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Performance Shadenet Colours on Maturity Period and Yield of Cabbage Varieties in Summer Season

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ABSTRACT: *The present investigation was conducted at Department of Agronomy, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra to study the response of cabbage varieties to different shadenet colours and open field conditions on growth, maturity period and yield potential during summer season, 2013. The soil of the experimental field was red sandy clay in texture with moderate in available nitrogen (273.1 kg ha^{-1}), high in available phosphorous (28.81 kg ha^{-1}) and very high in available potassium (354.42 kg ha^{-1}). The experiment was laid out in factorial randomized block design with three replications. The red shadenet colour with 75 per cent shading intensity gives significant increase in cabbage yield (28.73 t ha^{-1}) as compared to other shadenet colours while among the varieties the Scent variety registered maximum yield (22.77 t ha^{-1}) than Manas variety (21.35 t ha^{-1}). The red coloured shadenet with 75 per cent shading intensity coupled with Scent variety of cabbage in summer season recorded significant cabbage yield (30.08 t ha^{-1}).*

Keywords: *Cabbage varieties, shadenet colours, Open field conditions, yield potential, maturity period*

INTRODUCTION

Cabbage (*Brassica oleracea* var. capitata) is one of the most economically important Cole crop belonging to the family Cruciferae, originated from coastal region of England, Southern and Western Europe. Cabbage has an anti-cancer property, it protects against bowel cancer due to the presence of indole 3-carbinol. The optimum temperature required for growth and heading is between 15 to 20°C. In India, it is grown on area of 369 thousand hectares and production of 7949 thousand metric tonnes and per hectares yield is 21.5 tonnes (Anonymous, 2011). Photoselective shade-netting is an emerging approach in protected cultivation. The productivity of crop is however, very low in India in general and particularly in transition zone which is attributed to the extensive cultivation without restricting the season and lack of technical knowledge about its cultivation aspects. Shading nets are used in agriculture to protect crops from either excessive solar radiation (i.e. shading), or environmental hazards (e.g. hail, strong winds, sand storms) or flying pests (birds, fruit-bats, insects). Different coloured nets represent a new agro-technological concept which aims at combining the physical protection together with differential filtration of the solar radiation for specifically promoting desired physiological responses that are light regulated. The target responses are those determining the commercial value of each crop, including yield, product quality and rate of maturation. The coloured net add a new tool for light quality manipulation. It deals with light quality in its broad sense to include its dispersion featutes and thermal components in addition to the visible and near visible spectral components. Coloured shading nets differentiate and specifically modify the incident light in either the ultra violet (UV) the visible or the far red (FR) spectral regions and at the same time enhance the relative content of scattered vs. direct light and or absorb part of infrared (IR) radiation . Due to climate change, increase in temperature, hailstorm problems in Maharashtra, we have conducted the experiment in shadenet conditions. The yield potential of cabbage is more in *rabi* and *kharif* season even though we have tried to take this crop in summer season as a off season crop to fetch more market price to farmer under different shadenet colours with 75 per cent shading intensity and at the same time in open field condition

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for comparison of growth as well as yield potential of cabbage crop in off season. Therefore, an experiment on response of cabbage varieties to different shadenet colours and open field condition on growth, maturity period and yield of cabbage in summer season was planned and conducted during summer season of 2013.

MATERIALS AND METHODS

The present investigation experiment was carried out to study the response of cabbage varieties to different shadenet colours and open field conditions at Post Graduate Institute Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) during summer season, 2013. The soil of the experimental field was red sandy clay in texture with moderate in available nitrogen (273.1 kg ha^{-1}), high in available phosphorous (28.81 kg ha^{-1}) and very high in available potassium (354.42 kg ha^{-1}). The experiment was laid out in factorial randomized block design with three replications. The treatments consisted of six shadenet colours *viz*., white, blue, white + green, green, red and black and open field condition with two varieties *viz*., Scent and Manas. The mean maximum temperature ranged from 30.1 to 41.0 ^{0}C while minimum temperature from 17.8 to 23.1 ^{0}C. Raised beds of 45 cm height, 18 m length and 1.20 m width were prepared along the shadenet house with walking space of 30 cm between the beds as well as open field conditions. The transplanting of cabbge seedling was done on 18th April, 2013 at evening time for proper setting of seedlings. The three week old healthy and uniform cabbage seedlings were transplanted at the spacing of 45 cm x 45 cm on the raised beds. Fertigation of NPK was scheduled as per recommended dose at 30 days interval in equal splits starting from transplanting. The recommended dose for cabbage is 160:80:80 NPK kg ha^{-1} that was given through fertigation by using 19:19:19 grade of water soluble fertilizer and urea (46.6 % N). To avoid the incidence of pest viz., *Spodoptera* and dimond black moth, two sprays of profenophos 50 EC @ 15 ml per 10 liter of water and Spinosad @ 3 ml per 15 liter of water was carried out. All plants from the net plot were considered for the days to maturity and cabbage yield.

