A Preliminary Note on an Unrecorded Group of Paddy Varieties Occurring in Ceylon

BY

E. ABEYRATNE

INTRODUCTION

DURING the course of a study of the varieties of the North-Central Province of Ceylon it was noticed that thirty varieties belonging to the 45–60 days age *[1] class possessed similar morphological and physiological characters. These were consequently included in a single group, which is referred to here as the Heenati group. These varieties are normally sown in Yala *[2] under small irrigation tanks with restricted water supply and have evidently been grown in Ceylon for centuries. Attention in this note is confined to a description of the characters of this group of varieties.

MORPHOLOGICAL CHARACTERS OF THE HEENATI GROUP

Sterile glumes	..	Sterile glumes are larger than normal. Adaxial glumes are truncate with irregularly defined or almost serrate upper margins. The number of the teeth on the upper margin vary between 5 and 6. The Adaxial glumes are lanceolate but the tips are blunt and end in one to three tooth-like projections. (Plate 1)
Pedicel Attachment	..	The pedicel attachment is tranverse or very slightly oblique ; in other Ceylon varieties it is markedly oblique or almost vertical. (Plate 1)
Pubesence	..	All parts of the plant are strongly pubescent particularly the upper surface of the leaves peduncle, rachis and rachilla.
Pigmentation	..	There is an uniform type of anthocyanin pigmentation throughout the group. The leaf axil, stigma, apiculus and leaf sheath are always a very faint pink. This colour is often hardly visible and can only be seen with a lens. The rest of the plant is unpigmented.
Plant Habit	..	The angle of tillering varies from 40°—50° and the tillers are geniculate.

*[1] Interval from sowing to flowering. *[2] South-West Monsoon Season.

There is very little variation in grain size and shape. Grain measurements revealed no bigger differences between the varieties than would be expected to occur between strains or races of the same variety. The measurements of twelve varieties are presented in Table 1. The average grain measurements of the varieties are :—

Mean Grain Length mm	*Mean Grain Breadth* mm	*Mean Grain Thickness* mm	*Length/Breadth Ratio*	*Length/Thickness Ratio*
6·94	2·98	1·99	2·32	1·48

[For Table 1 see page 27.]

PHYSIOLOGICAL CHARACTERS OF THE HEENATI GROUP

During the course of breeding work it was noticed that these varieties showed responses to transplanting and sowing date that were different from those of the other varieties of the early maturing class. A study of the factors affecting heading duration* was consequently undertaken.

EFFECT OF TRANSPLANTING

The effect of transplanting on heading duration of 40 Heenati selections taken at random from different Heenati varieties and 40 selections taken at random from other early maturing varieties was studied. The results are presented in Table 2. When broadcast the Heenati took on the average 56 days to head and the other selections 65 days. When transplanted the Heenaties took 76 days and other selections 73 days. Seedlings were transplanted when 3 weeks old. The extension of age in the Heenaties is 20±2 days and in the other varieties it is 8±3 days. An extension of age of 7–12 days is the normal effect of transplanting on most varieties.

TABLE 2.—Effect of transplanting on heading duration.

Variety	*Mean Heading Duration Broadcast*	*Mean Heading Duration Transplanted*	*Mean Increase in Heading Duration*
Heenati	55·8	76·4	20·6 ± 1·9
Other varieties	65·1	73·1	8·0 ± 3·3

The effect on heading duration of transplanting 2, 3, 4 and 5 weeks old seedlings was studied with five selections each representative of popular early-maturing varieties in the Province. The selections are Heenati 1596, Suduwi 1595, Kannimurunga 1627, Pachaiperumal 2462/11 and Kalu Heenati 1667. Of these only 1596 belongs to the Heenati group. The results are given in Table 3.

* The interval from sowing to flowering is defined as heading duration.

TABLE 3.—Yala 1950. Effect of seedling age on heading duration

Selection	*Variety*	*Broadcast*	*2 weeks old seedlings*	*3 weeks old seedlings*	*4 weeks old seedlings*	*5 weeks old seedlings*	
1627	Murunga	61	64	67	66	62	72
1595	Suduwi	64	64	68	69	64	77
2462/11	Pachaiperumal	64	64	69	69	65	74
1667	Kalu Heenati	63	67	74	79	64	86
1596	Heenati	59	71	82	89	64	97

In all cases there is a progressive delay in heading duration with seedling age up to a maximum with 5 weeks old seedlings. The curves in all cases are similar except that Kalu Heenati is intermediate between Heenati and the other three selections, which are similar in their response. (Figure 1)

With the 5 weeks old seedlings two waves of flowering were noticed within each selection. The mean ages of each wave are presented in Table 3 column 8. It will be seen that heading duration in the first wave is almost the same as when broadcast. In a broadcast crop, primodium formation begins somewhere between the 30th and the 40th day from sowing and it is likely that some of the seedlings had already crossed from a vegetative to a reproductive state when transplanted. These seedlings flowered early while the others that were still in a vegetative state flowered late. No primodia were visible at the time of transplanting. Transplanting 6 weeks old seedlings should result in a heading duration almost equal to that when broadcast.

