Progress of Rice genotype improvement and production in Vietnam

Pham Van Cuong, Nguyen Van Hoan

Hanoi University of Agriculture, Vietnam

In Vietnam, rice is main crop with the total areas of country in year is about 7.36 million ha including spring, summer and autumn with 1.78, 2.14 and 2.44 million ha, respectively. Red River Delta, total is 1.06 million including spring, summer and autumn is 0.51, 0.13 and 0.42 mill. ha, respectively. In Mekong River Delta, the total is 3.76 mill. ha including spring, summer and autumn with 1.39, 1.77 and 0.60 mill. ha, respectively. The progress of rice production in Vietnam was contributed by the increase in cultivation areas and grain yield. The areas increased from 5.29 million ha (1975) to 7.3 million ha (2010) while the yield increased from 2.23 to 5.18 ton per ha due. The increase grain yield in spring, summer and autumn was from 2.68 to 5.71; 2.49 to 3.92 and 1.99 to 3.42 ton per ha, respectively. The increase in grain yield was due to both improved rice genotype and cultivation method, and the progress can be divided into five stage below:

First stage (1945-1957): Selection variety for expanding areas: The requirement from Vietnamese government to improve amount of total rice production. The policy focused on selection good variety, seed production with good quality, extend to divert area of cultivation and encouraged to use organic and chemical fertilizer, which helped rice production increased as 10% over. Several local rice varieties were selected and planted until now such in winter-spring season like Chiem Chanh, Chiem 314. In autumn season as Tam Thom, Nep Cai hoa Vang. Also several rice short photoperiod sensitive introduced from China was planted until now such as Bao Thai, Moc Tuyen. Most variety is long growth duration (240-245 days in winter-spring season, 155-160 days in autumn season), plant height from 150-170 cm, 3-4 panicle per hill and grain yield about 2.5-3.0 ton per ha.

Second stage (1958-1970): Breeding short growth duration rice for cropping system change as change rice from winter-spring season to spring season to avoid cold weather at transplanting time. Also, selection short photoperiod sensitive variety for early flowering and ripening in autumn season. This period many cultivation techniques for rice were improved such as row transplanting, applying chemical fertilizer, especially irrigation system. In spring season, several short growth duration (160-170 days), short plant height (130-150cm), 4-5 panicle per hills and grain yield (3.0-4.0 ton per ha) introduced from China were planted. In autumn season, several thermo sensitive rice variety like Khoa Tinh were planed and harvested 15-20 days earlier but grain yield was 15-20 percent over short photoperiod varieties. Beside rice plant, several new crop varieties was released such as maize, soybean, sweet potato.

Third stage (1970-1990): Applying achievement of green revolution and change cropping system: Introduction improved rice from IRRI with short growth duration (130-140 days in spring season, 115-120 days in autumn season), very short plant (90-100 cm) for lodging tolerance, 10-12 panicles per hills, 100-120 spikelets per panicle, 1000-grain weight 20-23 g and grain yield 6-7 ton per ha in spring season, 4.5-5.0 ton per ha in autumn season. As the result of green revolution, a popular cropping system such as Spring rice- Autumn rice - Winter crop was established and extending in North Vietnam and Winter-spring rice- Summer rice- Autumn rice was established and extending in South Vietnam. Together with rice plant, genotype of other crop like maize, soybean, potato, sweet potato were improved for being suitable with cropping system.
Fourth stage (1992-2004): Adaptation and extension of F₁ hybrid rice: First three lines system using cytoplasmic male sterile line introduced from China was applied to produce F₁ hybrid, then Vietnamese scientists developed two-lines system using thermo-sensitive genic male sterile line to produce F₁ hybrid seeds. Many F₁ hybrid rice varieties have been released and authorized as National varieties such as Viet Lai 20, Viet Lai 24, TH3-3, TH3-5 etc...Recently, the area of hybrid rice planted was about 10% of total areas in the country (~0.7 million ha) and the grain yield was 20-30% over inbred rice, mostly due to the higher number of grain per panicle (150-200) and 1000-grain weight (25-27 g). Also, F₁ hybrid maize have been planted with about 80% areas (~1 million ha).

Fifth Stage: (2000-Now): Applying marker assisted selection (MAS) with DNA makers (RAPD, SSR, RFLP), for improving genotypes of crop. In rice plant, the progress breeding on insect (brow plant hopper) and disease (blast, bacterial leaf blight) resistance and antibiotic tolerance (salt, submergence, drought). For example, the SATREP project on the Development of Crop Genotypes for the Midlands and Mountain Areas of North Vietnam (DCGV) have been conducted from 2010-2015 in cooperation between Hanoi University of Agriculture, Vietnam and Kyushu University and Nagoya University, Japan. The project purpose is strengthening Rice breeding system using high-through put genotyping system as well as eco-physiological traits to develop promising lines adapting for natural and socio-economic and natural conditions in the midlands and mountain areas of North Vietnam. First, we identify favorite genes related to traits such as high yielding (Gn1, WFP1), leaf blight bacterial (Xa5, Xa7, Xa21) and brown plant hopper (Bph3, Bph25, Bph26) resistance, then accumulation these genes into popular variety in Vietnam such as IR24, Khang dan 18. After backcross and fast generation in Mekong river delta, these lines will be selected by using high-throughput genotyping system (MAB) then phenotyping selection. The selected lines will be characterized by eco-physiological traits as well as ecological adaptation tested. After all, the improved lines together with cultivation technique will be transferred to the farmers.

Thus, the improve research capacity in the field of plant breeding using DNA markers and eco-physiology characters, this will help to shorten in breeding time to release new rice variety in Vietnam.

**Keywords:** Genotype Improvement, Cultivation Change, Rice production, Vietnam.