ISSN: 2394-1391

Indian Journal of Biology
Volume 2 Number 2, July - December 2015
DOI: https://dx.doi.org/10.21088/ijb.2394.1391.2215.7

Original Article

Variation in Net Radiation Over Wheat (*Triticum Aestivum* L.) in Different Phenophase Intercropped with *Dalbergia Sissoo* in Nelder Wheel Design

Ravi Kiran

Abstract

The present investigation attempts to study the diurnal radiation over wheat as an understory crop below 8 year old *Dalbergia sissoo* planted in a Nelder wheel design planted in fifteen spokes of trees numbered serially starting from north direction as 0^0. Wheat cv. PBW-226 was sown on 21st November, 1996 as an under story crop. Tree spokes were pruned 0%, 30%, 45% and 75% starting from north direction respectively. Studies have been made on the diurnal variation of net radiation attributable to orientation of tree rows of the trees at four important phonological stage of the crop i.e. tillering, flag leaf emergence, flowering and maturing stage of the crop and compared with the control (sole crop) viz T1 (312^O-72^O), T2 (72^O-192^O) and T3 (192^O-312^O) in the Nelder wheel. Regression equations between net radiation in control and different treatments below trees were also developed.

Keywords: Diurnal Variation of Net radiation; *Dalbergia Sissoo;* Wheat (*Triticum Aestivum* L.).

Introduction

Forests and forest products are one of the basic needs, both for human beings and animals. Due to population increase in geometric progression, there is an increased demand of food, shelter, fuel, fodder, timber etc., resulting into the increased pressure on natural resources. The present day modern agricultural practices have increased the level of agricultural production considerably yet it is not sufficient. Agricultural production needs very specific soil, water and atmospheric conditions. The area under suitable soil and water condition was increased through intensive research, extension and management programmes. The atmospheric conditions could not be modified easily. However, efforts are now being made to improve the microclimatic conditions through agroforestry. Trees act as wind-break and increase water use efficiency by retarding the water loss by evapotranspiration besides modifying radiation climate, crop energy balance temperature, photosynthesis and its rate and duration and plant growth. (Messing and Noureddine 1991). Heat load reduction during reproductive phase can increase the production of wheat (Johnson *et al.*, 1981). Excessive solar energy in sole cropped wheat fields at post anthesis period reduce wheat yield (Chinnoy, 1947; Wardlaw *et al.*, 1989). Introduction of treed in the monoculture can be used to optimize the microclimate in field conditions for winter wheat in North India. studies are scarse so far on tree-crop interactions of Wheat (*Triticum aestivum* L.) and *Dalbergia sissoo* planted in Nelder wheel design under shallow water table conditions. The present investigation attempts to quantify the diurnal variation of modified microclimate of wheat as an understory crop below *Dalbergia sissoo* planted in a Nelder wheel design.

Author's Affiliation: *Assistant Professor (Agrometeorology), Department of Agrometeorology, College of Agriculture, GBPUA&T-Pantnagar, Pin 263145, (Uttrakhand).

Reprint's Request: Ravi Kiran, Assistant Professor (Agrometeorology), Department of Agrometeorology, College of Agriculture, GBPUA&T-Pantnagar, Pin 263145, (Uttrakhand).

E-mail: ravikiransaxena@rediffmail.com

Materials and Methods

The present field investigation was carried out at the Horticultural Research Center, Patharchatta, located in the campus of GB Pant University of Agriculture and Technology, Pantnagar, India (29° N, 79° 30 E, 243.83 m above mean sea level). Trees of *Dalbergia sissoo* planted in a Nelder wheel design in March 1989 (Nelder, J.A. 1962). It consisted of fifteen tree spokes of wheel each oriented at an angle of 24°