EFFECT OF SOWING DATE

100 selections from Heenati and other early maturing varieties were sown at two dates each year, viz : on the 8th January (Maha *) and the 10th June (Yala) 1949 and 1950.

TABLE 4.—Effect of sowing date on heading duration

Variety	*Mean heading duration in days*		*Difference between Yala and Maha in days*		
	Yala	*Maha*			
Heenati	55	60	—	5 ±	1.2
Pachaiperumal	63	62	+	1	
Kalu Heenati	63	62	+	1	
Other 3 months varieties	62	58	+	4 ±	0.7

The effect of sowing date on heading duration is small but nevertheless three types of response are observable, viz :

(1) Heading duration unaffected by sowing date. Pachaiperumal 2462/11 and Kalu Heenati 1667 belong to this class.

(2) Heading duration in Yala longer in Maha, which is the typical response of short-day varieties. Most of the varieties other than the Heenatis fall into this group.

* North-east monsoon season.

(3) Heading duration in Maha longer than in Yala, which is the response to be expected from long-day varieties. All the Heenati varieties fall into this group.

To test this hypothesis that the response is photoperiodic the five representative selections used above were given photoperiodic treatment.

EFFECT OF PHOTOPERIOD

Two sets of fifty seeds of each selection were sown, after sprouting under similar conditions in plots and thinned down to 25 plants per pot nine days from sowing. One set of pots from each variety was exposed to day light from 6 a.m. to 3 p.m., each day (i.e. a nine-hour photoperiod) and kept the rest of the time in the dark room. Photoperiodic treatment was commenced on the 10th day after sowing and continued till ear emergence. The other set of pots was exposed to normal day length in the open.

TABLE 5.—Effect of photoperiod on heading duration

Maha 1949–50 — Sown on 8.1.50

Selection	*Variety*	*Heading time 9-hour photo-period days*	*Control days*	*Difference between treated and control days*
1627	Murunga	49	59	—10
1595	Suduwi	50	60	—10
2462/11	Pachaiperumal	59	64	—5
1667	Kalu Heenati	70	67	+3
1595	Heenati	78	69	+9

The results obtained confirm the view that the response to sowing date is a photoperiodic response. The Suduwi and the Kannimurunga selections behaved like short-day plants, while Kaluheenati and Pachaiperumal are day neutral and the Heenati selections behave like long-day plants.

Effect of other factors .. An experiment was set down with the same selections to investigate the following factors on heading duration—

(1) Cultural treatment.
(2) Fertilizers.
(3) Spacings.

The treatments were ..

(1) Five selections, viz : 1595, 1596, 1627, 1667, 2462/11.
(2) Cultural treatments, viz : Broadcast and Transplanted.
(3) Two doses of nitrogen, viz : None and 40 lb. N per acre.
(4) Two spacings. 3″ × 3″ and 9″ × 9″.

Each plot was split into half, spacings were allocated to the sub-plots and other treatments to the main plots. Each treatment was replicated twice. Sprouted seed was sown in the nursery and on the broadcast plots on the same day. The variance analysis of sowing-to-emergence intervals, transformed to the square root scale appropriate to Poisson series, is presented in Table 6.

TABLE 6.—Analysis variance heading duration transformed to the square-root scale

	D.F.	*S.S.*	*M.S.*	*F*
Block	1	0·0033	0·0033	
Varieties	4	1·6125	0·4031	60·16*
Nitrogen	1	0·0009	0·0009	
Cultural	1	8·2561	8·2561	123·23*
Vx N	4	0·0792	0·020	2·95*
Vx C	4	2·2957	0·5764	80·60*
Nx C	1	0·0152	0·0152	2·268
Vx N X C	4	0·0119	0·0029	
Error (*a*)	19	0·1281	0·0079	
Total	39	12·4029	—	
Spacings	1	0·5255	0·5255	31·848*
Sx V	49	0·1550	0·0387	2·34
Sx C	1	0·1466	0·1466	8·88
Sx N	1	0·0011	0·0011	
Vx S X C	4	0·0216	0·0054	
Vx S X C	4	0·0486	0·0121	
Sx C X N	1	0·0033	0·0033	
Error (*b*)	23	0·3793	0·0165	
Total	79	13·3839		

All the main effects and the interaction variety X cultural treatments are significant at the 1 per cent. level. The interaction variety X Nitrogen is significant at the 5 per cent. level. As regards the effect of transplanting, the results confirm those obtained earlier. The results are given in Table 7. Heenati takes 22 days longer to head when transplanted.

