Plants Mentioned in Vedas, Epics and Puranas: Scientific and Radiometric Data

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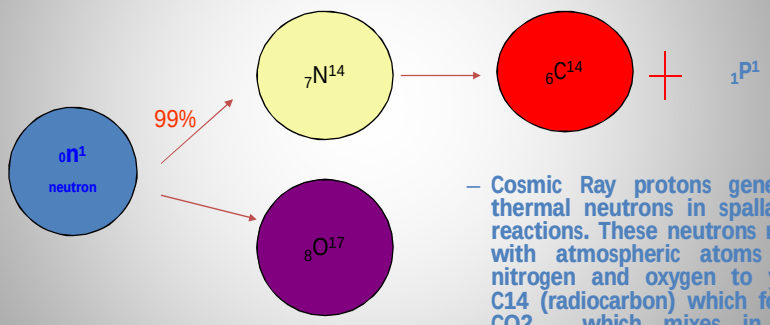
Production of Carbon- 14



- Cosmic Ray protons generate thermal neutrons in spallation reactions. These neutrons react with atmospheric atoms like nitrogen and oxygen to yield C14 (radiocarbon) which forms CO2 , which mixes in the atmosphere

Method for Peat, Charcoal, Sediments, Wood, Paper, Cloth, etc.

- This In this method, the sample is placed in a tray and kept inside a quartz tube and reusable quartz wool is placed in both sides of the sample, so that the heat will be confined within the quartz wool cogs. The two ends are sealed. Quartz tube is then slid inside an electric heater kept at 750 deg C for CO2 preparation.

Due to insufficient oxygen, sometimes, carbon mono oxide (CO) may be formed. Copper oxide turnings(Cu_2O) at 500 deg C are used to convert it to carbon dioxide(CO2).. The evolved CO2 gas is then passed through silver wool placed above the copper turnings to remove the halogen impurities from it.

Preparation of Acetylene ($C_2 H_2$)

The carbide reaction involves two steps, both carried out in vacuum. In the first step the reaction vessel containing half or less than half a centimeter pieces of Li rods is heated in vacuum, the furnace is at 550 deg C, the bottom tip of the reaction finger is heated. When the lithium converts into molten form, the evacuation is stopped and sample CO2 is introduced for the reduction of elemental carbon to carbide. When whole CO2 is converted into Lithium carbide, the pressure in the reaction vessel becomes zero.

- *1.* $2\ CO_2 + 8\ Li \rightarrow 2\ C + 4\ Li_2O$ --- (a)
- *2.* $2\ C + 2\ Li \rightarrow Li_2C_2$ --- (b)
- ---
- *(1+2)* $2\ CO_2 + 10\ Li \rightarrow Li_2C_2 + 4\ Li_2O$ --- (c)

This acetylene is trimerised to benzene in presence of a catalyst.

