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# SURVEY AND QUALITATIVE ANALYSIS OF SEEDLINGS OF SOME BROAD-LEAF WEEDS OCCURRING ALONG ROAD-SIDES IN BALURGHAT TOWN IN DAKSHINDINAJPUR DISTRICT, WEST BENGAL

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ABSTRACT ■ Seedlings of sixty weed taxa of Magnoliopsida belonging to twenty four families have been investigated from different road-sides in Balurghat Town, Dakshindinajpur. Qualitative traits of the seedlings have been emphasized for the construction of artificial key for their proper identification in the field. Inter-dependence of qualitative traits used in the key has been evaluated through Principal Component Analysis (PCA) following Varimax method. Conservation of some of these species through seedlings has been emphasized considering their multifarious importance.

**Key words:** *seedlings, roadside weeds, qualitative traits, artificial key, PCA, conservation*

## INTRODUCTION

Weeds are unwanted herbs, undershrubs, shrubs and climbers growing in crop fields, road sides, wall of covered area, waste places, *etc*. Many of the weeds have medicinal value and are used by local people for various purposes. The shrubs having good soil binding root-network potential can prevent soil erosion. Weeds produce huge number of seeds that are scattered surrounding mother plants or dispersed to some distance by different agents. They germinate under favourable condition and form seedlings in different habitats. The seedlings of road sides are not protected like *in-situ* conservations. Many useful weeds are rare, threatened or vulnerable and get escaped from attention of general people. Urbanization, various development programs like extension of roads, dam construction, formation of private or government industries, institutions, different renovation programmes, *etc.* destroy the adult weeds or their seedlings. Grazing animals are also one of the major threats for their survival. Roadside annual or perennial weeds are most affected because they grow in totally neglected, open, vulnerable habitats, although they are valuable air purifiers, soil binders are often medicinally useful. Therefore, *in-situ* and *ex-situ* conservation of many valuable roadside weeds happen to be the necessity of the hour. Identification of weeds at seedling stage is a crucial step for conservation, although we have adequate literatures for their characterization in India and abroad (Duke,

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1965, 1969; Burger, 1972; Tamura *et al.*, 1977; De Vogel, 1980; Sampathkumar, 1982; Balasubramanyam and Swarupanandan, 1986; Ibarra-Manríquez *et al.*, 2001; Paria *et al.*, 2006; Kamilya and Paria, 1990; Kamilya and Das, 2014; Chomas *et al.*, 2001; Parkinson *et al.*, 2013). Moreover, variations found in several seedling traits provide an important source of systematic characters in delimiting groups at different taxonomic levels (*e.g.* Rodrigues and Tozzi, 2008; Tillich, 2003).

Considering the significance of weeds and availability of different literatures, an effort has been made to identify the seedlings of ruderal weeds of Balurghat Block, Dakshindinajpur, West Bengal. The town of Balurghat is located at 25º22'N and 88º76'E with annual temperature ranging from 8 to 34ºC and mean annual rainfall of 460-520mm. The soil component is commonly silty-loam to sandy-loam.

## MATERIALS AND METHODS

Seeds and/or seedlings were collected from different roadsides of Balurghat Block *i.e.*State Highway from Patiram to Balurghat, Balurghat to Dangi Border, Balurghat to Fatepur through Chakbhrigu, Balurghat to Teor, roadways of Atreyi River side and Tank More to Airport through Raghunathpur, *etc.* (Map:1). In many cases adult plants were collected for proper identification with the help of literature (Prain, 1903; Kanjilal *et. al.*, 1934-1940; Kamilya, 2008 and Mitra and Mukherjee, 2013). Seeds of adult plants were sown in the seedbed of 1m×1m area in the experimental garden of Botany Department of Balurghat College. The seedlings raised from seedbeds were compared with the natural ones for proper identification. The seedlings were described with qualitative and quantitative traits following Duke (1965); Burger, (1972); Paria *et. al.*(1990, 2006) ; Das and Kamilya ( 2014 ) and Kamilya and Das (2014).

