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# Cereal Grains and Grain Pulses: Reassessing the archaeo-botany of the Indus Civilisation and Painted Grey Ware period occupation at Alamgirpur district *Meerut* U.P.

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## 1. Introduction:

This paper reviews the archaeo-botanical remains from the 2008 excavations at Alamgirpur (29° 00.206′N; 77° 29.057′E), which were carried out by Banaras Hindu University. Alamgirpur is the eastern most settlement of the Indus Civilisation thus far excavated, and represents an important site in relation to understanding how the Indus interacted with populations in the Yamuna-Ganges doab, and as a site that has later period occupation, how the transition between the Indus period and Painted Grey Ware (PGW) period occurred in this region. A preliminary report on the archaeobotanical remains have been published previously[1], and there has been detailed analysis of charcoal and phytolith remains explored in relation to fuel resources[2]. The macrobotanical remains have not been systematically reported, however, and the previous discussions have presented a partial taxa list from only a selection of the contexts that were sampled and the data were compiled by a number of analysts[3]. This approach resulted in the disaggregation of the sample assemblage, and this paper brings together the samples and the results of the various analyses to outline a systematic review of the datasets to present a more comprehensive analysis of the Harappan and PGW assemblages from the site.

**2. Location and Archaeology at Alamgirpur**

The archaeological site of Alamgirpur is situated in the modern Meerut District of Uttar Pradesh, India (Fig. 01), about 3km to the east of the present course, but on the edge of the palaeo-channel of the Hindon River, which is a tributary of the Yamuna River[4]. Known locally as *Parasuram-ka-Khera*, the mound sits on a consolidated sand dune that rises approximately 1.5 m above the surrounding flood plain. What remains of the archaeological mound measure roughly 60m east-west and 50m north-south, rising to a maximum height of 6m above the surrounding plain. The natural landscape around the site has been heavily modified for sugar cane and wheat agriculture, and the site is currently topped with a small shrine and primarily used for the storage of dung fuel.

Alamgirpur was first excavated in 1958 by Regional Camp Committee of *Bharat Sewak Samaj*[5], and more extensive excavations were undertaken by Sharma in 1959[6] who confirmed the Indus Civilisation affiliation of the site through ceramic typologies. Sharma[7] suggested a four-fold cultural sequence, with breaks between each period. However this chronology, particularly the cultural breaks between periods and the relative nature of the dating, was highly debated. In 2008, researchers from Banaras Hindu University undertook new excavations at the site. The excavations involved members of the *Land, Water, Settlement* project (LWS), which is a collaborative endeavour lead by Banaras Hindu University and the University of Cambridge, that also included collaborators from a range of other academic institutions and authorities, including Deccan College, Pune, and the Birbal Sahni Institute, Lucknow. These renewed excavations aimed to confirm the cultural sequence, provide absolute dates, collect material for faunal, botanical and palynological analyses, and explore human-climate interactions[8].

Five trenches were excavated in 2008 (Fig. 02): ZA1, ZA2, ZB1, ZB2 and YD2. In addition, a Section Cutting was carried out on an exposed section on the western side of the mound. The trenches confirmed a cultural sequence outlined in Table 1. No clear stratigraphic gaps were found between Periods I and II or II and III, but the sequence otherwise corresponds well with that identified by Sharma[9]. Further details of the excavations, sequence and finds can be found in Singh et al.[10].

