Afghanistan Research Journal
ISSN (Online): 0000-0000
Volume 1, Issue 1, pp. 1-11, December 2021

Effect of Planting Methods and Nutrition on Yield of Three Rice Varieties

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Abstract
Rice (*Oryza sativa L.)* is the most important cereal crop. The effect of planting methods and nutrition on the yield of three rice varieties was assessed under the greenhouse. Factorial experiment, three cultivation methods [dry direct seeding (DDS), wet direct seeding (WDS) and transplantation (TP)], three nutrient levels, [100% inorganic, 50% inorganic +50% organic and 100% organic], and three rice varieties (Pathumthani-1, RD57, and RD41) was considered with the layout of completely randomized design (CRD) with four replications. Moreover, yield and yield components data were collected from the rice plant. ANOVA was carried with IRRISTAT 5.0. The result showed that 100% inorganic level had more productive tiller than the other two levels. 50% inorganic +50% organic under DDS method, 100% organic under WDS and 100% inorganic under TP method had performed well on filled grain per panicle. However, all varieties suffered from the nutrient deficit under the TP method which caused high unfilled grain under 100% inorganic and 50% inorganic+50% organic and 100% organic levels were decreased by 21.05 under the DDS method. Finally, seed weight was high for Pathumthani-1vareity with no significant difference among the variety, but RD57 reduced by 13.88% under WDS than the TP method and no difference was found for RD41 under TP and WDS methods. The yield of Pathumthani-1 variety was increased by 22% under TP than WDS and DDS methods. The nutrient level has no significant differences on grain yield of RD41 variety. RD57 grain yield was high under TP and DDS methods and no significant difference was found for RD41 under TP and WDS methods of cultivation.

Keywords*:* Cultivation, Nutrient, Organic, Rice, Yield

INTRODUCTION

Globally, rice (*Oryza sativa* L.*)* is cultivated on 156 million hectares, and it is grown on 85% of the area in Asia (Yong Li, Jirka Šimůnek, Longfei Jing., 2014). Rice crop has a high amount of carbohydrates but a low amount of proteins, fiber, and lipids with the vitamins (B1, B2, and B6), and also has less amount of minerals and antioxidants (IRRI, 2013). Firstly, it has been predicted that rice cultivation can influence directly 2.3 billion farmers' life because they are already engaged in rice cultivation if any problem occurs it will change the socio-economic aspect of farmers over the world (Ali, A. M., Thind, H. S., & Sharma., 2014).

Moreover, it is also vital that without rice there will be less chance of survival and also hazard for humanity because it feeds the world population (Ali *et al*., 2014). To solve these problems, it is required to propose dry direct seeding (DDS) which can be a good alternative way for transplanting method because of less consumption water than the others and also this method does not require puddling of the soil (Ali *et al.*, 2014). Nowadays, direct seeding is a very usual and practical way for the cultivation of rice in lowland conditions and it may be used by either broadcasting or dibbling cultural practice (Li *et al.*, 2014). Each of these methods has its effect on the grain yield of rice (Abha Mishra, Vilas M., 2009). Especially the root growth of rice compared with the traditional method of cultivation (transplanting) (Li *et al*., 2014). In addition, there are many reforms in cultivation methods and changing from transplanting to direct seeding. Cultivation with direct seeding has more benefits as it can save labor and water (Mortimer, A. M., and Riches.2008). In contrast, weeds are a huge drawback of this method and it can be easily controlled with the application of chemical herbicide. Finally, it is required to reduce the water requirement of rice and it is needed to

cultivate rice by direct seeding (Naklang, Kunnika Shu, & Fukai Nathabut., 1996). Integrated nutrient management (INM) is a broad-based cure to manage the extreme soil fertility weakening or accumulation and this can help the soil know more about its condition and also a very nice approach to judge and handle the nutrient stocks to get this satisfaction and sustainable production of rice (Naklang *et al*., 1996).

