ZIBELINE INTERNATIONAL PUBLISHING

ISSN: 2521-5051 (Print)
ISSN: 2521-506X (Online)
CODEN: ASMCCQ

Acta Scientifica Malaysia (ASM)

DOI: http://doi.org/10.26480/asm.02.2020.61.63

RESEARCH ARTICLE

EFFECT OF PLANTING METHODS ON YIELD AND YIELD COMPONENTS OF SPRING RICE IN BARDIYA, NEPAL

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ARTICLE DETAILS

Article History:

Received 15 February 2020
Accepted 18 March 2020
Available online 13 April 2020

ABSTRACT

Most of the farmers are planting rice manually in Nepal due to lack of adequate knowledge and farm equipments. A field experiment was conducted using Hardinath-1 variety of rice during the spring season 2019 to evaluate the effect of planting methods on yield and yield attributes of rice in Bardiya district of Nepal. Four planting methods: manual transplanting, mechanical transplanting, drum seeder seeding and seed drill seeding were replicated five times in randomized complete block design with each plot size of 6m^2. The highest plant height was recorded on drum seeder seeding (68.46 cm) followed by mechanical transplanting (66.08 cm) and seed drill method (65.10 cm) but the lowest height was recorded on manual transplanting (60.84 cm). The highest number of effective tiller/m^2, panicle length and number of filled grain per panicle was obtained with mechanical transplanting (429.8, 24.82cm, 188.2) followed by drum seeder seeding (351.2, 24.02 cm, 171.6). The sterility percent was found higher at seed drill (22.78%) and drum seeder seeding (20.58%) as compared to mechanical (19.95%) and manual transplanting (18.91%). Thousand grains weight was higher at manual transplanting (22.12g) followed by mechanical transplanting (21.80g). The highest yield was obtained with mechanical transplanting (5.64 mt/ha) followed by drum seeder seeding (4.13mt/ha), whereas the lowest yield was obtained with seed drill (3.25mt.ha) followed by manual transplanting (3.73mt/ha). Therefore, mechanical transplanting could be the appropriate method of rice planting to increase productivity of rice in Nepal.

KEYWORDS

Planting methods, mechanical transplanting, transplanting, yield components, rice yield.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is the most important staple food crop of Nepal. Rice ranks third after wheat and maize in terms of global production whereas it ranks first among all the cereal crops in nepal in the term of area and production (Gowda, 2012; AICC, 2019). Productivity of rice in Nepal is 3.51 mt/ha while the productivity of bardiya is 4.06 mt/ha (AICC, 2019; MoALC, 2018). There is a decreasing trend in the area cultivated with rice due to less profitability from rice farming. Some of the reasons identified for less profitability are the decreased yield due to inappropriate method of planting and increased cost of cultivation due to increased cost on transplanting and weeding. Moreover, industrialization has led to increased labor migration to city areas and shift towards alternative rural employment causing severe farm labor shortage. Transplanting alone costs about 15% of total rice production cost and delayed transplanting due to labor shortage causes substantial loss in yield (Ponnuswamy et al., 1999). Therefore, there is demand of alternative methods to replace transplanting methods to find the suitable technique of planting or sowing which can tackle the labor scarcity in puddled rice.

Some study reported that transplanted rice produced maximum grain yield which was significantly higher than broadcasting and direct seeding techniques (Jaiswal and Singh, 2001). Moreover, transplanting ensures uniform crop stand, better control of weeds, uniform ripening and less lodging. In spite of all these advantages, manual transplanting is quite expensive, laborious, time consuming and causes lot of drudgery. Manual transplanting takes about 300 to 350 man hours / ha which is roughly 25 % of the total labor requirement of the crop (Goel et al., 2008). Non availability of labors for transplanting at appropriate time leads to delay in transplanting. Optimizing plant density and timeliness of operation is considered essential for maximizing yield in rice. In order to get the maximum returns, cost of cultivation has to be reduced through minimizing the dependence on labor for transplanting. Under such conditions mechanical transplanting of rice can be considered as the most promising option, as it saves higher labor cost, ensures timely transplanting and attains optimum plant density that ensures the high productivity and profitability. Keeping this in view, a study was conducted in Bardiya, Nepal to evaluate effect of different planting methods of rice on yield and yield components.

2. MATERIALS AND METHODS

A field experiment was conducted during spring season of 2019 in Bardiya, Nepal (at latitude of 28° 17" to 28° 39" North and longitude 81° 3" to 81°41 East and at 138 masl). The soil of the field was sandy loam type and pH was 7.5. The mean monthly temperature ranges from 17 ºC to 34 ºC and relative humidity ranges from 21% -52% with the total rainfall of about 342.4 mm during the crop period.

