International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
www.agronomyjournals.com
2025; 8(3): 174-183
Received: 02-12-2024
Accepted: 07-01-2025

RR Nigadi
Ph.D. Scholar, Department of Irrigation and Drainage Engineering, College of Agricultural Engineering and Technology, DBSKKV, Dapoli, Maharashtra, India

US Kadam
Director, Pravara Institutes of Agricultural Sciences (PIAS), Loni, Tal. Rahata, Ahmednagar and Former Director (Extension Education and Resource Development), Director (Education), MCAER Pune, Dean, FAE and Associate Dean, Professor and Head, Department of IDE, CAET, DBSKKV, Dapoli, Maharashtra, India

PM Ingle
Professor and Head, Department of Irrigation and Drainage Engineering, College of Agricultural Engineering and Technology, DBSKKV, Dapoli, Maharashtra, India

ST Patil
Associate Professor, Department of Irrigation and Drainage Engineering, College of Agricultural Engineering and Technology, DBSKKV, Dapoli, Maharashtra, India

HN Bhange
Associate Professor (CAS), Department of Soil and Water Conservation Engineering, College of Agricultural Engineering and Technology, DBSKKV, Dapoli, Maharashtra, India

PB Bansode
Assistant Professor of Statistics, Department of Soil and Water Conservation Engineering, College of Agricultural Engineering and Technology, DBSKKV, Dapoli, Maharashtra, India

Corresponding Author:
RR Nigadi
Ph.D. Scholar, Department of Irrigation and Drainage Engineering, College of Agricultural Engineering and Technology, DBSKKV, Dapoli, Maharashtra, India

Effect of different pulses through drip, irrigation and fertigation levels coupled with mulch on quality parameter of muskmelon (*Cucumis melo* L.)

RR Nigadi, US Kadam, PM Ingle, ST Patil, HN Bhange and PB Bansode

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i3c.2608

Abstract
The objective of the present study to investigate the influence of different pulse, irrigation and fertigation levels on quality attributes of muskmelon fruit. The field experiment was designed in a strip-split plot design with three replications. The experiment consist of four pulse level as vertical factor *viz*., P_1 - One time per day, P_2 - Two times per day, P_3 - three times per day, and P_4 - four times per day with an interval of 30 minute between two successive pulse levels, three fertigation levels as horizontal factor *viz*., F_1 - 80, F_2 - 85 and F_3 - 100% of RDF and three irrigation levels as sub plot factor *viz*., I_1 (0.7 × ETc), I_2 (0.85 × ETc) and I_3 (1.0 × ETc). The study results revealed for average value of highest total soluble solids of muskmelon fruit were observed in P_4, I_1, F_3, P_4I_1, P_4F_3, F_3I_1 and $P_4I_1F_3$ treatment combinations. Further, treatment combinations in P_4, I_3, F_3, P_4I_2, P_4F_3, F_3I_3 and $P_4I_3F_3$ showed maximum specific gravity of fruit.

Keywords: Total soluble solids, specific gravity, crop evapotranspiration (ET_c), recommended dose of fertilizer (RDF)

Introduction

The Muskmelon belongs to the family Cucurbitaceae is considered as vegetable crop being used as a delicious fruit. It is fourth most important fruit in the world fresh fruit market with several varieties (Mabalaha *et al*., 2007) [7]. It may also be used as a cooked vegetable in its green stage. The ripen fruits are very nutritious and are used for table purpose as well as refreshing drinks. The fruits contain 90 percent water which makes it useful to prevent dehydration and reduce constipation. The potassium present in it is quite helpful in lowering of blood pressure (Lester and Hodges, 2008) [16]. It is a rich source of vitamin C, ß-carotene (vitamin A), carbohydrates, sugars, protein and traces of vitamin B6, vitamin K, niacin, vitamin B2, and vitamin B1. Musk melon is a good source of nutrient which improves vision, sooth stomach ulcers, and an immune booster.

It is need of hour and important to increase the land under irrigation because of its many fold productivity than rain-fed agriculture and as farming is the main source of income for the maximum part of the population in India. Farmers completely rely on the monsoon which receives from June to September and is erratic in nature. If the rainfall is less, farmers are bound to suffer a major loss. The productivity of rain-fed agriculture is 1.1 $t.ha^{-1}$ which is much less compared to irrigated areas, 2.8 $t.ha^{-1}$ (Anonymous, 2020d) [7]. Therefore if water is available for irrigation to the farmers for a larger portion of land, it would lead to more productivity per unit area in India and also encourage farmers to take up newer crops with farming practices with minimum risk. Therefore the option is to utilize available water resources more precisely and judiciously. The present situation compels us to go for advanced irrigation systems.

More areas can be irrigated by adopting micro-irrigation including drip irrigation using less amount of water in comparison to areas that can be irrigated by adopting flow irrigation. Another in hand water resources are rapidly depleting, there is a need to enhance water use efficiency. Efficient methods like micro-irrigation can play a vital role in the management of irrigation water demand. Properly designed and well-maintained drip and sprinkler irrigation systems have irrigation efficiency is about 90% and 70% respectively, in contrast to surface irrigation methods have just about 40% (Jain *et al*. 2019) [13].

Pulse irrigation is the practice of irrigating a crop for a short period then waiting for another short period and repeating this process until the entire water requirement of the crop is to be delivered (Eric *et al*. 2004) [11]. Frequent application of irrigation water below the soil surface provides congenial conditions for soil moisture distribution and root water uptakes (Segal *et al*. 2000) [21]. In pulse irrigation system, the amount of irrigation water and time of operation play a significant role in reducing run-off, percolation and evaporation (El-Gindy and Abdel Aziz, 2001) [10].

Now a days mulching is being used for covering the soil surface with organic or inorganic material to provide favourable conditions for plant growth, minimize evaporation, pest and diseases and weed intensity for better crop production. Organic mulch includes dried leaves, rice straw, wooden sawdust, compost and inorganic mulches such as plastic sheets, rubber strips, and non-woven geotextiles. Plastic mulches are impermeable and play a significant role in saving labour for weeding with other benefits too. Suppression of evaporation also leads to the reduction in the rise of water containing salts. In addition to the above, it also facilitates more retention of soil moisture, controls the fluctuation of temperature, improves soil properties (i.e. physical, chemical and biological) and ultimately enhances crop growth and yield (Sharma and Bhardwaj, 2017) [22].

Fertigation is the process of applying water-soluble fertilizer through irrigation water. The advantage of fertigation over the broadcasting and band application are reduction in the uneven availability of nutrient concentration. With fertigation, it is possible to apply frequent and precise application of nutrients according to crop requirements.

The application of crop water requirement into six pulses with an interval of 50 minutes between two successive pulse irrigation resulted in 5.78% higher yield with 25% water saving without mulch and 50% with mulch over continuous irrigation with 100% of crop evapotranspiration (ET_c) in lettuce under sandy soil (Almeida *et al*. 2015) [5]. So many researchers have conducted scientific studies on various cash crops such as strawberry, capsicum, cabbage, cauliflower, watermelon, okra, onion, carrot, and broccoli in the Konkan region (Kadam *et al*., 2015; Madane *et al*., 2018a; Thokal *et al*., 2020; Rawat *et al*., 2022; Bhagwat *et al*., 2023) [14, 8, 23, 20, 8]. Therefore, there is a need for scientific study on the muskmelon crop in the Konkan region of Maharashtra state.

Materials and Methods

The field experiment was conducted during two consecutive *Rabi* seasons of 2021-22 and 2022-23, at the Instructional Farm of Department of Irrigation and Drainage Engineering, College of Agricultural Engineering and Technology, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The experimental site is located at 17° 45' 13.1" N latitude and 73° 10' 47.4" E longitude with altitude of 250 m above M.S.L. Climatic conditions were humid with average annual rainfall at Dapoli region is 3692 mm and average minimum to maximum air temperatures varies between 8 °C to 36.0 °C (Mandale, 2016). The average relative humidity of the site was about 50% (Gaikwad, 2013) [12].

