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Relative and Mean Density of Natural Enemies and Storage Pests associated with Lac Insect, *Kerria lacca* (*Kerr*) in Arid Western Plains

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ABSTRACT: Lac insect (*Kerria lacca*) is an economically important scale insect belonging to family Tachardiidae and order Hemiptera. It secrets resin which is used for the production of various artifacts. Large number of insects are found to be associated with lac insect that cause a huge loss to lac production as they feed on both lac insect and lac encrustations. Lac encrustations are heavily infested by insect pests in various parts of country including Arid Western Plains. Minute parasitoids and storage pests associated with lac insect are difficult to distinguish, therefore, there is an insufficient knowledge on the relative abundance of different natural enemies and storage pests associated with lac insect which restricts their effective management and hinders lac production in the region. A proper knowledge on the relative and mean densities of insect fauna infesting lac insect will help in the identification of most damaging insect pest fauna for its effective management. Hence the present study was carried out to find the relative density and mean density of different insect fauna associated with lac insect in Arid Western Plains, during 2022. Relative density of natural enemies and storage pests was maximum in Rajasthan followed by Haryana and Gujarat contributing 46.31, 34.73 & 18.94 per cent and 38.67, 33.53 & 28.09 per cent, respectively. The mean density of both natural enemies and storage pests was maximum in Haryana followed by Gujarat and Rajasthan with 1.43, 1.38 & 0.97 and 2.39, 2.11 & 1.42, respectively. Among natural enemies, relative and mean density both was recorded the maximum for primary parasitoids followed by predators and hyperparasitoids with 56.84, 38.42 & 4.73 per cent, respectively and 0.60, 0.40 & 0.05, respectively. Among storage pests, both relative and mean density was maximum for individuals of Liposelidae followed by Curculionidae and Silvanidae with 84.40, 15.50 & 1.20 per cent and 1.53, 0.28, 0.02, respectively.

Keywords: *Kerria lacca*, lac, relative density, mean density, predators, primary parasitoids, hyperparasitoids.

INTRODUCTION

Scale insects or coccoids belongs to superfamily *Coccoidea* (Hemiptera: Sternorrhyncha) which consists of almost 7,500 species belonging to more than 20 families (Resh and Carde 2009). Lac insect is a scale insect belonging to family Tachardiidae (=Lacciferidae) of Order Hemiptera and superfamily Coccoidea are important species for commercial production of dye, resin and wax (Mohansundaram *et al*., 2019). Lac is a resin, naturally secreted by an insect (*Kerria lacca*) which feeds and thrives on the tender portion of twigs of specific host trees. Distribution of lac insect is confined to subtropical and tropical areas of south and south-east Asia (Ramani *et al.,* 2007). India is a leading lac producing country contributing to 80 percent of total lac production worldwide (Ramani *et al.*, 2016) with an annual production of 20,000 metric tonnes (Pal *et al.*, 2011). Lac also plays an important role in the economic upliftment of around 3 to 4 million tribal people (Kumar, 2002). Cultivation of lac generates employment for both women and men (Shah *et al.*, 2015).

Lac production in the country is limited because of abiotic and biotic factors; the major limiting biotic factors are predators and parasitoids (Wang *et al*., 2003). Lac ecosystem is a complex and multi-trophic web of fauna and flora. There are total of 22 species of

lac predators, 30 species of primary parasites & 40 species of secondary parasites, respectively, along with fungal pathogens which represent rich biodiversity of lac associated fauna (Sharma *et al.,* 2006; Rao *et al.,* 2013). Around 35 to 40 per cent loss in lac production is caused by predators (Glover, 1937; Jaiswal *et al.,* 2008), while parasitoids cause 5 to 10 per cent loss (Varshney, 1976). Major lac associated fauna consists of predators, primary parasitoids and hyperparasitoids. High abundance observed was for *E. amabilis* among predator, *E. dewitzii* among primary parasitoid and *E. tachardiae* among hyperparasitoid in Arid Western Plains (Swami *et al.,* 2021). *Eublemma amabilis* is a monophagus predator of lac and it causes 20 to 25% loss to the crop (Shah *et al.,* 2015) whereas *Pseudohypatopa pulverea* acts as natural bio-agent of lac insect *Kerria lacca* (Kerr.) (Netam *et al.,* 2021).

