Response of irrigation and mulching on yield, water use efficiency, nutrient use efficiency and economy of mango Cv. Banganpalli in (semiarid region) southern Telangana region

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Abstract: An investigation was carried out on sandy loam soils of semi arid regions of southern Telangana to analyze the potential of drip irrigation along with mulch on fruit yield, water and nutrient use efficiency as well as economy. The treatments of present study were comprised of two levels mulching (M_0-without mulch and M_1 with mulching, respectively), with silver Polyethylene of 100 micron thickness were used and two levels of irrigation (I_1 -75% and I_2 100% ETc through drip). There were two levels of irrigation as main plot and two levels of mulching in the sub plot together constituting four treatment combinations with five replications under factorial randomized block design. Taking into account the scheduling of irrigation at different levels of ETc and mulching were used in the treatment combination: I_1M_0-75% ETc + No mulching, I_1M_1- 75% ETc + with mulch, I_2M_0- 100% ETc + No mulching and I_2M_1- 100 % ETc + with mulch. The study revealed that drip irrigation 100 % ETc along with silver polythene mulch showed better performance in terms of yield, water use efficiency, nutrient use efficiency as well as economics. Maximum yield of 89.11 kg tree^{-1} combination of 75 % ETc + with mulching has proven the maximum water use efficiency (5.54 g liter^{-1} water consumption) and fertilizers use efficiency (0.89 q kg^{-1} fertilizer application) however along with maximum net return of 400973. 90 ₹ ha^{-1}, net return of 346873.90 ₹ ha^{-1} per hectare and B: C ratio of 7.41 was recorded in I_2M_1 (100 % ETc + with mulch). So the experiment suggests that drip irrigation along with mulch has the potential to provide greater benefit by optimizing the use of water resources. But the interaction of 75 % ETc + with mulching has proven the maximum water use efficiency (6.28 g liter^{-1} water consumption).

Key words: Poly ethylene mulch; water and nutrient use efficiency and economy.

1. Introduction

Mango (*Mangifera indica* L.) is one the most luscious fruit since time immemorial in the tropical and subtropical region of the world and is native of South East Asia (Indo-Burma region). It is designated as the 'King of Fruits' (Purseglove 1972) because of its excellent flavour, attractive fragrance, beautiful shades of color and delicious taste with high nutritive value. Presently it is grown in India, China, Thailand, Mexico, Indonesia, Pakistan, Brazil, Egypt, Bangladesh and Nigeria (Pooja et al., 2019). India is the leader, sharing 41% of the world's mango production (Ganeshamurthy et al., 2018) with an area of 2.26 million ha with the production of 21.82 m Mt. and average productivity is 9.7 tones ha^{-1} (Anonymous 2018).

In Telangana mango occupies a prime position in cultivation among the fruit crops, *i.e.* 70 per cent of total fruit cultivated area and 56% of total production devoted to mango, but the average productivity of India and Telangana (9.7 and 9.3 t ha^{-1}, respectively) is very low compared to Uttar Pradesh (India) and Bangladesh (17.0 t ha-1 to 17.63 t ha^{-1}) and it indicating that, there is huge potential to increasing the productivity of mango (Anonymous 2018). However, the mango productivity has declined due to several biotic and a-biotic factors. Out of several biotic and a-biotic factors responsible, optimum water management is one of the most important factors that significantly influence productivity and quality, even though mango trees are tolerant to drought and occasional flooding. Water stress during the critical stages of fruit growth and development is the main reason for low productivity (Adak *et al*., 2012). In such situation, water management, especially during development stage plays an important role in improving yield and quality. But the amount and quality of available irrigation water of the arid and semi- arid regions are being main limiting factors for productivity of mango (Adak *et al*., 2012).

