opening*: Flowering did not commence till 7 A.M. in *P. ovata* and that maximum number of flowers opened between 7 A.M. and 9 A.M. (Table I). The number of flowers that opened during this period averaged 2·72 on each spike. After 9 A.M., there was a decrease in the number of opened flowers which came down to 1·76. Opening of flowers almost completely stopped after 11 A.M., there being only one or two flowers which opened during the rest of the day.

The number of flowers borne per spike in *P. ovata* averaged 55·6 (Table I), while the number of days required for completion of flowering were 13·4 days per spike (Table II). In the species, *P. lanceolata coronopus* and *lagopus*, completion of flowering took longer number of days than *P. ovata* which was 21·7 20·0 and 23·2 days, respectively, (Table II).

TABLE III

Average weekly temperature in February–March, 1974

Month	Week	Maximum	Minimum
February	I	21·5	4·7
	II	18·9	3·2
	III	24·6	6·6
	IV	26·3	8·5
March	I	26·0	11·6
	II	26·8	11·0

2. *Stigma emergence*: In the majority of spikes in *P. ovata*, the stigma remained within the unopened bud reaching only up to the apex of the bud, but in certain cases it protruded out of the bud giving the

indication of such flowers being long-styled. The stylar length was 3·25 mm in short styled ones while 3·96 mm in long-styled ones. Stigma emergence coincided with anther dehiscence in only, *P. pumilla, argentea* and in short-styled flowers of *P. ovata.* In other species, *viz., Psyllium, coronopus, lagopus, lanceolata* and *albicans* stigma emerges earlier than anther dehiscence; the time lag ranged between 40·8 and 76·8 hrs (Table II). Thus, these species expressed protogyny like *P. ovata* (long-styled flowers).

3. *Stigma receptivity and anther dehiscence*: The stigma in *P. ovata* appears to be single in bud stage having pointed apex covered with hairs. But next day when flower opens, it splits into two. In long-styled flowers, stigma becomes receptive as soon as it protrudes out of the bud. This happens 48 hrs before anther dehiscence. In short-styled flowers, stigma receptivity synchronises with the time of anther dehiscence. Thus, the long-styled flowers were protogynous which fact is of importance to the breeder in the maintenance of purity of seed and in developmet of appropriate breeding methods.

The authors are grateful to late Dr. H. B. Singh, and late Shri S. C. Issar for initiating these studies and to Shri S. C. Sinha, for field observations.

National Bureau of Plant Genetic Resources,
IARI Campus, New Delhi,
August 30, 1978.

S. P. MITAL.*
N. R. BHAGAT.

* Emeritus Scientist.

INCIDENCE OF *HAPALOPHRAGMIOPSIS PONDEROSUM* (SYD. & BUTL.) THIRUM. ON *ACACIA LEUCOPHLOEA* WILLD.

Hapalophragmiopsis ponderosum (Syd. and Butl.) Thirum[1,2] causes the production of large galls and imparts a striking appearance to *Acacia leucophloea*, Willd. a very common tree on the Poona University campus. As reported by Thirumalachar, the early stages of infection occur during the flowering seasons. Galls are formed either by infection of flower buds or very young twigs. Thereafter, the growth of the infected portion is very rapid due to hyperplasia, ultimately resulting in the formation of a tumour.

In view of the fact that details of the history of the rust were not known completely, attempts were made to examine critically all stages in the growth of the plant and trace the actual initiation of infection. A special search was made for alternate hosts and observations on withered and healthy pods falling on the ground around the *Acacia leucophloea* trees.

The seedlings from the seeds germinated during monsoon season and were collected for detailed study. Surprisingly, the young seedlings, also show gall formation at the nodal, internodal and leaf regions (Fig. 1). Thus, it is clear that the infection occurs at the seedling stage.

