

# Optimizing Rabi Chilli Production: Examining the Impact of Fertigation and Drip Irrigation Levels in the Context of Mulching Practices on Yield and Quality

## ABSTRACT

The field investigation was carried out to evaluate the influence of fertigation levels, mulch and drip irrigation levels on yield and yield quality at WTC fields, PJTSAU, Rajendranagar, Telangana during 2020-21 and 2021-22. The study was consisted of 12 treatment combinations viz. 75 %, 100 % (300-60-120 kg ha<sup>-1</sup> N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O & 125% RDF, drip irrigation levels (0.8 Epan & 1.0 Epan) imposed under factorial combination of mulch (M<sub>1</sub>) and no mulch (M<sub>0</sub>) conditions. An investigation was undertaken during *rabi* season. Among the fertigation levels, 100 % RDF (31.15 t ha<sup>-1</sup>, 195.04 mg 100 g<sup>-1</sup>, 10.33 % & 0.94 %, respectively) recorded the higher fresh fruit yield, ascorbic acid content, oleoresin content and capsaicin content in pooled data. With regards to mulch, the M<sub>1</sub> has recorded the maximum values for fresh fruit yield (37.56 t ha<sup>-1</sup>), ascorbic acid content (224.43), oleoresin content (11.11 %) and capsaicin content (0.74 %) in pooled data.

**Key Words:** Fertigation levels, irrigation levels, mulch, ascorbic acid, oleoresin content and capsaicin content

## Introduction

Vegetable and fruit production is one of the emerging businesses in India in off and on season. In Telangana, agriculture contributes a large sector of the state's economy and uses around 55.51 lakh ha with 27 different crops. Though vegetable production is limited due to water, labour availability and price fluctuations around the year. Inadequate soil moisture and high soil temperature with low organic carbon content are the major factors for declining the yield and quality of vegetable production (Yogarajuet *al.*, 2019).

Chilli (*Capsicum annuum* L.) commonly known as hot pepper belongs to family Solanaceae and is cultivated as an annual crop worldwide. It is an important spice as well as vegetable crop, where both ripe and unripe fruits are used for culinary, salad, anti-cancer agent and processing purposes. Its extract is used in pharmaceutical industry for colouring the drugs. It is an excellent source of vitamin A and C.

Beneficial effects of chilli sometimes referred as capsule of vitamin C due to high amounts of vitamin C (Davinder singh, 2016).

India contributes about 36.57% to the total world chilli production and occupies an area of 411.0 thousand hectares in the country with a production of 4363.0 thousand million tonnes and productivity of 10.6 MT ha<sup>-1</sup>. In Telangana, it occupies an area of 10.9 thousand hectares with a production of 15.78 thousand tonnes (Indiastat-2021-22). India is the largest producer, consumer and exporter of chilli, which contribute to 25 per cent of total world's production. It responds well to split application of nutrients through fertigation in terms of increased growth and yield. Pungency and colour are two important characters liked by consumers. Nitrogen is an essential component of nucleic acid and has been suggested to improve the development of vegetative structures. Potassium is well known for its role in improving quality. In foreign export and imports, quality is the important factor to be considered which can be achieved only through optimum nutrient application (Biwalkaret al., 2015).

Mulching is pertinent method to modify the hydrothermal regime of crop and enhance the efficiency of nutrients which resulting in more yield over open field condition (Shailendra et al., 2021). The consumption of water varies with method of application and frequency of application. To achieve more yield through drip, irrigation scheduling is a viable option since it can minimize the water losses of runoff and deep percolation (Supekaret al., 2021).

### **Materials and methods**

The present experiment was carried out at Water Technology Center, College Farm, College of Agriculture, Rajendranagar, Hyderabad. The field experiment was laid out in randomised complete block design, wherein three fertigation levels viz., F<sub>75</sub> (225-45-90 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O), F<sub>100</sub>(300-60-120 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) & F<sub>125</sub> (375-75-150 kg ha<sup>-1</sup> N, P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O) and two drip irrigation levels (I<sub>0.8</sub>& I<sub>1.0</sub>) imposed under factorial combination of with mulch (M<sub>1</sub>) and no mulch (M<sub>0</sub>). Thus, the experiment consisted of total 12 treatment combinations which were replicated thrice. Silver-black mulch (30 µ) sheet was laid on the field as per the treatments. Robust seeds of chilli hybrid (sonali) used as test crop and seedlings were transplanted in paired row method at spacing 45 / 30 cm x 40 cm. Equal amount of

irrigation was given up to 10 DAS to get better establishment after that irrigation was scheduled at 2 days interval based on daily evaporation data (0.8 Epan & 1.0 Epan) recorded from USWB class 'A' pan evaporimeter in agro-meteorological station, ARI Farm, Rajendranagar, Hyderabad. The fertigation was carried out through ventury system on every 4<sup>th</sup> day at 38 splits as per the treatments. Chilli fresh fruit yield was recorded at different pickings and sum of all the pickings considered as total fresh fruit yield plot and expressed in t ha<sup>-1</sup>. Quality parameters were analysed immediately after harvesting of fresh fruits during both the years. The ascorbic acid content, oleoresin content and capsaicin content was estimated as per the procedure given by Sadasivam, S and Manickam, A. (2005).