As the water and land are the important, indispensable resources for agricultural development and economic up-gradation of any country cannot be regarded as available in abundance and free forever. The demand for these two resources will continue to grow due to ever enhancing population. Increasing the water shortage has caused us to investigate the sustainable use of irrigation water. For this, specific effective water-saving irrigation techniques without detrimentally affecting crop production need to be developed urgently. In this context a shift in focus is indispensable for the development of additional water resources along with the efficient use of already developed water resources (Daniel and Eelco 2017). As the mango is irrigated by basin and drip irrigation systems without any concern on crop water requirement and schedule; that has leads to inefficient utilization of available water and it must be converted from the basin irrigation system to drip irrigation with a proper scheduled manner, their by we can save the water and also increase the acreage with available water (Panigrahi and Srivastava, 2011).

In addition to above the mulching is another important conservative cultural practice. As many studies have shown that mulches can improve soil qualities, weed control (Ross, 2010) and also helps in efficient water management under such situation, the drip irrigation along with mulching is the best practice which saves 25-30% irrigation water. Sing *et al*. (2006) suggested that, the irrigation requirement met through drip irrigation along with polyethylene mulch gave the 164 per cent greater yield compared to ring basin irrigation in guava. With an above brief background, we have carried an experiment to find out the effect of irrigation scheduling and mulching on yield, soil moisture content, water and nutrient use efficiency and economy of mango Cv. Banganpalli with the following objectives.

2. Materials and Methods

The study area

The field experiment was conducted during 2017-2019 was executed in the private mango orchard at Sathapur (Kollapur area) and the experimental farm is located at 16° 30' N latitude and 78° 19' E longitude at an elevation of 550 m above MSL, representing Southern Telangana zone, is mainly covered by red sandy soil, is locally known as ' Chelka soils' and THE soil properties are mentioned in table-1. Experiment comprised of 40 number of uniform size healthy trees of mango Cv. Banganpalli at the 12 years old mango orchard with spacing of 10 X 10 m. Two plants were selected for each treatment in each replication.

All plants were given similar cultural treatments except irrigation and mulching. The application of recommended dose of fertilizers (RDF *i.e.,* 1000:1000:1000 g of NPK and 50 kg of farm yard manure (FYM) plant^{-1} year $^{-1}$ for more than ten years old plants) are applied during third week of June i.e. half of doses of nitrogen, potassium, total FYM and phosphorus were applied. Another half dose of nitrogen and potassium was applied through soil, along with the micronutrients [ZnSO4 (50 g) + FeSO4 (25 g) + Borax (20g) + MgSO4 (30 g) tree^{-1}] are applied through foliar spray fruit at marble. Here, two levels M_0 and M_1 (i.e. without mulch and with mulching, respectively), mulch with silver Poly Ethylene of 100 micron thickness were used and two levels of irrigation (I_1 -75% and I_2 100% ETc through drip). There were two levels of irrigation as main plot and two levels of mulching in the sub plot together constituting four treatment combinations with five replications under factorial randomized block design. Taking into account the scheduling of irrigation at different levels of ETc and mulching were used in the treatment combination: I_1M_0- 75% ETc + No mulching, I_1M_1- 75% ETc + with mulch, I_2M_0- 100% ETc + No mulching and I_2M_1- 100 % ETc + with mulch.

Irrigation was scheduled by calculating ET using pan evaporation measurements adjusted by crop coefficient. The experimental plots were irrigated by using drip irrigation system and the crop water requirement was calculated daily with the help of meteorological data recorded by meteorological observatory of KVK, Palem, Nagarkurnool, PJTSAU-Telangana. The irrigation water requirement was estimated by Pan "A" evaporation method, where the daily water requirement was calculated using the formula (Shukla *et al.*, 2001):

$$V = Ep.\ Kp.\ Kc.\ Sp.\ Sr.\ Wp$$

Where,

V = Volume of water required (litre day^{-1} plant^{-1}),

Ep = Pan evaporation as measured by Class-A pan evaporimeter mm day^{-1}.

