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APAR AND PHOTOSYNTHETIC RATE AS INFLUENCED BY SHADENET COLOURS AND SHADING INTENSITIES AND ITS CORRELATION WITH GROWTH AND YIELD OF CABBAGE

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Abstract: *A field experiment was conducted in a specially designed shade net on an area of 1400 m^2 at Post Graduate Instructional Farm, Mahatma Phule Krshi Vidyapeeth, Rahuri, Dist. Ahmednagar (M.S.) during rabi season of 2011-12. The experiment was laid out in a factorial Completely Randomized Design (CRD) and replicated three times. The treatments consisted of three shade net colours viz., white, blue and Green + White; three shading intensities viz., 35, 50 and 75 per cent and two varieties viz., Scent and Saurabh. The transplanting of cabbage was done on 25th Nov, 2011 at the spacing of 45 cm × 45 cm on the broad bed furrow. The recommended fertilizer dose of 60:80:80 N, P_2O_5 and K_2O kg ha^{-1} was applied. The results revealed that, absorbed photosynthetically active radiation (APAR) and photosynthetic rate were significantly improved under white shade net followed by blue and green + white shade net colours. Similarly, APAR and photosynthetic rate were significantly increased under 35 per cent shading intensity throughout the crop growth period as compared to 50 and 75 per cent shading intensities. Amongst the two varieties, the scent variety registered significantly higher APAR and photosynthetic rate than the Saurabh variety. The positive and highly significant correlation was observed between photosynthetic rate, growth parameters and yield of cabbage with absorbed photosynthetically active radiation at all crop growth stages in respect of shade net colours and shading intensities.*

Key words: *Cabbage, APAR, photosynthetic rate, correlation, shade net colours, shading intensities.*

Introduction

Coloured netting modifies the spectrum of the incident radiation in the visible region and enriches the relative content of scattered light. Therefore, the fraction of the light that passes freely through the holes remains unchanged in its quality, while the fraction hitting the threads comes out of the net both spectrally modified and scattered. Plants react to the changes that occur in spectrum of electromagnetic radiation to which they are exposed through alterations in morphology and physiological functions that result in adaptation to different environmental conditions**.** The present study was undertaken to assess the absorbed photosynthetically active radiation, crop growth and yield of cabbage under shade net of different colours and intensities.

Materials and Methods

A field experiment was conducted in a specially designed shade net on an area of 1400 m^2 at Post Graduate Instructional Farm, Mahatma Phule Krshi Vidyapeeth, Rahuri, Dist. Ahmednagar (M.S.) during *rabi* season of 2011-12. The experiment was laid out in a factorial Completely Randomized Design (CRD) and replicated three times. The treatments consisted of three shade net colours *viz.,* white, blue and Green + White; three shading intensities *viz.,* 35, 50 and 75 per cent and two varieties *viz.,* Scent and Saurabh. The transplanting of cabbage was done on 25th Nov, 2011 at the spacing of 45 cm × 45 cm on the broad bed furrow. The recommended fertilizer dose of 60:80:80 N, P_2O_5 and K_2O kg/ha was applied. During photosynthesis, plants use energy in the region of the

electromagnetic spectrum from 400-700 nm. The radiation in this range, referred to as Photosynthetically Active Radiation (PAR).

The photosynthetically active radiation (PAR) was measured on a clear sky between 11.00 am to 1.00 pm with the LI-191SA Line Quantum Sensor (Li-Cor make) at an interval of 15 days. The absorbed photosynthetically active radiation (APAR) was calculated using the following formula given by Gallo and Daughtry (1986).