Moreover, (INM) is a very good option for the farmers to achieve a good yield from their soil fertility objectives. INM is a very nice approach to judge and handles the nutrient stocks in the soil in order, to find the alternative way for inorganic nutrients and to have a more satisfying product as well as sustainable production of rice (Buresh, R.J., and A. Dobermann., 2010). Finally, direct seeding can have a more balanced appearance to get water from different layers of the soil (Weerakoon, WMW Mutunayake & MMP Bandara., 2011). And thereby it can tolerate drought for a long duration of time than the transplanted crops (Mostafa Harby, Naoya Fujimoto., 2014). In comparison, those plants when growing under traditional rice field have lower root mass in the top layer, and also one serious problem can raise with transplanting while carrying of seedling to the main field (Naklang *et al*., 1996). In this case, the goal of this research is to find the suitable planting method and nutrition level on yield of three Thai rice varieties.

Materials and Methods

This experiment was conducted at the Green House of Agricultural Systems and Engineering (ASE) of the Asian Institute of Technology (AIT) from November 22, 2016, up to March 24, 2017, for one growing year, in the Khlong Luang district, Pathum Thani province, Thailand (14.0791°'N, 100.6114° E) with 2.27 meter from mean sea level. This research was set up in factorial experiment or CRD and in this study, seeds of rice were planted under three different methods of cultivation: dry direct seeding, wet direct seeding and transplanting, and Three different levels of nutrient such as 100% inorganic, 50% inorganic +50% organic, and 100% organic and three varieties of rice such as RD57, RD41, and Pathumthani-1 were used in this investigation. The soil for this experiment was collected from Agricultural Systems and Engineering (ASE) research field and the soil characteristics were clay soil. Rice plants were fertilized with the local recommended rate of 180 kg/ha of N-P-K (16-16-16) right before transplanting and the integrated nutrient was 100% inorganic (N1), 50% inorganic + 50% organic (N2), and 100% organic and (N3) and the rate of nutrient application to each level was 0.58 g/pot, 0.29 g+3.25g/pot, and 6.5 g/pot respectively (Heluf, G. & Mulugeta, S., 2006). Urea was added as a deficiency dose of 0.25 g/pot at the tillering stage and the rate OM rate was 2 t/h (Belder, P Spiertz, JHJ Bouman., 2010). Tensiometer equipment was used to measure the soil moisture and it was installed in the two pots and all the pots were watered at the level of -5 kPa when the tensiometer was dried and then water was added slowly to reach the water level to -5 kPa (Borrell, Andrew Garside & Alan Fukai., 1997). All the treatments were applied with the same amount of water with the help of a laboratory beaker (Bouman, BAM Tuong, & To Phuc., 2001). Yield and yield components data such us, Number of panicles per plant was counted manually and the number of productive tillers produced panicle was counted as a panicle in each plant to measure the number of the grains per panicle, so it was needed to collect the number of grain from each panicle per plant and then threshed them by hand and separated them into the filled grain and unfilled grain. It was measured the number of each grain. 1000- Seed weight, the moisture content of grain was measured Grain Moisture Meter (GMK). This equipment can determine easily moisture content of grains and the digital machine automatically start reading the moisture content of grain and when the moisture content was 14% it was the time for harvesting. The 1000- seed weight was measured from the total grain per pot.

The grain yield per plant was counted when the moisture content of all the seeds reach 14% then all of them were weighed and it was presented in grams per pot.

Statistical Analysis

The data were statically analyzed using IRRISTAT 5.0 software and to compare all these treatments in this experiment where the test probability (LSD) was also considered in this experiment.

Results

Table 1: Analyze of Variance and Effect of Different Planting Methods and Nutrition on Yield and Yield Components of Rice

Term	Number of panicle pot^{-1}	Panicle length (cm)	Number of grain panicle^{-1}	Number of filled grain panicle^{-1}	Number of unfilled grain panicle^{-1}	1000- grain weight (g/pot)	Grain yield (g/pot)
Varieties (V)	**	**	**	**	**	**	**
Cultivation (C)	**	**	Ns	Ns	**	**	**
Nutrient (N)	**	Ns	Ns	Ns	Ns	Ns	**
V × C	ns	Ns	*	Ns	Ns	**	*
V × N	*	Ns	Ns	Ns	Ns	Ns	*
C × N	ns	Ns	Ns	*	*	Ns	ns
V × C × N	ns	Ns	Ns	Ns	Ns	Ns	ns

Note. ** P<0.01 highly significant *P<0.05 significant P≥0.05 ns: not significant.

Analyze of variance (Table-1) show that among all yield and yield competent, the effect of varieties was highly significant on all yield component (Table-1). The cultivation method was non-significant on the number of grains per panicle and the number of filled grains per panicle and other components was highly significant. The effect of the nutrient level was highly significant on the number of panicles per pot and grain yield and the rest was non-significant.

