Tropical and Subtropical Agroecosystems

STUDIES ON AGROBOTANICAL CHARECTERS OF DIFFERENT ACCESSIONS OF VELVET BEAN COLLECTED FROM WESTERN GHATS, SOUTH INDIA

[ESTUDIO DE CARACTERES AGROBOTANICOS DE DIFERENTES ACCESIONES DE FRIJOL TERCIOPELO COLECTADOS EN LOS GHATS OCCIDENTALES, INDIA]

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SUMMARY

Seven different accessions of velvet bean, *Mucuna pruriens* var *utilis,* gathered from different agroecological regions of Western Ghats, South India are evaluated for agrobotanical traits. They exhibited wide diversity in respect of all the investigated characters especially the traits responsible for the overall biomass of the plant. The accession Thachenmalai (black - coloured seed coat) exhibited the highest fertility index, biomass production and seed yield followed by Valanad accession (black – coloured seed coat). Seed recovery percentage ranged between 62.08±0.19% and 88.70±0.50%. Thachenmalai accession registered the highest seed recovery percentage among all the investigated accessions. Besides, the leghaemoglobin content of root nodules, the mineral profiles of soil before and after cultivation of velvet bean were also studied. Kailasanadu (white – coloured seed coat) accession showed relatively high content of leghaemoglobin level compared to the other accessions. The genotypic, phenotypic and environmental variance and their coefficient variance % were also calculated, which indicate that variations in agrobotanical traits are more due to impact of both the genotype and phenotype compared to environmental factors.

Key words: Velvet bean, cover crop, agrobotanical traits, soil mineral profile, Western Ghats.

RESUMEN

Se evaluaron los caracteres agrobotánicos siete accesiones de frijol terciopelo (*Mucuna pruriens* var *utilis*) colectadas de diferentes regiones agroecológicas de los Ghats occidentales del sur de la India. Las accesiones exhibieron una amplia diversidad en todos los caracteres estudiados, especialmente en aquellos responsables de la biomasa total de la planta. La accesión Thachenmalai (semilla con pericarpio de color negro) presento los índices de fertilidad, producción de biomasa y producción de semilla más altos; seguido por la accesión Valanad (semilla de pericarpio negro). El porcentaje de recuperación de semilla vario entre 62.08±0.19% y 88.70±0.50%. La accession Thachenmalai registró el mayor porcentaje de recuperación de semilla entre todas las accesiones. Adicionalmente, se estudió el contenido de leghemoglobina de los nódulos de las raíces y el perfil mineral del suelo antes y después del cultivo de fríjol terciopelo. La accesión Kailasanadu (semilla de pericarpio blanco) mostró contenidos relativamente altos de leghemoglobina en comparación con las accesiones restantes. La varianza genotípica, fenotípica y ambiental y su coeficiente de variación (%) fueron estimados e indicaron que la variación encontrada fue principalmente debida al impacto del genotipo y fenotipo y no debida a factores ambientales.

Palabras clave: Frijol terciopelo, cultivo de cobertera, caracteres agrobotánicos, perfil mineral del suelo, Ghats occidentales.

INTRODUCTION

The velvet bean, *Mucuna pruriens* (L) DC var *utilis* (Wall ex Wight) Baker ex Burck is an under utilized tropical legume. It belongs to the family Fabaceae. The plant is a large twining herb; leaves are pinnately tri-foliolate, terminal leaflet often markedly smaller than laterals; flowers are large, purple or white in colour, the lowest calyx tooth is long and corolla is papilionaceous. Pods are long and linear with hairs; seeds are uniseriate and are white or black in colour (Wilmot Dear, 1987).

The velvet bean is widespread in the Southern, Southeastern and Asian regions (Duke, 1981). It is cultivated as a green

manure / cover crop (Buckles, 1995) and is used as a mixed crop with sugarcane and maize and in rotation with sugarcane in Burma. Besides, this species can be grown in a wide range of soil types including heavy clay and is tolerant of acid soil.

