

SOLAR OPERATED WEEDER MACHINE

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Abstract— This paper focuses on various methods of weed control. This paper also focuses on improving current weeding techniques into semi-automatic and thus reducing the efforts and consumption of time of the farmer. This project uses effective properties of Solar Energy and reduces the damage on the crop which is done by a conventional method. Our technique avoids the use of the convention chemical weed control method which further enhances crop productivity.

Keywords— Solar Energy, Weed Control, Enhance productivity

1. INTRODUCTION

Agriculture is the backbone of our country. It has provided continuous support to our country's economy. More the crops production more is the economic support. The enhancement of crop productivity depends on various factors like rain, fertility of the soil, use of pesticides, herbicides, etc.

Besides these, weed control also plays an initial role in productivity. If weeds are controlled properly, it will decrease crop damage and will also increase the fertility. On the other hand, if not controlled properly it may cause permanent damage to the land fertility. The amount of effect of weeds on crops is very considerable. The below figure (fig. 1) describes the effects of weeds on various crops.

Our project focuses on the development of a weeder machine that will use solar energy as the primary energy source instead of conventional non-renewable fuel sources. Using the photovoltaic effect of solar cells, the power of the sun is converted into electricity and stored in batteries. As Solar Energy systems are rapidly developing, the weeder machine will become more and more efficient in future.

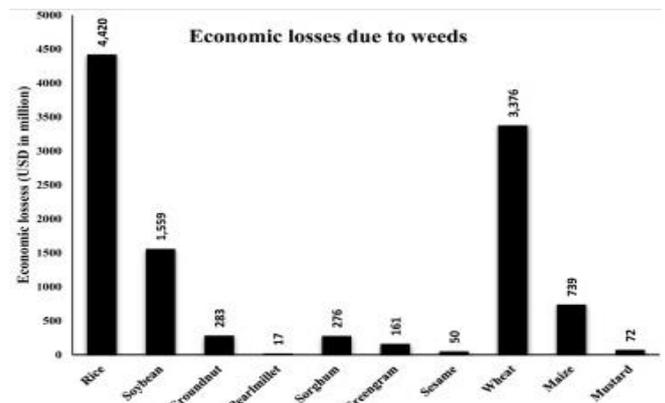


Fig. 1. Economic losses due to weeds

2. NEED TO CONTROL WEED

1. Prevent yield loss due to weed competition
2. Maintain purity and/or quality and market price of harvested grain
3. Prevent build-up of weed seeds in soil
4. Prevent weeds that may attract insects or rodents (rats) or act as a host for diseases
5. Prevent clogging of field irrigation channels to facilitate water flow
6. Reduce time and cost of land preparation and weeding operations

3. OBJECTIVE OF WEEDER MACHINE

1. To reduce the manpower in agricultural sector.
2. To reduce the overall power consumption during weeding.
3. To maintain accuracy during weeding.
4. This type of weeding machine provides work practically at low cost, low maintenance.
5. To perform the most rigid operation with high-speed weeding & to reduce time in Weeding.

4. METHODS OF WEED CONTROL

1. Cultural Method of Weed Control

Cultural weed control includes non-chemical crop management practices. Cultural weed control involves the use of various cultural, manual, and/or mechanical control methods. Some of the cultural practices to control weed are mentioned below.

1. **Timing:** Weeds need to be controlled from planting operation until the crop canopy covers most of the land.
2. **Land preparation and levelling:** Use land preparation to control growing weeds and to allow weed seeds to germinate. Kill newly emerged weeds by repeat tillage at intervals of 10 days.
3. **Reduce weed entry into fields:** Prevent the introduction of weeds into fields by: 1) Use clean good quality seed; 2) Keep seedling nurseries free of weeds to make sure weeds are not planted with the rice seedlings; 3) Keeping irrigation channels and field bunds free of weeds to prevent weed seeds or vegetative parts entering the fields; 4) Using clean equipment to prevent field contamination due to equipment used and 5) Crop rotation technique to break weed cycles.
4. **Fallow management:** Kill weeds in fallow fields (e.g., use tillage) to prevent flowering, seed-set and the build-up of weed seeds in the soil (Remember: “one year of seeds, seven years of weeds”).
5. **Crop-weed competition:** Select a weed-competitive variety with early seedling vigour, and high tillering to suppress weeds. Transplanted crops tend to have less weeds more yield than direct seeded crops. Maintaining an adequate plant population that its canopy covers most the visible land. Using nitrogen fertilizer just after weeding to minimize rice-weed competition for N.
6. **Water management:** Water is the best control for weeds. Weeds cannot sustain life in the flooded conditions so maintaining a 2-5 cm water level in the field can reduce weed drastically. Good land levelling is critical to avoid high spots where weeds can become established.

