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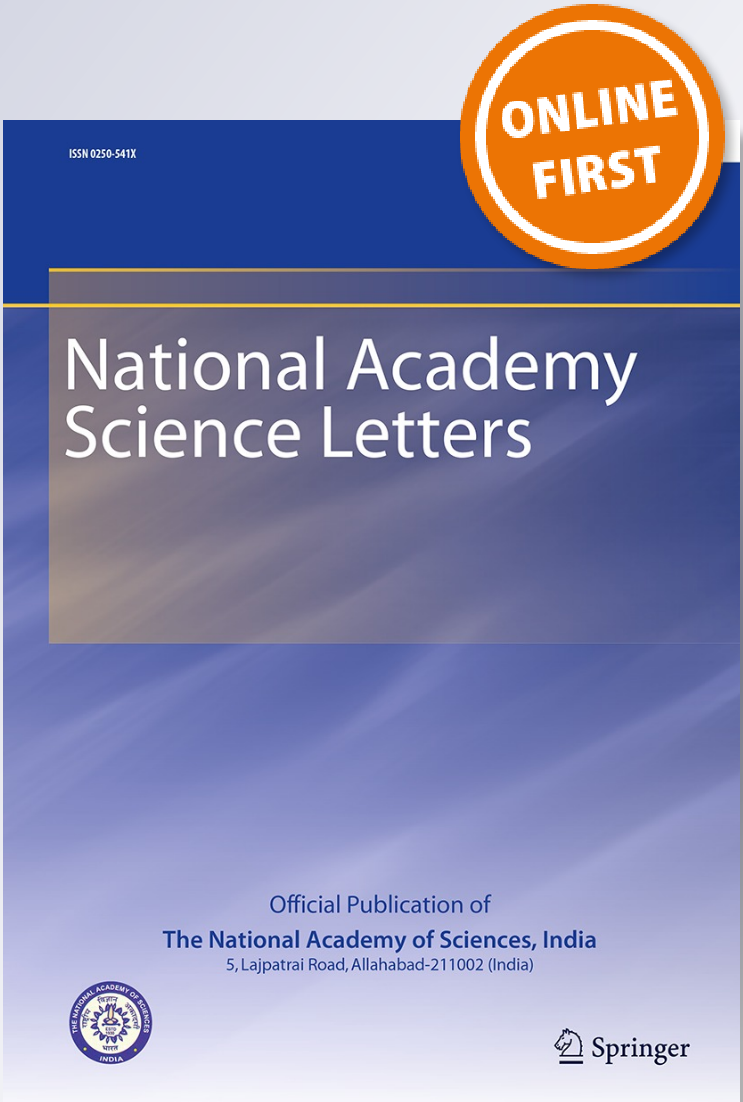

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SHORT COMMUNICATION

Effect of Pitcher Fertigation on Shooting Response and *Kusmi* Lac Crop Performance on *Ber* (*Ziziphus mauritiana*)

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Abstract Effect of pitcher fertigation (urea only) with 4 pitchers/tree (8 l capacity/pitcher) with seepage rate of 0.04 l/h was studied on summer and winter *kusmi* lac crop performance and shooting response on *ber* (*Ziziphus mauritiana*) during 2009–2012. There was an increase of 2.2 and 2.6 times in shoot length and girth in winter season than the summer season under pitcher fertigation. A significant increase in number of shoots per pruned point was also noticed in winter season as compared to summer season. Lac yield was 1.75 times more in winter season, compared to summer season. Interaction effect between seasons and treatments showed maximum yield ratio in pitcher fertigation in winter season and least yield ratio in control in summer season. Interaction of pitcher fertigation brought 106.9 and 13.5 % increase in lac yield ratio in summer and winter season, respectively. Much higher increase in lac yield was obtained when pitcher fertigation was applied in summer as compared to winter.

Keywords *Ber* · Broodlac yield ratio · *Kusmi* · Lac · Pitcher fertigation · *Rangeeni* · Summer season · Winter season

Lac is the resinous secretion of Indian lac insect *Kerria lacca* (Kerr) which thrives on more than 400 tree species [1, 2]. It is being cultured on several host plant species ranging from small bushy type to large species for economic returns in the lac growing regions of the country [3].

