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SURVEY AND COLLECTION OF *JATROPHA CURCAS* LINN. GERMPLASM IN CHIKKAMAGALURU, SHIVAMOGGA AND CHITRADURGA DISTRICTS OF KARNATAKA, INDIA

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Abstract

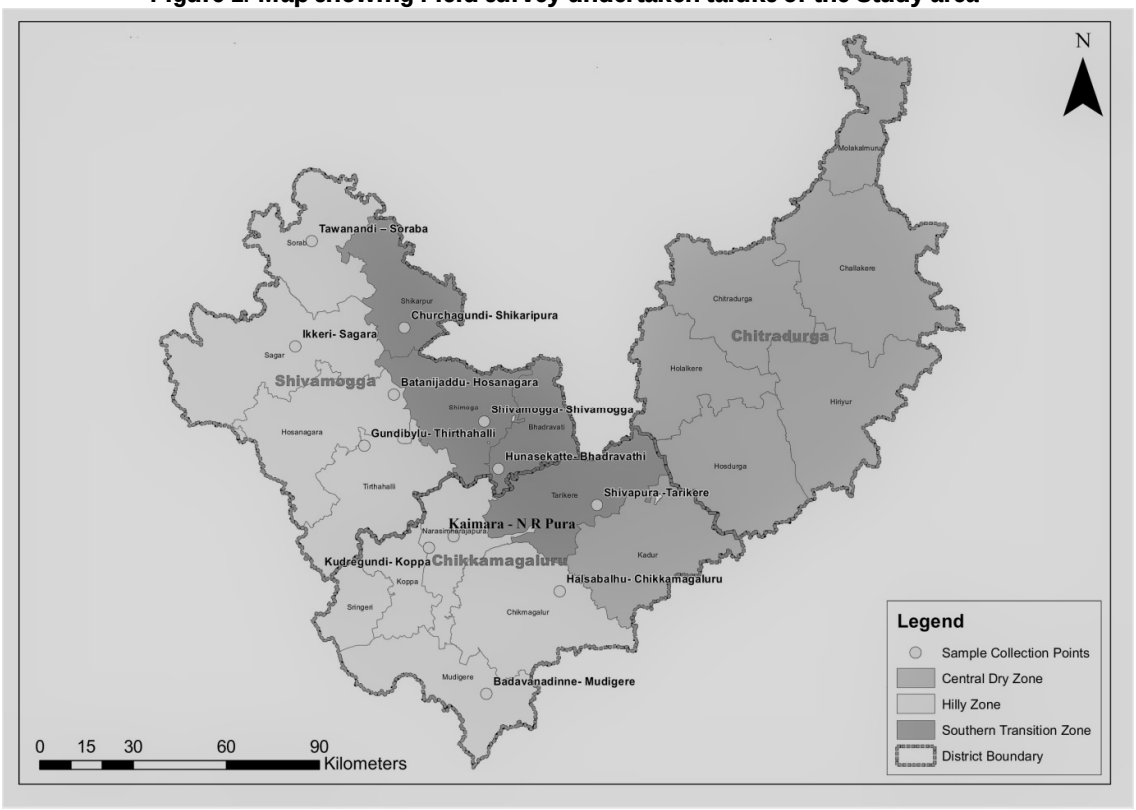
Jatropha curcas Linn. endemic to Tropical America is a drought-resistant plant which recently gained much importance in Asia and Africa as a biodiesel crop. Though it has wide cultivation in these areas the characterization and conservation of genetic resources remain poor. The present study focuses on surveying and collection of J. curcas germplasm in the study area. The study area falls under three different Agro-climatic zone of Karnataka viz., Southern Transition Zone (STZ), Hilly Zone (HZ) and Central Dry Zone (CDZ). All the taluks falling under STZ showed the incidence of J. curcas cultivation. In HZ except for Sringeri, all the taluks had an occurrence of J. curcas. The nonoccurrence of Jatropha plants in this area had been found mainly because of behavioral factor rather than environmental. In none of the taluks of CDZ which included entire Districts of Chitradurga and Kadur taluk of Chikkamagaluru district, J. curcas cultivation was found. The unawareness shown by farmers to the crop was found to be the reason for the non cultivation of Jatropha plants in these areas. Among the districts, in Shivamogga all the taluks had a prevalence of J. Curcas cultivation. In all the surveyed area J. curcas was grown as a hedge plant. The accessions belonging to drier regions of STZ had more fruit density per meter of live fence than the accessions of HZ with wet climate.