The two experimental trials were conducted during the *Rabi* season on muskmelon. The time period for first and second trial of research work from 22nd November 2021 to 24th February 2022, and 18th November 2022 to 20th February 2023, respectively. The soil texture of experimental site was sandy clay loam and having field capacity - 26.02%, permanent wilting point - 12.50%, bulk density - 1.68 g.cm^{-3}, basic infiltration rate - 6.03 cm.hr^{-1}, pH - 6.5 and EC - 0.4 respectively.

The field experiment was designed in strip-split plot with three replication of each treatment. The area of the experimental plot was 621.25 m^2 (35.5 m × 17.5 m) and having bed size of 3.5 m × 1.0 m. The recommended dose of fertiliser for the muskmelon crop is 200:100:100 kg ha^{-1} of NPK (Nitrogen (CH_4N_2O), Phosphorus (KH_2PO_4) and Potassium (K_2O), Kg.ha^{-1}) (TNAU, Coimbatore) was considering applying through water soluble fertilizers. The daily water requirement of muskmelon under a pulse drip irrigation system was worked out by following, FAO-56 Penman-Monteith method (Allen *et al*., 1998). The available emitter discharge and emission uniformity of the drip irrigation system was recorded as 2.16 L.h^{-1} and 91.0% for the year 2021-2022 and 2.16 L.h^{-1} and 90.8% for the year 2022-2023, respectively. The selection of harvested muskmelon fruits for quality contributing parameters was done by randomly collecting the five and two fruits from observation plants of individual treatment combinations for specific gravity and total soluble solids, respectively.

Results and Discussion

1. Effect of pulse levels on quality attributes of muskmelon fruit

The effect of different pulses through drip on quality attributes of fruit during the years 2021-22, 2022-23, and the pooled analysis is presented in Table 1 and graphically shown in Fig. 1 and 2.

In the years 2021-22, 2022-23, and the pooled data, the total amount of soluble solids of muskmelon fruit increased from P_1 to P_4, according to the data shown in Table 1. For the years 2021-22, 2022-23, and the pooled data, the same table showed the considerable impact of pulse levels on the total soluble solids of muskmelon. The highest total soluble solids, 10.6, 11.3, and 11.0 Brix* for the years 2021-22, 2022-23, and the pooled analysis, respectively, were produced by pulse level P_4, which was significantly better than the other pulse treatments. Also, for the years 2021-22, 2022-23, and the pooled data, the pulse level P_1 had the lowest total soluble solids, which were 9.1, 9.5, and 9.3 Brix*, respectively.

Table 1: Effect of pulse levels on quality parameter of muskmelon fruit

Pulse level	TSS (Brix)			Specific Gravity		
	2022	2023	Pooled	2022	2023	Pooled
P_1	9.1	9.5	9.3	0.925	0.926	0.926
P_2	9.6	10.0	9.8	0.935	0.936	0.935
P_3	10.0	10.4	10.2	0.948	0.948	0.948
P_4	10.6	11.3	11.0	0.957	0.957	0.957
S.E.(m)±	0.0	0.0	0.0	0.001	0.001	0.000
C.D. at 5%	0.1	0.1	0.1	0.002	0.002	0.001

These findings are consistent with those of Abdelraouf *et al*. (2019) [2], who found that the total soluble solids of orange fruit was increased as the number of pulse levels was increased from P_1 to P_4, particularly at 100% of the crop water requirement (ET_c).

In the years 2021-22, 2022-23, and the pooled data, the total amount of soluble solids of muskmelon fruit increased from P_1 to P_4, according to the data shown in Table 1. For the years 2021-22, 2022-23, and the pooled data, the same table showed the considerable impact of pulse levels on the total soluble solids of muskmelon. The highest total soluble solids, 10.6, 11.3, and 11.0 Brix* for the years 2021-22, 2022-23, and the pooled

analysis, respectively, were produced by pulse level P_4, which was significantly better than the other pulse treatments. Also, for the years 2021-22, 2022-23, and the pooled data, the pulse level P_1 had the lowest total soluble solids, which were 9.1, 9.5, and 9.3 Brix*, respectively.

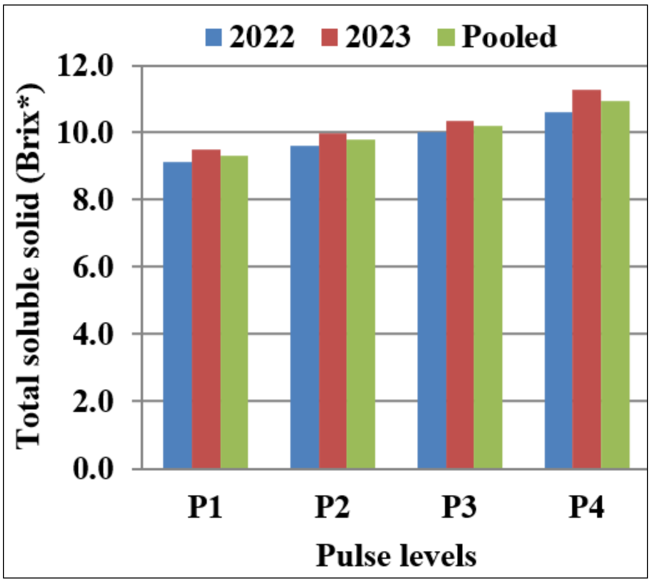

Fig 1: Effect of different pulses through drip on total soluble solids (Brix*) of fruit

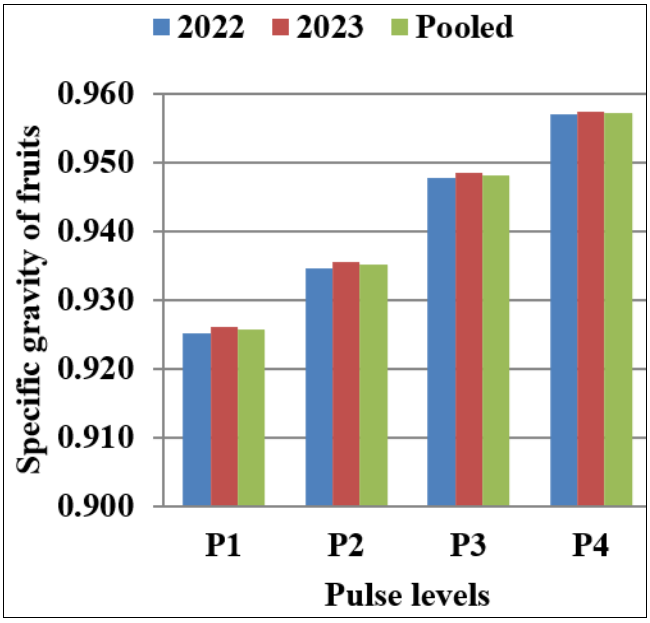

Fig 2: Effect of pulse levels on specific gravity of fruits

These results are comparable to those of Abdelraouf *et al*. (2009) [1] in the case of the potato crop, where specific density was found to increase by increasing the number of pulse levels from P_1 to P_4, particularly at 100 and 75% of the crop water requirement (ET_c).

2. Effect of different irrigation levels on quality parameter of muskmelon fruit

The quality attributes of muskmelon fruit was found to be significantly influenced by different irrigation levels in the years 2021-22, 2022-23, and the pooled data are reported in Table 2 and graphically shown in Fig. 3 and 4.

