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Current Availability Status in Terms of Standing Crop Biomass of the Medicinal Climber, *Solenaamplexicaulis* (Lam.) Gandhi. in relation to other Climbers in the Foot Hills of Western Ghats, Tamil Nadu, India.

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Research Article

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ABSTRACT

Current availability status of the medicinal climber, *Solenaamplexicaulis*in terms of standing crop biomass was determined in ten different habitats at lower Western Ghats of Coimbatore and Tirupur districts, Tamil Nadu, Indiafor three seasons*viz.,* monsoon, winter and summer. For comparison, other associated climber species in the study areas were also analyzed. The results of the study revealed that the biomass content of all the three parts *viz.,* leaf, stem and tubers with roots of the study species, *S. amplexicaulis*was lesser and not comparable to that of other climbers. However, the three species, *Kedrostisfoetidissima, Decalepishamiltonii* and *Cocciniagrandis*were present with lower biomass of all parts than the study species, *Solenaamplexicaulis.* The seasonal variation in tuber biomass of *S. amplexicaulis*showed that greater loss of reserves had happened during unfavourable season, which would expected to result in vanishing of *S. amplexicaulis*in the study areas in future. It was further known that the Madukkaraiforest is most suitable for the study species than the other study areas due to high biomass of *S. amplexicaulis*in that area. Therefore, appropriate propagation technologies to ensure adequate biomass availability and intensive habitat protection for conservation of *S. amplexicaulis*are suggested. Environmentally similar areas like that of Madukkarai forest are determined to be suitable for raising the species, *S. amplexicaulis.*

INTRODUCTION

Biomass is the functional attribute which can indicate the level of metabolism contributed by the respective species to the community and hence its role in ecological processes[1], In addition, the biomass level of individual species in the community is used to measure the degree of dominance exerted by the respective species in that community[2]. Besides these ecological significances, the current availability status of any species in the ecosystem can be determined by estimating the standing crop biomass of the species [3]. Estimation of biomass for a species or community, as influenced by habitat variations or seasonal variations within the community is an useful parameter to know the degree of response of the species to the changed environment with respect to functional behavior[4]. Therefore, determination of changes in biomass of species over a period of time, provides data on the quantum of availability of resource during different seasons in an year in ecosystems.

Solenaamplexicaulis(Cucurbitaceae) is one such medicinal climber seldom present in the scrub jungles and dry deciduous forests of lower Western Ghats in southern India and it is very rarely sighted in other hillocks and dry habitats of interior parts of sourthernIndia[5]. The tubers, leaves and seeds of this species are extensively used in traditional system of medical practice in hepatosplenomegaly, spermatorrhoea, haemorrhoids, invigorating and as thermogenic, appetizer, cardiotonic, and diuretic agents[6]. In the folklore medical practice of Tamil Nadu, India, it is prescribed for vitiated kapha, vata, anorexia, dyspepsia, colic, asthma, cough, renal calculi, urinary retention, hemorrhoids, splenomegaly and constipation[7,8]. Due to wide usage and hence the exploitation, population size of

this species has decreased drastically.As this species is medicinally important, information on current availability status of useful parts of this species such as leaf, stem and tuber on basis of biomass is essential both for ensuring services and conservation. However, in this line, no studies were carried out so far for S. amplexicaulis. To address this lacuna, the present study on seasonal availability of biomass in ten different habitats for this species for one year was carried out. The biomass content of other associated climber species was also studied to know the dry matter status of S. amplexicaulisin relation to other climbers.

