REVISTA ACADÉMICA
ALMAMATER
Universidad Autónoma de Santo Domingo

Comparison of three wet direct-seeding establishment packages for Juma 69-20 rice: grain yield, yield components, and profitability

Comparación de tres paquetes de establecimiento mediante siembra directa en húmedo del arroz Juma 69-20: rendimiento de grano, componentes del rendimiento y rentabilidad

Avilés Quezada, Elpidio*
Dominican Institute of Agricultural and Forestry Research (IDIAF); Faculty of Agronomic and Veterinary Sciences, Autonomous University of Santo Domingo (UASD), Dominican Republic
eaviles23@uasd.edu.do
https://orcid.org/0000-0002-3371-3256

Pérez Abreu, Aridio Aracelis
Dominican Institute of Agricultural and Forestry Research (IDIAF), Dominican Republic
aridiopereza@yahoo.com
https://orcid.org/0000-0002-8689-840X

Jiménez Robles, Leandra Gissell
Faculty of Agronomic and Veterinary Sciences, Autonomous University of Santo Domingo (UASD), Dominican Republic
leandrajimenezr@gmail.com
https://orcid.org/0009-0005-7485-3385

* Corresponding author: eaviles23@uasd.edu.do

Recibido: 24/02/2026 **Aceptado: 05/10/2026** **Publicado: 28/10/2026**

RESUMEN

El establecimiento del cultivo puede modificar el desempeño agronómico y económico del arroz de siembra directa, pero la evidencia de campo para el Caribe es limitada. Se compararon tres paquetes de siembra directa en húmedo de *Oryza sativa* L. cv. Juma 69-20 en un Vertisol irrigado de Esperanza, Valverde, República Dominicana: siembra manual al voleo con 116 kg ha⁻¹ de semilla, siembra en hileras con una Multi-Seeder de 10 hileras y 55 kg ha⁻¹, y siembra en hileras con una Semeato de 12 hileras y 116 kg ha⁻¹. Los tratamientos se evaluaron en un diseño de bloques completos al azar con cuatro repeticiones. El paquete de establecimiento afectó el rendimiento de grano ($p = 0.0018$), los granos llenos por panícula ($p = 0.0206$), los granos vanos por panícula ($p = 0.0189$), la fertilidad de la panícula ($p = 0.0255$), el peso de 1,000 granos (prueba de Friedman, $p = 0.0381$) y la altura de planta ($p < 0.0001$), pero no el peso de panícula, la

ABSTRACT

Crop establishment can alter the agronomic and economic performance of direct-seeded rice, but field evidence from the Caribbean is limited. The objective of this study was to compare the grain yield, yield components, plant development, and profitability of three wet direct-seeding establishment packages for Oryza sativa *L. cv. Juma 69-20 on an irrigated Vertisol in Esperanza, Valverde, Dominican Republic: manual broadcasting at 116 kg seed ha⁻¹, row seeding with a 10-row Multi-Seeder at 55 kg seed ha⁻¹, and row seeding with a 12-row Semeato at 116 kg seed ha⁻¹. Treatments were evaluated in a randomized complete block design with four replications, using the plot as the experimental unit, and economic performance was estimated with a partial budget per hectare. Establishment package affected grain yield ($p = 0.0018$), filled grains per panicle ($p = 0.0206$), unfilled grains per panicle ($p = 0.0189$), panicle fertility (p*

densidad de panículas ni la longitud de panícula. Multi-Seeder presentó el mayor rendimiento (10.26 Mg ha⁻¹), frente a Semeato (8.00 Mg ha⁻¹) y la siembra al voleo (6.32 Mg ha⁻¹). Con costos calculados de forma uniforme para los tres sistemas, las rentabilidades fueron 87.68%, 42.69% y 20.74%, respectivamente. El mayor rendimiento con Multi-Seeder estuvo asociado principalmente con un mayor número de granos llenos, no con una mayor densidad de panículas. Debido a que el tipo de implemento y la dosis de semilla variaron simultáneamente, los resultados corresponden a paquetes integrados de establecimiento y no permiten aislar el efecto de la maquinaria.