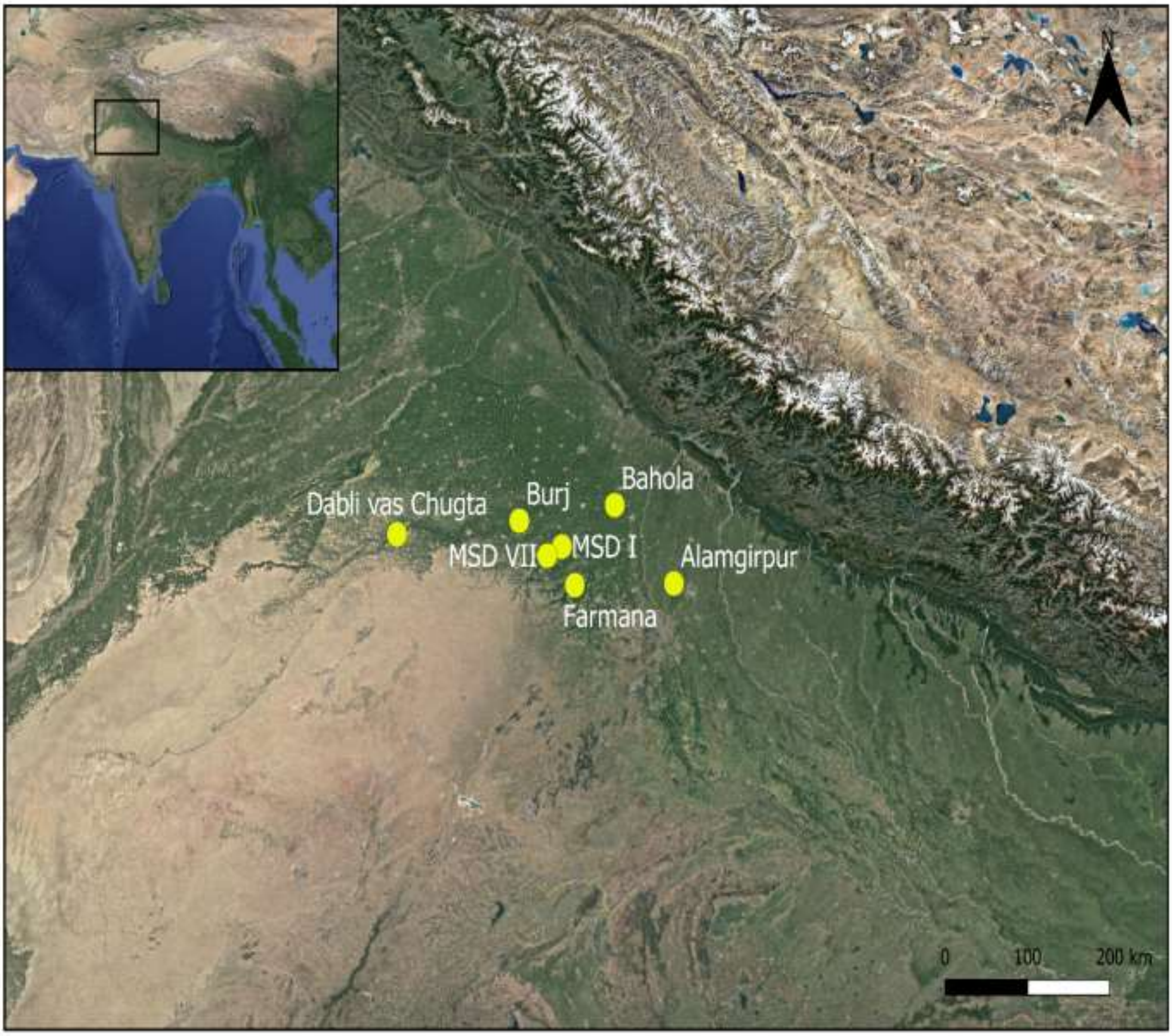


**Fig. No 01: Map showing location of Alamgirpur and other sites referenced in this paper**

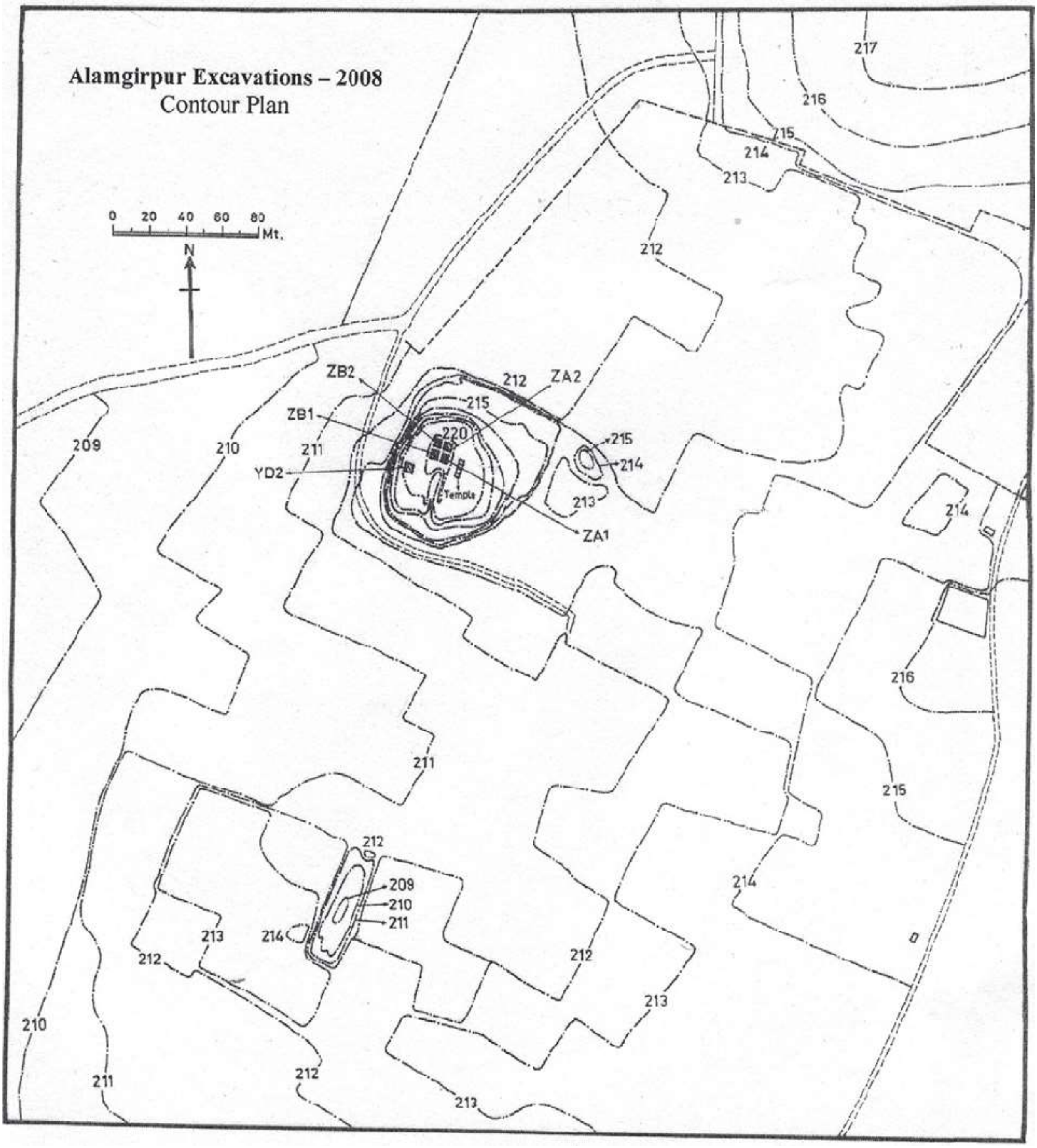


**Fig. No. 2: Trenches excavated at Alamgirpur.**

| **Cultural Period** | **Associated cultural material** |
|---|---|
| Period IA | Harappan (Mature Harappan and Late Harappan) |
| Period IB | Overlapped layer of mixed Harappan/PGW materials |
| Period II | PGW |
| Period III | Early Historic |
| Period IV | Late Medieval |

**Table 1: Periodisation of Alamgirpur**

**3. Nature of the Materials and Methodological Approach**

Early during the excavation it became apparent that Trenches ZA1 and ZA2 had been placed over the trench excavated by Samaj, and as such were excavated to a depth of 40-50cm only and not sampled for archaeo-botanical remains. Trench ZB1 had remains from the medieval, Kushana and PGW phases, but was not excavated below the PGW occupation, as a furnace and floor were found in layer 7, and time constraints limited further exposure. The sample from ZB1 were therefore not included in this analysis.

The archaeobotanical materials here were collected from ZB2, YB2 and the Section Cutting (SC), which were excavated using different methods. Trenches ZB2 and YD2 were excavated using a combination of layer and spit sampling, while the SC was excavated using a single context system. Despite these differences, a single archaeobotanical sampling strategy comprised of blanket coverage was carried out across the site, with 40l of sediment being collected from each layer-spit or context, and floated using a bucket system and 500micron mesh. A total of 82 samples were collected across the trenches.The samples were floated at site, and sent to Birbal Sahni Lab for initial analysis by K.S. Saraswat and A. Pathak[11]. This initial exploration mainly explored the >1mm fraction of some of the samples. Not all samples were analysed at this time (SI Table 1). Data was presented in Singh et al.[12] as a taxa limited presence/absence list. Following the initial sorting by Saraswat and Pathak, the samples were sent to the University of Cambridge for further analysis and selection of seeds for radiocarbon dating (Section 4.2). This sorting stage quantified the data from the samples that were selected for AMS by R. Ballantyne, C. Lancelotti and D. Mooney and the resultant data has been added both as presence data and quantified data to the relevant reanalysis outlined below.

All 82 samples have been reanalysed as part of this study. This study adds quantified information to the presence/absence data gathered by Saraswat and Patak, and Ballantyne et al.[13], and expands the analysis to include all samples from the site. This reanalysis was carried out at the GPR Laboratory of the McDonald Institute (University of Cambridge).

The reanalysis process has demonstrated that the movement of the samples between laboratories resulted in the loss of some of the <1mm and >1mm fractions in several samples. An effort has been made to reunite the fractions, and notations of where this may not have been achieved has been made on Table 1 in the SI. In some cases the taxa identified and reported in Singh et al.[14] could not be found in the relevant sample tubes, suggesting that it has not been possible to reunite the entire assemblage post-initial analysis.

In order to deal with the disjunction between the initial pilot analysis and this reanalysis of the entire floated dataset, two approaches have been taken: firstly a study of the presence/absence data across all samples, and secondly a study of the quantified data in those samples deemed to be 'whole' (containing both the <1mm and >1mm fractions). The initial taxa lists of Singh et al.[15] have been incorporated into the database as presence data.

The reanalysis of the samples for this paper was carried out using a Leica MZ8 microscope at 0.8x, 1.0x, 2.0x and 2.5x magnification. The material was identified using the GPR reference collection and with reference to botanical literature including Nesbitt[16], Berggren[17], Cappers et al.[18], Fuller[19], Galinato et al.[20], Jacomet[21], Martin and Barkley[22], Zohary et al.[23]. The Tropicoseflora of Pakistan (http://www.tropicos.org, accessed various dates) was used for nomenclature for all non-cereal elements, with Zohary et al.[24]used for cereals.

