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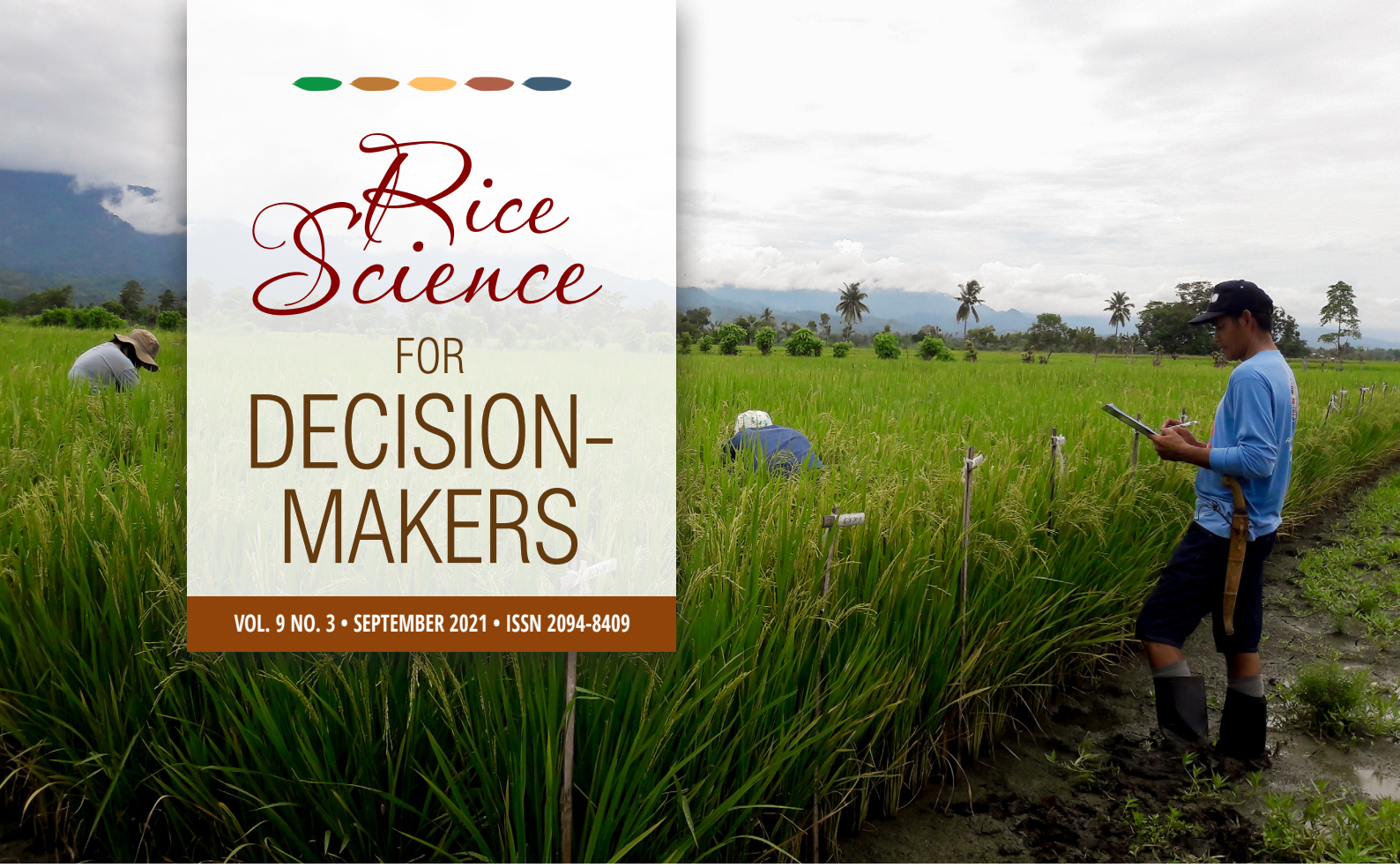

ARE THERE GOOD REASONS TO PUSH FOR VARMIX IN UNFAVORABLE RICE-GROWING AREAS?

WHAT IS VARMIX?

Varietal Mixture (VarMix) is a mixture of seeds of selected varieties with closely similar agronomic traits but with genetic dissimilarities. Agronomic traits pertain to maturity, height, and grain size and shape, while genetic dissimilarities refer to the distinct genetic makeup of a rice variety. These varieties have diverse functions to lessen the effects of both biotic (e.g. pest and diseases) and abiotic (e.g. water) stresses (Tooker & Frank, 2012; Barot et al., 2017; Montazeaud et al., 2017).

VarMix logo is currently applied for trademark in IPOPHL.

