

SETARIA IN ANCIENT PLANT ECONOMY OF INDIA

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ABSTRACT

The paper reports for the first time from India the discovery of spikelets of *Setaria* spp. It appears that the carbonized grains are represented by *Setaria italica*, *S. viridis* and *S. verticillata* or by unknown species. The material comes from the Harappan site, Surkotada in district Kutch, Gujarat and is radiocarbon dated to 1600 B.C. The identification of these carbonized spikelets is based upon comparative morphological study of ten extant species of *Setaria*.

INTRODUCTION

SURKOTADA, situated at a distance of 12 km north-east of Adesar and 160 km north-east of Bhuj in district Kutch in the Peninsula of Kutch, Gujarat, is the recently excavated Harappan site (Joshi, 1972). Three cultural periods have been recognized at this site, each characterized by more or less similar pattern of settlement with the Harappan influence and contact showing gradual decrease. The advent of a new culture preceded by a wide-spread conflagration and characterized by the white painted black and red ware resembling Ahar culture in south-eastern Rajasthan, is noticeable during Period III when the residual Harappans at this site appear to have been pushed into the background by the influx of new peoples.

Bags load of large charred lumps of carbonized grains were discovered by the excavators from deposits referred to Period III ranging in time from 1790 B.C. to 1660 B.C. (TF-1297, 1294, 1311, 1307; Agrawal, 1972; Joshi, 1972). The charred lumps placed at our disposal for investigation were recovered from an earthen pot.

Each lump on examination was found to comprise several different kinds of seeds mixed up irregularly in lumps. Owing to the extensively charred state of the lumps, it was a tough job to separate out the individual seeds from them. However, after several careful attempts it became possible to recover as many as 574 seeds belonging to several different wild grasses and weeds and a very small percentage (about 7%) appeared to belong to millets. This paper deals exclusively with the remains of *Setaria* among the millets recovered from this site.

OBSERVATIONS

The seeds segregated tentatively as of *Setaria* are ellipsoidal or globose-ellipsoidal, enclosed by a membrane (palea) on one side (probably the ventral side) enveloped partially along its length by lateral flaps of another overlying membrane (lemma) covering the rest of the grain (on the dorsal surface (Pl. 2, fig. 11). The enveloping membrane is much incurved and deeply boat-shaped. The inner membrane is slightly curved and flattened along its back with the basal pointed end and the blunt apex and encloses the seed tightly against it. Both the lemma and palea are ornamented with granulation making irregular rugose pattern occasionally anastomosing whereas the two lateral flaps are smooth and shiny (Pl. 2, figs. 12-14). The dimensions of the carbonized grains (Table 1)

TABLE 1 — SHOWING DIMENSIONS (in mm) OF CARBONIZED SETARIA GRAINS FROM SURKOTADA

NO. OF SPIKELETS	LENGTH	BREADTH	THICKNESS
1	1.00	1.00	0.80
1	1.20	1.00	0.80
8	1.50	1.20	1.00
9	1.50	1.00	1.00
5	1.70	1.50	1.00
7	1.70	1.00	1.00
1	1.70	1.20	1.00
2	1.80	1.00	1.00
1	1.80	1.50	1.00
1	2.00	1.20	1.00
1	2.00	1.20	1.00
2	2.00	1.50	1.00
1	2.00	1.70	1.00
Average	1.60	1.35	1.00

show a range from $1.2 \times 1.170 \times 0.80$ mm with the average length 1.60 mm, average breadth 1.35 mm and average thickness 1 mm.

Both in shape and rugose ornamentation the lemma and palea of these carbonized grains differ from those of *Sorghum* (ovoid, subrotund to orbicular or elliptic oblong without any pattern), *Pennisetum typhoides* (spindle-shaped, biconvex & devoid of any pattern), *Panicum* (biconvex seeds with extremely fine pattern) and *Paspalum scrobiculatum* (spindle-shaped to planoconvex without pattern) but compare closely the grains of *Setaria* spp. in the nature of membranes enclosing them. For specific identification, grains of as many as ten extant species of *Setaria* were examined (Pl. 1, figs. 1-9) and their average dimensions are given below.

