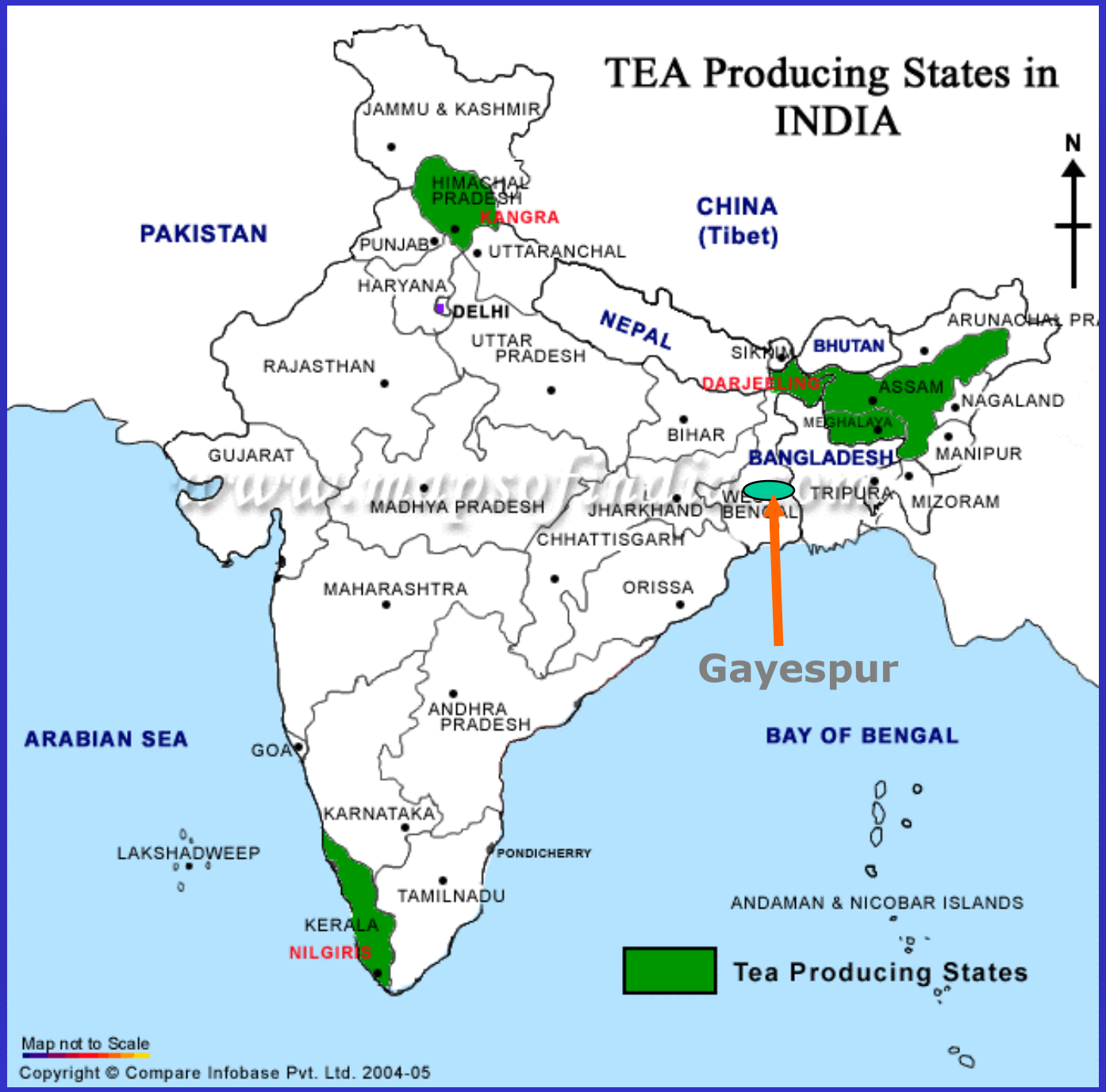
Microclimate study under agroforestry system and its impact on performance of tea

