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# Effect of Different Irrigation Levels on Growth and Yield of Chilli (*Capsicum annuum* L.)

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**ABSTRACT**

*The present investigation was carried out during Rabi season of 2017-2018 at the Horticulture complex, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). The treatments consisting of four levels irrigation 0.4, 0.6, 0.8 and 1.0 IW/CPE with different mulch . Results showed that soil temperature under the various colored mulches was 2 to 4 ˚C warmer compared to bare soil. The highest soil temperature was recorded under black mulch (20.63). The plants grown on 0.8 IW/CPE mulch produced Maximum plant heights (47.88cm.), primary branches/plant (15.00), secondary branches/plant (14.41),early flowering (14.41), fruit length (8.69cm), Fruit diameter (0.87cm), average weight of fruit (4.57g), number of fruits/plant (150.77), fruit yield/plant (713.21g), Fruit yield per plot (11.54kg), Ascorbic acid (257.31mg/100 g), water use efficiency (4.45 kg ha$^{-1}$-mm), moisture depletion pattern % and soil temperature under different stages. Under irrigation level 0.4 with without mulch condition, recorded maximum days taken to 50% flowering (22.84), maximum total soluble solids (2.32º Brix), weeds fresh weight (19.51g) and weeds dry weight(5.14g).In an attempt to reducing chemical input for weed control and increase to yield of chilli black and silver/black plastic mulch may be a good alternative for conventional without mulch .*

***Keywords****: Chilli, irrigation levels: 0.4, 0.6, 0.8 and 1.0 IW/CPE, Soil temperature, soil moisture, Weed control, growth, fruit yield.*

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## 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, flavour 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 anarea of 792 MH with a production of 1376 MT with an average productivity of 1643 kg/ha. (NHB 2015-16). Madhya Pradesh is the Chilli producing area with 88000 ha, production 70000 tonnes and productivity 795 kg/ha of Chilli [1]. Chilli is increasing in its popularity for its pungent fruits and is highest in vitamin 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. Mulching is the practice of covering the soil around plants to make conditions more favourable for growth, development and efficient crop production [6]. 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. Hot days, soil temperature under straw mulch was reduced as much as17 °c (30°F) lower than un-mulched plots [11]. Mulches of plant material like straw, dry grass and leaves etc. reduced the soil temperatures [4]. Black polyethylene induces soil temperature, more moisture conservation higher soil microbial activity resulting in more mineralization and availability of nutrients to the plant [9].

## MATERIAL AND METHODS

A field experiment was carried out during Rabi season of 2017-2018 at the Horticulture complex, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. The experiment was conducted for comparative study and influence of effect of mulch on performance of chilli cv. Arka Lohit, in Factorial Randomized Block Design experiment with three replications using three type of mulching as treatments *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. Plots were 4× 1.2 m on 15 cm high raised beds. Drip irrigation tubing was placed under mulches during the same process. The site was fertilized according to soil test recommendations. In control plots, no herbicides were applied and any weed escapes were controlled by bi-weekly hand weeding. Seeds of chilies were sown at nursery (low tunnel covered with clear plastic) on 5 sep. 2017. On 28 Oct., Fifty -day old seedlings were transplanted by making holes of 5 cm diameter. Soil temperature was measured at 10 cm depth for all treatments using soil thermometer. Observations were recorded on the basis of five random competitive plants selected from each treatment separately for morphological, phenological and yield characters were evaluated. Weeds were collect from plots and took their fresh and oven dried weight at harvest time.

## RESULTS AND DISCUSSION

### Effect of irrigation level on Growth characters

The data on various growth parameters i.e. plant height, number of primary and secondary branches per plant, flowering as influenced by different irrigation levels are presented in the Table 1.1 and 1.2

### Effect of irrigation level

Irrigation levels significantly influenced plant height, primary and secondary branches per plant, flowering. Irrigation scheduled at 0.8 IW/CPE was found significant maximum plant height (30.28, 35.82, 39.23, 47.88 cm), maximum number of primary branches per plant (2.35, 5.91, 8.82, 13.37),maximum number of secondary branches per plant (8.35, 16.42, 20.42) at 30, 45, 60 and 90 DAT respectively, over the other IW/CPE ratios.

Maximum days taken to flowering initiation (15.21), days taken to 50% flowering (22.84) at 0.4 IW/CPE and closely followed by days taken to flowering initiation (14.94), days taken to 50% flowering (22.73) was observed, when irrigation was scheduled at 0.6 IW/CPE. Minimum days taken to flowering initiation and days taken to 50% flowering recorded (14.41, 20.03) respectively at 0.8 IW/CPE. Higher growth 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 and number of branches and has enabled minimum days to flower initiation Similar finding was found by Christopher *et al.* [3], Awodoyin *et al.* [2] in tomato and Nagalakshmi *et al.* [6] in chilli.

