

PRELIMINARY INVESTIGATION ON ERGONOMIC CHALLENGES OF TRAY STACKING PROCESSES IN THE RICE TRAY SEEDING MACHINE AT THE NURSERY CENTRE

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ABSTRACT

The production methods for rice seed have been significantly impacted by the growing use of mechanical rice transplanting technologies, resulting in increased productivity and efficiency. For transplanting rice seedlings in paddy fields to go efficiently and effectively, a good rice seedling mat is necessary. Selecting premium seeds is the first step in creating a rice seedling mat. Next comes soaking and tossing, filling medium and planting pre-germinated rice seeds in trays, and keeping the seedlings in the nursery until they are ready to be transplanted. Biological and chemical risks, farm machinery, social and environmental stresses, and environmental factors all put agricultural workers' occupational health at risk. Work-related musculoskeletal disorders continue to be the most common cause of employee injuries, even with implementing mechanization. Not much attention has been paid to the ergonomic aspects of these technologies, especially the crucial part of the rice tray seeding machine. The aim of this study is to determine and examine the ergonomic issues related to stacking trays process in a rice tray seeding machine. Therefore, it has been determined that the delivery of five sets of rice trays from the stacking station to the pallet and the repetitive stacking in the tray station are crucial processes that need to be addressed. The suggested interventions aim to mitigate risks and enhance ergonomic risk factors.

Keywords: rice tray seeding machine, stacking process, ergonomic, musculoskeletal disorder

INTRODUCTION

In contemporary agriculture, mechanical rice transplanting has become a crucial technological advancement that contributes to increased productivity and decreased reliance on labor. This procedure requires the rice tray seeding machine, which is crucial for preparing the quality mat of rice seedlings from nurseries for field transplanting. Selecting premium seeds is the first step in making good rice seedling mat. Germination tests, that show a germination rate higher than 80%, come next. Subsequently, the procedure includes soaking for a full day, tossing for a full day, planting rice seeds and filling medium in trays, and keeping the seedlings in the nursery until they are prepared to be transplanted into paddy fields (Hossen et al., 2022). While there is no arguing the benefits of these technologies, to protect the health and safety of agricultural workers, it is imperative that ergonomic issues related to tasks like tray stacking be addressed.

Numerous occupational health hazards are commonly reported by farmers and other agriculture-related professionals. These hazards fall into several categories. This category covers biological and chemical risks, farm machinery-related risks, and stresses brought on by social and environmental variables. One of the main factors contributing to nonfatal workplace accidents and injuries among farmers has been found to be paddy cultivation (Meyers et al., 2000; Sharifirad et al., 2022). The ergonomic aspects of these technologies, especially the crucial part of the rice tray seeding machine system, have not received enough attention. This study aims to identify and explore the ergonomic challenges related to tray stacking within the context of a rice tray

seeding machine. Consequently, it has been determined that the act of continuously stacking rice trays in the tray station and moving five sets of rice trays to the pallet is a crucial procedure that needs to be addressed.

METHODOLOGY

The study was carried out at a particular nursery centre that uses rice tray seeding equipment. To evaluate ergonomic issues during tray stacking procedures, data were gathered through ergonomic assessments using standardised tools, operator interviews, and observations (Inthiyaz et al., 2021). The apparatus shown as figure 1 in this study. Figure 2 illustrates how every machine operation and related activity were watched over and documented.

Figure 1. Rice tray seeding machine used.