Table 2: Effect of irrigation levels on quality parameter of muskmelon fruit

Irrigation level	TSS (Brix)			Specific Gravity		
	2022	2023	Pooled	2022	2023	Pooled
I_1	10.3	10.6	10.5	0.930	0.930	0.930
I_2	9.9	10.3	10.1	0.943	0.945	0.944
I_3	9.3	9.9	9.6	0.950	0.950	0.950
S.E.(m)±	0.0	0.0	0.0	0.001	0.000	0.000
C.D. at 5%	0.1	0.1	0.1	0.002	0.001	0.001

According to the data in Table 2, across the years 2021-22, 2022-23, and the pooled data, the total soluble solids content of muskmelon fruits decreased from I_1 to I_3 irrigation levels. In comparison to the other irrigation levels, the irrigation level I_1 showed the highest total soluble solids values, which were 10.3, 10.6, and 10.5 Brix* for the years 2021-22, 2022-23, and the pooled study, respectively. Additionally, it was discovered that, with values of 9.3, 9.9, and 9.6 Brix*, respectively, irrigation level I_3 had the lowest total soluble solids.

These findings are consistent with those of Chander (1980) [9] and Yashavantakumar *et al*. (2022) [25] in the case of muskmelon and cucumber, where total soluble solids increased as the depth of irrigation (i.e., crop water requirements) decreased, showing comparable tendencies with the effects of irrigation levels on the total soluble solids content of muskmelon fruits.

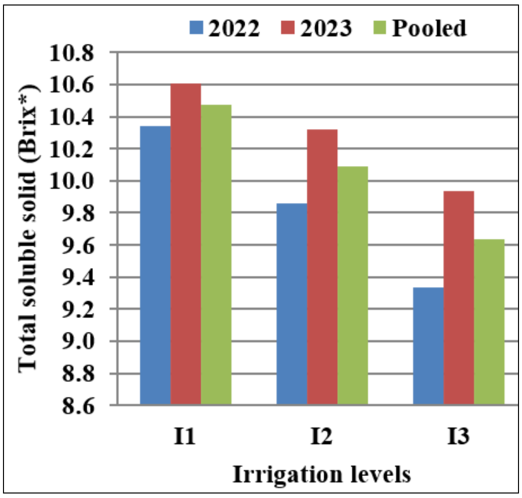

Fig 3: Effect of irrigation levels on total soluble solids (Brix*) of muskmelon fruit

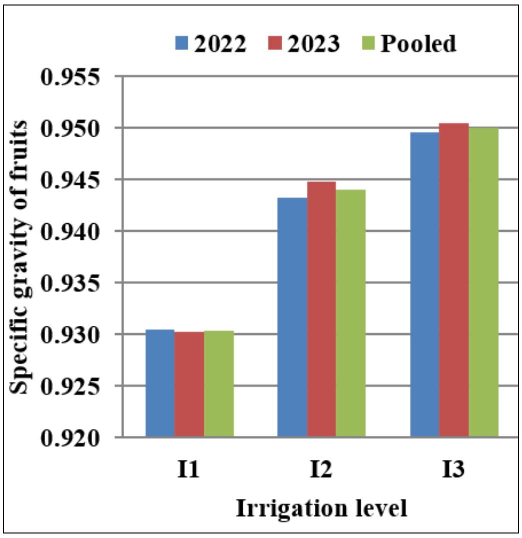

Fig 4: Effect of irrigation levels on specific gravity of fruit

According to Table 2, over the years 2021-22, 2022-23, and pooled analysis, the specific gravity of fruit was considerably impacted by various irrigation amounts. It was found that the irrigation level I_3 was noticeably better than the others. According to the same table, in the years 2021-22, 2022-23, and the pooled data, the highest and lowest values of fruit specific gravity were recorded at irrigation level I_3 (0.950) and I_1 (0.930), respectively.

The influence of irrigation levels on the specific gravity of muskmelon fruits has related findings with Amrapali (2009) [6], who had found that the specific gravity of fruits of watermelon increased from 0.2 PE to 0.6 PE.

3. Effect of different fertigation levels on quality parameters of muskmelon fruit

The influence of fertigation levels on total soluble solids and specific gravity of fruit was found to be significant during the years 2021-22, 2022-23, and the pooled data is presented in Table 3 and shown in Fig. 5 and 6.

From Table 3, it is observed that the total soluble solids of muskmelon increase as the fertigation level increases from F_1 to F_3 in the years 2021-22, 2022-23, and the pooled data. The maximum values of total soluble solids recorded at fertigation level F_3 during the years 2021-22, 2022-23, and the pooled analysis were found to be 10.6, 11.1, and 10.8 Brix*, respectively. Additionally, it is noted that the fertigation level F_1 had the lowest values of total soluble solids, which were 8.9, 9.3, and 9.1 Brix* in the years 2021-22, 2022-23, and the pooled data, respectively. This may be due to the adequate quantity of nutrients obtained from higher levels of NPK sources applied to the soil, which was directly responsible for the total soluble solids content of muskmelon.

These results are in line with those of Monali (2016) [19] in the case of the muskmelon crop, where it was discovered that an increase in the fertigation level led to an increase in the total soluble solids content.

Table 3: Effect of fertigation levels on quality attributes of fruit

Fertigation level	TSS (Brix)			Specific Gravity		
	2022	2023	Pooled	2022	2023	Pooled
F_1	8.9	9.3	9.1	0.928	0.928	0.928
F_2	10.1	10.5	10.3	0.942	0.943	0.943
F_3	10.6	11.1	10.8	0.953	0.955	0.954
S.E.(m)±	0.1	0.1	0.1	0.002	0.000	0.001
C.D. at 5%	0.3	0.2	0.2	0.006	0.001	0.003

Table 3 shows that in the years 2021-22, 2022-23, and pooled data, the specific gravity of muskmelon fruits increases when the fertigation level increases from F_1 to F_3. In comparison to other fertigation levels, the maximum specific gravity of fruits observed in fertigation level F_3 for the years 2021-22, 2022-23, and pooled data were 0.953, 0.955, and 0.954, respectively. Also, in the years 2021-2022, 2022-2023, and pooled data, the fertigation level F_1 displayed the lowest fruit specific gravity, or 0.928. This might be the result of the soil receiving enough nutrients from a larger amount of NPK source, which was directly in charge of achieving the highest fruit specific gravity values. The present investigation results are in agreement with the earlier findings of Amrapali (2009) [6], who found that as fertigation levels increased from 80 to 120% RDF, the specific gravity of watermelon fruits increased.