Finally, the interaction of variety and cultivation method was highly significant on 1000-seed weight and significant on several grains per panicle and grain yield and also the two-way interaction of variety and nutrition level was significant on several panicles per pot, grain yield per pot, and two-way effect of cultivation and nutrient level were significant on several filled and unfilled grain per panicle and the rest three-way interaction was non-significant.

Number of panicle per plant

The number of panicles in each pot was collected before harvesting and the number of panicles in each pot was manually counted and then the total number of the panicle were noted for each pot (Ghadirnezhad, R. & Fallah, A., 2014). The effect of nutrient level and variety on the number of panicles per plant was significant (P<0.05). 100% inorganic level was the highest number of panicles than the other nutrient levels and there was a significant difference between 100% inorganic level and 50% inorganic +50% organic level with Pathumthani-1 variety. Moreover, there was not statistically any difference among Pathumthani-1and RD57 varieties under 100% inorganic nutrient level, but the difference was found with RD41variety.

Pathumthani-1 was decreased by 13.36% under 50% inorganic +50% organic treatment than the 100% inorganic level. There was no difference between RD57 and RD41 varieties. 50% inorganic +50% organic nutrient level decreased for RD57 and RD41 varieties and it was different for Pathumthani-1 variety under 100% inorganic nutrient level. Moreover, 50%

inorganic+50%organic treatment was rose by 6.57% than the 100% organic nutrient level with Pathumthani-1variety. There was not statistically any difference for RD41 under the 100% organic and 100% inorganic (Table 2).

Table 2: Effect of Nutrient Level and Variety on Number of Panicle per Pot

Variety	Panicle number per pot		
	100% inorganic	50% inorganic +50% organic	100% organic
Pathumthani-1	18.7	16.2	15.2
RD57	17.9	14.1	15.4
RD41	16.1	14.2	15
LSD (0.05)	1.4		

Note. LSD: Least significant difference.

Length of Panicle

Length of the Panicles was measured in (cm) from the base of the neck node to the highest tip of panicles in the plant with a meter and then average values of three panicle lengths were registered for each plant (Ghadirnezhad *et al*., 2014). Panicle length is an important and good indicator for rice plants and as the panicle length is getting improved then it might a rise in grain yield indirectly by uplifting the number of spikelets per panicle (Uphoff, 2003). The effect of variety and cultivation method on panicle length was highly significant (P<0.01). The two-way interaction between these factors was not significant and the effect of single factors which were nutrient and cultivation method was separately highly significant. Firstly, the length of the panicle was at maximum with Pathumthani-1 variety and then slowly decreased to the RD57 and RD41 varieties, and the difference was observed among them. Pathumthani-1 was rose by 5.22% and 18.60% than the RD57 and RD41 respectively. In the same way, RD57 variety was increased by 12.72% than RD41 variety. Secondly, the effect of the cultivation method on the length of the panicle was also highly significant (P<0.05). There was not statistically any difference under dry seeding and wet seeding on panicle length, but there was some difference with transplanting method of cultivation and length of panicle was highest under transplanting the method cultivation. Panicle length under TP was increased by 6.30% than the WDS and DDS method of cultivation respectively (Table-2). No interaction has occurred so the data were pooled over the experimental runs.

Table 3: Effect of Variety and planting Method on Panicle Length

Variety	Panicle length (cm)	Cultivation method	Panicle length (cm)
Pathumthani-1	26.2	DDS	24.05
RD57	24.9	WDS	23.8
RD41	22.09	TP	25.3
LSD (0.05)	0.62		0.62

Note. DDS: dry direct seeding, WDS: wet direct seeding, TP: transplanting, LSD: Least significant difference.

