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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Fluid Delivery Subsystem for Oryza Sativa Pesticide Application

Thesis submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
Bachelor of Manufacturing Engineering (Robotic and Automation)

By

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UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA

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ABSTRACT

The automation of pesticide spraying is one of the new techniques in agriculture field lately. This automation is very important since conventional pesticide spraying method that been used nowadays can be hazardous and at the same time brings harmful toxic effect to farmer. Pesticide is a toxic solution or formulation which been used to control the pests and also unwanted plants. This project focuses mainly to develop automated pesticide fluid delivery subsystem for the pesticide automation system. This automated spraying subsystem is a combination of mechanical and electronic concepts. The mechanical components used in this subsystem are such as DC pump, nozzle, hose and container. While the electronic components used relay as a main component to control the system.

DEDICATION

1 dedicate this PSM thesis to my beloved parents, Hussain bin Hassan and Siti Halimah binti Mat , my beloved brothers, Mohd Paizam , my lovely sister,Zuaini and my love all my friends.

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CHAPTER 1
INTRODUCTION

1.1 Overview

Pesticide is a chemical substance or biological agent (such as a virus or bacteria) used against pests including insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms) and microbes that compete with humans for food, destroy property, spread disease or are a nuisance. Pesticides are usually, but not always, poisonous to humans.

The model of pesticide delivery system (refer the appendix B) were showed a relationship about three methods that used in the system. The combination about three methods can produce good result in pest control for all type of corp. The three methods are pesticides method, target method and applicator method. Pesticides method have a few thing that an influence the pesticides application. The pesticide toxicity for each brand is different. It based on the chemical structure that used in each pesticide. The table below showed the type of pesticide toxicity.

The mode of action for each type of pest is different. Some of pesticide can only be used for one species of pest and some of pesticide can be used to counter all pests. The examples of pesticide are such as follows;

- Bactericides for the control of bacteria
- Herbicides for the control of weeds
- Fungicides for the control of fungi
- Insecticides for the control of insects - Matricides for the control of mites
- Infanticides for the control of worms
- Rodenticides for the control of rodents
- Viruscides for the control of viruses

Table 1.1: Classification according to toxicity characteristics

Class	**Level**	**Explaining**
Class I A	Extremely hazardous	Black band on packing container, class LD_{50} over 20 mg or below per kg body eight of adult rat
Class I B	Highly hazardous	Red band and LD_{50} of 20-200 mg/kg body weight
Class II	Moderately hazardous	Yellow band and LD_{50} of 201-2000 mg/kg body weight
Class III	Slightly hazardous	Blue band and LD_{50} of 2001-3000 mg/kg body weight
Class IV	Other	No marked color band and ld50 above 3000 mg/kg

The formulation is about condition of pesticides. There are three types of formulation which are; solid formulation, liquid formulation and gases formulation. For pesticide application, we consider about liquid formulation because it easily to be used, and at the same time the effect it not longer than solid formulation, and more effective to destroy underground pest. The types of liquid formulation are such as follows;

- Emulsifiable concentrate (EC)

- Flowable (F)
- Oil concentrate(OC)
- Aerosol
- Liquefied gas fumigant
- Ultra low volume(ULV)

The cost for each pesticide is different. The cost was based on the class of pesticide. When refer to table above, for Class IA is more expensive than the Class IV. So, before buying the pesticide, we must consider what type of pesticide that must be used and what the pest in their crop. Ability to select the type of pesticide can save the economic because the pesticide is expensive thing. The weather can influence the pesticide efficiency, because pesticide can safely use without influence from weather. To use pesticide without distributed from weather it must know the type of rainfall, the level of wind speed and wind direction, humidity value and environment temperature. Without given more extension for this factor can give more effect to the pesticide efficient.

The second method is about target. The mean of target here about what objective used the pesticide and location of pest. The error to define the target can give more effect for the environment, animals and human. For get perfect pest target we must know three things about pest, first about pest biology that mean the pest size and structure inside or outside body. Second is about pest habitat, this important because we can know type of pest within look the habitat. Some pest lives in ground and some lives in water. And, third is about pest behavior. Have type of pest behavior based on type of pest. We looking what time the pest more active and how it destroys the crop.