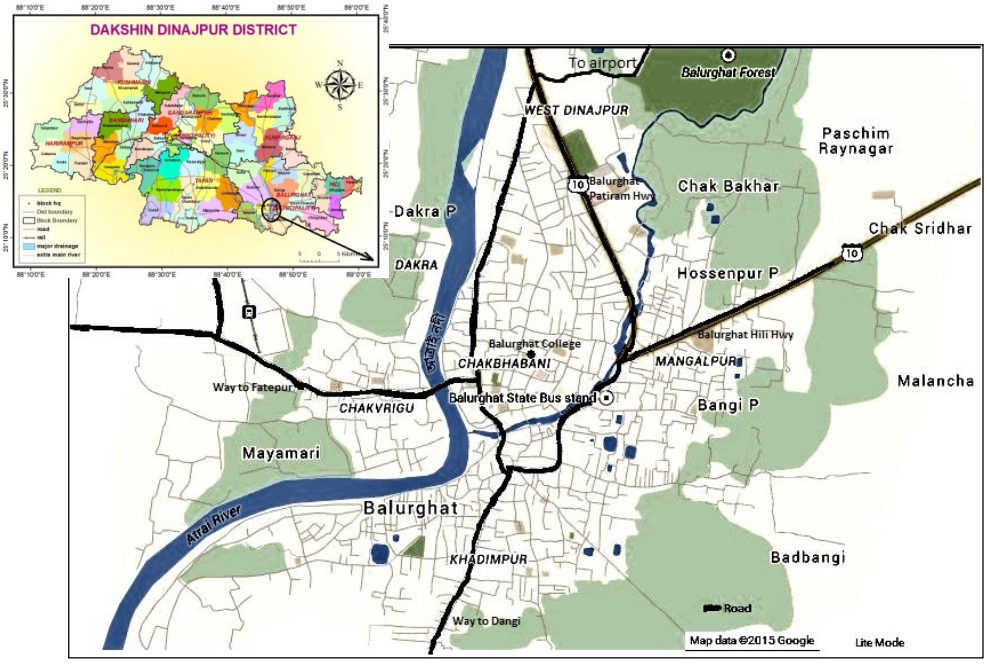


Fig. 1: Map of Balurghat Town highlighting the roads in black line

An artificial key to sixty taxa has been prepared using qualitative characters. An enumeration of the taxa has been made where author's name(s), figure number are mentioned. The families were arranged within the list following Takhtajan (1997). Within each family genera and species are arranged alphabetically. For the statistical analysis SPSS software (version 16.0) has been used. The entire data set of the considered qualitative traits was subjected to principal component analysis (PCA) using Varimax method. This analysis allows the identification of interrelated variables.

**Table 1:** List of the studied taxa arranged family wise following Takhtajan (1997) with corresponding photograph and voucher number.

**MAGNOLIOPSIDA:**

**Papaveraceae**

*Argemone Mexicana* L. [Plate 1: 11]; Das 37

**Amaranthaceae**

*Achyranthes aspera* L. [Plate 1: 3]; Das & Das 42

*Alternanthera polygonoides* (L.) R.Br.*ex.* Roem. & Schult. [Plate 1: 6]; Das & Kamilya 46