Quick Response Code	Access this article online	
	Website: www.actascientificamalaysia.com	DOI: 10.26480/asm.02.2020.61.63

Cite the Article: Ram Chandra Regmi, Raju Kharel, Rajendra Regmi (2020). Effect Of Planting Methods On Yield And Yield Components Of Spring Rice In Bardiya, Nepal. *Acta Scientifica Malaysia, 4(2): 61-63.*

The variety used for the experiment was hardinath-1 which was laid out in RCBD with five replications having each plot of 6m^2. Treatment comprised of four methods of planting:

T1- Manual transplanting
T2- Mechanical transplanting
T3- Drum seeder seeding
T4- Seed drill seeding.

For manual and mechanical transplanting seedling were raised by dry bed method and dapog method on tray, respectively. 30 days old seedling and 21 days old seedling was used for transplanting by manual and mechanical methods respectively. In drum seeder seeding pre germinated seed was used for sowing and in seed drill seeded dry seed was used for sowing on the same day when transplanting was done by manual methods and mechanical methods.

Field was prepared and puddled by power tiller. However, only one dry ploughing was done for seed drill seeding. NPK, 100:30:30 was supplied through the application of urea, DAP and MOP. DAP, MOP and split dose of urea was applied as the basal dose during the field preparation. The further 2 split dose of urea was applied at the 25 DAT/S and 50 DAT/S. After the emergence of weeds, nomine gold (Bispyribac sodium 10% SC) @0.5ml/ltr was sprayed at the field at 25 DAT/S which was followed by manual weeding at 45 DAT/S.

3. Observations

3.1 Morphological and yield attributing characters

Random sampling was followed for sampling for morphological and yield attributing parameters.

3.1.1 Plant height

In each plot 10 hills were randomly selected. From the selected hills height of plant was measured at 30 DAT/S and thereafter measured on every 15 days interval and during harvesting. Plant height before the panicle emergence it is measured from the base of the plant to the ligule of the fully opened top leaf. After panicle emergence, it is measured from base of the plant to the base of the panicle or up to the ring at the base of the panicle/spike.

3.1.2 Number of effective tillers per square meter

In each plot an area of square meter was randomly selected with the help of an iron frame of 1m^2 then the number of effective tiller were recorded at the time of harvesting.

3.1.3 Panicle length

Ten Panicles from each plot were randomly selected and pulled off from the tiller. The length of each collected panicles were measured by using scale. The length was measured from tip of the topmost grain to the base of the panicle.

3.1.4 Number of filled grains per panicle

The number of filled grains per panicle was counted from the ten selected panicle of each plot.

3.1.5 Number of unfilled grains per panicle

The number of unfilled grain was counted from the panicle that was selected for counting the filled grains of each plot. Sterility percentage was then calculated.

3.1.6 Thousand grains weight

Thousand filled grains from each plot were collected and dried to lower down the moisture content to 14%. Then it was weight by electronic balance.

3.1.7 Grain Yield

Plants within 50 cm from the border were excluded for measuring grain yield. Then, 1 m^2 was demarcated by using 1m^2 square frame in random place in each plot. Crops from those area, were harvested, sun dried for 2 days and bundle was made. Then, the harvested crop are threshed manually and cleaned. Cleaned grains from 1m^2 of each plot were weighed by portable electronic balance and yield was converted into mt/ha.

The moisture percentage of grains of each plot was measured by portable automated moisture meter and finally grain yield was adjusted at 14% moisture level by using following formula,

$$\text{Adjusted yield at 14\% moisture} = \frac{(100-\text{MC})}{(100-14)} * \text{Measured grain yield}$$

Where, MC is the moisture content in percentage of the grains.

3.2 Statistical analysis

The data recorded on different observations were tabulated and analyzed statistically by using the techniques of analysis of variance (ANOVA) through statistical package R- Studio software. Critical difference at 0.05 probability level was worked out to compare the treatments when 'F' test was found significant and the means were compared using Duncan's Multiple Range Test. (DMRT)

4. Result and Discussion

The data on the plant height at harvesting revealed that plant tends to be taller at drum seeder seeding (68.46cm) followed by mechanical transplanting (66.08cm) whereas lowest height among the planting methods was observed at the manual transplanting (60.84cm) followed by seed drill seeded (65.10cm). This may be due to the absence of transplanting shock in direct seeded rice. Kumari & Sudheer (2015) reported the similar result of higher height in the drum seeder seeded rice. The effect of planting methods on number of effective tillers per square meter was found to be significantly different. The number of effective tillers per square meter was highest at mechanical transplanting (429.8) which was followed by drum seeder seeded (351.2) and manual transplanting (334.0). While, the lowest number of effective tillers per square meter was found at seed drill seeded (233.2). Machine transplanting rice has higher effective tillers because it provides more room for both canopy and root growth resulting in increased uptake of nutrients which would have favored increased production of effective tillers or panicles (Sheeja et al., 2012).

