

Microclimatic profiles in soybean- pearl millet intercropping systems

MOHAMMAD SHAMIM*, RAJ SINGH, V.U.M.RAO and DIWAN SINGH

Department of Agricultural Meteorology
CCS Haryana Agricultural University, Hisar-125 004, Haryana

ABSTRACT

A field experiment was conducted during *kharif* season of 2003-2004 at research farm of department of Agril Meteorology, CCS HAU, Hisar located at 29°10'2 N lat 75°46'2 E. long and 215.2 m above the MSL. The experiment comprising eight treatments was laid out in a RBD with three replications. The crop was sown as rain fed in the last week of June. The temperature and relative humidity profiles were measured at four phenophases using Assmann's psychrometer. Air temperature profiles in all treatments were inverse throughout the day in comparison to the bare field. Relative humidity was higher in the crop canopy than above crop canopy in all the treatments but after harvest of pearl millet, the slope was less than that in the earlier growth phase. Leaf area index, dry biomass accumulation, test weight, yield and harvest index were reported for all the treatments.

Key words: Microclimate, bare soil, intercropping

Oilseeds form the second largest agricultural commodity after cereals in India, sharing 14 per cent of the country's gross cropped area and accounting for nearly 5 per cent of the gross national product and 10 per cent of value of agricultural products. India ranks fifth in the world in soybean production (50.9 lakh tones), however productivity in India (1008 kg ha⁻¹) is one of the lowest compared to 2140 kg ha⁻¹ in the world (Hegde2000). The microclimate of the crop is primarily determined by the manner in which radiant energy is portioned into different fluxes. Microclimatic profiles in soybean sole and intercropped with pearl millet under different planting systems are reported.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2003-2004 at research farm of department of Agril. Meteorology, CCS HAU, Hisar located at 29°10' N lat, 75°46' E long. and 215.2 m above MSL. The experiment comprised of eight treatments viz. T₁ (soybean sole), T₂ (pearl millet sole), T₃ (soybean paired row), T₄ (soybean + pearl millet; 2:1), T₅ (soybean + pearl millet; 3:1), T₆ (soybean + pearl millet, 4:1) T₇ (soybean paired row + pearl

millet, 2:1), and T₈ (soybean + pearl millet, 4:2) and was laid out in a randomized block design with three replications. The crops (rainfed) were sown in the last week of June.

Dry and wet bulb temperatures were measured at different phenophases from 0800 to 1600 hours at ground, 50, 100, and 200 cm height using hand held clock spring type Assmann's psychrometer. The relative humidity was calculated using psychrometric table. The temperature and relative humidity profiles were drawn for four phenological stages of the crop to reflect the crop microclimate.

Three randomly selected plants from each plot were cut from the surface and leaves were removed for recording leaf area by leaf area meter (LICOR 3000) and leaf area index was calculated. The same plants along with pods were also used for dry matter observation. Sun dried samples were dried in oven at 70°C temperature till constant weight was attained and expressed as mean dry weight (g plant⁻¹). The plants per square meter, pods per plant, seed per pod, grain yield (kg ha⁻¹), test weight of soybean (100 seeds) and Pearl millet (1000 seeds) were recorded at the time of harvest.

*Present address: Dept. of Agril. Meteorology, BACA, AAU, Anand - 388 110.

Fig. 1 : Temperature (upper) and relative humidity (lower) profile of various sole / intercropping system and bare field at vegetative growth stage of soybean and initiation of flowering in Pear millet