The last method of pesticide delivery system is about applicator. The applicator is about facilities that used by farmer to apply the pesticide in crop. The applicator scopes are about machines and tools maintenance, machine or tools design, performance of machine and cost for maintenance. Between the two methods, target and timing, have two factors were influence the two methods above. There are application timing and operator. In application timing, its must consider the model or rules pesticide spray and land structure. Logistics facilities can make pesticide system be easily, the pesticide supply can send to farmer on time. Spray day is about the spray table for each season. Ability to calculate the spray table can increase the pesticide spray efficiency. To use the machine, the operator must has knowledge about used pesticide machine. To get that knowledge operator must training to increase the efficiency. The operator must know to control objective based on the type of pesticide and type of crop and operator must have positive attitudes to reduce the accident occur.

1.2 Objectives of project

The project is about the automation of pesticide spraying and specific for paddy field pesticide spray. The objective is very important to guide line for make the project. Have a few objectives in make these projects.

a. To design the fluid delivery subsystem for oryza sativa pesticide application
b. Implement the technology in pesticide spray
c. To reduce the load was carried by driving system and structure
d. To increase the pesticide safety and reduce the risk of pesticide toxicity.
e. Agriculture technology development
f. To apply the knowledge what was learn before.

1.3 Scope of project

My scope of Liquid Delivery System for Oriza Sativa in Pesticide Application project can divide for two section, mechanical part and electrical part. In each section consider the objective of project. In mechanical section, more study about fluid mechanic application. For each part such as washer pump, nozzle, container, hose and connector were made;

- Analysis the characteristic for each part.
- Calculation analysis
- Develop the design system

The both of section were choosing by the current factor likes;

i) Cost for each components and raw material
ii) The technique and manufacture difficulty
iii) The market facilities to get and found component
iv) The characteristic for each components

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Most authorities agree that spray application is highly inefficient: Graham Bryce (1977) pointed out that in foliar sprays against sucking insects, only 0.02 - 0.03% of the insecticide was utilized on the target. The most efficient dose transfer for insecticides quoted was 6% for aerial spraying of locust swarms; with herbicides, higher (up to 30%) efficiencies can be achieved.

Rational pesticide use stresses the need to increase efficiency of dose transfer: the proportion of the applied dosage taken up by the target pest population. Part of the problem is that it can be difficult to define the true biological target with chemical pesticides (Hislop, 1987). With microbial agents likewise we cannot assume that simply delivering infectious propagates to the cuticles of target organisms will result in pest control, with complex pathogen-host attack and defense mechanisms (Clarkson and Charnley, 1996, Blanford *et al.*, 1998). True (living) pesticides thus add a further degree of complexity, and it can be most instructive to examine the interactions between the pathogen release regimes and target populations over long time periods after application (Keller, 1992; Thomas and Wood, 1997; Hails, 1997). However, with limited funding opportunities, a "fast track" approach to practical verification is needed for pesticide development, which means devising "pre-field trial" techniques then full-scale field testing as soon as possible (Bateman, 1998). What is important here is to understand where a "chemical model" of product development is valid and where it may undervalue the full potential of a pesticide.

From a regulatory a commercial point of view, microbial agents are pesticide products and their development is at least influenced by other trends in the pesticide industry. For example, spray drift is an issue for all types of pesticide in Europe and N. America and considerable efforts have been taken to classify hydraulic nozzles in relation to their drift potential (Southcombe *et al.*, 1997). Unfortunately, one of the practical consequences of these measures is that farmers have tended to use larger droplet size spectra: a trend that conflicts with what we know about the most efficient use of pesticides (especially to maximize coverage with insecticides and fungicides: see below).

"Efficiency" of spray application is determined by the complex phenomena that govern droplet transport from the nozzle to the target. Readers should refer to texts such as Bache and Johnstone (1992).

2.2 Application Equipment

2.2.1 Hydraulic sprayers

Hydraulic spraying systems are the main-stay of small-holder pesticide application in many countries. There is a wide variety of equipment available, ranging from hand-held "trombone prayers", side-lever knapsack sprayers, compression sprayers, to the wide range of tractor mounted equipment (see Matthews, 1992). Fig. 3a shows two forms of side-lever knapsack sprayer; the tank mixture is pumped using a diaphragm or piston mechanism, both requiring two valves. "Pulsation" (variations in pressure with pumping) is minimized with a pressure chamber that is mounted either internally or externally to the main tank, and certain sprayers have a pressure control mechanism mounted either in the tank or on the spray lance (or "wand").

