Information Sheet

7.21 Organic amendments: High fibre amendments

High fibre amendments refer to products with low nutrient content, but that contain high amounts of fibre (or carbon). As such, they are most used to improve soil organic matter levels (through addition biomass carbon) that can improve soil structure and enhance biological function over time. The most common amendment is bagasse, which is the fibre left after juice extraction from sugarcane stalks. There are several other sources of high fibre waste products, with sawdust, wood shavings (from woodmills and timber processing operations), pine bark chips and pith (also fibre from stalk crushing) being some of the more commonly available products. Occasionally, growers may also have access to papermill sludge, the by-product from the manufacture or recycling of paper products. All these products can be used similarly, though, specific risks are dependent on the source of the material.

The main concern associated with high fibre products is that they generally have unfavourable carbon to nitrogen ratios (C:N ratio) that can lead to temporary N lock-up in the soil, especially where high application rates are used. This can have disastrous consequences for an establishing sugarcane crop if there is a nutrient shortage during a high demand by the crop. Secondary concerns usually relate to whether the materials contain toxic or unfavourable compounds. This information sheet considers the composition of these products and provides guidance on their beneficial use.

Benefits of high fibre amendments

- Adds organic matter to the soil.
- Improves soil biological functions (over time).
- Improves soil structural properties (aeration, aggregation and infiltration, water holding capacity).
- Can be of benefit in sandy soils to increase organic matter content leading to better water and nutrient retention.
- Can benefit heavy clay, sodic and compacted soils by opening soil structure as well as improving infiltration and internal drainage.
- Is slowly biodegradable (compared to organic products with a low C:N ratio).

Disadvantages and risks of high fibre amendment application

- High C:N ratios can lead to short-term nitrogen immobilisation.
- Some products can be bulky and wet thus difficult to store and handle.
- Some industrial by-products may contain unfavourable or toxic compounds (e.g. papermill sludge).

Properties of high fibre amendments

A distinguishing property of these products is a very high fibre content, reflected in a high C:N ratio. Their nutrient contents are typically low; thus, they have marginal to no benefit as a nutrient source, except at very high application rates. Where these materials are composted or blended with other products or nutrients, their C:N ratios and nutrient content become more favourable than from the direct application of the raw products. Testing is advised to determine the C:N ratios and nutrient levels to allow for proper nutrient management. The table below provides typical values for some common high fibre amendments (values in brackets indicate amount (kg) of nutrient per ton of material).

Product*	N %	P %	K %	C:N	Moisture
Bagasse	0.34 (3.4)	0.27 (2.7)	0.21 (2.1)	40:1-50:1	>50%
Pith (tune)	0.35 (3.5)	Very low	0.07 (0.7)	130:1 – 300:1	±40%
Sawdust and wood shavings	0.32 (3.2)	0.11 (1.1)	0.14 (1.4)	>200:1	<20%
Papermill sludge**	0.1 (1)	0.28 (2.8)	0.06 (0.6)	>200:1	>40%

* These are typical values of fresh product. Where material has been stored or composted the values will vary and testing is essential to determine levels.
**Range in values can be high depending on source and process to produce.

The Carbon to Nitrogen ratio

The carbon: nitrogen ratio (C:N) is an indicator of how readily available the N will be from decomposition of organic matter. Typical C:N ratios of healthy soils and well-composted materials ranges from 12 to 15. Values above 20 are considered problematic for N lock-up. In the case of high fibre amendments, where values are generally >40 and as high as 200 to 300, there is an extremely high risk of N lock-up, which may last for several weeks to months, depending on soil and environmental conditions.

N-lockup occurs when high amounts of fibre (or carbon) are added to the soil. This carbon is a food source for soil microorganisms that breakdown the carbon-rich fibres. In this process they require other nutrients for their biological functions, the most notable being N. They will consume and trap any available N in the soil, thus lowering N available for plant growth. Fortunately, this N-lock-up is not permanent and given sufficient time, this N will be released back into the soil through decomposition of the organic matter by soil microorganisms (See Information Sheet 7.2: Nitrogen Management for more details).

