TWO WHEEL TRACTOR NEWSLETTER -OCTOBER 2013

==========

First two prototypes of 'Gongli Africa' 2WT row crop seed drill built at Centre for Agricultural Mechanisation and Rural Technology (CAMARTEC) in Arusha, Tanzania.

Some of the team of workers who built the first two 'Gongli Africa' seed drills in Arusha, Tanzania in mid-September 2013.
They are (from left) Joseph Mutua (KENDAT Kenya), Jeff Esdaile (Australia), Martin Kipunde and Aubrey Omari (CAMARTEC), Michael Kithome Makau (KENDAT), Urio Rashid and Mwinyi Magai (CAMARTEC).

==========

The aim of the exercise was to locally fabricate a pair of two wheel tractor (power tiller) zero tillage seed drills as part of the FACASI project (see May and July 2013 newsletters)

These drills were to be constructed along the general design lines and principles of the ARC Gongli Chinese made two wheel tractor seed drill. However there are several significant differences. These are:

- The seed drills are for use primarily in row crop agriculture, planting wide row spaced crops - principally maize. The standard ARC Gongli is primarily designed for close drill planting of cereals- mainly rice and wheat.
- More precise seed metering systems were to be used, to enable easier planting of spaced seeds. (again for use principally with maize)
- The seed boxes were to be set lower than the ARC Gongli for more convenient loading and checking of seed.
- Provision was to be made for an operator stand for convenient use in planting (where applicable) and also suitable movement between fields or nearby farms.
- Provision to be made for fitting of alternative soil engaging tools to the standard tine openers (possibly cutting coulters or disc openers) for high residue conditions.

The fabrication over the two weeks was carried out by a team of CAMARTEC technicians under the supervision of Mechanical Engineer Aubrey Omari. The technicians were all skilled metalworkers with talents in fitting and turning, welding, and general machinery fabrication.

As well as the Tanzanian staff, two Kenyan nationals, Dr. Joseph Mutua of KENDAT and part time technical assistant Mr. Michael Kithome Makau took an active role in all aspects of the construction. I assisted in a general supervisory role throughout the whole process.

The tool bars and frames were built exactly as per the ARC Gongli design.

Tool bar frame.

One seed box frame which had been sent from Australia was fitted to one tool bar assembly. A second identical frame was made up from local steel parts and fitted to the second tool bar assembly. Two sets of Chinese made vertical spoon feed seed meters were fitted, as well as two sets of fertiliser meters. Two sets of seed boxes were made up from local sheet steel parts.

Seed box frames –original on left, reproduction on right.

After construction of all of these items, the seed and fertiliser assemblies were fitted to the frames, and these units mounted to the tool bars. After mounting, the chain drives from the tractor wheel was made up, along with the master clutch. A set of sprockets (to change seed and fertiliser rates) were also made up for each seed drill. Two sets of operator stands were made up, partly from imported items, and partly from local materials.

Finally, the soil engaging parts (tines) were fitted, along with the seed and fertiliser delivery tubes.

Completed seed drill (optional cutting coulter discs fitted)

Field Testing:
The seed drill was field tested in a grassy area at CAMARTEC on Thursday 19 September. The soil was very dry as there had been no rain for the previous four months. The field had a moderate cover of drought stressed weeds along with some scattered crop residues. It was a loam-clay loam soil with a sprinkling of small stones in the soil, with the occasional large stone.
The surface of the soil was moderately rough; with evidence of livestock hoof imprints, as well as remnants of plough activity in the recent past. Moderate sized ruts and depressions from the plough activity were visible.

The unit was tested using two tines to plant two rows. This was reasonably satisfactory from a traction viewpoint, and the two wheel tractor could operate acceptably. However the dry soil and the uneven surface produced extreme variation in the depth of operation of the tines. Also some wrapping of residue and weed biomass around the tines occurred.

Field demonstration

A pair of cutting coulters was fitted in front of the tines, and this improved residue handling. However as the coulters were only supported from one side by the shank, some bending of the shank occurred. This was unsatisfactory. However cutting coulter frames, with support from both sides were also supplied as part of the equipment shipped from Australia. I recommend that these be used in the future, replacing the original cutting coulter shanks.


Optional staggered double disc opener (left) and cutting coulter disc (right)

The operator stand was also used for some of the demonstrations. It was noted that when the operator stood on the stand at the rear of the seed drill, the tractor struggled for traction. Perhaps the extra rolling resistance of the rear wheels, with the weight of the operator included adversely affected the tractive ability of the unit.

