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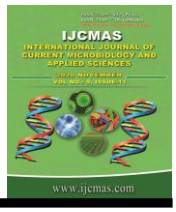

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Economics of Out-planting of Important Agroforestry Species with Different Organic Inputs in South-eastern Rajasthan

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A B S T R A C T

A field experiment was conducted to study the out- planting performance of *Dalbergia sissoo* Roxb. and *Moringa oleifera* Lam. plant at Harbal Garden, College of Horticulture and Forestry, Jhalawar (Rajasthan) from July, 2019 to March, 2020. The out planting experimental design was randomized block design (RBD) with three replication and at 5 x 5 m (R x P) spacing with ten treatments for both the species separately. Doses of organic inputs (sand, FYM and/or vermicompost) were given in different quaninty as well as at different time. In out planting of *Dalbergia sissoo*, However, treatment T_8 being costlier shown highly significant growth on many growth parameters and then treatment T_7 . In *Moringa oleifera* out planting significantly highest growth parameters were recorded in treatment T_7 and then T_9 while statically significant minimum value was recorded in treatment T_0. The economics of cultivation of shisam (*Dalbergia sissoo*) observed during the experiment and whole year on per plant basis that highest cost on out planting found in treatment T_9 and had a value Rs 97 & Rs 109.17 respectively and Rs. 43,666.67 per hectare and a minimum cost of out planting was recorded in treatment T_0 [soil: control] which has value Rs 45.00 from initial to 240 DAP per plant and Rs. 57.17 in whole year while Rs 22,866.67 cost in one hectare area in the first year.

Introduction

Agroforestry as a land-use option potentially increases livelihood security through simultaneous production of food, fodder, firewood etc. and reduces vulnerability to climate and environmental change (Pandey, 2007; Tiwari *et al.*, 2017). Concurrently, the agroforestry moderates micro-climate (reduction of wind speed, stabilization of daily mean temperature, modification of solar radiation, increase of air humidity and decrease of evaporation) and mitigates land degradation through the means of controlling water erosion, soil erosion, reclaiming marginalized land and increasing irrigation and agricultural productivity (Jerneck and Olsson, 2013; Oyebamiji *et al.*, 2013). With their multi-layered vegetation structures, agroforestry plantations serve as an important habitat for wild flora and fauna. Generally, plantation is a large group of plants and especially trees under cultivation. A

plantation is a large piece of land, especially in a tropical country, where crops such as rubber, coffee, tea, etc. are grown.

India having the vast potential of organic sources can effectively utilize this to sustain yield, improve soil aeration, permeability, aggregation, water and nutrient holding capacity, biological properties of soil and soil health.

Dalbergia sissoo Roxb. is one of the tropical timber tree species with multiple uses such as fuel wood, fodder, pulp, shade, shelter and N-fixing ability (Sharma *et al.,* 2007). It is widely used in agroforestry and afforestation programmes in Indian subcontinent (Chander *et al.,* 1998 and Huda *et al.,* 2007). The tree is a strong light- demander right from the seedling stage. Being a pioneer tree species, requires full overhead light for successful regeneration and establishment. It has light crown and reproduces by seeds and suckers. Trunks are often crooked when grown in the open. Various compounds obtained from Shisham such as isoflavone, biochanin is a potent chemotherapeutic cancer preventive agent, estrogenic activity from the fresh flowers of *D. sissoo*.

Moringa is a suitable tree for agro-forestry system due to its deciduous nature erects growth habit, light foliage and strong coppicing power. It is drought resistant and can be grown in a wide variety of poor soils, even barren land, with soil pH between 4.5 and 9.0.

Moringa oleifera Lam. can be grown by seeds or cuttings and seeds had better results than using the cuttings. Seeds are planted 2 cm deep and germinate within 1-2 weeks (Kiragu *et al.,* 2015) in any tropical and subtropical regions of the world with a temperature around 25–35°C. It requires sandy or loamy soil with a slightly acidic to slightly alkaline pH and a net rainfall of 250–3000 mm (Thurber and Fahey, 2010) but high rainfall in black cotton soil is not favorable for its cultivation. Germination rates are usually very good, as found out in India, but survival can drop to 0 % after two weeks.