MATERIAL AND METHODS

The studies on the natural enemies of lac insect were carried out in the Lac laboratory and Museum (NP-CLIGR), Department of Entomology, Rajasthan College of Agriculture, Udaipur, during the year 2022. The emerged natural enemies were collected up to 4-6 weeks at weekly intervals, from the 60-mesh nylon net bags having the samples collected from various parts of Rajasthan, Gujarat and Haryana, during 2022 in June-July/ Oct-Nov and were identified with the help of methods described in " Lac insect and associated fauna-A practical Manual" by Mohanasundaram *et al*. (2016). A proper record on the population of natural enemies was maintained. The population count of predators and parasitoids was recorded, respectively, for each sample of different locations of different districts of three states of Rajasthan, Gujarat and Haryana. The emerged population of natural enemies (Fig. 1) was segregated based on their morphological characters and their relative and mean densities were calculated.

Observations:

The following mathematical analyses were used for estimating mean density and relative density of lac associated fauna.

i) Mean density:

$$\text{Mean density} = \frac{\sum Xi}{N}$$

Where,

Xi = No. of insects or natural enemies in i^{th} sample

N = Total No. of plants sampled

ii) Relative density:

Relative density (RD%)=

$$\frac{\text{Number of individual of one species}}{\text{Total number of individual of all species}} \times 100$$

RESULT AND DISCUSSION

i) Relative Density

The emerged natural enemies were collected up to 4-6 weeks at weekly intervals, from the 60-mesh nylon net bags (Fig. 1) having the samples collected from various parts of Rajasthan, Gujarat and Haryana, during 2022.

Among the three states, the maximum relative density of natural enemies and storage pests was found to be 46.31 & 38.67 per cent in Rajasthan while it was 18.94 & 28.09 per cent in Gujarat which was the minimum. Among the natural enemies the relative density was highest, 44.21 & 12.63 per cent for primary parasitoids of family Encyrtidae and Eulophidae, respectively and was followed by predators *viz., Eublemma amabilis* and *Pseudohytopa pulverea* whith relative density of 30.52 and 7.89 per cent, respectively. Hyperparasitoids belonging to Braconidae family had the lowest relative density in all the three states with 4.73 per cent as presented in Table 1 and depicted in Fig. 2. Among the storage pests, the individuals belonging to Liposelidae family have highest relative density of 84.40 per cent and was followed by the relative density of individuals of Curculionidae and Silvanidae family with 15.50 & 1.20 per cent, respectively as presented in Table 2 and depicted in Fig. 3.

ii) Mean Density

Mean density of natural enemies was maximum in the lac samples collected from Haryana (1.43) followed by Gujarat (1.38) and Rajasthan (0.97), respectively. Among natural enemies, primary parasitoids have maximum mean density (0.60) followed by predators (0.40) and hyperparasitoids (0.05), respectively as presented in Table 1 and depicted in Fig. 4. Maximum mean density of storage pests was recorded in Haryana (2.39) followed by Gujarat (2.11) and Rajasthan (1.42), respectively. Among storage pests, highest mean density was recorded for individuals of Liposelidae family (1.53) followed by individuals of Curculionidae (0.28) and Silvanidae family (0.02), respectively, as presented in Table 2 and depicted in Fig. 5. There is scarcity of research work on the storage pests of lac insect and relative and mean density of lac associated fauna from the state wise lac samples specifically from Rajasthan, Gujarat and Haryana. However, there are some related studies which support the findings of present study. The present study gets support from the findings of Chiu *et al.* (1985) who have also recorded only one hyper parasitoid, *B. greeni* with contribution of 5.37 per cent to total lac associated fauna and Kalhal (2017) who recorded Coleopteran predator of *Orizaphilus* spp. with contribution of 1.26 per cent to total lac associated fauna. Findings of this study are in agreement with the findings of Meena and Sharma (2018) who reported that lac associated fauna comprises of predators *viz. E. amabilis & P. pulverea,* primary parasitoids *viz., E. dewitzii*, *T. tachardiae* & *P. purpureus* and hyperparasitoid *B. greeni.* Among all the lac associated fauna Encrytidae had maximum contribution of 27.27 per cent *and E. dewitzii* was recorded the most abundant parasitoid among all the associated fauna.

