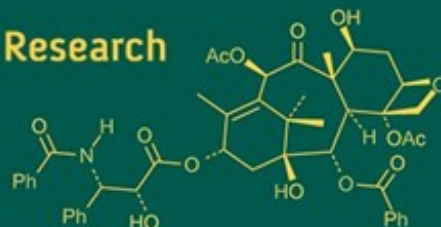


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Influence of fertigation, drip irrigation and mulching on yield and economics of watermelon (*Citrullus Lanatus*)

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ABSTRACT

A field experiment was conducted during the summer seasons of 2020–21 and 2021–22 at the Water Technology Centre fields, College Farm, College of Agriculture, Rajendranagar, Hyderabad, Telangana to evaluate the influence of fertigation levels, drip irrigation regimes and mulching on yield and economic returns of watermelon (*Citrullus lanatus*). The experiment was laid out in a factorial randomized block design with three replications. Treatments consisted of three fertigation levels viz., 75, 100 and 125% of the recommended dose of fertilizers (RDF), two drip irrigation regimes of 0.8 and 1.0 Epan and mulching and non-mulching conditions, resulting in 12 treatment combinations. The recommended fertilizer dose for watermelon was 100:100:60 kg N, P₂O₅ and K₂O ha⁻¹. Fertigation was imposed through a venturi system at four-day intervals. While, irrigation was scheduled based on evaporation recorded from a USWB Class-A pan evaporimeter. The results indicated that fertigation and mulching significantly influenced total fresh fruit yield. Whereas, the effect of irrigation levels was non-significant. In pooled data, application of 125% RDF through fertigation recorded the highest fruit yield (48.77 t ha⁻¹) compared with 100 and 75% RDF, respectively. Mulching markedly enhanced productivity (59.04 t ha⁻¹) over non-mulching (30.20 t ha⁻¹). Overall, the highest yield was 69.09 t ha⁻¹ under F₁₂₅ + I_{0.8} + mulch. Economic analysis revealed that F₁₂₅ resulted in the highest pooled gross returns (₹8,38,758 ha⁻¹), net returns (₹6,97,843 ha⁻¹) and B:C ratio (4.83) among fertigation levels. Mulching recorded substantially higher pooled gross returns (₹10,23,186 ha⁻¹), net returns (₹8,76,974 ha⁻¹) and B:C ratio (5.99) than non-mulching. The study revealed that integration of higher fertigation levels with drip irrigation and mulch substantially improved watermelon yield and economic returns under the semi-arid conditions of Telangana.

Keywords: Watermelon, Fertigation, Drip irrigation, Plastic mulch, Fruit yield, Gross returns, Net returns, Benefit-cost ratio

1. Introduction

Watermelon (*Citrullus lanatus*) is an economically important cucurbit crop grown widely in warm and semi-arid regions. The crop is highly valued for its juicy and refreshing fruit, high moisture content, nutritional properties and good market demand. Being a relatively short-duration crop with rapid vegetative development and substantial fruit biomass production, watermelon requires adequate availability of water and plant nutrients throughout its growth cycle. Among the different factors influencing productivity, efficient water and nutrient management assumes particular importance during flowering, fruit setting and fruit enlargement. Any restriction in water or nutrient supply during these critical stages may adversely affect fruit development, marketable yield and economic returns. Water management is particularly challenging during summer cultivation because of high atmospheric temperature, increased evaporative demand and rapid depletion of soil moisture. Drip irrigation offers an efficient approach for managing these conditions by delivering water at a controlled rate directly to the crop root zone. Frequent and localized irrigation helps maintain favourable soil-water conditions. While, reducing unnecessary water losses through surface runoff, evaporation and deep percolation. Maintaining relatively uniform moisture in the root zone can promote continuous plant growth and improve water availability during the critical stages of fruit development. Nisha *et al.* (2020) [1] reported that appropriate drip irrigation levels significantly influenced watermelon yield and quality, indicating the importance of maintaining an adequate soil moisture regime for optimum crop performance.

The advantages of drip irrigation can be further enhanced through fertigation, in which soluble fertilizers are supplied along with irrigation water. Fertigation enables nutrients to be distributed directly within the wetted root zone and allows their application in smaller quantities at appropriate intervals. Such synchronization between nutrient supply and crop demand can improve nutrient uptake and fertilizer-use efficiency and may re-

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duce nutrient losses associated with conventional soil application. This aspect is particularly relevant to watermelon because nutrient requirements increase considerably during vigorous vine growth and fruit development. Prabhakar *et al.* (2013) [2] reported that fertigation improved growth, fruit yield and economic performance of watermelon compared with conventional fertilizer application and indicated that appropriate fertigation practices could enhance productivity while improving the financial returns obtained from the crop. The quantity of fertilizer supplied through fertigation is also an important consideration. Application below the crop requirement may limit growth and fruit development, whereas excessive fertilizer application can increase production costs and may not provide a corresponding increase in yield. Therefore, identifying an appropriate fertigation level is essential for achieving a balance between crop productivity, fertilizer-use efficiency and profitability (Yogaraju *et al.*, 2019) [3]. Nisha *et al.* (2020) [1] observed considerable differences in watermelon yield and quality with changes in fertilizer and irrigation levels, demonstrating that appropriate synchronization of water and nutrient supply is important for achieving optimum production.

