



EFFECT OF PLASTIC MULCH AND NON MULCH ON GROWTH, YIELD AND QUALITY OF RED CHILLI (*CAPSICUM ANNUUM* L.) UNDER DRIP FERTIGATION

G. Chandramohan Reddy¹, S.S. Hebbar*, and Geddi Purna Dattha Reddy²

¹Division of Vegetable Crops, Indian Institute of Horticulture Research, Hessaraghatta, Bangalore-560 089 (Karnataka), India.

²Department of Vegetable science, College of Horticulture, Dr. YSR Horticultural University, Anantharajupeta-516105 (A.P.), India.

Abstract

A field study was carried out to determine the effect of different sources of fertilizers on growth, yield, and quality of red chilli during Kharif season 2015-16 at the Division of vegetable crops, IIHR-Hessaraghatta, Bangalore. The Experiment was laid out in Randomized complete Blok design with 3 replications and 9 treatments combinations involving fertigation and polythene mulching. The results revealed that significantly higher growth, yield and quality attributes viz., plant height, number of branches per plant (cm), leaf area and leaf area index, number of fruits per plant, length of the fruit (cm), girth of the fruit (cm), fruit weight (g) dry fruit yield per plant (g), dry fruit yield per hectare (t) were observed by the treatment T₁ viz., application of water soluble fertilizers 100 per cent RDF using urea, 19:19:19, KNO₃ through fertigation with mulching, followed by Normal fertilizers 100 per cent RDF using Urea, DAP, MOP through fertigation with mulching. Similarly, the same treatments were found to register significantly higher carotenoids content and pungency levels. From this investigation it is concluded that water soluble fertilizers as well as normal fertilizers fertigation with mulching ideal for maximum growth, yield and quality of the chilli crop.

Key words : Chilli, Fertigation, Mulch, growth, yield, quality.

Introduction

Efficient utilization of fertilizers and water resources are crucial for country like India which shares about 17 per cent of the global population with only 2.4 per cent land and 4.0 per cent of the water resources. Maximization of crop yield, quality and minimization of leaching losses of nutrients below rooting zone could be achieved by application of fertilizers and water using drip fertigation (Hagin and Lowengart, 1995). Mulch is a covering placed over the soil around the plants. Plastic mulch on the surface of the soil causes change in the microclimate on its vicinity. This results in moisture conservation, less soil compaction and higher CO₂ levels around plants. (Mane and Umrani, 1981). Fertigation opened up new possibilities for controlling water and nutrients supplies to the crops. By introducing fertigation, it is possible to saving the water, fertilizers about 45-50%, 30% and increasing the productivity about 40% respectively. (Sivanappan and

Ranghaswami, 2005).

Chilli (*Capsicum annuum* L.), the most widely used and universal spice of India, belongs to the Solanaceae family. This has high medicinal value especially anti cancerous and instant pain relief. In daily life, chillies are integral and the most important ingredient in many different cuisines around the world it is adds pungency, taste, flavor and colour. Major chilli growing countries with their export share are India 26%, China 22%, Spain 17%, Mexico 8%, Pakistan 7.2%, Morocco 7% and Turkey 5%. In India is grown on an area of 8.82 lakh ha⁻¹ with annual production of 12.69 lack ton, and productivity of 1530 kg ha⁻¹. In India major growing states are Andhrapradesh, Karnataka, Orissa, Maharashtra, Tamil Nadu, West Bengal and Rajasthan.

Chilli, being a long duration and energy rich crop require proper manuring and balanced fertilizers along with sufficient moisture level for higher yield and quality produce (Prasad *et al.*, 2009). Chilli being indeterminate

*Author for correspondence : E-mail: hebbar@ihr.res.in

in nature, vegetative and reproduction stages over lap and plant need nutrients even up to maturity and fruit ripening. Fertigation with mulching proved to be very effectiveness in increasing nutrient use efficiency, crop productivity and quality. Generally crop response to fertilizer application through drip irrigation has been excellent and frequent nutrient applications have improved the fertilizer-use efficiency (Shafeek *et al.*, 2012 and Malik *et al.*, 1994). Bar Yosef and Sagiv (1982) reported fertilizer saving and increase in tomato yield due to fertigation. Not much information is available on different aspects of fertigation on closely spaced crops like chilli under semiarid tropics. Therefore, the present investigation was conducted to study the effect of fertigation involving the source and rate of fertilizers, methods of fertilizer application like through soil, drip irrigation, combination of soil and irrigation water, and combination of nutrients for fertigation on growth, yield and quality of chilli.

Materials and Methods

A Field Experiment was conducted at the Division of vegetable crops, IIHR- Hessarghatta, Bangalore. The Experiment composed of 9 treatments. The design followed was RBD with having 3 replications. The soil of the experiment site was had pH 5.5, E.C. 0.24 dsm⁻¹, available N 303.18 kg ha⁻¹, P₂O₅ 41.44 kg ha⁻¹ and Exchangeable K 366.51 kg ha⁻¹. The treatment details are

- T₁**: Fertigation with water soluble fertilizers (Urea, 19:19:19 and KNO₃) @ 100% RDF and polyethylene mulching
- T₂**: Fertigation with water soluble fertilizers (Urea, 19:19:19 and KNO₃) @ 75% RDF and polyethylene mulching
- T₃**: Fertigation with water soluble fertilizers (Urea, 19:19:19 and KNO₃) @ 100% RDF and without mulching
- T₄**: Fertigation with water soluble fertilizers (Urea, 19:19:19 and KNO₃) @ 75% RDF and without mulching
- T₅**: Fertigation with normal fertilizers (Urea, DAP and MOP) @ 100% RDF and polyethylene mulching
- T₆**: Fertigation with normal fertilizers (Urea, DAP and MOP) @100% RDF and without mulching
- T₇**: N&K fertigation with water soluble fertilizers (Urea and KNO₃), soil application of P fertilizer (Single Super Phosphate) @100% RDF and polyethylene mulching
- T₈**: N&K fertigation with water soluble fertilizers (Urea and KNO₃), soil application of P fertilizer (Single Super Phosphate) @100% RDF and without mulching
- T₉**: Control–Drip irrigation, non mulched and soil application of NPK fertilizers (Urea, SSP and MOP) @ 100% RDF

The chilli hybrid Arka meghana was raised in portrays in June and transplanted in July at a spacing of 60 × 45 cm. A cut of 10 cm diameter was provided each seedling on polyethylene mulch and mulch was laid carefully on beds as per the layout. Drip laterals were laid under the mulching film and irrigation was applies daily on climatologically approach through drip system. The recommended dose of NPK (180:120:180 kg/ha) fertilizers applied as per the treatments imposed. Fertigation was done in weekly intervals starting from 21 DAP up to 150 DAP.

The observations on plant height, number of branches, leaf area and leaf area index (80 and 120 DAP and at harvest) dry matter production (80, 120 DAP) were recorded. The plant height was measured from the base of the plant to the tip of the growing tip of the plant and the average height was worked out and expressed in centimeters.

Total numbers of branches (primary) per plant were recorded average number of branches per plant was worked out and expressed in number of branches per plant. Fifteen leaves of all the stages were randomly taken from each plant and leaf area was measured by using leaf area meter and their average was expressed decimeters. Leaf Area Index was worked out by using the formula suggested by Sestak *et al.* (1971).

$$LAI = \frac{\text{Leaf area}}{\text{Land area}}$$

The yield components were taken as the number of red fruits harvested from five plants counted and the total weight of fruits harvested in each picking was computed, averaged and expressed in weight per plant in grams. Five fruits selected for determining the fruit weight were used for determining the fruit length and girth averaged and expressed in centimeters. The total fruits harvested in each pickings of the treatment were computed and expressed as the weight of fruit in kg per bed and converted as t ha⁻¹ (dry fruits). Quality parameters like pungency was measured by using HPLC analysis technique and expressed in terms of Scoville Heat Units (SHU) Total extractable carotenoids are estimated by using g spectrophotometer expressed as mg/g on dry weight basis.

Results and Discussion

Growt parameters

The growth parameters (table 1 and 2) differ significantly as influenced by different treatments. The treatment fertigation with water soluble fertilizers (Urea, 19:19:19 and KNO₃) at 100% RDF and polyethylene mulching produced maximum plant height (104.27 cm), number of primary branches (16.71), leaf area and leaf area index (89.44 dm² and 4.5.3), dry matter accumulation (185.49 g plant⁻¹) followed by T₅ fertigation with normal fertilizers at 100% RDF and polyethylene mulching, T₇ N & K fertigation with water soluble fertilizers (Urea and KNO₃), soil application of P fertilizer (Single Super Phosphate) @ 100% RDF and polyethylene mulching compared to other treatments. The minimum plant height, number of branches, leaf area and leaf area index were recorded in the treatment T₉ soil application of NPK fertilizers (Urea, SSP and MOP) @ 100% RDF without mulching.

The increase in plant height and various growth parameters due to application of fertilizers through fertigation with mulching at weekly intervals may enhances the better availability of sufficient quantity of nutrients and continuous wetting by drip irrigation. The applied higher dosage of NPK responsible for cell division and cell elongation during the vegetative growth and are quite essential for the plant growth as they directly or indirectly control the different physiological processes. Further, mulching might have helped in attaining optimum growth through controlling of weeds, conserving soil moisture and maintenance of optimum soil temperature.

Table 1 : Effect of fertigation and mulching on growth parameters of hybrid chilli.

Treatment	Plant height (cm)			Number of branches/plant		
	80 DAT	120 DAT	At final harvest	80 DAT	120 DAT	At final harvest
T ₁	70.20	91.20	104.27	11.95	15.80	16.71
T ₂	67.47	87.33	100.95	10.87	14.12	15.25
T ₃	67.73	84.07	96.91	10.33	13.53	14.39
T ₄	64.73	81.62	96.63	10.05	13.00	14.24
T ₅	69.48	87.64	102.87	11.27	14.71	15.54
T ₆	66.06	80.93	97.43	10.00	12.53	13.94
T ₇	68.01	87.58	100.83	10.94	14.88	15.78
T ₈	64.60	80.00	96.26	9.60	12.20	14.31
T ₉	60.02	73.68	85.85	8.94	9.68	11.35
S. EM±	1.05	1.49	1.4	0.57	0.59	0.53
C. D. at 5 %	2.74	3.14	4.47	1.7	1.76	1.58

Table 2 : Effect of fertigation and mulching on leaf area and leaf area index of hybrid chilli.

Treatment	Leaf area (dm ² plant)			Leaf area index		
	80 DAT	120 DAT	At harvest	80 DAT	120 DAT	At harvest
T ₁	73.36	89.44	68.87	3.63	4.55	2.93
T ₂	69.12	84.18	63.53	3.18	4.12	2.60
T ₃	63.13	75.64	59.44	3.12	3.79	2.39
T ₄	58.52	71.67	54.62	2.86	3.53	2.18
T ₅	72.15	87.91	64.37	3.57	4.31	2.71
T ₆	62.67	74.43	54.57	3.09	3.58	2.19
T ₇	69.21	86.40	64.70	3.28	4.22	2.64
T ₈	59.49	72.02	52.04	2.95	3.45	2.22
T ₉	49.01	60.95	48.62	2.37	3.07	1.73
S. EM±	1.59	1.84	2.19	0.16	0.19	0.13
C. D. at 5 %	4.78	5.51	6.57	0.47	0.56	0.39

Similar findings are reported by Ramakrishna (2002) in dry chilli, Tumbare and Nikam (2004) and Gulshan *et al.* (2007), Prabhakar *et al.* (2010), Pandey *et al.* (2013) in green chilli and Rajan *et al.* (2014) in tomato and Ayodele *et al.* (2015) in chilli.

Yield and yield parameters

The fruit characteristics and yield recorded after every picking and the average values are expressed under various treatments are shown (table 3). The yield attributes like no. of fruits per plant (142.74), fruit length (11.13 cm), fruit girth (4.75 cm), red fruit weight (1.29 g fruit⁻¹) and fruit yield per plant (184.11) and fruit yield

Table 3 : Effect of fertigation and mulching on Yield and Yield characters of hybrid chilli.

