

## Galls and Gall-makers in *Khejri* (*Prosopis cineraria* Linn. Druce) of Arid Zone of India

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**Abstract** In *Prosopis cineraria* trees, four types of galls, showing variability in structure, size and weight, were identified. 25 to 45.4% galls showed the presence of gall makers (insects/mites). Population of these gall makers increased with vegetative growth of trees. Infested galls were maintained in laboratory cages and the emerged adults were identified as a mite, *Eriophyes prosopidis* (Acarina) and six insects, *Contarinia prosopidis* (Diptera), *Pediobopsis* sp. (Hymenoptera) and four Lepidopterans, *Assura albicostalis*, *Anarsia triaenota*, *Eucosma lioplintha* and *Ascalenia* sp.

**Key words** morphometrics, infestation, population, gall organism, insect, mite

### Introduction

*Khejri* (*Prosopis cineraria*), one of the most important indigenous trees of the north west arid belt of the Indian sub-continent, is playing a significant role in rural economy as a source of top feed, fuel and timber (Parihar 1993). Plant gall is a serious problem of *Khejri* trees as it reduces vegetative growth and seed formation. The genesis of gall formation is a result of nutritional dependence of gall makers on plant tissues. Biology of galls and their producers have been reviewed, but, it mentions very little about the galls found on desert trees (Mani 1973 and Ananthkrishnan 1984). However, Kant & Arya (1971) and Kant (1975) studied the morbid anatomy of leaf and flower galls of *Zizyphus* sp. and *Salvadora persica* induced by *Eriophyes* spp. Kant & Ramani (1986) further investigated *in vitro* nutritional and physiological aspects of gall formation in *Prosopis cineraria* trees and continued their studies on pathological and bio-chemical aspects (Kant & Ramani 1989).

Although a considerable work has been done by previous workers, particularly on histo-pathology and physiological and chemical changes in the galls of desert trees, but information on morphometrics, seasonal prevalence of the gall types, population structure and systematic position of the associated gall makers is scanty. As such, the present investigations were made.

### Materials and Methods

Field observations were recorded during the years 1988-91 in the 5 ha area at Central farm of CAZRI and in the adjoining localities of Jodhpur city (26°05'N -73°01'E) where *Prosopis cineraria* trees are in plenty. The trees were visited weekly and galls were sampled randomly. Data on the size and weight of gall type were collected with the help of Vernier Caliper and the digital electronic balance and variability in shape of gall types was also studied. Population structure of gall makers (organism) was estimated by dissecting the pupae or larvae present in the sampled gall materials. Some of gall material was brought to the laboratory and reared in the insect cages for the emergence of adults. The time taken for the development of larva to adult was noted. The insects emerging from the galls were identified taxonomically.

### Results and Discussion

**Woody gall on branch** : It appears in the form of swelling on the branch, as globose, agglomerate, solid hard woody brown structure, measuring from 11.2 to 45.2 mm (mean 23.2 mm) in length, 11-42 mm (20.1 mm) in breadth and 10 to 150 mg (48.5 mg) in weight (Table 1). The epidermal cells of the young galls are rectangular having thick cuticle, while the entire epidermis cracks off and peels away in the old galls. Mostly open

Table 1 Morphometrics of different types of galls on *Prosopis cineraria* tree

Parameters	No. of galls examined	Minimum	Maximum	Mean	S.D. ( $\pm$ )	CV(%)
<b>I. Gall on branch</b>						
Length (mm) of gall	17	11.2	45.2	23.2	10.5	45.2
Breadth (mm) of gall	27	11.0	45.0	20.1	9.9	48.3
Weight (mg) of gall	27	10.0	150.0	48.5	36.9	76.0
No. of galls/tree	25	6.0	55.0	25.6	11.8	45.9
<b>II. Gall on leaf surface</b>						
Length (mm) of gall	15	0.5	5.1	2.8	2.0	71.6
Breadth (mm) of gall	16	0.5	4.3	2.2	1.8	82.2
Weight (mg) of gall	17	1.5	9.3	3.6	2.1	58.3
No. of galls/tree	21	2.0	40.0	15.2	5.2	36.2
<b>III. Gall on rachis</b>						
Length (mm) of gall	18	3.4	10.2	6.2	1.9	30.7
Breadth (mm) of gall	22	2.0	3.4	2.7	0.5	21.1
Weight (mg) of gall	22	3.8	12.2	7.1	2.2	31.3
No. of galls/tree	24	3.0	25.0	14.7	2.8	19.2
<b>IV. Gall on flowers/ inflorescence</b>						
Length (mm) of gall	22	11.0	42.2	26.2	10.6	38.1
Breadth (mm) of gall	27	11.0	34.0	18.5	2.3	12.2
Weight (mg) of gall	27	9.0	76.0	23.5	17.8	75.7
No. of galls/tree	17	3.0	60.0	22.2	16.7	75.2