In addition to water and nutrient management, mulching plays an important role in modifying the soil environment around watermelon plants. Plastic mulch covers the soil surface and reduces direct exposure of the soil to atmospheric conditions, thereby limiting evaporation and conserving moisture in the crop root zone. It can also suppress weed growth, reduce fluctuations in soil temperature and improve the physical environment surrounding the roots. These effects can be particularly advantageous under summer conditions, when high temperatures and evaporative losses can rapidly reduce available soil moisture. When used together with drip irrigation, plastic mulch can improve the effectiveness of irrigation by conserving a greater proportion of the water delivered to the root zone. Mulching may also influence crop growth and fruit productivity through its effects on soil temperature, moisture conservation and weed suppression. Parmar *et al.* (2013) [4] reported improved growth, yield and quality of watermelon under silver-black polyethylene mulch compared with non-mulched cultivation. Similarly, Dadheech *et al.* (2018) [5] observed favourable effects of plastic mulching on watermelon growth, yield and fruit quality. The improved productivity associated with mulching can be attributed to a more favourable soil microenvironment, better moisture conservation and reduced competition from weeds. Thus, mulch management represents an important component of resource-efficient watermelon production, particularly in regions characterized by high temperature and limited water availability. The combined use of drip irrigation, fertigation and mulching may provide greater benefits than the adoption of any single practice. Drip irrigation ensures efficient water delivery, fertigation provides nutrients in accordance with crop requirements, while mulch helps conserve the applied moisture and maintain a favourable root-zone environment. The interaction of these practices can potentially improve water and nutrient availability, enhance vegetative development, promote fruit formation and increase fruit size and total yield. However, the magnitude of these responses depends on the level of irrigation, amount of fertilizer supplied and type of mulch, as well as on prevailing soil and climatic conditions.

Improvement in yield is an important objective of crop management, but economic profitability is equally important for determining the practical suitability of a technology. Fertigation, drip irrigation and plastic mulching involve additional investment in irrigation infrastructure, fertilizers, mulch material and labour. Consequently, a treatment that produces the highest yield may not necessarily provide the highest economic return. Assessment of cost of cultivation, gross returns, net returns and benefit:cost ratio is therefore necessary to determine whether increased productivity is sufficient to compensate for the additional expenditure. Prabhakar *et al.* (2013) [2] demonstrated

that appropriate fertigation could substantially improve the economic performance of watermelon. Parmar *et al.* (2013) [4] also reported improved net returns and benefit:cost ratio under suitable mulch treatments. Recent investigations have further demonstrated that the response of watermelon to water, nutrient and mulch management is dependent on the production environment. Wang *et al.* (2022) reported that appropriate integration of irrigation and NPK fertigation improved watermelon yield and resource-use efficiency under drip-irrigated conditions.

Therefore, the present investigation was undertaken to evaluate the individual and interactive effects of fertigation levels, drip irrigation regimes and plastic mulching on yield and economic performance of watermelon under the semi-arid conditions of Telangana. The study was aimed at identifying an efficient combination of water, nutrient and mulch management practices capable of enhancing fruit yield, improving resource-use efficiency and maximizing economic returns from watermelon production.

2. Materials and Methods

The field experiment was conducted during the summer seasons of 2020–21 and 2021–22 at the Water Technology Centre fields, College Farm, College of Agriculture, Rajendranagar, Hyderabad, Telangana. The experimental site falls under the Southern Agro-climatic Zone of Telangana and represents semi-arid tropical conditions. The soil of the watermelon experimental field was sandy loam in texture, with a pH of 7.88 and electrical conductivity of 0.510 dS m⁻¹. The soil contained 0.69% organic carbon, 254.1 kg available N ha⁻¹, 41.5 kg available P₂O₅ ha⁻¹ and 268 kg available K₂O ha⁻¹. The experiment was conducted in factorial randomized block design with three replications. The treatments consisted of three factors *viz.*, three fertigation levels (75, 100 & 125 % RDF), Two drip irrigation levels (0.8 Epan and 1.0 Epan) and two mulching conditions (mulch and no mulch). In total of 12 treatment combinations were evaluated. The 100% RDF for watermelon was 100:100:60 kg N:P₂O₅:K₂O ha⁻¹. Fertilizers were supplied through fertigation using urea, urea phosphate and muriate of potash. Fertigation was imposed through a venturi system at four-day intervals. Irrigation was scheduled once in two days based on evaporation data obtained from a USWB Class-A pan evaporimeter. A UV-stabilized 30-μm dual-coloured black and silver mulch sheet was used under the mulched treatment. Completely matured fruits were harvested treatment wise. From each plot four times fruits were harvested from tagged plants. Further yield attributes were recorded at each picking and calculated average data of them and presented in the results. Total fresh fruit yield was recorded as the sum of four pickings and expressed as tonnes per hectare. Economic parameters included cost of cultivation, gross returns, net returns and benefit:cost ratio. Gross returns were calculated based on the prevailing market value of harvested watermelon. While, net returns were determined from the difference between gross returns and cost of cultivation. The B:C ratio was calculated as the ratio of gross returns to the total cost of cultivation using the following formula:

3. Results and Discussion

3.1 Watermelon yield attributes and yield

For any crop, production of more fruits and yield attributing parameters directly or indirectly impacts the total yield. Yield is a complex phenomenon and partitioning of dry matter between vegetative and reproductive parts is an important process that causes variations in yield. Yield potential of watermelon is dependent on the cultivar chosen and management practices adopted. Thus, it is important to measure variation among imposed fertigation levels, mulch and drip irrigation levels on each picking of watermelon. Data related to yield attributes and yield presented in table 3.1 to 3.6 and figure 3.1 & 3.2.