Filters adjacent to the tank lid are usually fairly coarse and unlikely to retain material from any but the crudest pesticide formulations; problems are much more likely to occur with the filters next to the nozzle tips. Long extension booms are frequently used to reach the branches of trees in which case a pump that delivers a high pressure is required. Compression sprayers (Fig. 3c) were originally designed for use in vector control operations, but they are preferred by farmers in some areas, since they are pre-pumped and offer more maneuverability than side-lever knapsack sprayers. Application to trees and bushes is a typical example. Because the World Health Organization procures many thousands of sprayers of this type, it has prepared a rigorous standard (WHO/EQP/1.R4) to ensure compression sprayers are reliable (WHO, 1971). Compression sprayers are pressurized by initial pumping (approximately 40 times) to approximately 4 bar (400 kPa); there then follows a steady reduction in tank pressure as spraying proceeds, to approximately 100 kPa, after which the tank must be re-pressurized. If liquid is transmitted directly to the nozzle there is a considerable increase in droplet size, so sprayers are often fitted with a pressure regulating valve. A number of companies now manufacture spray management valves (Fig. 4), which can be used with most hydraulic knapsack sprayers and are usually fitted on to the spray lance.

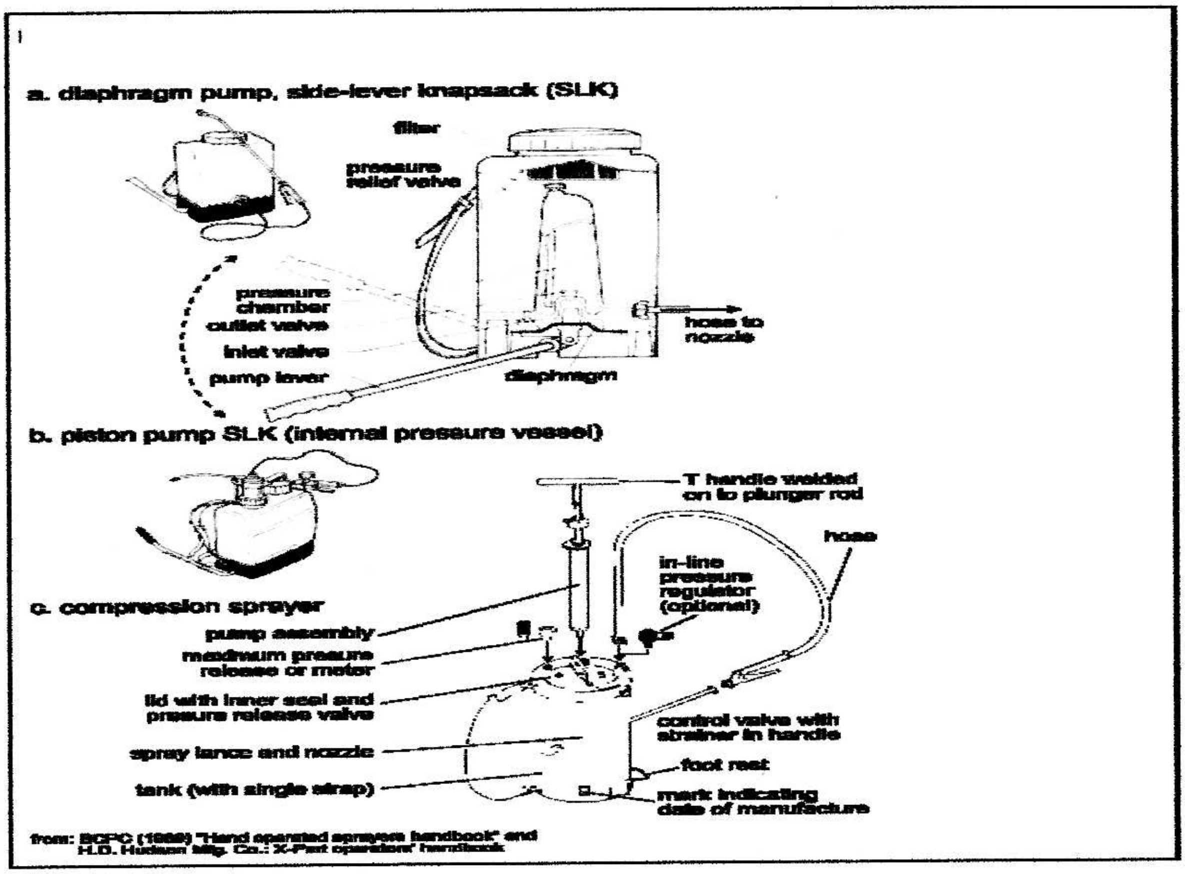

Figure 2.1: Portables hydraulic sprayer.

