INNSPUB
RESEARCH PAPER

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 24, No. 5, p. 253-258, 2024

OPEN ACCESS

Assessment of direct seeded and transplanting methods of Unoy Rice under nutrient management in Tabuk City, Kalinga

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Key words: Unoy rice, Direct-seeded rice, Transplanted rice, Heirloom rice, Nutrient management, Kalinga province

http://dx.doi.org/10.12692/ijb/24.5.253-258 Article published on May 12, 2024

Abstract

Unoy rice is a type of heirloom rice grown in Kalinga, in most areas of the municipalities of Pasil, Balbalan, Tinglayan, and Tanudan, Kalinga. It was conducted at Kalinga State University's experimental area (385 m2) to assess the effect of direct-seeded and transplanting methods of Unoy rice under nutrient management. The RCB design in the factorial experiment was used in the study—direct-seeded influence the plant height at 30 DAS and 60 DAS, except before harvesting. Transplanted Unoy was taller than direct-seeded rice, as revealed in the experiment. Transplanted Unoy produced more tillers (7) versus direct-seeded (3). The effect of nutrient management did not influence the height of Unoy before harvesting, but it affected the plant height 30 and 60 days after sowing and transplanting. Farmer's practice significantly affected the days to Maturity and the number of tillers. Panicle length did not obtain significant results under two planting methods—the same with percent filled grains, percent unfilled grains, and weight of 1000 grains. Transplanted Unoy produced a more significant number of grains (183) compared to direct-seeded (129.52). Transplanted Unoy had a significantly higher yield (4.52 kg/plot) than direct-seeded. The effect of nutrient management did not influence the number of grains/panicles, the percentage of filled grains and unfilled grains, the weight of 1000 grains, or biomass. Regarding panicle length, the farmer's practice measured longer panicles (35.48) compared to soil analysis and no fertilizer. Applying soil analysis produces significantly higher yields (5.32 kg/plot) than the farmer's practice and no fertilizer.

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Introduction

The "Unoy" rice is cultivated mainly in Tanudan, Tingayan, Pasil, and Balbalan, Kalinga province. The farmers in this place primarily grow this cultivar for food consumption; some are sold in the market. The Ykalinga indigenous people have a long history of Unoy rice farming. Their traditional Unoy production practices entail using indigenous knowledge in the farming system. The International Rice Research Institute (IRRI, 2023) describes Kalinga Unoy or Chong-ak as having medium-sized, rectangular, crimson grains. It tastes nutty and has a pandan-like sweet herbal scent. The grains are loose and not compact after cooking. It has a chewy character and is partially soft.

Conservation and characterization studies would further enrich diversity, particularly in its low diversity, such as anthocyanin coloration, awn presence, awn color, culm habit, panicle type, and panicle branching (Rabara *et al.*, 2014). Rice is one of the significant cash crops in the Philippines, yet its cost remains higher than in other top rice-producing countries in Southeast Asia (Bautista *et al.*, 2023).

Direct-seeded rice (DSR) has gained popularity due to its minimal input requirements. DSR offers numerous advantages, such as reduced labor and water requirements, early crop maturity, low production costs, better soil conditions for subsequent crops, lower methane emissions, and greater flexibility in various cropping systems. As a result, more farmers are adopting DSR as an alternative to traditional rice cultivation methods (Kaur and Singh, 2017). The study by Bautista *et al.* (2023) revealed that a higher proportion of DSR farmers were found in rainfed areas, with DSR farmers rising from 27% in 1996/1997 to 33-42% in 2016/2017. DSR has a cheaper cost of crop establishment and reduced labor requirements than TPR, which gives it an economic benefit. Weed invasion in DSR causes output loss with obstacles like blast disease, crop lodging, and poor grain quality. This review covers experiences, benefits, drawbacks, and future rice production (Kaur and Singh, 2017).

The transplanting method is a common practice for Unoy rice producers in Kalinga. Studies showed that transplanted Unoy rice prolonged the maturity of the crop, but it is the most effective way of avoiding weed development compared to direct-seeded rice. The International Rice Research Institute mentioned that transplanting is best for those with surplus workers and minor fields, and it can be done in fields with variable water levels.

