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Possibility of lac production on *Cajanus cajan* (L.) Millsp.

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Abstract
Lac is a cash crop and India is to leading producer as well as exporter. Presently lac is commercially produced on host tree viz. *Butea monosperma*, *Zizyphus mauritiana* and *Schlecheria oleosa*, that are naturally occur in forests, wasteland and field bunds. Pigeonpea [*Cajanus cajan* (L.) Millsp.] is the most popular pulse crop grown in India and Africa. This pulse crop is good and annual host of lac insect. The present field experiment was carried out of basal and foliar nutrient management of *C. cajan*. The treatments were evaluated for experiment was survival of lac insects as it is crucial for lac production. Among the treatments Rhizobium, Phosphate Solubilizing Bacteria, Mycorrhiza and Humic Acid (Soil + Foliar application) was found the best with Mycorrhiza 56.51% percent.

Keywords: *Cajanus cajan*, nutrient management, lac production

Introduction
Lac insects are plant sap feeders (Sharma *et al*., 2006; Singh *et al*., 2009) [9, 10], thrive well only on certain plant species known as lac hosts (Kumar *et al*. 2002) [3]. Lac makes a significant contribution to the foreign exchange earnings of the country. Lac production has a potential for generating employment for both men and women. It plays in the economic upliftment of a country is that roughly 3 to 4 million tribal people (Ogle *et al.* and Kumar 2006) [7]. It is being carried by all types of farmers i.e. marginal, small farmers and big farmers. Lac production in India is mainly restricted to the states of Chhattisgarh, Jharkhand, Madhya Pradesh, West Bengal, Maharashtra, Orissa (Khobragade *et al.* 2012) [4]. Chhattisgarh state ranks first in the production of lac in India followed by Jharkhand (Jaiswal *et al.* 2011) [2]. Madhya Pradesh is the third largest producer of lac in the country (Thomas, 2010) [15]. Jharkhand contributes around 39 percent while West Bengal contributes nearly 7.5 percent of total lac produced in India. The major lac producing districts in Madhya Pradesh are Balaghat, Seoni, Mandla, Chhindwara, Dindori, Narsingpur and Hoshangabad and they contribute about 80 percent of the lac produced in the state. The Chhattisgarh state has established lac processing facilities. The state has a total of 28 lac processing units located at Pendra (2 units), Dhamtari (12), Sakti (3), Kanker (2), Kathgora (6), Rajnandgaon (1) and Raipur (2). Lac based products manufactured in Chhattisgarh are Seedlac, Button lac, Shellac, Bleached lac, Dewaxed Shellac, Lac dye and Aleuritic acid (Pal 2014) [18].
C. cajan is widely grown in India with 3.56 m ha, which contributes 76% of global area and 2.31 m tons of global production. *C. cajan* is also well adapted to the needs of poor small holder farmers in the semi-arid tropics, because compared to maize, an important cash crop in Malawi, pigeonpea production is less resource intensive (Dhanalakshmi *et al*. 2017) [1].
C. cajan provides an opportunity to enhance the lac production in Madhya Pradesh (Patidar *et al.* 2021) [8]. It is cultivated widely in different parts of state and can be better exploited for commercial production of lac in the region, on ber, palas and kusum in M.P. presently lac is produced. Pigeonpea was identified as a favourite host for lac insect long back in 1950's, (Zhenghong *et al*. 2021) [17] but on-farm lac production with pigeonpea has recently emerged as a result of increasing demand of lac from various parts of world (Thomas 2003) [19]. Pigeonpea has been reported as promising host in North-Eastern parts of India.

Methodology
The present field study was conducted during the year 2015-16 and 2016-17 in the village Khairi, Block Shahpura, District Jabalpur, Madhya Pradesh to evaluate the effect of biological

products viz. (PSB, Rhizobium, Mycorrhiza and Humic acid on *C. cajan* on plants for Baishakhi lac production. Geographically, the village is located between $21^0$19' to $22^0$24' north latitude and $79^0$31' to $81^0$31' east longituted. The experiment in Randomized Block Design (RBD) with eight treatments and three replications was conducted in farmers field.

