Effect of mulch and irrigation schedule on performance of Chilli under trickle condition

THESIS

Submitted to

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur

In partial fulfillment of the requirements for the Degree of

MASTER OF SCIENCE

In

AGRICULTURE

HORTICULTURE (VEGETABLE SCIENCE)

By

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CERTIFICATE - I

*This is to certify that thesis entitled **"Effect of mulch and irrigation schedule on performance of Chilli under trickle condition"** submitted in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in Agriculture, Horticulture (Vegetable Science)** of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, is a record of the bonafide research work carried out by Mr. **Pankaj maida** under my guidance and supervision. The subject of the thesis has been approved by the Student's Advisory Committee and the Director of Instructions.*

All the assistance and help received during the course of the investigation have been acknowledged by him.

Place : Jabalpur

Date :

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The Professor and Head
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I, Pankaj Maida S/o Shri Gautam lal Maida, Certify the work embodied in thesis entitled "Effect of mulch and irrigation schedule on performance of Chilli under trickle condition" is my own first hand bonafide work carried out by me under the guidance of Dr. B.P. Bisen, Associate Professor, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during 2017-2018.

The matter embodied in the thesis has not been submitted for the award of any other degree/diploma. Due credit has been made to all the assistance and help.

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Place : Jabalpur **(Pankaj Maida)**

Date :

List of Contents

List of Tables

List of Figures

List of Symbols

Symbol		Stand for
@	-	At the rate
ANOVA	-	Analysis of Variance
cm	-	Centimetre
C.D.	-	Critical difference
“F” value	-	Fisher’s value
D.F.	-	Degree of Freedom
Cal	-	Calculated
DAT	-	Date after transplanting
etal.	-	And other co-worker
m	-	Metre
Fig	-	Figure
g	-	Gram
ha	-	Hectare
kg	-	Kilogram
Max.	-	Maximum
Min.	-	Minimum
M.S.S.	-	Mean Sum of Square
No.	-	Number
i.e.,	-	That is
MT	-	Metric tone
S.E.(m)±	-	Standard Error of Mean
%	-	Percent
IW/CPE	-	Irrigation water/cumulative pan evaporation
^{o}C	-	Degree Celsius

INTRODUCTION

Chilli (*Capsicum annum* L.*)* is considered as one of the commercial spice crops. It is the most widely used universal spice, named as wonder spice. Different varieties are cultivated for various uses like vegetable, pickles, spice and condiments. In daily life, chillies are the most important ingredient in many different countries around the world as it adds pungency, taste, flavor and color to the dishes.

India is the largest producer, consumer and exporter of chilli and contribute to 25% of total world's production. In India, chilli is grown in almost all the states across the length and breadth of the country. Andhra Pradesh the largest producer of chilli in India, contributes about 30% to the total area under chilli, followed by Karnataka (20%), Maharashtra (15%), Orissa (9%), Tamil Nadu (8%) and other states contributing 18 %. In India, it occupies an area of 792 MH with a production of 1376 MT with an average productivity of 1643 kg/ha. (NHB 2015-2016). Madhya Pradesh is the producing Chilli Area 88000 H, production 70000 T and productivity 795 kg/h of Chilli (Anonymous, 2015-16).

Chilli is increasing in its popularity for its pungent fruits and is highest in vitamins A, C, Iron and calcium. Chillies are used in making chilli vinegar, hot oil, tomato sauces, rice dishes, soups, hot condiments such as samber, beans, corn and curry powders. Chillies do well with several other spices including basil, ginger, oregano, cilantro, cinnamon, black pepper, fennel and cumin.

In general, the farmers raise chilli crop by adopting surface method of irrigation without any scientific basis in which appreciable quantity of water is lost due to evaporation and percolation resulting in low application and distribution efficiencies.

Mulching is the practice of covering the soil around plants to make conditions more favourable for growth, development and efficient crop production (Nagalakshmi *et al.* 2002). Mulches are used for the moderation of soil temperature, through the effects were highly variable. Colour of mulch affected soil temperatures. White (or) reflective plastic, decreased temperatures (Unger 1984). Use of straw and similar material mulches in different vegetable crops have greater insulating effect than pulverized soil mulch.

Hot days, soil temperature under straw mulch was reduced as much as 17 °c (30°F) lower than unmulched plots (Yamaguchi, 1983). Mulches of plant material like straw, dry grass and leaves etc. reduced the soil temperatures (Dhesi *et al.* 1964; Bansal *et al.* 1971). Black polyethylene inducing soil temperature, more moisture conservation higher soil microbial activity resulting in more mineralization and availability of nutrients to the plant (Patil and Bansod 1972). Thus keeping all above factor in view the present investigation "Effect of mulch and irrigation schedule on performance of Chilli under trickle condition (*Capsicum annum* L.)" was be conducted with following objectives.

OBJECTIVES:

1. To assess the weed population due to plastic mulch in chilli crop.
2. To study the effect of mulch on growth and yield.
3. To assume the combined effect of irrigation, mulching on green chilli yield.

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REVIEW OF LITERATURE

The literature on the effect of mulching and irrigation levels on chilli crop is scanty. Therefore, the information on other vegetable crops of Solanaceae family and other vegetable crops is reviewed and presented here under the following headings.

Effect of mulching and irrigation on growth

Goldberg (1971) reported that the trickle irrigation method encourages the development of a shallow root system, as observed in pepper and other crops and this emphasizes the need for uniform distribution of water and nutrients. The concentration of soluble salts is high near the soil surface and especially at the midpoint between adjacent nozzles. This concentration will gradually increase if the salt content of the soil (or) water is high, and if the wetting fronts between the 2 nozzles meet at a greater depth.

Patil and Basad (1972) reported that mulch regulates soil temperature, creates suitable condition for germination, improves soil moisture, suppresses weed growth, saves labour cost in tomato.

Beese *et al.* (1982) conducted an experiment to determine growth and development bell pepper when irrigated by trickle irrigation at different levels of water application. Water application rates of 0.8, 1.2 and 1.4 times the control treatment were maintained, the results indicated that limiting the water applied to pepper during the period of rapid vegetative growth reduced the final yield. However, the water use efficiencies varied little were between 8.1 and 8.2 cm actual ET per tonnes of dry mass production.

Ayoub (1986) reported that chilli is sensitive to water stress. Young chilli seedlings cannot withstand either water deficit or excess soil moisture while older plants can withstand deficit or excess water.

Kumar *et al*. (1998) studied the the effect of different plastic and organic mulches on growth characteristics of tomato cv. Pant Bahar was studied during the winter-spring season at Pantnagar. They reported that growth was best under 200 gauge polyethylene mulch. It was better under plastic mulches than under organic mulches and was least in the un-mulched control.

Prabhat *et al.* (1999) investigated the effects of different methods of irrigation [micro sprinkler, drip (trickle) (emitter), drip (micro tube) and surface irrigation) on growth of cabbages when Plants were grown at a spacing of 0.5 x 0.6 m. The tallest plants with the highest number of leaves and greatest crop canopy were produced in the micro sprinkler treatment.

Effect of mulching and irrigation on yield

Firake *et al* 1990 reported that plastic mulch conserved 47.08% of water and increased yield by 47.67% in tomato when compared to un-mulched control. Rajablariani *et al* (2010) grown tomato (*Lycopersicon esculentum* L.) plants under various types of coloured mulches to evaluate effect with bare soil and reported that black and silver/black plastic mulches suppressed weeds which were encouraged under clear, blue and red mulches. Results also indicated that soil temperature increased under the various coloured plastic mulches by about 3 to 6 °C more than it in bare soil.

Reddy *et al. (*1990) conducted an experiment to study the performance of drip, furrow and check basin methods of irrigation under cauliflower production. The experimental field was divided into three blocks, each block having a particular irrigation method i.e. drip, furrow and check basin methods of irrigation. Drip irrigation resulted into 40 to 65 per cent saving of water. The field water use and consumptive use efficiency were found maximum in drip irrigation. The increase in yield of cauliflower under drip method was 48 per cent over furrow and check basin.

Duraisamy *et al.* (1992) reported that the fruit yield was highest in the surface irrigation treatment (T1) i.e., 5 cm depth of water by surface irrigation at 1.0 IW/CPE ratio : the WUE was higher in sprinkler treatments T3 (3.75 cm depth of water through sprinkler irrigation at 0.75 IW/CPE ratio T4(2.50 cm depth of water through sprinkler irrigation at 0.5 IW/CPE ratio) significantly higher fruit yield than was than T4 through sprinkler, 21% of irrigation water can be saved compared to surface irrigation in tomato.

Mulching effectively manipulates crop growing environment leading to increased yield and improved product quality by suppressing weed growth, ameliorating soil temperature, conserving soil moisture, reducing soil erosion, improving soil structure and enhancing organic matter content (Opara-Nadi, 1993; Hochmuth *et al.,* 2001; Awodoyin and Ogunyemi, 2005).

Lourduraj *et al.* (1997) found that mulching significantly increased okra yield, particularly the plastic mulch. Irrigation at IW/CPE ratio of 0.6 was the best irrigation regime to promote yield. The black plastic mulch was very effective in controlling weeds and increased net seasonal income by Rs. 14300/ha as compared with the unmulched control.

Chandra *et al* (2002) found that potato yield increased with the use of mulches. Tuber weight was 0.23 kg per plant for no mulch but increased to 0.29 kg per plant when pine mulch was used. Similarly, number of tubers per plant increased to 6.5 from 5.4 with the use of pine mulch. Total yield was 165.0 q/ha for no mulch and 222.7 q/ha for pine mulching. Singh *et al* (2007) observed that straw mulch increased the potato yield to 17.4 tonnes from 12.2 tonnes ha-1 obtained from without mulch.

Nijamudeen and Dharamasena (2002) reported a 32% increase in yield and 28% lower water consumption in chilli due to the application of mulch.

Alemayehu-Ambaye and Joseph (2002) reported the significant influence of black LDPE mulch on increasing soil moisture retention, growth and yield of cucumber. Drip irrigations with 100 and 125% EP were superior to the lower levels of EP as well as farmer’s practice of basin irrigation once in three days with 45 litres of water. Depending on the availability of water for irrigation, the cultivator was opt either 100 or 125% of EP for scheduling drip irrigation.

Sannigrahi and Borah (2002) reported that mulching increased the number of tomato fruits per plant and had higher crop yield than the control. Water hyacinth mulch gave the highest increase in tomato yield (91%). The plant height, pod length and green pod weight of mulch-treated Okra were at par with those of the control. Maximum okra yield was recorded with black polyethylene mulch (121.2 q/ha) treatments, followed by water hyacinth (107.1 q/ha) and poultry waste (101.3 q/ha). Black polyethylene mulch increased Okra yield by 88% water hyacinth by 67%, poultry waste by 57%, spent straw by 53%, and rice straw by 41%. Stem yield (crop waste) after final harvesting was also higher with mulching than with no mulching. The rate of weed emergence was higher in Okra than in tomato plots, while black polyethylene mulch was the most effective treatment for weed control (83.5%).

Among various factors responsible for higher onion seed yield, the quantity of irrigation and fertilizer plays a pivotal role in enhancing the growth and productivity (Aklilu and Kataria, 2003; Pathak and Gowda, 1994; Tomar *et al*., 2004).

Ertek *et al*. (2007) Stated that the knowledge of water consumption in plants and the periods during which plants are susceptible to a lack of water, in addition to the irrigation intervals, is needed to increase crop yield.

Ertek *et al*. (2004) Reported that the optimum water quantity must be applied during the different crop growth periods in order to obtain a higher pepper yield.

Mahajan *et al* (2006) conducted that a field experiment was conducted by in Ludhiana, Punjab on weed control in red chilli in relation to use of back polythene and rice straw mulch. All the weed control treatments showed significant effect on weeds in terms of dry matter accumulation by weeds and caused significant improvement in yield of red chilli. Black polyethylene mulch provided good weed control and resulted in the highest yield (241.9 q/ha), followed by sole plastic mulching treatment (219.4 q/ha). The un-effected weeded control treatment registered only 30.2 q/ha red chilli yield.

Moniruzzaman *et al.* (2007) studied the effects of irrigation and different mulches on yield of cauliflower.(A field experiment on cauliflower var. Rupa) was conducted in two consecutive seasons (2000-01 and 2001-02) on sandy clay loam soil at the Agricultural Research Station, Raikhali, Rangamati Hill District. The intervals of irrigation were at 7, 14 and 21 days alone with five levels of mulching (non mulch, plastic mulch, rice straw mulch, sun grass mulch and mango leaves mulch). Irrigation at 7 days interval and plastic mulch independently as well as in combination produced maximum values for yield attributes and marketable yield of cauliflower. The highest curd yield of 30.38 and 29.40 t/ha were obtained from 7 days irrigation interval with plastic mulch respectively. Seven days interval irrigation and mulching with forest leaves (mango leaves) in combination gave the highest benefit cost ratio (6.51) closely followed by 14 days interval irrigation with the same mulch (6.48).

Vankar and Shinde (2007) reported that white polythene mulch treatment recorded statistically higher yield of fruit (22.06t/ha), leaves and stem dry matter, number of fruits per plant, weight of fruits per plant, length of fruit and total biomass production in Okra than black, straw and no mulch treatments.

Gordon *et al* (2008) conducted an experiment in which summer squash (*Cucurbita pepo* L.) cv. Prelude II, was grown on an Orangeburg sandy loam soil at Auburn. The summer squash was direct seeded in single rows. The experiment consisted of 12 treatments including: black plastic mulch in combination with spun bonded row cover, black polythene mulch alone, white plastic mulch in combination with row cover, White polythene mulch alone, red plastic mulch in combination with row cover, red plastic mulch alone, bare soil in combination with row cover, bare soil alone, silver plastic mulch in combination with row cover, silver plastic mulch alone, blue plastic mulch in combination with row cover and blue plastic mulch alone. Mulch colour x row cover interaction affected yield variables. Coloured plastic mulch with or without row covers increased early fruit yield in summer squash.

Rajablariani *et al*. (2010) Studied the effect of polyethylene mulch films and bare soil on tomato evaluate and the effect of colored plastic mulches on weed and crop yield. The plastic mulches were blue, black, clear, red and silver on black coloured . Black and silver/black plastic mulches suppressed weeds which were encouraged under clear, blue and red mulches. Results also indicated that soil temperature increased under the various colored plastic mulches about 3 to 6 °C more than in bare soil. Number of branches and leaves were better for the plants grown in plastic mulch compared to bare soil. The highest early yield was obtained in clear plastic likely due to light entrance and raising soil temperature. Mulching increased marketable yield relative to bare soil as the plants grown on silver/black plastic mulch indicated a 65% increasing in marketable mulch compared to control treatment. The plastic mulches resulted in an 84-98% reduction in weed biomass.

Singh *et al.* (2010) recorded that the plant height was improved by using the mulches. Weed density was always lower in plots having mulches and the plots sprayed with pendimethalin 30 EC or hand weeding. Pod length and pod diameter were often higher in mulch treated plots. Both black plastic mulch and wheat straw mulch were found to be helpful in conserving the moisture, controlling of weeds and produced higher yield.

Effect of mulching and irrigation on growth and yield

Drip irrigation has proved its superiority over other conventional method of irrigation, especially in the cultivation of fruits and vegetables due to precise and direct application of water in root zone. A considerably saving in water, increased growth, development and yield of vegetables under drip irrigation has been reported (Bhella 1988, Bafna *et al*., 1993; Raina *et al*., 1999 and Imtiyaz *et al*., 2000).

Straw mulching has been reported to lower soil temperature, conserve soil moisture and improve growth and yield of crops where soil moisture is a limiting factor for cultivation (Schonbeck and Evanylo 1998, Agele *et al*. 2000, Jalota *et al*. 2000, 2001).

Sannigrahi and Borah (2002) observed that the plant height, pod length and green pod weight of mulch-treated okra were on par with those of the control. Maximum okra yield was recorded with black polythene mulch (121.2q/ha) followed by water hyacinth (107.1q/h) and poultry waste (101.3q/ha). Black polythene mulch increased okra yield by 88%, water hyacinth 67% and poultry waste 57%, spent straw 53% and rice straw 41% stem yield (crop waste) after final harvesting with mulching than no mulch control.

Antony and Singandhupe (2004) studied the effect of different irrigation methods and schedules on morphological, yield and water use efficiency of capsicum (*Capsicum annum* L.) var. California Wonder. They found that the plants grown under drip irrigation had more number of branches and plant heights compared to that of surface irrigated plants. Root mass was more in surface irrigated crop where as total root length was more in drip irrigated crop.

Yang *et al*. (2006) Organic mulches such as sawdust, dry grass, maize cobs, water hyacinth, rice and wheat straw have enhanced vegetative growth and yield through improving water content of soil, heat energy and addition of some organic nitrogen and other minerals to improve nutrient status of the soil.

Salim *et al*. (2008) studied the response of cauliflower to polyethylene mulch. The study was evaluated from September, 2003 to January, 2004 at Regional Agricultural Research Station (RARS), Ishurdi, Pabna to find out whether polyethylene mulch is suitable or not for cauliflower production in Bangladesh in Snow crown variety. The experimental design was Randomized Complete Block Design with 3 replications. The plot size was 9 m x 1.2 m. Fertilizer application was done at a dose of N (120), P205 (80) and K20 (100) kg/ha. Resulted a positive impact of mulch on growth and yield attributes of the crop varieties. The tallest plant (57.40 cm) was observed in snow crown variety in mulched condition and the shortest plant (38.90 cm) was observed in plots without mulch. It was also observed that mulching significantly influenced the curd diameter. In all the cases, curd diameter was higher (18.10 cm) in mulched plots and smallest (12.31) in plots without mulch. The highest marketable yield (31-32 t/ha) was obtained. The highest marketable yield was 35.16 per cent higher than those yields obtained from treatments without mulch.

Lodhi (2009) conducted a field experiment at Ludhiana in 2008-09 to study the effects of low tunnel environment on growth and yield of drip irrigated capsicum (*Capsicum annuum* L. *var .grossum*).The experiment was laid out in split plot design keeping five irrigation treatments (drip irrigation with IW/CPE ratio of 0.60(I1),0.75(I2),0.90(I3),furrow irrigation with paired row planting (I4) and single row planting(I5) in main plots and replicated three times. The total yield, WUE and benefit cost ratio were observed highest in I_2 treatments. Highest economic returns were achieved in 75 cm low tunnel height and drip irrigated with IW/CPE ratio of 0.75.

Rathore (2009) studied the optimization of nitrogen application and irrigation schedules in tuberose (*Polianthes tuberosa*). The study showed that irrigation applied at 0.8 IW/CPE ratio increased the number of florets per spike and bulb yield by 23 and 22 per cent over the control (flood irrigation) and by 30 and 44 per cent, respectively, compared to the treatment receiving minimum water at 0.4 IW/CPE. Water productivity based on consumptive use, irrigation water and total water applied through irrigation and rainfall significantly improved the vegetative growth, spike and bulb yield with increasing ratio of water application from 0.4 to 0.8 IW/CPE ratio but failed to increase beyond 0.8 IW/CPE ratio which indicated that water application beyond 0.8 IW/CPE ratio is not being utilized the crop.

Ashrafuzzaman *et al*. (2011) observed the Effect of plastic mulch on growth and yield of Chilli. Different mulches generated higher soil temperature and soil moisture under mulch over the control. Transparent and blue plastic mulches encouraged weed population which were suppressed under black plastic. Plant height, number of primary branches, stem base diameter, number of leaves and yield were better for the plants on plastic mulch. At the mature green stage, fruits had the highest vitamin-C content in the black plastic. Mulching produced the fruits with the highest chlorophyll-a, chlorophyll-b and total chlorophyll contents and also increased the number of fruits per plant and yield. However, mulching did not affect the length and diameter of the fruits and number of seeds per fruit. Plants on black plastic mulch had the maximum number of fruits and highest yield.

Selvaperumal and Muthuchamy (2017) observed that the effect of drip fertigation and plastic mulching on the plant growth and yield attributes of chilli. The experiment were laid out factorial randomized block design which included three fertigation levels 80, 100, and 120 per cent Recommended

Dose of Fertilizers (RDF) and three different mulching treatments 25, 50 micron Black Plastic Mulch (BPM) and no mulch which were replicated thrice. In chilli Maximum yield of 128 numbers of fruits per plant which is worked out as 12.27 t/ha was observed for the treatments T3. The total quantity of water applied uniformly to all the treatments was 75.83 litres as per the crop water requirement. Maximum water use efficiency observed in T3 (66.36 kg ha-1.mm-1). The maximum N, P and K fertilizer use efficiency of 109.95 kg ha-1, 164.94 kg ha-1 and 164.94 kg per ha respectively, were observed in T1. The highest benefit cost ratio was recorded under both T2 (BPM of 25 micron thickness with 100 per cent RDF) and T3 (BPM of 25 micron thickness with 120 per cent RDF). From economic viability point the T2 treatment registered results that were economically viable with highest profit. Increased yield in fertigation treatments might be due to better availability of plant nutrients and irrigation water throughout the crop growth period under drip fertigation system and black) with drip irrigation on water requirement and yield of cucumber (*Cucumis sativus* L.). The treatments comprised of transparent mulched drip irrigation (DI + TM), black mulched drip irrigation (DI + BM), drip irrigation without mulching (DI) and surface furrow irrigation (SI). The results indicated that (DI + TM) treatment excelled all other treatments at yield and water use efficiency (WUE), where its yield was 63.9 t ha−1 and (WUE) was 0.262 t/ha/mm, while (DI + BM) treatment produced 57.9 t/ha, with a (WUE) of 0.238 t /ha/mm. However, cucumber yield and WUE declined in the remaining treatments of no mulch (DI) and (SI) to reach 44.1 t ha−1 with 0.153 t/ha/mm and 37.7 t/ha with 0.056 t ha−1mm−1, respectively. Further, DI + TM treatment gave the highest soil temperature and moisture in comparison to DI + BM. This enhanced its vegetative growth and almost doubled its productivity compared to the SI treatment.

Effect of mulching and irrigation on quality

Irrigation, mulching and fertilizer nitrogen (N) rates are known to affect quality parameters (ascorbic acid and capsaicin content) of chilli fruit. Besides improvement in soil hydrothermal regime, mulching is known to check weed growth and thus, improve crop growth, yield and water use efficiency (Barker and Bhowmik 2001, Panchal *et al*. 2001 and Hundal *et al*. 2002).

Patel and Patel (2011) recorded that significantly the highest pod yield (207.96 q/ha) was recorded under drip irrigation at 0.8 PEF and were higher 46.25% with 30.48 kg/ha-mm water use efficiency (WUE). Among mulching, black polyethylene mulch recorded significantly the highest plant height (110.71 cm), LAI (1.453), dry matter accumulation (68.94 g/plant), CGR, (5.551 g/day/m2) and total chlorophyll content (10.75 mg/g) and was followed by organic mulch, while the lowest values were observed under no mulch treatment. Black polyethylene mulch increased pod yield by 29.65% over no mulch. N-fertigation @ 100% recommended dose was found significantly superior to 70% recommended dose and recorded higher values of all the growth parameters and registered higher pod yield of okra (169.72 q/ha).