MATERIALS AND METHODS

Study areas

A total number of ten study areas situated in the foot hills of Western Ghats were selected, of which eight *viz.,*Maruthamalai, Kurunthamalai, Palamalai, Siruvani hills, Madukkarai, Velliangiri hills, Thadagaihills and Aliyar hills are located in Coimbatore district of Tamil Nadu and two *viz.,* Thirumurthy hills and Amaravathy hills are in Tirupur district of Tamil Nadu (Fig. 1). The geographical position of the study areas lies between the latitudes 11° 8' 15" and 11° 10' 20" N and longitudes 77° 3' 23" and 77° 5' 31" E. The data on climatic factors of the study areas are given in Table 1. The average annual rainfall of the study areas on basis of 15 years data varied between 510mm (Madukkarai) and 960mm (Siruvani hills). However, during the study period (June, 2012 – May, 2013), the rainfall ranged between 165 mm (Madukkarai) and 507 mm (Siruvani hills). Further, most of the rainfall was occurring during south-west and north - east monsoon periods (June -August and October - November respectively) only. One or two thunder showers also occurred during April and May, 2013 in the study areas. The temperature recorded ranged between 21°C and 40°C across the study areas with the peak at Madukkarai during summer (April - May). The altitudes of the study areas varied between 450 (Madukkarai) and 540 m above msl (Vellingiri hills).

The vegetation type is dry deciduous forest[9] except in Madukkari, where it is scrub jungle dominated by *Euphorbia antiquarum.* Altogether, 109 species were encountered in the study areas[10]. The species richness ranged between 27 (Madukkarai) and 83 (Velliangiri hills) across the areas studied. The dominant species differed according to the study area[11]. *Erithrozylonmonoxylum*was dominant in Maruthamalai, Palamalai and Thadagai hills. The shrub, *Acalyphafruticosa*was dominant in Kurunthamalai and Aliyar hills, whereas the tree species, *Acacia leucophloea*was showing its dominance in Thirumurthy hills and Amaravathy hills. Vellingiri hills and Siruvani hills were dominated by the tree species, *Terminaliaarjuna*and in Madukkarai, the succulent shrub, *Euphorbia antiquarum* was dominant.

METHODS

Biomass estimation was made for three seasons *viz.,* monsoon (July, 2012), winter (January, 2013) and summer (April, 2013) for all the existing climbers including the study species, *S. amplexicaulis*in all the ten study areas. As the study species is seldom in occurrence in its habitats, minimum disturbance only has given to it for biomass determination. In every study area, ten individuals of *S. amplexicaulis*were uprooted and dried at 80°C in oven for 48hrs. Then the dry weight of plant parts such as leaves, stems and tubers with roots was taken separately. The part-wise dry weights for the ten individuals were averaged to arrive the respective part-wise biomass of one individual. To determine the seasonal availability of biomass in total, the part-wise individual biomass were multiplied with the density value of the respective season and it was expressed in g/ha. In order to compare the biomass of the study species,*S. amplexicaulis*with that of the other similar life-form, estimation of biomass of other climber species distributed in the study areas was also made as per the method adopted for *S. amplexicaulis.*

RESULTS AND DISCUSSION

Changes in biomass of leaf, stem and tuber/root parts of the study species, *S.amplexicaulis*along with the other climber species in all the ten study areas were varied widely across the three seasons studied (Figs.2-4). The leaf biomass of *S.amplexicaulis*was determined to be higher (143.5g/ha) in Madukkarai during monsoon (July, 2012) (Fig. 2a) and it was lower (3.1g/ha) in Velliangiri hills during summer (April, 2013) (Fig. 4a). However, the other climber, *Pergulariadaemia*in Madukkarai habitat during monsoon recorded highest leaf biomass of 264.0g/ha and that of the lowest was recorded by another climber species, *Coccinia*grandis during summer in the same habitat of Velliangiri hills. As all the 16 species are under the same life-form (climbing type), the changes in biomass are simply the magnification of the structural attribute, the density of the respective species. Agreeing this concept, the highest density of *Solenaamplexicaulis*(41 individuals/ha) reported in Madukkarai forest during July, 2012[10] may also yield higher biomass for this species than in other study areas. Variations in leaf area, number of leaves present, season of leaf fall, the nature of metabolites available in leaves and environmental conditions of the study areas may be the factors for variation in leaf biomass among the climber species studied in different habitats. Montgomery(2004)[12]has reported that generally the area of photosynthetic region present in any species is depending on genetic factor and existing environmental conditions.

