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Short communication

Micro-environment of yam-bean grown in alley under agroforestry

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The continuum of micro-environment in the immediate vicinity of alley-crop is largely dependent on the forest tree species in agroforestry. The factors controlling these environmental conditions are spatial position of the branches of shade tree, cumulative leaf area index, spacing between trees or gap between crowns, planting orientation etc. (Baldy and Stigter, 1997). The thermal regimes and energy balance are strongly modified by co-existence of different plant species having different structural pattern. The growth and performance of alley crops are largely dependent on the micro-meteorological conditions in the agroforestry system (Garrett and McGraw, 2000; Lin *et al.*, 2001). With an aim to evaluate the performance of yam-bean (*Pachyrrhizus tuberosus* L.) grown as alley crop, an investigation was carried out in an agroforestry situated in the New Alluvial Zone of West Bengal, India during 2001-2003.

The field investigation was carried out in the Central Research Farm of Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Kalyani, West Bengal (Lat.: 22° 58' N, Long.: 88°30'E and Altitude: 9.75m amsl). The soil of the experimental site is of *Gayeshpur* series (Great group: Fluvaquents) having sandy-loam texture. The study area comes under subtropical humid climate having moderate summer and mild winter seasons.

Yam-bean (Variety: RM-1) was grown as an alley crop in an established (12 years old) agroforestry. Six different shade tree species (all having five rows, N-S orientation) namely, Australian oak (*Casuarina equisetifolia* Forst.), White teak (*Gmelina arborea* Roxb.), Shisham (*Dalbergia sissoo* Roxb.), Eucalyptus (*Eucalyptus globosus* Labill.), Lebbeck (*Albizia lebbeck* Benth.), and Mahogony (*Swietenia mahagoni* Jack.) were chosen for the present study. To avoid border effect, yield data of middle two rows only were considered.

Replicated readings on incoming PAR received in the alley above the crop canopy was recorded with the help of a point quantum sensor (Model-LI-185B) in the unit of m E m^{-2} sec^{-1} for all shade tree species. Soil temperature (15 cm below ground level), ambient temperature (at about 50 cm above

Table 1: Variation of some meteorological parameters and yield in the alley of different shade trees

Shade tree	PAR ($\mu E\ m^{-2}\ sec^{-1}$)	Net radiation (Wm^{-2})	Ambient temp. (°C)	Soil temp. (°C)	RH (%)	Yield ($t\ ha^{-1}$)
D. sissoo	96.5	120.3	25.9	26.0	70	10.56
A. lebbeck	122.6	168.4	24.8	25.0	68	25.08
Eucalyptus	140.4	190.8	25.5	24.9	66	12.94
G. arborea	89.0	146.3	25.1	25.8	69	7.00
C. equisetifolia	133.5	210.2	25.8	25.5	68	8.32
S. mahagoni	111.0	200.0	25.2	25.0	68	15.84
Mean	115.5	172.7	25.4	25.4	68	13.26
SEm ($\pm$)	3.60	6.09	0.24	0.08	0.23	1.17
Open	471.4	401.5	27.7	27.6	62	--

the crop surface), relative humidity and net radiation were taken in the alley with the help of soil thermometer, dry-bulb thermometer, whirling psychrometer and net radiometer at seven-day intervals throughout the growing season (i.e. end-August to October). All these meteorological observations were taken in the near-by bare field also i.e. in unshaded condition.

Amongst alley of different shade tree species, PAR received in the alley of *Eucalyptus* was the highest followed by *Casuarina* and *A. lebbeck*. Similarly the net radiation received in the alleys of above three shade tree species was also higher than in the others (Table 1). Compared to open field (i.e. unshaded condition), average PAR received was 24.5% under shade tree. Similarly 43% of the net radiation is received in the alley compared to open. The average values of PAR, net radiation and other meteorological factors (average of season-round data, n = 32, data recorded at 12 to 13 hrs) in the alley of different shade tree species are given in table 1 along with the average yield of six replicated plots.

It was observed that the prevailing ambient temperatures in the alley of different shade trees were about 2°C lower compared to the unshaded condition.

Likewise, the soil temperatures were also 2°C lower in the alley than the unshaded condition. RH in the alley was about 6% higher than the open field situation. So the micro-environment in the alley under agroforestry largely differs from an open unshaded field.

The performance of alley-crop was studied mainly in the light of differing crop climate to evaluate alley of which shade tree is the best for the growth of yam-bean among the selected shade tree species. As the ambient temperature, soil temperature and RH did not significantly differ from one alley to another, their effect on yield-difference was not studied. It was observed that yam-bean performs the best under *A. lebbeck,* having PAR interception relatively higher than *G. arborea*, *Dalbergia* and Mahogony. The greater reduction in yield, found under the alleys of *Dalbergia* and *G arborea,* is due to their higher canopy or crown cover which might have caused hindrance to required amount of incoming radiation (PAR) to crops underneath. The above results are in agreement with the observations reported by Jadeja (1996) for gram, mustard and Indian beans. PAR received in the alley of *Casuarina* is relatively higher than that of *A. lebbeck,* but here the adverse effects of some allelochemicals secreted by *Casuarina* have caused interference in the growth and development of alley crop. Similar results were observed by Khara *et al.,* 2004. In the alley of *A. lebbeck* the yield is about 25.08 t ha^{-1} whereas in case of sole crop, yam-bean yield is in the tune of 28 t ha^{-1} for October sowing crop to 31 t ha^{-1} for September sowing crop (Anonymous, 2001). Thus the yield reduction in the alley is not so high and the crop can easily be grown in agroforestry.

The present study thus shows that yam-bean performs the best in the alley of *Albizia lebbeck* and for maximum land utilization it can be grown in agroforestry system. Moreover the study on microenvironment condition under shade tree enables to form guideline to choose crops/ cultivars in agroforestry. The help received from the Director of Farms, BCKV and the constant encouragement of the Director of Research, BCKV are duly acknowledged.

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