from the adjacent tree spoke, arranged in ten concentric rings of trees of radii 2.0, 5.4, 13.5, 17.8, 21.5, 24.6, 27.4, 29.9, 32.2 and 34.4 m, respectively, enclosing a total number of 15 plots between the tree rows, numbered serially from 1 to 15 anticlockwise direction starting from a tree row oriented to 0° in north direction. Tree spokes were pruned 0%, 30%, 45% and 75% starting from north direction respectively. Each plot was divided into three sub plots of area 26.62 m^2 for the propose of the investigation. In each spoke the first, second and the tenth trees were considered as buffer trees to avoid border effect. Therefore, a constant tree stand of 333 trees per hectare was provided in the area between the third and the ninth trees of each spoke resulting each tree in the experimental area occupying an average area of 30 m^2. The climate of the region is humid subtropical, characterized by dry hot summers and cold winters having dry season from early October to mid June and a wet season from mid June to early October. Average annual total rainfall is 1434.4 mm (90% in mid June to end of September). The diurnal maximum air temperatures are highest in May–June and the diurnal minimum air temperatures are lowest in January (range 41.0- 3.0 °C) while relative humidity is highest in July–August and lowest in December–January; (range 80-35%) in April–May. The experimental area lies as a belt below and a few kilometers south of the foothills of the Himalayan mountains having gently slopped of less than 1% the soils are classified as Mollisols (Deshpande et al., 1971) along with characteristic fluctuating shallow water table ranging from surface to 1.8 m or so below the soil surface. The weather conditions during the experiment is depicted in Fig 1.

Field was harrowed four times with disc harrow, properly levelled for better germination and growth, before the sowing of experimental crop. Nitrogen, phosphorus and potassium were applied at the rate of 120kg, 80kg, and 60kg per hectare. Half of nitorgen and full doses of phosphorus and potassium were broadcasted during land preparation and mixed thoroughly by cross harrowing. The remaining half dose of nitrogen was top dressed at 25 DAS i.e. just after first irrigation. The wheat variety PBW-226 was sown below the tree canopies with the help of seed drill on 21st. November, 1996. The rate of seed was 100 kg/ha. The seed was sown in rows 23cm apart and at the depth of 5cm. The area not covered by seed drill was sown manually by hand hoe. Two hand weeding were given at 45 and 80 days after sowing. Only one irrigation was given at 20-25 days after sowing at crown root initiation (C.R.I.) stage.

Trees of *Dalbergia sissoo* were pruned 0%, 30%, 45% and 75% starting from north direction respectively to provide sufficient solar flecks penetration for growing of wheat as an understory crop. Radiation climate in the three microclimatic zones viz T1 (312°-72°), T2 (72°-192°) and T3 (192°-312°) in the Nelder wheel attributed to the trees row orientation were studied at four important stages of the wheat crop along with control.

Net radiation was measured with the help of portable Net Radiometer for each treatment at three points in the middle of the area for each subplot of each treatment along with control simultaneously at tillering, flag leaf emergence, flowering stage and maturing stage at half hour interval starting from morning to evening. Regression equations between net radiation in control and different treatments below trees were also developed.

Result and Discussion

Total diurnal net radiation in morning, noon and evening at tillering, flag leaf emergence, flowering stage and maturing stages of the wheat crop in various treatments is depicted in Fig 2-4. On temporal scale diurnal net radiation availability among different treatments and all four stages of crop on half hourly basis under the agroforestry conditions was found highly dynamic. Net radiation was available more in South direction treatments than that of north direction treatments in Nelder design under tree canopies.

With the advancement of the stage of crop total diurnal net radiation in all the treatments showed increasing trend. During morning the net radiation was lowest at tillering in T1 and highest at flowering stage in T3. During noon the net radiation was lowest at tillering in T1 and highest at flowering stage in T2. During evening the net radiation was lowest at tillering in T1 and highest at flag leaf emergence stage in T2 . Total diurnal net radiation at tillering flag leaf emergence, flowering stage and maturing stages ranged 14-55%, 54-62%, 65-73% and 44-70% of control, respectively. Net radiation availability was found more in T3 than that of other treatments under canopies. The changes in light intensity has profound effect on photosynthetic responses of crop growing beneath trees (Knapp and Smith, 1990).

All treatments had sufficient net radiation availability at all stages of crop growth. The foliated green tree canopy reduced radiation intensity along with the quality of light in PAR range (380–700 nm) (Zavitkovski 1982).

Relationship between net radiation in control and different treatments below trees in morning, noon and evening were developed separately for different stages of the crop. It was observed that there was a significant relationship between the net radiation in control and in understory crop in morning, noon and evening at four important stages which are presented in Fig 5.

In tarai region of Uttar Pradesh shallow water table can provide sufficient subirrigation to wheat crop intercropped with trees. Upward soil water ûux can contribute 36–73% of the total water requirement of wheat in tarai region of foothills, under shallow water table conditions. (Saini and Ghildyal 1978). The depletion of water table occurred in reproductive phase of crop because of more water requirement of the wheat crop but have no significant effect on the plant water potential (Powell 1980).

