



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 8(D), pp. 28529-28533, August, 2018

**International Journal of
Recent Scientific
Research**

DOI: 10.24327/IJRSR

Research Article

PERFORMANCE OF DIFFERENT HOST PLANTS OF LAC (*KERRIA LACCA* KERR.) INSECT IN KORBA DISTRICT OF CHHATTISGARH

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DOI: <http://dx.doi.org/10.24327/ijrsr.2018.0908.2475>

ARTICLE INFO

Article History:

Received 6th May, 2018
Received in revised form 10th
June, 2018
Accepted 24th July, 2018
Published online 28th August, 2018

Key Words:

Lac insect (*Kerria lacca* Kerr.) host plants
of lac, stick lac yield, *Kusmi*, and
Rangeeni

ABSTRACT

Performance of different hosts of lac insect was studied during year 2014-15 and 2015-16 at Korba District of Chhattisgarh. During the course of study, Productivity parameters are quantitative and qualitative attribute which justify the potentiality characters of the host plant for commercial lac production. The host plant kusum (*S. oleosa*) for *Kusmi*, Aghani (winter) strain of lac crop was found maximum number of stick lac 237.91 stick per plant with mean length of 52.14 cm per stick lac which was low, highest fresh weight of stick lac 47.68 g per 30 cm stick, maximum weight of scraped lac 23.96 g per 30 cm stick, highest total stick lac 54.94 kg per plant, maximum weight of fresh and dry 100 cell 7.31 and 6.86 g but in case of yield potential (ratio of inoculated brood lac and total raw lac) ber (*Z. mauritiana*) was maximum 11.01 for *Rangeeni*, *Baisakhi* (summer) strain, whereas kusum (*S. oleosa*) was maximum 7.01 for *Kusmi*, *Aghani* (winter) stain. Among the different host plant ber (*Z. mauritiana*) was better for *Rangeeni*, *Baisakhi* (summer) strain but kusum (*S. oleosa*) was found best host for the commercial lac cultivation of production at Korba district of Chhattisgarh because kusum (*S. oleosa*) was all over champion in terms of productivity parameters over the tested different host for lac production.

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INTRODUCTION

Production and trade of lac in India dates back to the *Vedic* period as it finds a mention in the *Atharaveda* and *Mahabharat*. There are some findings that lac production and trade in China is almost 4000 years and developed along with silk (Singh, 2006). Lac is a natural, biodegradable, non-toxic, odourless, tasteless, hard resin and non-injurious to health. Lac is one of the most valuable gifts of nature and only resin of animal origin secreted by a tiny scale insect, *Kerria lacca* (Kerr.) belonging to the family Lacciferidae (Kerriidae), superfamily Coccoidea and order Hemiptera (Pal, 2009 and Mohanta *et al.*, 2012). Lac is an export oriented commodity, cultivated in the states of Jharkhand, Chhattisgarh, West Bengal, MadhyaPradesh, Odisha, Maharashtra, parts of Uttar Pradesh, Andhra Pradesh, Gujarat and NEH region. Majority of the tribal households of lac growing regions carry out lac cultivation as a subsidiary occupation to agriculture. Lac cultivation generates employment opportunities, particularly in the off agricultural season (Pal *et al.*, 2012). Chhattisgarh is of one the major lac cultivated area in India. Korba is the major lac cultivated area in Chhattisgarh. The total area of the district is 7, 14, 544 sqkms out of this 2, 83,457 sqkms area is under forests or notified as 'forest' (chote/bade jhaadke jungle). So we need

identify the suitable profitable remunerative host of lac insect. Keeping this view studied the performance of different host plants of lac insect in Korba District of Chhattisgarh.

MATERIALS AND METHODS

The experiment was conducted in a Randomized Block Design (RBD) with six replications, in each replication four plants were selected. Insecticides were applied at 30 days and 60 days after BLI during the study period against predators and parasitoid. The same insecticides pesticides doses were applied in all (Palas, Ber, Kusum and Semialata) host plants in *rangeeni* and *kusmi* strain.

Table 1 List of different strains of lac with different hosts in different seasons

Strain	Host plants	Crop (Season)
<i>Rangeeni</i>	Palas and Ber	Summer (<i>Baisakhi</i> Ari lac)
<i>Kusmi</i>	Kusum and Semialata	Winter (<i>Aghani</i>)

The observations of different host plants with different stains in different seasons for commercial lac yield were carried out in terms of brood lac inoculation (BLI) and productivity parameters.