Keywords: *Jatropha curcas*, STZ, HZ, CDZ, hedge plant, STJCA1-A12.

INTRODUCTION

In the 15th century, the Portuguese introduced the Jatropha to Asian and African continents [1]. *Jatropha curcas* L. is a drought resistant shrub/tree belonging to the family Euphorbiaceae [1, 2]. In recent past *Jatropha curcas* L. has been considered as a potential biodiesel candidate in more than 50 countries. The reason being Jatropha biodiesel oil conforms to the International standards [3, 4, 5, 6]. According to [7] there are more than 2.5 million hectares of J. curcas planted in India and China alone. Even after such interest being shown in the large-scale cultivation of J. curcas, characterization and conservation of genetic resources remain poor [8]. According to [9] there is little work done on germplasm collection in J. curcas. Therefore in the present study attempts are made for to survey and collect J. curcas germplasm in Chikkamagaluru, Shivamogga and Chitradurga districts of Karnataka, India.

Figure 1: Map showing Field survey undertaken taluks of the Study area



METHODOLOGY

Field trips were undertaken from June 2016 to October 2016 for surveying the area under *Jatropha curcas* cultivation mainly to collect the germplasm. With the available literature and consulting local farmers' Jatropha growing areas were identified and visited consistently [10]. Visual observations were made for the collection of fruits from healthy looking matured plants. The physiologically ripened fruits ranging from yellow to dark brown to deep black color were plucked [8] and separately pooled into polythene bags and labeled accordingly. Then they were carried to the laboratory. Meanwhile, passport data of the collected accessions were maintained by recording the Latitude and longitude of the place with the help of handy GPS mobile handset app tool. The data obtained had ± 3 meter accuracy. The GIS map was created by using ARC GIS version 10.1 software.

Fruit Yield per meter of live Fence: [11] had opined that Fruit set had the highest positive direct path towards seed yield/plant. In our study, we had adopted a modified method of [12] for measuring the yield of hedge crop - Jatropha curcas. The yield was measured by counting the number of ripened fruits per meter of live fence. A measuring tape was laid along the fence and for every one meter counting was done [12]. The measuring was done thrice during the peak season i.e. June to September. Meanwhile, soil samples of the respective collection sites were collected and later sent to Leaf Analysis Laboratory, Bioscience Centre, Horticulture Department, Government of Karnataka, Shivamogga for analysis. The fruits brought into laboratory were shade dried. The dried fruits were dehusked and thus obtained seeds were shade dried. The dried seeds were cleaned and packed into polythene bags by giving unique Accession number.

The data related to weather was obtained from the website maintained by Karnataka State Natural Disaster Monitoring Centre, A registered society of Government of Karnataka.

The data's pertaining to results were subjected to ANOVA using software XLSTAT 2017.5.47365 version.

RESULT AND DISCUSSION

The information related to Altitude, Latitude, and Longitude of the surveyed places of Chikkamagaluru district were given in Table 1. Seeds representing each location were represented with Accession number ranging from 01, 02, 07, 08 and 10. *Jatropha curcas* was to be found growing as a hedge plant near the farm, around plantations and house plots in these surveyed areas.

