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# Performance Evaluation of a Developed Battery-Operated Portable Power Weeder

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**ABSTRACT:** India itself is an agricultural based country, approximately 75 per cent of the population depends on farming directly. Agriculture is the main foundation of Indian economy, which contributes about 18 per cent to the total GDP and provides employment to over 50 per cent of the population. But Weeding is considered as one of the major constraints in crop production. Weeds are plants that grow extremely quickly, take over the land, negatively impact crops, have no nutritional value, and have a negative impact on overall human welfare. Weeding is typically carried out manually in India, which is labour and time intensive. The weeding process must be mechanized to get over this main hurdle. Farmers frequently suffers significant losses because of a labour scarcity for weeding operations. Currently, most weeders are powered by a tractor or power tiller. These are too big and cannot be used for low inter and intra-row crops. The creation of a battery powered, portable power weeder was done to address these issues. The objective of this study was to develop and evaluate a battery-operated portable weeder. The developed weeder consists handle, flexible driven shaft, worm gearbox, rotor shaft, flanges, blades and switch. The developed battery-operated weeder was tested in the field based on various parameters like depth of cut, plant damage, weeding efficiency and ergonomical evaluation was done and compared with the manually weeding tool.

**KEYWORDS:** weeder, weeding, intra-row crops, ergonomic, GDP

## I. INTRODUCTION

Agriculture is a significant part of the Indian economy and the primary source of income in rural areas. A large section of the population in India is dependent on agriculture. It generates roughly 18.3 per cent of the national GDP (MoAFW, 2023) and more crucially, about half of India's population, or 115.5 million farm families, are entirely or partially reliant on agriculture and allied activities for their survival. Agriculture in India has grown steadily since independence. The economy has received continual structural support. The food grain production in India is increasing every year, and it now ranks among top in the world. Wheat, rice, lentils, sugarcane, and cotton are just a few of the crops that are grown. India is the world's largest producer of milk and the second largest producer of fruit and vegetables. As per PIB report, India supplied 25 per cent of the world's pulses production, 22 per cent of the world's rice production, and 12 per cent of the world's wheat production. It also accounted for nearly a quarter of cotton production. Apart from being the world's second-largest cotton exporter for several years, 2017 (Deshpande), the agricultural yield, on the other hand, was found to be lower per unit, in comparison to other top producing countries such as China, United States and Brazil.

India covers roughly 2.4 per cent of the world's total geographical area which is around 328.7 million ha. Out of which only 159.7 million ha land is available for agricultural purpose which retains second largest place in the globe after the United States. On the other hand, India's population, has surpassed 1.3 billion people, or 17.4 percent of the world's population and is rapidly increasing with annual growth rate of 1.08 per cent (Anonymous, 2021). As a result, the agricultural sector's greatest issue is meeting the rising need for food to feed the country's ever-increasing population. As a result, small and marginal farmers are finding it more difficult to make a sustainable living in the face



of such severe land shortages. Despite major improvements in crop production, agricultural yields per unit area are found to be lower for most crops, and are roughly 35-50 percent lower than the international average. There are a number of constraints on Indian agriculture, including climate change, insects, and pests, but weeds are one of the most significant factors affecting yield per unit area. As a result, enhanced agricultural weed management strategies must be implemented in order to produce a higher yield. Weeds are one of the main causes of the declining yield per unit agricultural area in India, an unwelcome plant that grows alongside the sowed crop is called a weed. It is a plant that competes with crops for resources such as water, nutrients, and sunlight that they need to flourish, which lowers crop quality and yield. The act of pulling weeds out of a field is known as weeding. By lowering the competition for water, nutrients, and sunlight, weeding helps crops develop more quickly. Since it requires labour to operate, weeding generally raises the cost of crop production. During the growing season, weeding contributes for roughly 25 per cent of the labour demand (900 to 1200 man-h/ha) (Nag and Dutta, 1979). Delay and carelessness during the weeding process may result in a 30–60 per cent decrease in crop production (Singh, 1988). Around the world, actual yield losses from pests have been estimated to be around 40 per cent, with weeds accounting for the biggest loss at 32 per cent, (Rao et al., 2007). If weeds are not properly managed, crops suffer severe losses that can reach 70 per cent, (Gharde and Singh, 2018). About 4.2 billion rupees are spent annually in India on weed control for important major crops. About 40 million tonnes of food grains are lost because of weeds each year (Singh and Sahay, 2001). Weeds caused a yield decrease of 16 to 42 per cent (Rangaswamy et al., 1993), hence in order to maximise agricultural yield, weeds must be removed as soon as possible.

**Performance evaluation of the developed machine**

Performance evaluation of the developed machine was done on the basis of four independent parameters as Depth of cut, Plant damage, Weeding efficiency and Theoretical field capacity with having number of blades as a dependent parameter.

**Depth of cut**

The depth of cut was determined by placing a measuring scale against an untilled surface. It was found that the effective depth of cut with different numbers of blades varied between 28 mm and 35 mm. It was found that as the number of blades increased, the depth of the cut also tends to increase. The depth of cut observed with 4 blades per flange arrangement was higher in maize crop as compared to the depth when number of blades in a flange were reduced to 2. The average depth of operation found with 4 blades was 33 mm whereas for 2 blades it was reduced to 30 mm.

