Omonrice 11: 1-9 (2003)

IMPROVING RICE PRODUCTIVITY UNDER WATER CONSTRAINTS IN MEKONG DELTA, VIETNAM

Bui Chi Buu and Nguyen Thi Lang

ABSTRACT

The problems/constraints vary across ecosystems. Therefore, the solutions to the problems will vary accordingly. The research thrushs of each ecosystem address these particular problems. The objectives of the study of production relationships include: (1) the identification of controllable and uncontrollable factors of production that significantly affect yield, and (2) the rice varietal improvement to the abiotic stress. Vietnam has relative advantage in terms of highly irrigated area that contributed to rice production. In the 1980s irrigated area expanded by 2.9% annually, and during the 1990s this growth rate amounted to 4.6% annually. During the 1990s, investment in irrigation has been increased from 1,538 billion VND to 2,506 billion VND. It was estimated that irrigated rice land has increased from 40% to 90%. For the Mekong Delta, this rate is around 70% while the lowest belongs to the High Plateau and Northeastern South.

Drought and salinity are now considered as more important than flood damage to rice productivity in the Mekong Delta, due to flood escaping strategy with the using of short duration genotypes before and after flood. Therefore, attentions are being paid for rice breeding efforts to improve rice productivity under salt stress and drought at seedling stage.

INTRODUCTION

The problems/constraints vary across ecosystems. Therefore, the solutions to the problems will vary accordingly. The research thrushs of each ecosystem address these particular problems, especially flood and drought influences.

The objectives of the study of production relationships include (1) the identification of controllable and uncontrollable factors of production that significantly affect yield, (2) the rice varietal improvement to the abiotic stress

In 1999, rice growing area covered 7.64 million ha, Mekong Delta and Red River Delta accounted for 53.38% and 14,03%, respectively. Mekong Delta and Red River Delta are considered as the biggest granaries of the country. The change of government policy from a centrally planned agricultural production system consisting of state farms and cooperatives to a more liberalized system has shown positive results in rice production, particularly in the Mekong Delta. Its rice production accounts for 51.85% of the whole country one, then its aquaproduct for 61.7%, its fruit cultivated area for 38.56%. Favorable soils for rice culture in two big granaries of the country as alluvial soils are 1.18 m Ha (30.1%) and 0.91 m Ha (48.5%) in Mekong Delta and Red River Delta, respectively.

In the unfavorable areas with various soil types as acid sulfate soils, low pH, aluminum toxicity, iron toxicity, and low phosphorous are considered as main limited factors for rice growing beside salt instrusion due to water shortage in dry season. Currently, water management and agronomic practices have been recommended. Some improved genotypes have been identified to tolerate to drought, salinity, acid sulfate but not stable.

Natunal calamities such as typhoon, storm, flood are also risks in rice production every year. Post-harvest losses of rice in Vietnam range from 13 to 16% as compared to 10-37% in Southeast Asian countries, mainly due to harvesting, drying, storage and milling.

Varietal improvement has provided farmers with the best materials avialable from pure line selection, introductions, and local hybridiztion. About 5,000 accessions of local rices and hundred populations of four wild rice species: *Oryza rufipogon, O. nivara, O. officinalis, O. granulata* have been collected, catalogued and evaluated. This resource material has provided donors for biotic and abiotic stresses (Buu et al 2002). Rice germplasm evaluation assited by DNA markers has been conducted at some institutions in Vietnam, to supply a reliable information to rice breeders while selecting appropriate materials.

The extra early rice varieties with 80-90 days duration, and early genotypes (91-105 days) created a new strategy to escape flood by growing them before and after flooding to increase more rice seasons in the Mekong Delta. Growing rice areas have increased from 2.2 million ha in previous 1990's to 3.9 million ha / 1.7 milion ha of cultivated areas up to now due to improving short duration genotypes. Farmers here are hard working, skillful, and respond well to new technology once they are convinced that the new technology is appropriate for their social and economic conditions. Their main emphasis is on new varieties of rice. The shortcoming has maintained for many years that they never mind the quality of their seeds so that seed technology should be mentioned in further development strategy.

