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Identification of agronomic characters of F1 rice plants derived from crossing Inpara 8 and Inpago 12 varieties

Syafira Zulfa Hidayanti*), Rujito Agus Suwignyo
Department of Agronomy, Faculty of Agriculture, Universitas Sriwijaya, Indralaya, Ogan Ilir 30662, South Sumatra, Indonesia
*)Email address: ssyafirazulfah@gmail.com

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ABSTRACT

Suboptimal rice productivity in the swamp was due to both drought stress and submergence stress during the lifetime of the rice, and swamp rice could only be planted once a year. One of the efforts to increase the productivity of swamp rice was to develop rice varieties that can tolerate drought stress and submergence stress. The study aimed to validate the success of the F1 cross and to develop rice varieties exhibiting dual tolerance through backcrossing. Data analysis utilized Analysis of Variance followed by 5% test. The planting method uses a Randomized Complete Block Design (RCBD) with three replications. Observed variables included plant height, number of tillers per clump, number of panicles per clump, number of grains per panicle, number of grains per clump, weight of grain per panicle, dry weight of harvested grain, dry weight of grain, weight of 1000 grains, percentage of empty grains, flowering age, and harvesting age. Evaluations of growth characteristics revealed no significant differences in genetic traits and characteristics between the crossed rice and the parental lines. Flowering age and harvesting age of rice Inpago 12 elders were faster than Inpara 8 elders. Plant height of Inpago 12 elders was higher than Inpara 8 elders. This was due to differences in genetic traits and characters between varieties, and finally it was concluded that F1 accessions were successfully crossed and did not single-cross.

Keywords: agronomic character, Inpago 12, Inpara 8, *Oryza sativa,* wetland

INTRODUCTION

Rice swamps suffer from two stresses during their life cycle, overwater saturation during the rainy season and drought conditions during the dry season (Wildayana & Armanto, 2018). High rainfall during the rainy season makes the swamp become oversaturated with water and the water in the river also gathers heavily in the swamp, causing flooding that was difficult to drain in the swamp. Futhermore (Wulandari et al., 2023) the Lebak swamp land had a primary challenge besides acidity was that the water fluctuation was unpredictable. The rice planting period of the Lebak swamp land was usually at the end of the rainy season, because farmers do cultivation at the beginning of the rainy season (Ekaputra et al., 2022). Water fluctuations in the Lebak swamp land were unpredictable, especially during the rainy season. The duration of flooding in the lebak swamp's could occur permanently or seasonally, causing the swamp surface water to change (Balwan & Kour, 2021). Rice in the lebak swamp experienced significant environmental changes during its lifetime, as found in research (Lakitan et al., 2018a) which explained that farmers in Pemulutan Ulu Village moved rice seedlings when the flood water was less than 15 cm high and at the time of harvest the paddy soil had dried up. Stress in the lebak swamp could cause less than the maximum yield of rice production (Fahad et al., 2018), therefore a good solution was needed in order to get maximum production results.

One of the ways to manage agriculture in the lebak swamp was by making canals, namely by digging large canals connected to tidal rivers (Sulaiman et al., 2019) and also by using floating planting techniques (Qurani & Lakitan, 2021). When the rainy season arrives the canal will absorb excess water into a drainage system, the canal aims to absorb excess water during the rainy season (Rahajeng et al., 2022). Canals in lebak swampland could only solve problems during the rainy season, when the dry season arrives canals will add more serious problems because of the potential for excess sulfuric acid and land fires caused by excessive drainage increasing the acidity and toxicity of sulfuric acid. Peat oxidation inevitably leads to land fires (Crowson et al., 2019; Seleiman et al., 2021).

Creating new varieties by crossing rice between superior elders who have passed the selection because modern researchers produce the desired strains by crossing between selected elders and backcrossing (Khan et al., 2019). The crossing method will produce new varieties that have the expected superior properties. Plant breeding allows for genetic improvement by using existing genetic resources in order to obtain the desired plant traits and genome (Zhang, 2021). Superior elders used for crosses depend on the goals and desires of the researcher, selection of several existing varieties to obtain the desired traits of plant elders (Sulistyo et al., 2018).

The elders used in this study were Inpago 12 and Inpara 8, because the superior traits contained in the elders were expected to increase production on lebak swamp land, because how to increase productivity on suboptimal land by crossing between rice that has the sub 1 gene and good agronomic characters (Suwignyo et al., 2021). New varieties of rice were expected to have sub 1 genes that could make rice tolerant to submergence stress for 2 weeks and also tolerant to drought stress so that rice production reaches maximum yield (Kato et al., 2019). The purpose of this research was to identify the agronomic characters of F1 cross accessions of Inpara 8 and Inpago 12 varieties.

