International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 1973-1976

Received: 19-09-2020
Accepted: 28-10-2020

Deepa H Pardhi
PG Student, Department of Forestry, PGI, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Dr. VP Mane
Professor, Department of Forestry, PGI, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Ritik D Bisane
PG Student, Section of Agriculture Botany, COA Nagpur, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Corresponding Author:
Deepa H Pardhi
PG Student, Department of Forestry, PGI, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra, India

Incident photosyntehticaly active radiation under and outside the canopy of *Acacia nilotica* (Linn.) for agroforestry system

Deepa H Pardhi, Dr. VP Mane and Ritik D Bisane

DOI: https://doi.org/10.22271/chemi.2020.v8.i6ab.11056

Abstract
The important factor to be considered in biomass production is the maximum light use efficiency. The capture of radiation and its use in dry matter production depends on the fraction of the incident photosynthetically active radiation (PAR). An experiment was conducted in the campus of Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra during 2018-2019 with the objective to study microclimatic effect under Babul (*Acacia nilotica* L.) for checking the suitability of Babul to match the under story agricultural crops and pasture grasses on the basis of microclimatic parameters recorded under and outside the canopy of Babul. Collected data were statistically analyzed with descriptive statistics by calculating mean and standard deviation. Observations on microclimatic parameters Photosynthetically active radiation were recorded from October to December (Rabbi Season). Observations were recorded under and outside the canopy of Babul by selecting ten trees from the 15x15 m plot of Babul plantation site and data were recorded during (9 am, 2pm, and 4pm) in a day by weekly intervals for three months. The results revealed that the microclimatic parameter such as photosynthetically active radiation (PAR) showed lower values under the canopy and higher value outside the canopy, and from West and South direction highest PAR was recorded. In comparison, average PAR values under the canopy from all the three months were lower for the outside canopy PAR value. On the basis of this farmer can chose the suitable understory agricultural crops and pasture grasses.

Keywords: Microclimate, photosynthetically active radiation, canopy

Introduction
Agroforestry as the land use system that integrates tree crops and animals in a way that, scientifically sound, ecologically desirable, practically feasible and socially acceptable to the farming communities. In this way agroforestry may be defined as the concurrent use of land for agriculture, forestry, horticulture and also for raising livestock. It represents the optimum use of land (Negi 1999) [4]. Agroforestry plays an important role to overcome the problems of global climatic change and also it reduces the pressure on natural forest.

Vidarbha region of Maharashtra categories into three eco-zones mainly eastern, western and central Vidarbha zone. The area of Akola district falls under western part of Vidarbha region of Maharashtra. As our study concern with Vidarbha region the information about different agroforestry system should be known. Farmers in Vidarbha region practicing different agroforestry system in their field namely: bund plantation, boundary planting, agri-silviculture, horti-silviculture, agro-silvopastural, agri-horti-silviculture, plantation along irrigation canal, kitchen garden, plantation near water resources, block plantation and scattered plantation (Arti Deshmukh *et al*., 2016) [2]. An important effect of tree in agroforestry system is the modification of the microclimate for annual crop or livestock (Ong *et al.*, 2000) [5]. Compare to an open environment the modified microclimate under trees is characterized by reduced solar radiation, more moderate temperature regime, higher humidity, lower rate of crop transpiration and higher soil moisture level (Singh *et al*., 2012) [6].

Acacia nilotica (L.) commonly known as Babul has been recognized worldwide as a multipurpose tree. It grows about 15-18 m in height and grows under climatic conditions ranging from sub-tropical to tropical (Bargail and Bargail, 2009) [3]. It is a relatively fast growing, drought resistant multipurpose leguminous with the ability of biological nitrogen fixation and can intensively exploit soil column for nutrients and moisture.

This species has been considered as one of the fast-growing species of the wastelands and agroforestry systems throughout India providing strong timber, fodder for goats and sheep and high-quality fuel wood apart from enriching the soil with nitrogen (Bargil and Bargil, 2007).

