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Recent Publications

Published
1. Al Hussain and AB Abdullah., Advances in Material Science and Engineering, 2023.

Active Grants

STG - Matching
Title: Tribological Performance of Additive Manufactured Aluminum Alloys, 2021-2023

FRGS Grant
Title: Investigation on the effect of hot forging on the deformation behavior and microstructural response of Wire Arc Additive Manufacturing (WAAM) of high strength low alloy (HSLA) steel components, 2022-2025

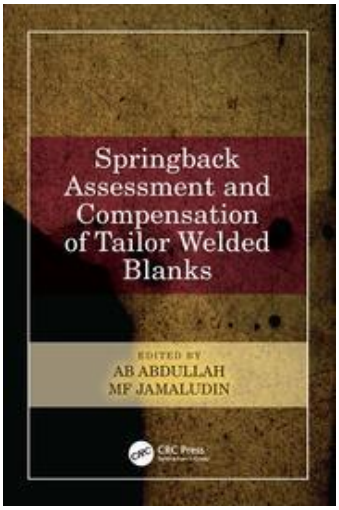
Preface

Metal Forming Research Lab (MFRL) achieved most of its aims in 2022.

Webinar Series 1 and 2, which were completed on October 28th, 2022 and January 11th, 2023, respectively, are among the most significant accomplishments. Another edited book had been published by CRC Press at the end of 2022. The approval of Bulletin MFRL to be listed under MyJurnal and its potential to be indexed under MyCite is another milestone, which the lab has targeted for many years. An unexpected achievement is our first patent filing, which was also completed by the end of 2022.After hard work and a few rejections, a new grant was secured under FRGS, which was a relief for sustaining the group's survival, as now, national grants are the most competitive funds to be obtained. Alhamdulillah, two PG students passed their viva voce and inspired others to finish their studies.

A few of our members also participated in various conferences (local and international) as regular speakers or as invited speakers. Last but not least, one of the projects conducted by an undergrad student managed to win a gold medal in a national level competition. The project has the potential to be further improved and developed in the future. However, publication in a WoS-indexed journal is the main weakness in 2022, and this is an area that must be seriously addressed in 2023. Compared to 2021, none of the published articles are in the journal listed under WoS. Even though we published 14 articles as book chapters, they still did not meet the expectations for each lab indicated by the school. This momentum will be carried into 2023 to continuously contribute to the nation by supplying trained researchers and solving community problems. May Allah help us.

New Book 2022



After hard work for about a year, the book finally published in the end of year 2022. The book contain 13 chapters, where 11 chapters wrote by MFRL members. Most importantly, the outcome of the chapter may contribute to the body of knowledge and benefited various parties especially the manufacturing sector.

Focusing on techniques developed to evaluate the forming behaviour of tailor welded blanks (TWBs) in sheet metal manufacturing, this edited collection details compensation methods suited to mitigating the effects of springback. Making use of case studies and in-depth accounts of industry experience, this book gives a comprehensive overview of springback and provides essential solutions necessary to modern-day automotive engineers.

New Member - Albannai

Welcome to Abdulaziz I. Albannai, our new member, who effectively joined us in December 2022. He is from Kuwait, and his project is related to wire arc additive manufacturing (WAAM). He will focus on the effect of post-weld deformation on the material properties of HSLA material. He has now worked as a welding instructor at the Public Authority for Applied Education and Training (PAAET) in Kuwait since 2002. His knowledge and experience in welding are advantageous to him in his study. 2023 seems to be a year where the number of foreign postgraduate students increases drastically. Students from Nigeria, Iraq, China, and Pakistan are among the countries to join the lab soon.

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Design of Mechanical Tool for Lodged Paddy Rice

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Keywords: lodged paddy rice, mechanical tool, B40

Abstract

Most of the farmer involve in paddy sector are under category of B40. Further loose due lodged must be minimized. Current methods via chemical cause further damaged to the soil and may spoiled for long term. In this project, the main aims of the tool to be produced must meet the customer needs and most importantly cheap. The trial sessions on the prototype show a very promising outcome. However, there are few modifications on the design to make the product manufacturable.