MATERIALS AND METHODS

Riset Site

The research was conducted in the Greenhouse of the Department of Agricultural Cultivation, Faculty of Agriculture, Sriwijaya University, Indralaya, Ogan Ilir from August 2021 to January 2022.

Preparation of Planting Media

The preparation of planting media included taking lebak swamp soil in the lebak swamp land of the Faculty of Agriculture, Sriwijaya University, and then the soil was dried and cleaned of plant debris. The processed soil was put into a 5 l bucket and given dolomite lime at a dose of 27.7 g/bucket (Kurniawan et al., 2021) and then allowed to stand for 7 days (Jumakir, 2015).

Genetic Materials and Seed Preparation

Rice seeds were obtained from the physiology laboratory of the Faculty of Agriculture, Sriwijaya University, including Inpara 8, Inpago 12 and F1 cross seeds (Inpara 8 x Inpago 12).

Preparation of Rice Seedlings

Rice seeds that have been taken from the laboratory were selected by soaking the seeds, seeds that sink were taken for sowing while floating seeds were not used for sowing (Syofian et al., 2022). Seeds that have been selected were soaked for 1 x 24 hours after which the seeds were drained for 24 hours (Saadah & Zakiyah, 2017) and then sown in trays that have been filled with soil for 14 days (Hubert et al., 2016).

Planting

Rice seedlings that were 14 DAT were transplanted into buckets that had been given water at a height of 2 cm from the ground surface (Umar & Hidayat, 2017).

Maintenance

Maintenance of carried out by giving urea fertilizer 1.5 g/plant (Anhar et al., 2016) which was given in three stages when rice was 7 Day after transplanting (DAT), 14 DAT, and 21 DAT, KCL fertilizer 0.75 g/plant (Kasno et al., 2016) and SP-36 0.75 g/plant (Susilo & Ariani, 2015); (Amalya et al., 2020). Environmental maintenance of rice was conducted by using insect net (Weintraub et al., 2017) and for weeds, conventional pulling was carried out (Singh et al., 2015).

Harvesting

Cut the panicles of rice that were ready to harvest, characterized by grain that was already filled, the grains were hard and yellow (Kamai et al., 2020).

Data Analysis

Data analysis utilized Analysis of Variance followed by 5% test. The planting method uses a Randomized Complete Block Design (RCBD) with three replications. Quantitative data obtained include plant height, number of tillers per clump, number of panicles per clump, number of grains per panicle, number of grains per clump, weight of grain per panicle, dry weight of harvested grain, dry weight of grain, weight of 1000 grains, percentage of empty grain, age of rice flowering, age of rice harvest.

RESULTS

Growth and Production Results of Rice

Based on the results of the analysis of variance that has been carried out, it shows that there were three variables that were significantly different in the three varieties, namely the percentage of empty grain, flowering age and harvest age. Two variables were significantly different in the three varieties, namely plant height and number of panicles per clump. Furthermore, there were variables that did not show significant differences in the three varieties, namely the number of tillers, number of grains per panicle, number of grains per clump, dry weight of grain per clump, dry weight of harvested grain per clump, weight of grain per panicle, and weight of 1000 grains (Table 1).

Table 1. Results of analysis of variance on all observed variables.

Variables	F Value	CV (%)
Plant height at 84 DAT	16.12*	3.30
Number of Tiller at 84 DAT	2.46tn	6.93
Flowering age	69.40**	18.83
Harvest age	39.64**	1.97
Number of Panicles per clump	8.97*	16.51
Number of Grain per panicle	1.56tn	15.62
Number of Grain per clump	0.58tn	25.25
Dry weight of harvested grain per clump	3.41tn	14.19
Dry weight of grain per clump	2.75tn	18.59
Grain weight per panicle	0.58tn	9.42
Weight of 1000 grains	0.02tn	5.43
Percentage of empty grain	104.97**	5.70
F Table 5%	6.96	
F Table 1%	18.00	

Notes : KK: Coefficient of variation, *: Significantly different, **: Very significantly different, tn: Not significantly different

Rice Height 14 DAT to 84 DAT

Based on the results of Anova analysis that has been carried out, it showed a significant difference between the three varieties, then continued with the 5% HSD test. The results showed that the Inpago 12 variety with an average height of 114.40 cm was significantly different from the Inpara 8 variety with an average height of 130.07 cm. However, the Inpara 8 variety was not significantly different from the F1 accession with an average height of 131.80 cm (Figure 1).