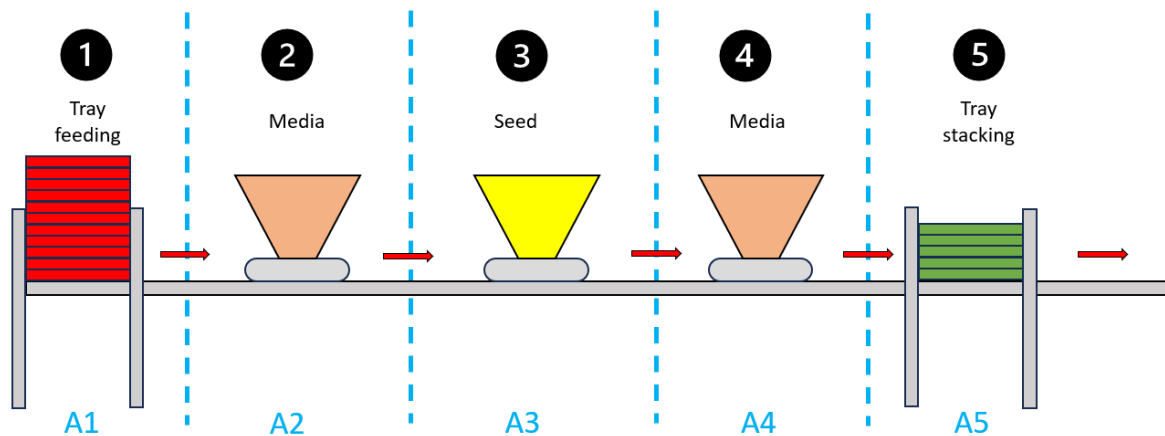
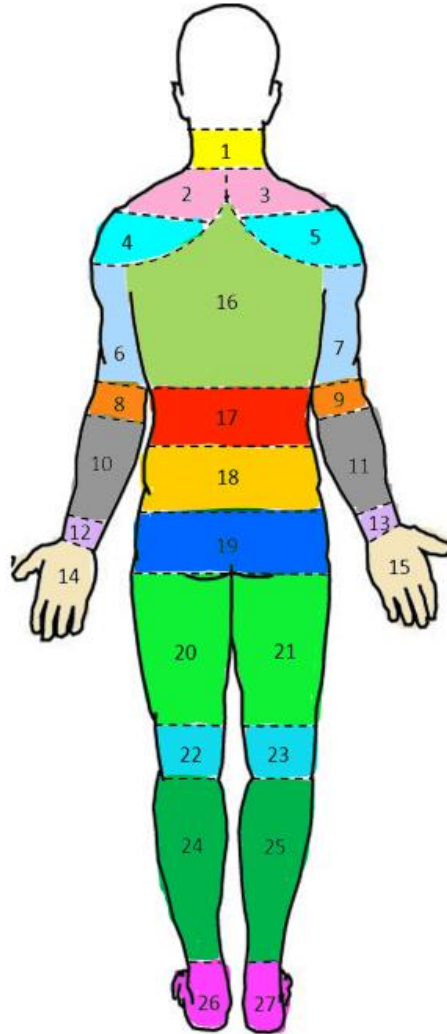


Figure 2. Rice tray seeding machine process and task observation based on original setup (A1, A2, A3, A4, A5).

Task observation and divided based on the machine's initial configuration into five separate tasks, denoted by the numbers A1, A2, A3, A4, and A5, as illustrated in figure 2. The worker actively used the machine to complete a task. The required data was gathered using the interview questionnaire (Inthiyaz et al., 2021). There were three separate sections to the questionnaire. The demographic data, which included the person's name, gender, age, height, and weight, was included in the first section. The worker's work history, comprising information on length of employment, previous experience with the task, and the work itself, made up the second section. The third section focuses on employees' self-report of how unpleasant or agonising certain tasks were for them after they finished them (refer to Figure 3).

Figure 3. Self-report on perceived pain/discomfort experienced by workers after performed the tasks in the questionnaire.



RESULT AND DISCUSSION

The results of the demographic survey are summarised in Table 1. Operators range in age from 26 to 56, with a mean age of 38. The standard deviation (SD) of 9.8 indicates that there is moderate variability in the age distribution. Knowing the age distribution is important because it affects things like experience, physical prowess, and vulnerability to musculoskeletal issues. Operators weigh an average of 67.4 kg, ranging from 49.0 to 100.0 kg. The wide variation in the operators' weights is indicated by the 17.2 standard deviation. Due to its impact on physical resilience and load-bearing capacities, weight is a significant consideration in ergonomic assessments. Operator heights average 159.1 cm, ranging from 148.0 to 188.0 cm. The moderate variation in height is indicated by the standard deviation of 11.3. When it comes to workstation dimensions, reach distances, and general comfort during task execution, height is a significant factor in ergonomic design. The average field experience of operators is 7.9 years, with a range of 5.0 to 15.0 years. There is variation in the operators' experience levels, as evidenced by the 5.2 standard deviation. Because more seasoned operators may react differently to task demands, experience plays a significant role in ergonomic assessments.

Table 1: Demographic information of the rice tray seeding machine workers included in the study.

| Variables | Range | Mean | SD |
|-------------------|---------------|-------|------|
| Age (years) | 26.0 - 56.0 | 38.0 | 9.8 |
| Weight (kg) | 49.0 - 100.0 | 67.4 | 17.2 |
| Height (cm) | 148.0 - 188.0 | 159.1 | 11.3 |
| Experience(years) | 5.0 - 15.0 | 7.9 | 5.2 |

The mean and standard deviation (SD) values for the different machine processes connected to the rice tray seeding machine are displayed in Table 2. The perceived intensity or difficulty of each process is indicated by these values. At various points during

the procedure, each task (A1, A2, A3, A4, and A5) was observed and recorded. For every batch, the tray seeding machine can yield about 286 trays per hour, or about 6124 trays over all the season. Preliminary research indicates that there are various ergonomic difficulties when stacking trays in a rice tray seeding machine. The tray out station (A5) has the highest mean of any process, suggesting that it is a more labour-intensive and challenging operation than the others. As seen in Figure 4, the A5 involved repeatedly stacking a load of five sets of rice trays from the stacking station to the pallet. Ergonomic issues like awkward postures, repetitive motions, and manual handling challenges fall under this category. The arrangement of the workstations might have played a role in the discomfort and musculoskeletal strain experienced by the operators.