Kirnak *et al* (2003) observed that, use of polyethylene mulch mitigates effects of water stress, improves bell pepper yield and fruit of plants grown with black mulch had a thicker pericarp compared with plants grown in bare soil. When green infrared transmitted (IRT) mulch was used, plants produced significantly wider fruit (5%) with 13% more TSS compared with plants grown in bare soil.

Effect of mulching and irrigation on soil temprature

Sandal and Acharya (1997) observed during winter season, the conservation of soil moisture may help in preventing the loss of water through evaporation from the soil facilitating maximum utilization of moisture by the plants. Mulching with plastic is a method by which soil moisture can be conserved.

Tiwari *et al*. (1997) reported that trapping dry and moist soils with different colour plastic mulches resulted in a significant increase in soil temperature. The highest temperature was under red plastic mulches closely followed by under transparent mulch. Black plastic sheet had the least effect on increase in soil temperature.

Mohammed and Mamkagh (2009) reported that in Okra the soil moisture content (SMC) varied among the experimental treatments. At 30 and 60 days after planting, there was a significant interaction between tillage time and mulching for SMC at 30 cm depth. Bare plots (non-mulched plots) had the lowest SMC than black plastic mulched (BP mulch) plots. After 30 days of planting the highest SMC (25.94) was recorded in plots tilled three times (T1) and covered with BP mulch followed by plots tilled two times (T2) and covered with BP mulch (23.27). At 60 days after planting, SMC was significantly highest, when plots covered with BP mulch regardless of tillage times. In general, SMC at 90 and 120 days after planting were not significantly affected by different treatment combinations.

MATERIALS AND METHODS

A field experiment entitled “**Effect of mulch and irrigation schedule on performance of Chilli under trickle condition.** was conducted during Rabi 2017-2018 at College of Agriculture Jabalpur, Madhya Pradesh. The material used and methods followed in the investigation are described here under.

3.1 Experimental site

The experiment was conducted at Horticulture complex, Department of Horticulture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.).

3.2 Soil

The soil of the experimental field was medium black with good drainage uniform texture with medium NPK status.

3.3 Climate and weather conditions

Jabalpur is situated on Kymore Plateau and Satpura hills agro-climatic zone of Madhya Pradesh at 23.91^0 North latitude, 79.5^0 East longitudes and on an altitude of 411.78 meters above the mean sea level. The climate of region is typically semi arid and sub tropical having extreme winter and summer. The average annual rainfall is 1350 mm, which is mostly received during June to October form South-west monsoon. The average maximum temperature is 46^0C and minimum temperature 6.8^0C. The average annual relative humidity is 74%.

The meteorological parameter during the crop season such as minimum and maximum temperature, sunshine hours, rainfall number of rainy days and relative humidity were recorded at Meteorological observatory Krishi Nagar, JNKVV, Jabalpur are presented in Table 3.1and figure 3.2.

Table 3.1 Meteorological information (week wise) during entire crop season of the year 2017-18 at Jabalpur.

Weekly Data	Tempe rature max.	Temper ature min.	Sun Shine (hrs).	Rainfall (mm)	Evapo (mm)	Rainy days
41	32.6	21.7	8.4	9.2	3.7	1
42	33.6	17.9	8.8	0	3.9	0
43	33.1	15.9	8.9	0	3.9	0
44	31.1	12.2	8.4	0	3.2	0
45	30	10.2	8.8	0	3.4	0
46	28.9	11.9	7.2	0	2.5	0
47	27.6	10.1	5.9	0	2.4	0
48	28.1	5.1	8.6	0	2.4	0
49	26.7	8.1	6.7	0	2.1	0
50	27.5	9	6.6	0	2.1	0
51	24.8	5.5	4.2	0	1.2	0
52	25.2	3.9	7.3	0	2.1	0
1	28.8	9.7	7.8	0.0	2.0	0
2	24.7	12.6	9.1	0.0	2.0	0
3	28.4	10.5	9.3	0.0	2.3	0
4	31.0	12.7	9.2	0.0	2.8	0
5	26.7	6.8	9.8	0.0	3.0	0
6	26.6	12.4	5.4	0.0	2.6	0
7	25.2	11.5	6.4	18.0	2.6	3
8	31.2	12.5	9.8	0.0	3.1	0
9	32.4	14.0	8.9	15.0	3.6	1
10	30.9	14.1	6.9	1.0	3.2	0
11	33.3	15.4	7.4	0.8	4.0	0
12	34.4	14.7	8.4	17.0	4.8	1
13	37.0	13.5	9.1	8.7	6.1	0
14	38.0	18.1	11.4	10.8	6.0	0
15	37.0	20.6	15.3	17.9	5.2	0

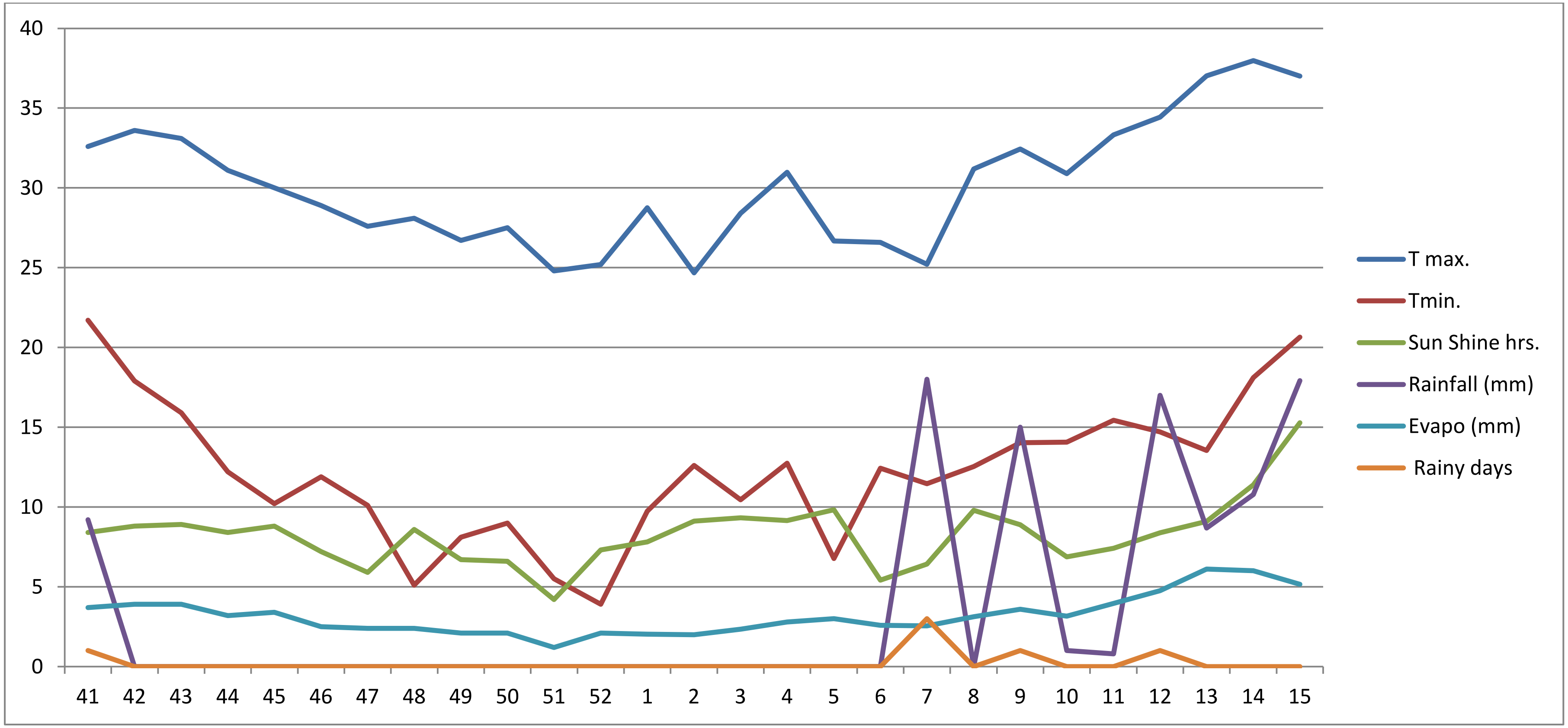

Fig – 3.2 Meteorological information (week wise) during entire crop season of the year 2017-18 at Jabalpur.

3.4 Experimental method :

The experiment was conducted in Factorial RBD with three replication. The experiment details is given below

Location:- The experiment was conducted at Horticulture complex, department of Horticulture, J.N.K.V.V., Jabalpur (MP)

Crop	: Chilli [*Capsicum annum L.*]
Variety	: Arka Lohit
Season	: Rabi (2017-18)
Treatment Combination	: 12
Design	: Two Factorial RBD
No. of Replication	: 03
Plot Size	: 4 m x 1.2m
No. of Plots	: 36
Distance b/w row to row	: 60 cm.
Distance b/w plant to plant	: 50 cm.
Number of Plants/Row	: 8
Replications distance	: 1 m
Gross plot size	: 459.82 sqm
Net plot size	: 172.8 sqm
Date of sowing	: 28/10/2017
Seed rate	: 1kg /ha

3.5 DESIGN AND LAYOUT

The experiment was laid out in a factorial randomized block design with factorial concept with three replications and 12 treatments. The crop was transplanted in plots of 4 x 1.2 m (4.8m^2) for each treatment adopting a spacing of 60 cm between the rows, 50 cm with in the plant. The layout plan of the experiment is presented in fig.3.2.

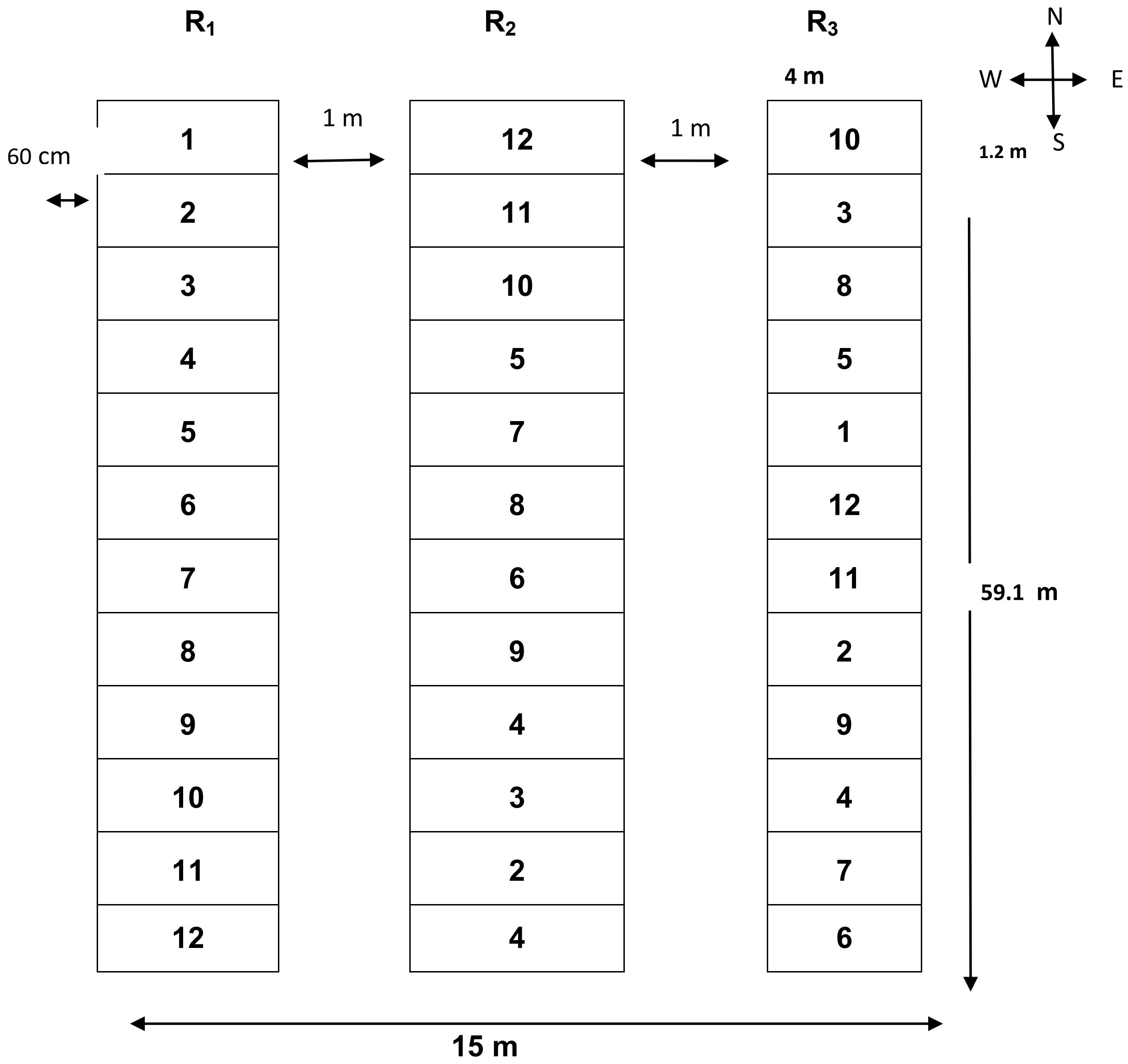

Fig. 3.2 Layout plan of the Experiment

3.6 Treatment details

The treatments consisted of four irrigation regimes based on IW/CPE (Irrigation water depth: cumulative pan evaporation minus rainfall since previous irrigation) ratio along with farmers practice and three mulching levels detailed below:

A/B	M0: No mulch	M1: Black mulch	M2: Silver mulch
I_1-0.4	MoI_1	M_1I_1	M_2I_1
I_2-0.6	MoI_2	M_1I_2	M_2I_2
I_3-0.8	MoI_3	M_1I_3	M_2I_3
I_4-1.0	MoI_4	M_1I_4	M_2I_4

Factor A-Mulching-M_O: No Mulch, M_1: Black Mulch and M_2: Silver Mulch,

Factor B- Irrigation- I_1-0.4, I_2-0.6, I_3-0.8 and I_4-1.0

3.7 CULTIVATION DETAILS

3.7.1 Land preparation

The experimental area was ploughed and harrowed in order to bring the land was prepared through ploughing and harrowing into fine tilth. Ploughing twice with tractor drawn implements in two directions and harrowing was done for breaking clods and finally leveling was done.

3.7.2 Nursery

Raised beds of 2 x 1 m used for the raising of nursery. Sowing of seeds was done by broadcasting of 54 g of seed uniformly. Seed treatment with Dithane M – 45 is done at the rate of 3 g/kg seed. Spraying copper oxychloride on 10 and 12 day of sowing to prevent damping off disease.

3.7.3 Transplanting and gap filling

Healthy and uniform seedlings were selected for planting. Light irrigation was given before uprooting seedlings from the nursery beds so that minimum damage may occurs to roots of the seedling. Transplanting was done in the afternoon at 60x50 cm distance and immediately followed by light irrigation for proper establishment of the seedlings. A week after transplanting gap filling was done. All the other recommended package of practices was followed to raise a healthy crop.

3.7.4 Manures and fertilizers

Well rotted FYM was applied 20 t/ha before second harrowing while preparing the field. Nitrogen, Phosphorus and Potash were applied @ 120, 80, and 80 kg ha^{-1} through Urea, Di ammonium phosphate (DAP) and Muriate of potash (MOP), respectively. Half dose of nitrogen and full amount of phosphorus and potash were applied as basal at the time of transplanting and rest of N was top-dressed in two equal splits at 25 and 45 days after transplanting.

3.7.5 Mulching

In this experiment three mulching treatments were taken up *i.e.,* no mulch (M0), Black plastic mulch (M1) and silver plastic mulch (M2). The Black plastic mulch and silver plastic mulch (low density polyethylene) of 25 micron thickness was fixed tightly during the non-windy period without any crease to cover the soil surface both ends of the plastic were buried into the soil upto the depth of 10 cm. Seedlings were immersed in holes at 60 x 50 cm spacing of polyethylene of sheet.

3.7.6 Irrigation water application

The field was irrigated immediately after transplanting with 5.0 cm depth of water to facilitate early establishment of the crop. One more general irrigation with 5.0 cm depth of water was given10 days after transplanting to replenish the soil profile (60 cm) to field capacity and to commence irrigation treatments.

3.7.7 Intercultural operation

The experimental plots were kept free from weeds, by carrying out hand weeding as and when weeds were observed. Light earthing up was given to keep be soil porous and to support the plants.

3.7.8 Harvesting

The fruits were harvested at green stage. The number of picking varies from depending upon the season, cultivar and cultural practices.

3.8 Observations recorded

The observations on morphological characters of chilli with regard to growth parameters were recorded at crop growth period to till harvest at different intervals. Five plants of Chilli were selected randomly in each treatment for sampling by tagging to record the plant height and other observations.

3.8.1Morphological Parameters

3.8.1.1 Plant height (cm)

Plant height was recorded from the base to the apical end at 30, 45, 60 and 90 days after transplanting and plant height at harvest expressed in centimeter.

3.8.1.2 Number of branches/plant (primary)

Number of primary branches developed on the main axis was measured at 30, 45, 60 and 90 days (last harvest) after transplanting, on the basis of five selected plants average was calculated.

3.8.1.3 Number of branches/plant (secondary)

Number of secondary branches developed on the primary stem was measured at 30, 45, 60 and 90 days (last harvest) after transplanting, on the basis of five selected plants average was calculated.

3.8.1.4 Days for initiation of flowering

Number of days required for the initiation of flowering from the date of transplanting in each all five selected plants per plot were recorded and average were worked out.

3.8.1.5 Days for fifty per cent flowering

Number of days required for the fifty per cent of flowering from the date of transplanting in each all five selected plants per plot were recorded and average worked out.

3.8.2 Fruit characters

3.8.2.1 Fruit length (cm)

The linear distance between the peduncle and pistillate end of randomly selected five fruits per treatment per replication was measured with the help of Venire caliper, average were calculated and recorded as a fruit length in centimeter.

3.8.2.2 Fruit diameter (cm)

The diameter of five randomly selected fruits per treatment per replication were measured at middle portion of fruit by Venire caliper and their average were recorded as diameter of fruit in centimeter.

3.8.2.3 Average fruit weight (g)

The average weight of each fruit among ten randomly selected fruit per treatment per replication was weighted on electric top pan balance and recorded the reading.

3.8.3 Yield characters

3.8.3.1Number of fruits per plant

The number of fruits harvested from each observational plant from first to last harvest of crop was counted and by adding all this values number of fruits per plant was calculated.

3.8.3.2 Fruit yield per plant (g)

The weight of harvested fruits of five observational plants at each harvesting was measured by using electronic weighing balance. Then after calculating total yield of observational plants a range was calculated and recorded as yield per plant (g).

3.8.3.3 Fruits yield per plot (kg)

Weight of fresh marketable fruits from each plot throughout the harvesting period was noted and average fruits yield per plot was worked out for each treatment

3.8.4 Quality parameters

3.8.4.1 Total soluble solids (^{0}Brix)

The TSS content of the squeezed and filtered juice of the flesh taken from the fruit was measured by hand refractometer (ERMA) and expressed interms of °Brix.

3.8.4.2 Ascorbic acid (Vitamin C) Content (mg 100 g-1)

Total ascorbic acid content was estimated 2, 6 Dichlorophenol – Indephenol visual Titration method by using 2, 6 – dichlorophenol indophenol dye (AOAC, 1975) and computed with the following formula.

$$\text{Ascorbic acid (Mg/ 100 g)} = \frac{\text{Titre value x Dye factor x Volume made up}}{\text{Aliquat of extract Taken for estimation} \times \text{Wt. of sample taken for estimation}} \times 100$$

3.8.5 Water use efficiency:

The total fruit yield obtained for each treatment was divided by the quantity of water used for each treatment. Water use efficiency was worked out and expressed as:

$$\text{WUE} = \frac{\text{Yield (kg/ha)}}{\text{Total amount of water used (cm)}}$$

3.8.6 Moisture depletion pattern (%)

The soil moisture was recorded at fruit maturity stage in different depth of soil. Soil sample were collect from vertical depth of 0 – 15 cm and 15 - 30 cm.

3.8.7 Variation in soil temperature

3.8.7.1 Flower initiation stage (5%)

Number of days required for the initiation of flowering from the date of transplanting in each all five selected plants per plot were recorded and average were worked out.

3.8.7.2 Days to first picking

Number of days for first harvest required from the date of transplanting for the first harvesting of the fruit in each selected plant treatment and replication was recorded, then the averages were worked out for each treatment and replication.

3.8.8 Weed growth at 1m^2 area of land (%) or Weed biomass (fresh weight)

Counted for the total plot of 18.5 m^2 and then calculated the weed growth and 1m^2 area of land.

3.8.8.1 Vegetative phase (30 DAT)

Number of days required for the 30 at vegetative stage from the date of transplanting in each all five selected plants per plot were recorded and average were worked out.

3.9 STATISTICAL ANALYSIS

The data pertaining to various parameters were subjected to statistical analysis following the method of analysis of variance for factorial randomized block design (Panse and Sukhatme, 1978) and correlation coefficients among various characters were worked out as per the procedure described by Snedecor (1959).

Skeleton of Analysis of variance

Source of variation	d.f.	S.S.	M.S.S.	F cal.	F table Value at	
					5%	1%
Factor A	p-1	SSA	MSA			
Factor B	q-1	SSB	MSB			
Interaction AB	p-1 q-1	SS(AB)	MSAB			
Error	r-1 pq-1	SSE	MSE			
Total	rpq-1					

n = Total number of observations.

t = Number of treatments.

The 'F' test was applied to check the overall significance of various treatments in general and comparison of individual treatment was made with the help of critical difference at 5 % level of significance, which was calculated as given below:-

SEm± for treatment = $\frac{\sqrt{\text{MS2e}}}{\text{No.of replication}}$.

SEd for treatment = SEm± x √2

CD for treatment = SEdx 't' value at 5% error degree of freedom.

Where,

SEm± = Standard Error of treatment means.

S.Ed = Standard Error of difference between two treatments.

CD = Critical difference

RESULTS

The present investigation entitled "Effect of mulch and irrigation schedule on performance of chilli under trickle condition" was conducted at Horticulture complex, Maharajpur, Department of Horticulture, JNKVV, Jabalpur in the year 2017-18. The results obtained during the course of investigation have been described in this chapter under appropriate headings. The observations recorded during study are summarized in the form of tables and illustrated through figures wherever found necessary. Analysis of variance table for all the characters studied has been appended for reference in appendices.

