Development of weed extractor for sugarcane farming

Abstract— India is one of the largest countries for sugar production. Sugarcane can be planted by various methods like- ridge-furrow, flat bed, rayungan and trench/jawa. This popular crop in India is reaching at almost 90% of its production by ridge-furrow method. The main issue in this method is to manage weed growth. After exploitation of many herbicides, fed up farmer is now looking for some feasible solution which will not affect the fertility of soil. With consideration of all these factors like environmental and economic sustainability, accessibility, easy handling etc. development of weed extractor is done diligently. For this activity a group of four students was prepared. As first priority, students were making farmers aware about side effects of chemicals in herbicides and how it is affecting productivity. Secondly, as economical condition of most of the farmers was moderate hence not expensive and complicated but economical and simple solution became the first requirement of design. In this research work designed weed extractor has shown good potential in uprooting weeds, soil ploughing to increase productivity without troubling main crop. Such solutions which are not so costly and complicated but environmentally and economically sustainable will be making students motivated to work for quality.

Keywords— weed extractor, ridge and furrow method

I. INTRODUCTION

As far as the sugarcane farming is concerned India is one of the largest sugar producers all over the world. Though there are so many traditional crops in India like- wheat, maize, rice, millets and pulses, cotton, jute, oilseeds, coffee, coconut, tea, rubber, fruits and vegetables etc. but sugarcane is most popular and demanding crop. Especially Maharashtra and Uttar Pradesh (states in India) contribute more than 75 % of total production together. For plantation of sugarcane, ridge and furrow method as shown in Fig. 1 is most suited as well as convenient. The structure of ridge and furrow is made by keeping 120 cm distance between two furrows for heavy soil and 105 cm for light to medium soil [10].

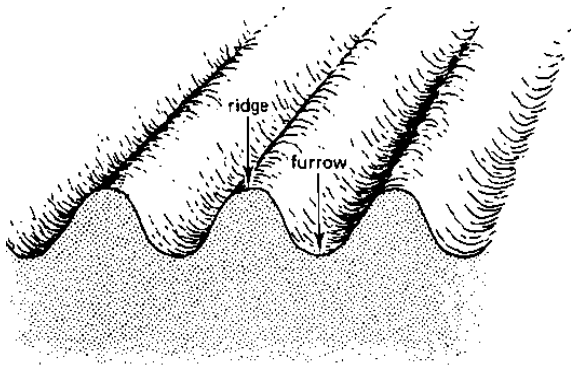

Fig. 1 Ridge and furrow method

The foremost problem facing by farmers for sugarcane is weed growth. The weeds decline crop yield and indirectly elevate farm production costs through energy spent in controlling them [5]. Generally weeds are growing in furrows where water level is almost at the higher side than ridges. For better growing of main crop these weeds should be destroyed. There are lots many herbicides available in market that can be used to destroy weeds but these herbicides are very toxic in nature and hence harmful to humans. Due to consumption of herbicides diseases like- asthma, skin rashes etc. can cause. At the same time herbicides are reducing the fertility of soil severely. On the other hand weed extractor uproots weeds without damaging the main crop and this is one of the positive sides of it.

II. INTEGRATIVE REVIEW

A review for intra-row weed control is taken by Peruzzi et al. Low-tech mechanical devices like torsion weeders, cultivators, brush weeders etc. can be used for low density crops whereas for narrow-row high density crops

spring-tine harrow is popular. If crop is heat tolerant then flame weeding is also a satisfactory option [1].

Determination of weed suppression potential of soil steaming plus activating compounds (KOH or CaO) to boost soil temperature is done by Baberi et al. [2]. While experimenting, no specific effect on weed density is observed but some individual species were affected. The result of this study indicates that the type and rates of activating compounds for soil steaming must be vary according to the weed community composition.