Comment [u1]: Procedure should be stated

## Results and Discussion

### Yield

The total fresh fruit yield of chilli was found to be significantly influenced by mulch and fertigation levels (Table 1). Among the fertigation levels, F<sub>100</sub> resulted in significantly the highest total fresh fruit yield (30.98 t ha<sup>-1</sup>) followed by F<sub>125</sub> (28.85 t ha<sup>-1</sup>) and the lowest was registered in F<sub>75</sub> (24.13 t ha<sup>-1</sup>) during I year. Likewise, the F<sub>100</sub> recorded the highest total fresh fruit yield of chilli (31.32 & 31.15 t ha<sup>-1</sup>) and was on par with F<sub>125</sub> (30.38 & 29.62 t ha<sup>-1</sup>) & significantly over F<sub>75</sub> (24.58 & 24.36 t ha<sup>-1</sup>). Drip fertigation with 100 % RDF positively influenced the total fresh fruit yield of chilli which was due to positive affect on yield attributing characters ultimately higher fruit yield. Right amount of NPK during flowering stage that favourably increased the number of flowers plant<sup>-1</sup> obviously led to increased fruit setting. Another possible reason was the timely availability of nutrients led to increased growth, higher uptake of nutrients, better photo assimilation and better translocation of assimilates from source to sink which in turn increased total fresh fruit yield (Subramani, 2008). Ayare *et al.* (2012) described about fertigation which was concentrated near the root zone and resulting in production of more dry matter by more efficient utilization of applied nutrients ultimately yield of the crop.

With mulching, during I year, it has recorded 1.83, 2.09 & 1.96 times higher fresh fruit yield over non-mulching (19.77, 18.62 & 19.19 t ha<sup>-1</sup>) during I, II year and in pooled data. It might be due to mulch provides the congenial conditions to the plant like water availability & its retention for long time and constant availability of

nutrients throughout the crop period which might have improved the growth and yield. Similar results were observed by Kumara *et al.* (2015). Another reason might be pest and disease attack was relatively less under mulch and healthier plants were observed in mulch which resulted higher yield over no mulch Iftikhar Ahmad *et al.* (2011).

The irrigation levels did not show any significant difference during both the years. Among the interactions, the combination of fertigation levels, mulch and drip irrigation levels found to be significant (Table 1). It was noticed that during 2020-21 (I year),  $F_{100} + I_{0.8} + M_1$  has recorded the highest total fresh fruit yield of chilli (42.85 t ha<sup>-1</sup>) and it was on par with  $F_{125} + I_{0.8} + M_1$  (38.13 t ha<sup>-1</sup>),  $F_{100} + I_{1.0} + M_1$  (38.03 t ha<sup>-1</sup>),  $F_{125} + I_{1.0} + M_1$  (34.78 t ha<sup>-1</sup>) and  $F_{75} + I_{1.0} + M_1$  (34.14 t ha<sup>-1</sup>) and significantly higher over all other treatments. During II year fertigation levels coupled with mulch treatments were found to be significant. The mean data revealed that  $F_{100} + M_1$  has recorded 43.36 t ha<sup>-1</sup> of total fresh fruit yield followed by  $F_{125} + M_1$  (41.28 t ha<sup>-1</sup>) and which was significantly higher over  $F_{75} + M_1$  (32.07 t ha<sup>-1</sup>),  $F_{125} + M_0$  (19.49 t ha<sup>-1</sup>),  $F_{100} + M_0$  (19.27 t ha<sup>-1</sup>) &  $F_{75} + M_0$  (17.09 t ha<sup>-1</sup>). In pooled data, none of the interactions showed any significant influence on total fresh fruit yield of chilli.

The water requirement of crop varies in mulch and non-mulching condition, optimum soil moisture condition near the root zone has reduced the moisture losses and proliferate the dry matter partitioning and helped in the diversion of photosynthesis to the reproductive parts ultimately resulted in higher yield (Rajane *et al.*, 2017). Maida *et al.* (2020) observed that 0.8 IW/CPE treatment has recorded the maximum fruit length, maximum fruit diameter, maximum average weight of fruit. Chilli is sensitive to fluctuation in temperature and moisture. Mulch protected the crop from higher temperatures and modifies the hydrothermal properties of soil which resulted better plant growth and yield (Siti Aishai Hassan *et al.*, 1995). Mulch in conjunction with drip irrigation and fertigation hasten the growth and yield of the crop may be due to favourable moisture maintained in the root zone, its availability to plants, avoiding leaching of soluble fertilizers, weed free environment. During second year of the study with higher levels of NPK @ 125 % lower the fresh fruit yield was noticed under no mulch condition (Anup Niranjana, 2017).

**Ascorbic Acid (mg 100 g<sup>-1</sup>)**

The results revealed that highest ascorbic acid content (Table 2) was observed with F<sub>100</sub> among fertigation levels, which was 2.47% higher over F<sub>125</sub> (198.33 mg 100 g<sup>-1</sup>). The F<sub>100</sub> and F<sub>125</sub> treatments are on par to each other. The lowest ascorbic acid content was noticed in F<sub>75</sub> (177.00 mg 100 g<sup>-1</sup>) during I year. Similarly higher ascorbic acid content was observed with F<sub>100</sub>, which was 7.69 % & 14.40 % higher over F<sub>125</sub> and F<sub>75</sub> respectively. Significantly lower ascorbic acid content was noticed in F<sub>75</sub> (180.51 mg 100 g<sup>-1</sup>) during II year. In pooled data, the F<sub>100</sub> has recorded the highest ascorbic acid content (204.87 mg 100 g<sup>-1</sup>) and was on par to the F<sub>125</sub> (195.04 mg 100 g<sup>-1</sup>) and the lower value was recorded in F<sub>75</sub> (178.75 mg 100 g<sup>-1</sup>). Higher ascorbic acid content found with optimum level of NPK @ 100 % RDF could be due to higher NPK which influenced the carbohydrate synthesis and formation of ascorbic acid, as ascorbic acid is mainly constituted of carbohydrate compounds. These results were in line with Mounika (2016) and Shilpa (2019). Mehnaz Akram *et al.* (2017) and Janardhanrao (2020) who reported that the highest ascorbic acid content (118 mg 100 g<sup>-1</sup>) with higher levels of NPK @ 100 % RDF was due to enhancement of enzyme activity for amino acids synthesis leading to higher ascorbic acid content.

