Fabrication of wheel operated pesticide sprayer

Ketan More
Student, Mechanical Engineering
Saraswati College of Engineering,
Navi Mumbai, India
ketan.more1010@gmail.com

Sachin Rahinj
Student, Mechanical Engineering
Saraswati College of Engineering,
Navi Mumbai, India
sachinrahinj2310@gmail.com

Akshay Supugade
Student, Mechanical Engineering
Saraswati College of Engineering,
Navi Mumbai, India
Akshaysupugade27@gmail.com

Ajit Pawar
Student, Mechanical Engineering
Saraswati College of Engineering,
Navi Mumbai, India
pawarajitme182@gmail.com

Anuprita Bhosale
Assistant Professor, Mechanical Engineering
Saraswati College of engineering,
Navi Mumbai ,India
anuprita92@gmail.com

***Abstract*—Farming is the heart of Indian culture. Around 70% of the rural economy depends on agriculture as means for livelihood. The farmers comes under different levels according to their economic condition like small, marginal, medium and rich farmers. Small scale farmers are still using manually operated instrument instead of developed techniques. In farming there are different works like sowing, weeding, reaping etc. In addition to that spraying pesticides is also preliminary action taken by farmers. To protect crops from insects, diseases, fungi and pests. Number of technologies are used for spraying pesticide by using electric, solar and chemical energies. Instead of wasting these energies we can use mechanical energy. Although using these equipment's farmers face different problems like more cost as compare to manual, less working area, less sprayer tank capacity, more time consuming etc. To overcome these limitations number of product are launched in market, but they are not able to come over all the limitations at a time. We found a solution for all these problems by developing a mechanically operated multi-nozzle sprayer for which any type of energy or fuel is not required except mechanical. Main objective of this paper is to generate a low cost sprayer pump for poor farmers and minimize the efforts. An accurate working model has been fabricated. It gives similar nozzle pressure and cover maximum area. We used crank mechanism along with piston pump, which is derived by rotation of wheel.**

KEYWORDS: multi nozzle, effort, mechanical energy, cost, time.

I. INTRODUCTION

Farming is the backbone of Indian economy. In India generally conventional methods of farming are used due to this efforts and manpower required is more. Also spraying pesticides plays vital role in farming industry. In conventional methods, the pesticide sprayer is mounted on the back which causes the back pain and also improper spraying of pesticides. In markets battery operated and fuel operated pesticide sprayer are available. But this also requires some external source of energy and increases cost of production.

To overcome all the above difficulties, we proposed design of wheel operated pesticides sprayer. In this method, we convert rotary motion of wheel into reciprocating motion of piston in pump. Several concepts of pesto -sprayer in farming are described as follows. Mohammad Ahmad, Borkar, Ghatole [1] Uses concept of manually operated multi nozzle pesto sprayer to cover maximum area in minimum time. Patil, Ikile, Jangate, Patil, Nalawade [2] it focused on spraying pesticides at maximum rate in minimum time by using Pedal operated mechanism. Fabricated in minimum cost and easy to handle. Jhod, Jumle, Apte, Borkar [3] Uses Whitworth mechanism to convert rotary motion in reciprocating motion for pest management to minimize the risk for the user Kolhe, Gajhbhiye [4] Implementing soil coulter along with spray pump to get double advantage. Sandeep H. Poratkar, Dhanraj R. Raut [5] as suggested model has more number of nozzles which will cover maximum area of spraying in minimum time & at maximum rate. Shailesh Malonde [6] they developed a multipurpose pesticide spraying machine based on solar panels .It gives maximum work output with minimum effort. The arrangement of nozzles is adjustable according to the crops and this alone pump can used for multiple crops.Shivaraja Kumar Parameswaramurthy [7] it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel and also peddling the equipment.

The aim of the project is to reduce the human efforts, save the fuel, time and cost during the spraying the pesticides in the farm.

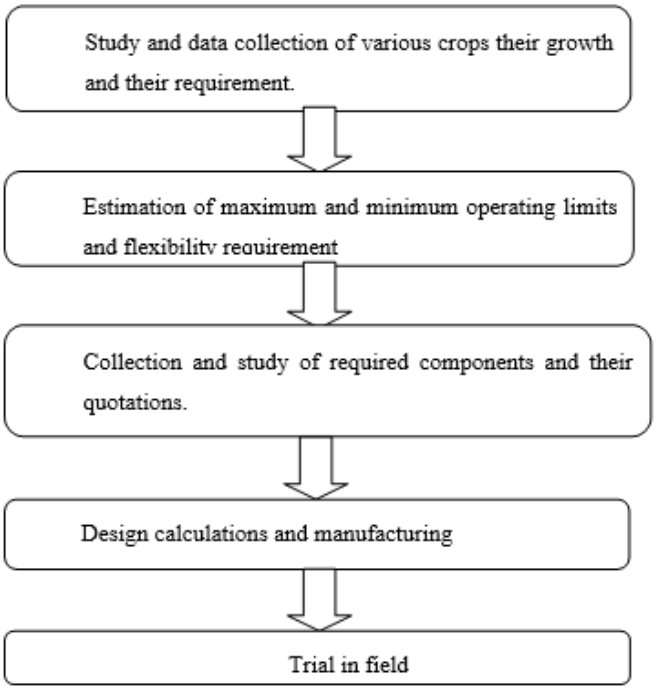


Fig 3.1 METHODOLOGY

III. DESIGN CALCULATIONS:

Fig.2 Actual Model

1. Selection of Wheel

Distance between two plants = 1 feet = 30.43 cm.
Line covered by one rotation of wheel = 30.43*3= 91.44 cm
152 = 2πr
r =152/2π r = 15 cm
The diameter of wheel = 30 cm