INTRODUCTION

Rice has become the most important staple food for all races and religions in Malaysia, although rice is the world's second-most important crop after wheat [1]. Asian countries are the largest producers and consumers of both products. The rice was consumed daily by every Malaysian. Nasi lemak, laksa, and pulut kuning are some of the examples of rice-based foods that are famous in Malaysia [2]. Usually, the farmer will use chemical fertiliser for the paddy rice in order to get the best result possible. Ammonium sulphate (NH4)2SO4 is the most suitable and commonly used fertiliser for paddy fields [3]. Rice farmers commonly apply the N-fraction in the ammonium form of ammonium sulphate to flooded soils because nitrate-based fertilisers are ineffective due to nitrogenous waste losses. This can help the farmer keep the soil fertile, allowing him to grow nutritious and healthy crops. Fertilizers are used by farmers because they contain plant nutrients, including nitrogen, phosphorus, and potassium. Most paddy rice can grow healthily and of good quality when combined with good soil and the use of appropriate fertilizer. Unfortunately, unhealthy paddy rice can still occur, which is known as lodged paddy rice. Lodging is the bending over of grain crop stems around ground level, which makes harvesting difficult and reduces production considerably [4]. In cereals, lodging is frequently caused by a combination of factors, including the crop's lack of standing power and environmental factors such as rain, wind, hail, topography, soil, the preceding crop, and others. Nowadays, a consistent production of rice is important in order to keep up with the increasing population in Asia [5]. Every farmer will try their best to have the best quality of rice, not only to sustain their income but also to fulfil the needs of every rice consumer. There are many methods used by the 2 farmers to have fine paddy rice, such as using the correct tactic to seed the paddy rice, using the best soil for planting, using chemical fertiliser to help the paddy rice grow healthier, and much more. However, an unwelcome problem persists in the form of lodged paddy rice.

Farmers are making some efforts to solve the lodged paddy rice problem. The first is to ensure proper plant spacing. Proper and regular spacing between plants promotes healthy plant development and allows plants to withstand the effects of uncontrollable threats such as storms, severe rains, and illnesses [6]. Plants that are crowded or unevenly spaced have a tendency to lodge. In short, short interrow spacing should improve lodging resistance while reducing grain yields to a minimum. Second, by grazing and clipping. This should be done before stem elongation has progressed far enough to harm the epics. Clipping or grazing, it appears, should be done without excessive soil compaction, and enough moisture and nutrient supply must be available over the following time to ensure high grain yields. However, it is possible that this strategy will obstruct the accomplishment of maximum yield [7]. Last but not least, the easiest and most common method used by the farmer is using fertilizer. Fertilizer applications need to be carefully monitored by the farmer because nitrogen is really effective at preventing lodging. The timing of the nitrogen application is critical in this situation. Reduce lodging by dividing the nitrogen into two or three splits and providing it as needed by the crop plant. The nitrogen, phosphorus, and potassium balance in the soil must also be considered [3]. When plants have a lot of nitrogen, it's very important to have enough potassium to keep them from lodging. To avoid the problem of lodging, it has been proposed that plant growth retardants and sulphur be used. Based on the above prevention methods, none of them use a mechanical tool to solve the lodging problem, aside from scissors for the clipping and grazing methods. Most of the methods were applied at the early stage of planting. To overcome this issue, a new mechanical tool will be developed in this project to solve the problem. The tool is user-friendly, environmentally friendly, and, most importantly, cheap.

METHODOLOGY

Customer survey was done to gain the information and then translate the need to a design concept. To conclude, most of the farmer's income is affected by the lodged paddy rice problem either the paddy field farming is their main source of income or just a side income. Most farmers use various types of chemical substances such as chemical fertilizer and insecticides to prevent the lodging problem, but it still occurs. So, the invention to produce the simple mechanical tool to solve the lodging problem will certainly help the farmer reduce their burden by minimizing or eliminating the lodged paddy rice problem. Three concepts were generated from the customer needs.