	Length	Breadth	Pattern
<i>Setaria glauca</i> L.	3.80	1.60	Coarsely rugose
<i>S. intermedia</i> (Roth.) Roem and Schult.	2.11	1.10	Irregularly rugose and anastomosing
<i>S. tomentosa</i> (Roxb.) Kunth	2.00	1.12	Irregularly rugose
<i>S. verticillata</i> (L.) P. Beauv.	2.41	1.46	Minutely rugose
<i>S. pallidifusca</i> (Schum.) Stapf et Hubb	2.80	1.25	Finely rugose
<i>S. palmaefolia</i> (Koenig) Stapf	3.91	1.09	Granulation fine and rounded
<i>S. homonyma</i>	2.91	1.25	Fine rugose pattern and anastomosing
<i>S. viridis</i> (L.) Beauv.	2.04	1.90	Subrugulose (Musil, 1963)
<i>S. faberii</i>	2.00	1.1-1.25	Irregularly and occasionally anastomosing
	2.16	1.25	
<i>S. italica</i> (L.) Beauv.	2.16	1.25	Irregularly rugose and occasionally anastomosing
<i>S. italica</i> (L.) Beauv.	2.50-2.75	1.50	(Renfrew, 1973, p. 102)

The carbonized grains are much smaller in size than the grains of modern species of *Setaria*. The reduction in size may be ascribed to carbonization. Usually on carbonization the length in grains of cereals

other than of *Setaria* is reduced proportionately more than the breadth which may increase slightly (Renfrew, 1973, pp. 10-12). In *S. viridis* particularly Van Zeist (1970, p. 96) reports that the seeds increase in size on carbonization, the thickness especially becomes greater and the seeds are nearly twice longer than broad unlike those of *S. italica*. The observations of Van Zeist (1970) would have us believe that the Surkotada seeds before carbonization were smaller than their present dimensions though the extent of actual increase in their size remains unknown. It must be stated here that no wild species of *Setaria* are known with grains smaller in size than the carbonized ones.

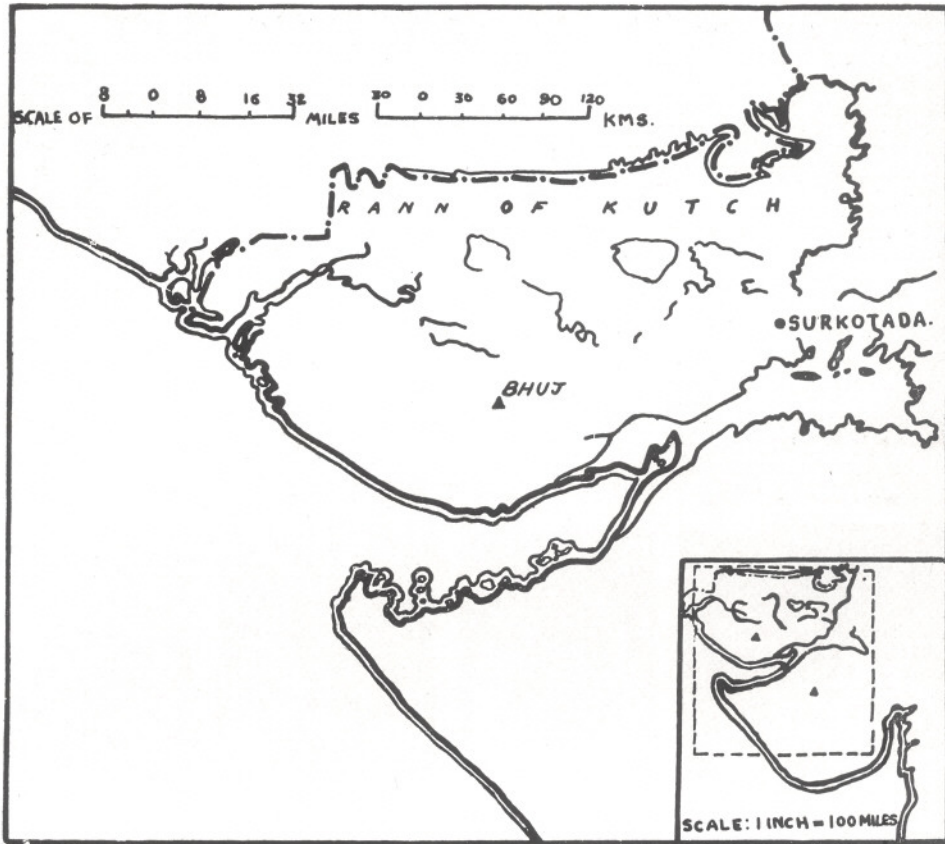
The smallest grains among the modern species of *Setaria* occur in *S. viridis* and *S. tomentosa*. The carbonized grains being ellipsoidal or globose ellipsoidal approach those of *S. italica*, *S. verticillata* and *S. tomentosa (intermedia)* than other modern species as shown in (Pl. 1, figs. 1-9). The pattern of lemma and palea of carbonized grains resembles pattern of lemma and palea of *S. italica* and *S. verticillata*.

