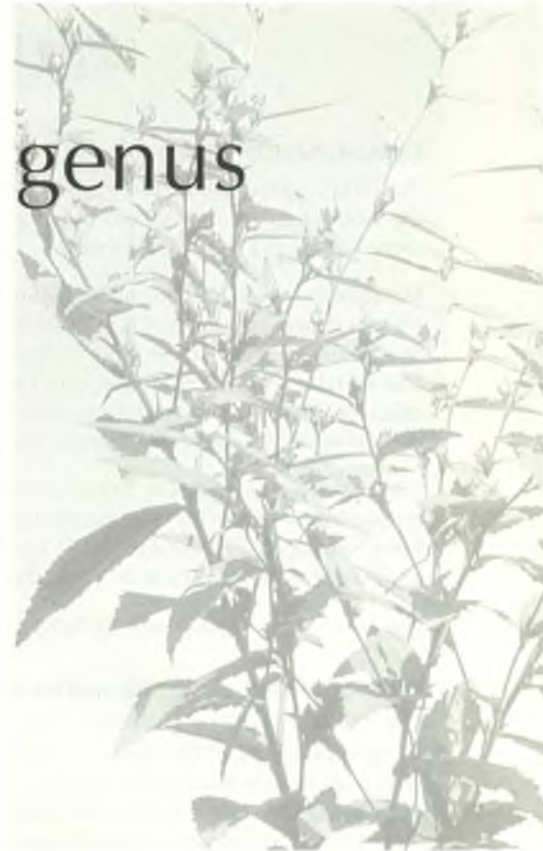


Practical identification of weeds in the *Sida* L. genus



Sida acuta.

Photo CIRAD-AMATROP

Researchers and professional farmers in tropical sub-Saharan Africa are often faced with the problem of identifying certain weeds. Complete samples, including flowers and fruit, are required to be able to accurately identify standard, but usually complex, weed flora. An identification key, based on leaf traits, is proposed for *Sida* L. species (Malvaceae family) commonly found in western Africa. Species can thus be readily identified from the first stages of development, before flowering.

Weed control strategies are often developed in terms of crop features when the weed flora present in the cropfield has not been fully characterized. Weed management should, however, be based on the biological and ecological characteristics of the weed population (LE BOURGEOIS, 1993; LE BOURGEOIS & MERLIER, 1995). The creation of simple practical tools for rapid identification of weeds at any development stage is therefore a major weed science research objective.

The present study focuses on the *Sida* L. genus (Malvaceae), common weeds of western Africa. As farmers and control operators have access to this identification key, targeted and fully adapted weed control methods could now be recommended.

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How the key was developed

Data for this identification key were derived from botanical studies, mostly conducted in western Africa, along with analysis of herbarium samples.

Flora guides used

Flore illustrée du Sénégal (BERHAUT, 1979) is a fully illustrated flora guide that is interesting because many vegetative characters are described. *Flora of West Tropical Africa* (HUTCHINSON *et al.*, 1958) is very complete but mainly based on flower characteristics. The *Handbook of West African Weeds* (AKOBUNDU & AGYAKWA, 1987) and the flora guide *West African Weeds* (IVENS *et al.*, 1978) are complementary works that include descriptions, drawings and photographs of the whole plant.

An identification key has already been drawn up for the *Eragrostis* Wolf genus (Poaceae family), annual weeds of the northern Cameroon

region, solely based on vegetative characters (LE BOURGEOIS & KAMBA, 1991). In addition, SEMELLART (1992) published an identification table for the veronicas (*Veronica* spp. (Tourn.) L., Scrofulariaceae family), crop weeds in France, based on leaf shape.

Table of vegetative characters in the *Sida* L. genus

Whenever possible, the descriptive elements were characterized using herbarium samples obtained from CIRAD's tropical weed science laboratory and the Institut Botanique de Montpellier (France). A table of the different vegetative characters was drawn up (Table 1).

