ON SPECIES OF *Calotropis* R. Br.: EVOLUTION IN ACTION AND LIVE STANDARDS FOR CLIMBER CROPS.

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ABSTRACT

Only two species of *Calotropis* R. Br. genus namely *Calotropis procera* R. Br. and *C. gigantea* R. Br. are usually reported in literature. Study of variation in these species distributed over a stretch of about hundred and fifty kilometers in the eastern Uttar Pradesh suggests the presence of at least four types of plants. These plants can be easily identified as *C. gigantea* blue (cgb) and *C. gigantea* white (cgw), *Calotropis procera* blue (cpb) and *C. procera* white (cpw). Simple morphological characters like maximum attainable plant height, corolla shape and corolla color are sufficient for constructing artificial dichotomous keys and their clear identification. A preliminary systematic study of these four types of plants on the basis of scatter plots between leaf length and leaf width also indicates their clear differentiation. Study of such variations in *Calotropis* leading to identification of clear differentiation and development of reproductive isolation barriers may help us identify suitable species or ecotypes/genotypes that can be tried further for tapping their full potential as medicinal and petro-crops, insect trap crops and ideotypes for multistorey cropping. In fact, out of these four types, cgb and cgw seem to be suitable live standards for many climber crops.

KEY WORDS: Artificial dichotomous keys, *Calotropis gigantea*, *C. procera*, medicinal and petro-crops, scatter plots.

INTRODUCTION

Calotropis species are weeds of waste-lands and are found mostly in dry habitats. The two species of *Calotropis* genus, generally reported in the literature namely *Calotropis procera* R. Br. and *C. gigantea* R. Br., are used in traditional medicines (Singh, *et al.,* 1990), vet-medicines, as ornamentals, floss for stuffing pillows, bark fibers for fishing net and twines, tanning, and potential petro-crops. Snap shot observations of these plants have led to their misidentification and hence a lot of confusion prevails in literature. For example, the photograph shown in a review article (Solomon Raju and Purnachandra Rao**,** 2006) is of *Calotropis gigantea* (blue, rotate corolla) but the text of that paper refers it as *Calotropis procera*. It could be compared with the excellent photographs of correctly identified *Calotropis procera* (Amritphale and Sharma 2007). The three functions of taxonomy namely identification, nomenclature and classification help in removing such confusions. Variations noticed in the two reported species of *Calotropis* genus found in three districts of eastern Uttar Pradesh, India over a stretch of about hundred fifty kilometers from Deoria district to Ghazipur district along roadsides, railway tracks and on waste-lands prompted us to take a bit more systematic study of these plants. The preliminary findings of this study are reported in this paper.

MATERIALS AND METHODS

Four types of plants of *Calotropis* genus noticed in the study area make our study materials (Figure 1). Typologically, these can be very easily identified as *Calotropis procera* blue, *C. procera* white, *C. gigantea* blue and *C. gigantea* white. The question arises whether the four types of plants could be considered as four different species or ecotypes. The question relates to finding out systematically whether reproductive isolation barriers have developed amongst the four types of plants and they are reproducing true to their types. The matter may not be very simple as the plant is reportedly/apparently entomophilous and hence might be having a high degree of cross pollination. The systematic approach, usually under such situations, is to 1. study morphological features, 2. examine scatter plots, 3. look into karyotypes and the cytological behaviour of chromosomes, 4. try transplantation experiments under uniform environmental conditions and 5. do breeding experiments to check whether the characteristic features show segregation in the offspring. In present effort, artificial dichotomous keys are constructed for their unambiguous identification based on some simple morphological characters like maximum attainable plant height, corolla shape and corolla color. Scatter plots between leaf length and leaf width are also examined to check whether the four types of plants could be clearly differentiated. Evidences have been gathered to check whether suitable plant types could be identified for their inclusion in multi-storey cropping as live (and also as dead) standards for climber crops.

(a) (b)

(c) (d)

Figure 1. Four types of *Calotropis* (a) cgb, (b) cpb, (c) cgw and (d) cpw.

RESULTS AND DISCUSSION

On the basis of maximum attainable plant height and shape of corolla the four types of plants could be classified into two groups namely ***procera*** and ***gigantea***. The procera group of plants hardly attains heights more

than one and half to two meters whereas gigantea group could attains height up to five meters. The procera group has cup shaped corolla whereas gigantea group has rotate (or even recurved backwardly) corolla shape under fully open state of the flowers. Further on the basis of corolla color the two groups of plants can be classified as blue and white. Thus a tentative dendrogram showing four types of *Calotropis* could be drawn as given below in figure 2.