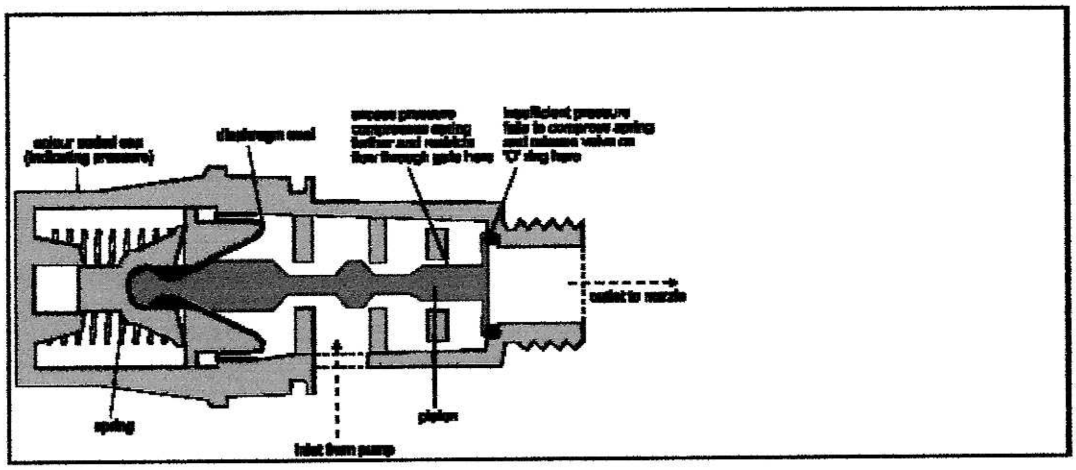

Figure 2.2: A spray management valve.

2.2.2 Herbicide application (especially rotary atomizers)

Weed control can be an important issue with perennial crops, and the use of herbicides is increasing with generally higher labor costs. Hydraulic sprayers maybe used when fitted with atomizers such as anvil nozzles that give large droplets. In order to decrease the production of small droplets, low pressures can be maintained with the use of spray management valves. The use of ULV and VLV techniques has become important in many S.E. Asian plantations to improve work rates, since the high cost of water transport has almost been eliminated by reducing spray vol. from 400-600 l/ha to 14-110 l/ha (Turner, 1985). In oil palm and rubber plantings in Indonesia and Papua New Guinea conventional knapsack spraying has been replaced by a combination of CDA/ULV and VLV equipment. Improved productivity has led to reduced labor requirement and it has been possible to reduce the application rates of certain herbicides including glyphosate.

The overall cost saving in 1983 using CDA was at least 40% compared with HV spraying. Other major reasons for using spinning disc sprayers in herbicide application are: reduction (preferably elimination) of spray drift and reduction of operator exposure to the herbicide. Much of the initial development work was carried out by Bals (1975), with the development of the 'Herbi' (Fig. 5a) and the 'Handy'. The 'Herbi' atomizer has been modified and copied by other manufacturers, although some have attempted to simplify the design in order to reduce costs. The 'Herbi' motor is mechanically governed to maintain disc speeds of approximately 2000 PM. Ideally the flow rate and physical characteristics of the formulation are such that single droplet formation occurs: small satellite droplets associated with ligament formation are likely to drift.

