Original Research Article

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.….

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

Introduction

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The life-supporting tree of the Thar Desert called Kkhejri (*Prosopis cineraria*) is the most crucial element of the traditional farming systems used in the arid and semi-arid regions of northwestern India (…)'s northwest. It is a key source of premium feed, fuel, and lumber for the rural economy (…). Foliage of the tree is It has thick, green and foliage that tolerates to harsh edapho-climatic conditions, and it produces fruit even during the driest season, . Its pods (sangri) and nourishing leaf-fodder (loong) are 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).

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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, called *Eriophyes prosopidis*, which causes severe pod reduction and gall formation (…). The effects of eriophyoid 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 began tobecome bulge at the beginning stages of gall growth. Instead of pods, various kinds of galls, such as circular, rectangular, egg shaped, spindle shaped, and vase shaped,

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forms.Flower galls significantly reduce the pod yield. A great number of dangling, disorganised, and deformed green galls giveThe gall-infested trees have aa sickly appearance during the summer (..). Flower galls significantly reduce the pod yield.

As the infestation of flower galls causes economic losses to the farmers therefore, the studies on the relationship between girth class of KKhejri 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*.

Review of literature

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), high reproductive potential (Sabelis and Bruin, 1996), and the inefficiency of existing miticides (Chong, 2013). 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, and they have 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). The pests' interactions with one another lower plant defenses (Kiekiewicze *et al*., 2019). Eriophyoids are obligate plant feeders with extraordinary morphological, biochemical, and behaviouralspecialisation in comparison to other Acari members, according to Skorackaet *al*., (2010). Despite the fact that many of them are major pests of commercial and ornamental crops, as well as wild plants, grasses, and plants in urban and community forestry, they rarely cause the mortality of these plants (Lindquist *et al*., 1996). The types of plant modifications brought on by eriophyoids depend significantly on the genotypes, age, and lifestyle of the host plants as well as the species and strains of the mites (Petanovi and Kielkiewicz, 2010a,b; Skoracka *et al*., 2010; Chakrabarti *et al*., 2011; Cvrkovi, 2012).

Materials and methods

Methodology:Study sites

The study was conducted in in District Jodhpur, in Rajasthan, state in northern India. Investigations were carried out from 2017 to 2022 in fFive distinct sites in Rajasthan were chosen to evaluate the effect of tree girth on flower gall formation in Khejriviz:., Phalodi, Lohawat, Osian, Pipar and Baori.

Effect of tree girth on flower gall formation

.Ten flowering *Prosopis cineraria* trees belonging to of 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

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…..was used: bBy comparing the presence and absence of flower gall in the chosen trees, the number of trees with flower gall infestation was determined (Fig 4 & 5).. Also for collecting data on flower gall formation per inflorescence, canopy of each selected tree was divided into four horizontal quadrants, representing the cardinal all the four directions namely,(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 raw data from every location that was sampled over the course of five years was converted in an electronic format and laid up in a spreadsheet (Microsoft Excel, 2016). The data thus collected 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

The data was collected for consecutive five years from five locations Phalodi, Lohawat, Osian, Pipar and Baori Tehsil in District Jodhpur, Rajasthan (Fig 4 & 5). It was observed Dduring the study years (from 2017 to 2022), that the average numbero. of galls per inflorescence (Table 1; Fig 1, 2) was found to be highest in the year 2020-21 at Phalodi for all girth classes and the 13.57(70-100 cm), 9.3(100-130cm) and 9.15 (130-160 cm) followed by lohawat viz., 13.15 (70-100 cm), 8.88 (100-130cm) and 8.7 (130-160 cm) and least owest in Baori. viz., 11.9 (70-100 cm), 8.08 (100-130cm), 7.75 (130-160 cm). In fact, The the average numbero. of galls per inflorescence of all the sites was highest in the year 2020-21 viz., 12.62 (70-100 cm), 8.52 (100-130cm) and 8.26(130-160 cm)(Table 1, Fig 1). For the other sites, it ranged from…(year) to…(year) . Thus we conclude that tThe average number of galls per inflorescence wasis higher st in girth class 70-100 for the 1st group (…± SD) cm followed by girth class 100-130cmthe 2nd group (…± SD) and least lower in girth classfor the 3rd group (…± SD) 130-160 cm. …………..

At all of the research sites, tThe larger average number of galls per inflorescence was observed on larger on younger trees with girth classes of 70 to 100 cm(1st group) than it was on older trees with girth classes of 130 to 160 cmand 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±0.31) and lower for the 2nd and 3rd groups with respectively 7.80±0.24 and 7.60±0.23.which is highest among all girth classes under study (Table 2).

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.

Table 1. The average no. of galls per inflorescence

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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	11.59	11.58	12.62	10.82
	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	7.13	7.78	8.52	7.49
	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	6.97	7.522	8.266	7.312
	Correlation	-0.21	-0.262	-0.102	-0.117	-0.23
	Variance	0.454	0.270	0.365	0.391	0.482

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Table 2. The average number of galls per inflorescence and standard deviation based on girth class.

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Girth Class	Average no. of galls per inflorescence	Standard Deviation
70-100cm	11.53±0.31	0.69
100-130cm	7.80±0.24	0.54
130-160cm	7.60±0.23	0.51

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Regression analysis showed a highly significant inverse relationship between DBH and average number of galls per inflorescence in Khejritrees in Agro-forestry habitats (R^2 =0.796). The normal distribution cure ~~(fig.3)~~ represents that the number of galls per inflorescence is maximum in the girth class 70-100cm (Fig.3). ~~As we know that n~~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.