Plants have been categorised into broad groups (e.g. cereal, pulse etc.). Following discussion with Lancelotti[25], it was clear that no seed elements were found in the dung fragments from Alamgirpur, making discussion of deliberate foddering (e.g.: with barley, millets or small 'fodder' pulses like *Medicago*) difficult. Phytolith evidence of mainly early stage crop processing waste (leaf/stem) from cereals has been found in samples with data suggesting dung fuel use[26], with limited evidence of inflorescence presence, but this analysis/result does not allow for species level distinctions, or for direct evidence of grain foddering. Based on evidence from comparable small sites in the northeast of the Indus[27] and the limited evidence for cereal foddering in the dung fuel data in Lancelotti[28], an assumption that any wheat, barley, rice and millet remains found in the macrobotanical assemblage represent cereal crops has been made, but this can and should be revised should further data be made available.

*Ziziphus* sp. has been included as a fruit because the seed remains have been charred and there is no evidence of this species being a wood fuel at Alamgirpur[29]. The oilseed/vegetal plants are more complex. As noted in Bates[30], such plants are difficult to classify, and at Alamgirpur the assemblage associations and contextual information does not indicate their possible use. *Brassica campestris*, *Sesamum* sp., and cf. *Indigofera* sp. have been tentatively placed in this category based on comparison with other Indus sites. There appears to be little contextual patterning between these species and cereal or pulse plants, perhaps suggesting that these are not weeds of crops, but this is tentative given the lack of larger quantifiable datasets. *Cannabis sativa* has not been included in this group because these were not identified as archaeologically charred remains in the reanalysis. As noted in the process of selecting samples for AMS dating and this reanalysis, much of the modern contamination observed in the assemblage was cannabis seeds, and there is therefore some likelihood that the *Cannabis sativa* are modern contaminants that were not specified as such in Singh et al.[31].

**4.1 Previous Archaeobotanical Findings**

The previous archaeobotanical analyses suggested that various cereals including barley (*Hordeum vulgare*), wheats (*Triticumaestivum* and *sphaerococcum*), and rice (*Oryza sativa*) were present in the Harappan levels (Period Ia), and also in the PGW phase (Period II), along with tropical pulses such as horsegram (*Macrotyloma uniflorum*), mung bean (*Vigna radiata*) and urad bean (*Vigna mungo*) and Near Eastern pulses such as peas (*Pisum sativa* and *Lathyrus* sp.) and vetch (*Vicia* sp.). These species were accompanied by a range of possible oil/fibre seeds, fruits and wild plants. The full list of the taxa identified can be seen in Table 2[32] (Tables 6-8). These suggest that the inhabitants of Alamgirpur were practicing agriculture, and the presence of both *rabi* (winter) and *kharif* (summer) crops and 'weeds' suggest that a mixed season cropping system was being employed[33].

| | Harappan | | | PGW | |
|---|---|---|---|---|---|
| | SC | YD2 | ZB2 | YB2 | ZB2 |
| *Triticum* sp. | x | | | | |
| *Triticum aestivum* | x | x | x | x | x |
| *Triticum sphaerococcum* | | x | | x | |
| *Hordeum* sp. | | | x | | |
| *Hordeum vulgare* | x | x | x | x | x |
| *Hordeum* var *nudum* | | x | | | |
| *Oryza sativa* | | x | x | x | x |
| *Panicum* sp. | | x | x | x | x |
| *Siteria* sp.? (cf. *Setaria* sp.?) | | | x | x | |
| *Lathyrus* sp. | | x | | x | |
| *Lathyrus aphaca* | | x | | | |
| *Lathyrus hirsute* | | x | | | |
| *Lathyrus sativa* | | | x | | |
| *Lens* sp. | | | x | | |
| *Pisum* sp. | | x | | | |
| *Pisum arvense* | x | | x | | |
| *Pisum granum* * | | | x | | |
| *Pisum sativum* | | x | x | x | |
| *Macrotyloma* sp. | | | x | | |
| *Dolichosbiflorus* (syn. of *Macrotyloma uniflorum*) | | x | x | x | |
| *Vicia* sp. | x | x | x | x | x |
| *Vicia hirsute* | x | x | x | x | |
| *Vigna* sp. | x | | | x | |
| *Vigna mungo* | | x | x | | |
| *Vigna radiata* | x | | x | x | x |
| *Ziziphus* sp. | | | | x | |
| *Ziziphus nummularia* | x | | | x | |
| *Indigofera* sp. | x | x | x | | |
| *Amaranthus* sp. | | x | x | x | x |
| *Argemone mexicana*** | | x | x | x | x |
| *Brassica campestris* | | | | x | |
| *Bromus* sp. | | x | | | |

| | | | | | |
|---|---|---|---|---|---|
| *Cannabis* sp. | | | | x | x |
| *Cannabis sativa* | | | x | x | |
| *Chenopodium* sp. | | x | x | x | |
| *Chenopodium album* | x | | | x | x |
| *Commelina* sp. | x | | | | |
| Convolvulaceae | | x | | | |
| Cyperaceae | x | | | | |
| *Cyperus* sp. | x | x | x | x | x |
| Euphorbiaceae ? | | x | | | |
| *Fimbristylis* sp. | | | x | | x |
| *Grainae* sp.? *** | | | x | | |
| Poaceae grain? (and syn. *Gramine* sp.) | x | x | x | x | x |
| *Rumex* sp. | | x | | | |
| *Trianthema* sp. | x | x | x | x | x |
| *Trianthema portulacastrum* | x | x | x | x | x |
| Unknown grain | | | x | | |
| Unknown grass | | | x | | |
| Unknown flower | | | x | x | |
| Unknown seed | | | x | | |
| 7-8 different weed species | | x | | | |

**Table 2: Taxa identified by Saraswat and Pathak (Singh et al. 2013: tables 6-8).**

*** Pisum granum is not a recognised taxa in the local or international flora. ** Argemone mexicana is a native of the New World and was not introduced to South Asia until the modern era. ***Grainae is not a recognised taxa in the local or international flora.**

However, some of these initial identifications are problematic, including the presence of *Argemone mexicana* amongst the taxa. This species from the Papaveraceae family is a native of Mexico that has, post-AD 1492, been naturalised across the globe. As a New World introduction to India, it must be either a modern contaminant to the assemblage or a misidentification. Throughout the taxa lists presented in Singh et al.[34] a distinction has not been made between modern (uncharred) and ancient (charred). The presence of *Argemone mexicana*made it clear that it was essential to reassess all of the material, particularly the potential ubiquity of *Cannabis sativa*, which has been noted by Ballantyne in her assessment of the samples for AMS as a modern contaminant (see Section 4.2).

In addition to the macrobotanical taxa list, analysis of a subset of the charcoal and phytolith materials has been carried out[35]. The four dicotyledonous wood species identified at Alamgirpur come from dry thorn scrubland, reflecting the environmental conditions in the region at the time of occupation are similar to those of today, with a fifth charcoal identified as an as yet unknown monocotyledon[36]. The general lack of charcoal combined with evidence from phytoliths, spherulites and geochemical analysis suggested that fuel exploitation at Alamgirpur was reliant on dung fuel due to a scarcity of tree resources[37]. Cane and grass inflorescences (from crop processing) may also have been exploited[38].

