

Effect of natural resources on plant growth, yield and quality in chilli cultivars (*Capsicum annuum* L.)

P. IRENE VETHAMONI AND S. NATARAJAN

Accepted : September, 2008

See end of the article for authors' affiliations

Correspondence to:

P. IRENE VETHAMONI
Department of Fruit Crops
& Post Harvest
Technology, Horticultural
College & Research
Institute, Tamil Nadu
Agricultural University,
PERIYAKULAM (E.) (T.N.)
INDIA

ABSTRACT

Studies were conducted to know the effect of (Natural Resources) light, relative humidity and temperature on growth, yield and quality characters by growing two varieties of chilli viz., K1 and PKM1 under 3 levels of shade viz., open field condition, 35 and 50 per cent shade during two seasons viz., September 2004 to March, 2005 and June – December 2005 at college orchard of Agricultural College and Research Institute, TNAU, Killikulam. The experiments were laid out in factorial randomized block design and a plot size of 4.5 x 2.2 m was used for each treatment. Observations were recorded on growth, yield and quality characters. In chilli, except for plant height, all the other growth and yield contributing characters registered higher values under open field condition than shade. All the quality characters exhibited higher values under open field condition. Since chilli is a high light and temperature preferring crop, its response was good under open field than shade.

Key words: Chilli, Shade, Capsaicin, Capsanthin, Oleoresin.

Chilli is the highest consumed spice in the world. The widely used word chilli usually refers to the hot variant of red pepper. Mostly chilli is grown all over the world and predominantly under tropical condition. Capsaicin and allied pungent principles viz., dihydrocapsaicin and nor-dihydrocapsaicin are the most important pungent components of red pepper. Even though chilli is a tropical crop, changes in climatic factor more so in temperature and light bring about considerable variations in vegetative characteristics, fruit setting and pungent principles.

MATERIALS AND METHODS

Studies were conducted to know the effect of (Natural Resources) light, relative humidity and temperature on growth, yield and quality characters by growing two varieties of chilli viz., K1 and PKM1 under 3 levels of shade viz., open field condition, 35 and 50 per cent shade during two seasons viz., September 2004 to March, 2005 and June – December 2005 at college orchard of Agricultural College and Research Institute, Killikulam. The experiments were laid out in factorial randomized block design and a plot size of 4.5 x 2.2 m was used for each treatment. Raised beds of 80 cm width were formed with a furrow of 40 cm between two beds. Forty five Days old seedlings were transplanted in paired rows on both sides of the drip laterals adopting a spacing of 60 cm between rows and 45 cm between plants. The recommended dose of N, P and K at 75 : 35 : 35 kg/

hectare was applied through fertigation. Observations were recorded on growth, yield and quality characters viz., plant height, number of branches/plant, fruits/plant, fruit length, fruit girth, mean fruit weight, seeds/fruit, yield/hectare, capsaicin, capsanthin, oleoresin and ascorbic acid contents. Five plants were selected at random in each treatment and each replication for recording plant growth and yield characters. Red ripe fruits obtained from third harvest were utilized for estimating the quality characters.

RESULTS AND DISCUSSION

In the present study, the results showed that the plants of K1 chilli under 50 per cent shade were significantly taller (273.42, 210.88 cm) and least plant height was recorded in open field condition. (110.95, 95.70 cm) (Table 1 and 2). The least plant height under open field condition might be due to the prevalence of high temperature and light intensity coinciding with early stage of crop growth forcing the plants to attain early reproductive stage. Number of primary branches were more in open field condition in K1 chilli (19.95, 15.10) than shade during both seasons. Since chilli is a light preferring crop, its response was good under open field. Reduced number of primary branches under shade could be due to low light intensity which would have influenced plant hormones, rate of photosynthesis and thus the amount of carbohydrate available for growth, resulting in reduced number of branches. (Krishnamohan *et al.*, 1993) Prevailing weather parameters significantly influenced the yield parameters

Table 1 : Effect of shade levels on growth, yield and quality characters in chilli cultivars–Season I

Characters	PKM 1			K 1		
	Open	35 %	50 %	Open	35 %	50 %
Plant height(cm)	110.95	197.93	221.05	150.10	240.83	273.42
No .of primary branches	15.03	12.93	9.08	19.95	14.98	11.93
No. of fruits per plant	116.05	76.73	53.76	125.49	85.74	63.54
Fruit length (cm)	9.55	5.15	4.20	10.80	7.73	5.98
Fruit girth(cm)	3.35	2.35	1.95	4.50	3.50	2.55
Fruit weight (g)	1.04	0.62	0.57	1.37	0.70	0.60
No. seeds per fruit	71.85	62.25	55.80	95.88	66.03	63.38
Yield per hectare (t)	2.51	1.51	1.04	2.88	1.83	1.22
Capsaicin content (per cent)	0.56	0.53	0.48	0.53	0.51	0.43
Capsanthin content (ASTA units)	27.65	21.78	17.40	24.55	19.38	15.33
Ascorbic acid content (mg 100 g ⁻¹)	127.52	123.75	119.08	81.58	79.63	77.90
Oleoresin content (per cent)	12.70	11.38	10.70	8.65	7.08	6.25

