

Table 1 Effect of Butachlor on the growth and the ammonia assimilating enzymes of *Azolla*

Butachlor (ppm)	Mean <i>Azolla</i> weight (g)	% decrease over control	Units per mg of protein		
			GDH	GOGAT	GS
Control	23.00	—	4.94	412	235
25	22.50	-2.17	4.83	403	230
50	22.00	-4.35	4.81	386	225
75	21.00	-8.70	4.36	382	221
100	20.00	-13.04	4.20	380	214
125	18.00	-21.74	4.01	351	210
150	16.00	-30.44	3.79	325	202
175	14.00	-39.14	3.83	308	191
200	12.50	-45.65	3.05	302	180

rogen. Biological nitrogen fixation through *Azolla-Anabaena* complex is considered to be a potential biological system for increasing rice yield at comparatively low cost¹.

Butachlor-N-(butoxymethyl)-2-chloro',6'-diethyl acetanilide is a herbicide commonly used to control the weeds in the rice field. It is applied to the rice field as granules or sprays on 7th day after sowing or transplantation before the weeds emerge². A pot experiment was conducted to find out the effect of Butachlor on the growth and ammonia assimilating enzymes of *Azolla*. Mud pots filled with one kg of rice field soil and 4 lit of water were used in this experiment. An initial inoculum level of *Azolla* at 15 g per pot was added. The herbicide—Butachlor 50% EC at 25, 50, 75, 100, 125, 150, 175 and 200 ppm concentrations was sprayed over the *Azolla* by using a hand sprayer. *Azolla* samples were drawn on 3rd day and ammonia assimilating enzymes viz glutamate dehydrogenase (GDH)³, glutamine synthetase (GS)⁴ and glutamate synthase (GOGAT)⁵ were estimated. Fresh weights of *Azolla* biomass were recorded on the 10th day after inoculation. Increase in the concentrations of Butachlor has gradually decreased the growth of *Azolla*. The reduction in the growth of *Azolla* has been noticed at higher doses of Butachlor. This indicates that Butachlor not only controls the weeds but also the growth of *Azolla* also which is useful for rice crop by supplementing organic nitrogen. The harmful effect of the herbicides on *Azolla* biofertilizer has been reported recently⁶. In general the ammonia assimilating enzymes viz GDH, GS and GOGAT have been considerably inhibited at higher concentrations (table 1). The inhibition has been found to be significant from 100 to 200 ppm levels and maximum at 200 ppm level. Growth and nitrogen

assimilation of *Azolla* were reduced at concentrations between 0.1 and 10 ppm for each of the triazine dinitro aniline and urea herbicides where as chloramben at 1 ppm caused 99% reduction in nitrogen fixation and phenolic herbicides at 0.1 ppm caused 75% reduction⁷.