Moreover nonconventional weed management strategies for modern agriculture are reviewed by Bajwa et al. [3]. This research has included the vital role of the biotechnological advancements to develop herbicide-resistant crops and bio herbicides. If weeds are not controlled in early stages then cane yield can suffer [5]. Insect pests get attracted to weeds and hence cause diseases to the main crop (i.e. sugarcane)

Preventive measures for weed control are- mechanical methods, cropping or cultural methods, biological methods and chemical methods. Cropping method is not so effective for weed control but it can minimize the weed population to some extent [8]. Biological weed control method includes high initial cost and it cannot control different weed species in cropped land. As compared to biological method, chemical method is effective due to availability of herbicides but consumption of herbicides can cause dangerous diseases. In addition weed control achieved by mechanical method can be proved as a precise solution for weed management as it can not only control weeds but deeply ploughing the land.

According to Indian Institute of Sugarcane Research, the combination of cultural and chemical methods works effectively for weed management [9]. Monitoring of weed growth and increase in cane yield is possible by this method. Weeds in main crop compete for nutrients, space, light and result in favorable environment for diseases. Some variety of weeds that grow quickly and frequently are- *Echinochloa colonum* and *E. crusgalli* (grasses), *Dacryloctanum aegyptium* (makra), *Amaranthus viridis* (cholai) and *Celosia argentia* (safed murg) etc. [10]

Muhammad Aslam et al. [11] have done experimentation on weed control in spring planted sugarcane by using the combination of cultural and chemical method. Four weedicides namely Krismat 75 W.G, Prexmixtra gold 720S.C, Authority 4F, Atrazine+Ametryne 80WP and hand weeding were tested against weedy check. Results interpret that both measures give good weed control. By the analysis it is come to know that hand weeding excelled with 85.13% weed control comparably followed by Krismat and Atrazine+Ametryne.

Design requirements to develop weed extractor

As the distance between furrows varies from farm to farm, design should take care of the distance variation and hence should be flexible. Provision for primary digging should be added to make design more powerful in uprooting weeds. Facility to indicate proper direction will make design more feasible.

How is it set up

By considering design requirements, a drawing is prepared in Computer Aided Drafting (CAD). As Fig. 2 shows we can adjust the depth and angle between two discs which are in direct contact with soil in furrows. According to the condition of the soil (i.e. hard, loose etc.) we can decide the depth and angle too. These metal discs will serve the purpose of variation in distance between two furrows. C-section as shown in Fig.4 is assembled at an angle so that it will dig the soil in forward direction before the reach of discs. As it will operate in a central part of the furrow, it will not damage any roots of the main crop. Finger weeder blades are at the frontal side of discs as shown in Fig. 3.

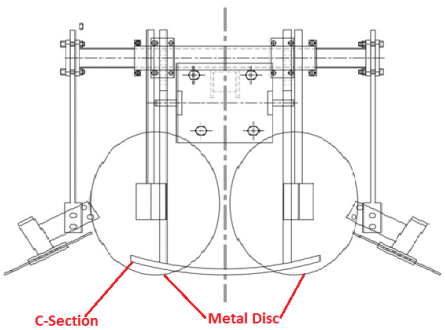

Fig. 2 CAD software: Front view

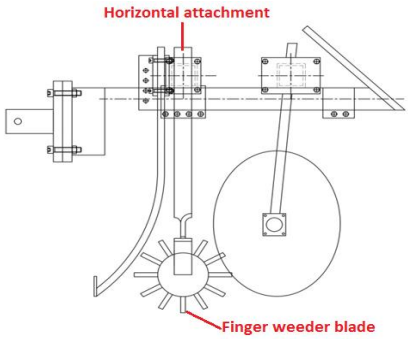

Fig. 3 CAD software: Side view

The horizontal adjustments at the top are mainly provided for placing these blades at a certain distance with one another. The distance mainly depends on plant size and age as roots for older plants are spread over larger area than that of younger ones. These blades rotate around their own axis with the help of pulling force to indicate the direction by scratching the soil. Moreover as the flexible finger moves, it fractures soil from the root zone and gives free passage for uprooting, also makes the young weeds loose so they dry out. This allows the main crop to take up more moisture and nutrients without competition. Finger weeders are available in different diameters and harnesses, selected based on row spacing and soil type. The speed of the extraction will be decided by the condition of soil.