The stem biomass of the species, *S. amplexicaulis*was also higher (164 g/ha) during monsoon (July, 2012) in Madukkarai forest (Fig. 2b) and lower (3 g/ha) in Velliangirihills during summer (Fig. 4b) which was the lowest among the 16 species of climbers. For stem biomass, the species,*Abrusprecatorius*contributed higher amount (409.2 g/ha) in Amaravathy hills during monsoon period. Similar to leaf biomass, the total number of individuals in unit area that is the population size of the respective species in respective study area, the physical and chemical nature of stem of the species and the environmental factors in the habitats may play pivotal role in the standing crop of stem biomass of the climbers in the study areas.

The belowground biomass (tuber/roots) during three different studied seasons was also varied widely across the climbers studied. The higher belowground biomass of 556.0 g/ha was possessed by the species, *Pergulariadaemia*in Madukkarai forest during monsoon (Fig. 2c). On the other hand, *Kedrostisfoetidissima*was the species recorded the lower belowground biomass (8.1 g/ha) in Maruthamalai forest during summer (Fig. 4c). The study species, *Solenaamplexicaulis* registeredits tuber biomass between 8.2g/m^2 in Velliangiri hills during summer and 348.5g/ha in Madukkarai forest during monsoon. The successful persistence of species in a habitat even during unfavourabe season is mainly depending on the belowground biomass as it is the storage part of reserves which can be utilized effectively during lean periodand hence the species withstand the adverse conditionssuccessfully[13]. Agreeing this fact, the higher biomass of belowground parts of all most all climbers of the study areas including the study species, *Solenaamplexicaulis*aid them to survive in unfavourable seasons by offering primary reserves.

Generally, the total standing crop biomass of all parts of *S. amplexicaulis*was also lower (14.3 g/ha) during summer than the other climbers in all the study areas except in Madukkarai forest (Fig. 2d). It may be due to poor adaptability of the species, higher exploitation for its medicinal uses and other intrinsic factors. However, comparatively higher biomass of this species in Madukkarai forest may be due to suitable ecological niches available in that habitat than the other study areas. Higher number of preferred host species availability in that habitat may also be a factor for this fact[14,15].

Biomass of all the studied part, *viz.,* leaf, stem and belowground portions showed greater changes between the three seasons (monsoon, winter and summer) for all the climbers in the study areas. Generally, during monsoon season biomass was higher and it was decreased during summer through winter. Presence of more number of individuals of all species both by seed germination and tillering through tubers during monsoon season may account this fact. The reduction of biomass of tubers of studied species, *S. amplexicaulis*from monsoon to winter and winter to summer was determined to be ranging between 18.18% (Aliyar hills) and 80.71% (Velliangiri hills) across the study areas and the total loss of tuber biomass over the period of one year was ranging between 70.61% (Madukkari forest) and 91.43% (Velliangiri hills) (Figs. 2-4). This great loss of reserve through the reduction of tuber biomass within the year is not a good sign for the consistent presence of *S. amplexicaulis*in the prolonged adverse conditions if comes in future. Comparatively less loss of tuber biomass in Madukkarai forest (70.61% against 91.43%) indicates that this habitat is relatively better than the other study sites for the survival of *S. amplexicaulis.*

Among the 16 climbers, the study species, *S. amplexicaulis*occupied lower position in terms of biomass availability along with the three climbers*viz., Kedrostisfoetidissima, Decalepishamiltonii*and*Cocciniagrandis.* Intensive exploitation of all parts particularly theperennating tuber and seeds for their medicinal uses by the local public and herb gathers might be the major factor for the past dwindling of biomass of these species in their habitats. In addition, the lower biomass hold at individual level by these species may vanish at rapid rate if the adverse condition proceeds more than an year in the lower Western Ghats of Tamil Nadu in general and the ten study areas in particular. Therefore, the study species, *Solenaamplexicaulis*due to its higher demand than the other climbers need more attention for restoration and more regeneration. For this, effective propagation technologies must be developed both at *in vivo* and *in vitro* levels. Development of home gardens with *S. amplexicaulis*may also reduces the pressure upon wilds. Saikia*et al.*(2012)[16] reported that in upper Assam, India, many rare species like *Acoruscalamus, Aquilariamalaccensis, Costusspeciosus, Clerodendroncolebrookianum, Livistonajenkinsiana*etc are conserved effectively by growing them in home gardens. Rehabilitation programmes by the introduction and reintroduction of *Solenaamplexicaulis.* in suitable habitats at lower Western Ghats of Tamil Nadu by proper augmentation is another method of restoration of species in its original communities[17]. Further, still severe habitat protection must be given throughout the lower Western Ghats of Tamil Nadu to protect the species like *S. amplexicaulis* from extinction in future.