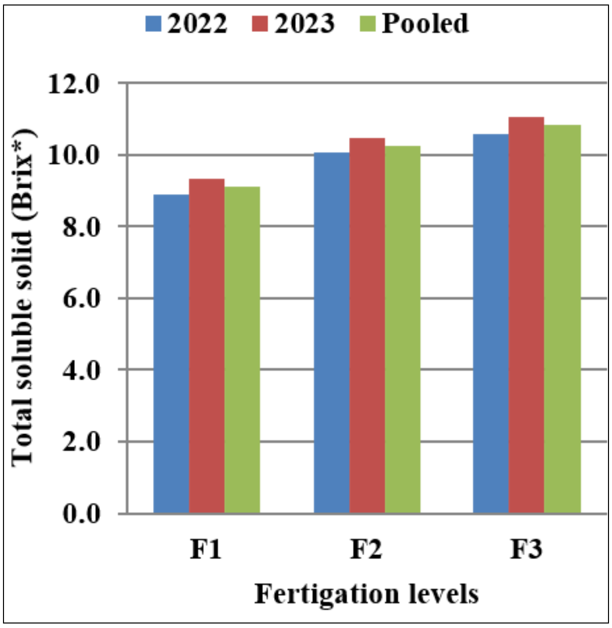

Fig 5: Effect of fertigation levels on total soluble solids (Brix*) of fruit

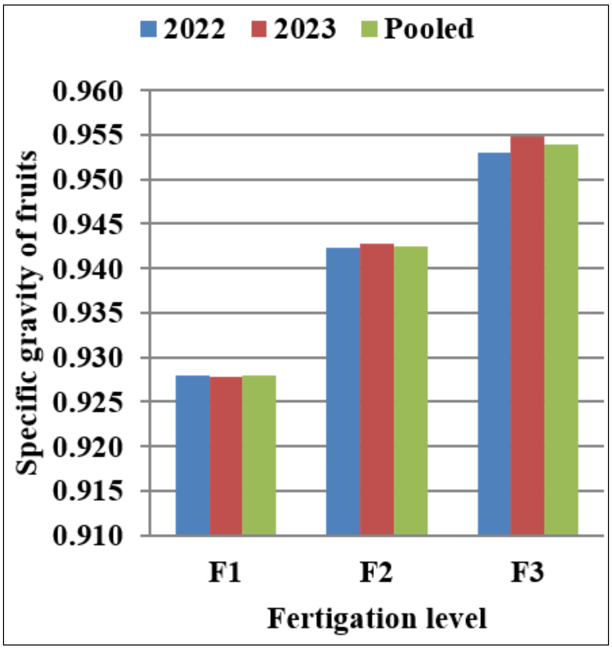

Fig 6: Effect of fertigation levels on specific gravity of fruits

4. Interaction effect of different pulse and irrigation levels on quality attributes of fruit

The interaction effect of various pulse and irrigation levels on total soluble solids and specific gravity of fruit were estimated statistically, and the results are tabulated in Table 4 and graphically depicted in Fig. 7 and 8, respectively.

Table 4: Effect of different pulse and irrigation levels on quality parameter of muskmelon fruit

Treatment combination	TSS (Brix)			Specific Gravity		
	2022	2023	Pooled	2022	2023	Pooled
P_1I_1	9.7	9.8	9.8	0.912	0.910	0.911
P_1I_2	9.3	9.6	9.5	0.928	0.930	0.929
P_1I_3	8.4	9.1	8.7	0.935	0.938	0.936
P_2I_1	10.2	10.2	10.2	0.923	0.923	0.923
P_2I_2	9.6	10.1	9.8	0.937	0.939	0.938
P_2I_3	9.1	9.7	9.4	0.944	0.944	0.944
P_3I_1	10.4	10.5	10.5	0.940	0.940	0.940
P_3I_2	9.9	10.4	10.1	0.949	0.950	0.949
P_3I_3	9.7	10.2	10.0	0.955	0.955	0.955
P_4I_1	11.1	11.9	11.5	0.946	0.947	0.947
P_4I_2	10.6	11.2	10.9	0.960	0.960	0.960
P_4I_3	10.2	10.8	10.5	0.965	0.964	0.965
S.E.(m)±	0.1	0.1	0.1	0.001	0.001	0.001
C.D. at 5%	0.2	0.1	0.2	0.003	0.003	0.002

The response of various pulse and irrigation levels on the total soluble solids of muskmelon during the years 2021-22, 2022-23, and the pooled data was found to be significant. The Table 4 reveals that the treatment combination of P_4I_1 produced significantly higher values of total soluble solids for the years 2021-22, 2022-23, and the pooled data, which were found to be 11.1, 11.9, and 11.5 Brix*, respectively. The same table also indicates that the lowest values of total soluble solids were found in the treatment combination of P_1I_3 i.e., 8.4, 9.1, and 8.7 Brix*, respectively.

The influence of various pulse and irrigation levels on the total soluble solids content of muskmelon fruit has similarities with the collective findings of Chander (1980) [9], Madane (2018) [8], Abdelraouf *et al.* (2019) [2], Abdelraouf *et al.* (2022) [3], and Yashavantakumar *et al.* (2022) [25]. The total soluble solids of various crops such as white onion, orange, and cucumber were reported to increase as the number of pulse levels increased by Madane (2018) [8], Abdelraouf *et al.* (2019) [2], and Abdelraouf *et al.* (2022) [3], respectively. Chander (1980) [9] and Yashavantakumar *et al.* (2022) [25] claimed that the combined interaction of the lowest depth of irrigation and the highest fertigation level produced the maximum values of total soluble solids in the case of muskmelon and cucumber. Based on the above findings, it might be concluded that the higher level of pulse (P_4) and lowest depth of irrigation (I_1), and combinely written as P_4I_1.

The various pulse and irrigation levels had a significant impact on the specific gravity of muskmelon fruits in 2021-22 and 2022-23, according to the pooled research. Table 4 shows that for the years 2021-22, 2022-23, and the pooled data, the P_4I_3 treatment combination had the highest specific gravity value (0.965, 0.964, and 0.965, respectively), outperforming the other treatment combinations. The information in Table 4 also showed that the P_1I_1 treatment combination had a minimum specific gravity of 0.912, 0.910, and 0.911. This might be due to the development of a congenial environment within the root zone at pulse level P_4 and optimum moisture availability to the plant at irrigation level I_3, collectively written as P_4I_3 i.e., P_4 - four pulse level + I_3 - 100% of ET_c.

Similar results were reported by Abdelraouf *et al.* (2009) [1] while studying the interaction between the different pulse and irrigation levels in the context of a potato crop. They stated that the specific density of the potato increases as the number of pulse levels increases from P_1 to P_4 at the irrigation levels, 75 and 100% of crop water requirement (ET_c), except 50% of ET_c. Hence, the result of the present study shows that the highest values of specific gravity of fruits at four pulse levels (P_4) and irrigation level (I_3 - 100% of ET_c), which can be denoted as P_4I_3 treatment combination.

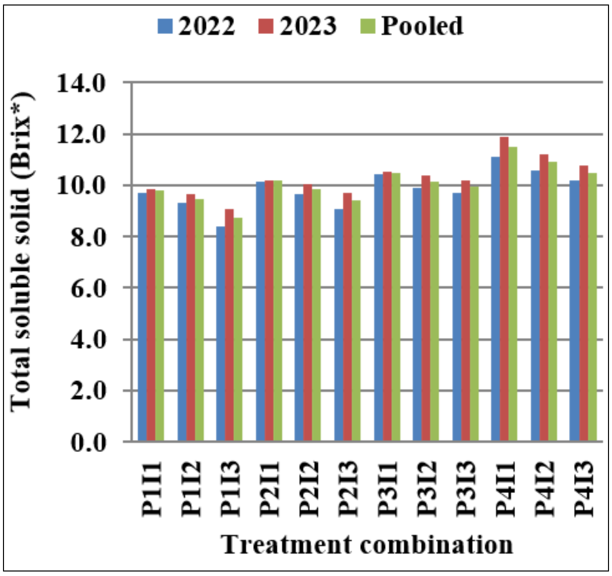

Fig 7: Interaction effect of different pulse and irrigation levels on total soluble solids (Brix*) of muskmelon fruit

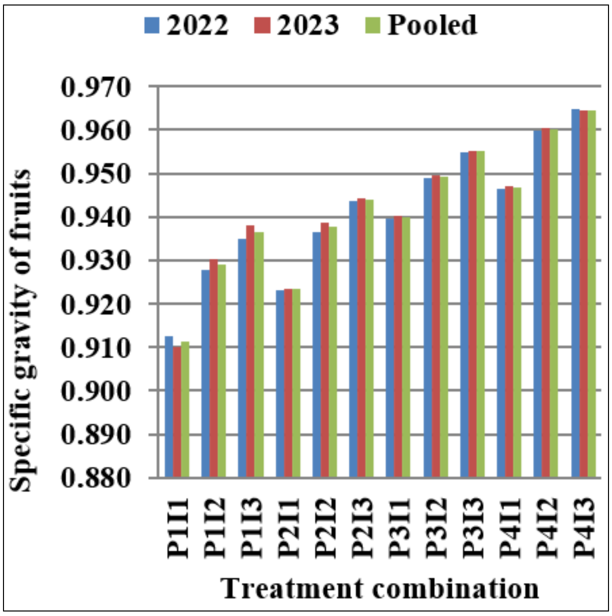

Fig 8: Interaction effect of pulse and irrigation levels on specific gravity of fruits

5. Interaction effect of pulse and fertigation levels on quality parameter of fruit

The interaction effect of various pulse and fertigation levels on total soluble solids and specific gravity of muskmelon fruit were worked out statistically and outputs are presented in Table 5 and graphically shown in Fig. 9 and 10, respectively.