*Alternanthera sessilis* (L.) R.Br.*ex.* DC. [Plate 1: 7]; Das 89

*Amaranthus spinosus* L. [Plate 1: 8]; Das & Das 23

*Amaranthus viridis* L. [Plate 1: 9]; Das 31

**Chenopodiaceae**

*Chenopodium ambrosioides* L. [Plate 1: 16]; Das & Kamilya 55

**Polygonaceae**

*Persicaria hydropiper* (L.) Spach [Plate 3: 48]; Das & Kamilya 21

*Persicaria orientalis* (L.) Assenov [Plate 3: 42]; Das & Kamilya 23

*Rumex dentatus* L. [Plate 3: 49]; Das 35

**Plumbaginaceae**

*Plumbago zeylanica* L. [Plate 3: 47]; Das 61

**Capparaceae**

*Cleome rutidospermum* DC. [Plate 1: 17]; Das & Das 53

**Tiliaceae**

*Triumfetta rhomboidea* Jacq [Plate 3: 53]; Das 44

**Sterculiaceae**

*Pentapetes phoenicea* L. [Plate 3: 43]; Das 58

**Malvaceae**

*Abutilon indicum* (L.) Sweet subsp. *indicum* [Plate 1: 1]; Das & Kamilya 43

*Urena lobata* L. ssp. *lobata* [Plate 3: 56]; Kamilya & Das 50

**Euphorbiaceae**

*Acalypha indica* L. [Plate 1: 2]; Das 51

*Croton bonplandianus* Baill. [Plate 2: 36]; Das & Das 74

*Euphorbia hirta* L. [Plate 2: 26]; Kamilya & Das 67

*Euphorbia serpens* H.B.& K [Plate 2: 27]; Das 64

*Jatropha gossypifolia* L. [Plate 3: 60]; Das & Das 81

*Phyllanthus urinaria* L. [Plate 3: 44]; Kamilya & Das71

**Leaceae**

*Leea macrophylla* Roxb. *ex.* Hornem. [Plate 2: 35]; Kamilya & Das 70

**Apiaceae**

*Centella asiatica* (L.) Urb. [Plate 1: 15]; Das 86

*Hydrocotyle sibthorpioides* Lam. [Plate 3: 58]; Kamilya & Das 75

**Asteraceae**

*Ageratum conyzoides* L. [Plate 1: 4]; Das & Kamilya 32

*Ageratum houstonianum* Mill. [Plate 1: 5]; Das & Kamilya 35

*Eclipta prostrata* (L.) L. [Plate 2: 24]; Das 63

*Gnaphalium polycaulon* Pers. [Plate 2: 31]; Das & Kamilya 14

*Grangea maderaspatana* (L.) Poir. [Plate 2: 29]; Das & Kamilya 19

*Mikania micrantha* Kunth [Plate 2: 25]; Kamilya & Das 82

*Vernonia cinerea* (L.) Less. [Plate 3: 57]; Das 48

*Youngia japonica* (L.) DC. [Plate 3: 59]; Das & Das 73

**Rubiaceae**

*Dentella repens* J.R. & G. Forst. [Plate 2: 23]; Das 49

*Hedyotis biflora* (L.) Lam. [Plate 3: 41]; Kamilya 41

**Apocynaceae**

*Calotropis gigantea* (L.) R.Br. [Plate 1: 12]; Das 12

**Solanaceae**

*Datura metel* L. [Plate 1: 21]; Das & Das 27

*Datura stramonium* L. [Plate 2: 22]; Das 88

*Physalis angulata* L. [Plate 3: 45]; Das & Das 16

*Physalis peruviana* L. [Plate 3: 46]; Das & Das 19

*Solanum indicum* L. [Plate 3: 53]; Das & Kamilya 90

*Solanum nigrum* L. [Plate 3: 51]; Das & Das 08

*Solanum sisymbrifolium* Lam. [Plate 3: 52]; Kamilya 76

**Convolvulaceae**

*Evolvulus nummularius* L. [Plate 2: 28]; Das79

**Boragenaceae**

*Coldenia procumbens* L. [Plate 1: 19];Kamilya & Das 25

*Heliotropium indicum* L. [Plate 2: 32]; Das 27

**Onagraceae**
*Ludwigia perennis* L. [Plate 2: 37]; Kamilya 56
**Fabaceae**
*Crotalaria pallida* Aiton [Plate 1: 20]; Das 57
*Mimosa pudica* L. [Plate 2: 38]; Das & Das 60
*Senna sophera*(L.) Roxb. [Plate 1: 14]; Kamilya & Das 84
*Senna tora* L. [Plate 1: 13]; Das & Das 66
*Tephrosia purpurea* (L.) Pers. [Plate 3: 56]; Kamilya & Das 52
**Rutaceae**
*Murraya koenigii* Spreng [Plate 2: 39]; Das 54
*Glycosmis arborea* (Roxb.) DC. [Plate 2: 30]; Das & Kamilya 62
**Scrophulariaceae**
*Scoparia dulcis* L. [Plate 3: 50]; Das & Das 15
**Verbenaceae**
*Clerodendrum viscosum* Vent. [Plate 1: 18]; Das 11
*Lantana camara* L. [Plate 2: 34]; Das & kamilya 77
**Lamiaceae**
*Anisomeles indica* (L.) Kuntze [Plate 1: 10]; Das 09
*Hyptis suaveolens* (L.) Poit. [Plate 2: 33]; Das 68

*Ocimum canum* Sims. [Plate 2: 40]; Das & Kamilya 39

**Artificial key** (valid for the studied taxa only):

1. Seedlings with first two leaves opposite to subopposite, rarely alternate (exception: *Croton bonplandianus, Murraya koenigii*); internodes very reduced……..2

1a. Seedlings with first two leaves alternate; internodes not reduced……..37

2. Seedlings phanerocotylar……3

2a. Seedlings cryptocotylar……...35

3. Seedlings with interpetiolar stipule……4

3a. Seedlings exstipulate……5

4. Paracotyledons ovate-orbicular; stipules in eophylls fimbriate……. *Hedyotis biflora*

4a. Paracotyledons broadly ovate; stipules on eophylls not fimbriate (forming a cup without ciliated appendages)…..… *Dentella repens*

5. Paracotyledons sessile or subsessile, when present, petioles are very reduced….6

5a. Paracotyledons with prominent petioles……..13

6. Paracotyledons broadly ovate; margin of first two leaves serrate or crenate-dentate or irregularly toothed .....….....7

6a. Paracotyledons elliptic or suborbicular; margin of first two leaves entire……...10

7. First two leaves opposite, ovate in shape with serrate or crenate-dentate margin and actinodromous venation……..…...8

7a. First two leaves subopposite, broadly elliptic in shape with irregularly toothed margin and camptodromous venation…….... *Youngia japonica*

8. Seedlings hairy; margin of first two leaves crenate-dentate……..…..9

8a. Seedlings glabrous; margin of first two leaves distantly serrate or distantly toothed..……. *Mikania micrantha*

9. Paracotyledons sub-orbicular…….. ……... *Ageratum conyzoides*

9a. Paracotyledons ovate…..... *Ageratum haustonianum*

10. Hypocotyl much reduced (0.1-0.3 cm)…….....……11

10a. Hypocotyl comparatively longer (0.9-1.7 cm)…….....12

11. Seedlings hairy; paracotyledons elliptic in shape with obtuse apex……. *Grangea maderaspatana*

11a. Seedlings glabrous; paracotyledons suborbicular in shape with rounded apex…….... *Gnaphalium polycaulon*

12. Paracotyledons elliptic with obtuse apex; first two leaves opposite with obtuse apex…….. *Eclipta prostrata*

12a. Paracotyledons suborbicular with rounded apex; first two leaves subopposite with acute apex……. *Vernonia cineria*

13. Paracotyledons ovate or acicular in shape……14

13a. Paracotyledons oblong or orbicular in shape……25

14. Paracotyledons thick, acicular in shape; margin of first two leaves sinuately sharply toothed, subsequently leaves spiny…. ……..... *Argemone mexicana*

14a. Paracotyledons comparatively thin, otherwise in shape; margin of first two leaves entire or serrate or undulate, spine absent…….....15

15. Paracotyledons broadly ovate; seedlings without purplish tinge……...16

15a. Paracotyledons narrow lanceolate or ovate-lanceolate or elliptic-oblong; seedlings with purplish tinge on hypocotyls, petioles and lower surface of paracotyledons and eophylls (exception: *Plumbago zeylanica*)……..…..19

16. Apex of paracotyledons obtuse; first two leaves elliptic in shape, base attenuate; seedlings not aromatic……...… *Scoparia dulcis*

16a. Apex of paracotyledons retuse; first two leaves ovate in shape, base broadly truncate or subrounded; seedlings aromatic……....17

17. Paracotyledons ovate to deltoid in shape; margin of first two leaves entire……..... *Ocimum canum*

17a. Paracotyledons broadly ovate; margin of first two leaves crenate-dentate……..…18

18. Paracotyledons with subrounded base; first two leaves with subrounded base and obtuse apex……..…..... *Anisomeles indica*

18a. Paracotyledons with truncate base; first two leaves with subcordate base and acute apex…….…. *Hyptis suaveolens*

19. Seedlings with typical purplish tinge on hypocotyls, petioles and lower surface of paracotyledons and eophylls; base of paracotyledons cuneate……20