**Table 1. 1. Effect of irrigation level on Growth characters**

| Treatment | Plant Height(cm) | | | | Primary branches | | | |
|---|---|---|---|---|---|---|---|---|
| Irrigation (I) | 30 DAT | 45 DAT | 60 DAT | 90 DAT | 30 DAT | 45 DAT | 60 DAT | 90 DAT |
| $I_1$ | 25.43 | 33.26 | 37.42 | 43.59 | 1.91 | 5.26 | 7.42 | 11.60 |
| $I_2$ | 28.66 | 34.13 | 37.79 | 44.51 | 2.06 | 5.42 | 8.06 | 11.71 |
| $I_3$ | 30.28 | 35.82 | 39.23 | 47.88 | 2.35 | 5.91 | 8.82 | 13.37 |
| $I_4$ | 29.09 | 34.82 | 38.31 | 46.03 | 2.17 | 5.48 | 8.26 | 12.21 |
| **S.Em.±** | **0.070** | **0.070** | **0.045** | **0.093** | **0.066** | **0.087** | **0.058** | **0.067** |
| **C.D.@ 5%** | **0.206** | **0.207** | **0.134** | **0.274** | **0.194** | **0.256** | **0.171** | **0.197** |

***Note*: DAT- Days After Transplanting**

**Factor B- Irrigation Schedule- $I_1$-0.4 IW/CPE $I_2$-0.6 IW/CPE**

**$I_3$-0.8IW/CPE $I_4$-1.0 IW/CPE**

**Table 1.2 Effect of irrigation level on Growth characters**

| Treatment | Secondary branches | | | Flowering initiation (From DAT) | Days taken to 50% flowering |
|---|---|---|---|---|---|
| **Irrigation (I)** | **45 DAT** | **60 DAT** | **90 DAT** | | |
| **$I_1$** | 6.97 | 13.98 | 18.03 | 15.21 | 22.84 |
| **$I_2$** | 7.12 | 15.06 | 18.57 | 14.94 | 22.73 |
| **$I_3$** | 8.35 | 16.42 | 20.42 | 14.41 | 21.63 |
| **$I_4$** | 7.53 | 15.70 | 19.21 | 14.80 | 22.07 |
| **S.Em.±** | **0.072** | **0.038** | **0.048** | **0.052** | **0.070** |
| **C.D.@ 5%** | **0.212** | **0.112** | **0.142** | **0.154** | **0.208** |

**Effect of irrigation level on Fruit characters**

The beneficial effects of irrigation 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. A perusal of data given in Table 2, indicates that the fruit length, Fruit Diameters (cm), Average weight of fruit (g) were significantly influenced by different irrigation levels.

**Effect of irrigation level**

Irrigation scheduled at 0.8 IW/CPE produced maximum number of fruit length (8.70), maximum number of fruit diameter (0.87), maximum number of average weight of fruit (4.57) followed by other irrigation treatments. 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 and 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. Similar finding was reported by and Nagalakshmi *et al.* [6] in chilli.

**Table 2.Effect of mulch and irrigation level on Fruit characters**

| Treatment<br>Irrigation (I) | Fruit length (cm) | Fruit Diameters (cm) | Average weight of fruit (g) |
|---|---|---|---|
| **$I_1$** | 7.80 | 0.80 | 3.91 |
| **$I_2$** | 7.98 | 0.84 | 4.04 |
| **$I_3$** | 8.70 | 0.87 | 4.57 |
| **$I_4$** | 8.16 | 0.86 | 4.03 |
| **S.Em.±** | **0.058** | **0.006** | **0.049** |
| **C.D.@ 5%** | **0.173** | **0.018** | **0.144** |

**Effect of irrigation level on Yield and Quality characters**

Data pertaining in Table 3 indicate the number of fruits per plant, fruit yield per plant, fruit yield per plot, total soluble solids (ºBrix), ascorbic acid (mg/ 100 g) have been significantly influenced by different irrigation levels.

**Effect of irrigation level**

Maximum number of fruits per plant, fruit yield per plant, fruit yield per plot (150.77, 713.21 g, 11.54 kg)respectively, was observed, when irrigation was scheduled at 0.8 IW/CPE and closely followed by 1.0 IW/CPE (148.11, 671.93 g, 10.68 kg) respectively and recorded minimum number of fruit plant, fruit yield per plant, fruit yield per plot (141.77, 604.59 g, 9.53 kg) respectively in irrigation scheduled at 0.4 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. Similar finding was reported by Christopher *et al.* [3] in tomato and Nagalakshmi *et al.* [6] in chilli.

Maximum Ascorbic acid(257.31 mg) was observed, when irrigation scheduled at 0.8 IW/CPE and closely followed by 1.0 IW/CPE (253.21 mg) and recorded minimum (244.82 mg) in irrigation scheduled at 0.4 IW/CPE. Higher total soluble solids were recorded at 0.4IW/CPE (2.32ºBrix) followed by 1.0 IW/CPE (1.95ºBrix) and it was minimum(1.55 ºBrix) at 0.8 IW/CPE.