### 4.2 Radiocarbon Dates

In addition to the macrobotanical sorting by Saraswat and Pathak, sorting and identification of seeds for AMS dating was led by R. Ballantyne with the assistance of C. Lancelotti and D. Mooney at the University of Cambridge. A subset of 17 samples were examined to identify material suitable for AMS dating. The sampling strategy aimed at isolating single macrofossils for each sample. In the cases when this was not possible, the lowest number of seeds/fragments of the most clearly identifiable plants were chosen. Samples with very small identifiable individual material (<6mg) automatically included additional material included in case more material was required for dating. Many of the selected items were fragmentary, and some had adhering rootlets or sedimentary matrix. The mass values (mg) quoted were an estimate of the carbon mass before treatment. The analysis included a preliminary analysis of the other material in the samples that were assessed, and these data are outlined in Table 3.

| Trench | Context | Depth (cm) | Sample No. | Charred macrofossils sent to Oxford for AMS C14 dating | Mass (mg) | Notes on alternative charred macrofossils retained at Cambridge | Mass (mg) | Modern contamination (grass culms, seeds of *Malva/Hibiscus*, *Cannabis* sp., *Setaria* sp.) |
|---|---|---|---|---|---|---|---|---|
| SC | 107 | | 7 | 3 *Hordeum vulgare*sensulato (domesticated barley) | 9 | | | Moderate |
| SC | 112 | | 14 | 1 whole *Vicia/Lathyrus* (vetch/wild pea) | 8 | | | Low |
| SC | 114 | | 16 | 1 naked *Hordeum vulgare* sensulato (domesticated barley) | 6 | | | Low |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SC | 118 | | 24 | 11 cereal small fragments | 10 | | | Low |
| SC | 124 | | ?36 | 1 half a *Vicia/Lathyrus/Pisum* (vetch/wild pea/pea) | 6 | | | Low |
| SC | 126 | | 40 | 1 *Hordeum vulgare*sensu lato (domesticated barley), 3 *Hordeum/Triticum* (barley/wheat) as alternative | 5; 13 | | | Low |
| SC | 128 | | 44 | 1 *Hordeum/Triticum* (barley/wheat), 6 cereal fragments as alternative | 3; 13 | | | Almost none |
| YD2 | Pit 1 in 1 | 75-80 | | 1 *Oryza sativa* (rice) | 8 | 2 *Oryza sativa* (rice) | 13 | Very high |
| YD2 | 3 | 130-5 | | 1 *Hordeum vulgare*sensu lato (domesticated barley) | 7 | 1 *Vigna mungo/radiata* (urd/mung bean) | 8 | Moderate |
| YD2 | 4 | 190-5 | | 1 whole *Vigna radiata* (mung bean) | 9 | | | Moderate |
| YD2 | 6 | 240-5 | | 1 *Hordeum vulgare*sensu lato | 12 | | | Low |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | (domesticated barley) | | | | |
| YD2 | 7 | | | 1 whole *Lathyrus/Pisum* (wild pea/pea) | 14 | | | Almost none |
| YD2 | Pit 4 in 8 | 305-10 | | 1 whole *Vicia/Lathyrus* (vetch/wild pea), 8 grain/pulse fragments | 2, 8 | | | Almost none |
| ZB2 | 2 | 40-50 | | 1 whole *Vigna radiata* (mung bean) | 14 | | | Very high |
| ZB2 | 5 | 200-205 | | 1 *Vigna radiata* cotyledon (half mung bean) | 11 | 1 *Vigna radiata* cotyledon (half mung bean), 1 whole *Vigna* sp. (bean) | 5, 8 | High |
| ZB2 | 6 | 230-5 | | 1 whole *Vigna radiata* (mung bean), 1 whole *Vigna radiata* (mung bean) as alternative, 1 *Oryza sativa* (rice) as alternative | 5, 4, 5 | Alternatives already included | | Moderate |
| ZB2 | Pit 2 in 7 | 295-300 | | 1 whole *Vigna radiata* (mung bean) | 22 | | | Low |
| ZB2 | 9 | 365-370 | | 1 *Hordeum/Triticum* | 8 | 1 *Hordeum/Triticum* | 6 | Almost none |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | (barley/wheat) | | (barley/wheat) | | |

**Table 3: Taxa chosen for AMS dating**

The material selected for dating were analysed at the Oxford Radiocarbon Accelerator Unit, AMS Laboratory, University of Oxford (NERC Grant NF/2008/2/9). These samples were processed following the guidelines outlined in Bronk Ramsey et al.[39]. Of the 18 samples submitted, seven failed to provide enough material for dating after pre-treatment, and the uncalibrated BP dates for the remaining samples are shown in Table 4, using a half-life of 5568 years with the calibrated dates BC shown at 95% confidence interval[40] (These were calibrated using OxCal v4.1 INTCAL09).

| AMS code | Context | Material | | Uncal BP date | Cal BC (95%) | Period |
|---|---|---|---|---|---|---|
| OxA-21856 | SC 107 | *Hordeum vulgare* | $\delta^{13}C$=22.43 | 3630 ± 26 BP | 2124-1814 | Late Harappan |
| OxA-21857 | SC 114 | *Hordeum vulgare* | $\delta^{13}C$=24.51 | 3508 ± 26 BP | 1903-1749 | Late Harappan |
| OxA-21858 | SC 118 | *Cerealia* | $\delta^{13}C$=24.34 | 3610 ± 27 BP | 2032-1895 | Mature Harappan |
| OxA-21859 | SC 126 | *Hordeum vulgare* | $\delta^{13}C$=24.22 | 3652 ± 28 BP | 2135-1942 | Mature Harappan |
| OxA-21881 | SC128 | *Hordeum/Triticum* | $\delta^{13}C$=22.71 | 3737 ± 31 BP | 2275-2033 | Mature Harappan |
| OxA-21860 | YD2 pit 1 in 1 | *Oryza sativa* | $\delta^{13}C$=25.43 | 2486 ± 25 BP | 771-430 | PGW |
| OxA-21861 | YD2 3 | *Hordeum vulgare* | $\delta^{13}C$=22.15 | 2458 ± 25 BP | 754-414 | PGW |
| OxA-21862 | YD2 6 | *Hordeum vulgare* | $\delta^{13}C$=23.54 | 3725 ± 27 BP | 2201-2035 | Mix of PGW/ Harappan (residual?) |
| OxA-21863 | YD2 7 | *Lathyrus/Pisum* | $\delta^{13}C$=23.58 | 3729 ± 28 BP | 2203-2035 | Mature Harappan |
| OxA-21882 | ZB2 6 | *Vigna radiata* | $\delta^{13}C$=26.54 | 3659 ± 31 BP | 2136-1948 | Mature Harappan (residual?) |
| OxA-21883 | YD2 pit 4 in 8 | Charred seeds | $\delta^{13}C$=25.23 | 3760 ± 33 BP | 2288-2042 | Mature Harappan |

**Table 4: AMS from Alamgirpur**

### 4.3 Reanalysis of archaeobotanical remains – period-wise descriptions

#### 4.3.1 Mature Harappan

Material from Period IA (Mature Harappan) is comprised of 32 samples from trenches ZB2 and YD2 and the SC. Of these, 26 samples were previously analysed and included in the taxa list by Saraswat and Pathak[41]. The majority of contexts analysed were fills, but three floors and two pit fills were also sampled. Table 5 summarises the data.