Materials and methods

Study was conducted in the campus of Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola. Akola is situated in sub-tropical region between 22^0 42' N latitude and 77^0 02' E longitudes. The altitude of the place is 304.42 m above mean sea level. Climate of Akola is semi-arid and characterized by three distinct seasons *viz.*, hot and dry summer from March to May, warm humid rainy season from June to October and mild cold winter from November to February. Average annual precipitation on the basis of last fifteen years is 515.8 mm. Plantation of Babul within university campus was selected for the study of microclimatic parameters. Ten trees from Babul were randomly selected and marked from 15x15 m plot and numbered from T_1-T_{10}. The observations on photosynthetically active radiation (PAR) under the canopy and outside the canopy were recorded from the all four direction (East, West, North, and South) of each marked tree for the period of three months from October to December (Rabbi Season). The readings were recorded once in a week in a day for three intervals (9 am, 2 pm, and 4 pm). Collected data were analyzed with the descriptive statistics by calculating the mean and standard deviation.

Results and Discussion

A sound understanding of effect of microclimate under the tree species is of utmost importance for utilization of available resources in environment by agricultural crop for the development of more reliable and productive agroforestry system. Keeping this in view, experiments were designed to study the microclimatic parameters under and outside the plantation of Babul for agroforestry system in the month of October to December (Rabbi Season) 2018 at University campus, Dr. PDKV, Akola. Results obtained from investigations are discussed below.

Photosynthetically active radiation

Weekly averages of PAR recorded during 9:00 am, 2:00 pm, 4:00 pm (Appendix I) and percentage availability of PAR values were given in Table 1. From recorded data it was observed that among all the four direction, West and South direction has recorded same PAR value (144 µmol m^{-2} s^{-1}) and East direction has recorded lowest PAR (133 µmol m^{-2} s^{-1}) followed by North direction (134 µmol m^{-2} s^{-1}). Average PAR in all the direction under canopy was highest in 8^{th} week (190 µmol m^{-2} s^{-1}) followed by 2^{nd} week (157µmol m^{-2} s^{-1}) and lowest in 11^{th} week (112 µmol m^{-2} s^{-1}) followed by 12^{th} week (115 µmol m^{-2} s^{-1}). PAR outside the canopy was highest in 1^{st} week (428 µmol m^{-2} s^{-1}) followed by 2^{nd} week (369 µmol m^{-2} s^{-1}) and lowest in 4^{th} week (155 µmol m^{-2} s^{-1}).

Table 1: Average PAR (µmol m^{-2} s^{-1}) recorded in a day/week under and outside the canopy of *Acacia nilotica* (Linn.) during October to December

Month		PAR under the tree canopy (µmol m^{-2} s^{-1})					PAR outside the tree canopy	Percent availability of PAR under canopy
		East	West	North	South	Mean	Outside	
Oct	Week 1	125	153	153	155	147	428	32.50
	Week 2	155	166	170	164	157	369	42.67
	Week 3	138	127	122	136	130	287	45.37
	Week 4	129	139	145	148	140	155	90.72
Nov	Week 5	146	158	139	153	149	326	45.85
	Week 6	145	141	125	148	140	356	39.28
	Week 7	140	148	121	140	138	169	81.63
	Week 8	169	194	189	207	190	222	85.65
Dec	Week 9	126	167	124	136	138	277	46.58
	Week 10	119	116	112	122	120	258	46.58
	Week 11	113	112	111	112	112	222	50.64
	Week 12	115	118	112	117	115	263	43.96
	Week 13	111	127	120	127	122	198	61.44
	Mean	133	144	134	144	138	239	54.80
	SD	17.5	24.0	24.2	24.6	20.6	53.0	18.90
	Min	111	112	111	112	112	155	32.50
	Max	169	194	189	207	190	428	90.70
	Deviation					101		

The percentage availability of PAR under canopy in comparison to outside canopy was highest in 4^{th} week (90.7%) and lowest in 1^{st} week (32.5%) with average percent availability of 54.8%. The data in Table 1 were represented graphically in Fig.1