The findings of the present study are in line with the findings of Swami *et al.* (2021) who recorded highest relative abundance for Encyritidae & Eulophidae families among all the lac associated fauna with contribution of 54.21 and 32.30 per cent, respectively. Predators were next in abundance with *E. amabilis* (8.44%) and *P. pulveria* (2.64%) and a small abundance of 0.59 per cent was recorded for hyperparasitoids of Braconidae family.

Table 1: Relative density and mean density of natural enemies associated with lac insect, *Kerria lacca* (*Kerr*), emerged from the lac samples collected from Arid Western Plains, during 2022.

Sr. No.	STATE	Natural Enemies							
		PREDATOR (%)			PRIMARY PARASITOID (%)			HYPER PARASITOID (%)	Total Density
		Noctuidae (ea)	Blastobasidae (pp)	Total	Encyrtidae (ed & tt)	Eulophiodae (ap)	Total	Braconidae (bg)	
1.	RAJASTHAN (90)	28.40 (0.27)	7.95 (0.07)	**36.35 (0.35)**	43.18 (0.42)	15.90 (0.15)	**59.08 (0.57)**	4.54 (0.04)	**46.31 (0.97)**
2.	GUJARAT (44)	25.00 (0.20)	8.33 (0.06)	**33.33 (0.27)**	55.55 (0.45)	5.55 (0.04)	**61.10 (0.50)**	5.55 (0.04)	**18.94 (1.38)**
3.	HARYANA (46)	36.36 (0.52)	7.57 (0.10)	**43.92 (0.63)**	39.39 (0.56)	12.12 (0.17)	**52.05 (0.73)**	4.54 (0.06)	**34.73 (1.43)**
Total (180)		30.52 (0.32)	7.89 (0.08)	**38.42 (0.40)**	44.21 (0.46)	12.63 (0.13)	**56.84 (0.60)**	**4.73 (0.05)**	

[ea=*Eublemma amabilis; pp=Pseudohypatopa pulverea; ed=Erencyrtus dewitzi;* tt=*Tachardiaephagus tachardiae;* ap= *Aprostocetus purpureus;* bg= *Bracon greeni*]

[value inside the parenthesis ( ) represents mean density {individuals per sample}; values outside the parenthesis ( ) represents relative density]

Fig. 1. Emergence of natural enemy from stored lac.

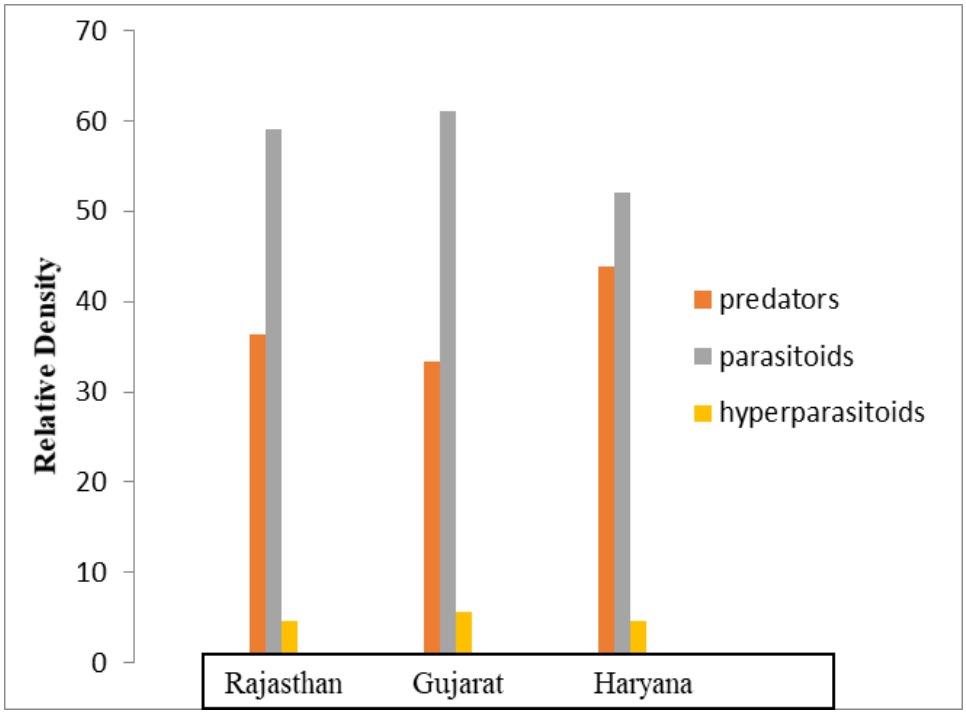

Fig. 2. Relative density of natural enemies.

