



E-ISSN: 2278-4136

P-ISSN: 2349-8234

JPP 2018; 7(6): 2463-2466

Received: 28-09-2018

Accepted: 30-10-2018

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Fabrication and testing of manually operated potato ridger cum earthing attachment tool for wheel hoe

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Abstract

Manually operated ridger cum earthing implement is becoming popular for Potato and other vegetable earthing because of its less initial investment, easy operation, low repair and maintenance cost. Here, we analyze the human comfort during operation of earthing for assessing the suitability to rural men. A comparison was also made between mechanized and manual operations.

Three male subjects were selected for the investigation. The selected three subjects were calibrated in the field by direct assessment of oxygen uptake. The heart rate of all three subjects varied between 94.67 to 128.67 bpm in light soil at moisture content of 7.94 % (db) and bulk density of 1.67 g/cc and 99.00 to 134.33 bpm in heavy soil of moisture content of 9.24 % (db) and bulk density of 1.34 g/cc at different speeds. The postural configuration of all three subjects varied between 2.110 to 5.890 in light soil and 2.500 to 6.110 in heavy soil. The anthropometric data for the subjects were different which changed the level of posture for different subjects. Effect of all the three subjects on overall discomfort rating varied between 2.17 to 4.50 in light soil and 2.50 to 5.00 in heavy soil. Based on the mean energy expenditure, the operation was graded as "moderately heavy" for direct earthing.

Keywords: Earthing, wheel-hoe, potato, ergonomics

Introduction

In India about 90% potatoes are produced in sub-tropical plains, where crop is raised under short day condition during winter season. Agriculture in most developing countries is predominantly subsistence, dominated by small holder farmers. Over 80% of the arable land falls into this sector. Human power is still the biggest power source used in crop production.

Allahabad, the district of many dimensions lies in the eastern part of Uttar Pradesh. It has an area of 5482.10 sq. km. It has a population of 49.36 lakh and is densely populated with 911 persons per sq. km. Majority of the population lives in urban areas. Net area under cultivation is 3, 26,000 hectare, out of which 2, 40,286 ha area is irrigated. The district is endowed with good soil, adequate ground water and all three growing seasons, Rabi, kharif and summer. Every year approximately 5, 80,398 hectare is put under total cultivators more than 70% farmers produce potato in Chaka block of the district Allahabad. Although most of the farming communities belong to small and medium category, yet they produce potato as commercial crop. The study was conducted in block Chaka district, Allahabad (U.P.) to work out the resources allocation in production of potato on different farm size groups. On the basis of study, it was concluded that the potato production fluctuates every two to three years besides production increases at increasing rate with increase of prices in the mark.

Potato is mainly a vegetative propagated crop. The potato is generally planted during the months of February–March, and harvested from June–August depending on the altitude. So this crop needs safety and clearness. Through the surface, draw some soil over them.

The main bit of 'maintenance' to perform on your potatoes is known as 'earthing up'. Green stems and leaves will grow up out of the ground from your potatoes and 'earthing up' is the process of drawing up a mound of soil along either side of these stems or 'haulms'.

Earthing done through push and pull action of the unit. It has weights 8.5 kg and field capacity is 0.09 ha per hour. One man can operated for earthing up soil in intercultural row crop. Manually operated potato earthing implement has been designed with precision engineering and ensure efficient performance in different agricultural applications. The Wheel Hoe has dimensional accuracy and can be handled with ease. The Wheel Hoe requires less maintenance and can easy operate to earthing up soil. The furrow opener is a hand tool to open the furrow and divided the soil into two sides for (earthing up the soil inter row). In this project an approach has been made to develop Wheel Hoe as a multi-purpose implement by providing

different attachments for operations like seeding, furrow opening, ridge making, and Leveling and mulch preparation along with weeding.

It has a share point or sweep attached to a handle with the wheel hoe frame. It is operated by pulling action in standing posture. This implement works to the soil lift up in the potato field. The share and other parts of the furrow opener are fabricated from mild steel. It can be used for intercultural operations like loosening soil, ridge, harrowing and weeding. This part is fixed just back of wheel. It can easily pass in inter row of potato. To maintain weed free crop intercultural operations are carried out three times i.e., 40-45, 60-65, and 85-90 days after planting.

It can be operated without damage to the crop. It has an output of 1 acre per hour. Crop intensification, timeliness in farm operations and efficient use of production resources are critical inputs in increasing the productivity of the agricultural sector. A decrease in the availability of agricultural labour is a direct consequence of migration of agricultural labours.

Materials and method

The details of the procedure followed in the development of Manually Operated Ridger Cum Earthing tool attachment with wheel hoe for and its evaluation both in laboratory as well as in the field are discussed in the chapter. The experiment unit was developed and the study carried out at SHIATS Allahabad during year 2014.

Shoe type furrow opener works well in trashy soil where the seed beds prepare smoothly. They are made from two flat pieces of steel welded together to form a cutting edge. It is made of carbon steel having minimum carbon content of 0.5% with a minimum thickness of 4mm.