Where sample analysis do not provide the C:N ratio but rather just the total amounts of C and N, the C:N can simply be calculated by dividing the total C by total N (using the same units).

Other properties

In the case of some industrial by-products, most notably paper mill sludge, testing for excess sodium (Na) and toxic metals is necessary. Caustic chemicals are often used in paper manufacture leading to high levels of Na in the waste sludge, along with elevated pH. In some recycling processes, metals from ink can be concentrated into the waste sludge. Paper mill sludges also tend to have high moisture, and, at high surface application rates, can lead to soil sealing. Where used, incorporation is normally advised.

Composting these products before use is often an effective method to improve key properties that will be beneficial in agricultural applications. See Information Sheet 7.18: Organic amendments: manures for further information on composts.

Application of high fibre amendments

Bagasse

Application rate ranges from 10 to 40 t/ha (and sometimes higher). These materials are usually applied during a replant cycle and can be spread over fields before incorporation into the soil or applied in the planting furrow. Where broadcast, it is advised to apply these materials several weeks before planting to permit the C:N ratio to stabilise. Where these high fibre materials are applied soon before planting, additional N is usually required to offset the initial lock-up. Typically, an additional 30 to 50 kg N/ha is recommended (or about 1 kg N for every ton of bagasse applied). In some instances, growers may wish to apply the material into the planting furrow. Typically, it is advised to apply half below the sett followed by covering of the sett with the remaining material and soil. Like for broadcast application, additional N is advised to offset early lock-up.

Other high fibre amendments

These materials are often applied at a rate similar to that of bagasse (10 to 40 t/ha). However, due to the particularly unfavourable C:N ratios it is strongly advised that these materials are broadcast applied and incorporated several weeks to months before planting. As for bagasse, applying additional N will promote faster breakdown of these materials and stabilisation of N supply in the soil. However, the higher C:N ratios typically mean greater additional N is required. As a general rule, for materials with a C:N ratio of 80 to 150, an additional 6 to 7 kg N per ton of material is recommended, while an additional 8 to 10 kg N per ton of material is suggested for C:N ratios > 150.

Cautionary notes

As some of these amendments may contain undesirable elements, it is important to test them for potential risk. Where these are found, it is important to adjust application rates to ensure that soil or crop health is not compromised. Particular attention must be paid to Na (which can lead to sodicity problems at high levels) and heavy metal levels in some types of paper mill sludge (that can cause plant toxicity and environmental pollution at high levels). Before applying these types of materials, calculate the potential application rates of these unfavourable elements to decide if they are likely to be a risk factor.

Where these products are to be used as surface mulches, caution must be applied to prevent excessively thick layers as this can impede crop growth and lead to surface sealing. Some products may develop hydrophobic (water repelling) properties if allowed to dry completely, and can thus promote run-off.

Sampling high fibre materials for analysis

Testing of these products is usually advised to evaluate the C:N ratio, and test for nutrients and in the case of paper mill sludges, levels of heavy metals. As this material is generally stored in piles, heaps or windrows, the following sampling procedure is advised:

- As there can be high variation in the piled or heaped material piles/heaps should be thoroughly mixed prior to sampling.
- Several samples from different sampling locations and depths in the heaps must be collected.
- Collect the sample as close to the time of field application for most accurate results of composition.
- Samples can be collected using a spade or auger. Avoid galvanised sampling instruments as these can introduce zinc in the sample.
- Avoid collecting samples too close to the soil surface where the heap is located as soil can be introduced into the sample. Even a small amount of soil can result in anomalous results.
- Subsamples (20 to 30) can be placed and thoroughly mixed in a bucket before subsampling (about 500 grams) for analysis.
- Break-up large chunks/aggregates into finer pieces before mixing.
- Place subsamples for analysis in a heavy-duty/thick-walled plastic-bag, squeezing all air from the bag before sealing tightly.
- Label the sample with relevant information required by the laboratory to ensure proper identification of the sample.
- If the sample cannot be sent for analysis immediately then store in a cool dark place (ideally in the fridge or cooler box with ice).

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