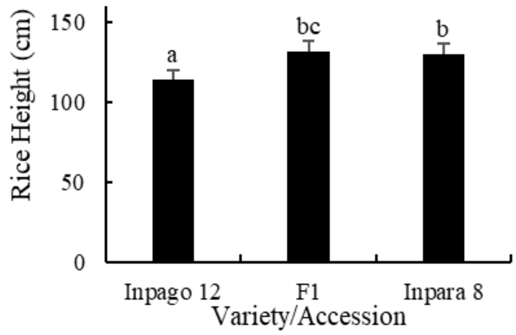

Figure 1. Rice height at 84 DAT observation

Rice tillers 14 DAT to 84 DAT

Based on the results of ANOVA analysis that has been carried out, the number of tillers was not significantly different for the three varieties. The average number of tillers of Inpago 12 was 4 tillers, F1 accession was almost 4 tillers and Inpara 8 was 4 tillers (Figure 2).

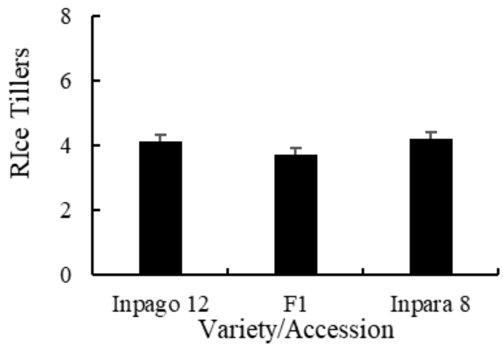

Figure 2. Number of rice tillers at observation 84 DAT

Flowering Age

The results of Anova analysis of flowering age that has been carried out, it show a very significant difference between the three varieties, then continued with the 5% HSD test. The Inpago 12 variety with an average flowering age of 61 after transplanting (DAT) showed significantly different results from the F1 accession. F1 accession average flowering age 68 DAT significantly different from the Inpara 8 variety. Inpara 8 variety average flowering age 72 DAT significantly different from Inpago 12 (Figure 3).

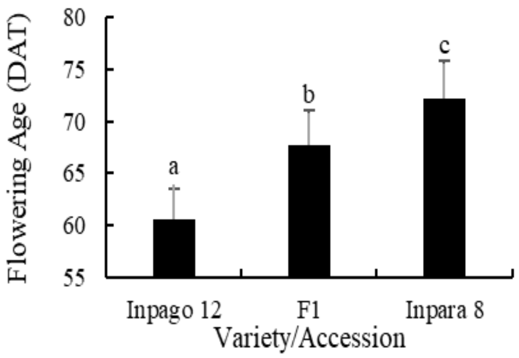

Figure 3. Flowering age of rice plants

Rice Harvest Age

From the results of Anova analysis of rice harvest age that has been carried out, there was a very significant difference between the three varieties, then continued with the 5% HSD test. Variety Inpago 12 average harvest age 83 DAT significantly different among accession F1. F1 accession average harvest age 89 DAT significantly different from Inpara 8. Inpara8 variety average harvest age 96 DAT significantly different from Inpago 12 (Figure 4).

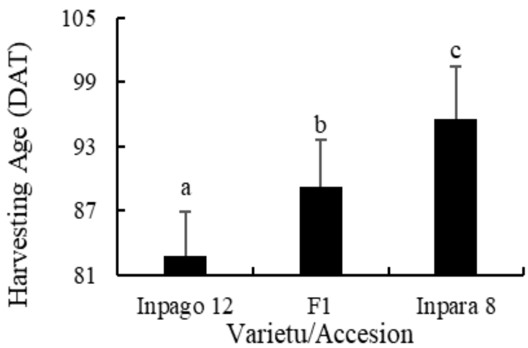

Figure 4. Harvest age of rice plants

Number of Panicles per Clump

The results of Anova analysis of panicles per clump that has been done show that there were significant differences between the three varieties, then continued with the 5% HSD test. Accession F1 average panicle 1 was significantly different from Inpago 12 average panicle 2 and Inpara 8 average panicle 2 (Figure 5).

Number of Grain per Panicle

The results of ANOVA analysis of grain per panicle that has been carried out indicate that there was no significant difference among the three rice varieties. The number of Inpago 12 grains was 94 grains, the number of F1 grains was 114 grains and Inpara 8 was 116 grains (Figure 6).