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Table 1: Temperature and rainfall data of the study areas for the study period of one year from June, 2012 to May, 2013.

Year and Month	Temperature* (°C)										Rainfall (mm)									
	M	K	P	S	M^1	V	T	A	T^1	A	M	K	P	S	M^1	V	T	A	T^1	A
2012 Jun	25 (29)	25 (29)	24 (30)	25 (29)	26 (32)	24 (30)	24 (32)	25 (32)	25 (31)	25 (32)	14	25	26	48	12	40	16	26	18	11
Jul	25 (29)	25 (30)	24 (31)	26 (31)	26 (32)	25 (32)	25 (34)	24 (35)	25 (34)	24 (34)	17	22	21	69	15	62	22	53	28	17
Aug	24 (31)	25 (30)	25 (32)	24 (34)	27 (33)	25 (35)	24 (32)	25 (37)	25 (36)	25 (35)	10	19	22	49	13	46	19	48	37	22
Sep	24 (32)	24 (31)	24 (33)	25 (35)	26 (36)	24 (34)	24 (37)	25 (36)	24 (36)	25 (37)	13	26	23	30	9	32	29	36	37	20
Oct	24 (34)	25 (36)	24 (32)	24 (34)	26 (36)	24 (31)	25 (35)	25 (33)	23 (36)	26 (36)	22	35	32	96	26	89	34	74	40	31
Nov	24 (30)	24 (34)	24 (33)	24 (31)	26 (35)	25 (32)	24 (33)	24 (34)	24 (34)	24 (35)	36	42	40	89	32	93	39	79	36	38
Dec	22 (28)	23 (33)	22 (32)	23 (30)	24 (34)	23 (30)	22 (31)	22 (32)	22 (33)	22 (33)	17	26	29	11	11	9	15	16	19	21
2013 Jan	22 (28)	23 (31)	22 (33)	22 (29)	23 (33)	22 (30)	22 (31)	23 (31)	21 (32)	23 (33)	-	-	-	-	-	-	-	-	-	-
Feb	26 (34)	25 (34)	25 (36)	26 (33)	27 (36)	26 (36)	26 (35)	26 (35)	26 (35)	27 (36)	9	19	22	18	3	15	6	18	6	9
Mar	28 (38)	27 (36)	28 (38)	28 (38)	29 (39)	27 (39)	28 (36)	27 (38)	27 (37)	28 (38)	22	29	25	26	18	13	18	26	-	-
Apr	29 (39)	28 (38)	29 (39)	28 (39)	30 (40)	29 (38)	28 (38)	29 (39)	28 (38)	29 (39)	17	23	20	32	10	6	9	15	18	15
May	28 (36)	27 (38)	27 (38)	29 (36)	29 (40)	29 (38)	30 (38)	27 (39)	29 (39)	27 (39)	22	29	31	39	16	15	26	31	24	22

* The values in parentheses are max. temperature and the values outside the parentheses are min. temperature.
M- Maruthamalai, K- Kurunthamalai, P- Palamalai, S- Siruvani hills, M^1– Madukkarai, V- Velliangiri hills, T- Thadagai hills, A- Aliyar hills, T^1– Thirumurthy hills, A- Amaravathi hills.