IMPACT OF IRRIGATION

Vietnam has relative advantage in terms of highly irrigated area that contributed to rice production. In the 1980s irrigated area expanded by 2.9% annually, and during the 1990s this growth rate amounted to 4.6% annually. During the 1990s, investment in irrigation has been increased from 1,538 billion VND to 2,506 billion VND. It was estimated that irrigated rice land has increased from 40% to 90%. The Red River Delta has the largest irrigation rate (90%). For the Mekong Delta, this rate is around 70% while the lowest belongs to the High Plateau and Northeastern South

Except for the severely acid sulfate soils located in Plain of Reeds, Long Xuyen Quadrangle and Ca Mau peninsula, some acid peats and mountainous rock outcrops, the soils of the Delta pose no major constraints to agriculture. Permanently saline soils form a narrow fringe along the coast. Further inland along the coast of the South China Sea, an area of temporary saline soils is planted to paddy in the wet season. With improved irrigation and drainage, it could also be put to agricultural use in the dry season. Slightly to moderately acid-sulfate soils can be used for agriculture, provided good water management is established and development is carefully monitored. Development of the more severely acid sulfate soil areas may lead to serious environmental problems. Exposure to air of potentially acid material leads to generation of large quantities of soluble acids in the surface water and to permanent acidity of the soil. Currently, drought which often occurred at early wet season in Mekong Delta creates problem for rice production beside salt instrusion.

APPROACH AND METHODOLOGY

The use of land and water must be optimized within each senario with the purpose of (1) to bring out the comparative advantages of development options, (2) to provide the framework for the development plan and for the formulation of strategies that could direct Government action in water resource development, and (3) to provide a background against which projects can be assessed.

Unpredictable drought is the single most important factor affecting world food security and the catalyst of the great famines of the past. In term of water management, rice is a voracious consumer, for example, 5000 litres of water is needed to produce 1kg of grain (Gale 2002). At present, an unsustainable 70% of the world's water is used for agriculture. More than 400,000 ha in Vietnam are suffering severe drought actually in highland and mountainous regions. Drought at early rainy season in the Mekong Delta has caused salt instrusion due to erratic rain.

Table 1. Annual rainfall at three main stations in Mekong Delta (LeSam 2003)

Annual Rainfall	Can Tho	Rach Gia	Soc Trang
Max. (mm)	1787	2747	2611
Min. (mm)	1257	1013	1160
Av. rainy days / year	131	132	135

Table 2. Annual rainfall distribution (mm) through multilocations and years (LeSam 2003)

Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Av.
C.Doc	6.5	4.5	25.0	80.0	157.7	114.2	134.2	146.8	160.3	252.1	135.3	46.9	**1246**
L.Xuyen	8.3	2.6	11.7	66.5	147.2	151.6	209.4	174.4	213.8	260.3	130.7	41.8	**1418**
C.Tho	8.9	2.3	9.7	42.8	170.1	195.2	211.7	209.1	250.5	271.4	146.0	32.3	**1550**
D.Ngai	4.0	5.2	6.6	38.7	199.5	319.4	218.6	337.8	307.8	257.0	133.9	20.5	**1849**
P.Hiep	1.4	2.5	3.7	44.9	183.2	198.9	229.0	257.8	306.4	263.4	114.2	14.1	**1620**
XeoRo	4.0	0.8	36.9	60.2	253.3	283.6	214.5	400.9	334.3	224.7	137.2	20.7	**1971**
P.Long	5.6	7.6	17.5	72.2	223.2	267.3	215.8	320.5	271.9	265.5	145.8	28.4	**1841**
CaMau	16.4	7.6	34.1	101.2	270.1	323.3	323.6	365.4	349.2	330.8	190.3	63.6	**2376**
G.Hao	0.9	0.0	3.8	34.1	187.3	297.3	233.2	294.0	254.7	296.6	196.2	27.5	**1826**
T.Chau	11.3	7.2	7.8	65.9	110.4	96.0	140.2	112.8	160.3	253.1	202.8	20.0	**1188**
C.Moi	10.9	1.1	13.3	51.1	163.7	137.8	137.3	189.3	209.1	269.1	181.8	26.5	**1391**
MyTho	5.0	2.5	4.5	38.5	148.6	187.8	185.7	170.8	233.0	267.0	103.6	35.1	**1382**
T.Vinh	1.0	0.1	7.4	29.2	172.7	193.0	226.5	212.8	253.1	236.4	115.4	15.7	**1463**
TanAn	6.9	2.3	7.2	35.6	187.1	222.2	203.9	187.2	245.5	260.8	136.5	40.3	**1536**
B.Luc	3.0	1.0	4.7	59.2	170.8	236.2	207.8	177.7	264.2	304.8	128.0	14.2	**1572**
M.Hoa	13.0	4.2	14.1	48.2	187.7	181.6	184.4	168.1	268.7	312.1	150.3	39.9	**1572**