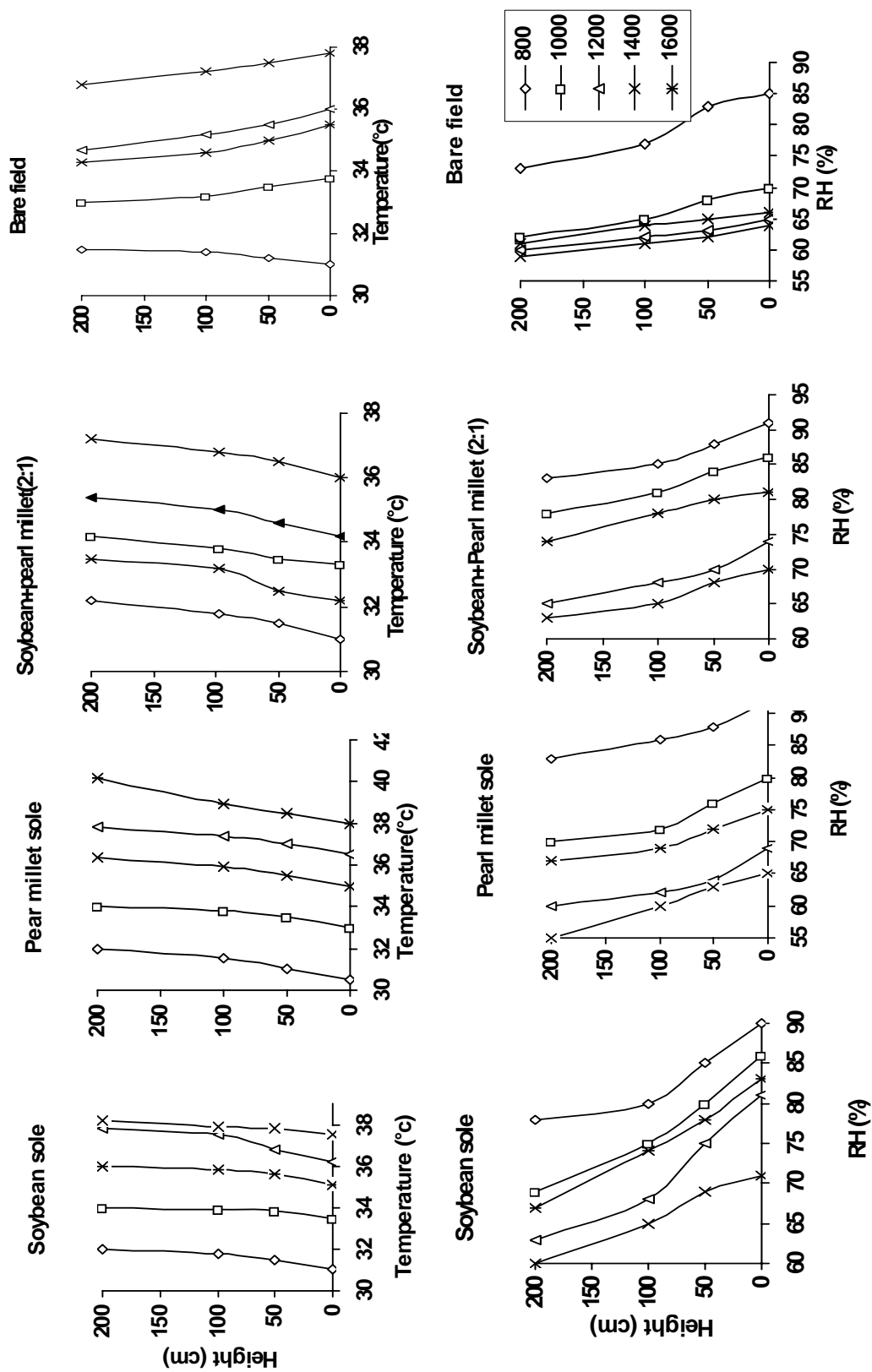


Fig. 2 : Temperature (upper) and relative humidity (lower) profile of various sole / intercropping system and bare field at initiation of flowering of soybean and end of flowering of Pearl millet