Kc = Crop co-efficient (co-efficient depends but for fully grown plants is 0.85 Singh *et al*., 2003)

Kp = Pan co-efficient (0.7)

Sp = Plant to plant spacing (m) Sr = Row to row spacing (m)

Wp = Fractional wetted area, which varies with different growth stage (0.3 for wider spaced crops).

Water use efficiency

Water use efficiency (WUE) was computed from the following relationship and has been expressed as g liter$_{-1}$ water.

$$\textbf{Water use efficiency (WUE)} = Y/LWA$$

Where;

Y- Yield (g L$_{-1}$)

LWA- liter of water applied

Nutrient use efficiency (NEU- q kg^{-1} fertilizer)

The word "efficiency" generally indicates "the level of output per unit of input." Referred to the plant system, "efficiency" defines the "growth, physiological activity, yield or harvested yield (output) per unit of land, water, nutrient, or energy (input)." While focusing the attention on the nutrients, the term NUE is defined as "the plant growth, physiological activity, yield or harvested yield per unit of nutrient." Even within this simple ratio, NUE has been defined in 18 different ways in diverse contexts which are primarily grouped in "Agronomic" (uptake efficiency) and "Physiological" (utilization efficiency) terms.

$$NEU\ (Q\ kg^{-1}\ fertilizer) = \text{Fruit yield in treated plant} / \text{Nutrient applied for treated plant}$$

Economics:

The cost of cultivation of mango was worked out for one hectare area and the details of economics are presented in table-4.

3. Results and Discussion

Fruit yield (kg tree^{-1})

Significant differences have been recorded with respect to fruit yield (kg tree^{-1}) of mango Cv. Banganpalli among the different treatments (Table 2) and the maximum fruit yield tree^{-1} (78.83 kg) was recorded in (100 % ETc). However, minimum fruit yield tree^{-1} (66.48 kg) was recorded in I_1 (75 % ETc). The average increase in the yield per tree is about 15.61 per cent I_2 over I_1. The results are in conformity with the findings of Srinivas (2008); Dixit *et al.* (2003) and Dinesh *et al.* (2008) in mango. Similarly, Shirgure *et al.* (2003, 2004) noted the maximum fruit yield with irrigation equivalent to 0.8 of open pan evaporation in citrus under Nagpur conditions. Drip irrigation provides a consistent moisture regime in the soil due to which root remains active throughout the season, resulting in optimum availability of water helps proper translocation of food materials which accelerates the fruit growth and development. Pavel and Villers (2004) observed increased fruit yield per tree in mango due to drip irrigation and Coelho and Borges (2004) also emphasized the importance of drip irrigation in mango for better yield.

The average data on the effect of mulching on fruit yield tree^{-1} of mango Cv. Banganpalli had shown the significant difference and the maximum fruit yield tree^{-1} (82.45 kg) was recorded in M_1 (with mulching), the minimum of fruit yield tree^{-1} (62.87 kg) was recorded in M_0 (without mulching) and the average increase in the fruit yield per tree is 23.75 per cent. Increase yield was directly related to the reduced weed density, weed control efficiency under mulched condition that resulted in increased availability of soil-water and nutrients to the plants that, subsequently enhanced fruit weight and fruit yield. The present observations were in line with the findings of Kumar (2008).