Among the seven taluks of Chikkamagaluru, Tarikere falls under Southern Transition Zone (STZ). While Chikkamagaluru, Mudigere, Narasimharajapura (N.R.Pura), Koppa, and Sringeri falls under Hilly Zone (HZ).

In the hilly tracts of Chikkamagaluru taluk (STJCA8) and the plain areas of Tarikere taluk (STJCA1), the plant to plant distance was around one meter. Unlike the results of [8] who found an occurrence of Jatropha mainly in level topography, the present study found Jatropha growth even in undulating topography. This was similar to the findings of [13] where the distribution of Jatropha plants was found both in plain and undulating topography. In Koppa taluk (STJCA10) only at few residential houses, Jatropha plants were grown as a hedge crop. In Sringeri taluk for fencing of farms, plantation and residence plot other hedge crops were used. Hedge crops need regular pruning and during the activity, the latex from Jatropha plants causes a stain on clothes. This according to farmers of the region is a deterrent and is the main reason for choosing alternative hedge crops. Thus rather than the environmental factor, it is the people's behavior in this region which discourages Jatropha cultivation.

On the other hand, Kadur comes under Central Dry Zone (CDZ) and in the entire taluk, there was no incidence of *Jatropha curcas* cultivation. Farmers in this region showed their ignorance towards the crop.

In Table 1. Latitude, Longitude, and Altitude of surveyed places of Shivamogga district were being provided. Seed sample representing each location was represented with Accession number ranging from 03, 04, 05, 06, 09, 11 and 12.

Table 1: Showing list of Places of Sample Collection with Coordinates

Sl No	Place	Altitude (In meter)	Latitude	Longitude	Accession number	Agro-climatic Zone
1.	Shivapura-Tarikere	774	13° 40' 26.81" N	75° 55' 38.53" E	STJCA1	STZ
2.	Kaimara- N R Pura	712	13°35'8.53" N	75°29'57.74" E	STJCA2	HZ
3.	Shivamogga-Shivamogga	577	13°55'5.57" N	75°35'28.99" E	STJCA3	STZ
4.	Tawanandi– Soraba	617	14°26'48.58" N	75°4'42.09" E	STJCA4	HZ
5.	Churchagundi-Shikaripura	613	14°11'38.8" N	75°21'11.7" E	STJCA5	STZ
6.	Ikkeri- Sagara	628	14°8'27.35" N	75°1'44.27" E	STJCA6	HZ
7.	Badavanadinne-Mudigere	933	13°7'41.05" N	75°35'45" E	STJCA7	HZ
8.	Halsabalhu-Chikkamagaluru	1072	13°25'29.48" N	75°48'52.89" E	STJCA8	HZ
9.	Batanijaddu-Hosanagara	667	13°59' 59.54" N	75° 19' 19.88 E	STJCA9	HZ
10.	Kudregundi-Koppa	676	13°33'8.57" N	75°25'35.34" E	STJCA10	HZ
11.	Hunasekatte-Bhadravathi	635	13°46'49.83" N	75°37'59.64" E	STJCA11	STZ
12.	Gundibylu-Thirthahalli	676	13°50'56.65" N	75°14'1.03" E	STJCA12	HZ

Note: STZ-Southern Transition Zone; HZ- Hilly Zone;
STJCA-SEED TECHNOLOGY JATROPHA CURCAS ACCESSION

The incidence of *Jatropha curcas* cultivation was found in all the seven taluks of Shivamogga district. Among the seven taluks of Shivamogga, including Shivamogga, Shikaripura and Bhadravathi come under Southern Transition Zone (STZ). While Soraba, Sagara, Hosanagara, and Thirthahalli falls under Hilly Zone (HZ).