= 0.0255), 1000-grain weight (Friedman test, p = 0.0381), and plant height (p < 0.0001), but not panicle weight, panicle density, or panicle length. Multi-Seeder had the highest grain yield (10.26 Mg ha⁻¹), followed by Semeato (8.00 Mg ha⁻¹) and manual broadcasting (6.32 Mg ha⁻¹). When all cost categories were applied consistently across packages, profitability was 87.68%, 42.69%, and 20.74%, respectively. The greater yield under Multi-Seeder was associated mainly with more filled grains per panicle rather than greater panicle density. Because implement type and seed rate changed simultaneously, the findings apply to integrated establishment packages and do not isolate a machinery effect; factorial trials across locations and seasons are needed to separate the contribution of each component.

Palabras clave: arroz; componentes del rendimiento; mecanización; siembra directa; siembra en húmedo

Keywords: *rice; yield components; mechanization; direct seeding; wet seeding*

How to cite: Avilés Quezada, E., Jiménez Robles, L. G., & Pérez Abreu, A. A. (2026). Comparison of three wet direct-seeding establishment packages for Juma 69-20 rice: grain yield, yield components, and profitability. *Alma Mater*, *1*(2). https://doi.org/10.64678/2hm72f95

INTRODUCTION

Rice establishment methods influence seed-soil contact, stand uniformity, early weed competition, crop vigor, labor demand, and the timing of field operations. In direct-seeded rice, these factors can affect grain filling, yield stability, and production cost. Interest in direct seeding has therefore increased as producers seek alternatives to labor-intensive transplanting and as research focuses on systems that maintain yield while using water, seed, labor, and machinery more efficiently (Ahmed et al., 2025; Farooq et al., 2011; Kumar & Ladha, 2011; Mishra et al., 2017).

The outcome of direct seeding depends on more than the presence or absence of a planter. Seed placement, seeding rate, row arrangement, land preparation, weed control, and equipment calibration operate together during crop establishment. Precision dry direct seeding has increased net returns and reduced labor and variable costs relative to conventional farmer practice in

eastern India (Panneerselvam et al., 2020). In the Mekong Delta, mechanized wet row seeding combined with lower seed and fertilizer rates improved input-use efficiency and income relative to high-rate broadcast seeding (Hung et al., 2024). These results support evaluating establishment treatments as complete management packages when several components change at the same time.

Rice is a strategic staple and an important source of rural employment in the Dominican Republic (Ministerio de Agricultura de la República Dominicana, 2021). Available Dominican studies have examined sowing systems, seeding density, yield, and profitability in Jaragua, Sabana Rey, and Esperanza (Durán et al., 2021; Estrella & De la Rosa, 2021; Pérez & González, 2022). However, this evidence is site- and cultivar-specific, and it does not compare the three establishment packages evaluated here. The cultivar Juma 69-20 has been promoted for mechanized direct seeding and for production systems intended to reduce costs and water demand (Bio-Arroz, 2020, 2022), yet field evidence for this cultivar on irrigated Vertisols in the northwestern rice region remains limited.

The objective of this study was to compare the grain yield, yield components, plant development, and profitability of three producer-relevant wet direct-seeding establishment packages for Juma 69-20 rice in Esperanza, Valverde. We expected the row-seeding packages to differ from manual broadcasting in grain yield and economic return and examined whether those differences were accompanied by changes in panicle fertility and grain filling. Because machinery and seed rate were not varied factorially, the hypothesis and conclusions were evaluated at the establishment-package level.

THEORETICAL FRAMEWORK

WET DIRECT SEEDING AND ESTABLISHMENT EFFICIENCY

Direct-seeded rice is sown in the production field without nursery preparation and transplanting. Depending on soil moisture and seed condition, the system may be classified as dry, wet, or water seeding. In wet direct seeding, pre-

e-ISSN: 3060-9917
CC BY NC ND

germinated seed is placed on puddled or saturated soil by broadcasting or by row-seeding equipment. The system can reduce labor requirements and shorten crop duration, but successful establishment requires uniform emergence, adequate seed-soil contact, suitable water management, and effective weed control (Farooq et al., 2011; Kumar & Ladha, 2011).