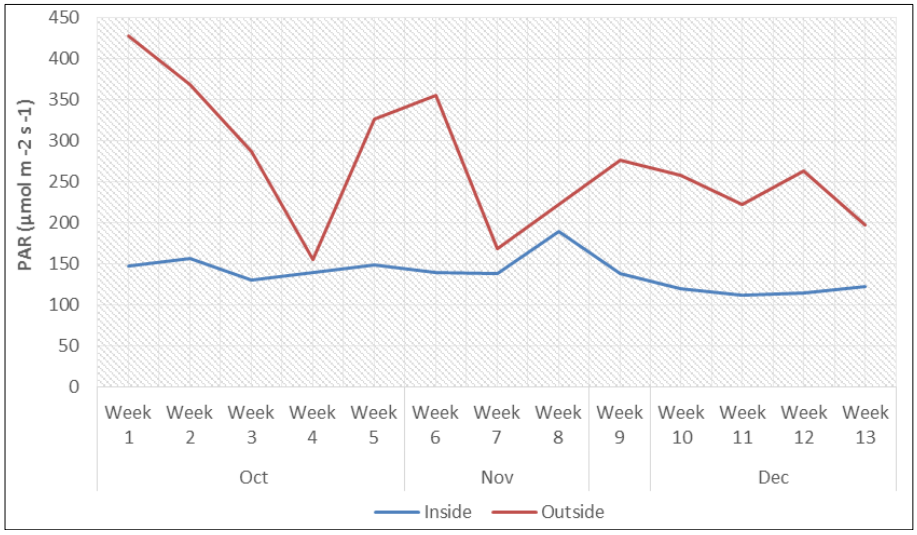

Fig 1: Graphical representation of average PAR (µmol m^{-2} s^{-1}) recorded in a day/week under and outside the canopy of *Acacia nilotica* (Linn.) during October to December

Overall behavior of photosynthetically active radiation under and outside *Acacia nilotica* (Linn.)

Average PAR recorded during October to December months were showed in table 2. Average monthly PAR under tree canopy ranged from 121 µmol m^{-2} s^{-1} to 154 µmol m^{-2} s^{-1} with a mean PAR value (140.1 µmol m^{-2} s^{-1}). South direction had recorded highest average PAR (162 µmol m^{-2} s^{-1}) in November and lowest PAR value (116 µmol m^{-2} s^{-1}) was recorded in North direction in December.

Table 2: Overall behavior of PAR under and outside the canopy of *Acacia nilotica* (Linn.) trees recorded during October to December

Months	Photosynthetically active radiation (PAR) under tree canopy (µmol m^{-2} s^{-1})					PAR outside tree canopy (µmol m^{-2} s^{-1})
	East	West	North	South	Average	
Oct	137	146.6	148.1	151.3	143.9	316.2
Nov	150	160.8	144.0	162.7	154.6	265.6
Dec	117.4	128.5	116.5	123.3	121.9	248.2
mean	135.0	145.3	136.2	145.8	140.1	277.6
SD	16.6	16.1	17.1	20.2	16.6	34.70
min	117.4	128.5	116.5	123.3	121.9	248.2
Max	150.5	160.8	148.1	162.7	154.6	316

In comparison, monthly PAR value (316 µmol m^{-2} s^{-1}) outside the tree canopy control was higher in the month of October whereas under canopy PAR value (154 µmol m^{-2} s^{-1}) was higher in November. Average PAR value (140.1 µmol m^{-2} s^{-1}) under tree canopy recorded during all three months was less than that of outside canopy PAR (277 µmol m^{-2} s^{-1}). It may be due to the canopy spread of tress which restricts the entry of photosynthetically active radiation to pass below the crown. Alados *et al*., (1996) [1] observed that the highest value is for summer months, while in winter value were lower and more variable. The effect of sky conditions has been studied using different ratios of broadband solar radiation the more influencing factor is the presence of cloud that could be evaluated using ratios of solar broadband radiation.