The Jatropha plants collected in Soraba taluk (STJCA4) were showing luxuriant vegetative growth compared to rest of the Accessions within the Shivamogga districts. The tallest Jatropha plants were observed in Hosanagara Taluk (STJCA9) attaining a height of up to 5 meters. This was mainly because of lack of pruning activity. In Sagara Taluk (STJCA6), the incidence of Jatropha growth was restricted to in and around few residential houses as a hedge plant. Here the Jatropha plants were found intermixed with other hedge plants. The number of fruits bore by these plants was one of the fewest among the accessions of Shivamogga district. All the taluks falling under hilly zones of Shivamogga district showed the incidence of Jatropha cultivation.

Entire Chitradurga district with six taluks comes under Central Dry Zone (CDZ). Though extensive field trip was undertaken throughout the Chitradurga district, the prevalence of Jatropha cultivation was not at all found in any of the taluks. Like farmers' of Kadur taluk which falls under CDZ, the Chitradurga farmers also showed their ignorance to the crop. Similar to our results, in the survey conducted by [14] they did not find any Jatropha specimens in arid climates. According to them Jatropha species are uncommon in arid climates and hold the risk of low productivity and irrigation requirement when introduced into such regions.

Fruit yield per meter of live fence (Table 2) – STJCA1, STJCA3, STJCA5, and STJCA11 all belonged to Southern Transition Zone (STZ). Within STZ the number of fruits per one meter live fence was recorded highest among STJCA5 (40). While minimum recorded was in STJCA3 (24). The mean value obtained for the parameter within STZ was 31.00±4.390. The variation observed was significant at 5%

level. The post hoc analysis shows significant variations in the said parameter between STJCA5 and STJCA3.

Table 2: Fruit Yield per Meter of Live Fence

	STZ				HZ							
Accession → Replication ↓	STJ CA1	STJ CA3	STJ CA5	STJ CA11	STJ CA2	STJ CA4	STJ CA6	STJ CA7	STJ CA8	STJ CA9	STJ CA10	STJ CA12
R1	32	27	36	29	23	35	10	17	34	28	6	18
R2	35	28	40	30	25	36	11	20	35	30	10	20
R3	31	24	32	28	21	34	7	16	33	26	5	15
Mean	**32.67^{ab}**	**26.33^{c}**	**36^{a}**	**29^{bc}**	**23^{C}**	**35^{A}**	**9.33^{E}**	**17.67^{D}**	**34^{A}**	**28^{B}**	**7^{E}**	**17.67^{D}**

Within STZ				Within HZ			
Total Mean	31.000	Standard Deviation	4.390	Total Mean	21.458	Standard Deviation	10.164
MSE	6.417	CD @ 5%	8.346	MSE	4.000	CD @ 5%	82.570
R^2	0.758			R^2	0.973		

Between STZ and HZ			
Total Mean	24.639	Standard Deviation	9.734
MSE	76.116	CD @ 5%	9.569
R^2	0.220		

Note: MSE-Mean Standard Error; STZ-Southern Transition Zone; HZ- Hilly Zone; Means with same letter show no significant variation.

Hilly Zone (HZ) had accessions- STJCA2, STJCA4, STJCA6, STJCA7, STJCA8, STJCA9, STJCA10, and STJCA12. Within HZ the Mean number of fruits per one meter of live fence was 21.458±10.164. The values for the parameters ranged from minimum 05 (STJCA10) to maximum 36 (STJCA4). At 5% level, the variation obtained was significant. The post hoc analysis interpretation exhibits significant variations by STJCA9 and STJCA2 with all other accessions and also between them. On the other hand STJCA7 and STJCA12, STJCA6 and STJCA10, STJCA4 and STJCA8 did not show any significant variations between them.

The Mean value for both the zone combined was 24.639±9.734. The interaction between the STZ and HZ showed significant variation between them at 5% level.