| Taxa | Ubiquity (%) (n=32) | Av. Density per 40l (n=6) | Av. Proportion of crops (n=6) |
|---|---|---|---|
| *Hordeum* sp. * | 25.00 | 3.83 | |
| *Triticum* sp. * | 34.38 | 0.33 | |
| *Hordeum/Triticum* | 18.75 | 1.17 | |
| *Oryza* sp. * | 21.88 | 0.17 | |
| Small Millets * | 34.38 | 10.83 | |
| Indet. cereals | 12.50 | 0.33 | |
| **Cereals Total** | **62.50** | **16.67** | **68.97** |
| *Vigna* sp. * | 31.25 | 2.00 | |
| *Macrotyloma uniflorum* | 31.25 | 2.00 | |
| *Pisum* sp.* | 18.75 | 0.67 | |
| *Cicer sp.* | 9.39 | 0.50 | |
| *Lens* sp. | 6.25 | 0.17 | |
| *Lathryus* sp. * | 12.50 | 0.17 | |
| *Vicia* sp. * | 53.13 | 0.00 | |
| *Vicia/Lathyrus* | 3.13 | 0.17 | |
| *Lathyrus/Pisum* | 3.13 | 0.17 | |
| *Vicia/Lathyrus/Pisum* | 3.13 | 0.00 | |
| Indet. Fabaceae | 15.63 | 0.50 | |
| **Pulses Total** | **84.38** | **6.33** | **26.21** |
| *Ziziphus* sp. * | 6.25 | 0.17 | |
| **Fruits Total** | **6.25** | **0.17** | **0.69** |
| *Sesamum* sp. | 6.25 | 0.17 | |
| Cf. *Indigofera* sp. | 18.75 | 0.67 | |
| Indet. Oil/Vegetal | 9.38 | 0.17 | |
| **Oil/Vegetal Total** | **25.00** | **1.00** | **4.14** |
| *Amaranthus* sp. | 6.25 | | |
| *Argemone mexicana* | 3.13 | | |
| cf. *Chenopodium* sp. | 6.25 | | |
| cf. *Chrysopogon* sp. | 3.13 | | |
| *Commelina* sp. | 3.13 | | |

| | | | |
|---|---|---|---|
| Cyperaceae | 18.75 | | |
| Cyperaceae cf. S*cirpus* | 3.13 | | |
| long Cyperaceae | 3.13 | | |
| silicified Cyperaceae | 25.00 | | |
| *Cyperus* sp. | 3.13 | | |
| *Eleocharis* sp. | 18.75 | | |
| *Eragrostis* sp. | 12.50 | | |
| Small Fabaceae * | 18.75 | | |
| *Fimbristylus* sp. | 3.13 | | |
| *Fumaria* cf. *officinalis* | 3.13 | | |
| *Medicago* sp. | 12.50 | | |
| *Medicago/Melilotis/Trifolium* | 6.25 | | |
| Poaceae grain? | 18.75 | | |
| *Solanum* cf. *dulcamera* | 3.13 | | |
| *Trianthema* sp. | 31.25 | | |
| *Trianthemaportulacastrum* | 31.25 | | |
| *Trianthematriquetra* | 3.13 | | |
| Indeterminate Small | 25.00 | | |
| **Wild Plants Total** | **81.25** | | |

**Table 5: Summary of data from Mature Harappan sample. Full dataset can be found in SI Table 1. *entries include total of all seed/grain material, including cf. identifications**

Using a simple study of the ubiquity (% of contexts a taxa is present in) to account for the issues of sample handling[42], the most frequently used crops were pulses and cereals, with wild plants (possible weeds of agriculture but also perhaps brought to site through non-anthropic pathways such as dung) also being ubiquitous across contexts.

Within this set of species *Vicia sp*. was the most frequently occurring, but a wide range of taxa were seen. The high ubiquity of *Vicia* sp. likely skewed the seasonality analysis in spite of the high density of summer millets. Overall in the Mature Harappan phase at Alamgirpur as a result of the low density but regular ubiquity of *Vicia* sp. there is an even occurrence of *rabi* and *kharif* crops appearing across contexts.

Chaff was not commonly found across the Mature Harappan contexts. The sample from one context - YD2 7 200-205cm - appears to have the majority of chaff types. This absence overall through the Mature Harappan assemblage could reflect the use of a particular off-settlement crop processing space or the use of chaff in dung fuel. Sample YD2 7 200-205cm was from a context that had not been previously analysed. The chaff consisted mainly of awn fragments (n=24), which are difficult to quantify further as fragmentation patterns are complex. One piece of culm was present. Beyond this, the majority were rachis fragments, with one being unidentifiable beyond Family level, one as *Hordeum/Triticum*, one as *Hordeum* sp. and one as 6-row *Hordeum* sp. This ties in with the 15 barley grains that were found, though it is notable that one of the grainsthat could be identified further was hulled straight *Hordeum vulgare*. Two silicified domesticated rice spikelet bases were noted in sample Trench YD2 7 250-255cm, and though no rice grains were found in this samplethey have been noted from other Mature Harappan samplesat Alamgirpur (Table 5). A further silicified domesticated spikelet base was found in YD2 7 floor 270-275cm, which also contained a rice grain apex. Chaff from a range of wild plants was noted throughout the Mature Harappan assemblage across all trenches (Table 1 SI). A more in-depth crop processing analysis was not carried out, however, given the issues of some samples missing the <1mm fraction. As shown in Table SI1, at 15 of the 32 samplesfrom the Mature Harappan samples were considered to be missing their >1mm fraction, and as such this could skew the analysis.

The wild plant taxa were seen frequently throughout the Mature Harappan samples, with a diverse range noted. The most ubiquitous at 31.25% was the *Trianthema* genus (*T. portulastrum*, *T.triquetra* and *Trianthema* sp.), but this frequency reveals an additional pattern – the low ubiquity of individual wild plant taxa. When combined as a disparate and wide ranging group of 'wild' plants they are found in almost all samples, but as individual species/genera they are not commonly found. One sample (YD2 7 250-5cm) had a particularly wide range of taxa, including both those expected as dung inclusions (i.e. eaten through grazing or foddering), and those that are not palatable. There were also a mix of taxa found as crop processing waste and those less likely to be present through this pathway. This pattern could thus reflect the presence of a combination of both dung fuel and crop processing waste, showing the complex nature of the site.

The contents of the samples are very similar, the pits for example do not stand out, but one set of contexts does appear interesting: contexts in phase 7 of YD2. The samples from this set of contexts has a greater number of taxa in each sample than those in the other contexts. YD2 Phase 7 contains two floors which appear distinct from one another – floor 7 250-5cm contains only *Lathyrus* sp. and *Vicia* sp., while floor 7 270-5cm contains a diversity of taxa, including cereals, pulses, fruits, oilseed/vegetal plants and wild taxa, as well as chaff. This variation could reflect different uses of these spaces/surfaces, differential preservation, or (more likely) different sample handling. Sample handling between different labs and the loss of material through sieving and sorting of fractions seems more likely as the other sample from the same depth, 250-5cm, shows a much higher diversity of material, similar to that seen in the floor from 270-5cm. . The broad range of taxa represented across all the samples from phase 7, including the two rammed floors of the circular structures from the Mature Harappan period, suggests that plants were regularly being brought into living spaces, handled, charred and incorporated into floors and fills regularly.