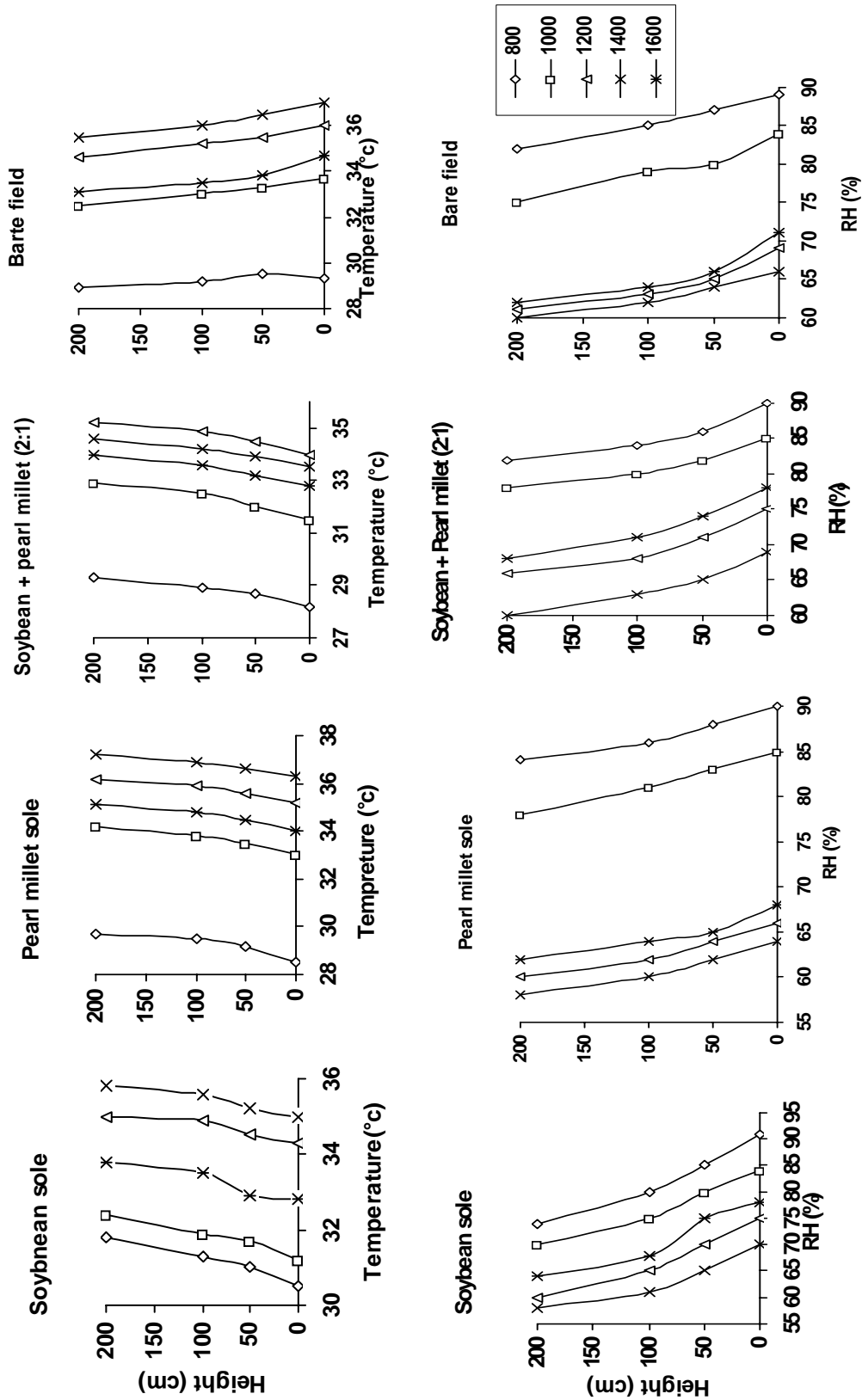