Figure 4. workers performing tray stacking and delivery to pallet.



Table 2: Worker involvement in based on identical processes in rice tray seeding machine.

| Machine Process | | Mean | SD |
|-----------------|----------------|------|------|
| T1 | Tray In | 0.46 | 0.52 |
| M1 | Media Hopper 1 | 0.54 | 0.52 |
| S1 | Seed Hopper | 0.23 | 0.44 |
| M2 | Media Hopper 2 | 0.38 | 0.51 |
| T2 | Tray out | 0.62 | 0.51 |

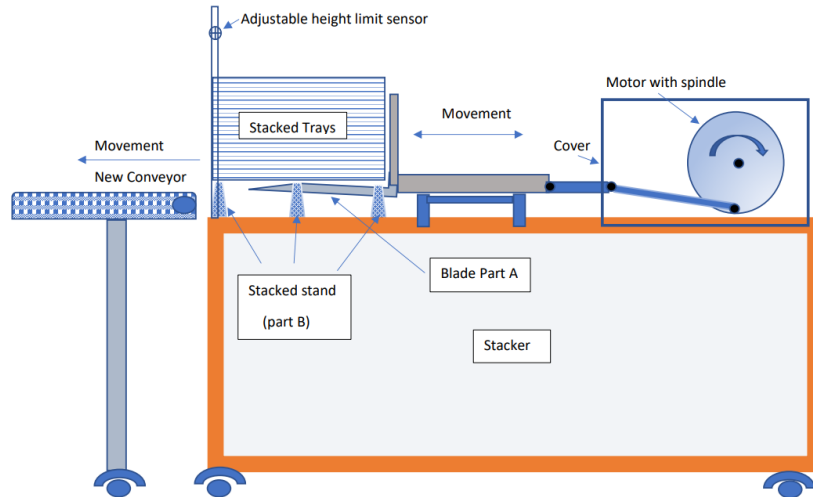
The self-reported pain and discomfort that rice tray seeding machine operators experienced during the tray stacking process is broken down in Table 3. Based on body parts and the corresponding pain or discomfort levels, which are expressed as percentages, the results are categorised. Of the self-reported data, the most noteworthy finding is that 45.5% of operators report having lower back pain. This suggests that repetitive movement-based activities or postures that strain the lower back may be a part of the tray stacking process. Even though 9.1% is a lower percentage, it's important to remember that the same percentage of operators complained of pain in their left and right shoulders. 9.1% is the constant amount of discomfort in the buttocks and both feet. These results suggest that some aspects of the tray stacking process may cause discomfort in these areas, even though it is not as common as lower back pain. Examining the workstations, seating configurations, and motions necessary for tray stacking may assist in determining the causes of discomfort.

Table 3: Self-report pain and discomfort results

| Pain/Discomfort self-report | | Result (%) |
|-----------------------------|----------------|------------|
| Code | Item | |
| 4 | Left shoulder | 9.1 |
| 5 | Right shoulder | 9.1 |
| 18 | Lower back | 45.5 |
| 19 | Buttocks | 9.1 |
| 26 | Left foot | 9.1 |
| 27 | Right foot | 9.1 |

The rice tray seeding machine's design must be altered to address the existing ergonomic issues. This can entail reassessing the tray stacking station intervention by modifying workstation configurations or the stacking mechanism, which incorporates ergonomic design concepts as illustrated in figure 5.

Figure 5. suggested tray stacker components.



SUMMARY

The results of the demographic survey show that there is a moderate degree of variation in the age, height, weight, and experience of rice tray seeding machine operators. For each batch, the machine can yield about 286 trays per hour, or 6124 trays over the course of the season. There are various ergonomic challenges associated with stacking; the tray out station (A5) has the highest mean, indicating greater difficulty and the need for additional workers. The most noteworthy result indicates that 9.1% of operators have shoulder discomfort and 45.5% of operators have lower back pain. 9.1% is the constant amount of discomfort in the buttocks and both feet. These results imply that certain aspects of the tray stacking procedure might be uncomfortable for these people. Changes to the machine's design are needed to address these issues, such as reassessing the tray stacking station intervention or integrating ergonomic concepts into the stacking mechanism.

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