About 90% of annual rainfall focusses in rainy season (six months), and 10% in dry season (six months)

Flood in Mekong Delta which depends on upstream hydrology, tidal influences in China Sea and Thailand Gulf, and rainfall, is a typical stagnant flood in wetland. The extra early rice varieties with 80-90 days duration, and early genotypes (91-105 days) created a new strategy to escape flood by growing them before and after flooding to increase more rice seasons in the Mekong Delta.

Dry season can be determined from December up to June, and salt instrusion influence is considered as the most serious problem at that moment during one to eight months varying across systems affected 2.1 million ha. The dynamics of China Sea tide is considered as a key factor which influences Mekong river flow in dry season, roughly 2,000 m^3/s (LeSam 2003).

Table 3. Soils in Mekong Delta (Buu et al 1995)

	Ha	%
Sandy soils	43,318	1.10
Saline soils	744,547	18.93
Acid sulfate soils	1,600,263	40.69
Alluvial soils	1,184,857	30.13
Peat soils	24,027	0.61
Grey soils	134,656	3.42
Red yellow soils	2,420	0.06
Laterite soils	8,787	0.22
Rivers, canals	190,257	4.84
Total	3,933,132	100.00

Acid sulfate soils which occupies the largest areas (table 4) are located mainly in Dong Thap Muoi, Long Xuyen quadrangle, Ca Mau peninsula. Water management in theses asreas is also considered as a key practice to reduce the toxicity of aluminum, iron, acidity, and to prevent from capillary effect of sulfate compounds.

Saline soils which are strongly influenced by sea tidal system, especially in dry season account for 19% of natural areas in the delta (table 4). In the coastal areas from Long An to Kien Giang, salt timely instruses with the salt degree varying from 10 to 25 g/l in dry season.

IMPROVEMENT OF RICE PRODUCTIVITY

At present, the following controllable factors are of interest: (1) rate and time of applying nitrogen and phosphorous, (2) weed control, (3) pest and disease control, (4) crop genotype. A broad understanding of the agro-chemical characteristics of the soils in the area has been developed. However, it takes intense and lenthly research to fully understand these important relationship.

To get optimum yield with farmer's resources, we have studied land preparation, field contructs, seed rate, sowing date, fertilizer application, plant protection, irrigation, sowing time in dry and wet seasons, in terms of rice cultivation in salinity and acid sulfate soils. This study aims at improving rice genotypes adapted to saline areas at seedling stage.

