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Original Research Article

Light Response Curve of Mango (*Mangifera indica* L.) Cv. Alphonso under Cloudy and Sunny Conditions of Rainy Season of Konkan Agro-climatic Conditions

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A B S T R A C T

The present investigation entitled "Light response curve of mango (*Mangifera indica* L.) Cv. Alphonso" was conducted at Department of Horticulture, College of Agriculture, Dr. B.S.K.K.V. Dapoli. The experiment of light response curve was consists of 8 levels of light intensity as 8 treatments (250 PFD, 500 PFD, 750 PFD, 1000 PFD, 1250 PFD, 1500 PFD, 1750 PFD and 2000 PFD).In the light response curve, the light saturation point obtained for mango Cv. Alphonso was in between 750 – 1000 PFD i.e. T_4 (1000 PFD light intensity) in low light intensity in rainy season. In rainy season, the maximum stomatal conductance rate was (0.1232 µmol $H_2O/m^2/Sec$). Rate of photosynthesis was (8.67 µmol $CO_2/m^2/Sec$). Rate of transpiration was (3.49 µmol $H_2O/m^2/Sec$) obtained in T_4 (1000 PFD) under sunny condition in rainy season; where the average light intensity in rainy season was 780.37 PFD. The all physiological observations were 2 – 3 times less under cloudy condition in rainy season. Under cloudy condition of rainy season the maximum stomatal conductance rate was (0.0610 µmol $H_2O/m^2/Sec$). Rate of photosynthesis was (3.32 µmol $CO_2/m^2/Sec$). Rate of transpiration was (2.11 µmol $H_2O/m^2/Sec$) obtained in T_4 (1000 PFD) under sunny condition in rainy season; where the average light intensity in rainy season was 400.58PFD.

Keywords

Mango, Light saturation point, Photosynthesis, Alphonso, Light response curve

Introduction

Mango is tasted by all corners of world and rightly known as 'King of fruits' owing to its nutritional richness, unique taste, pleasant aroma and its religious and medicinal importance. India is the largest producer of mango in the world and ranks first in area and production. The total production of mango in India is 19.69 million MT from about 2.26 million ha area with the productivity of 8.7 MT/ha (Anon., 2017). Konkan region on the west coast of Maharashtra is one of the largest mango growing belts. Alphonso is

leading variety in Konkan region in terms of area and production; which is locally called as 'Hapus'. It thrives and yields early under warm and humid climate of Konkan region. Alphonso is considered as one of the choicest variety because of its earliness, keeping quality, typical sugar acid blend, aroma, processing potential and thus holding major share in export of fresh mangoes and mango pulp among the mango varieties from India. Konkan region receives 3000 to 4000 mm rainfall annually from June to September. Cloudy days during this period reduce the number of bright sunshine hours. The light intensity during rainy days is less than light saturation point required for optimum photosynthesis of mango (Burondkar *et al.*, 2012). This could be one of the reasons for less carbon assimilation leading to low productivity (Burondkar, 2015). However, in the recent years Konkan region is witnessing marked climatic aberrations during all the three seasons viz. monsoon, winter and summer season; such as abnormal rains, sudden fluctuations in the temperature, fog, cloudy days, etc. adversely affect the growth of mango trees causing morpho-physiological deviations. Thus to observed the response of mango Cv. Alphonso under rainy season of Konkanagro climatic conditions this experiment was conducted.