Number of Grains per Panicle

The number of grains per panicle was collected from the three random samples that were selected from each pot and then the mean of three was counted and represented that the overall grains per panicle were the same in each panicle (Yoshida, 1981). The effect of variety and cultivation method on the number of grains per panicle was significant (P<0.05). The result was illustrated that the number of grain per panicle was the highest under the transplanting method for RD41 variety and the lowest number of grain per panicle was recorded under dry direct seeding with Pathumthani-1 variety. RD41 variety was increased by 2.19% and 37.04% than the RD57 and Pathumthani-1under DDS method

of cultivation. Under the WDS method Pathumthani-1was reduced by 24.84% than the RD57 variety. Similarly, RD41 variety was also rose by 15.63% and 7.24% than the Pathumthani-1 and RD57 variety under the transplanting method of cultivation. Moreover, there was a significant difference between the transplanting and wet direct seeding for Pathumthani-1. TP method of cultivation was rose by 14.48% than the WDS method for Pathumthani-1. Statistically, there was no any difference among the RD57 and RD41 variety with all methods of cultivation and this finding was very important that the RD57 and RD41 could have more grain number while grown under these three methods of cultivation. Finally, the number of grains per panicle had better performance for RD41 variety under the dry direct seeding method than RD57 variety and it was increased by 5.54% under the transplanting method of cultivation. In short, not only the transplanting method had a high number of grains per panicle for Pathumthani-1, but also statistically there was no difference between DDS and WDS methods of cultivation for RD57 and RD41 varieties.

Table 4: Effect of planting Method and Variety on Number of Grain per Panicle

Variety	Number of grains per panicle		
	DDS	WDS	TP
Pathumthani-1	108.8	111.6	130.5
RD57	145.9	148.5	140.7
RD41	149.1	146.6	150.9
LSD (0.05)	13.7	-	-

Note. DDS: dry direct seeding, WDS: wet direct seeding, TP: transplanting, least significant difference.

Number of Filled Grain per Panicle

Filled grain per panicle was affected by an interaction between cultivation method and nutrient level and it was significant (P<0.05). The number of filled grains per panicle was the highest under the wet direct seeding method of cultivation with 100% organic. The second-highest number of grain per panicle was under the dry direct seeding with INM (50% inorganic +50% organic) nutrient level and finally, it was reduced with 100% inorganic under DDS and WDS methods. The transplanting method of cultivation observed the lowest filled grain in all nutrient levels. Especially, the number of filled grain decline with 50% inorganic +50% organic and 100% organic under TP method and it the similarly, result was found in a study that the application of organic manure was not beneficial under transplanting method of cultivation (Mamaril *et al*., 2009). This result demonstrates that statistically there was not any difference among the nutrient level under dry direct seeding, but the 50% inorganic +50% organic nutrient level under the DDS method of cultivation increased by 11.79% and 6.53% than the 100% inorganic nutrient level and 100% organic accordingly. In addition, the 100% organic nutrient level was increased by 6.99% and 14.32% than the 50% inorganic +50% organic and 100% inorganic treatment correspondingly under the WDS method. 50% inorganic +50% organic was reduced by 4.58% and 10.64% than the 100% organic nutrient level and 100% inorganic nutrient level respectively under the transplanting method of cultivation. 100% organic level was increased by 14.32% than the 100% inorganic nutrient level under wet-dry seeding on the filled grain. There was not statistically any difference in the case of 50% inorganic+50%organic and 100% organic (Table-5). It could be concluding that the 50% inorganic+50%organic nutrient level or INM under the DDS method, 100% organic under WDS method, and 100% inorganic under TP method had performed well on filled grain per panicle. Likewise, the impact of integrated

nutrient application was beneficial and it increases the filled grains per panicle in rice (Yang, 2004).

Table 5: Effect of Cultivation Methods and Nutrient Levels on Number of Filled Grain per Panicle

Nutrient level	Number of filled grain per panicle		
	DDS	WDS	TP
100% inorganic	113.7	113.8	122.1
50% inorganic+50%organic	127.1	121.6	116.5
100% organic	118.8	130.1	109.1
LSD (0.05)	13.6	-	-

Note. DDS: dry direct seeding, WDS: wet direct seeding, TP: transplanting, LSD: least significant difference.