The panicle length was found higher in mechanical transplanting (24.82cm) at par with drum seeder seeded (24.02cm) followed by manual transplanting (23.42cm) and seed drill seeded (22.40cm). Sreenivasulu & Reddy, (2014) found out similar higher panicle length in mechanical transplanting on the study conducted for the year 2009, 2010 and 2011. Similarly, the number of filled grain was highest in mechanical transplanting (188.2) followed by manual transplanting (173.2) at par with drum seeder seeded (171.6) and least number of filled grains per panicle was recorded at the seed drill seeded (121.8). Sreenivasulu & Reddy, (2014) found out the higher number of filled grain per panicle in mechanical transplanting on the study conducted for the year 2009, 2010 and 2011.

Sterility percentages was found higher in the seed drill seeded (22.78%) at par with drum seeder seeded (20.58%). While, least sterility percentages was found at manual transplanting (18.91%) at par with mechanical transplanting (19.95%). Hossain et al. (2002) reported the similar result of highest sterility in the direct seeded rice. Thousand grains weight was found highest in manual transplanting (22.12g) at par with mechanical transplanting (21.80g) followed by seed drill seeded (21.48g) and drum seeder seeded (21.12g). Similar result of higher thousand grains weight in manual transplanting was reported by sheeja et al. (2012).

Yield was highest in the mechanical transplanting (5.64mt/ha) followed by drum seeder seeded (4.13mt/ha) and manual transplanting (3.73mt/ha) whereas the lowest yield was recorded at the seed drill seeded (3.25mt/ha). Sheeja et al. (2012) documented the result of highest yield of rice in mechanical transplanting in comparison to conventional or manual transplanting, drum seeding and broadcasting. Highest yield recorded on mechanized transplanting might be due the use of younger seedling, which preserves a potential for higher tillering and rooting. Better vegetative growth and assimilate translocation leads to increased number of panicle per square meter and fertile grains per panicle resulting in higher grain yield (Sheeja et al., 2012).

Table 1: Effect of planting method on yield and yield components of spring rice in Bardiya, Nepal 2019

Planting method	Plant height(cm)	Effective tiller/m^2	Panicle length(cm)	Filled grains per panicle	Sterility percent (%)	Thousand grains weight(g)	Yield (mt/ha)
Manual transplanting	60.84^{c}	334.0^{c}	23.42^{b}	173.2^{b}	18.91^{b}	22.12^{a}	3.73^{c}
Mechanical transplanting	66.08^{b}	429.8^{a}	24.82^{a}	188.2^{a}	19.95^{b}	21.80^{ab}	5.64^{a}
Drum Seeder seeding	68.46^{a}	351.2^{b}	24.02^{ab}	171.6^{b}	20.58^{ab}	21.12^{c}	4.13^{b}
Seed drill seeding	65.10^{b}	233.2^{d}	22.40^{c}	121.8^{c}	22.78^{a}	21.48^{b}	3.25^{d}
SEM(±)	0.683	0.594	0.164	19.748	1.680	0.025	0.0018
LSD-0.05	1.703	9.557	0.835	9.157	2.671	0.323	0.088
F-test	s	s	s	s	s	s	s

Note: LSD-0.05: least significant differences at 5% level of significance; SEM (±), standard error of mean; s: significantly different, Letters a, b, c, d represents the ranking of treatments according to DMRT at 0.05 level of significance.

5. Conclusion

The effect of planting methods on yield and yield components of spring rice in Bardiya, Nepal was studied and the effect of planting methods on the plant height, number of effective tillers per square meter, panicle length, number of filled grains per panicle, sterility percentages, thousand grains weight and yields was assessed. Mechanical method of transplanting was found to be best method of planting rice resulting highest number of the effective tillers per square meter (429.8), larger panicle length (24.82cm), highest number of grains per panicle (188.2) and highest yield (5.64mt/ha). The highest plant height was found at drum seeder seeding (68.46cm) followed by mechanical transplanting (66.08cm).

The higher thousand grains weight was found manual transplanting (22.12g) at par with mechanical transplanting (21.80g). Similarly, the least sterility percentages was found at manual transplanting (18.91%) at par with mechanical transplanting (19.95%).Thus, the mechanical method of planting rice can be recommended as suitable method of planting rice for improvement of the yield and yield components in comparison to the manual transplanting, drum seeder seeding and seed drill seeding. However, drum seeder seeding can also be considered as an alternate strategy for planting the rice after mechanical transplanting, so that the yield can be maintained. Similarly, further study may be required to assess the effect of planting method on growth, yield and yield components of rice. The findings of this study could be beneficial for students and researchers willing to conduct similar studies as the spring season short duration rice is most to be promoted as it is high yielding than summer rice.

Acknowledgement

The authors are thankful to Prime Minister Agriculture Modernization Project (PMAMP), Agriculture and Forestry University (AFU) and Rice Superzone, Bardiya for their support provided to carry out this research and for their co-operation.

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