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Brood lac inoculation

Healthy Brood lac weighing 50 to 9000 g were used per tree of Palas (*B. monosperma*), Kusum (*S. oleosa*), Ber (*Z. mauritiana*) and Semialata (*F. semialata*). Depending on the size of the tree, the brood lac were divided into six to thirty five bundles and inoculated in both seasons *Rangeeni Baisakhi* and *Kusmi Aghani* for 2014-15 and 2015-16.

Productivity parameters

Potentiality of different host plants viz. Palas (*B. monosperma*), Kusum (*S. oleosa*), Ber (*Z. mauritiana*) and Semialata (*F. semialata*) for lac insect in different seasons viz. *Rangeeni Baisakhi* (Summer) and *Kusmi Aghani* (Winter) were examined in terms of productivity parameters. The productivity parameters viz. number of stick lac per plant, length of stick lac per plant (cm), fresh weight of stick lac per 30 cm of stick lac (g), weight of scraped lac per 30 cm of stick lac (g), total stick lac per plant (kg), fresh weight of 100 lac cells (g) and dry weight of 100 lac cells (g) were observed with the help of an Electronic balance at the time of harvest. The yield potential was calculated with the help of the following formula.

$$\text{Yield Potential} = \frac{\text{Total Raw Lac/tree (g)}}{\text{Total Inoculated Brood lac/tree (g)}}$$

RESULT AND DISCUSSION

Brood lac inoculation (BLI)

Transfer of crawling larvae of *K. lacca* from brood lac to branches of host trees is known as brood lac inoculation (BLI). The data of brood lac inoculation presented in table no. 2. The brood lac inoculation was done on *B. monosperma* and *Z. mauritiana* with mean brood lac weight 550.00 and 485.00 g per host plant during November 2014. Similarly, during November 2015 the brood lac was inoculated on *B. monosperma* and *Z. mauritiana* with mean weight of brood lac 563.33 and 448.33 g per host plant in *rangeeni* strain.

The brood lac of *kusmi aghani* (Winter) crop was inoculated during the month of July 2015 on *S. oleosa* and *F. semialata* with mean brood lac weight 7833.33 and 47.00 g per host plant. Similarly, during the month of July 2016 the brood lac was inoculated on *S. oleosa* and *F. semialata* with mean weight of brood 8000.00 gm and 46.83 gm per host plant, respectively.

On the basis of overall mean, the brood lac inoculation for crops varied from 46.92 to 7916.67 g in both the strains viz. *rangeeni* and *kusmi*. There was a significant difference in the mean weight of brood lac inoculation. The brood lac inoculation per plant was found highest on *kusmi* strain during the year 2014-15 and 2015-16 on host plant *S. oleosa*.

Similarly, Jaiswal and Singh (2012) suggested that 40-50 g brood lac is sufficient for *F. semialata* host tree. Sharma and Ramani (2011) reported 1.5 kg and 4 kg brood lac for ber and kusum, respectively. In the present studies, 4.66 and 7.92 kg brood lac was used for ber and kusum, respectively. The amount of the brood inoculation depended on the size and number of branches on the palas, ber, kusum and semialata host plants. The result revealed that the *S. oleosa* host plant needed high amount of brood lac inoculation because of large size, canopy and more number of branches per plant.

Table 2 Brood lac inoculation (BLI) on different host plant during the year 2014-15 and 2015-16

Strains	Host plant	Mean weight of lac/ plant (g)		
		2014-15	2015-16.	Pooled Mean
<i>Rangeeni</i>	Palas (<i>B. monosperma</i>)	550.00	563.33	556.67
	Ber (<i>Z. mauritiana</i>)	485.00	448.33	466.66
	Kusum (<i>S. oleosa</i>)	7833.33	8000.00	7916.67
<i>Kusmi</i>	Semialata (<i>F. semialata</i>)	47.00	46.83	46.92
	SEm±	175.25	203.33	
	CD (P=0.05)	533.10	618.51	

Productivity parameters of lac insect on different host plants

The productivity parameters of lac insect presented in table no. 3.