Manual broadcasting requires little equipment but can produce uneven seed distribution and locally excessive or insufficient plant populations. Row seeders can meter seed and organize plants in rows, which may improve crop uniformity when the machine is properly calibrated. Across studies, the yield penalty sometimes associated with direct seeding decreases as establishment becomes more uniform and management improves (Panneerselvam et al., 2020; Xu et al., 2019). These relationships are conditional, however, because machine performance depends on field preparation, operator skill, seed condition, and water status.

Seed rate, competition, and yield formation

High seed rates are often used in broadcast systems to compensate for uncertain emergence and nonuniform distribution. Excessive density can increase competition for light, nutrients, and space, reduce tiller survival per plant, increase lodging risk, and constrain grain filling. Conversely, a lower rate applied uniformly can maintain or increase yield when stand establishment is adequate (Onwuchekwa-Henry et al., 2022; Pulver, 2010; Zamora, 2012). Seed rate should therefore be interpreted together with seed placement, planter calibration, land preparation, fertilization, and weed management rather than as an independent input.

Rice yield is determined by panicle density, grains per panicle, the proportion of filled spikelets, and individual grain mass. Dense stands may produce many panicles per unit area, but that response can be offset by fewer grains per panicle, lower spikelet fertility, or reduced grain mass. More uniform spacing can reduce within-canopy competition and improve access to radiation and nutrients. During reproductive development, these conditions may support panicle

formation and assimilate supply to developing grains, thereby increasing the number or proportion of filled grains (Hung et al., 2024; Kumar & Ladha, 2011; Xu et al., 2019).

Economic performance and regional relevance

A lower-cost establishment operation is not necessarily the most profitable if it reduces yield. Likewise, a mechanized package with higher service or labor costs can be economically favorable when the additional grain income exceeds those costs. Previous studies have reported gains in labor efficiency, net return, or production efficiency from well-managed direct-seeding packages, while also showing that outcomes vary with location, management, and season (Devkota et al., 2020; Mishra et al., 2017; Panneerselvam et al., 2020). Consequently, agronomic and partial-budget indicators should be interpreted together.

Evidence generated in Asian rice systems cannot be transferred directly to Dominican irrigated Vertisols because cultivars, soil properties, water management, machinery services, seed prices, and labor costs differ. Local studies provide an initial basis for comparing establishment practices, but additional field-scale evidence is needed for Juma 69-20 under the management conditions of northwestern Dominican Republic (Durán et al., 2021; Estrella & De la Rosa, 2021; Pérez & González, 2022).

METHODOLOGY

Site description

The experiment was conducted from January to August 2021 at the Esperanza Rice Experimental Station of the Instituto Dominicano de Investigaciones Agropecuarias y Forestales (IDIAF), Valverde Province, Dominican Republic (19°36′13.95″ N, 70°58′25.93″ W; 60 m a.s.l.). The site has a mean annual temperature of 26.9 °C and annual rainfall of 777 mm. The soil is a clay loam Vertisol containing 45.8% sand, 18.7% silt, and 35.5% clay, with pH 6.9 and 4.8% organic matter (Pérez & González, 2022).

Experimental design and establishment packages

The experiment was arranged in a randomized complete block design with three establishment packages and four blocks, for a total of 12 experimental units. The trial occupied 15,000 m². Each block covered 3,750 m² and contained the three treatments randomly assigned to 1,250-m² plots (50 m × 25 m). The plot, rather than the within-plot sample, was the experimental unit.