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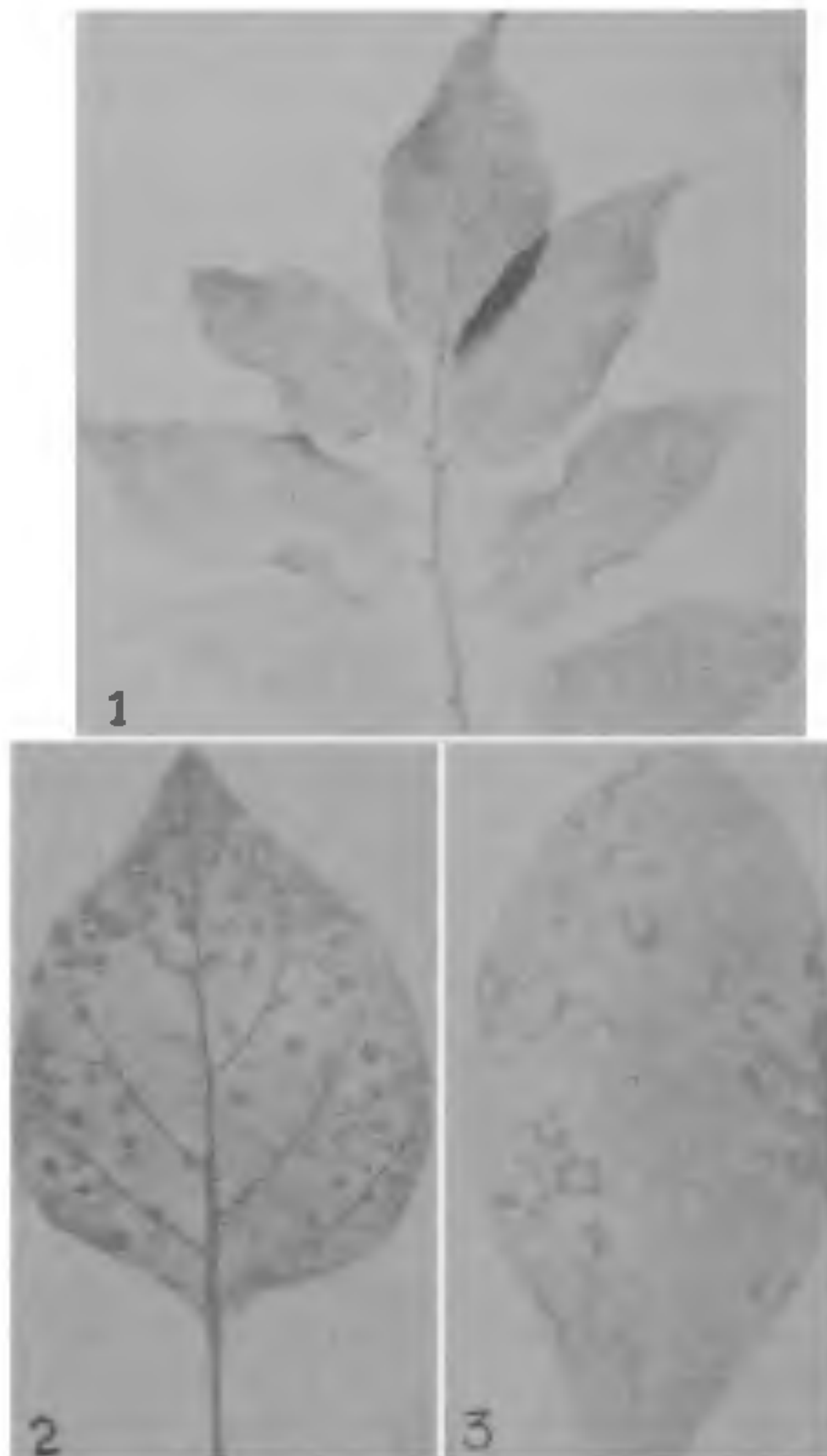
POTATO VIRUS X ON WILD POTATO SPECIES *SOLANUM CHACOENSE* FROM INDIA

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SOLANUM CHACOENSE Bitt. is a tuber-bearing *Solanum* species, native of south America. It has got

naturalized in the Simla hills¹. Several plants of this wild potato species, in the vicinity of this Institute, have been observed with mild mosaic symptoms for the last few years. This disease is tuber transmitted. Symptoms consist of mild stunting of growth, chlorosis of leaves which are slightly reduced in size and with wavy margins (figure 1). The symptoms are more conspicuous during rainy season on expanded upper leaves. Earlier reports indicated that *S. chacoense* is seldom infected by potato viruses²⁻⁴. Hence, in order to determine the identity of the causal virus the present study was undertaken.



Figures 1-3. 1. *S. chacoense* leaves showing mild mosaic and wavy margins. 2. *C. pendulum* leaf showing necrotic local lesions. 3. *N. debneyi* leaf showing lesions/spots.

The causal virus was found readily sap transmissible to *Capsicum pendulum*, *Datura stramonium*, *D. metel*, *Gomphrena globosa*, *Nicotiana debneyi* and *N. glutinosa*. The virus was further isolated from individual local lesions induced by the virus on *C. pendulum* (figure 2) and its culture was maintained on *N. glutinosa* for detailed studies. The standard transmission tests were carried out to confirm the causal virus.