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TEA Producing States in INDIA
N
JAMMU & KASHMIR
HIMACHAL PRADESH
KANGRA
PAKISTAN
CHINA (Tibet)
PUNJAB
UTTARANCHAL
HARYANA
DELHI
NEPAL
UTTAR PRADESH
RAJASTHAN
SIKKIM
BHUTAN
ARUNACHAL PR
DARJEELING
ASSAM
NAGALAND
MEGHALAYA
BIHAR
GUJARAT
BANGLADESH
MANIPUR
TRIPURA
MIZORAM
MADHYA PRADESH
JHARKHAND
WEST BENGAL
CHHATTISGARH
MAHARASHTRA
ORISSA
Gayespur
ANDHRA PRADESH
ARABIAN SEA
BAY OF BENGAL
GOA
KARNATAKA
LAKSHADWEEP
PONDICHERRY
TAMILNADU
KERALA
NILGIRIS
ANDAMAN & NICOBAR ISLANDS
Tea Producing States
Map not to Scale
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Back ground

- Tea, a major commercial crop of India occupied 20 percent area of global cultivation and shared 28 percent of its production (Boriah, 2002).
- It is evident that photosynthesis of tea is decreased by strong solar radiation due to photoinhibition.
- Shade trees played an important role on micro climate around the tea canopy and thus influence overall performance of the crop.
- Impact of different shade trees on changes of microclimate under a particular agroclimatic region is still scare.
- Besides, information on seasonal variation of microclimate in relation to productivity is also important.

OBJECTIVES

To assess the microclimatological status under different shade trees.

To study the seasonal microclimatological variation under different shade trees.

To correlate modified microclimatic status with the productivity.

MATERIALS AND METHODS

Location: Lower Gangetic plain (Lat 22^0 $58^/$ N, Long 88^0 $31^/$ E, altitude 9.75 m amsl of W.B

Climate: Tropical sub-humid,

Maximum temperature: 25-36 ^{o}c Minimum temperature: 11-26 ^{o}c

Rainfall: 1450 mm

Mainplot treatments: 7 tree species viz:

Acacia auriculiformis, Casuarina equisetifolia, Dalbergia sissoo, Glyricidia sepium, Albizia lebbek, Gmelina arborea and *Eucalyptus hybrid*

Subplot treatments: **4 growing season** *viz,*

September seventh to October third (phase - I), October fourth to November thirteen (phase - II), November fourteenth to February twenty second (phase - III) and February twenty third to March thirteen (phase - IV).

Design: *Split – plot*

Observations: *Net radiation, photosynthetic active radiation, atmospheric temperature, relative humidity, soil temperature and biomass of tea leaves*



Plate: The study site at a glance



Plate: Close view of the tea crop



Plate: Point quantum sensor, thermometers



Plate: Above instruments are in use



Plate: Net radiometer is in use

RESULTS

Table 1 Impact of shade trees on different micrometeorological parameters at 09 hours

Treatments	R_n (w m^{-2})	IPAR (μ E $m^{-2}s^{-1}$)	AT (^{o}c)	RH (%)	ST-15 (^{o}c)
Trees					
Acacia	77.3	154.0	25.9	87.8	23.0
Casuarina	79.9	204.7	26.5	77.9	22.6
Glyricidia	94.6	156.8	26.1	85.9	22.5
Eucalyptus	74.0	165.5	26.3	84.7	22.7
Albizia	79.1	166.3	26.1	84.0	22.2
Dalbergia	101.0	219.8	26.1	84.9	22.5
Gmelina	90.4	147.8	26.1	87.0	22.8
Open	220.2	579.5	28.4	81.4	25.0
CD(P=0.05)	13.2	33.6	NS	NS	0.36
Phase (P)					
Phase I	63.8	187.5	29.8	86.7	25.3
Phase II	51.0	179.4	28.8	89.0	23.7
Phase III	101.3	144.4	18.7	82.7	16.5
Phase IV	124.6	183.1	27.3	80.1	25.0
CD(P=0.05)	8.6	34.3	0.22	5.9	0.27

R_n- net radiation, IPAR- Incident photosynthetic active radiation, AT-Atmospheric temperature, RH- relative humidity,ST-15 soil temperature at 15 cm depth

Table 2 Impact of shade trees on different micrometeorological parameters at 13 hours