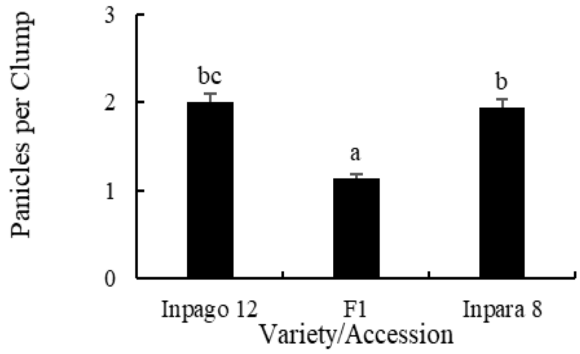

Figure 5. Number of panicles per Clump

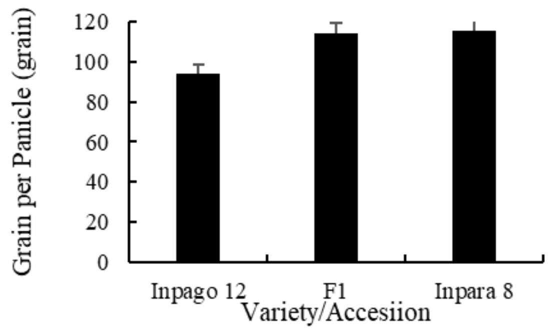

Figure 6. Number of grain per panicle

Number of Grain per Clump

Based on the results of ANOVA analysis that has been carried out on grain per clump there was no significant difference among the three rice varieties. grain per clump Inpago 12 as many as 160 grains, F1 as many as 129 grains and Inpara 8 as many as 154 grains (Figure 7).

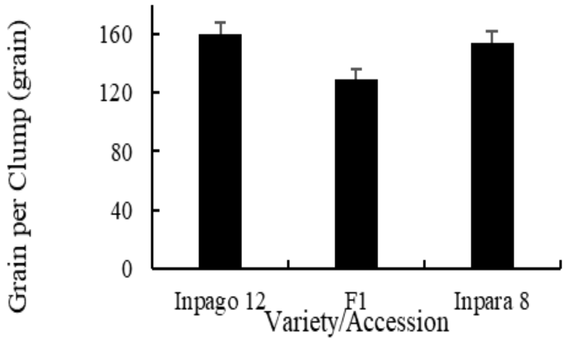

Figure 7. Number of grain per clump

Dry Weight of Harvested Grain per Clump

According to the results of Anova analysis of the results of Anova analysis that has been done, the dry weight of harvested grain has no significant difference from the three varieties. Inpago 12 average dry weight of harvest grain weighs 2.39 grams, F1 weighs 1.77 grams and Inpara 8 weighs 2.20 grams (Figure 8).

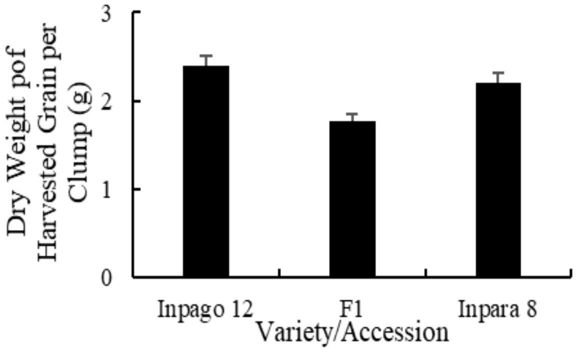

Figure 8. Dry weight of harvested grain per clump

Dry Weight of Grain per Clump

From the results of Anova analysis that has been carried out on the dry weight of grain per clump there was no significant difference from the three varieties. The average dry weight of Inpago 12 was 2.29 grams, F1 was 1.59 grams and Inpara 8 was 2.03 grams (Figure 9).

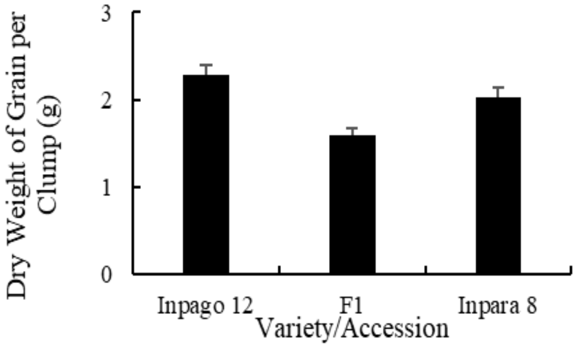

Figure 9. Dry weight of grain per clump

Grain Weight per Panicle

The results of Anova analysis that has been carried out on the weight of grain per panicle there was no significant difference between the three varieties. The average weight of grain per panicle of Inpago 12 weighs 1.61 grams, F1 weighs 1.54 grams and Inpara 8 1.67 grams (Figure 10).