**4.3.2 Late Harappan**

The archaeobotanical samples from this phase came from the SC only, which means that direct sample comparison is possible. All except context 112 (sample no.14) were previously analysed and a limited taxa list outlined in Singh et al.[43]. Table 6 summarises the data.

| Taxa | Ubiquity (%) (n=8) | Av. Density per 40l (n=1) | Av. Proportion of crops (n=1) |
|---|---|---|---|
| *Hordeum* sp. * | 62.50 | 0.00 | |
| *Oryza* sp. * | 12.50 | 0.00 | |
| Small millets * | 12.40 | 1.00 | |
| **Cereals** | **62.50** | **1.00** | **50.00** |
| *Vigna* sp. * | 62.50 | 0.00 | |
| *Vicia* sp. * | 62.50 | 0.00 | |
| *Vicia/Lathyrus* | 12.50 | 1.00 | |
| **Pulses** | **100.00** | **1.00** | **50.00** |
| **Fruits** | **0.00** | **0.00** | **0.00** |
| Cf. *Indigofera* sp. | 12.50 | 0.00 | |
| **Oil/Vegetal** | **12.50** | **0.00** | **0.00** |
| *Cannabis sativa* | 12.50 | | |
| *Chenopodium album* | 37.50 | | |
| Poaceae grain? | 50.00 | | |
| *Trianthema* sp. | 50.00 | | |
| *Trianthemaportulacastrum* | 25.00 | | |
| *Trianthematriquetra* | 12.50 | | |
| Indeterminate Small | 12.50 | | |
| **Wild Plants** | **87.50** | | |

**Table 6: Summary of data from Late Harappan sample. Full dataset can be found in SI Table 1. *entries include total of all seed/grain material, including cf. identifications.**

In general, there was a lack of material in the samples, which is reflected in a low taxa diversity. Cereals, pulses, wild plants were present in high frequency, as they were in the Mature Harappan samples, but the number of taxa represented was lower. Within the crops, barley, rice and small millets (*Echinochloa* sp.) are the only cereals present, with barley being the most ubiquitous. *Vigna* sp. (specifically *V.radiata*) and *Vicia* sp. (*V.hirsuta* and *Vicia/Lathyrus*), and the tropical pulses were marginally more ubiquitous than the winter pulses. Unlike the Mature Harappan period there were no fruits and *Indigofera* sp. was found in one context, which raises the question as to whether this was an oilseed/dye or a weed at Alamgirpur.

Chaff was also present in low ubiquity and only as indeterminate forms, and while there were wild plants, again there were fewer taxa, although the ubiquity is similar to that seen in the Mature Harappan phase.

### 4.3.3 Potentially Contaminated Layer containing Late Harappan-PGW Mixed Material

The stratigraphic context of deposits that have been labelled Period IB in the previous reports is difficult to interpret. Such deposits were not seen in the Section Cutting. In YD2 and ZB2 there were PGW period pits that cut into the Late Harappan layers. It is not clear that Period IB provides evidence of continuous occupation or a transition layer between the Late Harappan and PGW. It may be a phase of deposits that has been contaminated, and represents the mixing and redeposition of earlier material into deposits laid down in the later PGW phase. Within the Late Harappan-PGW mixed sample there were pits (phase 7 of ZB2 and phase 6 of YD2), and a floor (phase 6 of YD2), as well as multiple fill contexts.

A total of 15 samples came from ZB2 and YD2. The number of taxa was increased in comparison with the Late Harappan material. Of the 15 samples, all but three have been previously analysed and reported as a limited taxa list in Singh et al.[44]. Table 7 summarises the data.

| Taxa | Ubiquity (%) (n=15) | Av. Density per 40l (n=3) | Av. Proportion of crops (n=3) |
|---|---|---|---|
| *Hordeum* sp. * | 73.33 | 13.33 | |
| *Triticum* sp. * | 40.00 | 0.00 | |
| *Hordeum/Triticum* | 20.00 | 0.00 | |
| *Oryza* sp. * | 40.00 | 0.00 | |
| Small Millets * | 86.67 | 13.33 | |
| Indet. cereals | 6.67 | 0.00 | |
| **Cereals Total** | **100.00** | **14.67** | **83.02** |
| *Vigna* sp. * | 73.33 | 0.00 | |
| *Macrotyloma uniflorum* | 46.67 | 0.33 | |
| *Pisum* sp.* | 46.67 | 0.00 | |
| *Lens* sp. | 20.00 | 0.00 | |
| *Lathryus* sp. * | 26.67 | 0.00 | |
| *Vicia* sp. * | 40.00 | 0.00 | |
| Indet. Fabaceae | 66.67 | 1.67 | |
| **Pulses Total** | **100.00** | **2.00** | **11.32** |
| **Fruits Total** | **0.00** | **0.00** | **0.00** |
| Cf. *Indigofera* sp. | 20.00 | 0.33 | |
| Indet. Oil/Vegetal | 20.00 | 0.67 | |
| **Oil/Vegetal Total** | **33.33** | **1.00** | **5.66** |
| *Amaranthus* sp. | 33.33 | | |
| *Argemone mexicana* | 20.00 | | |
| cf. *Bromus* sp. | 6.67 | | |
| Charophyte | 6.67 | | |
| *Chenopodium album* | 6.67 | | |
| cf. *Chenopodium* sp. | 13.33 | | |
| cf. *Chrysopogon* sp. | 6.67 | | |
| Convolvulaceae | 6.67 | | |

| | | | |
|---|---|---|---|
| Cyperaceae | 53.33 | | |
| Cyperaceae cf. scirpus | 6.67 | | |
| long Cyperaceae | 26.67 | | |
| silicified Cyperaceae | 60.00 | | |
| *Cyperus* sp. | 13.33 | | |
| *Eleocharis* sp. | 20.00 | | |
| *Eragrostis* sp. | 13.33 | | |
| Small Fabaceae * | 80.00 | | |
| *Fimbristylus* sp. | 20.00 | | |
| *Fumaria* cf. *officinalis* | 26.67 | | |
| *Medicago* sp. | 13.33 | | |
| *Medicago/Melilotis/Trifolium* | 6.67 | | |
| Poaceae grain? | 6.67 | | |
| *Solanum* cf. *dulcamera* | 6.67 | | |
| *Trianthema* sp. | 20.00 | | |
| *Trianthemaportulacastrum* | 33.33 | | |
| *Trianthematriquetra* | 6.67 | | |
| Indeterminate Small | 53.33 | | |
| '7-8 different weed species' | 6.67 | | |
| **Wild Plants Total** | **93.33** | | |

**Table 7: Summary of data from Late Harappan -PGW Mixed sample. Full dataset can be found in SI Table 1. *entries include total of all seed/grain material, including cf. identifications.**

Cereals and pulses were present in all samples across both trenches. This high ubiquity represents a continuity of the trends seen in the other earlier samples. Another continuity from the Late Harappan (as seen in SC) is the lack of fruits, although the ubiquity of oilseed/vegetal seeds increased, as did the diversity of these. The most frequently used species is also different from the Mature Harappan period and Late Harappan period. Barley and *Echinochloa* sp. millet were found in over 60% of samples. This pattern is more consistent with the PGW phase and adds to the suggestion that Period IB represents a mixing of Later Harappan material of Period I with material from the Period II PGW .The seasonality of crops remains constant throughout – showing that an even frequency of *rabi* and *kharif* crops are used across the sample.

