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A Review on Manual Intra Weeders for Field Crops

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Abstract— *Weeds are one of the major constraints limiting agricultural productivity due to their rapid growth and competition with crops for nutrients, sunlight, water, and space. Effective weed control is therefore essential for improving crop yield, reducing production losses, and ensuring sustainable farm management. This review summarizes the different categories of weeders-manual, manually drawn, mechanical, inter-row, and intra-row and highlights their working principles, advantages, and limitations. Traditional hand tools such as the hoe, sickle, hand fork, and grubber weeder continue to play a crucial role in small-scale farming, while manual drawn weeders like wheel hoes and cono weeders offer improved efficiency and reduced drudgery. Mechanized solutions, including rotary weeders, power weeders, rotavators, and tractor-mounted cultivators, enable faster and more uniform weed removal across larger areas. Recent advancements focus on ergonomics, precision navigation, and automation through machine vision, robotics, and solar-powered systems. Together, these technologies contribute to sustainable weed management by reducing labor demand, minimizing herbicide dependence, and enhancing overall field efficiency. The review places special emphasis on manual intra-row weeders used in field crops due to their importance in small-scale and sustainable farming systems.*

Keywords— ***Weed management, Manual weeder, Mechanical weeder, Inter-row weeder, Intra-row weeder.***

I. INTRODUCTION

A weed is defined as any plant growing where it is not wanted [3]. It destroyed ideal environmental conditions which is required for optimal crop productivity. Since the beginning of crop production system and all through generation, waste plant growth among the planted crops has been the major task facing agriculturalists all generations. There is competition between the non-crop plant and crops for sunlight, soil water, space and soil nutrient, the non-crop plant/waste plant is known has weed [2]. In plant propagation and production cycle, weed removal is essential and similarly a tedious operation. It is therefore essential to control weed to reduce losses in production cost and improve crop yield. Poor weed control can result in over 50-70 % reduction in crop yield and one third of the cultivation costs is weed cost [4]. The damages caused by weeds can be severe in agricultural sector [14].

In India, weeds are one of the major biological constraints that limit crop productivity. A weed can be thought of as any plant growing in the wrong place at the wrong time and doing more harm than good [1]. Weeds grow far more quickly than crops do and if they are not controlled and maintained they may take over the entire field. Unfortunately, its sustainable nature will reduce crop productivity [2]. Most crops require that the field be kept weed-free during the first 4 to 6 weeks after planting to prevent serious yield losses from early season weed competition. Managing weeds effectively is one of the most crucial agricultural tasks. Weeds reduce crop productivity because they compete with plants for resources and nutrients [2]. Weeds reduce productivity, increase the cost

of cleaning and overall, adversely affect the value of the land and thereby affecting the farmer's energy, time or money [19]. Weed control is an essential aspect of farm management, primarily because it has a detrimental impact on crop productivity and quality. There are several different types of weed control techniques, including mechanical, biological, cultural, chemical, and preventative [6,7]. Organic farming relies on the interactions between preventive measures and mechanical weed control while conventional farming heavily relies on herbicides [24]. There are various commercial mechanical weeders that employ the three physical weed management methods of Burying, Cutting, and Uprooting.

II. REVIEW OF EXISTING WEEDERS

Manual and mechanical drawn Inter-row Weeder Farmers typically substitute mechanical interrow weeding for herbicides. Row crops including vegetables, sugar beets, and cereal crops, among others, use it. The weeder's goal is to weed as much of the space as they can without harming the crop [23]. Different types of manual and mechanical drawn weeders discussed fallowing sections.

2.1 Common Types of Manual Weeders (Hand-held Tools)

1. Hand Hoe (Khurpi)

A small hand-held tool with a flat blade used for scraping, cutting, and uprooting shallow-rooted weeds. It is commonly used in vegetable beds, nursery plots, and smallholder farms because of its precision and ease of use shown in Fig.1.

2. Sickle

A curved-blade tool used for cutting tall weeds, grasses, and unwanted vegetation. It is effective for clearing field borders, bunds, and harvesting fodder weeds in mixed cropping systems shown in Fig.3.

3. Hand Fork

A three-or four-tined tool used for loosening soil around plants and removing weeds along with their roots. It is useful for orchards, flower beds, and home gardens shown in Fig.2.

