Paper ID: 161
Theme 2. Grassland production and utilization
Sub-theme 2.6. Interdependence of grassland and arable lands for sustainable cereal, forage and livestock production

Evaluation of productivity of pearl millet and clusterbean and growth parameters of neem strains under agro-forestry system under semi-arid and rainfed condition

S. S. Meena[1*], R. P. Nagar, S. L. Meena[2]
[1*]IGFRI-WRRS, Avikanagar, Avikanagar, India
[2]Division of Agronomy, Indian Agricultural Research Institute, New Delhi, India
[*]Corresponding author e-mail : ssmeena123@yahoo.com

Keywords: Agroforestry, *Azadirachta indica*, Clusterbean, Forage, Pearl millet, Semi-arid

Introduction

Neem (*Azadirachta indica*) tree is a native to Indian sub-continent and found throughout the India with maximum number of trees which are distributed over 70-75% geographical area of this country. It is distributed throughout south and south-east Asia, Australia, Africa and many other countries in central and south America including Carribean, Puer to Rica and Virgin Islands (Ram Mohan and Nair, 1993). The tree has been considered so invaluable and miraculous that it became a major inseparable component of the Indian ecosystem. Neem has been held in high esteem because of it provde medicinal and insecticidal properties. As a single tree it has maximum uses like medicines, bio-pesticides, mosquito repellents, fertilizers, diabetic foods, soaps, lubricants, gums, agriculture implements, tooth paste, tooth sticks, contraceptives etc. which is receiving worldwide recognition for its variety of bio-active principles. For a farmer the tree provided seeds, leaf and bark which could be converted into fertilizer and pest control material and medicine for livestock. Neem enjoys a wide range of climatic and edaphic factors. It is successfully grown in arid, semi-arid, wet tropical and sub-tropical climates. It is tolerant to high temperature up to 49^{o}C but susceptible to excessive frost and water logged conditions (Hegde, 1993). Its performance is well on poor, shallow, stony or sandy soils and can be established easily without irrigation in hot and dry regions with low annual rainfall of 500 mm or less. It can be planted at farm/field boundaries, road sides, canal banks, river banks and wherever any space is vacant. Neem is the most ideal tree known to be successful under various agroforestry systems. Many Indian companies are currently engaged in processing neem seeds for extracting *Azadirachtin.* A large number of liquid and powdered formulations are being marketed in India. Although, this tree has tremendous potential, but till now it is to be exploited for full genetic potential in terms of growth and Azadirachtin content. By increasing Azadirachtin content more than 0.50 % in seed kernel much better price would be fetched (Gupta e*t. al.* 2010). Realizing the economic potential of neem products in world market and good adaptability in wider climatic conditions and land situations in India, Central Agroforestry Research Institute, Jhansi collected a good amount of neem germplasm from nine states and evaluated critically for all the important characters and published in the form of "Neem catalogue" (Gupta *et. al.* 2011).

Materials and Methods

Ten promising neem strains identified through evaluation of germplasm at Central Agroforestry Research Institute, Jhansi acquired to evaluate for growth and morphological traits under agroforestry system under semi-arid and rainfed condition in Rajasthan. The selected neem strains were planted at Western Regional Research Station of Indian Grassland and Fodder Research Institute, Avikanagar, (Rajasthan) situated between latitude 26^{o}18'-37'' N and longitude 75^{o}25'-50" E at 326 m above mean sea level. The climate of the Avikanagar is semi-arid with an average rainfall of 600 mm and mean maximum temperature varied from 40-45^{o}C in summer and minimum of 5-6^{o}C in winter. The soil of evaluation site was sandy with low water retention capacity and light in texture. A field experiment was laid out in Randomised Block Design in a plot size of 18 x 12 m sq. One year old saplings were planted in the spacing of 6x6 m plant geometry during July 2009. The inter spaces of plantation were used for growing of crops, pearl millet (var. AVKB-19) and clusterbean (Bundel Guar-1) during kharif season of 2010-14. These crops were sown in alternate strips of 2.1 m width by tractor operated seed drill machine. As control pearl millet and clusterbean crops were cultivated without neem trees. Observations for growth parameters of neem were recorded from the age of 2.5 years. The height of individual tree was measured from the ground level to the tip of the main branch. Diameter at breast height (DBH) was measured with the help of tree caliper at 1.37 m above ground level. For canopy spread average diameter of two directions (N-S and E-W) was measured for each tree. Tree pruning at their 50% height of each branch was done during the month of December 2012, 2013 and 2014 for recording leaf biomass. Out of six plants per plot of each strain, two separate plants were pruned in each year for leaf biomass recording. All the leaves were detached from the pruned branches for weighing the foliage production per plant.