Table 5: Effect of different pulse and fertigation levels on quality parameter of fruit

Treatment combination	TSS (Brix)			Specific Gravity		
	2022	2023	Pooled	2022	2023	Pooled
P_1F_1	8.1	8.3	8.2	0.916	0.913	0.915
P_1F_2	9.4	9.8	9.6	0.925	0.927	0.926
P_1F_3	10.0	10.4	10.2	0.934	0.938	0.936
P_2F_1	8.8	9.2	9.0	0.922	0.922	0.922
P_2F_2	9.8	10.2	10.0	0.936	0.936	0.936
P_2F_3	10.2	10.6	10.4	0.946	0.948	0.947
P_3F_1	9.0	9.6	9.3	0.933	0.934	0.933
P_3F_2	10.2	10.4	10.3	0.949	0.950	0.950
P_3F_3	10.8	11.1	10.9	0.961	0.962	0.961
P_4F_1	9.7	10.2	9.9	0.941	0.942	0.942
P_4F_2	10.8	11.5	11.2	0.958	0.958	0.958
P_4F_3	11.4	12.2	11.8	0.971	0.972	0.971
S.E.(m)±	0.0	0.0	0.0	0.001	0.001	0.001
C.D. at 5%	0.1	0.0	0.0	0.003	0.002	0.002

The response of various pulse and fertigation levels on the total soluble solids of muskmelon in the years 2021-22, 2022-23, and pooled analysis were found to be significant. From Table 5, it is noted that the maximum value of total soluble solids was observed in the P_4F_3 treatment combination for the years 2021-22, 2022-23, and the pooled data, which were 11.4, 12.2, and 11.8 Brix*, respectively. This is followed by P_4F_2 (i.e., 10.8, 11.5, and 11.2 Brix*) and P_3F_3 (i.e., 10.8, 11.1, and 10.9 Brix*). The same table also reveals that the lowest values of total soluble solids, 8.1, 8.3, and 8.2 Brix*, were observed in the P_1F_1 treatment combination.

For the first time, the interaction effect of various pulse and fertigation levels on the total soluble solids of muskmelon has been investigated by applying fertilizer as a variable in addition to pulse levels. These results are consistent with those of Madane (2018) [8], Abdelraouf *et al.* (2019) [2], and Monali (2016) [19] when examining individual pulse and fertigation levels as variables. The findings of Madane (2018) [8] and Abdelraouf *et al.* (2019) [2] on pulse levels concluded that the total soluble solids of onion and orange fruit increase as the pulse level increases from P_1 to P_4 and P_1 to P_8, respectively. Additionally, Monali (2016) [19] observed that the total soluble solids content of muskmelon increases as the fertigation level increases. The present study resulted the superior values of total soluble solids content at the combination of the highest level of pulse and optimum fertigation level collectively written as P_4F_3 i.e., P_4 - four pulse level + F_3 - 100% of RDF (200: 100: 100 kg/ha of NPK) through WSF.

In the years 2021-22 and 2022-23, it was discovered that different levels of fertigation and pulse had a significant impact on the specific gravity of fruits, is presented in Table 5. The treatment combination P_4F_3 was found to be significantly superior to other treatment combinations in terms of specific gravity, with values of 0.971, 0.972 and 0.971 during the years 2021-22, 2022-23, and the pooled analysis, respectively. This could be the consequence of optimal nutrient availability at the fertigation level F_3 and the proper amount of soil moisture at the pulse level P_4.

This is the first attempt to study the influence of pulse irrigation and fertigation levels on the specific gravity of fruits of muskmelon; however, these results have some similarities with the collective findings of Abdelraouf *et al.* (2009) [1] and Amrapali (2009) [6]. Abdelraouf *et al.* (2009) [1] study concluded that the specific density of potato tuber increases as the pulse irrigation level increases from P_1 to P_4. Additionally, Amrapali (2009) [6] revealed that the specific gravity of fruits of watermelon increases when the quantity of fertilizer applied increases from 80 to 120% of RDF through WSF. The present investigation's results correlate with the collective findings of previous researchers, the treatment combination P_4F_3 produced the highest specific gravity of muskmelon fruits.

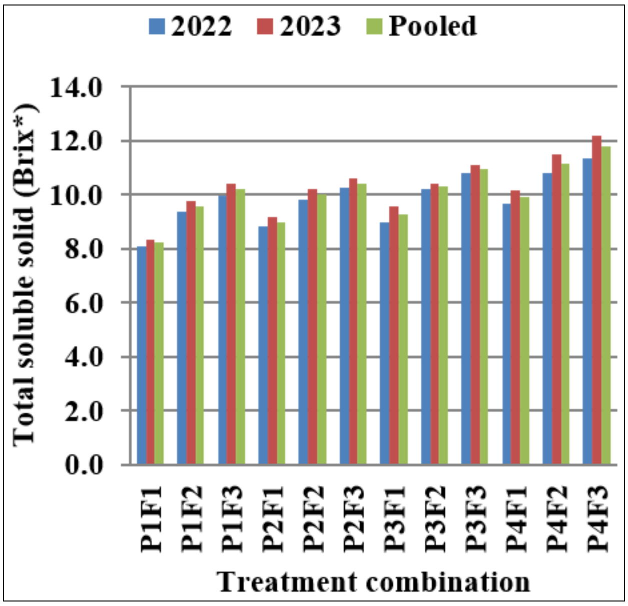

Fig 9: Interaction effect of pulse and fertigation levels on total soluble solids (Brix*) of fruit

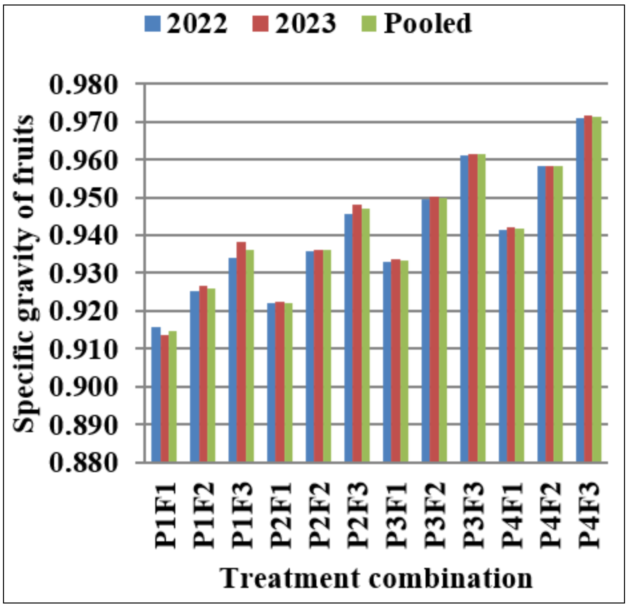

Fig 10: Interaction effect of pulse and fertigation levels on specific gravity of fruits

6. Interaction effect of different irrigation and fertigation levels on quality parameter of fruit

The influence of various irrigation and fertigation levels on quality parameter were analysed statistically, and the results are presented in Table 6 and graphically depicted in Fig. 11 and 12.