Treatments	R_n (w m^{-2})	IPAR (μ E $m^{-2}s^{-1}$)	AT (^{o}c)	RH (%)	ST-15 (^{o}c)
Tree					
Acacia	190.4	398.1	30.3	75.8	26.7
Casuarina	**200.3**	399.1	30.2	76.0	26.2
Glyricidia	150.1	321.4	29.9	77.3	26.0
Eucalyptus	161.0	380.8	30.2	74.4	26.3
Albizia	**144.6**	**271.8**	29.9	75.6	25.9
Dalbergia	179.7	**518.5**	30.1	77.1	26.5
Gmelina	161.2	319.0	30.4	75.9	26.6
Open	**407.9**	**1000.3**	**32.4**	**68.5**	**30.8**
CD(P=0.05)	**22.6**	**170.0**	**NS**	**NS**	**0.39**
Phase (P)					
Phase I	152.5	460.3	32.0	81.2	29.4
Phase II	**113.5**	**266.8**	30.2	83.3	25.8
Phase III	179.2	297.4	23.7	65.8	20.7
Phase IV	**233.3**	**466.2**	**34.7**	73.7	29.4
CD(P=0.05)	**14.3**	**143.7**	**0.36**	**1.56**	**0.45**

R_n- net radiation, IPAR- Incident photosynthetic active radiation, AT-Atmospheric temperature, RH- relative humidity,ST-15 soil temperature at 15 cm depth