B: C ratio	:	Gross returns (₹ ha ⁻¹) Cost of cultivation (₹ ha ⁻¹)
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3.1.1 Effect of fertigation on watermelon yield attributes and yield

Fertigation level exerted a significant influence on number of fruits plant⁻¹, fruit length, fruit girth and average fruit weight of watermelon. Among the fertigation levels, F₁₂₅ has recorded the highest mean number of fruits plant⁻¹ (3.54, 3.63 & 3.58), mean fruit length (34.14, 38.80 & 36.47 cm), mean fruit girth (29.25, 30.40 & 29.83 cm), average fruit weight (2.67, 2.82 & 2.75 kg plant⁻¹) and yield (42.87, 54.67 & 48.77 t ha⁻¹) during 2020-21, 2021-22 and in the pooled data.

The 125% RDF treatment increased pooled fruit yield by 7.81% over F₁₀₀. While, F₁₀₀ increased yield by 13.55% over F₇₅. Similarly higher yield attributes increased with increase in NPK levels from 75% RDF to 125% RDF due to application of higher nutrients by fertigation at frequent intervals during various growth stages leads to its accessibility to the roots of plants in the vicinity of the root zone subsequent more efficient utilization of applied nutrients (Shubham, 2020) [6]. Higher quantity of N encourages faster vegetative growth of the watermelon, P hasten the root development and K application increases the production of female flowers and successively enhances the improvement in fruit count. Madhukarrao (2019) [7] explained that application of higher N levels produced maximum number of vines which could bear a greater number of fruits plant⁻¹ in cucumber. Raosaheb (2016) [8] opined that greater fruit length of muskmelon influenced by higher dose of K into fruits which might enhance water entry into cells by osmotic processes and produced an increase in cell expansion and fruit length. Quamruzzaman *et al.* (2021) [9] and Sajitha (2013) [10] observed higher fruit girth with 125% RDF which might be due to the increased rate of photosynthesis that could have further led to the better partitioning of assimilates.

3.1.2 Effect of mulch on watermelon yield attributes and yield

Mulching had a significant influence on the yield attributes and yield of watermelon. With mulching during I year, average number of fruits (4.28, 3.63 and 3.58 plant⁻¹), mean fruit length (38.00, 42.46 & 40.23 cm), mean fruit girth (32.88, 33.33 & 33.11 cm), average fruit weight (2.11, 3.09 & 2.95 kg plant⁻¹) during first year, second year and in the pooled data. Similarly, during 2020-21, it has recorded that with mulching 51.72 t ha⁻¹ fresh fruit yield which was 1.97 times higher over non-mulching (M₀) (26.30 t ha⁻¹). Likewise, during 2021-22 year also the crop has recorded total fresh fruit yield (66.35 t ha⁻¹) which was 65.39% higher over non-mulching (34.10 t ha⁻¹). In pooled data, the mulching treatment has recorded 59.04 t ha⁻¹ total fresh fruit yield which was 1.95 times higher as compared to non-mulch (30.20 t ha⁻¹).

Mulch improved the micro climate around the plant roots by maintaining optimum moisture, temperature and weed suppression condition which resulted in higher cell division and cell elongation there by increased leaf area index, synthesises more fruit yield (Pawar *et al.*, 2019) [11]. Since, watermelon is summer crop, hot soil temperatures were reduced due to application of silver black mulch which reflects the photosynthetically active radiation and conserve the more moisture for better number of fruits plant⁻¹, fruit length, fruit girth and mean fruit weight plant⁻¹ subsequently yield of watermelon (Parmar *et al.*, 2013) [4]. Extended retention of soil moisture leading to the higher uptake of nutrients resulted in a greater number of fruits, fruit length, fruit girth and weight of the fruit (Dadheech *et al.*, 2018) [5]. Soil under mulch is loose, friable well aerated and roots have access to O₂ which might have induced favourable conditions supportive to attainment of fruits with higher weight.

3.1.3 Effect of drip irrigation levels on watermelon yield attributes and yield

There was no significant variation found between I_{0.8} & I_{1.0} irrigation levels during both the years. The average number of fruits plant⁻¹ ranged from 3.24 to 3.38, mean fruit length ranged from 34.50 to 35.10 cm, mean fruit girth ranged from 28.33 to 28.63 cm and average single fruit weight plant⁻¹ ranged from 2.52 to 2.54 kg plant⁻¹ in the pooled data.

3.1.4 Interaction effect of fertigation and irrigation and optimum treatment combination

Output analysis variance revealed that interaction between fertigation and drip irrigation resulted in higher total fruit yield during 2020-21 and presented in table 3.2, 3.4 & 3.5. The treatment F₁₂₅ + I_{0.8} has recorded the highest average number of fruits (3.70 plant⁻¹), average fruit weight (2.77 kg plant⁻¹) and total fresh fruit yield of watermelon (44.25 t ha⁻¹) and it was on par with F₁₂₅ + I_{1.0}, F₁₀₀ + I_{0.8}, F₁₀₀ + I_{1.0}, F₇₅ + I_{1.0} (and F₇₅ + I_{0.8}). During 2021-22, fertigation levels coupled with mulch treatments were found to be significant. The highest average number of fruits (4.54 plant⁻¹), average fruit weight (3.16 kg plant⁻¹) and total fresh fruit yield was recorded by F₁₂₅ + M₁ (72.49 t ha⁻¹) which was comparable with F₁₀₀ + M₁ and F₇₅ + M₁. While, significantly lower average number of fruits (2.20 plant⁻¹), average fruit weight (2.37 kg plant⁻¹) and fresh fruit yield was recorded in F₇₅ + M₀ (31.84 t ha⁻¹). In pooled data, none of the interactions showed any significant influence on total fresh fruit yield of watermelon. Relatively the highest fresh fruit yield was recorded in F₁₂₅ + I_{0.8} + M₁ (69.09 t ha⁻¹) closely followed by F₁₀₀ + I_{0.8} + M₁ (61.88 t ha⁻¹). From pooled data under no mulch conditions, at F₁₂₅ & F₁₀₀ levels, I_{1.0} has recorded 18.51% & 7.32% higher yield than I_{0.8}, respectively. Whereas F₇₅ + I_{1.0} has recorded 4.14 t ha⁻¹ higher yield over I_{0.8}. Thus it was reported that that under no mulch condition irrespective of fertigation levels, irrigation level @ I_{1.0} required for watermelon if mulching is done for lower fertigation levels (F₇₅) we need to go for I_{1.0} but at higher fertigation levels (F₁₂₅ & F₁₀₀), I_{0.8} was enough to meet the crop need. It might be due to the beneficial effect of mulch becomes more pronounced when combined with drip irrigation and fertigation.