The interaction between irrigation and mulching had shown statistically significant difference among the treatments (depicted in the Fig 1) and the greater fruit yield tree^{-1} (89.11 kg) was recorded in I_2M_1 (100% ETc + with mulching) followed by I_1M_1 (75% ETc + with mulching) with 75.78 kg fruits tree^{-1}. However the minimum fruit yield tree^{-1} (57.18 kg) was recorded in I_1M_0 (75 % ETc + without mulching). The average fruit yield per tree increased by 35.83 percent over 75 % ETc+ without mulch to at 100 % ETc +with mulching. Similar kind of findings were reported by Kumar *et al*. (2008) under drip irrigated mango Cv. Arka Anmol has obtained the maximum yield of 65.72 kg tree^{-1} at 75 per cent PER. Similarly, Sharma *et al*. (2011) while working with drip irrigation in guava revealed that 164 per cent greater yield was found in case of drip irrigated guava as compared to ring basin irrigation. Pradhan *et al.* (2010) in mango got a maximum yield under 80 per cent irrigation through drip and plastic mulch. Joshi *et al.* (2011) also reported maximum yield under high density litchi at 100 per cent estimated irrigation water requirement along with black plastic mulch. Several other scientists working with drip irrigation and mulch on various fruit crops also stressed on the significant improvement in yield parameters *viz.*, Dixit *et al.* (2003), Sriniwas (2005) and Coelho and Borges (2004) in mango; Shirgure *et al.* (2000) in Nagpur mandarin, Sulochanamma *et al*. (2005) in pomegranate and Ramniwas *et al*. (2012) in guava etc. here, the possible reason for highest yield under 100% ETc and mulching, maintained optimum soil moisture throughout fruit growing period and mulching also has helped in soil moisture and nutrient conservation and favorable hygrothermal balance, which ultimately helps in better yield.

Water use efficiency (g liter^{-1} water)

Current findings evident that, the water use efficiency (WUE) was found to be influenced variably by different irrigation and mulching treatments (Table 3). The data on main effect of irrigation indicate the WUE to the tune of 5.51 g liter^{-1} water under I_1 (75 % ETc) and minimum WEU (4.90 g liter^{-1} water) was recorded in I_2 (100 % ETc). Similarly, maximum WUE (5.91 g liter^{-1} water) registered with M_1 and minimum (4.50 g liter^{-1} water) was noted in M_0 (without mulching). Similarly, the maximum WUE (6.28 g liter^{-1} water) was noted with conjugation of mulching and 75% ETc (I_1M_1). However, minimum WUE (4.26 g liter^{-1} water) was noted in without mulching and 100 % ETc (I_2M_0). The results suggested that, 75 % ETc was registered highest yield per unit water consumption. From present investigation the highest WUE might be due to the effect of improved soil, microclimate, weed free environment, low evaporation and higher moisture availability in the root zone that helped in better nutrient uptake by plant resulting in earlier and better vegetative growth, which then enhanced the photosynthesis rate and translocation of synthesized food from leaves to fruits, resulted in early harvesting and increased number of fruits per plant under black plastic mulch. Among the different treatments the conjugation of irrigation and mulching has proven higher WUE i.e. 25 percent water saving over 100 % ETc + un-muching condition, without adverse effect on yield and similar finding are suggested by Panigrahi *et al.* (2010) in mango with 60% water through drip with black polythene mulch and Srivastava *et al.* (1999) in banana. Here, the lower WUE in 100 % ETc without mulching due to huze water lost through evaporation which lead to least WUE that of 75 % ETc with mulching. Similarly, Tiwari *et al.* (2014) also noted higher WUE with 80% of irrigation met through drip irrigation along with plastic mulching in sapota. From the present study it was indicated that I_1 has recorded 12.45 percent more water use efficiency compared to I_2. The mulching has also registered 23.86 % higher WUE compared to unmulched condition. Similarly the intreraction of irrigation and mulching the treatment I_1M_1 has noted 32.17 % more WUE compared to I_2M_0 and 14.44 % better WUE with I_1M_1 compared to I_2M_1.