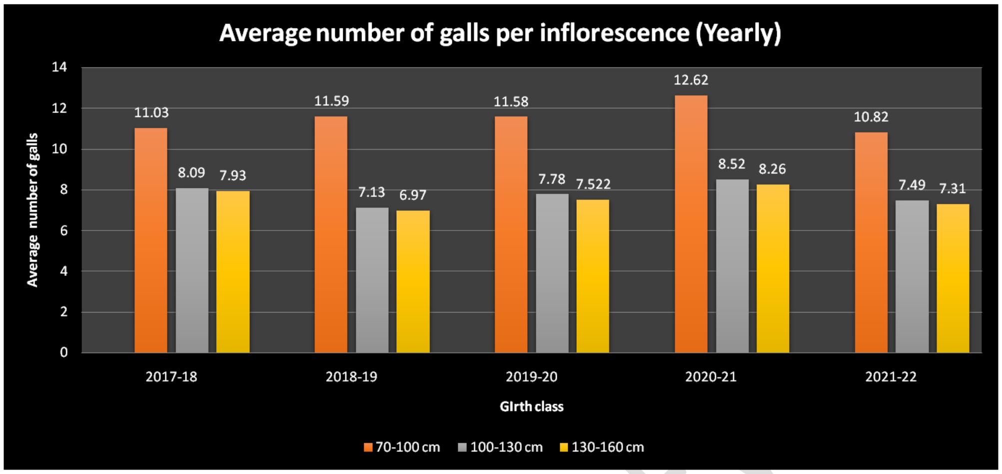

Fig 1. Graphical representation of Average number of galls per inflorescence per year

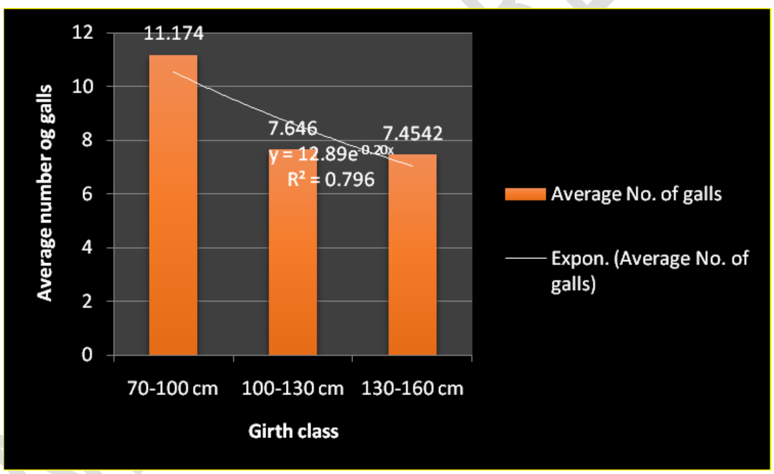

Fig 2. Graphical representation of of Average number of galls with Girth class

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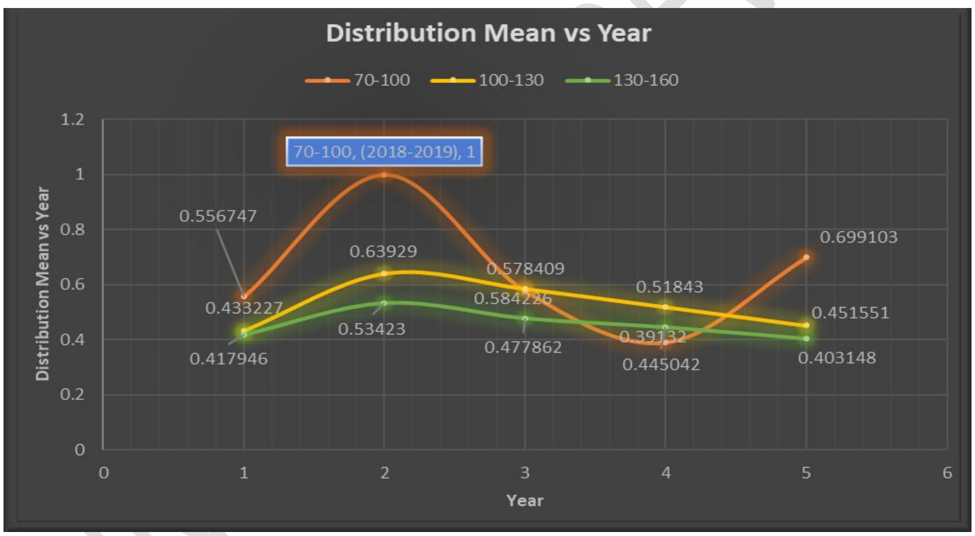

Fig 3. Graphical distribution of Distribution Mean vs Year.

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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 ~~larger~~ high number of galls per inflorescence in the girth class of 70-100 cm which is supported by findings of Mutitu *et al.* (2010) ~~that~~ on *Leptocybe~~.~~ invasa* infestation on young *Eucalyptus* ~~(1-3 year old)~~ trees (1-3 year old) that was ~~is~~ more severe than on older ~~trees~~ones. According to the findings of Madoffe (1989), young pine trees were more susceptible to Pine Woolly Aphid infection than older trees. In fact, ~~According to~~ Rohfritch (1981)~~,~~ showed that the accumulation of secondary defense chemicals, such as tannins, ~~their~~ 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, ~~According to~~ 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) and then ~~. It is possible that pectinolytic and cellulolytic enzymes are involved in~~ the production of galls (…)~~given that the middle lamella and cell walls can be destroyed by the saliva of piercing and sucking insects~~.

~~Because of this, it~~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

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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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