The field trial was conducted on TJT-501 variety of *C. cajan* obtained from Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur Madhya Pradesh.

Treatments

The experiment had following eight treatments (Table 1)**.**

Table 1: Details of the Experiment

Treatments combinations	
No.	**Details**
T_1	Rhizobium + PSB (Soil application)
T_2	Rhizobium + PSB + Mycorrhiza (Soil application)
T_3	Mycorrhiza (Soil application)
T_4	Rhizobium + PSB + Humic Acid (Soil + Foliar application)
T_5	Rhizobium + PSB + Mycorrhiza + Humic Acid (Soil + Foliar application)
T_6	Mycorrhiza + Humic Acid (Soil + Foliar application)
T_7	Humic Acid (Foliar application)
T_8	Control (no soil and Foliar application)

Nursery raising of *C. cajan*

Black polythene bag of size 10x14 inch and 38 guage were used for the raising of *C. cajan* in the nursery. All the polythene bag were perforated with 10-12 holes before filling the substrate (medium). It was done to drain excess of irrigation water from polythene bags.

Substrate

Substrate was prepared by mixing of light soil and well rotten Farm yard manure (FYM) in the ratio of 1:1, during the first week of May. FYM was treated with *Trichoderma viride*, at the rate of 2.5kg per five quintals of FYM and kept under shade. The treated FYM was then mixed thoroughly at weekly intervals for one month for the growth of *T. viride*, prior to its filling in the polythene bag. The substrate was filled in the perforated polythene bags upto three quarters of its capacity. The substrate filled polythene bags were than arranged in 4 rows under shade to protect the growing seedling from direct sun.

Seed treatment

C. cajan seeds after treating with *T. viride*, *Rhizobium* and Phosphorous solubulizing bacteria (PSB) culture were spread on a polythene sheet. These treated seeds were sown in the substrate filled perforated Polythene bags at the rate of 2 seeds per bag in the last week of May. Watering was done at weekly intervals. On attaining a height of 8 to10 inches, the growing tips at 10 to 15 days interval till its transplantation. Nipping was done to initiate side braches.

Pit digging

Pit of dimension 1x1x1 foot was dug with a sharp iron rod. After removing the loose soil from the pit, well rotten FYM, Diammonium phosphate (DAP), Zinc and Murate of Potash (MoP) as well as *T. viride*, *Rhizobium* and PSB were added to all the pits and mixed well before transplantation. After transplantation, the plants were again nipped at 10 days interval till 1st week of October during both the years.

Transplantation

All the seedlings of *C. cajan* were transported in the field during the first week of July. Seedling in the polythene were transported to the main field and kept adjacent to the 1x1x1feet pits dug at a spacing of 6x6 feet. The polythene bag was carefully removed, keeping the *C. cajan* seedling and the soil holding it intact. The seedling was gently placed in the pit and pressed tightly all over the side.

Broodlac inoculation (BLI)

Healthy Broodlac with minimum signs of predator and parasite infestation were selected for its inoculation of the *C. cajan* plants. Broodlac weighing 10-20g was inoculated per *C. cajan* plant depending on the size of the plant. Broodlac stick was tied with a twine on the main stem about one foot above the ground.

Removal of phunki

Majority of the larvae of *K. lacca* left Broodlac to settle on branches within 21 days. The left over Broodlac on the plant without lac larvae is called *Phunki*, was removed after 21 days of (BLI) and scrapped to recover raw lac. In this process the predators were removed from the field (Janghel, 2013) [20].

Slot preparation

On 30th day after BLI, three branches of *C. cajan* with good lac insect settlement were randomly selected per plants. On each branches five slot each of 2.5cm long and 1.0cm wide were made. The slot after measuring 2.5cm^2 dimension was marked by removing the lac insect settlement in the adjoining area.