The descriptions mainly concern fully-developed leaves, as the shapes of leaves under inflorescences are highly variable. The only characters

Sida L. genus

General characteristics

The *Sida* L. genus belongs to the Malvaceae family, which can be found throughout the world, except in very cold regions. It mainly includes herbaceous plants, with some bushes, but very few trees.

Malvaceae leaves are alternate, generally stipulate, and the leaves and stems are always downy. The corolla (generally white, pink, red or yellow) is formed by five petals inserted at the base of the central column, which bears the stamens. The sepals, fused at the base, can be accompanied by bracteoles, forming an epicalyx. The fruit is a capsule formed by several loculi that contain the seeds. The floral diagram for the Malvaceae family is very stable for all genera.

Some Malvaceae genera are of considerable economic interest, i.e. for the production of textile fibres extracted from the stems (*Hibiscus*, *Abutilon*, *Urena* and even *Sida* L.; BOULANGER, 1977) or capsules (cotton, genus *Gossypium*). Some Malvaceae genera are used in horticulture (*Hibiscus*, *Abutilon*, etc.).

The *Sida* genus includes weeds that can threaten crops.

Botanical features of the *Sida* species studied

The *Sida* L. species described in this study are generally annual plants which sometimes lignify at the base and persist for several years. Both herbaceous and bushy plants can thus be found within the same species population. The density of pubescence on the leaves and stems can vary under different environmental conditions. Nevertheless, this pubescent trait is common to all *Sida* species, and particularly pronounced in *S. cordifolia*, which remains very downy throughout the year.

Distribution of *Sida* L. species

According to HUTCHINSON (1967) quoted by UGBOROGHO (1983), there are 250 *Sida* L. species distributed throughout the Americas and warmest regions of both hemispheres.

HUTCHINSON *et al.* (1958) identified 11 species of this genus in western Africa (Table 2). Among these, *S. stipulata* Cav. and *S. acuta* Burm. f. are now classified as the same species; *S. scabrida* Wight & Arn. is not mentioned in this study as it is a rare species and not considered to be a weed.

Table 2. Classification of nine *Sida* L. weed species of western Africa (from MERLIER, 1994).

Valid name	Synonyms
<i>Sida acuta</i> Burm. f.	<i>Sida carpignifolia</i> auct., non L. <i>Sida stipula</i> Cav.
<i>Sida alba</i> L.	<i>Sida spinosa</i> L.
<i>Sida cordifolia</i> L.	<i>Sida althaeifolia</i> Sw.
<i>Sida garckeana</i> Pol.	<i>Sida corymbosa</i> R.E. Fr.
<i>Sida linifolia</i> C. Juss. ex Cav.	—
<i>Sida ovata</i> Forssk.	<i>Sida grewoides</i> Guill. & Perr.
<i>Sida pilosa</i> Retz.	<i>Melochia cordata</i> Burm. f. <i>Sida cordata</i> (Burm. f.) Borss. Waalk. <i>Sida veronicifolia</i> Lam. <i>Sida humilis</i> Cav.
<i>Sida rhombifolia</i> L.	<i>Sida riparia</i> Hochst.
<i>Sida urens</i> L.	—

described (as simply as possible) are those that are clearly visible on plants *in situ* habit, stem, base and apex of the lamina, lamina margin, average size of the lamina, venation of the lamina base, lamina pubescence, and the petiole. A minor exception concerns the shape of the hairs (simple or stellate), which requires a magnifying glass or a trained eye.

The identification key

The nine species can be dichotomously identified solely on the basis of eight leaf traits.

Major characters

Only eight main characters are taken into consideration in the key (Table 3). Based on these criteria, several keys could have been developed by simply changing the dichotomous order of the characters used for the identification. After investigating different combinations, a single key was adopted for identifying species with minimum confusion. The identification begins with the plant habit, which is a very obvious character (Table 3, Figure 1). All other keys tested had various disadvantages. For instance, pubescence could be considered in the initial identification steps as this character is easily assessed by confirmed botanists, but it can be confusing for non-specialists. A key that starts with this identification criterion would therefore be unsuitable. The length of the petiole was considered as a starting point for another key. However, this measurement is difficult to evaluate without comparison, and too many species have a short petiole.