The Mean Value of over 30 fruits per meter of live fence for Southern Transition Zone was observed in STJCA1, STJCA5 and for Hilly Zone in STJCA4, STJCA8. The soil samples of areas of the respective accessions (SA1, SA5, SA4, and SA8) showed optimum to high Organic carbon and Nitrogen availability (Table 3). On the other hand, the low Mean yield of fewer than 10 fruits per meter of the live fence was observed in STJCA10 and STJCA6. The soil samples of the areas belonging to these two accessions showed low Organic carbon and Nitrogen availability. The study conducted by [15] found that the highest fruit production was observed at optimum Nitrogen application. While in Nitrogen control the fruit yield was low. This points out J. curcas' high demand for nitrogen for seed/fruit production. According to [16] and [17], the Nitrogen deficiency might also impose a low demand of plants for other major nutrients like K, P, and secondary nutrients like Ca, S and Mg as the nitrogen deficient organs may not provide high sink strength.

With Annual rainfall ranging from 633.89 mm to 891.54 mm in 2016 Southern Transition Zone recorded Mean number of fruits per meter of live fence at 31.00±4.390. On the other side with annual rainfall ranging from 924.19 mm to 2168.58 mm in 2016 Hilly Zone registered Mean number of fruits per meter of live fence at 21.458±10.164. Compared to accessions of HZ, STZ accessions showed better fruit yield with less Annual Rainfall (Table 3).

Table 3: Meteorological and Soil Analysis Details

2016			Meteorology (Mean Annual)			Soil analysis				
Zone	Accessions	Soil sample	Rainfall (mm)	Humidity	Temperature	OC	N	P	K	pH
STZ	STJCA1	SA1	670.84	62.75417	25.22083	0.85	308.448	13.51	186.54	6.11
	STJCA3	SA3	891.54	64.5425	26.575	1.02	370.1376	1.86	50.66	6.31
	STJCA5	SA5	633.89	63.42083	25.675	1.38	500.744	5.49	570.25	6.85
	STJCA11	SA11	749.27	70.07917	25.35583	0.81	293.9328	4.54	242.86	6.42
HZ	STJCA2	SA2	1125.64	68.005	25.4525	1.06	384.6528	5.8	583.96	6.54
	STJCA4	SA4	924.19	67.76167	25.90167	1.72	624.1536	2.74	114.37	6.37
	STJCA6	SA6	1117.38	72.4725	25.81083	0.63	228.6144	1.47	149.99	6.55
	STJCA7	SA7	1297.83	65.91167	23.4	0.69	250.3872	4.01	247.69	6.44
	STJCA8	SA8	933.84	63.645	25.515	1.46	529.8048	2.85	359.65	6.33
	STJCA9	SA9	1485.32	79.56667	24.36667	1.39	504.4032	2.64	289.36	6.17
	STJCA10	SA10	1844.24	74.06667	26.17	0.5	181.44	14.67	203.75	7.99
	STJCA12	SA12	2168.58	69.03167	25.76583	1.15	417.312	10.94	43.81	5.87

[Source: https://www.ksndmc.org]

Note: STZ-Southern Transition Zone; HZ- Hilly Zone; OC- Organic Carbon, N-Nitrogen, P-Phosphorous, K-Potassium,

CONCLUSION

Of the surveyed areas of three district falling under three different zones, all the taluks of Southern Transition Zone had shown the incidence of *Jatropha curcas* cultivation. The plants observed here were healthy. In the Hilly Zone except for Sringeri in all the taluks, Jatropha cultivation was found. The behavioral factor was found to be the main reason for the noncultivation of Jatropha plants in Sringeri. In all the taluks of CDZ, there was no incidence of Jatropha cultivation. Farmers in this zone showed their ignorance toward the crop. Thus in future, there is a fair chance of *Jatropha curcas* being introduced into the Central Dry Zone.

The fruit density per meter of live fence was found to be varying from low to high in the Hilly Zone. The low yield might be mainly because of inadequate soil nutrient. With respect to Fruit yield accessions of STZ with less Annual rainfall fared better than the Hilly Zone accessions. This indicates *Jatropha curcas* being drought resistant crop could do better in general in semi-arid regions compared to wet climate.

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