4.1 Effect of mulch and irrigation level on Growth characters

The data on plant height, number of primary and secondary branches per plant, flowering as influenced by mulching and irrigation levels irrigation levels treatments are presented in the following sub-headings.

Table 4.1 Effect of mulch and irrigation level on Plant height at 30 DAT (cm)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	25.43	25.43	25.43	25.43
I_2	25.73	28.91	31.34	28.66
I_3	26.35	30.33	34.15	30.28
I_4	25.68	29.22	32.38	29.09
Mean	25.80	29.19	32.00	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.070	0.060	0.121	
CD at 5%	0.206	0.178	0.356	

4.1.1 Plant height at 30 DAT (cm)

The data in respect of plant height are presented in Table 4.1 and depicted in Figure 4.2. Irrigation levels significantly influenced plant height at 30 days after transplanting. Irrigation scheduled at 0.8 IW/CPE was found significant (30.28) over the other IW/CPE ratios. Among mulching treatments, silver plastic mulch recorded maximum height (32.0) followed by black plastic mulch (29.18) and minimum plant height (29.80) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced plant height at 30 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum plant height (34.15) followed by 1.0 IW/CPE (32.38) and minimum plant height (25.43) was observed at irrigation level 0.4 IW/CPE.

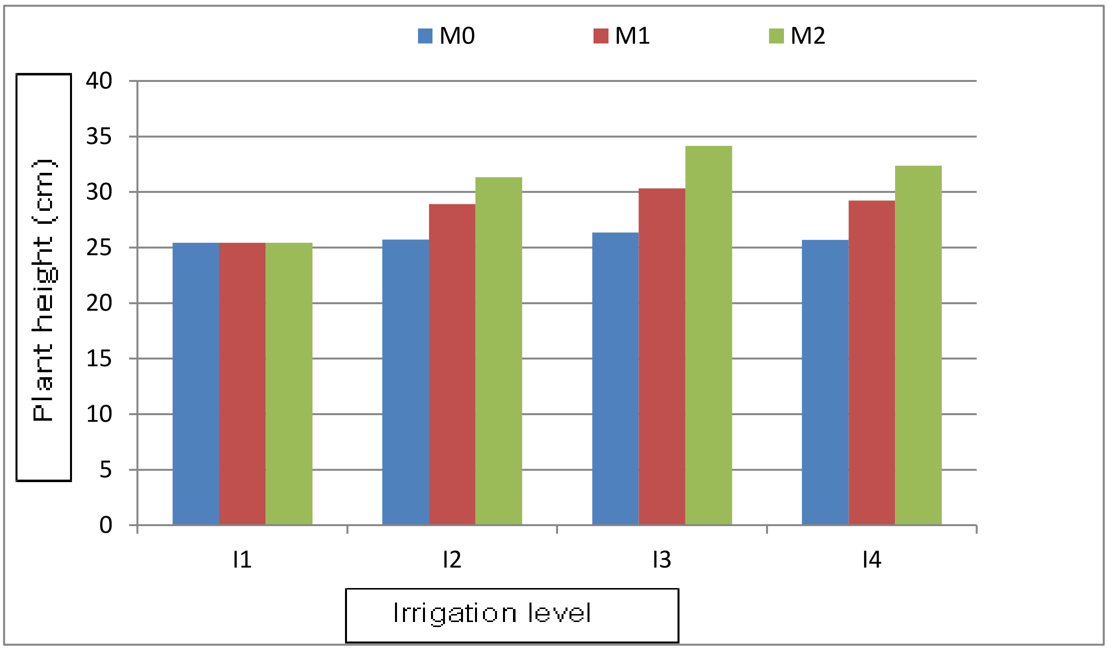

Fig. 4.2 Effect of mulch and irrigation level on Plant height at 30 DAT (cm)

Table4.3 Effect of mulch and irrigation level on plant height at 45 DAT (cm)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	30.34	34.20	35.25	33.26
I_2	31.35	34.83	36.23	34.13
I_3	32.59	36.41	38.45	35.82
I_4	32.01	35.38	37.45	34.82
Mean	31.57	35.20	36.75	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.070	0.061	0.122	
CD at 5%	0.207	0.180	0.359	

4.1.2 Plant height (cm) at 45 DAT

A perusal of data given in Table 4.3 and depicted in Figure 4.4 Irrigation levels significantly influenced plant height at 45 days after transplanting. Irrigation scheduled at 1.8 IW/CPE was found significant (35.82) over the other IW/CPE ratios. Among mulching treatments, silver plastic mulch recorded maximum height (36.75), followed by black plastic mulch (35.20) and minimum plant height (31.57) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced plant height at 45 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum plant height (38.45) followed by 1.0 IW/CPE (37.45) and minimum plant height (30.34) was observed at irrigation level 0.4 IW/CPE.

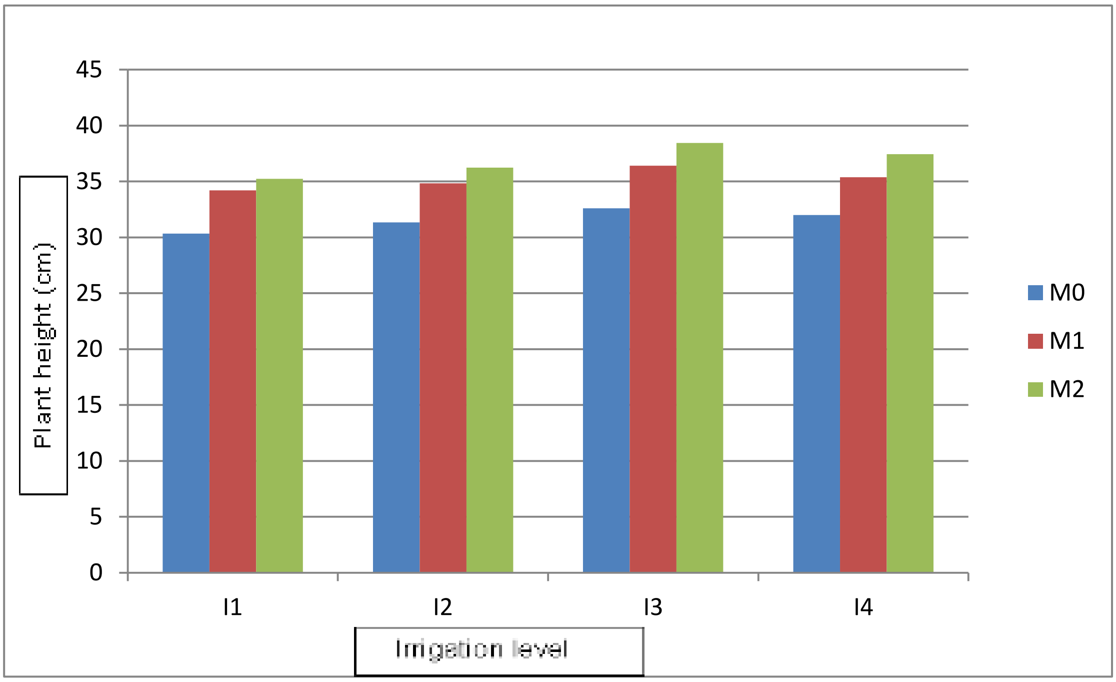

Fig. 4.4 Effect of mulch and irrigation level on plant height at 45 DAT (cm)

Table 4.5 Effect of mulch and irrigation level on plant height at 60 DAT (cm)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	34.30	38.56	39.39	37.42
I_2	34.76	38.79	39.81	37.79
I_3	36.15	40.12	41.43	39.23
I_4	35.20	39.54	40.19	38.31
Mean	35.10	39.25	40.20	
	Irrigation (I)	Mulching (M)	Interaction (IxM)	
S.E(m)±	0.045	0.039	0.078	
CD at 5%	0.134	0.116	0.232	

4.1.3 Plant height (cm) at 60 DAT

A perusal of data given in Table 4.5 and Figure 4.6 indicates that the plant height at 60 DAT. Irrigation levels significantly influenced plant height at 60 days after transplanting. Irrigation scheduled at 0.8 IW/CPE was found significant (39.23) over the other IW/CPE ratios. Among mulching treatments, silver plastic mulch recorded maximum height (40.20) followed by black plastic mulch (39.25) and minimum plant height observed (35.10) in no mulch condition.

Irrigation levels and mulching significantly influenced plant height at 60 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum plant height (41.43) followed by 1.0 IW/CPE (40.19) and minimum plant height (34.30) was observed at irrigation level 0.4 IW/CPE.

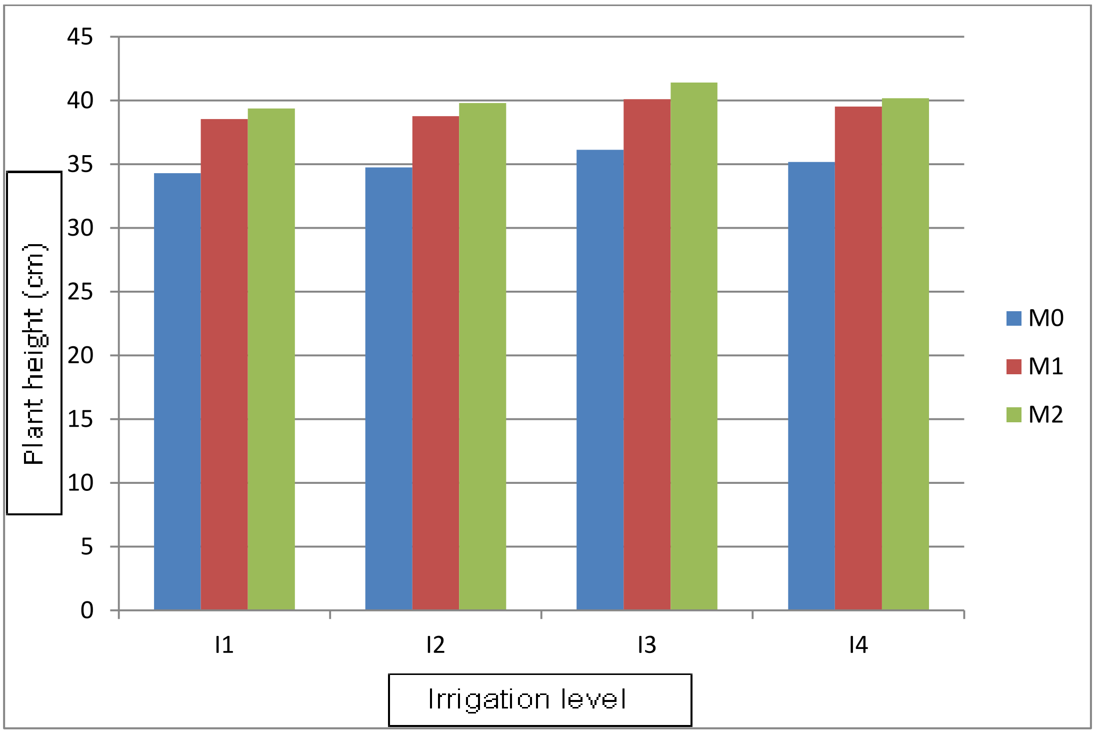

Fig 4.6 Effect of mulch and irrigation level on plant height at 60 DAT (cm)

Table no. 4.7 Effect of mulch and irrigation level on Plant height at 90 DAT (cm)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	40.26	44.48	46.02	43.59
I_2	41.23	45.71	46.60	44.51
I_3	42.59	48.54	52.50	47.88
I_4	41.49	46.39	50.21	46.03
Mean	41.39	46.28	48.83	
	Irrigation (I)	Mulching (M)	Interaction (IxM)	
S.E(m)±	0.093	0.080	0.161	
CD at 5%	0.274	0.237	0.474	

4.1.4 Plant height (cm) at 90 DAT

A perusal of the data given in Table 4.7 and Figure 4.8 revealed that Irrigation levels significantly influenced plant height at 90 days after transplanting. Irrigation scheduled at 0.8 IW/CPE was found significant (47.88) over the other IW/CPE ratios. Among mulching treatments, silver plastic mulch recorded maximum height (48.83) followed by black plastic mulch (46.28) and minimum plant height (41.39) was observed in open no mulch condition.

Irrigation levels and mulching significantly influenced plant height at 90 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum plant height (52.50) followed by 1.0 IW/CPE (50.21) and minimum plant height (40.26) was observed at irrigation level 0.4 IW/CPE.

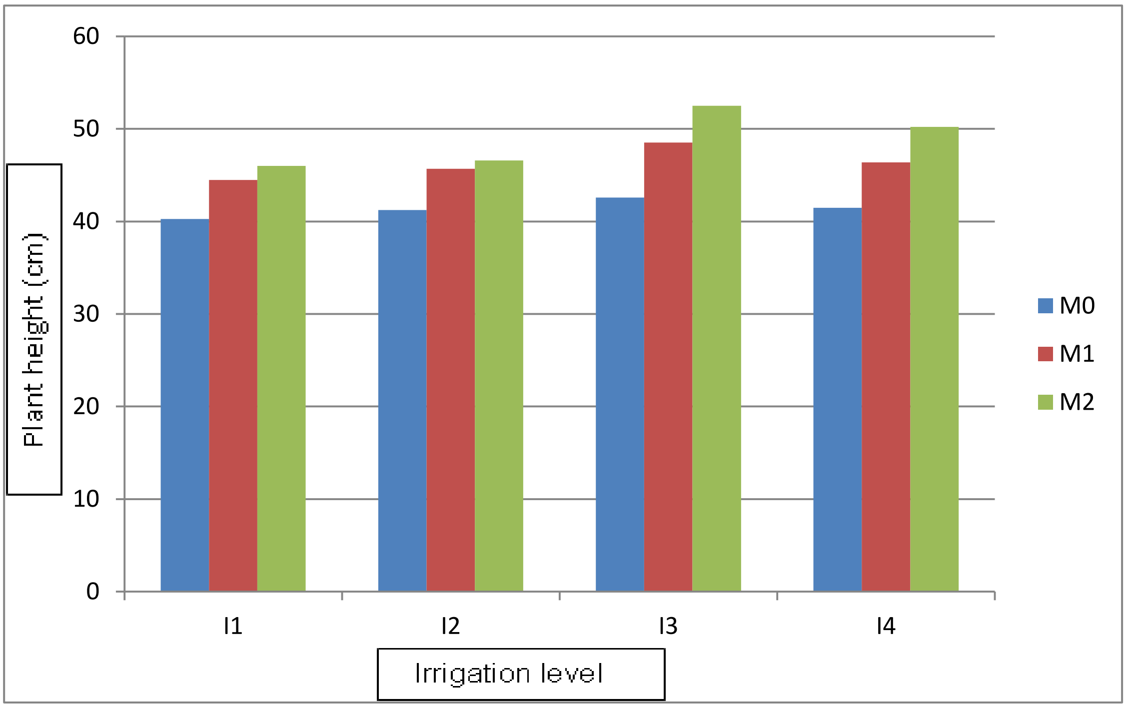

Fig. 4.8 Effect of mulch and irrigation level on Plant height at 90 DAT

Table 4.9 Effect of mulch and irrigation level on no. of primary branches at 30 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	1.40	1.86	2.46	1.91
I_2	1.53	2.13	2.53	2.06
I_3	1.73	2.73	2.73	2.35
I_4	1.60	2.60	2.60	2.17
Mean	1.56	2.23	2.58	
	Irrigation (I)	Mulching (M)	Interaction (IxM)	
S.E(m)±	0.066	0.057	0.114	
CD at 5%	0.194	0.168	NS	

4.1.5. Number of primary branches per plant at 30 DAT

The data given in Table 4.9 and Figure 4.10 shows that the Number of primary branches was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of primary branches (2.35) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum primary branches (2.58) followed by black plastic mulch (2.23) and minimum primary branches (1.56) observed in no mulch condition.

The effect of interaction between irrigation levels and mulching were not statistically significant.

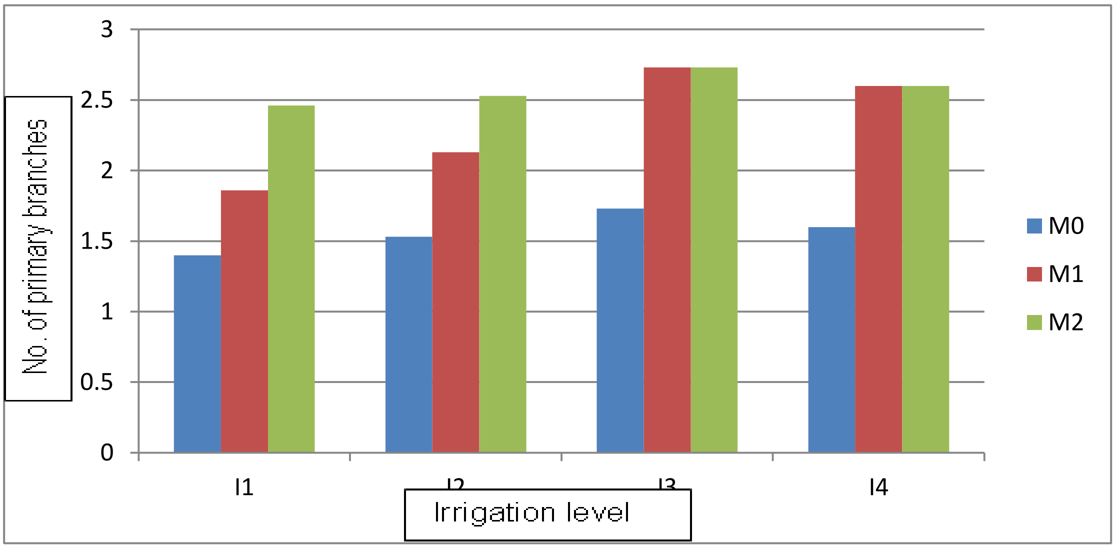

Fig. 4.10 Effect of mulch and irrigation level on no. of primary branches at 30 DAT

Table 4.11 Effect of mulch and irrigation level on no. of primary branches at 45 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	3.80	5.80	6.20	5.26
I_2	4.00	6.06	6.20	5.42
I_3	3.93	6.40	7.40	5.91
I_4	3.86	6.13	6.46	5.48
Mean	3.90	6.10	6.56	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.087	0.075	0.150	
CD at 5%	0.256	0.221	0.443	

4. 1.6. Number of primary branches per plant at 45 DAT

The data given in Table 4.11 and Figure 4.12 shows that the Number of primary branches was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of primary branches (5.91) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum primary branches (6.56) followed by black plastic mulch (6.10) and minimum primary branches (3.90) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced primary branches at 45 DAT (Table-6). Irrigation scheduled at 0.8 IW/CPE recorded the maximum primary branches (7.40) followed by 1.0 IW/CPE (6.46) and minimum primary branches (3.80) was observed at irrigation level 0.4 IW/CPE.

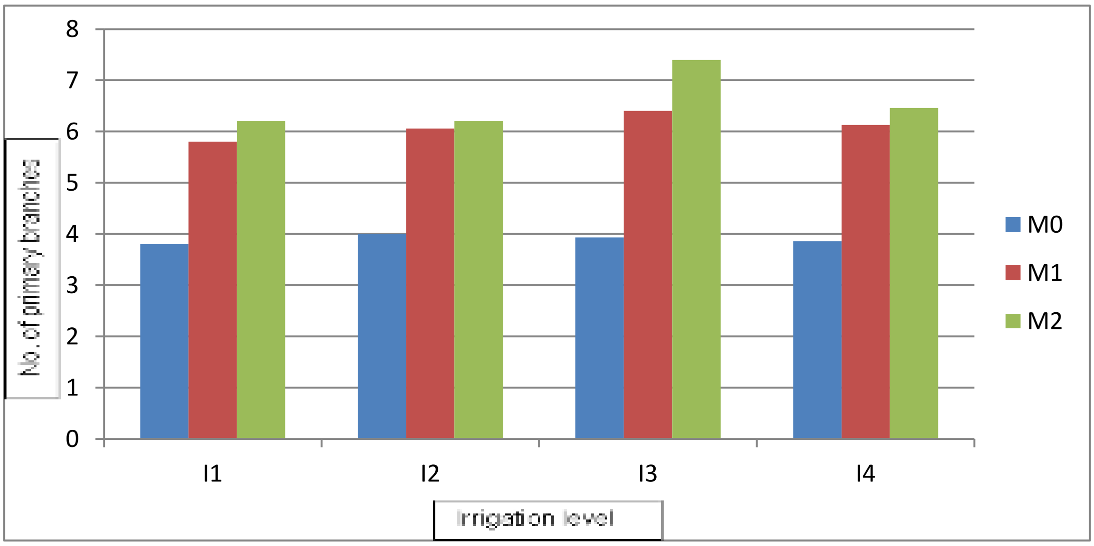

Fig. 4.12 Effect of mulch and irrigation level on no. of primary branches at 45 DAT

Table 4.13 Effect of mulch and irrigation level on no. of primary branches at 60 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	6.20	7.40	8.66	7.42
I_2	6.46	8.40	9.33	8.06
I_3	7.26	8.80	10.40	8.82
I_4	6.60	8.66	9.53	8.26
Mean	6.63	8.31	9.48	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.058	0.050	0.100	
CD at 5%	0.171	0.148	0.296	

4. 1.7. Number of primary branches per plant at 60 DAT

A perusal of the data given in Table 4.13 and Figure 4.14 revealed that the number of primary branches was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of primary branches (8.82) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum primary branches (9.48) followed by black plastic mulch (8.31) and minimum primary branches (6.63) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced primary branches 60 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum primary branches (10.40) followed by 1.0 IW/CPE (9.53) and minimum primary branches (6.20) was observed at irrigation level 0.4 IW/CPE.