Number of lac stick

Branches of the host tree with lac encrustation of mature lac insects when ready to harvest is called lac stick. The mean number of lac stick varied from 10.55 to 234.29 lac stick per plant during the year 2014-15. 25.33, 34.71, 234.29 and 10.55 lac stick per plant were recorded on palas, ber, kusum and semialata host plants in both strains. Highest 234.29 lac stick per plant was observed on kusum in *kusmi* strain followed by 34.71 lac stick per plant on ber in *rangeeni* strain.

Similarly, the mean number of lac stick varied from 11.31 to 241.53 lac stick per plant during the year 2015-16. 25.96, 35.29, 241.53 and 11.31 lac stick per plant were counted in palas, ber, kusum and semialata host plants in both strains. Highest 241.53 lac stick per plant was recorded on kusum in *kusmi* strain followed by 35.29 lac stick per plant on ber in *rangeeni* strain.

The overall mean number of lac stick varied from 10.93 to 237.91 lac stick per plant. The highest numbers of lac stick (237.91 per plant) was found on kusum followed by ber, palas and semialata with 35.00, 25.65 and 10.93 lac stick per plant in both the strains, respectively.

Similar trend of result was obtained by Janghel (2013) who reported that the mean number of lac stick per tree at harvest varied from 14 to 41.33 in *rangeeni* strain with palas host tree. Patel *et al.*, (2014) reported that mean number of lac stick 22-50 in *kusmi* strain and 15-32 in *rangeeni* strain in ber host plant. It suggested that there was more larvae in case of *kusmi* as compared to *rangeeni* lac. Namdev (2014) reported that mean number of lac stick varied from 13.16 to 18.00 in *kusmi* strain in ber host plant. Sahu (2016) reported that the mean number of lac stick per tree varied from 16.44 to 22.00 in *rangeeni* with palas host plant at harvest.

In the present finding the mean number of lac stick varied from 10.93 to 237.91 per plant. The highest lac stick was found in kusum followed by ber, palas and semialata in both the strains. This variation in number of lac insect was probably due to variation in size, canopy and succulent branches of host plants. The highest lac stick was observed in kusum which was big in size and large canopy area and lowest in semialata which was bushy host plant smaller than kusum, palas and ber.

Length of lac stick (cm)

The mean length of lac stick varied from 51.18 to 87.73 cm per plant during 2014-15. The mean length of lac stick was highest 87.73 cm in ber followed by semialata, palas and kusum with 60.54, 53.73 and 51.18 cm lac stick per plant in both the strains.

Similarly, mean length of lac stick per plant was found 53.10 to 89.11cm during the year 2015-16. The mean length of lac stick was highest 89.11 cm in ber followed by semialata, palas and kusum with 62.15, 54.11 and 53.10 cm lac stick per plant in both the strains, respectively.

Similarly, during the year 2015-16 the fresh weight of lac stick per 30 cm lac stick varied from 34.13 to 48.25 g per 30 cm stick. The mean fresh weight of 30 cm lac stick recorded 34.13, 45.04, 48.25 and 42.63g in palas, ber, kusum and semialata host plants in both the strains. Kusum recorded highest fresh weight of lac stick 48.25 g per 30 cm stick in *kusmi* followed by ber 45.04 g per 30 cm stick in *rangeeni* strain. The overall mean of fresh weight of lac stick per 30 cm stick varied from 33.96 to 47.68 g per 30 cm stick. The fresh weight of lac stick was highest in kusum with 47.68 g per 30 cm stick followed by ber, semialata and palas with 44.21, 42.20 and 33.96 g per 30 cm stick in both the strains, respectively.

Table 3 Productivity parameters of lac on different host plant at Kobra during the year 2014-15 and 2015-16