Table 4. Salt instrusion level by km per month at main rivers (LeSam 2003)

River	4 g/l				1 g/l			
	Feb	Mar	April	May	Feb	Mar	April	May
Cua Tieu	23	32	37	32	43	51	59	58
Ham Luong	23	30	34	26	46	51	57	54
Co Chien	22	31	35	27	44	58	55	51
Bassac	25	32	33	26	44	54	58	51

Salt instrusion level which becomes the most serious length (km) occurs at the end of March or early April in which rainfall is yearly recognized the lowest (table 5). So that salt tolerance at seedling stage is needed in rice varietal improvement.

The uncontrollable factors of rice production are mainly due to erratic rainfall, global climate changing. Their consequences such as salt instrusion, flood should be paid more attention.

Identification of rice germplasm

The nature of gene action for some agronomic traits in rice was studied to develop salt-tolerant and high-yielding rice varieties (Buu and Tao 1993). Heterosis was recorded in grain yield, panicle per hill, and plant height. It was due to dispersed dominant and interacting genes, and genes with dominance and epistatic properties that were in linkage disequilibrium.

Under saline conditions, filled grains per panicle had the largest direct effect on yield (Buu and Truong 1988). Filled grains per panicle and sterility percentage appear to be the most reliable indices for selection under the conditions.

The existence of non-additive gene effects for yield components was noticed, except for 1000-grain weight (Tao et al.1992). There were at least five groups of genes to govern the plant height of deep water rice growing in the coastal areas.

Good combiners for the sink size character were recognized from traditional cultivars: Lua Giau, Ba xe giai, and Bong Huong (Lang 1994).

Salt tolerant varieties have generally been considered as the most economical and effective way of increasing crop production in saline soils. Efforts have been made to identify a parameter that could be used as the criterion for mass screening. Parameters generally proposed are leaf injury rate at seedling stage, sterility after heading, and Na^+/K^+ ratio in the shoots under saline condition (Buu et al. 1995). Selection efficiency for salinity tolerance under field condition remains very low due to of stress heterogeneity and presence of other soil related stress. Two or more genes (quantitative) govern salt tolerance that significantly interact with environment. Recent advances in DNA marker technology have triggered the molecular dissection of complex traits. RFLP linkage maps have also been developed for rice (Kuraka et al. 1994, McCouch et al. 1998).

Considerable genetic variation has been reported in salinity tolerance among rice varieties. The salt tolerance of Nona Bokra is greatest at seedling and vegetative stages, Pokkali is more tolerant at reproductive stage and less sensitive to photo-period (Senadhira 1987), and Doc Do, Doc Phung were considered as salt tolerant donors in Vietnam (Buu et al. 1995). Among 418 local rice accessions screened under salt stress of 6-12dS/m, there were 44 tolerant accessions including Nang Co do, Soc Nau (Buu et al. 1995), Doc Do, Doc Phung, Trai May, Ca Dung trang (Buu et al 2000)

QTL analysis for salt tolerance in rice

One hundred eight F_8 recombinant inbred lines (RILs) derived from the cross between Tesanai 2 / CB were evaluated. Recombinant inbred lines were evaluated for seedling survival day (SD), dry root weight, dry shoot weight, Na^+, K^+ concentration and Na^+/K^+ ratio in culture solution (EC= 12 dS/m). RFLP and microsetellite map of this population were used with 108 markers to detect the linkage to target traits. A linkage map was constructed from 12-linkage groups based on the population. The map covers 2,340.50 cM with an average interval of 21.68 cM between marker loci. Markers associated with salt tolerance were located mostly on chromosomes 1, 2, 3, 9, 11, and 12. Quantitative trait loci (QTL) mapping was used to determine effects of QTLs associated with salt tolerance traits. We also mapped QTLs for morphological attributes and ion accumulation of salt tolerance. Chi-square tests (χ^2), single maker analysis (SMA), interval mapping (IM) were combined in QTL analysis procedure. All approaches are similar to QTL detection result. Four QTLs were identified for SD, one QTL for dry shoot weight, two QTLs for dry root weight, one QTL for Na^+ absortion, one QTL for K^+ absorption and four QTLs for Na^+/K^+ ratio. The proportion of phenotypic variation explained by each QTL ranged from 5.2% to 11.6% for SD, and 4.80 to 14.38% for morphological characters and Na^+, K^+ accumulation. Common QTLs were observed in chromosome 3 and 9 for quantitative traits (SD and Rt.wt) and (SD and Na^+/K^+) . Common QTL were also detected on chromosome 12 for (Na^+/K^+ and K^+). The result explains much of the transgressive variation for the most traits observed in this population (Lang et al. 2000, 2001a, 2001b and 2001c).