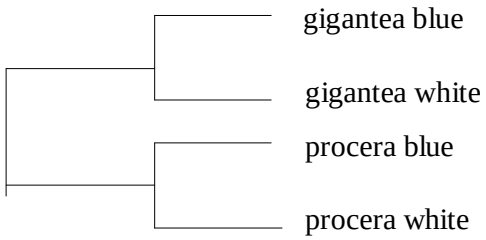

Figure 2. A tentative dendrogram showing four types of *Calotropis*.

Although a scatter plot between leaf length and leaf width is showing clear differentiation between gigantea (cgb) and procera (cpb) groups (Figure 3.) yet five more comparisons are needed to be made to check whether the four types of plants could be considered as four different species.

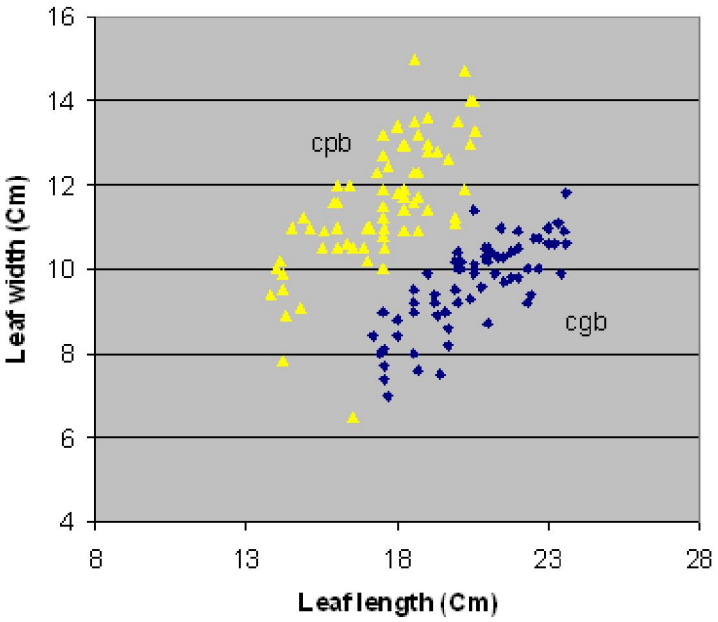

Figure 3. Scatter plot between leaf length and leaf width of *C. gigantea* (blue) and *C. procera* (blue).

Only on the basis of morphological features and scatter plots of four types of *Calotropis* plants, they

may not be judged to be four different species. For confirmation, cytological studies, transplantation experiments and breeding experiments are needed. On ecological and utility grounds, the four types of *Calotropis* seem to be quite different from one another. Sympatric existence of three types of plants of *Calotropis* genus namely *C. gigantea* blue, *C. gigantea* white and *C. procera* blue at a single location along the railway track towards east of Deoria town and non-availability of intermediates indicates that a sympatric speciation might have occurred. Similarly, the presence of fourth type, *C. procera* white (cpw), along with cpb, cgw and cgb near bridge (Beer Abdul Hamid Setu) over river Ganges at Ghazipur indicates their allopatric speciation (Figure 4). From the point of view of ecological niche, the cpb is occupying relatively drier habitats compared to cgb and cgw. There is a very high degree of niche overlap between cgb and cgw. The fourth type (cpw) was seen only once at Ghazipur on the slope of river-bank. The river-bank remained flooded during heavy monsoon and hence only rotten shoot portion is left now. Further study on this plant could be done only if new shoot emerges.