Materials and Methods

Present experiment was held at Department of Horticulture, Dr. B. S. K. K. V. Dapoli during rainy season. The experiment was conducted in randomized block design with different light intensities as treatments. There were eight light intensities viz. 2000 PFD, 1750 PFD, 1500 PFD, 1250PFD, 1000 PFD, 750PFD, 500 PFD and 250 PFD replicated thrice. Healthy one year old plants were selected having equal age, height, girth, leaves, shoots, and internodes. Rebagging of these plants was done. These plants transferred to 30 X 15 cm polythene bags containing potting mixture (top soil + FYM + Vermiphose) and then kept in greenhouse for a month for hardening. After one month hardening plants were taken out from greenhouse and arranged at 1m x 1m distance of spacing on experimental plot under open sky. All observations were taken by using IRGA machine (Portable photosynthesis system); the artificial light source (different light intensities) provided by IRGA. The observations taken at same time for 8 treatments on same leaf and were replicated 5 times. The light response curve was recorded under two conditions for each replication / each plant viz. one under cloudy condition and second under sunny condition (Fig. 1–3 and Table 1).

Results and Discussion

Stomatal conductance rate

The stomatal conductance rate lowest at less light intensity it slowly increased and reached at peak at light saturation point and then again decreased with increase in light intensity. It was lowest at highest and lowest at both extreme light intensities. Mean stomatal conductance rate was 0.0476 µ mol H_2O m^{-2} Sec^{-1}. The stomatal conductance rate was maximum in treatment T_4 (0.0610µ mol H_2Om^{-2} Sec^{-1}) (i.e. at 1000 PFD) followed by T_3 (0.0604) (i.e. 750 PFD) and T_5 (0.0537) (i.e. 1250 PFD); which were at par with each other. The lowest Stomatal conductance was found in T_8 (0.0326µ mol H_2Om^{-2} Sec^{-1}) (i.e. 2000 PFD), followed by T_7 (0.0394µ mol H_2Om^{-2} Sec^{-1}) (i.e. 1750 PFD); where the actual light intensity (PAR out value) available was 400.58 PFD. This was 2-3 time less than stomatal conductance in sunny day of rainy season when natural light intensity was more than light saturation point. Data showed that the maximum stomatal conductance rate was 0.1232 µ mol H_2O m^{-2}

Sec^{-1} and it was found in T4 (1000 PFD light intensity); Which was 2 times more than stomatal conductance rate observed in diffused light condition. This could be because of feedback photo inhibition (Gil Nir *et al.,* 1995 and Naom Adir *et al.,* 2003).

The rate of photosynthesis was less at low as well as at high light intensity. This attributed to less functioning of stomata (opening and closing) at extreme light intensities. At light saturation point rate of photosynthesis was maximum lead to maximum stomatal conductance rate.

Similar results were given by Pari *et al.,* (2007) in forest plant *Nothofagus*, Juntamanee *et al.,* (2013) in mango, Kurva M. (2015) in Mango and Kulkarni *et al.,* (2015) in Mango.

Rate of photosynthesis

Mean rate of photosynthesis obtained was 2.5977µ mol CO_2 m^{-2} Sec^{-1}. The rate of photosynthesis was increased up to the peak (1000 PFD light intensity) then it again decreased with increase in light intensity. The light saturation point for mango Cv. Alphonso recorded was between the range of 750 – 1000 PFD where the rate of photosynthesis was maximum. It was highest in treatment T4 (3.32 µ mol CO_2 m^{-2} Sec^{-1}) (i.e. 1000 PFD), followed by T3 (i.e. 750 PFD), T5 (1250 PFD), T2 (500 PFD), T6 (1500 PFD), T_7 (1750 PFD), T_8 (2000 PFD) which were at par with each other and lowest in T_1 (250 PFD), where the actual light intensity available was about 400.58 PFD. This rate of photosynthesis 2-3 times less than rate of photosynthesis in sunny days of rainy season; when natural light intensity more than light saturation point. The observations showed that maximum rate photosynthesis under sunny condition in rainy season was 8.67 µ mol CO_2 m^{-2} Sec^{-1} was also found in T4 (1000 PFD light intensity); which was 2 -3 times more than observed under low light condition. This could be because of feedback photo inhibition (Gil Nir *et al.,* 1995 and Naom Adir *et al.,* 2003).