19a. Seedlings without purplish tinge; base of paracotyledons attenuate…... *Plaumbago zeylanica*

20. First two leaves with irregularly undulate margin; subsequent leaves ovate-rhomboid……. *Chenopodium ambrosioides*

20a. First two leaves with entire margin; subsequent leaves ovate or obovate……..21

21. First two leaves opposite with acute or obtuse apex……...22

21a. First two leaves alternate with retuse apex……...24

22. First two leaves obovate or oblanceolate in shape, venation hyphodromous……23

22a. First two leaves ovate in shape, venation camptodromous……. *Achyranthes aspera*

23. First two leaves oblanceolate; paracotyledons narrow lanceolate……. ……. *Alternanthera polygonoides*

23a. First two leaves obovate; paracotyledons elliptic oblong……. ……... *Alternanthera sessilis*

24. Seedlings with axillary spines appearing at 3rd-4th leaf stage……. *Amaranthus spinosus*

24a.Seedlings without spines at any stage……..... *Amaranthus viridis*

25. First two leaves compound……. ……. *Cleome rutidospermum*

25a. First two leaves simple……26

26. First two leaves with crenate-serrate margin……...27

26a. First two leaves with entire margin……...29

27. Paracotyledons broadly oblong to rectangular, base truncate; seedlings aro-

matic……. *Lantana camara*

27a. Paracotyledons narrowly oblong, base subrounded; seedlings not aromatic……..28

28. First two leaves subopposite, elliptic-obovate in shape, surface crisped…….. …….. *Coldenia procumbens*

28a. First two leaves opposite, ovate in shape, surface not crisped… *Heliotropium indicum*

29. First two leaves opposite, shape elliptic or obovate…….30

29a. First two leaves alternate, shape ovate……34

30. First two leaves elliptic; seedlings without any purple coloration……...31

30a. First two leaves obovate; seedlings with purplish tinge on hypocotyls, petioles and lower surface of paracotyledons and eophylls……32

31. First two leaves elliptic with camptodromous venation; margin of subsequent leaves entire……..... *Calotropis gigantea*

31a. First two leaves elliptic-rhomboid with actinodromous venation; margin of subsequent leaves serrate……..… *Acalypha indica*

32. First two leaves opposite; seedlings with latex……..33

32a. First two leaves subopposite; seedlings without latex……... *Phyllanthus urinaria*

33. Seedlings smaller in size, minutely pubescent……..…… *Euphorbia serpens*

33a. Seedlings comparatively larger, tomentose…….. *Euphorbia hirta*

34. Seedlings with stellate hair on internodes; heteroblasty absent…….. …… *Croton bonplandianum*

34a. Seedlings with glandular hair present on leaf margin; heteroblasy present……. ……... *Jatropha gossypifolia*

35. Seedlings geal; cataphylls present, subsequent leaves compound…… *Murraya koenigii*

35a. Seedlings hypogeal; cataphylls absent, subsequent leaves simple……..36

36. First two leaves elliptic, apex obtuse, margin entire……. *Glycosmis arborea*

36a. First two leaves ovate, apex acute, margin serrate……. *Clerodendrum viscosum*

37. Seedlings with first two leaves stipulate (free lateral or ochreate)……...…….38

37a. Seedlings exstipulate……..……..50

38. Seedlings with first two leaves compound; paracotyledons thick, fleshy……39

38a. Seedlings with first two leaves simple; paracotyledons herbaceous……...43

39. First leaf unipinnate, second leaf bipinnate……..…… *Mimosa pudica*

39a. First two leaves unipinnate…….…..40

40. Paracotyledons oblong-suborbicular with actinodromous venation; number of leaflets in first two leaves four……..41

40a. Paracotyledons oblong-falcate with hyphodromous venation; number of leaflets in first two leaves three……..…42

41. Number of leaflets in 3$^{rd}$-4$^{th}$ leaf 3 pairs…… *Senna tora*

41a. Number of leaflets in 3$^{rd}$-4$^{th}$ leaf 2 pais……...…… *Senna sophera*

42. Eophylls with secondary veins parallel and retuse apex…… *Tephrosia purpurea*

42a. Eophylls with secondary veins reticulate and obtuse apex …..… *Crotalaria pallida*

43. Paracotyledons with hyphodromous venation; first two leaves with entire margin……..…44

43a. Paracotyledons with actinodromous venation; first two leaves with dentate or crenate-dentate margin……..46

44. First two leaves subopposite with stipules scaly, not fimbriate, deciduous…….. *Rumex dentatus* subsp. *klotzscianus*

44a. First two leaves alternate with stipules not scaly, fimbriate, persistant……45

45. Paracotyledons obovate to ovate; first two leaves with apex subrounded-mucronate…….. *Persicaria hydropiper*

45a. Paracotyledons linear; first two leaves with apex obtuse to acute…..... *Persicaria orientalis*

46. Internodes angular; petioles of eophylls and internodes winged, first two leaf surface crisped…… *Leea macrophylla*

46a. Internodes round; petioles of eophylls and internodes not winged, leaf surface not crisped……..…47

47. Paracotyledons bilobed; apex of first two leaves obtuse…….. *Pentapetes phoenicia*

47a. Paracotyledons ovate or suborbicular; apex of first two leaves acute……....48

48. Apex of paracotyledons retuse, base truncate; subsequent leaves sinuately 3-lobed……49

48a. Apex of paracotyledons rounded, base rounded; subsequent leaves not lobed…..……*Triumfetta rhomboidea*