The packages were: (1) manual wet direct seeding by broadcasting at 116 kg seed ha⁻¹; (2) mechanized wet row seeding with a 10-row Multi-Seeder at 55 kg seed ha⁻¹ and 25-cm row spacing; and (3) mechanized wet row seeding with a 12-row Semeato at 116 kg seed ha⁻¹. Certified seed was used in all treatments. Because the implement and seed rate changed simultaneously, these treatments represent integrated establishment packages. The design does not estimate a machinery main effect independently of seed rate or plant arrangement.

Table 1

Wet direct-seeding establishment packages evaluated in Esperanza, Valverde

Code	Establishment mode	Equipment	Seed rate (kg ha⁻¹)
T1	*Manual wet broadcast*	*Manual broadcasting*	*116*
T2	*Mechanized wet row seeding*	*10-row Multi-Seeder*	*55*
T3	*Mechanized wet row seeding*	*12-row Semeato*	*116*

Seed preparation and crop management

Seed of Juma 69-20 was soaked in water for 24 h, drained, and shade-dried before sowing. The crop received four fertilizer applications: 15-15-15 at 252.9 kg ha⁻¹ at 25 d after sowing; 20-5-20 at 252.9 kg ha⁻¹ 20 d later; 20-0-20 at 216.8 kg ha⁻¹ at panicle initiation; and ammonium sulfate at 180.6 kg ha⁻¹ 15 d after the third application. Weed, pest, and water management were applied uniformly across treatments according to station recommendations.

Measurements

Grain yield was determined from five 1-m^2 quadrats harvested from the internal area of each plot, excluding borders. The five subsamples were averaged to obtain one yield value per plot. Paddy rice was cleaned, adjusted to 14% moisture, weighed, and expressed as kg ha^{-1}.

Ten representative plants or panicles were randomly sampled within each plot to measure filled grains per panicle, unfilled grains per panicle, panicle weight, 1000-grain weight, and panicle length. Panicle fertility was calculated as filled grains divided by the sum of filled and unfilled grains and multiplied by 100. Panicle density was recorded as panicles m^{-2} in the sampling area. Subsample measurements were averaged so that each plot contributed one value per variable to the statistical analysis.

Plant height was measured one day before harvest from the soil surface to the base of the panicle. Panicle length was measured from the panicle base to the terminal grain, excluding awns.

Partial-budget analysis

Economic performance was estimated per hectare using the cost and price schedule updated to 12 November 2021. Gross income was calculated from paddy yield and a farm-gate price of RD$22.91 kg^{-1}. Production costs included inputs, labor, external services, and land rent. Administrative costs included an administrator and transportation. Financial cost was calculated as financing 100% of production cost at an annual rate of 8.5% for one-half year. Machinery was charged under external services; therefore, no separate depreciation was assigned. Total expenditure was the sum of production, administrative, financial, and depreciation costs. General balance equaled gross income minus total expenditure, and profitability (%) equaled general balance divided by total expenditure and multiplied by 100. The partial budget was descriptive because it used treatment mean yield and one cost schedule per establishment package.

e-ISSN: 3060-9917

Statistical analysis

Agronomic data were analyzed in InfoStat with the plot as the experimental unit (n = 4 per treatment). Normality and homogeneity of variance were checked before inference. Variables that satisfied the assumptions were analyzed by analysis of variance for a randomized complete block design, with establishment package as the treatment factor and block as the blocking factor. When the treatment effect was significant, means were compared with Duncan's multiple range test at $\alpha = 0.05$. Because 1000-grain weight did not satisfy the normality assumption, it was analyzed with the Friedman test using blocks. Results are presented as mean ± standard deviation and the observed p-value. No inferential test was applied to the partial-budget results.

RESULTS

Grain yield, yield components, and plant development

Establishment package affected grain yield ($p = 0.0018$). Multi-Seeder produced 10,260 kg ha^{-1}, Semeato 8,000 kg ha^{-1}, and manual broadcasting 6,320 kg ha^{-1}; Duncan's test separated the three means. Relative to manual broadcasting, the numerical yield increases were 62.3% for Multi-Seeder and 26.6% for Semeato (Table 2).

