

Seedling handedness in Gramineae

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Abstract. Seedling handedness with regard to first seedling leaf above the coleoptile has been studied in 67 genera and 93 species spread over 11 tribes of Gramineae. In general the tribes Paniceae, Andropogoneae, Festuceae, Hordeae, Aveneae, Bambuseae, Oryzeae and Chlorideae show seedling handedness whereas it is absent in Agrostideae, Phalarideae and Poaceae. Some tribes contain species that show handedness. Seedling handedness may be used for taxonomic purposes for delimiting the various tribes of Gramineae.

Keywords. Left-and right-handedness; neutral seedlings; Gramineae; taxonomic significance.

1. Introduction

Van Tiegham (1897) was the first to study the embryo and seedling characters in Gramineae. This was followed by a thorough study of several characters including seedlings by Avdulov (1931), Stebbins (1956). Reeder (1957) made extensive studies on various aspects of Gramineae in relation to grass systematics. Al-Aish and Brown (1957) studied the grass germination responses to isopropyl-phenyl carbamate in the classification of Gramineae, but missed the seedling handedness. Arber (1925) illustrated several genera showing seedling handedness. Compton (1910, 1911, 1912) published an account of right- and left-handedness in seedlings of various cereals. Kihara (1972), Ono (1956), Ono and Suemoto (1957) described handedness in seedlings and spikelets of *Triticum* and *Aegilops*. Suemoto (1961) extensively studied right- and left-handedness in the genus *Triticum*.

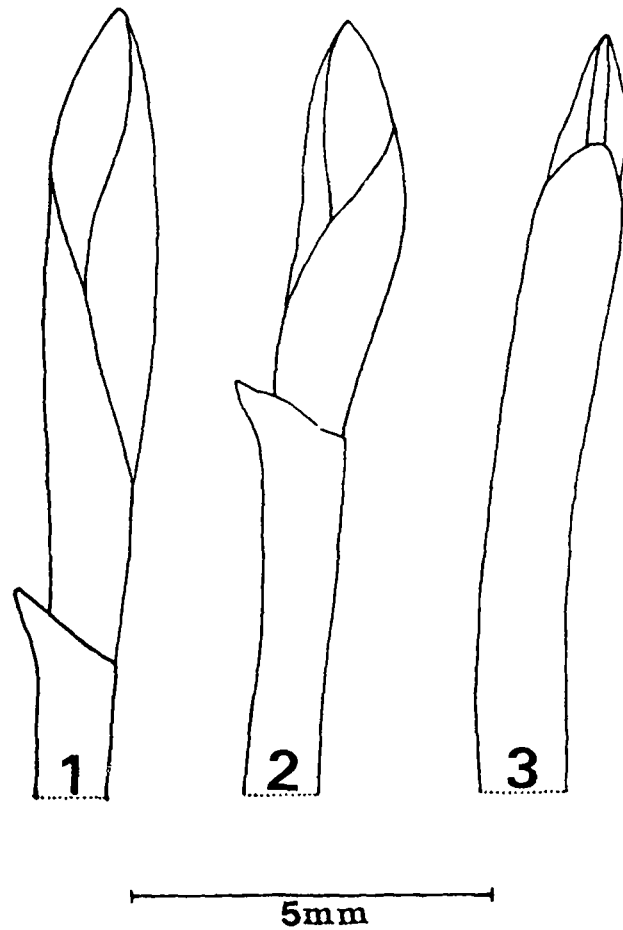
It is thus obvious that no detailed study on seedling handedness in Gramineae has been undertaken although, Bahadur *et al* (1978) in *Bambusa arundinacea*; Bahadur and Ramaswamy (1983), Ramaswamy and Bahadur (1983) in *Triticale* and its parents and Bahadur and Udayachandra (1983) in *Sorghum vulgare* have recently studied various aspects of seedling handedness. The present paper deals with a survey of seedling handedness in Gramineae representing 11 tribes and discusses the taxonomic implications of this character.

2. Material and methods

A total of 67 genera consisting of 93 species have been studied. Seeds were sown in petri-plates containing moistened blotters and periodically examined. Seedling handedness was observed after 4-8 days by either dissecting or cutting the coleoptile transversely. Depending on the folding of the first leaf either to the left or to the right, a seedling may be classified as left- or right-handed (figures 1,2). Seedlings lacking in handedness (ptyxis folding) have been designated as neutral seedlings (figure 3) and are incurved. The ratio of the L- and R-handed and neutral seedlings has been studied and the data statistically interpreted.

Table 1. Distribution of left- and right-handed seedlings in various tribes of Gramineae.