Material and methods

Locale of the study

The study was conducted at the KSU rice field experimental area from April to September 2023. Due to the water scarcity, the field experiment was conducted in a rainy month. The study covered a total area of 385 m2 and employed two-factor trials.

Experimental design and layout

The study used of two (2) factor trials with the Randomized Complete Block Design (RCBD). The experimental location spanned 385 m2 in total. Plots were separated by 0.50 m, and blocks were separated by 1 m. The following treatment was followed: Factor A: (Method of planting) - a_1-Direct seeding and a_2-Transplanting; Factor B: (Nutrient Management) b1-No fertilizer application, b_2-Farmer's practice, b_3-Soil Analysis

Randomization and layout

The randomization and layout of the experimental area, as randomization of treatment used, was based on the principle and procedure of Randomized Complete Block Design in a two-factor experiment. The basis of randomization was adopted from Gomez and Gomez (1984).

Land preparation and layouting

The seedbed was prepared via plowing and harrowing, with 4m x 4m plots established and the surface leveled for consistent water levels in the paddy field. Initial soil preparation was achieved through primary tillage, utilizing a rotavator affixed to a four-wheeled tractor. Subsequently, the field underwent seven-day submersion to soften clods and decompose organic matter. Following this process, drainage was implemented to facilitate the germination of volunteer and weed seeds. Harrowing was then conducted three times at seven-day intervals with a combed-tooth harrow mounted on a hand tractor. Heirloom Rice seeds were pre-germinated in water and then incubated until roots emerged. Ventilation was provided with slotted pallets and rice straws.

Seedbed establishment and pre-germination of seed

The seedbed was established in the fields and endowed with favorable soil composition and drainage. The young plants were irrigated three days after sowing (DAS), gradually augmenting to two centimeters contingent upon seedling height. Using the straight-row technique, the seedlings were manually transplanted roughly 23 days after sowing by a planting distance of 20 × 20 centimeters. The pre-germinated seeds were sown directly into the field. However, the plot underwent drainage and leveling procedures prior to direct seeding.

Irrigation

Soil moisture was regulated after transplanting to prevent snail infestation and improve soil-root connection. Water was kept at a 6cm depth during tillering to flowering stages for deeper roots, more tillers, secure anchorage, nutrient balance, and soil detoxification. Irrigation stopped during ripening for even grain maturity.

Fertilizer application

The quantity of nutrients applied was computed based on the soil analysis results from a sample collected at the Cagayan Valley Integrated Agricultural Laboratory (CVIAL). Fertilizer application in the farmer's practice was based on the estimated amount in which the farmers are doing.

Weeding and insect pest management

Weeds were observed ten days after transplanting and direct seeding; however, they were controlled by uprooting the weeds. The uprooted weeds were placed in the bunds to be rotten. No herbicide was applied for the entire duration of the study.

Harvesting

Manual harvesting was done using a sickle (kumpay in Ilocano vernacular). The initial plants selected for sampling were the first to undergo harvesting. Manual threshing and drying methods were employed to prevent grain loss, particularly from the sample plants. Data collected: plant height, days to maturity, tiller count, grain/panicle count, panicle length, filled/unfilled grains, 100-grain weight, and yield/plot. Primary data was analyzed using ANOVA for the RCBD factorial experiment, and DMRT was used to compare treatment means.

Tagging of data plants

Ten (10) sample plants were randomly selected from each experimental plot. A 1-meter stick was placed in each corner of the ten sample plants.

Data gathering procedures

Plant height

Plant height was recorded for 10 randomly selected sample plants per plot. It was measured from the ground level up to the tip of the longest leaf at 30, 60 DAT, and at maturity or before harvest.

Days to maturity

This was done by counting from the days after sowing up to the maturity of the Unoy rice.

Tiller count

The total number of tillers was counted from the 10 sample plants. Productive tillers were taken by counting all panicle – bearing tillers, while tillers with panicles bearing five seeds or less were considered productive.

Panicle length

The length of the panicle was determined by measuring the linear distance from the base of the node of the panicle to its tip using ten representative sample plant panicles per plot.

Number of grains/panicle

The number of grains per panicle for the ten sample plants per plot was counted. The total number of grains was divided by the total number of panicles of the sample plants.

Filled and unfilled grains

The ten representative sample panicles will be threshed after measuring their length. The grains will be sorted and counted into filled and unfilled grains. The value will be expressed in percentages as follows.