In Southeast Asia, the immature pods and leaves of velvet bean are used as vegetables. The seed has high viscosity starch, which acts as a thickening agent for food products, or as an adhesive in the paper and textile industries (Haq, 1983). Velvet bean has also been reported to have potential for reducing weed populations, partly by smothering weed competition by rapid growth and partly through protective allelochemicals. After conducting crop rotation studies with velvet bean for the management of nematodes, Kloepper *et al* (1991) demonstrated significantly higher yield for cotton, peanut and soyabean, which suggest that the soil building and weed suppression effects are important in addition to nematode control. The seed yield reaches 1.5 – 2.0 tonnes/hec and the yield of fresh leaves and stems is 20-30 t/hec; thus, it is considered to be one of the most productive legumes of the world (Fujii *et al*., 1991).

Interest in developing *Mucuna's* food and feed uses originates in the efforts of many national and international organizations during the 1980s and 1990s. *Mucuna* has repeatedly impressed farmers and researchers due to its high biomass production, weed suppression and consequent beneficial impacts on many crop yields. It has proved to be less impressive in providing more direct benefits to farmers, despite its track record as a food and feed crop.

Although detailed information is available on the nutritional and anti-nutritional properties of velvet bean (*Mucuna pruriens* var *utilis*) (Janardhanan and Lakshmanan, 1985; Ravindran and Ravindran, 1988; Udedibe and Carlini, 1998; Vadivel and Janardhanan, 2000; Siddhuraju *et al*., 2000) there has been relatively few reports on the systematic collection and evaluation of diverse *Mucuna* been accessions. Despite of the potential of this species as a source of food and fodder, to our knowledge, meager information is available on the germplasm collection from South India and their evaluation for agrobotanical traits (Vadivel and Janardhanan, 2000; Siddhuraju *et al*., 2000). In short, selection of elite germplasm among all available accessions should be the objective for purpose of conventional breeding and/or genetic engineering.

In view of this, in the present study seven accessions of *Mucuna* bean were collected from five different agroecological regions of Western Ghats (Tamil Nadu and Kerala states), South India and their agrobotanical traits evaluated.

MATERIALS AND METHODS

Seven different accessions of velvet bean (*Mucuna pruriens* var *utilis* (L.) DC) were collected as mature pods from the natural stands of five different agroecological regions of Tamil Nadu and Kerela. (Table 1). After drying thoroughly in the sunlight for 2-3 days, the pods were thrashed to remove seeds. The seeds, after thorough cleaning and removal of broken seeds and foreign materials, were stored in plastic containers until further use.

Evaluation of agrobotanical traits.

The agrobotanical characters are the ideal tools for the analysis and evaluation of elite germplasm. For evaluation of agrobotanical traits of collected seven different accessions, the dry and mature seeds were sown in a Randomised Blocks with three replications in the experimental plots of the Botanical Garden, Bharathiar University, Coimbatore, Tamil Nadu, India.

Approximate plots of 15m by 7m ($105m^2$) were constructed at Botanical Garden, Bharathiar University, (latitude 11.02'N and longitude 76.58'E) located at foothills of Marudhamalai, (Palakkad gap of Western Ghats) and situated at an altitude of 409m above the sea level. The total plot area ($105m^2$) was equally divided into 21 small sub - plots each measuring an area of $5m^2$ (7m X 0.71m). Seeds were sown on 18th September 2002 at 50cm regular intervals along rows of each sub - plot.

The plants were raised in open sunlight and watered regularly twice a week. In the agroclimatic of Coimbatore, the average annual rainfall is 61.22cm, the temperature is maximum 34.7^{o}C and minimum 22.1^{o}C in general and the Bharathiar University campus in particular is semi-arid and the soils are alfisols.

