UTILIZATION OF LAND LEVELLING INDEX DATA FOR VARIABLE RATE SEEDING APPLICATION

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ABSTRACT

Land levelling is very critical in rice cultivation since it is the first step in controlling variabilities. The variability of land level in rice fields would affect seeding operation which will cause uneven crop establishment and water management problems resulting in yield loss. In rice cultivation, land levelness of more than 85 percent at ±2.5cm from the average land level is considered as a good benchmark for rice crop establishment. The objective of this study is to determine the performance of variable rate seeding application in managing the land level variability to achieve good crop establishment. Crop establishment performance will be uniform in the field once the variable rate seeding is applied. Variable rate seeding will minimize the variability in crop establishment. Land levelling index data was gathered by using a Global Navigation Satellite System (GNSS) system which was attached to a tractor implement during the land smoothing operation. A treatment map for variable rate seeding established from data collected and generated using the geographical information system software (QGIS) consisted of 3 main regions of land levelling index which is LI 2.5 (x < ±2.5cm) , in-between LI 2.5 and LI 5 (2.5cm < x < 5.0)cm and more than LI 5 (x > 5.0cm). The control plot for the experiment was established using the normal or conventional practices of land levelling. The variable rate seeding was able to manage the land level variability which resulted in better crop establishment. There was no significant difference in terms of crop establishment among plots that used variable rate seeding compared to the control plot. Therefore, the result from this experiment showed that the variable rate seeding based on recommended levelling index could produce better crop establishment resulting in better crop yield.

Keywords: Land levelling index, precision farming, variable rate seeding, crop establishment

INTRODUCTION

Variable rate application is part of precision farming technologies where it can be used in managing variability within field or between field. It has a big potential to be used in rice production by managing the infield variability such as soil fertility, topography, climates, pest and diseases infestation which affect the crop establishment and contribute to yield loss. (Chan & Rukunuddin, 2010; GRISSO et al., 2011; Tran & Nguyen, 1999). Land levelling is very critical in rice cultivation since it is the first step of controlling variability. The variability of land levelling in rice fields would affect seeding operation which will cause uneven crop establishment and water management problems resulting yield loss (Omar, Abdul Hamid, Mohamad Ghazali, & Johari Jiken, 2010). In rice cultivation, land levelness which is more than 85 percent at ±2.5cm is considered as a pre-requisite for a good land levelness to achieve the targeted yield through set of population density and crop establishment(Abdul Hamid, Daud, & Omar, 2009). Missing plant spots and non-uniform crop establishment due to uneven land levelling are major issues to cater in rice direct seeding method. It is one of the factors that can contribute to poor crop establishment. Seeding under land saturated conditions is done using normal motor blower or using commercial high clearance 4-wheel tractor fitted with a spreader. The number of crop established must not be less than 200 plant per square meter or else correction work must be done to get the targeted crop establishment and population density and subsequently targeted yield. The objective of this study is to determine the performance of variable rate seeding application in managing the land levelling variability to achieve good crop establishment. Crop establishment performance will be more uniform in the field once the variable rate seeding is applied. Variable rate seeding will minimize the variability in crop establishment.

MATERIAL AND METHOD

Precise land levelling consist of land grading and smoothing surface by altering the field in such a way to create a constant slope of 0%. Land levelling status is determined by evaluating the levelness of the field and can be calculated by formula as below (H., Ayob; M.Y., Shahrin; D, Abu Hassan; K., 1991; Omar et al., 2010)

$$Levelling\ Index, LI_X = \frac{Number\ of\ (10\times10)m\ grid\ point\ within \pm x\ cm\ from\ mean}{total\ number\ of\ grid\ points}$$

A shallow cut/fill is required but not to disturb the soil unnecessarily. 8 plots with 1 hectare size each are selected for this study. Fields that achieve LI2.5 m will use a blanket seeding rate and fields that achieved LI2.5 – LI5 will use variable seeding rate.

Treatment map

Land levelling index data was gathered using a GNSS system which was attached to the tractor implement (drive harrow) during final tilling (land smoothing) as in figure 1. A treatment map for variable rate seeding established from the data collected by a geographical information system software QGIS consisted of 3 main regions of land levelling index which is LI2.5 ($x < \pm 2.5$cm) , in-between LI2.5 to LI5 (2.5cm $< x < 5.0$)cm and more than LI5 ($x > 5.0$cm) (Abdul Hamid et al., 2009; Taufik & Abu, 2018).

Seed Rate

The blanket seeding rate known as a normal seeding rate followed the current farmer's practice which was 160kg/ha. Variable seed rates were applied for different management zone/regions which was decided earlier into 3 main regions of land levelling index which was LI2.5 using normal seeding rate 160kg/ha, in-between LI2.5 to LI5 10% was added on top of the normal seed rate (176kg/ha) and more than LI5 25% was added on top of the normal seed rate (200kg/ha).

Variable Rate seeding

The variable seed rates were applied using a treatment map which was uploaded to a variable rate applicator controller system. The applicator (mechanized direct seeded spreader) must be calibrated before seeding.