Drip irrigation supplies water directly to the effective root zone, while fertigation provides nutrients in small and frequent quantities, thereby improving synchronization between nutrient availability and crop demand. Wang *et al.* (2023) [12] demonstrated that deficit mulched drip irrigation could improve watermelon yield, fruit quality and water-use efficiency under water-limited conditions, indicating that appropriate deficit irrigation combined with mulching can conserve water without proportionally reducing productivity. Liu *et al.* (2023) stated that appropriate fertigation regimes under drip irrigation can improve watermelon yield, nutrient-use efficiency and irrigation-water productivity compared with less efficient irrigation and fertilizer-management practices. Such responses indicate that fertigation is particularly effective when nutrient application is closely synchronized with crop water requirements.

3.2 Economics of watermelon production

Economic analysis demonstrated that the increase in production obtained through fertigation and mulching was reflected in higher monetary returns. Data pertaining to cost of cultivation, gross returns, net returns and B: C ratio was presented in table 3.7.

3.2.1 Effect of fertigation levels on economics

In pooled analysis, the cost of cultivation increased from ₹1,27,068 ha⁻¹ under F₇₅ to ₹1,34,326 ha⁻¹ under F₁₀₀ and ₹1,40,915 ha⁻¹ under F₁₂₅. The higher cost under F₁₂₅ was primarily associated with the additional quantity of fertilizers. Despite the higher cultivation cost, F₁₂₅ generated the highest pooled gross returns of ₹8,38,758 ha⁻¹ and net returns of ₹6,97,843 ha⁻¹. The corresponding values under F₁₀₀ were ₹7,72,430 and ₹6,38,104 ha⁻¹, respectively, while F₇₅ recorded ₹6,94,186 and ₹5,67,118 ha⁻¹. The pooled B:C ratio was highest under F₁₂₅ (4.83), followed by F₁₀₀ (4.62) and F₇₅ (4.35).

Therefore, the additional investment associated with the higher fertigation level was compensated by the increased fruit production and market returns (Rao *et al.*, 2017 and Sajitha, 2013) [13].

3.2.2 Effect of mulching on economics

Mulching considerably increased the cost of cultivation because of the additional expenditure on mulch material and its installation. The pooled cost of cultivation was ₹1,46,213 ha⁻¹ under mulch compared with ₹1,21,993 ha⁻¹ under non-mulching. However, the additional investment in mulch generated substantial economic benefits. Pooled gross returns increased from ₹5,13,730 ha⁻¹ under non-mulching to ₹10,23,186 ha⁻¹ under mulching. Similarly, pooled net returns increased from ₹3,91,737 to ₹8,76,974 ha⁻¹. The pooled B:C ratio was 5.99 under mulching compared with 3.21 under non-mulching. Thus, despite its higher cultivation cost, mulching was economically superior because of its large positive effect on fruit yield and gross income (Sajitha, 2013) [10].

3.2.3 Effect of irrigation levels on economics

The effect of irrigation level on economic returns was statistically non-significant. In pooled analysis, I_{0.8} recorded gross returns of ₹7,62,146 ha⁻¹ and net returns of ₹6,28,626 ha⁻¹, whereas I_{1.0} recorded ₹7,74,771 and ₹6,40,084 ha⁻¹, respectively. The B:C ratios were 4.56 and 4.65 under I_{0.8} and I_{1.0}, respectively. Thus, the relatively similar economic performance of the two irrigation regimes suggests that increasing irrigation from 0.8 to 1.0 Epan did not pro-

vide a proportional economic advantage under the experimental conditions.

3.4. Conclusion

The two-year field investigation demonstrated that fertigation and mulching were important determinants of watermelon productivity and profitability under the semi-arid conditions of Telangana. Increasing fertigation from 75 to 125% RDF progressively increased fruit yield, gross returns, net returns and B:C ratio. Among fertigation levels, 125% RDF recorded the highest pooled fruit yield (48.77 t ha⁻¹), net returns (₹6,97,843 ha⁻¹) and B:C ratio (4.83). Mulching produced a much stronger response, increasing pooled fruit yield from 30.20 t ha⁻¹ under non-mulching to 59.04 t ha⁻¹ under mulching. It also resulted in the highest pooled gross returns (₹10,23,186 ha⁻¹), net returns (₹8,76,974 ha⁻¹) and B:C ratio (5.99). Drip irrigation at 0.8 Epan produced a yield comparable with 1.0 Epan, indicating the possibility of maintaining productivity with reduced irrigation input when effective moisture-conservation practices are adopted. Overall, the integration of 125% RDF through drip fertigation with plastic mulch and 0.8 Epan irrigation emerged as a promising production strategy, with the highest numerical fruit yield of 69.09 t ha⁻¹ under the pooled treatment combination. The results support the adoption of integrated fertigation, drip irrigation and mulching for enhancing watermelon productivity, profitability and resource-use efficiency in the semi-arid conditions of Telangana.

Table 3.1. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on mean number of fruits plant⁻¹ of watermelon during summer season (2020-21, 2021-22 and pooled data).