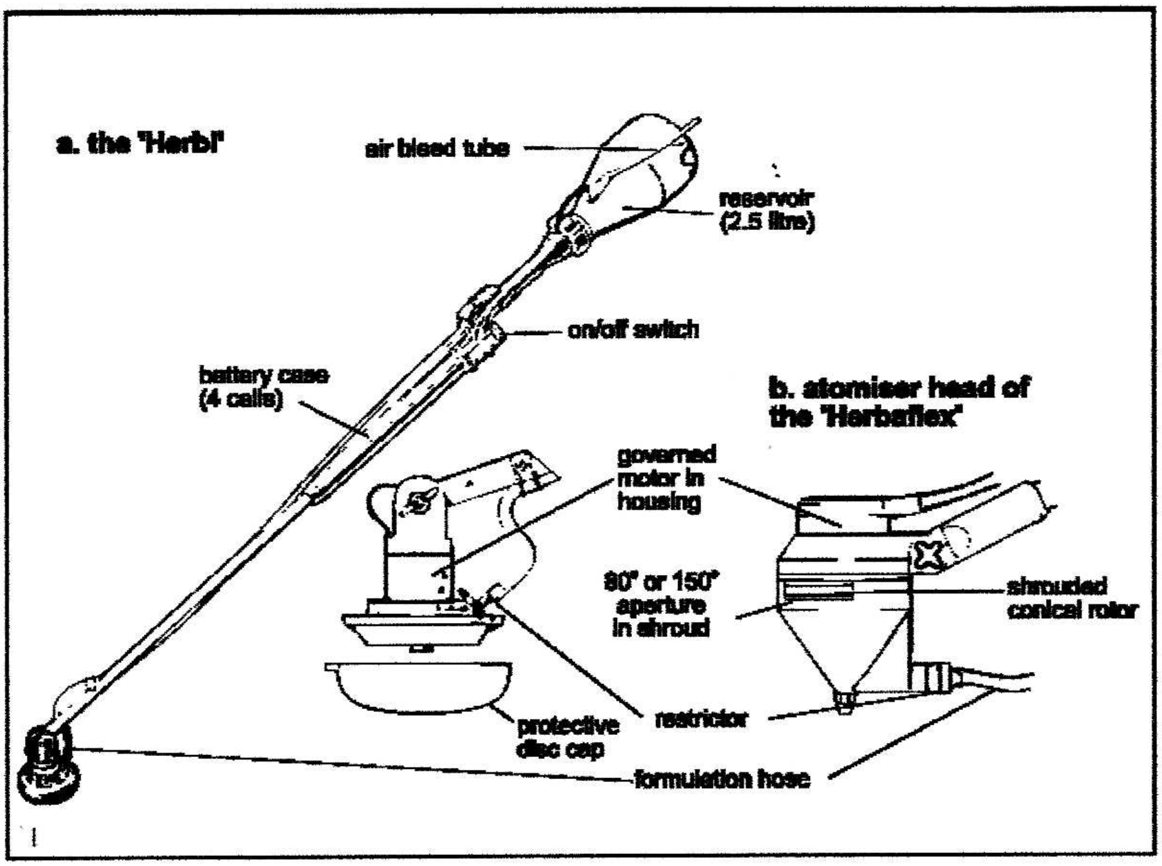

Figure 2.3: Two hand-held CDA herbicide sprayers (courtesy Micron sprayers)

Since Arnold's (1983) review of CDA atomisers, the basic 'Herbi' concept has been augmented with two major departures in rotary nozzle design. Several manufacturers have recognized the need for spraying narrow bands of herbicide that are less than the 1.2 m. swath produced by the 'Herbi' disc. There are now several examples of shrouded spinning discs including the Horstine Farmery 'Lancelot' and the Microcide 'Atilla'. Both these makes have a small pump in the base of the head to re-circulate excess formulation collected by the shroud; however pumping fluid expends energy and reduces battery life. An elegant design is found with the 'Herbaflex', where the rotor consists of a spinning cone with its open base immersed in a "sump" of formulation (Fig. 5b). As the sump level initially rises, the diameter of liquid surface in contact with the spinning cone increases. Flow rate increases due to greater centrifugal force that conducts fluid up a central conical insert and grooves on the inner surface of the atomizer cone. An equilibrium is reached with the flow that is regulated by the restrictor that upplies formulation to the sump. The prospect of applying bioherbicides offer potential for future development, with 'DeVine' (an aqueous suspension of mycelium and chlamydospores of *Phythophthora palmivova*) providing an important recedent. It is important to note that this broad spectrum fungus was applied to the soil for control of strangler vine in citrus orchards (Kenney, 1986). This product has had only very limited commercial success (due to its small market), as have mycoherbicides in invert mulsion formulations (Amselem et al., 1990). One of the constraints identified with the latter as the high cost of applying the carrier oil and investigations into ULV techniques might be productive here. Humectants such as water soluble gums have also been investigated by several research groups, but these may produce disastrously poor droplet spectra with rotary atomizers (Ellison and Bateman, unpublished).

2.2.3 Motorised Knapsack Mistblowers

Motorized knapsack mist-blowers (or air blast sprayers: see Fig. 6) have many uses, although these sprayers were originally developed for obtaining good droplet coverage for Mirid control n cocoa trees. Clayphon (1971) described the important criteria for evaluating machines and technical requirements are now being standardized by FAO (1998). The most common design f nozzle is of the air-shear type, in which thin layers of liquid are introduced into the air trim and thus produce fine sprays. Apart from the ULV versions, there are usually no very inner restrictions in the liquid delivery system, so clogging is unlikely: they are therefore appropriate for use with pesticides. Mist blowers are popular for their versatility, since they an be adapted for granule application and may even used as flame throwers for clearing needs. They can create wide swaths: for use on crops that are difficult to walk through (such s rice) and have been used in locust control operations either to penetrate dense clumps of oppress, or with the nozzle directed upwards to increase swath width and work rate.