Development of Rice for Unfavorable Ecosystems

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Abstract: Development of rice cultivars which is tolerant to multiple abiotic stresses is essential to improve food security. With the objective of improving grain yield (GY) under low water input (RS), three drought yield QTLs *qDTY*$_{2.2}$, *qDTY*$_{3.1}$ and *qDTY*$_{12.1}$ had successfully pyramided into Malaysian mega-variety rice, MR219 via marker assisted QTLs pyramiding (MAQP) technique. Donor of the QTLs were the near isogenic lines developed by International Rice Research Institute (IRRI). Three selected pyramided lines (PLs) were evaluated for their yield potential under RS and non-stress (NS), and survivability under anaerobic germination, submergence and salinity stresses. Pyramided lines produced higher yield compared to recipient parent, MR219 in all trials. PL-5 became the most promising PL as it gave a yield advantages of 461.15 kg/ha and 1360.00 kg/ha under RS and NS conditions. Under submergence stress, survival rate (SR) of all PLs and submergence tolerant check IR64-*Sub1* was significantly different to MR219 (highly susceptible to submergence) in two evaluation cycles (SS1 and SS2). Furthermore, non-significant result was obtained for SR between PL-2 (80.00%) and IR64-*Sub1* (86.67%) under anaerobic germination indicate that these PLs especially PL-2 was capable to germinate and growing well under flooded condition. For salinity stress, SR of PL-68 was higher than salinity tolerant check, Nona Bokra under intermediate (8 dS/m) and severe (15 dS/m) salinity levels. Recovery score (RecS) of PL-68 was either same or higher than Nona Bokra for both salinity levels in two evaluation cycles may indicate a high tolerance level of PL-68 under SL condition. This study suggests that MAQP could be an effective strategy to enhance abiotic stresses tolerance in rice. Promising PLs used in this study can be recommended for cultivation in either normal or unfavorable rice ecosystems in Malaysia as it may help in stabilizing rice production and improving food security.

Table 1: Survival rate under anaerobic germination (AG), submergence (SS) and salinity stress (SL) conditions

Genotype	Survival Rate				
	AG	SS1	SS2	SL (8 dS/m)	SL (15 dS/m)
PL-2	80.00a	91.53a	77.78a	-	-
PL-5	46.67c	85.20a	66.67a	55.55b	15.64b
PL-68	66.67b	87.50a	71.80a	88.89a	29.41a
MR219	40.00c	0.00b	6.36b	25.00c	12.50b
IR64-*Sub1*	86.67a	88.80a	80a	-	-
Nona Bokra	-	-	-	66.67b	7.69b

Recent Publications:

1. Gwen Iris Descalsota-Empleo et al. (2019) Genetic dissection of grain nutritional traits and leaf blight resistance in rice. Genes 2019,10,30: 1-23.
2. Arvind K, Nitika S, Shalabh D, Shailesh Y, BPM Swamy, & Noraziyah AAS (2018) Marker-assisted selection strategy to pyramid two or more QTLs for quantitative trait-grain yield under drought. Rice 11:35.
3. Margaret C, Nitika S, Shalabh D, Noraziyah AAS, Kenneth MN, Amelia H, & Arvind K. (2017) Genetic loci enhancing grain yield and root development under variable cultivation conditions. Frontiers in Plant Science 2017(8):1763.
4. Swamy BPM, Noraziyah AAS, Site Noorzuraini AR, Mauleon R, Wickneswari R, Ma. Teressa SC, & Kumar A (2017) Association mapping of yield and yield-related traits under reproductive stage drought stress in rice (*Oryza sativa* L.). Rice 2017(10-22).
5. Noraziyah AA., Swamy BPM, Wickneswari R, Ma. Teressa SC, Anitha R, & Kumar A (2016) Marker assisted pyramiding of drought yield QTLs into popular Malaysian rice cultivar, MR219. BMC Genetics 2016: 17-30.



Biography (150 word limit)

Dr. Nora is a senior lecturer in Plant Breeding and Genetics from Biology Program, Faculty of Science and Technology, Universiti Kebangsaan Malaysia (UKM). She finished her PhD on Genetics from UKM-IRRI (International Rice Research Institute) twin program in 2014 and joined UKM as senior lecturer a year after. Dr. Nora research interest focus on the genetic improvement of rice and vegetables for biotic and abiotic stresses tolerance. She has published 12 articles related to her research interest in high impact journals. She also a member of Genetic Society of Malaysia. In her free time, Dr. Nora enjoys spending time with family as well as gardening, reading, and baking.

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Notes/Comments: