Indian Journal of Agronomy **62** (3): 295–300 (September 2017)

Research Paper

Performance of summer chilli (*Capsicum annum*)–watermelon (*Citrullus lanatus*) crop sequence under different irrigation regimes and fertigation levels under silver black polyethylene mulch

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Received : February 2017; Revised accepted : June 2017

ABSTRACT

The investigation was carried out in the year 2014 and 2015 at Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra), with summer chilli (*Capsicum annum* L.)–watermelon [*Citrullus lanatus* (Thunb). Mansf.] crop sequence to evaluate the response of irrigation regimes and fertigation levels under black polyethylene mulch. The experiment consisted of 12 treatment combinations with 4 irrigation regimes 70, 80, 90 and 100% of ETc and 3 fertigation levels 75, 100 and 125% of RDF. The treatments were replicated thrice in split-plot design. Control treatment with recommended package of practice and absolute control with recommended package of practice with no fertiliser for chilli and watermelon were grown separately. Black silver polyethylene mulch of 50 micron was used common to all the treatments, except control. Fertigation of N, P_2O_5 and K_2O was done as per growth stages for both the crops by using water soluble fertilizers. The yield contributing characters of chilli and watermelon were higher in irrigation regime of 100% Etc, but at par with irrigation regime of 90% ETc. Fertigation of 125% of RDF recorded higher yield contributing characters of chilli as well as watermelon, but was at par with fertigation of RDF in case of chilli. Irrigation regime of 100% Etc recorded maximum fruit yield of chilli (42.11 t/ha) and watermelon (43.39 t/ha), and it was at par with Irrigation regime of 90% Etc in case of chilli (41.61t/ha) and watermelon (42.12 t/ha). Fertigation of 125% of RDF recorded maximum fruit yield of chilli (42.79 t/ha) and watermelon (46.38 t/ha) and was at par with fertigation RDF in case of chilli yield (40.34 t/ha). In case of irrigation regime, the maximum chilli equivalent yield (57.47 t/ha) and net monetary returns/ha (₹11,37,000) were recorded with 100% Etc, while in case of fertigation level maximum chilli equivalent yield (59.18 t/ha) and net monetary returns (₹11,85,000) were recorded with 125% RDF.

Key words **:** Chilli, Crop sequence, Fertigation, Irrigation regimes, Mulch, Watermelon

Chilli is an important spice cum vegetable crop cultivated extensively in India. In Maharashtra chilli occupies an area of 0.99 lakh ha with 18.10 lakh tonnes of production (GoI, 2015). In recent years, apart from export of dry chilli (2,41,000 tonnes), value added products, viz. chilli powder and oleoresin are exported with the annual total revenue of about ₹1,304.4 crore (Anonymous 2011–12). It occupies 39% of the total volume of spice exports and 24% of the total exports earnings during 2014–15. Watermelon is cultivated in India on 74.6 thousand ha with production of 1809.9 thousand tonnes (GoI, 2015). The hot and dry climate along with irrigation provides excellent condition to obtain high yield and fruit quality of watermelon. Drought is the major inevitable and recurring feature of semi-arid tropics and despite our improved ability to predict their onset, duration and impact, crop scientists are still concerned about it as it remains the single most important factor affecting the yield potential of crops. Optimum use of water is of paramount importance being a scarce resource. Most of the water use in India is for irrigation, amounting to 94% of total withdrawal. With increasing demand of water for industrial and urban uses, the proportion of water use for irrigation will decline to 83% by 2025 AD. This needs an immediate attention towards the judicious application of water. This is possible only by following some scientific water management prac-

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tices. In agriculture, besides water nutrients are most critical inputs and their efficient management is important not only for higher productivity, but also for maintaining environmental quality. Limited supply of water necessitates a shift in the production objectives from attainment of potential yield per unit of land to potential yield per unit of water. Scarce water can be utilized efficiently only through high-tech irrigation system like drip irrigation. Applying the correct amount of water is particularly effective for high value crops like important vegetable as well as commercial crop. Applying plant nutrients along with irrigation water particularly with the drip system (termed as fertigation) is the most efficient way of nutrient application. The rapid development of trickle irrigation and fertigation systems in many parts of the world followed demands to minimize water loss in agriculture, which arose from the shortage of water caused by increasing house hold and industrial demands, and the urge to expand area under irrigation. Therefore, it is necessary to popularize the use of fertigation in vegetables for an efficient use of water and nutrients in eco-friendly manner.

MATERIALS AND METHODS

The experiment was conducted in year 2014 and 2015 at Irrigation Water Management Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra, situated between 19°47' and 19°57' N latitude and between 74°19' and 74°32' E and at the altitude of 495 to 555 m above the mean sea-level. The soil used for the experiment was clay and well drained. The soil physical properties viz., field capacity, permanent wilting point and bulk density were 34.4%, 19.4% and 1.32 g/cm^3 respectively. The soil chemical properties, viz. *p*H, EC of soil water suspension (1: 2.5) and organic carbon content were 7.99, 0.42 dS/m and 0.71%, respectively with low in available nitrogen (153.7 kg/ha), high in available phosphorous (20.3 kg/ha) and very high in available potassium (462.9 kg/ha). The average annual rainfall is 520 mm, which is mostly concentrated during monsoon months from June to October from south-west monsoon, which is nearly 80% of the total rainfall. The distribution of rainfall is erratic with 15 to 45 rainy days. The tract is under the rain shadow area lying on eastern sides of Western Ghats, agro-climatically falls under scarcity zone of Maharashtra.

The experiment consists of 12 treatment combinations with 4 irrigation regimes and three fertigation levels. Irrigation regimes consist of 70, 80, 90 and 100% of ETc, while fertigation levels consist of 75, 100 and 125% of RDF. The treatments were replicated three times in split-plot design. Control treatment with recommended package of practices for chilli as well as watermelon was grown separately. Absolute control with recommended package of practice with no fertiliser for chilli as well as watermelon was grown separately. Black silver polyethylene mulch of 50 micron was used common to all the treatments, except control and absolute control. Fertigation of N, P_2O_5 and K_2O was applied in equal quantity as per growth stages in fertigation treatments by using water soluble fertilizers (Table 1).

The transplanting of 15-days old seedlings of chilli hybrid 'sitara' and watermelon hybrid 'sugar queen' was done at spacing of 60 cm × 45 cm on 120 cm wide raised bed covered with black silver polyethylene mulch on March 27, 2014 and February 27, 2015 in case of chilli and on October 10, 2014 and September 15, 2015 in case of watermelon. Same layout along with black polyethylene mulch, which was used for summer chilli crop was utilized for growing watermelon crop by escaping the land preparation for watermelon. For control of weed between the two crops weedicide glyphosate was used. Resting period of one moth is kept in between two crops to avoid residual effect of weedicide.

Crop water productivity is calculated by using following formula

$$\text{Crop water productivity} = \frac{\text{Net income (₹/ha)}}{\text{Total water used (m}^3\text{/ha)}}$$

Equivalent yield of cropping sequence was calculated

Table 1. Scheduling of fertigation as per crop growth stages

Crop	Growth stages	Days	No of splits	Fertilisers in kg/ha		
				N	P	K
Chilli	Growth and branching	60	6	20	10	10.7
	Flowering	30	4	40	20	17.8
	Fruiting	60	6	40	20	21.4
	Total			100	50	50
Watermelon	Growth	15	2	25	12.5	11.5
	Flowering	30	4	50	25	23.1
	Fruiting	15	2	25	12.5	15.4
	Total			100	50	50

by using following formula

Chilli equivalent yield (t/ha)=

$$\text{Green chilli yield (t/ha)} + \frac{\text{Yield of watermelon (t/ha)} \times \text{market rate of watermelon (₹)}}{\text{Market rate of chilli (₹)}}$$

Production efficiency of cropping sequence was calculated by using following formula

$$\text{Production efficiency (kg/ha/day)} = \frac{\text{Green chilli equivalent yield (kg/ha)}}{\text{Total duration of cropping sequence (days)}}$$

RESULTS AND DISCUSSION

Performance of component crops

In case of summer chilli, irrigation regime of 100% ETc produced significantly higher number of fruits/plant (287), fruit weight/plant (1,089g) and green fruits yield (42.11 t/ha) as compared to irrigation regimes of 70% of ETc (Table 2). While, in case of late rainy season (*kharif*) watermelon, irrigation regime of 100% of ETc produced significantly higher number of fruits/vine (1.40), fruit weight/vine (2.34 kg) and fruit yield (43.39 t/ha) as compared to irrigation regimes of 70% of ETc (Table 2). Average fruit length and unit fruit weight in case of summer chilli and unit fruit weight in case of watermelon (Table 2) were not influenced due to the different irrigation regimes. The higher irrigation regime maintained the soil moisture at field capacity throughout the crop period, which enhanced all the growth attributes of the both the crops. More growth attributes resulted in maximum absorbed photosynthetic radiation. This enhanced the rate of photosynthesis and dry-matter accumulation. All these resulted in improve the number of fruits and fruit weight/plant in both the crops owing to efficient translocation of photosynthates towards reproductive parts. All irrigation regimes under study recorded higher number of fruits, fruit weight/plant and fruit yield in case of summer chilli and watermelon as compared to control (recommended practice)**.** Sezen *et al.* (2006) observed decrease in bell paper yield attributes and yield with decrease in the amount of irrigation water applied. Gadissa and Chemeda (2009) recorded maximum values of yield and yield components in case of green paper with higher irrigation level. Similar findings were reported by Hatutale (2010), Choudhary and Bhambri (2012) and Abayomi *et al.* (2012) in case of chilli. While, Kirnak and Dogan (2009) observed the highest yield of watermelon from full irrigated treatment, where as lower ET rates and irrigation amounts in water stress treatments resulted in reductions in all measured

Table 2. Effect of different treatments on yield attributes and yield of green chilli and water melon (mean data of 2 years)

Treatment	Green chilli					Water melon			
	Green fruits/ plant	Green fruits weight/ plant (g)	Unit fruit weight (g)	Average fruit length (cm)	Fruit yield (t/ha)	Fruits/ vine	Fruits weight/ vine(kg)	Unit fruit weight (kg)	Fruit weight (t/ha)
Irrigation regimes									
I_1, 70% ETc	258	919	3.63	9.59	36.41	1.28	2.07	1.62	38.35
I_2, 80% ETc	283	1,049	3.65	9.66	39.86	1.32	2.11	1.60	39.08
I_3, 90% ETc	286	1,076	3.75	9.84	41.61	1.36	2.27	1.67	42.12
I_4, 100% ETc	287	1,089	3.86	9.88	42.11	1.40	2.34	1.67	43.39
SEm±	7.4	37	0.13	0.15	1.20	0.02	0.06	0.02	1.05
CD (P=0.05)	22.7	114	NS	NS	3.70	0.08	0.18	NS	3.24
Fertigation levels									
F_1, 75% RDF	251	925	3.66	9.53	36.86	1.18	1.91	1.62	35.46
F_2, 100% RDF	279	1044	3.78	9.77	40.34	1.36	2.18	1.61	40.36
F_3, 125% RDF	305	1129	3.73	9.92	42.79	1.49	2.50	1.69	46.38
SEm±	11.5	39	0.11	0.10	1.24	0.03	0.05	0.02	1.02
CD (P=0.05)	33.2	112	NS	0.30	3.58	0.09	0.16	0.07	2.93
Interaction									
SEm±	23.1	78.1	0.22	0.21	2.48	0.06	0.11	0.05	2.03
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
SEm±	20.2	73.7	0.22	0.22	2.36	0.06	0.11	0.04	1.97
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	278	1,033	3.72	9.74	40.00	1.34	2.20	1.64	40.73
Control (RP)	163	538	3.65	8.59	21.30	0.72	0.99	1.41	18.75
Absolute control (NF)	144	439	3.60	8.17	16.89	0.68	0.78	1.18	14.37

RP, Recommended practice; NF, no fertilizer; RDF, recommended dose of fertilizer; ETc, crop evapotranspiration parameters. The highest yield and most of fruit traits of melon was obtained by Sensoy *et al*. (2007) from the treatment employing the greatest frequency and quantity of irrigation.

The fertigation at 125% of RDF produced significantly higher number of fruits/plant (305.1), fruit weight/plant (11,29.8 g) and average fruit length (9.9 cm) in case of summer chilli as compared to fertigation at 75% of RDF (Table 2). Unit fruit weight in case of summer chilli was not influenced significantly due to the different fertigation levels. In case of watermelon, fertigation at 125% of RDF recorded significantly higher number of fruits/vine (1.49), fruits weight/vine (2.50) and unit fruit weight (1.69 kg) as compared to fertigation at 100% and 75% of RDF (Table 2). This can be explained on the basis that split application of water soluble fertiliser to both the crops saves fertilizer nutrients as it permits applying for fertilizer in small quantity at a time matching with the plants nutrient need. This contributes to an improved availability of moisture, nutrients, and uniform distribution of fertigated nutrients in the crop root zone throughout the growth stages leading to better uptake of nutrients. This might favoured in increasing growth attributes resulted in better chlorophyll development and higher stomatal conductance reflected in higher photosynthetic rate. This further led to more photosynthates, which translocated to the sinks leading to more and heavier fruits subsequently leading to higher yield in both the crops. All fertigation levels under study recorded higher number of fruits, fruit weight/plant and fruit yield in case of summer chilli and watermelon as compared to control (recommended practice). This is in agreement with the findings of Khan *et al.* (2010), who reported significant increase in plant height and branches/plant of chilli at harvest owing to increase in dose of nitrogen fertilizer. Further, Bhuvaneswari *et al.* (2013) recorded more plant height and fruits/plant of chilli at final harvest with higher nitrogen fertilizer dose. Furthermore, the findings of watermelon are collaborated by Feleafel *et al*. (2014), they observed that the application of 125% of recommended NPK resulted in the highest significant mean values for the per cent fruit setting, number fruits/plant, and fruit yield in case of cucumber. Further, Maluki *et al*. (2015) recorded improved growth, yield and quality of watermelon in the coastal region of Kenya with higher dose of nitrogen and phosphorous fertilizers.

Chilli equivalent yield and production efficiency

Irrigation regime of 100% ETc recorded significantly higher chilli equivalent yield (57.47 t/ha) and production efficiency (188.9 kg/ha/day) for summer chilli–water-

Table 3. Effect of different treatments on system productivity water productivity and economics of chilli–watermelon and economics of summer chilli-watermelon sequence (mean data of 2 years)

Treatment	Chilli equivalent yield (t/ha)	Production efficiency (kg/ha/day)	Total water applied (cm-ha)	Water productivity (₹/m^3)	Cost of cultivation (× 10^3₹/ha)	Net monetary returns (× 10^3₹/ha)	Benefit: cost ratio
Irrigation regimes							
I_1, 70% ETc	49.89	163.9	42.6	220.5	494	941	2.74
I_2, 80% ETc	53.63	176.2	47.8	217.5	499	1042	2.89
I_3, 90% ETc	56.51	185.8	53.1	209.8	504	1115	3.02
I_4, 100% ETc	57.47	188.9	58.5	194.5	509	1137	3.05
SEm±	1.35	4.4	–	–	–	38	–
CD (P=0.05)	4.16	13.7	–	–	–	117	–
Fertigation levels							
F_1, 75% RDF	49.33	162.0	50.5	183.2	491	926	2.69
F_2, 100% RDF	54.61	179.5	50.5	210.8	502	1065	2.93
F_3, 125% RDF	59.18	194.5	50.5	234.4	512	1185	3.14
SEm±	1.19	3.9	–	–	–	35	–
CD (P=0.05)	3.43	11.2	–	–	–	100	–
Interaction							
SEm±	2.38	7.8	–	–	–	70	–
CD (P=0.05)	NS	NS	–	–	–	NS	–
SEm ±	2.37	7.8	–	–	–	68	–
CD (P=0.05)	NS	NS	–	–	–	NS	–
General mean	54.37	178.7	50.5	210.6	502	1059	2.92
Control (RP)	27.89	91.5	132.3	32.3	377	428	1.98
Absolute control (NF)	22.04	72.5	132.3	22.5	331	299	1.75

RP, Recommended practice; NF, no fertilizer; RDF, recommended dose of fertilizer; ETc, crop evapotranspiration melon crop sequence as compared to irrigation regime of 70% Etc (Table 3). Yield performance of both the crops was better at liberal irrigation regime resulted in higher chilli equivalent yield and production efficiency. Fertigation at 125% RDF recorded significantly higher chilli equivalent yield (59.18 t/ha) and production efficiency (194.9 kg/ha/day) for summer chilli–watermelon crop sequence as compared to fertigation at 75 and 100 % RDF (Table 3). Both the crops individually reported higher yield at higher fertigation level, which reflected in higher chilli equivalent yield and production efficiency.

Water productivity

Irrigation regimes of 70% ETc produced numerically higher water productivity, while irrigation regimes of 100% ETc resulted numerically low water productivity for summer chilli–watermelon crop sequence (Table 3). In drip irrigation method, irrigation water was applied every day based on crop evapotranspiration in restricted area directly in the vicinity of crop root zone, which minimize the water losses in evaporation and deep percolation. Therefore, the total water requirement was more in surface irrigation than drip irrigation method. However, all the irrigation regimes applied through drip method registered higher water productivity compared to surface irrigation method. Though the total quantity of water applied was more in surface method, the outcome in terms of fruit yield was low because of losses of soil moisture as a deep percolation and evaporation as compared to drip irrigation method. In drip irrigation method, higher fruit yield was obtained with less quantity of water, which resulted in increase in water productivity. The findings are in conformity with Choudhary *et al.* (2012). They reported significantly higher WUE when the chilli crop was exposed to drip irrigation at 0.6 Epan. The highest water-use efficiency in case red hot paper was obtained by Mahajan *et al.* (2007) with drip irrigation at 0.5 Epan as compared to 1.0 Epan with considerable saving of irrigation water compared to check basin method of irrigation. Simsek and Comlekcioglu (2011) reported that WUE in case of melon (*Cucumis melo* L.) increased with decrease in amount of water. Similarly, Fernandes *et al.* (2014) observed the highest water-use efficiency (177.13 kg/ha/mm) in case of watermelon when irrigation was daily and parceled (DPI) compared to more interval irrigation treatments.

Fertigation at 125% RDF recorded numerically higher water productivity, while fertigation at 75% RDF produced numerically low water productivity for summer chilli–watermelon crop sequence (Table 3). This higher water productivity may be due to higher fruit yield in the aforesaid fertigation level with the same quantity of moisture. These results are in accordance with Mahajan *et al.* (2007), who recorded higher water use efficiency in case of chilli with higher level of nitrogen fertilizer. Similarly Ramachandrappa *et al*. (2010) observed higher water-use efficiency when fertigation was applied in the form of MAP and KNO_3 at 125% RDF in case of chilli.

Economics

Irrigation regime of 100% ETc recorded significantly more net monetary returns (₹11,37,000/ha) for summer chilli-watermelon crop sequence as compared to irrigation regime of 70% Etc (₹9,41,000/ha) (Table 3). Numerically higher benefit: cost ratio (3.05) was reported by irrigation regime of 100% ETc. This may be because of higher irrigation regime through drip maintained the soil moisture always at field capacity throughout crop growth period resulting maximum absorption of moisture and nutrients, which favoured important growth and yield attributes, which ultimately resulted in increase on chilli and watermelon fruit yield and gross and net monetary returns. The results are in confirmatory with the findings Choudhary and Bhambri (2012).

The fertigation at 125% RDF recorded significantly higher net monetary returns (₹11,85,000/ha) for summer chilli–watermelon crop sequence than fertigation at 75% RDF (₹9,26,000/ha) and fertigation level of 100% RDF (₹10,65,000/ha) (Table 3). Numerically higher benefit: cost ratio (3.14) was reported by fertigation levels of 125% RDF. In fertigation nutrients are applied in vicinity of the root zone with uniformity and in limited required quantity throughout crop growth period. This increases the nutrient-use efficiency. These results are in line with Brahma *et al*. (2010). Similarly, Ramachandrappa *et al*. (2010) observed that net returns/ha was significantly higher with Urea, SSP, MOP at 125% RDF fertigation (₹69,237/ha) and significantly lower in soil application of Urea, SSP, and MOP at 75% RDF (₹36,015/ha). Brahma *et al*. (2014) noticed higher benefit cost ratio (1:6.86) in case of winter season capsicum with higher fertilizer dose of N and K at Johrat, Assam.

The surface irrigation with recommended dose of fertilizers produced lower chilli equivalent yield and production efficiency in summer chilli–watermelon crop sequence due to lower fruit yield in both the crops, and thereby obtained lower gross and net monetary returns as well as benefit: cost ratio than mean gross, net monetary returns and also benefit: cost ratio of different irrigation regimes and fertigation levels treatments. The results are confirmatory with the findings i.e. net returns and benefit: cost ratio were less with flood irrigation as reported by Choudhary and Bhambri (2012) in case of capsicum (*Capsicum annum* L.).

From pooled analysis of component crops and cropping sequence the irrigation regime of 100% ETc and fertigation at 125% RDF applied in split according to growth stages of component crops, recorded higher yield of individual component crop, system production efficiency, net monetary returns of crop sequence/ha and benefit: cost ratio of crop sequence.

REFERENCES

Abayomi, Y.A., Aduloju, M.O., Egbewunmi, M.A. and Suleiman B.O. 2012. Effects of soil moisture contents and rates of NPK fertilizer application on growth and fruit yields of pepper (*Capsicum* spp.) genotypes. *International Journal of Agricultural Science* **2**(7): 651– 663.

Anonymous. 2011-12. Major Spice wise area and production and item wise export.www. indiaspices, com.

Bhuvaneswari, G., Sivaranjani, R., Reeth, S. and Ramakrishnan, K. 2013. Application of nitrogen and potassium efficiency on the growth and yield of chilli (*Capsicum annuum* L). *International Journal of Current Microbiology Applied Science* **2**(12): 329–337.