Location of the study

Research shows that a ridge till system is best suited to medium-to-heavy textured soils with gentle slopes and a continuous Potato and soybean cropping system. Because potato and soybeans predominate in the state, and many of the agricultural soils are medium-to heavy and gently sloping, ridge till is a viable system in the farm operations. Perhaps it should be used much more throughout in the (Allahabad) Uttar Pradesh state.

Constructional detail and working principle of earthing tool

Experimental use in potato earthing field, and analyses the field efficiency of the attachment earthing tool.

Fabrication of wheel hoe

The material and methods adopted for modification, fabrication, testing and evaluation of manually operated Potato earthing implement for soil cut and lift, turn on ridge are provided in this chapter. The machine design was done using "Auto CAD" software and fabricated in the research workshop of Shiats Allahabad (U.P). The selection of material was generally made as per.



Fig 1: Fabrication of manually operated Potato earthing attachment tool.

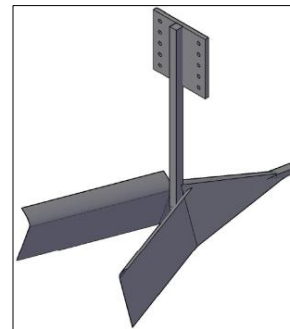


Fig 2: Isometric view of Potato earthing attachment tool.

Condition of field: Percentage of Moisture in soil (30%).

Two independent variables were selected during study are speed of operation and no. of operation. Forward speeds, subjects and soil type were treated as independent variable, since physiological responses would vary with the subject and speed. Effective Field capacity, Field efficiency, Height of ridge, Labour requirement, Work rest cycle and Cost of operation are selected as dependent variables.

The speed of operation was considered as an independent variable to see its effect on various performance parameters like field capacity, field efficiency etc. Three speed of operation of ridge making were measured and taken as 1, 1.5 and 2 km/h.

No. of operation: In which the field operation we declare the row and column because they are made by earthing tool implement. There are eleven row ridge and ten columns.

Result and Discussion

Effective Field capacity

The effective field capacity obtained at three different forward speeds and depths of sowing is given in table 1, 1.5 and 2 km/h. The effective field capacity was found to be 0.036 ha/h (maximum) at forward speed of 2 km/h and 20 cm width of ridge and 0.017 ha/h (minimum) at 1 km/h forward speed and 19 cm width. Since, effective field capacity depends upon time and as the depth increases, more time is required for earthing and hence, it decreases. The manual drawn potato earthing has been evaluated which having 87 and 90% viability in sandy loam soil respectively. The speed of human, so adjusted to operate at average forward speed of 1.0, 1.5 and 2.0 km/h.

Field capacity and field efficiency

The effective field capacity of the ridger cum earthing tool was observed to be 0.018 ha/hr. The theoretical field capacity of the ridger cum earthing tool was observed 0.02 ha/h. The field efficiency of the ridger cum earthing tool was observed 90 %. The cost of operation of the ridger cum earthing tool worked out to be 33.34 Rs./h and 266.72 Rs./ha.

Field efficiency

The data for field efficiency of ridge is given in the table 4.6. It is found to be 90% (maximum) at 2 km/h speed and 15 cm depth of ridge and 89% (minimum) at 1 km/h speed.

Height of ridge

The Height of ridge was also considered as a dependent variable. Three heights of ridge were measured and taken as 12 cm, 12.5 cm and 13 cm to see its effect on various performance parameters like field theoretical capacity, field efficiency and its interaction with speed on the following parameters.