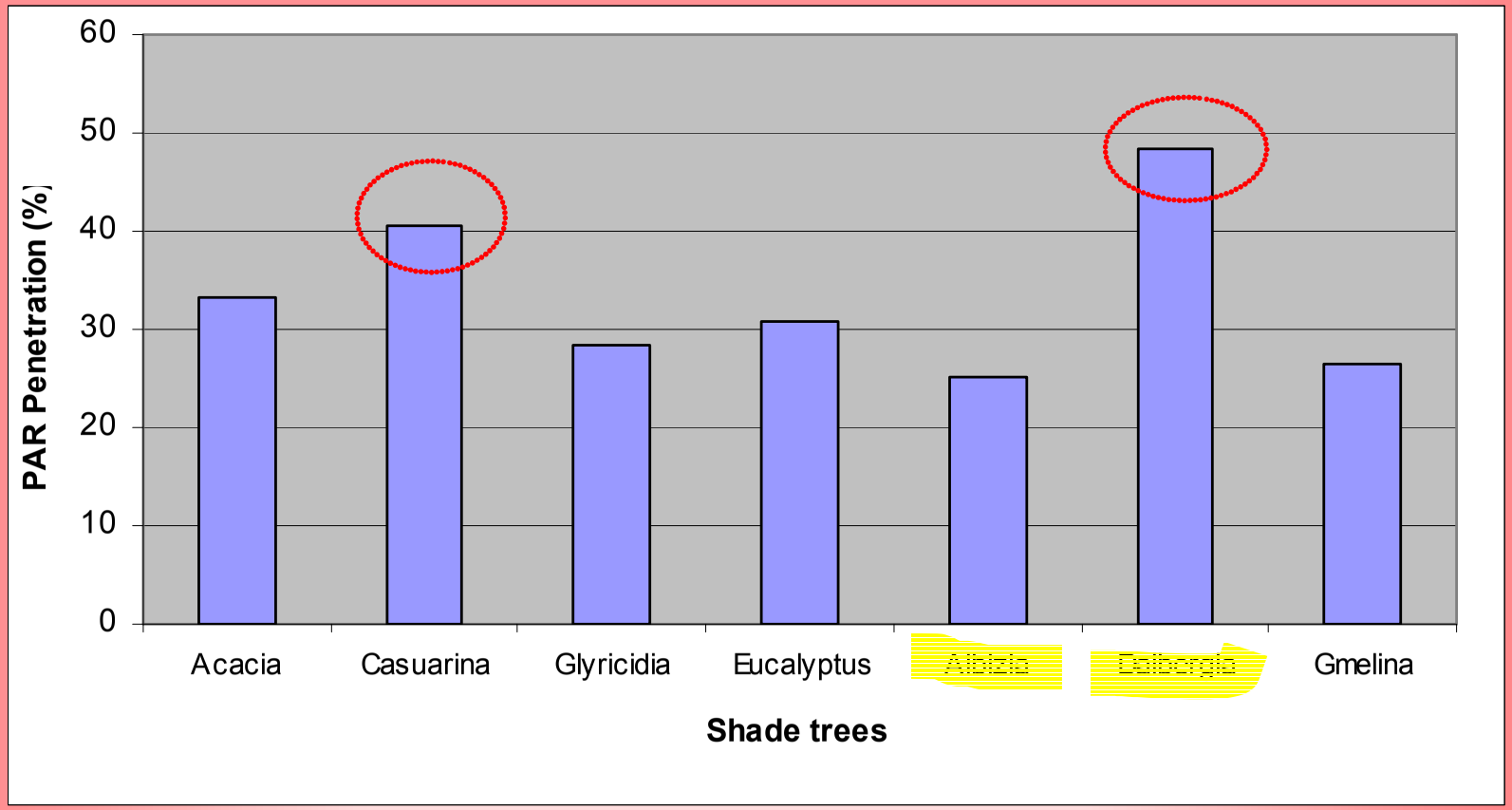


Fig 1 Penetration of PAR through different shade tree



Acacia

Sparse canopy allow more radiation to penetrate



Casuarina



Eucalyptus

Dense canopy allow low radiation to penetrate



Albizia

Table 3 Absorbed photosynthetic active radiation ($\mu Em^{-2}s^{-1}$) by tea canopy

Shade trees	P-1	P-II	P-III	P-IV	Mean
Acacia	80.1	58.4	43.6	78.2	
Casuarina	84.4	53.9	46.0	77.0	
Glyricidia	72.6	48.2	37.4	54.8	53.2
Eucalyptus	65.7	41.1	37.7	63.4	51.9
Albizia	62.7	40.5	34.9	50.5	47.1
Dalbergia	82.9	60.4	42.9	71.1	
Gmelina	61.6	44.0	36.6	53.8	49.0