RESULTS AND DISCUSSION

Days to Head Maturity

The number of days to head maturity was influenced significantly due to different shadenet colours with 75 per cent shading intensity and open field conditions. The red shadenet colour registered significantly minimum number of days to head maturity (55.02 days) than other shadenet colours followed by green, green + white and white nets, whereas in black and blue colour shadenet higher number of day to head maturity was recorded at harvest, similar results were also reported by Balradi *et al*. (1998). The open field conditions recorded highest number of days to head maturity as compared to shading effect of different coloured shade nets (75.30 days).

The number of days to head maturity was influenced significantly due to different varieties. Scent variety required minimum number of days to head maturity (62.67) compared to Manas variety. This might be due to genetic potential of plants and good adoptability to environmental condition which results in to early head maturity. Significantly maximum number of days to head maturity was observed in Manas variety (63.37).

The interaction effect between different shadenet colours with 75 per cent shading intensity and open field conditions and varieties were significant in respect of number of days to head maturity. The interaction between red coloured shadenet and Scent variety recorded significantly minimum number of days to head maturity (54.30) than rest of treatment combinations. The open field conditions combined with Manas variety recorded highest number of day to head maturity (75.87). Similar results were also reported by Vethamoni and Natarajan (2008).

Yield and Yield Attributing Characters

The yield attributes of cabbage viz., head girth, head weight and head yield were studied during experimentation.

Head Girth

The head girth of cabbage was influenced significantly due to different shade net colours with 75 per cent shading intensity and open field condition. The red shadenet colour registered significantly higher head girth (45.17 cm) than other shade net colours followed by green, green + white and white shadenets. This might be due to greater extent of light scattering giving more diffused radiation leading to higher amount of light penetration. Whereas in black and blue colour shadenet lower plant head girth was recorded at harvesting stage. The open field conditions showed lowest plant head girth (29.15 cm) as compared to shading effect of different coloured shadenet.

The head girth of cabbage was influenced significantly due to different varieties. Scent variety exhibited significantly higher head girth (38.53 cm) compared to Manas variety. This may be attributed to genetic potential of variety Scent result into more head girth. Significantly, lowest head girth was observed in Manas variety (37.67 cm).

The interaction effect between different shadenet colours with 75 per cent shading intensity and open field condition and varieties were significant in respect of head girth of cabbage. The interaction between red coloured shadenet and Scent variety recorded significantly the highest head girth (45.67 cm) than rest of treatment combinations. However, it was found lowest with open field conditions under Manas variety (28.23 cm), due to unfavourable climatic condition. Similar results were also reported by Yan Qinyan *et al.* (2011) (Table 1a).

Head Weight

The head weight was influenced significantly due to different shadenet colours with 75 per cent shading intensity and open field conditions. The red shadenet colour registered significantly higher head weight (674.83 g) than other shade net colours followed by green, green + white and white nets. Significant improvement in plant height, plant spread, number of leaves and photosynthetic rate under red colour and green ultimately increased weight of fresh head. Whereas in black and blue colour shadenet lower plant head weight was recorded at harvesting stage, similar results were also reported by Swagatika Srichandan *et al.* (2006) and Yan Qinyan *et al.* (2011). The open field conditions showed lowest plant head weight as compared to shading effect of different coloured shadenet, due to unfavourable climatic condition (397.03 g), similar results were also reported by Zoran *et al.* (2011).