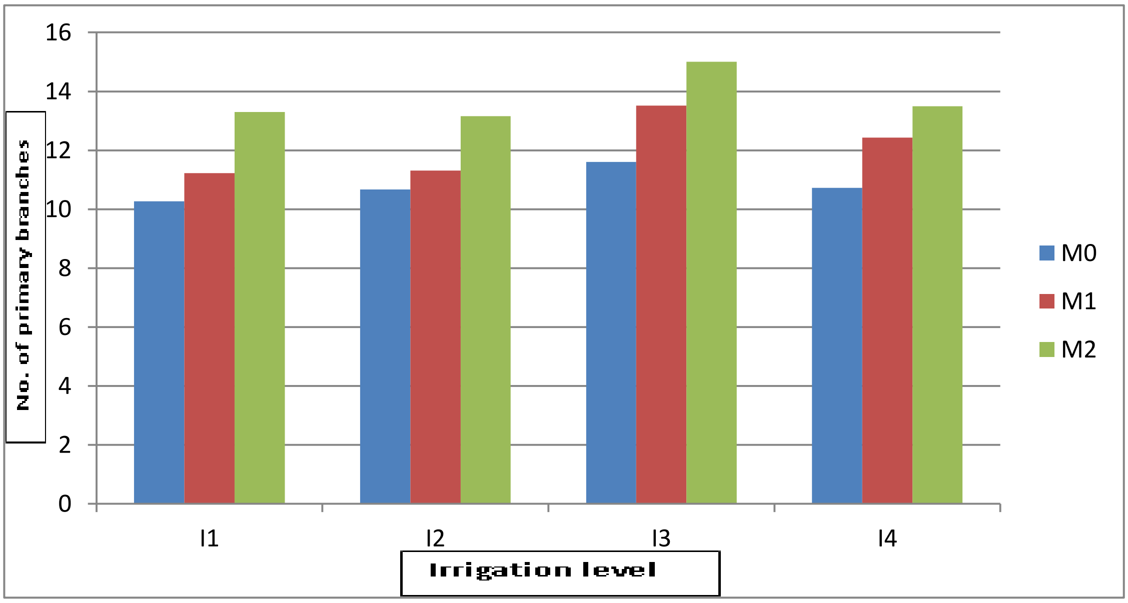

Fig. 4.14 Effect of mulch and irrigation level on no. of primary branches at 60 DAT

Table 4.16 Effect of mulch and irrigation level on no. of primary branches at 90 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	10.27	11.22	13.30	11.60
I_2	10.67	11.31	13.16	11.71
I_3	11.60	13.52	15.00	13.37
I_4	10.72	12.43	13.49	12.21
Mean	10.81	12.12	13.74	
	Irrigation (I)	Mulching (M)	Interaction (IxM)	
S.E(m)±	0.067	0.058	0.116	
CD at 5%	0.197	0.171	0.342	

4. 1.8. Number of primary branches per plant at 90 DAT

A perusal of the data given in Table 4.15 and Figure 4.16 revealed that number of primary branches was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of primary branches (13.37) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum primary branches (13.74) followed by black plastic mulch (12.12) and minimum primary branches (10.81) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced primary branches 90 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum primary branches (15.00) followed by 1.0 IW/CPE (13.49) and minimum primary branches (10.27) was observed at irrigation level 0.4 IW/CPE.

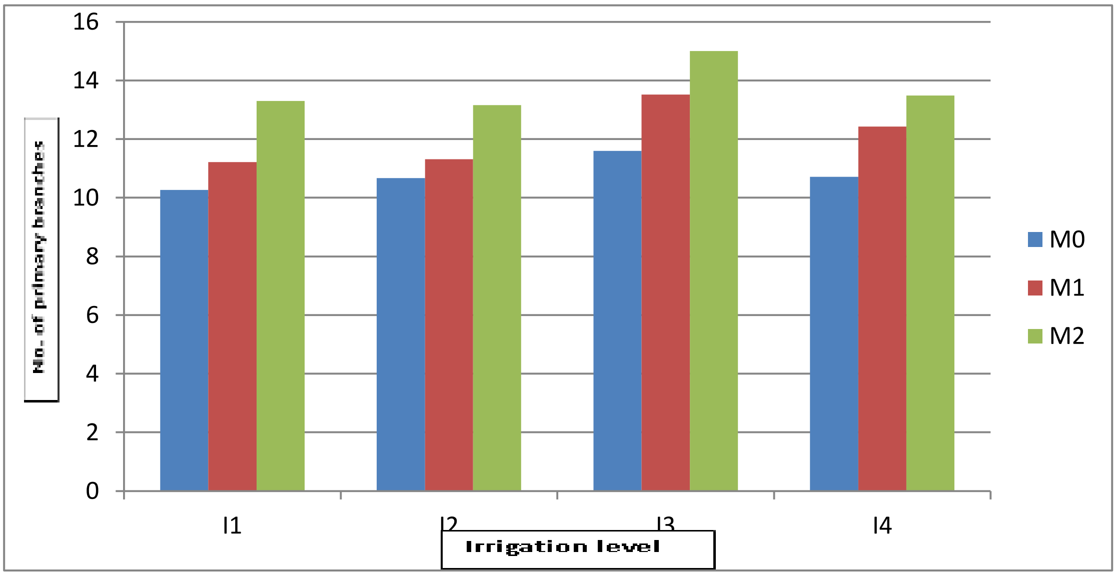

Fig.4.16 Effect of mulch and irrigation level on no. of primary branches at 90 DAT

4. 1.9 Number of secondary branches per plant at 30 DAT

There is not obtain secondary branches at 30 date after transplanting in chilli crop.

Table 4.17 Effect of mulch and irrigation level on no. of secondary branches at 45 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	5.26	7.23	8.41	6.97
I_2	5.40	7.47	8.49	7.12
I_3	6.20	8.55	10.30	8.35
I_4	5.53	7.72	9.36	7.53
Mean	5.60	7.74		
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.072	0.062	0.124	
CD at 5%	0.212	0.183	0.367	

4. 1.10 Number of secondary branches per plant at 45 DAT

A perusal of data given in Table 4.17 and Figure 4.18 indicates that the number of secondary branches was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of secondary branches (8.35) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum secondary branches (9.14), followed by black plastic mulch (7.74) and minimum secondary branches (5.60) was observed at no mulch condition.

Irrigation levels and mulching significantly influenced secondary branches 45 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum secondary branches (10.30), followed by 1.0 IW/CPE (9.36) and minimum secondary branches (5.25) was observed at irrigation level 0.4 IW/CPE.

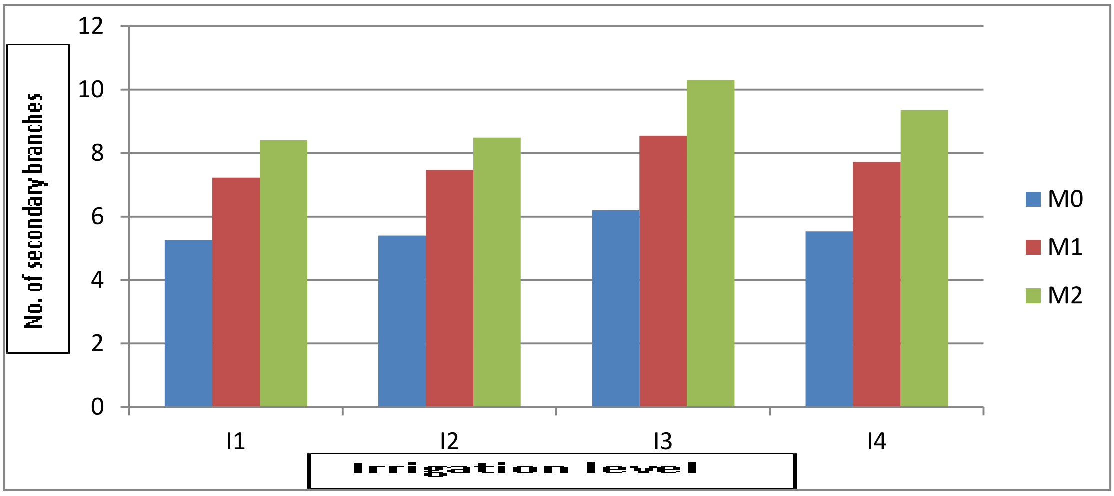

Fig. 4.18 Effect of mulch and irrigation level on no. of secondary branches at 45 DAT

Table 4.19 Effect of mulch and irrigation level on no. of secondary branches at 60 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	11.30	14.41	16.23	13.98
I_2	12.30	15.37	17.51	15.06
I_3	13.36	16.56	19.35	16.42
I_4	12.65	16.10	18.35	15.70
Mean	12.40	15.61	17.86	
	Irrigation (I)	Mulching (M)	Interaction (IxM)	
S.E(m)±	0.038	0.033	0.066	
CD at 5%	0.112	0.097	0.194	

4.1.11 Number of secondary branches per plant at 60 DAT

A perusal of data given in Table 4.19 and Figure 4.20 indicates that the number of secondary branches was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of secondary branches (16.42) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum secondary branches (17.86) followed by black plastic mulch (15.61) and minimum secondary branches (12.40) was observed in no mulch condition.

Interaction effect of irrigation levels and mulching significantly influenced secondary branches 60 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum secondary branches (19.35) followed by 1.0 IW/CPE (18.35) and minimum secondary branches (11.30) was observed at irrigation level 0.4 IW/CPE .

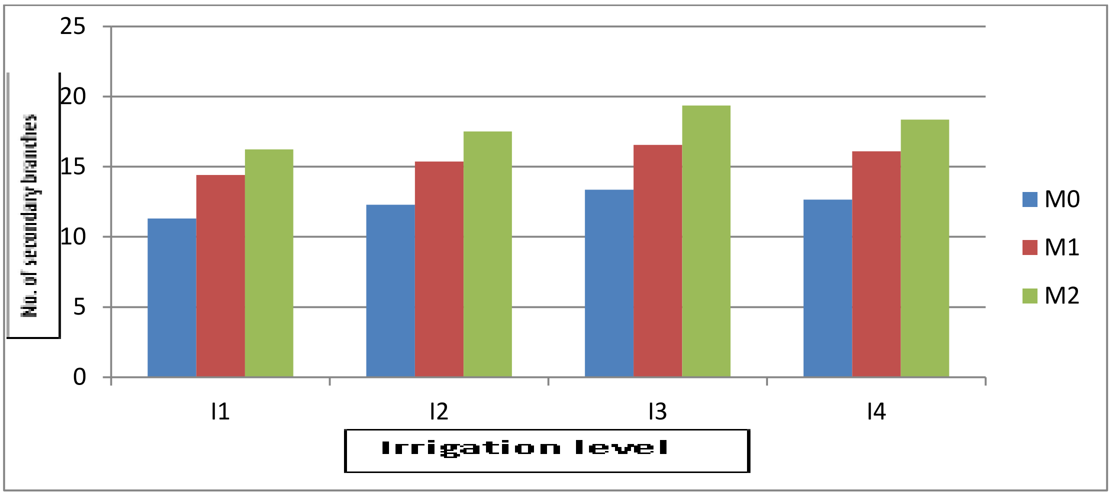

Fig. 4.20 Effect of mulch and irrigation level on no. of secondary branches at 60 DAT

Table 4.21 Effect of mulch and irrigation level on no. of secondary branches at 90 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	16.20	18.35	19.54	18.03
I_2	16.78	18.71	20.23	18.57
I_3	17.78	20.31	23.18	20.42
I_4	16.54	19.51	21.56	19.21
Mean	16.83	19.22	21.13	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.048	0.042	0.083	
CD at 5%	0.142	0.123	0.245	

4.1.12 Number of secondary branches per plant at 90 DAT

Data pertaining in Table 4.21 and Figure 4.22 indicated that the number of secondary branches was significantly influenced by different irrigation levels and mulching. Irrigation scheduled at 0.8 IW/CPE produced maximum number of secondary branches (20.42) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum secondary branches (21.13) followed by black plastic mulch (19.22) and minimum secondary branches (16.83) was observed in no mulch condition. Irrigation levels and mulching significantly influenced secondary branches 90 DAT. Irrigation scheduled at 0.8 IW/CPE recorded the maximum secondary branches (23.18) followed by 1.0 IW/CPE (21.56) and minimum secondary branches (16.20) was observed irrigation level 0.4 IW/CPE.

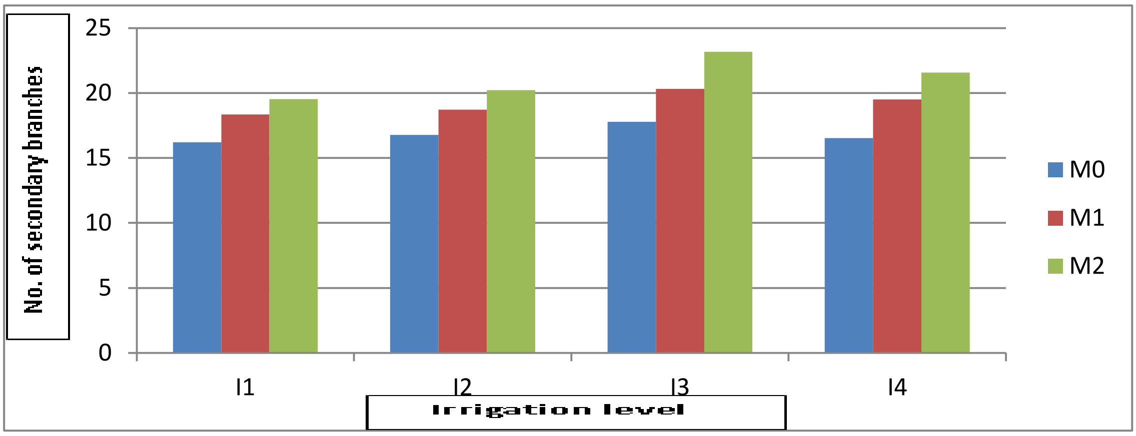

Fig. 4.22 Effect of mulch and irrigation level on no. of secondary branches at 90 DAT

Table 4.23 Effect of mulch and irrigation level on flowering initiation (Days)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	17.75	14.30	13.59	15.21
I_2	17.29	14.33	13.22	14.94
I_3	16.43	14.29	12.53	14.41
I_4	17.30	13.59	13.53	14.80
Mean	17.19	14.13	13.22	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.052	0.045	0.090	
CD at 5%	0.154	0.133	0.267	

4.1.13 Flower initiation (Days)

Data pertaining in Table 4.23 and Figure 4.24. Days to flowering initiation was significantly influenced by different irrigation levels and mulching treatment. Maximum days taken to flowering initiation (15.21) was observed, when irrigation was scheduled at 0.4 IW/CPE and closely followed by 0.6 (14.94), and recorded minimum (14.41) was in irrigation scheduled at 0.8 IW/CPE. Among mulching treatments, no mulch recorded maximum days taken to flowering initiation (17.19) followed by black plastic mulch (14.12) and minimum days taken to flowering initiation (13.21) was observed at silver plastic mulch.

Irrigation levels and mulching significantly influenced days taken to flowering initiation. Irrigation scheduled at 0.4 IW/CPE recorded the maximum days taken to flowering initiation (17.74) followed by 0.6 IW/CPE (17.29) and minimum days taken to flowering initiation (12.52) was observed irrigation level 0.8 IW/CPE.

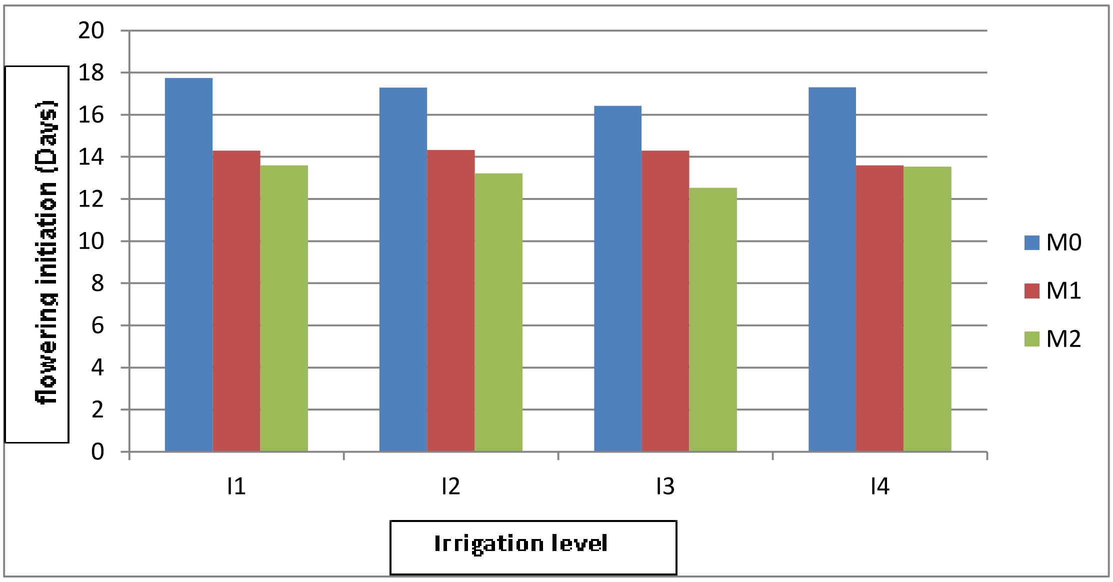

Fig. 4.24 Effect of mulch and irrigation level on flowering initiation (Days)

Table 4.25 Effect of mulch and irrigation level on Days taken to 50% flowering

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	24.80	22.53	21.20	22.84
I_2	24.73	22.40	21.07	22.73
I_3	24.27	20.60	20.03	21.63
I_4	24.53	21.27	20.40	22.07
Mean	24.58	21.70	20.68	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.070	0.061	0.122	
CD at 5%	0.208	0.180	0.360	

4.1.14 Days taken to 50% flowering

A perusal of data given in Table 4.25 and Figure 4.26 indicates that the days taken to 50% flowering were significantly influenced by different irrigation levels, mulching treatment and their interactions. Maximum days taken to 50% flowering (22.84) was observed, when irrigation was scheduled at 0.4 IW/CPE (22.84) and closely followed by 0.6 (22.73), and recorded minimum (21.63) in irrigation scheduled at 0.8 IW/CPE. Among mulching treatments, no mulch recorded maximum days taken to 50% flowering (24.58) followed by black plastic mulch (21.70) and minimum days taken to 50% flowering (20.68) was observed in silver plastic mulch.

Irrigation levels and mulching significantly influenced days taken to 50% flowering. Irrigation scheduled at 0.4 IW/CPE recorded the maximum days taken to 50% flowering (24.80) followed by 0.6 IW/CPE (24.73) and minimum days taken to 50% flowering (20.03) was observed at irrigation level 0.8 IW/CPE.

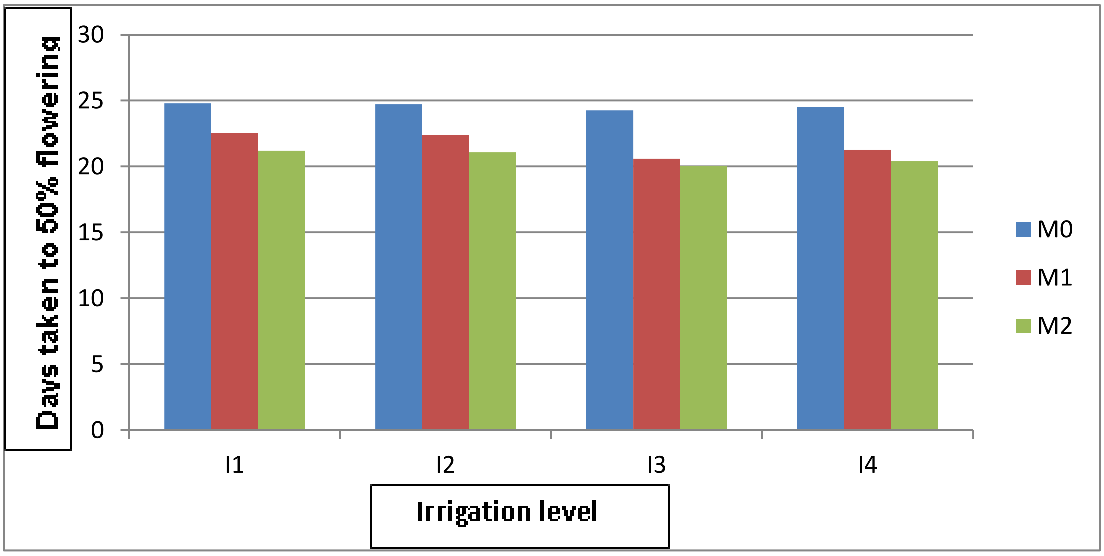

Fig. 4.26 Effect of mulch and irrigation level on Days taken to 50% flowering

Table 4.27 Effect of mulch and irrigation level on Fruit length (cm)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	7.267	7.580	8.547	7.798
I_2	7.307	8.280	8.363	7.983
I_3	8.203	8.450	9.437	8.697
I_4	7.323	8.523	8.630	8.159
Mean	7.525	8.208	8.744	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.058	0.051	0.101	
CD at 5%	0.173	0.149	0.299	

4.2 Effect of mulch and irrigation level on Fruit characters

4.2.1. Fruit length (cm)

A perusal of data given in Table 4.27 and Figure 4.28 indicates that the fruit length was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of fruit length (8.70) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum fruit length (8.74) followed by black plastic mulch (8.21) and minimum fruit length (7.53) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced fruit length. Irrigation scheduled at 0.8 IW/CPE recorded the maximum fruit length (9.44) followed by 1.0 IW/CPE (8.63) and minimum fruit length (7.27) was observed at irrigation level 0.4 IW/CPE.

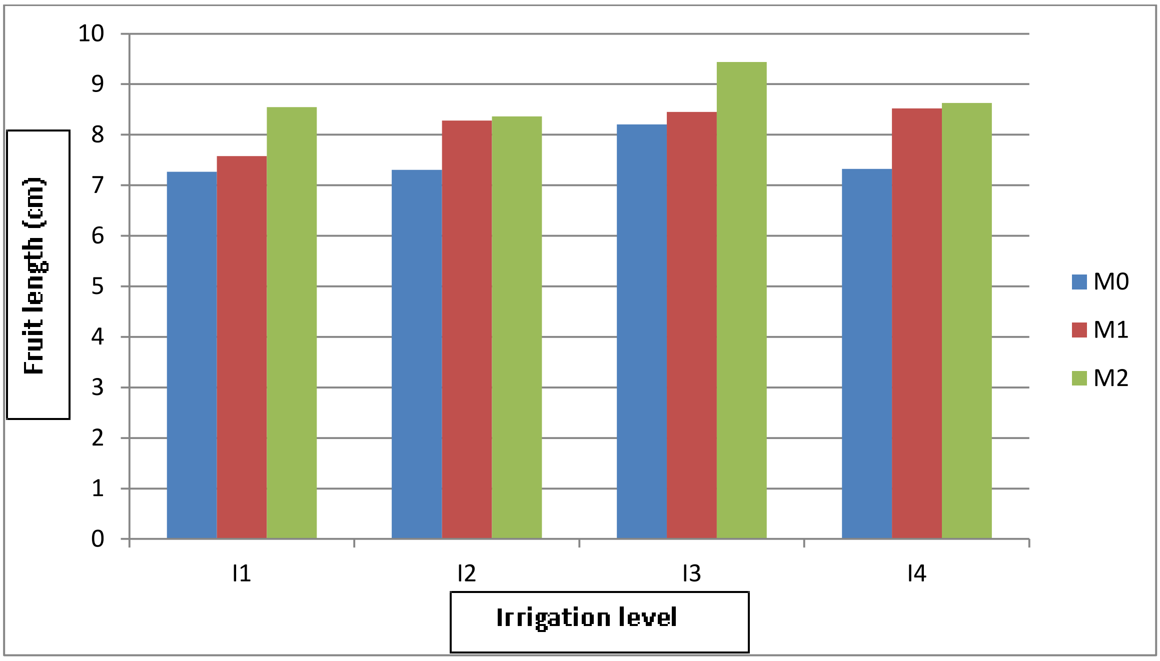

Fig. 4.28 Effect of mulch and irrigation level on Fruit length (cm)

Table 4.29 Effect of mulch and irrigation level on fruit Diameters (cm)

Irrigation (I)	**Mulching**			**Mean**
	M_0	**M_1**	**M_2**	
I_1	0.73	0.83	0.84	0.80
I_2	0.82	0.85	0.87	0.84
I_3	0.84	0.86	0.92	0.87
I_4	0.83	0.86	0.90	0.86
Mean	0.80	0.85	0.88	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.006	0.005	0.006	
CD at 5%	0.018	0.016	0.032	

4.2.2. Fruit Diameters (cm)

A perusal of data given in Table 4.29 and Figure 4.30 indicates that the fruit diameter was significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of fruit diameter (0.87) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum Fruit diameter (0.88) followed by black plastic mulch (0.85) and minimum Fruit diameter (0.80) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced fruit diameter. Irrigation scheduled at 0.8 IW/CPE recorded the maximum Fruit diameter (0.92) followed by 1.0 IW/CPE (0.90) and minimum fruit length (0.74) was observed at irrigation level 0.4 IW/CPE.