Mean live lac insects count per 2.5cm^2 (MNL)

The MNL was recorded by counting live lac insects per 2.5cm^2 on *C. cajan* plants at five fixed spots per branch. Three branches per plant was selected and there were twelve observations on the MNL during the lac cropping season i.e. at 30, 45, 60, 75, 90, 105, 120, 135, 150, 165, 180,195 days after BLI.

Application of pesticides

The pesticides solution (Cartap hydrochloride + Mancozeb) were sprayed on the *C. cajan* plants with the help of a foot sprayer for management of predators and parasites of lac insects as well as diseases.

Preparation of pesticide solution

Solution of pesticide was prepared by adding Cartap hydrochloride 1g /litre of water and Mancozeb @ lg/litre of water) in two small seperate containers followed by brisk stirring with a piece of stick. Both the solutions were poured into the bucket containing 13 liters of clean water. The solution in the bucket of the spray was again stirred with the help of a stick to ensure proper mixing of the pesticides, before filling in the sprayer tank.

Spraying schedule: The first spray was done after 30 days of BLI. The second spray was done in the month of December.

Results and Discussion

The mean number of live lac (MNL) insects per 2.5cm^2

a. 30 days after BLI

The MNL in all the treatments was highest 30 days after BLI and lowest before harvest of lac crop i.e. at 195 days after BLI.

The MNL was significantly highest in T_3-Mycorrhiza (81.65) over all the treatments. The MNL in T_4-Rhizobium + PSB + Humic acid (71.94), T_5-Rhizobium + PSB + Humic acid + Mycorrhiza (72.09), T_6-Humic acid + Mycorrhiza (72.46) and T_7-Humic acid (71.26) were at par with each other. It was significantly highest in T_3 (81.65) while that of T_1(74.09) and T_2 (74.47) were at par with each other.

b. 45 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (78.83) over all the treatments. Treatments T_1-Rhizobium + PSB (72.43), T_2-Rhizobium + PSB + Mycorrhiza (70.90), T_4-Rhizobium + PSB + Humic acid (70.39), T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (70.55), T_6-Mycorrhiza + Humic acid (70.95) and T_7-Humic acid (70.33) were at par with each other.

c. 60 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (77.30) over all the treatments. The MNL in T_1-Rhizobium + PSB (68.98), T_2-Rhizobium + PSB+Mycorrhiza (67.83), T_4-Rhizobium + PSB + Humic acid (67.98), T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (68.57), T_6-Mycorrhiza + Humic acid (68.77) and T_7-Humic acid (67.76) were at par with each other.

