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# Design of Plastic Mulch Hole Maker to Decrease Work Load and Increase Work Speed Strawberry Farmer in Bali

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***Abstract***

*Strawberry is one of favorite plant in Bedugul (Bali-Indonesia) agro tourism. Soil as growing media strawberry need another layer of plastic in order strawberry can grow well and are not bothered by a pool of water, rain, and sunlight. To coat the soil as planting media, should be made of plastic with a hole diameter and distance between holes. During this strawberry farmers using scissors as a maker of holes. While the hole in the plastic that must be made so much, especially if the planting medium is so broad. For that conducted the research design of plastic mulch hole maker that meets the rules of ergonomics as a tool for holes maker in the plastic to decrease work load of farmers strawberry. The research was conducted on 12 strawberry farmer by "treatment by subject design" which were developed in two treatments such as T0 (make hole on the plastic manually by scissors), T1 (make hole on the plastic by tool of plastic mulch hole meker). Work load was measured by using work heart rate which was count using ten pulses methods, work speed was measured by time of many holes are made on plastic mulch. The data were analysed by using t pired test at significant level 5%. Results were showed as follows: significant of difference (p ¡ 0.05) of work load, subjective disorders, and work speed between T0 and T1. The average of work load on T0 and T1 were 101.32 2.51 beats/minute and 90.78 ± 2.33 beats/minute or decreased 10.4%. And then the average of hole product on T0 and T1 were 11,42 1,94 and 96,71 4,52 hole/minute and work speed on T0 or increased 746,8%. Its can be concluded that T1 give larger decreased of work load and give larger increased of work speed compared with T0. That is why, it was recommended the design plastic mulch hole maker should be used by strawberry farmer in Bali.*

***Keywords :*** *Plastic Mulch Hole Maker, Work Load, Work Speed, Strawberry*

## 1 INTRODUCTION

Bedugul is a tourist area in Bali. there are tours of the lake and the botanical gardens there. besides that some people there is a farmer. Bedugul farmers usually grow vegetables, maize, peanut and strawberry.

Strawberry is one of the many plants encountered in Bedugul Tabanan. Soil as growing media strawberry need another layer of plastic in order strawberry can grow well and are not bothered by a pool of water, rain, and sunlight. To coat the soil as planting media, should be made of plastic with a hole diameter and distance between holes. During this strawberry farmers using scissors as a maker of holes. While the hole in the plastic that must be made so much, especially if the planting medium is so broad.

Make a hole in the plastic manually using scissors to make the worker/farmer quickly feel tired in the hand. besides requiring a long time, the hole that was made is also less precise. especially if the soil is tilled area that requires plastic width/length and the hole that much, then making a hole in the plastic will make the farmers feel tired and appeared ill at the hands of a complaint. for it is necessary to attempt to provide a solution to the problem.

One of the solutions of these problems is to create a tool that can make holes in the plastic with a relatively faster time without cause complaints in the hands of the worker/farmer. The tool designed by ergonomic rule. low cost, making it easy, environmentally friendly, does not require electrical energy. Simple to use. so the design plastic hole tool is made for finding solutions to these problems strawberry farmers. Base on above background, so the problems which can be exposed in this research were as follows: (a) Is design of plastic mulch hole maker can decrease work load strawberry farmers in Bali?, (b) Is design of plastic mulch hole maker can increase work speed strawberry farmers in Bali?

## 2 MATERIAL AND METHOD

This study was an experimental study with treatment by subject design. There were developed in two treatments such as T0 (make hole on mulch manually using canned heat), T1 (make hole on mulch using design of plastic mulch hole maker). Work load was predicted from heart rate that was counted by 10 rates method on artery radialis by digital stop watch. Environ temperture was measured by sling Psychometer. Noise was measured with sound level meter. work speed was measured by time of many holes are made on plastic mulch. Statistical analysis to know the significant different from data which were collected before and after work, were analyzed with t-paired test at a degree of significance 5%.