2020-21 (I Year)-Mean number of fruits plant ⁻¹								
Treatments			No Mulch	Mean	Mulch		Mean	Overall Mean
	I _{0.8}	I _{1.0}			I _{0.8}	I _{1.0}		
F ₇₅	1.48		2.22	1.85	3.90	4.10	4.00	2.93
F ₁₀₀	1.73		2.78	2.26	4.13	4.53	4.33	3.30
F ₁₂₅	2.30		2.85	2.58	5.10	3.90	4.50	3.54
Mean	1.84		2.62	2.23	4.38	4.18	4.28	
Mean of I _{0.8}				3.11	Mean of I _{1.0}		3.40	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)		Interactions			SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	0.22	0.64		<i>I</i> X <i>M</i>			0.31	NS
Irrigation (<i>I</i>)	0.22	NS		<i>F</i> x <i>M</i>			0.38	NS
Fertigation (<i>F</i>)	0.08	0.23		<i>F</i> x <i>I</i>			0.38	1.11
				<i>F</i> x <i>M</i> X <i>I</i>			0.54	NS
2021-22 (I Year)-Mean number of fruits plant ⁻¹								
Treatments			No Mulch	Mean	Mulch		Mean	Overall Mean
	I _{0.8}		I _{1.0}		I _{0.8}	I _{1.0}		
F ₇₅	2.00		2.39	2.20	3.78	3.47	3.63	2.91
F ₁₀₀	2.36		2.72	2.54	4.80	4.44	4.62	3.58
F ₁₂₅	2.36		3.00	2.68	4.95	4.19	4.57	3.63
Mean	2.24		2.70	2.47	4.51	4.04	4.27	
Mean of I _{0.8}				3.38	Mean of I _{1.0}		3.37	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)		Interactions			SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	0.14	0.42		<i>I</i> X <i>M</i>			0.20	NS
Irrigation (<i>I</i>)	0.14	NS		<i>F</i> x <i>M</i>			0.25	0.72
Fertigation (<i>F</i>)	0.05	0.27		<i>F</i> x <i>I</i>			0.25	NS
				<i>F</i> x <i>M</i> X <i>I</i>			0.35	NS
Mean of two years (Pooled data)- Mean number of fruits plant ⁻¹								
Treatments			No Mulch	Mean	Mulch		Mean	Overall Mean
	I _{0.8}		I _{1.0}		I _{0.8}	I _{1.0}		
F ₇₅	1.74		2.30	2.02	3.84	3.79	3.81	2.92
F ₁₀₀	2.05		2.75	2.40	4.47	4.49	4.48	3.44
F ₁₂₅	2.33		2.93	2.63	5.02	4.05	4.54	3.58

(continued on next page)

2020-21 (I Year)-Mean number of fruits plant ⁻¹						
Mean	2.04	2.66	2.35	4.44	4.11	4.28
Mean of I _{0.8}			3.24	Mean of I _{1.0}		3.38
Treatments	SEm(±)	CD(P = 0.05)		Interactions	SEm(±)	CD(P = 0.05)
Mulch (M)	0.26	0.76		I X M	0.36	NS
Irrigation (I)	0.26	NS		F x M	0.45	NS
Fertigation (F)	0.09	0.27		F x I	0.45	NS
				F x M X I	0.63	NS

Table 3.2. Interaction effect between fertigation levels and irrigation levels on mean number of fruits plant⁻¹ of watermelon during summer season (2020-21).

2020-21 (I Year)-Mean number of fruits plant ⁻¹ (mean of four pickings)							
Treatments	I _{0.8}		Mean	I _{1.0}		Mean	Overall Mean
	No Mulch Mulch			No Mulch Mulch			
F ₇₅	1.48	3.85	2.67	2.22	4.10	3.16	2.91
F ₁₀₀	1.73	4.13	2.93	2.78	4.53	3.66	3.30
F ₁₂₅	2.30	5.10	3.70	2.85	3.90	3.38	3.54
Mean	1.84	4.36	3.10	2.62	4.18	3.40	
	No Mulch		2.23	Mulch		4.27	
Treatments	SEm(±)	CD		Interactions	SEm(±)	CD	
		(P = 0.05)				(P = 0.05)	
Mulch (M)	0.22	0.64		I × M	0.31	NS	
Irrigation (I)	0.22	NS		F × M	0.38	NS	
Fertigation (F)	0.08	0.23		F × I	0.38	1.11	
				F × M × I	0.54	NS	

Figure 3.2. Effect of fertigation levels, mulch and irrigation levels on mean fruit girth (cm) (2020-21, 2021-22 and Pooled data)