Table 7

	Broadcast days	*Transplanted days*	*Differences*
Heenati 1596 ..	61	83	+22
Kalu Heenati 1667	63	75	+12
Pachaiperumal 2462/11	64	67	+3
Suduwi 1595 ..	62	70	+8
Kannimurunga 1627	61	71	+10

[For Table 8 see page 28.]

Flowering is delayed at the wider spacing. The interaction of spacings and variety is not significant. In Heenati 1596 however, the plants at the wider spacing takes 6 days longer to head than at closer spacing.

DISCUSSION

The North-Central Province varieties included in the Heenati group carry different local names and those commonly met with are, Heenati, Rathu Heenati, Kalu Heenati, Heen Heenati, Madael, Sudu Madael, Dhanala, Hatadawi, Matale Heenati, &c. Village names however are no guide as some varieties with the above names carry none of the Heenati characters and vice versa. These varieties all possess in common a number of characters which distinguish them from other varieties, viz: characteristic grain size and shape, sterile glumes, pedicel attachment, pubescence and pigmentation, and mark them out as belonging to a homogeneous group. There is variation within the group as regards simple monogenic and oligogenic characters such as palea and lemma colour and awning. It should be possible, therefore, to regard all these varieties as races or strains of the same variety. Out of a collection of varieties made in different parts of Ceylon it was observed that twenty-seven possess the distinguishing morphological characters of the Heenati group. There is considerable variation between varieties in grain size and shape as indicated in Table 8 and which distinguishes them as distinct varieties. Examination of the available material did not reveal any instances in which these characters were separated and it is likely that this is a case of plicomorphism. The evidence collected so far seems to indicate that the varieties of the Heenati group possess a distinct morphological pattern superimposed on a well defined pattern of physiological behaviour. The latter appears in some way to be related to the very short age of the varieties.

[For Table 8 see page 28.]

ACKNOWLEDGMENTS

I am deeply grateful to Dr. M. F. Chandraratne for the valuable help and guidance he has given me and to Messrs. H. Weeraratna and T. Kanthasamy for helping with the records.

TABLE 1—Some North-Central Province belonging to the Heenati Group

Variety	*Origin*	*Grain Measurement*					*Predominant*
		Length	*Breadth*	*Thickness*	*l/b*	*b/t*	*Palea and Lemma colour*
Heenati	Minneriya	7·012	2·860	1·980	2·452	1·444	Straw
Sudumadael	—	7·044	3·061	2·036	2·301	1·330	Straw
Madael	—	7·084	2·892	1·984	2·449	1·448	Black
Matale Heenati	Wilachiya	6·984	2·956	1·948	2·363	1·517	Dark brown furrows
Madael	Minneriya	6·932	2·932	1·880	2·364	1·559	Straw
Heen-heenati	Kallanchiya	6·700	3·068	2·136	2·184	1·436	Light brown furrows
Sudu Heenati	Kalediulwewa	6·936	3·028	2·008	2·304	1·450	Straw
Ratu Heenati	—	6·932	2·932	1·880	2·364	1·560	Dark brown wash
Hatadawi	Maha Illuppallama	6·936	3·008	2·004	2·306	1·501	Black
Heenati	Eppawala	6·628	3·060	1·996	2·166	1·533	Very light brown furrows
Heenati	Kahatagasdigiliya	6·896	3·008	2·060	2·291	1·460	Dark brown furrows
Matale Heenati	Nuwaragampalatha West	7·156	3·072	2·032	2·329	1·512	Light brown furrows

TABLE 8—Varieties from other parts of the Island with the Morphological characters of the Heenati Group

