DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF A SELF-PROPELLED THREE-TINED MECHANICAL ONION (*Allium cepa* L.) FURROW CULTIVATOR

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An Undergraduate Thesis Submitted to the Faculty of the Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Munoz, Nueva Ecija, Philippines,
in Partial Fulfilment of the Requirements
for the Degree of

BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING
(Agricultural Power, Energy and Machinery Engineering)

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This undergraduate thesis entitled **"DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF A SELF-PROPELLED THREE-TINED MECHANICAL ONION (*Allium cepa* L.) FURROW CULTIVATOR,"** prepared and submitted by **MENARD A. SONI**, in partial fulfilment of the requirements for the degree of **BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING (AGRICULTURAL POWER, ENERGY AND MACHINERY ENGINEERING)**, is hereby accepted:

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BIOGRAPHICAL SKETCH

Menard Arellano Soni was born on August 25, 1997 at Canaan East, Rizal, Nueva Ecija. He is the second child of Ariston Quilaman Soni and Minda Arellano Soni.

He finished his primary education at Canaan East Elementary School on 2010 and secondary education on 2014 at Canaan East High School, Canaan East, Rizal, Nueva Ecija. He has been a consistent honor student from elementary to high school. He finished high school with first honorable mention. He is also skilled in drawing. During his high school years, he frequently joined poster making competitions and managed to win on almost all of them. He joined campus journalism on his final year in high school as an editorial cartoonist. During this period, he has had the opportunity to compete with other schools and had won his first and final inter-school competition.

He entered college on June 2014 at Central Luzon State University. Living in a community with agriculture as the primary livelihood of people, his interest in machines and skill in drawing led him to take a degree of Agricultural and Biosystems Engineering with a field of specialization in Agricultural Power, Energy and Machinery Engineering. During his early years in college, he excelled in academics and became an academic scholar.

He has also participated in various seminars to increase his knowledge in the current affairs in his field. These include the Smart Farming: Engraining the Future seminar held at the College of Engineering, Central Luzon State University with the theme "Strengthening Agricultural and Biosystems Engineering for Global Competence" on April 11, 2018. He also attended the Lecture Series on Technopreneurship presented

by the CLSU Technopreneurship Hub and Society of Agricultural Engineering Students— Philippine Society of Agricultural Engineers (SAGES-PSAE) on March 7, 2019. He is also a proud beneficiary of Vicente B. Bello Scholarship Program popularly known as the Natasha Scholarship Program.

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ABSTRACT

SONI, MENARD A., Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines, **JUNE 2019, DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF A SELF-PROPELLED THREE-TINED MECHANICAL ONION FURROW CULTIVATOR**

Adviser: ROMEO B. GAVINO, Ph.D.

This study was conducted to design, fabricate and evaluate the performance of a self-propelled three-tined mechanical furrow cultivation for onion. The machine was designed with the aim of reducing the man-hour requirement of weeding and furrow cultivation of onions. It also increased the timeliness of operation due to a readily available machine as compared to the manual labor who may not always be available when needed.

The machine was fabricated using locally available materials. The furrow cultivator machine's overall dimension is 1838mm x 1400mm x 900mm (LxWxH) with a gross weight of about 77 kg. The machine, powered by a 4.8kW gasoline engine (air-cooled) has 7 major components, namely: prime mover, transmission system, handle, shank assembly, implement frame, power unit frame and traction wheel.

The working performance of the machine was evaluated at varying depths of cut (T1: 2cm, T2: 4cm, T3: 6cm) with three replicates arranged in completely randomized design. Analysis of variance (ANOVA) was used to determine the significant differences among treatment means. The Tukey Test was used to determine which among the means would be significantly different from each other.

ABSTRACT

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Results of the performance test showed that operating the machine at 2cm depth of cut exhibited the highest effective field capacity (0.291ha/hr) and field efficiency (80.48%). However, lowest values for weeding efficiency (51.89%), wheel slip (40.18%) and fuel consumption (0.34L/hr) were recorded on this treatment. Highest values for weeding efficiency (70.40%), fuel consumption (0.67L/hr) and wheel slip (70.89%) was recorded on 6cm depth of cut. There was no recorded damaged plant on any of the treatments. Percentage error for mean depth was found statistically comparable to each other. Hence, the machine can be operated at any depth setting from 2 to 6 cm depending on the needs of the farmer.

Comparison between machine and manual furrow cultivation showed that the machine capacity (0.291ha/hr) is almost four times higher than the manual capacity (0.075ha/hr). Percentage damage plant on the manual method (3.81%) is almost four times higher than that of the machine (0%). Weeding efficiency was found not significantly different from each other.

Cost analysis of operating the machine indicated a break-even point of 5.78 ha/yr based on the investment cost of ₱25, 837.00 (covering materials and labor cost), machine capacity of 0.291ha/hr and custom rate of ₱1600 per hectare. The annual net income that can be generated is ₱152,161.57. The projected time needed to recover acquisition cost based on the machine capacity of 0.291ha/hr and operating time of 400hrs/yr was 0.17 year or 2 months.

Results of this study also assessed a 75% decrease in manpower requirement on the traditional manually operated furrow cultivator of 4 man-days/ha to 1 man-day/ha when using the mechanical furrow cultivator.

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