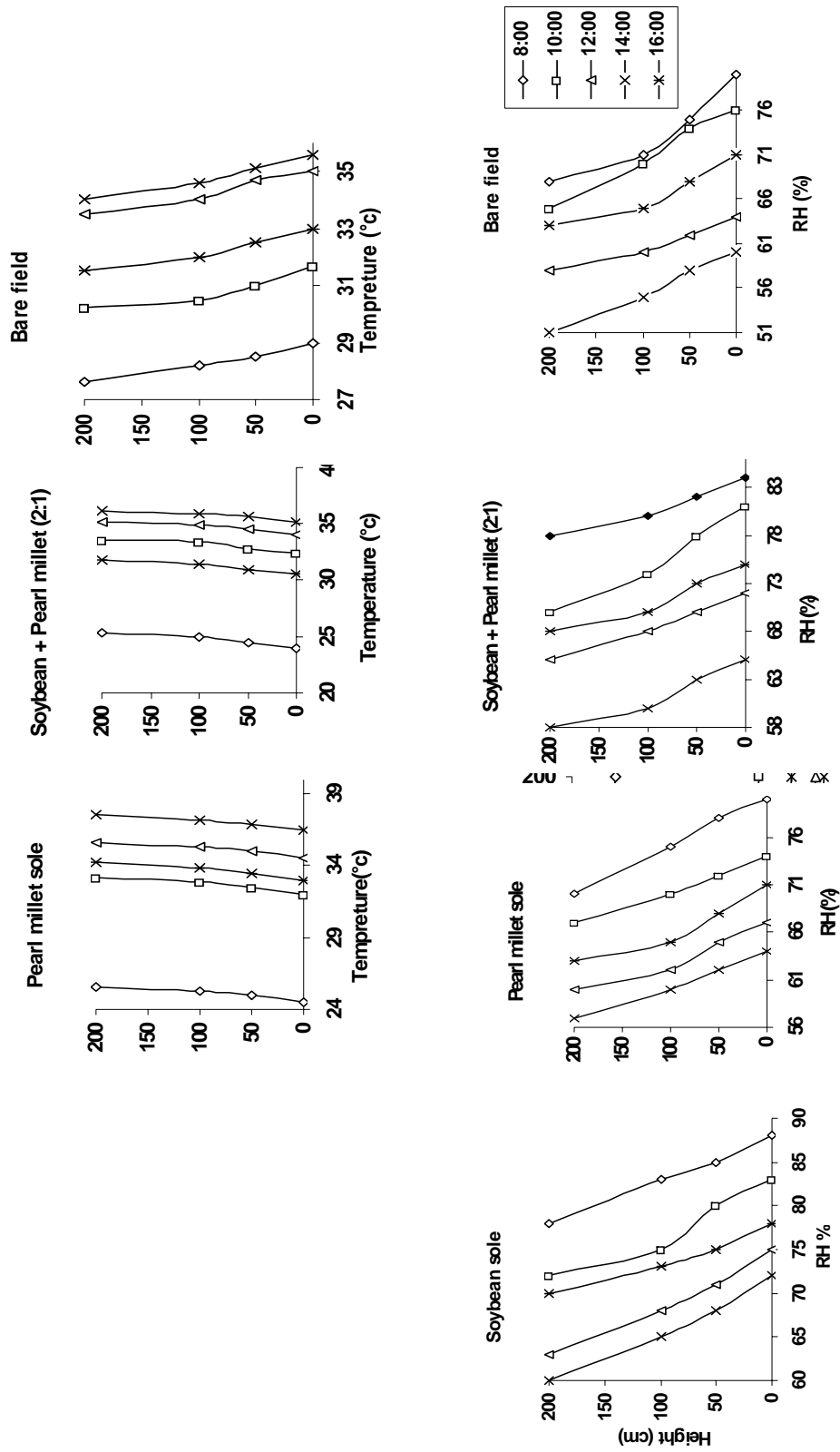