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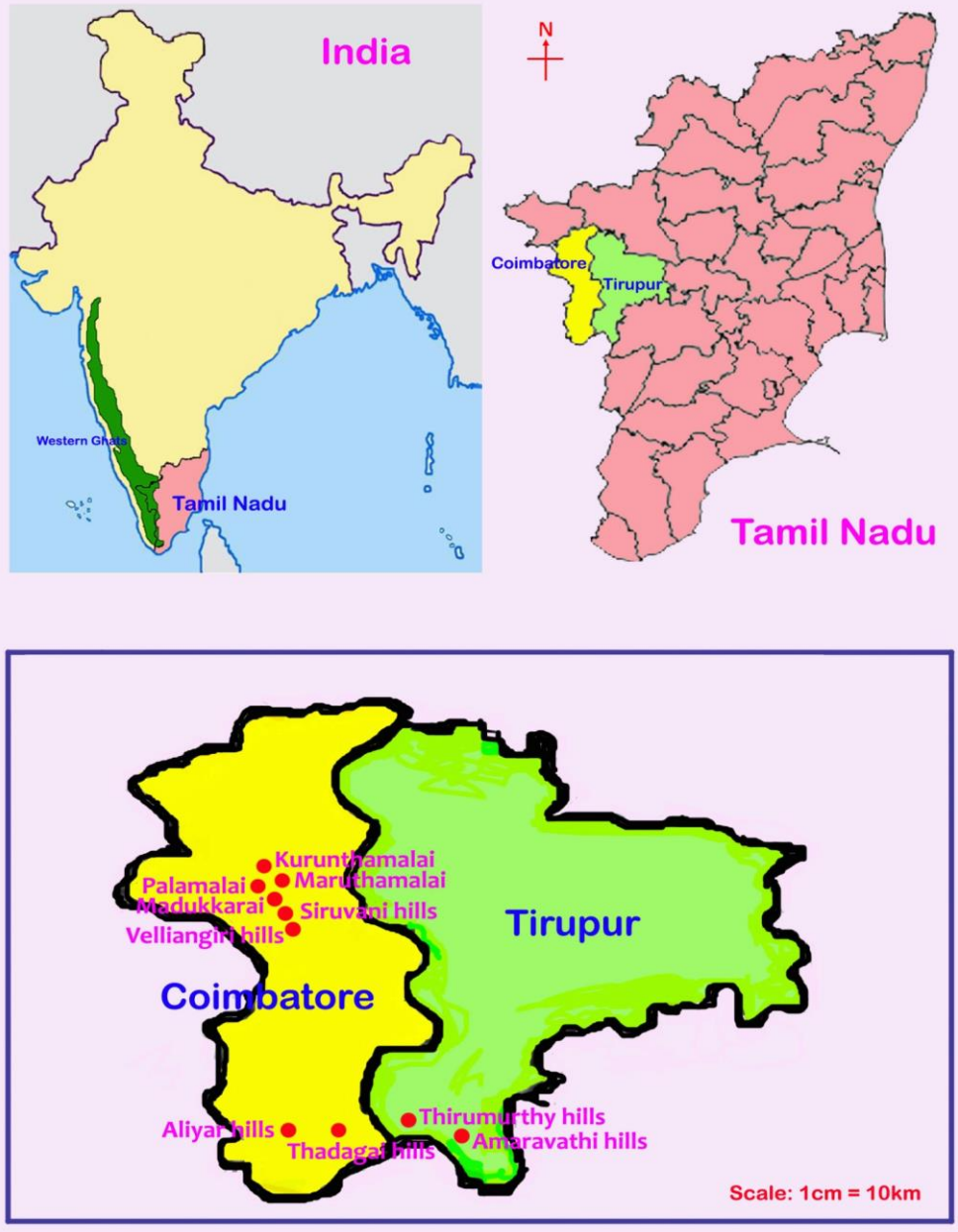

Fig. 1. Location of the study areas

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Fig. 2.Estimation of leaf, stem, tuber and total biomass of 16 climber speciesin monsoon season of 10 different study areas.