Number of Unfilled Grain per Panicle

Two-way interaction of nutrient level and cultivation method were significant (P<0.05) on the number of unfilled grains per panicle. The number of unfilled grains per panicle was affected by the cultivation method and the highest number of unfilled grain was observed under the TP method of cultivation with three nutrient levels. The important difference was found under the TP method and it was rose by 36.84% and 21.64% than the WDS and DDS method of cultivation respectively under 100% inorganic. In the same way, the WDS method of cultivation was decreased by 55.67% than the TP method of cultivation. The lowest number of unfilled grains was found with 50% inorganic +50% organic nutrient level under the WDS method of cultivation and this was a positive effect that the numbers of unfilled grains were less with the INM (50% inorganic +50% organic) under the DDS method of cultivation as well (Table 4.14). Furthermore, the second-highest unfilled grain per panicle was observed under 100%inorganic and it was increased by 26.60% than the 50% inorganic +50% organic and 100% organic nutrient levels under the DDS cultivation method. As well as, the number of unfilled grains with 100 inorganics was rose by 21.60% than the 50% inorganic +50% organic and 100% organic nutrient levels under the WDS cultivation method. In brief, this result declared that the 50% inorganic +50% organic nutrient level performed well under the DDS and WDS method of cultivation which had less number of unfilled grains per panicle; hence the number of unfilled grain was high in all nutrient levels under the TP method of cultivation. It was shown that nutrient effect was negative on TP method under 100% inorganic which was decreased by 26.24% than the 50% inorganic +50% organic and organic nutrient level. Similarly, the effect of the application of combine inorganic fertilizer with organic manure was studied to build the soil more fertile and active the amount of N, P, and K in the soil layer (Wu & Ma, 2015). And also made it available for the plant growth and grain number (Gill & Meelu, 1982). 100% organic nutrient level had the high number of unfilled grain per panicle was recorded under TP method of cultivation. In the same way, a study reported that the poor grain filling due to inadequate biomass production also occurred with organic nutrients (Peng, 2008) (Table 6).

Table 6: Effect of Cultivation Method and Nutrition on Number of Unfilled Grain per Panicle

Planting method	Number of unfilled grain per panicle		
	100% inorganic	50% inorganic +50%organic	100% organic

DDS	17.1	13.5	13.5
WDS	15.2	12.5	13.4
TP	20.8	28.2	25.2
LSD (0.05)	5.3		

Note. DDS: dry direct seeding, WDS: wet direct seeding, TP: transplanting, LSD: least significant difference.

1000- Seed Weight

The interaction between variety and cultivation method on 1000-seed weight was highly significant (P<0.01) (Table-7). Pathumthani-1 variety had the maximum grain weight under the TP method of cultivation than the other varieties. The lowest was observed with RD57 variety under of WDS method of cultivation. While, TP method of cultivation experienced the highest grain weight but, there was not statistically any difference among the TP and WDS and DDS method cultivation with Pathumthani-1. TP method of cultivation was increased by 3.80% and 3.48% than WDS, DDS method of cultivation accordingly for Pathumthani-1 variety. 1000-seed weight was high with Pathumthani-1 while it was compared with RD57 variety under the DDS cultivation method and then it decreased gradually from RD57 to RD41. RD57 variety was reduced by 4.74% than Pathumthani-1and RD41 was decreased by 8.97% than the RD57 variety under the DDS method of cultivation. RD57 variety under WDS was also reduced by 13.88% than the TP method. RD57 variety was increased by 6.62% than the RD41 variety under the TP method of cultivation. There was no significant difference observed for the RD57 variety under DDS and RD41 variety under the WDS method cultivation. Pathumthani-1 and RD57 varieties were higher than RD41 variety and the differences were also recorded among them. Furthermore, 1000-seed weight was also declined gradually for the RD41 variety under the TP method of cultivation. To conclude, as above mentioned the WDS method cultivation had a negative effect only for RD41 variety and it caused to reduce the grain weight and no significant difference was observed for the other varieties.

Table 7: Effect of Three Rice Varieties and Cultivation Method on 1000-Seed Weight

Variety	1000- seed weight (g/pot)		
	DDS	WDS	TP
Pathumthani-1	31.6	31.5	32.7
RD57	30.1	27.3	31.7
RD41	27.4	28.3	29.6
LSD (0.05)	1.3		

Note. DDS: dry direct seeding, WDS: wet direct seeding, TP: transplanting, LSD: least significant difference.