1.1 Advantages:

1. Cost effective and easy to practice: Acceptable and accessible to small & large farmers
2. Non-chemical and ecologically sound
3. Prevention is better than cure

1.2 Limitations:

1. Needs good knowledge and understanding of various cultural practices that can reduce weed pressure

2. Continuous vigilance and monitoring are essential to control weeds by cultural methods
3. Some practices are labour intensive.



Fig. 2. Cultural Weed Control

2. Physical Method of Weed Control

In physical weed control either manual, animal or mechanical power is employed to regulate the weed i.e., to drag out or kill weed. Counting on weed situation one or combination of the subsequent are used,

1. Hand weeding
2. Hand Hoeing
3. Digging
4. Mowing
5. Cutting
6. Dredging and cutting
7. Burning and flaming
8. Mulches
9. Intercultivation

2.1 Advantages:

1. Old effective and economical
2. Safest method for crops
3. Deep rooted weed will be kills properly

2.2 Disadvantages:

1. Labour consuming
2. Crops may get damaged
3. Practically difficult



Fig. 3. Physical Weed Control



Fig. 4. Biological Weed Control

3. Biological Weed Control

Biological control of weed is that the deliberate use of natural enemies to cut back the density of a selected weed to a tolerable level. the target of biological weed control isn't eradication but simply the reduction of the weed population to an economically low level. after all, for biological control to be a continuously successful small number of the weed host should be present to substantiate the survival of the natural enemy.

3.1 Advantages

1. Cost-effective in the long run.
2. High degree of specificity of target weed.
3. No effect on non-target and beneficial plants for man.
4. No residue build-up in the environment.
5. Effectiveness for managing herbicide-resistant weed populations.

3.2 Disadvantages

1. Weed must be highly specialized.
2. It must be in the new environment in which it was established.
3. Lot of planning and money goes into developing a successful system.
4. It's a slow process life, a lot of your time and patience for the biological agents to figure their magic on pest population.

4. Chemical Weed Control

In chemical weed control, chemicals called herbicides are accustomed kill certain plants or inhibit their growth. Chemical weed control generally refers to the use of cultural, manual, mechanical or chemical control methods.

4.1 Advantages

1. Less labour and fewer drudgery is needed.
2. Cost-effective, if practiced properly.
3. hand weeding can be done when the weeds are small.
4. Herbicides can differentiate between rice and weeds, even at the seedling stage where it's very difficult for people to determine the difference.

4.2 Disadvantage

1. Herbicides are toxic substances, which if used unwisely or incorrectly can cause health and environment problems.
2. Herbicides are often weed-specific.
3. Weeds can develop herbicide resistance if farmers are too reliant on one sort of herbicide Drift risk to neighbours' crop.
4. Applicators require skills in application and calibration.



Fig. 5. Chemical Weed Control

4. MATERIALS AND METHODS

4.1 Working Principle

The main source of energy for developed weeder machine is solar power. This energy are going to be harvested by employing a suitable electrical device. The panel utilized in weeder is 10W Solar module (consists of 36 cells). The solar panels works on the principle of photovoltaic effect. The photovoltaic effect may be a process that generates voltage or current during a cell when it's exposed to sunlight. it's this effect that creates solar panels useful, because it is how the cells within the panel convert sunlight to voltage. The electricity generated by the panel is then transmitted to the batteries for storage purpose. From there the batteries sends it to a circuit card which transmits power to different components of the developed weeder machine.