Fertilizer use efficiency (q kg-1 fertilizer)

The present study exhurted that, the fertilizer use efficiency (FUE) has significantly influenced by different irrigation and mulching treatments (Table 4). The data of main effect of irrigation was indicated the FUE to the tune of 0.79 q kg^{-1} fertilizer under I_2 (100 % ETc) and minimum FUE (0.66 q kg^{-1} fertilizer) was recorded in I_1 (75 % ETc). Similarly, maximum FUE (0.82 q kg^{-1} fertilizer) registered with M_1 and minimum (0.69 q kg^{-1} fertilizer) was noted in M_0 (without mulching). Similarly, the maximum FUE (0.89 q kg^{-1} fertilizer) was noted with conjugation of 100 % ETc and mulching (I_2M_1). However, minimum FUE (0.57 q kg^{-}

^{1}fertilizer) was noted in without mulching and 75 % ETc (I_1M_0). Present study suggests that, application 100 % ETc along with mulching proven to higher FUE compared to other treatments it may be due to the plastic mulch increase soil moisture by reducing loss of water through evaporation, increase nutrient use efficiency by reducing loss of nutrients through leaching, surface run off or volatilization, eliminates weed growth at the vicinity of tree, thereby providing congenial environment for enhanced tree growth, fruit yield and quality, besides ameliorating leaf nutrient contents and water use efficiency Neilsen *et al.* (2003) in apple and Barman *et al*. (2017) in guava Cv. Lalit. From our study I2 (100 % ETc) has registered 16.46 % better FUE as compared to I_1 (75 % ETc). Regarding to mulching, the mulched plants was found 23.17 % efficient in fertilizer usage. Similarly the interaction of mulching along with 100% ETc has exurted 35.96 % higher FUE over 75 % ETc + without mulching.

Economics

The economics of mango influenced by different levels of irrigation and fertilization had shown significant among the treatments and the data is presented in Table 4.1.32 and the detail of cost of cultivation is given in table-5 and 6**.**

The data on cost of cultivation per hectare revealed that, the irrigation treatment I_2 has recorded maximum gross returns and net returns (3.55 and 3.06 lakh ha^{-1}, respectively) and least values were registered with I_1 (3.00 and 2.50 lakh ha^{-1}), similarly maximum gross returns and net returns (3.71 and 3.16 lakh ha^{-1}, respectively) was registered with M_1 (with mulching) and minimum was noted with M_0 (2.82 and 2.38 lakh ha^{-1}, respectively). The maximum benefit cost ratio (BCR) was registered with I2 (7.20) and minimum BCR was noted with I_1 (6.07). Here, 100 % ETc gave 15.67 % higher BCR compared to 75 % ETc. Similarly, maximum benefit cost ratio (BCR-6.86) was registered with M_1 (with mulching) and minimum BCR (6.41) was noted with M_0 (without mulching) and the mulched plants has registered 6.56 % more BCR compared to unmulched plants. Similarly, maximum gross returns and net returns (4.00 and 3.46 lakh ha^{-1}, respectively) was registered with I_2M_1 (with mulching) and minimum was noted with I_1M_0 (2.57 and 2.13 lakh ha^{-1}, respectively) and the maximum BCR (7.41) was noted with conjugation of 100% ETc and mulching (I_2M_1). However, minimum BCR (5.83) was noted in without mulching and 75% ETc (I_1M_0). Present study suggests that, application 100 % ETc along with mulching proven to higher BCR compared to other treatments it may be due to the plastic mulch increase soil moisture by reducing loss of water through evaporation, increase nutrient use efficiency by reducing loss of nutrients through leaching, surface run off or volatilization, eliminates weed growth at the vicinity of tree, thereby providing congenial environment for enhanced tree growth, fruit yield resulted higher BCR in mango (Pradhan *et al.*, 2010). From this the interaction of 100 % ETc along with mulching has gave 21.32 % higher BCR compared to 75 % ETc + unmulched condition, 14.98 % more compared to 75 % ETc + mulched plants and 5.3 % higher BCR compared to 100 % ETc + unmulched condition.