Liquid Scintillation Counter

Decay of radiocarbon

$_6C^{14} \rightarrow {}_7N14 + beta^- + anti\ neutrino + Q\ (0.156\ MeV)$

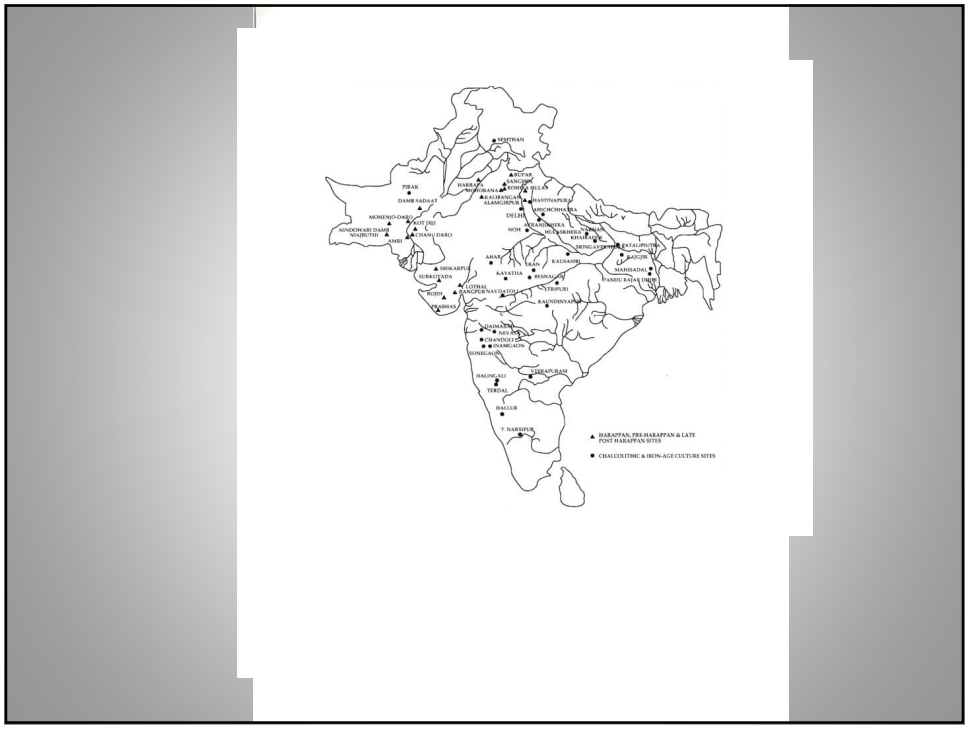
Half Life: 5730 +- 40 yr

International Calibration- VIRI-III (2009)

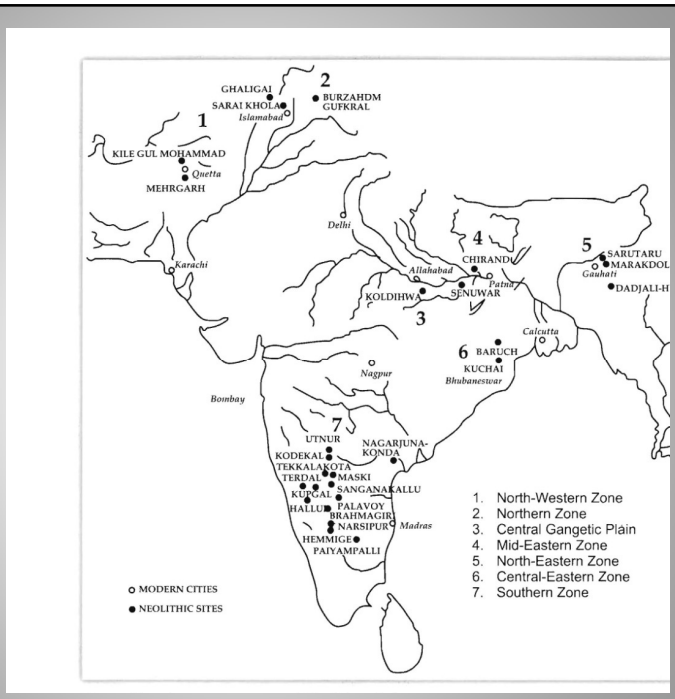
- **(pMC)**

	Consensus (Ac)	Ours (Am)	Deviation 100 (Am- Ac)/Ac
Charcoal (P)	80.457	81.49	+1.28%
Wood (M)	73.9	73.6	- 0.4%
Wood (L)	75.719	78.06	+3.1%
Murex Shell (R)	73.338	74.61	+1.7%
Humic Acid (U)	23.079	23.4	+1.39%

Barley mash turned out to be modern


HARAPPAN, PRE-HARAPPAN & LATE POST HARAPPAN SITES
CHALCOLITHIC & IRON-AGE CULTURE SITES

Sites


GHALIGAI
SARAI KHOLA
Islamabad
BURZAHOM
GUFKRAL
KILE GUL MOHAMMAD
Quetta
MEHRGARH
Karachi
Delhi
CHIRAND
Allahabad
Patna
SENUWAR
KOLDIHWA
SARUTARU
MARAKDOL
Gauhati
DADJALI-H
Calcutta
BARUCH
KUCHAI
Bhubaneswar
Nagpur
Bombay
UTNUR
NAGARJUNA-KONDA
KODEKAL
TEKKALAKOTA
TERDAL
MASKI
SANGANAKALLU
KUPGAL
HALLUR
PALAVOY
BRAHMAGIRI
NARSIPUR
Madras
HEMMIGE
PAIYAMPALLI
MODERN CITIES
NEOLITHIC SITES
1. North-Western Zone
2. Northern Zone
3. Central Gangetic Plain
4. Mid-Eastern Zone
5. North-Eastern Zone
6. Central-Eastern Zone
7. Southern Zone