KEY POINTS

- VarMix is a stopgap strategy in unfavorable rice-growing environments to overcome biotic (e.g. pest and disease) and abiotic (e.g. water) stresses. This is made possible by sowing mixed seeds of two or more carefully selected varieties.
- A study by DA-PhilRice shows that VarMix combinations outyielded their single variety counterparts in different experiment areas across the country.
- VarMix combinations command higher prices than their single variety counterparts among millers in Nueva Ecija.
- VarMix combinations have comparable, sometimes better eating qualities vis-à-vis single varieties.
- Above (e.g. rainfall and water table-monitoring, and pest and disease evaluation) and below-ground (e.g. root analysis, and screening under adverse conditions) investigations show that VarMix combinations effectively address common rice cultivation issues.

THE PHILRICE STUDY

VarMix research initially took off in 2013 under the Department of Agriculture- Regional Field Office (DA-RFO) III-funded project "*Collection of indigenous rice cultivars and assessment of rice genetic diversity for yield stability in Region III*". The field experiment was conducted in Umiray, Dingalan, Aurora where perennial issues on rice diseases such as bacterial leaf blight and rice blast persisted. Hence, the place proved an ideal site to assess the performance of VarMix for disease management.

Four varieties were selected based on genetic dissimilarities (PSB Rc 82, NSIC Rc 214, Rc 216, and Rc 222), and two check varieties were included to assess disease infection. The combination formula was used to generate 15 and 20 VarMix combinations with 1:1 and 1:1:1 ratios, respectively. In the 2014 dry season (DS) setup, VarMix performance assessment saw high yield stability of selected combinations amid environmental stresses. VarMix combination seed sources were from PSB Rc 82, NSIC Rc 214, Rc 216, Rc 238, Rc 298, and Rc 300.

From 2015 to 2018, the DA-Bureau of Agricultural Research funded the project "*Varietal mixture of rice to enhance yield and mitigate effects of climate change in stress-prone areas*". The aim was to evaluate VarMix's potentials in different locations having biotic and abiotic stresses.

Thirteen locations spread over Northern and Southern Luzon, Western and Central Visayas, and Central and Northern Mindanao were selected. Six good-performing combinations with 1:1 and 1:1:1 ratios selected from the Region III study and six untested VarMix ratios (1:1:1:1; 1:1:1:1:1, 1:1:1:1:1:1) were assessed.

The project had several study components. One of them was on the comparison of the genetic dissimilarities of six varieties used in VarMix to 31 PSB/NSIC varieties developed from the rainfed and irrigated ecosystems. Another study investigated the above-ground environment, i.e., pest and disease, rainfall and water table-monitoring; and below-ground environment under controlled conditions, i.e., root analysis and adverse settings such as drought and salinity screening. Market acceptability was also studied to determine how VarMix fared in terms of buying prices compared with current popular varieties.

Lastly, grain quality was also evaluated to establish if VarMix improved the grain characteristics of their single varieties.

Prior to the current study, no investigation in the Philippines had been conducted using the VarMix approach in rice, particularly to deal with water scarcity (*see Kiaer, Skovgaard & Ostergard (2012) for a VarMix study in barley*). This study also used varieties developed for favorable environments that performed well in unfavorable ecosystems.

RESULTS

- **There is large genetic variability, resolved by using molecular markers, in VarMix seed sources,** namely PSB Rc 82, NSIC Rc 214, Rc 216, Rc 238, Rc 298, and Rc 300 compared with 31 PSB/NSIC varieties (commonly planted by farmers in selected regions/provinces, Rice Varietal Improvement Group, 2016). Genetic variability is an important quality and basis for finding VarMix seed sources as it acts as built-in protection against biotic and abiotic stresses. The larger the genetic variability in VarMix seed sources, the better for dealing with stresses.

- **VarMix significantly reduced pest and disease infections in many experiment areas:** tungro incidence in Albay during 2016 DS; occurrence of leaf blast in Bohol during 2017 DS; and incidence of sheath blight in Ilocos Norte in 2017 wet season.

- **Mixing effect analysis from 12 experiment locations showed that 10 out of 12 VarMix combinations outyielded their single variety counterparts.** For instance, VarMix using NSIC Rc 298:214:216:238 showed positive relative mixing effect and thus outyielded its counterpart single varieties. Inter-varietal analysis also showed that VarMix of PSB Rc 82:214:238 outyielded its corresponding single varieties.

- **With right VarMix combinations, root branching index (RBI) can be increased to maintain water use and increase water use efficiency (WUE) under drought conditions.** Root branching index refers to the length of lateral roots produced per unit length of crown or nodal roots. Subsequently, increasing the RBI may increase the grain weight in some VarMix combinations. The high-performing VarMix may express its full potential over single varieties when grown under real field conditions where the varieties are not only exposed to water stress but also to insect pest and disease pressures. These findings show the rich potential VarMix has in dealing with various abiotic and biotic stresses.

- **Some VarMix combinations showed mechanism for tolerance to adverse conditions partially due to the collective reaction of its corresponding single varieties.** This suggests that the VarMix approach with right combinations may lessen the effects of adverse environments.

