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Original Research Article

Status of Mechanization in Harvesting of Onion Crops

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A B S T R A C T

Harvesting of onion crop at proper maturity stage is essential factor in deciding storage life of onion. Traditionally, the well matured bulbs are harvested by manual digging which is time consuming and inefficient. In view of this the study revealed on technologies developed on harvesting of onion crop like: adoption of blade harrow, digger, tractor drawn digger cum elevator suitable with respect to the soil, crop and method of planting for the benefit of the farmers and scientist. The reviews reported the field capacity of tractor drawn onion digger was 0.32 ha h^{-1} at forward speed of 3.0 km h^{-1}. The average of fuel consumption was 4.10 l h^{-1}. The draft for operating the machine was 778 kg. f. The estimated fixed cost of the developed onion digger was Rs.12500 and operation cost of Rs 992 ha^{-1}. The cost of manual onion digging was Rs 2025 ha^{-1}. A saving of Rs 1033 per hectare (51 per cent) in comparison to manual digging, The break-even point for operation was 122 hours which was of 49 per cent of annual utility with payback period 3.9 years.

Keywords

Onion harvester, Field efficiency, Cost economics of onion harvesting, Break- even point etc.

Introduction

The package of modern technology, improved seed and fertilizers, use of efficient and economical farm implements, machines and suitable form of farm power is very important. Production suffers because of improper seed bed preparation, delay in sowing and harvesting.

Mechanization enables the conservation of input through precision metering, ensuring better distribution, reducing quantity needed for better response and prevention of losses of inputs applied. Mechanization reduces unit cost of production through higher productivity (Ashwini Talokar *et al.*, 2014).

The country occupies second position after china in onion production with a share of around 14%. Onion (*Allium Cepa* L.) is one of the important Commercial bulbous vegetable crops grown in different parts of the India. In terms of area, India ranks second in the world, cultivated area under onion cultivation was 2.7 million ha with the productivity of 16.31 million tonnes per ha (www.indiastat.com). The production as well as market value of this potential vegetable is increasing day by day.

Onion is the most important crop in India. The harvesting of onion crop at the proper maturity stage is essential and has to be completed within specified period. In India most of the onion is harvested manually. Manual harvesting is done by use of Khurpa

or spade which requires 21.4 per cent of total expenditure on onion cultivation (Jadhav *et al.,* 1995). Manual harvesting of onions is a tedious, time consuming, labour intensive and costly operation. It is therefore, necessary to mechanize this operation. One of the main reasons of low productivity is insufficient power availability on the farm and low level of farm mechanization.

Review of literature

Onion (*Allium Cepa* L.) is one of the important commercial bulbous vegetable crops grown in different parts of the world. In terms of area, India ranks first in the world with over 0.83 million ha (Anonymous 2009) but the productivity of onion in India is around 16.30 tonnes per ha, which is lower than the world average of 19.59 tonnes per ha as well as the Asian average of 18 tonnes per ha (Anonymous, 2009). Mechanization of onion harvesting is needed as traditionally, the well-matured bulbs are harvested by hand shovel (*khurpa*) which requires 21.4% of total expenditure of onion cultivation (Jadhav *et al.,* 1995). Also, it is necessary to complete the harvesting operation of onion within specified time limits for reduced harvest losses and higher storage life (Srivastava *et al.,* 2001, Maw *et al.,* 2001). In fact, early harvesting affects the keeping quality of onions adversely and reduces the yield, whereas delayed harvesting leads to infection caused by rot organism (Maw and Mullinix, 1997; Maw and Mullinix, 2005). A combination of machines for harvesting onions including the machine for removing onion leaves and weeds, the pull-type mounted onion digger, and the onion windrow pickup was developed by Penza State Agricultural Academy. The pull-type mounted onion digger intended for two stage harvesting of onion cultivars with field capacity 0.42–0.6 ha/hr, and digging efficiency is 98.0–98.9% (Laryushin and Laryushin, 2009). But, the design was complex and not suitable for small land holdings due to high cost. For onion growers in India an economical partial mechanized onion harvesting would be a mechanical harvester which can dig the onion, help detaching soil and mixture, separating soil mass and finally windrowing the harvested crop which can be picked up manually. Although tractor-drawn elevator type potato diggers have been developed (Vatsa and Thakur, 1993) but biometric properties of onion crop are entirely different from the potato. The aim of the study is to develop and evaluate a prototype of tractor drawn onion digger and study its economic feasibility for adoption.