Variety	*Origin*	*Grain Measurements*					*Predominant*
		Length	*Breadth*	*Thickness*	*l/b*	*b/t*	*Pales and Lemma colour*
Yapalwelai	Vavuniya	7·916	2·988	2·100	2·649	1·423	Dark brown furrows
Karuthasaraat	—	6·804	2·784	1·924	2·444	1·447	Black
Hirigithiliyal	Matara	6·652	2·656	1·816	2·504	1·463	Dark brown wash
Mahasuduwee	Tanaliyadde	8·064	2·912	2·072	2·769	1·406	Very light brown furrows
Ratasuduwee	Kalutara	6·632	2·672	1·856	2·482	1·439	Straw
Heenati	Kurunegala	7·768	3·240	2·020	2·397	1·604	Straw
Kaluhetadawee	Kalutara	8·004	2·888	2·100	2·771	1·375	Black
Hatadawee	Matale	7·272	2·952	2·008	2·463	1·470	Light brown furrows
Pollal	Kalutara	7·084	2·632	1·948	1·691	1·351	Black
Kaluheenati	Kandy	7·284	2·800	2·088	2·639	1·375	Black
Dahatalawee	Keliliyapola	7·580	2·872	2·088	2·639	1·375	Black
Kaluheenati	Puttalam	7·864	3·104	2·040	2·533	1·516	Black
Heenati	Paranthan	7·124	3·024	2·104	2·356	1·437	Dark brown furrows
Karathasal	Periyakulama	7·164	2·820	1·972	2·540	1·430	Black
Kalukada	Kandy	8·236	2·840	2·016	2·900	1·409	Black
Kaluheenati	Colombo	7·892	2·944	2·136	2·681	1·378	Black
Heenatiwee	Kurunegala	7·284	2·908	2·028	2·505	1·434	Brown furrows
Kombila	Kalutara	7:624	2·848	2·092	2·677	1·361	Very light brown furrows

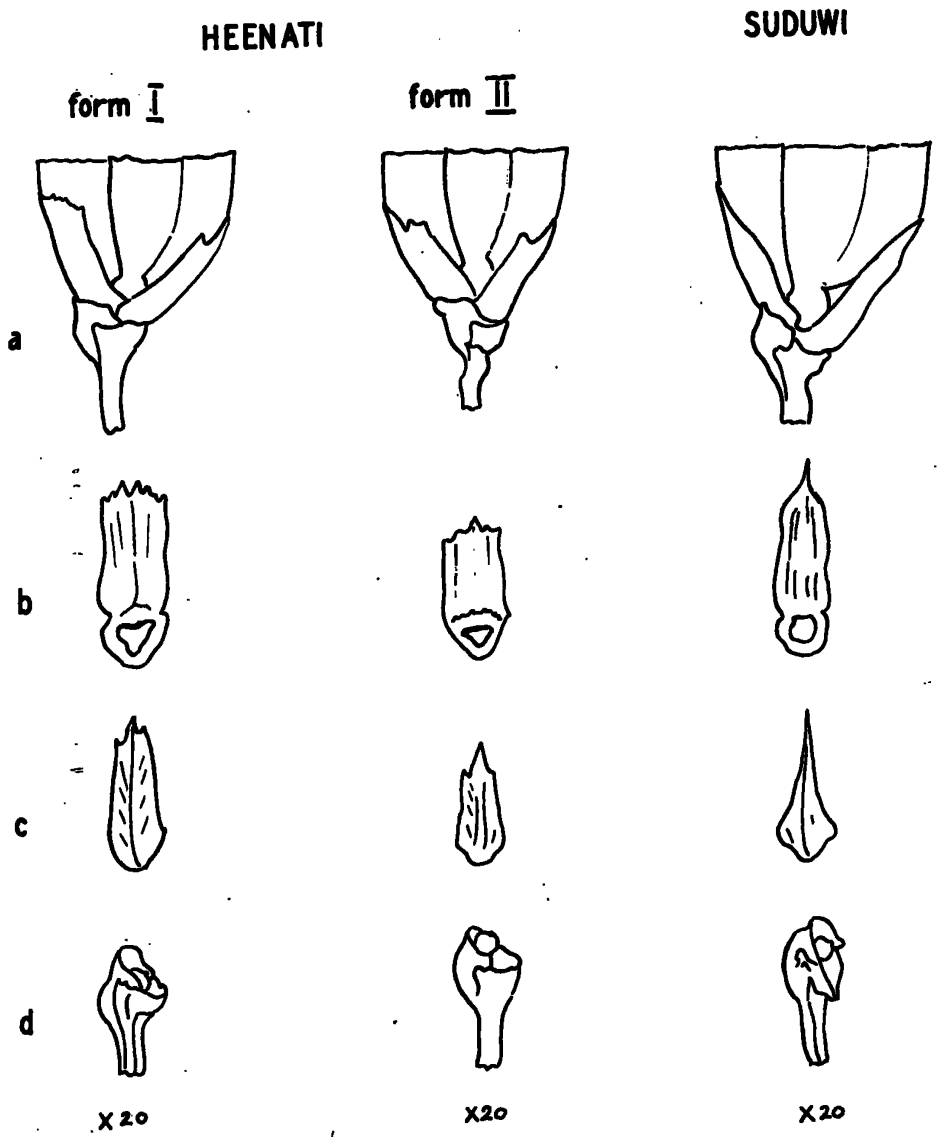

PLATE I. Illustrating differences between spikelet characters of the Heenati Group and Suduwi, which represents the usual types.

