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Effect of Seedling Age at Trans Planting on Yield and Yield Components of Low Land Rice in Fogera Plain

Zelalem Tadesse*

Department of Agricultural Research, Fogera National Rice Research and Training Center, P.O. Box 1937 Fogera, Ethiopia

Abstract

Basically, there are two methods of rice plant establishment namely transplanting and direct seeding. Direct seeding is the major method of rice planting being used in Fogera plain. However, transplanting is the major means of rice planting used in other parts of the world Therefore, field experiments were conducted in the area for two growing seasons during the 2018 and 2019 cropping years. The objective of the experiment was to study the effects of seedling age at transplanting on the yield and yield components of the crop under rain-fed condition. The treatments consist of six seedling age 0, (dry seed as a control) 7, (pre-germinated), 14, 21, 28, 35 days old seedlings were laid in RCB Design with three replications. Data were collected on yield and yield components of the crop. The data were subjected to analysis of variance using SAS software. Economic analysis was also performed to compare the economic advantage of the treatments. The results of the experiment indicated that seeding age was (p<0.001) affecting, Plant height, number of total tillers per m2 and number of filled grains per panicle. Whereas seedling age also (p<0.01) affecting panicle length, number of filled grains per panicle and grain yield. Moreover age of seedlings for transplanting (p<0.001) affecting straw yield and thousand grain weight. The highest grain and straw yield (4.54 and 11.7 t/ha-1) was obtained from 21 days old seedling age respectively. The economic analysis indicated that 21 days old seedling age was the most profitable treatment with mean net benefit of 75132.0.Birr ha-1. Therefore it can be concluded that twenty-one days old seedling age in the nursery was appropriate and recommended for transplanting method of rice production in Fogera plain.

Keywords: Seedling age; Transplanting; Low land rice; Grain yield; Economic analysis

Introduction

Rice is one of the most important food crops and is considered as a major source of calories for more than half of the global population. More than 90% of rice is produced and consumed in Asia. The total world rice production has risen steadily from about 200 million tons (1960) to over 678 million tons. In the 2010/2011 and 2011/2012, the world paddy productions were estimated at 691.3 and 713.8 million tons, respectively. Globally, 158.9 million hectares (ha) of rice was harvested during the 2011/2012 (USDA, 2012).

Africa has sufficient land and water resource to produce enough rice to feed its own population and, in the long term, generate export revenues. Rice cultivars, rice-based cropping systems and the rice itself will, however, have to undergo adaptations and improvements in order to meet future demands for both food security of the growing population and environmental conservation [1-3].

Rice is a recent introduction to Ethiopia; its importance is well recognized as the production area coverage of about 10,000 ha in 2006 has increased to over 63,000 ha in 2018 (CSA 2019). The area coverage in domestic rice production has increased considerably linked with expansion of production in the wetland and upland areas with the introduction of suitable rice varieties for the different agro-ecologies. In line with the area expansion, the production levels have been increasing consistently over years. CSA (Central Statistical Authority) data indicate that rice production increased from 71,316.07 tons in 2008 to 171,854.1 tons in 2018. The number of farmers engaged in rice production has also grown year after year. Rice production has brought a significant change in the livelihood of farmers and created job opportunities for a number of citizens in different areas of the country. Currently, Amhara, Southern Nations, Nationalities and Peoples Region (SNNPR), Oromia, Somali, Gambella, Benishangul Gumuz, and Tigray regions are the rice producing areas in Ethiopia. The Amhara region takes the lion's share of producing the crop and accounted for 65-81% of the area coverage and 78-85% of the production in the years 2016-2018. According to the report of MoARD, the potential rice production area in Ethiopia is estimated to be over 5,590,895 ha. Most of Ethiopia's rice production potential area lies in the western part of the country. The national average yield of rice is about 2.8t ha^{-1} which is lower compared to the world average productivity of 4.6 tones ha^{-1}. Weeds, pests, soil nutrient deficiencies and terminal moisture stress are the major causes of low rice productivity in Ethiopia.

Rice is generally established through direct seeding or by transplanting. Direct seeding is the practice of sowing seeds directly in the main field. On the other hand, transplanting is the practice of raising seedlings in a nursery and moving them into the main field. The major advantages of transplanting over direct seeding are better weed suppression and higher grain yield. In some temperate Asian countries such as Japan and Korea, transplanting rice helped

***Corresponding author:** Zelalem Tadesse, Department of Agricultural Research, Fogera National Rice Research and Training Center, P.O. Box 1937 Forgera, Ethiopia; Email: tadesse@zelelam.et

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farmers to deal with the low temperature that can adversely affect the performance of direct-seeded rice at higher altitudes. Transplanting has high labour demands for uprooting nursery seedlings, puddling fields, and transplanting seedlings into fields [4].

