Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

J P P Journal of Pharmacognosy and Phytochemistry

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(5): 2798-2802
Received: 24-07-2017
Accepted: 25-08-2017

Dipesh Rasal
Department of Seed Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

HS Kanwar
Department of Seed Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Shruti Kirti
Department of Basic Sciences, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Rohit Pawar
Department of Vegetable Science, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Aditika Sharma
Department of Vegetable Science, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Vivek Gir
Department of Plant Pathology, College of Agriculture Lature, University VNMK, Parbhani, Maharashtra, India

Correspondence
Dipesh Rasal
Department of Seed Science and Technology, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Effect of drip irrigation and polyethylene mulching on growth and yield of bell pepper (*Capsicum annuum* L.) under mid hill zone of Himachal Pradesh

Dipesh Rasal, HS Kanwar, Shruti Kirti, Rohit Pawar, Aditika Sharma and Vivek Gir

Abstract
Bell pepper (*Capsicum annum* L.) plants have a high demand for water and nutrients and are particularly sensitive to water stress during the establishment period and fruit setting. High levels of irrigation are often applied in order to maximize yields. Water and temperature are critical for producing vegetable crops, especially during winter, when the availability of water is meager and temperature falls. Studies of drip irrigation and mulch were undertaken to find the effect on different growth and yield parameters in pepper (*Capsicum annuum* L.) cv. Solan bharpur at Department of Seed Science and Technology, Dr. Y.S Parmar University of Horticulture and Forestry, Nauni, Solan (HP) during *Kharif* 2015. The treatment comprised with eight different levels of irrigations with polythylene mulches viz., T_1 = Flood irrigation, T_2 = 100% Evapotranspiration through drip irrigation, T_3 = 80% Evapotranspiration through drip irrigation, T_4 = 60% Evapotranspiration through drip irrigation, T_5 = Flood irrigation + polyethylene mulch, T_6 = 100% Evapotranspiration through drip irrigation + polyethylene mulch, T_7 = 80% Evapotranspiration through drip irrigation + polyethylene mulch, T_8= 60% Evapotranspiration through drip irrigation + polyethylene mulch. The observations were recorded on plant height (71.50 cm) at final harvest, days to ripe fruit harvest (102.41), harvest duration (58.00), number of branches per plant (8.20), ripe fruit weight (58.87 g), ripe fruit length (7.38 cm), ripe fruit width (5.83 cm), number of ripe fruits per plant (15.67). The treatment T_6 was found superior over all other treatments in terms of plant and fruit growth characters, fruit growth characters.

Keywords: Bell pepper, drip irrigation, Mulching, Growth and Evapotranspiration.

1. Introduction
Bell pepper (*Capsicum annuum* L.) commonly known as sweet pepper, capsicum, green pepper or Shimla mirch, belongs to family Solanaceae. It is a high value vegetable and an important cash crop of subtropical regions. It is the most commonly grown species of *Capsicum* throughout the world. There are about 150 different types of peppers characterized on the basis of colour, shape and pungency (Berke, 2002) [6]. It is grown as a summer crop in Himachal Pradesh, Jammu and Kashmir, Arunachal Pradesh, hills of UP and Darjeeling district of West Bengal and as an autumn crop in Maharashtra, Karnataka, Tamil Nadu and Bihar states of India (Singh *et al.*,1993) [7]. Himachal Pradesh has about 50% share in the country's area and production of capsicum. In order to meet the growing demand of burgeoning population, large amounts of herbicides, pesticides and fertilizers are being applied to the fields every year to achieve maximum production leading to deleterious environmental effects.

In India bell pepper covers an area of 21,000 ha with 268,000 metric tonnes production (NHB, 2015). It is a warm season crop and performs well under an extended frost free season with the potential of producing high yields of outstanding quality. Water supply is a major constraint to crop production. The increased competition for water between agricultural, industrial, and urban consumers creates the need for continuous improvement of irrigation practices in commercial vegetable production in the region. The economy of the region relies heavily on irrigated crop production. However, Efficient use of water by irrigation is becoming increasingly important, and alternative water application methods such as drip and sprinkler, may contribute substantially to the best use of water for agriculture and improving irrigation efficiency. Scheduling water application is very critical to make the most efficient use of drip irrigation system.

The plastic materials used as mulch are poly vinyl chloride or polyethylene films. Owing to its greater permeability to long wave radiation it can increase temperature around the plants.