4. Conclusion

From the investigations on the effect of irrigation and mulching was proved that the maximum fruit yield, water and nutrient use efficiency, and the higher BCR were also obtained with the application of 100 % ETc along with mulching. But the WUE was highest with 75 % ETc + with mulching, and it is also suggested the during water scare condition the combination of 75 % ETc + with mulching is an effective way to manage irrigation without any adverse on fruit yield, quality and economy of mango Cv. Banganpalli. In this instance efficient water use is possible with crop improvements by enabling crops to grow successfully under drought environments and use of advanced water-saving irrigation techniques and measures can significantly reduce water consumption, improve agronomic water use efficiency, save labor and costs, reduce the adverse effects of agricultural water resource availability from climate change and relieve the crisis of water resource and so on.

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Table: 1 Physical and chemical properties of experimental soil.

Particulars	Value for 0-60 cm depth
A. Physical properties	
Sand (%)	70
Silt (%)	19
Clay (%)	11
Textural class	Red sandy lome
B. Chemical properties	
pH	7.5
Electrical conductivity (dS m^{-1} at 25°C)	0.33
Organic carbon (%)	0.56
Available N (kg ha^{-1})	185
Available P_2O_5 (kg ha^{-1})	23
Available K_2O (kg ha^{-1})	240

Table 2: Effect of irrigation and mulching on fruit yield (kg $tree^{-1}$) of mango Cv. Banganpalli *.

Particulars	Fruit yield (kg $tree^{-1}$)

	M_0	M_1	Mean
I_1 (75% ETc)	57.18[d]	75.78b[c]	**66.48[b]**
I_2 (100% ETc)	68.56c	89.11[a]	**78.83[a]**
Mean	**62.87[B]**	**82.45[A]**	
Factors	**F- Test**	**SEm±**	**CD at 5%**
Irrigation (I)	*	2.346	7.308
Mulching (M)	*	2.346	7.308
Interaction (IXM)	*	3.317	10.61

(Average values of two years data)

Note: **M_0**- Without mulch; **M_1**-With mulch; **F-Test (*)**-significant; **CD** at 5 per cent level of significance; **NS**-Non-significant.