Strains	Host plant	Number of stick lac/plant	Length of lac stick / plan (cm)	Productivity parameters					
				Fresh weight of stick lac/ 30 cm of lac stick (g)	Weight of scraped lac / 30 cm of lac stick (g)	Total stick lac/ plant (kg)	Fresh weight of 100 lac cells (g)	Dry weight of 100 lac cells (g)	Yield potential (ratio of inoculated brood lac and total raw lac)
2014-15									
<i>Rangeeni</i>	Palas (<i>B. monoperma</i>)	25.33 (5.09)	53.73	33.79	15.94	3.50	4.06	3.71	6.58
<i>Summer</i>	Ber (<i>Z. mauritiana</i>)	34.71 (5.95)	87.73	43.38	22.37	5.19	6.77	5.99	10.82
<i>Kusmi</i>	Kusum (<i>S. olesosa</i>)	234.29 (15.29)	51.18	47.12	24.11	53.42	7.27	6.79	6.87
<i>Winter</i>	Semialata(<i>F.semialata</i>)	10.55 (3.38)	60.54	41.77	19.92	0.30	6.45	5.82	6.35
	SEm±	0.32	5.22	3.09	1.69	0.81	0.33	0.29	
	CD	0.98	15.87	9.40	5.17	2.46	1.02	0.89	
2015-16									
<i>Rangeeni</i>	Palas (<i>B. monoperma</i>)	25.96 (5.16)	54.11	34.13	16.17	3.93	4.13	3.73	7.08
<i>Summer</i>	Ber (<i>Z. mauritiana</i>)	35.29 (6.01)	89.11	45.04	22.61	5.44	6.70	6.04	11.20
<i>Kusmi</i>	Kusum (<i>S. olesosa</i>)	241.53 (15.55)	53.10	48.25	23.80	56.46	7.34	6.93	7.15
<i>Winter</i>	Semialata(<i>F.semialata</i>)	11.31 (3.48)	62.15	42.63	21.09	0.30	6.58	5.92	6.19
	SEm±	0.25	4.47	3.03	1.49	0.25	0.30	0.29	
	CD	0.77	13.59	9.22	4.53	0.75	0.91	0.88	
Pooled									
<i>Rangeeni</i>	Palas (<i>B. monoperma</i>)	25.65 (5.12)	53.92	33.96	16.06	3.72	4.09	3.72	6.83
<i>Summer</i>	Ber (<i>Z. mauritiana</i>)	35.00 (5.55)	88.42	44.21	22.49	5.32	6.73	6.02	11.01
<i>Kusmi</i>	Kusum (<i>S. olesosa</i>)	237.91 (15.42)	52.14	47.68	23.96	54.94	7.31	6.86	7.01
<i>Winter</i>	Semialata(<i>F.semialata</i>)	10.93 (3.43)	61.34	42.20	20.51	0.30	6.52	5.87	6.27

Note: Figures in parenthesis are Square root transformed value.

The overall mean length of lac stick per plant varied from 52.14 to 88.42 cm. The length of lac stick was highest in 88.42 cm in ber followed by semialata, palas and kusum with 61.34, 53.92 and 52.14 cm lac stick per plant in *rangeeni* and *kusmi* strain, respectively.

Janghel (2013) reported that the length of lac stick per tree varied from 750 to 1530 cm on palas host tree in *rangeeni* strain, which is higher than the present finding. Sahu (2016) reported mean length of lac stick 68.66 to 77.56 in palas which was similar to the present findings. The length of lac stick depended on the settlement of lac insect larvae on succulent branches of host plant and the quality of food.

Weight of 30 cm lac stick (g)

The fresh weight of lac stick per 30 cm stick varied from 33.79 to 47.12 g during 2014-15. The fresh weight of lac stick per 30 cm stick on different host plants showed significant difference. The mean fresh weight of 30 cm lac stick recorded 33.79, 43.38, 47.12 and 41.77 g in palas, ber, kusum and semialata host plants in the both strains. The highest weight 47.12 g per 30 cm lac stick was obtained on kusum in *kusmi* strain followed by 43.38 g per 30 cm lac stick on ber in *rangeeni* strain.

More or less similar findings were obtained by Janghel (2013) who reported that mean weight of 30 cm lac stick varied from 28.74 to 58.91 g in *rangeeni* on *B. monosperma* at harvest. Further, Patel *et al.*, (2014) reported that mean weight of 30 cm lac stick varied from 24.26 to 80.59 g in case of *kusmi* strain and 21.86 to 76.00 g in case of *rangeeni* strain in *Z. mauritiana* host plant. Namdev (2014) reported that mean weight of lac stick per 30 cm varied from 16.88 to 92.03 g in *kusmi* strain on *Z. mauritiana*.

Weight of scraped lac (g)

The fresh weight of scraped lac from 30 cm stick lac varied from 15.94 to 24.11 g during the year 2014-15. The fresh weight of scraped lac from 30 cm stick on different host plant showed significant difference. The fresh weight of scraped lac was highest in kusum with 24.11 g followed by ber, semialata and palas with 22.37, 19.92 and 15.94 g in both the strains.