India is the largest producer of drumstick globally and Andhra Pradesh is the largest producing state of India followed by Karnataka and Tamil Nadu in both area and production (Barela *et al.,* 2019). Various parts of Moringa plant such as the leaves, roots, seed, bark, fruit, flower and immature pods are used for food, certain nutritional and/or medicinal propose (Rebecca *et al.,* 2006); (Muhl, 2009), water treatment and also an important source of income for local and national economies (Kiragu *et al.,* 2015), for fodder and its gum is used in textile industries (Paliwal & Sharma, 2011).

Materials and Methods

The present research was conducted at the Herbal Garden, College of Horticulture and Forestry, Jhalrapatan city, Jhalawar (Rajasthan). Geographically, Jhalawar district falls in zone-V i.e. humid south-eastern plains. The district is bounded on the northwest by Kota district, on the northeast by Baran district, on the east by Guna district of Madhya Pradesh state, on the south by Rajgarh and Shajapur districts of Madhya Pradesh state and on the west by Ratlam, Mandsaur and Nimach districts of Madhya Pradesh state. The district occupies an area of 6928 km² and district lies in the south eastern corner of Rajasthan between Latitude 23°45’20” to 24°52’17” & Longitude 75°27’35” to 76°56’48”. The district head quarter Jhalawar is situated on the national highway no. 12 about 85 Km from Kota. Total area under forest is about 127328 ha and cultivated land is 336562 ha. Average annual rainfall is 919.6 mm. Agriculture and

forest lands occupy 73.5 percent area in the district.

Following doses of Sand, FYM and Vermicompost were given to each treatment with three replication are given in the Table 1.

The initial expenditure in terms of rupees per plant and per treatment was worked out on the basis of cost of cultivation of each treatment per plant and per hectare.

Results and Discussion

Shisam (*Dalbergia sissoo*)

The economics of cultivation of shisam (*Dalbergia sissoo*) is presented in Table 2 and graphically in Figure 1. In whole period of the experiment, the highest cost on out planting was observed in treatment T_9 [Vermicompost (2 kg at basal application + 1 kg in October, 2019 + 1 kg in January, 2020) + FYM (2 kg at basal application + 1 kg in October, 2019 + 1 kg in January, 2020)] and had a value Rs 1160, Rs 1310 in whole year and Rs 43,666.67 cost/ha. Followed by T_8, T_7, T_6, T_5 and minimum cost of out planting was recorded in treatment T_0 [soil: control] which has value Rs 536 from initial to 240 DAP and Rs 686 in whole year while Rs. 22,866.67 cost in one hectare area in first year. Similar trends was observed by Dahiya (2002) in Ber cultivation in Rohtak district of Haryana; Meena *et al.,* (2018) in *Psidium guava*. Barela *et al.,* (2019) in *Moringa oleifera* L.; Nasreen *et al.,* (2013) in Mandarin (*Citrus reticulata*) with the combined application of N, P, K and Mg along with organic manure; Bakshi *et al.,* (2018) recorded in Kinnow Mandarin cultivation using inorganic and organic inputs along with bio fertilizers.

Saijana (*Moringa oleifera*)

Where as in case of Saijana (*Moringa oleifera*), it is presented in Table 3 and graphically in Figure 2. In whole period of the experiment, the highest cost on out planting was observed in treatment T_9 [Vermicompost (2 kg at basal application + 1 kg in October, 2019 + 1 kg in January, 2020) + FYM (2 kg at basal application + 1 kg in October, 2019 + 1 kg in January, 2020)] and had value Rs 1184, Rs 1334 in whole year and Rs 44,466.67 cost/ha. followed by T_8, T_7, T_6, T_5 and minimum cost of out planting was recorded in treatment T_0 [soil: control] which has value Rs 560 from initial to 240 DAP and Rs 710 in whole year while Rs 23666.67.