Grain Yield

The interaction of variety and cultivation method on grain yield of rice was significant (P<0.05). TP cultivation method was the highest grain yield for Pathumthani-1 variety while it was compared with DDS and WDS methods of cultivation. TP method of cultivation was increased by 22% than the WDS and DDS method of cultivation for Pathumthani-1. However, Pathumthani-1 variety under WDS and DDS method of cultivation shown similar results, and no significant differences were

observed among DDS and WDS methods of cultivation (Table-8). In addition, grain yield for RD57 was also affected by the TP method of cultivation and it was increased by 10.26% than the WDS method and there was no statistically found difference under TP and DDS method for RD57 variety. In the same way, for the RD41 variety, there was not any significant difference under the WDS and TP method of cultivation but the TP method increased by 13.55% than the DDS method. However, there was not observed statistically any difference among the WSD and DDS methods for RD41 variety (Table 8). Finally, grain yield (g/pot under transplanting method of cultivation was high for all three rice varieties, but for the RD57 variety, there was no statistically any difference under the TP and DDS method of cultivation.

Table 8: Effect of Cultivation Method and Variety on Grain Yield (g/pot)

Variety	Grain yield g/pot		
	DDS	WDS	TP
Pathumthani-1	51.1	51.8	63.2
RD57	43.2	41.9	46.2
RD41	45.09	47.6	51.2
LSD (0.05)	4.2		

Note. DDS: dry direct seeding, WDS: wet direct seeding, TP: transplanting, LSD: least significant difference.

Last but not the least, the interaction of variety and nutrient level were also significant ($P<0.05$) on grain yield. 100% inorganic nutrient level had the maximum grain yield for Pathumthani-1 variety. Pathumthani-1 variety was increased by 10.26% than 50% inorganic +50% organic nutrient level. It was also highest for RD57 variety under 100% inorganic. 50% inorganic +50% organic increased by 6.22% than 100% organic for Pathumthani-1. 100% inorganic was increased by 17.12% than 100% organic nutrient level for Pathumthani-1 variety. 100% inorganic was increased by 14.83% than the 50% inorganic +50% organic and 100% organic for RD57 variety; in comparison, there were not statistically any differences among the 100% inorganic, 50% inorganic +50% organic, and 100% organic nutrient levels for RD41 (Table-9). Application of 50% inorganic +50% organic and 100% organic nutrient levels performed well for RD41 variety. It was similar among these three nutrient levels so the effect of this organic nutrient was precious. In the same way, it was found that the application of inorganic combine with organic nutrient increase the grain yield (Yang, 2004).

Table 9: Effect of Nutrient Levels and Rice Varieties on Grain Yield (g/pot)

Variety	Grain yield (g/pot)		
	100% inorganic	50% inorganic +50% organic	100% organic
Pathumthani-1	60.2	54.6	51.4

RD57	48.0	41.8	41.5
RD41	48.2	47.9	47.8
LSD (0.05)	4.2		

Note. LSD: least significant difference.

Conclusion

The Effect of different planting methods and nutrition on yield of three Thai rice varieties with planning method; dry direct seeding, wet direct seeding, and transplanting. There was a highly significant difference among variety and planting methods on panicle length and 1000-grain weight; in the same way, the effect of variety and planting method were a significant number of grain per panicle and grain yield. The result was illustrated that the number of grains per panicle with RD41 variety has increased by 2.19% and 37.04% than the RD57 and Pathumthani-1under the DDS method of cultivation. There was a significant difference between the transplanting and wet direct seeding for Pathumthani-1and it was increased by 14.48% than the WDS method, but also statistically there was not found any difference under DDS, WDS, and TP method of cultivation for RD57 and RD41 varieties.

Our findings reveal that 1000-grain weight was highest for Pathumthani-1 and no significant difference was found among the planting methods, but only RD57 variety under the WDS method was reduced by 13.88% than the TP method of cultivation and also no difference was found for RD41 under TP and WDS method. Pathumthani-1 variety had the maximum grain yield under the TP method and it was improved by 22% than the WDS and DDS method of planting. Grain yield of RD57 variety under TP method of cultivation and it was increased by 10.26% than the WDS method. Pathumthani 1 had poor performance under these planting systems and might not be a better choice; however, the performance of RD57 and RD41 was statistically similar and could be a suitable choice under DDS and WDS cultivation systems.

Integrated nutrient management practice (50% NPK and +50% FYM) rate produced higher panicle per plant, longer panicle, and higher 1000-grain weight in these rice varieties. The difference between the tested varieties and the planting methods was evident. The application of 50% NPK and 50% FYM could be a feasible option for these rice varieties under the WDS method, but the results might vary for different varieties and planting methods. Further Open field trials are needed to elaborated nutrient combinations to present better findings along with confirmation of the results.

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