% filled grains= (Total number of filled grains/Total number of grains) ×100

% unfilled grains = (Total number of unfilled grains/Total number of grains) × 100

Weight of grain (based on 1000 seeds)

After harvesting, the weight of 1000 seeds in grams will be determined using an Analytical weighing balance by taking sample seeds from each experimental plot. Before measuring, the seeds' moisture content (MC) will be measured to 14%.

Yield/Plot

The grains per plot were harvested. It was threshed and sun-dried. The dried grains x the total weight of the sample plants per plot and the non-sample plants per plot was the yield.

Biomass

After harvesting, the ten representative samples were cut from the base, immediately sundried, and weighed using a digital weighing scale with a 100-gram capacity.

Data analysis

Primary data were gathered from the experiment and used for the analysis and recommendation. The data were summarized and analyzed statistically using the Analysis of Variance (ANOVA) for the RCBD factorial experiment. A comparison of treatment means was done using DMRT.

Results and discussion

Effect of direct and transplanting method in Unoy Rice

The different planting methods significantly influenced the plant height (Table 1). At 30 days, direct planting produced taller Unoy rice (96.85 cm) than transplanting, while (82.15 cm) was obtained in transplanting. The same results were obtained at 60 days for Unoy rice, with direct planting producing a taller plant height (161.98 cm) and a minimum plant height (151.33 cm) observed in transplanting. However, the transplanting method produced a taller height (183.03 cm) of Unoy rice, with 174.17 cm observed in direct seeding. A higher number of tillers (7) was obtained in transplanting than direct seeding, with (3) tillers. This observation shows that Unoy rice produced few tillers compared to inbred and hybrid varieties. The Unoy rice matured at (129 days under transplanting, while 118 days were observed in direct seeding. Rice that was transplanted usually experienced transplanting shock, which they recover in about 1-2 weeks.

Effect of no fertilizer, farmer's practice, and soil analysis application in Unoy rice

The effect of nutrient management is presented in Table 2. The results showed that farmer's practice highly influenced the plant height of Unoy rice (103.88 cm) at 30 days, followed by Unoy rice in soil analysis (95.72 cm), and 68.92 cm obtained the lowest plant height of 68.92 cm). However, at 60 days, Unoy rice under soil analysis (168.88 cm) overtook the farmer's practice (154.48 cm). The lowest height of Unoy rice with no fertilizer was observed (146.43 cm). The plant height of the Unoy rice was measured before harvesting to determine the effect of nutrient management, but the results showed no significant differences. In terms of days to maturity, it was found that soil analysis highly influenced Unoy rice (127 days) with a 2-day gap from farmer's practice (125 days) and the lowest at no fertilizer (120 days). These results showed that applying fertilizer affects the Maturity of Unoy rice. The highest number of tillers was observed under the farmer's practice (6.12), followed by Unoy rice in soil analysis (5.29), and the lowest was observed in no fertilizer (3.86).

Effect of direct seeding and transplanting method in Unoy rice as to yield and yield character

The effect of the planting method on the yield and yield parameters of Unoy rice is presented in Table 3. The results showed that the method of planting did not affect the panicle length of Unoy rice.

Table 1. Effect of method of planting on the agronomic character of Unoy rice

Method	30 DAS, DAT (cm)	60 DAS, DAT (cm)	Before harvesting (cm)	Days to maturity(d)	No. of tillers
Direct seeding	96.85[a]	161.98[a]	174.17[b]	118[b]	3[b]
Transplanting	82.15[b]	151.33[b]	183.03[a]	129[a]	7[a]

Table 2. Effect of Nutrient management on the agronomic character of Unoy rice

Nutrient management	30 DAS, DAT (cm)	60 DAS, DAT (cm)	Before harvesting (cm)	Days to maturity	No. of tillers
No fertilizer	68.92[c]	146.43[c]	177.45[a]	120[c]	3.86[c]
Farmer's practice	103.88[a]	154.68[b]	179.48[a]	125[b]	6.12[a]
Soil analysis	95.72[b]	168.33[a]	178.88[a]	127[a]	5.29[b]