Filled grains per panicle differed among packages ($p = 0.0206$). Multi-Seeder exceeded manual broadcasting, while Semeato was intermediate and did not differ from either. Semeato had more unfilled grains per panicle than Multi-Seeder and manual broadcasting ($p = 0.0189$). Panicle fertility was lower under Semeato than under Multi-Seeder and manual broadcasting ($p = 0.0255$); the latter two did not differ.

The Friedman test indicated an overall difference in 1000-grain weight ($p = 0.0381$), but no post hoc pairwise test was applied; accordingly, treatment-level separation is not claimed for this variable. Panicle weight ($p = 0.0851$), panicle density ($p = 0.8073$), and panicle length ($p = 0.1204$) did not differ among

packages. Plant height differed ($p < 0.0001$), with the greatest mean under Multi-Seeder, followed by Semeato and manual broadcasting.

Table 2

Mean ± SD for grain yield, yield components, and plant development (n = 4)

Variable	Multi-Seeder	Manual broadcast	Semeato	p-value
Grain yield (kg ha⁻¹)	10,260 ± 1,193 a	6,320 ± 753 c	8,000 ± 894 b	0.0018
Filled grains panicle⁻¹	171.33 ± 13.21 a	134.90 ± 11.98 b	154.43 ± 4.53 ab	0.0206
Unfilled grains panicle⁻¹	12.58 ± 0.84 b	10.88 ± 1.44 b	15.70 ± 2.30 a	0.0189
Panicle fertility (%)	93.16 ± 0.22 a	92.52 ± 1.02 a	90.80 ± 1.17 b	0.0255
1000-grain weight (g)	26.50 ± 0.58	24.50 ± 0.58	26.25 ± 0.50	0.0381†
Panicle weight (g)	3.61 ± 0.33	3.25 ± 0.12	3.44 ± 0.10	0.0851
Panicles m⁻²	376.45 ± 58.76	393.80 ± 25.64	375.10 ± 31.84	0.8073
Plant height (cm)	110.38 ± 0.69 a	95.12 ± 1.80 c	98.40 ± 0.59 b	<0.0001
Panicle length (cm)	27.19 ± 0.91	25.67 ± 1.01	26.31 ± 0.40	0.1204

Note. Within an ANOVA row, means followed by different lowercase letters differ according to Duncan's test ($\alpha = 0.05$). Rows without letters had a nonsignificant ANOVA. †1000-grain weight was evaluated with the Friedman omnibus test; no pairwise mean separation was performed.

Partial-budget results

Economic outcomes followed the numerical ranking in grain yield (Table 3). Multi-Seeder generated the highest gross income (US$5,365.46 ha⁻¹), net return (US$2,506.60 ha⁻¹), and profitability (87.68%). Semeato ranked second, with a net return of US$1,251.55 ha⁻¹ and profitability of 42.69%, while manual broadcasting generated a net return of US$567.75 ha⁻¹ and profitability of 20.74%. Multi-Seeder incurred higher total expenditures than manual broadcasting, but its greater grain yield and gross income more than compensated for this difference. Semeato had the highest total expenditures (US$2,932.04 ha⁻¹), mainly because of its higher labor, external service, and financial costs.