Weight of 1000 Grains

From Anova analysis that has been carried out on the weight of 1000 grains, there was no significant difference between the three varieties. The 1000 grain weight of Inpago 12 was 17.13 grams, F1 was 17.23 g and Inpara 8 was 17.10 grams (Figure 11).

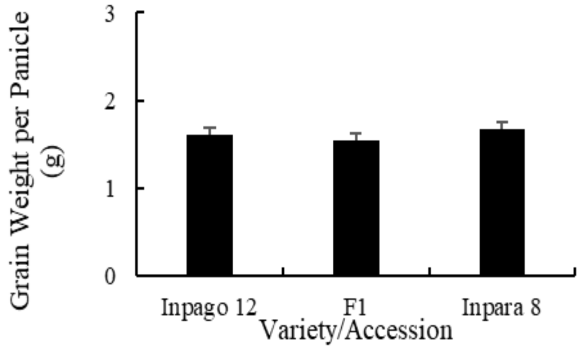

Figure 10. Grain weight per panicle

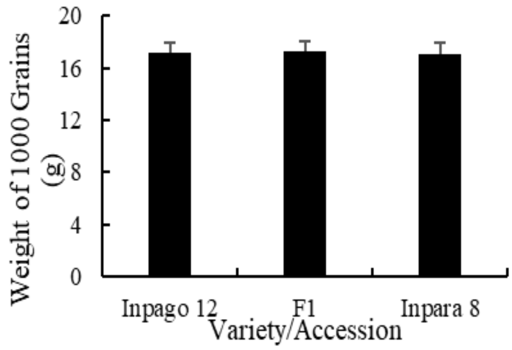

Figure 11. Weight of 1000 grains

Percentage of Empty Grain

The results of Anova analysis that has been carried out on the percentage of empty grain there were very significant differences from the three varieties, then conducted a further test of HSD 5%. The results showed that the F1 accession with a hollow grain percentage of 19.89% was significantly different from the Inpago 12 variety with a percentage of empty grain percentage of 39.36% and Inpara 8 with a hollow grain percentage of 38.38% (Figure 12).

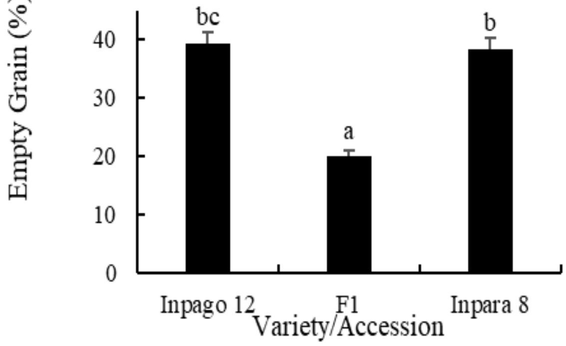

Figure 12. Percentage of empty grain

DISCUSSION

This study found no significant differences in phenotypic characteristics between the F1 accession and its parents. Analysis of variance (ANOVA) conducted on 12 variables revealed significant differences for only two variables between the F1 generation and its parents. This finding was attributed to the more substantial infestation of the F1 generation by brown planthoppers (*Nilaparvata lugens*) and rice stink bugs (*Leptocorisa oratorius*) compared to the parental lines. Three varieties were attacked by brown planthoppers, which affected rice yields. The high population of leafhoppers is due to humid environmental conditions and rainfall (Sembiring & Mendes, 2022).

The research was conducted during the rainy season as a result of which the three varieties were attacked by the Brown Stem Leafhopper (BSL). rice tillers, rice panicles, rice grain, and dry weight of grain of F1 accessions were not significantly different from the two elders. This indicates that the F1 accession was successfully crossed. The impact of BSL attack on production could be seen from the dry weight of grain. BSL attacks plants by sucking plant cell fluid so that plants become dry (Senewe et al., 2020); (Xu et al,. 2021); (Sudewi et al., 2020). Water in plant tissues is the raw material for photosynthesis, a solvent, and a medium for transporting mineral nutrients (Henni & Ardian 2015); (Hermanto et al., 2022). If the water is sucked by the brown stem leafhopper, it could disrupt the process of photosynthesis spread. It is suspected that this causes the dry matter contained in the seeds to be less than optimal.