With mulching of the chilli crop, the M<sub>1</sub> has recorded 38.04 %, 40.15 % & 39.09% higher ascorbic acid content over M<sub>0</sub> (162.03, 160.67 & 161.35 mg 100 g<sup>-1</sup>, respectively) during I, II year and in pooled data. There was insignificant variation found between I<sub>0.8</sub> & I<sub>1.0</sub> irrigation levels during both the years. The interaction effect among fertigation levels, mulch and drip irrigation levels found to be non-significant. Relatively higher content was observed in F<sub>100</sub>+I<sub>1.0</sub>+M<sub>1</sub> (241.35 mg 100 g<sup>-1</sup>). There was positive correlation observed between yield and mean ascorbic acid content. The determination coefficient (R<sup>2</sup>) (Figure 1) was 0.962 in pooled data which showed a linear increase in ascorbic acid content observed with total fresh yield.

Generally ascorbic acid production mainly controlled by changes in the soil temperature (Davinder Singh 2016). Mulch maintains the temperature range from 24°C to 32°C at different pickings hence higher ascorbic acid content recorded. Similar results were observed by Ashrafuzzaman *et al.* (2011) and Maida *et al.* (2019).

#### **Oleoresin content (%)**

Oleoresin is essential oil that gives sharp pungent aroma and the data related to oleoresin content of fresh chilli is presented in Table 3. With respect to the fertigation levels, during I year, F<sub>100</sub> recorded the higher oleoresin content (11.36 %) followed by F<sub>125</sub> (10.50 %) and the lowest oleoresin content was registered in F<sub>75</sub> (10.02%). During II year, F<sub>100</sub> recorded higher oleoresin content (9.30 %) followed by F<sub>75</sub> (8.51 %) whereas the minimum oleoresin content was recorded in lower level of NPK (F<sub>125</sub>-8.20 %) treatment. In the pooled data, higher content was recorded in F<sub>100</sub> and which was 1.08, 1.13 & 1.10 times higher over F<sub>125</sub> (9.35 %). The lowest content was found in F<sub>75</sub> (9.26 %) though it was on par with F<sub>125</sub>. There was significant variation found between mulch and non-mulch treatments. The mulch (M<sub>1</sub>) treatment was observed 33.58 %, 38.16% & 35.62% higher content when compared to the no mulch treatment (9.10, 7.28 & 8.19 %, respectively) during I, II year and in pooled data. With respect to irrigation levels, their interaction with fertigation levels and mulch has not shown significant influence on oleoresin content.

The data on correlation between yield and mean oleoresin content (Figure 1) revealed that there was significant positive correlation observed for oleoresin (0.896) in I, II year and in pooled data respectively.

The highest oleoresin content observed with F<sub>100</sub> treatment, it might be attributed due to greater synthesis and translocation of photosynthates in fruits on account of increased uptake of nutrients. These results were in corroborative to Shilpa (2019), Mounika (2016). Under mulch it could be due to optimum soil moisture which hastens the physiological growth that ultimately increased the production of secondary metabolites (Davinder Singh, 2016).

#### **Capsaicin content (%)**

Market demand of chilli depends on the pungency of the fruit, capsaicin major is the alkaloid responsible for pungency in chilli. It is mainly controlled by genetic characters of the plant but external environment and management practices also plays significant role in synthesis of capsaicin and data related capsaicin content of fresh of chilli fruit is presented in Table 3. The capsaicin content was significantly influenced by fertigation levels and mulch during both the years. With respect to the fertigation levels, during 2020-21 (I year), F<sub>125</sub> recorded higher capsaicin content (0.90 %) and was on par with F<sub>100</sub> (0.86 %). the lowest capsaicin content (0.73 %) was registered in

F<sub>75</sub> treatment. The F<sub>100</sub> has recorded higher capsaicin content (1.02 & 0.94 %) followed by F<sub>125</sub> (0.93 & 0.91 %) whereas minimum capsaicin content was recorded with F<sub>75</sub> (0.85 & 0.79 %) during II year and in pooled data respectively. Higher levels of NPK improved the fruit quality, Capsaicin content increased with increase in the NPK fertigation levels which might be due to external application of nitrogen that is essential for the synthesis of capsinoids as nitrogen controls the activity of phenylalaineammonialyase enzyme and capsaicin synthase enzyme which were responsible for production as well as longitivity of capsaicin content in the chilli. Similar results were observed by Mounika (2016) and Shilpa (2019).