During the year 2015-16, fresh weight of scraped lac from 30 cm lac stick varied from 16.17 to 23.80 g. The fresh weight of scraped lac from 30 cm stick on different host plants showed significant difference. The fresh weight of scraped lac was highest in kusum with 23.80 g followed by ber, semialata and palas with 22.61, 21.09 and 16.17 g in both the strains.

The overall mean fresh weight of scraped lac from 30 cm lac stick varied from 16.06 to 23.96 g. The mean fresh weight of scraped lac was highest in kusum with 23.96 g followed by ber, semialata and palas with 22.49, 20.51 and 16.06 g in both the strains.

The findings are more or less similar to Patel *et al.*, (2014) who reported that mean weight of raw lac per 30 lac stick varied from 12.43 to 48.04 g in *kusmi* and 7.54 to 22.37 g in *rangeeni* strain, the more raw lac was found in *kusmi* than *rangeeni*. The mean weight of scraped lac was more in *kusmi* and lower in *rangeeni*.

Yield of raw stick lac (per plant)

The yield of raw lac per plant varied from 0.30 to 53.42 kg during the year 2014-15. The yield of raw lac on different host plants showed significant difference. The maximum yield was obtained in kusum 53.42 kg per plant followed by ber, semialata and palas with 5.19, 3.50 and 0.30 kg per plant in both the strains.

During the year 2015-16, the yield of raw lac per plant varied from 0.30 to 56.46 kg. The yield of raw lac on different host plants showed significant difference. The maximum yield was obtained in kusum 56.46 kg per plant followed by ber, semialata and palas with 5.44, 3.93 and 0.30 kg per plant in both the strains.

The two year pooled yield of raw lac varied from 0.30 to 54.94 kg per plant. The yield of raw lac per plant was maximum in kusum with 54.94 kg per plant followed by semialata 0.30 kg in *kusmi* strain and ber with 5.32 kg per plant followed by palas 3.72 kg in *rangeeni* strain.

More or less similar finding was obtained by Patel *et al.*, (2014) who reported that the yield of lac per plant were recorded 4.00 to 5.70 kg in *kusmi* strain and 3.20 to 4.55 kg in *rangeeni* strain on *Z. mauritiana* host plant. Further, Sharma and Ramani (2011) also reported that the average yield of stick lac on palas (1.2-2.8 kg) on *rangeeni* and kusum (10-100kg), Ber (3-12 kg) in *kusmi*. Singh *et al.*, (2015) reported 120 kg brood lac yield recorded from 400 semialata host plant in *kusmi* strain.

Fresh weight of 100 lac cell (at harvest)

The fresh weight of 100 lac cell varied from 4.06 to 7.27 g for 2014-15. The mean fresh weight of 100 lac cells on different host plants showed significant difference. The fresh weight of 100 lac cell was maximum in kusum 7.27 g followed by ber, semialata and palas with 6.77, 6.45 and 4.06 g in both the strains.

During the year 2015-16, the fresh weight of 100 lac cells varied from 4.13 to 7.34 g. The mean fresh weight of 100 lac cells on different host plant showed significant difference. The fresh weight of 100 lac cell was maximum in kusum 7.34 g followed by ber, semialata and palas with 6.70, 6.58 and 4.13 g in both the strains.

On the basis of pooled mean, the fresh weight of 100 lac cell varied from 4.09 to 7.31 g. The mean fresh weight of 100 lac cell was highest 7.31 g in kusum followed by semialata 6.52 g in *kusmi* and 6.73 g in ber followed by palas 4.09 g in *rangeeni* strain.

The present findings are partially in agreement with Janghel (2013) who reported that mean fresh weight of 100 lac cells varied from 3.66 to 4.08 g at harvest. Namdev *et al.*, (2015) reported that mean fresh weight of 100 lac cell varied from 6.14 to 8.02 g in *kusmi* strain on *Z. mauritiana* at harvest. Patel (2014) reported that mean fresh weight of 100 lac cell varied from 3.07-5.74 g in *kusmi* and 2.35 to 4.14 g in case of *rangeeni* at the time of harvest. Kumar *et al.*, (2017) recorded that the mean fresh weight of 100 lac cell varied 6.36 to 11.14 g at harvest in *rangeeni* strain on *B. monosperma*.