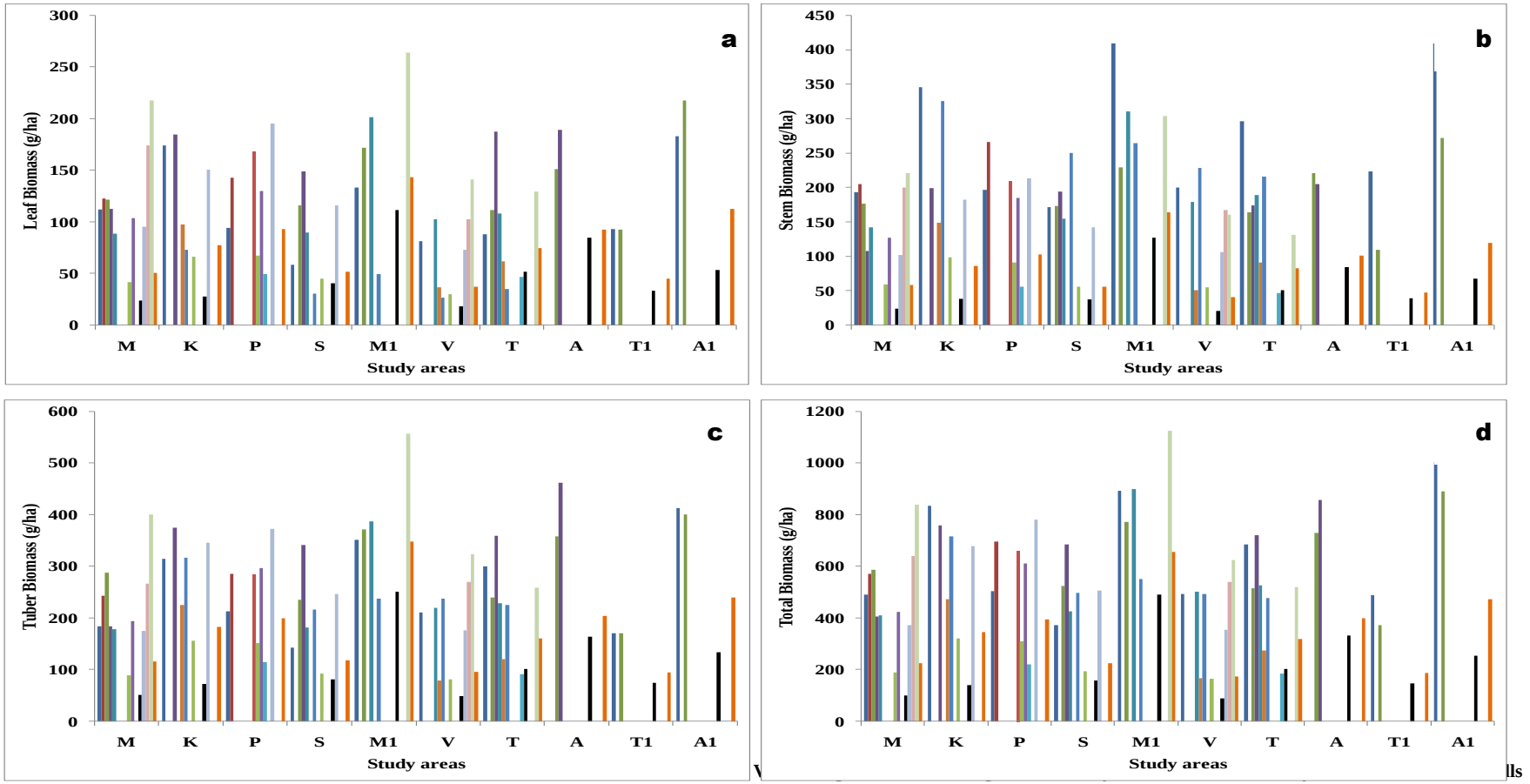

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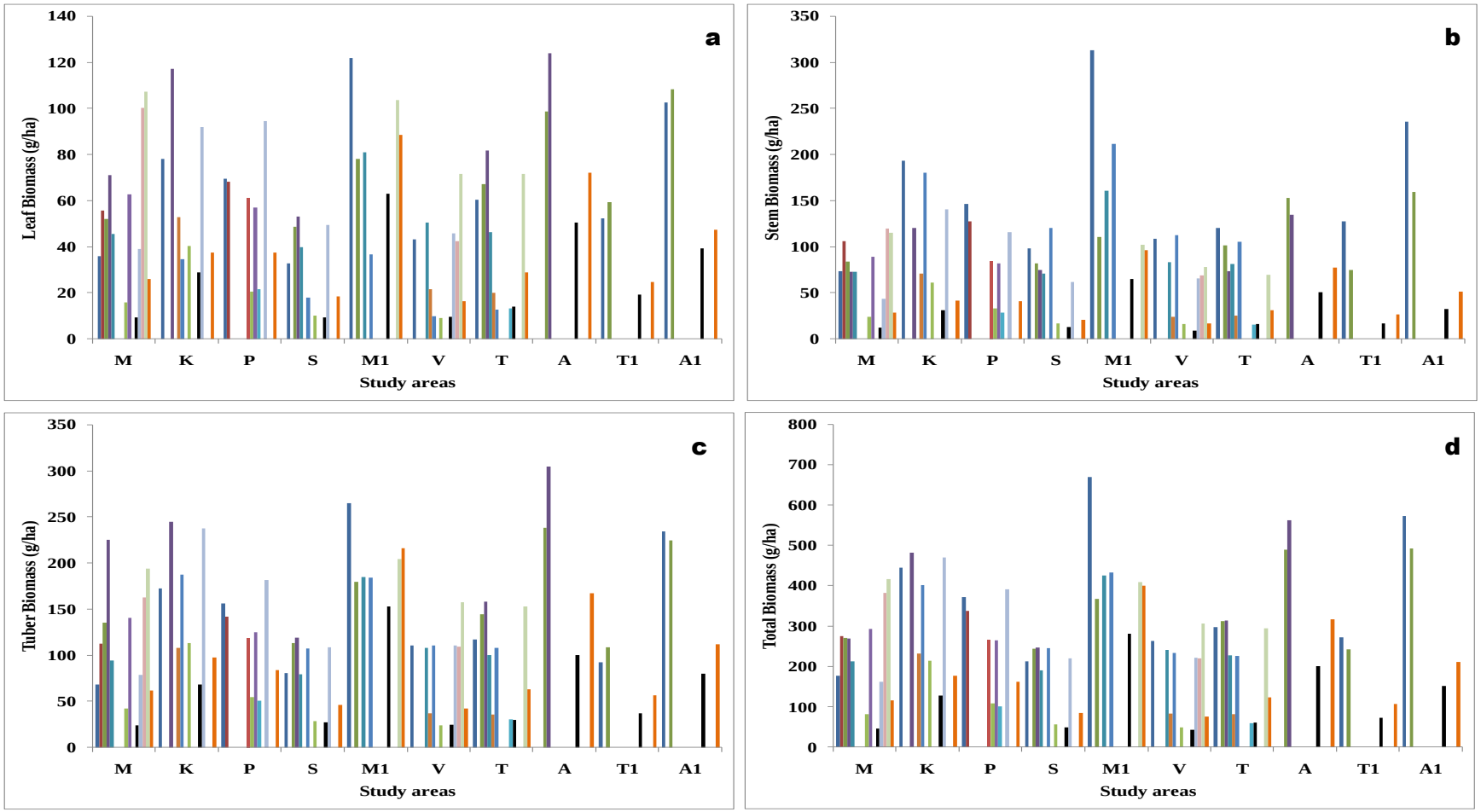
Fig.3. Estimation of leaf, stem, tuber and total biomass of 16 climber speciesin winter season of 10 different study areas.



M- Maruthamalai, K- Kurunthamalai, P- Palamalai, S- Siruvani hills, M^1– Madukkarai, V- Velliangiri hills, T- Thadagai hills, A- Aliyar hills, T^1– Thirumurthy hills, A^1– Amaravathi hills

- Abrus precatorius
- Acacia torta
- Azima tetracantha
- Cardiospermum canescens
- Cissampelos pareira
- Cissus heyneana
- C. quadrangularis
- Clitoria ternatea
- Coccinia grandis
- C. indica
- Decalepis hamiltonii
- Kedrostis foetidissima
- Naravelia zeylanica
- Passiflora foetida
- Pergularia daemia
- Solena amplexicaulis