Of these host plants, palas (*Butea monosperma*), kusum (*Schleichera oleosa*) and ber (*Ziziphus mauritiana*) constitute the main hosts for lac production from commercial point of view. Out of these conventional commercial hosts, *ber* occupies an important position with regard to its suitability to lac insects as both the strains i.e., *kusmi* and *rangeeni* can be cultured on this host. Besides, productivity of lac on this host is also high. It supports only the winter crop in case of *kusmi* strain of lac insects, as the summer season (jethwi) crop fails miserably on this host due to crop maturing stage coinciding with high temperature of summer season.

The summer mortality of *kusmi* insects during summer may be attributed to death of thinner shoots, direct exposure of sunlight to lac insects and partial death of male lac insects due to hot wind and desiccation in third instar when they stop sucking plant sap. Providing irrigation to the *ber* plants during summer could help in supply of moisture and nutrients to desiccating shoots, triggering leaf initiation and metabolic activities in plant tissues. Similarly, *ber* plants with lac crop in winter season experiences stress during later part of the season i.e., December–February. Observation on weather pattern of Ranchi for last 10 years suggests that there is negligible amount of rainfall during December–February, which coincides with the maturing stage of winter season lac crop, necessitating the need of supplemental irrigation to the host plants for better crop growth. Thus, applying irrigation water to the *ber* plants and keeping the root zone moist for longer period may be one of the solutions, which could help in keeping the lac 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

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technical, economic, and socio-economic factors prevent the adoption of these technologies [4]. 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 [5]. Pitcher irrigation is also more suited to resource constraint poor lac growers. Increased summer season sticklac yield under pitcher irrigation over control (no irrigation) was reported for two consecutive years during 2006–2007 and 2007–2008 in a study conducted at Indian Institute of Natural Resins and Gums, Ranchi [6].

An effective irrigation practice alone is not enough for higher production as nutrient also plays important role. Pitcher irrigation system 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 [7].

The present study was an attempt to visualize the impact of fertigation through pitcher on *kusmi* broodlac yield and shooting response of *ber* (*Z. mauritiana*). The study was conducted at Research Farm of Indian Institute of Natural Resins and Gums, Namkum, Ranchi (23°23′ N longitude, 85°23′ E latitude and 650 m above mean sea level) from January 2009 to March 2012. The region falls under the sub-humid and sub-tropical climatic zone. The average annual rainfall is 1,350–1,400 mm, of which 85–90 % is received during June–September. The rainfall received was recorded to be 3,961.3 mm during the experimental period i.e., January 2009–March 2012.

Out of 32 trees under each summer and winter season crop, 16 were provided with pitchers (8 l capacity), while same number of trees were 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 both season crops counted for 128. The 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) and three winter season crops (aghani) were harvested. Fertilizer in form of urea at the rate of 200 g/tree for whole crop cycle was applied. In one crop cycle 18–20 irrigations were provided to ber trees, splitting the dose of urea 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 irrigation was provided from February for summer season and November for winter season crop. The seepage rate through pitchers was observed to be 0.04 l/h.Water requirement was determined by quantifying the amount of water applied at each irrigation cycle. A measuring cylinder was used to measure the quantity of water required to replenish the existing level for pitchers at each irrigation cycle. The depleted amount of water was added to fill up the pitchers.

For summer season crop, *kusmi* broodlac was inoculated in the month of January and was harvested in July–August every year. For taking winter season crop, the broodlac was inoculated in July–August and harvested in February–March. Data on shoot length, shoot girth, shoots/pruned point and broodlac yield ratio were recorded. Broodlac was inoculated at the mean rate of 0.4 kg/tree for summer season broodlac production every year, while same was done at the mean rate of 1.17 kg/tree for winter season lac production. 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 broodlac inoculation and its harvesting in both the seasons and data on both the parameters were recorded. New shoots emerged after pruning, were counted in January and July for summer season and winter season crops, respectively in all 3 years.

Effect of season was very much prominent on growth of *ber* plants. Increase in shoot length and girth was 2.2 and 2.6 times in winter season than the summer season (Fig. 1). Regarding other factors, pitcher fertigation could increase shoot length significantly over control. Supplemental irrigation through pitchers might have played an instrumental role in mitigating stress of *ber* trees.

