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# Development of a Manually Operated Ridge Profile Weeder

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*Abstract*
*A manually operated ridge profile rotary weeder was developed. The weeder is equipped with two rotary hoes each weeding one half of adjacent ridges. The inclination of the rotary hoes to the ridge profile is adjustable to conform to the angle of repose of the ridge. The weeder is designed for a row spacing of 750 – 900 mm and is not limited by crop height. Preliminary tests carried out on the weeder showed that the weeder is effective for control of young weeds; however, the energy requirement to push the weeder was observed to be high.*

***Keywords:*** *Ridge, Profile, Weeder*

## Introduction
The recent trend toward restricting herbicide use due to rising cost and concern over potential health and environmental risks have intensified the search for alternate and integrated weed control strategies that include cultivation. As a result, newly-developed implements are now available to farmers. Mechanical weed control allows farmers to reduce or even eliminate herbicide use, and contribute to a more eco-friendly environment. In cereal crops, it costs the same or less than chemicals while still providing a satisfactory weed control (Jean Duval, 1997).

During mechanical weeding, weeds are mostly destroyed when buried by moving soil. Tools like the rotary hoe or the finger weeder, used at pre-emergence and/or post-emergence of the crop do this as well. The number of passes required varies with the level of infestation. One to two passes are generally needed. Very weedy fields may require three passes. Alexandrou and Coffing (2001) reported that Consumers in the United State are alarmed from reports on the consequences of herbicides on health and have supported the idea of organic farming (where the use of chemical herbicides are prohibited). Organic farmers use alternative weeding control techniques where mechanical devices play an important role.

Mechanical weeding is not a new technique for controlling weeds. Mechanical weeders range from basic hand tools to sophisticated tractor driven or self-propelled devices. Various classes of mechanical weeders have been available for many years in Nigeria. (Oni, 1990; Kamal and Babatunde, 1999; Odigbo and Ahmed, 1979; kamal et al., 1996). Similar situation exists abroad. (Rangasamy et al., 1993). Hand weeding, which gives nearly complete weed control, is of particular importance where the terrain and climate are unsuitable for mechanized systems, or local technical knowledge is lacking (Anobah, 1993). Hand weeding may also be combined with mechanical inter-row weeding to deal with weeds left in the crop row. But whatever the level of sophistication of the farming system, there will be times when hand-removal of the odd plant or patch of a particular weed is the most effective way of preventing that weed from proliferating or spreading and becoming a serious problem (Marshall, 1992; Putnam, 1990). There are several advantages and disadvantages of both mechanical weeding and herbicides. Table 1 gives a comparison of both methods.

**Table 1:** Comparison of mechanical weeding and use of herbicides.

| | Advantages | Disadvantages |
|---|---|---|
| Mechanical weeding | * Maintains yields<br>* Maintains or reduces cost of weed control<br>* Aerates soil, stimulates crop growth<br>* Reduces pollution<br>* Breaks soil crust | *** Leaves on average 20% more weeds in the field than herbicides**<br>*** Timing is critical**<br>*** Stony surfaces reduce degree of coverage**<br>*** Needs drier soil conditions to operate** |
| Herbicides | *** Give nearly complete weed control**<br>*** Cover large areas in less time** | *** Result in pollution**<br>*** Are subject to price fluctuation**<br>*** Create weed resistance problems which reduce herbicide effectiveness**<br>*** Involve health risks for the applicator** |

Weeding continues to constitute a major bottle – neck limiting agricultural production in Nigeria. Weeding of crops planted on ridges poses a special problem because mechanical weeders available in the country are mostly for crops planted on flat fields (NCAM, 1996). Efforts to develop weeders for ridge cultivation in the country have not yielded satisfactory results as weeding is still widely done manually.

Oni (1985) reported the development of an animal drawn straddle-row rotary weeder for weeding on the ridges. It consisted of two pairs of rotary hoes clamped on a toolbar and aligned with the ridge in a straddle manner. The performance of the weeder indicated a promising device for weed
Control on ridges. With adequate weight reduction and slight modifications this weeder could be converted to a manually operated device for use where animal traction is not applicable. This informs the objective of this work which is to develop a hand operated ridge profile inter-row rotary weeder suitable for solving the problem of weeding Nigerian farms.

**The ridge profile weeder**
The ridge profile weeder (Fig.1) is a manually operated (push-type) mechanical weeder specially designed for weeding on ridges. It makes use of the rotary hoes which consist of tines sharpened both at the cutting edges and at the tip. The weeder is made up of five major parts as follows: the frame, the tool bar, the rotary-hoe gang, the handle assembly and the ground wheel.

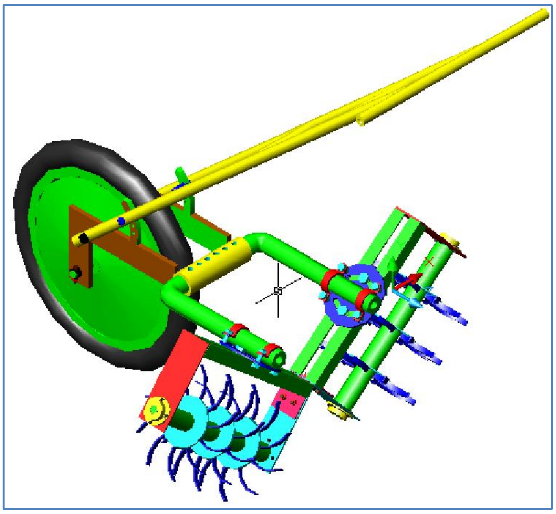

**Fig.1** The ridge profile weeder

**The Frame**
The frame is constructed from 6mm mild steel bar, consisting of two similar L shape components joined to a 150mm long circular pipe of 25 mm internal diameter. This frame supports the ground wheel at one end and the tool bar at the other end.