Table 2: Mean no. of live lac insects settlement per 2.5cm^2

Variety TJT-501	Mean no. of live lac insects settlement per 2.5cm^2												Survival %
	30 Days	45 Days	60 Days	75 Days	90 Days	105 Days	120 Days	135 Days	150 Days	165 Days	180 Days	195 Days	
T_1	74.09 (8.64)	72.43 (8.54)	68.98 (8.34)	65.91 (8.15)	63.37 (7.99)	59.15 (7.72)	56.18 (7.53)	45.64 (6.79)	44.14 (6.68)	42.63 (6.57)	41.18 (6.46)	38.42 (6.24)	51.86
T_2	74.47 (8.66)	70.90 (8.54)	67.83 (8.27)	64.11 (8.04)	62.87 (7.96)	58.97 (7.71)	57.18 (7.59)	45.90 (6.81)	43.56 (6.64)	41.07(6.45)	40.90(6.43)	39.21(6.30)	52.65
T_3	81.65 (9.06)	78.83 (8.91)	77.30 (8.82)	70.71 (8.46)	71.03 (8.44)	68.78 (8.32)	67.45 (8.24)	52.55 (7.28)	50.91 (7.17)	48.72(7.02)	48.08(6.97)	46.14(6.85)	56.51
T_4	71.94 (8.51)	70.39 (8.42)	67.98 (8.28)	65.19 (8.11)	63.76 (8.02)	59.91 (7.77)	59.75 (7.76)	45.95 (6.82)	44.70 (6.72)	42.21(6.54)	41.87(6.51)	40.23(6.38)	55.92
T_5	72.09 (8.52)	70.55 (8.43)	68.57 (8.31)	64.27 (8.05)	61.89 (7.90)	59.26 (7.73)	58.06 (7.65)	45.72 (6.80)	43.43 (6.63)	42.61(6.57)	41.76(6.50)	40.34(6.39)	55.56
T_6	72.46 (8.54)	70.95 (8.45)	68.77 (8.32)	64.73 (8.08)	61.47 (7.87)	57.60 (7.62)	57.23 (7.60)	44.34 (6.70)	42.23 (6.54)	41.23(6.46)	40.56(6.41)	39.52(6.33)	54.54
T_7	71.26 (8.47)	70.33 (8.42)	67.76 (8.26)	63.85 (8.02)	61.87 (7.90)	59.87 (7.77)	57.24 (7.60)	43.60 (6.64)	41.85 (6.51)	40.29(6.39)	40.07(6.37)	38.93(6.28)	54.63
T_8	66.95 (8.21)	66.09 (8.16)	62.76 (7.95)	59.29 (7.73)	56.26 (7.53)	54.24 (7.40)	51.42 (7.21)	39.39 (6.32)	38.73 (6.26)	38.06(6.21)	37.21(6.14)	32.68(6.01)	48.81
SE(m)±	0.571	0.887	0.818	0.826	0.867	3.763	0.974	0.657	0.416	0.403	0.339	0.340	
CD at 5%	1.731	2.690	2.482	2.506	2.631	1.414	2.966	1.994	1.263	1.221	1.029	1.031	

Figure in parenthesis are transformed value$\sqrt{x+0.5}$

d. 75 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (70.71) over all the treatments .The MNL in T_1-Rhizobium + PSB (65.91),T_2-Rhizobium + PSB + Mycorrhiza (64.11), T_4-Rhizobium + PSB + Humic acid (65.19), T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (64.27), T_6-Mycorrhiza + Humic acid (64.73) and T_7-Humic acid (63.85) were at par with each other.

e. 90 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (71.03) over all the treatments .The MNL in T_1-Rhizobium + PSB (63.37), T_2-Rhizobium + PSB + Mycorrhiza (62.87), T_4-Rhizobium + PSB + Humic acid (63.76),T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (61.89), T_6- Mycorrhiza + Humic acid (61.47) and T_7-Humic acid (61.87) were at par with each other.

f. 105 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (68.78) over all the treatments. The MNL in T_1-Rhizobium + PSB (59.15), T_2-Rhizobium + PSB + Mycorrhiza (58.97), T_4-Rhizobium + PSB + Humic acid (59.91), T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (59.26), and T_7-Humic acid (59.87) had significantly higher MNL than that of (57.60) T_6. However, T_1, T_2, T_4, T_5 and T_7 were at par with each other.

g. 120 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (67.45) over all the treatments. The MNL in T_1-Rhizobium + PSB (56.18), T_2-Rhizobium + PSB + Mycorrhiza (57.18), T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (58.06), T_6-Mycorrhiza + Humic acid (57.23) and T_7-Humic acid (57.24) were at par with each other. The MNL in (67.45) T_3 was significantly highest followed by that (59.75) in T_4.

h. 135 days after BLI

The MNL was significantly highest in (52.55) T_3-Mycorrhiza (52.55) over all the treatments. The MNL in T_6-Mycorrhiza + Humic acid (44.34) and T_7-Humic acid (43.60) were at par with each other, similarily, that of T_1-Rhizobium + PSB (45.64), T_2-Rhizobium + PSB + Mycorrhiza (45.90), T_4-Rhizobium + PSB + Humic acid (45.95), and T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (45.72) were also at par with each other.

i. 150days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (50.91)

over all the treatments. The MNL in T_6-Mycorrhiza + Humic acid (42.23) and T_7-Humic acid (41.85), were at par with each other similarily, the MNL in T_1-Rhizobium + PSB (44.14), T_2-Rhizobium + PSB + Mycorrhiza (43.56), T_4-Rhizobium + PSB + Humic acid (44.70) and T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (43.43) were at par with each other.