All factors i.e., seasons and treatment (control/pitcher) played an important role in influencing broodlac yield. Imposition of pitcher was found to increase broodlac yield ratio to the tune of 40 % as compared to control (Fig. 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 (November–February in winter season and April–June in summer season), even a small amount of water through pitcher irrigation helps reasonable growth in plant's attributes and thus lac crop is sustained on the host.

Effect of seasons was also very much prominent in lac yield. Lac yield was 1.75 times more in winter season, compared to summer season (Fig. 1). Rainfall received during the span of winter crop was far more than that received during summer crop (Fig. 2), which resulted in more residual soil moisture availability to lac host trees in winter season when compared to that of summer season, leading to enhanced broodlac yield in winter season. Pitcher fertigation showed superiority over control treatment may be evidenced by interaction between seasons and treatments also as broodlac yield ratio were found statistically significant in pitcher fertigation treatments (Fig. 3).

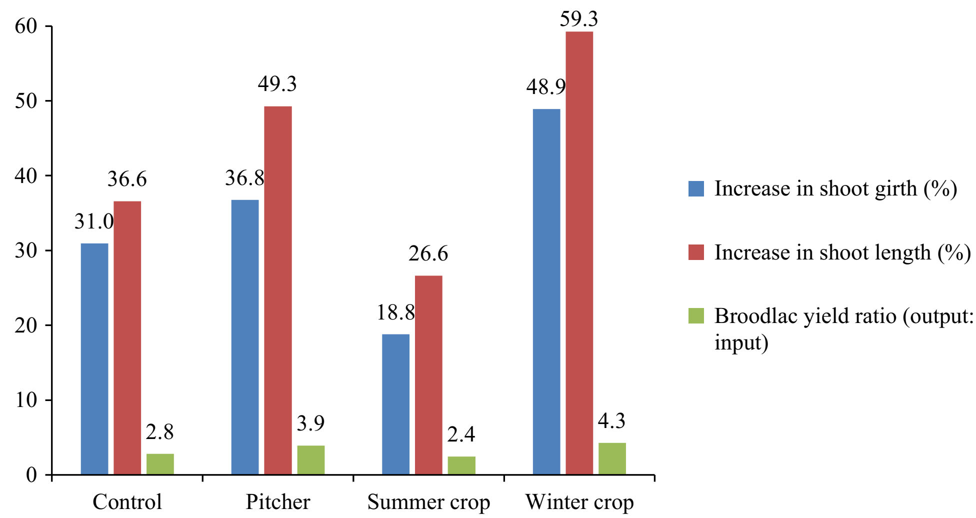

Fig. 1 Growth parameters and lac yield ratio as affected by different treatments and seasons