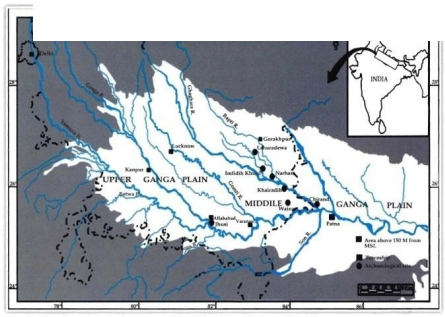


Fig. 2: Map showing the location of Middle Ganga Plain and Vindhyan region

expres ettled life at this site has marked the beginning of a ceramic and non-metallic occupational phase of Early Farming tradition characterized by cereal cultivation during 7th millennium BC spanning for several thousand years up to about 2000 BC. It was succeeded by an Advanced Farming phase and a few confined phases of cultures in the Early Historic times. The presence of carbonized grains of wild or weedy rice *(Oryza rufipogon)* and domesticated rice *(Oryza sativa)* were the most important finds of sub-period IA. The remains of domesticated rice husk were dated to 6,409 BC (cal. 8,359 BP). Remains of foxtail-millet *(Setaria cf. glauca)*, goose-foot/*bathua (Chenopodium album)*, job's tear *(Coix iachryma-jobi)*, Artemis *(Artemisia sp.)* flatsedge *(Cyperus sp.)* and catchfly *(Silene conoidea)* has also been recorded (Fig. 3). In sub-period IB barley, wheat, lentil and kodon-millet were also found in addition to the rice (Fig. 4 & 5) (after Tweari 2007-2008: 350-355).

The results in the first season's report had implications pertaining to the aspects of the commencement of early farming and the antiquity of the cultivation

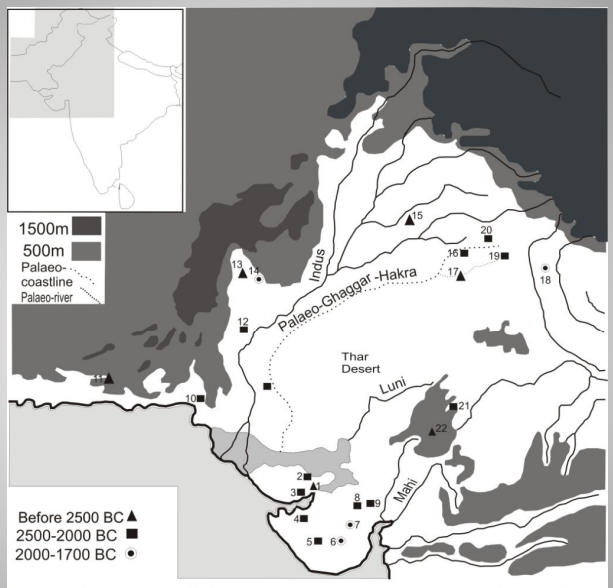
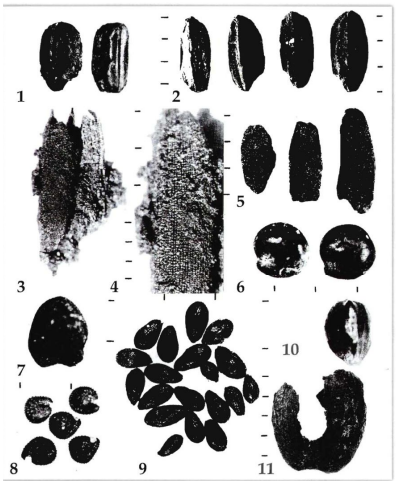


Figure1. Map of Northwestern part of Indian subcontinent showing archaeological sites discussed in the text:(1) Kanmer (2) Surkotada (3) Shikarpur (4) Kuntasi (5) Rojdi (6) Babor-kot (7) Oriyo Timbo (8) Rangpur (9) Lothal (10) Balakot (11) Miri Qalat (12) Mohenjodaro (13) Mehrgarh (14) Pirak (15) Harappa (16) Banawali (17) Kunal (18) Hulas (19) Balu (20) Rohira (21) Ojiyana (22) Balathal (Modified after Fuller, 2006).