From the parameters of size, shape and ornamentation pattern it appears that the carbonized grains are either represented by *S. viridis*, *S. verticillata* and *S. italica* or by unknown species of *Setaria*. Until the impact of carbonization upon increase or decrease of size of *Setaria* grains is established, the specific identification of *Setaria* grains from Surkotada shall remain tentative.

CONCLUSION

Three wild species of *Setaria* occur today in Northern Gujarat (Saxton & Sedgewick, 1918, pp. 510-511), viz., *S. glauca* Beauv., *S. tomentosa* (Roxb.) Kunth (Syn *S. intermedia* Roem & Schult.) and *S. verticillata* (L.) P. Beauv. The last two occur commonly in meadows and hedges growing luxuriantly on nitrophilous soil in the back gardens of houses in villages. Of these, only *S. glauca* L. occurs in the environs of Ahmedabad.

Both *S. italica* and *S. verticillata* with which the carbonized grains from Surkotada compare occur in the regions of Gujarat and Kutch. Of these, *S. italica* is cultivated and *S. verticillata* usually occurs in shady places and also in arid regions.



MAP 1 — Showing the location of Surkotada in Kutch

The grains of *Setaria italica* are used as food both for humans and cage birds and for feeding poultry. The association of *Setaria* grains with enormous quantity of wild seeds of grasses, sedges and others is highly suggestive of the fact that the Harappans at Surkotada had gathered and used them as feed for birds rather than to feed themselves. We cannot be certain for want of further evidence that they had raised crops of foxtail millet or their seeds had been introduced here as impurities in food grains imported from the other parts of the Harappan Empire or from elsewhere through their cultural contacts. Lamentably the grains of *Setaria* are unknown so far from the Harappan Empire or from other early or contemporary cultures.

Elsewhere the remains of *S. italica* are known from the Bronze Age deposits in

Switzerland and Austria though *S. viridis* has been found more frequently in Neolithic and Bronze Age settlements (Renfrew, 1971, pp. 101-102). From the New World *Setaria* dated to 6000-5500 B.P. is known from Ocampo caves, Tamaulipas Mexico (Callen, 1967) where the grains are larger and plumper than those dated to Ca. 7500 B.P. from the Tehuacan Valley (Reed, 1976).

The materials of extant species of *Setaria* were collected from the Kew Herbarium, London, England by the kind permission of Director, Kew Herbarium. It is with pleasure that senior author records his thanks to him. Our thanks are also due to Mr J. P. Joshi of the Archaeological Survey of India for kindly giving the carbonized materials from Surkotada, the site excavated by him, for investigation.

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EXPLANATION OF PLATES

PLATE 1

Ornamentation pattern over the lemma of 10 species of modern *Setaria*. × 24.

1. *S. pallidifusca*
2. *S. faberii*
3. *S. homonyma*
4. *S. tomentosa*
5. *S. intermedia*
6. *S. viridis*
7. *S. verticillata*
8. *S. palmaefolia*
9. *S. glauca*

PLATE 2

10. Oblong and globose grains of modern *S. italica* both in dorsal and ventral view.
11. Carbonized grains of *Setaria* and *Eleusine* intermixed. × 5.
- 12-14. Carbonized spikelets of *Setaria* cf. *S. italica*. × 25.
15. Modern grain of *S. italica*. × 50.
16. Carbonized grain of *Setaria* cf. *S. italica*. × 50.