Dry weight of 100 lac cell

The dry weight of 100 lac cell varied from 3.71 to 6.79 g during the year 2014-15. The mean dry weight of 100 lac cells on different host plants showed significant difference. The dry weight of 100 lac cell was maximum in kusum 6.79 g followed by ber, semialata and palas with 5.99, 5.82 and 3.17 g in both the strains, respectively.

During the year 2015-16, the mean dry weight of 100 lac cells varied from 3.73 to 6.93 g. The mean dry weight of 100 lac cells on different host plants showed significant difference. The dry weight of 100 lac cell was maximum in kusum 6.93 g followed by ber, semialata and palas with 6.04, 5.92 and 3.73 g in both of strains, respectively.

On the basis of pooled mean, the dry weight of 100 lac cells varied from 3.72 to 6.86 g. The mean dry weight of 100 lac cells was highest 6.86 g in kusum followed by semialata 5.87 g in *kusmi* and 6.02 g in ber followed by palas 3.72 g in *rangeeni* strain.

The present findings are more or less similar to Janghel (2013) who reported that the mean dry weight of 100 lac cells varied from 2.24 to 2.54 g at harvest. Namdev *et al.*, (2015) reported that mean dry weight of 100 lac cell varied from 4.25 to 7.84 g in *kusmi* strain on *Z. mauritiana*. Patel *et al.*, (2014) reported that mean dry weight of 100 lac cell varied from 2.56-5.40 g in *kusmi* and 1.79 to 3.42 g in case of *rangeeni*. Kumar *et al.*, (2017) also reported that mean dry weight of 100 lac cell varied 4.95 to 8.21 g in *rangeeni* strain on *B. monosperma* at harvest.

Yield potential (ratio of total raw lac yield and inoculated brood lac)

The yield potential of different host plants was described in terms of yield ratio. The yield ratio of different host plant during 2014-15 (ratio between total raw lac and inoculated brood lac) varied from 6.35 to 10.82. The yield ratio was highest 10.82 in ber followed by kusum, palas and semialata with 6.87, 6.58 and 6.35, respectively.

During the year 2015-16, the yield ratio of different host plants varied from 6.19 to 11.20. The yield ratio was highest 11.20 in ber followed by kusum, palas and semialata with 7.15, 7.08 and 6.19, respectively.

On the basis of pooled mean, the yield ratio of different host plants varied from 6.27 to 11.01. The yield ratio was highest 11.01 in ber followed palas 6.83 in *rangeeni* strain and 7.01 in kusum followed by semialata with 6.27 in *kusmi* strain, respectively.

Similar trend of result was obtained by Sharma *et al.*, (2005) who observed that a single lac insect (*K. lacca*) has a potential

to multiply 250 times in one generation, but the actual seed (brood lac) to yield (lac-produced) ratio is very low. Single cell cultures maintained on *F. macrophylla* in the laboratory yield 56-175 times more lac while it was reduced to 45 to 50 times in the field conditions. Kumar *et al.*, (2007) found that the ber was to be the best host for lac production as maximum quantity was recorded on it (165.50 g/m). Ferdousee *et al.*, (2010) reported that ber (*Z. mauritiana*) was determined as pioneer, major and the most preferable host plant compared to other host species like Raintree (*Samanea saman*), Babla (*Acacia nilotica*), Khair (*A. catechu*) and Palas (*B. monosperma*) as Kul provide fruits in association with the lac.

More or less similar finding was obtained by Singh *et al.*, (2015) who reported that brood lac ratio of *F. semialata* varied from 1:3.8 in Bokaro (Jharkhand) to 1:9 in Patna (Bihar) with mean brood lac yield ratio of 1:5.5. It was 1:6 in Chhattisgarh state.

Acknowledgement

The first author expresses his heartfelt gratitude to Dr. Rajeev Gupta, Professor, Department of Entomology, College of Agriculture, Raipur, (C.G.) for his full support, constant enthusiasm and motivation. A special thanks to Dr K N S Banafar Dean, CARS, Janjgir-Champa for giving me help during my research period.

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How to cite this article:

Yogesh Kumar Meshram., Rajeev Gupta and Katlam B. P., 2018, Performance of Different Host Plants Of Lac (*Kerria Lacca* Kerr.) Insect In Korba District of Chhattisgarh. *Int J Recent Sci Res.* 9(8), pp.28529-28533.
DOI: <http://dx.doi.org/10.24327/ijrsr.2018.0908.2475>