Hence, polyethylene film mulch is preferred as mulching material for crop production. Numerous workers have given reasonable proof that most of the mulches whether organic or synthetic type used in crop production are helpful in controlling weed population, reducing the impact of falling rain drops and reducing soil erosion, regulation of soil temperature conservation of soil moisture (Agarwal *et al.*, 2003). So the present investigation was carried out to see the impact of drip irrigation and polyethylene mulching on plant, fruit and yield of bell pepper.

Materials and Methods

The present investigations were carried out at the experimental farm of Department of Seed Science and Technology, Dr. Y. S Parmar University of Horticulture and Forestry, Nauni, Solan (HP). It is located at an altitude of 1,250 meters above mean sea level with latitude of 35.5ºN and longitude of 77.8ºE in the mid- hill zone of Himachal Pradesh, India. The experiment was laid out in experimental field during *Kharif* season of 2015 with Completely Randomized Block Design (RBD) with three replications comprising of fourteen treatment combinations (Table 3). Replications were sown as per the treatments in a plot having size of 1.2 m × 2.7 m. The treatment comprised with four different levels of irrigations with polyethylene mulches are as below:

Experimental Details

Crop	Bell Pepper (*Capsicum annuum* L.)
Variety	Solan Bharpur
Design	Randomized Block Design
Replications	3
Plot size	1.2 m × 2.7 m
Number of plots	24
Number of plants/plot	12
Spacing	60 cm × 45 cm
Date of transplanting	26th April, 2015

Treatment Details

Treatment code	Treatment Details
T_1	Flood irrigation
T_2	100% Evapotranspiration through drip irrigation
T_3	80% Evapotranspiration through drip irrigation
T_4	60% Evapotranspiration through drip irrigation
T_5	Flood irrigation + polyethylene Mulch
T_6	100% Evapotranspiration through drip irrigation + polyethylene Mulch
T_7	80% Evapotranspiration through drip irrigation + polyethylene Mulch
T_8	60% Evapotranspiration through drip irrigation + polyethylene Mulch

Drip Irrigation

The amount of water applied under drip irrigation was computed on the basis of CPE, pan factor, crop coefficient and canopy area factor and replenished weekly according to EP recorded in previous week. The volume (V) of water for irrigation was computed by using the following formula:

$V= (Ep \times Kc \times Kp \times CF – Re \times A)$

Where,

V = Volume of water used for each irrigation (I/plant)
Ep = Total pan evaporation (mm/week)
Kc = Crop factor
Kp = Pan factor
CF = Canopy area factor (Canopy area × 0.70)
Re = Effective rainfall (mm)

The crop factor (Kc) and pan factor (Kp) values were considered, as described in the FAO Irrigation and Drainage paper No.24 (Doorenbos *et al.*,1984). The effective rainfall was calculated by using balance sheet method (Doorenbos *et al.*, 1984).

Flood Irrigation

In the spring season: After an interval of 10 days, 5 cm water was applied.
In the autumn season: After an interval of 15 days, 5 cm water was applied.

Statistical Analysis

The data recorded for various parameters under laboratory conditions were statistically analyzed as described by Gomez and Gomez (1984).

Result and Discussion

The data pertaining to the various observations on plant growth, fruit growth and yield parameters in bell pepper have been shown in Table 3 and 4.

Plant height (cm)

A perusal of data on plant height presented in Table 3 indicates a significant effect of drip irrigation and polyethylene mulching on plant height at final harvest. The maximum plant height (71.50 cm) was recorded under treatment T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch) which was at par with T_2 (100% Evapotranspiration through drip irrigation), T_7 (80% Evapotranspiration through drip irrigation + polyethylene mulch) and T_8 (60% Evapotranspiration through drip irrigation + polyethylene mulch), The results are in agreement with the findings of Tiwari *et al.* (1998a) [19], Tiwari *et al.* (1998b) [20], Pattanaik *et al.* (2003) [12] and Paul *et al.* (2013) [13] who reported that the availability of adequate soil moisture and temperature positively influenced the microbial activity thereby improving cellular growth and development of the plant in bell pepper. And the lowest plant height (60.08 cm) was recorded in treatment T_1 (flood irrigation) which might be due to excess moisture regime in the soil which created conducive environment for weeds and also caused leaching of essential nutrients away from root zone, both of which negatively influenced growth (Pattanaik *et al.*, 2003, Agrawal and Agrawal, 2005 and Paul *et al.*, 2013) [12, 2, 13]. It can be concluded that the plants under treatment T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch) performed better as there was no competition for water and nutrition. However, in treatment T_1 (flood irrigation) there was excessive loss of water, abundant weed growth and development of anaerobic condition that reduced the efficiency of rhizosphere for water and nutrient absorption.