Starting point: plant habit

From the key shown in Figure 1, *S. pilosa* can be immediately identified by its creeping habit. Then

S. linifolia is easily distinguished in terms of leaf shape, as it is the only species with a very long narrow leaf. *S. ovata* is identified by the rounded shape of the lamina apex. For pointed apex leaves, species without a very cordate base are separated from *S. urens*, which has a clearly cordate leaf base. Then the pubescence density is considered. Very dense and felt-like downy leaves indicate

S. cordifolia. If this pubescence is less marked, or absent, the length of the petiole is then considered for identification of other species. *S. alba* is characterized by a very long petiole. Among species with a short petiole, *S. garckeana* is identified if the lamina margin is irregularly dentated.

In the group of plants having lamina margins which are regularly dentated,

S. rhombifolia and *S. acuta* can be differentiated as follows: the lamina margin of *S. acuta* is dentate from the base, while that of *S. rhombifolia* is only dentate from the lower third.

S. rhombifolia, *S. acuta* and *S. garckeana* are morphologically quite similar, but they can be easily differentiated on the basis of descriptions given in the key.

Table 1. Table of vegetative traits of *Sida* L. species of western Africa.

	Habit	Stem	General lamina shape	Lamina base	Lamina apex	Lamina margin	Lamina size			Lamina basal venation	Lamina pubescence	Petiole
							L*	W*	R*			
<i>S. pilosa</i>	Creeping	Slender, roots at level of nodes	Cordate	Broadly cordate	Acuminate	Doubly dentate	5 cm	4 cm	1.25	5	Moderate	Long (almost as long as the lamina)
<i>S. linifolia</i>	Upright, diffuse. Around 60 cm	Woody at base, hispid	Linear to lanceolate	Rounded	Narrowly attenuate	Entire	12 cm	1.5 cm	8	3	Moderate. Simple long hairs on both surfaces	Short (relative to the length of the lamina)
<i>S. ovata</i>	Upright. Around 60 cm	Covered with stellate hairs	Oval elliptical	Rounded slightly notched	Terminated by a rounded tooth	Crenellate	3 cm	2 cm	1.50	3	Cottony , particularly on the under surface. Small stellate hairs	Medium length (1/3 of the lamina). Thickened at both ends
<i>S. urens</i>	Upright. Up to 0.5 to 1 m	Covered hispid simple and stellate hairs	Cordate	Cordate	Acuminate	Dentate	8 cm	5 cm	1.6	5 or 7	Considerable. Mix of simple stellate hairs	Medium length (1/4 of the lamina)
<i>S. cordifolia</i>	Upright. Around 1 m	Very dense pubescence of stellate hairs	Oval	Slightly notched, broadly rounded	Obtuse truncate	Dentate	5 cm	3 cm	1.6	5	Very dense felting of stellate hairs, greater on under surface	Long (about as long as the lamina). Thickened at the apex
<i>S. alba</i>	Upright. Up to 30 to 80 cm	Covered with short stellate hairs	Oval	Rounded or slightly notched	Obtuse	Finely dentate	3 cm	1.5 cm	2	5	Upper surface glabrous; stellate hairs on the under surface	Long . Nearly as long as the lamina. 3 horny spurs at the base
<i>S. garckeana</i>	Upright. To 2 m	Covered simple long hairs	Rhomboid	Rounded	Acute	Irregularly dentate	14 cm	7 cm	2	5	Quite pubescent. Simple long hairs	Short
<i>S. acuta</i>	Upright. To 1 m	Pubescent	Oval lanceolate	Rounded	Regularly attenuate	Regularly dentate	7 cm	2 cm	3.5	3	Slightly pubescent	Thickened at both ends. Much shorter than the lamina
<i>S. rhombifolia</i>	Upright. To 2 m	Pubescent	Rhomboid	Truncate	Obtuse	Dentate on upper two thirds	5 cm	3 cm	1.6	3	Upper surface glabrous stellate hairs on the under surface	Short

*L = length; W = width; R = length/width ratio.