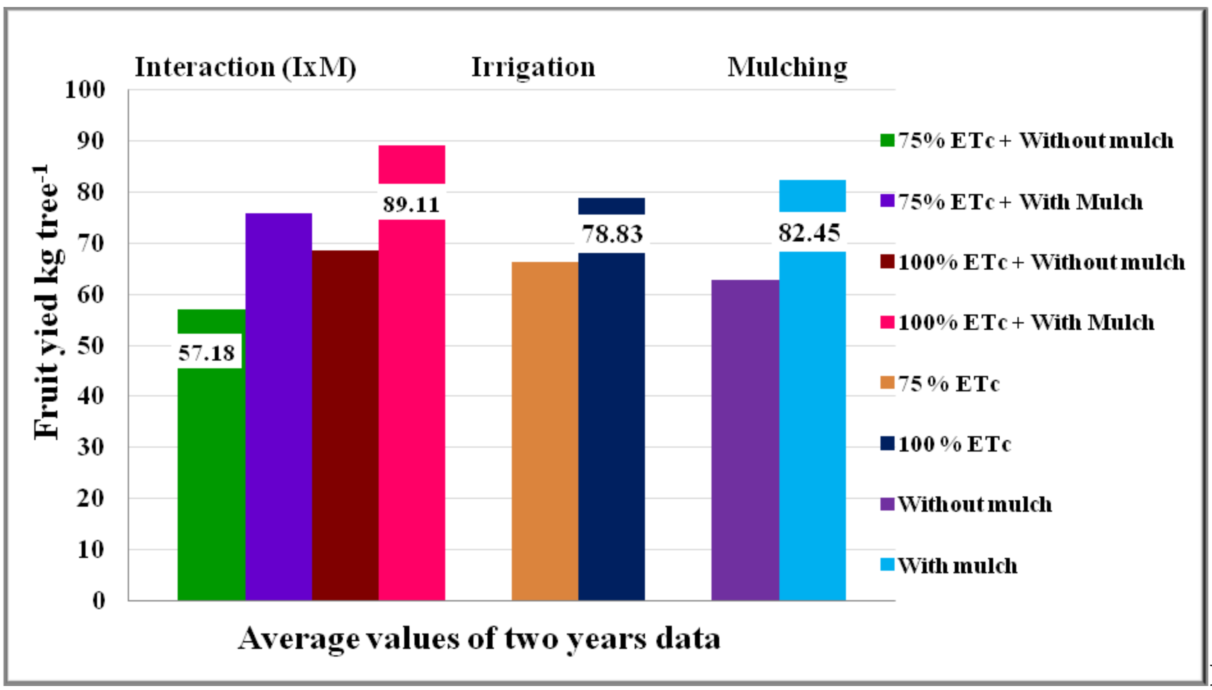

Fig 1: Effect of irrigation and mulching on fruit yield (kg tree^{-1}) of mango Cv. Banganpalli.

Table 3: Water use efficiency of mango (g liter^{-1} water)*.

Particulars	WUE (g liter^{-1} water)		
	M_0	M_1	Mean
I_1 (75% ETc)	4.74	6.28	**5.51[a]**

I_2 (100% ETc)	4.26	5.54	**4.90[b]**
Mean	**4.50[b]**	**5.91[a]**	
Factors	**F- value**	**SEm±**	**CD at 5%**
Irrigation (I)	*	0.17	0.53
Mulching (M)	*	0.17	0.53
Interaction (IXM)	NS	0.24	-

(*Average values of two years data)

F-value (*)-significant; **CD** at 5 per cent level of significance; **NS**-Non-significant; **M_0**-without mulch; **M_1**-With mulch

Table 4: Fertilizer use efficiency (q kg^{-1} fertilizer)

Particulars	**FUE (q kg^{-1} fertilizer)**		
	M_0	**M_1**	**Mean**
I_1 (75% ETc)	0.57	0.76	**0.66[b]**
I_2 (100% ETc)	0.69	0.89	**0.79[a]**
Mean	**0.63[b]**	**0.82[a]**	
Factors	**F- value**	**SEm±**	**CD at 5%**
Irrigation (I)	*	0.023	0.073
Mulching (M)	*	0.023	0.073
Interaction (IXM)	NS	0.033	-

(*Average values of two years data)

F-value (*)-significant; **CD** at 5 per cent level of significance; **NS**-Non-significant; **M_0**-without mulch; **M_1**-With mulch

Table-5: Cost of cultivation for mango Cv. Banganpalli with different levels of irrigation, fertigation and mulching.

(Note: Marketable price of mango Cv. Banganpalli 45 ₹ kg^{-1})