e-ISSN: 3060-9917
CC BY NC ND

Table 3

Partial budget per hectare in US dollars

Category	Mechanized seeding (Multi-Seeder)	Broadcast seeding	Mechanized seeding (Semeato)
Net production (kg ha⁻¹)	*10,260*	*6,320*	*8,000*
Net production (fanegas ha⁻¹)	*85.5*	*52.67*	*66.67*
Farm-gate price (US$ fanega⁻¹)	*$62.75*	*$62.75*	*$62.75*
Farm-gate price (US$ kg⁻¹)	*0.5229*	*0.5229*	*0.5229*
Gross income (US$ ha⁻¹)	***$5,365.46***	***$3,305.04***	***$4,183.59***
Production costs			
Inputs	*$1,569.85*	*$1,593.01*	*$1,593.01*
Labor	*$482.70*	*$410.87*	*$529.74*
External services	*$310.99*	*$243.05*	*$310.99*
Land rent	*$203.82*	*$203.82*	*$203.82*
Total production costs	***$2,567.36***	***$2,450.75***	***$2,637.56***
Management	*$174.03*	*$174.03*	*$174.03*
Transportation	*$8.35*	*$8.35*	*$8.35*
Total administrative expenses	***$182.38***	***$182.38***	***$182.38***
Financial expenses	*$109.11*	*$104.16*	*$112.10*
Depreciation	–	–	–
Total expenditures (US$ ha⁻¹)	***$2,858.86***	***$2,737.28***	***$2,932.04***
Net return (US$ ha⁻¹)	***$2,506.60***	***$567.75***	***$1,251.55***
Profitability (%)	***87.68%***	***20.74%***	***42.69%***

Note. Financial expenses were calculated as total production costs × 8.5% annual interest rate ÷ 2, corresponding to a six-month production cycle. Total expenditures include production costs, administrative expenses, financial expenses, and depreciation. Values for broadcast seeding and mechanized seeding (Semeato) were recalculated to ensure the consistent inclusion of administrative expenses.

DISCUSSION

The three establishment packages produced different agronomic and economic outcomes under the conditions of this trial. The Multi-Seeder package had a higher grain yield than both Semeato and manual broadcasting, and Semeato

e-ISSN: 3060-9917

exceeded broadcasting. These comparisons are treatment-level results: they describe the combined effect of implement, seed rate, row arrangement, and associated establishment operations. They should not be interpreted as evidence that the Multi-Seeder implement alone caused the yield difference.

The yield pattern was more closely associated with grain number and grain filling than with panicle density. Panicles m^{-2} did not differ among treatments, whereas Multi-Seeder had more filled grains per panicle than manual broadcasting. Its panicle fertility was also greater than that of Semeato, although it did not differ from manual broadcasting. A plausible explanation is that the lower seed rate and row arrangement in the Multi-Seeder package reduced within-stand competition and improved the distribution of light and nutrients during reproductive growth. A more balanced source-sink relationship can support spikelet fertilization and assimilate supply during grain filling (Kumar & Ladha, 2011; Onwuchekwa-Henry et al., 2022; Xu et al., 2019). However, emergence, canopy light interception, leaf area, nutrient uptake, and biomass partitioning were not measured, so this mechanism remains an agronomic interpretation rather than a directly tested pathway.

Semeato yielded more than manual broadcasting even though both packages used 116 kg seed ha^{-1}. This pattern is compatible with a benefit from row placement or another component of mechanized establishment, but the present design cannot identify which component was responsible. Semeato also had more unfilled grains and lower panicle fertility than the other treatments. One possible explanation is that the combination of the higher seed rate and the spatial pattern produced by that planter increased competition during panicle development or grain filling. Similar studies show that the response to mechanized direct seeding depends on joint adjustment of seed rate, placement, nutrient management, and field conditions (Hung et al., 2024; Panneerselvam et al., 2020).

The significant Friedman result for 1000-grain weight indicates an overall treatment difference, but the absence of a post hoc nonparametric comparison prevents assigning that difference to a specific pair. Plant height differed among

the three packages, yet plant height alone does not explain grain yield. The lack of significant effects on panicle weight, panicle density, and panicle length further shows that the treatments did not change all yield components in the same direction. These results support a focused interpretation centered on filled grain number and panicle fertility rather than a general claim of improvement in every agronomic trait.

The corrected partial budget strengthens the practical interpretation. Multi-Seeder required greater total expenditure than manual broadcasting, but the 62.3% numerical yield increase produced a much larger balance and profitability. Semeato remained intermediate in yield and profitability but had the highest total expenditure. For Dominican producers, adoption decisions should therefore consider access to machinery services, planter calibration, seed savings, operator training, timeliness, field size, and financing rather than equipment purchase alone. Studies in other rice regions likewise show that the economic value of direct seeding depends on the complete management package and local prices (Hung et al., 2024; Mishra et al., 2017; Panneerselvam et al., 2020). The present budget reflects prices and costs on 12 November 2021 and does not quantify price risk, annualized ownership cost, or variability among farms.