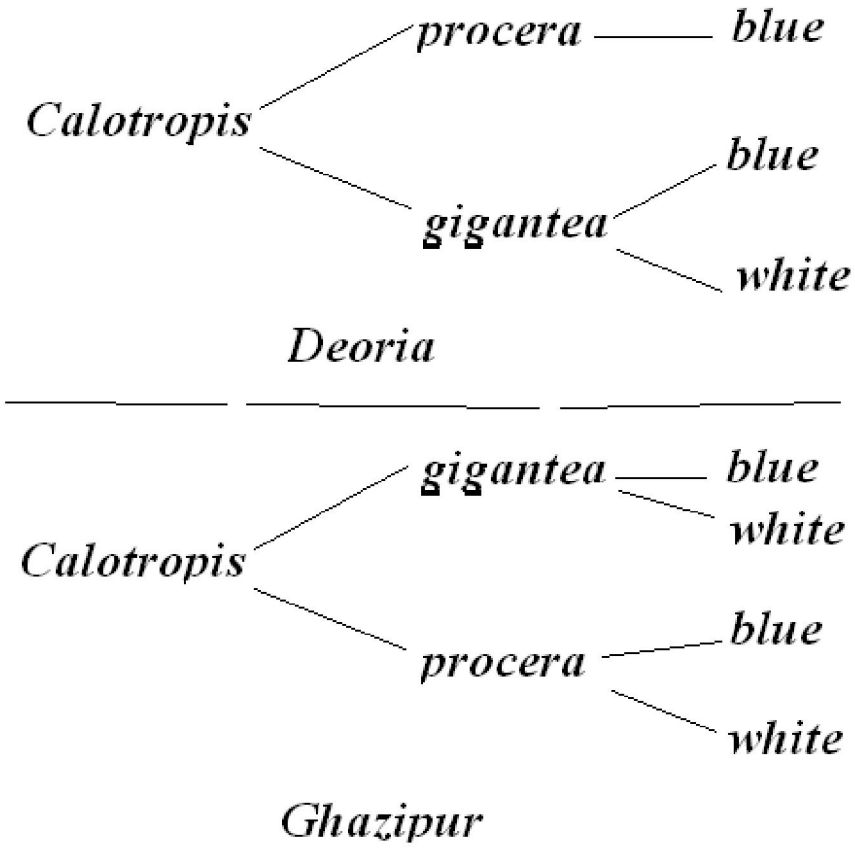

Figure 4. Sympatric and allopatric speciation in *Calotropis*.

Calotropis gigantea white is the most frequently seen plant type planted at the gate towards the left side (while entry and towards right side while exit) in most of the houses in Deoria and other types of *Calotropis* plants are mistakes in choosing the right type of *Calotropis* by the house owners. *Calotropis gigantea white* is considered to be very auspicious here. In wild, the order of the relative abundance of the three types of plants in Deoria is cgb > cgw > cpb. Similarly, once a person was selectively picking inflorescences of only cgw in spite of presence of other two types (cgb and cpb). These instances show the choosiness of local people towards right

variation they prefer. Therefore, there is a need to explore the full potential of these plants because they have excellent coppicing capacity, year-round growth potential, suitable plant types as live (& also dead) standards for climber crops and many uses. Figure 5 (a) shows a cucurbit (*Luffa aegyptiaca* Mill.) fruiting well while using cgb as a live standard. This figure is from a chance natural experiment in which cgb is growing as a weed and the cucurbit as an escape near a blacksmith's hut. Probably, the results would be better if cgb (or cgw) and the cucurbits (or (m)any climber crops) will be grown/cultivated together purposefully. The canopy of *Calotropis gigantea* is highly amenable to management and could be given proper shape (vertical branches) to support the climber crops. Figure 5 (b) shows such a shape, by chance.

(a) (b)

Figure 5 (a) *Luffa aegyptiaca* Mill. fruiting well while using cgb as a live standard.
(b) Proper shape of cgw that can be used effectively as a live standard.

In some types of these plants intra-specific variation is seen in some characters. For example, the leaves are usually opposite and decussate. However, figure 6(a) shows emergence of three leaves from a single node in *C. procera* blue in Deoria. Similarly, its fruits called follicles usually develop from bicarpellary apocarpus ovary. However, figure 6(b) shows development of a bicarpellary syncarpus ovary. In the same figure, another fruit is developing in which syncarpy is not complete. The point to be noted here is that apocarpy is considered to be primitive and syncarpy as evolved. In *C. procera* white type, there is variation in plant height and corolla opening pattern. Such variations might be indicators of evolution in action. *Calotropis* is considered to be a xerophytic plant. These plants grow luxuriantly under normal mesic conditions. In fact, cgb and cgw are growing very well in seasonally flooded but usually dry ditches and ponds in the sandy soils of Deoria and slopes of riverbanks. At certain places, cgb and cgw have replaced *Ipomoea fistulosa* Mart. ex Choisy (commonly known as behaya/besharam) from small ditches and edges of ponds. These are also doing well on garbage dumps. These instances indicate that they might do well if they are brought under cultivation for

inclusion in multistorey cropping. The excellent coppicing ability (Figure 7a) of cgb and cgw is producing a lot of biomass every year on the wastelands. This biomass is being used by poor people as fuelwood (Figure 7b).

(a) (b)

Figure 6 (a) Three leaves from a single node & (b) Fruit development from bicarpellary, syncarpus ovary.

(a) (b)

Figure 7(a) Excellent coppicing ability of *Calotropis gigantea*.

(b) *Calotropis gigantea* as fuelwood for use by poor people.

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