The head weight was influenced significantly due to different varieties. Scent variety exhibited significantly higher head weight (567.69 g) compared to Manas variety. This might be due to genetic potential of variety scent which resulted into more solid and compact heads leads to increased head weight. Significantly, lowest head weight was observed in Manas variety (534.54 g)

The interaction effect between different shadenet colours with 75 per cent shading intensity and open field condition and varieties were significant in respect of head weight of cabbage. The interaction between red coloured shadenet and Scent variety recorded significantly higher head weight (706.00 g) than rest of treatment combinations. However, it was found lowest with open field conditions under Manas variety (392.00 g) (Table 1b).

Table 1
Yield and days to head maturity of cabbage as influenced by different treatments

Treatment	*Yield attributes*		*Yield*			
	Head girth (cm)	*Head weight (g)*	*kg m^{-2}*	*kg unit^{-1} (756m^{-2})*	*t ha^{-1}*	*Days to head maturity*
Shadenet colours (C)						
C_1 - White	40.85	573.13	2.42	1829.52	24.18	59.70
C_2 - Blue	36.27	516.17	2.17	1643.04	21.74	65.60
C_3 - Green+white	41.20	602.00	2.54	1921.50	25.40	59.10
C_4 - Green	41.68	623.67	2.63	1989.54	26.32	57.02
C_5 - Red	45.17	674.83	2.87	2170.98	28.73	55.02
C_6 - Black	32.37	471.00	1.98	1499.40	19.83	69.38
C_7 - Open field	29.15	397.00	0.82	622.44	8.21	75.30
S. Em. (±)	0.15	4.29	0.02	13.07	0.18	0.12
C.D. at 5 %	0.44	12.48	0.05	37.99	0.51	0.36
Varieties (V)						
V_1 - Scent	38.53	567.69	2.28	1721.88	22.77	62.67
V_2 - Manas	37.67	534.54	2.14	1614.24	21.35	63.37
S. Em. (±)	0.08	2.30	0.01	6.99	0.09	0.07
C.D. at 5 %	0.23	6.67	0.03	20.31	0.27	0.19
Interaction						
C x V						
S.Em. (±)	0.18	5.26	0.02	16.01	0.21	0.15
C.D. at 5 %	0.53	15.28	0.06	46.54	0.62	0.44
General mean	38.10	549.95	2.21	1668.06	22.06	**63.02**

Yield

The cabbage yield was influenced significantly due to different shadenet colours with 75 per cent shading intensity and open field conditions. The red shadenet colour registered significantly higher cabbage yield (2.87 kg m^{-2} and 28.73 t ha^{-1}) than other shadenet colours followed by green, green + white and white shadenets and whereas in black and blue colour shadenets lower yield was recorded at harvest. This might be due to red, green, green + white shadenet scattered more radiation resulting into availability of more PAR and photosynthetic rate. Similar results were also reported by Swagatika Srichandan *et al.* (2006). The open field conditions showed lowest yield (0.82 kg m^{-2} and 8.21 t ha^{-1}) as compared to shading effect of different coloured shadenet, similar results were also reported by Zoran *et al*. (2011) and Yenglem and Tumbare (2014).

The cabbage yield was influenced significantly due to different varieties. Scent variety exhibited significantly higher cabbage yield (2.28 kg m^{-2} and 22.77 t ha^{-1}) compared to Manas variety. This might be due to significant improvement in growth of Scent variety which exploited their potential under favourable soil and microclimatic conditions prevailed during crop growing season which increased the all the growth and yield attributes of crop which finally leads to increase the yield of cabbage. Significantly low yield (2.14kg m^{-2} and 21.35 t ha^{-1}) was observed in Manas variety.

The interaction effect between different shadenet colours with 75 per cent shading intensity and open field conditions and varieties were significant in respect of cabbage yield. The interaction between red coloured shadenet and Scent variety recorded significantly higher cabbage yield (3.01 kg m^{-2} and 30.08 t ha^{-1}) than rest of treatment combinations. However, it was found lowest with open field conditions under Manas variety (0.80 kg m^{-2} and 7.96 t ha^{-1}). Similar results were also reported by Yan Qinyan *et al.* (2011) and Arthrus *et al*. (Table 1c and 1e).