As in all of the assemblages, chaff is not commonly found, and it was very generic types, for example awn fragments being the most ubiquitous. Wild plants were found in all but one sample (ZB2 7 280-5cm), and in a diverse range of taxa. In all samplesa mix of dung fuel and crop processing waste type wild taxa are seen.

**4.3.4 PGW**

The PGW material is represented by samples from contexts in ZB2 and YD2 only. A total of 27 samples were taken, of which 20 were previously analysed by Saraswat and Pathak as part of the pilot of study of <1mm material and a taxa list outlined in Singh et al.[45].

Material from three floors (all in ZB2) and nine pits (across both trenches) are represented in this phase, as well as from fills. Table 8 summarises the data.

| Taxa | Ubiquity (%) (n=27) | Av. Density per 40l (n=7) | Av. Proportion of crops (n=7) |
|---|---|---|---|
| *Hordeum* sp. * | 48.15 | 0.43 | |
| *Triticum* sp. * | 25.93 | 0.00 | |
| *Hordeum/Triticum* | 11.11 | 0.29 | |
| *Oryza* sp. * | 77.78 | 13.57 | |
| Small Millets * | 70.37 | 79.29 | |
| Indet. cereals | 7.41 | 0.29 | |
| **Cereals Total** | **88.89** | **93.86** | **88.07** |
| *Vigna* sp. * | 70.37 | 5.86 | |
| *Macrotyloma uniflorum* | 29.63 | 0.86 | |
| *Pisum* sp.* | 22.22 | 0.00 | |
| *Lens* sp. | 7.41 | 0.29 | |
| *Lathryus* sp. * | 11.11 | 0.00 | |
| *Vicia* sp. * | 44.44 | 0.14 | |
| *Vicia/Lathyrus/Pisum* | 3.70 | 0.14 | |
| Indet. Fabaceae | 51.85 | 1.86 | |
| **Pulses Total** | **92.59** | **9.14** | **8.58** |
| *Ziziphus* sp. * | 40.74 | 0.57 | |
| Indeterminate fruit seed | 14.81 | 0.71 | |
| Indeterminate fruit flesh | 3.70 | 0.14 | |
| Agglomeration impression fruit/oil | 3.70 | 0.00 | |
| **Fruits Total** | **44.44** | **1.43** | **1.34** |
| *Brassica campestris* | 3.70 | 0.00 | |
| *Sesamum* sp. | 7.41 | 0.14 | |
| Cf. *Indigofera* sp. | 11.11 | 1.86 | |
| Indet. Oil/Vegetal | 11.11 | 0.14 | |
| **Oil/Vegetal Total** | **22.22** | **2.14** | **2.01** |
| *Aeluropus* sp. | 7.41 | | |
| *Amaranthus* sp. | 14.81 | | |

| | | | |
|---|---|---|---|
| *Argemone mexicana* | 7.41 | | |
| Charophyte | 7.41 | | |
| *Cannabis sativa* | 18.52 | | |
| *Chenopodium album* | 14.81 | | |
| cf. *Chenopodium* sp. | 11.11 | | |
| cf. *Chrysopogon* sp. | 14.81 | | |
| Cyperaceae | 51.85 | | |
| Cyperaceae cf. S*cirpus* | 3.70 | | |
| long Cyperaceae | 14.81 | | |
| silicified Cyperaceae | 44.44 | | |
| *Cyperus* sp. | 11.11 | | |
| *Eleocharis* sp. | 7.41 | | |
| *Eragrostis* sp. | 22.22 | | |
| Euphorbiaceae? | 3.70 | | |
| Small Fabaceae * | 40.74 | | |
| *Fimbristylus* sp. | 3.70 | | |
| *Fumaria* cf. *officinalis* | 3.70 | | |
| *Medicago* sp. | 29.63 | | |
| *Medicago/Melilotis/Trifolium* | 11.11 | | |
| cf. Papaveraceae | 7.41 | | |
| Poaceae grain? | 7.41 | | |
| *Rumex* cf. *crispus* | 7.41 | | |
| *Solanum* cf. *dulcamera* | 18.52 | | |
| *Stellaria* sp. | 7.41 | | |
| *Stellaria* cf. *nemorum* | 3.70 | | |
| *Trianthema* sp. | 40.74 | | |
| *Trianthemaportulacastrum* | 14.81 | | |
| Indeterminate Small | 48.15 | | |
| **Wild Plants Total** | **92.59** | | |

**Table 8: Summary of data from Late Harappan -PGW Mixed sample. Full dataset can be found in SI Table 1. *entries include total of all seed/grain material, including cf. identifications**.

Fruits re-appear in this phase, and are at their highest ubiquity across all phases (44.4% of all contexts). However, as in all other samples discussed here, pulses and cereals are the most ubiquitous crop type. Within these, a change from earlier phases is seen as rice (*Oryza* sp.) is the most frequently seen crop present in 78% of all samples. Millets are also highly ubiquitous. The tropical pulse *Vigna radiata* is highly ubiquitous through the assemblage, a change from the Harappan phases. The winter pulse *Vicia*sp, is also seen frequently through the samples, which represents a continuity from earlier periods. As in the previous phases, the ubiquity of *rabi/kharif* crop taxa was comparable to one another, but perennial crops were also present due to the inclusion of the fruits (of which *Ziziphus* sp., including *Z.nummularia*, is the only identified taxa).

Chaff was found in roughly half of the samples, and in a greater diversity of types than the other phases. However in the PGW samples, chaff types were not concentrated in individual samples. Indeed rice spikelet bases appeared regularly throughout the phase.

The wild plant taxa were seen frequently throughout the PGW assemblage. The most ubiquitous at between 40-50% of the samples were the *Trianthema* sp. (*T. portulastrum*, *T.triquetra* and *Trianthema* identified to species level), but also Cyperaceae (charred and silicified forms), and small Fabaceae. The wild plants included both those expected as dung species (i.e. eaten through grazing or foddering), and those that are not palatable to cattle. These were also a mix of species found as crop processing waste at other sites[46] and those less likely to be present through crop processing disposal pathways. This pattern could thus reflect a combination of both dung fuel and crop processing waste, continuing to show the complex nature of the site in the PGW phase

**4.4 Comparison of Periods**

There are many similarities across the assemblages discussed above. Both pulses and cereals were the most frequently used types of crops at Alamgirpur. This is different from most Indus sites, which typically show a dominance of cereals. Weber[47] suggested that across Indus sites cereals were the main staples, with pulses as ‘Tier II’ “cultivated crops of lesser importance”[48]. This pattern can be seen at nearby Indus sites such as Bahola, Masudpur I and VII, Burj, Dabli vas Chugta and Farmana[49], where the ubiquity suggests that cereals were the most frequently used crops, likely staples, followed by pulses as lesser or secondary crops. This pattern is different from that seen across all of the phases at Alamgirpur.