Material selection

The very first choice was for plastics due to its low weight, low cost and longer life but as far as the Indian ground is concerned it will not sustain due to hard soil. Then the next choice is given to 'iron' as it is sturdier and can be used for larger strength requirement.

Various forms of iron used for fabrication are as follows-

1) N-9 Iron for disc
2) High speed steel for bearing
3) M8,M9,M10 for nut bolts
4) Iron metal sheet for finger weeder
5) Iron Square & round pipes

Fig. 4 C-Section for primary digging

Fabricated views of weed extractor are as shown in Fig. 5 & 6. After manufacturing is done weed extractor is attached to a tractor so as to use on the field as shown in Fig. 7.

Fig. 5 Fabricated view 1

Fig. 6 Fabricated view 2

Fig. 7 Weed extractor: Ready to use

Experimental analysis

Still uprooting of weeds is done by human efforts in rural areas as investing so much cost for high tech extractors based on remote sensing; robotics is not possible to farmers. But in this research work, weed extractor is manufactured by considering the affordability as the main concern. The experimentation is carried out in a sugarcane farm where distance between two furrows was 3.5 feet. According to this distance and hardness of soil, distance between two discs and depth of penetration is adjusted. The angle of discs is decided by the approximate area covered by weeds as we can see in Fig 8. This mechanical method of weed extraction is then compared with manual method where labors are doing same work by using muscle power.

Fig. 8 Weed extractor on the field

Table 1 Cost Analysis

Sr. No.	Component	Quantity	Cost (Rs)
1	Cone bearing	4 No.s	1600
2	Bearing housing	4 No.s	7200
3	Pipe (3 feet's)	3 kg	165
4	Square Pipe(4 feet's)	8 kg	520
5	Square Pipe(3 feet's)	6 kg	390
6	Metal disc	2 No.s	3300
7	Nut & Bolts	24 No.s	466
8	Clamping plates	4 kg	220
9	Square rod	6 kg	360
Total			**14155/-**

RESULTS AND DISCUSSIONS

After the demonstration on the field it is compared with the conventional method i.e. manual method.

Quality of work- If quality is the main concern then manual method is coming forward with precise results than mechanical one. Though the distance and angle of discs are adjustable parameters but root growth of main crop has no limitations. Hence some of the roots can be extracted by mechanical method but this is not done in case of manual method.

Expensive or not- Generally a labor costs Rs.200/- per day and for 1 acre approximately 5 labors are required. If suppose weed extraction will be done in 2 days then manual method costs- 200×5×2= Rs.2000/-. For sugarcane farming weeds are growing very frequently so this should be repeated for 3 to 4 time in a one crop. According to this calculation manual method costs approximately Rs.6000/- to Rs.8000/- for a one turn of sugarcane for 1 acre. On the other hand investing Rs.14155/- in a weed extractor is like a onetime investment and affordable to farmers as it is useful for prolong period of time.

Root status after the use of extractor- When weed extractor works on the field then about 10% of main crop roots can be damaged. Roots away from the base of main crop are comparatively weak and can be redeveloped hence not affecting the yield.

Height limitations for extractor- Through this experiment it is observed that up to 3.5 to 4 feet of main crop weed extractor is feasible, beyond that it cannot work safely because heighted sugarcane is spreading on large area and in such a case extractor can damage cane sticks. On the other hand any type of weed and its height is accepted for extractor. Smaller weeds have very weak root support and can be extracted manually but if weeds are grown more than a feet then mechanical method is more superior.

Extraction as well as ploughing- Weed extractor adds extraction as well as ploughing to the field. Due to ploughing, soil gets loosen and aeration is possible which will help to grow roots. But manual method never gives such bonus of ploughing.

Condition suitable to use weed extractor- The criteria for extraction by both methods includes necessary conditions like moisture content in soil, accumulation of water in furrows. Due to these conditions neither labors can work properly nor will tractor motion be feasible. Comparison of soil texture and weed removal can be done with the help of Fig.9 and 10. It uproots all the weeds in decided area as well as the soil is ploughed and loosens.