Days to ripe fruit harvest

The data pertaining to the effect of drip irrigation and polyethylene mulching on days to ripe fruit harvest have been presented in Table 3. The main effect of drip irrigation and polyethylene mulching had non-significant effect on days to ripe fruit harvest. The minimum number of days to ripe fruit harvest (102.41 days) were observed in T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch), whereas, maximum number of days to ripe fruit harvest (108.22 days) were recorded in T_1 (flood irrigation).

Harvesting duration (days)

The data pertaining to the effect of drip irrigation and polyethylene mulching on harvesting duration have been presented in Table 3. The longest significant harvest duration (58.00 days) was observed in T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch), which was at par with T_3 (80% Evapotranspiration through drip irrigation), T_7 (80% Evapotranspiration through drip irrigation + polyethylene mulch) and T_8 (60% Evapotranspiration through drip irrigation + polyethylene mulch). This might be due to accelerated accumulation of maximum photosynthates and proper reflection of long waves and better utilization of short waves for photosynthesis that favoured early flowering and increased harvesting period. The results are in line with the findings of Sharma *et al.* (2015) [16] who reported that drip irrigation in combination with mulching leads to maximum accumulation of photosynthates favouring fast growth, early initiation of flowers and increase in harvesting period in tomato. The shortest harvest duration (50.33 days) was observed in T_1 (flood irrigation).

Number of branches per plant

A perusal of data presented in Table 3 indicates significant effect of drip irrigation and polyethylene mulching on number of branches per plant. Maximum number of branches per plant (8.20) were recorded in T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch). It may be due to prolonged vegetative growth along with increased photosynthetic rate accelerated maximum number of branches per plant. Godara *et al.* (2013) [8] also studied progressive and vigorous plant growth and development due to drip irrigation and mulching in fennel. They concluded that the sufficient soil moisture maintained by drip irrigation leads to better development of photosynthetic area and full fills the nutritional requirements of the plants. The minimum number of branches per plant (6.13) were recorded in T_1 (flood irrigation).

Ripe fruit weight (g)

Ripe fruit weight is an important character which contributes to the fruit yield, seed yield and quality. The data contained in Table 4 indicates significant effects of drip irrigation and polyethylene mulching on ripe fruit weight. Maximum ripe fruit weight (58.87 g) was recorded in T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch) which was found at par with T_7 (80% Evapotranspiration through drip irrigation + polyethylene mulch), The increase in fruit weight may be due increased biochemical activities in the soil, high uptake of nutrients, reduction of evaporation leading to higher soil moisture content, reduction in weed growth, buildup of sufficient photosynthates and better nutrient availability to the plants. Similar findings were also recorded by Ogutu (2006) [10] and Belel (2012) in bell pepper; Rajablariani *et al.* (2012) [14] and Sharma *et al.* (2015) [16] in tomato. Sankar *et al.* (2008) [15] also concluded that more nutrient availability, especially near the root zone might have increased the translocation of photosynthates to storage oragan resulting in an increased fruit weight of capsicum under drip irrigation. The minimum ripe fruit weight (50.30 g) was recorded in T_1 (flood irrigation).

Ripe fruit length (cm)

The data contained in Table 4 indicates significant effects of drip irrigation and polyethylene mulching on ripe fruit length. Maximum ripe fruit length (7.38 cm) was recorded in T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch), which was at par with T_7 (80% Evapotranspiration through drip irrigation + polyethylene mulch) and T_8 (60% Evapotranspiration through drip irrigation + polyethylene mulch), It is due to better water utilization and higher uptake of nutrients by plants in tomato by Bafana *et al.* (1993) [4]. Similarly, Ogutu (2006) [10] also reported longer and larger fruits in plants grown using plastic mulch in bell pepper. Improvement in fruit length in treatment T_6 over T_1 may be attributed due to accumulation of phtosynthates, maximum nutrients and water use efficiency. The minimum fruit length (5.55 cm) was recorded in T_1 (flood irrigation).