The causal virus incited mosaic mottling on *D. stramonium*, *Lycopersicon esculentum*, *Nicandra physaloides*, *N. ambalema*, *N. clevelandii*, *N. bigloveii*, *N. glutinosa*, *N. tabacum* varieties Samsun and NL 95 and *S. chacoense*; necrotic local lesions on *Amaranthus caudatus*, *C. pendulum*, *Chenopodium amaranticolor*, *C. album*, *C. quinoa*, *G. globosa* and *N. megalosiphon* and lesions/spots followed by systemic mosaic on *D. metel*, *C. annuum* and *N. debneyi* (figure 3). Some of the plants namely *N. rustica*, *Physalis floridana*, *Solanum melongena* and *S. tuberosum* cvs. Kufri Alankar, Kufri Jyoti and up-to-date carried the virus symptomlessly. Symptoms on *S. chacoense* were also masked at higher temperature (30°C) in summer. The virus did not infect plants belonging to the families *Cucurbitaceae*, *Cruciferae* and *Leguminosae*.

Physical properties of the virus were studied on *C. pendulum*. The virus was infective upto dilution 1:10⁻³. Its thermal-inactivation-point was 64-66°C. It remained infective in sap upto 42 days at room temperature (20-24°C) and 55 days at -20°C (deep-freeze). The virus reacted positively with antiserum of PVX and negatively with those of PVS and PVY, confirming its identity as PVX.

On the basis of symptomatology particularly on *C. pendulum*⁵, *D. stramonium*, *G. globosa*⁶ and *C. amaranticolor*, physical properties and serological studies of this virus clearly indicated that the causal virus of mosaic disease of *S. chacoense* was PVX. This isolate of PVX resembled PVX₃ strain of Verma *et al*⁷ with regard to its symptom on *C. pendulum* a differential host of PVX strains⁸. Its resemblance could not be proved serologically due to non-availability of the serum of PVX₃ strain. In literature, *S. chacoense* is known to be infected by PVX and Y^{2,4} from abroad and only Y³ from India. The present investigation, therefore, shows that PVX is reported for the first time from India. This virus was observed in nature on *S. chacoense*, which might act as a reservoir of the above virus.

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DIFFERENTIAL BROOD EMERGENCE OF SUB-TROPICAL MEGACHILID BEES

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DIAPAUSE is a physiological process¹ and occurs in insects during adverse climatic and physical conditions^{2,3}. It may be obligatory or facultative; however, the purpose is to tide over the harsh environmental extremes. Megachilid bees in subtropical climates show multivoltine life cycle^{4,5}. Here a part of each seasonal brood always remains in dormancy. The implication of such a behaviour pattern and the possible factors causing this behaviour are given below.

The study was conducted from 1976 to 1981 on the emergence pattern of three species of megachilid bees viz *Megachile flavipes* Spinola, *M. lanata* Lepel and *M. cephalotes* Smith. The pattern of emergence is shown in figure 1 which clearly indicates that a part of the brood of each season remains always in the state of larval diapause. These bees do not show an obligatory diapause and univoltine life cycle; rather the diapause seemed to be facultative, resulting in multivoltine life cycle pattern. It is opined that facultative diapause is largely controlled by environmental factors^{2,6-12}. Different races/strains of a species may become genetically differentiated with respect to diapause so that

their behaviour is different and not readily altered¹⁰. This is best shown in the present study where each seasonal brood has a specialized fraction which shows different degree of diapause and hence differential emergence spreading from 2 to 5 subseasons (defined by Sihag⁵).

The most consistent indicator of season is the day length or photoperiod^{2,7-11} and this is the most important sign stimulus initiating diapause. Photoperiodism should not be a factor to induce emergence or breakage of diapause in these bees because the developmental stages are completely deprived of light due to the complete darkness in their nests. Other possible indicators are temperature, the state of the food and age of parents¹⁰. Kapil and Sihag¹³ opined that probably caloric value reward provided during mass provisioning of food for developing larvae may act as an external signal to cause differences in the degree of diapause leading to a differential brood emergence. On the other hand, temperature plays a big role in the induction of diapause in these bees¹⁴. Age of the parents may also be responsible for the production of such eggs which may show differential emergence in a brood. Whatever the recourse may be, the ultimate end is the presence of differential brood emergence where the emergence of a