Data related to mulch indicated that the variation between the mulch and no mulch treatments was significant. During I year, the maximum capsaicin content was observed in M<sub>0</sub> (0.99 %, 1.05 % & 1.02 %, respectively) over M<sub>1</sub> (0.67 %, 0.81% & 0.74 %, respectively) during I, II year and in pooled data. Data pertaining to the irrigation levels, there was no significant variation found between the I<sub>0.8</sub> & I<sub>1.0</sub> during both the years. The interaction effect among the fertigation levels, mulch and drip irrigation levels found to be significant during II year but not in I year and in pooled data. During II year, the highest content was noticed in F<sub>100</sub>+I<sub>1.0</sub>+M<sub>0</sub> (1.33 %) which was on par with F<sub>100</sub>+I<sub>0.8</sub>+M<sub>0</sub> (1.06 %), F<sub>125</sub>+I<sub>1.0</sub>+M<sub>0</sub> (1.06 %), F<sub>75</sub>+I<sub>0.8</sub>+M<sub>0</sub> (1.00 %), F<sub>75</sub>+I<sub>1.0</sub>+M<sub>0</sub> (0.95 %), F<sub>125</sub>+I<sub>1.0</sub>+M<sub>1</sub> (0.95 %), F<sub>125</sub>+I<sub>0.8</sub>+M<sub>0</sub> (0.93 %) and F<sub>100</sub>+I<sub>0.8</sub>+M<sub>1</sub> (0.90 %). The lowest content was resulted in F<sub>75</sub>+I<sub>1.0</sub>+M<sub>1</sub> (0.70 %). In pooled data, relatively higher capsaicin content was observed in F<sub>100</sub>+I<sub>1.0</sub>+M<sub>0</sub> (1.22 %) closely followed by F<sub>100</sub>+I<sub>0.8</sub>+M<sub>0</sub> (1.03 %). Capsaicin content and fruit yield are highly negatively correlated. The determination coefficient (R<sup>2</sup>) (Figure 1) showed as non-significant (P=0.01) in pooled data (0.4222).

No mulch treatment recorded higher capsaicin content due to water stress condition which boosted the activity of antioxidant enzyme in chilli leaves and fruits and leads to the production of high capsaicin content. Another reason might be due to limited moisture content under no mulch condition along with with optimum NPK enhances activity of capsaicin synthase enzyme and ultimately increased the production of capsaicin (Subramani 2008).

#### **Conclusion:**

From the current study, it can be concluded that application of 100 % RDF along with I<sub>0.8</sub> + mulch resulted in higher yield and quality of chilli further increment in the nutrients and water reduced the spiciness of the chilli besides reduction in the yield. So that 100 % RDF along with I<sub>0.8</sub> + mulch might be recommended for green chilli growers for achieving higher quality.

## Reference

- Ashrafuzzaman, M., Abdul Halim, M., Mohd Razi Ismail., Shahidullah, S.M and Alamgir Hossain, M. 2011. Effect of plastic mulch on growth and yield of chilli (*Capsicum annuum* L.). *Brazilian Archives of Biology and Technology*. 54(2): 321-330.
- Bisen., B.P and Garima Diwan. 2019. Effect of plastic mulch on growth and yield of chilli (*Capsicum annuum* L.). *International Journal of Current Microbiology and Applied Sciences*. 8(12): 2056-2062.
- Biwalkar, N., Singh, K.G., Jain, A.K., Sharda, R., Jindal, S.K., Singh, K and Chawla, N. 2015. Response of coloured sweet pepper to fertigation and irrigation levels under naturally ventilated greenhouse. *Agricultural Research Journal*. 52 (1): 19-25.
- Davinder Singh. 2016. Growth, yield and quality of chilli (*Capsicum annuum* L.) in relation to use of various types of mulches. *M.Sc Thesis* submitted to Punjab Agricultural University, Ludhiana.
- Indiastat, 2022. <https://www.indiastat.com/table/agriculture/area-production-productivity-chilli-india-2011/962548>
- Janardhanrao, S.S. 2020. Impact of irrigation and fertigation levels on growth, yield and quality of summer chilli (*Capsicum annuum* L.). *Ph.D Thesis* submitted to Department of Agricultural Engineering, Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India.
- Maida, P., Maida, Bisen., B.P and Garima Diwan. 2019. Effect of plastic mulch on growth and yield of chilli (*Capsicum annuum* L.). *International Journal of Current Microbiology and Applied Sciences*. 8(12): 2056-2062.
- Mehnaz Akram., Sayed Hussain., Abdul Hamid., Sajid Majeed., Saeed Ahmed

- Chaudary., Zulifqar Ali Shah., Abid Yaqoob., Fozia Kayani., Uzma Arif., Kiran Fareed., Faiza Jamil., Zarfishan Mehmood., Saba Basher., Ayaz Ahmed Arif and Naveed Akhter. 2017. Interactive effect of phosphorus and potassium on growth, yield, quality and seed production of chili (*Capsicum annuum* L.). *Journal of Horticulture*. 4(1): 1-5.
- Mounika, D. 2016. Paprika (*Capsicum annuum*. L) response to fertigation levels of nitrogen and potassium. *M.Sc thesis* submitted to Department of Water Technology Center, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana, India.
- nutrient management studies on growth, yield and quality attributes in chilli (*Capsicum annuum* L.). *International Journal of Current Microbiology and Applied Sciences*. 8(2): 2518-2526.
- Palacio J.J.R. 1977. Flavours and non alcoholic beverages. *Journal of American Agricultural Chemistry*. 60: 970.
- Sadasivam, S and Manickam, A. 2005. *Biochemical Methods*. New Age International Publishers. New Delhi.
- Shilpa. 2019. Response of coloured varieties of capsicum (*capsicumannuum* var. grossum) to nitrogen and potassium fertigation under shade net. *M.Sc thesis* submitted to Department of Water Technology Center, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana, India
- Subramani. 2008. Optimization of nutrient requirement for hybrid chillies under drip fertigation system in open field cultivation. *Ph.D Thesis*. Submitted to Agricultural College and Research Institute, Tamil Nadu Agricultural University. Tamil Nadu, India.
- Yogaraju, M. Srinivasa, V., Mahadevprasad, Y.M and Devaraju. 2019. Integrated nutrient management studies on growth, yield and quality attributes in chilli (*Capsicum annuum* L.). *International Journal of Current Microbiology and Applied Sciences*. 8(2): 2518-2526.
- Shailendra Kumawat, Ajay Kumawat, KP Asati and Rajesh Bhuriya. 2021. Effect of different mulches on growth, yield and economics of chilli (*Capsicum annuum* L.). *The Pharma Innovation Journal*. 10(7): 903-906.