Appendix-I

Table 3: Average PAR recorded under and outside canopies of *Acacia nilotica* (Linn.) at different intervals during October to November

Week no.	PAR under canopy of tree 9:00 am					Out-side tree	PAR under canopy of tree 2:00 pm					Out-side tree	PAR outside canopy of tree 4:00 pm					Out-side tree
	E	W	N	S	Mean		E	W	N	S	Mean		E	W	N	S	Mean	
W 1	110	128	134	150	131	230	135	167	148	148	149	292	131	164	177	167	160	162
W 2	174	189	187	156	156	390	156	164	177	187	171	212	136	145	146	149	144	210
W 3	140	121	105	131	124	152	144	131	129	145	137	535	129	127	132	133	129	146
W 4	122	139.	138	154	138	143	160	149	163	143	154	156	104	129	136	148	129	167
W 5	140	128	109	132	127	130	179	197	174	187	184	370	119	147	135	141	136	129
W 6	140	110	100	104	113	176	177	181	174	199	183	665	117	132	101	142	123	229
W 7	123	124	104	123	121	220	179	189	145	176	172	153	118	132	113	122	121	136
W 8	124	147	136	152	139	105	270	308	308	338	306	346	114	128	125	132	125	216
W 9	112	129	106	145	123	247	158	157	149	141	151	296	110	216	118	122	141	289
W 10	113	108	197	114	108	236	127	128	127	135	137	312	118	112	113	116	115	226
W 11	105	107	99	99	103	213	123	114	126	120	121	263	112	115	109	118	114	192
W 12	107	109	107	108	107	236	120	127	119	122	122	302	116	117	111	123	117	253
W 13	111	125	119	133	122	213	114	129	134	125	125	168	110	129	108	124	118	215
Mean	120.0	122.9	111.8	126.7	120.5	191.9	161.2	168.4	162.3	169	165	303	118.5	138	125.2	133.9	128.9	197.6

SD	12.4	13.7	14.86	19.9	12.5	50.1	46.2	57.0	54.90	65.8	54.8	149.1	9.0	27.3	20.5	15.0	13.5	47.7
Min	105.8	107	97	99	103	105	114	114	119	120	121	153	104	112	101	116	114	129
Max	140.4	147.1	138.3	154.3	139.7	247	270.4	308.7	308.2	338.8	306.4	665	136	216	177	167	160	289

Conclusion

The study showed that the influence and effect of microclimatic factors changes seasonally so that according to this changes understory crop can be introduced. On the basis of total amount of PAR under the canopy of babul, farmers can check the suitability of this tree for raising the agriculture crops and pasture grasses in agroforestry system. The suitable agricultural crops and pasture grasses which will withstands with the recorded microclimatic conditions under Babul can be select by the farmers. This study will help the farmers to overcome the failures of agroforestry system and increase the overall production of the farmers also the off seasons crops can be grown as the microclimate under the tree is varied from microclimate outside the trees canopy.

References

1. Alados I, Foyo-Moreno I, Arboledas LA. Photosynthetically active radiation: measurement and modelling, Agric. Forest Meteorol 1996;78:121-131.
2. Deshmukh A, Deshmukh HK, Taide YB, Chinchamalatpure, Walke RD, Madke V. Species diversity of agroforestry system in Patur Tehsil of Akola district in Maharastra. J Tree Sci 2016;35(1):21-26.
3. Bargali K, Bargali SS. *Acacia nilotica*: a multipurpose leguminous plant, J of Nature and Science 2009;7(4):11-19.
4. Negi SS. Agroforestry handbook, International Book Distributors Book sellers and publishers 9/3, Rajpur road (1st floor) Dehradun, India 1999.
5. Ong CK, Black CR, Wallace JS, Khan AAH, Lott JE, Jackson NA *et al*. Productivity, microclimate and water use in Grevillearobusta-based agroforestry systems on hill slopes in semi-arid Kenya, Agric. Ecosyt. Environ 2000;80:121-141.
6. Singh A, Kumar P, Singh R, Rathore N. Dynamics of tree-crop interface in relation to their influence on microclimatic changes-a review. Hort flora Res Spectr 2012;1(3):193-198.