At the onset of germination, seed germination percentage was recorded. Subsequently, the day of plumule emergence and day of first leaf formation were also recorded. On 90th day to study the variation in the size of leaflets among the different accessions, twenty five leaves were selected at random, their petiole length (cm), leaf area of both lateral and terminal leaflets (cm^2) were measured with a Portable leaf Area Meter (LI-COR Model, Li-3000). Their mean values were calculated and recorded. The yield based characters such as day of flower initiation, number of clusters per plant, number of flowers per cluster, and number of pods per cluster of all plants were recorded.

Pods were harvested between 160 and 170 days from planting, as leaves began to turn yellow from green. The following data were also collected: number of branches per

plant, pod length (cm), pod weight (g) and the number of seeds per pod.

The fertility index was calculated as

$$\frac{\text{Number of pods per cluster}}{\text{Number of flowers per cluster}} \times 100$$

The seed recovery percentage was calculated as

$$\frac{\text{Weight of seeds per pod}}{\text{Weight of pods with seeds}} \times 100$$

The average100 -seed –weight (g) from three estimates per plot were also recorded. The harvest index (tonnes/hec) was calculated and recorded.

Table 1. Agroecological regions of the seven collected accessions of velvet bean.

S.No	Name of the accession	Month & year of collection	Place of Collection	Ecological region
1	Thachenmalai (white– coloured seed coat)	March, 2001	Kanyakumari district, Tamil Nadu	Deciduous forest, slightly elevated, sandy soil, near river side
2	Thachenmalai (black– coloured seed coat)	March, 2001	Kanyakumari district, Tamil Nadu	Deciduous forest, slightly elevated, sandy soil, near river side
3	Mundanthurai (white – coloured seed coat)	March, 2001	Tirunelveli district, Tamil Nadu	Evergreen forest, red soil, altitude 500m
4	Kailasanadu (white – coloured seed coat)	March, 2001	Idukki district, Kerala	Semi evergreen forest, red soil, altitude 500-700m
5	Valanad (black – coloured seed coat)	March, 2001	Thiruvananthapuram district, Kerala	Moist deciduous forest, black clay soil, altitude 600-800m
6	Mundanthurai (black –coloured seed coat)	March, 2002	Tirunelveli district, Tamil Nadu	Evergreen forest, red soil, altitude 500m
7	Mylaru (white – coloured seed coat)	March, 2002	Tirunelveli district, Tamil Nadu	Evergreen forest, red soil, altitude 500m

Estimation of chlorophyll content (Arnon, 1949).

The chlorophyll content was estimated following the method of Arnon (1949), from leaves collected at random at regular intervals of 30^{th}, 60^{th}, 90^{th}, 120^{th} and 150^{th} day after sowing.

Extraction and estimation of leghaemoglobin content (Appleby and Bergersen, 1980).

Like most legumes, velvet bean has the potential to fix atmospheric nitrogen through symbiotic relationship with soil microorganisms (Sanginga *et al.,* 1996; Stefan and Christian, 2002). The nitrogen is converted by the Rhizobia on the root nodules of the plant to an available form by leghaemoglobin, and making the plant an efficient source of nitrogen. Thus to find out capacity of this plant to fix atmospheric nitrogen, the leghamoglobin content was determined from fresh root nodules from 90 – day-old plants

Extraction: Fresh nodules were mixed with 3 volumes of phosphate buffer and macerated. The contents were filtered

through two layers of cheesecloth. Nodule debris was discarded and remaining brown filtrate was centrifuged and diluted.

To an equal volume of extract, alkaline pyridine reagent was added and mixed. The resulting hemochrome was equally divided into two portions. To one portion, few crystals of sodium dithionite was added to reduce the hemochrome and stirred without aeration. To the other portion, few crystals of potassium hexacyanoferrate were added to oxidize the hemochrome and the contents of both of the test tubes were measured at 556nm and 539nm respectively. Leghaemoglobin content was calculated using the following formula

$$\text{Lb concentration (mM)} = \frac{A_{556} \text{ --- } A_{539} \text{ x } 2D}{23.4}$$

where, D is initial dilution.

pH

Ten gram of dry soil was taken in a beaker and 100 ml of double distilled water added to make a suspension of 1:10 (w/v) dilution and the pH was determined with a digital pH meter.

