



Short Communication

Effect of Pitcher Fertigation on Summer Kusmi Lac Yield and Growth of Ber (*Ziziphus mauritiana*) Lam.

R.K. Singh*

ICAR-Indian Institute of Natural Resins and Gums, Ranchi 834 010, India

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Ber (*Ziziphus mauritiana*) is a hardy lac host on which both the strains of Indian lac insect *Kerria lacca* (kerr) (Homoptera: Tachardiidae) i.e., *kusmi* and *rangeeni* thrive well and complete their life cycle. It occupies an important position in the list of conventional hosts *kusum* (*Schleichera oleosa*), *ber* (*Ziziphus mauritiana*) and *palas* (*Butea monosperma*). Among these lac hosts, utilization of *ber* is high due to its wide distribution in homestead area and farmers' land holding/bunds (Ghosal and Singh, 2012). Although this host supports both crops of *rangeeni* strain to a greater extent, it supports only the winter crop in case of *kusmi* strain of lac insects and the summer season (*jethwi*) crop fails miserably on this host, probably due to high temperature and soil moisture stress, leading to crop mortality. The summer mortality of *kusmi* insects during summer may be attributed to death of thinner shoots and direct exposure of sunlight to lac insects. Mishra *et al.* (1999) also reported delay in male emergence during summer on *Z. mauritiana* and *Flemingia macrophylla* due to low physiological activity as compared to *S. oleosa*. Providing irrigation to the host plant during summer might help in supply of moisture and nutrients to desiccating shoots and triggering leaf initiation and metabolic activities in plant tissues. Thus, applying irrigation water to the *ber* plants and keeping the root zone moist for longer period may be one of the solutions, for keeping the lac insect mortality in check and consequently leading to enhanced lac yield.

Micro irrigation systems such as drip and sprinkler do save half of the water presently used for irrigation but technical, economic and socio-economic factors prevent the adoption

of these technologies (Siyal *et al.*, 2009). It has been concluded that a modernized 'old' system can be taken up more unpretentiously by farmers given that it is much closer to traditional practices (Prinz and Malik, 2004). In this context, pitcher irrigation is more suited to resource constraint poor lac growers. Increased summer season stick lac yield under pitcher irrigation over control (no irrigation) was already reported in a study conducted at Indian Institute of Natural Resins and Gums, Ranchi (Singh *et al.*, 2010). However, an effective irrigation practice alone is not enough for higher production as nutrient also plays important role. Pitcher irrigation system also provides an opportunity for efficient and effective nutrient management through fertigation. Since nitrogen concentration is very low in acidic soils of Ranchi, application of urea helps in enhancing nitrogen availability to the plants (Sinha, 1974). To address the problem, a study was conducted to assess the impact of fertigation through pitcher on summer season *kusmi* brood lac yield and growth of *ber* (shoot girth and length). The study was conducted for three summer season lac crops during January 2009-July 2011 at the Research Farm of Indian Institute of Natural Resins and Gums, Namkum, Ranchi (23°23' N, 85°23' E) and 650 m above MSL. The soil of the experimental plot was of sandy loam texture with acidic soil reaction and low organic carbon content.

Out of 32 trees under summer season crop, 16 were provided with pitchers (8 litre capacity), while same number of trees was kept under control (no pitcher). Four pitchers, with a circular hole at the bottom and inserted with cotton wick, for one tree were buried in the soil at a radial distance of 2/3rd of the canopy spread from the tree trunk. Thus, the total number of pits for tree counted for 64. The

*E-mail: rksinghiinrg@gmail.com

Present address: ICAR-Central Arid Zone Research Institute, Jodhpur - 342 003, India

mouth openings of the pitchers were left above ground. The pitchers were filled with water and covered with clay lids in order to avoid evaporation. Water was filled in the pitchers up to its neck at weekly interval. During this period three summer season crops (*jethwi*) were harvested. Fertilizer in form of urea at the rate of 200 g tree⁻¹ for whole crop cycle was applied. In one crop cycle 18-20 irrigations were provided to *ber* trees, splitting the dose of urea to 10-12 g/irrigation/tree. Before starting irrigation through pitchers, the periphery of the *ber* trees was flooded with water to bring the plant root zone in saturated condition. The seepage rate through pitchers was observed to be 0.04 l ph (liter hr⁻¹). Water requirement was determined by quantifying the amount of water applied at each irrigation cycle.