Table 6: Effect of different irrigation and fertigation levels on quality attributes of muskmelon fruit

Treatment combination	TSS (Brix)			Specific Gravity		
	2022	2023	Pooled	2022	2023	Pooled
F_1I_1	9.3	9.6	9.5	0.922	0.920	0.921
F_2I_1	10.5	10.8	10.7	0.929	0.930	0.930
F_3I_1	11.2	11.4	11.3	0.940	0.940	0.940
F_1I_2	8.8	9.3	9.1	0.928	0.929	0.928
F_2I_2	10.2	10.5	10.4	0.947	0.948	0.947
F_3I_2	10.6	11.1	10.8	0.955	0.958	0.956
F_1I_3	8.5	9.1	8.8	0.934	0.934	0.934
F_2I_3	9.5	10.1	9.8	0.951	0.951	0.951
F_3I_3	10.0	10.7	10.3	0.964	0.966	0.965
S.E.(m)±	0.0	0.0	0.0	0.001	0.001	0.001
C.D. at 5%	0.1	0.0	0.0	0.002	0.002	0.002

The total soluble solid content of muskmelon were found to be significantly influenced by fertigation and irrigation levels during the years 2021-22, 2022-23, and the pooled data, as reported in Table 6. From Table 6, it was noticed that higher values of total soluble solid content was observed in F_3I_1 during the years 2021-22, 2022-23, and the pooled data, which were 11.2, 11.4, and 11.3 Brix*, respectively. The same table showed that the lowest values of total soluble solids for the treatment combination of F_1I_3 were found to be 8.5, 9.1, and 8.8 Brix*. This might be due to the lowest moisture availability at the irrigation level I_1 and the increased nutrient availability to the crops at the fertigation level F_3.

These findings are in line with those of Chander (1980) [9] and Yashavantakumar *et al*. (2022) [25], who claimed that the lowest level of irrigation and maximum quantity of fertilizer application produced higher values of total soluble solid content in cases of muskmelon and cucumber, respectively. The present study provides superior values of total soluble solids at the lowest depth of irrigation and the highest level of fertigation was combinely written as F_3I_1 i.e., 100% of RDF (200: 100: 100 kg/ha of NPK) and 70% of ET_c.

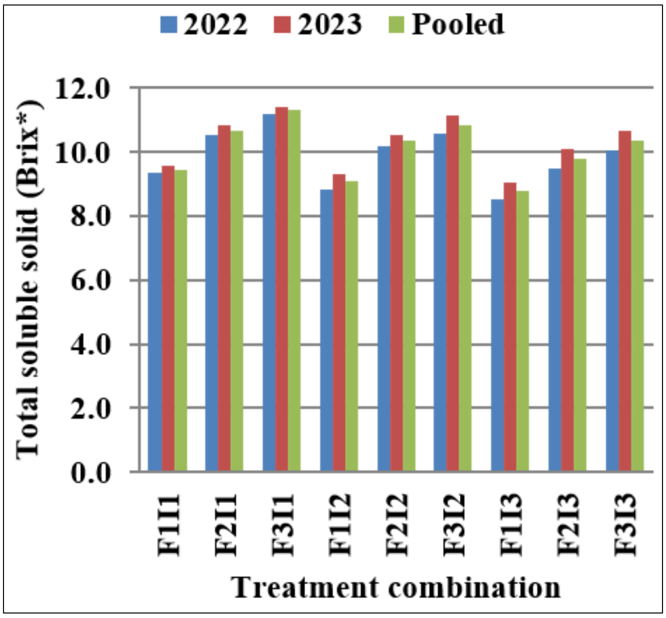

Fig 11: Interaction effect of different irrigation and fertigation levels on total soluble solids (Brix*) of muskmelon fruit

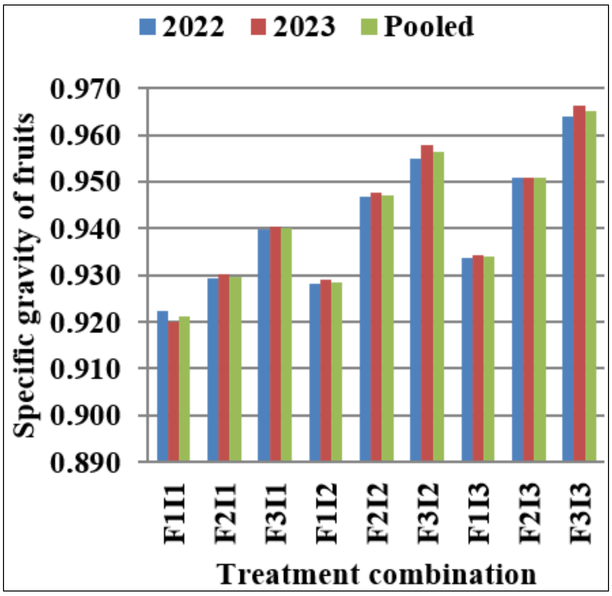

Fig 12: Interaction effect of different irrigation and fertigation levels on specific gravity of fruits

The Table 6 depicts the effects of different irrigation and fertigation levels on fruit specific gravity for the years 2021-22, 2022-23, and pooled data were found to be significant. From Table 6, it is revealed that the maximum values of specific gravity were observed in the treatment combination of F_3I_3 i.e. 0.964, 0.966 and 0.965 in the years 2021-22, 2022-23, and the pooled data, respectively, which was significantly superior to the rest of the treatment combinations. The same table further noticed that the lowest values of specific gravity in the treatment combination F_1I_1 were 0.922, 0.920 and 0.921.

The present study revealed that the maximum values of specific gravity of fruits were found in F_3I_3 treatment combination, which correlates with findings of Amrapali (2009) [6] in case of watermelon.

7. Interaction effect of different pulse, irrigation and fertigation levels on quality parameter of muskmelon fruit

The influence of different pulses through drip, irrigation and fertigation levels on quality parameter of fruit were worked out statistically, and the results are presented in Table 7 and graphically shown in Fig. 13 and 14.

Table 7: Interaction effect of different pulse, irrigation and fertigation levels on quality parameter of fruit