Electrical conductivity

Ten gram of dry soil was taken in a beaker and 100 ml of double distilled water was added to make a suspension of 1:10 (W/V) dilution and the electrical conductivity was measured with a digital electric conductivity meter.

Estimation of mineral profiles of the soil:

The soil samples were collected from study area before and after raising the velvet bean. For analysis of micro and macronutrients, 25 cores or sub samples were collected randomly by traversing in a zig – zag manner along with different sections of area until the whole area is covered on random basis. Before collecting the soil samples for analysis, the surface area / top soil was removed for about 1 inch thickness and then with soil auger 'V' shaped depth was made for about 20cm and removing the slice about 2.5cm thickness from the sides of the depth. The soil aggregates are broken down and dried at 25^{o}C. All the sub samples / cores are mixed to provide composite sample and passed through sieve to provide 50g of air dry sample.

The total nitrogen (N) and available phosphorus (P) were determined respectively by micro-Kjeldahl and molybdenum blue methods of Jackson (1973). Exchangeable K was extracted from the soil in ammonium acetate solution (pH 7) and measured with a digital flame photometer (Jackson, 1973).

The micronutrients are estimated by following the method of Lindsay and Norvell (1978) using DTPA (diethylene triamine penta aceticacid).

Statistical analysis

All the values were estimated in triplicate determinations except soil samples. The statistical values: range, mean, standard error, standard deviation were computed for agronomic traits. An analysis of variance (ANOVA) such as genotyic, phenotypic and environmental and coefficient variance% such as GCV, PCV, ECV were also calculated using the software package, Genres Agres D square / Path D square analysis.

RESULTS AND DISCUSSION

The evaluated agrobotanical characters of seven different accessions of velvet bean are presented in Tables 2-5. Range of variation displays wide diversity among the different accessions in respect of all the characters studied especially leaf area (90- day-old-plant) number of pods per cluster, number of clusters per plant, seed weight per pod, seed yield per plant and 100-seed-weight.

IBPGR adopted a germination percentage of 85% as the preferred standard (Frankel *et al.,* 1995). The latter four characters may have an impact on the over all biomass of the plant, which can affect the plant yield.

Among the investigated seven accessions, Mundanthurai (black-coloured seed coat) registers the highest germination percentage (99.75±0.29%) while in others germination percentage ranges between 79.75±0.25% and 96.00± 0.00% and these values seem to be higher when compared with the other wild pulses like *Vigna aconitifolia, V. sublobata and V.glabrascens* (Rajaram, 1990); *V.trilobata* (Siddhuraju, 1990) and *Bauhinia malabarica* (Vijayakumari, 1990). Thus it is inferred that the Mundanthurai (black – coloured seed coat) accession undoubtedly is an elite accession when compared to the various accession of different species of *Vigna*/ *Bauhinia* evaluated in our Laboratory.

Table : 2. Agrobotanical traits of seven different accessions of velvet bean[a]