No.	Materials/works	I_1M_0	I_1M_1	I_2M_0	I_2M_1
I.	**Inputs**	**30,941.88**	**40,941.88**	**30,941.88**	**40,941.88**
1.	Recommended dose (RDF) is 1000:1000:1000 g of NPK and 50kg FYM $plant^{-1}$ $year^{-1}$ for >10 years old plants (1.33 kg of Urea; 2.2 kg of DAP and 2.0 kg of SOP per plant)	16480.88	16480.88	16480.88	16480.88
	∗ Urea ₹ 5.52 kg^{-1}	732.00	732.00	732.00	732.00
	∗ DAP ₹ 10.4 kg^{-1}	2261.00	2261.00	2261.00	2261.00
	∗ SOP ₹ 17.44 kg^{-1}	348.00	348.00	348.00	348.00
	∗ FYM ₹ 2.00kg^{-1}	10,000.00	10,000.00	10,000.00	10,000.00
	∗ Zinc ₹ 100 kg^{-1}	500.00	500.00	500.00	500.00
	∗ Iron ₹ 80 kg^{-1}	200.00	200.00	200.00	200.00
	∗ Boron ₹ 90 kg^{-1}	180.00	180.00	180.00	180.00
	∗ Magnesium ₹ 80 kg^{-1}	240.00	240.00	240.00	240.00
	∗ Mulch material 2000 ₹ $Roll^{-1}$ (400 x 0.9 m) to cover 20 m canopy area $plant^{-1}$ ha^{-1}	--	10000.00	--	10000.00
II.	**Cultural operations, plant protection and labour charges**	**48,800.0**	**48,800.0**	**48,800.0**	**48,800.0**
2.	Spraying of micronutrients 4 labour (300 ₹. per day)	1200.00	1200.00	1200.00	1200.00
3.	Bunds formation, Weeding, irrigation and fertilizer application 75 labours	21,000.00	21,000.00	21,000.00	21,000.00
4.	Plant protection chemicals and measures (700 litte $water^{-1}$ ha^{-1})	8,800.00	8,800.00	8,800.00	8,800.00
	∗ 16 labours for 4 sprays (300 ₹. per day)	4,800.00	4,800.00	4,800.00	4,800.00
	∗ Neem oil @ 2.5 ml l^{-1} (1.75 l Neem oil and 400 ₹ l^{-1})	700.00	700.00	700.00	700.00
	∗ Thiomethoxam @ 0.5 ml l^{-1} (0.35 l ha^{-1} and 1,600 ₹ l^{-1})	560.00	560.00	560.00	560.00
	∗ Imidachloprid @ 0.5 ml l^{-1} (0.35 l ha^{-1} and 2,000 ₹ l^{-1})	700.00	700.00	700.00	700.00
	∗ Profenophos +cypermetrin 0.5 ml l^{-1}(0.35 l ha^{-1} and 1,200 ₹ l^{-1})	420.00	420.00	420.00	420.00
	∗ SAAF (Carbendazim 12 % + Mancozeb 63 % wp) @ 2.0 g l^{-1} (2.00 kg l ha^{-1} (600 ₹ kg^{-1})	1200.00	1200.00	1200.00	1200.00
	a. Hexaconazole @ 0.5 ml l^{-1} (0.35 l ha^{-1} and 1,200 ₹ l^{-1})	420.00	420.00	420.00	420.00
5.	15- Labours for each harvesting in control (4,500 .00 ₹ $harvest^{-1}$)	9,000.00	9,000.00	9,000.00	9,000.00
III.	**Total cost of cultivation**	**79, 7741.88**	**89, 7741.88**	**79, 7741.88**	**89, 7741.88**

Table 6: Economy of mango influenced by irrigation and mulching treatments*.

Particulars	Gross income (₹ ha^{-1})			Net income (₹ ha^{-1})			BCR		
	M_0	**M_1**	**Mean**	**M_0**	**M_1**	**Mean**	**M_0**	**M_1**	**Mean**
I_1 (75% ETc)	257,298.40	341,028.90	**299,163.70**	213,198.40	286,928.90	**250,063.70**	5.83	6.30	**6.07^B**
I_2 (100% ETc)	308,499.20	400,973.90	**354,736.50**	264,399.20	346,873.90	**305,636.50**	7.00	7.41	**7.20^A**
Mean	**282,898.80**	**371,001.40**		**238,798.80**	**316,901.40**		**6.41**	**6.86**	
Factors	**F- value**	**SEm±**	**CD at 5%**	**F- value**	**SEm±**	**CD at 5%**	**F- value**	**SEm±**	**CD at 5%**
Irrigation (I)	*	10,554.73	32,882.56	*	10,554.74	32,882.60	*	0.21	0.64
Mulching (M)	*	10,554.73	32,882.56	*	10,554.74	32,882.60	NS	0.21	-
Interaction (IXM)	NS	14,926.64	-	NS	14,926.66	-	NS	0.29	-

(*Average values of two years data)

F-value (*)-significant; **CD:** at 5 per cent level of significance; **NS**-Non-significant; **M_0**- without mulch; **M_1**-With mulch