2020-21 (I Year)-Average weight of the fruit (kg) plant ⁻¹								
Treatments			No Mulch	Mean	Mulch		Mean	Overall Mean
	I _{0.8}	I _{1.0}			I _{0.8}	I _{1.0}		
F ₇₅	1.49		1.93	1.71	2.77	2.44	2.61	2.16
F ₁₀₀	1.75		2.33	2.04	2.90	2.92	2.91	2.47
F ₁₂₅	2.41		2.46	2.43	3.34	2.48	2.91	2.67
Mean	1.88		2.24	2.06	3.01	2.61	2.11	
Mean of I _{0.8}				2.44	Mean of I _{1.0}		2.43	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)		Interactions			SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	0.14		0.42	<i>I</i> X <i>M</i>			0.20	NS
Irrigation (<i>I</i>)	0.14		NS	<i>F</i> x <i>M</i>			0.25	NS
Fertigation (<i>F</i>)	0.05		0.15	<i>F</i> x <i>I</i>			0.25	0.72
				<i>F</i> x <i>M</i> X <i>I</i>			0.35	NS
2021-22 (I Year)- Average weight of the fruit (kg) plant ⁻¹								
Treatments			No Mulch	Mean	Mulch		Mean	Overall Mean
	I _{0.8}		I _{1.0}		I _{0.8}	I _{1.0}		
F ₇₅	1.69		1.95	1.82	2.96	2.96	2.96	2.39
F ₁₀₀	2.01		2.42	2.21	3.12	3.18	3.15	2.68
F ₁₂₅	2.41		2.55	2.48	3.41	2.90	3.16	2.82
Mean	2.03		2.30	2.17	3.16	3.01	3.09	
Mean of I _{0.8}				2.60	Mean of I _{1.0}		2.66	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)		Interactions			SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	0.10	0.28		<i>I</i> X <i>M</i>			0.14	NS
Irrigation (<i>I</i>)	0.10	NS		<i>F</i> x <i>M</i>			0.17	0.49
Fertigation (<i>F</i>)	0.03	0.10		<i>F</i> x <i>I</i>			0.17	NS
				<i>F</i> x <i>M</i> X <i>I</i>			0.24	NS
Mean of two years (Pooled data)- Average weight of the fruit (kg) plant ⁻¹								

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2020-21 (I Year)-Average weight of the fruit (kg) plant ⁻¹								
Treatments		No Mulch		Mean	Mulch		Mean	Overall Mean
		I _{0.8}	I _{1.0}		I _{0.8}	I _{1.0}		
F ₇₅	1.59		1.94	1.76	2.86	2.70	2.78	2.27
F ₁₀₀	1.88		2.37	2.13	3.01	3.05	3.03	2.58
F ₁₂₅	2.41		2.50	2.46	3.38	2.69	3.03	2.75
Mean	1.96		2.27	2.11	3.08	2.81	2.95	
Mean of I _{0.8}				2.52	Mean of I _{1.0}		2.54	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)			Interactions		SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	0.15	0.44			<i>I</i> X <i>M</i>		0.21	NS
Irrigation (<i>I</i>)	0.15	NS			<i>F</i> x <i>M</i>		0.26	NS
Fertigation (<i>F</i>)	0.05	0.15			<i>F</i> x <i>I</i>		0.26	NS
					<i>F</i> x <i>M</i> X <i>I</i>		0.37	NS

Table 3.3. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on average fruit weight plant⁻¹ of watermelon during summer season (2020-21, 2021-22 and pooled data).

2020-21 (I Year)- Average weight of the fruit (kg) plant ⁻¹							
Treatments	I _{0.8}		Mean	I _{1.0}		Mean	Overall
	No Mulch Mulch			No Mulch Mulch			Mean
F ₇₅	1.49	2.77	2.13	1.93	2.44	2.18	2.16
F ₁₀₀	1.70	2.84	2.27	2.33	2.94	2.63	2.45
F ₁₂₅	2.17	3.37	2.77	2.32	2.64	2.48	2.62
Mean	1.79	2.99	2.19	2.19	2.67	2.43	
	No Mulch		1.99	Mulch		2.83	
Treatments	SEm(±)	CD	Interactions		SEm(±)	CD	
		(P = 0.05)				(P = 0.05)	
Mulch (M)	0.14	0.42	I × M		0.20	NS	
Irrigation (I)	0.14	NS	F × M		0.25	NS	
Fertigation (F)	0.05	0.15	F × I		0.25	0.72	
			F × M × I		0.35	NS	

Table 3.4. Interaction effect between fertigation levels and irrigation levels on average fruit weight plant⁻¹ of watermelon during summer season (2020-21).

2020-21 (I Year)- total fresh fruit yield (t ha ⁻¹)							
Treatments	I _{0.8}		Mean	I _{1.0}		Mean	Overall
	No Mulch	Mulch		No Mulch	Mulch		Mean
F ₇₅	21.24	45.21	33.73	25.79	50.29	38.04	35.63
F ₁₀₀	25.87	53.53	39.70	26.23	48.51	37.37	38.53
F ₁₂₅	28.14	60.36	44.25	30.53	52.45	41.49	42.87
Mean	25.08	53.03	39.06	27.52	50.42	38.97	
No mulch			26.30	Mulch		51.72	
Treatments	SEm(±)	CD (<i>P</i> = 0.05)		Interactions		SEm(±)	CD (<i>P</i> = 0.05)
Mulch (<i>M</i>)	2.42	7.10		<i>I</i> × <i>M</i>		3.42	NS
Irrigation (<i>I</i>)	2.42	NS		<i>F</i> × <i>M</i>		4.19	NS
Fertigation (<i>F</i>)	0.86	2.51		<i>F</i> × <i>I</i>		4.19	12.29
				<i>F</i> × <i>M</i> × <i>I</i>		5.93	NS

Table 3.5. Interaction effect between fertigation levels and irrigation levels on total fresh fruit yield (t ha⁻¹) of watermelon during summer season (2020-21).