The control plot for the experiment was established using the normal or conventional practices of land levelling. Crop establishment sampling was taken using (1×1)m sampling quadrate at 15, 25, 45 and 65 days after sowing (DAS).

Figure1. LI data collection during final tilling (land smoothing) using level sensor

Figure2. Seed broadcasting using mechanized direct seeding applicator

RESULT AND DISCUSSION

Land levelling index data gathered during final tilling (land smoothing) in eight plots has shown only one plot achieved LI more than 85%±2.5cm and blanket seeding rate at 160kg/ha was applied. Another seven plots achieved less than 85%±2.5cm where variable rate seeding were needed to be applied in order to manage the land level variability. Treatment map established consisted of three main regions which also included the amount of seeding rate based on the land levelling index as presented in figure 3. Three of seven plots consists of two different seeding rate regions and four plots contained three seeding rate regions The crop establishment samplings were collected based on LI regions and control plot shown in figure 4. The results confirmed that there was a significant difference for plots that used variable rate seeding compared to the control plot which used the conventional method (blanked seeding rate) at 15 DAS and 25 DAS. It was also noticed that there were no significant difference among all variable rate regions at 15 DAS and 25DAS which represented the uniformity of the crop establishment in the field.

Figure 3: Variable Rate Seeding Treatment Map.

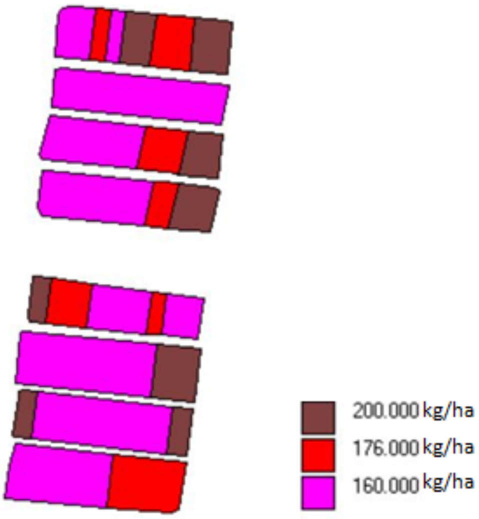
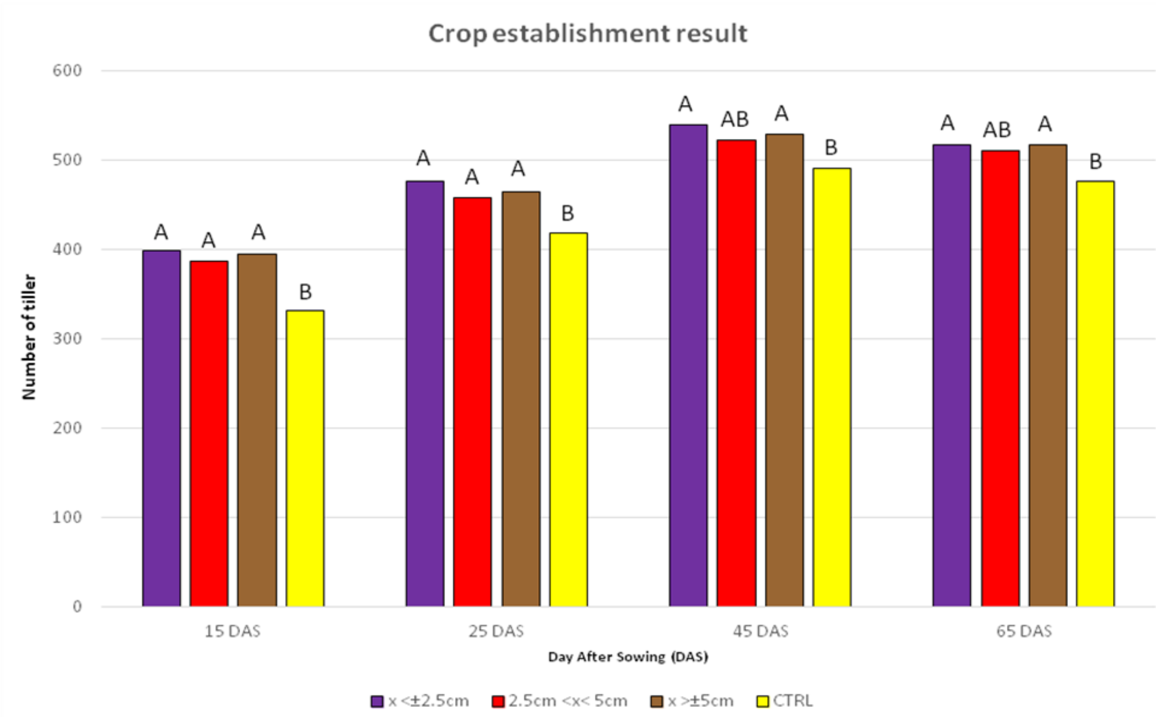


Figure 4: Crop establishment result (day after sowing (DAS) vs number of tiller



CONCLUSION

The results confirmed that the land levels variability can be managed thru variable rate application. The result from this work showed that variable rate seeding can achieve better crop establishment during the vegetative phase. the crop establishment uniformity achieved at 15 DAS and 25 DAS.

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