An advanced backcross population BC_2F_2 were developed with the parents included OM1706, Type3, Cheng Hui 448, FR13A, Almol 3 and Madhadar as donors of salt tolerance, and IR64, IR68552-55-3-2, Teqing as recurrent parents with good quality traits. Molecular markers associated with both qualitative and quantitative salt tolerance were identified by using 150 microsatellite markers. IR64 / ChengHui 448, IR68552-55-3-2 / Type 3, and IR64 / FR13A derived alleles nearly located at RM315, associated with salt stress tolerance at seedling stage at a distance of 21.2cM, 1.9cM, and 0.0cM in chromosome 1, respectively. In IR68552-55-3-2 / OM1706, the alleles controlling salt stress tolerance were linked with RM223 in chromosome 8 at a distance of 7.2cM. Microsatellite markers in chromosome 1 may be used efficiently in rice breeding marker-assisted selection (Lang et al. 2001c)

Rice breeding for salt tolerance

Rice varieties needed to exploit the full potential of the ecosystem must be adapted to many constraints including saline soils. The coastal rainfed lowland rice areas need varieties adapted to water depth of 30-50m, growth duration 120-140 days or 90-105 days, drought tolerance at seedling stage, and tolerance to salt instrusion before wet season

(EC = 4-6 dS/m). Two tolerant varieties CSR10 and CSR13 were used to investigate biochemical changes under saline conditions. Salinity caused a drastic decrease in potassium content of salt-sensitive varieties. Polyamine, putrescine, spermidine, spermine concentration are also reported in terms of osmotic shock and desiccation symtomps. A population of 257 segregants from F_3 family was developed from a cross between IR28 and Doc Phung . Phenotypes were evaluated by visual score of salt tolerance at vegetative and reproductive stages under saline stress of EC 10=dS/m in phytotron. Beside that QTL mapping was conducted with microsatellite markers on this population. Some mid-duration genotypes were well developed such as IR42, OM723-11, A69-1, OM861, OM922, Tep Hanh mutant, OM1346, OM1348, OM1849. Some early duration genotypes were noticed to be suitable under such conditions as OM1314, OM1490, OM2031

Table 5. Standard evaluation score (SES) of visual salt injury at vegetative and reproductive stages .

Score	Observation	Tolerance
1	Normal growth, no leaf symptoms	Highly tolerant
3	Nearly normal growth, but leaf tips or few leaves whitish and rolled	Tolerant
5	Growth severely retarded; most leaves rolled, only a few are elongating	Moderately tolerant
7	Complete cessation of growth; most leaves dry; some plants dying	Susceptible
9	Almost all plants dead or dying	Highly susceptible

Marker RM223 was used to facilitate marker-assisted selection (MAS) to identify target genotypes which tolerate salt stress (Lang et al. 2001b, 2001c)

Table 6. Salt screening at vegetative stage under stress conditions of 6dS/m and 12 dS/m in Yoshida solution

Designation	Leaf injury at 6dS/m	Leaf injury at 12dS/m
AS996	3	9
OM1490	3	5
AS1007	5	7
OM1838	3	7
OM2031	3	9
OM2401	3	9
OM1346	3	7
OM1348	3	9
OM1849-5	7	9
A69-1	3	7
OM723-7	3	7
IR28 (susc. check)	5	9
Pokkali (tol. check)	1	3
Doc Do (tol. check)	1	1

