<u>Original Research Article</u>

Relationship between flower galls and girth class of *Prosopis cineraria*

Abstract

Khejri (*Prosopis cineraria*) recognized as a multipurpose tree species of Thar Desert gets infested with flower galls caused by *Eriophyes prosopidis.* The heavy infestation turns the flowers into galls without forming pods causing high losses in the yield of pods locally known as sangri. The present work was conducted to find out the relation between girth class of tree and average number of galls per inflorescence in the flower gall infested trees. In the present study we concluded that the relation between girth class of tree and average number of galls per inflorescence is negative. The average number of mite induced galls per inflorescence was highest in the girth class 70-100 cm and least in girth class 130-160 cm showing a highly significant inverse relationship between DBH and average number of galls per inflorescence in Khejri

Key words: *Prosopis cineraria*, *Eriophyes prosopidis*, girth class, galls, inflorescence

Introduction

The life-supporting tree of the Thar Desert called Khejri (*Prosopis cineraria*) is the most crucial element of the traditional farming system used in the arid and semi-arid regions of northwestern India (Samadia et al., 2021). It is a key source of feed, fuel, and lumber for the rural economy (Mann and saxena, 1980). Foliage of the tree is thick, green and tolerates to harsh edapho-climatic condition, and it produces fruit even during the driest season, leaf-fodder (loong) is widely used. Its pod “Sangri” is the primary ingredient in the vegetables Panchkutta and Trikuta and it is offered both fresh and dehydrated at high prices. Its beneficial effects on the ecology and the development of soil fertility are well known. Typically, 4-5 kg of pods is produced per plant in healthy trees (Rathore, 2009).

Gall mites and other arthropod species, as well as other herbivores, commonly attack crop plants in both natural and farmed environments (Glase *et al*., 2014). Gall mites are also difficult to control in agricultural settings due to their small size (Lindquist, 1996), and high reproductive potential (Sabelis and Bruin, 1996). Galls can be caused by a wide range of species, including mites, aphids, wasps, and midges (Redfern *et al*., 2011). Eriophyoid mites are generally phytophagous arthropods that form intimate relationships with the plants that serve as their hosts (Acari: Eriophyoidea). These highly specialized mites are found on both annual and perennial plants with a potent monophagy. Gall production is triggered by insects or mites that feed on plants or by the release of growth hormones, which then interact with the host plant's defense mechanism (Ananthakrishnan, 1984).

Despite the considerable correlation between pod production and tree diameter at breast height, arid areas have been shown to generate roughly 1.4 quintals of pods/ha with a variance of 10.7% (Rathore, 2009). Flower galls are to be blamed for the loss of pods and seed production in *P. cineraria*. In Khejri trees, these galls are the result of an eriophyid mite infestation, *Eriophyes prosopidis* which causes severe pod reduction and gall formation (Bhansali, 2012). The effects of eriophyid feeding on their hosts may not always be predictable in advance. Pale yellow flowers turned to green at the bases and the size of the ovary become bulge at the beginning stages of gall growth. Flower galls significantly reduce the pod yield. The gall infested trees have a sickly appearance during the summer

(Bhatnagar *et al*., 2018). As the infestation of flower galls causes economic losses to the farmers therefore, the studies on the relationship between girth class of Khejri tree and average number of galls per inflorescence deserve to be discussed. The current study was carried out to investigate the effect of tree girth on floral gall formation in *Prosopis cineraria*.

Materials and methods

Study sites

The study was conducted in District Jodhpur, in Rajasthan, state in northern India. Investigations were carried out from 2017 to 2022 in five distinct sites in Rajasthan: Phalodi, Lohawat, Osian, Pipar and Baori.

Effect of tree girth on flower gall formation

Ten flowering *Prosopis cineraria* trees belonging to three groups of circumferences: Group 1 (70-100 cm), group 2 (100-130cm) and group 3 (130-160 cm) each based on girth were selected at each site. The protocol of Perea et al., (2021) was used for comparing the presence and absence of flower gall in the chosen trees, the number of trees with flower gall infestation was determined (Fig 1& 2). Also for collecting data on flower gall formation per inflorescence, canopy of each selected tree was divided into four horizontal quadrants, representing the cardinal directions (North, South, East and West). From each quadrant, 10 inflorescences were collected and number of healthy pods and flower galls were counted in each inflorescence and average no. of galls per inflorescence was calculated.