**Table 3. Effect of irrigation level on Yield and Quality characters**

| Treatment Irrigation (I) | Number of fruits plant$^{-1}$ | Fruit yield Plant$^{-1}$ (g) | Fruit yield Plot$^{-1}$ (kg) | Total soluble solids (ºBrix) | Ascorbic acid content (mg/100 mg) |
|---|---|---|---|---|---|
| $I_1$ | 141.77 | 604.59 | 9.54 | 2.32 | 244.82 |
| $I_2$ | 145.11 | 644.35 | 10.13 | 1.93 | 250.99 |
| $I_3$ | 150.77 | 713.21 | 11.54 | 1.55 | 257.31 |
| $I_4$ | 148.11 | 671.93 | 10.69 | 1.96 | 253.21 |
| **S.Em.±** | **0.520** | **4.831** | **0.055** | **0.079** | **2.400** |
| **C.D.@ 5%** | **1.532** | **14.252** | **0.162** | **0.233** | **7.085** |

**Effect of irrigation level on weeds**

A perusal of data given in Table 4 indicate that the weeds fresh weight, Weeds biomass (g), Water use efficiency (kg ha-1-mm) were significantly influenced by different irrigation levels.

**Effect of irrigation level**

Among Irrigation levels the maximum weeds fresh weight (19.51 g), maximum weeds dry weight (5.60 g) were observed, when irrigation was scheduled at 1.0 IW/CPE, closely followed by0.8 IW/CPE (19.02 g, 5.39 g), and recorded minimum (18.70 g, 5.14 g) respectively, in irrigation scheduled at 0.4IW/CPE. The weed density was influenced by the irrigation schedules, 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 and dry weight.

Maximum water use efficiency (4.44 kg ha$^{-1}$-mm) was observed, when irrigation scheduled at 0.8 IW/CPE, closely followed by 1.0 (4.19 kg ha$^{-1}$-mm) and recorded minimum (3.65 kg ha$^{-1}$-mm) at irrigation scheduled 0.4 IW/CPE. 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* [10] in green gram and Patel *et al* [8] in cow pea.

**Table 4.Effect of irrigation level on weeds**

| Treatment Irrigation (I) | Weeds fresh weight (g) | Weeds biomass (g) | Water use efficiency (kg ha$^{-1}$-mm)(kg) |
|---|---|---|---|
| $I_1$ | 18.70 | 5.14 | 3.66 |
| $I_2$ | 18.97 | 5.31 | 4.12 |
| $I_3$ | 19.02 | 5.39 | 4.45 |
| $I_4$ | 19.51 | 5.60 | 4.20 |
| **S.Em.±** | **0.085** | **0.065** | **0.035** |
| **C.D.@ 5%** | **0.251** | **0.191** | **0.103** |

**Effect of irrigation level on soil moisture depletion pattern (%) and variation in soil temperature at different stage**

A perusal of data given in Table 5 indicate that the soil moisture depletion pattern (%) and variation in soil temperature have been significantly influenced at different stage by different irrigation levels.

**Effect of irrigation level**

Maximum soil moisture depletion at fruit maturity stage in the depth of 0- 15 cm and 15- 30 cm (33.53, 23.35) was observed, when irrigation was scheduled at 1.0IW/CPE, closely followed by 0.8 IW/CPE (33.24, 22.78) and recorded minimum (31.41, 22.36) at irrigation scheduled of 0.4 IW/CPE. This may be due to frequent irrigations and more availability of soil moisture in the root zone.

Maximum soil temperature at vegetative phase at 30 DAT, flowering initiation stage, days to first harvest (temp.) were observed, when irrigation was scheduled at 0.4 IW/CPE (20.02, 20.13, 20.13), closely followed by 0.6 IW/CPE (19.48, 19.82, 19.82) respectively and recorded minimum at irrigation scheduled at 1.0 IW/CPE (19.22, 19.53, 19.58) at vegetative phase at 30 DAT, flowering initiation stage, days to first harvest (temp.) respectively. This may be due to not frequent irrigations and less availability of soil moisture in the root zone, which lead to increased soil temperature. 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*., [7] in and Kashyap and Sharma [5].

**Table 5.Effect of irrigation level on Soil moisture depletion pattern(%) and Variation in soil temperature at different stage**

| Treatment | Soil moisture depletion pattern (%) | | Soil Temperature at different stage (℃) | | |
|---|---|---|---|---|---|
| Irrigation (I) | Fruit maturity stage (0- 15 cm depth) | Fruit maturity stage (15- 30 cm depth) | Vegetative phase at 30 DAT | Flowering initiation stage | Days to first harvest |
| $I_1$ | 2.32 | 22.36 | 20.02 | 20.13 | 20.13 |
| $I_2$ | 1.93 | 22.66 | 19.48 | 19.82 | 19.82 |
| $I_3$ | 1.55 | 22.80 | 19.38 | 19.71 | 19.71 |
| $I_4$ | 1.96 | 23.35 | 19.22 | 19.53 | 19.58 |
| **S.Em.±** | **0.161** | **0.057** | **0.071** | **0.051** | **0.053** |
| **C.D.@ 5%** | **0.474** | **0.169** | **0.210** | **0.149** | **0.156** |

## CONCLUSION

On the basis of present investigation, it is concluded that the chilli cv. ArkaLohit 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. To get maximum net profits, the chilli crop can be safely irrigated at 0.8 IW/CPE ratio.

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