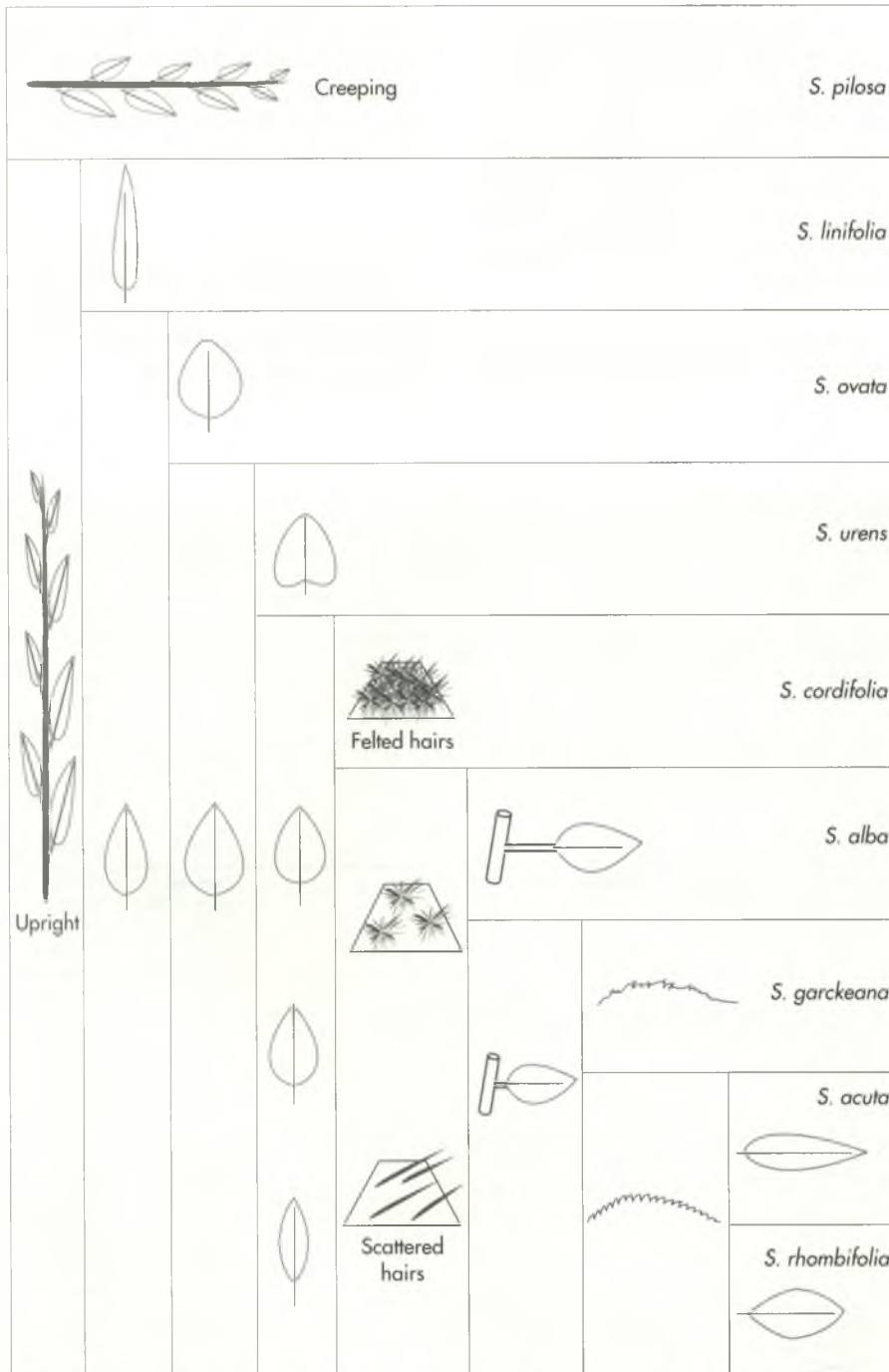


Figure 1. Identification key for *Sida* L. species, with plant habit as the starting point.