The main limitations are the single location, one production cycle, and the simultaneous variation in implement and seed rate. The trial therefore provides local comparative evidence but not a factorial estimate of machinery and seeding-rate effects. Future studies should cross planter type with several seed rates over multiple seasons and locations. Measuring emergence, stand uniformity, tillering, weed pressure, lodging, canopy traits, nutrient uptake, water use, and soil physical conditions would allow the physiological and operational mechanisms to be tested directly.

CONCLUSIONS

Under the irrigated Vertisol conditions of Esperanza, the establishment packages affected grain yield, filled and unfilled grains per panicle, panicle

fertility, 1000-grain weight, and plant height, but did not affect panicle weight, panicle density, or panicle length.

The Multi-Seeder package at 55 kg seed ha^{-1} produced 10.26 Mg ha^{-1} and achieved 87.68% profitability. Semeato at 116 kg seed ha^{-1} produced 8.00 Mg ha^{-1} and achieved 42.69% profitability, while manual broadcasting at 116 kg seed ha^{-1} produced 6.32 Mg ha^{-1} and achieved 20.74% profitability. The yield advantage of the Multi-Seeder was associated mainly with a higher number of filled grains per panicle rather than greater panicle density.

These findings identify the Multi-Seeder package as the best-performing option among the three packages tested at this site and during this season. They do not demonstrate an independent machinery effect because seed rate and implement were changed together. A multi-location, multi-season factorial experiment is required before recommending a specific planter independently of seed rate and associated crop-establishment practices.

ACKNOWLEDGMENTS

The authors thank the Dominican Institute of Agricultural and Forestry Research (IDIAF) for its logistical support, the local producers of Constanza for their collaboration during the development of the research, and the National Institute of Agricultural Research (INIA) of the Autonomous University of Santo Domingo (UASD) for its institutional support.

STATEMENT ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE

The authors used ChatGPT, developed by OpenAI, to assist with English translation, language editing, and improvement of the clarity and organization of the manuscript. The tool was not used to generate, modify, or analyze research data. All calculations, interpretations, and AI-assisted text were critically reviewed and verified by the authors, who assume full responsibility for the accuracy, integrity, and final content of the manuscript.

ETHICAL DECLARATIONS

Conflicts of Interest: The authors declare that they have no conflicts of interest.

Funding: This research was funded by the KOPIA–IDIAF project entitled "Introduction and Use of Korean Agricultural Machinery and Equipment to Reduce Costs and Improve the Profitability of Rice Production in the Dominican Republic.

REFERENCES

Ahmed, S., Kumar, V., Zaman, A. U., Dewan, M. R., Khatun, A., Hossain, K., Singh, S., Timsina, J., & Krupnik, T. J. (2025). Dry direct-seeded and broadcast rice: A profitable and climate-smart alternative to puddled transplanted aus rice in Bangladesh. Field Crops Research, 322, 109739. https://doi.org/10.1016/j.fcr.2025.109739

Bio-Arroz. (2020). Manejo de la tecnología limpia-rinde-calidad 'LRC'. Ministerio de Agricultura de la República Dominicana.

Bio-Arroz. (2022). Mercado del arroz en la República Dominicana: Tendencias y perspectivas [Conference presentation]. Instituto Dominicano de Investigaciones Agropecuarias y Forestales.

Devkota, K. P., Sudhir-Yadav, Khanda, C. M., Beebout, S. J., Mohapatra, B. K., Singleton, G. R., & Puskur, R. (2020). Assessing alternative crop establishment methods with a sustainability lens in rice production systems of Eastern India. Journal of Cleaner Production, 244, 118835. https://doi.org/10.1016/j.jclepro.2019.118835

Durán, E., Solano, C., & Padilla, J. (2021). Efecto de tres métodos de siembra sobre el rendimiento y sus componentes en la variedad de arroz Jaragua (Oryza sativa L.) bajo la modalidad de retoño [Undergraduate thesis, Universidad Autónoma de Santo Domingo].