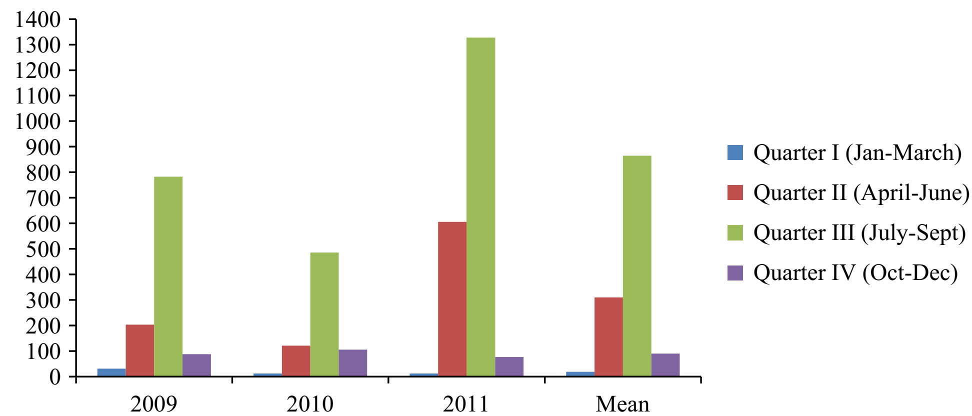

Fig. 2 Rainfall (mm) received during the experimental period

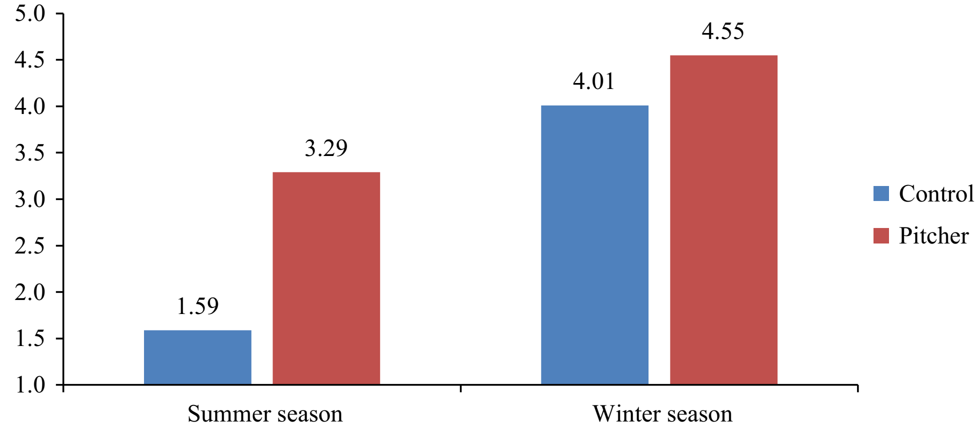

Fig. 3 Lac yield ratio as affected by interaction between seasons and treatments

Interaction effect between seasons and treatments revealed that maximum yield ratio was obtained in pitcher fertigation in winter season and least yield ratio recorded under control in summer season. Interaction of pitcher fertigation has brought 106.9 and 13.5 % increase in lac yield ratio in summer and winter season, respectively (Fig. 3). Relatively much higher increase in lac yield was obtained when pitcher fertigation was applied in summer as compared to winter. Therefore, broodlac output per unit water was much higher when pitcher fertigation was applied in summer months than that in winter months. First two quarters of a year represent the summer season and the next two quarters represent the winter season. Mean half yearly rainfall corresponding to the season varied largely, causing wide variation in lac yield ratio in two seasons under control condition.

Table 1 Economics of *kusmi* lac cultivation on *ber* (400 trees/ha) at 5 m × 5 m spacing under pitcher fertigation and control (without fertigation) in summer and winter season

	Summer season		Winter season	
	Amount (Rs.)		Amount (Rs.)	
	First year	Second year onwards	First year	Second year onwards
Pitcher treatment expenditure				
Expenditure related to lac cultivation	101,500	101,500	245,400	245,400
Expenditure related to other than lac cultivation	89,680	26,950	85,880	23,150
Total	~191,200	~128,500	~331,300	~268,600
Income				
Harvested broodlac	157,920	157,920	638,820	638,820
Sticklac from *phunki*	32,000	32,000	93,500	93,500
Total	~189,900	~189,900	~732,300	~732,300
Profit	(−) 1,300	61,400	401,000	463,700
Control condition expenditure				
Expenditure related to lac cultivation	54,000	54,000	150,400	150,400
Expenditure related to other than lac cultivation	47,500	47,500	95,000	95,000
Total	101,500	101,500	245,400	245,400
Income				
Harvested broodlac	76,320	76,320	563,004	563,004
Sticklac from *phunki*	32,000	32,000	93,500	93,500
Total	~108,300	~108,300	~656,500	~656,500
Profit	6,800	6,800	411,100	411,100

The economics of *kusmi* lac cultivation on *ber* (400 trees/ha) under pitcher fertigation and control (without fertigation) in summer and winter season has been presented in Table 1. Perusal of table shows that there is not much difference in the profit during the first year for both summer and winter season under pitcher and control conditions. In fact, it is lower under pitcher condition due to costs involved towards pitcher, its installation and filling with water at regular intervals. Profit increases significantly from second year onwards under pitcher condition, as proportion of 'expenditure related to other than lac cultivation' reduces substantially. A net increase in profit from second year onwards can be found to the tune of Rs. 62,000–63,000 for both summer and winter season crop under pitcher condition. Profit in control condition remains stagnant all the years at given price of broodlac (Table 1).

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