Table.1 Treatment name, organic inputs and various doses of inputs at different period

Treatment Name	Treatment inputs, Quantity (Kg. per plant) (Dose=Basal dose + Oct-19 + Jan-20)
T_0	Soil (Control)
T_1	Sand [1 kg as basal application only]
T_2	FYM [2 kg as basal application only]
T_3	1 kg as basal application only
T_4	Sand : FYM [1 kg. sand + FYM (1+1+1)]
T_5	Sand : FYM [1 kg. sand + FYM (2+1+1)]
T_6	Sand : Vermicompost [1 kg. sand + Vermicompost (1+1+1)]
T_7	Sand : Vermicompost [1 kg. sand + Vermicompost (2+1+1)]
T_8	Vermicompost + FYM [Vermicompost (1+1+1) + FYM (1+1+1)]
T_9	Vermicompost + FYM [Vermicompost (2+1+1) + FYM (2+1+1)]

Table.2 Influence of various growing media on economics of cultivation of Shisam (*Dalbergia sissoo*)

Treatments (Dose=Basal dose + Oct-19 + Jan-20)	*Dalbergia sissoo* - Economics of cultivation (Rs) during the experiment										Cost (Rs) in whole year			
	Pits digging	Cost of growing media (Rs)			Seedling (including transport) cost (Rs)	Stacking cost (Rs)	Labour cost (Rs)		Total cost (Rs)	Cost per plant (Rs)	Cost in remaining months of year	Total cost (Rs)	Cost per plant (Rs)	Total cost (Rs) per ha
		Sand	FYM	Vermi-compost			Irrigation	Weeding			Weeding & Irrigation			
T_0	120	0	0	0	156	60	100	100	536	45	150	686	57.17	22866.67
T_1	120	48	0	0	156	60	100	100	584	49	150	734	61.17	24466.67
T_2	120	0	120	0	156	60	100	100	656	55	150	806	67.17	26866.67
T_3	120	0	0	96	156	60	100	100	632	53	150	782	65.17	26066.67
T_4	120	48	180	0	156	60	100	100	764	64	150	914	76.17	30466.67
T_5	120	48	240	0	156	60	100	100	824	69	150	974	81.17	32466.67
T_6	120	48	0	288	156	60	100	100	872	73	150	1022	85.17	34066.67
T_7	120	48	0	384	156	60	100	100	968	81	150	1118	93.17	37266.67
T_8	120	0	288	180	156	60	100	100	1004	84	150	1154	96.17	38466.67
T_9	120	0	384	240	156	60	100	100	1160	97	150	1310	109.17	43666.67
Total (Rs)	**1200**	**240**	**1212**	**1188**	**1560**	**600**	**1000**	**1000**	**8000**		**1500**	**9500**		

*Note:

1. Tractor + pit digging cost = Rs 10 per pit
2. Cost of Sand = Rs 4 per kg
3. Cost of FYM = Rs 5 per kg
4. Cost of Vermicompost = Rs 8 per kg
5. Seedlings (including transport cost) purchase cost = Rs 13 per plant
6. Bamboo sticks for stacking = Rs 5 per stick
7. Labour cost = Rs 250 per labour/day

Table.3 Influence of various growing media on economics of cultivation of Saijana (*Moringa oleigera*)

Treatments	*Moringa oleifera* - Economics of cultivation (Rs) during the experiment										Cost (Rs) in whole year			
	Pits digging	Cost of growing media (Rs)			Seedling (including transport) cost (Rs)	Stacking cost (Rs)	Labour cost (Rs)		Total cost (Rs)	Cost per plant (Rs)	Cost in remaining months of year	Total cost (Rs)	Cost per plant (Rs)	Total cost (Rs) per ha
		Sand	FYM	Vermi-compost			Irrigation	Weeding			Weeding & Irrigation			
T_0	120	0	0	0	180	60	100	100	560	47	150	710	59.17	23666.7
T_1	120	48	0	0	180	60	100	100	608	51	150	758	63.17	25266.7
T_2	120	0	120	0	180	60	100	100	680	57	150	830	69.17	27666.7
T_3	120	0	0	96	180	60	100	100	656	55	150	806	67.17	26866.7
T_4	120	48	180	0	180	60	100	100	788	66	150	938	78.17	31266.7
T_5	120	48	240	0	180	60	100	100	848	71	150	998	83.17	33266.7
T_6	120	48	0	288	180	60	100	100	896	75	150	1046	87.17	34866.7
T_7	120	48	0	384	180	60	100	100	992	83	150	1142	95.17	38066.7
T_8	120	0	288	180	180	60	100	100	1028	86	150	1178	98.17	39266.7
T_9	120	0	384	240	180	60	100	100	1184	99	150	1334	111.2	44466.7
Total (Rs)	**1200**	**240**	**1212**	**1188**	**1800**	**600**	**1000**	**1000**	**8240**		**1500**	**9740**		

