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Owning and operating cost evaluation of backpack granular fertiliser dispenser

(Penilaian kos pemilikan dan operasi penabur baja butir bergalas)

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Abstract

Plant nursery is the place where plants are propagated and grown to a desired size before being transferred to farm. The backpack granular fertiliser dispenser is developed by MARDI to tackle issue from plant nursery industry related to ergonomic practices of dispensing granular fertiliser at plant root zone area. This traditional practice of dispensing fertiliser is found tedious, inaccurate and exposing the operator to the high risk of harmful chemical contamination. The effect of the tool in general economic aspect was studied. Parameters used were the cost for manufacturing, owning and operating of the tool. From the analysis, it was found that the backpack granular fertiliser dispenser is an innovation that fulfils the plant nursery industry in terms of its technical and economical requirement. The introduction of backpack granular fertiliser dispenser was welcomed by the industry where the functionality of this tool is proven.

Introduction

Plant nursery is an important requirement to raise seedlings. It is where seedlings are propagated and grown to a required size. Fertiliser is applied for seedling growth. The fertiliser used can be in liquid or granular form. Proper application of fertiliser depends upon the type and amount of fertiliser applied to the seedling and equipment used for fertilisation. It is essential that the right amount of fertiliser is provided to the growing plants (Mohd Fazly et al. 2011).

The main methods of applying fertilisers to crop include broadcasting solid or liquid fertiliser and sometimes working it into the soil before sowing; injecting liquids or gases into the soil before sowing; applying the fertiliser at the time of sowing, either in contact with the seed or quite close to it; surface distribution to a growing crop; and injecting the fertiliser into the soil in or alongside the growing crop (Culpin 1982). Common practice of fertilising at local nursery is by applying the fertiliser at the time of sowing and surface distribution to a growing crop.

The backpack granular fertiliser dispenser was developed by MARDI to tackle issue from plant nursery industry related to tiring practice of dispensing granular fertiliser at plant root zone area. The traditional practice is tedious, causing inaccurate dispensing of fertiliser and high risk of harmful chemical exposure to the

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operator. The introduction of backpack granular fertiliser dispenser was welcomed by the industry where the functionality of this equipment was proven. From the field test result during product development stage, it was apparent that an operator exerts less physical effort when fertilising potted plant and nursery seedlings assisted by dispensing tool compared to direct fertilising (Mohd Fazly et al. 2011).

The backpack granular fertiliser dispenser comprises a hopper with slopping base, metering device, plant hose connected between metering device to a long pipe, reducer and handle for driving mechanism. This equipment can distribute fertiliser in the amount of 6, 9, 12, 15 and 20 g/application based on its metering set up, while its nozzle allows the fertiliser displacement precisely to the intended area (Mohd Fazly et al. 2011).

Economic pressures are encouraging farmers to pay more attention to managing their machinery resources. On today's commercial farm, substantial components of both capital investment and annual production costs are machinery related. As a result, farmers must not overlook effective strategies to manage their machinery resources (Norman 2008).

Machinery and equipment are major cost items in farm businesses. This paper focuses the effect of the equipment in general economic aspect. Measuring productivity of mechanised system is an important aspect for an industry in which efficiency and lower operating cost become the main objective (Khairul Fithri et al. 2010). Making smart decisions about how to acquire machinery, when to trade, and how much capacity to invest in, can reduce machinery costs as much as possible. All these decisions require accurate estimates of the costs of owning and operating farm machinery.

For plant nursery, efficiency of production is partly influenced by the growth of the plants, in which accurate fertilising is the main aspect. Automation may provide uniformity but equipment like the backpack granular fertiliser dispenser seems to be the best approach to assist operator in the plant nursery at the present time.

Materials and methods

The study evaluated the backpack granular fertiliser dispenser's economic performance by evaluating important parameters such as machine manufacturing costs, owning and operating costs. Farm machinery costs can be divided into two categories: ownership cost or fixed cost, which occur regardless of machine use, and operating costs, which vary directly with the amount of machine usage.

Ownership cost includes depreciation of the machine, interest on the investment, and cost of taxes, insurance and housing of the machine. Operating costs are costs associated with use of the machine. They include the costs of labour, fuel and oil, repair and maintenance. A constant hourly labour cost can be determined for hired operators. If the owner operates the machine, the labour cost is determined from the alternative uses of the owner time. If the labour cost is unknown at the time of analysis, a typical community labour rate is used (Srivastava et al. 2006).

The true value of the ownership costs is not known until the machine is sold or worn out. But the costs can be estimated by making a few assumptions about machine life, annual use, and fuel and labour prices. Ownership costs include depreciation, interest (opportunity cost), taxes, insurance, and housing and maintenance facilities.

Depreciation is the loss in value of a machine with the passage of time, whether or not it is used. Depreciation can be regarded as the amount of money that should be saved each year as a machine is used so that, at the end of its useful life, this money along with the remaining value of the machine (salvage value) could be used to replace it (Field et al. 2007).

Before an estimation of annual depreciation can be calculated, the economic

life for the machine and a salvage value at the end of the economic life need to be specified. The economic life of a machine is the number of years for which costs are to be estimated. Salvage value is an estimate of the sale value of the machine at the end of its economic life.

The owning and operating cost is usually stated in hourly basis. This study established one single unit of cost per hour based on assumed parameters listed in *Table 1*. In this study, an owning and cost calculator established by Decisive System Incorporated Company based in Florida, United States, was adopted. It is meant to assist owning and operational cost calculation by providing approximate value using 16 cost factors which represent major cost points that make up a percentage of cost, but not all costs. It is a static lifecycle cost calculator because it does not adapt to changing conditions of machine or equipment use. For this study, the cost factors applied are considered sufficient.