Table 2: Relative density and mean density of storage pests associated with lac insect, *Kerria lacca* (*Kerr*), emerged from the lac samples collected from Arid Western Plains, during 2022.

Storage Pest (%)			Total Density
Curculionidae (so)	Silvanidae (os)	Liposelidae (ld)	
17.96 (0.25)	1.56 (0.02)	80.46 (1.14)	**38.67 (1.42)**
13.97 (0.29)	1.07 (0.02)	84.94 (1.79)	**28.09 (2.11)**
13.63 (0.32)	0.90 (0.02)	85.45 (2.04)	**33.53 (2.39)**
15.5 (0.28)	**1.20 (0.02)**	**84.40 (1.53)**	

[so= *Sitophilus oryzae; os= Oryzaephilus surinamensis*; ld= *Liposcelis divinatorius*]
[value inside the parenthesis ( ) represents mean density {individuals per sample}; values outside the parenthesis ( ) represents relative density]

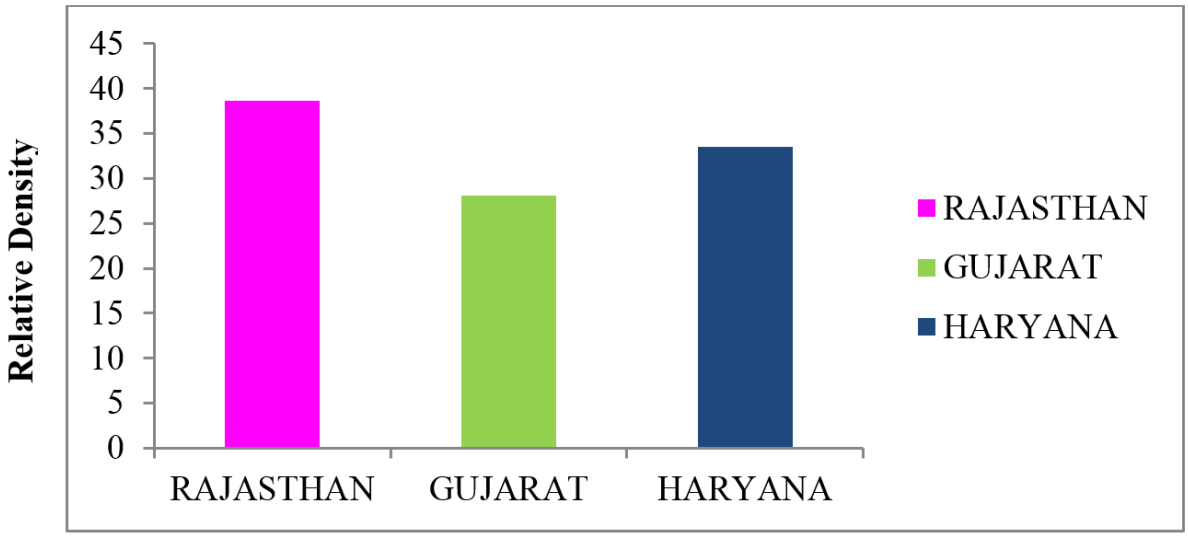

Fig. 3. Relative density of storage pests.