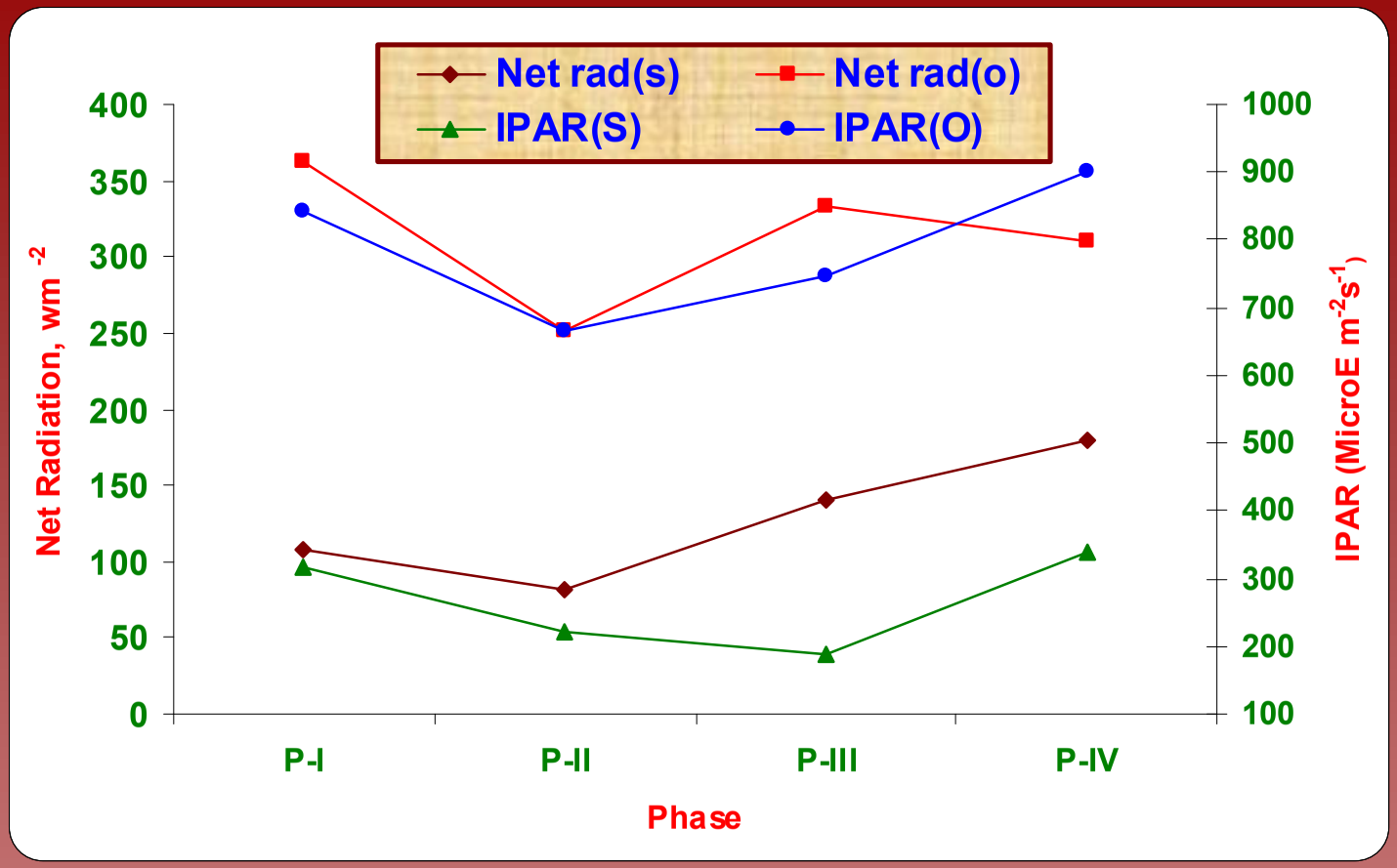


Fig2. Comparison of net radiation and incident photosynthetic active radiation in open and shaded condition throughout the experimental period

[(S)=shaded condition, (O)=open condition]