4. Grubber Weeder

A hand tool with 3-5 curved tines used for loosening soil, uprooting weeds, and breaking soil crusts in vegetable beds, orchards, and nursery plots shown in Fig.4.

Fig 1: Khurpi

Fig 2: Hand fork

Fig 4: Grubber Weeder

Fig 3: Sickle

2.2. Manual Drawn weeders

Manual drawn weeders are hand operated tools designed to remove weeds by cutting, uprooting, or covering them. These tools are commonly used in small farms where mechanized equipment may not be available or practical [23]. They are particularly suitable for row crops like vegetables, cereals, and sugar beets because they can be easily adjusted to different row spacings [16].

Manual weeders are precise and do not damage crops. Modern designs, such as wheel hoes and adjustable handled weeders, reduce fatigue and increase efficiency [12]. However, manual weeding require a lot of labor and are less suitable for large farms.

Manual weeders also play an important role in organic and sustainable farming. By mechanically controlling weeds, they reduce the need for chemical herbicides, lowering production costs and supporting environmentally friendly practices [20]. Effectiveness depends on soil type, crop density, and operator skill.

2.3 Common Types of Manual Drawn Weeders

2.3.1 Wheel Hoe - A push-type tool with interchangeable blades for inter-row weeding vegetables and cereals.

2.3.2 Cono Weeder- A lightweight manual device used primarily in wetland paddy fields.

2.3.3 Push-Pull Weeder- A V-shaped blade that cuts weeds during forward and backward movement.

Fig 5: Wheel Hoe

Fig 6: Cono Weeder

Fig 7: Push-Pull Weeder

2.4. Mechanical weeders

Mechanical weeders are powered or tractor drawn implements that remove weeds over larger areas more efficiently than hand tools. They typically luse blades, discs, tines, or rotary mechanisms to cut, uproot, or bury weeds [4].

These machines allow farmers to weed faster and reduce labor requirements. Tractor mounted inter row cultivators are commonly used for crops such as maize, sugarcane, and cereals. The performance of these machines depends on factors like working depth, forward speed, and blade configuration to avoid crop damage [20].

For smaller plots, motorized walk behind weeders are widely used. These machines improve consistency and reduce operator fatigue while maintaining good weed control [10]. Mechanical weeders require higher initial

investment and maintenance, which can be difficult for small farmers.

2.5 Common Types of Mechanical Weeders

2.5.1 Rotary Weeder Uses rotating blades or discs to cut and mix soil while uprooting weeds.

2.5.2 Power Weeder/ Walk-Behind Weeder Self-propelled machines used for small and medium farms.

2.5.3 Rotavator (Rotary Tiller) Performs weed control and soil pulverization simultaneously.

Tractor-Mounted Inter-Row Cultivator- Uses tines or sweeps to remove weeds between crop rows.

Fig 8: Rotary Weeder

Fig 9: Rotavator

2.6 Inter and Intra Row Weeders

Inter row weeders target weeds between crop rows. Intra row weeders remove weeds within the crop row. Inter row tools include rotary hoes, tined cultivators, and disc harrows. They are effective for many crops and tolerate small alignment errors [16]. Intra row tools, such as finger weeders and torsion weeders, require precision to avoid crop damage. They are useful during early growth or for widely spaced crop [20]. Recent advances combine inter and intra row weeding tools into integrated systems, including robotic and sensor assisted implements. These systems can selectively remove weeds, reduce chemical use, and improve overall efficiency [10]. However, intra row tools still face challenges such as cost, soil condition limitations, and residue management.

Recent developments in weeder technology focus on ergonomic improvement, precision guidance and sustainability. Ergonomic studies emphasize handle design, weight distribution, and posture optimization to minimize operator fatigue during prolonged manual weeding operations [8]. At the mechanical scale, smart weeders are being integrated with machine vision, GPS, and AI-based weed detection to achieve targeted control [18]. These systems distinguish crop and weed species using color, shape, and spectral features, allowing selective actuation of cutting tools or micro-sprayers. Moreover, hybrid weeders powered by solar-electric drives are being tested to reduce fuel consumption and carbon emissions [15]. Such innovations bridge the gap between manual precision and mechanized efficiency, promoting sustainable weed management practices that align with precision agriculture goals.

Fig 10: Finger Weeder

Fig 11: Disc Harrow

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