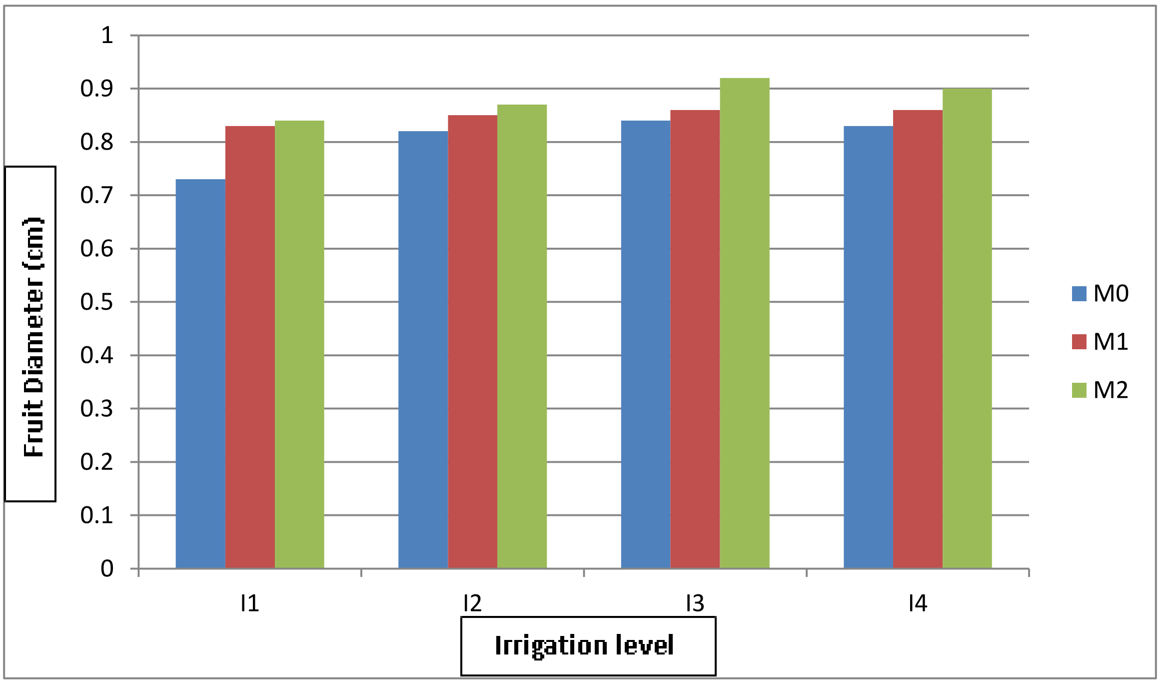

Fig. 4.30 Effect of mulch and irrigation level on fruit Diameter (cm)

Table 4.31 Effect of mulch and irrigation level on average fruit weight (gm)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	3.34	4.19	4.19	3.91
I_2	3.42	4.34	4.36	4.04
I_3	4.14	4.39	5.18	4.57
I_4	3.47	4.39	4.24	4.03
Mean	3.59	4.33	4.49	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.049	0.042	0.085	
CD at 5%	0.144	0.125	0.250	

4.2.3. Average weight of fruit (g)

A perusal of data given in Table 4.31 and Figure 4.32 indicates that the average weight of fruit significantly influenced by different irrigation levels. Irrigation scheduled at 0.8 IW/CPE produced maximum number of average weight of fruit (4.57) followed by other irrigation treatments. Among mulching treatments, silver plastic mulch recorded maximum average weight of fruit (4.49) followed by black plastic mulch (4.33) and minimum average weight of fruit observed in no mulch condition.

Interaction effect of irrigation levels and mulching significantly influenced average weight of fruit. Irrigation scheduled at 0.8 IW/CPE recorded the maximum average weight of fruit (5.18) followed by 1.0 IW/CPE (4.24) and minimum average weight of fruit (3.34) was observed at irrigation level 0.4 IW/CPE.

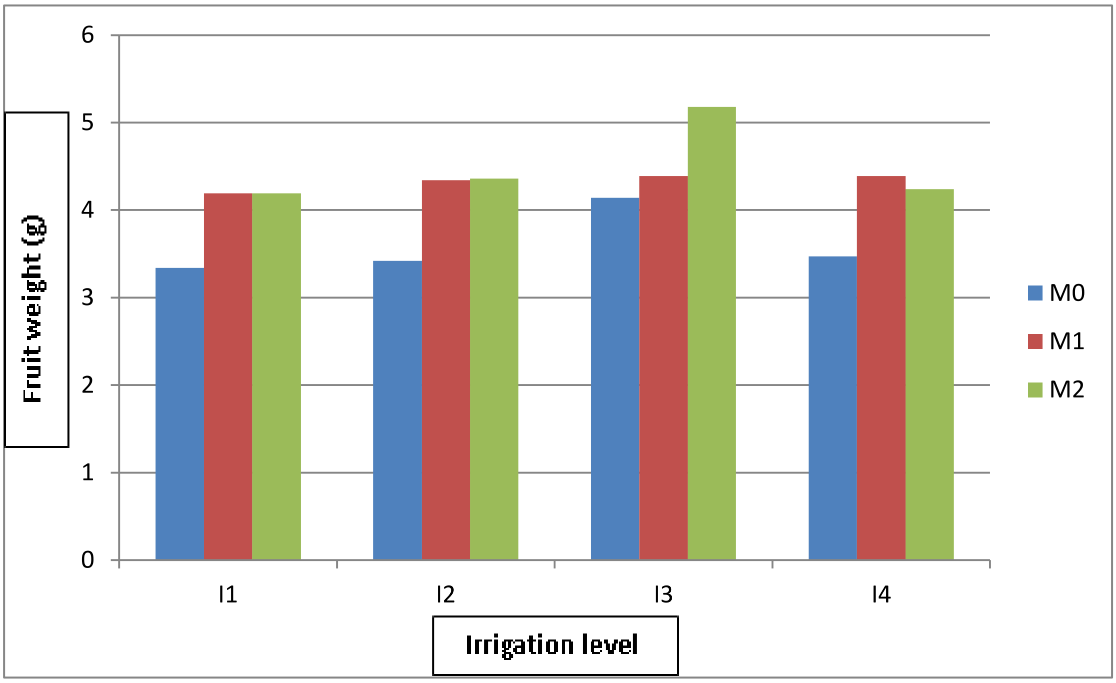

Fig. 4.32 Effect of mulch and irrigation level on average fruit weight (gm)

Table 4.33 Effect of mulch and irrigation level on no. of fruit per plant (g)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	134.67	142.67	148.00	141.77
I_2	136.00	145.33	154.00	145.11
I_3	142.00	149.00	161.33	150.77
I_4	140.67	146.00	157.67	148.11
Mean	138.33	145.75	155.25	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.52	0.45	0.90	
CD at 5%	1.53	1.33	2.66	

4.3 Effect of mulch and irrigation level on yield characters

4.3.1. Number of fruits per plant

Data pertaining in Table 4.33 and Figure 4.34 indicate the number of fruits per plant has been significantly influenced by different irrigation levels, mulching treatment and their interactions. Maximum number of fruits (150.77) was observed, when irrigation was scheduled at 0.8 IW/CPE and closely followed by 1.0 (148.11) and recorded minimum (141.77) in irrigation scheduled at 0.4 IW/CPE. Among mulching treatments, silver plastic mulch recorded maximum number of fruits (155.25) followed by black plastic mulch (145.75) and minimum number of fruits (138.33) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced number of fruits. Irrigation scheduled at 0.8 IW/CPE recorded the maximum number of fruits (161.33) followed by 1.0 IW/CPE (157.66) and minimum number of fruits (134.66) was observed irrigation level 0.4 IW/CPE.

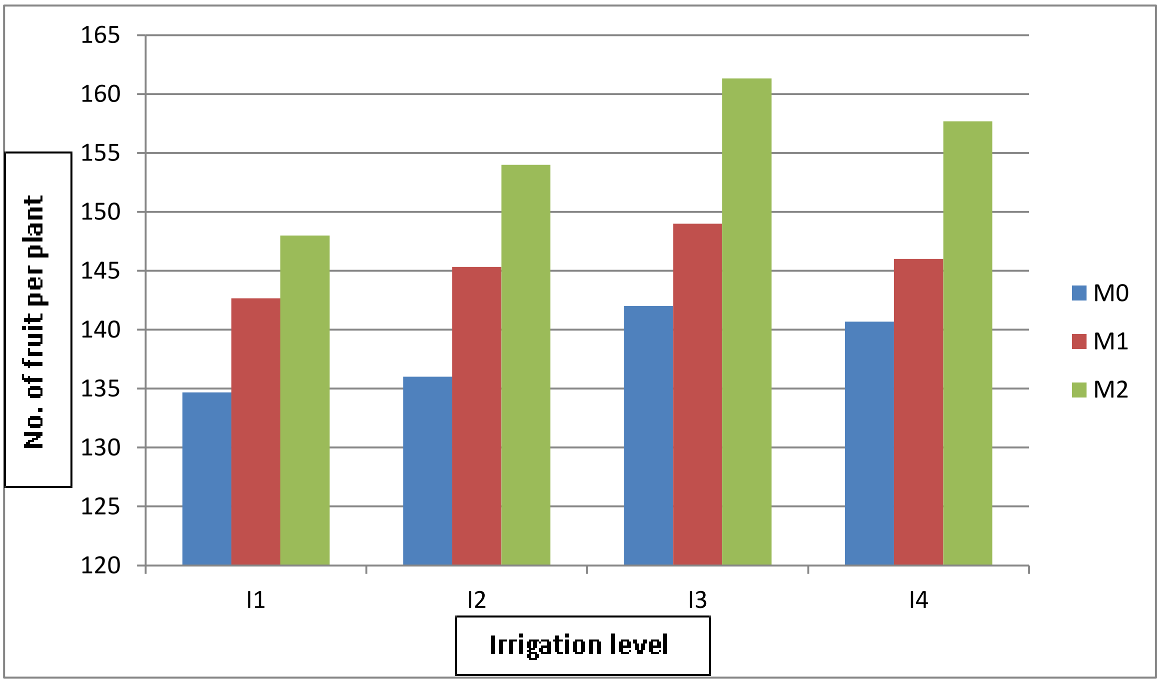

Fig. 4.34 Effect of mulch and irrigation level on no. of fruit per plant

Table 4.35 Effect of mulch and irrigation level on Fruit yield per plant (g)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	550.71	614.78	648.28	604.59
I_2	560.42	649.1	723.58	644.35
I_3	626.49	713.21	853.13	713.21
I_4	579.27	684.97	751.57	671.93
Mean	579.22	665.50	744.14	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	4.83	4.18	8.36	
CD at 5%	14.25	12.35	24.69	

4.3.2 Fruit yield per plant (g)

A perusal of data given in Table 4.35 and Figure 4.36 indicates that the fruit yield per plant has been significantly influenced by different irrigation levels, mulching treatment and their interactions (Table-18, Fig. 18). Maximum Fruit yield per plant (713.21) was observed, when irrigation was scheduled at 0.8 IW/CPE and closely followed by 1.0 (671.93), and recorded minimum (604.59) in irrigation scheduled at 0.4 IW/CPE (604).

Among mulching treatments, silver plastic mulch recorded maximum fruit yield per plant (744.14) followed by black plastic mulch (665.50) and minimum fruit yield per plant (579.22) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced fruit yield per plant. Irrigation scheduled at 0.8 IW/CPE recorded the maximum fruit yield per plant (853.13) followed by 1.0 IW/CPE (751.56) and minimum fruit yield per plant (550.70) was observed at irrigation level 0.4 IW/CPE.

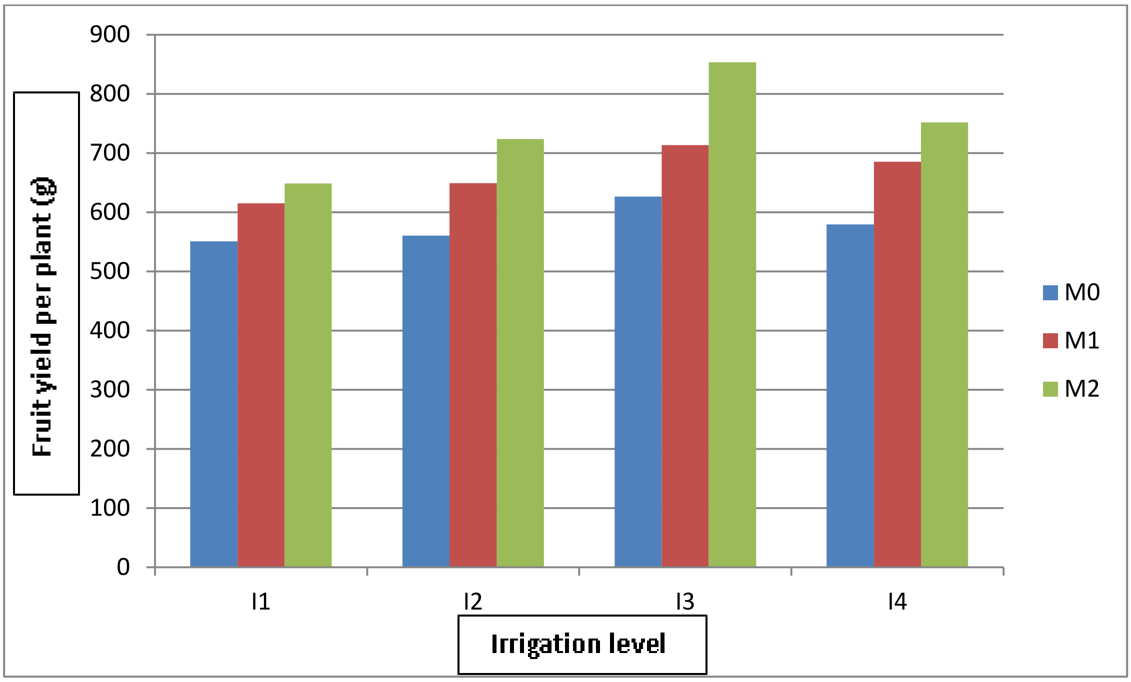

Fig 4.36 Effect of mulch and irrigation level on fruit yield per plant (g)

Table 4.37 Effect of mulch and irrigation level on fruit yield per plot (kg)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	8.61	9.47	10.54	9.54
I_2	8.83	10.38	11.17	10.13
I_3	9.38	11.83	13.40	11.54
I_4	9.15	10.74	12.18	10.69
Mean	8.990	10.61	11.823	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.055	0.047	0.095	
CD at 5%	0.162	0.140	0.280	

4.3.3 Fruit yield per plot (kg)

A perusal of data given in Table 4.37 and Figure 4.38 indicates that the fruit yield per plot was significantly influenced by different irrigation levels, mulching treatment and their interactions. Maximum Fruit yield per plot (11.54**)** was observed, when irrigation was scheduled at 0.8 IW/CPE, closely followed by 1.0IW/CPE (10.68), and recorded minimum (9.53) in irrigation scheduled at 0.4 IW/CPE. Among mulching treatments, silver plastic mulch recorded maximum Fruit yield per plot (11.82) followed by black plastic mulch (10.61) and minimum Fruit yield per plot (8.99) was observed in no mulch condition.

Irrigation levels and mulching significantly influenced Fruit yield per plot. Irrigation scheduled at 0.8 IW/CPE recorded the maximum fruit yield per plot (13.40) followed by 1.0 IW/CPE (12.18) and minimum fruit yield per plot (8.61) was observed at irrigation level 0.4 IW/CPE.

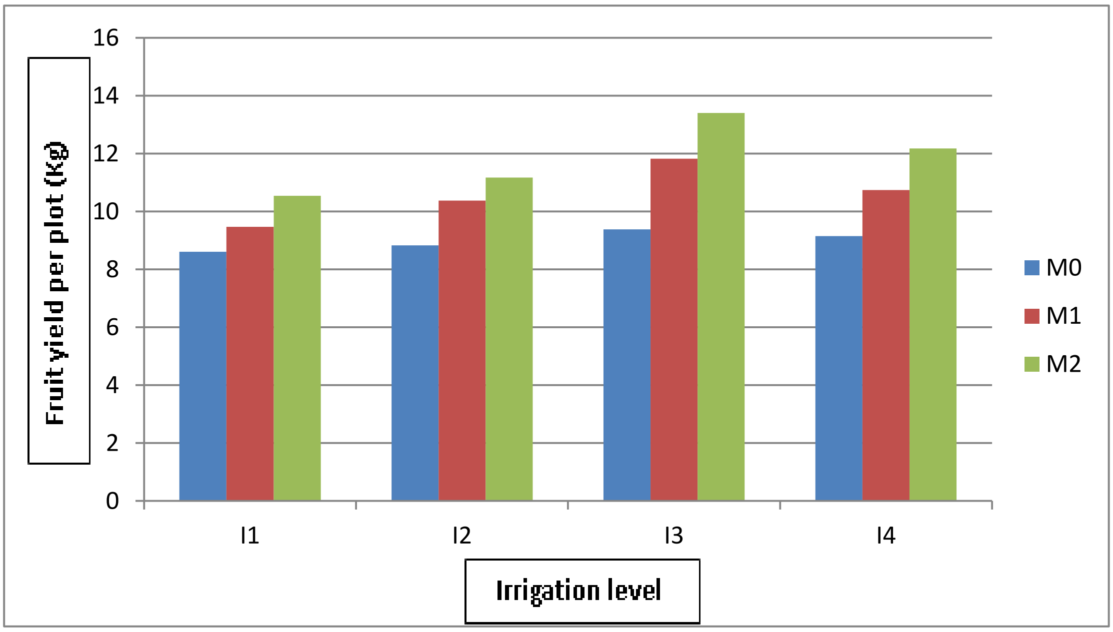

Fig. 4.38 Effect of mulch and irrigation level on fruit yield per plot (kg)

Table 4.39 Effect of mulch and irrigation level on TSS of chilli (Brix)

Irrigation (I)	Mulching			Mean
		M_1	M_2	
I_1	2.40	2.23	2.33	2.32
I_2	2.27	1.87	1.67	1.93
I_3	2.60	1.06	0.99	1.55
I_4	2.27	2.20	1.40	1.96
Mean	2.38	1.84	1.60	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.079	0.068	0.137	
CD at 5%	0.233	0.201	0.403	

4. 4. Effect of mulch and irrigation level on Quality parameters

4.4.1. Total soluble solids (ºBrix)

A perusal of the data given in Table 4.39 and Figure 4.40 leads to the Irrigation levels and mulching has been found to be significant on total soluble solids. Higher total soluble solids were recorded in open condition at o.4 IW/CPE (2.32) followed by 1.0 IW/CPE (1.95) ratio's and it was minimum (1.55) in 0.8 IW/CPE. Among mulching treatments, no mulch recorded maximum total soluble solids (2.38) followed by black plastic mulch (1.84) and minimum total soluble solids (1.60) was observed at silver plastic mulch.

Irrigation levels and mulching significantly influenced total soluble solids. Irrigation scheduled at 0.8 IW/CPE recorded the maximum total soluble solids (2.60) followed by 0.4 IW/CPE (2.40) and minimum total soluble solids (0.99) was observed at irrigation level (silver mulch) 0.8 IW/CPE.

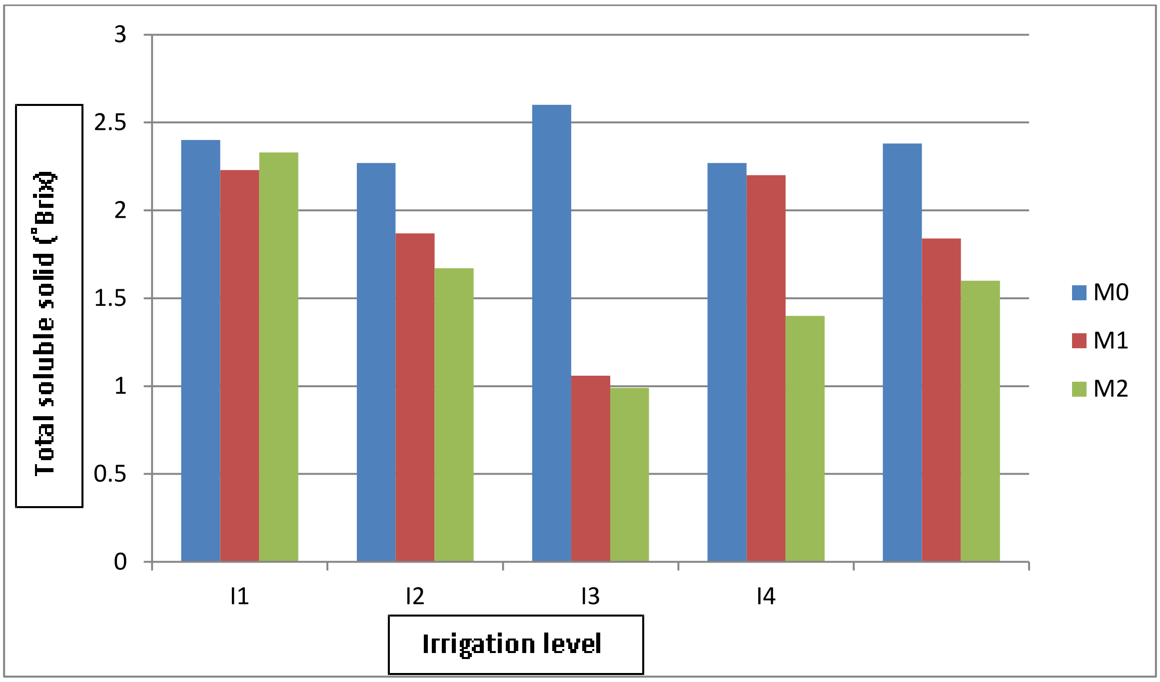

Fig.4.40 Effect of mulch and irrigation level on TSS of chilli (ºBrix)

Table 4.41 Effect of mulch and irrigation level on ascorbic acid of chilli (mg/100 g)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	218.48	253.13	262.83	244.82
I_2	228.30	255.17	269.50	250.99
I_3	232.73	266.83	272.37	257.31
I_4	229.37	258.70	271.57	253.21
Mean	227.22	258.46	269.07	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	2.400	2.079	4.157	
CD at 5%	7.085	6.136	NS	

4.4.2. Ascorbic acid content (mg/100 g)

A perusal of the data given in Table 4.20 and Figure 4.19 leads to the ascorbic acid (mg/ 100 g) were significantly influenced by different irrigation levels, mulching treatment and their interactions. Maximum Ascorbic acid (257.31) was observed, when irrigation scheduled at 0.8 IW/CPE, at par and closely followed by 1.0 IW/CPE (253.21) and recorded minimum (244.82) in irrigation scheduled at 0.4 IW/CPE. Among mulching treatments, silver plastic mulch recorded maximum Ascorbic acid (269.07) followed by black plastic mulch (258.46) and minimum Ascorbic acid observed was (227.22) in no mulch condition. The change in vitamin-C in chilli due to plastic mulch increased amount of vitamin-C in chilli fruit was observed in all the mulch treated plants compared to control. But among the mulch treatments, there was no significant difference in vitamin-C content of the fruits.