**The Tool Bar**
The tool bar is formed from a galvanized iron pipe of 25 mm external diameter, bent into an L-shape. One end is attached to the rotary hoe through the rotor plate while the other end has holes drilled through it and can slide horizontally in the pipe on the frame to allow for variation in inter-row spacing of the ridges.

**The Rotary Hoe Gangs**
There are two identical rotary hoe gangs (Fig.2), each of which consists of the following major parts:

a) ***The Brackets*** – formed from a pair of angle bars (335 mm long), joined at the ends by two flat mild steel bars. The angle irons are separated 13mm apart forming a slot to provide means of varying the angular setting of each hoe along the ridge profile.
b) ***The tines*** – consisting ten 10mm x 3mm mild steel bars curved rearward and welded radially on each circular plate. The cutting edges and tips of the tines are sharpened for easy penetration and effective weeding.
c) ***The axles***- these are galvanized iron pipes of 32 mm external diameter on which are welded circular plates that carry the tines. 25 mm diameter rods are welded to the ends of the pipes to support ball bearings.
d) ***The Rotor Plates***- These are slotted circular mild steel plates for aligning the rotary hoes with the surface of the ridge. Each plate is bolted to the bracket on one side by two bolts and clamped to the toolbar by two U-shaped brackets on the other side.

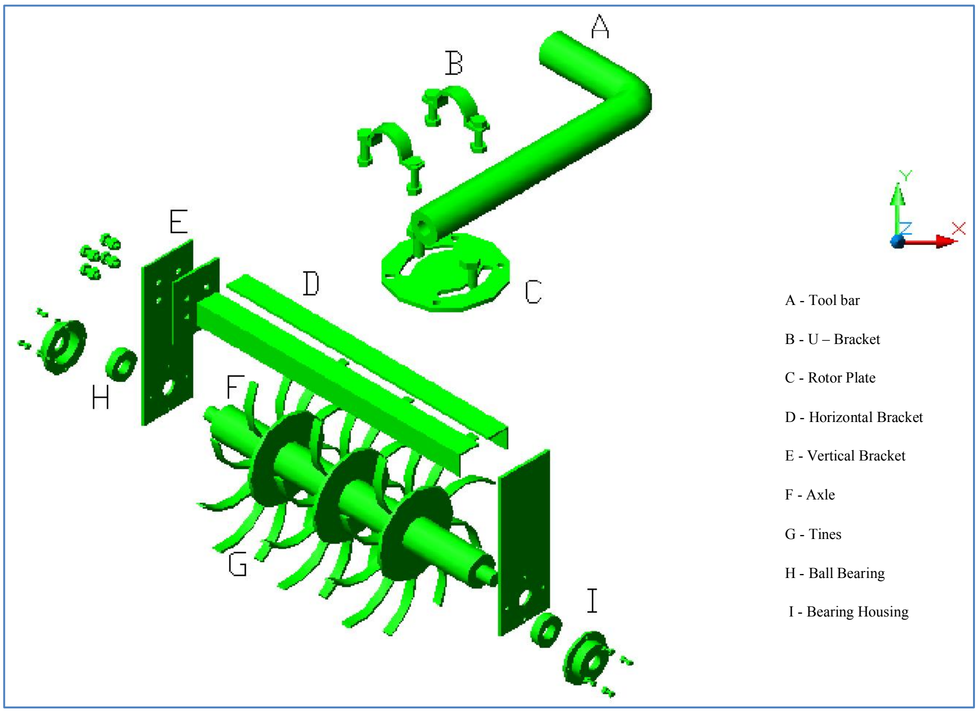


**Fig.2** Exploded view of the rotary hoe gang

**The Ground Wheel**
A pneumatic wheel was used to facilitate traction.

**The Handle Assembly**
The handle assembly was fabricated from mild steel pipe of 25 mm external diameter. It is adjustable and attached to the frame. The height of the handle grip is in the range of 900mm and 1100 mm from the ground level. The length of the handle is 1113 mm.

**Mechanics of weed control**
The weeder is inter-row in its operation. It consists of rotary hoes mounted on the rear of a frame with each of the two hoes weeding one half of adjacent ridges. The major advantage of this ridger is that its operation is not limited by crop height. Each rotary hoe is inclined to the ridge slope at about $30^0$ (θ) and tilted in the direction of travel at an angle of $60^0$ (α). These were found to be the optimum setting for maximum weed removal within the range of draught power (0.71-1.26 kW) investigated by Oni (1985). Angle θ conforms to the angle of repose of the ridge and is determined by the soil type and ridging technique. However, experience showed that a decrease in angle beyond $60^0$ increases draught power while the weed removal potential of the tool decreases.

The rotary hoes are set up along the ridge profile to ensure simultaneous weed removal and a slight upheaval of soil around the base of the crops. The weeder is designed for a row spacing of 750-900 mm. The inclination of the rotary hoe to the ridge profile is adjustable to conform to the angle of repose of the ridge. A standard size adjustable wrench is all that is needed for the adjustment.

## Results and Discussion
Preliminary tests carried out on the weeder showed that the weeder is effective for control of young weeds where light earthing up is required. However, the energy requirement to push the weeder was observed to be high. Higher rotational speed of the tines is required to pulverize the soil sufficiently

## Conclusion
To overcome the above problems, It is suggested that for optimal performance, the weeder can be powered by a small Internal combustion engine to be mounted on the weeder.

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