Fig. 3 : Temperature (upper) and relative (lower) humidity profile of various sole / intercropping system and bare field at end of flowering of soybean and physiological maturity of Pearl millet



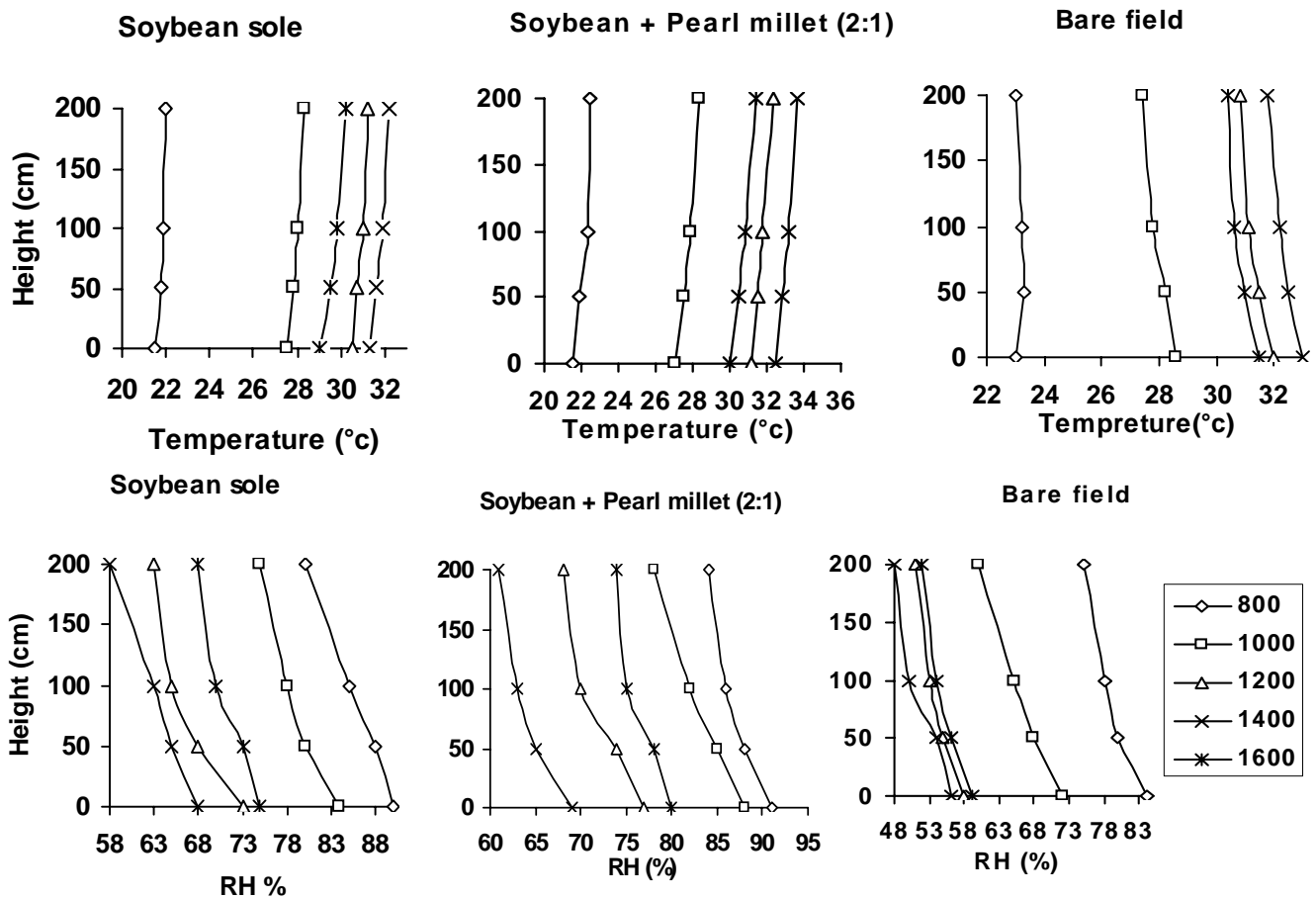


Fig. 4 : Temperature (upper) and relative (lower) humidity profile of various sole / intercropping system and bare field at physiological maturity of soybean

RESULTS AND DISCUSSION

Temperature profiles

The microclimate of crop stands was largely influenced by air temperature within and above the canopy temperature profiles were drawn at four phenophases depicted in figure 1 to 4 (upper). At all phases the profiles indicated that temperature inside the canopy was lower than that above the canopy in all the treatments (i.e. temperature profiles showed an inversion throughout the day) But slope of the air temperature profiles was greater at vegetative stage than that of later growth phase of crops. There was no notable difference found in temperature profiles of different treatments. Hence only temperature profiles of T_1 , T_2 , T_4 and bare field are shown here.

The temperature variation from bottom to top

of canopy could have resulted partly because of the transpirational cooling occurring inside the canopy and partly because of the reduced transmission of solar radiation to the bottom of the canopy. Similar results were reported by Niwas (1986) for *brassica*, Baldocchi *et al.* (1983) for soybean and Shivdeva (1986) for Gram + Raya intercropping.