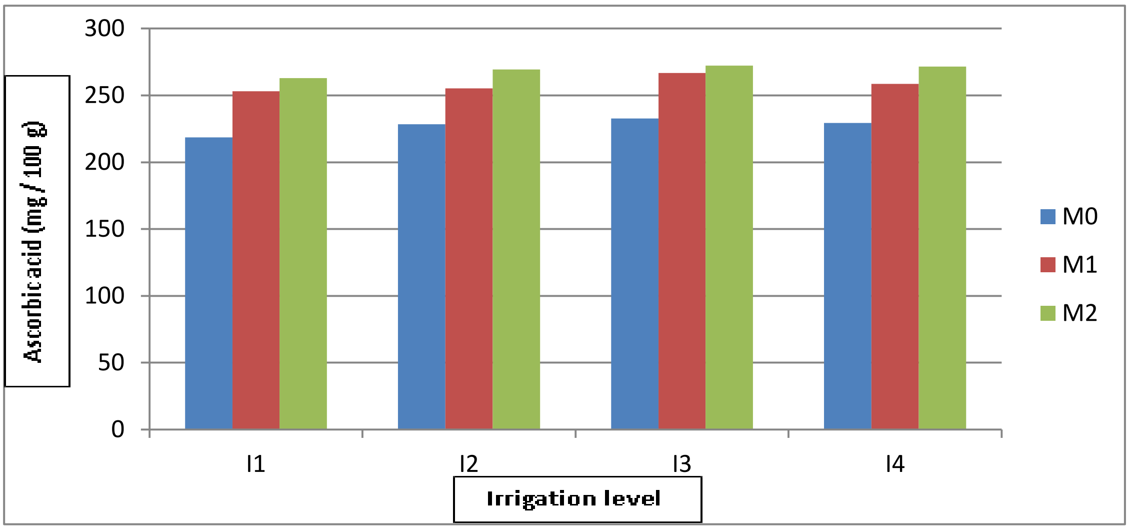

Fig 4.42 Effect of mulch and irrigation level on ascorbic acid of chilli (mg/100 g)

Table 4.43 Effect of mulch and irrigation level on weeds fresh weight (g)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	40.68	7.20	8.22	18.70
I_2	41.44	7.20	8.26	18.97
I_3	41.54	7.25	8.27	19.02
I_4	42.29	7.38	7.38	19.51
Mean	41.49	7.26	8.40	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.085	0.074	0.147	
CD at 5%	0.251	0.217	0.434	

4.5 Effect of mulch and irrigation level on weeds

4.5.1 Weeds fresh weight (g)

A perusal of data given in Table 4.43 and depicted in Figure 4.44 indicates that the weeds fresh weight was significantly influenced by different irrigation levels and mulching. Maximum weeds fresh weight (19.51) was observed, when irrigation was scheduled at 1.0 IW/CPE, closely followed by 0.8 (19.02), and recorded minimum (18.70) in irrigation scheduled at 0.4 IW/CPE. Among mulching treatments, no mulch recorded maximum weeds fresh weight (41.49) followed by silver plastic mulch (8.40) and minimum weeds fresh weight (7.26) observed at black plastic mulch.

Interaction effect of Irrigation levels and mulching significantly influenced weeds fresh weight. Irrigation scheduled at 1.0 IW/CPE recorded the maximum weeds fresh weight (42.29) followed by 0.8 IW/CPE (41.54) and minimum weeds fresh weight (7.20) was observed at irrigation level (black mulch) 0.4 IW/CPE.

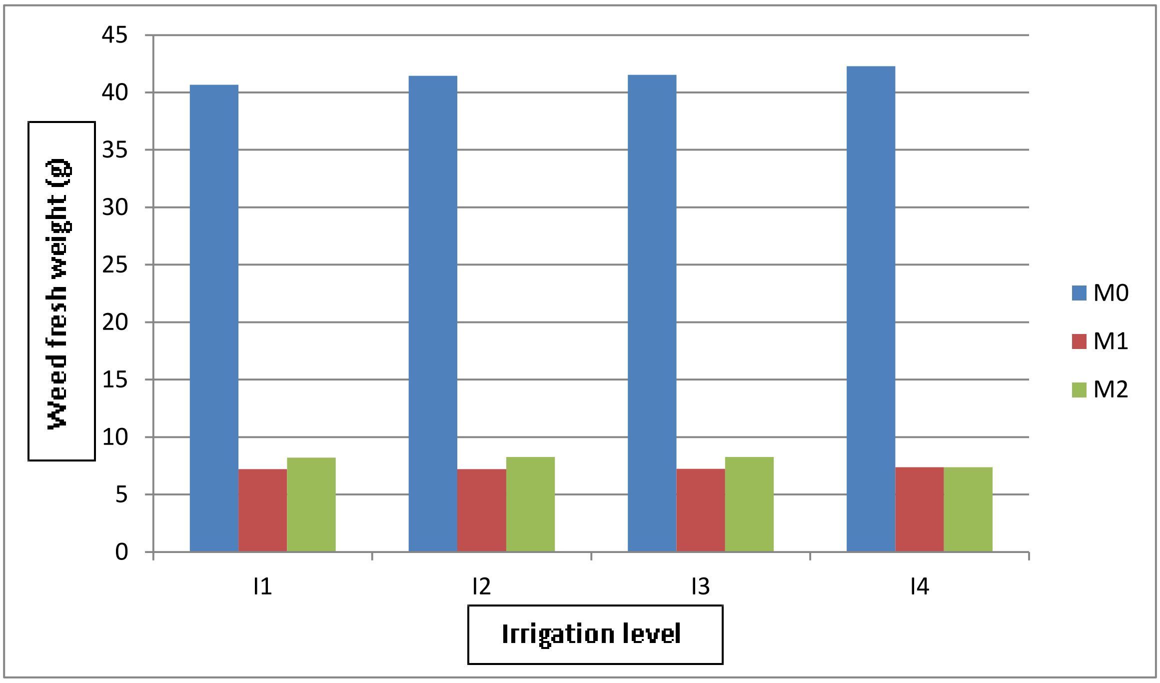

Fig .4.44 Effect of mulch and irrigation level on weeds fresh weight (g)

Table 4.45 Effect of mulch and irrigation level on weeds Biomass (g)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	11.26	2.07	2.10	5.14
I_2	11.39	2.11	2.43	5.31
I_3	11.44	2.23	2.50	5.39
I_4	11.81	2.36	2.61	5.60
Mean	11.48	2.19	2.41	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.065	0.056	0.112	
CD at 5%	0.191	0.165	NS	

4.5.2. Weeds biomass (g)

A perusal of data given in Table 4.45 and depicted in Figure 4.46 indicates that the weeds dry weight has been significantly influenced by different irrigation levels and mulching. Maximum weeds dry weight (5.60) was observed, when irrigation was scheduled at 1.0 IW/CPE, closely followed by 0.8 (5.39), and recorded minimum (5.14) in irrigation level at 0.4 IW/CPE. Among mulching treatments, no mulch recorded maximum weeds dry weight (11.48) followed by silver plastic mulch (2.41) and minimum weeds dry weight (2.19) observed at black plastic mulch.

Interaction effect of irrigation levels and mulching significantly influenced weeds dry weight. Irrigation scheduled at 1.0 IW/CPE recorded the maximum weeds dry weight (11.81), followed by 0.8 IW/CPE (11.44) and minimum weeds dry weight (2.07) was observed at irrigation level with black mulch 0.4 IW/CPE.

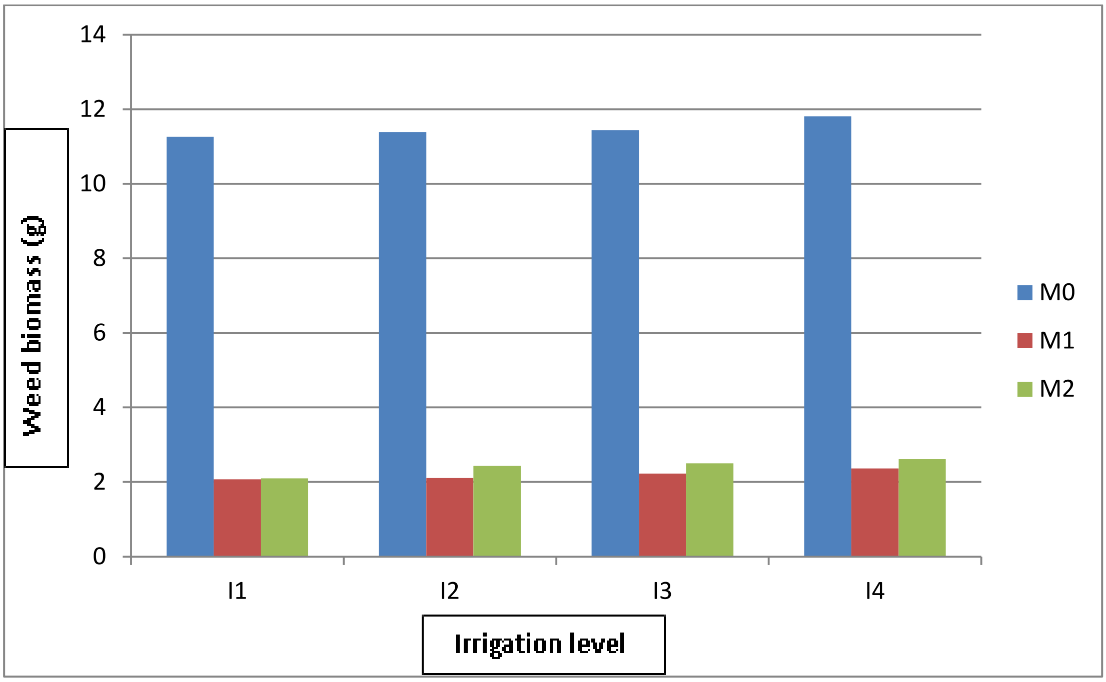

Fig. 4.46 Effect of mulch and irrigation level on weeds Biomass (g)

Table 4.47 Effect of mulch and irrigation level on water use efficiency

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	2.75	3.86	4.34	3.66
I_2	3.046	4.22	5.11	4.12
I_3	3.51	4.53	5.31	4.45
I_4	3.12	4.34	5.12	4.20
Mean	3.11	4.24	4.97	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.035	0.030	0.061	
CD at 5%	0.103	0.089	0.179	

4.6. Water use efficiency (kg ha-^{1}-mm)

A perusal of data given in Table 4.47 and depicted in Figure 4.48 indicates that the water use efficiency was significantly influenced by different irrigation levels and mulching treatment. Maximum water use efficiency (4.44) was observed, when irrigation scheduled at 0.8 IW/CPE, closely followed by 1.0 (4.19) and recorded minimum (3.65) at irrigation scheduled 0.4 IW/CPE.

Among mulching treatments, silver plastic mulch recorded maximum water use efficiency (4.96), followed by black plastic mulch (4.23) and minimum water use efficiency (3.11) was observed in no mulch.

There interaction effect of irrigation levels and mulching significantly influenced water use efficiency. Irrigation scheduled at 0.8 IW/CPE recorded the maximum water use efficiency (5.30), followed by 1.0 IW/CPE (5.11), minimum water use efficiency (2.76) was observed at irrigation level (silver mulch) 0.6 IW/CPE.

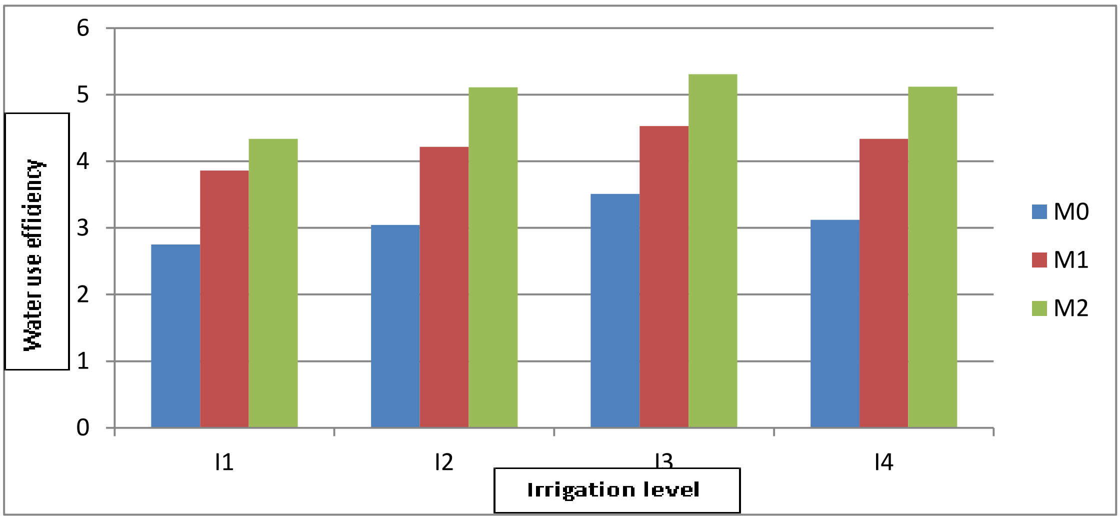

Fig. 4.48 Effect of mulch and irrigation level on Water use efficiency (kg ha-^{1}-mm)

Table 4.49 Effect of mulch and irrigation level on fruit maturity stage (depth of 0-15cm)

Irrigation (I)	**Mulching**			**Mean**
	M_0	**M_1**	**M_2**	
I_1	23.24	30.17	31.41	
I_2	23.57	31.98	32.32	
I_3	24.20	32.42	33.24	
I_4	25.39	32.62	33.53	
Mean	24.10	31.80	32.63	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.161	0.139	0.278	
CD at 5%	0.474	0.410	NS	

4.7 Effect of mulch and irrigation level on Soil moisture depletion pattern (%)

4.7.1 Fruit maturity stage (depth of 0- 15cm)

A perusal of data given in Table 4.49 and depicted in Figure 4.50 indicates that the soil moisture depletion has been significantly influenced by different irrigation levels, mulching treatment. Maximum soil moisture depletion (33.53) was observed, when irrigation was scheduled at 1.0IW/CPE, closely followed by 0.8 (33.24) and recorded minimum (31.41) at irrigation scheduled 0.4 IW/CPE (31.41). Among mulching treatments, silver plastic mulch recorded maximum soil moisture depletion (32.63), followed by black plastic mulch (31.80) and minimum soil moisture depletion (24.10) observed in no mulch.

Interaction effect of irrigation levels and mulching significantly influenced soil moisture depletion. Irrigation scheduled (silver mulch) at 1.0 IW/CPE recorded the maximum soil moisture depletion (33.53), followed (silver mulch) by 0.8 IW/CPE (33.24) and minimum soil moisture depletion (23.24) was observed at irrigation level 0.4 IW/CPE.

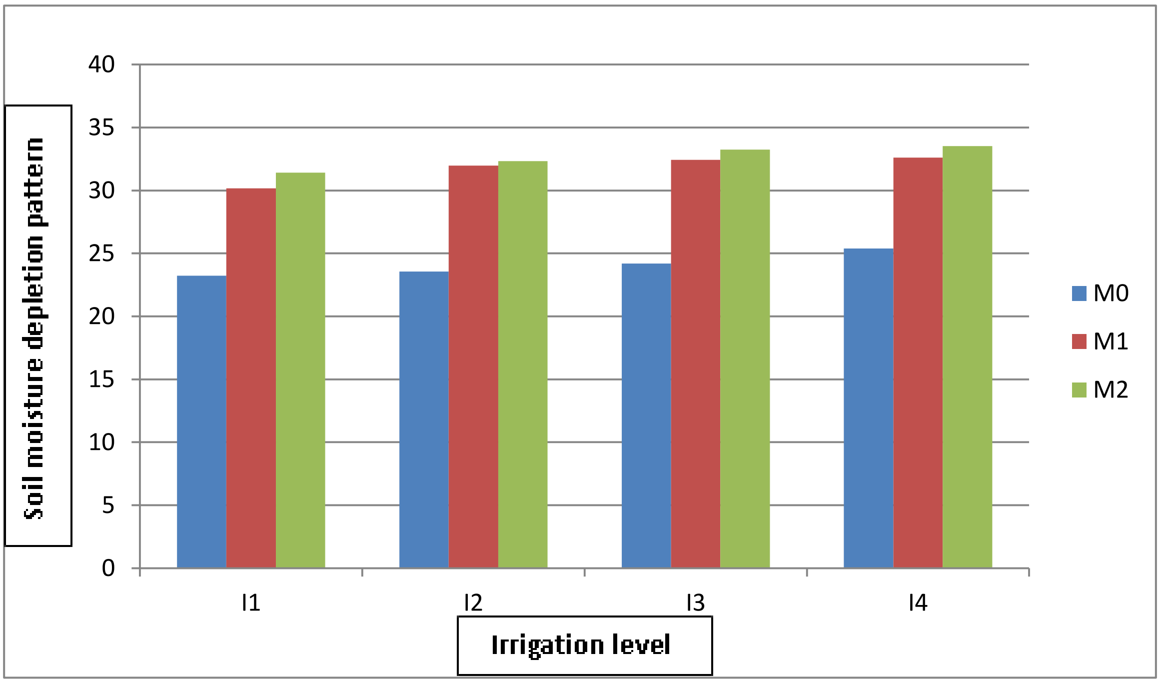

Fig.4.50 Effect of mulch and irrigation level on fruit maturity stage (depth of 0-15cm)

Table 4.51 Effect of mulch and irrigation level on fruit maturity stage (depth of 15- 30cm)

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	19.33	23.36	24.38	22.36
I_2	19.73	23.77	24.49	22.66
I_3	20.17	23.64	24.61	22.80
I_4	20.53	24.32	25.21	23.35
Mean	19.94	23.77	24.67	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.057	0.050	0.099	
CD at 5%	0.169	0.147	0.293	

4.7.2 Fruit maturity stage (depth of 15- 30 cm)

A perusal of data given in Table 4.51 and depicted in Figure 4.52 indicates that the Soil moisture depletion was significantly influenced by different irrigation levels, mulching treatment. Maximum soil moisture depletion was observed, when irrigation was scheduled at 1.0IW/CPE (23.35), closely followed by 0.8 (22.78), and recorded minimum (22.36) at irrigation scheduled 0.4 IW/CPE. Among mulching treatments, silver plastic mulch recorded maximum soil moisture depletion (24.67) followed by black plastic mulch (23.77) and minimum soil moisture depletion (19.94) was observed no mulch.

Interaction effect of irrigation levels and mulching significantly influenced soil moisture depletion at Irrigation scheduled (silver mulch) 1.0 IW/CPE recorded the maximum soil moisture depletion (25.21), followed (silver mulch) by 0.8 IW/CPE (24.61) and minimum soil moisture depletion (19.33) was observed at irrigation level 0.4 IW/CPE.

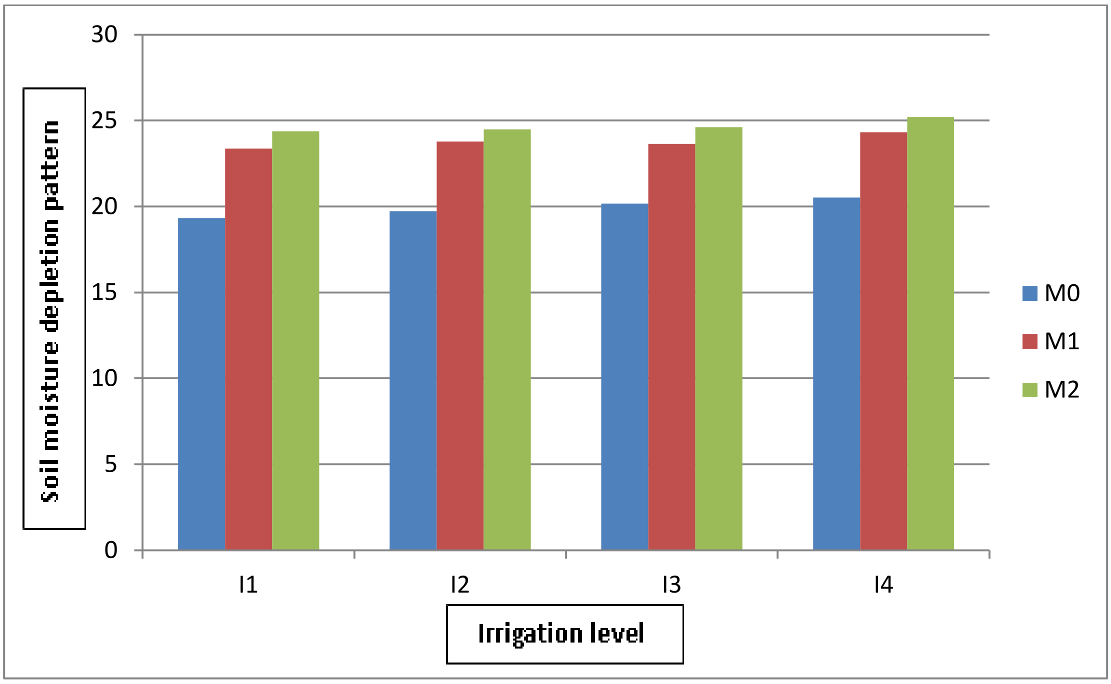

Fig .4.52 Effect of mulch and irrigation level on fruit maturity stage (depth of 15- 30cm)

Table 4.53 Effect of mulch and irrigation level on Vegetative phase at 30 DAT

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	17.53	21.33	21.20	20.02
I_2	17.47	20.60	20.37	19.48
I_3	17.47	20.40	20.27	19.38
I_4	17.27	20.20	20.20	19.22
Mean	17.43	20.63	20.51	
	Irrigation (I)	Mulching (M)	Interaction (IxM)	
S.E(m) ±	0.071	0.062	0.123	
CD at 5%	0.210	0.182	0.365	

4.8 Effect of mulch and irrigation level on Variation in soil temperature at different stage

4.8.1 Vegetative phase at 30 DAT

A perusal of data given in Table 4.53 and depicted in Figure 4.54 indicates that the Soil temperature was significantly influenced by different irrigation levels, mulching treatment. Maximum soil temperature were observed, when irrigation was scheduled at 0.4 IW/CPE (20.02), closely followed by 0.6 (19.48), and recorded minimum at irrigation (19.22) scheduled 1.0 IW/CPE. Among mulching treatments, black plastic mulch recorded maximum soil temperature (20.63) followed by silver plastic mulch (20.51) and minimum soil temperature (17.43) was observed no mulch.