- Supekar., S.J, Kadale., A.S and Bhagyawant., R.G. 2021. Effect of different irrigation and fertigation levels on fruit quality and yield of summer chilli(*Capsicum annuum* L.). 9(2): 1039-1043.
- Ayare, B.L., Thokal, R.T., Mane, M.S.,Thorat, T.N. and Dabke, D.J. 2012. Effect of micro-irrigation systems and fertilizer levels on growth and yield of green chilli (*Capsicum annuum*). *International Journal of Agricultural Engineering*. 5(2): 220-224.
- Kumara, N., Loganandhan, N., Somashekhar and Hanumanthe Gowda, B. 2016. Effect of black polythene mulches on growth and yield of green chilli (*Capsicum annuum*) in Tumkur District, Karnataka. *Nature, Environment and Pollution Technology*. 15(1): 201-204.
- Iftikhar Ahmad, Zahoor Hussain, Shuaib Raz, Noor-Un- Nisa Memon and Summar Abbas Naqvi. 2011. Response of vegetative and reproductive components of chili to inorganic and organic mulches. *Pakistan Journal of Agricultural Science*. 48(1):19-24.
- Maida., Bisen, B.P and Umesh Dhaka. 2020. Effect of different irrigation levels on growth and yield of chilli (*Capsicumannuum* l.). *Bulletin of Environment, Pharmacology and Life Sciences*. 9(5): 18-22.
- Rajanee Salunkhe., Wadatkar, S.B., Kale, M.U., Rao, K.V.R and Deshmukh, M.M. 2017. Response of capsicum to different irrigation schedules under protected and open cultivation. *Agriculture Update*. 12(4): 995-1001.
- Siti Aishai Hassan, Zainal Abidin, R and Ramlan, M.F. 1995. Growth and yield of chilli (*Capsicumannuum* l.) in response to mulching and potassium fertilization. *Pertanika Journal of Agricultural Science*. 18(2): 113-117.
- Anup Niranjan. 2017. Effect of polyethylene mulch and drip fertigation on production of chilli crop. *M.Tech. thesis* submitted to Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. India.

Comment [u2]: sort

Table 1. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on total fruit yield ( $t\ ha^{-1}$ ) of chilli during 2020-21 (I year), 2021-21 (II year) and in pooled data during rabi season. Table 2. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on ascorbic acid content ( $mg\ 100\ g^{-1}$ ) of chilli during 2020-21 (I year) and 2021-21 (II year) during rabi season.

2020-21 (I Year)- Total fruit yield ( $t\ ha^{-1}$ )							
Treatments	No mulch		Mean	Mulch		Mean	Overall Mean
	I <sub>0.8</sub>	I <sub>1.0</sub>		I <sub>0.8</sub>	I <sub>1.0</sub>		
F <sub>75</sub>	15.63	17.44	<b>16.53</b>	29.34	34.14	<b>31.74</b>	<b>24.13</b>
F <sub>100</sub>	17.15	25.89	<b>21.52</b>	42.85	38.03	<b>40.44</b>	<b>30.98</b>
F <sub>125</sub>	19.31	23.18	<b>21.24</b>	38.13	34.78	<b>36.46</b>	<b>28.85</b>
<b>Mean</b>	<b>17.36</b>	<b>22.17</b>	<b>19.77</b>	<b>36.77</b>	<b>35.65</b>	<b>36.21</b>	
<b>Mean of I<sub>0.8</sub></b>			<b>27.07</b>	<b>Mean of I<sub>1.0</sub></b>		<b>28.91</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions		SEm(±)	CD (P=0.05)	
Mulch (M)	1.81	5.31	I X M		2.56	NS	
Irrigation (I)	1.81	NS	F x M		3.14	NS	
Fertigation (F)	0.64	1.88	F x I		3.14	NS	
			F x M x I		4.44	13.01	
2021-22 (II Year)- Total fruit yield ( $t\ ha^{-1}$ )							
F <sub>75</sub>	17.37	16.81	<b>17.09</b>	32.25	31.88	<b>32.07</b>	<b>24.58</b>
F <sub>100</sub>	18.27	20.27	<b>19.27</b>	42.57	44.14	<b>43.36</b>	<b>31.32</b>
F <sub>125</sub>	15.94	23.05	<b>19.49</b>	43.09	39.46	<b>41.28</b>	<b>30.38</b>
<b>Mean</b>	<b>17.19</b>	<b>20.04</b>	<b>18.62</b>	<b>39.30</b>	<b>38.50</b>	<b>38.90</b>	
<b>Mean of I<sub>0.8</sub></b>			<b>28.25</b>	<b>Mean of I<sub>1.0</sub></b>		<b>29.27</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions		SEm(±)	CD (P=0.05)	
Mulch (M)	2.03	5.94	I X M		2.87	NS	
Irrigation (I)	2.03	NS	F x M		3.51	10.30	
Fertigation (F)	0.72	2.10	F x I		3.51	NS	
			F x M x I		4.96	NS	
Mean of two years (pooled data)- Total fruit yield ( $t\ ha^{-1}$ )							
F <sub>75</sub>	16.50	17.12	<b>16.81</b>	30.79	33.01	<b>31.90</b>	<b>24.36</b>
F <sub>100</sub>	17.71	23.08	<b>20.40</b>	42.71	41.09	<b>41.90</b>	<b>31.15</b>
F <sub>125</sub>	17.62	23.11	<b>20.37</b>	40.61	37.12	<b>38.87</b>	<b>29.62</b>
<b>Mean</b>	<b>17.28</b>	<b>21.11</b>	<b>19.19</b>	<b>38.04</b>	<b>37.07</b>	<b>37.56</b>	
<b>Mean of I<sub>0.8</sub></b>			<b>27.66</b>	<b>Mean of I<sub>1.0</sub></b>		<b>29.09</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions		SEm(±)	CD (P=0.05)	
Mulch (M)	3.00	8.80	I X M		4.25	NS	
Irrigation (I)	3.00	NS	F x M		5.20	NS	
Fertigation (F)	1.06	3.11	F x I		5.20	NS	
			F x M x I		7.35	NS	
F <sub>75</sub> = 225-45-90 g N-P2O5-K2O ha-1; F <sub>100</sub> = 300-60-120 g N-P2O5-K2O ha-1; F <sub>125</sub> = 375-75-150 g N-P2O5-K2O ha-1							