Stage IA from Lahuradewa Tewari et al. (2007, 08, 352)

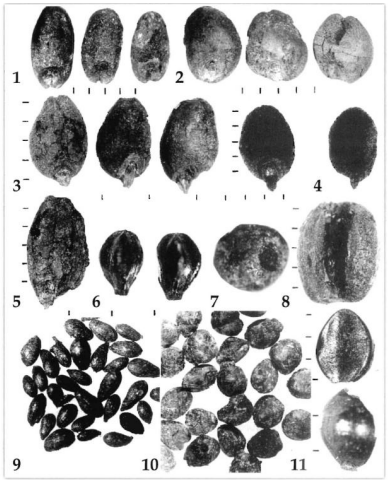
Lahuradewa

1. Domist. Rice grains (puffed during carbonisation)
2. Rice grains
3. Caryposis of wild rice
4. Surface of husk
5. Wild rice (oryza rufipogan)
6. Goosefoot seeds
7. Foxtail millet
8. Catchfly seeds
9. Mugwarts nuts
10. Flatsedge nut
11. Job's tear grain

Scale in mm

IA Lahuradewa

1-4: Domesticated rice
5. Two dost. Rice grains
6-7. Husk-remains of domesticated rice
8. Grains of wild rice Oryza rufipogan
9. Wild Rice Oryza officianalis
10-11. Husk of Oryza officinalis
12. Surface tissue enlarged Oryza officinalis



1. Bread wheat
2. 2. Dwarf Wheat
3. 3,4,5. Barley
6. Flat Sedge
7. Lentil
8. Job's Tear
9. Nuts of Mugworts
10. Fox tail millet
11. Husk pieces of kondon-millet

Tewri et al. 2007. Scale in mm

Agricultural Crops in Vindhyan Region

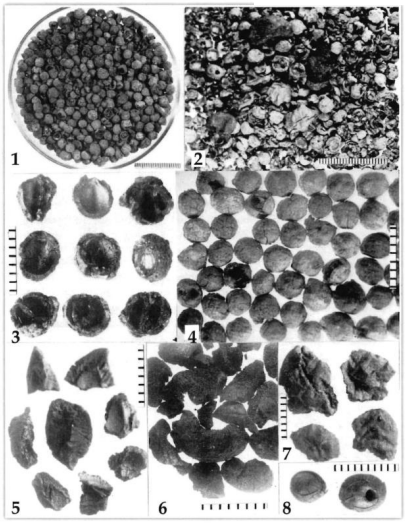
Koldihwa (6500 BC)	Mahagara (2200-1800)	Tokwa (3rd-2nd millennium BC)	Senuwar (2200 BC)
Cultivated rice	Cultivated rice, Hulled barley, Lentil, Green gram, Black gram, Pigeon pea	Cultivated rice, Hulled barley, Bread wheat, Lentil, Field pea, Green gram	Cultivated rice, Hulled barley, Bread wheat, Dwarf wheat, Jowar, Ragi and Kodon millet, Lentil, Field pea, Chick pea, Green gram

(Pokharia 2008)

South Indian Soapnut/ Reetha

1. Reetha
2. Carbonised shampoo
3,4. South ind. Soapnuts
5. Endocarp pieces of aanwala
6. Fruit pieces of aanwala
7. Shikakai
8. Shikakai seeds

Saraswat 2007, 08:11



Herbal material during Harappan

- Herbal detergent/ medicinal material in the Harappan settlement at Banawali, Hissar
- Include fruit of South Indian soapnut tree and aanwala, pods of shikakai
- Widely dated to be about 2750- 2500 Yrs BC

(Bisht , 1992; Saraswat(2007). Pragdhara 17, 11)

Kunal (Ratia tahsil, Hissar (Haryana)

- Carbonised seed and grains in s mound along the palaeochannel of Saraswati (29deg 30'N, 75deg 41'E).
- The samples were dated to be 3020 BC to 2580 BC.
- Sub Period I : 3000- 2850 BC
- Sub period IB: 2850- 2600 BC
- Sub Period IC: 2600- 2500 BC
- Dr. BB Lal: No samples from the earliest 3 levels seem to have been dated.

Saraswat and Pokharia (2003) Pragdhara 13, P.105.

Tokwa, Mirzapur (UP)

- At the confluence Belan and Adwa rivers in Mirzapur, Tokwa charcoal samples yield 3 dates of

BS	Trench	Depth(m)	Layer	Age (BP)
2354	H-8	2.20- 2.25	12A	3810-3570
2369	H-8	3.00- 3.30	14	7930-7510
2370	I8	2.43- 2-53	16	3640-3410

- Even if the date of about 7926 Yrs BC. Is ignored as being a result of mix-up(
- But no associated husk found.
- AKP (2008) Curr. Sci.94, 2. P.248

The dates for domesticated rice from Lahuradeva , Middle Ganga plains(St. Kabir Nagar, UP):