Trait	Accessions						
	TW	TB	MW	KW	VB	MB	MYW
Germination %	84.25±0.25	79.75±0.25	95.75±0.25	96.00±.0.00	95.50±0.29	99.75±.0.25	91.75±0.25
Day of plumule emergence	9.75±0.48	10.50±0.28	11.50±0.25	10.75±0.25	9.00±.000	9.50±0.28	9.25±0.25
Day of first leaf formation	11.75±0.25	11.00±0.58	13.75±0.25	14.00±0.00	10.75±0.25	11.50±0.50	12.75±0.25
Leaf Area (cm^2)90 day– old plant	109.02±0.21	108.76±0.61	84.40±1.56	117.00±0.41	78.70±0.69	96.02±0.39	123.40±0.72
Day to flower initiation	59.75±0.48	59.75±0.25	61.50±0.29	66.50±0.25	61.75±0.48	60.50±0.29	60.25±0.25
No.of branches per plant	6.50±0.65	5.50±0.65	5.25±0.25	5.05±0.75	4.25±0.63	5.50±0.29	4.50±0.50
No. of clusters per plant	8.75±1.11	13.0±0.91	11.25±2.39	6.50±0.64	11.50±1.94	12.25±2.29	6.50±0.65
No. of flowers per cluster	12.5±2.96	7.50±0.65	8.00±0.91	9.50±1.32	5.75±0.25	9.25±0.25	15.5±1.32
Fertility index	66.28±0.57	81.54±0.60	66.01±0.51	72.54±0.75	76.23±1.61	80.55±1.54	79.45±2.18
No. of pods per cluster	9.25±2.56	7.00±0.70	5.25±0.25	7.75±1.65	5.75±0.48	7.52±0.85	10.00±2.35
Pod length (cm^2)	10.34±1.31	9.57±0.16	11.45±1.31	9.20±0.90	11.18±0.10	10.34±0.10	12.41±0.14
Pod weight(g)	9.50±0.36	10.41±0.32	12.20±0.80	8.42±0.23	9.80±0.16	10.83±0.26	12.30±0.22
No. of seeds per pod	5.25±0.25	4.25±0.63	5.25±0.25	4.75±0.48	5.25±0.25	5.50±0.50	6.50±0.65
Seed weight per pod (g)	6.11±0.80	9.49±0.16	8.16±0.40	6.43±0.60	7.05±0.70	7.79±0.17	8.90±0.11
Seed recovery %	62.08±0.19	88.70±0.50	66.06±0.37	75.33±0.24	71.83±0.33	70.33±0.32	71.30±0.17
100 – seed weight(g)	113.84±1.61	104.60±1.67	120.52±0.77	106.03±0.90	100.59±1.35	101.89±1.11	120.76±0.89
Leghaemoglobin content (mM)	0.29±0.06	0.27±0.04	0.18±0.04	0.52±0.03	0.18±0.08	0.20±0.04	0.42±0.03
Life span	152	152	150	156	150	148	156
Harvest index (t/hec)	1.307	1.181	0.934	1.164	1.528	2.995	3.128

a. All the values are mean of tripilicate determinations, ± Standard Error

TW: Thachenmalai (white- cloured seed coat); TB: Thachenmalai (black- coloured seed coat); MW: Mundanthurai (white – coloured seed coat);KW: Kailasanadu (white – coloured seed coat);VB: Valanad (black – coloured seed coat);MB: Mundanthurai (black – coloured seed coat); MYW: Mylaru (white–coloured seed coat)

Table 3: Range,Mean,Standard deviation,variance and coefficient variance of 17 traits in different accessions of velvet bean