2020-21 (I Year)- Total fresh fruit yield (t ha ⁻¹)							
Treatments		No Mulch		Mean	Mulch		Overall Mean
		I _{0.8}	I _{1.0}		I _{0.8}	I _{1.0}	
F ₇₅		21.24		23.52	45.21	50.29	47.75
F ₁₀₀		25.87		26.05	53.53	48.51	51.02
F ₁₂₅		28.14		29.34	60.36	55.45	56.40
Mean		25.02		26.30	53.03	50.42	51.72

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2020-21 (I Year)- Total fresh fruit yield (t ha ⁻¹)							
Mean of I _{0.8}			39.02	Mean of I _{1.0}		38.97	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)	Interactions			SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	2.42	7.10	<i>I</i> X <i>M</i>			3.42	NS
Irrigation (<i>I</i>)	2.42	NS	<i>F</i> x <i>M</i>			4.19	NS
Fertigation (<i>F</i>)	0.86	2.51	<i>F</i> x <i>I</i>			4.19	12.29
			<i>F</i> x <i>M</i> X <i>I</i>			5.93	NS
2021-22 (I Year)- Total fresh fruit yield (t ha ⁻¹)							
Treatments	No Mulch		Mean	Mulch		Mean	Overall Mean
	I _{0.8}	I _{1.0}		I _{0.8}	I _{1.0}		
F ₇₅	29.97	33.70	31.84	53.88	58.64	56.26	44.05
F ₁₀₀	31.56	35.63	33.60	70.22	70.37	70.30	51.95
F ₁₂₅	32.45	41.26	36.85	77.83	67.15	72.49	54.67
Mean	31.33	36.87	34.10	67.31	65.38	66.35	
Mean of I _{0.8}			49.32	Mean of I _{1.0}		51.12	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)	Interactions			SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	2.87	8.41	<i>I</i> X <i>M</i>			4.05	NS
Irrigation (<i>I</i>)	2.87	NS	<i>F</i> x <i>M</i>			4.96	14.56
Fertigation (<i>F</i>)	1.01	2.97	<i>F</i> x <i>I</i>			4.96	NS
			<i>F</i> x <i>M</i> X <i>I</i>			7.02	NS
Mean of two years (Pooled data)- Total fresh fruit yield (t ha ⁻¹)							
Treatments	No Mulch		Mean	Mulch		Mean	Overall Mean
	I _{0.8}	I _{1.0}		I _{0.8}	I _{1.0}		
F ₇₅	25.61	29.75	27.68	49.54	54.46	52.00	39.84
F ₁₀₀	28.71	30.93	29.82	61.88	59.44	60.66	45.24
F ₁₂₅	30.29	35.90	33.10	69.09	59.80	64.45	48.77
Mean	28.20	32.19	30.20	60.17	57.90	59.04	
Mean of I _{0.8}				Mean of I _{1.0}		45.05	
Treatments	SEm(±)	CD(<i>P</i> = 0.05)	Interactions			SEm(±)	CD(<i>P</i> = 0.05)
Mulch (<i>M</i>)	3.48	10.20	<i>I</i> X <i>M</i>			4.92	NS
Irrigation (<i>I</i>)	3.48	NS	<i>F</i> x <i>M</i>			6.02	NS
Fertigation (<i>F</i>)	1.23	3.61	<i>F</i> x <i>I</i>			6.02	NS
			<i>F</i> x <i>M</i> X <i>I</i>			8.52	NS

Figures

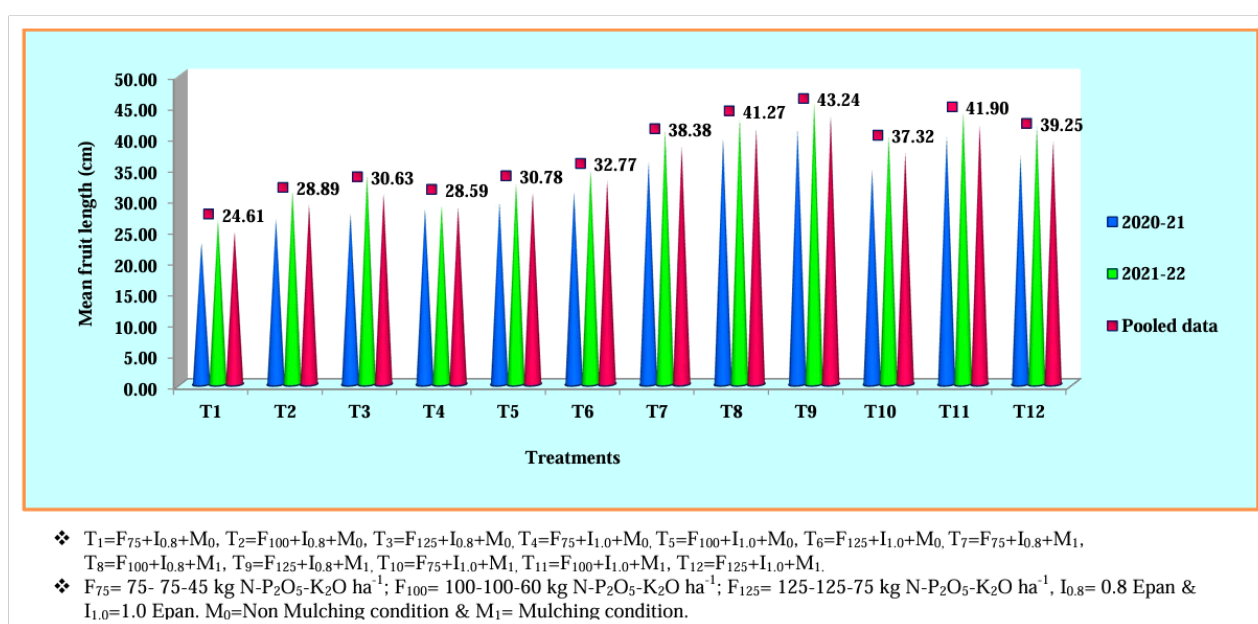
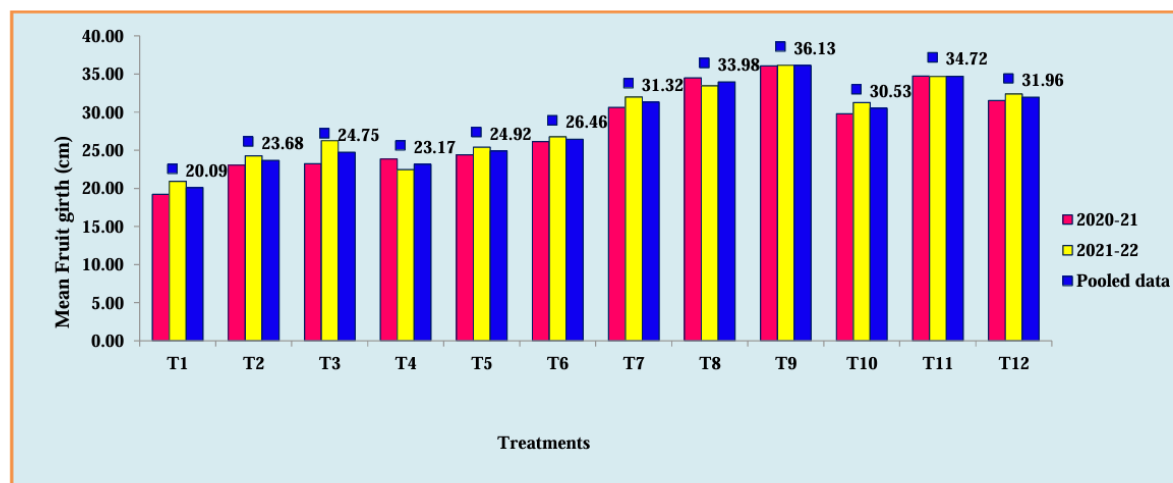