Jadhav *et al.,* (1995) designed and developed a self-propelled onion digger windrower. The digger was operated with a 5hp diesel engine mounted on the wheeled frame along with main gear box. A handle is provided for steering the entire unit and the digging unit consisted of sweeps. The field performance of this machine was evaluated and compared with the prevalent local onion harvester practice during different seasons at different locations in 1991-1992. It was observed that the actual field capacity of the onion digger windrower varied from 0.16 to 0.19 ha h^{-1}. The percentage of damaged bulbs varied from 2.63 to 3.45. The machine gave a digging efficiency in the range of 89.66 to 93.23 %. The cost of prototype was Rs.16000 and cost of operation was Rs.126 to Rs. 149 ha^{-1}.

Khura *et al.,* (2011), designed and developed tractor-drawn onion harvester (Fig. 1). Six different shape digging blades were evaluated for the digging efficiency. The minimum mean draft of 625.6N was observed for inverted V- shaped blade. The optimal design values of variables like length, speed ratio and slope of the elevator were determined as

1.2 m, 1.25:1 and 15°, respectively. During the field evaluation, the prototype onion digger, with the above design values, performed as per the recommended standards with digging efficiency 97.7%, separation index 79.1%, bulb damage 3.5%, fuel consumption 4.1 litre/ha (12.81 litre/ha) and draft 10.78kN. The saving in cost of onion digging/ha with the use of the developed digger in comparison to manual was found to be `1170/ha.

The commonly used manual harvesting of onion (*Allium cepa* L.) is time consuming, less efficient and full of drudgery so the mechanization of onion harvesting is essentially needed. Various crop-machine and operational variables related to design of mechanical onion harvester were evaluated in laboratory and field. The main components of the harvester were digging, conveying and separating units. Six different shape digging blades were evaluated for the digging efficiency. The minimum mean draft of 625.6N was observed for inverted V- shaped blade. The optimal design values of variables like length, speed ratio and slope of the elevator were determined as 1.2 m, 1.25:1 and 15°, respectively.

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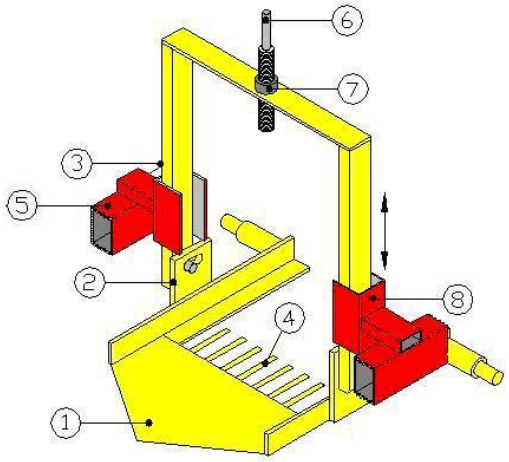
Fig.1 Tractor drawn onion harvester

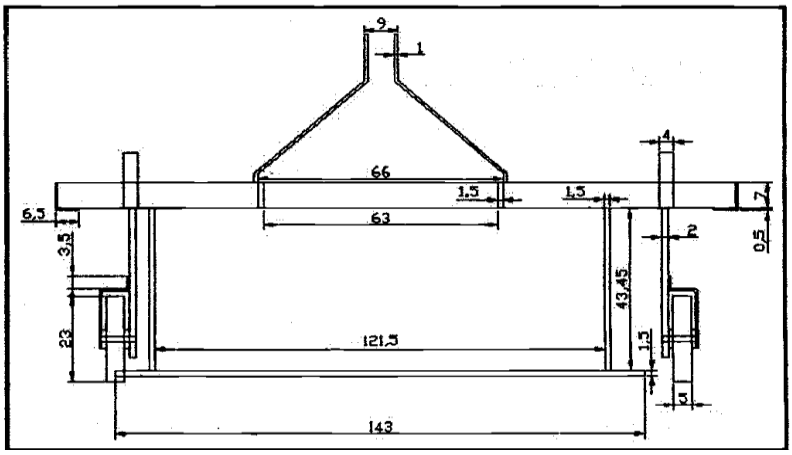
Fig.2 Head of onion harvester including control depth system

Fig.3 Depth variable mechanism



1. Blade
2. Notched part,
3. Linkage bars,
4. Finger separator,
5. Chassis,
6. Power screw,
7. Power nut,
8. Rail.

Fig.4 Tractor operated onion digger



Jafar (2011), studies conducted on comparison between capacitive and photo sensors in depth control of onion harvester at Tehran University Iran (Fig. 2). In this study, depth control system is important in bulb crop harvester. The higher the depth causes the greater amount of soil entering to harvesting system. A proper depth control leads to optimize energy consumption. A four-bar mechanism was used in order to move the blade of the machine and to control the operation depth while a DC electrical motor provided the movement of the blade. The four-bar mechanism consisted of a power screw, linkage bars, moveable pin and a blade (Fig. 3). A control system

was used to follow the uneven ground surface and control the displacement of the blade by sending commands to the DC electrical motor. The tests were carried out in laboratory on artificial uneven ground in sinuous curves as well as square and triangle shapes. The displacement of the blade was recorded by a digital camera and converted to image and analyzed using Matlab software. All the tests were replicated three times. The photo sensor responded better than the capacitive sensor for all obstacle shapes.