Interaction effect of irrigation levels and mulching significantly influenced soil temperature. Irrigation scheduled (black mulch) at 0.4 IW/CPE recorded the maximum soil temperature (21.33) followed by 0.4 IW/CPE (silver mulch) (21.20) and minimum soil temperature (17.27) was observed at irrigation level 1.0 IW/CPE.

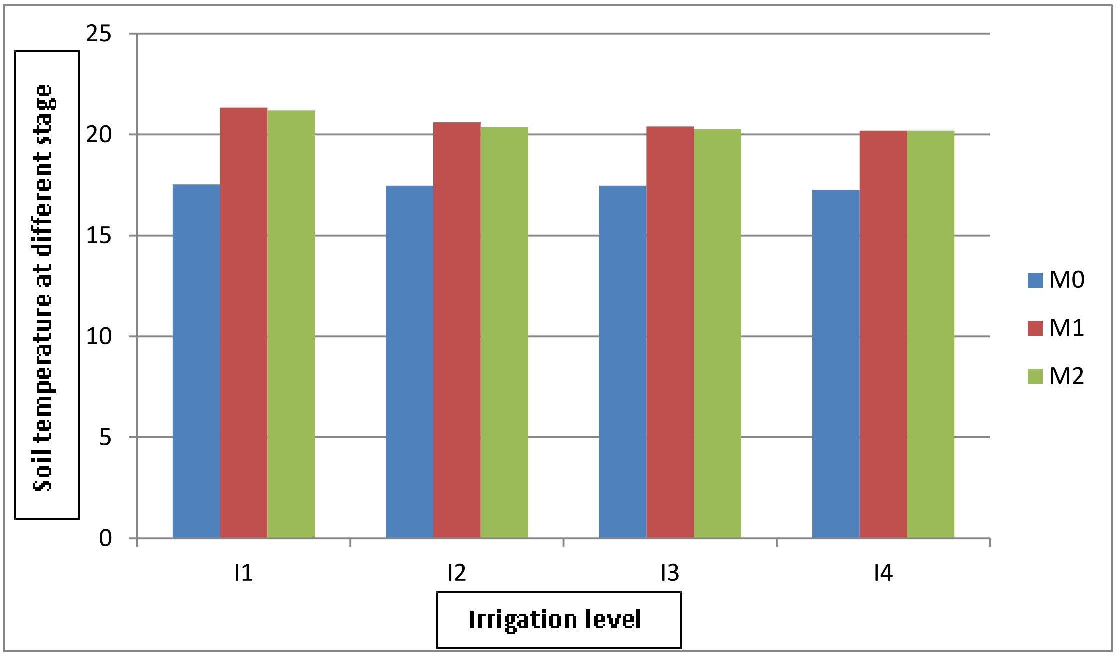

Fig .4.54 Effect of mulch and irrigation level on Vegetative phase at 30 DAT

Table 4.55 Effect of mulch and irrigation level on flowering initiation

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	18.40	21.7	20.73	20.13
I_2	18.33	20.53	20.60	19.82
I_3	18.27	20.47	20.40	19.71
I_4	18.13	20.20	20.27	19.53
Mean	18.28	20.67	20.50	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.051	0.044	0.088	
CD at 5%	0.149	0.129	0.259	

4.8.2. Flowering initiation stage

A perusal of data given in Table 4.55 and depicted in Figure 4.56 indicates that the Soil temperature was significantly influenced by different irrigation levels, mulching treatment.

Maximum soil temperature (20.13) was observed, when irrigation was scheduled at 0.4 IW/CPE, closely followed by 0.6 (19.82) and recorded minimum at irrigation (19.53) was scheduled 1.0 IW/CPE. Among mulching treatments, black plastic mulch recorded maximum soil temperature (20.67), followed by silver plastic mulch (20.50) and minimum soil temperature (18.28) was observed no mulch.

Interaction effect of irrigation levels and mulching significantly influenced soil temperature .Irrigation scheduled (black mulch) at 0.4 IW/CPE recorded the maximum soil temperature (21.72), followed by 0.6 IW/CPE (silver mulch) (20.73) and minimum soil temperature (18.13) was observed at irrigation level 1.0 IW/CPE.

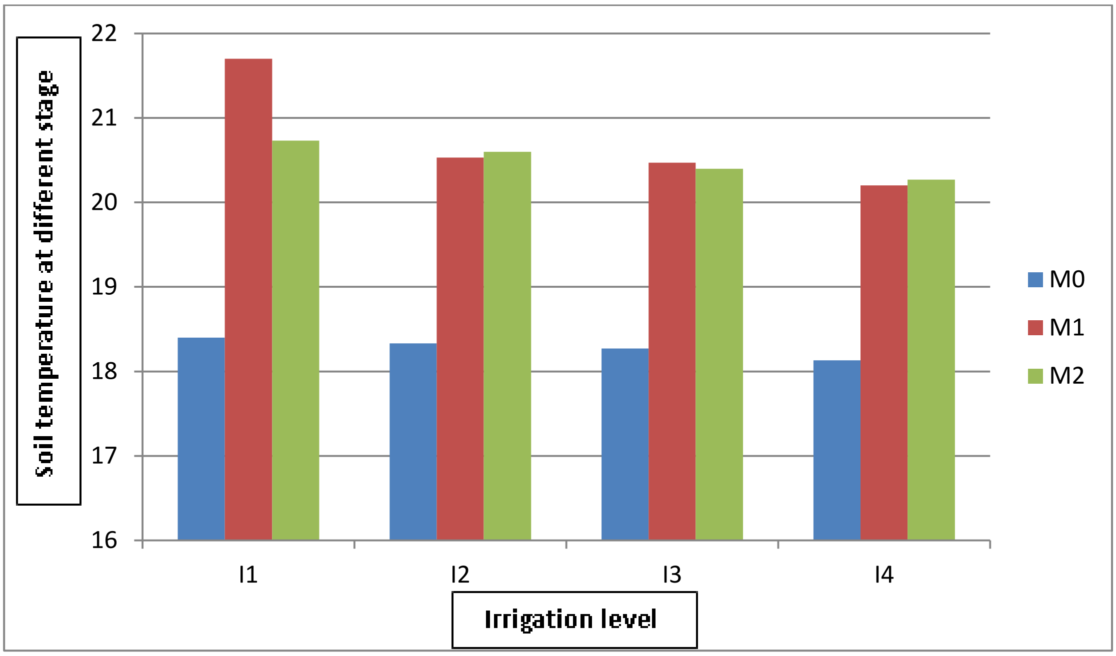

Fig .4.56 Effect of mulch and irrigation level on flowering initiation

Table 4.57 Effect of mulch and irrigation level on Days to first harvest

Irrigation (I)	Mulching			Mean
	M_0	M_1	M_2	
I_1	18.47	21.20	20.73	20.13
I_2	18.27	20.53	20.67	19.82
I_3	18.20	20.47	20.47	19.71
I_4	18.13	20.33	20.27	19.58
Mean	18.27	20.63	20.53	
	Irrigation (I)	**Mulching (M)**	**Interaction (IxM)**	
S.E(m)±	0.053	0.046	0.091	
CD at 5%	0.156	0.135	0.270	

4.8.3. Days to first harvest (Temp.)

A perusal of data given in Table 4.57 and depicted in Figure 4.8 indicates that the Soil temperature was significantly influenced by different irrigation levels, mulching treatment and their interactions. Maximum soil temperature were observed, when irrigation was scheduled at 0.4 IW/CPE (20.13) and closely followed by 0.6 (19.82), and recorded minimum in irrigation scheduled at 1.0

IW/CPE (19.58). Among mulching treatments, black plastic mulch recorded maximum soil temperature (20.63) followed by silver plastic mulch (20.53) and minimum soil temperature (18.27) observed no mulch.

Interaction effect Irrigation levels and mulching significantly influenced soil temperature Irrigation scheduled (black mulch) at 0.4 IW/CPE recorded the maximum soil temperature (21.20) followed (silver mulch) by 0.4 IW/CPE (20.73) and minimum soil temperature (18.13) was observed at Irrigation level 1.0 IW/CPE.

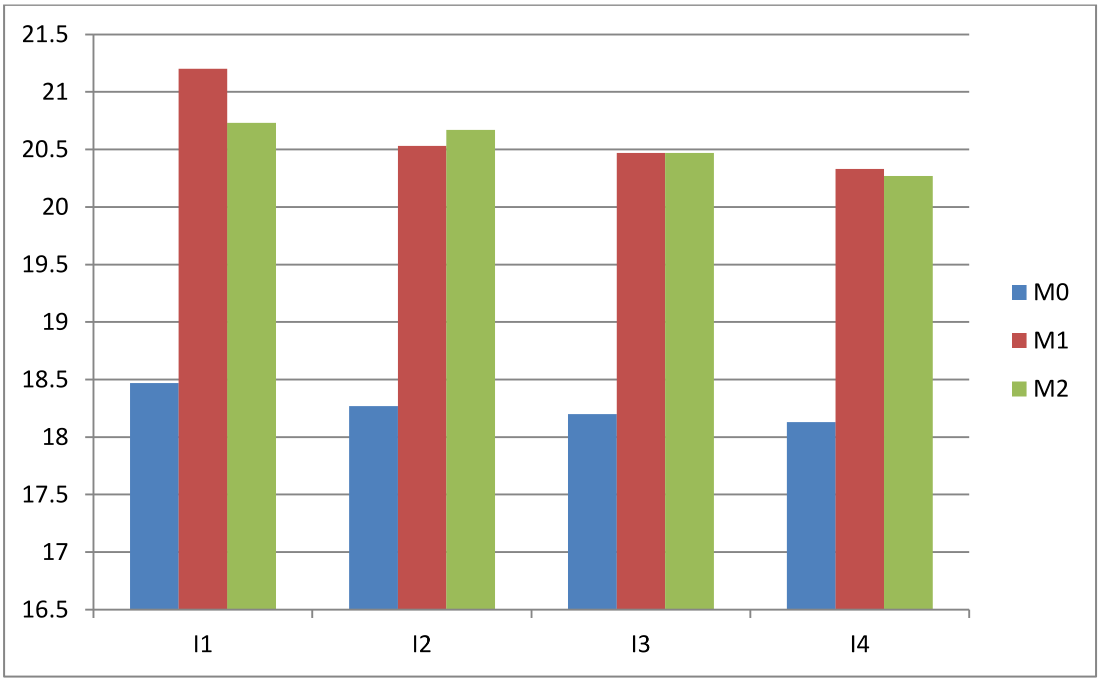

Fig. 4.58 Effect of mulch and irrigation level on Days to first harvest

PLATE -1   Flowering stage in chilli

PLATE -2 Taking reading of soil moisture by digital soil moisture meter

PLATE-3 Fruiting stage in chilli

PLATE-4 Fruits of different treatments

PLATE-5 Taking soil temperature

DISCUSSION

The present investigation entitled "Effect of mulch and irrigation schedule on performance of chilli under trickle condition" was carried out to observe the different irrigation levels and mulching system on crop growth and production of chilli crop in relation to the saving of water. On this basis of findings described in the preceding chapter, the result has been discussed here critically in the light of literature pertaining to the findings of other workers for different character, whenever possible.

5.1 VEGETATIVE CHARACTERS

5.1.1. Plant height (cm)

The vegetative growth characteristics of chilli were remarkably influenced by the amount of irrigation and mulching. Plant height at 30, 45, 60 and 90 DAT recorded significantly higher value of IW/CPE. Among the different irrigation regimes, irrigation at 0.8 IW/CPE recorded significantly higher plant height than 0.4 and 0.6 irrigation levels, respectively. This may be due to irrigations and more availability of soil moisture in the root zone. Gap between two irrigations lead to proliferation, active growth, leading to feeding roots there by possibility of absorption of more water, more minerals and rapid cell division, alternatively produced the larger plant height. Similar finding was found by Christopher *et al.* (1996) in tomato and Nagalakshmi *et al.* (2002) in chilli.

Silver plastic mulch has recorded significantly higher plant height at 30, 45, 60 and 90 DAT and followed by black plastic mulch. Changes in the plant height of chilli have been observed by using different mulches and plastic mulch increased the plant height than other mulches. It may be due to reflected sun light and less evapotranspiration and maintain soil moisture compare to black mulch condition. Similar findings were reported by Ashrafuzzaman et al. (2011) in chilli, Gordon et al. (2010) in okra and Hamidreza et al. (2012) in tomato.

5.1.2. Primary and Secondary branches

The vegetative growth characteristics of chilli were remarkably influenced by the amount of irrigation and mulching. Silver plastic mulch has recorded significantly highest primary branches at 30, 45, 60 and 90 DAT and followed by black mulch condition. Primary branches at 30, 45, 60 and 90 DAT recorded significantly higher value of 0.8 IW/CPE and followed by 1.0 IW/CPE. It may be due to reflected sun light, less evapotranspiration, maintain soil moisture and provided microclimatic condition compare to black mulch in plant. Similar findings were recorded by Awodoyin *et al.* (2007), Christopher *et al.* (1996) in tomato and Nagalakshmi *et al.* (2002) in chilli.

Mulching produced significantly higher number of secondary branches per plant than that of controls, except at 30 DAT throughout the whole growth period. The number of secondary branches per plant increased gradually till through 60 DAT and then after increased rapidly up to 90 DAT. The maximum number of secondary branches per plant was found on the plants mulched with silver plastic mulch at all growth stages, followed by the black mulch. The microclimate condition improved by the mulches might have provided a suitable condition for producing higher number of secondary branches in the plants. The effectiveness of plastic mulches for the production of secondary branches in the plants were better than control (no mulch) as reported by Christopher *et al.* (1996) in tomato.

5.1.3 Flower initiation (Days)

Days to flower initiation recorded significantly minimum number of days at 0.8 IW/CPE. This may be due to optimum soil moisture in the root zone has reduced the moisture stress. Gap between two irrigations lead to proliferation, active growth, leading to feeding roots there by possibility of absorption of more water, more minerals and rapid cell division, alternatively it has enabled minimum days to flower initiation.

The data presented in table 4.23 clearly indicated that application of mulch covers significantly encouraged the early initiation of flowers. So, it is an important factor which determines early crop production. There was wide variation observed among the treatments in initiation of flowering in chilli. Among the mulch treatments, minimum number of days taken by plants to reach anthesis stage after transplanting were recorded when the plants mulched with silver polythene. It took about minimum days in silver mulch and followed by black mulch. The surface color of plastic mulch can change the quantity of light and spectral balance reaching plants, with resulting effects on early initiation of flowers. In the other hand, plastic mulches often enhanced soil temperatures under the mulch covering and provided plants early season growth boost. Similar findings were reported by Hamidreza et al. (2012) in tomato.

5.1.4. Days to 50% flowering

The data presented (Table 4.24) that application of mulch covers significantly encouraged the early flowering that determines 50% flowering. There was wide variation observed among the treatments in 50% flowering in chilli. Among the mulch treatments, minimum number of days taken to 50% flowering after transplanting were recorded when the plants mulched with sliver polythene. It took minimum days in silver mulch followed by black mulch. It may be due to reflected sunlight and less evapotranspiration and maintain soil moisture compared to control or no mulch. It might be due to gap between two irrigations lead to proliferation, active growth, leading to feeding roots there by possibility of absorption of more water, more minerals and rapid cell division alternatively it has enabled minimum days to 50% flowering.

5.2 FRUIT CHARACTER

The beneficial effects of irrigation and mulching treatments was subsequently reflected in yield attributes like fruit length, average fruit weight, circumference of fruit, number of fruits per plant yield per plant and fruit yield per plot.

5.2.1 Fruit length (cm)

Fruit length was significantly more at 0.8 IW/CPE which was at par with 1.0 IW/CPE. This is because more number of irrigations has increase the vegetative growth and which has helped in the diversion of photosynthesis to the reproductive parts. Hence increase in more length and diameter of fruit. Similar finding was reported by Nagalakshmi *et al.* (2002) in chilli.

Silver plastic mulch has recorded significantly maximum fruit length followed by black plastic mulch. Higher fruit length in mulch treatments might be due to its effects on soil temperature, soil moisture and weed suppression. The highest total and marketable fruit length although produced on silver plastic mulch. It may be due to reflected sun light and less evapotranspiration and maintain soil moisture compare to no mulch. Similar findings were reported by Singh and Kamal (2012), Hamidreza et al. (2012) in tomato.

5.2.2 Fruit Diameters (cm)

Maximum diameter of fruit was obtained at 0.8 IW/CPE, which was at par with 1.0IW/CPE irrigation level. Timely irrigation to the part of root system has maintained constant soil moisture in the root zone which has helped to increase the fruit diameter. Silver plastic mulch has recorded significantly maximum fruit diameter followed by black plastic mulch. Higher fruit diameter in mulch treatments might be due to its effects on soil temperature, soil moisture and weed suppression. The highest total and marketable fruit diameter although produced on silver plastic mulch and it also might be due to reflected sun light and less evapotranspiration and maintain soil moisture compare to no mulch. Similar findings were reported by Nagalakshmi *et al.* (2002) and Singh and Kamal (2012).

5.2.3 Average weight of fruit (g)

Average weight of the fruit was significantly more at 0.8 IW/CPE which was followed by 0.6 IW/CPE. This is because less number of irrigations has reduced the vegetative growth and a temporary stress which has helped in the diversion of photosynthesis, to the reproductive parts.

Silver plastic mulch has recorded significantly maximum average fruit weight followed by black plastic mulch. Higher fruit diameter in mulch treatments might be due to its effects on soil temperature, soil moisture and weed suppression. The highest total and marketable fruit diameter although produced on silver plastic mulch and it also might be due to reflected sun light and less evapotranspiration and maintain soil moisture compare to no mulch. Similar finding were reported by Hamidreza *et a*l. (2012).

5.3 Yield characters

5.3.1. Number of fruits per plant

Number of fruits per plant recorded significantly higher value at 0.8 IW/CPE. This may be due to optimum soil moisture in the root zone has reduced the moisture stress, absorption of more water, more mineral, rapid cell division and reduced the fruit drop, which has enabled more number of fruits per plant. Large amount of photosynthesis production and utilization for the retention of fruits. Christopher *et al.* (1996) in tomato and Nagalakshmi *et al.* (2002) in chilli.

Silver plastic mulch has recorded significantly maximum number of fruit and followed by black plastic mulch. The increase in the number of fruits per plant of mulched plot was probably associated with the conservation of moisture and improved microclimate both beneath and above the soil surface. The suitable condition enhanced the plant growth and development and produced increased fruit bearing nodes compared to the control. Considering relationship between the soil moisture and large amount of photosynthesis production and utilization for the retention of fruits. Similar finding was reported by Hamid Reza et al. (2012) in tomato and Ashrafuzzaman et al. (2011) in chilli.

5.3.2 Fruit yield per plant (g)

Fruits yield per plant (g) recorded significantly higher value at 0.8 IW/CPE. This may be due to optimum soil moisture in the root zone has reduced the moisture stress and reduced the fruit drop, which has enabled more fruits yield per plant Large amount of photosynthates production and utilization for the retention of fruits. Similar findings were reported by Nagalakshmi *et al.* (2002) in chilli and Christopher *et al.* (1996) in tomato.

Silver plastic mulch has recorded significantly maximum fruit per plant (g) and followed by black plastic mulch. The increase in the number of fruits per plant of mulched plot was probably associated with the conservation of moisture and improved microclimate both beneath and above the soil surface. The suitable condition enhanced the plant growth and development and produced increased fruit bearing nodes compared to the control. Considering relationship between the soil moisture and large amount of photosynthates production and utilization for the retention of fruits. Similar findings were reported by Hamid Reza et al. (2012) in tomato and Ashrafuzzaman et al. (2011) in chilli.

5.3.3 Fruit yield per plot (kg)

Fruit yield per plot recorded higher value of 0.8 IW/CPE. This is due to optimum availability of soil moisture in the root zone. Similar findings were reported by Christopher *et al.* (1996), Hamid Reza et al. (2012) in tomato and Ashrafuzzaman et al. (2011) in chilli.

Silver plastic mulch has recorded significantly maximum yield per plot (kg) and followed by black plastic mulch. The increase in the fruit yield per plot of mulched plot was probably associated with the conservation of moisture and improved microclimate both beneath and above the soil surface. The suitable condition enhanced the plant growth and development and produced increased fruit bearing nodes compared to the control.Considering relationship between the soil moisture and large amount of photosynthates production and utilization for the retention of fruits. Similar finding was reported by Hamidreza et al. (2012) in tomato.

5.4 Quality parameters

5.4.1 TSS (ºBrix)

High total soluble solids percentage in the open (without mulch) practice was recorded compared to other irrigation levels. This may be due to more evaporations losses which resulted in high percentage in TSS. Decrease of TSS percentage with mulches may be due to high moisture conservation through frequent irrigation levels. Minimum total soluble solids was obtained with no mulch can be attributed to low soil water tension maintained under no mulch which lead to higher water uptake and hence dilution of the concentration of the total soluble solids (Kere *et al*., 2003).

5.4.2 Ascorbic acid (mg/100 g)

The data on ascorbic acid content in chilli fruits are furnished in variation observed in ascorbic acid was significant. It was maximum in 0.8 IW /CPE followed by 1.0 IW/CPE. This may be due to frequent irrigations and more availability of soil moisture in the root zone.