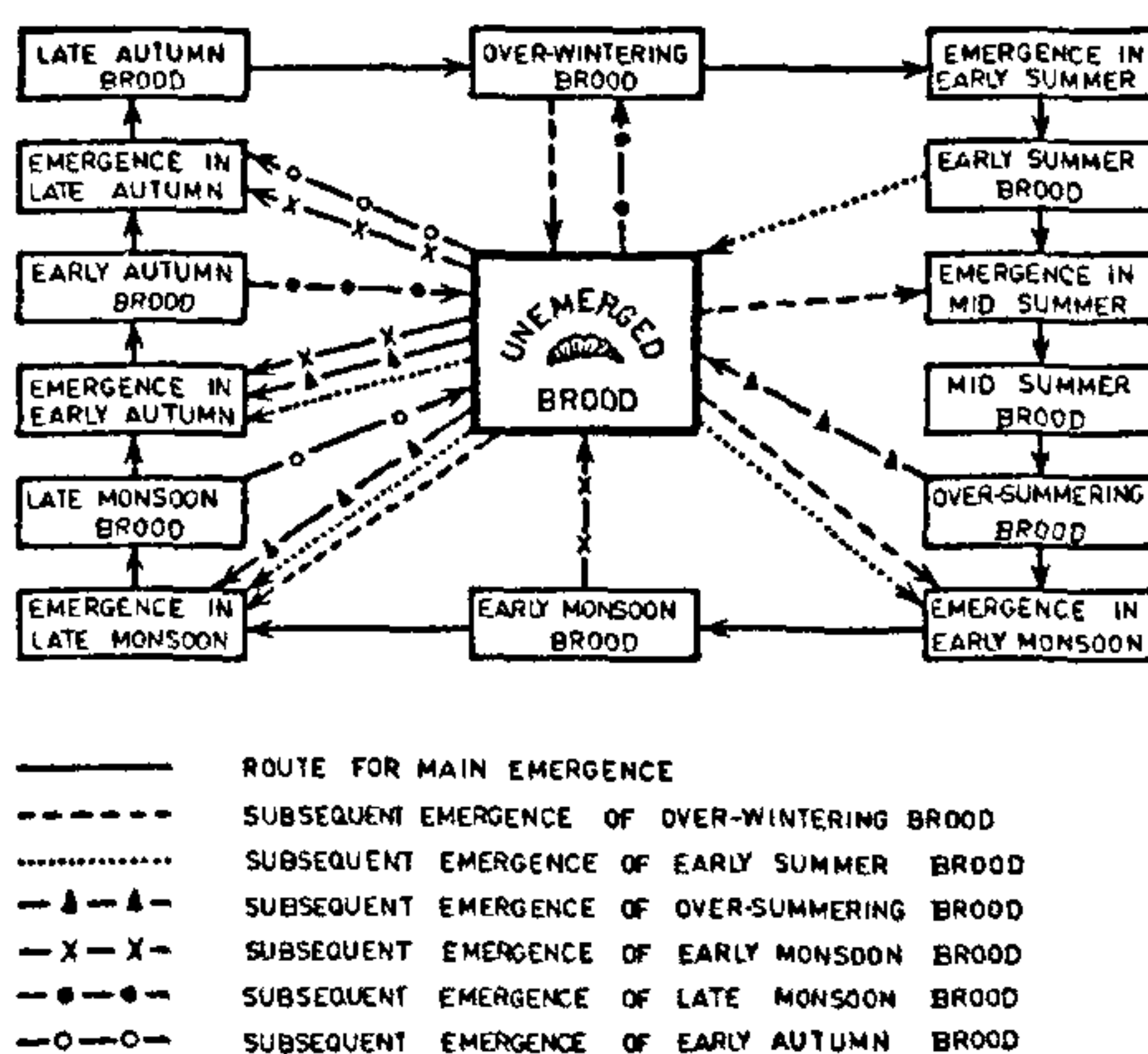


Figure 1. A schematic model on the emergence pattern of subtropical solitary megachilid bees to show that besides main emergence in immediate next season, a part of each seasonal brood contributes to the un-emerged brood pool which shows a differential emergence spreading over 1-3 sub-seasons.