Kusmi brood lac was inoculated in the month of January and was harvested in July-August every year as a part for summer season (*jethwi*) lac crop production. Brood lac was inoculated at the mean rate of 0.4 kg tree⁻¹ for brood lac production every year. Data on shoot length, shoot girth and brood lac yield ratio was recorded. For determination of shoot length and girth, three samples of branches from five trees, selected randomly, under treatment and control were taken at the time of brood lac inoculation and data on both the parameters were also recorded at harvest.

Shoot length

Shoot length (34.15%) and shoot girth (24.11%) of *ber* for summer lac crop showed a definite increase under pitcher fertigation (Table 1). Shoot length was found to be significantly superior in pitcher fertigation over control in all the years. Shoot girth was significantly superior over control in first two years of experimentation. Supplemental irrigation through pitchers might have played an instrumental role in mitigating stress of *ber* trees, leading to improved shoot performance.

The result is in agreement with the findings of Kurian *et al.* (1983) who used buried clay pot irrigation to grow *Prosopis* (*Prosopis* spp.) seedlings in which trees irrigated with clay pots were more than three times taller than rainfed trees and 70% taller than surface irrigated trees. Memon *et al.* (2010) also reported an overall yield increase 58% under pitcher over furrow for okra crop.

Lac crop yield

The brood lac yield ratio in case of pitcher fertigation was recorded to be 3.9:1, while it was 1.6:1 for control (Table 1) in summer season lac crop 2009. It appears that lac crop was adversely affected by the moisture stress on the plants during summer, yielding the brood lac just equal to the input level in control; where as those plants provided with irrigation with urea through pitchers yielded a good crop with high yield ratio. Complete crop mortality was observed, hence no brood lac was obtained (Table 1) in year 2010, which may be due to less rainfall (121mm) and comparatively high mean maximum temperature (39.2°C) during lac development stage compared to rainfall received during the second quarter in 2009 (203 mm) and 2011 (606.1 mm) (Fig. 1). Mean half yearly rainfall corresponding to the year varied largely, causing wide variation in lac yield ratio under control condition. The comparison of weather data for the year 2010 with that of average of last ten years (2000-2009) with respect to mean maximum temperature during the crop growth stage (March-April), rainfall received and relative humidity during the crop period (December-May) revealed that mean maximum temperature was higher by approximately 1°C, rainfall lower by 57 mm and relative humidity lower by 3-20%, substantiating the cause of crop mortality in 2010.

Year 2011 witnessed a good lac crop due to tolerable mean maximum temperature limit and sufficient rainfall during second quarter of the

Table 1. Increase in shoot length and girth and brood lac yield ratio under different treatments during the experimental period

Treatment	Shoot length increase (%)				Shoot girth increase (%)				Brood lac yield ratio (Harvested: inoculated)			
	2009	2010	2011	Mean	2009	2010	2011	Mean	2009	2010	2011	Mean
Pitcher	44.63	27.03	30.8	34.15	25	25.84	21.48	24.11	3.90	0	2.68	3.29
Control	19.18	15.48	22.55	19.07	9.85	11.21	18.76	13.27	1.60	0	1.58	1.59
CD at 5%	8.72	6.93	5.41	-	10.47	8.49	NS	-	0.51	-	0.42	-