*Note:

1. Tractor + pit digging cost = Rs 10 per pit
2. Cost of Sand = Rs 4 per kg
3. Cost of FYM = Rs 5 per kg
4. Cost of Vermicompost = Rs 8 per kg
5. Seedlings (including transport cost) purchase cost = Rs 15 per plant
6. Bamboo sticks for stacking = Rs 5 per stick
7. Labour cost = Rs 250 per labour/day

Fig.1 Influence of various growing media on economics of cultivation of Shisam (*Dalbergia sissoo*)

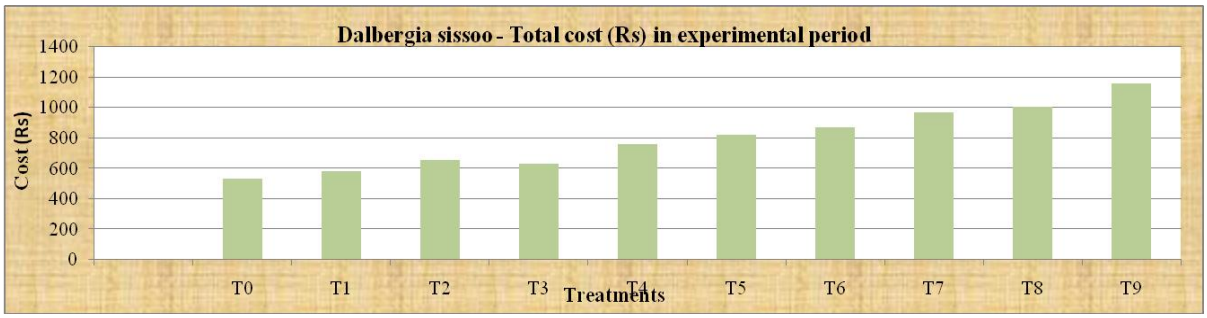
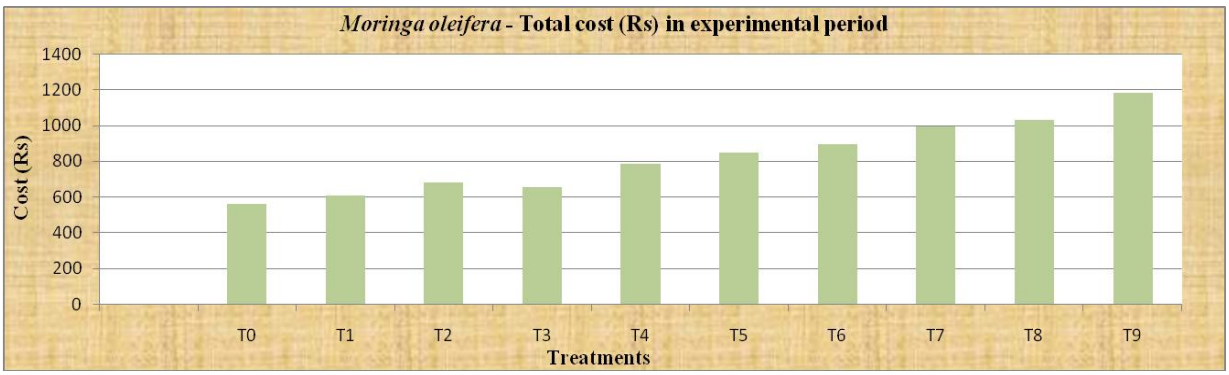


Fig.2 Influence of various growing media on economics of cultivation of Saijana (*Moringa oleigera*)



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