The rate of photosynthesis was highest at light saturation point. At both conditions i.e. light intensity below and above light saturation point hampers the physicochemical activities in plant which affected rate of photosynthesis in plants.

Similar results were cited by Pari *et al.,* (2007) in forest plant *Nothofagus*, Juntamanee *et al.,* (2013) in mango, Kurva M. (2015) in mango and Kulkarni *et al.,* (2015) in mango.

Rate of transpiration

The rate of transpiration increased with increased in light intensity, but up to the light saturation point then after it was decreased. It was less at higher and lower light intensity and maximum at light saturation point. Mean of transpiration rate was 1.7834 µ mol H_2O m^{-2} Sec^{-1}. The rate of transpiration was maximum in treatment T_4 (2.1148µ mol H_2Om^{-2} Sec^{-1}) (i.e. 1000 PFD), followed by T_8 (i.e. 2000 PFD), T_3 (750 PFD), T_5 (1250 PFD), T_7 (1750 PFD), T_6 (1500 PFD) and T2 (500 PFD) which were at par with each other.

The lowest transpiration rate was found in T_8 (1.2710µ mol H_2Om^{-2} Sec^{-1}) (i.e. 250 PFD) where the actual light intensity available was 400.58 PFD. The light response curve for rate of transpiration in sunny days of rainy season, when natural light intensity more than light saturation point recorded maximum rate of transpiration was 3.92 µ mol H_2O m^{-2} Sec^{-1}, also found in T_4 (1000 PFD light intensity) which was two to three times more than rate of transpiration observed in diffused light condition in rainy season.

Table.1 Light response curve of mango (*Mangifera indica* L.) Cv. Alphonso under cloudy and sunny conditions of rainy season of Konkan agro-climatic conditions

Treatments	**Stomatal conductance rate**		**Rate of photosynthesis**		**Rate of transpiration**	
	($\mu molH_2O\ /m^2\ /Sec^1$)		($\mu molCO_2\ /m^2\ /Sec^1$)		($\mu molH_2O/m^2/Sec^1$)	
	Under cloudy condition of Rainy season	Under cloudy condition of Rainy season	Under cloudy condition of Rainy season	Under sunny condition of rainy season	Under sunny condition of rainy season	Under sunny condition of rainy season
T1 – 250 Photon flux density	0.0402	0.0537	1.52	3.99	1.271	1.529
T2 – 500 Photon flux density	0.0463	0.0930	2.65	7.48	1.502	2.837
T3 - 750 Photon flux density	0.0604	0.1152	3.30	8.59	1.919	3.021
T4 -1000 Photon flux density	**0.0610**	**0.1232**	**3.32**	**8.67**	**2.115**	**3.495**
T5 -1250 Photon flux density	0.0537	0.1014	2.96	6.80	1.876	3.145
T6 -1500 Photon flux density	0.0474	0.0926	2.51	5.91	1.717	2.952
T7 -1750 Photon flux density	0.0394	0.0830	2.28	6.06	1.798	2.644
T8 -2000 Photon flux density	0.0326	0.0606	2.24	8.12	2.069	2.462
Mean	0.0476	0.0903	2.60	6.95	1.783	2.760
S.Em±	0.0046	0.0016	0.43	0.04	0.217	0.005
C.D. at 5%	0.0133	0.0047	1.25	0.13	0.629	0.013