In addition to BSL obstacles, there are several other obstacles during research activities that cause low rice production. Among them were shading that the researchers were unaware of because in the greenhouse there was an insect net, above the insect net there was leaf litter and the roof of the greenhouse had crusty moss. This affects the growth and production of rice such as the number of rice tillers. Rice tillers affect the number of rice panicles, rice panicles also affect rice grains (Barokah & Susanto, 2020). Because the higher the level of shading, the higher it could reduce rice tillers (Alridiwirsah et al., 2015).

When approaching harvest, the walang sangit also attacks rice grains that are still in milky stage (Sarumaha, 2020), causing a high percentage of empty grains. Although the research used a greenhouse and there was an insect net, pest attacks could not be avoided because the research site was less sterile and the plants planted always used the same species and varieties. This caused the use of insecticides to also have little effect, presumably because the pests had developed resistance. There is a significant difference in rice height between the two elders, Inpago 12 and Inpara 8, this is because each variety has genes that control and give rise to different phenotypes in each variety, the height of F1 accession rice is more like the elder variety Inpara 8. Flowering age and harvest age of the three varieties also have differences, the elder Inpago 12 flowered first and then followed by F1 accession and the elder Inpara 8 had a longer flowering time. This is also due to genetic diversity in each variety, but it could be seen that F1 accessions flower faster than Inpara 8 elders although not as fast as Inpago 12 elders. However, it could be concluded if F1 accessions are successfully crossed and not crossed themselves.

CONCLUSSION

Based on the results of the study, it can be concluded that the F1 accession was successfully crossed and did not cross over by itself, because its characters were similar to its male parent, Inpara 8.

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REFERENCES

Alridiwirsah, H, H., M.H, E., & Muchtar Y. (2015). Tolerance test of some varieties of padi (*Oryza sativa* L.) on shading. *Jurnal Pertanian Tropik. Pertanian Tropik*, *2*(2), 93–101.

Amalya, N. S., Yuniarti, A., Setiawan, A., & Machfud, Y. (2020). The Effect of N, P, K fertilizer and nano silica fertilizer to total N Content, N Uptake, and black rice yield (*Oryza sativa* L . Indica) on inceptisols from Jatinangor. *Journal of Plant Sciences*, *8*(5), 185–188.

https://doi.org/10.11648/j.jps.20200805.21

Anhar, R., Hayati, E., Agroteknologi, M., Pertanian, F., Syiah, U., Agroteknologi, D., Pertanian, F., Syiah, U., & Aceh, D. B. (2016). Effect of urea fertilizer dose on growth and production of local rice germplasm of Aceh origin. *Jurnal Kawista*, *1*(1), 30–36.

Balwan, W. K., & Kour, S. (2021). Wetland- an ecological boon for the environment. *East African Scholars Journal of Agriculture and Life Sciences*, *4*(3), 38–48. https://doi.org/10.36349/easjals.2021.v04i03.001

Barokah, U., & Susanto, U. (2020). Response of various rice varieties on organic land with System of Rice Intensification (SRI) in Sragen. *Jurnal Agrinika : Jurnal Agroteknologi dan Agribisnis*, *4*(2), 130–142. https://doi.org/10.30737/agrinika.v4i2.1065

Crowson, M., Warren-Thomas, E., Hill, J. K., Hariyadi, B., Agus, F., Saad, A., Hamer, K. C., Hodgson, J. A., Kartika, W. D., Lucey, J., McClean, C., Nurida, N. L., Pratiwi, E., Stringer, L. C., Ward, C., & Pettorelli, N. (2019). A comparison of satellite remote sensing data fusion methods to map peat swamp forest loss in Sumatra, Indonesia. *Remote Sensing in Ecology and Conservation*, *5*(3), 247–258. https://doi.org/10.1002/rse2.102

Ekaputra, E. G., Yanti, D., Irsyad, F., & Setyanto, E. (2022). Spatial distribution of rice planting calendar in West Sumatra Province Based on MODIS image data. *Andalasian International Journal of Applied Science, Engineering and Technology*, *2*(1), 1–10. https://doi.org/10.25077/aijaset.v2i1.28

Fahad, S., Adnan, M., Noor, M., Arif, M., Alam, M., Khan, I. A., Ullah, H., Wahid, F., Mian, I. A., Jamal, Y., Basir, A., Hassan, S., Saud, S., Amanullah, Riaz, M., Wu, C., Khan, M. A., & Wang, D. (2018). Major constraints for global rice production. In *Advances in Rice Research for Abiotic Stress Tolerance*. *Elsevier Inc,* 1–22. https://doi.org/10.1016/B978-0-12-814332-2.00001-0

Henni, M. K., & Ardian, M. A. K. (2015). use material of storage and volume giving water on the growth seed oil palm (*Elaeis guineensis* Jacq.) the main nursery. *Jurnal Online Mahasiswa Fakultas Pertanian Universitas Riau*, *2*(2), 1–15.

