POPULATION-CORRELATED MORPHISM IN THRIPS-INDUCED GALLS OF *CALYCOPTERIS FLORIBUNDUS* LAMK

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VARYING populations of gall thrips in natural and induced gall systems appear to considerably influence not only the size and shape of the galls but also the surface area, thickness, dry weight as well as degree of hyperplasy and hypertrophy. The age of the gall and the involved populations of thrips therefore also tend to influence the tissue dynamics. Increased diversities both in the expression of the external form as well as the pace at which tissues react are discussed as a consequence of age in terms of days and variation of population with reference to the pouch galls of *Calycopteris floribundus* Lamk caused by *Austrothrips cochinchinesis* Karny.

Different stages of *C. floribundus* galls were collected, thrips population counted and transverse sections of the galls examined under 12.5×40 magnification for counting cells in a standard eyepiece graticule. The gall tissues were oven-dried at 37°C and the dry weight was calculated.

Feeding by varying numbers of gravid females of *A. cochinchinesis* on the axillary buds resulted in the fusion of four leaf primordia leading to the formation of a pouch-like structure, the unfed terminal portions remaining free (figures 1A and B). Young maturing and old galls harboured populations of 26–68, 400–900 and 1600–3000 respectively. Feeding by 1–2 adult females prior to laminar expansion resulted in gall development[1] in 3–5 days old axillary buds, retaining however the identity of the apices of the leaves. In three different experiments, 3, 6 and 9 adult females were allowed to feed for 7 days in the young leaf primordia of the axillary buds, a critical stage prior to laminar expansion, after which they were carefully removed from the buds. These axillary buds were subsequently allowed to grow for 90 days, the normal period taken by the galls to attain the senescent stage in the field. In the experiment with three adults, only two leaves showed fusion at the basal region, while in experiments with more individuals the tendency for a greater fusion of all leaf primordia was evident (figures 1A and C). The feeding impact of varying population densities of thrips in the axillary buds affects the fusion of the leaves leading to variation in the size as well as the number of rudimentary leaves present at the gall apices. An analysis of the young (5–12 days), mature (25–40 days) and old (70–90 days) galls indicated the trends of complexity in terms of the increase in populations within the galls, which gradually become highly wrinkled, convoluted and thick-walled and retaining in many cases the rudiments of leaf apices (figure 1A inset). With an average increase in populations from 23 to 990, the wall thickness of the gall increased from 5 to 43 mm (table 1). Similarly the number of cells per unit area and surface area showed a positive correlation (table 1), the surface area ranging from 832 to 2894 sq. mm and the number of cells per unit area from 16 to 227 with populations of 23 to 900. A positive correlation was also evident in respect of the dry weight of 1375 mg, with a population of 990 and only 52 mg, with a minimal population (table 1). A correlation therefore exists between the degree of hyperplasy and cellular hypertrophy and the increase in population.

Figures 1A–C. **A.** Axillary bud showing basally fused leaf primordia due to thrips feeding; **inset**: Mature gall L.S. showing highly wrinkled walls and unfed terminal portions of the leaf; **B.** Fully developed gall with unfed apices of the leaves at the tip; **C.** Developed axillary buds showing basally fused leaf primordia due to thrips feeding.

A comparative study[2] of the normally developed galls and those from which the gall maker was removed at different stages of development, revealed that two kinds of processes are involved in

Table 1 *Simple regression analysis of the impact of thrips population on various gall parameters*

Population of thrips (Y)	Laminar thickness (mm) (x_1)	No. of cells per unit area (x_2)	Gall size (mm) Length (x_3)	Gall size (mm) Breadth (x_4)	Dry weight (mg) (x_5)	Surface area (sq. mm) (x_6)
23	5	16	5	3	52	832
55	10	30	12	5	81	1133
84	12	42	16	7	135	1322
125	15	53	21	10	205	1587
210	18	67	25	16	396	1623
345	22	98	29	18	529	1810
432	25	117	32	20	620	2136
620	28	136	36	24	869	2345
825	34	140	45	30	1152	2583
905	37	180	49	35	1232	2710
990	43	227	53	40	1375	2894
Regression coefficient (b)	b_1: −7.32	b_2: 2.00	b_3: 11.27	b_4: −23.72	b_5: −0.113	b_6: 1.05
Correlation coefficient (r)	0.98	0.97	0.98	0.99	0.97	0.99

gall formation, some attaining the final 'form' even when the cecidozoa are rendered inactive in the beginning, acting as 'inductors' and others needing the continuous presence/stimulus of the insect so that the final form is not attained if the insect is removed or killed. In the light of the present investigation on the pouch galls of *Calycopteris* as well as on other leaf roll and fold galls[3], thrips galls fall under the second category, since the continued presence of the cecidozoan is an essential prerequisite for the completion of the gall formation. The population of thrips in the complex galls of *Calycopteris, Acacia* and *Schefflera* being 3–15 times more than that in the simpler galls[4] indicates that the maximum complexity is attained with increasing density of thrips populations.

Axillary buds infested with varying populations being allowed to feed for a constant period exhibit varying degrees of leaf fusion. Such induced morphological variations brought about by the feeding impact of varying populations with a constant feeding duration, amply support the direct effect of populations which have a decisive role in the display of varying morphology of the affected organ. Removal of gallmakers within the susceptible range of growth of the host plants leads to little deformity so that the development is normal in the temporarily affected part.

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