- **The VarMix market acceptability study showed that millers quoted higher prices for VarMix ABC (NSIC Rc 298:214:216) and AFE (NSIC Rc 298:300:238) compared with known premium rices such as NSIC Rc 160 and Rc 216.** Millers put premium on VarMix's excellent grain characteristics that have high market demand (Figure 1). Additionally, traders and agents gave the same feedback on VarMix acceptability where some combinations showed comparable prices with two premium rice samples.

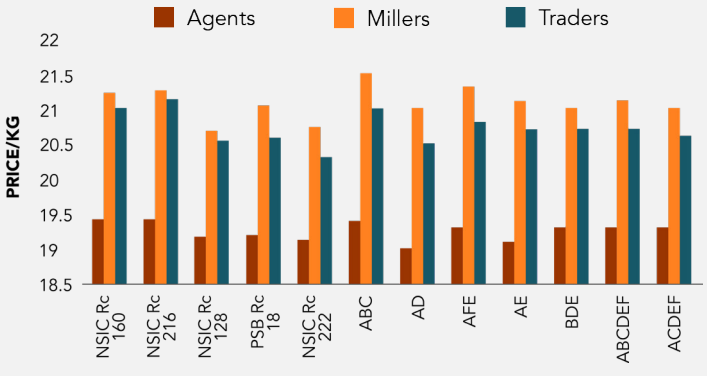

Fig. 1. Average quoted price per kilogram of *palay* samples given by market players in Region III. All samples were properly dried at 14% moisture content and were individually packed in clear plastic labeled with letter codes to maintain secrecy of the samples among respondents. The survey was conducted from December 2016 to May 2017.

- **VarMix combinations also improved the grain quality of single varieties and even better than the eating quality of the check variety, IR64.**

TECHNOLOGY TAKERS

Farmers in Sta. Barbara, Iloilo and its neighboring town appreciated the excellent yield performance of VarMix. The staff members of the Field Operations and Extension Unit of DA-Regional Field Office VI were convinced that VarMix is a promising approach to achieving higher yield in rice-growing areas in Western Visayas with adverse conditions. Hence, the DA-RFO VI implemented a project related to VarMix in 2019: *Assessment of VarMix technology in Western Visayas*.

CONCLUSION

VarMix is a stopgap strategy in unfavorable rice-growing environments. Their yields are comparable with, if not better than, single varieties, in most sites covered by the project. Sensory characteristics were comparable or even better than their single variety counterparts. Lastly, VarMix commanded higher miller prices than single varieties in Nueva Ecija.

CALL FOR ACTION

- **Promote VarMix locally in more stress-prone areas, but only as a stopgap measure.** Farmers should know that there is an alternative option other than planting single varieties if the aim is to get higher yield and have better fighting stance against farming issues such as insect pests and diseases (Castilla et al., 2003) and availability of water. It should be made clear, however, that VarMix should only be promoted in areas with known rice cultivation challenges. They are not meant to compete with single varieties in favorable rice-growing conditions.

- **Come up with implementing guidelines on mixing varieties.** Guidelines must be crafted on how VarMix should be made available commercially. For instance, tapping interested seed growers for seed production and marketing of needed single varieties. Other issues must also be addressed at the policy level such as the availability of a pre-mixed pack of seeds to farmers.

- **Support future research.** As with other technologies, continuous research is needed to ensure that bits of unknowns will be unpacked, and fuel continual improvement. Varietal mixture is a common strategy in disease management in various crops and is widely adapted in Europe, United States, and China. The scientific exploration of VarMix for combatting water scarcity provides a big impact particularly in rainfed rice areas in the Philippines. This is an important point given that currently there is no single multi-trait local variety that is well-adapted to various abiotic and biotic stresses. Identification of new varieties for VarMix purposes is challenging but interesting for plant breeders to explore particularly that there are now newly released varieties (300 to 500 series). A deeper investigation for below-ground environment provides technical precision for determining the right combination; thus, there is a need for a more rigorous study.

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ABOUT THE MATERIAL

Rice Science for Decision-Makers is published by the Department of Agriculture-Philippine Rice Research Institute (DA-PhilRice). It synthesizes findings in rice science to help craft decisions relating to rice production and technology adoption and adaptation. It also provides recommendations that may offer policy triggers to relevant rice stakeholders in search of opportunities to share their knowledge on rice-related products.

The articles featured here aim to improve the competitiveness of the Filipino rice farmers and the Philippine rice industry through policy research and advocacy.

This issue discusses about VarMix as a stopgap mechanism in unfavorable rice-growing areas. VarMix, as presented above, offers a way to deal with various rice cultivation issues, such as pests and diseases and water inadequacy.

Should you need any data from this study, please feel free to contact PhilRice: prri.mail@philrice.gov.ph.

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