j. 165 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (48.72) over all the treatments .The MNL in T_6-Mycorrhiza + Humic acid (41.23),T_7-Humic acid (40.29) and T_2-Rhizobium + PSB + Mycorrhiza (41.07) were at par with each other while, that in T_1-Rhizobium + PSB (42.63),T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (42.61) and T_4-Rhizobium + PSB + Humic acid (42.21) were at par with each other.

k. 180 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (48.08) over all the treatments. The MNL in T_6-Mycorrhiza + Humic acid (40.56), and T_7-Humic acid (40.07) were at par with each other while, that of T_1-Rhizobium + PSB (41.18), T_2-Rhizobium + PSB + Mycorrhiza (40.90), T_4-Rhizobium + PSB + Humic acid (41.87) and T_5-Rhizobium + PSB + Mycorrhiza + Humic acid (41.76) were also at par with each other.

l. 195 days after BLI

The MNL was significantly highest in T_3-Mycorrhiza (46.14) over all the treatments. The MNL in T_1-Rhizobium + PSB (38.42), T_2-Rhizobium + PSB + Mycorrhiza (39.21),T_6 Mycorrhiza + Humic acid (39.52), and T_7-Humic acid (38.93) were at par with each other while that of T_4-Rhizobium + PSB + Humic acid (40.23) and T_5- Rhizobium + PSB + Mycorrhiza + Humic acid (40.34) were also at par with each other.

In comparison to the MNL 30 days after BLI, the MNL at the harvest of lac crop was always less as reported by earlier workers like Vajpayee *et al*. (2019) [16], Patidar *et al*. (2021) [8], Kakade *et al*. (2020) [3], has reported a decline in the population of live lac insects on *C. cajan* between BLI and harvest of lac crop. The survival rate of live lac insects on *C. cajan* was 56.51%. Loss of insects in the population during its growth and development stage are a natural phenomena (Khaliq *et al*. 2014) [6]. It may also be due competition, infestation by predators and parasities, abiotic factor improper management or host dependent factors (Vajpayee *et al*. 2019) [16]. However, health of the host plants play a major role in the survival of the insects feeding on it. It is also a fact the host with good nutrienal support helps not only, its own growth and survival but also of the insects feeding on it (Kakade *et al*. 2020) [3]. In the present case, the treatment T_3 was found to be the best for the highest survival of the lac insects. The role of nutrient management of host in the survival of lac insects has been earlier reported by Shah *et al*. (2015) [12] Vajpayee *et al*. (2019) [16], Patidar *et al*. (2021) [8], Kakade *et al*. (2020) [3].

Conclusion

The survival percent of lac insects has a direct influences on the yield of lac. Therefore survival percent of lac insects is an economic factor in lac production. Further more, *C. cajan* is an agricultural crop of economic importance and growing lac insects for lac production (another lac crop) on it implies additional stress on the crop. In this context, nutritional management of *C. cajan* crop especially when also exploited for lac production needs nutritional management. Thus, the present finding are of increase value to all the pigeonpea farmers in the world to double their produce and income.