Trait	Range	Mean	S.D	Variance			Coefficient variance %		
				Genotypic	Phenotypic	Environmental	Genotypic	Phenotypic	Environmental
Germination %	79.75 - 99.75	91.82	7.22	52.00	52.23	0.23	7.85	7.87	0.52
Day of plumule emergence	9.00 - 11.50	10.04	0.91	0.72	1.12	0.40	8.47	10.54	6.28
Day of first leaf formation	10.75 -14.00	12.21	1.30	1.59	2.01	0.42	10.33	11.61	5.31
Leaf Area (cm^2)90 day– old plant	78.70 – 123.40	102.47	16.66	276.87	279.27	2.39	16.24	16.31	1.51
Day to flower initiation	59.75 - 66.50	61.43	2.37	5.26	6.70	1.43	3.73	4.21	1.95
No.of branches per plant	4.25 - 6.50	5.29	0.74	0.23	1.51	1.28	9.08	23.26	21.42
No. of clusters per plant	6.50 - 13.00	9.96	2.71	4.50	15.77	11.27	21.30	39.86	33.69
No. of flowers per cluster	5.75 - 15.50	9.71	3.29	9.50	14.86	5.35	31.74	39.68	23.82
Fertility index	66.01 - 81.54	74.66	1.72	41.75	46.12	4.38	8.65	9.09	2.80
No. of pods per cluster	5.25 - 10.00	7.46	6.55	1.35	7.83	6.49	15.54	37.50	34.12
Pod length (cm^2)	9.20 - 12.41	10.64	1.12	1.24	1.29	0.05	10.46	10.66	2.05
Pod weight(g)	8.35 - 12.31	10.49	1.44	2.04	2.16	0.12	13.62	14.03	3.34
No. of seeds per pod	4.25 - 6.50	5.25	0.69	0.25	1.16	0.90	9.60	20.47	18.08
Seed weight per pod (g)	6.11 - 9.49	7.71	1.25	1.56	1.59	0.03	16.21	16.37	2.21
Seed recovery %	62.08 - 88.70	72.23	8.43	70.96	71.52	0.56	11.66	11.71	1.03
100 – seed weight(g)	100.59 -120.63	109.74	8.53	72.62	73.78	1.16	7.77	7.83	0.98
Leghaemoglobin content (mM)	0.18 - 0.52	0.29	0.13	0.02	0.02	0.001	44.06	44.98	9.03

Table 4: Variation in chlorophyll content level in different accessions of velvet bean in 30,60,90,120, and 150 - day old plants

Accessions	Chlorophyll content mg / g fresh weight														
	30 day			60 day			90 day			120 day			150 day		
	chl a	chl b	total chl	chl a	chl b	Total chl	chl a	chl b	Total chl	chl a	chl b	total chl	chl a	chl b	Total Chl
TW	0.21	0.17	0.38	0.30	0.23	0.53	0.26	0.20	0.46	0.13	0.10	0.23	0.07	0.01	0.08
TB	0.25	0.20	0.45	0.30	0.24	0.54	0.27	0.21	0.48	0.19	0.14	0.33	0.11	0.01	0.12
MW	0.23	0.19	0.42	0.27	0.21	0.48	0.26	0.21	0.47	0.12	0.09	0.21	0.01	0.04	0.05
KW	0.20	0.16	0.37	0.27	0.22	0.49	0.24	0.18	0.42	0.09	0.07	0.16	0.10	0.04	0.14
VB	0.18	0.14	0.32	0.25	0.19	0.44	0.23	0.18	0.41	0.22	0.16	0.38	0.05	0.01	0.06
MB	0.18	0.14	0.32	0.30	0.23	0.53	0.26	0.19	0.45	0.13	0.09	0.22	0.13	0.04	0.17
MY-W	0.27	0.21	0.48	0.31	0.24	0.55	0.29	0.23	0.52	0.13	0.09	0.22	0.06	0.005	0.065

TW: Thachenmalai (white- cloured seed coat); TB: Thachenmalai (black- coloured seed coat); MW: Mundanthurai (white – coloured seed coat); KW: Kailasanadu (white – coloured seed coat);VB: Valanad (black – coloured seed coat);MB: Mundanthurai (black – coloured seed coat);MYW: Mylaru (white – coloured seed coat)

The data on the day of plumule emergence indicate that in the accessions Valanad (black-coloured seed coat) and Mylaru (white-coloured seed coat) the plumule emerges earlier i.e. on the 9th day after sowing while in other investigated accessions plumule emerges either on 10th or 11th day after sowing.

In respect of the formation of the first leaf, all the accessions exhibit more or less similar trend, which is in good agreement with an earlier investigation on the same species collected from some other agroclimatic regions (Vadivel and Janardhanan, 1997).

Regarding the amount of chlorophyll pigments, their contents keep on increasing with the age of the plant and slightly decrease when the plants enter reproductive phase with 90-day – old plants registering the maximum chlorophyll content in all the investigated accessions.