and plants of K1 chilli under open field condition registered more number of fruits/plant (125.49,121.06) than under shade during both the seasons. Reduced number of fruits per plant under shade might be due to flower shedding caused by unfavorable micro climate *viz.*, low temperature, low light intensity and high relative humidity for chilli growth and development. (Krishnamohan *et al.*, 1993) Fruit length,girth, weight and number of seeds were more in K1 chilli under open field condition in season I (10.80 cm,4.50 cm,1.37 g and 95.88, respectively) and the same trend was observed in season II also (11.13 cm,4.80 cm,2.49 g and 101.18, respectively). Reduced fruit length, fruit weight, fruit girth observed under shade might be due to low temperature .Fruit length, girth, weight and number of seeds were more in season II compared to season I. This was due to the presence of favourable environmental variables *viz.*, high light intensity, low relative humidity and high temperature in season I

compared to season II This is in conformity with the findings of Tarchoun *et al.* (2003) in hot pepper. Least number of seeds recorded under shade might be due to low temperature. Ali and Kelly (1982) also reported that low temperature at the stage of flower opening reduced the pollen viability in chilli leading to seed deficient fruits. Yield per hectare was highest under open field condition in K1 chilli (2.88 t, 2.64 t) in both the seasons. Reduced yield under shade might be due to low light intensity which caused reduction in photosynthetic yield. This is in line with the findings of Krishnamohan *et al.* (1993) who reported that partial shading prevents the radiation falling on the plants and reducing the photosynthetic efficiency of the crop affecting the formation of photosynthates, their partitioning and distribution for the final sink resulting in reduced pod yield.

Chilli cultivars had significant variation in growth and yield parameters during both the seasons. Among the

Table 2: ffect of shade levels on growth, yield and quality characters in chilli cultivars– Season II

Characters	PKM 1			K 1		
	Open	35 %	50 %	Open	35 %	50 %
Plant height(cm)	95.70	153.30	181.65	121.60	191.08	210.88
No. primary branches	11.35	10.38	6.23	15.10	12.40	7.78
No. of fruits per plant	112.25	64.95	45.83	121.06	72.69	54.10
Fruit length (cm)	9.65	5.56	4.50	11.13	8.03	6.30
Fruit girth(cm)	3.50	2.53	2.30	4.80	3.83	2.80
Fruit weight (g)	2.05	1.43	0.94	2.49	1.47	1.16
No. seeds per fruit	85.77	77.71	65.79	101.18	82.27	73.74
Yield per hectare(t)	2.31	1.33	0.96	2.64	1.51	1.06
Capsaicin content (per cent)	0.58	0.55	0.49	0.55	0.53	0.48
Capsanthin content (ASTA units)	29.55	25.15	19.13	26.98	22.11	16.78
Ascorbic acid content (mg 100 g ⁻¹)	128.95	174.98	120.20	82.80	81.65	79.24
Oleoresin content (per cent)	11.83	10.55	9.03	8.12	6.87	6.13

cultivars K1chilli was superior in growth and yield characters than PKM1 chilli. Similar variations were also observed by Paramaguru (1997) in chillies.

Effect of shade on quality parameters:

In the present study, increase in level of shade correspondingly decreased the capsaicin content in chilli and highest capsaicin content was recorded in PKM1chilli under open field condition.(0.56, 0.58 per cent) Increased capsaicin content under open field condition might be due to high transpiration rate and high temperature which would have reduced the soil moisture content.

Carotenoid compounds are yellow to red pigments and the red colour in capsicum mainly comes from capsanthin and capsorubin, while the yellow orange colour is from beta-carotene and violaxanthin. In the present study, the colour value of chilli was more under open field condition in PKM1 chilli (27.65,29.55 ASTA units) than under shade condition. Low colour value under shade might be due to presence of low temperature, which reduces water and nutrient absorption (Tarchoun *et al.*, 2000). The insufficient nutrient absorption might have hampered the colour development.

The ascorbic acid content of chilli was significantly decreased during both the seasons with increasing shade level. The highest ascorbic acid content in fruits of PKM1 chilli was noticed under open field condition.(127.52,128.95 mg 100 g⁻¹). Similar results were obtained by Priya *et al.* (2002) in paprika. In the present study, there was an increase in ascorbic acid in the fruits developed during June - July than September - October season. This might be due to high temperature prevailed during the June - July season. This is in conformity with the findings of Priya *et al.* (2002) in paprika.