- **The Age of domisticated rice inferred on the basis of wood charcoal:**
- **BS Location (Period) Age**
- **1951 Lower most (IA) 6140 BP**
- **1966 " (IA) 7250 BP**
- **1950 Upper Level (IB) 4040 BP**
- **1939 Lowest Fe yield.(III) 3150 BP**

The AMS dating of rice- husk pushed it further back into time viz. 8360 BP (AMS, Erlangen)

Tewari et al. 2005-6 in Pragdhara 16, p. 36 and 50

Phytoliths of Wild and Cultivated Rice from Lahuradewa lake

- Wild Rice since 10,300 Yrs BC

- Phytoliths are OpalA particles reflecting the shape and size of the cells of the living plant tissues. The associated charcoal pieces were dated by AMS (Erlangen, Germany)
- Wild Rice phytoliths (Oryza rufipogon) – 2.7 m depth (10, 300 Yrs BC)
- Cultivated Rice (Oryza sativa) phytoliths- 2.4 m depth (8,300 Yrs BP)

- Saxena et al. (2006), Curr. Sci. 90, 11, P. 1547
- Tewari et al. (2003). Pragdhara 13, P. 37.

Madnapur

- Site: Madnapur (Shahjahanpur, UP)
- Trench M11 , qdt.III (110 cm, sealed by floor 2)
- PGW found
- Age for BS-2418: 4913 +- 203 Cal BP (Charcoal)

Saumphari

- **Site:** Saumphari, Shahjahanpur, UP (28 deg, 12' 30"N; 80deg, 15' 5")
- **Age:** 4849 +- 120 Cal yr BP (charcoal)
- **Cereals:** Barley, Domesticated Rice, Bread wheat, ragi millet
- **Pulses:** Field Pea, Lentils, Blk gram, Khesari, Horse gram, Aconite bean
- **Weeds & Wild Taxa:** Andropogon sp. Eleusine indica, Meadow grass, Cheno/ Ams; ....

Timber During Harappan Period

Wood Charcoal Remains

Timber Taxa	Lothal	Rangpur
Acacia sp.	+	+
Adina cordifolia (Haldu)	+	
Albizia sp.	+	+
Soymida febrifuga	+	+
Tectona grandis (Teak)	+	
Azadirachta indica (Neem)		+
Pterocarpus santalinus (*Lal-chandan*)		+
Tamarix sp.		+

For Lothal see Rao & Lal 1985; for Rangpur see Ghosh & Lal 1963.

Winter (Rabi), Summer (Kharif) Crops at Kanmer, Gujarat

- The site, also known as Bakar Kot is close to Little Runn of Kuchh (23 deg 23' N, 70 deg, E)
- The 25 dates, AMS as well as LSC, on carbonised plant materials are in excess of 2000 Yrs BC and several beyond 3000 Yrs BC
- **Winter**: Cereals-Barley, bread wheat, dwarf-wheat,
  Legu. Crops- Field pea, grass pea, fenugreek
  Oil seeds- Cereals- Linseed, jujube
- **Summer**: Rice, jowar-millet, pearl millet
  Green-blk gram, horse gram
  sesame, cotton

- A combined study by scientists from 5 institutions from India and Japan published in Current Science (June, 2011) AKP et al. 2011. Curr. Sci., 100,12, P.1833.

Arawali Hills, Ojiyana (Raj.)

- Ojiyana, Bhilwara, Raj. (25 deg, 53'N; 25 deg 53'E)
- Study of 25 samples revealed carbonised cereal, pulse grains, oil seeds, weeds etc. grains, seeds, fruits of wild and cultivated variety
- Hulled barley, naked barley, bread wheat, dwarf wheat, cultivated rice, jowar-, ragi-, fox tail millets
- Lentil, field pea, chickpea, grasspea, green/ blk gram, moth bean
- Linseed, sesame, safflower
- Jangli palak, job's tear, fox tail, goosefoot, lunki, falsa, babool, and many others

Thus the dwellers exploited the vegetational resources efficiently

Balu and Chandauli

- An ancient mound 2km from Balu, Kaithal, Haryana:
- Malhar, Chandauli, UP
- Evidence for rice cultivation from 6570 BC site

- KSS, AKP Pragdhara 12, 153.
- Tewari et al. (2001-2Pragdhara 12,153.)