Relative humidity profiles

Relative humidity was higher in the crop canopy than above it in all the treatments throughout the crop duration but after the harvesting of pearl millet, the slope is less than those in the earlier growth phase, figure 1, 2, 3 and 4(lower). Relative humidity profiles were lapse inside the crop canopy throughout the day but profiles were nearly isohumic at 0800 hrs and 1600 hours in most of the treatments. The relative humidity under crop field was higher than that above

Table 1: Effect of sole and intercropping systems on leaf area index (LAI), accumulated dry matter (g plant⁻¹), grain yield (kg ha⁻¹), test weight and harvest index

Treatments	Maximum LAI		Accumulated dry matter(g plant ⁻¹)		Grain yield (kg ha ⁻¹)		Test weight		Harvest index	
	Soybean	Pearl millet	Soybean	Pearl millet	Soybean	Pearl millet	Soybean*	Pearl millet*	Soybean	Pearl millet
T ₁	2.53	-	19.45	-	2207	-	10.56	-	0.318	-
T ₂	-	2.45	-	35.10	-	2686	-	8.20	-	0.350
T ₃	2.65	-	20.25	-	2215	-	10.55	-	0.311	-
T ₄	3.10	2.51	24.85	38.85	2298	1086	10.61	8.25	0.324	0.364
T ₅	2.75	2.65	22.85	40.25	1799	822	10.58	8.28	0.326	0.368
T ₆	2.71	2.75	22.50	42.10	1731	677	10.58	8.35	0.323	0.360
T ₇	2.90	2.54	23.56	38.20	2067	1065	10.57	8.26	0.330	0.371
T ₈	2.80	2.56	22.87	39.45	1759	1048	10.56	8.30	0.321	0.350
CD at 5%	0.10	0.12	1.05	2.06	124	147	NS	NS	NS	0.100

*(g 100 seeds⁻¹)** (g1000 seeds⁻¹)

the bare soil by 10 to 20 per cent. These results are in close agreement with the results of Shrinivas (1984) for rice. Niwas (1986) also reported the same result for *brassica*.

Growth and yield

Maximum leaf area index accumulated dry matter, grain yield, test weight and harvest indices of both soybean and pearl millet for all treatments are depicted in Table 1. Soybean recorded significantly higher (LAI) accumulated dry matter in the case of T₄ while test weight and harvest index showed non significant difference among the various treatments. Pearl millet produced significantly higher LAI and accumulated dry matter in T₆ (soybean + pearl millet, 4:1) whereas T₂ recorded significantly highest yield over all other treatments. Harvest index of Pearl millet was significantly lower in T₂, the significant higher LAI and dry matter for pearl millet in T₆ was partly due to low plant density as soybean: Pearl millet ratio was 4:1. Joshi *et al* (1999) reported that planting of soybean and pigeonpea in alternate paired rows (30 cm) gave highest land equivalent ratio (1.69) due to minimum competition between crops. soybean in T₄ was due to lower intra species competition, availability of more space and better utilization of natural resources than other treatments. Pearl millet produced significantly higher LAI and

accumulated dry matter in T₆ (soybean + pearl millet, 4:1) whereas T₂ recorded significantly highest yield over all other treatments. Harvest index of Pearl millet was significantly lowest in T₂ whereas test weight showed non significant difference among various treatments. The significant higher LAI and dry matter for pearl millet in T₆ was due to low plant density as soybean: Pearl millet ratio was 4:1 and also due to lower competition with short stature and slow growing nature of soybean Joshi *et al* (1999) again revealed that planting of soybean and pigeon pea in alternate paired rows (30 cm) gave highest land equivalent ratio (1.69) due to minimum competition between crops.

REFERENCES

- Baldocchi, D.D., Verma S.B. and Rozenberg, N.J. (1983). Microclimate in soybean canopy. *Agric. Meteorol.*, 28:321-327.
- Cochran, W. and Cox, G.M.(1967). Experimental design, second edition, New York, Wiley.
- Hegde, D.M. 2000. Technology for high yields. The Hindu survey of Indian Agriculture.65-70.
- Joshi, O. P., Billore, S. D. and Bhatia, V. S. (1999). Studies on planting pattern in sorghum/pigeon pea intercropping system. *Indian J. Agron.*, 44

(2): 271-274.

Niwas.R.(1986). To quantify microclimate under different planting systems in raya (*Brassica juncea* L.) var.RH30.M.Sc. Thesis, CCS,HAU,Hisar.

Shivdeva. (1986). Quantification of crop

microclimate in intercropping of Gram (*Cicer arietnum*) with Raya (*Brassica juncea*). M.Sc. Thesis. CCS HAU, Hisar.

Shriniwas, A. (1984). The effect of climatic and microclimatic factors on growth and yield of rice. M.Sc. thesis . P.A.U., Ludhiana

Received: January 2008; Accepted: August 2008