Statistical analysis

The data were subjected to statistical analysis using analysis of mean, standard error, standard deviation, correlation and variance by using software NCSS 2023 Version 23.0.1.The average no. of galls per inflorescences was calculated taking all the sites and using regression analysis, the number of flower gall per inflorescence was compared with DBH.

Results

Variation of galls per inflorescence and per site

During the study years (from 2017 to 2022), the average number of galls per inflorescence was found to be highest in the year 2020-21 at Phalodi for all girth classes and the lowest in Baori. In fact, the average number of galls per inflorescence of all the sites was highest in the year 2020-21 (Table 1, Fig 1). For the other sites, it ranged from year 2017- 2022.

The larger average number of galls per inflorescence was observed on younger trees (1st group) and older ones (3rd group) in all investigated sites. On taking the combined averages of all the sites and years, the average number of galls per inflorescence was found to be the highest for the 1st group (11.53±0.69) and lower for the 2nd and 3rd group i.e. 7.80±0.54 and 7.60±0.51 respectively.

The probability of galls per inflorescence is more in group 1 than other two groups (Fig. 3) as depicted in the normal distribution curve. The trend shows that with the increase in girth of the tree probability of gall formation per inflorescence are less in comparison to trees of lower girth.

Table 1. The average no. of galls per inflorescence

Girth class (cm)	TREE	Average per inflorescences (Yearly)				
		2017-2018	**2018-2019**	**2019-2020**	**2020-2021**	**2021-2022**
		No. of Galls	**No. of Galls**	**No. of Galls**	**No. of Galls**	**No. of Galls**
70-100	Phalodi	11.7	11.75	12.46	13.57	11.3
	Lohawat	11.33	11.70	11.45	13.15	11.10
	Osian	11.03	11.70	11.50	12.35	10.82
	Pipar	10.65	11.60	11.40	12.13	10.35
	Baori	10.45	11.23	11.08	11.90	10.50
	Mean	11.03±0.50	11.59±0.21	11.58±0.51	12.62±0.71	10.82±0.39
	Correlation	-0.40	-0.86	-0.32	-0.31	-0.47
	Variance	0.25	0.04	0.27	0.50	0.15
100-130	Phalodi	9.15	7.82	8.63	9.30	8.43
	Lohawat	8.35	7.35	7.85	8.88	7.83
	Osian	7.83	6.93	7.6	8.18	7.20
	Pipar	7.58	6.83	7.38	8.18	6.88
	Baori	7.58	6.75	7.45	8.08	7.13
	Mean	8.09±0.44	7.13±0.199	7.78±0.25	8.52±0.29	7.49±0.39
	Correlation	-0.23	-0.29	-0.37	-0.271	-0.31
	Variance	0.44	0.19	0.25	0.29	0.39
130-160	Phalodi	8.95	7.70	8.48	9.15	8.28
	Lohawat	8.30	7.34	7.75	8.70	7.78
	Osian	7.60	6.68	7.25	7.93	7.00
	Pipar	7.43	6.55	7.10	7.80	6.90
	Baori	7.40	6.58	7.03	7.75	6.60
	Mean	7.936±0.67	6.97±0.52	7.522±0.60	8.266±0.62	7.312±0.69
	Correlation	-0.21	-0.262	-0.102	-0.117	-0.23
	Variance	0.454	0.270	0.365	0.391	0.482

Regression analysis showed a highly significant inverse relationship between DBH and average number of galls per inflorescence in Khejri trees in Agro-forestry habitats (R^2 =0.796). The normal distribution cure represents that the number of galls per inflorescence is maximum in the girth class 70-100cm (Fig.3). Normal distribution graph is a continuous probability function therefore from the graph it is clear that occurrence of a flower galls are more in younger trees of girth class 70-100 in comparison to older trees.

