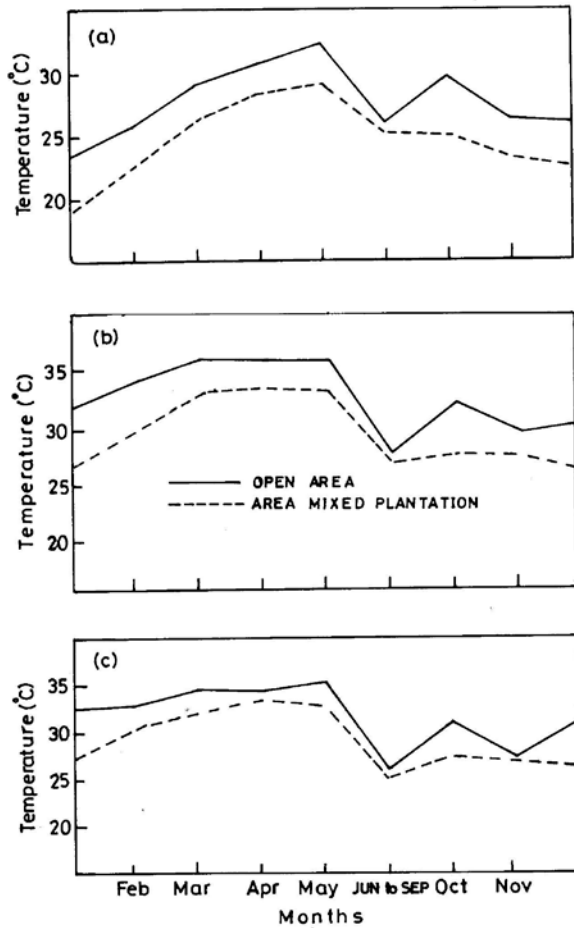


551.5 : 63

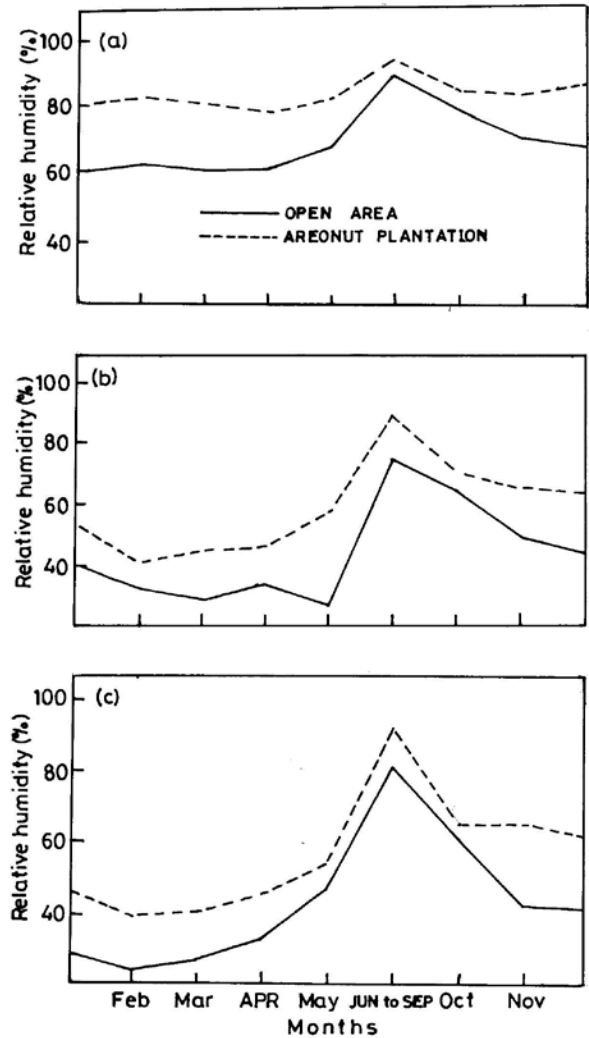
INFLUENCE OF ARECANUT BASED MIXED CROPPING (IRRIGATED) SYSTEMS ON TEMPERATURE AND HUMIDITY OF A PLANTATION MICROCLIMATE

1. Growing of perennials *viz.*, black pepper, banana, cocoa, cardamom, betelvine, citrus *etc.*, in the inter space of plantation crops like arecanut is referred as mixed cropping. The microclimate developed due to these crop combinations shows considerable difference with respect to air temperature and humidity. Modifying effects due to crop combination or plant communities on local climate is reported by Aiyer (1949). Monteith *et al.* (1981) emphasized the importance of quantifying the changes in microclimate of a mixed plantation. Temperature and humidity inside crop environment shows deviations than that of open space (Ramdas, 1960). The present study was undertaken to characterize the microclimate of arecanut based mixed plantation (irrigated) in respect of air temperature and relative humidity.