Treatment combination	TSS (Brix)			Specific Gravity		
	2022	2023	Pooled	2022	2023	Pooled
$P_1I_1F_1$	8.5	8.5	8.5	0.907	0.897	0.902
$P_1I_1F_2$	10.0	10.3	10.2	0.914	0.915	0.915
$P_1I_1F_3$	10.6	10.7	10.7	0.917	0.917	0.917
$P_1I_2F_1$	8.0	8.3	8.2	0.918	0.919	0.918
$P_1I_2F_2$	9.7	10.0	9.9	0.928	0.930	0.929
$P_1I_2F_3$	10.2	10.6	10.4	0.938	0.942	0.940
$P_1I_3F_1$	7.8	8.2	8.0	0.923	0.924	0.924
$P_1I_3F_2$	8.3	9.0	8.7	0.934	0.935	0.934
$P_1I_3F_3$	9.1	10.0	9.5	0.947	0.955	0.951
$P_2I_1F_1$	9.5	9.5	9.5	0.916	0.915	0.915
$P_2I_1F_2$	10.2	10.4	10.3	0.923	0.923	0.923
$P_2I_1F_3$	10.7	10.7	10.7	0.931	0.932	0.932
$P_2I_2F_1$	8.7	9.2	9.0	0.922	0.923	0.922
$P_2I_2F_2$	10.0	10.3	10.1	0.941	0.940	0.940
$P_2I_2F_3$	10.2	10.7	10.4	0.947	0.954	0.951
$P_2I_3F_1$	8.2	8.8	8.5	0.929	0.929	0.929
$P_2I_3F_2$	9.2	10.0	9.6	0.944	0.945	0.945
$P_2I_3F_3$	9.8	10.4	10.1	0.958	0.959	0.958
$P_3I_1F_1$	9.4	9.9	9.7	0.929	0.930	0.930
$P_3I_1F_2$	10.4	10.5	10.4	0.937	0.938	0.938
$P_3I_1F_3$	11.4	11.2	11.3	0.952	0.953	0.953
$P_3I_2F_1$	8.9	9.5	9.2	0.933	0.933	0.933
$P_3I_2F_2$	10.3	10.4	10.4	0.953	0.954	0.954
$P_3I_2F_3$	10.6	11.2	10.9	0.960	0.961	0.961
$P_3I_3F_1$	8.7	9.3	9.0	0.936	0.937	0.937
$P_3I_3F_2$	10.0	10.4	10.2	0.957	0.958	0.958
$P_3I_3F_3$	10.5	10.8	10.6	0.970	0.971	0.971
$P_4I_1F_1$	9.9	10.4	10.1	0.937	0.938	0.938
$P_4I_1F_2$	11.4	12.2	11.8	0.943	0.944	0.943
$P_4I_1F_3$	12.0	13.0	12.5	0.959	0.960	0.959
$P_4I_2F_1$	9.7	10.3	10.0	0.940	0.941	0.940
$P_4I_2F_2$	10.7	11.4	11.0	0.965	0.966	0.965
$P_4I_2F_3$	11.3	12.0	11.6	0.974	0.975	0.974
$P_4I_3F_1$	9.4	9.9	9.6	0.947	0.947	0.947
$P_4I_3F_2$	10.3	11.0	10.6	0.967	0.965	0.966
$P_4I_3F_3$	10.8	11.5	11.2	0.980	0.981	0.980
S.E.(m)±	0.0	0.0	0.0	0.002	0.001	0.001
C.D. at 5%	0.1	0.1	0.1	0.005	0.004	0.003

Table 7 shows that in the years 2021-22, 2022-23, and pooled analysis, the total soluble solids content of muskmelon was significantly influenced by various levels of pulse, irrigation, and fertigation. It was discovered that as fertigation and pulse levels increased and irrigation levels decreased, the total soluble solids increased as well. During the years 2021-22, 2022-23, and the pooled analysis, the $P_4I_1F_3$ treatment combination i.e., 12.0, 13.0, and 12.5 Brix* showed the highest value of total soluble solids, which was noticeably higher than other treatment combinations. Additionally, it was discovered that the $P_1I_3F_1$ treatment combination had the lowest total soluble solids values, which were 7.8, 8.2, and 8.0 Brix* for 2021-22, 2022-23, the pooled analysis, respectively. This may be due to the congenial environment in the root zone at four pulses (P_4) with the optimum fertigation level F_3 under stressed irrigation level, I_1. Therefore, the total soluble solids of muskmelon were found to be highest in the treatment combination of $P_4I_1F_3$.

The interaction effect of different pulse, irrigation and fertigation levels on the total soluble solids of muskmelon was investigated for the first time. When looking at individual pulse, irrigation and fertigation levels as variables, these results are compatible with those of Chander (1980) [9], Monali (2016) [19], Madane (2018) [8], Abdelraouf *et al.* (2019) [2], and Yashavantakumar *et al.* (2022) [25]. As the pulse irrigation level increases from P_1 to P_4 and P_1 to P_8, the total soluble solid of onion and orange fruit increase, in accordance with the findings of Madane (2018) [8] and Abdelraouf *et al.* (2019) [2], respectively. The total soluble solids content of muskmelon increases as the quantity of fertilizer application increases as claimed by Monali (2016) [19]. Additionally, Chander (1980) [9] and Yashavantakumar *et al.* (2022) [25] stated that the decrease in irrigation level and increase in fertigation level contributed to obtaining higher values of total soluble solids with muskmelon and cucumber crop, respectively. The present study found that, the maximum values of total soluble solids content of muskmelon in the $P_4I_1F_3$ treatment combination i.e., P_4 - four pulse level + I_1 - 70% of ET_c + F_3 - 100% of RDF (200: 100: 100 kg/ha of NPK).

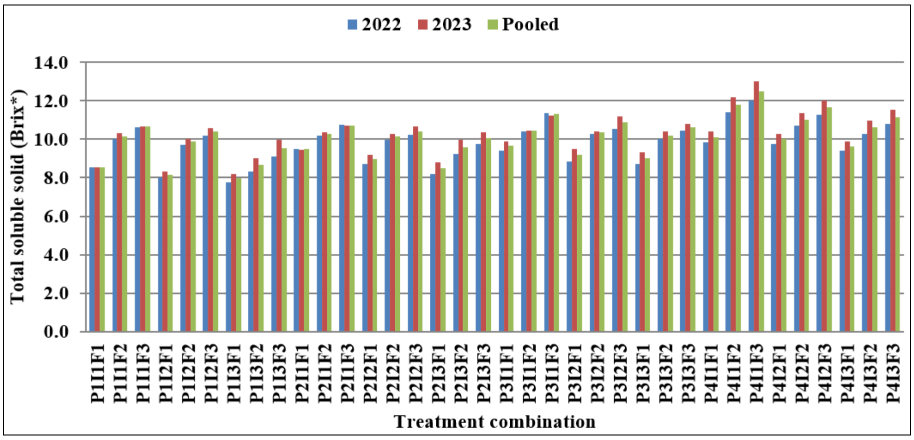

Fig 13: Interaction effect of different pulse, irrigation and fertigation levels on total soluble solids (Brix*) of fruit

It is noticed from Table 7 that the specific gravity of fruits was significantly influenced by various pulse, irrigation and fertigation levels in the year 2021-22 and 2022-23, pooled analysis. Additionally, the data shown in Table 7 showed that the $P_4I_3F_3$ treatment combination had greater fruit specific gravity values than other treatment combinations for the years 2021-22, 2022-23, and pooled analysis. Higher levels of pulse P_4, along with adequate irrigation and fertigation levels I_3 and F_3, provide the perfect growing environment for crops, which in turn raises fruit specific gravity values. The higher values of specific gravity of fruits, during the years 2021-22, 2022-23 and the pooled data were found to be 0.980, 0.981 and 0.980 in the treatment combination $P_4I_3F_3$ followed by $P_4I_2F_3$ (i.e. 0.974, 0.975 and 0.974) and $P_3I_3F_3$ (i.e. 0.970, 0.971 and 0.971). The treatment combination of $P_1I_1F_1$ showed the lowest values of specific gravity of fruits for the years 2021-22, 2022-23 and the pooled data of two years, which were discovered to be 0.907, 0.897 and 0.902, respectively. This could be the result of a single pulse applied at the minimum irrigation and fertigation levels.

Although this is the first attempt to investigate the interaction effect of various pulse, irrigation and fertigation levels on the specific gravity of fruits, the results show some overlap with the previous findings of Abdelraouf *et al* (2009) [1] and Amrapali (2009) [6]. The results of Abdelraouf *et al*. (2009) [1] showed that the specific density of potatoes increases as the number of pulse levels increases at irrigation levels of 100 and 75% of ET_c. In contrast, Amrapali (2009) [6] observed that the specific gravity of fruits of watermelon increases as the irrigation (i.e. 0.2 to 0.6 PE) and fertigation level (i.e., 80 to 120% of RDF) increases. The results of the present study are consistent with the combined discoveries of earlier researchers and provided the highest values of specific gravity of fruits in the treatment combination of $P_4I_3F_3$.