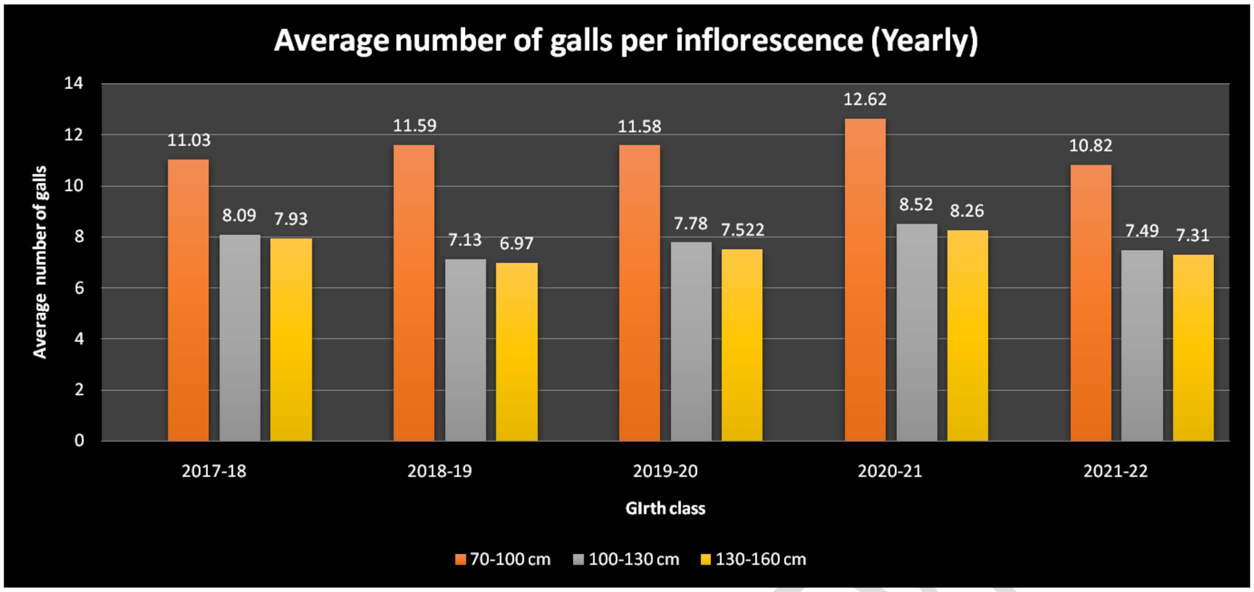

Fig 1. Graphical representation of Average number of galls per inflorescence per year

