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Study on Adaptation of 22 Traditional Glutinous Rice Varieties in The Lao PDR

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Abstract

Study on adaptation of 22 traditional glutinous rice varieties (TVs) was conducted on 9 sites in three agricultural regions of Lao PDR, north, central and south in wet season 2004. These traditional glutinous rice varieties (TVs) were selected from Lao Rice Germplasm (LRG), with good adaptation and high yield to the Lao rainfed lowland conditions and using TDK4 as a check variety. The trials were laid out in Randomized Complete Block (RCB) design with four replications and a plot size of 1m x 5m. The locations of the trials were based on soil type that represent the main rice growing areas. All cultural practice was the same as farmerี่s usual practices. Rice was transplanted using 3-5 seedlings per hill with hill spacing of 20 x 20 cm and fertilizer was applied at a rate of 60-30-30 kg/ha equivalent to N : P_2O_5 : K_2O. The objectives of this study were examined their adaptation and genotype x environment interaction of these varieties in term of yield and some agronomic characters, and to evaluate yield stability in TVs. The results showed the environmental variance had very large influence compared to genotypic variance. This indicated that the suitable location should be identified for growing each TVs.

In this study, grain yield had very high variation among these TVs and ranging from 3379 kg/ha (Ikhao) to 2235 kg/ha (Kainoy). There were 12 varieties: Ikhao, Phouangmalay, Bongleuang, Homnangnuan, Meuangnga, Khaola, Takhiet, Khaomeuay, Homdang, Leuathet, Yuando and Makhing showed non-significant different and had yield performance as good as improved variety (TDK4).

The days to maturity ranged from 129 to 163 days, which are acceptable for rainfed lowland rice environment for different toposequence positions. The number of panicles per hill varied from 4.7-6.8 panicles, which was quite suitable for traditional varieties and plant height ranged from 114 to 152 cm. This means all traditional varieties are tall plant type. The result from stability analysis indicated that Ikhao, TDK4, Phouangmalay, Bongleuang, Khaola and Takhiet are suitable genotypes for growing under favorable environments while Homdang and Homdo could be adapted to unfavorable environments or poor environments. Ikhao showed good adaptation to 3 regions but Kainoy was well adapted to only in its northern origin. The correlation among regions of the mean grain yield showed a quite small correlation between central and north, high correlation between central and south but no correlation for north and south. The good TVs can be recommended across locations between central and south, but can not be recommended across locations between central-south and north as they had good adaptation only to their origin. Pattern analysis to groups with similar interaction patterns showed there were two groups of environments and four genotype groups were classified.

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Introduction

Increasing rice production dramatically by expanding on new lands is impossible. On the other hand, some of the fertile soil for rice is being lost to population growth and rapidly expanding urban centers while the remaining virgin lands are not suited for rice (IRRI 1992, 1993). Total area planted to rice worldwide has remained the same since 1980 (IRRI, 1995), with the population of rice consuming coun-tries growing at a faster rate than the rest of the world. It becomes clear, therefore, that increasing rice production to meet the demand for the next century could be attained only through development and wide scale adoption of improved varieties.

In the Laos approximately 85% of the rainfed lowland rice area is located in provinces of the central and southern agricultural regions where seven rice producing plains are recognized. All of these plains are adjacent to the Mekong River valley and its tributaries, with an altitude generally not exceeding 200 m ASL. The remaining rainfed lowland areas are scattered in rather narrow valleys of the northern provinces with elevation from 300-1000 m ASL. The rainfed lowland rice area of the Lao PDR can be classified as 'shallow rainfed', and be further subdivided into four categories: favorable (10%), drought prone (60%), drought and submergence prone (20%) and submergence prone (10%). Rainfall in most provinces adjacent to the Mekong River Valley ranges from 1,200-2,000 mm, with about 75% being received in the period May to October. In some northern provinces, it drops to between 1,200 to 1,300 mm. August and September are generally the wettest months, during this period, heavy rain can cause localized severe flooding, with resulting substantial crop losses. The soils through much of the main rice producing area adjacent to the Mekong River are derived mainly from old alluvial deposits and in some provinces (Saravane and Savannakhet), sandstone materials. They are usually highly weathered, moderately acid, loams, sandy loams and loamy sands. They typically have a topsoil sand content exceeding 65% (and occasionally more than 80%), and clay content sometimes as little as 5%. Low organic mater content, CEC and base saturation percentage are usual. Their low water retention capacity makes them very drought prone. Recent research has shown that many of these soils are acutely deficient in P and N. Parts of some provinces in central and south have shown a response to K. Soils in the rainfed lowland areas of northern Laos are generally more fertile. However, parts of few provinces shown to be P deficient; N responses in the northern region are also widespread and often large (Linquist et al., 1998).