Table 3. Effect of method of planting on the yield and yield components

Method	Panicle length (cm)	No. of grains/ sample plant	Filled grains %)	Unfilled grains (%)	Wt. 1000 grains (g)	Biomass	Yield/Plot (kg)
Direct seeding	33.59[a]	129.52[b]	89.07[a]	11.26[a]	32.32[a]	0.27[b]	3.93[b]
Transplanting	34.48[a]	183[a]	86.59[a]	12.69[a]	32.3[a]	0.55[a]	4.52[a]

Table 4. Effect of nutrient management on the yield and yield components

Nutrient management	Panicle length (cm)	No. of grains/sample plant	Filled grains (%)	Unfilled grains (%)	Wt. of 1000 grains	Biomass	Yield/Plot (kg)
No fertilizer	33.48a[b]	159.09[a]	84.11[a]	15.2[a]	31.21[a]	0.36[a]	2.94[c]
Farmer's practice	35.48[a]	165.98[a]	89.31[a]	10.67[a]	33.72[a]	0.42[a]	4.43[b]
Soil analysis	33.17[ab]	143.41[a]	90.08[a]	10.07[a]	32.03[a]	0.44[a]	5.32[a]

However, in the number of grains/sample plant/panicle, the transplanting method of Unoy rice produced a higher number of grains (183) per panicle, while (129.52) in direct seeding. There were no significant differences in the percent filled and percent unfilled grains under the two planting methods. Transplanted Unoy rice produced higher biomass (0.55) than direct-seeded Unoy rice (0.27). The transplanting method highly influenced the Unoy rice yield per plot, which was 16m2 (4.52 kg), comparable to (3.93 kg) in direct seeding.

The farmer's practice produced the tallest panicle length (35.48 cm) (Table 4), while soil analysis (33.17) and no fertilizer were obtained (33.48 cm). Nutrient management did not influence the number of grains/sample plants per panicle of Unoy rice. The same results were observed in percent filled grains, percent unfilled grains, weight of 1000 grains, and biomass of Unoy rice. Highly significant data showed in soil analysis that Unoy rice produced the highest yield/plot, 16 m^2 (5.32 kg), compared to the farmer's practice (4.43 kg). The lowest yield per plot, at 16 m^2, was obtained with no fertilizer at 2.94 kg.

Generally, the average yield of Unoy rice under Tabuk City conditions is 2.64 tons/ha. However, the study showed that applying soil analysis under the transplanting method would increase the yield to 3.58 tons/ha. Providing the right amount of nutrients at the right time is essential for a good crop yield. This can be done by optimizing crop management practices, using available nutrients in soil and manure, and using mineral fertilizers when necessary. Setting realistic yield goals and balancing fertilizer use with input costs for maximum profit (Faihurst *et al.*, 2007).

Conclusion

The study assessed Unoy rice's performance under two methods of planting (direct and transplanted), subject to three nutrient management practices (no fertilizer, farmer's practice, and soil analysis). The study was conducted at Kalinga State University research station, following the RCB design in a factorial experiment. Direct seeding of Unoy rice influenced the height of the plant at 30 DAS and 60 DAS, except before harvesting. Transplanted Unoy rice matured longer compared to directly seeded Unoy rice.

Unoy rice's average maturity is 123 days with an average tiller of 9. The results of the interaction effect of the planting method highly influenced the Unoy rice's maturity. A highly significant result was also determined regarding the interaction effect of the planting method under different nutrient management. The transplanted Unoy rice produced more tillers than directly seeded. Nutrient management influenced the height of the Unoy plant at 30, 60 DAS & DAT, days to maturity, and the number of tillers, regardless of whether they were directly seeded or transplanted. The effect of the method of planting showed that transplanting influenced the number of grains/panicles and biomass. Transplanting produced a higher yield/plot of 4.52 kg versus 3.93 kg for direct seeding. Nutrient management did not influence the number of grains/panicles, percent filled and unfilled grains, weight of 1000 grains, and biomass. The farmer's practice produced the tallest panicle length compared to soil analysis and no fertilizer. The yield of Unoy rice under soil analysis obtained the highest yield/plot of 5.32 kg.

Recommendation(s)

Based on the findings of the field experiments, the researcher recommends implementing the transplanting method for Unoy rice and conducting soil analysis to optimize crop yield. A follow-up study conducted on the different field locations in Kalinga is recommended to determine crop yield across different rice fields.

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