Tree row orientation and distance affected considerably the net radiation over the crop, but, reduced heat load from earhead developement to maturity and its more duration in an agroforestry system especially the deciduous tree like *Dalbergia sissoo* may possibly mitigate the effect of shading below trees as excessive solar radiation to sole cropped wheat field at post anthesis period reduces wheat yield (Chinnoy J., 1947).

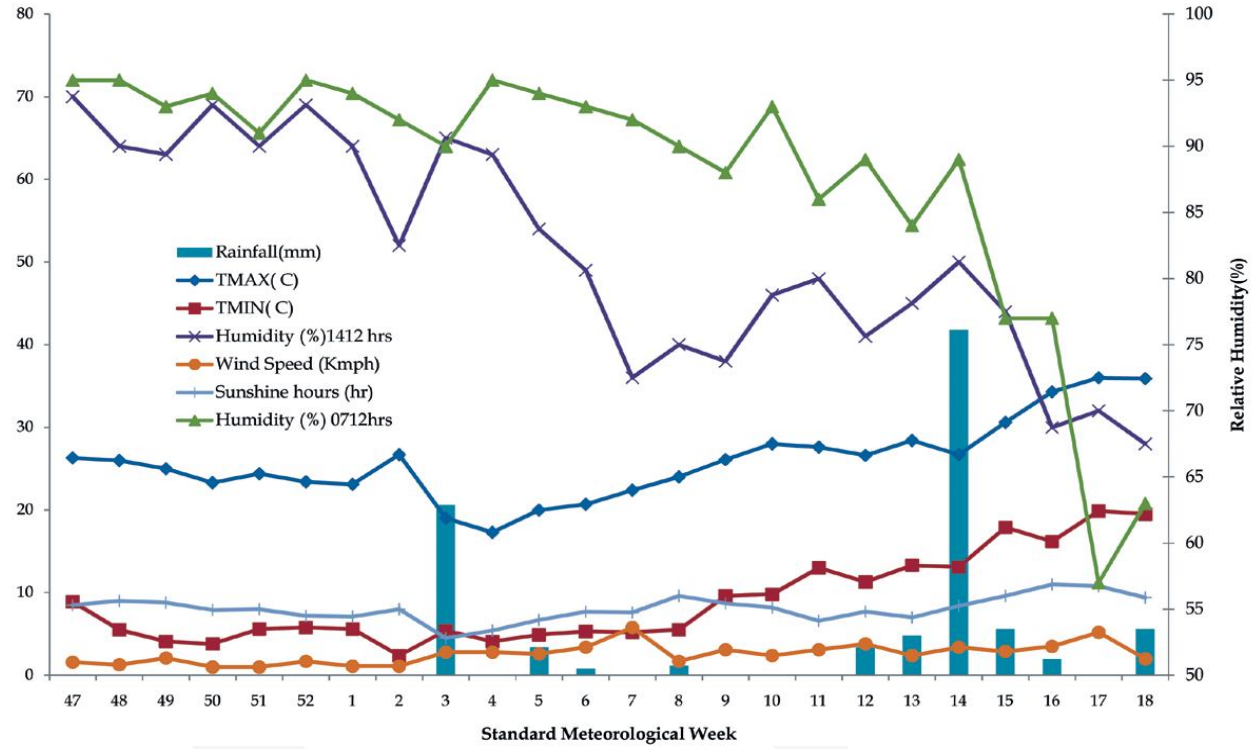

Fig. 1: Weekly average weather data for experimental period (November1996 - April1997)

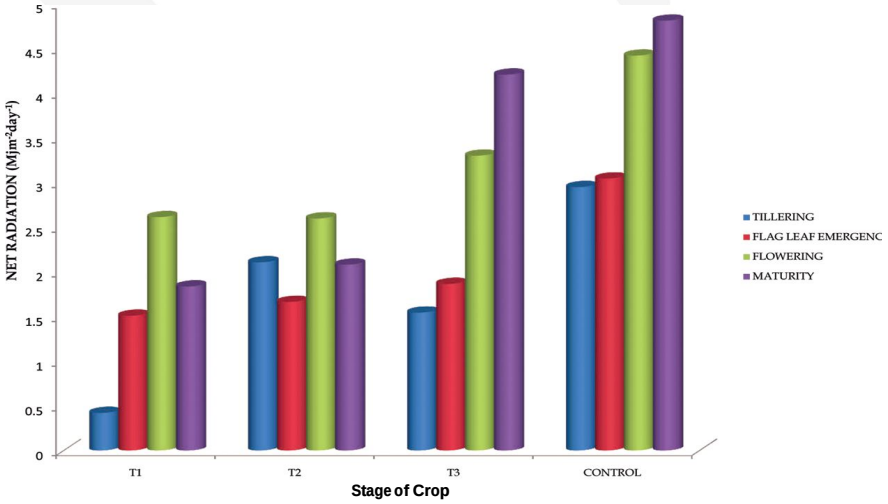

Fig. 2: Variation in net radiation in wheat intercropped with shisham during morning hours