49. Paracotyledons suborbicular in shape; first two leaves with dentate margin…….. …….. *Urena lobata* subsp. *lobata*

49a. Paracotyledons broadly ovate in shape; first two leaves with crenate-dentate margin…… *Abutilon indicum* subsp. *indicum*

50. Seedlings with ovate or ovate-lanceolate or oblong paracotyledons; first two leaves ovate or reniform……..51

50a. Seedlings with or suborbicular paracotyledons; first two leaves oblong…….. *Evolvulus numularius*

51. First two leaves ovate or broadly ovate in shape with entire or sinuate margin……..……52

51a. First two leaves reniform in shape with crenate margin……..…59

52. Base of eophylls oblique…….53

52a. Base of eophylls attenuate, not oblique…….... *Ludwigia perennis*

53. First two leaves elliptic; subsequent leaves with entire margin……..54

53a. First two leaves ovate, broadly ovate or sinuately lobed; subsequent leaves with repand-dentate margin……..……55

54. Purplish colour present on hypocotyl..... *Datura stramonium*

54a. Purplish colour absent on hypocotyl ..... *Datura metel*

55. Paracotyledons ovate with subrounded base……..…….56

55a. Paracotyledons lanceolate with cuneate base……..…….57

56. Seedlings hairy; hypocotyls and first internodes with purple tinge..... *Physalis peruviana*

56a. Seedlings glabrous hypocotyl and first internodes pale green..... *Physalis angulata*