Hermanto, S. R., Aprianingrum, E., Ketapang, P. N., & Ketapang, J. R. S. (2022). Growth of sleeping eye rubber stum seed on peat media. *Journal of Agro Plantation*, *01*(01), 27–33.

Hubert, J., Luzi-kihupi, A., Hébrard, E., & Lyimo, H. J. F. (2016). Farmers' knowledge and perceptions of rice yellow mottle virus in selected rice growing areas in Tanzania. *International Journal of Science and Research*, *5*(2), 549–559.

Jumakir, J. (2015). The Performance and Results of Strains Harapan Padi in Tidal Marshes. *Journal Agroekoteknologi*, *7*(2), 160–166.

Kamai, N., Omoigui, L. O., & Kamara, A. Y. (2020). Guide to rice production in Northern Nigeria (*I. Ibadan* (ed.)). *International Institute of Tropical Agriculture,* p.1–27.

Kasno, A., Rostaman, T., & Setyorini, D. (2016). Increasing productivity of rainfed rice fields with N, P, and K nutrient fertilization and use of superior rice varieties. *Jurnal Tanah dan Iklim*, *40*(2), 147–157.

Kato, Y., Collard, B. C. Y., Septiningsih, E. M., & Ismail, A. M. (2019). Increasing flooding tolerance in rice: combining tolerance of submergence and of stagnant flooding. *Annals of Botany*, *124*(7), 1199–1209. https://doi.org/10.1093/aob/mcz118

Khan, S., Anwar, S., Ashraf, M. Y., Khaliq, B., Sun, M., Hussain, S., Gao, Z. Q., Noor, H., & Alam, S. (2019). Mechanisms and adaptation strategies to improve heat tolerance in rice. A Review. *Plants*, *8*(11), 1–21. https://doi.org/10.3390/plants8110508

Kurniawan, H. H., Mulyanto, D., & Nurcholis, M. (2021). The effect of calcite application to several chemical properties of latosol in Patuk Gunung Kidul. *Jurnal Tanah dan Air*, *18*(6), 37–47.

Lakitan, B., Alberto, A., Lindiana, L., Kartika, K., Herlinda, S., & Kurnianingsih, A. (2018a). The benefits of biochar on rice growth and yield in tropical Riparian Wetland, South Sumatra, Indonesia. *Chiang Mai University Journal of Natural Sciences*, *17*(2), 111–126. https://doi.org/10.12982/CMUJNS.2018.0009

Qurani, I. Z., & Lakitan, B. (2021). Inland swamp agriculture: opportunities and challenges. *TJF Brief*, *18*(5), 1–6. https://doi.org/10.6084/m9.figshare.14608230

Rahajeng, S. S., Jayadi, R., & Maas, A. (2022). Assessment of reservoir and canals revitalization to improve the reclamation process at Unit Tamban Tidal Irrigation Area, Central Kalimantan. *IOP Conference Series: Earth and Environmental Science*, *1091*(1), 1–10. https://doi.org/10.1088/1755-1315/1091/1/012034

Saadah, D. R.,, Zakiyah, M. R. U. M. S. S. (2017). Red algae (*Gracilaria coronopifolia*) as a potential source of phytohormone cytokinin. *Chimica et Natura Acta*, *5*(3), 124–131.

Sarumaha, M. (2020). Identification of insect pests on rice plants in Bawolowalan Village. *Jurnal Education and Development*, *8*(3), 86–91.

Seleiman, M. F., Al-Suhaibani, N., Ali, N., Akmal, M., Alotaibi, M., Refay, Y., Dindaroglu, T., Abdul-Wajid, H. H., & Battaglia, M. L. (2021). Drought stress impacts on plants and different approaches to alleviate its adverse effects. *Plants*, *10*(2), 1–25. https://doi.org/10.3390/plants10020259

Sembiring, J. A., & Mendes, J. A. (2022). Population of brown stem leafhopper (*Nilaparvata lugens*) and green planthopper (*Nephotettix virescens*) on rice plant of Inpara 2 Variety in Bokem Village, Merauke Regency, Papua. *Sainmatika: Jurnal Ilmiah Matematika dan Ilmu Pengetahuan Alam*, *19*(2), 201–207. https://doi.org/10.31851/sainmatika.v19i2.9321

