# **CHAPTER 03**

# **MATERIALS AND METHODS**

## **3.1 Experimental Location**

The field experiment was carried out in open fields at the agronomy division of the Rice Research and Development Institute (RRDI), Bathalagoda (Longitude- 80.264 0, Latitude- 7.5310) in the Low country Intermediate Zone (IL3) during of Sri Lanka. The experiment was conducted in the “Maha” season from September to December 2018. The annual rainfall of the area is 1500-2285mm and the daily mean temperature is 230C – 280C. The soil type of that area is Red Yellow Podzolic.

## **3.2 Description of the Treatments and Experimental Design**

The experiment for determination of optimum seed rate for nursery trays use for Machine Transplanting was conducted using the Complete Randomized Design (CRD) separately for the two varieties Bg 360 (three and half month’s variety with white short round shape, Keera Samba) and Bg 374 (three and half month’s variety with white intermediate bold shape, Nadu) in order to generalize the experiment. The experiment was consisting with four treatments and three replicates, which included with twelve experimental units for each variety. One nursery tray was considered as an experimental unit.

**Table 3.1 Treatment combinations**

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| 75g / tray  100g / tray  150g / tray  200g / tray  1  2  3  4  Treatment  Seed rate |

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As the design for the experiment, Comparison of mechanical transplanting with other establishment methods Randomized Complete Block Design (RCBD) was used separately for the two varieties Bg 360 and Bg 374. The experiment was conducted in two stages including the nursery period and period after field establishment to the end of vegetative phase in the field. The experimental design was consisting with three replicates and four treatments; therefore, twelve experimental units for one variety. One block was considered as one experimental unit and two fields were used separately for the two varieties.

**Table 3.2 Treatment combinations**

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| Broadcasting (BC)  Random Transplanting (RT)  Mechanical Transplanting (MT)  Parachute method (PA)  1  2  3  4  Treatment  Establishment method |
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## **3.3 Agronomic Practices**

### **3.3.1 Nursery Management**

The first experiment was determination of optimum seed rate for nursery trays for that the raised beds were prepared in the field for about 5 cm height, width of 60 cm and the length of 360 cm separately for the two varieties. The trays (30x 60cm) were arranged according to the experimental design and fine mud or fine textured soil without any pebbles was filled uniformly in to each tray up to 2.5cm thickness. The treatments were randomized and allocated to the trays accordingly and the trays were labelled according to the received treatment for identification (Figure 3.1). The seed samples of the two varieties Bg 360, Bg 374 which showed 90% germination percentage were selected. The seeds were distributed uniformly on the trays according to the seed rates allocated by each treatment after 24 hours soaking followed by 24 hours incubation period. The nursery beds were covered with coconut leaves for about 3 to 4 days, in order to avoid the damage from the high rain condition prevailed during that period and the damages from animals. Then the seedlings were hardened to the environment by exposing them to the sunlight during the morning period for some days and then the seedlings were fully exposed to the sunlight. The seedlings were raised for 12 days period and then uprooted for taking measurements.