In chilli, oleoresin content was more in open field condition in PKM1 chilli (12.70,11.83 per cent) than shade during both the seasons. Reduced oleoresin content under shade might be due to low light intensity and low temperature, which affect the rate of photosynthesis and organic substances supplied for the synthesis of oleoresin. This is in agreement with the findings of Krishnamohan *et al.* (1993), who stated that under 25 and 35 per cent shading, the formation of photosynthates, their partitioning

and distribution for the final sink are affected in chilli. Tarchoun *et al.* (2000) observed poor water absorption under low temperature resulting in low water content of plant and less synthesis of photosynthates.

Significant difference was observed for quality characters among the cultivars of chilli. PKM1 chilli excelled in quality characters than the cultivar K1.

Effect of shade on environmental variables:

The light intensity was reduced highly by 50 per cent shade nets (593.00,609.38 $\mu\text{mol m}^{-2} \text{s}^{-1}$) which caused reduction in yield of chilli (Table 3). The light requirement of crops varies in intensity, quality and duration or photoperiod. Since chilli is a tropical crop, its requirement for light is more. So the yield of chilli under open field condition was more compared to shade. This is in accordance with the findings of Krishnamohan *et al.* (1993), who suggested that under 25 and 35 per cent shading, the formation of photosynthates, their partitioning and distribution for the final sink were reduced and resulted in poor yield in chilli.

Relative humidity under 50 per cent shade was high (96.13, 94.29 per cent) and it was low under open field condition.(85.24, 83.06 per cent). The yield of chilli was low under 50 per cent shaded condition since the relative humidity under this shade level was high as compared to other levels of shade. The high humidity prevailed under shade resulted in poor fruit setting, malformed fruits and low yield. This is in accordance with the findings of Tarchoun *et al.* (2003) in chilli.

The temperature present inside the 50 per cent shade net was low(23.93,25.35°C) and it was high under open field condition(28.08,29.71°C). However, in chilli, the yield was reduced under shade due to poor water and nutrient absorption in low temperature (Salveit and Morris, 1990). Ali and Kelley (1982) also reported that lower temperature is more harmful to chilli than supra optimal temperature.

There was no significant variation between varieties for light intensity, relative humidity and temperature. Similar results were observed by Priya, (2002) in paprika.

In chilli, except for plant height, all the other growth and yield contributing characters registered higher values under open field condition than shade. All the quality

Table 3 : Effect of shade levels on light intensity, relative humidity and temperature above the canopy of chilli cultivars in Season I and season II

Characters	Season I			Season II		
	Open	35 %	50 %	Open	35 %	50 %
Light intensity ($\mu\text{mol m}^{-2} \text{s}^{-1}$)	1011.75	783.85	593.00	1149.62	859.50	609.38
Relative humidity (per cent)	85.24	91.12	96.13	83.06	89.31	94.29
Temperature (°C)	28.08	25.18	23.93	29.71	26.62	25.35

characters exhibited higher values under open field condition. Since chilli is a high light and temperature preferring crop, its response was good under open field than shade. Reduced light and temperature with increased relative humidity present inside the shade net is not suitable for growth, yield and quality of chilli. Among the cultivars the performance of K1 chilli was superior than PKM 1 for yield and yield contributing characters and PKM 1 for quality characters.

Authors' affiliations:

S. NATARAJAN, Department of Fruit Crops and Post Harvest Technology, Horticulture College and Research Institute, Tamil Nadu Agricultural University, PERIYAKULAM (E.) (T.N.) INDIA

REFERENCES

- Ali, A.M.** and Kelley, W.C. (1982). Effect of temperature on flower development in chilli (*Capsicum annuum*.) *GFR Int. Soc. Hort. Sci., I. Abstr., No.1562*.
- Krishna Mohan, K.**, Hanumantha Rao, G.V. and Srinivasulu, R. (1993). Effect of light stress and hormonal sprays on plant growth, retention of reproductive structures and yield in chilli (*C. annuum* L.). *South Indian Hort.*, **41**(1) : 22-27.
- Paramaguru, P.** (1997). Studies on evaluation of genotypes, heterosis and combining ability in chilli (*Capsicum annuum* L.) under south Tamil Nadu conditions. Ph.D (Hort.) Thesis, TNAU, Coimbatore.
- Priya, W.**, Vijayakumar, M., Veeragavathatham, D., Jeyakumar, P. and Chezian, P. (2002). Effect of seasons and growth environments on paprika (*Capsicum annum* var. longum) growth and yield. *South Indian Hort.*, **50**(4-6) : 463-471.
- Salveit, J.M.E.** and Morris, L.L. (1990). Over view on chilling injury of horticultural crops. In: *Chilling Injury of Horticultural Crops*. Ed. C.Y. Wang, pp. 3-17.
- Tarchoun, N.**, Jemmali, A., Daly, N. and Bodson, M. (2000). Effect of low night temperature on plant growth of *Capsicum annuum* L. *Capsicum Egg plant Newsl.*, **19** : 27-30.
- Tarchoun, N.**, Bodson, M. and Mougou, A. (2003). Low temperature effect on pepper ovaries characteristics. Histological study. *Capsicum Egg plant Newsl.*, **22** : 29-32.