Reference

1. Dhanalakshmi TN, Rudramuni T, Hanumantha GN, Pallavi, Chandrappa D. Evaluation of Different Pigeon Pea Hybrids and Varieties for Yield Trait under Central Dry Zone of Karnataka, India. International J. of Current Microbiology and Applied Sciences ISSN: 2319-7706 Volume 6 Number. 2017;4:627-629.
2. Jaiswal AK, Pal G, Singh JP, Patel B. Growth Analysis of Lac production for the state of Chhattisgarh; 2011. DOI: 10.54207/bsmps2000-2011-ZIZU14.
3. Kumar KK. Scope of lac cultivation in employment and income generation. In Recent advances in lac culture ILRI, Ranchi; c2002. p. 254-262.
4. Khobragade D, Thomas M, Pachori R, Sharma JL, Shrivastava A. Farmer participatory trial on the predator management of Lac insect *Kerria lacca* (Kerr) in Anuppur District, Madhya Pradesh. J. of Tropical Forestry. 2012;28(1&2):38-45.
5. Kakade S, Patidar R, Vajpayee S, Thomas M, Tripathi N, Bhowmick A, *et al*.. Survival of Lac Insects *Kerria lacca* (Kerr.) on *Cajanus cajan* (L) Millsp. Int. J Curr. Microbiol. App. Sci. 2020;9(12):173-182.
6. Khaliq A, Javed M, Sohail M, Sagheer Muhammad. Environmental effects on insects and their population dynamics. Journal of Entomology and Zoology Studies. 2014;2(2) 1-7.
7. Ogle A, Thomas M, Tiwari LM. Strategic development of lac in Madhya Pradesh; c2006 June. p. 1-34.
8. Patidar R, Vajpayee S, Kakade S, Thomas M, Tripathi N, Upadhyay A. Simultaneous Production of Both Lac and Pulse from Pigeonpea [*Cajanus cajan* (L) Millsp.] for Doubling Farmers' Income. Legume Research; 2021. 10.18805/LR-4553.
9. Sharma KK, Jaiswal AK, Kumar KK. Role of lac culture in biodiversity conservation: Issues at stake and conservation strategy. Current Sci. 2006;91:894-898.
10. Singh JP, Jaiswal AK, Monobrullah MD, Bhattacharya A. Response of sime selected insecticides on neuropteran predator (*Chrysopa lacciperda*) of lac insect (*Kerria lacca*). Indian J Agric. Sci. 2009;79:727-731.
11. Sharma H, Ghugal SG, Thomas M, Pachori R. Impact of Nutrient Management in *Butea Monosperma* (Lam.) Taub. on the survivability of *Kerria Lacca*.(Kerr). Trends in Biosciences, 2015, 8(24) Print: ISSN 0974-8431, 6873-6877.
12. Shah TH, Thomas M. Survival of kusmi lac insects *kerria lacca* (Kerr) on nutrient managed Zizypus mauritiana. Indian J of Entomology. 2018;80(1):56-63.
13. Shanmugaraja P, Kishor SK, Prabudoss V, Sakthivel VS, Dinesh SK**.** A study on extent of adoption of paddy farmers about the integrated nutrient management technologies in Nagapattinam district of Tamil Nadu. Int. J of Botany Studies. 2021, 6(5).
14. Thingujam U, Phonglosa A, Mandal J, Bhattacharyya K. Studies on the integrated nutrient management of Brinjal [*Solanum melongena* (L.]. Agricultural & Horticultural Sciences. 2014, 03-05.
15. Thomas M. Madhya Pradesh: Current status of Lac production, issues, remedial measures and support system for development. Curent issues related to lac production;

c2010. p. 35-37.
16. Vajpayee S, Patidar R, Kakade S, Thomas M, Tripathi N, Bhowmick AK, *et al*. Effect of Population Density of *Kerria lacca* (Kerr).on its Growth and Survival**.** Int. J of Curr. Microbiol. Appl. Sci, 2019, 8(12).
17. Zhenghong LI, Saxena KB, Chaohong Z, Jianyun Z, Yong GU, Xuxiao Z, *et al*. Pigeonpea : An Excellent Host for Lac Production. Chinese Academy of Forestry, Kunming, China. ICPN8. Int. Crops Research Institute for the Semi-Arid Tropics (ICRISAT); c2001. p. 502 324.
18. Sharma U, Pal D, Prasad R. Alkaline phosphatase: an overview. Indian Journal of Clinical Biochemistry. 2014 Jul;29(3):269-278.
19. Thomas DR. A general inductive approach for qualitative data analysis; c2003.
20. Tiwari A, Janghel V, Jain A, Mishra A. A Survey Paper on Overload Monitoring Parameters and Modernisation in Load Shedding Approach. International Journal of Electrical and Electronic Engineering & Telecommunications. 2013 Oct;2(4):81-6.