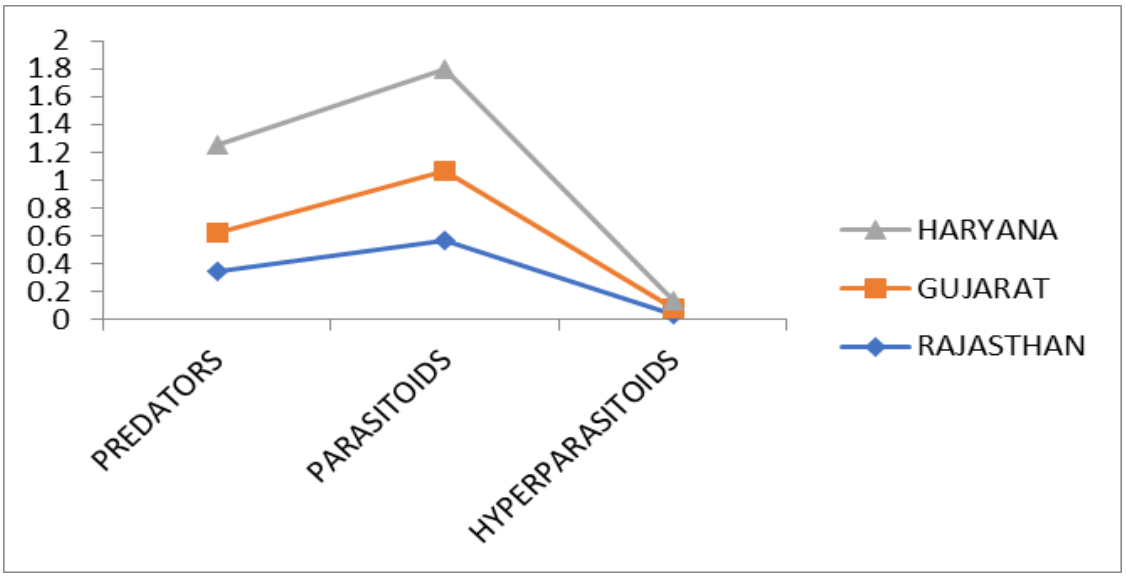

Fig. 4. Mean density of natural enemies.

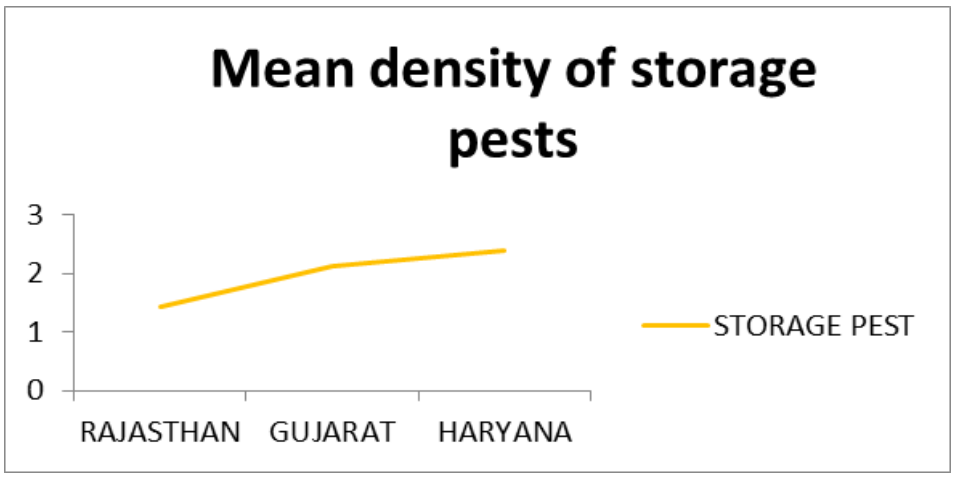

Fig. 5. Mean density of storage pests.

CONCLUSION

Among the insect fauna associated with lac insect (*Kerria lacca*) the maximum relative and mean densities of 56.84 per cent and 0.60 was recorded for primary parasitoids (Encrytidae & Eulophidae) which was followed by the predators (Noctuidae & Blastobasidae) and hyperparasitoids (Braconidae) with relative densities of 38.42 & 4.73 per cent and mean densities of 0.40 & 0.05, respectively. The relative density of the natural enemies which emerged from the collected lac samples was maximum with 46.31 per cent in Rajasthan followed by 34.73 per cent in Haryana and 18.94 per cent in Gujarat whereas, mean density of natural enemies was maximum of 1.43 in Haryana and was followed by 1.38 & 0.97 in Gujarat & Rajasthan, respectively. Among storage pests a high relative density was recorded for individuals belonging to family Liposelidae followed by Cuculionidae and Silvanidae with 84.40, 15.50 & 1.20 per cent, respectively.

FUTURE SCOPE

There is a huge scope through which we can develop appropriate management practices to control natural enemies and storage pests associated with lac insect. Knowledge on the relative density and mean densities will help to identify most damaging insect pest of lac insect among all the associated fauna and thus specific management practices through chemicals or bioagents can be developed. This will enhance lac production in the region as the artisans in the states of Arid Western Plains mostly depend on artifacts made up of lac resin and it is also a part of their culture specially in Rajasthan.