## 3 RESULTS AND DISCUSSIONS

### 3.1 Subject Characteristic

The total descriptive analysis to data subject characteristic include age, body height, body weight, and work experiences. was presented on Table 1. The means of age subjects on this research is 27,22 $\pm$ 4,12 year with ranges 19  42 year and total subjects 16 person. Base on statistic analysis can be seen onTable 5.1, subject ages 95% be on interval 21,22 to 30,12 year. So can be said that ranges subject age still on optimal to work because of productive age. Age condition affected to physical work ability or the strength of muscle in self. The maximal fisic ability can be acheave on age range 25 35 years and decrease continously paralel ages increase [1, 2].

Table 1: Data subjects characteristic on farmers

| No | Variable | Means | SD | Range |
|---|---|---|---|---|
| 1 | Age (yr) | 27,22 | 4,214 | 19 42 |
| 2 | Body weight (kg) | 60,12 | 5,162 | 54,5 69 |
| 3 | Body tall (cm) | 165,11 | 3,547 | 155 170 |
| 4 | Work experiences (yr) | 5,21 | 2,326 | 2 10 |
| 5 | Body Mass Index | 22,02 | 0,54 | 20,22 24,13 |

### 3.2 Environment Work Condition

Environmental work condition can indicated from wet temperature, dry temperature, relative humadity, Indeks Temperature Wet Ball (ITWB), noising and light intensities. Environmental condition data which were attained in this research its normality were tested with Kolmogorov Smirnov. (K-S) The result showed that the data work environmental on three treatment distributed normal (P¿0.05), To know each treatment showed homogenous data, there were t-paired test. The analysis result work environmental on the research showed on table 2 as follows:

Table 2: Analysis result work environmental measuring on the research

| No | Variable | Treatment 0 | | Treatment 1 | | t | p |
|---|---|---|---|---|---|---|---|
| | | average | SD | average | SD | | |
| 1 | Wet temperature (oc) | 16,81 | 2,01 | 17,01 | 1,25 | -1,473 | 0,295 |
| 2 | Dry temperature (oc) | 18,12 | 1,21 | 18,79 | 1,71 | -0,718 | 0,551 |
| 3 | Relative humidity (%) | 70,51 | 3,66 | 70,24 | 2,73 | 0,709 | 0,523 |
| 4 | ITWB (oC) | 25,14 | 1,62 | 25,39 | 1,56 | -1,949 | 0,092 |
| 5 | Wind velocity (m/s) | 2,15 | 1,33 | 2,31 | 1,42 | -3,049 | 0,181 |
| 6 | Voice intencyties (dBA) | 61,30 | 1,72 | 62,11 | 1,51 | 1,253 | 0,382 |

Analysis result showed on table 2, clarified that wet and dry temperature variable were under borderline value Humindities average each treatment between 70-80%. And voice intencities (noising) also under borderline voices highest (85 dBA). Those showed that work environmental were on save and comportable for each treatment so it cant cause physiologies effect that can disturb work. Those result concord with research which were performed by Sutjana located at Bali where its dry temperature around between 28-29C [3]. Manuaba and Kamil stated, that the temperature at dry monsoon increased until 31-32 C at the shade place and attained 36 C under the direct sun rays [4].

The result t paired test to environmental as showed on table 5.3 stated that the variable wet, dry temperature relative humidity, and lighting intencity (at T1 and T2) founded p ¿ 0,05. This case stated that each group not different significantly so it can the same effect each group treatment.

### 3.3 Workload

Workload treat base on heart pulse farmer during a rest (rest heart pulse) and work heart pulse. Before analysis treatment effect was done, it need to normalities test to heart pulse. Normalities test done using Kolmogorov-Smirnov (K-S) test. Test result Kolmogorov-Smirnov (K-S) founded that rest heart pulse and work heart pulse the third treatment normal distributed (P 0,05).

Comparability rest heart pulse done to know first condition the workrs, are there significant differentiated or not. It need to known what the changed workload is original caused by treatment effect or outside factors that follows give changed that workload. Comparability rest heart pulse of farmers done using t paired test. . Analysis result can be seen at Table 3.