Singh *et al.*, (2014), development and evaluation of onion digger at Punjab Agricultural University, Ludhiana (Fig. 4). In this study an effort has been made to develop and evaluate the performance of an onion digger. Blade made up of high carbon steel material (EN 45) was the main component having dimensions 143 cm x 7 cm x 1.5 cm. Depth control wheels were provided to control the depth of cut by blade. Tests were conducted to check the comparative performance of developed onion digger and manual labour in the field. The digger was operated at a speed ranging 3.76 to 4.83 km h^{-1} with minimum losses at 4 km/h in first high gear at a field capacity of 0.46 ha h^{-1}. The average operational depth of 7.62 cm of the developed digger was suitable with practically no damage to the onion bulbs. The operational time of digger including and excluding the time in turning were 3.10 h ha^{-1} and 2.38 h ha^{-1}, respectively. Lift percentage, mean digger efficiency and damage percentage were 94.9, 89.8 and 5.1, respectively. It was found that there was 58 per cent and 49 per cent saving of labor and cost, respectively.

Mehta and Yadav (2015), developed an onion harvester operated with tractor power and tested to the onion plants with bulbs and laid these on the surface of bed unevenly. The theoretical field capacity of harvester was found as 0.57 ha h^{-1}while effective field capacity was 0.45 ha h^{-1} with the field efficiency of 78.95 per cent. The savings in time required, energy consumed and harvesting cost of onion were 87.64 per cent, 46.23 per cent and 78.86 per cent respectively over manual harvesting method.

The commonly used manual harvesting of onion (*Allium cepa* L.) is time consuming, less efficient and full of drudgery so the mechanization of onion harvesting is essentially needed for the benefit of the farmer particularly to those who are engaged in onion cultivation at commercial rate.

References

Ahwini Talokar, Kanchan Wankhade and V.M. Khambalkar 2014, Design of onion harvester, *Yuva Engineers in Agricultural Engineering*, Pp. 1-10.

Anonymous, 2009, Economic survey of Maharashtra (2009-10), Directorate of Economics and Statistics, Planning Department, Govt. of Maharashtra, Mumbai, India.

Jadhav, R.V., Turbatmath, P.A. and Gharte, L.V. (1995), Design, development and performance evaluation of onion digger windrower. *Agric. Mech. Asia, Africa and Latin America*, 26(3): 26(3): 35-38.

Khura T K, Indra Mani and Srivastava A P. 2010. Some engineering properties of onion. *Journal of Agricultural Engineering* 47 (1):1-8.

Laryushin, N.P. and Laryushin, A.M. 2009, Energy saving onion harvesting technology, *Russian Agric. Sci.*, 35(1): 66-67.

Mahesh Chand Singh, 2014, Development and performance evaluation of a digger for harvesting onion (*Allium cepa* L.), *International Journal of*

Agricultural Engineering, 72(2) 391-394.

Massah Jafar, Lotfi Ahmad and Arabhosseini Akbar, 2011, Comparison between capacitive and photo sensors in depth control of onion harvester, *Journal of Engineering Studies and Research,* 17(4): 64-72

Maw B W, Smittle D A and Mullinix B G. 1997. The influence of harvest maturity, curing and storage conditions upon the storability of the sweet onions. *Applied Engineering in Agriculture* 13 (4): 511–5.

Maw B W and Mullinix B G. 2001.Grade distribution of sweet onions harvested at different maturities. *Applied Engineeringin Agriculture* 17 (6): 833–6.

Maw B W and Mullinix B G. 2005. Moisture loss of sweet onions during curing Post harvest. *Biology and Technology* 35 (2): 223–7.

Mehta T.D., and Yadav R., 2015, development and performance evaluation of tractor operated onion harvester, *Agricultural Mechanization in Asia, Africa and Latin America*, 46(4): 7-13.

Srivastava A P, Kalra M S and Indra Mani. 2001. *Training Manual*, Winter school on mechanization of vegetable. IARI, New Delhi.

Vatsa D K, Thakur T C and Singh B. 1993. Effect of speed and shape of shares on performance of oscillatory sieve potato digger. *Agricultural Mechanization in Asia, Africa and Latin America* 24 (4): 51–6.