Rice in the Indian Sub continent

RICE	Baluch, Swat, Upp. Sind	Kashmir (.6 Ka-1.5 Ka BC)	Central Gang. Plain(~ 7Ka-5.5 Ka)	Bihar (2Ka-8oo BC)	S. India (2Ka-1K BC)	NW India (2.5-1.1 Ka)	Gujarat, Maha (2.5 Ka-1.1 Ka)	Gang. Plain (2.2Ka-0.8 Ka)
RICE Wild Peren.			*					
Wild Annual			*					
Cultivat.		*	*	*		*		*
FIELD PEA		*		*		*	*	*

Wheat In Indian Sub Continent

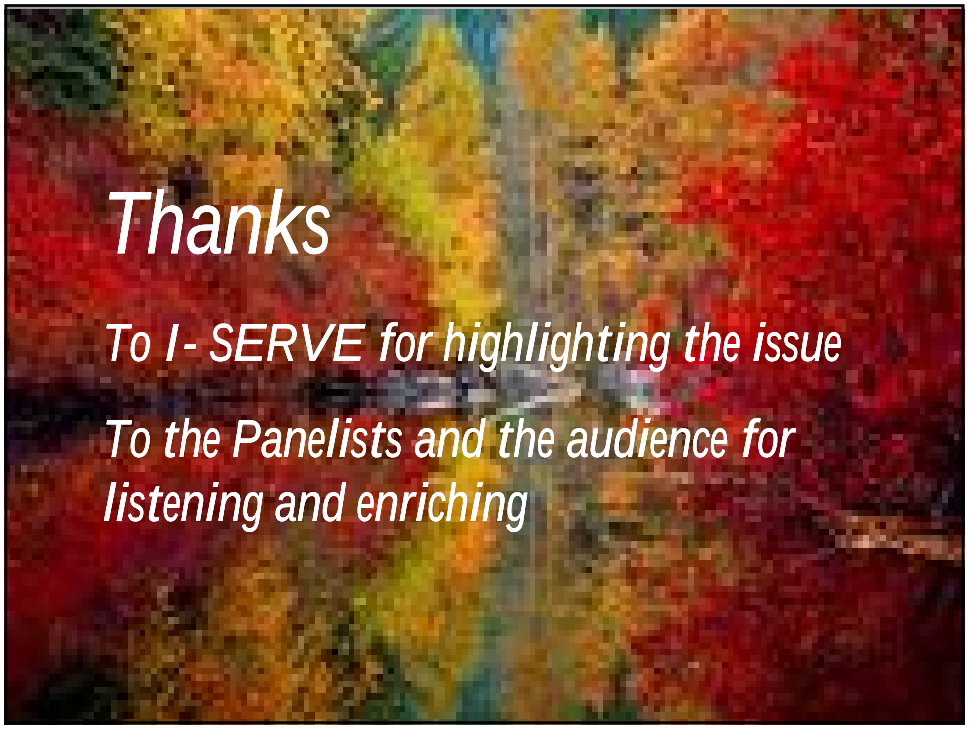
Wheat	Baluch, Swat, Upp. Sind	Kashmir (.6 Ka-1.5 Ka BC)	Central Gang. Plain(~ 7Ka-5.5 Ka)	Bihar (2Ka-8oo BC)	S. India (2Ka-1K BC)	NW India (2.5-1.1 Ka)	Gujarat, Maha (2.5 Ka-1.1 Ka)	Gang. Plain (2.2Ka-0.8 Ka)
Einkorn	*							
Emmer	*				*	*		
Hard	*							
Bread	*	*		*		*		*
Club	*	*				*		*
Dwarf	*	*		*		*		*

Wheat in the Indian Subcontinent

Barley	Baluch, Swat, Upp. Sind	Kashmir (2.6 Ka-1.5 Ka BC)	Central Gang. Plain(~ 7Ka-5.5 Ka)	Bihar (2Ka-8oo BC)	S. India (2Ka-1K BC)	NW India (2.5-1.1 Ka)	Gujarat, Maha (2.5 Ka-1.1 Ka)	Gang. Plain (2.2Ka-0.8 Ka)
Wild	*							
2 Row Hulled	*							
6 row Hulled	*	*	*	*		*	*	*
6 Row Naked	*					*		

To Keep in Mind

1. Not everywhere do the developments have to be contemporaneous. The age of PGW is getting back in time and hence removal of a mental block essential.
2. Lack of a fossil or of its evidence doesn't prove that it didn't exist!
3. Radiometric and similar physical dating yield numerical date not 'absolute' dates
4. Association of the material (dated) with the site is critical
4. No date is better than the sample


Thanks
To I- SERVE for highlighting the issue
To the Panelists and the audience for listening and enriching