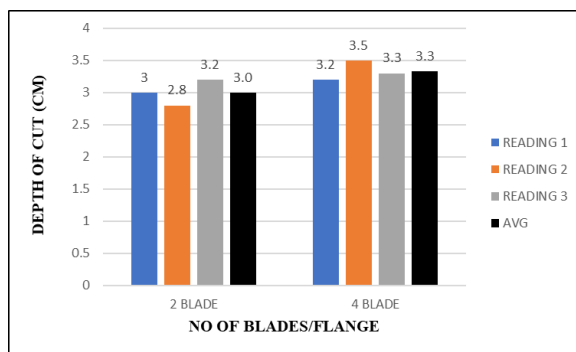


Fig. 1 Effect of number of blades on depth of cut

**Plant damage**

Different blade combinations i.e. 2 blades on a flange and 4 blades on a flange were used to calculate the plant damage for the maize crop. According to the test results, a weeder's maximum and minimum plant damage for a maize crop was 6% with 2 blades and 1% with 4 blades. The average plant damage in a maize crop was found to be 4.7% with 2 blades arrangement and 3.3% with 4 blade arrangement. Maximum plant damage was seen when two blades were used, the impact of the cutting blades on the soil during the weeding process caused the machine to jerk, which increased plant damage with a two-blade arrangement. With 4 blades arranged, there was less machine jerking caused by the impact of the cutting blades on the soil than there was with 2 blades arranged, which resulted in a reduced proportion of plant damage in the maize crop.

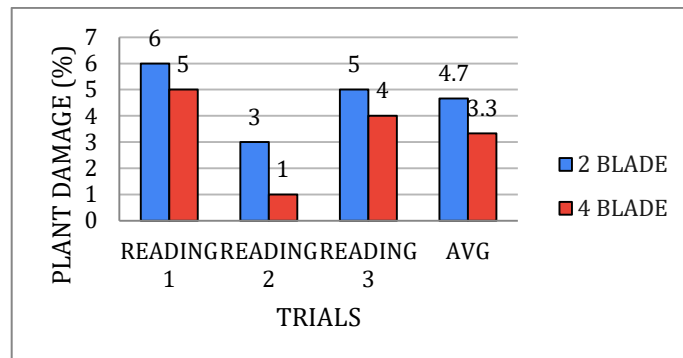


Fig. 2 Effect of number of blades on plant damage

### Weeding Efficiency

By counting the number of weeds before and after weeding in a square meter area marked at random points throughout the field. The maximum and minimum weeding efficiency of weeder for maize crops were found to be 89.5 percent with 4 blades and 82 percent with 2 blades. The average weeding efficiency with 2 blades was found to be 82.3 percent as compared to 86.9 percent with 4 blades arrangement. The higher weeding efficiency was found with 4 blades due to higher depth of cut, less speed and more stability of the weeder during operation whereas the weeding efficiency was lower in case of 2 blades due to lower depth of cut and jerk was more during operation due to high speed which caused lower stability of the weeder.

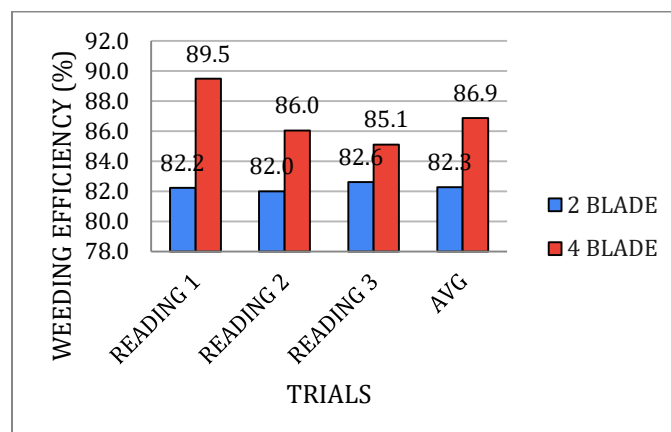


Fig. 3 Effect of number of on weeding efficiency

### Theoretical field capacity

The weeder's theoretical field capacity with various blades was calculated in accordance with 3.5.6. The width of weeder was 15 cm and speed of operation was assumed as 1.5 km/hr for all (2 and 4) blades. The theoretical field capacity of weeder was found to be 0.0225 ha/hr.

## II. CONCLUSION

Indian agriculture has consistently supported the economy structurally ever since the country gained its freedom. Agriculture is still the most significant economic sector in India, giving a living and employment to over 115.5 million families. It has done well to feed the expanding population throughout. The growth of weeds continues to be a significant barrier to crop production. Weed control has always been a difficult and demanding job. The size of the farm, the availability of laborers, the type of crop, and the weeds all affect the weed control techniques. Power weeders, which are widely used nowadays, are powered by engines, and rely on fossil fuels to run. As burning fossil fuels releases greenhouse gases that are bad for both the environment and human health. On the other hand, the cost of gasoline is rising daily, increasing the machine's operating expenses and making them appear prohibitive for small-scale farmers. To prevent an impending energy crisis, it has always been necessary to move to alternative fossil fuel sources. As everyone is aware, air pollution also plays a significant part in the environmental threat and climate change.

Developing an option that is both economical and environmentally friendly is need of an hour. An effort was made to create and assess the performance of a battery operated portable power weeder in response to these issues and to offer the weeding operation a new direction. Development and evaluation of battery operated portable power weeder would serve the purpose of minimizing operating cost as well as maintenance cost and maintenance time. Besides that, it will also help in reducing the intra row weeds which are present between the plants. Consequently, it greatly enhances weeding quality and operational condition.

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