Ripe fruit width (cm)

The data presented in Table 4 indicates significant effects of drip irrigation and polyethylene mulching on ripe fruit width. It is an important character which contributes to the seed yield and quality. Maximum ripe fruit width (5.83 cm) was recorded in T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch) which was at par with T_7 (80% Evapotranspiration through drip irrigation + polyethylene mulch), T_8 (60% Evapotranspiration through drip irrigation + polyethylene mulch), T_2 (100% Evapotranspiration through drip irrigation), T_3 (80 % evapotranspiration through drip irrigation) and T_4 (60 % evapotranspiration through drip irrigation), whereas, minimum ripe fruit width (4.94 cm) was recorded in T_1 (flood irrigation). Better fruit width in T_6 may be due to optimum level of moisture which enhances the cell metabolism resulting in an increase of released energy which ultimately induces growth of fruits. Pandey *et al.* (2005) [11] and Verma (2014) [21] reported that less competition between and within the plants for nutrients, sunlight and water resulted in better growth and development of the fruits in bell pepper.

Number of ripe fruits per plant

The data contained in Table 4 indicates significant effects of drip irrigation and polyethylene mulching on number of ripe fruits per plant. Maximum number of ripe fruits per plant (15.67) were recorded in T_6 (100% Evapotranspiration through drip irrigation + polyethylene mulch) which was at par with T_7 (80% Evapotranspiration through drip irrigation + polyethylene mulch), and T_8 (60% Evapotranspiration through drip irrigation + polyethylene mulch), The results are similar with findings of Paul *et al.* (2013) [13] who reported that favorable environmental condition generated via drip irrigation and mulching leads to higher vegetative growth contributing more number of fruits per plant. Drip irrigation together with mulching leads to better weed control, less nutrient loss through leaching, creates favourable soil temperature because of soil cover and enhances activities of micro organisms in the soil thereby resulting in better plant

growth, increased physiological activities and fruit bearing nodes. Similar results are reported by Siti *et al.* (1994) in bell pepper, Nagalakshmi *et al.* (2002) [9] in chilli and Sharma *et al.* (2015) [16] in tomato. The minimum number of ripe fruits per plant (10.33) were recorded in T_1 (flood irrigation).

Table 1: Effect of drip irrigation and polyethylene mulching on plant growth characters of bell pepper cv. Solan Bharpur

Parameters / Treatments	Plant height (cm)	Days to ripe fruit harvest	Harvesting duration (days)	Number of branches per plant
T_1	60.08	108.22	50.33	6.13
T_2	66.32	105.20	55.67	6.95
T_3	64.70	106.15	55.00	6.80
T_4	63.32	106.70	53.67	6.62
T_5	63.23	106.90	51.33	6.50
T_6	71.50	102.41	58.00	8.20
T_7	68.75	103.93	56.37	7.13
T_8	67.24	104.03	56.33	7.00
$CD_{0.05}$	**6.05**	**N/S**	**2.92**	**0.84**

Table 2: Effect of drip irrigation and polyethylene mulching on fruit characters of bell pepper cv. Solan Bharpur

Parameters / Treatments	Ripe fruit weight (g)	Ripe fruit length (cm)	Ripe fruit width (cm)	Number of ripe fruits per Plant
T_1	50.30	5.55	4.94	10.33
T_2	54.52	6.18	5.68	13.33
T_3	53.39	5.91	5.54	13.00
T_4	52.92	5.83	5.45	12.00
T_5	51.70	5.60	5.35	11.33
T_6	58.87	7.38	5.83	15.67
T_7	58.66	7.24	5.80	15.00
T_8	54.59	7.20	5.73	14.67
$CD_{0.05}$	3.86	0.64	0.50	2.23

Conclusion

On the basis of one year of study, (100% Evapotranspiration through drip irrigation conjunction with polyethylene mulch) T_6 gave best result for growth and development characters (plant height (cm), days ripe to fruit harvest, harvest duration, number of branches per plant), fruit growth characters (ripe fruit weight (g), ripe fruit length (cm), ripe fruit width (cm), number of ripe fruit per plant), seed yield characters (number of seed per fruit, seed yield per plant (g), seed yield per plot (kg), per cent seed recovery), seed quality characters (1000 seed weight (g), germination %, seedling length cm), seedling dry weight(mg). Hence, 100% evapotranspiration through drip irrigation conjunction with polyethylene mulch) T_6 can be recommended for getting higher yield of quality seeds in capsicum in mid hill zone of Himachal Pradesh.