APAR = (PARo + RPARs) – (TPAR + RPARc)

Results

Effect of shade net colours

The white coloured shade net recorded significantly higher absorbed photosynthetically active radiation (APAR) at all crop growth stages (163.33, 203.83, 334.22 and 271.56 μ mol/m^2/s at 15, 30, 45 DAT and at harvest, respectively) compared to the blue and green + white Shade net colours. However, it was at par with blue coloured shade net at all the days of observation. Similarly, the white coloured shade net recorded significantly higher photosynthetic rate at all crop growth stages (9.73, 14.75, 17.27 and 15.32 μ mol/m^2/s at 15, 30, 45 DAT and at harvest, respectively) compared to blue and green + white shade net coloures. The results are in conformity with the findings of Jongschaap *et al.* (2006) and Sarlikioti *et al.* (2011).

Effect of shading intensities

The significantly highest Absorbed Photosynthetically Active Radiation (APAR) (178.72, 219.33, 342.67 and 294.94 μ mol/m^2/s at 15, 30, 45 and at harvest, respectively) and photosynthetic rate (10.29, 15.48, 18.20 and 16.72 μ mol/m^2/s at 15, 30, 45 and at harvest, respectively) was recorded in 35 per cent shading intensity at all crop growth stages compared to 50 and 75 per cent shading intensities. Similar results were reported by Jongschaap *et al.* (2006) and Sarlikioti *et al.* (2011).

Effect of varieties

The variety scent recorded significantly higher absorbed photosynthetically active radiation (APAR) (183.63, 223.63, 376.93 and 304.48 μ mol/m^2/s at 15, 30, 45 and at harvest, respectively) and photosynthetic rate (10.43, 16.52, 18.80 and 16.19 μ mol/m^2/s at 15, 30, 45 and at harvest, respectively) at all crop growth stages compared to Saurabh variety The results corroborate the findings of Srivastava *et al.* 2011.

Correlation studies

The highly significant positive correlation was registered between, growth parameters, photosynthetic rate and yield of cabbage with absorbed photosynthetially active radiation at all crop growth stages under white, blue and green + white shade net colours (Table 2) and under all three shading intensities *viz;* 35,50 and 75 per cent (Table3).

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Table 1: Effect of shade net colours and shading intensities on absorbed photosynthetically active radiation and photosynthetic rate of cabbage cultivars

Treatment	Absorbed Photosynthetically active radiation (μ mol/m²/s)				Photosynthetic rate (μ mol/m²/s)				Yield (t/ ha)
	15 DAT	30 DAT	45 DAT	At harvest	15 DAT	30 DAT	45 DAT	At harvest	
Shade net colours (C)									
White	163.33	203.83	334.22	271.56	9.73	14.75	17.27	15.32	43.82
Blue	160.50	197.72	328.17	262.44	9.26	14.36	16.66	15.04	42.58
Green+white	152.89	197.56	317.78	252.44	9.20	14.29	16.19	14.73	41.38
SEm(±)	2.70	1.75	2.38	4.48	0.15	0.13	0.22	0.15	0.52
CD at 5%	7.76	5.01	6.82	12.84	0.43	0.38	0.62	0.44	1.48
Shading intensities (I)									
35 %	178.72	219.33	342.67	294.94	10.29	15.48	18.20	16.72	46.49
50%	154.56	202.61	333.78	270.78	9.53	14.71	16.74	14.55	42.22
75 %	143.44	177.17	303.72	220.72	8.37	13.21	15.18	13.82	39.07
SEm ±	2.70	1.75	2.38	4.48	0.15	0.13	0.22	0.15	0.52
CD at 5 %	7.76	5.01	6.82	12.84	0.43	0.38	0.62	0.44	1.48
Varieties (V)									
Scent	183.63	223.63	376.93	304.48	10.43	16.52	18.80	16.19	45.87
Saurabh	134.19	175.78	276.52	219.82	8.36	12.42	14.62	13.95	39.32
SEm(±)	2.21	1.43	1.94	3.66	0.12	0.11	0.18	0.12	0.42
CD at 5%	6.33	4.09	5.57	10.48	0.35	0.31	0.50	0.36	1.21
Interaction									
C x I									
SEm ±	4.68	3.03	4.12	7.75	0.26	0.23	0.37	0.26	0.89
CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS
I x V									
SEm ±	3.82	2.47	3.36	6.33	0.21	0.19	0.30	0.22	0.73
CD at 5 %	10.97	7.09	9.69	18.16	NS	0.54	0.87	NS	2.09
C x V									
SEm ±	3.82	2.47	3.36	6.33	0.21	0.19	0.30	0.22	0.73
CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS
C x I x V									
SEm ±	6.62	4.28	5.82	10.97	0.37	0.33	0.53	0.37	1.26
CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	**158.91**	**199.70**	**326.72**	**262.15**	**9.40**	**14.47**	**16.71**	**15.03**	**42.59**