chalcid larva was present in the larval chamber (Fig. 1A). Kant & Ramani (1988) reported high proliferation of the vascular cylinder and smaller diameter of the vessel in the gall tissue, as compared to that of the normal leaf tissue. Each gall has oval larval chamber in the centre, which opens externally through small pore present in the periphery, and is visible on peeling the corky layer. The chambers varied from 18 to 300 in number, depending on the size of galls, and were closely packed in the gall therein, larval development took place. Newly developed adults, having metallic green colour, remained in the chambers

and exerted pressure continuously upon the periphery until pore gets opened. Consequently, the bark of galls peeled off in irregular patches and adults escaped from the chambers. The insects involved were identified as chalcid, *Pedipobopsis* sp. (Eulophidae) (Table 2). They were parasitised by *Eurytoma* sp. after emerging from the galls. Nearly 45% gall samples contained these insects. The prevalence of insect attack was visible throughout the season. The chalcid galls present on branches cause shortening and premature death of branches, occasionally detach from the tree and fall on the ground. It was found that

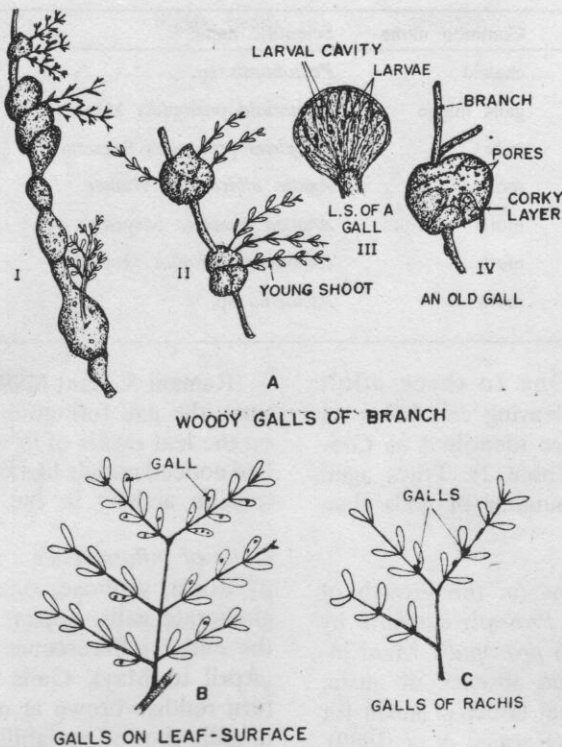


Fig 1A (I-IV) Woody galls on branches of *P. cineraria* as I. structural appearance of woody galls, II. lobed galls with young emerging shoots from the axis, III. L.S. of gall with larval cavities and chalcid larvae, IV. an old gall with pores on the periphery in the corky layer

Fig 1B Galls on the surface of the leaflets of *P. cineraria*  
Fig 1C Galls on the rachis of leaves of *P. cineraria*

occurrence of galls cause loss of biochemicals needed for normal growth of the branches and so growth is affected.

**Galls on the leaf surface :** Galls present on both the surfaces are green when young, and turn light yellow at the maturity; globose or agglomerate, occasionally lobed, unilocular, indehiscent (Fig 1B), variability in size and weight of galls are listed in Table 1. Gall density increased considerably from June to September, having peak in July, and is followed by growth of the leaf biomass. Nearly 26.7% galls were associated with mite - *Eriophyes prosopidis* Saksena (Eryophyidae : Acarina). The mite breeds parthenogenetically, producing enormous galls on the leaflets in the wet season of the year. Galls

are scattered irregularly over the lamina or sometimes restricted to the angles between veins. Auxin and phenolic contents are generally high in the galls than in the normal leaf tissue (Purohit *et al.* 1979).