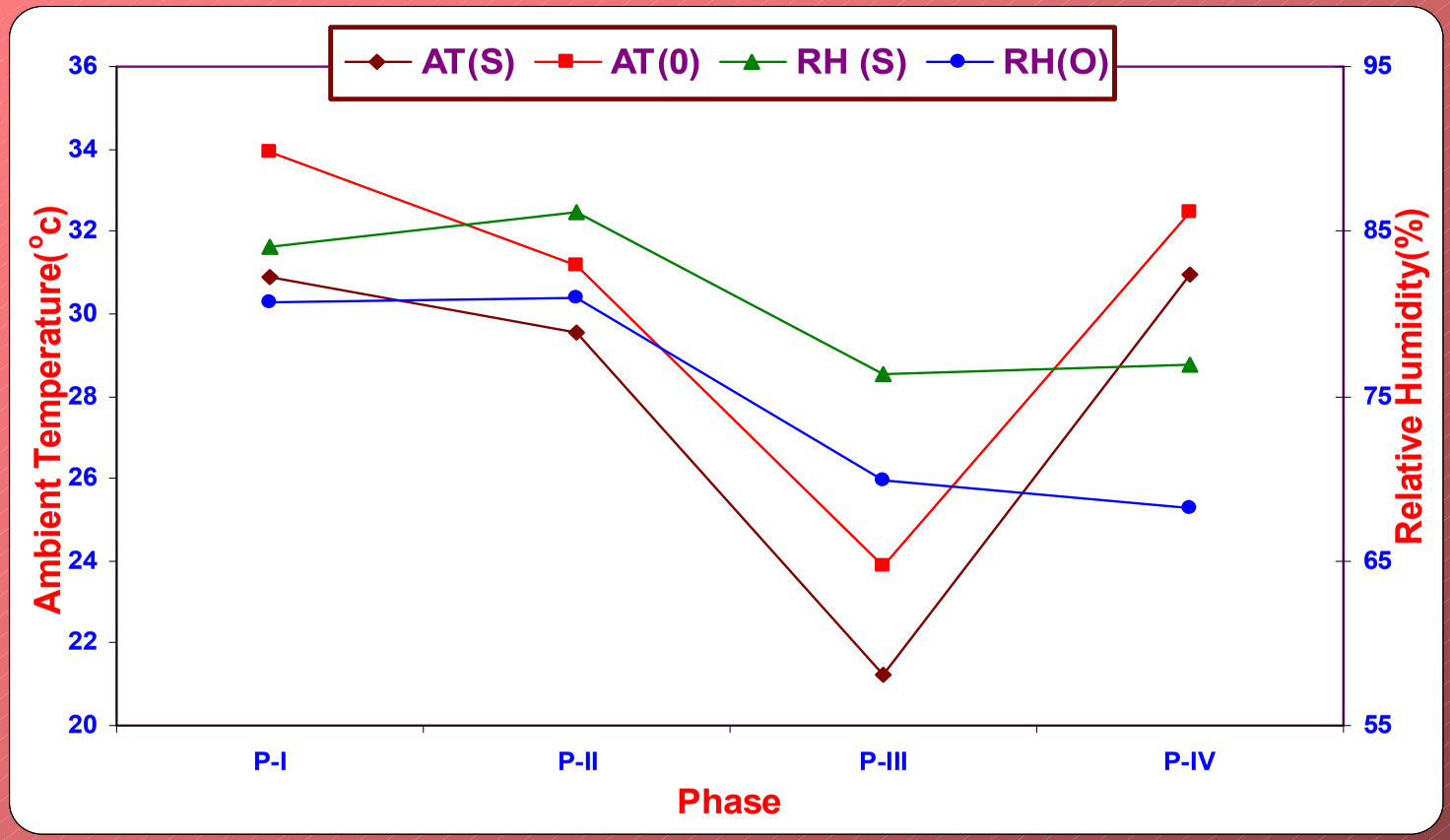


Fig3.Comparison of Atmospheric temperature and relative humidity in open and shaded condition throughout the experimental period

[(S)=shaded condition, (O)=open condition]