Table 2: Correlation between growth parameters, photosynthetic rate and yield of cabbage with absorbed photosynthetically active radiation at all crop growth stages in respect of Shade net colours

Parameters	White				Blue				Green + White			
	15 DAT	30 DAT	45 DAT	At harvest	15 DAT	30 DAT	45 DAT	At harvest	15 DAT	30 DAT	45 DAT	At harvest
Plant height	0.755**	0.906**	0.844**	0.82**	0.785**	0.902**	0.814**	0.801**	0.855**	0.818**	0.857**	0.885**
Plant spread	0.894**	0.896**	0.963**	0.858**	0.784**	0.938**	0.928**	0.926**	0.882**	0.93**	0.928**	0.904**
Leaf number	0.781**	0.952**	0.855**	0.884**	0.834**	0.946**	0.82**	0.84**	0.877**	0.901**	0.763**	0.923**
Leaf area	0.893**	0.967**	0.974**	0.826**	0.815**	0.945**	0.959**	0.933**	0.804**	0.961**	0.966**	0.813**
Dry matter	0.871**	0.896**	0.949**	0.761**	0.799**	0.868**	0.956**	0.861**	0.822**	0.866**	0.949**	0.902**
Photosynthetic rate	0.854**	0.947**	0.939**	0.908**	0.775**	0.91**	0.913**	0.833**	0.743**	0.903**	0.847**	0.85**
Yield	0.773**	0.857**	0.797**	0.88**	0.672**	0.887**	0.8**	0.833**	0.8**	0.829**	0.723**	0.86**

* Significant at 5 per cent level **Significant at 1 per cent level

Table 3: Correlation between growth parameters, photosynthetic rate and yield of cabbage with absorbed photosynthetically active radiation at all crop growth stages in respect of shading intensities

Parameters	35 per cent				50 per cent				75 per cent			
	15 DAT	30 DAT	45 DAT	At harvest	15 DAT	30 DAT	45 DAT	At harvest	15 DAT	30 DAT	45 DAT	At harvest
Plant height	0.891**	0.795**	0.889**	0.799**	0.753**	0.698**	0.888**	0.771**	0.676**	0.947**	0.917**	0.785**
Plant spread	0.887**	0.932**	0.946**	0.892**	0.88**	0.88**	0.935**	0.837**	0.721**	0.815**	0.965**	0.851**
Leaf number	0.917**	0.936**	0.824**	0.88**	0.844**	0.786**	0.919**	0.824**	0.513*	0.939**	0.877**	0.837**
Leaf area	0.909**	0.944**	0.969**	0.937**	0.88**	0.871**	0.969**	0.894**	0.599**	0.974**	0.981**	0.871**
Dry matter	0.86**	0.965**	0.956**	0.803**	0.891**	0.906**	0.935**	0.781**	0.67**	0.978**	0.982**	0.852**
Photosynthetic rate	0.864**	0.927**	0.968**	0.932**	0.702**	0.896**	0.869**	0.807**	0.78**	0.971**	0.871**	0.858**
Yield	0.775**	0.823**	0.79**	0.833**	0.563*	0.545*	0.642**	0.645**	0.655**	0.892**	0.936**	0.9**

* Significant at 5 per cent level **Significant at 1 per cent level