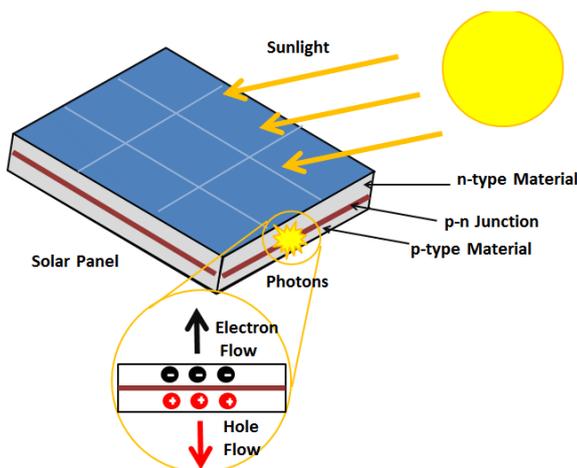


Fig. 6. Photovoltaic Effect

4.2 Selection of Solar Panel

Total PV panels energy needed =

$$\frac{\text{Total Power required for motor}}{\text{Efficiency of all components}}$$

1. Rated Maximum Power = 10 W
2. Open Circuit Voltage = 21.70 V
3. Short Circuit Current = 0.67 A
4. Rated Voltage = 17.20 V
5. Rated Current = 0.60 A
6. Type of Solar Panel = Polycrystalline Solar PV Module
7. Length = 318 mm
8. Width = 354 mm
9. Height = 18 mm
10. Weight = 1.4 kg

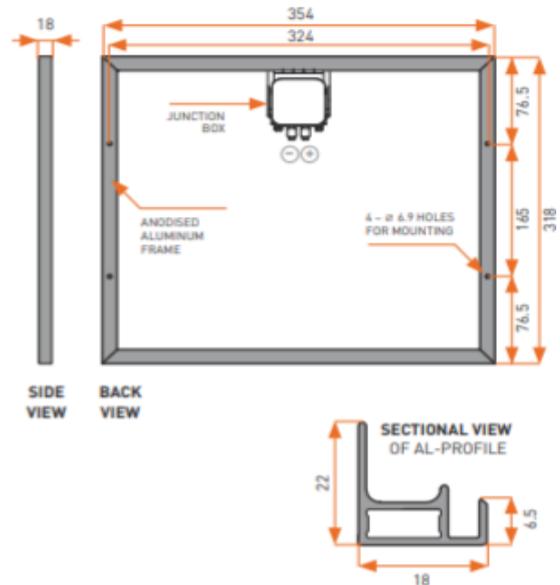


Fig. 7. Solar Panel specification

4.3 Selection of Battery

Total Power = Σ Power rating of all Component x Hours of usage

1. Voltage = 12 V
2. Charge = 1.3 Ah
3. Length = 95 mm
4. Width = 43 mm
5. Height = 50 mm

4.4 Selection of Rack and Pinion

Specification:

1. Tip Diameter of Pinion Gear= 26 mm
2. Base diameter of Pinion Gear = 23 mm
3. Root diameter of Pinion Gear = 19 mm

4. Pitch circle diameter of Pinion Gear = 24.5 mm
5. Number of teeth of Pinion Gear = 15 N
6. Tooth Thickness of Pinion Gear = 3 mm
7. Tooth Depth of Pinion Gear = 4 mm
8. Length of Rack = 240 mm
9. Tooth Thickness of Rack
10. Tooth Depth of Rack = 4 mm
11. Number of teeth on Rack Gear = 50

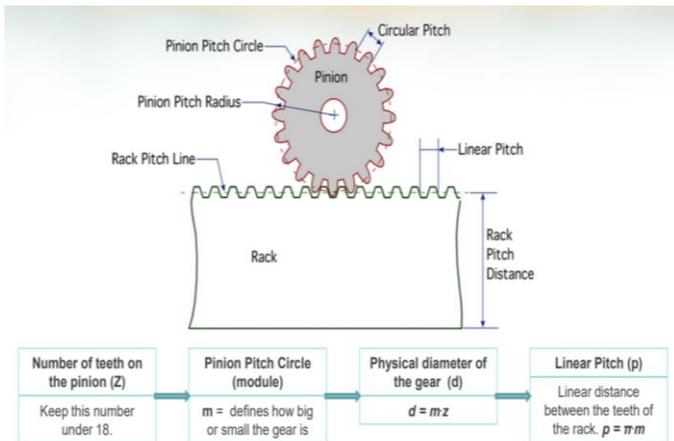


Fig. 8. Basic Terminology of Gear

4.5 Design

Before constructing or manufacturing any machine, most important part is designing of the product. Many different designs were made according to the need. Out of all designs best suited design was chosen. Later, we did this designing using AutoCAD and 3Ds Max software. The dimensions of each part were calculated on the basis of requirement. Designing of each part was done and then a 3D drawing was drafted and used for manufacturing process. The drawing was also referred during assembly of the machine. The Front view, Side view, Top view, Isometric view and Rendered view are attached below for reference purpose.