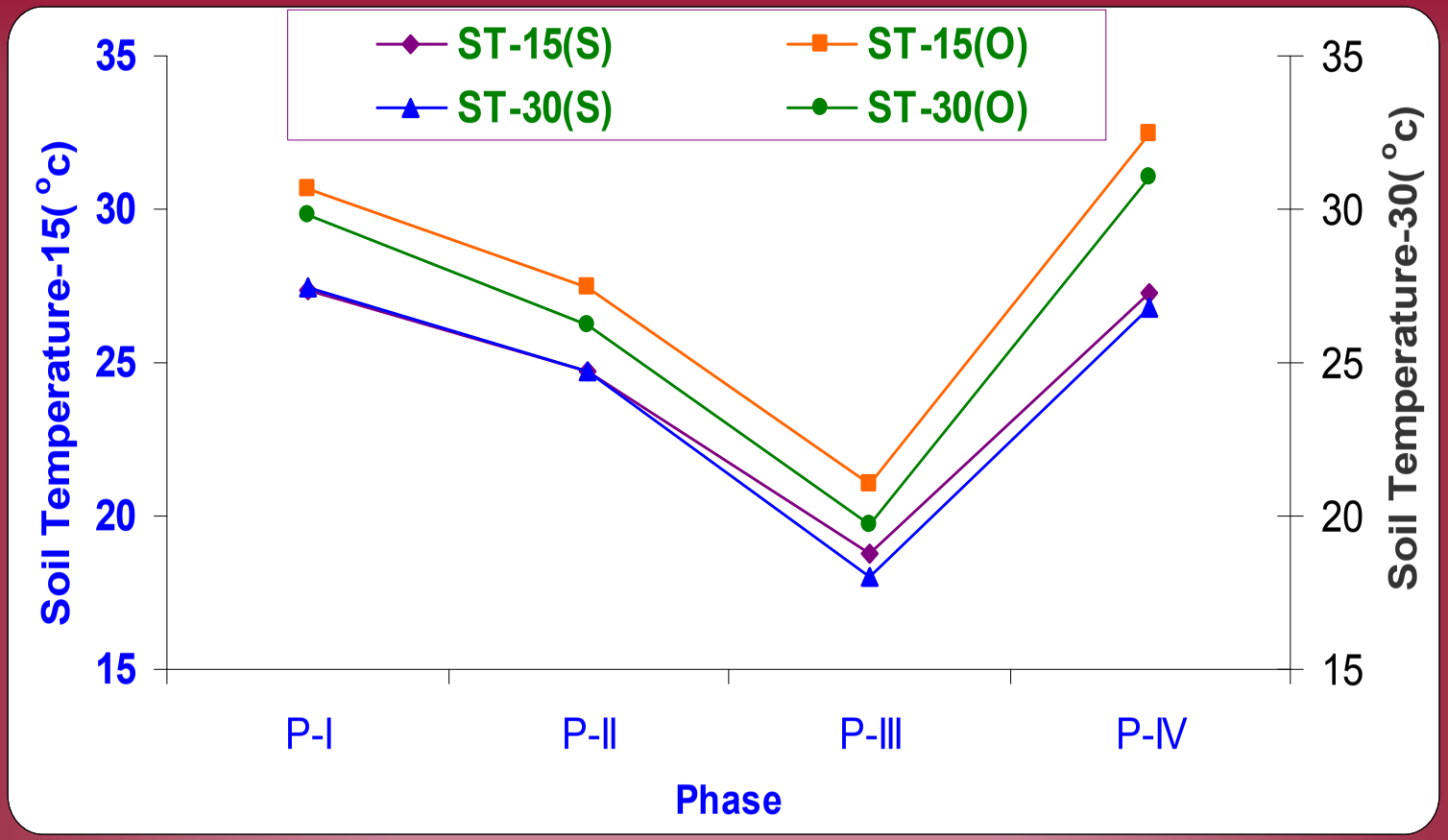


Fig3. Comparison of soil temperatures in open and shaded condition throughout the experimental period

[(S)=shaded condition, (O)=open condition]

Table 4. Impact of shade trees on dry leaf weight (Kg ha^{-1}) of tea at different growing periods.

Shade tree species	P-1	P-II	P-III	P-IV	Total
Acacia	135.3	54.2	85.3	120.1	395
Casuarina	132.7	30.8	98.5	65.0	327
Glyricidia	074.3	36.9	69.4	91.1	272
Eucalyptus	113.6	47.8	99.6	91.8	353
Albizia	084.3	69.3	85.9	108.9	348
Dalbergia	117.5	70.4	131.9	78.3	398
Gmelina	111.6	43.4	114.8	92.0	362
Mean	109.9	50.4	97.9	92.5	
	S Em ±		LSD (P = 0.05)		
Shade(S)	5.82		17.34		
Phase(P)	3.22		9.18		
S x P	8.51		24.29		

Table 5. Simple linear regression equation of different meteorological parameters on yield of tea

Regression equation	Correlation Coefficient	probability
Yield = 0.299 NR + 31.19	0.484	0.009
Yield = 0.6 APAR +31.08	0.606	0.001
Yield = - 4.05 RH +428.09	-0.493	0.008
Yield = 4.23 ST_{15} -31.70	0.510	0.005

Multiple Regression Equation

Y= 942.772 - 1.4 Rn (9) + 1.5 Rn (13) - 1.3 APAR (9) +0.59 APAR (13) - 12.4 RH(9) + 6 .3 RH (13) -11.3AT (9) - 75.6 AT (13) - 29.4 ST 15(9) -71.7 ST 15 (13) - 55.3 ST 30 (9) - 6.07 ST 30(13)

CONCLUSION

- **Crop under *Dalbergia* received maximum net and photosynthetic active radiation and yield was also at highest level.**
- **Both atmospheric and soil temperature lowered down by 2– 4 ^{0}c under shade trees as compared to open condition.**
- **Relative humidity was higher 3-8 % under tree shades than the open condition.**

Future scope

- Such study should be carried long term basis so that impact of position of sun and bright sunshine hours on changes in micrometeorological environment of the tea garden under shade trees can perfectly be evaluated.
- Measurement of transpiration rate from tea crop will give better idea on effect of microclimatic variation on transpiration status of the crop.
- Photosynthetic rate of the crop can be measured with the help of portable photosynthesis system to correlate it with the photosynthetically active radiation.

Thank you

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