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Conflict of interest. None.

REFERENCES

Chiu, S., Chou, L. and Chou, K. (1985). Survey of the natural enemies of the lac insect, *Kerria lacca*, in Taiwan. *Biological Control of Crop Pests in Taiwan*, *1*, 9-11.

Glover, P. M. (1937). Insect enemies of lac and their control. Lac cultivation in India. Indian Lac Research Institute, Ranchi, Jharkhand, India, *1*, 147.

Jaiswal, A. K., Bhattacharya, A., Kumar, S. and Singh, J. P. (2008). Evaluation of *Bacillus thuringiensis* (Berliner) subsp. kurstaki for management of lepidopteran pests of lac insect. *Entomon*, *33*, 65-69.

Kalahal, C. (2017). Biology and productivity-linked parameters of lac insect on pigeonpea and its natural enemies. M.Sc. thesis, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India, 25-44.

Kumar, K. K. (2002). Scope of lac cultivation in employment and income generation. Recent advances in lac culture, Indian Lac Research Institute, Ranchi, Jharkhand, India, 254-262.

Meena, S. C and Sharma, K. K. (2018). Species composition and richness of entomo-fauna associated with lac insect, *Kerria lacca* (Kerr) in western plains of India. *Journal of Entomology and Zoology Studies*, *6*, 684-690.

Mohanasundaram, A., Monobrullah, Md., Sharma, K.K., Meena, S. C. and Ramani, R. (2016). Lac insect and associated fauna- a practical manual. Technical Bulletin No. 14/2016, Indian Institute of Natural Resins and Gums, Ranchi, Jharkhand, India, *14*, 01-42.

Mohanasundaram, A., Sharma, K.K. and Naaz, N. (2019). Lac insect, natural enemies and their management. *Commercial Entomology*, 111-128.

Netam, P. K., Netam, P. K. and Markam, P. S. (2021). Population dynamics of associated fauna of lac insect *Kerria lacca* (Kerr) in kusum host plant at Kanker district of Chhattisgarh. *Pharma Innovation Journal*, *10*, 359-362.

Pal, G., Jaiswal, A. K. and Bhattacharya, A. (2011). Lac statistics at a glance 2010. Technical Bulletin No. 01/2011, Indian Institute of Natural Resins and Gums, Ranchi, 1-24.

Rao, K., Ramesh, S. R. and Jaiswal, A. K. (2013). Record of host trees, predators and parasitoids of lac insect in

Andhra Pradesh. *Indian Journal of Plant Protection*, *41*, 190-191.

Ramani, R., Baboo, B. and Goswami, D. N. (2007). Lac: An introduction. Indian Lac Research Institute, Ranchi, India, 1-12.

Ramani, R. and Pal, G. (2016). Lac marketing and crop economics. Beneficial insect farming-benefits and livelihood generation. Indian Institute of Natural Resins and Gums, Ranchi, Jharkhand, India, 133-152.

Rao, K., Ramesh, S. R. and Jaiswal, A. K. (2013). Record of host trees, predators and parasitoids of lac insect in Andhra Pradesh. *Indian Journal of Plant Protection*, *41*, 190-191.

Resh, V. H. and Carde, R. T. (2009). Insecta, overview. Encyclopedia of insects. Academic Press, London, United Kingdom, *2*, 901-902.

Shah T. H., Thomas, M. and Bhandari, R. (2015). Lac production, constraints and management- A review. *International Journal of Current Research*, *7*(3), 13652-13659.

Sharma, K. K., Jaiswal, A. K. and Kumar, K. K. (2006). Role of lac culture in biodiversity conservation: issues at stake and conservation strategy. *Current Science*, *91*, 894-898.

Swami, H., Lekha, Chhangani, G., Kumawat, K., and Vikram, (2021). Tri- trophic interaction of lac, *Kerria lacca* (Kere.), its host and associated natural enemies in arid western plains of India. *The pharma Innovation Journal*, *10*(10), 1301-1305.

Wang, W. X., Vinocur, B. and Altman, A. (2003). Plant responses to drought, salinity and extreme temperatures: towards genetic engineering for stress tolerance. *Planta*, *218*(1), 1-14.

Varshney, R. K. (1976). A check list of insect parasite associated with lac. *Oriental Insects*, *10*(1), 55-78.

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