Table 3: Compatibilities Heart Pulse Farmers between Treatment.

| **Variable** | **T 0** | | **T 1** | | t | p |
|---|---|---|---|---|---|---|
| | **average** | **SD** | **average** | **SD** | | |
| Rest Heart Pulse (Pulse/minutes) | 68,15 | 5,22 | 67,91 | 4,76 | -0,140 | 0,872 |
| Work Heart Pulse (Pulse/minutes) | 103,31 | 3,45 | 87,34 | 2,63 | -58,042 | 0,000 |

On table 3, can be found that rest heart pulse each group treatment not significantly different ($p > 0,05$). That means first condition rest heart pulse workers for each group treatment can be consider the same. Can we see that the average decrease among treament 0 (T0 / control), treatment 1 (T1). Among group T0 with T1 were siginificance differences ($P < 0,05$).

during work rest, there were no significant differences in pulse rate in both groups T0 and T1 groups. This indicates that the initial conditions of the worker's workload is the same. while at work, there are differences in working heart rate significantly ($p < 0.05$) between T0 to T1, T0 gives greater pulse. while T1 has a smaller pulse. This shows that there is a pulse decrease between T0 with T1. The average pulse T0 is 103.31, while in T1 was 87.34 or a decrease of 15.5%.

In the T0 group were due to workload including plastic perforate job using the handle of a hand holding a tin of embers attention and caution. Exposure to the sun's heat in the added work of blowing embers on the tin, and the smoke embers in a tin can increase heart rate. This job requires a greater energy. Power or energy is physiologically derived from the body's metabolic processes. This metabolism requires O2 as the fuel is taken through breathing so that the greater the power purposes the faster frequency of breathing and heart beating.

While in the treatment group T1, the pulse of the work had a significant reduction ($p < 0.05$) for control of 10.4% This is because the work of making a hole mulch treatment assisted by a pit with a natural standing work posture, so that workers feel more comfortable and just do a little pressure to plug the tool into plastic mulch pit. Physiologically energy purposes in the treatment group (T1) was smaller than the T0 group.

Workload (workload) is a body stressor factors that can be divided internal and external of body [5]. Assessment workload objectively the most convenient and inexpensive, quantitatively reliable accuracy is a measurement of heart rate pulse [6].

### 3.4 Work Speed

To known treatment effect was done difference siginificant. Average among each group treatment ( Control groups or T0, treatment 1 or T1). Statistics test that used is t paired test. Result analysis shown on table 4 as follows:

Table 4: Result Product and Work Productivity Jewel Worker.

| **Variable** | **T 0** | | **T 1** | | t | p |
|---|---|---|---|---|---|---|
| | **average** | **SD** | **average** | **SD** | | |
| Work Speed (hole/minut) | 11,42 | 1,94 | 96,71 | 4,52 | 18125,28 | 0,000 |

On Table 4 above can shown that product and work speed worker has difference siginificant among both treatment (p¡0,05). Shown that work speed on Treatment 1 (T1) more height than Treatmen 0 (T0). Average result work speed was 11,42  1,94 holes/minute, on treatment 1, Average result work speed was 96,71  0,925 holes/minut or increased as much 746,8%.

This condition shown that T1 (make hole on the plastic by tool of plastic mulch hole meker) give effect increase work speed better than T0 (make hole on the plastic manually by scissors). Ergonomics intervention to improvement work posture or work station its needed especially at small scale industry [7]. Agro ergonomics approach will play an important role in improving the speed and productivity of farmers [8]. Because of ergonomics intervention at home isdustry , intervetion use work chair appropriate with anthropometry and etc. will can decrease workload or subjective complain also increase work productivity [9, 10].

## 4 CONCLUSSIONS AND RECOMMENDATIONS

Based on the research that has been done in previous sections, as follow are some conclusions can be take like as follows:

1. Usage of Design Of Plastic Mulch Hole Maker can decreas work load strawberry farmer in Bali.

2. Usage of Design Of Plastic Mulch Hole Maker can increase work speed strawberry farmer in Bali.

3. There are some suggestion can be present on this research such as follows : a) From the research which has done evidence using Design Of Plastic Mulch Hole Maker can decreas work load strawberry farmer in Bali.can increase work speed farmer so its suggestion design of Plastic Mulch Hole Maker for soil cover (mulch) of strawberry plant, and b) Necessary to study more deeply about the treatment plant strowbwery when making trenches and watering to meet the ergonomic rules.

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