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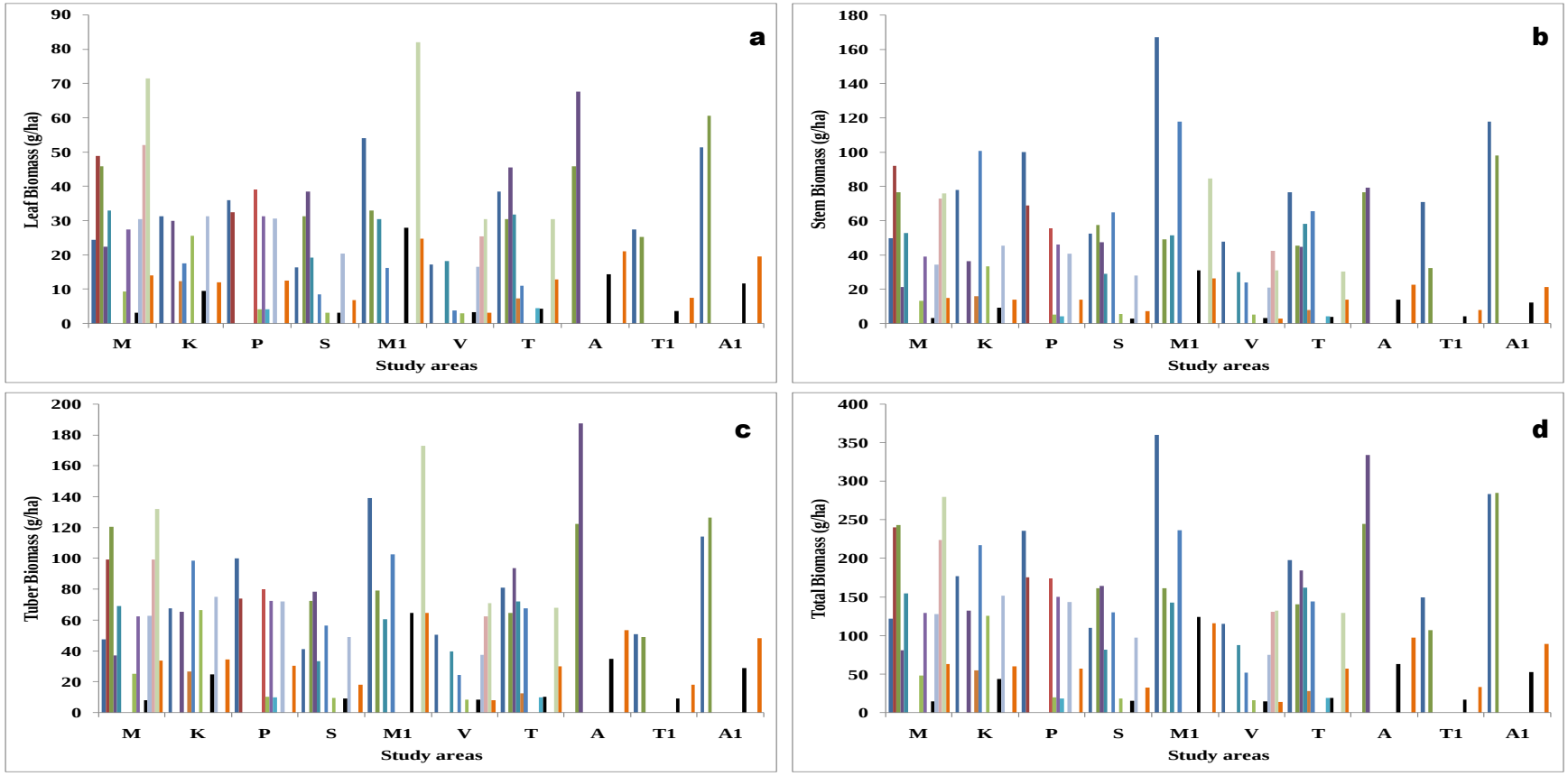
Fig. 4.Estimation of leaf, stem, tuber and total biomass of 16 climber species in summer season of 10 different study areas.



M- Maruthamalai, K- Kurunthamalai, P- Palamalai, S- Siruvani hills, M¹– Madukkarai, V- Velliangiri hills, T- Thadagai hills, A- Aliyar hills, T¹– Thirumurthy hills, A¹– Amaravathi hills

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