Table 3.2. Interaction effect between fertigation levels and irrigation levels on mean number of fruits plant⁻¹ of watermelon during summer season (2020-21).



❖ $T_1 = F_{75} + I_{0.8} + M_0$, $T_2 = F_{100} + I_{0.8} + M_0$, $T_3 = F_{125} + I_{0.8} + M_0$, $T_4 = F_{75} + I_{1.0} + M_0$, $T_5 = F_{100} + I_{1.0} + M_0$, $T_6 = F_{125} + I_{1.0} + M_0$, $T_7 = F_{75} + I_{0.8} + M_1$, $T_8 = F_{100} + I_{0.8} + M_1$, $T_9 = F_{125} + I_{0.8} + M_1$, $T_{10} = F_{75} + I_{1.0} + M_1$, $T_{11} = F_{100} + I_{1.0} + M_1$, $T_{12} = F_{125} + I_{1.0} + M_1$.
❖ $F_{75} = 75-75-45$ kg N-P₂O₅-K₂O ha⁻¹; $F_{100} = 100-100-60$ kg N-P₂O₅-K₂O ha⁻¹; $F_{125} = 125-125-75$ kg N-P₂O₅-K₂O ha⁻¹, $I_{0.8} = 0.8$ Epan & $I_{1.0} = 1.0$ Epan. M_0 = Non Mulching condition & M_1 = Mulching condition.

Figure 3.1. Effect of fertigation levels, mulch and irrigation levels on mean fruit length (cm)

Table 3.7. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on monetary returns (₹. ha⁻¹) of water-melon during summer season (2020-21, 2021-22 and pooled data).

Treatments	Cost of cultivation (₹. ha ⁻¹)			Gross returns (₹. ha ⁻¹)			Net returns (₹. ha ⁻¹)			B : C ratio		
	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled	2020-21	2021-22	Pooled
Fertigation levels												
F_{75}	124747	129388	127068	727660	660713	694186	602913	531325	567118	4.69	4.01	4.35
F_{100}	132018	136634	134326	765672	779189	772430	772430	642555	638104	4.69	4.56	4.62
F_{125}	138607	143224	140915	857447	820070	838758	838758	676846	697843	5.05	4.60	4.83
SEm±	-	-	-	19990	23840	16296	16296	19333	14437	-	-	-
CD(P = 0.05)	-	-	-	58629	69919	47795	47795	56703	42342	-	-	-
Mulching treatments												
Mulch (M_1)	142792	149633	146213	1051163	995210	1023186	908371	845576	876974	6.35	5.64	5.99
No-mulch (M_0)	120789	123197	121993	516022	511438	513730	395233	388241	391737	3.27	3.15	3.21
SEm±	-	-	-	56540	67429	46092	51232	54683	40834	-	-	-
CD(P = 0.05)	-	-	-	165827	197762	135184	150257	160380	119762	-	-	-
Drip irrigation levels												
$I_{0.8}$	131282	135757	133519	784516	739775	762146	653234	604018	628626	4.82	4.29	4.56
$I_{1.0}$	132299	137074	134687	782669	766875	774771	650370	629799	640084	4.80	4.49	4.65
SEm±	-	-	-	56540	67429	46092	51232	54683	40834	-	-	-
CD(P = 0.05)	-	-	-	NS	NS	NS	NS	NS	NS	-	-	-
Interactions: I X M												
SEm±	-	-	-	79960	95359	65184	72452	77334	57748	-	-	-
CD(P = 0.05)	-	-	-	NS	NS	NS	NS	NS	NS	-	-	-
F x M												
SEm±	-	-	-	97931	116790	79834	88736	94714	70727	-	-	-
CD(P = 0.05)	-	-	-	NS	NS	NS	NS	NS	NS	-	-	-
F x I												
SEm±	-	-	-	97931	116790	79834	88736	94714	70727	-	-	-
CD(P = 0.05)	-	-	-	NS	NS	NS	NS	NS	NS	-	-	-
F x M x I												

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Table 3.7. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on monetary returns (₹. ha⁻¹) of water-melon during summer season (2020-21, 2021-22 and pooled data).

SEm±	-	-	-	138495	165166	112902	125491	133946	100023	-	-	-
CD(P = 0.05)	-	-	-	NS	NS	NS	NS	NS	NS	-	-	-

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