R3, T4

R1, T1

R1, T3

R2, T2

R2, T4

R1, T4

R3, T2

R3, T1

R2, T1

R1, T2

R2, T3

R3, T3

Figure 3.1 Layout of Nursery tray experiment



Plate 3.1 Arrangement of the nursery trays for the experiment

For the second experiment comparison of Mechanical Transplanting with other establishment methods, nurseries are prepared as Wet bed for Random Transplanting, Parachute nursery, nursery trays for Mechanical Transplanting and the Broadcasting was done. The nursery beds for the Wed bed, Parachute are prepared according to the seed rates recommended by the Department of Agriculture (DOA) Sri Lanka and for the nursery trays use for machine transplanting the optimum seed rate found from the first experiment was used. The raised beds were prepared for wet beds by puddling, leveling the soil well and constructing of drainage canals to facilitate removal of water by occupying 1/10 of the area from the total area to be established (IRRI, 2007). The seed rate was used as the recommendations which was 40 kg/ha for the variety Bg 360 and 50 kg/ha for the Bg 374. The germinated seeds were scattered evenly on the nursery bed after 24 hours of water soaking followed by 48 hours of incubation. The raised beds were prepared for parachute trays (30\*60 cm, with 434 plugs) with 10 cm height, width of 60 cm and the length was adjusted according to the number of trays required. The trays were kept on the raised beds and filled with fine mud up to the 2/3 height of the cavities in the parachute trays. The seed rate use for the Parachute trays was 12 kg/acre for the both varieties Bg 360 and Bg 374. The germinated seeds after water soaked for 24 hours followed by incubation period of 24 hours, were distributed uniformly on the nursery trays as 3 seeds per each cavity and covered with a thin layer of mud. The nursery trays (60x 30 cm) were kept on levelled raised beds and the fine mud was filled up to the thickness of 2.5cm for the modified dapog nurseries use in mechanical transplanting. The seed rate used for Bg 360 was 100g per tray and the seed rate used for the variety Bg 374 was 150g per tray according to the results of the previous experiment. The germinated seeds were scattered uniformly on the trays after water soaked and incubated for 24 hours. The three nurseries were covered with coconut leaves from about 3 to 4 days period to prevent damages from high rain, animals’ ant to conserve the moisture. The hardening of the seedlings was done by gradually increasing the time period of seedlings exposing to the sunlight. The Direct sowing of seeds was done on the date of nursery establishment in order to get an even aged plants to get data for comparison of growth parameters.

### **3.3.2 Land Preparation**

The land preparation was done according to the recommendation of Department of Agriculture (DOA) Sri Lanka. After the basic land preparation practices the land was prepared according to the layout (Figure 3.2). The blocks were prepared with the dimensions of 7 m length and 4.5 m width, and 30cm space was kept between each block. The experiment was conducted in two fields for two varieties using the same layout.

R1,MT

R1, BC

R1, PA

R1, RT

R1,PA

R1, RT

R1, MT

R1, BC

R1,BC

R1, PA

R1, RT

R1, MT

Figure 3.2 Layout of the experiment field

### **3.3.3 Crop Establishment**

The broadcasting in the blocks was done according to the layout, on the day of nursery establishment in order to get uniform age crop stand. The seed rate used for Bg 360 was 75 kg/ha and 100 kg/ha used for Bg 374 according to the recommendations of Department of Agriculture (DOA), Sri Lanka.

The seedlings in the nurseries were uprooted and transplanted in the field when the seedlings were 12 days old as it was identified as the optimum seedling age (SA) for mechanical transplanting of seedlings and also in all the establishment methods transplanting of tender seedlings increased the production (Columbia and Division, 2013; Illangakoon et al., 2017; Krishna and Biradarpatil, 2009). The Wet beds were flooded before uprooting of seedlings to facilitate easiness of uprooting and avoid breakage of seedlings, washed the soil from the roots and buddle them in convenient sizes. In Random Transplanting the seedlings were poked in to the soil as three seedlings per hill without standard row spacing by the labors, in the blocks according to the layout.

The seedlings were thrown to the field from 1 m above the ground in the Parachute method as 35 to 40 plants per square meter according to the recommendations of Department of Agriculture, Sri Lanka.

The transplanter used for the mechanical transplanting was Kubota NSP-4W self-propelled walking behind type transplanter. The transplanter was capable of adjusting the within row space (WRS), per hill number of seedlings (PHNS), planting depth of seedlings (PD) and the between row space (BRS) was fixed as 30 cm. The machine was consisting with 5 WRS (12 cm, 14 cm, 16 cm, 18 cm, 21 cm), as the spacing of plants 30x 21.5 cm was used as wider spacing was having a positive impact on increasing the yield (Islam et al., 2015; Islam and Khan, 2017). The PHNS was adjusted as 3 - 4 seedlings per hill as it was identified as the optimum rate which should dispersed per hill to gain the maximum yield (Islam and Salam, 2017; Negalur and Halepyati, 2017; Rasool et al., 2013). There are 5 PD in the machine as 1.5 cm, 2 cm, 2.3 cm, 2.7 cm, 3 cm, 3.7 cm the middle gear which plants at 2.3 cm depth was used for planting the seedlings considering the soil type and the level of pudding the soil. The seedlings grown in the trays were introduced to the feeding platform of the transplanter.

### **3.3.4 Management Practices**

#### **3.3.4.1 Fertilizer Application**

The Fertilizer was applied according to the recommendation given by the Department of Agriculture (DOA) according to the three- and half-month age varieties and the method of establishment.