Among the seven accessions studied Mylaru (white-coloured seed coat) registers the highest number of flowers per cluster, pods per cluster compared to the other accessions. Nonetheless, Thachenmalai (black-coloured seed coat) shows higher number of clusters per plant (13.00 ± 0.91) and the highest fertility index, and this value seems to be closer to that of certain *Vigna* species such as *Vigna calcaratus; V. sublobata* (Rajaram, 1990), *V. trilobata (*Siddhuraju, 1990). From this it is inferred that accession Mylaru (white – coloured seed coat) and Thachenmalai (black – coloured seed coat) are at least on par with several accessions of different species of *Vigna* evaluated earlier in our Lab.

Both the accessions of Thachenmalai (black-coloured seed coat) and Mylaru (white-coloured seed coat) come to flowering on 60th day after sowing, earlier than others. Early flowering is an important trait because it reduces the incidence of pest and disease, thereby improving yield and quality of pods and seeds (Vadivel *et al.,* 1998). Other accessions come to flowering on 61st, 62nd, 63rd, and 67th day after sowing. In the present study, flower initiation appears to be earlier when compared to an earlier report from our Lab for some other accessions of velvet bean collected from Kanyakumari, Tirunelveli and Thiruvananthapuram districts in Tamil Nadu and Kerala (Vadivel and Janardhanan, 1997).

In the present study, the seed recovery percentage ranges between 62.08 ± 0.19% and 88.70 ± 0.50% and 100- seed-weight ranges from 100.59 ± 1.35 to 120.52 ± 0.77(g). These values seem to be higher when compared with that of other little known pulses such as *Vigna aconitifolia, V.radiata* and *V. trilobata* reported by Rao *et al* (1978); Tawer *et al* (1988); Rajaram (1990) and Siddhuraju (1990).

Earlier Bennett – Lartey (1998) has studied the agrobotanical traits of 8 accessions of velvet bean (*M. pruriens* var *utilis* Wall) collected from the Ashanti, Eastern and Upper West Regions of Ghana, which include pods per plant, pod length and 100 – seed – weight.

The leghaemoglobin content of the presently investigated accession of velvet bean ranged from 0.18±0.04 to 0.52±0.03mM. Kailasanadu (white-coloured seed coat) shows the maximum value compared to the other investigated accessions. Higher the content of legheamoglobin more the efficiency of a particular accession in terms of its capacity for atmospheric nitrogen fixation.

Quick growing legumes are valuable green manure for many low input systems, and have the potential to meet much, if not all, of the nitrogen requirements of succeeding non-legume crops. The equivalent amount of nitrogen fertilizer required to match the green manure can be 80-200kg/hec. One of the most remarkable features of the velvet bean is it can fix large amounts of nitrogen and can annually produce 50 – 100 tonnes/hec of organic matter.

The present study brings to light a significant increase in the soil nutrient status as a result of cultivation of Kailasanadu (white – coloured seed coat) accession (Table 6).

Not only the contents of soil macronutrients such as N, P, K increase from 175.2 to 194.4; 13.4 to 16.8; 211.2 to 480 kg/hec respectively but also the contents of micronutrients such as Fe, Zn, Cu and Mn also are found to increase (1.92 to 20.2; 0.72 to 2.01; 1.15 to 1.63; 4.37 to 9.65 kg/hec). In recent years it has been reported that of the various types of green manure legumes introduced into farming systems to improve soil fertility and replenish soil nutrients, *Mucuna* exhibits the greatest potential to improve soil fertility (Mureithi *et al.,* 2000) It is known to effectively control a wide range of diverse pests. Among the seven accessions investigated in the present study Mylaru (white-coloured seed coat) accession exhibits maximum production of biomass and gives relatively a high harvest index i.e. 3.128 tonnes/hec while in others the harvest index ranges between 0.934 and 2.955 tonnes/h.