57. Seedlings with spine present on subsequent leaves and internodes…….58

57a. Seedlings without spines…… *Solanum nigrum*

58. Subsequent leaves pinnatisect…….. ……*Solanum sisymbrifolium*

58a. Subsequent leaves entire…… *Solanum indicum*

59. Paracotyledons ovate…….. *Hydrocotyle sibthorpioides*

59a. Paracotyledons oblong…….. *Centella asiatica*

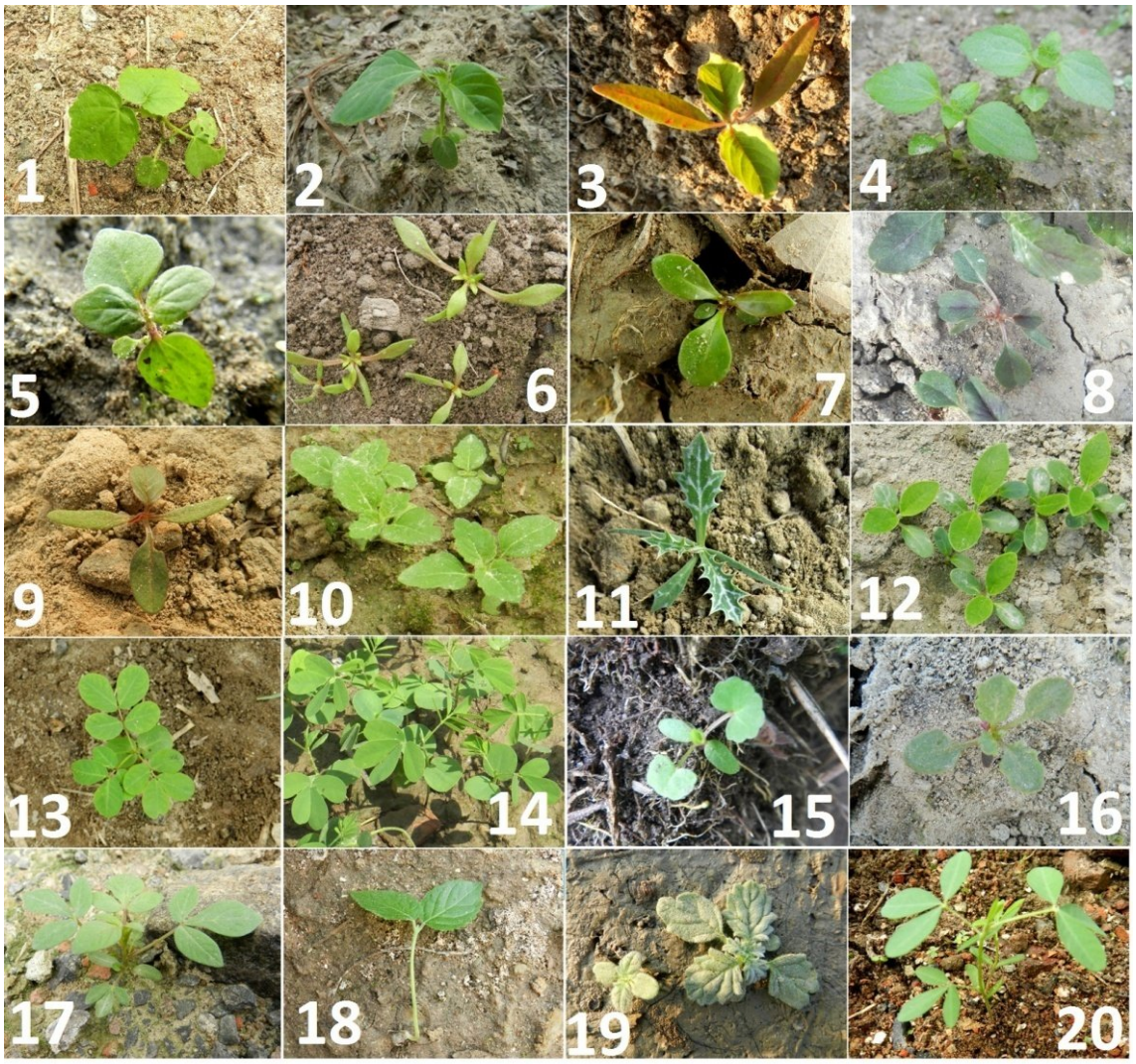


**Plate-I:** Photographs of seedling : 1.*Abutilon indicum* subsp. *indicum;* 2. *Acalypha indica;* 3. *Achyranthus aspera;* 4. *Ageratum conyzoides;* 5. *Ageratum houstonianum;* 6. *Alternanthera polygonoides;* 7. *Alternanthera sessilis;* 8. *Amaranthus spinosus;* 9. *Amaranthus viridis*; 10. *Anisomeles indica;* 11. *Argemone mexicana;* 12. *Calotropis gigantean;* 13. *Senna tora*; 14. *Senna sophera;* 15. *Centella asiatica;* 16. *Chenopodium ambrosioides;* 17. *Cleome rutidospermum*; 18. *Clerodendrum viscosum;* 19. *Coldenia procumbens;* 20. *Crotalaria pallida.*

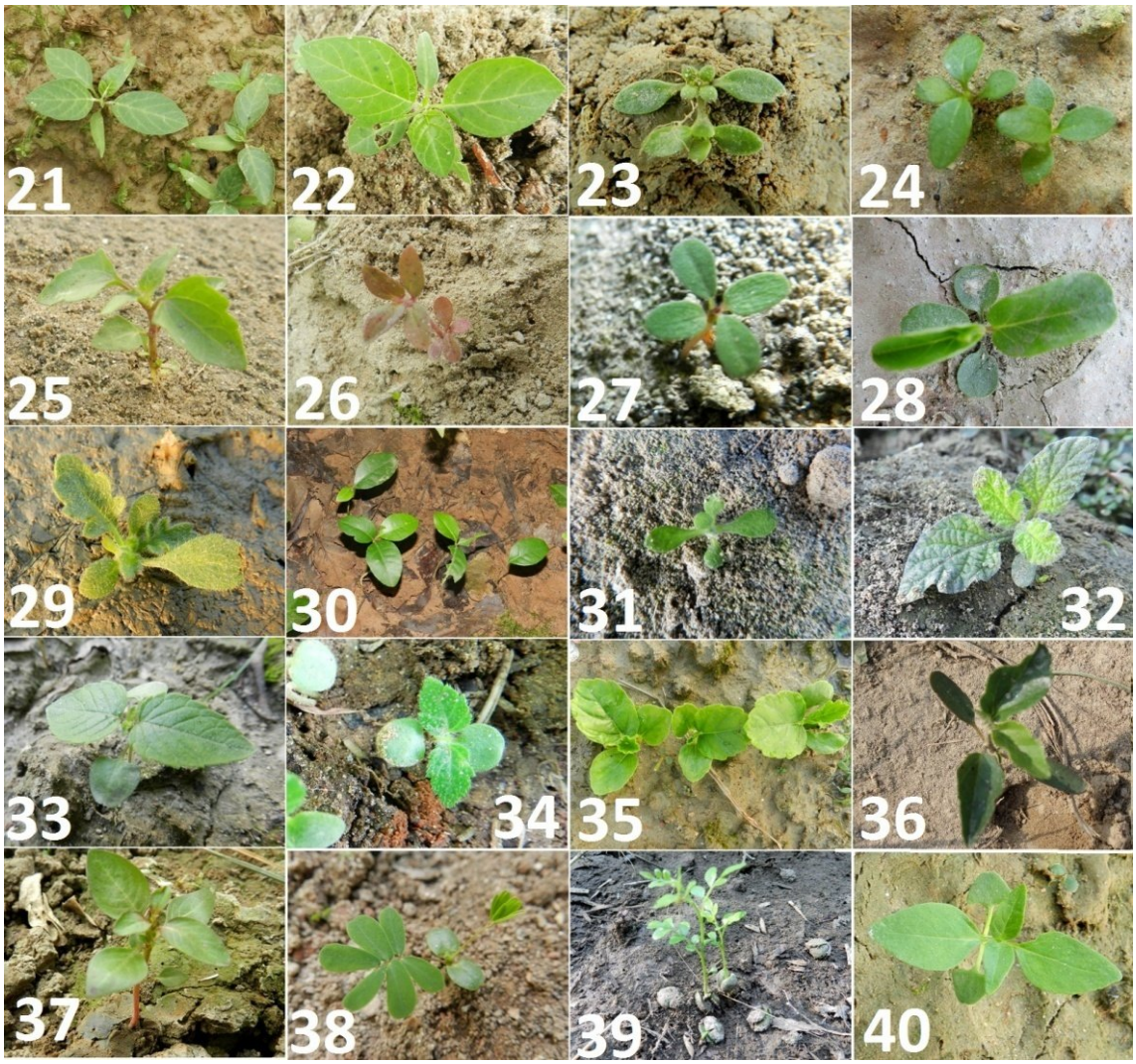


**Plate- II**: Photographs of seedling: 21. *Datura metel;* 22. *Datura stramonium;* 23. *Dentella repens;* 24. *Eclipta prostrata;* 25. *Mikania micrantha;* 26. *Euphorbia hirta;* 27. Euphorbia serpens; 28. *Evolvulus nummularius;* 29. *Grangea maderaspatana; 30. Glycosmis arborea;* 31. *Gnaphalium polycaulon;* 32. *Heliotropium indicum;* 33. *Hyptis suaveolens;* 34. *Lantana camara;* 35. *Leea macrophylla;* 36. *Croton bonplandianus;* 37. *Ludwigia perennis;* 38. *Mimosa pudica;* 39. *Murraya koenigii;* 40. *Ocimum canum.*