**Galls on rachis of the leaflet :** Gall is moniliform, globose, indehiscent, hard solid and brownish in appearance (Fig. 1C). It measures from 3.4 to 10.2 mm (mean 6.2 mm) in length, 2.0 to 3.4 mm (mean 2.7 mm) in breadth and from 3.8 to 12.2 mg (mean 7.1 mg) in weight (Table 1). Prevalence of galls was observed throughout the season, and the population density of the cecidomyid insects present in the galls was 30.9%. The larval development took place in the gall cavity and larvae fed on plant tissue by sucking

**Table 2** Taxonomic position of gall causing organisms and their association with the parts of host plant *P. cineraria*

Insect/mite	Family	Common name	Scientific name	Gall bearing part
Hymenoptera	Eulophidae	chalcid	<i>Pediobopsis</i> sp.	Shoot/stem
Diptera	Cecidomyiidae	galls midge	<i>Contarinia prosopidis</i> Mani	Rachis of leaflets
Acarina	Eriophyidae	mite	<i>Eriophyes prosopidis</i> Saksena	Leaf surface
Lepidoptera	Pyralidae	moth	<i>Assura albicostalis</i> Walker	Inflorescence/flower
-do-	Gelechiidae	moth	<i>Anarsia triaenota</i> Meyrick	-do-
-do-	Tortricidae	moth	<i>Eucosma lioplintha</i> Meyrick	-do-
-do-	Consmopterigi- dae	moth	<i>Ascalenia</i> sp.	-do-

sap from the tissues. One to three adult cecidomyiids emerge out, leaving exit holes on the gall periphery and were identified as *Contarinia prosopidis* Mani (Table 2). Trees aged 3 to 4 years had more number of galls than the older trees.

Effect of various auxins on the growth of galls and normal tissue of *Prosopis cineraria* by *Labopteromyia* (*Contarinia*) *prosopidis* Mani indicated poor growth in the absence of auxin, and attributed the beneficial effect of auxin for the growth of gall tissues (Ramani *et al.* 1989). Induced gall showed histochemical changes of localisation in proteins, tannin, lignin, polyphenol oxidase, peroxidase and acid phosphatase in the gall as compared to the normal tissues (Ramani *et al.* 1991).

Ramani & Kant (1993) reported, for the first time, the gall formation by a cecidomyiid larva on the leaf rachis of *in vitro* germinated seedling and noticed nodule like structures with high meristematic activity in the galls.

*Galls of inflorescence* : Smooth masses of oval, pyriform, globose, occasionally lobed or agglomerate galls, appear either on florets or to the entire inflorescence during blossom season (April to May). Galls are green initially, but turn reddish brown at maturity. Morphometrics of galls showed variability in shape, size, weight (Table 1) and the percentage infestation (Table 3). Four microlepidotern insects were associated with the galls, and the rate of infestation by the moth increased with the maturity of galls. The frequency of attack was more in the lobed

**Table 3** Seasonal prevalence and population structure of gall markers associated with galls on *P. cineraria*

Part of the plant bearing gall	Seasonal prevalence	Gall causing organism	Population structure of gall makers		
			No. of galls examined	No. of gall makers present in galls	Percent of population
Branch	Throughout the year	Insect Chalcid	132	60	45.4
Rachis	August to September	Insect Cecidomyiid	55	17	30.9
Leaf surface	July to September	Mite Acarina	105	27	25.7
Inflorescence/flower	April to May	Moth insect	125	55	44.0

or agglomerate galls than that of the single lobed galls. The larval development took place in the galls while it attacked the inflorescence, and the fully developed pupae in the old galls fell down to ground (soil) and consequently, adult moth came out from the gall within 2-5 days of its detachment. The infested galls were reared in the insect cages and the adults emerged out and were identified as *Assura albicostalis* walker (Pyrilidae), *Anarsia triaenota*, Meyrick (Gelchiidae), *Eucosma lioplintha* Meyrick (Tortricidae) and *Ascalenia* sp. (Cosmopterigiae).

*Ecological interaction between gall and galls makers* : Accumulation of nutritive substances and succulence in galls provided favourable breeding conditions to gall makers (insects/mites). It represented some ecological adaptation of insects or mites with plant tissue, and thus derived food and protection from the attack of natural enemies (parasites and predators). In turn, the plant suffered loss of nutrients. The gall bearing branches withered and dried up by continuous breeding of larvae on gall contents. Foliages were deprived of nutrients and became shrivelled due to loss of plant sap, caused by the feeding of cecidomyid insects and mites. Fluctuation in ambient temperatures increased competitive ability against disease resistance, predation and parasites (Mani 1964). However, insects present in gall core were protected from the extremities of temperature. In some parts of Rajasthan (Sikar & Nagaur districts), the lopping of trees is being practised from November to January, and thus reduces the intensity of gall formation on the new flushes of *P. cineraria* tree.

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