Several researchers have emphasized the importance of seedling age and transplanting time on the performance of transplanted rice. When seedlings are transplanted at the right time, tillering and growth proceed normally with uniform stand establishment. If the age of a seedling is more than optimum, the seedling produces fewer tillers thereby resulting in poor yield. According to seedlings older than 35 days led to more prolonged recovery from transplanting shock than younger seedlings. It indicated that, in addition to seedlings age, transplanting time determined rice yield. Transplanting at the optimum age of seedlings and time is important for ensuring less risk of crop failures in rainfed lowland environments. According to delayed transplanting particularly at an inappropriate seedling age resulted in adverse effects on rice yields due to the compound effect of late-season drought and heavy insect and pest infestations [5].

The reported that transplanted rice matured earlier and escaped terminal moisture stresses than direct seeded rice. Farmers in Fogera plains of northwestern Ethiopia generally establish rainfed lowland rice through broadcast direct seeding. Rice production in the study often faces the problem of terminal moisture stress owing to abrupt ending of rainfall at the reproductive and grain filling stages of the crop. The farmers spend much of their family labour and money on weeding. The average rice productivity of the area is 2.53 ha^{-1} and is much lower than the world's average rice productivity of 4.4 t ha^{-1}. Terminal moisture stress, weeds and soil nutrient deficiencies are the major reasons for the low productivity of rice in Ethiopia. This research was therefore conducted to determine appropriate seedling age for transplanting for better rice production in Fogera Plains of northwestern Ethiopia.

Methodology

The study site

Effect of rice Seedling age at transplanting experiment was conducted for two consecutive years (2018-2019) cropping season in Fogera plain. The study site receives averages mean annual rainfall, minimum and maximum temperature of 1219 mm, respectively. The dominant soil type on the Fogera plains is black clay soil. The experimental soil was clayey in texture with a pH of 6.05.

Treatments and experimental design

The treatments consist of six seedling ages 0, (dry seed as a control) 7, (pre-germinated), 14, 21, 28, 35 days old seedlings were laid in RCB Design with three replications. The gross plot size was 4 m × 3 m with 1m spacing between plots and replications. Treatments were assigned to each plot randomly. Seeding at the nursery was staggered to coincide with the transplanting schedule. For field planting, seedlings were transplanted at the spacing of 25 cm between rows and 20 cm between plants. Three seedlings were planted per hill according to the planned treatment. The variety Edget was used for this experiment. Recommended fertilizer rates of 69/23 kg N/P2O5 ha-1 for each treatment was used Urea fertilizer was applied for all the plots few days after transplanting just after the seedlings recover from the transplanting shook [6,7].

Nursery management

In order to raise the seedlings first a mixture of soil and rice husk at a ratio of 8:1 was prepared. Then the mixture was spread on the plastic covered seed bed at a thickness of about 5 cm. The rice seeds were broadcasted at a rate of 25 kg seed/100 m^2 seed bed. Finally the seeds were covered with very thin layer of soil and dry grass which was removed when the seeds started emerging. The seed bed was watered in the morning and night every day till the transplanting. Hand weeding was used to control the weeds from nursery field. It is necessary to develop the healthy & weeds free nursery, which is essential to get maximum yield. Land was well prepared during puddling [8].

Data collection and measurement

Data were collected from a net plot size of 3m × 2m avoiding two rows from the left and two rows from the right as border rows and 50 cm from each of the top and bottom sides of the plots. Data was collected from the net plot area on plant height, Panicle length, number of total number of fertile panicle number of filled spiklets/panicle, thousand seeds weight, grain yield, straw yield and harvest index.

Results

Plant height

The results of the analysis of Variance Showed that, the highest plant height recorded from old seedling age in 2018 and 2019 growing season, respectively. Whereas the shortest Plant height was observed from dry sowing treatment which was statistically similar in both years. The combined analysis of variance over two years result indicated that effects of seedling age at transplanting very highly significantly affected Plant height ($p<0.001$) The taller plant height was recorded from 14 days old seedling age followed by 21 days seedling age (91.2) which were statistically similar. On the other hand, the shortest plant height was obtained from the control treatment or dry sowing. The result indicated that plant height increased significantly by planting younger seedlings as compared to older .This might be due to higher phyllo crone production in younger seedlings before entering to reproductive stage, as well as less transplanting shock at this stage. These results are in line with who recorded more plant height after transplanting younger seedlings, as compared to older seedlings. Significant variation in plant height was also observed due to variation in seedling age [9,10].

Panicle Length

Rice panicle length was significantly ($P<0.01$) responding to seedling age at transplanting. The longest panicle length was observed at old seedling age followed by 7 (pre-germinated), old seedling age (18.0 cm) respectively which was statistically similar in 2018. The shortest panicle length (15.7 cm) was recorded from the control treatment (dry sowing).In addition to this the highest panicle length was recorded from a younger seedling age of respectively in 2019. The minimum panicle length of was obtained from 7 days seedling age (pre-germinated) and the control treatment which was statistically similar. The combined analysis of variance over two years result showed that effects of seedling age at transplanting highly significantly affected Plant height ($p<0.01$) The taller panicle length (18.6 cm) was recorded from 14 days old seedling age followed by 21 days seedling age. On the other hand, the shortest panicle length (15.7 cm) was obtained.