a. Spikelet b. Abaxial sterile glumes c. Adaxial sterile glumes d. Pedicel

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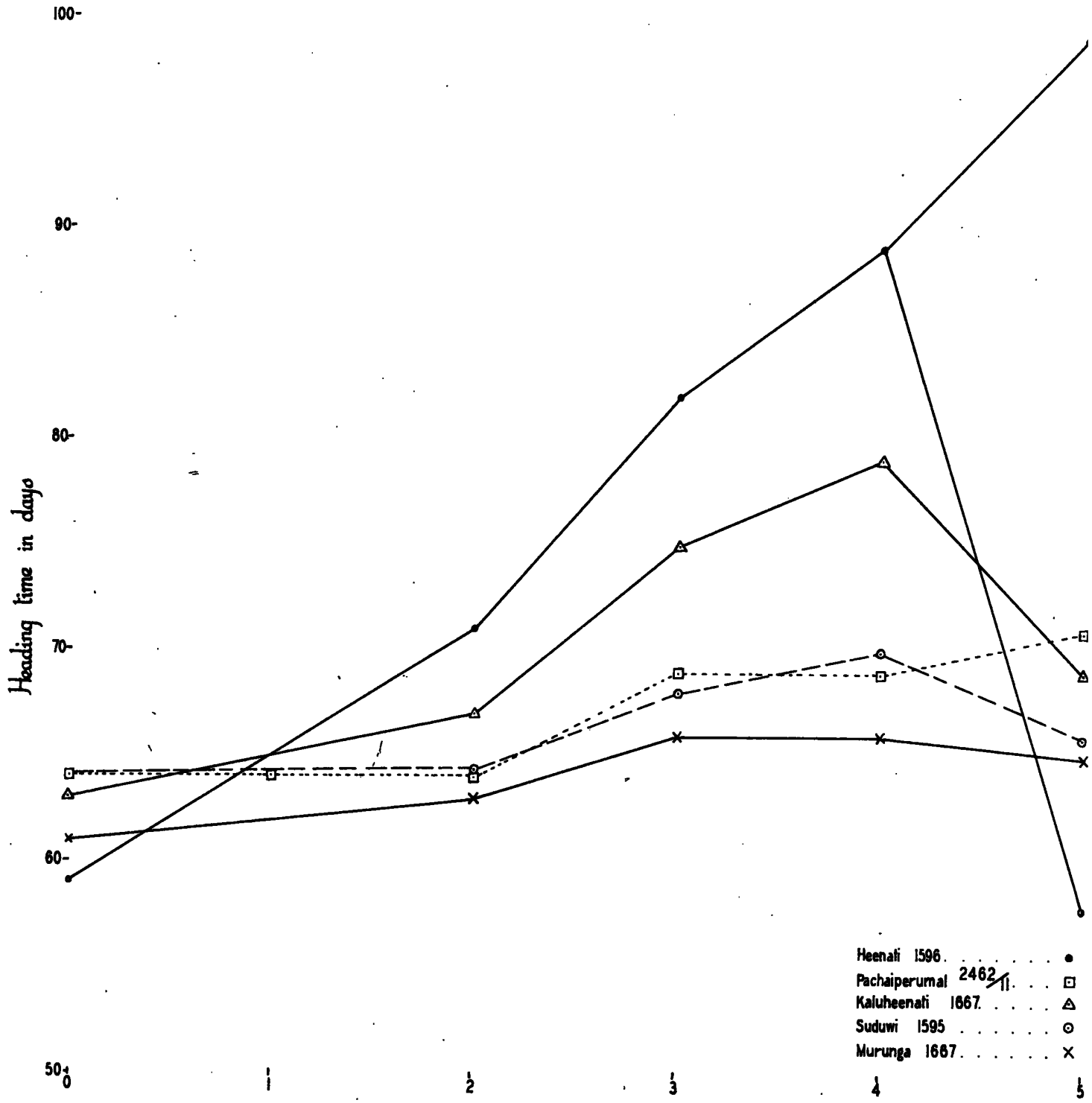

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