2. Discharge calculations

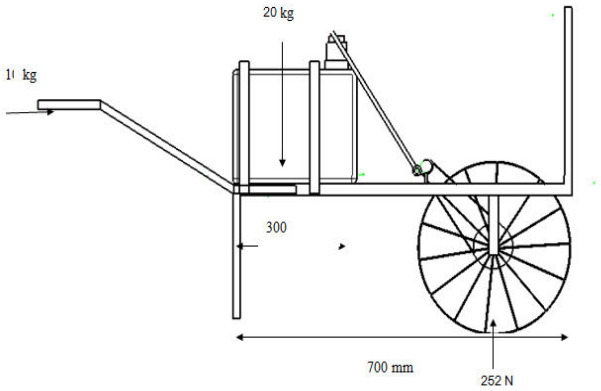
Total Discharge through nozzle – 16 liter in 10 min
I.e. 1.6 liter/min =1.6 $*10^{-3}$ m^3/min
Discharge of single Nozzle=$1.6*10^{-3}$/ 6 = 0.266 m^3/min
Pump discharge per stroke=A*L
$=\pi/4*(0.04)^2*0.08$
$=1.005*10^{-4}$ m^3
Required speed or stroke N=Total Discharge of nozzle/Pump discharge per stroke
$N_4= 9.25*10^{-4}/1.005*10^{-4}$
=9.20rpm
Angular velocity of crank
$\omega_4= (2*\pi*9.20)/60$
ω_4=0.96 rad/sec

Crank and slotted lever mechanism
$\omega_2=\omega_4*(I_{14}I_{24}/I_{12}I_{24})$
=0.96*(14.3/5.6)
$\omega_2 =$ 2.45 rad/sec
N_2=23.40rpm
Human walking speed under load below 50Kg
=3 km/hrs.
$N_1= V*60/D*\pi$ (where V=m/s)
N_1=39.78rpm
For required reduction in rpm
$Z_2/z_1=N_1/N_2=39.78/23.40=1.7$ (3.15<3.43<4 DDB 7.71)
No. of teeth on sprocket Z_1=18
Z_2=18*1.7=32
Pitch=12.7mm

Optimum central distance = (30 to 50) P
=30*12.7
=381mm

Selected chain =R1248
Approximate center distance in multiple of pitch
$a_p= a_0/P$
a_p=300/12.7=23.62
Length of continuous chain in multiple of pitches
$t_p=2*a_p+Z1+Z2/2+ (z1-z2/2*\pi)^2/a_p$
$=2*23.62+ (23+48)/2 + (48-23/2*\pi)^2/a_p$
=83.41=84mm
Length of chain $L=L_p*P$
=84*12.7
=1066.88mm

3. Design of frame



Determine dimension of frame –
A pump required space = 300*120 mm
Diameter of wheel = 300 mm
Total length of frame = 300+300 +100 = 700mm
Width of frame = 150 mm
Total angle required for frame = 2300 mm = 7.6 ≈ 8 ft
Total weight of 25 *25* 3 angle = 0.086 (kg/ft) i.e. = 0.688 Kg
Assume total weight of other assembly = 5 kg
Total load on tire = 5+ 20+0.688 = 25.688 kg = 251.99 ≈ 252N
Therefore,

Pull force required = μ W

μ = 0.45 for wet mud

Total force = 0.45 *252 = 133.4 N = 100 kg

4. Result

Sr.NO	Parameters	Single nozzle sprayers	Multi nozzle sprayer
1	Nozzle	1	6
2	Covered area	3 ft	5ft /3-4ft
3	Time	3hrs/acre	1 hr/acre
4	To operate	difficult	easy

IV. CONCLUSION

Thus it is concluded that the 'Mechanically Operated Pesticide Sprayer' using the 'Crank-Slider Mechanism' is much better as compared to the other different type of options available. It is a case of complete 'Mechanical Automation' as no external power sources will be employed in its operation. Moreover, various materials selected for the entire mechanism will be easily available at a considerably affordable price. The main problem being faced by the farmer was to carry the entire load of the pests on his shoulder and this problem can be very efficiently solved by the adoption of this method. Also, very fewer efforts are needed to be applied for its working on the real-situation fields. In addition to that, no special skills or training is required for the farmer (operator) to operate it.

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