References

1. Aggarwal S, Korla BN, Raina JN. Effects of mulches on soil hydrothermal Regimes, weed incidence, yield and quality of ginger. Journal of the Indian Society of Soil Science. 2003; 51:65-67.
2. Agrawal N, Agrawal S. Effect of drip irrigation and mulches on the growth and yield of banana cv. Dwaraf Cavendish. Indian Journal of Horticulture. 2005; 62(3):238-240.
3. Anonymous. Indian Horticulture Database. National Horticultural Board, Gurgaon, Haryana. 2015, 18.
4. Bafana AM, Dafturdar SY, Khade KK, Patel PV, Dhatre RS. Utilization of nitrogen and water by tomato under drip irrigation system. Journal of water management. 1993; 1(1):1-5.
5. Balel MD. Effect of grassed and synthetic mulching materials on growth and yield of sweet pepper (*Capsicum annuum* L.) in Mubi, Nigeria. Journal of Agriculture Social Sciences. 2012; 8(3):97-99.
6. Berke T. The Asian vegetable research development center pepper project. In: Proceedings of the 16th International Pepper Conference, Tampico. Tamaulipas, Mexico, 2002, 1-16.
7. Deorenbos J, Pruitt WO, Aboulkalad A, Dastane AG. Guidance for predicting crop water requirement. FAO Irrigation and Drainage, 1984, 24.
8. Godara SR, Verma IM, Gaur JK, Bairwa S, Yadav PK. Effect of different level of drip irrigation along with fertigation on growth yield and water use efficiency in fennel (*Foeniculum vulgare* Mill.). Asian journal of horticulture. 2013; 82(2):758-762.
9. Nagalakshmi S, Palanisamy D, Eswaram S, Sreenarayanan VV. Influence of plastic mulching on chilli yield and economics. South Indian Horticulture. 2002; 50(1-3):262-265.
10. Ogutu M. Effects of colored plastic mulches on bell pepper yield and fruit characteristics. Hort Science. 2006; 41(4):1075-1076.
11. Pandey V, Ahmed Z, Tewari HC, Kumar N. Effect of greenhouse models on plant-growth and yield of capsicum in Northwest Himalayas. Indian Journal of Horticulture. 2005; 62:312-313.
12. Pattanaik SK, Sahu NN, Pradhan PC, Mohanty MK. Response of Banana to drip irrigation under different irrigation designs. Journal of Agricultural Engineering. 2003; 40(3):29-34.
13. Paul JC, Mishra JN, Pradhan PL, Panigrahi B. Effect of drip and surface irrigation on yield, water use efficiency and economics of capsicum (*Capsicum annum* L.) grown under mulch and non mulch conditions in eastern coastal India. European Journal of Sustainable Development. 2013; 2(1):99-108.
14. Rajablariani H, Rafezi R, Hassankhan F. Using colored plastic mulches in Tomato. production. International Conference on Agriculture and Animal Science. 2012; 47:12-16.

15. Sankar V, Tripathi PC, Lawande KE, Qureshi AA. Micro-propagation studies in onion and garlic. (Abstract). In; International conference on plasticulture and precision farming New Delhi. 2008, 232-232.
16. Sharma P, Kothari M, Lakhawat SS, Bhakar SR. Effect of deficit irrigation on growth and yield of tomato under drip irrigation in shade net house. Journal of Agricultural Engineering. 2015; 52(2):42-47.
17. Singh OP, Anand N, Deshpandey AH. Improvement of bell pepper. Advance in Horticulture. 1993; 5:87-104.
18. Siti AH, Ramalan ZA, Inon S. Influence of potassium fertilizer and mulching on growth and yield of chilli (*Capsicum annuum* L.). Acta Horticulure. 1994; 369:311-315.
19. Tiwari KN, Mal PK, Singh RM, Chattopadhya A. Response of okra to drip irrigation under mulch and non-mulch conditions. Agricultural Water Management. 1998a; 38:91-102.
20. Tiwari KN, Singh RM, Mal PK, Chattopadhya A. Feasibility of drip irrigation under different soil covers in tomato. Journal of Agricultural Engineering, ISAE. 1998b; 35(2):41-49.
21. Verma R. Effect of mulching and planting geometry on seed production in bell pepper (*Capsicum annuum* L). M.Sc. (Agri.) *Thesis*, Dr. Y.S. Parmar University of Horiculture and Forestry, Nauni, Himachal Pradesh, India, 2014.