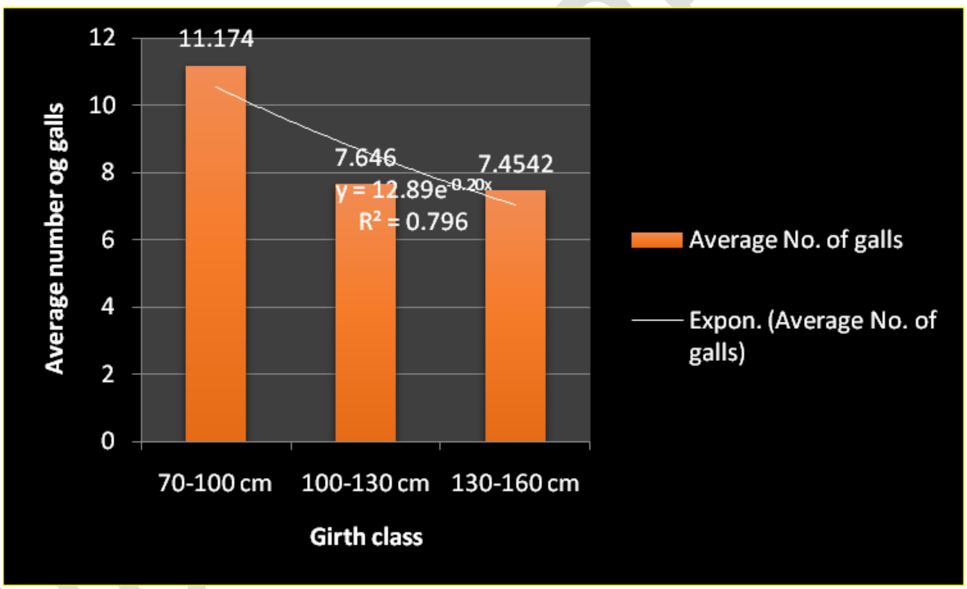

Fig 2. Graphical representation of of Average number of galls with Girth class

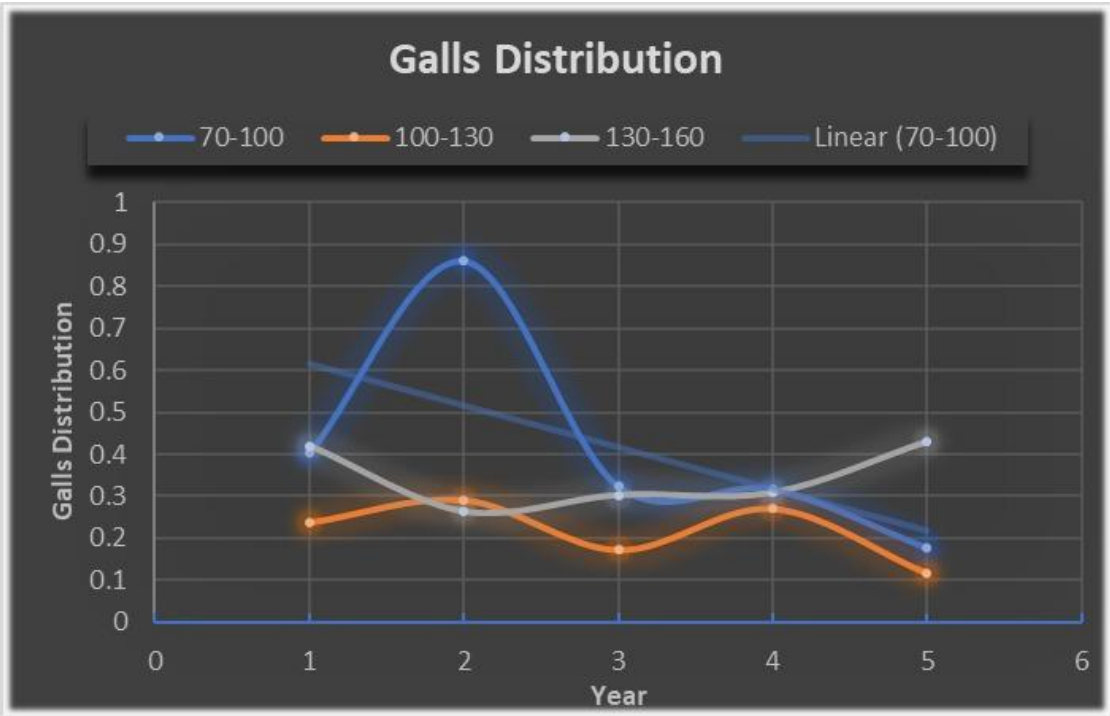

Fig 3. Graphical distribution of Distribution Mean v/s Year.

Fig 4: Khejri flower gall

Fig 5: Girth wise data collection

Discussion

The lower defense mechanisms of young trees may be the cause of the high number of galls per inflorescence in the girth class of 70-100 cm which is supported by findings of Mutitu *et al*. (2010) on *Leptocybe invasa* infestation on young *Eucalyptus* trees (1-3 year old) that was more severe than on older ones. According to the findings of Madoffe (1989), young pine trees were more susceptible to Pine Woolly Aphid infection than older trees. In fact, Rohfritch (1981) showed that the accumulation of secondary defense chemicals, such as tannins, phenolic precursors, and lignin, is a form of defense against injury or the presence of invading organisms. According to Rohfritch (1981), all secondary defense compounds rise in concentration with tree age. Additionally, infestation may be greater in young trees due to their weaker insect defense mechanisms. In contrary, Ruohomäki *et al*. (2000) demonstrated that *Epirrita autumnata* outbreaks primarily occurred in mature birch trees due to minimal parasitism or good foliage quality as well as the availability of more advantageous oviposition locations in mature trees.

Depending on the genotype of the mite and plant, the density of the mites, the feeding period, the age of the plant, and the environment, some of them displayed a noticeable degree of variability (Petanovi and Kielkiewicz, 2010a, b; Duso *et al*., 2008; Royalty and Perring, 1996; Westphal and Manson, 1996). Salivary secretions must play a significant role because mechanical action only triggers the synthesis of chitosan and callose at the feeding site as a plant's wound response (Petanovi and Kielkiewicz, 2010a, b).

It is crucial to understand the physiological changes in infected trees, their genetic foundation, and heredity as well as host plant relationships and preferences within various girth classes in order to develop resistant varieties (Mitchell *et al*., 2016; Stenberg and Muola, 2017). This will provide a base for future studies to develop a resistant variety against the flower gall mite.

Conclusion

Present study concludes that the eryiophid mites induced flower galls per inflorescence were highest in girth class 70-100 cm followed by girth class 100-130cm and least in girth class 130-160 cm showing a highly significant inverse relationship between DBH and average number of galls per inflorescence in Khejri (*Prosopis cineraria*) trees.

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