2. Observations on air temperature and relative humidity in arecanut based mixed crop combination were recorded during 1995 in an established plantations at Ashisara and Hulgol villages of Sirsi (14.60° N, 74.83° E, 619 m), Uttara Kannada (district) in Karnataka. Sirsi is situated under hill zone receiving an annual rainfall of 2500 mm distributed from June to September with a peak during July and August. The mixed plantation under study consisted of arecanut as main crop spaced at 2.7 m × 2.7m and associated crops were cardamom, black pepper, cocoa and banana. Observations were recorded on air temperature and relative humidity in open area and in arecanut based mixed plantations. Air temperature was recorded at the surface and at 1.20 m height by using N₂ filled 76 mm immersion Zeal thermometer of 0 to 50° C range. Time of recording temperature was between 0900 and 0930 hr IST, 1200 and 1230 hr IST, 1500 and 1530 hr IST at fortnightly intervals both in open area and in arecanut based mixed plantation and monthly mean was worked out. However, air temperature recorded during monsoon (June to September) did not show much variation and hence mean of monsoon temperature is



Figs. 1(a-c). Mean air temperature in open area and in mixed arecanut plantation (irrigated) during 1995 (a) 0900 to 0930, (b) 1200 to 1230 & (c) 1500 to 1530 hrs (IST)



Figs. 2(a-c). Relative humidity in open and in mixed arecanut plantation during 1995 (a) 0900 to 0930, (b) 1200 to 1230 & (c) 1500 to 1530 hrs (IST)

presented. A thick paper was covered at 30 cm above the thermometer bulb whenever there was direct solar radiation falling on the bulb (Ghadekar, 1995). The lapse rate of air temperature was calculated in both open area and arecanut based mixed plantation.

Whirling psychrometer with the range of -5°C to 50°C was used to record relative humidity in both open area and mixed plantation of arecanut. Relative humidity was recorded between 0900 and 0930 hr IST, 1200 and 1230 hours IST and 1500 and 1530 hr IST to work out monthly mean except for monsoon (June to September).

3. Plantation microclimate is characterized in the present study by quantifying the extent of reduction in air

temperature and increase in relative humidity of plantation microclimate during different season of a year in comparison with non-cropped area.

3.1. *Air temperature* - Mean air temperature in open area and in a mixed arecanut plantation (irrigated) is presented in Table 1 and Fig. 1. Though there was general decrease in plantation temperature all round the year, the difference between open and plantation was higher during summer months when compared to monsoon (June to September). Lapse condition (negative lapse rate) was observed in the open throughout the year. It was interesting to observe slight inversion in plantation temperature except during May (pre monsoon), June to September (monsoon) and October (post monsoon)

TABLE 1

Mean air temperature (°C) in open area and in a mixed arecanut plantation at ground surface and at 1.2 m height

Month	Time (hr IST)	Open area				Lapse rate (°C/m)	Arecanut mixed plantation				Lapse rate (°C/m)
		Surface (0 m ht)	1.2 m ht	Mean max. temp.	Mean min. temp.		Surface (0 m ht)	1.2 m ht	Mean max. temp.	Mean min. temp.	
January	0900-0930	23.7	23.2			-0.42	19.0	19.2			+0.17
	1200-1230	32.9	30.5	33.0	12.0	-2.00	26.4	26.6	29.5	11.5	+0.17
	1500-1530	33.3	31.7			-0.88	27.1	27.3			+0.17
February	0900-0930	26.3	25.3			-0.83	22.3	22.6			+0.25
	1200-1230	35.2	32.7	36.0	11.0	-2.08	29.1	30.1	32.5	11.0	+0.83
	1500-1530	34.2	31.4			-2.33	29.7	30.9			+1.00
March	0900-0930	30.0	28.0			-1.67	26.1	26.3			+0.17
	1200-1230	37.0	34.5	37.0	19.0	-2.08	32.7	33.1	33.5	18.0	+0.33
	1500-1530	36.0	33.0			-2.50	32.0	32.4			+0.33
April	0900-0930	31.6	29.3			-1.92	28.0	28.4			+0.33
	1200-1230	36.9	34.4	38.5	23.0	-2.09	33.1	33.5	35.0	22.5	+0.16
	1500-1530	35.6	33.1			-2.09	33.6	33.4			-0.17
May	0900-0930	32.5	31.3			-1.00	29.0	28.8			-0.17
	1200-1230	36.5	34.8	39.5	25.5	-1.42	33.1	32.9	35.5	22.0	-0.17
	1500-1530	36.3	34.3			-1.67	33.1	32.6			-0.42
June to	0900-0930	26.0	25.5			-0.42	25.0	24.8			-0.17
September	1200-1230	28.5	27.1	28.0	18.63	-1.17	26.9	26.8	26.8	17.5	-0.08
	1500-1530	26.5	25.9			-0.60	25.4	25.1			-0.25
October	0900-0930	29.7	28.8			-0.75	24.6	24.5			-0.08
	1200-1230	32.7	31.5	32.5	20.0	-1.00	27.8	27.3	29.0	19.0	-0.42
	1500-1530	31.5	30.7			-0.67	27.7	27.5			-0.17
November	0900-0930	26.4	25.3			-0.92	22.6	23.1			-0.42
	1200-1230	30.1	29.1	33.0	16.0	-0.83	27.2	27.7	29.5	15.0	+0.42
	1500-1530	28.8	26.2			-2.17	27.0	27.1			+0.08
December	0900-0930	26.1	25.1			-0.83	21.8	22.1			+0.25
	1200-1230	31.1	29.5	33.5	14.0	-1.30	26.0	26.4	28.5	13.0	+0.33
	1500-1530	32.0	30.5			-1.25	26.3	26.4			+0.08

