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Short communication

Effect of supplementary irrigation and mulching on vegetative growth, yield and quality of *ber*

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ABSTRACT

***Ber* is one of the most important fruit crops in arid areas. Though it is drought resistant, its fruit yield is not satisfactory under extreme rainfed conditions. The studies were therefore, conducted to determine the frequency of supplemental irrigation and efficacy of mulching with black polythene and date palm leaves in conserving the moisture and its impact on fruit yield and quality of *ber* cv. Gola. The treatments comprised of four irrigation intervals (no irrigation, 60, 90 and 120 CPE) and three mulching materials (no mulch, black polythene and date palm leaf) with a total of 12 combinations. It emerged that supplementary irrigation at 60 or 90 CPE from September to November with mulching (black polythene or date palm leaves) significantly enhanced fruit yield by 21.8-43.88% over control. It was concluded that supplementary irrigation at 90 CPE from September to November along with mulching with leaves if available, can be adopted to enhance yield and quality of *ber*.**

Key words: Supplementary irrigation, black polythene mulch, *ber*.

The Indian *ber* or jujube (*Ziziphus mauritiana* Lam.) is one of the most ancient cultivated fruit trees in north Indian plains. Gola is a commercial cultivar being grown in Rajasthan, Haryana and Punjab. Though the keeping quality of this variety is poor, but still it is preferred by the growers because of its early maturity and higher yield potential and fetching remunerative price in the market. In order to enhance yield and quality of *ber* during low rainfall/ drought years, mulching with black polythene sheet or organic materials conserve soil moisture and also suppress weed growth. In a multi-location trial under AICRP on Arid Zone Fruits, black polythene proved most effective (Pareek and Vishal Nath, 6). However, impacts of such a combination of black polythene mulch with supplemental irrigation on *ber* are not clearly understood. Hence, an experiment was conducted.

The experiment was conducted on six-year-old plants of *ber* 'Gola' planted at 6 m × 6 m in CAZRI, Jodhpur during 2010. The soil of experimental field was loamy sand with low organic carbon (0.18%). The available NPK were of the order 130-140, 13-15 and 230-280 kg per hectare, respectively. The orchard was rainfed from beginning except that establishment irrigation was given during first and second year of planting. The mulching was done in the first week of July, 2010, while supplementary irrigation was started in the first week of October after the withdrawal of monsoon rain. There were three levels of mulching, *i.e.*, M_0 (No mulch), M_2 (mulching with date palm leaves), and M_3 (Mulching with black polyethylene sheet, 100 gauge) and four irrigation regimes, *i.e.*, I_0 (rainfed), I_1 (irrigation at 60 CPE), I_2 (Irrigation at 90 CPE) and I_3 (irrigation at 120 CPE). The experiment was conducted in RBD with 12 treatment combinations (Table 2) replicated thrice. The irrigation was applied on the basis of daily pan evaporation reading as per schedule in tree basin size of 7 m^2 at about 6 cm depth (420 l water approx.).The experimental year had exceptionally high rainfall year (Table 1), therefore, very little supplementary irrigation could be provided. The other cultural operations were uniformly applied to all the plants. The observations were recorded on vegetative growth, number of weeds, fruit physico-chemical parameters and fruit yield. The data on fruit physical parameters such as weight, length, pulp: stone ratio and TSS were recorded on five fruits selected randomly from each plant during the peak maturity time, *i.e.* middle of January. The data were analysed statistically.

The data on effect of supplementary irrigation and mulching on plant height and canopy area revealed that plant height was not significantly influenced by irrigation and mulching treatment. This is obvious because cv. Gola is a spreading type and has more vegetative growth as reflected in canopy spread rather than plant height. The canopy area was significantly affected by the treatments. The highest canopy area (13.35 m^2) was recorded in T_6 (Irrigation at 60 CPE + polythene mulch), though it was at par with many other treatments (T_1, T_2, T_7, T_8 & T_9) but it was significantly

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Table 1. Mean weather during the experimentation period (2010).

Month	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	I	II	
Jan	26.3	10.9	70	24	1.5
Feb	29.5	13.8	49	17	0.5
Mar	37.2	20.5	41	13	0
Apr	41.3	26.4	35	12	0.2
may	43.4	29.5	40	13	0
June	40.9	29.8	57	29	45.4
July	37.2	27.8	77	49	133.9
Aug	36.6	26.4	83	63	120.7
Sep	33.8	23.7	81	53	202.9
Oct	36.5	22.9	60	25	0
Nov	29.1	17.5	73	45	39.8
Dec	25.1	9.9	73	28	17.3
Total/Mean	28.0	21.6	62	31	562.2

higher over control, T_2, T_3 and T_4. The increased canopy area may be explained as cumulative effect of irrigation, moisture conservation due to mulches and reduction in weed population.

The weed population in the tree basin was counted during August. Weeds were found least in polythene mulched plants (T_3, T_6, T_9 & T_{12}) followed by date palm leaves mulched plants (T_2, T_5, T_8 & T_{11}), while highest weed population was observed in non-mulched plants (T_1, T_4, T_7 and T_{10}). These results are obvious as plastic mulch almost completely inhibited weeds. The reduced weed population not only decreased the competition for nutrient and moisture but also provided favourable microclimate for root growth and growth of beneficial soil microflora.