Tribe	Genera/Species	Seedlings		L+R	L-R	L/R	χ^2 (1:1)	P value	Reference
		Left handed	Right handed						
Hordeae	5	1938	1787	3725	151	1.085	6.12	<0.01	Ramaswamy (1978)
Oryzae	1	8385	8771	17156	-386	0.956	8.63	<0.01	Unpublished
Paniceae	11	1085	1208	2293	-123	0.898	6.59	<0.01	Present work
Andropogoneae	12	1086	871	1957	215	1.246	23.62	<0.01	-do-
Chlorideae	2	126	161	287	-35	0.782	4.27	<0.05	-do-
Bambuseae	2	355	345	700	10	1.029	0.14	>0.50	-do-
Festuceae	5	58	47	105	11	1.23	1.15	>0.20	-do-
Aveneae	3	13	15	28	-2	0.866	0.143	>0.50	-do-
Total	41	13046	13205	26251	-159	0.988	0.963	<0.50	



Figures 1-3. Right- and left-handed seedlings and neutral seedlings of *Dendrocalamus strictus*. Note the folding of the first seedling leaf above the coleoptile to the right- and left-hand side. Neutral seedling is incurved.

Table 2. Tribe-wise break-up of species in Gramineae showing absence of seedling handedness.

Tribe	No. of Genera	No. of species	No. of seedlings scored
Andropogoneae	2	2	25
Agrostideae	5	6	1035
Chlorideae	4	6	463
Festuceae	8	15	779
Poaceae	1	1	68
Aveneae	2	2	177
Phalarideae	4	4	40
Total	26	36	2587

3. Results and discussion

Compounded data on the distribution of left- and right-handed seedlings in various Gramineae are summarised in table 1. Of the 8 tribes showing seedling handedness, Paniceae, Andropogoneae, Festuceae and Hordeae show a greater number of genera and species than other tribes. Oryzeae, Paniceae and Chlorideae show a uniform excess of right-handed seedlings, whereas Hordeae and Andropogoneae show an excess of left-handed seedlings. In Bambuseae, Festuceae and Aveneae the deviation of the two types of seedlings is not significant.

Although seedling handedness is present in Andropogoneae, Chlorideae, Festuceae and Aveneae, surprisingly some of the genera under these tribes viz *Anthoxanthus odoratum*, *Bromus squassosa*, *Phragmites communis*, *Holcus laciniatus* and *Trisetum flavescence* are characterised exclusively by neutral seedlings only. Thus of the 6 genera examined in Chlorideae only two show seedling handedness while in Festuceae out of 13 genera studied only 5 exhibited seedling handedness. In Andropogoneae, however, the number of genera showing neutral seedlings is much less. In Oryzeae several cultivars of *Oryza sativa* were examined and the compounded data shows a great excess of right-handed seedlings; the deviation from equality is statistically significant at 1% level. In Bambuseae, *Bambusa arundinacea* and *Dendrocalamus strictus* show seedling handedness. The former showed excess of right-handed seedlings with no neutral seedlings (Bahadur et al 1978) in the latter, however, an excess of left-handed seedlings with considerable neutral seedlings was observed in the ratio 33L:25R:14N.

Tribewise break-up of the species showing absence of seedling handedness is given in table 2. Tribes which are exclusively characterised by such seedlings are Agrostideae, Phalarideae and Poaceae, while Andropogoneae, Chlorideae, Festuceae and Aveneae show species with seedling handedness and those that lack it (see table 1).

Within the species of the 8 tribes showing seedling handedness, neutral seedlings also occurred, the percentages being: Paniceae (0.61%); Andropogoneae (5.14%); Chlorideae (31.2%); Bambuseae (1.9%). In *Triticale* whose seedling handedness has recently been described by Bahadur and Ramaswamy (1983) neutral seedlings occur (1.6%), but in its parents viz *Triticum* and *Secale cereale*, incidence of neutral seedlings shows peculiar distribution. Compton (1911, 1912) and Bahadur and Ramaswamy (1983) reported a very high incidence of neutral seedlings in *Secale cereale* (98%) but in *Triticum* neutral seedlings occur as a rarity. Ramaswamy (1978) studied the various aspects of seedling handedness in *Triticale* and its parents and according to him seedling handedness in Hordeae is represented by 5 genera spread over 17 species.

On the basis of the data presented, there is a relationship between the presence and absence of seedling handedness in the various tribes. Hence, seedling handedness may serve as a useful tool for taxonomic purpose for delimiting the various tribes of Gramineae as has recently been shown in Fabaceae by Bahadur and Rao (1981).

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