Table 3. The eight characters considered in the key, in the best chronological order for easy identification.

Characters	Variations
Habit	creeping or upright
General lamina shape	narrow or broad
Lamina apex shape	rounded or pointed
Lamina base shape	cordate or notched, attenuated, rounded
Pubescence	very dense or not
Petiole	long or short
Lamina margin	regularly or irregularly dentate
Lamina margin	dentate from the base or not

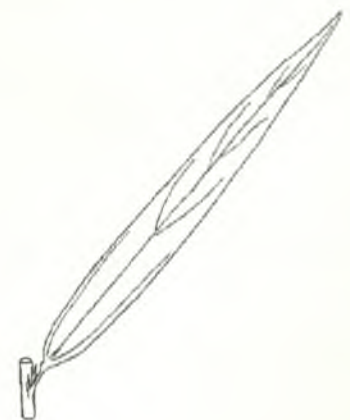
Species descriptions



Sida pilosa Retz.

S. pilosa is characterized by its creeping habit, with a thin stem and roots generally emerging from the nodes. The leaves and stems are moderately pubescent. The lamina, broadly cordate at the base and acuminate at the apex, has a double-dentated margin. The petiole is almost as long as the lamina. The cream-yellow flowers occur singly or in pairs. This species is rarely found in dense populations or in tropical regions.

Sida linifolia C. Juss. Ex Cav.



S. linifolia is the only species with a linear straight-margined leaf. It has an upright and relatively diffuse habit. The very dark-green stem is woody at the base. Long simple hairs are clearly visible on the stem. The central vein of the lamina is prominent.

*Sida linifolia*.

Photo CIRAD-AMATROP

The pubescence hairs on both sides of the lamina are simple and long. The petiole is short, with a pair of linear filiform stipules arising from the base. The flowers, white with a red centre, are clustered in a terminal corymb.

BERHAUT (1979) reported finding this plant in wet regions of Senegal, growing in sandy soils of wooded savanna zones. It is common in fallow lands of tropical Africa and America (LEBRUN *et al.*, 1991).

Sida ovata Forssk.



S. ovata is characterized by its oval (only a slight difference in length and width) lamina and the apex is tipped with a rounded tooth. The margin is crenellate, a trait that is not found in the other *Sida* species (mainly dentate). The lamina (especially the under surface) is coated with short stellate hairs, which gives it a whitish, cotton-like appearance. The short petiole is thickened at both ends, with two linear stipule outgrowths. The flowers are single or paired, with an orange-yellowish corolla.

This species flourishes in dry regions from Senegal to Ethiopia. It is found in Egypt and as far away as Transvaal, Saudi Arabia and India (LEBRUN *et al.*, 1991).

Sida urens L.



S. urens has an upright habit. This species is easily recognized by the sharply cordate shape of its lamina. *S. pilosa* is the only other species with a similar-shaped lamina, but it has a creeping habit. *S. urens* has a quite pubescent lamina, with a mixture of stellate and simple hairs, and a simple dentate margin. This plant is often chlorotic, i.e. the leaves turn yellow and only the small veins remain green. The petiole is quite long, highly pubescent, with two linear stipule outgrowths.

The floral corolla is pale orange-yellow. Glomerules of 2-10 flowers grow at the ends of small axillary branches.

This species is quite common in Senegal during the rainy season, and year-round in wet regions (BERHAUT, 1979).

*Sida urens*.

Photo CIRAD-AMATROP

Sida cordifolia L.



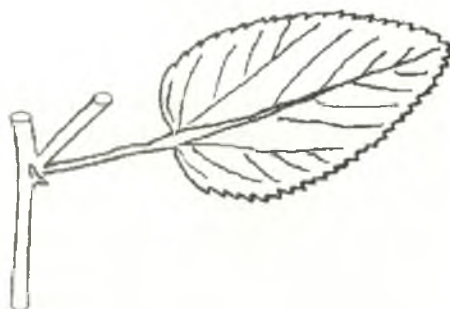
S. cordifolia has a slightly notched lamina that is broadly rounded at the base, not clearly cordate like *S. urens*. This species can be distinguished by its very dense pubescence on the stems, petioles and leaves. The lamina has a velvety appearance and texture because of the densely felted stellate hairs. This coat is thicker on the under surface than on the upper surface. The petiole is long and thickened at the apex. The flowers arise singly, or in groups of 2-4, from the leaf axils. They have a rose-coloured or orange-yellow corolla.