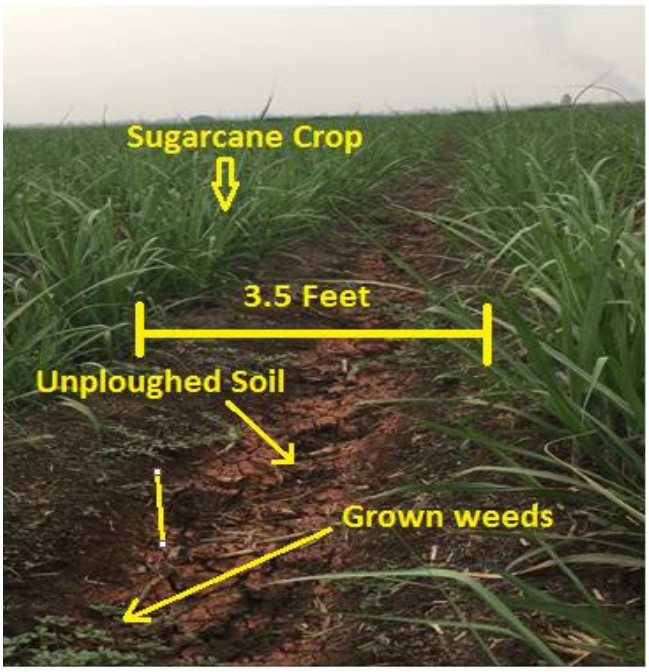

Fig. 9 Before the use of weed extractor

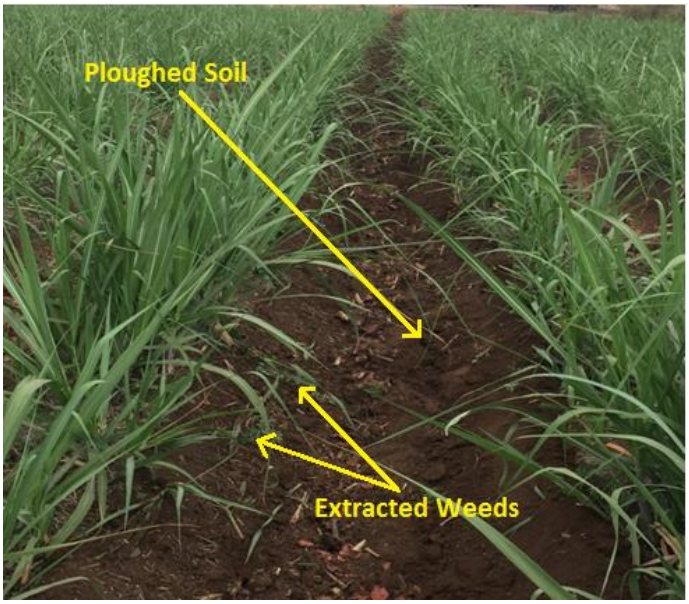

Fig. 10 After the use of weed extractor

ADVANTAGES WEED EXTRACTOR

1) Motor or engine power is not required.
2) One labor is enough for operation.
3) Faster operation as compared to primitive work method.
4) Initial and maintenance cost is less.
5) Feasible design
6) Uprooted weeds can be used for mulching.

CONCLUSION

To increase the productivity of food without hampering the fertility of soil is one of the highly demanding topics. Various herbicides, chemicals are doing their best but soil fertility and environment is suffering. The weed management technique in this research is specially provided for those who are looking for simple and affordable weed extraction. Although the high tech expensive solutions including remote sensing, robotics etc. are towering all over the globe but the economic condition of common farmer is unavoidable. Dearer high tech solutions can also accomplish the purpose but the availability in rural areas and cost is not according to one's means.

Weed extractor is less expensive and provides best weed uprooting with less time. Moreover this will be the onetime investment for farmers and they can make it useful for long lasting. Extracted weeds can be used for mulching purpose for soil coverage to elevate fertility. Extractor gives aeration by ploughing near the roots so that feeding roots will boost to move forward.

Such group activities are leading students towards environmental awareness and team work. Each student is analyzed for individual efforts as well as for team work.

The future of this research can come up with hydraulic motor for effective, fast and smooth working of discs and finger weeders. Multiple finger cutters will also enhance the quality of operation.

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