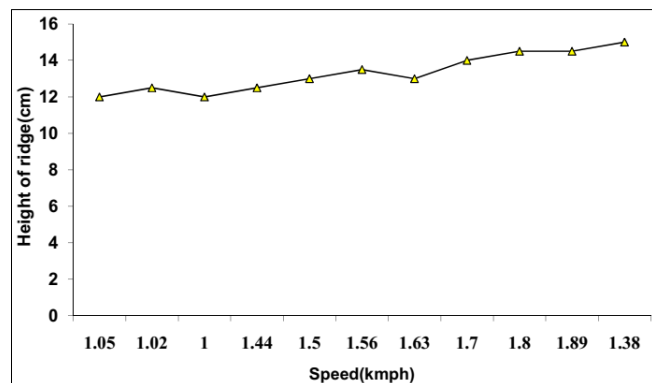


Fig 3: Effect of speed on height of ridge

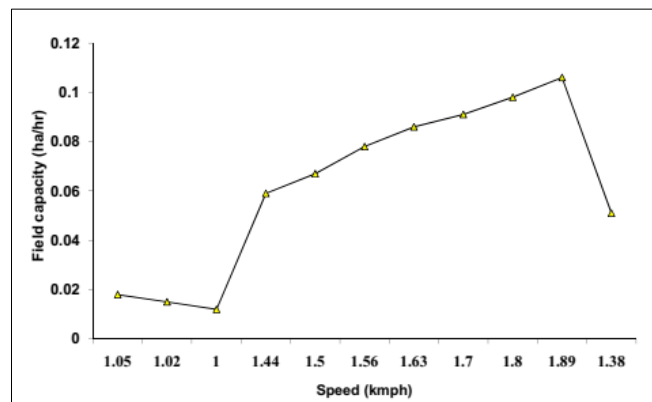


Fig 4: Effect of speed on Field capacity

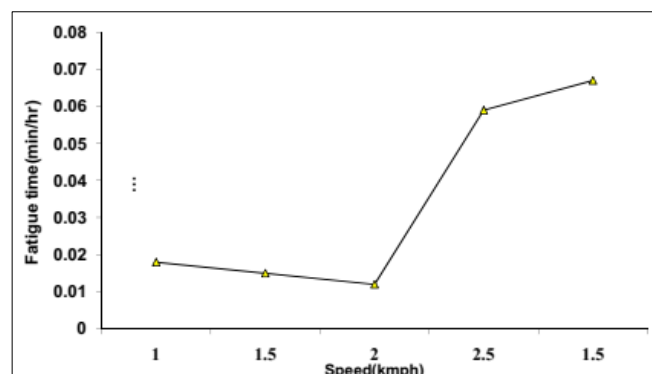


Fig 5: Effect of Speed on Fatigue time

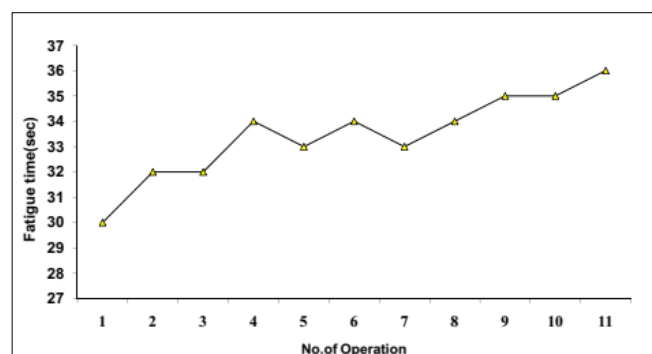


Fig 6: Effect of No. of operation

Labour requirement

The labour requirements for conventional method, and required a Ridger cum earthing tool for land preparation and one skilled labour for broadcasting of seeds. In conventional method, labour required 8 hours to cover 1 hectare land. The coefficient of operated land was 0.098 in the inefficiency

model, which was significant at 1% level. This indicated that technical inefficiency of the potato growers would decrease with the increase in farm size. The coefficient of extension linkage was -0.093, which was significant at 1% level. This indicated that technical inefficiency decrease with the increase in extension linkage. On the other hand, the estimated coefficients of farming experience, farmers' education, family size and training had shown no effect on the technical inefficiency of the potato growers.

Work rest cycle:

When labour works in potato field it requires pushing implement force, and then he works at 30 minutes continue after that requires rest for minimum 10 minutes Labour there is a great demand for cheap and efficient labours in potato cultivation. The different cultural methods such as land preparation, sowing of seed, intercultural operation, manuring, harvesting, transportation, storage etc is possible to be done successfully if efficient labours are available in potato.

Heart Rate

As discussed there are various physiological responses which can be used for indirect assessment of energy expenditure and hence workload. In this study, heart rate was taken as a basic physiological response to find suitable level of selected parameters of manually operated potato earthing tool attachment with wheel hoe.

Postural Configuration

Postural configuration mainly includes the position of trunk (spine). Improper work posture of the body is one of major factors which cause mild to severe fatigue in human body. Inclination of spine during the operation of manually operated potato earthing tool attachment wheel hoe depends on the grip height from the ground.

Body Discomfort

Discomfort is the body pain or unrest arising as a result of the working posture and or the excessive stress on muscles due to the effort involved in the activity. In many situations though the work may be well within the physiological limit of the worker, the body discomfort may restrict the duration of work depending upon the static loading component involved in it. The analysis of variance of independent variables i.e. forward speed, depth and their interaction effect on dependent variables for potato intercultural operation. These parameters as seen effect mean spacing and precision in spacing is significantly. While the interaction of depth and forward speed of earthing tool is no significant for both mean depth and speed.

Cost of operation

Charges of labour was calculated on the basis of they will be worked per day in how much time. It will be assumed 8 hours worked per day. Experimental data on cost of operation with respect to different of implement and soil type were analyzed at 5 % level of significance. The difference performance in various types of soil and intercultural operation in potato field. Cost operation was 266.72 Rs./ha with implement in sandy loam soil.

Cost economics

The cost for the labor charge is Rs. 150/day/people. The cost is not seemed too much as it performance and it reduces the

labor charge and time taken to Field. It works like cultivator, to cut the soil and lift on ridge. It is removed and the lever for lifting the furrow opener set works very well. The cost of operation for ridging without including implement cost for potato field was Rs. 266/h and Rs. 275/h respectively.

Conclusion

It was found that the width of the furrow is 21-23 cm and height of the top of ridge is 15cm at moisturized soil. Forward speeds, subjects and soil type were treated as independent variable, since physiological responses would vary with the subject and speed. To operate this implement we required force is 0.1 hp. The effective field capacity of the ridger cum earthing tool was observed to be 0.018 ha/h. The theoretical field capacity of the ridger cum earthing tool was observed 0.02 ha/h. The field efficiency of the ridger cum earthing tool was observed 90 %.

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