At these other Indus sites, the densities and proportions also show the importance of cereals as staples. This type of quantified assessment is harder to do with the samples at Alamgirpur due to the differential lab handling of the sample fractions (Section 3), but the few samples that can be used to look at densities and proportions show a different pattern from the ubiquities, which is more in line with other Indus sites in the region. In all phases cereals are the most densely crop found and form the largest proportion of crops, and this proportion increases over time. Over time, there are changes within the cereals and pulses in terms of which were the most ubiquitous – in the Mature Harappan phase it was *Vicia* sp., in the Late Harappan phase it was *Hordeum* sp., in the Late Harappan-PGW mixed phase it was *Hordeum* sp. and several small millets, and in the PGW phase it was *Oryza* sp. This pattern is not reflected in the proportions or densities (Tables 5-8) – which show dominance of small, long-embryo millets in the Mature Harappan, (the Late Harappan is reflected by only one sampleand thus difficult to comment on), *Echinochloa* sp. in the Mixed/contaminated layers, and *Brachiaria* sp. in the PGW. Small millets may thus have been important for the inhabitants of the settlement, although each species was not used frequently throughout the sampled contexts. The role of millets in the Indus Civilisation has been explored extensively, for example by Reddy[50], Weber and Fuller[51], Pokharia et al.[52], García-Granero et al.[53], Weber and Kashyap[54], Bates et al.[55], Petrie and Bates[56]. Underlying all these patterns is the continual presence of a diverse range of pulses, with similar ubiquities to the cereals. While their identities and proportions may not have been quite as high as the cereals this may be due to preservation issues, as explored in work by Fuller and Harvey[57] for example. The interrelation between the ubiquity of the pulses and other cereals and the proportion/densities of the small millets at Alamgirpur would be interesting to explore further should a fully quantifiable assemblage be recovered from future excavations.

The question of seasonality is something that is debated in many papers[58]. When looking at the ubiquity of the crops on the basis of their growing seasons, and it is clear that the seasonality of the crops was similar in all four phases: a mix of *rabi* and *kharif* crops, which is a pattern similar to that seen in other sites in the northeast of the Indus. This pattern is also reflective of the rainfall of the region, where both winter rains and summer monsoon fall[59]. There is some variation over the phases at Alamgirpur in terms of the seasonality of cereals or pulses. The even ubiquity of *rabi/kharif* season crops overall is not reflected in the limited densities and proportions. This suggests that *kharif* crops (and within these *kharif* cereals and tropical *kharif* pulses) were more important and used in greater numbers at the site. This again does not fit with the broader patterns of the northeast Indus archaeobotanical data[60], and suggests that perhaps Alamgirpur had a different agricultural strategy or dietary package. This possibility should be explored further with a fully quantifiable assemblage recovered from future excavations. The patterns in the limited quantifiable data are mostly consistent across the phases, although there was an increase in the relative densities and proportions of *kharif* crops, cereals and pulses over the phases.

The lack of dramatic differences in the phases is reflected in a simple correspondence analysis (carried out in PAST 3.24). The data clusters tightly, and three samples seem to be causing the majority of patterning pushing the data apart. These samples are SC 112 14 (Late Harappan), YD2 *7 and YD2 pit 4 in 8 305-310cm (Mature Harappan). In these samples there are limited taxa. SC 112 14 and YD2 pit 4 in 8 305-310cm are the only samplesin which *Vicia/Lathyrus* appear, YD2 pit 4 in 8 305-310cm also has indeterminate millet (this does appear in other samples), and YD2 *7 is the only sample which has *Lathyrus/Pisum*. Even when these samplesare removed, the CA patterns remain tightly clustered, and groups related to trench, period and trench/period overlap.

**5. Discussion**

This paper has developed insights into the use of plants by the inhabitants of Alamgirpur over the Mature Harappan, Late Harappan and PGW phases and a potentially mixed phase of Late Harappan-PGW material. There are consistent patterns in the ubiquity of different plant groups, but it is questionable if this consistent pattern in the use of plants throughout the contexts at site is also reflected in the relative importance and the density of plants on site.

The role of grain pulses at Alamgirpur is interesting, as they appear to have been used more frequently by people in all phases at Alamgirpur than by people at other settlements in the Indus Civilisation of comparable date, perhaps implying these may have been a Tier I plant[61]. However, sample handling and subsequent quantification problems raise questions about this possibility. The role of cereals is in line with other Indus Civilisation settlements, and particularly those in the northeast, with barley, rice and small millets prominent[62] in either the ubiquity or the limited densities and proportions at Alamgirpur.

A wide range of wild plant taxa are also evident at Alamgirpur, suggesting that there is the potential to look further at questions of agricultural strategy[63], but this will require complex modification of existing methods due to the sample handling, and the presence/absence nature of the majority of the data. In line with the data presented in Lancelotti[64] and Singh et al.[65], the wild plant taxa show a mix of possible crop processing waste and dung inclusions, which was perhaps burnt perhaps as fuel. The value of dung as a fuel at Alamgirpur has been demonstrated by Lancelotti[66], and this stable, slow burning fuel is especially important to people in environments without much wood[67]. This finding therefore suggests that further work exploring the role of species such as *Medicago* sp. is needed to look at foddering. Clovers and other small Fabaceae appear regularly at numerous northeast Indus sites[68]. Discriminating foddering, free grazing and crop processing through the wild plants (along with the limited and poorly preserved chaff) is this another line for further work on the samples.

Along with this approach, further work can be done with the data to explore people's land use in the area around Alamgirpur[69]. The wild plants imply the presence of multiple ecological zones. For example, in the PGW period, *Trianthema* sp., *Rumex* sp. and *Eleocharis* sp. are found. *Trianthema* sp. is an annual, *kharif* C4 genus that grows in disturbed, rocky, hilly, cultivated or waste land, as an arable/pasture/waste land genus, that prefers alkali or neutral soils that are light/sandy, deep, wet but not flooded[70]. *Rumex* sp. on the other hand are perennials that grow in arable or grasslands, in shallow acidic soils that are heavy/clay, fruiting in the *rabi* season and do not mind flooding or drought although prefer wet soils, and reproduce through rhizomes and seed, but also have taproots on occasion[71]. They spread through rhizomes and seeds[72]. This small subset of the PGW sample wild plants demonstrates the range of possible environments that were being exploited by people at Alamgirpur, and work in the future exploring how land was being allocated (free grazing, animal management, crops) is important as this links in with questions of the social organisation of agriculture and space[73].

**6. Conclusion**

Alamgirpur is clearly an important Indus Civilisation settlement as it sits close to the eastern edge of the Indus settlement distribution and potentially documents a transition between the Harappan and PGW periods, though this possibility requires further substantiation. The archaeobotanical data shows that people used a diverse spectrum of seeds and plant across all phases, which does not vary much across time. This pattern is generally comparable with datasets published from other settlement in the northeast of the Indus Civilisation, particularly in terms of the taxa and role of cereals, but the regular use of grain pulses can be noted as being different and warrants further investigation as to their role in diet and agriculture. Whether the high ubiquity of grain pulses reflects their importance at the inhabitants of the site will require careful analysis of more samples that can be systematically quantified. However, even relying on the presence/absence data, there is still work that can be done looking into the wild plant sources, and the land use at the site, linking in with broader discussions about the role of agricultural strategies in the Indus Civilization, and the nature of social and climatic change during the transitions between the Mature Harappan, Late Harappan and PGW periods.

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