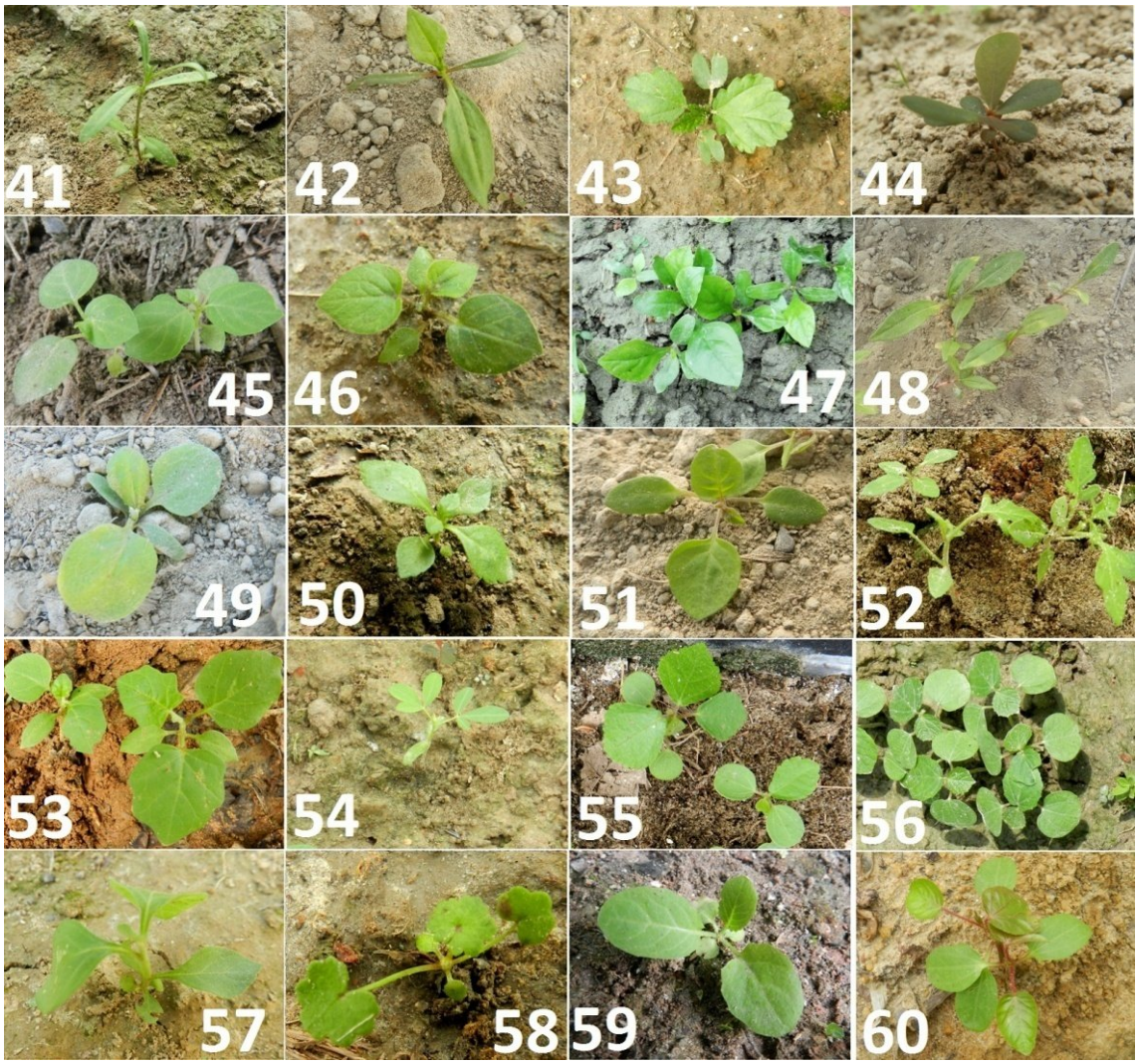


**Plate-III**: Photographs of seedling: 41. *Hedyotis biflora;* 42. *Persicaria orientalis;* 43. *Pentapetes phoenicea;* 44. *Phyllanthus urinaria;* 45. *Physalis angulata;* 46. *Physalis peruviana;* 47. *Plumbago zeylanica;* 48. *Persicaria hydropiper;* 49. *Rumex dentatus* subsp. *klotzscianus;* 50. *Scoparia dulcis;* 51. *Solanum nigrum;* 52. *Solanum sisymbrifolium;* 53. *Solanum indicum;* 54. *Tephrosia purpurea;* 55. *Triumfetta rhomboidea;* 56. *Urena lobata* ssp. *lobata;* 57. *Vernonia cinerea;* 58. *Hydrocotyle sibthorpioides;* 59. *Youngia japonica;* 60. *Jatropha gossypifolia.*

## DISCUSSION

Seedling morphology of sixty weeds of Magnoliopsida (*sensu* Takhtajan, 1997) have been studied of which *Mikania micrantha* is the only climber while remaining ones are from herb, under-shrub and shrub category. Only three are cryptocotylar taxa *viz.*, *Clerodendrum viscosum, Glycosmis arborea* and *Murraya koenigii* and they all are shrubs. Majority of phanerocotylar taxa having more than one species are grouped family-wise as shown in the key indicating their inter-relationships parallel to the behaviour of adult vegetative and reproductive characters. First

grouping is made with phyllotaxy of first two leaves. In the group having opposite or sub-opposite phyllotaxy, presence of interpetiolar stipule separates two members of Rubiaceae *i.e. Hedyotis biflora* and *Dentella repens* from eight members of Asteraceae, six members of Amaranthaceae, three members of Lamiaceae, two members of Boraginaceae and one member of each of Papaveraceae (*Argemone mexicana*), Plumbaginaceae (*Plumbago zeylanica*), Scrophulariaceae (*Scoparia dulcis*), Chenopodiaceae (*Chenopodium ambrosioides*), Capparaceae (*Cleome rutidospermum*), Verbenaceae (*Lantana camara*) and Apocynaceae (*Calotropis gigantea*).