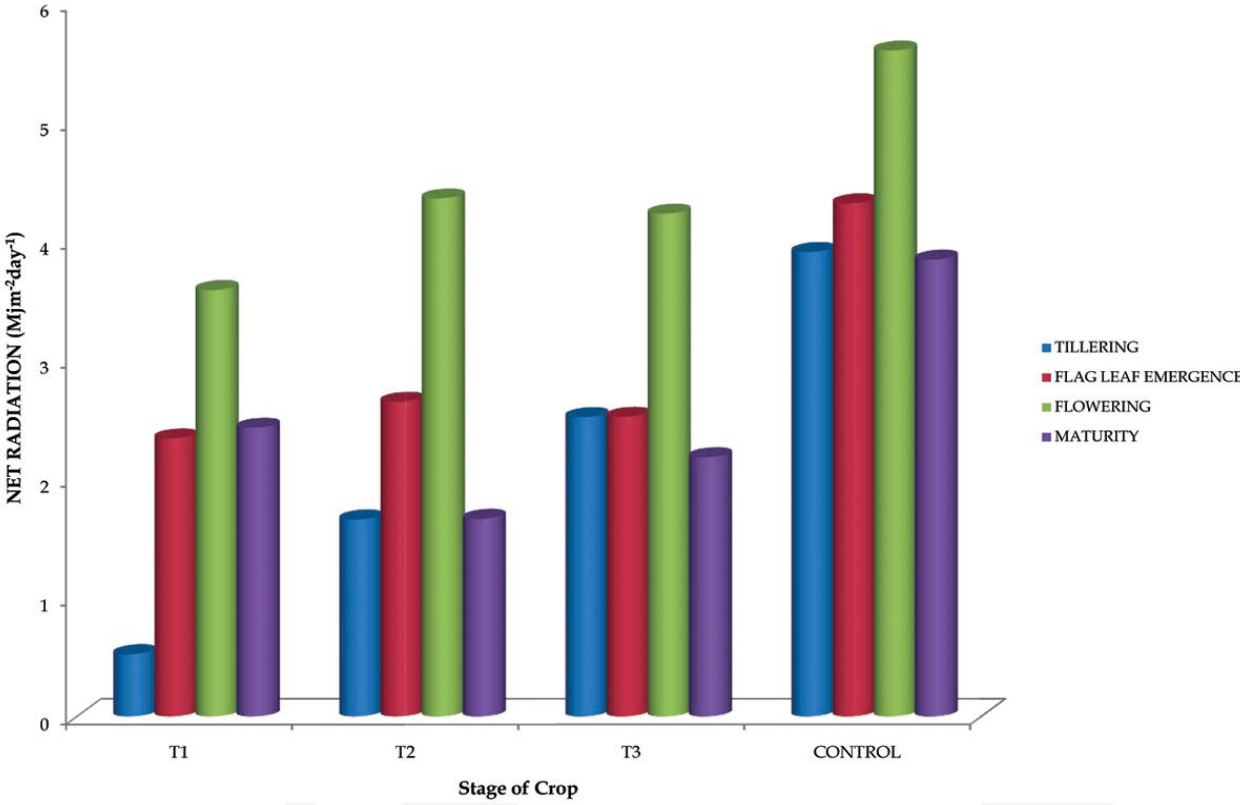

Fig. 3: Variation in net radiation in wheat intercropped with shisham during noon hours