2020-21 (I Year)- ascorbic acid content (mg 100 g <sup>-1</sup> )							
Treatments	No mulch		Mean	Mulch		Mean	Overall Mean
	I <sub>0.8</sub>	I <sub>1.0</sub>		I <sub>0.8</sub>	I <sub>1.0</sub>		
F <sub>75</sub>	146.86	150.48	<b>148.67</b>	204.28	206.36	<b>205.32</b>	<b>177.00</b>
F <sub>100</sub>	158.12	179.92	<b>169.02</b>	239.40	235.51	<b>237.46</b>	<b>203.24</b>
F <sub>125</sub>	165.87	170.95	<b>168.41</b>	236.25	220.24	<b>228.24</b>	<b>198.33</b>
<b>Mean</b>	<b>156.95</b>	<b>167.11</b>	<b>162.03</b>	<b>226.64</b>	<b>220.70</b>	<b>223.67</b>	
Mean of I <sub>0.8</sub>			<b>191.80</b>	Mean of I <sub>1.0</sub>		<b>193.91</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions			SEm(±)	CD (P=0.05)
Mulch (M)	12.09	35.45	I X M			17.10	NS
Irrigation (I)	12.09	NS	F x M			20.94	NS
Fertigation (F)	4.27	12.54	F x I			20.94	NS
			F x M x I			29.61	NS
2021-22 (II Year)- ascorbic acid content (mg 100 g <sup>-1</sup> )							
F <sub>75</sub>	158.40	154.77	<b>156.58</b>	199.59	209.29	<b>204.44</b>	<b>180.51</b>
F <sub>100</sub>	166.01	176.38	<b>171.20</b>	236.44	247.20	<b>241.82</b>	<b>206.51</b>
F <sub>125</sub>	133.86	174.61	<b>154.24</b>	228.12	230.45	<b>229.28</b>	<b>191.76</b>
<b>Mean</b>	<b>152.76</b>	<b>168.59</b>	<b>160.67</b>	<b>221.39</b>	<b>228.98</b>	<b>225.18</b>	
Mean of I <sub>0.8</sub>			<b>187.07</b>	Mean of I <sub>1.0</sub>		<b>198.78</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions			SEm(±)	CD (P=0.05)
Mulch (M)	11.22	32.92	I X M			15.87	NS
Irrigation (I)	11.22	NS	F x M			19.44	NS
Fertigation (F)	3.97	11.64	F x I			19.44	NS
			F x M x I			27.49	NS
Mean of two years (pooled data)- ascorbic acid content (mg 100 g <sup>-1</sup> )							
F <sub>75</sub>	152.63	152.62	<b>152.63</b>	201.94	207.83	<b>204.88</b>	<b>178.75</b>
F <sub>100</sub>	162.07	178.15	<b>170.11</b>	237.92	241.35	<b>239.64</b>	<b>204.87</b>
F <sub>125</sub>	149.86	172.78	<b>161.32</b>	232.19	225.34	<b>228.76</b>	<b>195.04</b>
<b>Mean</b>	<b>154.85</b>	<b>167.85</b>	<b>161.35</b>	<b>224.01</b>	<b>224.84</b>	<b>224.43</b>	
Mean of I <sub>0.8</sub>			<b>189.43</b>	Mean of I <sub>1.0</sub>		<b>196.35</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions			SEm(±)	CD (P=0.05)
Mulch (M)	11.38	33.38	I X M			16.10	NS
Irrigation (I)	11.38	NS	F x M			19.71	NS
Fertigation (F)	4.02	11.80	F x I			19.71	NS
			F x M x I			27.88	NS
F <sub>75</sub> = 225-45-90 g N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O ha <sup>-1</sup> ; F <sub>100</sub> = 300-60-120 g N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O ha <sup>-1</sup> ; F <sub>125</sub> = 375-75-150 g N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O ha <sup>-1</sup>							

Table 3. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on oleoresin content (%) of chilli during 2020-21 (I year) and 2021-21 (II year) during *rabi* season.