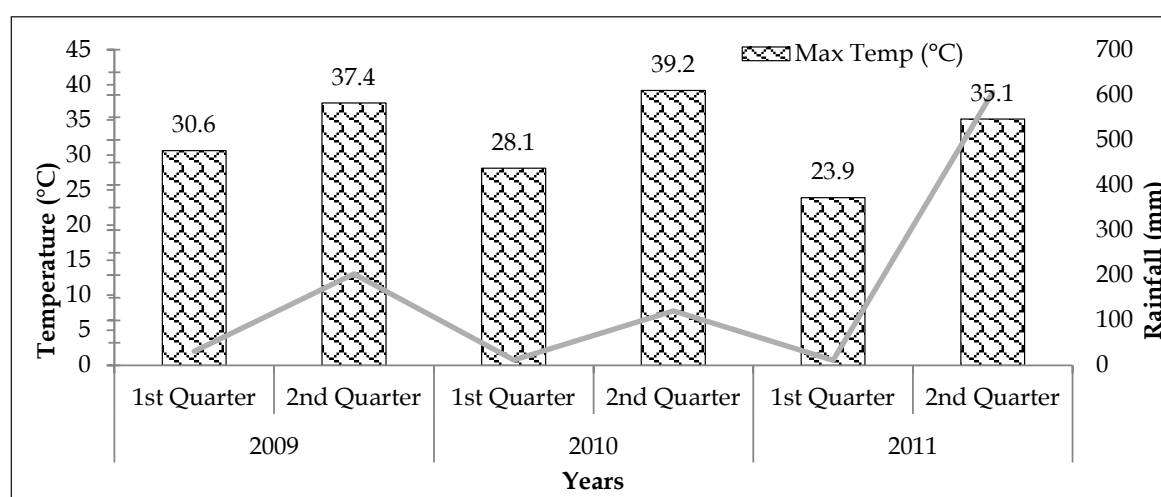


Fig. 1. Rainfall (mm) and maximum temperature (°C) during growth and development of lac insect
 *1st Quarter: January-March; 2nd Quarter: April-June.

year, which coincides with the developmental and maturity stage of lac crop. However, brood lac yield was significantly superior under treatment trees. Application of pitcher fertigation was found to increase brood lac yield ratio to the tune of 106.9% as compared to control comparing the mean values during these years (Table 1). Due to increased shoot growth, succulence of shoot was maintained, which might have facilitated growth of lac insect leading to increased lac yield. During stress period (April to June in summer season), even a small amount of water through pitcher irrigation helps reasonable growth in plant's attributes which favours lac crop sustainability.

It is concluded that pitcher fertigation technique can be successfully employed for taking summer *kusmi* lac production on *ber*. Small scale lac growers (farmers) can adopt this technology for extra remuneration by producing brood lac during the summer season, which is otherwise vulnerable. Pitcher irrigation technique is also helpful in mitigating high temperature regime below the ground level which ultimately helps the plant to take up nutrients for its enhanced metabolic activities. Irrigation through pitchers has no negative environmental impacts, is cost effective, and most importantly is neither using electricity for its operation nor is subjected to managerial gaffe by the farmers as in the case of other micro irrigation technologies.

References

- Ghosal, S. and Singh, R.K. 2012. Effect of irrigation and mulching on establishment of *ber* (*Ziziphus mauritiana*) plantation in Jharkhand. *Bioved* 23(1): 41-44.
- Mishra, Y.D., Kumar, S., Sushil, S.N., Bhattacharya, A. and Singh, B.P. 1999. Development of *kusmi* lac insect, *Kerrianagoliensis* (Mahdihassan) on different hosts. *Insect Environment* 5(3): 130-131.
- Prinz, D. and Malik, A.H. 2004. More yield with less water: How efficient can be water conservation in agriculture? *European Water* 5/6: 47-58.
- Singh, R.K., Mishra, Y.D. and Baboo, B. 2010. Impact of pitcher irrigation and mulching on the summer season (*jethwi*) lac crop sustainability and pruning response on *ber* (*Ziziphus mauritiana*). *The Indian Forester* 136: 1709-1712.
- Sinha, H. 1974. Distribution, characteristics and management of acid soils of Bihar. ICAR. Acid soils in India. *Proceedings of the Autumn Institute R.A.U., Bihar*, pp. 76-79.
- Siyal, A.A., Van, Genuchten M. and Skaggs, T.H. 2009. Performance of pitcher irrigation system. *Soil Science* 174(6): 312-320.
- Kurian, T., Zodapa, S.T. and Rathod, R.D. 1983. Propagation of *Prosopis juliflora* by air layering. *Transactions Indian Society of Desert Technology and University Centre of Desert Studies* 8(1): 104-108.
- Memon, A.H., Soomro, A.G. and Gadehi, M.A. 2010. Water use efficiency and saving through pitcher and polyethylene bag over furrow irrigation. *Pakistan Journal of Agriculture, Agricultural Engineering, Veterinary Sciences* 26(1): 16-29.