Senewe, R. E., Permatasari, S., & Pesireron, M. (2020). Response of brown planthopper *Nilaparvata lugens* Stal. (Hemiptera: *Delphacidae*) on the Resistance and Vulnerability of Rice Varieties. *Jurnal Budidaya Pertanian*, *16*(1), 51–55. https://doi.org/10.30598/jbdp.2020.16.1.51

Singh, B., Hussain, T., & Bernard, S. (2015). Field crops research effect of crop establishment methods and weed control treatments on weed management and rice yield. *Field Crops Research*, *172*, 72–84. https://doi.org/10.1016/j.fcr.2014.12.011

Singh, S. K., Bhati, P. K., Sharma, A., & Sahu, V. (2015). Super hybrid rice in china and india: current status and future prospects. *International Journal of Agriculture and Biology*, *17*(2), 221–232.

Sudewi, S., Ala, A., Farid, M., Agroteknologi, D., Pertanian, F., Hasanuddin, U., Hama, D., Pertanian, F., & Hasanuddin, U. (2020). Variety of plant disturbing organisms in rice plant of new superior varieties and local varieties in semi field experiments. *Jurnal Agrikultura*, *31*(1), 15–24.

Sulaiman, A. A., Sulaeman, Y., & Minasny, B. (2019). A framework for the development of wetland for agricultural use in Indonesia. *Resources*, *8*(1), 1–16. https://doi.org/10.3390/resources8010034

Sulistyo, A., Purwantoro, & Sari, K. P. (2018). Correlation, path analysis and heritability estimation for agronomic traits contribute to yield on soybean. *IOP Conference Series: Earth and Environmental Science*, *102*(1), 1–6. https://doi.org/10.1088/1755-1315/102/1/012034

Susilo, J., & Ariani, E. (2015). The effect of seed number in the planting hole and dosage of N, P, K fertilizer forward growth and production on rice (*Oryza sativa* L.) with Sri Methode. *Jurnal Online Mahasiswa Fakultas Pertanian Universitas*

Riau, *2*(1), 1–15.

Suwignyo, R. A., Irmawati, I., Hose, F., & Aulia, S. L. (2021). Development of rice varieties adaptive to nontidal swampland using MABC: growth characteristics of parent plant and F1 Result. *IOP Conference Series: Earth and Environmental Science*, *741*(1), 1–5. https://doi.org/10.1088/1755-1315/741/1/012022

Syofian, W. M., Anhar, A., Sciences, N., Negeri, U., & Sumatera, W. (2022). The effect of trichoderma sp. against germination speed of batok glutinous rice seeds (*Oryza sativa* L. var. glutinosa). *Bioscience*, *6*(1), 33–39. https://doi.org/10.24036/0202261109181-0-00

Umar, S., & Hidayat, A. R. (2017). Assesment of Jarwo Transplanter on tidal swamp land. *Jurnal Teknik Pertanian Lampung*, *6*(1), 63–72.

Weintraub, P. G., Recht, E., Mondaca, L. L., Harari, A. R., Diaz, B. M., Bennison, J., Negev, D. N., Protection, P., Services, I., Dagan, B., Experimental, E., Concordia, A., & Tecnología, I. N. De. (2017). Arthropod pest management in organic vegetable greenhouses. *Journal of Integrated Pest Management*, *8*(1), 1–14. https://doi.org/10.1093/jipm/pmx021

Wildayana, E., & Armanto, M. E. (2018). Lebak swamp typology and rice production potency in jakabaring South Sumatra. *Agriekonomika*, *7*(1), 30–36. https://doi.org/10.21107/agriekonomika.v7i1.2513

Wulandari, N. B., Nugroho, A., Saidy, A. R., & Priatmadi, B. J. (2023). Amelioration of planting media in chili cultivation with floating system in lebak swamp. *Tropical Wetland Journal*, *9*(1), 20–25. https://doi.org/10.20527/twj.v9i1.117

Xu, J., Xing, Y., Xu, Y., & Wan, J. (2021). Breeding by design for future rice: genes and genome technologies. *Crop Journal*, *9*(3), 491–496. https://doi.org/10.1016/j.cj.2021.05.001

Zhang, G. (2021). Target chromosome segment substitution: a way to breeding by design in rice. *Crop Journal*, *9*(3), 658–668. https://doi.org/10.1016/j.cj.2021.03.001