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| Time of Application  Urea (kg/ha)  TSP (kg/ha)  MOP (kg/ha)  Basal dressing  Top dressing 1 (3 WAS)  Top dressing 2 (5 WAS)  Top dressing 3 (7 WAS)  Top dressing 4 (8 WAS)    50  75  65  35  55  25  35 |

Table 3.3 Fertilizer recommendation for the three- and half-month age Transplanted varieties - DOA

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TSP – Triple Super Phosphate MOP – Murate of Potash

WAS – Weeks After Establishment

Table 3.4 Fertilizer recommendation for the three- and half-month age Direct Seeded varieties - DOA

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| --- |
| Time of Application  Urea (kg/ha)  TSP (kg/ha)  MOP (kg/ha)  Basal dressing  Top dressing 1 (3 WAS)  Top dressing 2 (5 WAS)  Top dressing 3 (7 WAS)  Top dressing 4 (8 WAS)    50  75  65  35  55  25  35 |

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#### **3.3.4.2 Weed control, Pest and Disease Control**

Weeds emergences were controlled through the manual weeding and flooding. The weedicide Sofit 300 EC (Pretilachlor + Safener) was applied to the field for control the weeds. Mimic 20F (Tebufenozide) was applied to control the Brown plant hoppers. Tatamida (Imidacloprid) was added to control the thrips attack and Stem borer was controlled through the application of Diazinon. The Klerat pellets (Brodifacoum 0.005%) and Gliricidia leaves were added to control the rat damages in the Broadcasted blocks.

## **3.4 Data Collection**

### **3.4.1 Growth Parameters of Rice Seedlings during Nursery stage**

Seedling height was recorded at 3 DAS (Days After Sowing), 6 DAS, 9 DAS and 12 DAS. Height was measured from the collar region to the apex of the seedlings. Randomly selected ten seedlings from the trays or nursery bed to take the seedling height.

The total root length was measured using the WinRhizo 2016 root scanning device which was used for morphological, architectural, topological and color analyzing of roots. Randomly selected ten seedlings for measuring the seedling height at 12 DAS were used for measuring the total root length by separating from the collar region. The roots were placed in a tray with water and inserted in to the scanner to get the total root length.

Plate 3.2 The Root Scanner WinRhizo 2016 and scanned image of total root length.

The seedling dry weight was recorded from the same sample of seedlings which were used to measure the total root length and the seedling height. The seedling samples were oven dried in the oven at 600 C temperature for 24 hours and the dry weight was taken after cooling in the desiccator (Rani, 2012; Vasudevan et al., 2014).

The leaf Chlorophyll content was measured using the SPAD meter (MINOLTA 502) 12 DAS at the time for uprooting to transplanting by selecting 10 seedlings randomly from each experimental unit.

Plate 3.3 SPAD meter (MINOLTA 502)

The number of seedlings per 25 cm2 was measured randomly in three places of the nursery trays using a 5 x 5 cm Quadrat for the experiment of Determination of optimum seed rate in nursery trays for Mechanical Transplanting**.**

The number of seedlings dispersed per hill according to the low gear, mid gear and the high gear from the transplanter with each seed rate was counted using the transplanter which was planned to use for Mechanical transplanting in order evaluate whether there was an impact of seed rate on the number of seedlings dispersed per hill.

### **3.4.2 Growth Parameters of Rice plants during the Early growth stage**

### The plant height, chlorophyll content of the leaves using SPAD meter and the ground cover percentage were recorded at one-week interval until the end of vegetative period.

The plant height was taken from the base to the tip of the top most leaf in the plant by selecting randomly 10 plants from each block.

SPAD meter (MINOLTA 502) was used to measure the Chlorophyll content of the leaves in randomly selected 10 plants.

The Ground Cover Percentage was measured using the beaded string method until the varieties reached 100%. Two strings with 2 m length were taken and 20 knots were made on each string at 10 cm apart. The two strings were diagonally placed in two locations of each block and counted the number of knots hitting the plant canopy by looking perpendicularly from the top. The ground cover percentage was taken by multiplying the number of knots hitting by 5 (Sarrantonio, 1991).

**2**

**1**

Figure 3.3 Layout for measuring ground cover percentage in the blocks.

The number of hills per square meter and total number of tillers per square were measured by randomly placing the 0.5 **x** 0.5 m quadrant randomly in two places of each block. The total number of tillers per square meter measured 2 months after field establishment at the end of the vegetative growth phase of the plants.