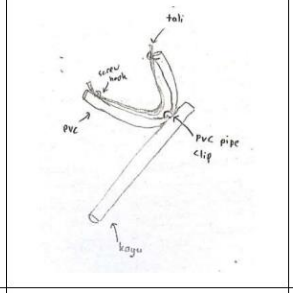
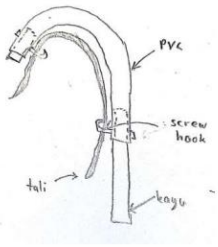
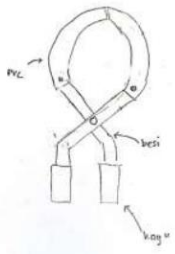
	Concept 1	Concept 2	Concept 3
Design			

Figure 1: 3 concepts developed.

RESULTS AND DISCUSSION

Customer Needs

The following are some findings from the survey that has been conducted. Firstly, 66.7% of the respondents said that paddy field farming is their main source of income, while the other respondent (33.3%) said that paddy field farming is only their side income. Furthermore, approximately 90% of the respondents said lodged paddy rice has a big impact on their source of income, with the average total lost between RM1000 and RM3000. According to the survey, the weather is the main cause of lodged paddy rice, with 66.7% of respondents voting for it. In addition, to overcome the lodged paddy rice problem, 60% of the respondents use various types of chemical substances, such as fertiliser and insecticide. None of them used mechanical tools to overcome the problem. Most importantly, 100% of respondents were willing to spend additional money to buy a mechanical tool to overcome the problem of lodged paddy rice, and most of them only agreed that the price of the tool was cheap and affordable. According to the survey, the top 3 very important specifications for mechanical tools as voted by the respondents are cheap, durable, and safe to use.

Other suggestions, such as being easy to carry anywhere, can also be considered for the design process. Based on the second stage survey, most of the respondent choose concept 2 as their choice because it is the easiest and most comfortable to use by the user.

Product Features

The tool consist of 7 parts, the body, wedge, cutter, screw hook, hand grip, rope holder and handle as shown in figure xx. There are few features only a single hand is needed, already have a built-in cutter, pre-install rope handler, comfortable rubber hand grip, ergonomic design based on anthropometric data and have a wedge to easily lift the stuck lodge paddy rice.

Product Trial

Place the jute rope at the rope holder before starting any process. Manually pull the rope through the screw hook along the body. Cut the rope using the pre-build cutter at the center of the body. Hook the lodged paddy rice by using the body of the simple tool to form a loop of paddy rice. Tie the loop of paddy rice by using the jute rope cut before. Repeat step 2 – step 5 for the next loop of lodged paddy rice as shown in Figure 3.