Certain assumptions need to be declared to determine the stated cost. The assumptions may come from data taken during experiments (working rate and capacity), common practices (operating hour, operator cost) design specifications (purchase price, depreciation time, maintenance and repair cost), and general economic assumptions (interest rate, annual depreciation). For this study, assumptions used were considered as the most practical for local and current conditions.

The assumptions (*Table 1*) and estimated manufacturing cost (*Table 2*) of the backpack granular fertiliser distributor were keyed in the calculator software. The result of the calculation is shown in *Table 3*.

Table 1. List of assumptions

Description	Variable
Equipment working rate	1.5 s/plant
Working capacity	2,000 plants/day
Operating hours (per year)	249 hours
Equipment purchase price	RM294.00
Depreciation time	5 years
Salvage value	RM193.00
Interest rate	10%
Insurance (per year)	RM20.00
Maintenance and repair (per year)	RM50.00
Operator cost (per year)	RM14,940.00
Depreciation cost annually	RM20.20
Total interest cost annually	RM29.40

Table 2. Cost estimation for machine manufacturing

Items (per set)	Cost (RM)
Backpack with container	75
Metering device (housing, opening, & block ring)	130
Lance	3
Hose	2
Total	210

Table 3. Cost estimation for owning and operating cost

Description	Cost per hour (RM)
Ownership	
Depreciation	0.08
Interest	0.12
Insurance	0.08
Operating	
Maintenance and repair	0.20
Operator cost	60.00
Total	60.48

Results and discussion

The estimation cost to manufacture the backpack granular fertiliser by the manufacturer (based on year 2013) is RM210.00 (*Table 2*) with selling price of around RM294.00. This estimated manufacturing cost may be reduced by considering cheaper alternative component material and mass production. The estimated owning and operation cost of the backpack granular fertiliser is RM60.48 per hour (*Table 3*). This figure had included the insurance cost that may also apply for other working condition, thus reducing the exact owning and operating cost.

Equipment users would have to balance productivity and costs to achieve optimum performance that is to be able to achieve desired production at the lowest possible cost.

In terms of product fabrication, the initial design requirement favours cheap and easy-to-get material for parts construction. Most of the parts like the hopper, lance and backpack are readily available on the shelf. These parts are rather common and easy for bargaining cheaper supply. Therefore, the replacement or maintenance for most of the equipment is favourable. Failure to provide adequate maintenance can shorten the life of the machine or equipment, and would increase its operating cost (Field et al. 2007).

Generally the backpack granular fertiliser is easy to manufacture, consume simple materials, consistent fertiliser dispensing and ergonomic to operator. The purchase price of below than RM300.00 is considered affordable for local nursery industry.

The equipment is meant to assist operator in distributing matter without having to bend the operator's body. Other than its ergonomic aspect, the equipment also enhances the safety by extending the distance between the broadcasted fertilisers and the operator, thus minimising the chemical exposure.

During this research time, it is believed that there is no such equipment in Malaysia's agricultural machinery market. The nearest equipment that reflects its function are like backpack fertiliser liquid sprayer and paddy seed broadcaster. Unlike those equipments, backpack granular fertiliser has the metering part that measured its every single shot. This unique function fulfils the precision farming objective. Precision job in agricultural practices has been recognised as the way forward in improving Malaysian agriculture industry.

By all its benefit, the estimated owning and operation cost of the backpack granular fertiliser has concluded that a stakeholder would invest RM60.48 per hour (based on this study) for the priviledge of having this equipment. It is important to note that the value may be reduced depending on actual economics parameters.

The general concept of the backpack applicator may also be applied for uses other than fertilising. An extended use of particular equipment may further reduce the equipment owning cost (Chan and Tay1993). The closest example is the seed distribution in a field. However, it is yet to be tested on subject other than granular fertiliser.

The study of machine manufacturing, owning and operating costs would contribute for further economic study that cover viability of owning and operating the machine at several target annual usage levels, expected market size and annual sales, and viability of manufacturing the machine locally at several manufacturing strategies. This economic study would help the stakeholder in managing agricultural machinery and equipment issue like economical capacity, acreages and ownership status.

Conclusion

Machinery is one of the largest investments for agricultural enterprises. The selection process may include manufacturer, design, size and options. A bad decision on any one of these factors will have a serious effect on the profitability of the enterprise. For plant nursery, the efficiency of production is measured by the growth of the plants, in which influenced by accurate fertilising. It is viable to have this tool in the nursery industry because it reduces fertiliser waste by its consistent delivery of fertiliser and improves the operator's working performance by its ergonomic feature.

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Abstrak

Tapak semaian adalah tempat tumbuh-tumbuhan dibiakkan dan berkembang kepada saiz yang dikehendaki sebelum dipindahkan ke ladang. MARDI telah membangunkan alat penabur baja butir bergalas bagi mengatasi isu amalan pembajaan kawasan zon akar di tapak semaian yang kurang ergonomik. Amalan sedia ada dilihat lebih meletihkan di samping baja yang ditabur kurang tepat dan operator mudah terdedah kepada pencemaran kimia. Kertas kerja ini ialah untuk mengkaji kesan alat dalam aspek ekonomi. Parameter yang digunakan ialah kos untuk pembuatan, pemilikan dan operasi alat. Kajian mendapati bahawa alat penabur baja butir bergalas ini merupakan suatu inovasi yang berjaya memenuhi keperluan industri dari segi teknikal serta ekonomi. Peralatan yang diperkenalkan telah mendapat sambutan baik dalam kalangan industri kerana konsep yang diketengahkan adalah praktikal.