Similarly, in the group having seedlings with first two leaves alternate, the taxa are separable with stipule characters; first. Group of seedlings having free lateral or ochreate stipule possess five members of Fabaceae (free lateral stipule), three members of Polygonaceae (ochreate stipule), two members of Malvaceae (free lateral stipule) and one member each of Sterculiaceae (*Pentapetes phoenicia*), Leeaceae (*Leea macrophylla*) and Tiliaceae (*Triumfetta rhomboidea*). Again the other group with first two leaves exstipulate contains seven members of Solanaceae, two members of Apiaceae and one member each of Onagraceae (*Ludwigia perennis*) and Convolvulaceae (*Evolvulus nummularius*).

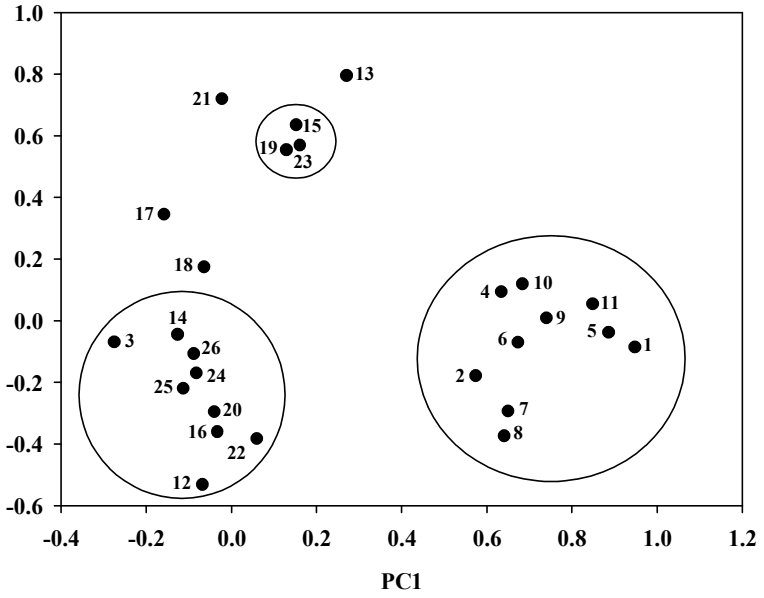


**Fig. 2:** The principal component analysis (PCA) of qualitative traits in sixty weed seedling species. The scatter plot of both the traits on the PC1 and PC2 side. Each round black symbol represents the mean values for the PC scores of the three replicates of each parameter. For the convenience, the parameters are denoted by numbers like – (1) germination type, (2) hypocotyl length, (3) hypocotyl colour, (4) cataphyll, (5) petiole of paracotyledons, (6) colour of paracotyledons, (7) surface of paracotyledons, (8) shape of paracotyledons, (9) base of paracotyledons, (10) apex of paracotyledons, (11) venation of paracotyledons, (12) phyllotaxy of first two leaves, (13) nature of first two leaves, (14) colour of first two leaves, (15) stipule of first two leaves, (16) surface of first two leaves, (17) shape of first two leaves, (18) base of first two leaves, (19) apex of first two leaves, (20) margin of first two leaves, (21) venation of first two leaves, (22) first internodal length, (23) nature of subsequent leaves, (24) spine of subsequent leaves, (25) presence of latex, (26) aromatic nature.

Principal Component Analysis (PCA) shows three groupings of twenty two qualitative traits having their inter-relationships. Only four parameters like nature first two leaves (13), shape and base of first two leaves (17,18) and venation of first two leaves (21) are lying outside the clusters indicating their distant relationship with the other parameters (Fig. 2). Each black round symbol within or outside the group represents the mean values for the PC scores of the three replicates of each parameter. The parameters are denoted by numbers. This study indicates the inter-dependence or close affinity of traits giving justification of use of these traits in the key to draw distinction or association among the taxa, even in such a juvenile stage as seedling.

## CONCLUSION

As many as sixty herbs, under-shrubs, shrubs and climber (*Mikania micrantha*) under Magnoliopsida could be identified in the seedling stage. Some rare medicinally important weeds in the study area (*e.g. Hydrocotyle sibthorpioides, Mimosa pudica, Plumbago zeylanica, Ocimum canum, Leea macrophylla, Pentapetes phoenicea, Jatropha gossypifolia, Solanum sisymbrifolium, etc.*) deserve consideration for *ex-situ* conservation by appropriate authority or any NGO. The seedlings of shrubs or under-shrubs (*e.g. Murraya koenigii, Glycosmis arborea, Jatropha gossypifolia* and *Clerodendrum viscosum*) can be considered for *in-situ* conservation for beautification, prevention of pollution and soil erosion. The principal Component Analysis (PCA) indicates the clustering of qualitative traits and their interdependence for consideration in preparation of artificial key.

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