In the coastal areas affected by salt instrusion in Mekong Delta, IR42 has been stably developed since early 1980's. Beside that, A69-1 was well suitable but not well developed due to its bad grain quality. One introduced variety IR29723-143-3-2 was accepted although it was susceptible to bacterial leaf blight. Some promising inbred lines of miduration genotypes obtained were:

OM344	Mahsuri / IR42
OM723	A69-1 / NN6A
OM861	Ba Thiet / IR42
OM916	BG380 / A69-1
OM924	IR29723-143-3-2 / OM80
OM1571	A69-1 / OM87-9

Recently, early duration genotypes have been also developed in the target areas such as

Ham Trau (OM576)	Hungari/IR48	115-120 days
OM1314	OM80/OM576	105-110
OM1490	OM606/IR44592-62-1-3-3	90-105
OM2031	Thai Lan/Bong Huong	90-105

Mid-duration genotypes should be recommended as followed:

OM1346	IR42 / OM739-7-2-2-1	120-130 days
OM1348	IR42 / OM736-8-1-1	125-130
OM1849	OM723-11 / KSB54	130-135
TepHanh mutant	Tep Hanh (traditional cultivar)	130-135

Salt screening presented in table 7 showed that salt-tolerant lines at seedling stage should be recommended as compared to Pokkali, and Doc Do as tolerant checks, and IR28 as sensitive check.

Some of the coastal salinity in the delta associated with flooding due to tidal fluctuation should be considered with submergence tolerance. Breeding for salinity tolerance is highly feasible because there is no antagonism between high yield and salt tolerance (Akbar et al. 1985). Attention should be paid to introgress from wild gene pool such as *Oryza rufipogon* and *Oryza officinalis* just collected in mangroves of the coastal areas, and traditional cultivars as Doc Do, Doc Phung, Soc Nau. Recombination frequency will be enhance due to duplicated backcrossing to obtain desirable phenotypes among segregants through the strategy.

Drought and salinity are now considered as more important than flood damage to rice productivity in the Mekong Delta, due to flood escaping strategy with the using of short duration genotypes before and after flood. Therefore, attentions are being paid for rice breeding efforts to improve rice productivity under salt stress and drought at seedling stage.

Abiotic stress with the emphasis of water shortage is a major constraint to rice production in Mekong Delta although water resource is considered there optimum as compared to other regions. Considerable collaborative work is ready underway for the most mandate crop (*Oryza sativa* L.). However, the various projects are being carried out in relative isolation so that rice breeding for salt stress and drought stress tolerance is slowly progressive. It requires the collaboration among breeders, physiologists, water resource scientists, soil scientists, etc... to set up an appropriate research strategy. Most farmers in the target areas are very poor so that high input technologies are restrictedly accepted. Varietal improvement is considered the most economical approach but it cannot be alone.

REFERENCES

Akbar M, GS Khush, D HilleRisLambers. 1985. Genetics of salt tolerance. In: Rice Genetics, IRRI Philippines, pp. 399-409

Buu BC, DX Truong. 1988. Path analysis of rice grain yield under saline conditions. IRRN 13(6): 20-21

Buu BC, NT Lang, PB Tao, ND Bay. 1995. Rice breeding research strategy in the Mekong Delta. Pages 739-755 *in* Proc. of the Int. Rice Res. Conf. "Fragile Lives in Fragile Ecosystems", IRRI, Philippines.

Buu BC, ND Bay, PB Tao, DX Truong, NT Lang. 2000. Rice breeding for saline areas in Mekong Delta of Vietnam. OMonRice 8:16-26

Buu BC, NV Tao, TT Luy, NTLang. 2002. Rice germplasm conservation in Mekong Delta. In Plant Genetic Resources Conservation in Agriculture. MARD (ed.). Nong Nghiep Publishing House, Hanoi. pp 38-56

Buu BC, PB Tao. 1993. Genetic nature of some agronomic traits in rice (*Oryza sativa* L.) through triple test cross analysis. OMonRice 3:5-10