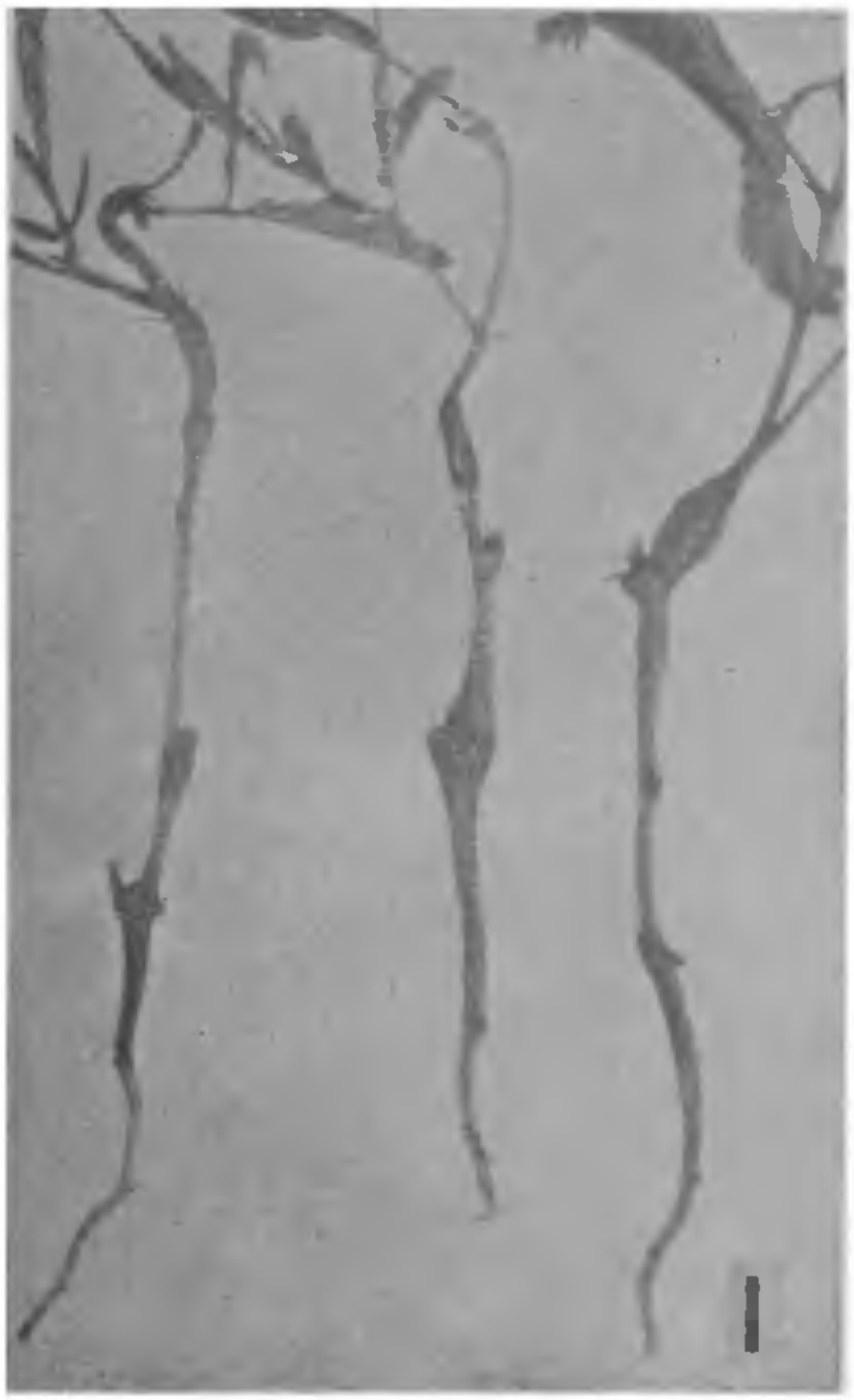

FIG. 1. *Acacia leucophloea* seedlings showing young galls.

Transverse sections from the infected portions showed the presence of Pycnial, early Telial (Uredial) and Telial stages. Pycnial cups are subepidermal, conical with a flat basal hymenium. Pycniospores are oval or spherical (Fig. 2). Infected swollen portion just before the appearance of telial stage, showed single-celled immature uredospores mixed with teleutospores (Fig. 3). A section through the tiny black specks appearing on the infected portions showed telia with three-celled brown coloured teleutospores (Fig. 4).

Germination of the teleutospore was studied, following the method of Thirumalachar[1]. Teleutospores germinate producing a four-celled promycelium, which abstricts a basidiospore at the tip. (Figs. 5 and 6). Basidiospores start germinating when still attached to the sterigmata producing germ tubes (Fig. 6).

Thus our studies show that *Hapalophragmiopsis ponderosa* to be systemic and seed-borne.