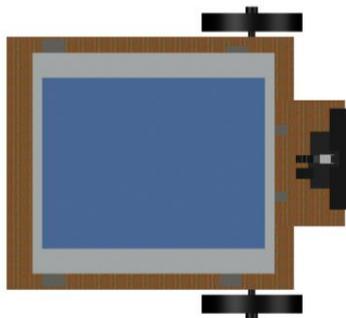


Fig. 9. Top View

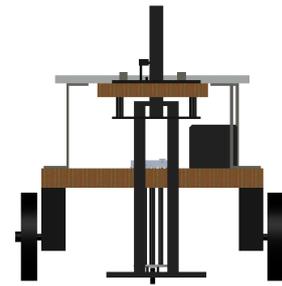


Fig. 10. Front View

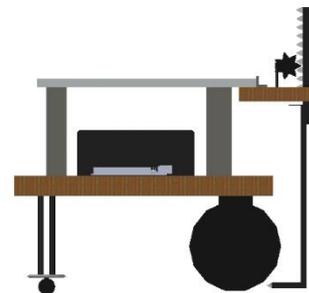


Fig. 11. Side View



Fig. 12. Isometric View

5. ADVANTAGES

- 1) Higher efficiency than that of old weeding machine.
- 2) Simple in designing and fabrication.
- 3) Faster weeding speed.
- 4) It increases the protection during weeding.
- 5) Effective for extended period Weeding Operations.
- 6) Power efficient.
- 7) Save conventional fuels.
- 8) Eco-friendly.

6. DISADVANTAGES

- 1) Labour consuming.
- 2) Possibility of damaging crop.
- 3) Works only in ideal working condition.
- 4) Practical difficulty in adoption.
- 5) Batteries can't be charged by in overcast weather.

We can reduce these disadvantages within the future by modifying certain parts of the machine. Currently the machine is semi-automatic, in barely future we will make it fully automatic reducing two of the disadvantages.

7. CONCLUSIONS

Weeds are harmful for the crops hence should be removed. Weeding and intercultural are the critical management practices which have proportionate effect on soil moisture conservation, nutrients loss and finally affect the crop yield significantly. Though manual, bullock drawn and mechanical weeding methods are available but the availability, efficiency and prevailing operational charges discourages the farmers to take up these methods. In our country, till now many people use the power of fossil fuels to run IC engines or external combustion engines.

Our project will help to overcome the above-mentioned problem. The weed cutter is safe as all the materials used can be recycled and does not pollute the environment as it is driven by solar energy. It is not so complicated mechanism and can be run by anyone without any special requirement of training.

The field capacity of machine can be easily calculated by simple formula i.e., Area of field weeded per day. After observation, the field capacity was machine was calculated as 0.5 acre per day according to the observational conditions. The above value may differ according to the condition of land and climatic conditions.

Weeding efficiency was also observed. It can be calculated by testing machine on the same field. It is calculated by using equation.

$$W. E. = \frac{(w_1 - w_2)}{w_1} \times 100$$

Where,

W_1 = Number of weeds before weeding

W_2 = Number of weeds after weeding

Weeding Efficiency of our machine was calculated around 85% which is up to the expectation.

8. FUTURE SCOPE

As we know that due to increase in demand for chemical free vegetable crop production, farmers have started using mechanical techniques to control weed. Only difference is that instead of using conventional methods i.e., manual operation of the system farmers has started using automated mechanical machines to achieve the goal. Our project is now semi-automatic weeder, but in

future we can make it fully automatic. We can also use tractor drive to fully automatically actuate the weeder blades for its future working.

In future, AI will far better than now. We hope to use the power of AI in future to make the machine independent and fully automatic. After utilizing power of AI, it will cut off the weed time to time on its own without any commands or instructions. Also, the operator can use the machine for anywhere and at any time. This machine can be linked with the special types of sensors will allow the machine to recognize the height of weed, location of weed, and it can also determine whether it is harmful or not.

We also hope to attach a watering system to this machine. As it will be travelling all over the field, a watering system will be a great upgrade. It will save more time of farmers. Along with watering system, we can also combine it with sowing machine and also use for hoe purpose. After these upgrades, it will nearly be Semi - Automatic Farming Machine.

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