2020-21 (I Year)- oleoresin content (%)							
Treatments	No mulch		Mean	Mulch		Mean	Overall Mean
	I <sub>0.8</sub>	I <sub>1.0</sub>		I <sub>0.8</sub>	I <sub>1.0</sub>		
F <sub>75</sub>	8.53	9.13	<b>8.83</b>	11.08	11.33	<b>11.21</b>	<b>10.02</b>
F <sub>100</sub>	9.70	9.69	<b>9.69</b>	13.85	12.22	<b>13.03</b>	<b>11.36</b>
F <sub>125</sub>	9.05	8.50	<b>8.77</b>	12.90	11.56	<b>12.23</b>	<b>10.50</b>
<b>Mean</b>	<b>9.09</b>	<b>9.11</b>	<b>9.10</b>	<b>12.61</b>	<b>11.70</b>	<b>12.16</b>	
Mean of I <sub>0.8</sub>			<b>10.85</b>	Mean of I <sub>1.0</sub>		<b>10.40</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions			SEm(±)	CD (P=0.05)
Mulch (M)	0.59	1.73	I X M			0.84	NS
Irrigation (I)	0.59	NS	F x M			1.02	NS
Fertigation (F)	0.21	0.61	F x I			1.02	NS
			F x M x I			1.45	NS
2021-22 (II Year)- oleoresin content (%)							
F <sub>75</sub>	7.08	7.67	<b>7.38</b>	9.21	10.06	<b>9.63</b>	<b>8.51</b>
F <sub>100</sub>	7.53	7.58	<b>7.56</b>	10.75	11.34	<b>11.05</b>	<b>9.30</b>
F <sub>125</sub>	6.49	7.32	<b>6.91</b>	10.07	8.92	<b>9.50</b>	<b>8.20</b>
<b>Mean</b>	<b>7.04</b>	<b>7.52</b>	<b>7.28</b>	<b>10.01</b>	<b>10.11</b>	<b>10.06</b>	
Mean of I <sub>0.8</sub>			<b>8.52</b>	Mean of I <sub>1.0</sub>		<b>8.82</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions			SEm(±)	CD (P=0.05)
Mulch (M)	0.49	1.44	I X M			0.69	NS
Irrigation (I)	0.49	NS	F x M			0.85	NS
Fertigation (F)	0.17	0.51	F x I			0.85	NS
			F x M x I			1.20	NS
Mean of two years (pooled data)- oleoresin content (%)							
F <sub>75</sub>	7.81	8.40	<b>8.10</b>	10.15	10.69	<b>10.42</b>	<b>9.26</b>
F <sub>100</sub>	8.62	8.63	<b>8.63</b>	12.30	11.78	<b>12.04</b>	<b>10.33</b>
F <sub>125</sub>	7.77	7.91	<b>7.84</b>	11.49	10.24	<b>10.86</b>	<b>9.35</b>
<b>Mean</b>	<b>8.06</b>	<b>8.32</b>	<b>8.19</b>	<b>11.31</b>	<b>10.90</b>	<b>11.11</b>	
Mean of I <sub>0.8</sub>			<b>9.69</b>	Mean of I <sub>1.0</sub>		<b>9.61</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions			SEm(±)	CD (P=0.05)
Mulch (M)	0.51	1.50	I X M			0.72	NS
Irrigation (I)	0.51	NS	F x M			0.88	NS
Fertigation (F)	0.18	0.53	F x I			0.88	NS
			F x M x I			1.25	NS
F <sub>75</sub> = 225-45-90 g N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O ha <sup>-1</sup> ; F <sub>100</sub> = 300-60-120 g N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O ha <sup>-1</sup> ; F <sub>125</sub> = 375-75-150 g N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O ha <sup>-1</sup>							

Table 4. Effect of fertigation and irrigation levels under mulch and non-mulch conditions on capsaicin content (%) of chilli during 2020-21 (I year), 2021-21 (II year) and in pooled data during *rabi* season.

2020-21 (I Year)- capsaicin (%)							
Treatments	No mulch		Mean	Mulch		Mean	Overall Mean
	I <sub>0.8</sub>	I <sub>1.0</sub>		I <sub>0.8</sub>	I <sub>1.0</sub>		
F <sub>75</sub>	0.87	0.82	<b>0.85</b>	0.52	0.68	<b>0.60</b>	<b>0.73</b>
F <sub>100</sub>	1.01	1.12	<b>1.06</b>	0.55	0.78	<b>0.66</b>	<b>0.86</b>
F <sub>125</sub>	1.03	1.08	<b>1.05</b>	0.74	0.75	<b>0.74</b>	<b>0.90</b>
<b>Mean</b>	<b>0.97</b>	<b>1.01</b>	<b>0.99</b>	<b>0.60</b>	<b>0.74</b>	<b>0.67</b>	
Mean of I <sub>0.8</sub>			<b>0.79</b>	Mean of I <sub>1.0</sub>		<b>0.87</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions		SEm(±)	CD (P=0.05)	
Mulch (M)	0.06	0.18	I X M		0.08	NS	
Irrigation (I)	0.06	NS	F x M		0.10	NS	
Fertigation (F)	0.02	0.06	F x I		0.10	NS	
			F x M x I		0.15	NS	
2021-22 (II Year)- capsaicin (%)							
F <sub>75</sub>	1.00	0.95	<b>0.98</b>	0.74	0.70	<b>0.72</b>	<b>0.85</b>
F <sub>100</sub>	1.06	1.33	<b>1.20</b>	0.90	0.81	<b>0.85</b>	<b>1.02</b>
F <sub>125</sub>	0.93	1.06	<b>0.99</b>	0.78	0.95	<b>0.87</b>	<b>0.93</b>
<b>Mean</b>	<b>1.00</b>	<b>1.11</b>	<b>1.05</b>	<b>0.81</b>	<b>0.82</b>	<b>0.81</b>	
Mean of I <sub>0.8</sub>			<b>0.90</b>	Mean of I <sub>1.0</sub>		<b>0.97</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions		SEm(±)	CD (P=0.05)	
Mulch (M)	0.05	0.15	I X M		0.07	NS	
Irrigation (I)	0.05	NS	F x M		0.09	NS	
Fertigation (F)	0.02	0.05	F x I		0.09	NS	
			F x M x I		0.12	0.44	
Mean of two years (pooled data)- capsaicin (%)							
F <sub>75</sub>	0.94	0.89	<b>0.91</b>	0.63	0.69	<b>0.66</b>	<b>0.79</b>
F <sub>100</sub>	1.03	1.22	<b>1.13</b>	0.72	0.80	<b>0.76</b>	<b>0.94</b>
F <sub>125</sub>	0.98	1.07	<b>1.02</b>	0.76	0.85	<b>0.80</b>	<b>0.91</b>
<b>Mean</b>	<b>0.98</b>	<b>1.06</b>	<b>1.02</b>	<b>0.71</b>	<b>0.78</b>	<b>0.74</b>	
Mean of I <sub>0.8</sub>			<b>0.84</b>	Mean of I <sub>1.0</sub>		<b>0.92</b>	
Treatments	SEm(±)	CD (P=0.05)	Interactions		SEm(±)	CD (P=0.05)	
Mulch (M)	0.06	0.16	I X M		0.08	NS	
Irrigation (I)	0.06	NS	F x M		0.10	NS	
Fertigation (F)	0.02	0.06	F x I		0.10	NS	
			F x M x I		0.14	NS	