Table 1a
Interaction effect between shadenet colours and varieties on head girth (cm) of cabbage

Varieties	*Shadenet colours*						
	White	*Blue*	*Green+ White*	*Green*	*Red*	*Black*	*Open*
Scent	41.23	36.47	41.57	42.10	45.67	32.60	30.07
Manas	40.47	36.07	40.83	41.27	44.67	32.13	28.23
S.Em. ±	0.18			C.D. at 5 %		0.53	

Table 1b
Interaction effect between shadenet colours and varieties on head weight of cabbage (g)

Varieties	*Shadenet colours*						
	White	*Blue*	*Green+ White*	*Green*	*Red*	*Black*	*Open*
Scent	586.83	524.67	627.00	645.00	706.00	482.33	402.00
Manas	559.42	507.67	577.00	602.33	643.67	459.67	392.00
S.Em. ±	5.26			C.D. at 5 %		15.28	

Table 1c
Interaction effect between shadenet colours and varieties on yield of cabbage (kg m-2)

Varieties	*Shadenet colours*						
	White	*Blue*	*Green+ White*	*Green*	*Red*	*Black*	*Open*
Scent	2.48	2.21	2.65	2.72	3.01	2.03	0.85
Manas	2.36	2.14	2.44	2.54	2.74	1.93	0.80
S.Em. ±	0.02			C.D. at 5 %		0.06	

Table 1d
Interaction effect between shadenet colours and varieties on yield of cabbage (kg 756 m^{-2})

Varieties	*Shadenet colours*						
	White	*Blue*	*Green+ White*	*Green*	*Red*	*Black*	*Open*
Scent	1872.36	1670.76	2000.88	2056.32	2273.04	1537.20	624.60
Manas	1786.68	1615.32	1842.12	1922.76	2068.92	1461.60	602.28
S.Em. ±	16.01			C.D. at 5 %		46.54	

Table 1e
Interaction effect between shadenet colours and varieties on yield of cabbage (t ha^{-1})

Varieties	*Shadenet colours*						
	White	*Blue*	*Green+ White*	*Green*	*Red*	*Black*	*Open*
Scent	24.76	22.10	26.46	27.22	30.08	20.31	08.46
Manas	23.60	21.38	24.38	25.42	27.39	19.35	07.96
S.Em. ±	0.21			C.D. at 5 %		0.62	

Table 1f
Interaction effect between shadenet colours and varieties on number of days to head maturity

Varieties	*Shadenet colours*						
	White	*Blue*	*Green+ White*	*Green*	*Red*	*Black*	*Open*
Scent	59.36	65.27	58.60	57.30	54.30	69.10	74.73
Manas	60.03	65.93	59.60	56.73	55.73	69.67	75.87
S.Em. ±	0.15			C.D. at 5 %		0.44	