Results and Discussion

Analysis of variance for growth and morphological traits revealed that at the age of 2.5, 3.5, 4.5 and 5.5 years there was significant difference among the neem strains for growth parameters *viz.* tree height, stem diameter and leaf biomass production. Canopy diameter at the age of 2.5 and 3.5 was significant but at the age of 4.5 and 5.5 years it showed non significant difference. Most of promising strains gave higher growth rate as compared to local strain for most of the parameters. On the basis of growth parameters observed during four years (2011-14) strain-5 found best followed by strain-3. The average per year growth rate of strain-5, strain-3 and local strain for tree height was 1.43, 1.37 and 1.07 m for DBH 3.77, 3.90 and 3.10 cm for leaf biomass production 18.6, 18.5 and 15.0 kg/tree, respectively. (Table 1) Morphological traits *viz.* number of primary branches and width of leaflet showed significant difference, while leaf length, number of leaflet per leaf and leaflet length were not significantly differed. The seed of best strains will be collected and supplied to Forest Department for propagating through its nurseries. The fodder and grain yield of pearl millet and clusterbean under different neem strains was not significantly different up to the age of 4 years, while at the age of 5 years the fodder and grain both decreased significantly irrespective of neem strains as compared to control (crops without neem trees). The reduction in productivity of crops is believed to be due to shading effects. Clusterbean crop is highly sensitive to the shade as it was severely affected by powdery/downy mildew disease under shade. On the other hand pearl millet crop become highly vulnerable to bird damage due to dense neem plantation.

Table 1: Growth parameters of neem strains under semi-arid conditions during 2011-14 at Avikanagar, Rajasthan.

Neem strain	Plant height (m)				Stem diameter at breast height (cm)				Canopy diameter (m)				Leaf biomass (kg/plant)		
	2.5 yr	3.5 yr	4.5 yr	5.5 yr	2.5 yr	3.5 yr	4.5 yr	5.5 yr	2.5 yr	3.5 yr	4.5 yr	5.5 yr	3.5 yr	4.5 yr	5.5 yr
Local strain	2.6	4.1	5.0	5.8	3.2	6.0	9.7	12.5	1.3	2.9	3.9	4.8	3.9	19.6	33.9
Strain-1	3.4	5.0	5.4	6.3	4.8	7.2	13.3	15.6	1.9	3.4	3.8	4.8	12.4	22.4	37.8
Strain-2	3.7	5.0	5.8	6.4	5.2	7.3	13.6	15.2	2.0	3.4	4.0	5.0	10.0	17.8	32.2
Strain-3	3.9	5.0	6.7	8.0	5.5	7.8	15.2	17.2	2.3	3.8	4.0	5.5	10.8	28.6	47.7
Strain-4	3.7	4.9	5.7	6.4	4.6	7.5	10.9	15.3	2.1	3.6	4.4	5.4	9.3	19.6	36.3
Strain-5	3.8	5.2	6.9	8.1	5.3	7.8	15.6	16.6	2.2	3.4	4.4	6.1	15.6	31.3	52.7
Strain-6	3.9	5.1	5.8	6.6	4.3	5.9	11.5	13.3	1.7	3.3	4.2	5.0	8.0	19.1	37.3
Strain-8	3.7	4.9	5.8	6.8	5	6.9	13.9	14.5	2.0	3.2	4.6	5.7	11.6	25.1	40.5
Strain-9	3.8	5.3	5.5	6.4	5.5	7.5	13.2	17.3	2.0	3.4	4.1	4.9	10.9	22.6	36.6
Strain-10	3.8	4.8	5.9	6.9	5.8	7.7	15.4	16.8	2.2	3.7	4.0	5.4	11.6	24.2	43.4
Strain-11	3.8	5.0	5.1	6.0	5.1	7.1	13.2	15.3	2.1	3.3	3.8	4.7	7.7	20.5	34.9
Mean	3.6	4.9	5.8	6.7	4.9	7.2	13.4	15.4	2.0	3.4	4.1	5.2	10.2	22.8	39.4
CD (5%)	0.47	0.59	1.0	0.62	0.78	0.92	1.7	2.33	0.43	0.45	NS	0.83	2.83	3.73	10.21

Conclusion

Cultivation of the pearl millet and clusterbean crops under neem tree is not economic after five years age of neem trees with the plant geometry of 6x6 m. Clusterbean crop is highly sensitive to the shade as compared to pearl millet.

References

Gupta, V.K., S. P. Ahlawat, R. V. Kumar and A. Ajit Datta. 2010**.** Effect of season and year on azadirachtin A and oil content in neem (*Azadirachta indica* A. Juss) seeds and relationship of azadirachtin A and oil content with rainfall, temperature and humidity. *Current Science* 99: 953-956

Gupta V. K., S. K. Dhyani, S. P. Ahlawat, R. V. Kumar, Ajit, A. Datta and R. Tiwari. 2011. *Neem germplasm catalogue*. National Research Centre for Agroforestry, Jhansi (UP), India pp 67.

Hegde, N. G., 1993. Neem production and development - constraints at grass root level. In *Souvenir of World Neem Conference* , pp. 1-7. Indian Society of Tobacco Science, CTRI, Rajamundry (A.P.) India.

Ram Mohan, H.Y., and M.N.B. Nair. 1993. Botany. *Neem Research and Development*. pp. 6-26. Society of Pesticide Science. India.

Acknowledgement

Sincere gratitude goes to the Director, Central Agroforestry Research Institute, Jhansi for providing saplings of ten promising neem strains. Authors are grateful to Dr. VG Gupta for providing passport data and guidance for observation of neem trees.