Gale M. 2002. Applications of molecular biology and genomics to genetic enhancement of crop tolerance to abiotic stress – a discussion document. CGIAR Interim Science Council, Italy 26-30 August 2002

Kurata N, Y Nagamura, K Yamamoto, Y Harushima, N Sue, J Wu, BA Antonio, A Shomura, T Kiriha, K Hayasaka, A Miyamo, A Monna, HS Zhong. Y Tamura, ZY Wang, T Momma, Y Umehara, M Yano, T Sasaki, Y Minobe. 1994. A 300 kilobase interval genetic map of rice including 883 expressed sequences. Nat. Genet 8: 365-372

Lang NT, S Yanagihara, BC Buu. 2001a. A microsatellite marker for a gene conferring salt tolerance on rice at the vegetative and reproductive stages. SABRAO 33(1):1-10

Lang NT, S Yanagihara, BC Buu. 2001b. QTL analysis of salt tolerance in rice (*Oryza sativa* L.). SABRAO 33(1):11-20

Lang NT, Z Li, BC Buu. 2001 c. Microsatellite markers linked to salt tolerance in rice. OMonRice 9: 9-21

Lang NT. 1994. Studies on heterosis of some physiological traits and grain yield of rice (*Oryza sativa* L.). PhD Thesis. National Institute of Agricutural Sciences, Hanoi, Vietnam

Lang NT. 2000. Quantitative trait loci for salt tolerance in rice via molecular markers. OMonRice 8:37-48.

Le Sam. 2003. Salt instrusion in the Mekong Delta, Vietnam. LeSam (ed), Nong Nghiep Publishing House, Ho chi Minh City. 422 pp.

McCouch SR, G Kochert, ZH Yu, ZY Wang, GS Khush, WR Coffman, SD Tanksley.1998. Molecular mapping of rice chromosomes. Theor,Appl, Genet.76:815-829.

Senadhira SD. 1987. Salinity as a contraint to increasing rice production in Asia. Required worshop on maintenance of life support species in Asia Pacific Region 4-7 April ,1987.

Tao PB, DX Truong, BC Buu. 1992. Assessment breeding materials from salt tolerant deep water rices in the Mekong Delta . OMonRice 2: 56-63

SUMMARY IN VIETNAMESE

Cải tiến năng suất lúa chống chịu điều kiện bất lợi do hạn chế nguồn nước

Mục tiêu của nghiên cứu này là: (1) xác định những yếu tố kiểm soát được và yếu tố không kiểm soát được ảnh hưởng đến năng suất lúa, (2) cải tiến giống lúa chống chịu với điều kiện bất lợi. Việt Nam là quốc gia hiện có nhiều thuận lợi về hệ thống thủy nông cho canh tác lúa. Trong thập niên 1980, diện tích lúa có nước tưới tăng trung bình 2,9% mỗi năm, và trong thập niên 1990 tăng 4,6% mỗi năm. Giai đoạn những năm 1990s, đầu tư cho thủy nông đã tăng từ 1.538 tỉ đồng lên đến 2.506 tỉ đồng. Do đó, diện tích lúa có nước tưới đã tăng từ 40% lên đến 90%. Đối với đồng bằng sông Cửu Long, diện tích có nước tưới vào khoảng 70% trong khi đó ở miền Đông Nam Bộ và Tây Nguyên diện tích này thấp nhất.

Khô hạn và mặn hiện đang được xem xét như những yếu tố quan trọng hơn lũ lụt đối với năng suất lúa, bởi vì chúng ta thực hiện chiến lược tránh né lũ bằng những giống lúa có thời gian sinh trưởng ngắn, trồng trước và sau mùa lũ. Do đó, ảnh hưởng xâm nhập mặn trong mùa khô được quan tâm một cách đặc biệt. Công tác cải tiến giống lúa tập trung vào cải tiến tính chống chịu hạn và mặn trong giai đoạn mạ.