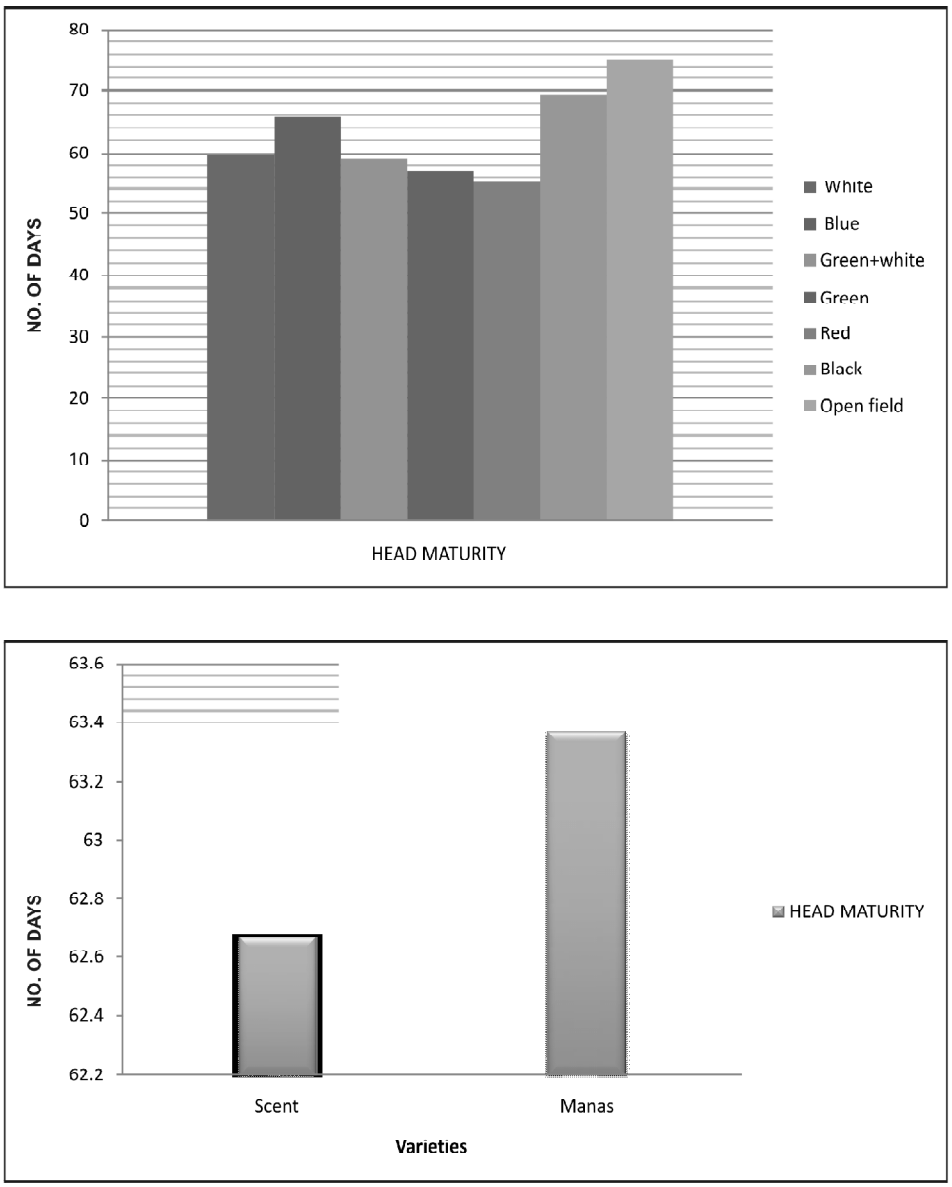
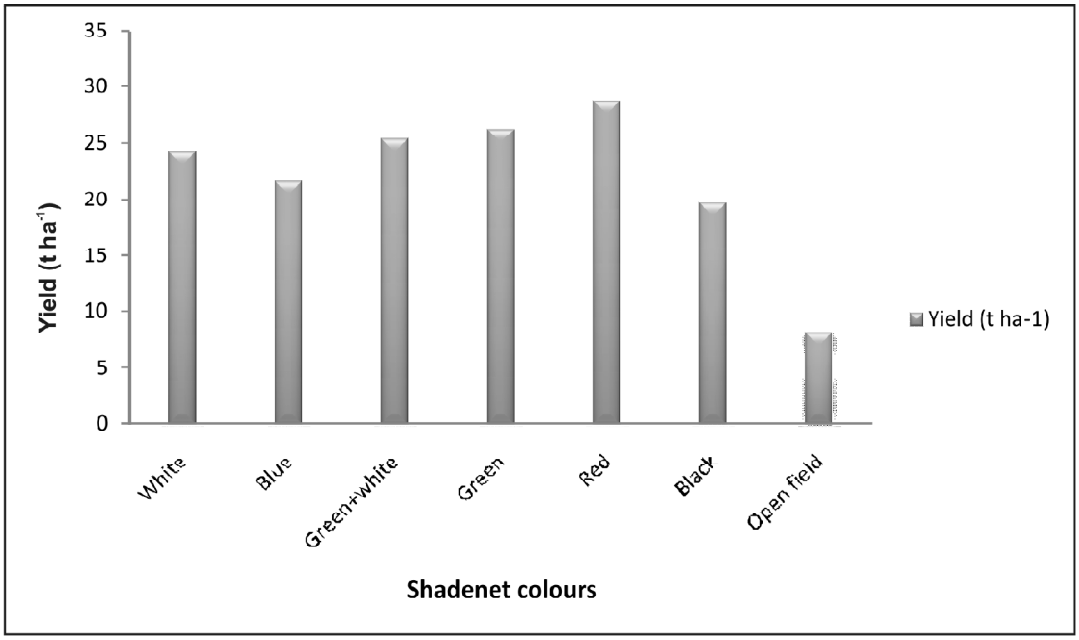