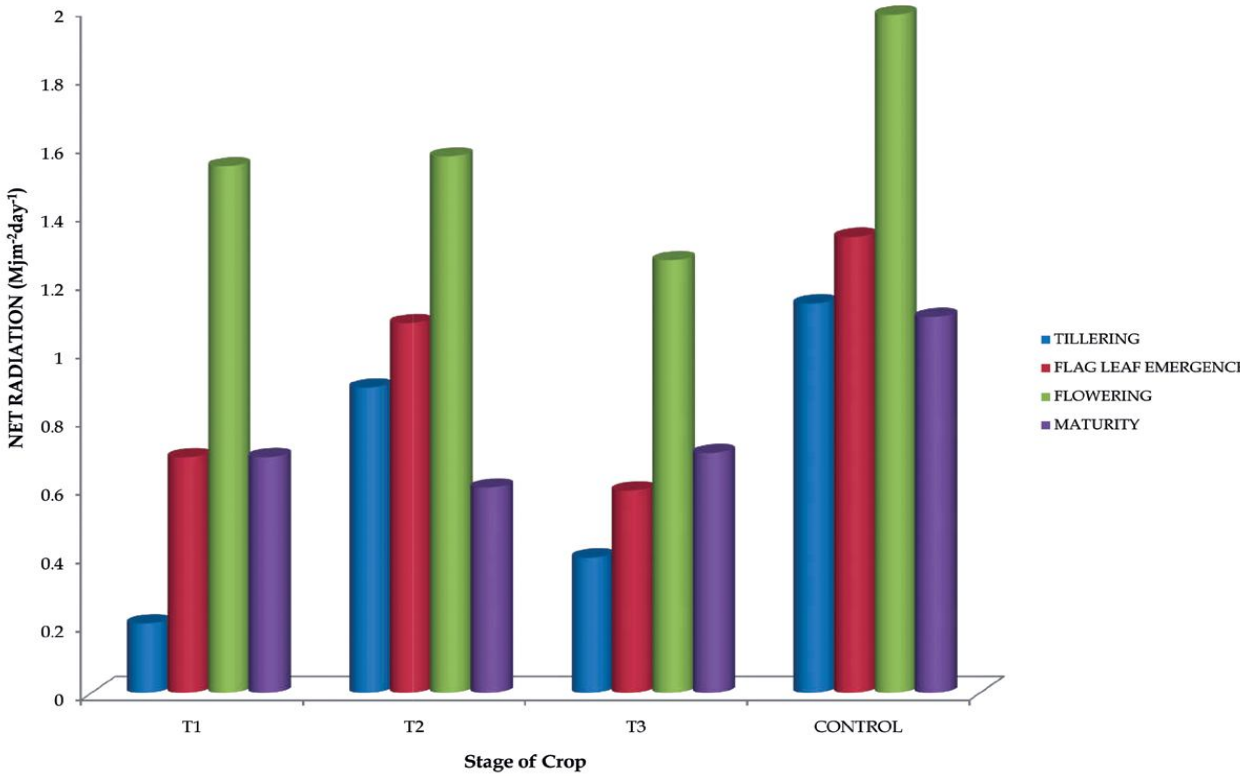

Fig. 4: Variation in net radiation in wheat intercropped with shisham during evening hours