Further improvements.

Based on observations in the fabrication of the two seed drills, the following improvements will be considered.

1. The seed drills used tool bar beams made from a box section of two 50mm x 4mm angle iron sections. In the future 3mm thick rectangular hollow square sections are preferred or alternately 50mm x 3mm angle iron sections box welded as they are lighter in weight. However 2.5mm thick sections should not be used (Fraser 2008)
2. The tine rake angle could be reduced to 30 degrees, rather than 55 degrees as on the prototypes. This will probably reduce draft requirements. (Fraser 2008)

Tine with rake angle 30 degrees (left) and 55 degrees (right)

3. The prototypes used large (21cm diameter) Chinese vertical 18 cell spoon seed meters. Optional smaller (15cm diameter) 12 cell meters should be considered in the future. These meters are more compact and will allow the size of the seed box frame to be reduced.


Large 18 cell spoon seed meter (left) and small 12 cell spoon seed meter (right)

4. Alternative inclined plate seed boxes and meters could be considered as an option to the vertical spoon meters. Although a little less accurate, these units are much simpler to produce. They also lend themselves to local manufacture.


A basic inclined plate seed box and meter (left) and the assembled unit complete with drive gears (right)

5. The operator stand struts should be replaced by chains. This flexibility will allow the stand to be used by the operator in some situations, and folded away when not required.


Operator stand – down position (left) up position (right)

6. Wheel spacers for the main traction wheels should be considered. At the present standard wheel track of 800mm, a row spacing of 600mm is the maximum that can be used, without the seeding tines planting behind the tractor tyres. I note that Dong Feng offers wheel spacers as an option on the steel cage wheel arrangement, as used in rice paddy production. When wheel spacers are fitted, a maximum row width of 850-900mm is possible.

Dong Feng wheel spacers

At the end of the two weeks of fabrication, one seed drill has been allocated to Tanzania for further evaluation by Tanzanian staff, during the 2013/2014 planting season.

The second seed drill has been transferred to Kenya, under the control of Dr. Joseph Matua and KENDAT for field testing and evaluation in that country.

As soon as conditions are adequate for successful sowing in regards to moisture the machines hopefully will be tried out on a sensible/average sized "farm" field and a full report made as to performance.

Reference:
Fraser (2008) *Development of a no-till toolbar for a two wheeled Power Tiller* ENG4112 Research Project towards the degree of Bachelor of Engineering (Agricultural) University of Southern Queensland Faculty of Engineering & Surveying. pp 114

==========

An ARC Gongli seed drill assembled in Zambia.

Following the visit to Tanzania, I assisted in the assembly and preliminary testing of a Chinese ARC Gongli Seed drill in Kitwe – Copperbelt province in Zambia. It is matched to a Dong Feng DF-12 2WT.

While the ARC Gongli has provision for the planting of up to four rows of crop, this unit has been re-configured to plant either a single row or two rows of maize. The fluted roller metering seed system is to be used. Although this farm is cropped using traditional farming systems at present, it is to be gradually converted to a conservation Agriculture (CA) system using the ARC Gongli as the principal seed drill.

==========

Some views on the necessity for surface following ability of soil engaging tools for 2WT seed drills.

The current suite of soil engaging tools for the ARC Gongli and the Gongli Africa seed drills are rigidly mounted to the tool bars, with no provision for surface following ability. Is this necessary, when the maximum front/rear clearance is maximum 700 mm? Rigid tools are cheap to make, light in weight, and simple in operation.

However I was told by colleagues in Africa that an uneven soil surface is the norm in Africa, due to animal tracks and footmarks, old plough irregularities and soil erosion unevenness as well as natural contours of the landscape. Can a set of trouble-free soil engaging tools be designed, which are relatively plain, and will do the job of even depth of planting, given the modesty and simplicity that is required?

I realise that this is less of a challenge in South Asia, where *rabi* crops are direct sown into residues of *aman* rice and other crops, and the soil is relatively flat after crop harvest. **Any ideas?**

==========

Note: This newsletter has been sent in a low resolution pdf. format for those on slow internet connections. If you require the newsletter or parts of it in higher resolution please let me know.

R. J. Esdaile, Agricultural Consultant 22 Meadowbanks Drive, TAMWORTH NSW 2340 Australia
rjesdaile@bigpond.com. rjesdaile@gmail.com (alternate) E. & OE.