Among mulching treatments, silver plastic mulch recorded maximum ascorbic acid content followed by black plastic mulch and minimum ascorbic acid content was observed in open (without mulch) condition. Increased amount of vitamin-C in chilli fruit was observed in all the mulch treated plants compared to control. But among the mulch treatments, there was no significant difference in vitamin-C content of the fruits. The findings were in agreement with Panchal et al. (2001) and Ashrafuzzaman et al. (2011) in chilli.

5.5 Weeds parameters

5.5.1 Weeds fresh weight (gm)

Weeds fresh weight recorded significantly higher value at 1.0 IW/CPE (19.51) and followed by 0.8 IW/CPE (19.02). This may be due to frequent irrigations and more availability of soil moisture in the root zone, which lead to more cell division and increased weeds population. The weed density was influenced by the irrigation schedules. However at higher irrigation more weed density was observed.

Among mulching treatments, open (without mulch) recorded maximum weeds fresh weight (41.49) followed by silver plastic mulch (8.40) and minimum weeds fresh weight observed at black plastic mulch was (7.26). Black plastic mulch produced weeds only through the punch and no weed was found under the plastic, which might be due to lack of percentage of light through black plastic. Black plastic mulch blocked the weeds, except a few, which emerged through the planting holes .There was complete elimination of weeds under black polyethylene mulch. Similar findings were reported by Ramakrishna *et al*. (2006) in groundnut and Singh (2005) in tomato and Schonbeck, (1999) in vegetable crops.

5.5.2 Weeds biomass (g)

Fresh weed biomass recorded significantly higher value at 1.0 IW/CPE (5.60) followed by 0.8 IW/CPE (5.39). This may be due to frequent irrigations and more availability of soil moisture in the root zone, which lead to more cell division and increased dry weight.

Among mulching treatments, no mulch recorded maximum weeds dry weight (11.48) followed by silver plastic mulch (2.41) and minimum weeds dry weight observed at black plastic mulch was (2.19). It is due to transparent plastic mulch produced maximum weed population and dry matter which might be due to direct entrance of solar radiation through

them and as well as due to higher soil temperature There was complete elimination of weeds under black polyethylene mulch. Similar findings were also reported by Ramakrishna *et al*. (2006) in groundnut and Singh (2005) in tomato.

5.6. Water use efficiency (kg ha^{-1} mm)

The maximum mean consumptive use of water significantly higher value at 0.8 IW/CPE (4.44) followed by irrigation level 1.0 IW/CPE (4.19). This may be due to frequent irrigations and more availability of soil moisture in the root zone. Similar findings were reported by Prajapati *et al* (2007) in green gram and Patel *et al* (2005) in cow pea.

Silver plastic mulch has recorded significantly maximum mean consumptive use of water followed by black plastic mulch. It may be due to reflected sun light and less evapotranspiration and maintain soil moisture compare to no mulch in plant. Similar findings was recorded by Mukherjee *et al*. (2010) in tomato

5.6.1 Soil moisture depletion pattern (%) at Fruit maturity stage (depth of 0-15cm)

Data recorded indicated in table 4.49 that the soil moisture depletion pattern was faster during the initial period of observation and slowed down during the later period. Higher soil moisture was extracted from the surface layer (0-15 cm) in frequently irrigated and extraction from this layer decreased progressively in less frequent irrigation schedules. Soil moisture recorded significantly higher value at 1.0 IW/CPE (32.63) and followed by 0.8 IW/CPE (31.80). This may be due to frequent irrigations and more availability of soil moisture in the root zone.

Among mulching treatments, silver mulch recorded maximum soil moisture depletion followed by black plastic mulch. It may be due to reflected sun light, increase moisture conservation less evapotranspiration and maintain soil moisture compare to no mulch.

Higher moisture extraction from top layer in the treatment receiving frequent irrigations may be attributed to higher availability of soil moisture coupled with high root volume in these treatments. Similar findings were recorded by Panigrahi *et al*., (2010) in and Kashyap and Sharma (2009).

5.6.2 Soil moisture depletion pattern (%) at fruit maturity stage (depth of 15-30 cm)

Data recorded indicated that the soil moisture depletion pattern was faster during the initial period of observation and slowed down during the later period. Higher soil moisture was extracted from the surface layer (15-30 cm) in frequently irrigated and extraction from this layer decreased progressively in less frequent irrigation schedules. Soil moisture recorded significantly higher value at 1.0 IW/CPE (23.35) and followed by 0.8 IW/CPE (22.78). This may be due to frequent irrigations and more availability of soil moisture in the root zone.

Among mulching treatments, silver mulch recorded maximum soil moisture depletion followed by black plastic mulch. It may be due to reflected sun light and less evapotranspiration and maintain soil moisture compare to black mulch.

Higher moisture extraction from top layer in the treatment receiving frequent irrigations may be attributed to higher availability of soil moisture coupled with high root volume in these treatments Similar findings were recorded by Panigrahi *et al*., (2010) and Kashyap and Sharma (2009) in tomato.

4.7. Variation in soil temperature at different stage

4.7.1. Vegetative stage at 30 DAT

Soil temperature recorded significantly higher value at 0.4 IW/CPE and followed by 0.6 IW/CPE. This may be due to not frequent irrigations and less availability of soil moisture in the root zone, which lead to increased soil temperature.

Among mulching treatments, black plastic mulch recorded maximum soil temperature followed by silver plastic mulch and minimum soil temperature observed open (without mulch). It is due to using black plastic mulch increase 3.3 to 6.6 ˚C observed radiation to pass through and store in soil.. Similar results were reported by Decoteau *et al.* (1990), Ham and Kluitenberg (1994), Tarara (2000) and Dodds *et al.* (2003).

4.7.2 Flowering initiation stage

Soil temperature recorded significantly higher value at 0.4 IW/CPE and followed by 0.6 IW/CPE. This may be due to not frequent irrigations and less availability of soil moisture in the root zone, which lead to increased soil temperature.

Among mulching treatments, black plastic mulch recorded maximum soil temperature followed by silver plastic mulch and minimum soil temperature observed open (without mulch). It is due to black mulch observed radiation to pass through and store in soil. Similar results were reported by Decoteau *et al.* (1990), Ham and Kluitenberg (1994), Tarara (2000) and Dodds *et al.* (2003).

4.7.3 Days to first harvest

Soil temperature recorded significantly higher value at 0.4 IW/CPE and followed by 0.6 IW/CPE. This may be due to not frequent irrigations and less availability of soil moisture in the root zone, which lead to increased soil temperature.

Among mulching treatments, black plastic mulch recorded maximum soil temperature followed by silver plastic mulch and minimum soil temperature observed open (without mulch). It is due to black mulch observed radiation to pass through and store in soil. Similar results were reported by Decoteau *et al.* (1990), Ham and Kluitenberg (1994), Tarara (2000) and Dodds *et al.* (2003).

SUMMARY, CONCLUSION AND SUGGESTIONS FOR FUTURE WORK

6.1 Summary

The present investigation entitled "Effect of mulch and irrigation schedule on performance of chilli under trickle condition" was conducted during rabi season of 2017-2018 at Horticulture complex, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). The experimental material for the treatments consisted of four irrigation levels and three mulching treatments. These treatments were transplanted in Factorial Randomized Block Design with three replications using cv. Arka Lohit. Observations were recorded on the basis of five random competitive plants selected from each treatment separately for morphological, phonological and yield attribute yield characters evaluated as per standard procedure. On the basis of results, the present investigation is summarized as follows:

Drip irrigation scheduling at 0.8 IW/CPE ratio was recorded significantly superior and recorded maximum growth parameter such as plant height, number of primary branches and secondary branches as compared to other treatment at all growth stage except 30 DAT. Among mulch the application of silver mulch recorded significantly maximum plant height, number of primary and secondary branches over to no mulch at all the growth stage.

Drip irrigation scheduled at 0.8 IW/CPE ratio recorded minimum days taken to flower initiation and 50% flowering with application of silver mulch whereas maximum days taken to flower initiation and 50% flowering in without mulch treatment.

Maximum fruit length was recorded at 0.8 IW/CPE ratio and mulching treatments, silver plastic mulch recorded maximum fruit length. Maximum diameters of fruit was recorded with 0.8 IW/CPE ratio and followed by 1.0 IW/CPE ratio mulching treatments, silver plastic mulch significantly increased the diameters of fruit.

Drip irrigation scheduled at 0.8 IW/CPE ratio recorded maximum total number of fruits per plant and was significantly superior to 1.0 IW/CPE ratio. Application of silver mulch produced more number of fruits per plant followed by black mulch and compared to no mulch. Lowest number of fruits per plant was observed with no mulch.

Drip irrigation scheduled at 0.8 IW/CPE ratio recorded maximum fruit weight (g) and was significantly superior at 1.0 IW/CPE ratio. Application of silver mulch produced higher fruit weight followed by black mulch and lowest fruit weight found with no mulch.

The chilli fruit yield was recorded with drip irrigation scheduled at 0.8 IW/CPE ratio with application of silver mulch whereas the lowest fruit yield was recorded with drip irrigation at 0.4 IW/CPE ratio with no mulch treatment.

Total soluble solids content was higher with drip irrigation scheduled at 0.4 IW/CPE ratio which was superior to all other irrigation schedules, while without mulch recorded higher TSS content.

Irrigation levels were found to be significant for ascorbic acid content. Maximum ascorbic acid content was noticed in 0.8 IW/CPE ratio and followed by 1.0 IW/CPE ratio. Among mulch treatment silver much recorded significantly higher ascorbic acid content followed by black mulch compared with without mulch.

The highest water use efficiency was observed with drip irrigation scheduled at 0.8 IW/CPE ratio followed by 1.0 IW/CPE ratio with application of silver mulch whereas the lowest water use efficiency was recorded with drip irrigation at 0.4 IW/CPE ratio with no mulch treatment.

The highest weeds fresh weight and weed biomass were obtained with drip irrigation scheduled at 1.0 IW/CPE ratio and followed by 0.8 IW/CPE ratio with treatment of without mulch whereas the lowest weeds fresh weight and dry weight were recorded with drip irrigation at 0.4 IW/CPE ratio with black mulch treatment.

The highest moisture depletion pattern at different depth of 0-15 and 15-30 (cm) at fruit maturity stage were obtained with drip irrigation scheduled at 1.0 IW/CPE ratio and followed by 0.8 IW/CPE ratio with application of silver mulch , whereas the lowest moisture depletion pattern were recorded with drip irrigation at 0.4 IW/CPE ratio with without mulch treatment.

The highest soil temperature were obtain at different stage like vegetative stage 30 DAT, flowering initiation stage and first harvesting stage were obtained with drip irrigation scheduled at 0.4 IW/CPE ratio and followed by 0.6 IW/CPE ratio with application of silver mulch whereas the lowest soil temperature were recorded with drip irrigation at 1.0 IW/CPE ratio with without mulch treatment.

6.2 Conclusion

On the basis of present investigation, it is concluded that the chilli cv. Arka Lohit responded well in terms of morphological, phonological, yield attributing character and quality parameters. Maximum yield the chilli crop can be drip irrigated at 0.8IW/CPE ratio.

Higher water productivity and yield can be obtained by application of silver/ black polythene mulch. To get maximum net profits, the chilli crop can be safely irrigated at 0.8 IW/CPE ratio with application of silver polythene mulch.

6.3 Suggestions for future work

On the basis of present investigation, the following suggestions are made for future line of work.

1. The present experiment should be repeated for two or three years to know the consistency of treatment effects.
2. Study should be conducted on scheduling of irrigation under constrains of irrigation water.
3. There is a need to conduct long-term investigation to ascertain the benefits of mulches on yield and quality of chilli and also its impact on physical, chemical and biological properties of soil.
4. Effect of mulching on temperature modulation, pest and disease changes, nutrient mineralization may be studied.

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Appendix - I

Effect of mulch and irrigation level on plant height at 30 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.013	0.0065	0.147	3.443
Factor A	2	231.401	115.701	2,646.472	3.444
Factor B	3	25.773	8.591	196.505	3.049
Intraction A X B	6	8.288	1.381	31.596	2.519
Error	22	0.962	0.044		
Total	35	266.437			

Effect of mulch and irrigation level on plant height at 45 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.003	0.0015	0.034	3.443
Factor A	2	169.880	84.940	1,913.707	3.444
Factor B	3	31.540	10.513	236.868	3.049
Intraction A X B	6	1.340	0.223	5.033	2.519
Error	22	0.976	0.044		
Total	35	203.741			

Effect of mulch and irrigation level on plant height at 60 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.229	0.114	6.36	3.443
Factor A	2	176.635	88.317	4,786.199	3.444
Factor B	3	16.727	5.576	302.160	3.049
Intraction A X B	6	0.390	0.065	3.525	2.519
Error	22	0.406	0.018		
Total	35	194.387			

Effect of mulch and irrigation level on plant height at 90 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.283	0.141	1.83	3.443
Factor A	2	343.069	171.535	2,215.813	3.444
Factor B	3	95.015	31.672	409.123	3.049
Intraction A X B	6	24.064	4.011	51.807	2.519
Error	22	1.703	0.077		
Total	35	464.135			

Effect of mulch and irrigation level on primary branches at 30 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.002	0.001	0.025	3.443
Factor A	2	6.402	3.201	82.740	3.444
Factor B	3	0.946	0.315	8.146	3.049
Intraction A X B	6	0.211	0.035	0.910	2.519
Error	22	0.851	0.039		
Total	35	8.412			

Effect of mulch and irrigation level on primary branches at 45 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	1.129	0.564	8.42	3.443
Factor A	2	48.676	24.338	360.794	3.444
Factor B	3	2.049	0.683	10.126	3.049
Intraction A X B	6	1.484	0.247	3.667	2.519
Error	22	1.484	0.067		
Total	35	54.823			

Effect of mulch and irrigation level on primary branches at 60 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.135	0.067	2.25	3.443
Factor A	2	49.268	24.634	814.859	3.444
Factor B	3	9.017	3.006	99.425	3.049
Intraction A X B	6	1.043	0.174	5.750	2.519
Error	22	0.665	0.030		
Total	35	60.128			

Effect of mulch and irrigation level on primary branches at 90 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.312	0.160	4.01	3.443
Factor A	2	51.613	25.807	641.983	3.444
Factor B	3	17.757	5.919	147.242	3.049
Intraction A X B	6	2.159	0.360	8.952	2.519
Error	22	0.884	0.040		
Total	35	72.725			

Effect of mulch and irrigation level on secondary branches at 45 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.018	0.009	0.195	3.443
Factor A	2	76.452	38.226	824.567	3.444
Factor B	3	10.361	3.454	74.499	3.049
Intraction A X B	6	1.216	0.203	4.373	2.519
Error	22	1.020	0.046		
Total	35	89.067			

Effect of mulch and irrigation level on secondary branches at 60 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.221	0.110	8.5	3.443
Factor A	2	180.574	90.287	6,957.563	3.444
Factor B	3	29.022	9.674	745.475	3.049
Intraction A X B	6	1.262	0.210	16.204	2.519
Error	22	0.285	0.013		
Total	35	211.364			

Effect of mulch and irrigation level on secondary branches at 90 DAT

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.355	0.1775	8.452	3.443
Factor A	2	111.459	55.730	2,690.005	3.444
Factor B	3	28.661	9.554	461.148	3.049
Intraction A X B	6	5.612	0.935	45.147	2.519
Error	22	0.456	0.021		
Total	35	146.544			

Effect of mulch and irrigation level on flowering initiation (days)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.117	0.058	2.32	3.443
Factor A	2	104.285	52.143	2,125.218	3.444
Factor B	3	2.976	0.992	40.429	3.049
Intraction A X B	6	3.042	0.507	20.661	2.519
Error	22	0.540	0.025		
Total	35	110.960			

Effect of mulch and irrigation level on 50% flowering initiation (days)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.063	0.0315	0.7	3.443
Factor A	2	98.554	49.277	1,102.807	3.444
Factor B	3	8.832	2.944	65.886	3.049
Intraction A X B	6	2.181	0.363	8.135	2.519
Error	22	0.983	0.045		
Total	35	110.614			

Effect of mulch and irrigation level on fruit length (cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.052	0.026	0.838	3.443
Factor A	2	8.962	4.481	145.595	3.444
Factor B	3	4.054	1.351	43.910	3.049
Intraction A X B	6	1.494	0.249	8.089	2.519
Error	22	0.677	0.031		
Total	35	15.240			

Effect of mulch and irrigation level on fruit Diameters (cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.001	0.0005	1.25	3.443
Factor A	2	0.036	0.018	52.979	3.444
Factor B	3	0.025	0.008	24.234	3.049
Intraction A X B	6	0.008	0.001	3.781	2.519
Error	22	0.008	0.0004		
Total	35	0.077			

Effect of mulch and irrigation level on average fruit wt (cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.001	0.0005	1.66	3.443
Factor A	2	0.036	0.018	52.979	3.444
Factor B	3	0.025	0.008	24.234	3.049
Intraction A X B	6	0.008	0.001	3.781	2.519
Error	22	0.008	0.0003		
Total	35	0.077			

Effect of mulch and irrigation level on no. of fruit per plant

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	6.222	3.111	1.272	3.443
Factor A	2	1,725.722	862.861	352.989	3.444
Factor B	3	406.000	135.333	55.364	3.049
Intraction A X B	6	59.167	9.861	4.034	2.519
Error	22	53.778	2.444		
Total	35	2,250.889			

Effect of mulch and irrigation level on fruit yield per plant (g)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	536.848	268.42	12.78	3.443
Factor A	2	163,306.400	81,653.200	389.062	3.444
Factor B	3	76,104.213	25,368.071	120.874	3.049
Intraction A X B	6	15,232.692	2,538.782	12.097	2.519
Error	22	4,617.183	209.872		
Total	35	259,797.337			

Effect of mulch and irrigation level on fruit yield per plots (kg)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.201	0.1005	3.722	3.443
Factor A	2	48.455	24.227	896.386	3.444
Factor B	3	19.514	6.505	240.663	3.049
Intraction A X B	6	4.165	0.694	25.685	2.519
Error	22	0.595	0.027		
Total	35	72.929			

Effect of mulch and irrigation level on TSS (brix)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.040	0.02	0.357	3.443
Factor A	2	3.879	1.940	34.699	3.444
Factor B	3	2.679	0.893	15.972	3.049
Intraction A X B	6	3.076	0.513	9.171	2.519
Error	22	1.230	0.056		
Total	35	10.904			

Effect of mulch and irrigation level on Ascorbic acid (mg/100g)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	30.148	15.074	0.290	3.443
Factor A	2	11,357.451	5,678.726	109.521	3.444
Factor B	3	734.135	244.712	4.720	3.049
Intraction A X B	6	100.106	16.684	0.322	2.519
Error	22	1,140.710	51.850		
Total	35	13,362.550			

Effect of mulch and irrigation level on weeds fresh wt (g)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.067	0.033	0.515	3.443
Factor A	2	9,072.447	4,536.224	69,865.292	3.444
Factor B	3	3.064	1.021	15.730	3.049
Intraction A X B	6	1.738	0.290	4.462	2.519
Error	22	1.428	0.065		
Total	35	9,078.745			

Effect of mulch and irrigation level on weeds dry wt. (g)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.019	0.0095	0.25	3.443
Factor A	2	673.740	336.870	8,934.711	3.444
Factor B	3	0.948	0.316	8.382	3.049
Intraction A X B	6	0.145	0.024	0.639	2.519
Error	22	0.829	0.038		
Total	35	675.681			

Effect of mulch and irrigation level on water use efficiency

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.083	0.0415	3.77	3.443
Factor A	2	20.963	10.482	953.536	3.444
Factor B	3	2.940	0.980	89.143	3.049
Intraction A X B	6	0.255	0.043	3.872	2.519
Error	22	0.242	0.011		
Total	35	24.484			

Effect of mulch and irrigation level on moisture depletion pattern (depth 0-15 cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.195	0.097	0.420	3.443
Factor A	2	530.138	265.069	1,142.622	3.444
Factor B	3	25.006	8.335	35.930	3.049
Intraction A X B	6	2.593	0.432	1.863	2.519
Error	22	5.104	0.232		
Total	35	563.034			

Effect of mulch and irrigation level on moisture depletion pattern (depth 0-30 cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.074	0.037	1.233	3.443
Factor A	2	151.463	75.731	2,558.604	3.444
Factor B	3	4.597	1.532	51.765	3.049
Intraction A X B	6	0.518	0.086	2.916	2.519
Error	22	0.651	0.030		
Total	35	157.302			

Effect of mulch and irrigation level on soil temperature (30 DAT)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.055	0.0275	0.639	3.443
Factor A	2	90.638	45.319	1,047.639	3.444
Factor B	3	2.094	0.698	16.138	3.049
Intraction A X B	6	0.872	0.145	3.358	2.519
Error	22	0.952	0.043		
Total	35	94.610			

Effect of mulch and irrigation level on soil temperature at flowering initiation

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	F table at 5%
Replication	2	0.055	0.027	1.309	3.443
Factor A	2	90.638	45.319	1,047.639	3.444
Factor B	3	2.094	0.698	16.138	3.049
Intraction A X B	6	0.872	0.145	3.358	2.519
Error	22	0.952	0.043		
Total	35	94.610			

Effect of mulch and irrigation level on soil temperature at first fruit harvesting

Source of Variation	**DF**	**Sum of Squares**	**Mean Squares**	**F-Calculated**	**F table at 5%**
Replication	2	0.175	0.087	4.165	3.443
Factor A	2	45.553	22.777	1,078.065	3.444
Factor B	3	1.048	0.349	16.528	3.049
Intraction A X B	6	0.456	0.076	3.595	2.519
Error	22	0.465	0.021		
Total	35	47.696			

CURRICULUM VITAE

The author of this thesis **Mr. Pankaj maida** S/o Shri Goutam lal Maida was born May 1, 1992 at Devka, Dist. Ratlam (M.P.). He passed the High School Examination in the year 2009 with 45.6 percent marks and Higher Secondary Examination in the year 2011 acquiring 65.6 percent marks from, Govt. Boys Higher Secondary School bajna, ratlam (M.P.) He joined the College of Horticulure, v.r. gudem (A.P.) in the year 2012 and successfully completed the degree of B.Sc. (Horticulture) from dr. YSR Horticulture university during the year June, 2016 with (6.8 OGPA out of 10.00 point scale).

After completing graduation, he was selected for M.Sc. (Ag.) Horticulture degree programme in Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur through Joint entrance exam for specialization in Vegetable Science. He successfully completed all the course requirements for master's degree with First Division securing an OGPA of 7.1 out of 10 point scale.

For the fulfillment of the master's degree programme, he was allotted a research problem entitled **"Effect of mulch and irrigation scheduled on performance of chilli crop under trickle condition"**. This is duly completed by him and presented in the form of this thesis.