F<sub>75</sub>= 225-45-90 g N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O ha<sup>-1</sup>; F<sub>100</sub>= 300-60-120 g N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O ha<sup>-1</sup>; F<sub>125</sub>= 375-75-150 g N-P<sub>2</sub>O<sub>5</sub>-K<sub>2</sub>O ha<sup>-1</sup>

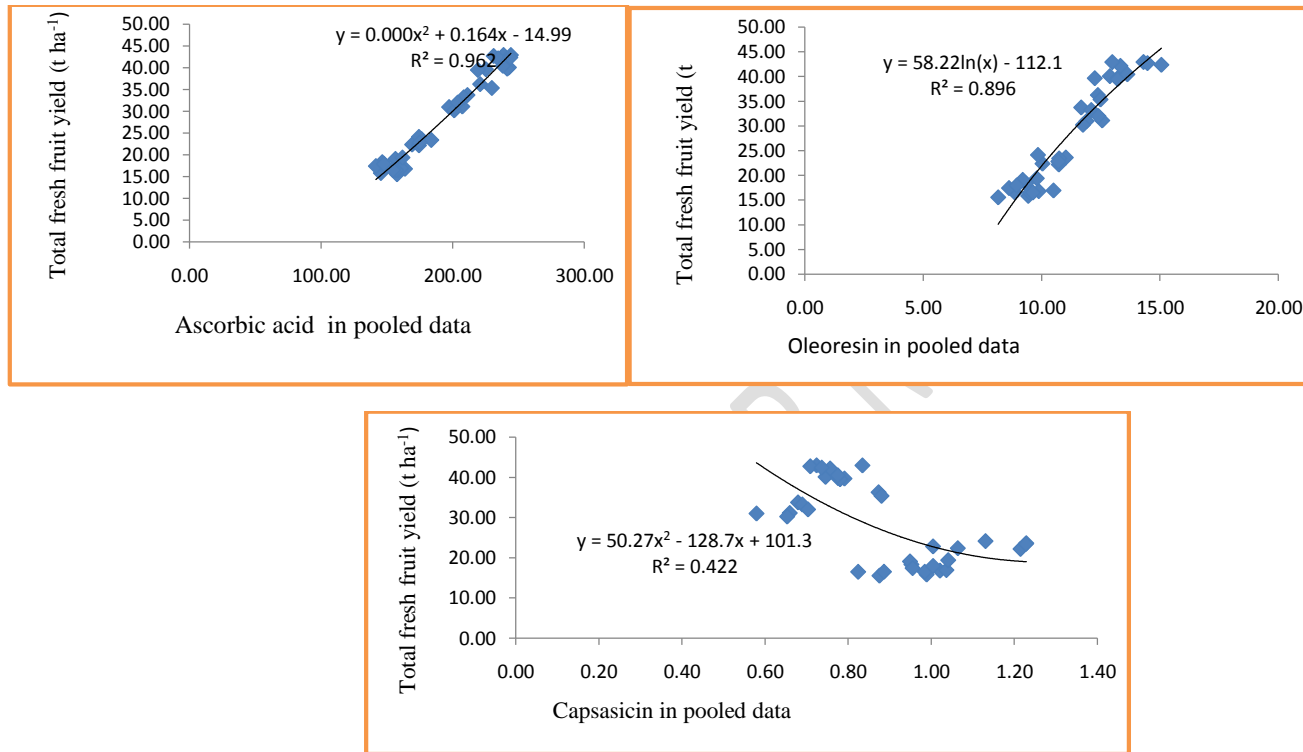


Fig 1 Regression of chilli fruit yield (t ha<sup>-1</sup>) with ascorbic acid content (mg 100 g<sup>-1</sup>), oleoresin content (%) and capsaicin content (%) in pooled data.

**Comment [u4]:** Take it under your discussion part