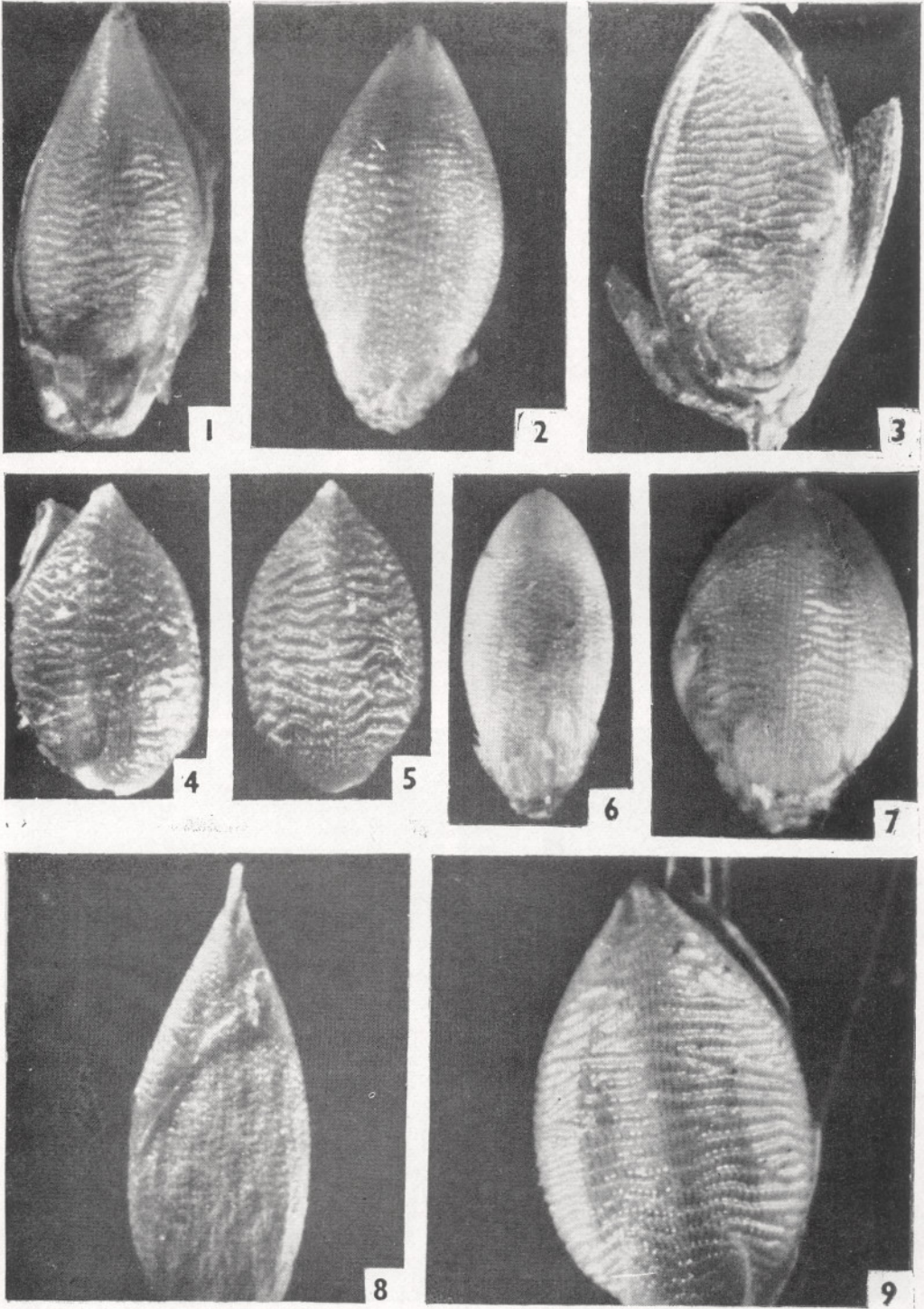


PLATE 1

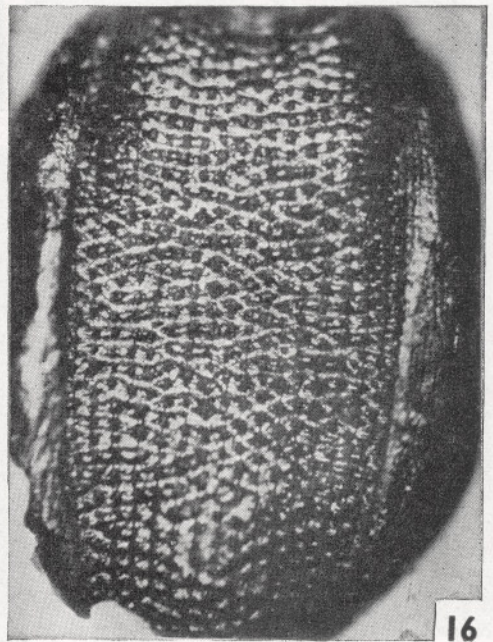
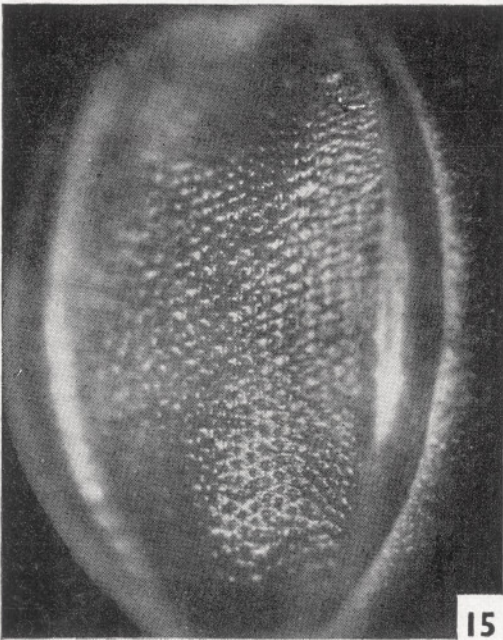