Sida cordifolia.
Photo CIRAD-AMATROP

This species is common in sandy soils of Senegal, during the rainy season and immediately thereafter (BERHAUT, 1979). This ruderal plant is generally found in tropical and subtropical countries, and flourishes in wet sandy soils throughout the Sahel (LEBRUN *et al.*, 1991).

Sida alba L.



S. alba can be identified by its petiole shape. The base bears three horny spurs (or sub-spiny glands), one on each side and one below. The petiole is very long, almost as long as the lamina. The lamina is small (relative to the other *Sida* species), with a very

finely dentated margin. The upper surface is glabrous, while the under surface is covered with stellate hairs, giving it a whitish appearance. It has single whitish flowers.

This species is common in tropical regions. It grows well in quite sandy wet soils and lateritic soils in Sudano-Sahelian regions (LEBRUN *et al.*, 1991). It is quite common in Senegal (BERHAUT, 1979).

Sida garckeana Pol.

An irregular dentate lamina is the main distinguishing trait of *S. garckeana*. It has a fibrous greenish stem coated with long hairs. The lamina is rhomboid (i.e. diamond-shaped) or oval lanceolate. The simple long hairs on the lamina also differentiate this species from *S. acuta* and *S. rhombifolia*, which have stellate hairs (this difference is difficult to detect with the naked eye). It has single yellow flowers. *S. garckeana* is found in cultivated fields by roadsides and is quite abundant in Nigeria (AKOBUNDU & AGYAKWA, 1987).

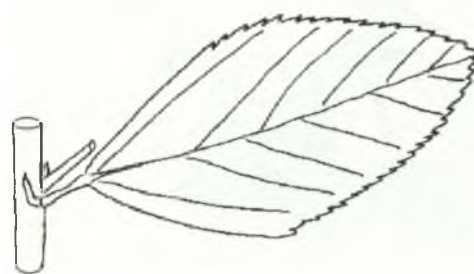
Sida acuta Burm. f.

S. acuta is a herbaceous (even bushy) upright species that grows up to 1 m high. It is generally has many branches arising from the base. The lamina is oval lanceolate and slightly asymmetrical. The margin is dentate from the lamina base, i.e. the main criterion for differentiating this species from *S. rhombifolia*. It is only slightly pubescent. There are simple (sometimes double) hairs on the upper surface of the lamina, with small stellate hairs on the under surface. The petiole is thickened at both ends and much shorter than the lamina. The petiole has two linear stipule outgrowths, one longer and more leaflike than the other. It has pale-yellow to ochre flowers growing at the apex of an axillary penduncle.

Fairly dense populations of this weed grow in wetland zones of Senegal (BERHAUT, 1979). It is one of the most common ruderal species of

western Africa. It is found almost everywhere along roadsides and around houses. Once established, this species is highly competitive and considered to be one of the world's worst weeds (HOLM *et al.*, 1977). In Africa, it is often used to make brooms because of its morphological characteristics.

Sida rhombifolia L.



S. rhombifolia has a very rhomboid lamina, which is the main trait differentiating it from *S. acuta*. In addition, only the lower third of the lamina margin is dentate, thus emphasizing its rhomboid shape. The upper surface of the lamina is glabrous (or bears a few very scattered hairs), while the under surface is coated with short stellate hairs. A pair of filiform stipules arise from the base of the short petiole. This plant sometimes has a trailing habit, and it can grow along the ground. There are generally single, pale yellow to ochre flowers that grow from the leaf axils. This species has been cultivated in USA as a fodder crop. It produces a finer and more brilliant textile fibre than jute (*Corchorus* L. genus). However, as the stems grow only half as high as those of jute plants, the overall crop yields are lower (HENRY, 1924). *S. rhombifolia* grows readily in rubble and is quite common in most tropical and subtropical countries and seems to prefer wet soils. It is one of the most common ruderal species in western Africa and found almost everywhere along roadsides and around houses.