Table 5.Variation in leaf size in different accessions of *Mucuna pruriens* var *utilis* in 90 - day – old plants[a]

S.No	Name of the accession	Petiole length (cm)	Lateral leaflet area (cm^2)	Terminal leaflet area (cm^2)
1	Thachenmalai (white -coloured seed coat)	15.9 ± 1.20	102.32 ±1.29	97.15 ± 2.52
2	Thachenmalai (black -coloured seed coat)	10.3 ± 0.80	95.46 ±1.38	89.22 ± 1.63
3	Mundanthurai (white-coloured seed coat)	7.2 ± 1.70	94.17 ± 3.46	88.04 ±1.18
4	Kailasanadu (white -coloured seed coat)	20.3 ± 0.90	173.35 ± 1.71	142.08 ± 3.69
5	Valanad (black -coloured seed coat)	18.0 ± 1.30	93.85 ± 1.97	62.58 ± 1.78
6	Mundanthurai (black-coloured seed coat)	18.5 ± 0.60	143.65 ± 2.58	102.45 ± 3.35
7	Mylaru (white-coloured seed coat)	24.1 ± 0.80	128.22 ± 1.85	105.87 ± 1.77

a. All the values are mean of triplicate determinations
± Standard Error

Table: 6 Profiles of macro and micronutrients of soil samples before and after raising Kailasanadu (white - coloured seed coat) accession

Soil test	pH	EC	Macronutrients kg/hec			Micronutrients kg/hec			
			N	P	K	Fe	Zn	Cu	Mn
Before cultivation	7.90	0.10	175.2	13.4	211.2	1.92	0.72	1.15	4.37
After cultivation	8.29	0.10	194.4	16.8	480.0	20.2	2.01	1.63	9.65

The genotypic, phenotypic and environmental variance and coefficient variance % (GCV, PCV and ECV) are shown in Table –3. In general, magnitude of the PCV is higher than that of both GCVand ECV in almost all traits. Nonetheless, GCV seems to be more or less equal for traits such as germination percentage, day to flower iniation, fertility index, seed weight per pod (g), seed recovery percentage, 100- seed weight and leghaemoglobin content. Thus it is inferred that the diversity in all the investigated traits is mainly due to phenotypic and partly by genotypic factors. ECV is less pronounced for a majority of the traits.

The life span of all the accessions is found to be more or less similar i.e.152 days after sowing. This value seems to be lower than an earlier investigation in the same species (Vadivel and Janardhanan, 1997). The results of the present study go to suggest that *Mucuna* definitely can act as an effective green manure crop.

CONCLUSIONS

The evaluation of agrobotanical traits of seven different accessions of velvet bean collected from five different agroecological regions, in the present study reveals the existence of diversity in all the investigated.

The accession Thachenmalai (black - coloured seed coat) exhibited the highest fertility index, biomass production and seed yield followed by Valanad accession (black – coloured seed coat). Kailasanadu (white – coloured seed coat) accession showed relatively high content of leghaemoglobin level compared to the other accessions. Seed recovery percentage ranged between 62.08±0.19% and 88.70±0.50%. Taking into account the versatile nature of this plant, it can be recommended as a successful green

manure crop in addition to its track record as food and feed crop.

Though all the seven accessions are collected from different agroecological zones of South India, the evaluated agrobotanical traits are not markedly affected by environment. From this it is inferred that there exists genetic diversity among the evaluated accessions of velvet bean which does not seem to be influenced by the environment. Attempts to decipher the gene diversity and phenetic relationship among all the available accessions of velvet bean from Western Ghats, South India by employing modern biotechnological techniques such as AFLP and RAPD are in progress.

ACKNOWLEDGEMENT

Thanks are due to Mr.P.Muthsamy, Assistant Soil Chemist, Soil Testing Laboratory, Govt.of Tamil Nadu, Coimbatore, India for his help in soil analysis. Thanks are also due to Dr.M.Pugalenthi, Lecturer, Dept. Biotech, Karpagam Arts & Science College and Mr. A.Nanjukutti, Field Assistant for their help in collection of velvet bean accessions.

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Submitted May 16, 2003 - Accepted July 21, 2003