months. Lapse condition observed in open temperature was more during summer months of February through May while, inversion observed in plantation microclimate was not higher than one degree Celsius per meter height throughout the summer. The slight inversion and lapse conditions in a temperature of a plantation microclimate indicate stability of air temperature. Kakade (1985) also reported that, in irrigated crops low temperature exists near the ground and temperature rises with height indicating inversion. Near the ground level temperature is

low and relative humidity is high in the cropped land and both are high and drop rapidly (lapse condition as observed in the present study) in bare land. Nair and Balakrishnan (1976) also reported that, coconut grown in combination with cocoa reduces the evaporation from the area and make the environment within the crop mix cooler.

Mean maximum temperature in open varied from 39.5° C during May to 26.5° C during July while in

arecanut plantation it ranged between 35.5° C during May and 25.5° C during July. Minimum air temperature of arecanut plantation did not show much variation. Mean maximum air temperature in open was higher than 32.5° C throughout the year except during monsoon (June - September), while in arecanut plantation it was higher than 30° C only from February to May. Mean minimum temperature in open varied from 11° C during February to 25.5° C during May. In arecanut plantation the lowest minimum air temperature was recorded during February (11° C) and the highest was during April (22.5° C). It is reported that in a forest microclimate there is usually reduction in maxima and an increase in minima of air temperature and winter temperature in the forest does not differ appreciably from that in the open (FAO, 1962). Nair and Balakrishnan (1977) also reported that, maximum temperatures in open area was higher compared to corresponding temperature recorded in mixed plantation of coconut and cocoa.

3.2. *Relative humidity* - Relative humidity in open area and in arecanut based mixed plantation temperatures is depicted in Fig. 2. The vegetative cover has modified microclimate by increasing relative humidity. Observations in the present study clearly revealed that, relative humidity in a mixed arecanut plantation was higher than that in open throughout the year. Relative humidity between 1500 to 1530 hr IST was higher than that of 1200 to 1230 hr IST only during monsoon months in both open area and arecanut plantations and there was slight decrease in relative humidity during remaining part of the year. Nair and Balakrishnan (1977) reported that, in the afternoon particularly during November to January when the relative humidity in the open area was low, the microclimate of coconut or coconut + cocoa plantation was more humid than open. Bhat (1983) also obtained a lower relative humidity in the afternoon than in the forenoon and opined that, mixed crop of arecanut and cocoa has influenced to a considerable degree in bringing down the difference. In the present study relative humidity of arecanut based mixed plantation in the morning (0900 to 0930 hr IST) was 80 % and high throughout the year, except in April (77%).

References

- Aiyer, A.K. Y.N., 1949, "Mixed cropping in India", *Indian J. Agric. Sci.*, **19**, 439-543.
- Bhat, K.S., 1983, "Plant interactions in a mixed cropping community of arecanut (*Areca catechu* L.) and cocoa", Ph. D. Thesis, Univ. of Mysore, Karnataka, p159.
- FAO., 1962, "Forest influences- An introduction to ecological forestry, FAO, Food and Agricultural Organization", Forest Series No.- 9, 7-26.
- Ghadekar, S.R., 1995, *Meteorology*, Agrimet. Publishers, Nagpur - 10, Maharashtra , p140.
- Kakade, J.R., 1985, "Agricultural Climatology", Metropolitan Book Pvt. Ltd., New Delhi, p385.
- Monteith, J. L., Gregory, P. I., Marshall, B., Ong, C.K., Safiell, R. A. and Squire, G.R., 1981, "Physical measurements in crop physiology - I ; Growth and gas exchange", *Expt. Agric.*, **17**, 113 - 126.
- Nair, P. K. R. and Balakrishnan, T.K., 1976, "Pattern of light interception by canopies of coconut + cocoa crop combination," *Indian J. Agric. Sci.*, **46**, 453-461.
- Nair, P.K.R. and Balakrishnan, J. K., 1977, "Ecoclimate of coconut + cocoa crop combination on the west coast of India", *Agric. Meteorology*, **18**, 455 - 462.
- Ramdas, L. A., 1960, "Crops and weather in India", Indian Council of Agricultural Research, New Delhi, p127.

N. K. HEGDE*
G. S. SULIKERI**
B. P. RATNAM**

* *K. R. C. College of Horticulture,
Arabhavi -591 310, Karnataka*
** *College of Agriculture,
University of Agricultural Sciences,
Dharwad- 580 005, Karnataka*

29 March 2000, Modified 12 July 2001