Sida rhombifolia.
Photo CIRAD-AMATROP

An aid for integrated weed control

This key was designed to be simple enough for anyone without botanical training to be able to quickly identify all *Sida* species.

With this approach, interactive identification tools have been created that are of considerable interest for field technicians, e.g. the Adventrop multimedia system, including a flora guide *Adventrop. Weeds of Sudano-Sahelian Africa* (LE BOURGEOIS & MERLIER, 1995) and a CD-ROM that was developed by GRARD *et al.* (1995). This system provides a complete botanical description of each of development stage, while focusing on vegetative characters to enable identifications from incomplete samples.

Finally, it will be possible to evaluate integrated control procedures once insight has been gained on the development cycle of these weeds, the impact of certain cropping practices on weed development cycles, and the ecological and agronomic conditions required for their growth. The ultimate goal is long-term management of weed populations. Farmers could thus avoid unwanted changes in the weed flora (e.g. herbicide resistance, competition, weed propagation induced by cropping practices) that could force them to abandon their croplands (LE BOURGEOIS, 1993).

Weed control, in this perspective, could help in stabilizing agricultural systems and enhance environmental management.

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Abstract... Résumé... Resumen

N. VIAROUGE, P. MARNOTTE, H. MERLIER—Practical identification of weeds in the *Sida* L. genus.

Nine *Sida* L. species of West African crop weeds are identified according to eight vegetative system characteristics. A table of these traits, descriptions and drawings are proposed. Together they enable easy identification of these nine weeds without requiring whole samples. They are meant as aids for professional farmers who do not necessarily have any botanical training.

Keywords: Weed, *Sida* L. genus, *S. acuta*, *S. alaba*, *S. cordifolia*, *S. garckeana*, *S. linifolia*, *S. ovata*, *S. pilosa*, *S. rhombifolia*, *S. urens*, vegetative system, identification, Africa.

N. VIAROUGE, P. MARNOTTE, H. MERLIER—Détermination pratique des mauvaises herbes du genre *Sida* L.

Neuf espèces du genre *Sida* L. (Malvaceae), adventices des cultures en Afrique de l'Ouest, sont différenciées à partir de huit critères de l'appareil végétatif. Un tableau de ces caractères, une clé de détermination pratique, un texte de description et des planches sont proposés. Ces éléments permettent une détermination aisée de ces mauvaises herbes sans disposer d'échantillons complets. Leur application est destinée particulièrement aux professionnels agricoles qui n'ont pas forcément une formation de botaniste.

Mots-clés : mauvaise herbe, genre *Sida* L., *S. acuta*, *S. alaba*, *S. cordifolia*, *S. garckeana*, *S. linifolia*, *S. ovata*, *S. pilosa*, *S. rhombifolia*, *S. urens*, appareil végétatif, identification, Afrique.

N. VIAROUGE, P. MARNOTTE, H. MERLIER—Determinación práctica de las malezas del género *Sida* L.

Nueve especies del género *Sida* L. (Malvaceae), adventicias de los cultivos en África occidental, se diferencian respecto a ocho criterios del aparato vegetativo. Se proponen un cuadro de estos caracteres, una clave de determinación práctica, un texto de descripción y planchas. Estos elementos permiten determinar fácilmente las malezas sin disponer de muestras completas. Su aplicación está destinada en especial a los profesionales agrícolas que no poseen forzosamente una formación de botanistas.

Palabras clave: malezas, género *Sida* L., *S. acuta*, *S. alaba*, *S. cordifolia*, *S. garckeana*, *S. linifolia*, *S. ovata*, *S. pilosa*, *S. rhombifolia*, *S. urens*, aparato vegetativo, identificación, África.