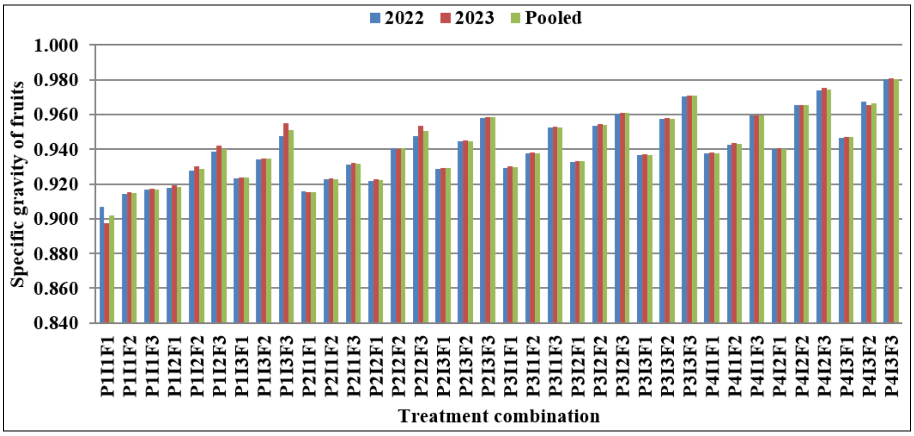

Fig 14: Interaction effect of different pulse, irrigation and fertigation levels on specific gravity of fruits

Conclusion

The quality parameter of muskmelon fruit was influenced by various pulse, irrigation and fertigation levels during the research work. The treatment combination $P_4I_3F_3$ showed significantly higher values of fruit specific gravity, which is followed by $P_4I_2F_3$ and $P_4I_3F_2$ treatment combinations. The $P_4I_1F_3$ treatment combination produced significantly superior values of total soluble solids content of muskmelon fruit. For the Konkan region, the treatment combination $P_4I_2F_3$ recommended to get superior quality parameter of muskmelon fruit.

Acknowledgement

I am highly thankful to Indian Council of Agricultural Research for financial assistance through ICAR- JRF/SRF fellowship during my Ph.D. degree programme.

References

1. Abdelraouf RE. Study the performance of pulse drip irrigation in organic agriculture for potato crop in sandy soils [Doctoral dissertation]. Cairo University, Egypt: faculty of agriculture; c2009.
2. Abdelraouf RE, Ahmed A, Tarabye HH, Refaie KM. Effect of pulse drip irrigation and organic mulching by rice straw on yield, water productivity and quality of orange under sandy soils conditions. Plant Archives. 2019;19(2):2613-2621.
3. Abdelraouf R, Alashram M, Hamza A, Fathi M. Effect of pulse irrigation and pulse fertigation on the yield, water productivity and quality of cucumber under the dry environmental conditions of sandy soil. Egypt J Chem. 2022;65(131):621-633.
4. Allen RG, Dirk R, Martien S. Crop evapotranspiration guidelines for computing crop water requirement - FAO Irrigation and Drainage Paper 56. Rome: Food and Agriculture Organizations of the United Nations; c1998.
5. Almeida de WF, Lima LA, Pereira GM. Drip pulses and soil mulching effect on American crisphead lettuce yield. Eng. Agríc. Jaboticabal. 2015;35(6):1009-1018.
6. Amrapali D. Effect of different irrigation and fertilizers levels on growth and yield of watermelon (*Citrullus lanatus*) coupled with different mulches in Konkan region [M. Tech Thesis]. Dr. B. S. K. K. V., Dapoli: College of Agricultural Engineering and Technology; c2009.
7. Anonymous. Annual report 2019-20. Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agricultural and Farmers Welfare, Government of India; c2020.
8. Bhagwat SM, Ingle PM, Kadam US, Patil ST, Bansode PB. Effect of different irrigation and fertigation levels on water use efficiency, fertilizer use efficiency and biometric parameter of strawberry crop under coastal climatic condition of Konkan region. The Pharma Innov J. 2023;12(7S):2564-2569.
9. Chander A. Studies on nitrogen fertilization under various soil moisture regimes on growth, flowering, yield and quality of muskmelon [M.sc Thesis]. Haryana Agricultural University Hisar; c1980.
10. El-Gindy AM, Abdel Aziz AA. Maximizing water use efficiency of maize crop in sandy soils. Arab University Journal of Agriculture Science. 2001;11:439-452.
11. Eric S, David S, Robert H. To pulse or not to pulse drip irrigation that is question UF/IFAS-horticultural science department. Florida, USA NFREC-SV-Vegetarian (04-05); c2004.
12. Gaikwad MA. Estimation of crop water requirement under varying climatic conditions for Dapoli Tahsil [M.Tech Thesis]. Dr. B.S.K.K.V. Dapoli, Maharashtra: College of Agricultural Engg. And Tech; c2013.
13. Jain R, Kishore P, Sigh DK. Irrigation in India: Status, Challenges and Options. Journal of Soil and Water Conservation. 2019;18(4):1-11.
14. Kadam US, Ingle PM, Thokal RT, Mahale DM. Response

of coloured capsicum under protective cover for different irrigation and fertilizer levels. Engg. Tech India. 2015;6(1):29-34.
15. Kapoor S. 20 Reasons Why Muskmelon Is Healthy for You. Practo. 2017.
16. Lester GE, Hodges DM. Antioxidants associated with fruit senescence and human health: Novel orange fleshed non-netted honey dew melon genotype comparisons following different seasonal productions and cold storage durations. Postharvest Biol Technol. 2008;48:347-354.
17. Mabalaha MB, Mitei YC, Yoboah SO. A Comparative Study of the Properties of Selected Melon Seeds Oil as Potential Candidates for Development into Economical Edible Vegetable Oil. J Am Oil Chem Soc. 2007;84:31-34.
18. Madane DA, Mane MS, Kadam US, Thokal RT. Effect of pulse irrigation (drip) through different irrigation levels on soil moisture distribution pattern and yield parameters of white onion (*Allium cepa* L.). Journal of Pharmacognosy and Phytochemistry. 2018:2421-8.
19. Monali RR. Response of muskmelon to different fertigation and schedules under polyhouse condition [M. Sc. (agri) Thesis]. MPKV Rahuri; c2016.
20. Rawat G, Kadam US, Ingle PM, Bhange HN, Dhekale JS, Patil ST, *et al*. Effect of irrigation and fertigation levels through pulse drip irrigation on water use efficiency of carrot (*Daucus carota* L.). The Pharma Innov J. 2022;11(9):2932-2938.
21. Segal U, Ben-Gal A, Shani U. Water availability and yield response to high frequency micro irrigation in sunflower. 6th International Micro-irrigation Congress. Micro-irrigation Technology for Developing agriculture; c2000 Oct 22-27.
22. Sharma R, Bhardwaj S. Effect of mulching on soil and water conservation -A review. Agric Rev. 2017;38(4):311-315.
23. Thokal RT, Sanap PB, Thorat TN, Thaware BG, Chavan SA. Influence of Irrigation Regimes, Crop Spacing and Fertilization Methods on Growth and Yield of Okra in Coastal Region of Maharashtra. J Agric Eng India. 2020;57(4):349-633.
24. Thokal RT, Sanap PB, Thorat TN, Thaware BG, Chavan SA. Influence of Irrigation Regimes, Crop Spacing and Fertilization Methods on Growth and Yield of Okra in Coastal Region of Maharashtra. J Agric Eng India. 2020;57(4):349-363.
25. Yashavantakumar KH, Mantur SM, Biradar MS, Rajkumar S, Hebsur NS. Studies on Influence of different Regimes of Irrigations and Fertigation Levels on Growth and Quality Parameters of Cucumber Grown under Protected condition. Biological Forum - An International Journal. 2022;14(2a):71-75.