Figure 1: Days to head maturity as influenced by different treatments



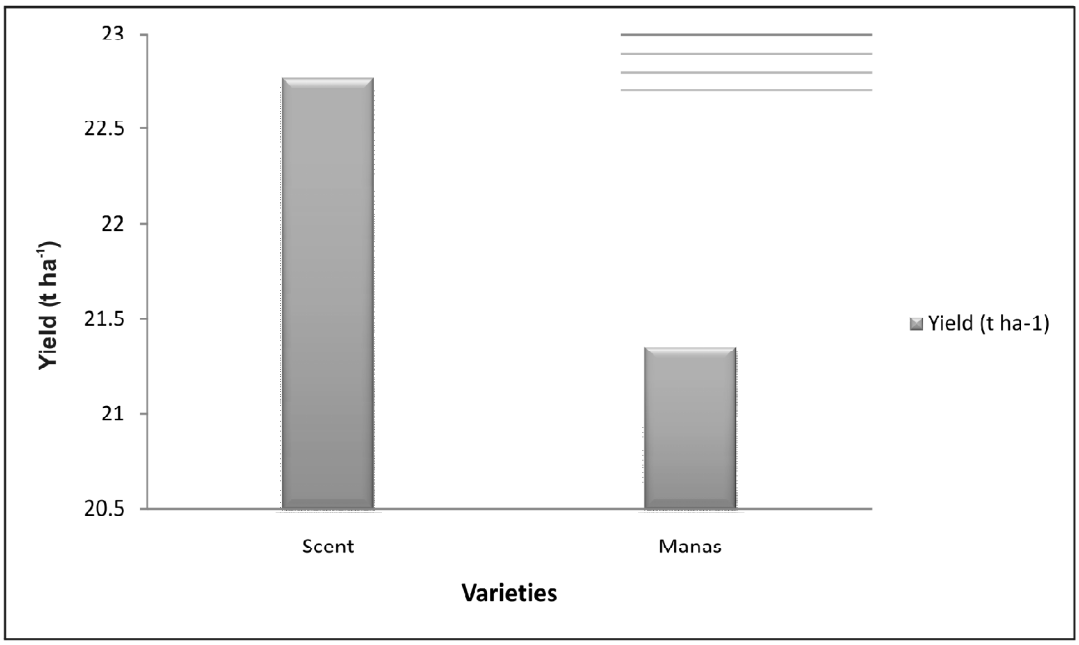


Figure 2: Cabbage yield as influenced by different treatments

REFERENCES

Anonymous, (2011), Agricultural Statistics At a Glance, Department of Agriculture and Co-operation, 2006. Ministry of Agriculture. Government of India. *http:// eands dacnet.nic.in/ latest_2006.htm*

Arthurs S.P., Stomps R.H. and Giglia F.F., (2013), Environmental modification inside photoselective shadehouses. *Hort. Sci.* 48(8):975-979

Balradi, R., Rapparini, F., Bertazza, G. and Rotondi, A. (1998), Effcet of simulated light environment on growth and leaf morphology of peach plants. *J. Hort. Sci. Biotech*. 73(2): 251-258.

Swagatika Srichandan, Panda, S.C., Sahu, G.S., Mahapatra, P. and Mishra, R. (2006), Effect of shadenet on growth and yield of cauliflower. *Orissa J. Hort*. 34(1): 28-31.

Vethamoni, P.I. and Natarajan, S. (2008), Cultivation of sweet pepper cultivars (*Capsicum annuum* var. *grossum* L.) under shadenet in tropical plains of Tamil Nadu. *Asian J. Hort*., 3(2): 372-376.

Yan Qinyan, Song Shiwei and Dong Fei. (2011), Effect of colour shading net on the growth and photosynthetic characteristics of flowering Chinese cabbage. *J. Huazhang Agri. Univ*. 30(1): 44-48.

Yanglem S. D. and Tumbare A.D. (2014), Influence of irrigation regimes and fertigation levels on yield and physiological parameters in cauliflower. *The Bioscan, International Quarterly Journal of Life Sciences*. 9(2): 589-594.

Zoran Ilic, Lidija Milenkovic, Mihal Durovka and Nikolaos Kapoulas. (2011), The effect of color shade nets on the greenhouse climate and pepper yield. Proceedings. 46th Croatian and 6th International Symposium on Agriculture. Opatija. Croatia. pp 529-532.