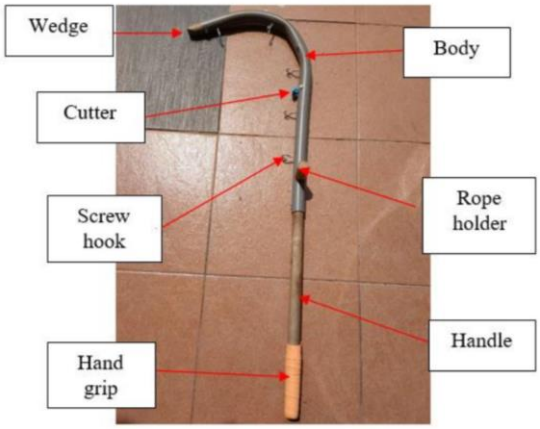
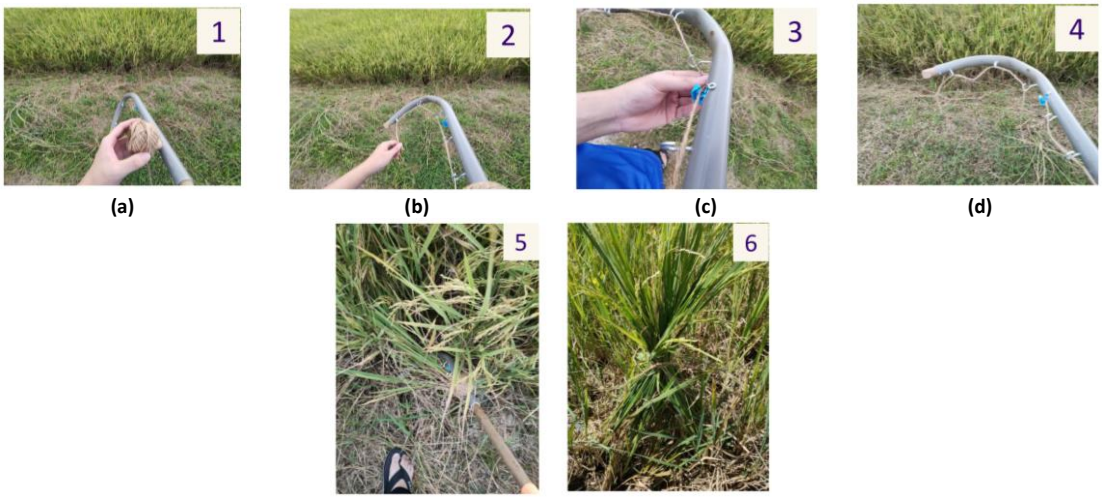


Figure 2: The developed prototype.



(a) **(b)** **(c)** **(d)**

(e) **(f)**

Figure 3: Steps in using the tool.

CONCLUSIONS

As a conclusion, the design and prototype for the simple tool according to the farmer's desire criteria were able to be created. The design of this product is simple but can still get the job done, which is to solve the lodged paddy rice problem. The features of this simple tool can be easily used by anybody, and the material selection for this product is overall cheap in price and not harmful to the environment. Furthermore, the rope used to tie the lodged paddy rice is also an environmentally friendly material. So, the farmers can use this product without needing to worry about harming the paddy rice or the soil. Further investigation into the tool used to solve lodged paddy rice indicates that many improvements can be made in the future. For example, an automatic approach can be added to the tool in order to tie the paddy rice automatically or automate the rope installation process. This will greatly reduce the overall time taken to tie one loop of the lodged paddy rice. A proper jig and fixture can also be included to reduce the overall time for the assembly process.

REFERENCES

[1] Y. Rajamoorthy, K. b A. Rahim, and S. Munusamy, "Rice Industry in Malaysia: Challenges, Policies and Implications," Procedia Econ. Finance., vol. 31, no. 15, pp. 861–867, 2015.
[2] M. Musa, N. Othman, and F. A. Fatah, "Determinants of Consumers Purchasing Behavior for Rice in Malaysia," Am. Int. J. Contemp. Res., vol. 1, no. 3, pp. 159–167, 2011.
[3] P. Sampanpanish, "Use of organic fertilizer on paddy fields to reduce greenhouse gases," ScienceAsia, vol. 38, no. 4, pp. 323–330, 2012.
[4] A. N. Shah, M. Tanveer, A. Rehman, and S. A. Anjum, "Lodging stress in cereal — effects and management: an overview," Environ. Sci. Pollut. Res., 2016.
[5] Department of Agriculture Peninsular Malaysia, "Paddy Production Survey Report - off Season 2015," Paddy Prod. Surv. Rep. - off Seas. 2015, 2016.
[6] G. M. D. Joseph et al., "Journal of Wind Engineering & Industrial Aerodynamics Determination of crop dynamic and aerodynamic parameters for lodging prediction," J. Wind Eng. Ind. Aerodyn., vol. 202, no. March, p. 104169, 2020.
[7] M. Adnan, A. Basir, M. Arif, S. R. Ali Shah, M. Khan, and Y. Jamal, "Impact of Grazing on Wheat Yield and Associated Weeds," Pakistan J. Weed Sci. Res., vol. 21, no. 3, pp. 351–358, 2015.