Estrella, K., & De la Rosa, E. (2021). Efecto de tres sistemas de siembra sobre el rendimiento y rentabilidad del cultivo de arroz, Sabana Rey, provincia Duarte [Undergraduate thesis, Universidad Autónoma de Santo Domingo].

Farooq, M., Siddique, K. H. M., Rehman, H., Aziz, T., Lee, D.-J., & Wahid, A. (2011). Rice direct seeding: Experiences, challenges and opportunities. Soil and Tillage Research, 111(2), 87-98. https://doi.org/10.1016/j.still.2010.10.008

Hung, N. V., Thach, T. N., Hoang, N. N., Binh, N. C. Q., Tâm, D. M., Hau, T. T., Anh, D. T. T., Khuong, T. Q., Chi, V. T. B., Lien, T. T. K., Gummert, M., Rakotoson, T., Saito, K., & Kumar, V. (2024). Mechanized wet direct seeding for increased rice production efficiency and reduced carbon footprint. Precision Agriculture, 25, 2226-2244. https://doi.org/10.1007/s11119-024-10163-8

Kumar, V., & Ladha, J. K. (2011). Direct seeding of rice: Recent developments and future research needs. Advances in Agronomy, 111, 297-413. https://doi.org/10.1016/B978-0-12-387689-8.00001-1

Ministerio de Agricultura de la República Dominicana. (2021). Consumo estimado (aparente) de los principales productos agropecuarios (frescos), 2015-2021 (en quintales). https://agricultura.gob.do/category/estadisticas-agropecuarias/consumo-de-productos-agropecuarios/

Mishra, A. K., Khanal, A. R., & Pede, V. O. (2017). Is direct seeded rice a boon for economic performance? Empirical evidence from India. Food Policy, 73, 10-18. https://doi.org/10.1016/j.foodpol.2017.08.021

Onwuchekwa-Henry, C. B., Van Ogtrop, F., Roche, R., & Tan, D. K. Y. (2022). Seeding rate, fertiliser and herbicide effects on canopy growth and productivity of direct-seeded rice under different management practices. Field Crops Research, 284, 108565. https://doi.org/10.1016/j.fcr.2022.108565

Panneerselvam, P., Kumar, V., Banik, N. C., Kumar, V., Parida, N., Wasim, I., Das, A., Pattnaik, S., Roul, P. K., Sarangi, D. R., Sagwal, P. K., Craufurd, P., Balwinder-Singh, Yadav, A., Malik, R. K., Singh, S., & McDonald, A. J. (2020). Transforming labor requirement, crop yield, and profitability with precision dry-direct seeding of rice and integrated weed management in Eastern India. Field Crops Research, 259, 107961. https://doi.org/10.1016/j.fcr.2020.107961

Pérez, D., & González, F. (2022). Efecto de densidades de siembra sobre el rendimiento y desarrollo de cultivares de arroz índica en Esperanza, provincia Valverde [Undergraduate thesis, Universidad Autónoma de Santo Domingo].

Pulver, E. (2010). Manejo estratégico y producción competitiva del arroz con riego en América Latina. In V. Degiovanni, C. Martínez, & F. Motta (Eds.), Producción eco-eficiente del arroz en América Latina (pp. 350-362). Centro Internacional de Agricultura Tropical.

Xu, L., Li, X., Wang, X., Xiong, D., & Wang, F. (2019). Comparing the grain yields of direct-seeded and transplanted rice: A meta-analysis. Agronomy, 9(11), 767. https://doi.org/10.3390/agronomy9110767

Zamora, J. (2012). Efectos de densidades de siembra y niveles de nitrógeno en el rendimiento de la línea promisoria de arroz GO-38426 en condiciones de riego [Undergraduate thesis, Universidad Técnica de Babahoyo].