Fig.1

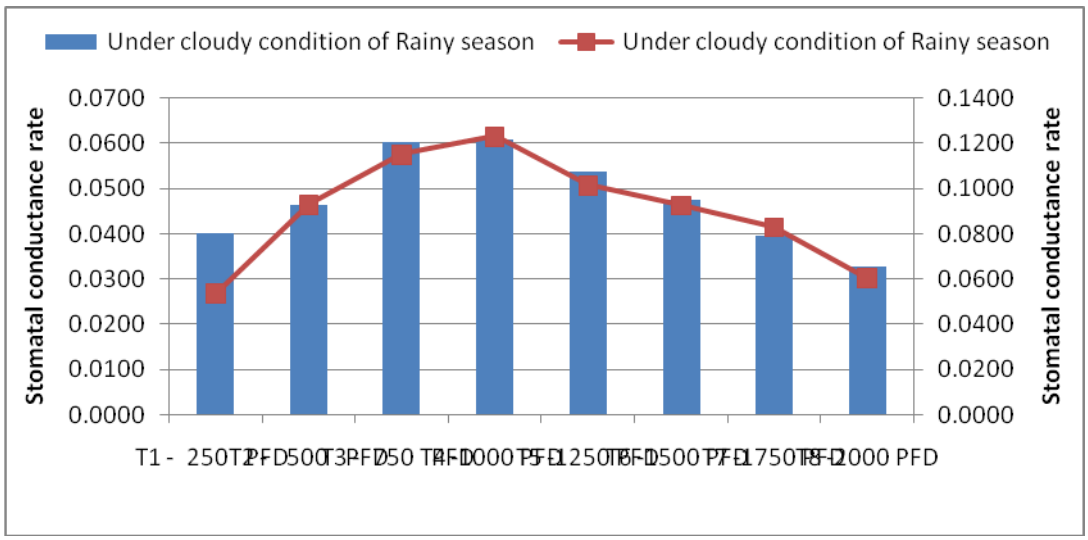

Under cloudy condition of Rainy season
Under cloudy condition of Rainy season
Stomatal conductance rate
Stomatal conductance rate
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
T1 - 250
T2 - PFD 500
T3 - PFD 750
T4 - PFD 1000
T5 - PFD 1250
T6 - PFD 1500
T7 - PFD 1750
T8 - PFD 2000 PFD