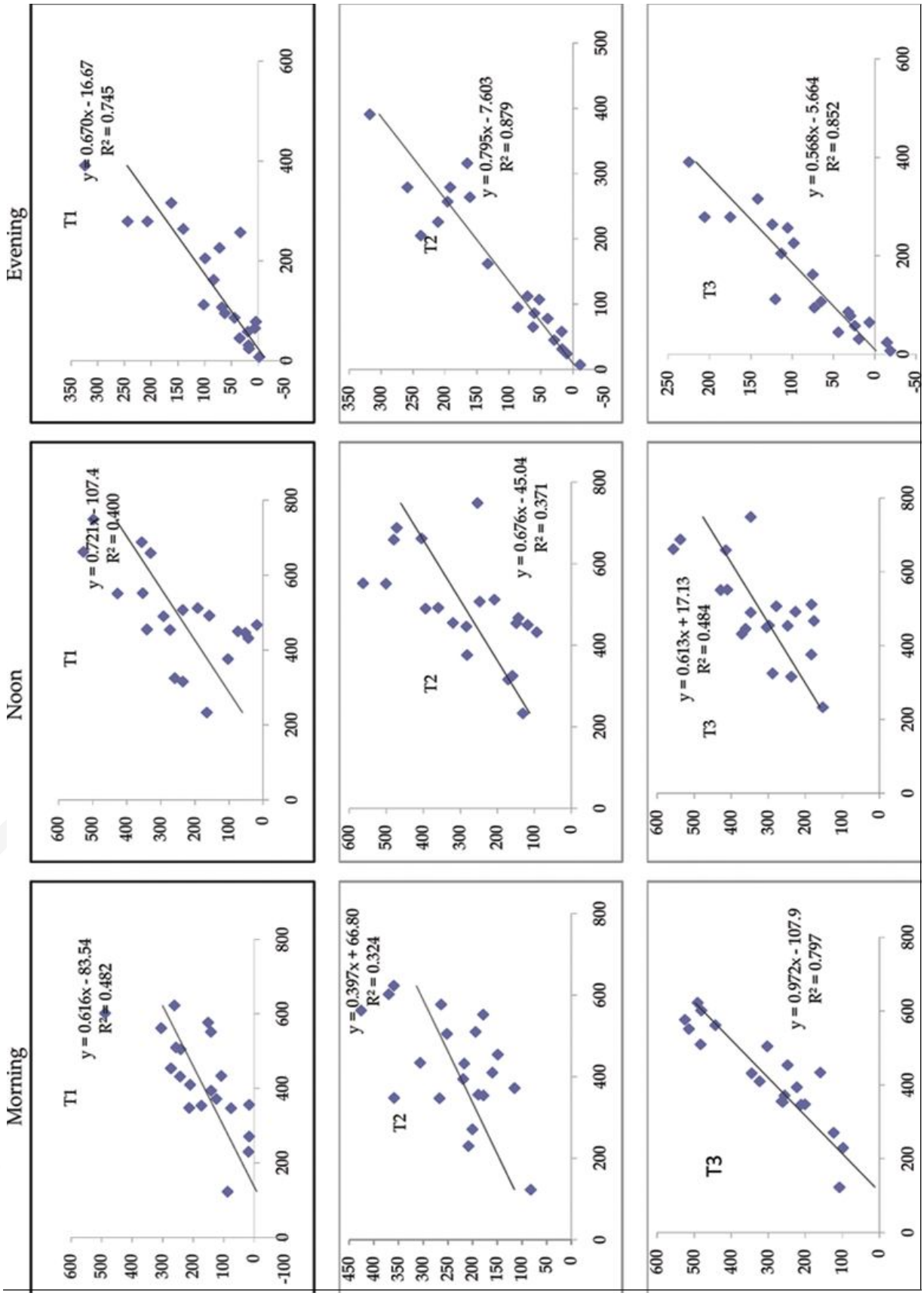

Fig. 5: Relationship between Net Radiation in different treatments and control during morning, noon and evening during crop growth period

Agroforestry has vide scope to modify the microclimatic conditions subjected to the proper tree spacing and their pruning for wheat.

Acknowledgements

Author acknowledges the facilities provided during the course of investigation by All India Coordinated Research Project on Agroforestry (ICAR Project).

References

1. Chinnoy, J.J. Correlation between yield of wheat and temperature during ripening of grain. *Nature.* 1947; 159: 442-444.
2. Deshpande S.B., Fehrenbacher J.B. and Beavers A.H. Mol-lisols of terai region of Uttar Pradesh, northern India, 1. Morphology and mineralogy. Geoderma 1971; 6: 179–193.
3. Knapp, A.K. and Smith, W.K. Stomatal and photosynthetic responses to variable sunlight. *Physiologia Plantarum*. 1990; 78: 160-165.
4. Mehra, R.; Shukal, D.S. and Pande, P.C. Studies on the mechanism of temperature tolerance in wheat (*Triticum aestivum*). *Indian J. Plant. Physiol.* 1991; 34(4): 362-368.
5. Messing, I. and Noureddine, A. 1991. Effect of wind breaks on wind velocity, evapotranspiration and yield of irrigated crops in the arid zone. Sidi Bouzid, Central Tunisia. *Rural Development Studies.* 1991; 30: 40.
6. Nelder J.A. New kinds of systematic designs for spacing experiments. Biometrics 1962; 18: 283–301.
7. Powell D.B.B. Wheat water relations and lysimeter experiments, Agriculture Research. South Asian Department of Agriculture and Technology Services, 1980; 86 p.
8. Saini, B.C. and Ghildyal, B.P. 1978. Seasonal water use by winter wheat grown under shallow water table conditions. *Agricultural Water Management.* 1978; 1: 263-276.
9. Wardlaw, I.F.; Dawson, I.A. and Munibi, P. The tolerance of wheat to high temperatures during reproductive growth. II Grain development. *Aust. J. Agric. Res.* 1989; 40: 15-24.
10. Zuvitkovski, J. Characterization of light climate under canopies of intensively cultured hybrid poplar plantations. *Agric. Meteorol.* 1982; 25: 245-255.