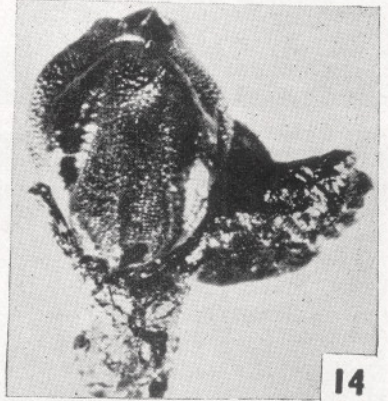
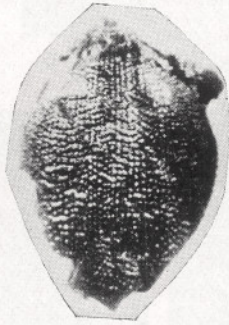
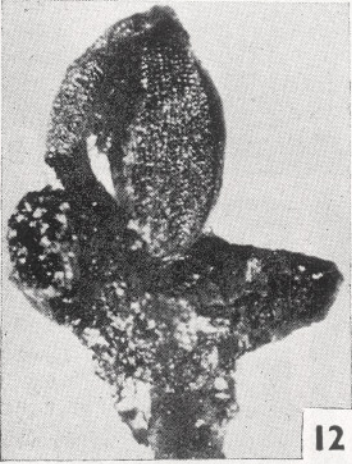
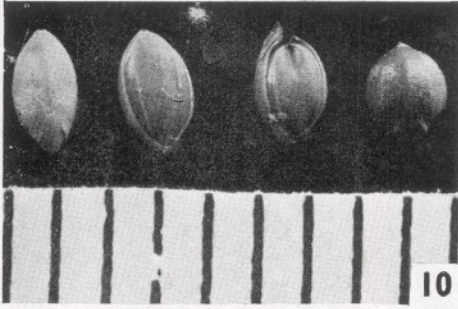


PLATE 2