Fig.2

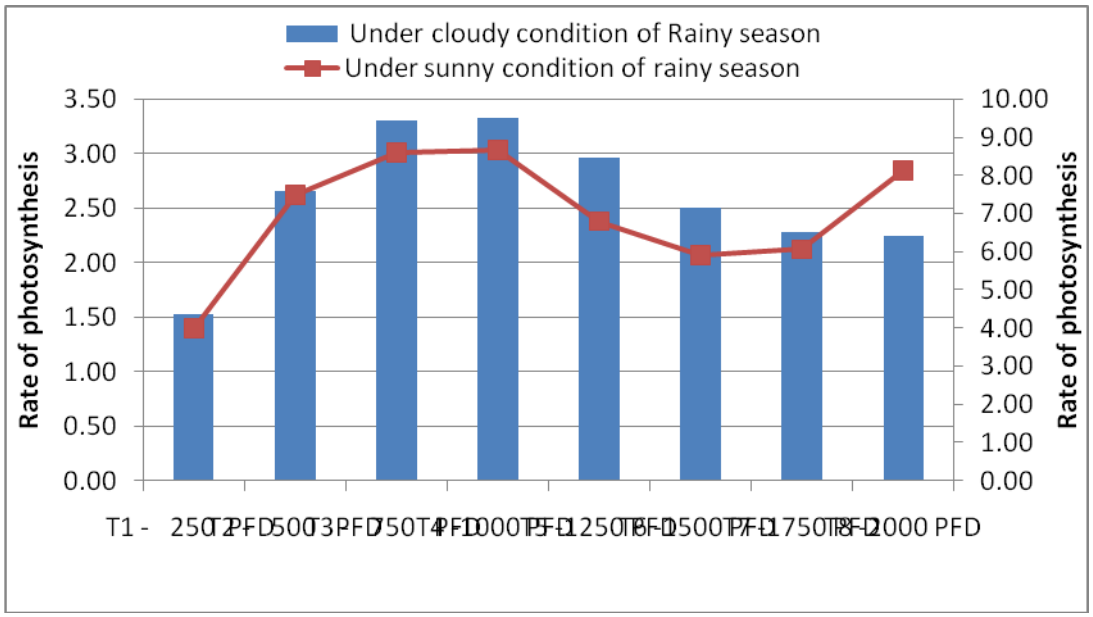
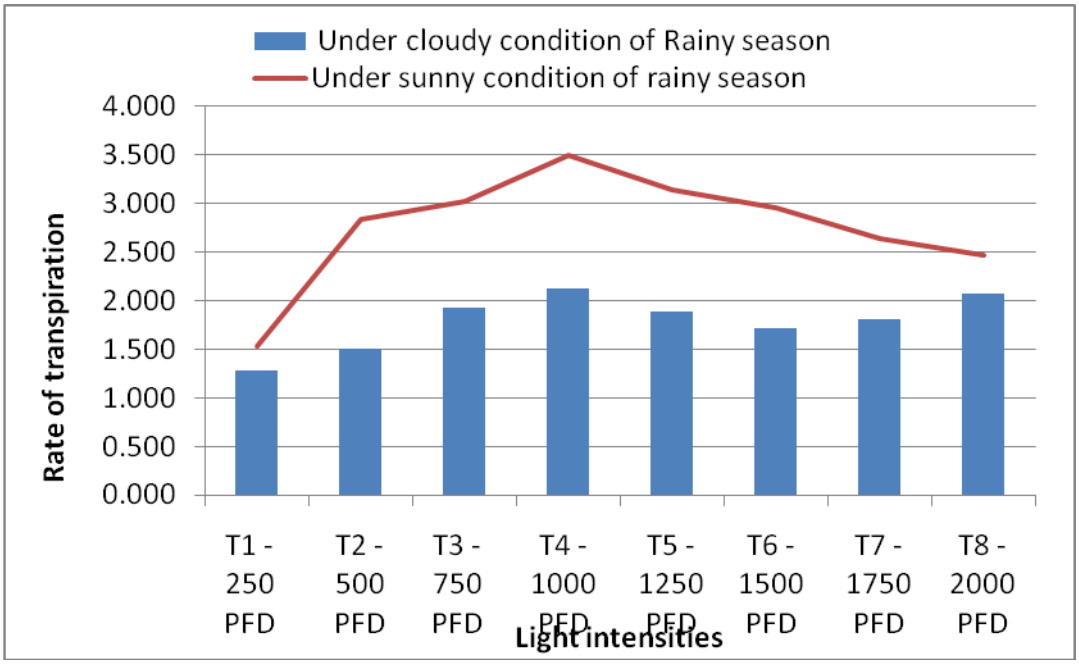

Under cloudy condition of Rainy season
Under sunny condition of rainy season
Rate of photosynthesis
Rate of photosynthesis
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
T1 - 250
T2 - PFD 500
T3 - PFD 750
T4 - PFD 1000
T5 - PFD 1250
T6 - PFD 1500
T7 - PFD 1750
T8 - PFD 2000 PFD

Fig.3



This may be because of feedback photo inhibition (Gil Nir *et al.,* 1995 and NaomAdir *et al.,* 2003).

The rate of transpiration was also, affected by change in light intensities. The at higher and lower light intensity physiological functioning was at low rate or stopped and there was less stomatal conductance resulted in low rate of photosynthesis at lower and higher light intensities, which leads to similar results in rate of transpiration.

In the present investigation the light saturation point (i.e. intensity of light at which rate of photosynthesis reaches at peak and then remain almost stagnate) was observed to be in between 750 PFD to 1000 PFD in mango Cv. Alphonso. Whereas the available light intensity during cloudy (non-sunny) days is also 200 to 400 PFD i.e. about 2-3 times less than the optimum light intensity required for the normal photosynthesis. Similar results recorded in present investigation were in agreement with the finding of Pari *et al.,* (2007) in forest plant *Nothofagus*, Juntamanee *et al.,* (2013) in mango, Kurva M. (2015) in mango and Kulkarni *et al.,* (2015) in Mango.

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