Brahma, S., Saikia, L., Barua, P., Hazarika, T. and Sarma, B. 2010. Studies on effect of fertigation with different levels of N and K fertilizers on growth, yield, quality and economics of early season capsicum (*Capsicum annuum* L. Var. *grossum*) under cover. *Vegetable Science* **37**(2): 160–163.

Brahma, S., Saikia, L., Barua, P., Hazarika, T. and Sarma, B. 2014. Response of capsicum (*Capsicum annuum* var. *grossum*) to different levels of N and K fertigation under Assam conditions. *Progressive Horticulture* **46**(1): 80–84.

Choudhary, V.K. and Bhambri, M.C. 2012. Agro-economic potential of capsicum with drip irrigation and mulching. *SAARC Journal of Agriculture* **10**(2): 51–60.

Choudhary, V.K., Bhambri, M.C. and Pandey, N. 2012. Weed dynamics, yield, quality and root growth of capsicum under drip irrigation and mulching. *SAARC Journal of Agriculture* **10**(2): 71–82.

Feleaf, M.N., Miradad, Z.M. and Hassan, A.S. 2014. Effect of NPK fertigation rate and startes fertilizer on growth and yield of cucumber grown in green house. *Journal of Agricultural Science* **6**(9) : 81–92.

Fernandes, C.N.V., de Azevedo, B.M., Neto, J.R.N., de Araújo Viana, T.V. and de Sousa, G.G. 2014. Irrigation and fertigation frequencies with nitrogen in the watermelon culture. *Bragantia Campinas* **73**(2): 106–112.

Gadissa, T. and Chemeda, D. 2009. Effects of drip irrigation levels and planting methods on yield and yield components of green pepper (*Capsicum annuum* L.) in Bako, Ethiopia. *Agricultural Water Management* **96**(1): 1,673–1,678.

GoI. 2015. Indian Horticulture database 2014. National Horticulture Board, Ministry of Agriculture, Government of India, pp. 279–285.

Hatutale, G. 2010. The effect of plant population and mulching on green pepper (*Capsicum annuum* L.) production under irrigation. A dissertation submitted in fulfillment of the requirements for the degree of Magister Scientiae Agriculture in, the Faculty of Natural and Agricultural Sciences, Department of Soil, Crop and Climate Sciences, University of the Free State, Bloemfontein, South Africa.

Khan, M.S.I., Roy, S.S. and Pall, K.K. 2010. Nitrogen and phosphorus efficiency on the growth and yield attributes of *capsicum. Academic Journal of Plant Sciences* **3**(2): 71–78.

Kirnak, H. and Dogan, E. 2009. Effect of seasonal water stress imposed on drip irrigated second crop watermelon grown in semi-arid climatic conditions. *Irrigation Science* **27**(1):155–164.

Krishnamoorthy, V. and Hanif, A.K and Noorjehan. 2014. Effect of water soluble and conventional fertilizers on growth and yield of chillies. *Journal of Krishi Vigyan* **2**(2): 28–30.

Mahajan, G., Singh, K.G., Sharda, R. and Siag, M. 2007. Response of red hot pepper (*Capsicum annuum* L.) to water and nitrogen under drip and check basin method of irrigation. *Asian Journal of Plant Sciences* **6**(5): 815–820.

Maluki, M., Gesimba,R.M. and Ogweno, J.O. 2015. Evaluation of interaction effect of nitrogen and phosphorus on yield and quality of watermelon (*Citrullus lanatus* (Thunb.) Matsumara and Nakai. *International Journal of Science and Nature* **6**(2) : 188–194.

Ramachandrappa, B.K., Nanjappa, H.V., Soumya, T.M. and Mudalagiriyappa. 2010. Effect of fertigation with sources and levels of fertilizer on yield, quality and use efficiency of water and fertilizer in green chilli (*Capsicum annuum* L.). *Indian Journal of Dryland Agriculture Research and Development* **25**(2): 33–39.

Sensoy, S., Ertek, A., Gedik, I and Kucukyumuk, C. 2007. Irrigation frequency and amount affect yield and quality of field-grown melon (*Cucumis melo* L.). *Agricultural Water Management* **88**(1): 269–274.

Sezen, S.M., Yazar, A., Eker, S. 2006. Effect of drip irrigation regimes on yield and quality of field grown bell pepper. *Agricultural Water Management* **81**(1): 115–131.