Treatment	No. of fruits plant ⁻¹	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Fruit yield per plant (g)	Fruit yield t ha ⁻¹
T ₁	142.74	11.13	4.75	1.29	184.11	5.03
T ₂	139.07	10.60	4.53	1.24	172.49	4.72
T ₃	129.66	9.77	4.46	1.16	150.39	4.46
T ₄	126.32	9.52	4.29	1.09	137.62	4.28
T ₅	142.20	10.77	4.50	1.29	183.46	4.84
T ₆	125.57	9.56	4.29	1.14	143.44	4.23
T ₇	140.68	10.58	4.46	1.25	175.84	4.81
T ₈	122.43	9.34	4.22	1.12	137.12	4.22
T ₉	106.83	8.36	3.95	1.08	115.36	3.30
S. EM±	1.14	0.54	0.07	0.06	2.64	0.11
C. D. at 5 %	4.22	0.70	0.20	0.17	7.9	0.32

(5.03 t ha⁻¹) were higher in T₁ (Fertigation with water soluble fertilizers at 100% RDF and polyethylene mulching) Which was followed by T₅, T₇ and T₂ respectively. This was due to higher availability of soil moisture, optimum NPK nutrients and uptake when nutrients supplied through fertigation with mulching which helped in establishing the roots, initiating more fruiting points, their subsequent retention and development in the plant leading to the higher number of fruits per plant, yield and other parameters as compared to conventional fertilizer application. Similar findings were reported by Sajjan (2000), Prabhakar *et al.* (2010) and Ramachandrappa *et al.* (2010) in green chilli. Manohar (2002) in capsicum, Krishnamoorthy and Noorjehan (2014) and Leela Rani *et al.* (2015) in chilli.

Quality parameters

The mean values of the all treatments recorded significant increases in pungency level and total carotenoids content (figs. no. 1 and 2) over control. The treatment T₁ (WSF fertigation 100 % RDF with mulching) recorded the highest pungency (46441.66 SHU) over rest of the treatments. Significantly the treatment T₉ recorded the lowest pungency (32659.67 SHU) as compared to other treatments. The treatment T₁ showed highest carotenoids content (246.27 mg/100 g of dry weight) which is on par with T₇, T₅ and T₂ respectively. Whereas the treatment soil application 100% RDF without

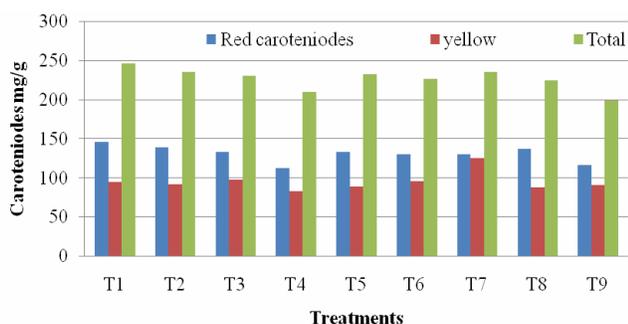


Fig. 1 : Effect of fertigation and mulching on carotenoids content of hybrid chilli.

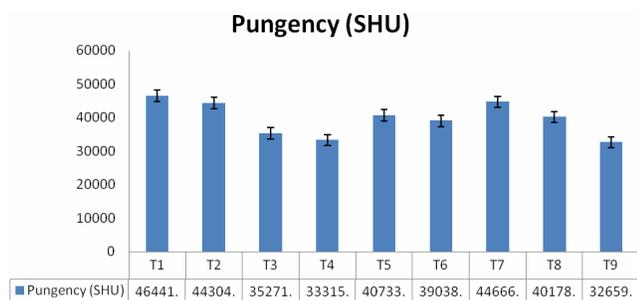


Fig. 2 : Effect of fertigation and mulching on Pungency (SHU) of hybrid chilli.

mulching recorded the least carotenoids content (103.57 mg/100 g of dry weight) as compared to all other treatments. The probable reason for recording higher pungency of chilli may be due to the more nutrients and soil moisture availability during the crop growth period as compared to non-mulching and conventional fertilizer application. Similar results were reported by Sahin *et al.* (1998) and Aruna *et al.* (2007) in tomato. Ramakrishna (2002) and Prabhakar *et al.* (2010) in chilli.

Conclusion

From the present investigation it can be concluded that fertigation with water soluble fertilizers and normal fertilizers produced on par results. Similarly, 100 and 75 per cent of recommended dosage of water soluble fertilizer and NK fertigation (P soil application) also recorded on par results with 100% WSF fertigation. Cost on water soluble fertilizer can be reduced by normal fertilizer application, 75% RDF fertigation or NK fertigation. Overall fertigation and polyethylene mulching produced higher yield and quality of hybrid chilli compared to soil application and non mulching.

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