The data on fruit physical characteristics such as fruit length, breadth, mean fruit weight and pulp: stone ratio (Table 2) revealed that size of the fruit (length and breadth) and pulp: stone ratio was not affected significantly by different treatments, whereas, mean fruit weight differed significantly among various treatments. The maximum mean fruit weight (20.64 g) was recorded in T_8 (irrigation at 90 CPE with date palm leaves mulch). This however, was statistically at par with several other treatments (T_4, T_5, T_6, T_7, T_9, T_{10}, T_{11} and T_{12}). The lowest fruit weight (15.98 g) was observed in case of control, which was significantly lower than the values in respect of most other treatments receiving either supplementary irrigation or mulched with black polyethylene sheet. The higher fruit weight recorded under most of the treatments

Table 2. Effect of mulching and supplementary irrigation on plant growth, fruit yield and physico-chemical characteristic of *ber* cv. Gola.

Treatment	Plant height (m)	Canopy area (m^2)	Weed population (No.)	Fruit wt. (g)	Fruit length (mm)	Fruit breadth (mm)	Pulp: stone ratio	TSS (°Brix)	Fruit yield (kg $plant^{-1}$)
T_1	1.38	7.56	164.33	15.98	31.67	31.46	8.5	15.7	23.56
T_2	1.7	9.30	23.66	16.39	31.67	30.36	8.6	18.16	23.76
T_3	1.36	9.86	1.33	17.43	34.03	32.76	9.6	19.40	26.76
T_4	1.48	9.75	154.66	19.84	33.83	32.73	10.53	18.26	23.20
T_5	1.15	10.35	52.00	18.10	31.30	31.03	8.70	15.20	32.32
T_6	1.23	13.35	2.66	20.03	33.16	32.33	10.00	18.43	33.9
T_7	1.43	11.34	141.66	20.45	32.86	31.60	9.56	19.43	28.70
T_8	1.2	11.23	22.66	20.64	33.87	32.20	9.46	19.90	33.70
T_9	1.43	11.97	2.00	19.92	32.26	32.00	9.13	18.00	30.33
T_{10}	1.08	10.24	89.33	19.28	32.53	33.67	8.96	19.86	26.83
T_{11}	1.43	10.92	47.33	18.88	32.00	31.53	8.97	18.00	27.33
T_{12}	1.23	12.78	3.00	19.01	31.63	30.96	9.13	17.43	29.83
CD (p = 0.05)	NS	2.57	42.88	01.92	NS	NS	NS	1.58	3.39

T_1 = control (no irrigation, no mulch), T_2 = Muchling (date palm leaves), T_3 = Black polythene mulch, T_4 = Irrigation at 60 CPE, T_5 = Irrigation at 60 CPE + datepalm leaves mulch, T_6 = Irrigation at 60 CPE + polythene mulch, T_7 = Irrigation at 90 CPE, T_8 = Irrigation at 90 CPE + date palm leaves mulch, T_9 = Irrigation at 90 CPE + polythene mulch, T_{10}= Irrigation at 120 CPE, T_{11} = Irrigation at 120 CPE + date palm leaves mulch, T_{12} = Irrigation at 120 CPE + polythene mulch.

may be attributed to better moisture availability in the root zone due to good amount of rainfall received during September and November, which however, minimized the influence of supplementary irrigation and mulching. Mukherjee *et al.* (5) also observed highest fruit weight in *ber* under black polythene mulch as compared to other mulches.

The maximum TSS was recorded in supplementary irrigation at 90 CPE with date palm leaf mulch (19.9%), followed by supplementary irrigation at 120 CPE (T10) and mulching with black polyethylene (T3), though, the difference were non-significant but it was significantly higher over control T_1, T_{11}, T_{12}, T_4, T_5 and T_6. Frequent irrigation with or without mulch caused reduction in TSS (T_4, T_5 & T_6). The reduction in TSS in such cases may be attributed to more water availability in the root zone thereby having the dilution effect. The higher TSS recorded under most of the treatments may be attributed to better availability of nutrients, optimum soil moisture and temperature that might have been maintained due to mulching treatments. Tang *et al*. (7) attributed higher temperature in rhizosphere under black polyethylene mulched plants to be the principal cause of higher fruit TSS content. Similarly, Agarwal *et al.* (1) in mango and Ali and Gaur (2) in strawberry reported the highest TSS content under black polythene mulch.

The maximum fruit yield was recorded under supplementary irrigation at 60 CPE along with black polythene mulch (33.9 kg ha^{-1}) followed by irrigation at 90 CPE with date palm leaf mulch (33.7 kg ha^{-1}). The difference in yield recorded with mulching either with black polythene or date palm leaves was insignificant when irrigated at 60 and 90 CPE. The fruit yield was significantly reduced without supplementary irrigation (T_1, T_2, & T3) and irrigation at long interval, *i.e.*, 120 CPE (T_{10}, T_{11} & T_{12}) irrespective of mulching treatments. This was because of less moisture availability for vegetative growth and subsequent flowering and fruit development. It is observed that in sub-tropical semi-arid regions of north India, irrigation during the fruit development period increases productivity by decreasing fruit drop. In Chinese jujube, fruit yield increased by 60% when irrigated at 60-65% minimum soil moisture content (Tagiev and Gadzhiev, 8). In this experiment, supplementary irrigation supported by mulching resulted in significant yield increase (T_5, T_6 & T_9). Byun *et al*. (3, 4, 5) found that black polythene mulch was better than rice straw mulch in Chinese jujube. The effect of mulching and supplementary irrigation was partially diluted by frequent rain during September and again in November and December (Table 1). The year 2010 was an exceptional year in terms of rainfall, *i.e*. 202 mm in September, whereas in arid zone, monsoon rain normally recedes in September. This partially explains good fruit yield recorded even in control, which otherwise used to be lower.

Based on the findings, it could be inferred that supplementary irrigation at 90 CPE from September to November along with mulching with black polythene or date palm leaves depending upon availability can be followed for enhanced yield and quality of *ber* in arid zone.

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