A single wet-season rice crop is the basic production system in this environment. However, rice accounts for only about 12% of farm income; the major source of cash income of households is from livestock (46%), with off-farm income sources accounting for a further 40%. The adoption of higher yielding improved varieties in combination with the use of appropriate fertilizer management has taken place mainly in the plains of the Mekong River valley in the central and southern agricultural regions. The mechanization of land preparation with the use of small hand-operated tractors is also becoming increasingly popular in the country. In the rainfed lowland rice condition, the improved rice varieties (modern varieties) have been limited to the farmers in some areas as well as specific adaptation, high level of fertilizer, susceptible performance to insect pests, small grain and semi-dwarf, but traditional varieties have these desired characteristics. At present, many traditional varieties are still using by the farmers who are growing rice under diverse conditions in each region. On the other hand, traditional varieties still used widely are not only exciting by main-ethnic group but also more favorable among sub-ethnic groups in the whole country.

The major objective is to study genotype by environment (GxE) interaction of traditional glutinous rice varieties (TVs) in term of yields and agronomic characters, (for using in the future breeding programs). The study was particularly aimed at to selecting the best TVs that have high yield stability, good agronomic characters and well adapted to wet season of the Laos.

Materials and Methods

Twenty-two traditional glutinous rice varieties (TVs) were used in this study, the trials were conducted at nine locations across country. These varieties were selected from the Lao rice gene bank (LRG), which were identified that they had good adaptation and high yields to the Lao rainfed lowland conditions. TDK4, an improved variety with high yield and tolerance to saline soil that was released in 1998 from the National Rice Research Program (NRRP), was used as a check variety. Inorganic chemical fertilizers 15:15:15 or 16:20:00 and 46:00:00 were used. The trials were carried out in wet season 2004.

The trials were laid out in Randomized Complete Block (RCB) design with four replications and a plot size of 1m x 5m. The locations of trials were based on soil type that represent the main rice growing areas as well as transplanting period (from May to July) and are the same as farmers' usual practices. Rice is transplanted using 3-5 seedlings per hill with hill spacing of 20 x 20 cm and fertilizer is applied at a rate of 60-30-30 kg/ha equivalent to N : P_2O_5 : K_2O. No pest control was undertaken throughout the experiments except in case of heavy damage by golden snail after transplanting. For yield measurement, the standard measurement of the International Rice Research Institute (IRRI) was used: seed yields were recorded after being adjusted to 14% moisture content.

$$\text{Yield (kg/ha)} = \frac{100-MC}{100-14\%} \times \frac{(a)g}{1000g} \times \frac{10000m^2}{(b)m^2}$$

MC = Moisture content of sample measurement

(a) = Grain yield of the sample/plot

(b) = Sample area/plot

Physiological maturity from seeding to 50% flowering plus 30 days as well as number of panicle per hill, grain shape, head rice, 1000 grain weight and plant height were recorded with average 10 hills before harvesting about 10 days. In addition, alkali digestion was also considered in this study for testing eating quality.

The Irristat 5.0 program for windows, which was developed by the Biometrics division, IRRI, Philippines was used to analyze and determine the adaptation of these varieties. This program for windows test is commonly used to test a hypothesis concerning the adaptation of the varieties within different locations (G x E) and test for biplots of hypothesis is a common application.

Analyses of variance were calculated considering each location-year as a separate environment. Genotypes and environments were treated as fixed effects. Variance components were estimated using expected mean squares to compare the relative magnitude of main effect and interaction variances. Genotypes mean were compared using Duncan Multiple Range Test (DMRT) estimates (α = 0.05). Testing of homogeneity of variances among environments used Bartlett's test (Steel and Torrie 1980). A logarithmic transformation was used to reduce error heterogeneity (Hinz and Eagles 1976). The ratio of genotypic variance to phenotypic variance as defined by Comstock and Moll (1963) was used to estimate broad-sense heritabilities.

Results and Discussion

The twenty-two TVs have been tested at 9 locations across country, represented all main rice planting areas which differ in climate, topography and soil characteristics (Table 1). Genotypes, environments and their interactions contributed significant variation for all observed characters (Table 2). The environmental variance had a very large influence compared to genotypic variance. This indicated that the suitable location should be identified for growing each TVs. Average yield and some agronomic characters: grain yield, maturity, number of panicle and plant height of TVs presented in Table 3. The results show that grain yield had very high variation among these 22 TVs, the yields ranging from 3379 kg/ha (Ikhao) to 2235 kg/ha (Kainoy) and there were 12 varieties which showed non-significant differences in statistical terms with TDK4 (check). Ikhao was highest yield got 3379 kg/ha, followed by TDK4 was 3258 kg/ha, at the same time TDK4 was significantly different in statistical terms with the rest varieties. Therefore, these 12 TVs showed yield performances as good as TDK4. The days to maturity ranged from 129 days in the earliest maturity (Homthong) to 163 days in the latest maturity (Dokphao) among all TVs, which are acceptable for rainfed lowland rice environment for different toposequence positions. The number of panicles per hill varied from 4.7-6.8 panicles per hill, which was quite suitable for traditional varieties and plant height ranged from 114 cm (TDK4) to 152 cm (Pouangmalay). This indicated that all traditional varieties are tall plant type.

Table 1 Coordinates, sowing and transplanting date, rainfall and soil type of each of the 9 testing locations

Item	Location (provinces)								
	XKH	LNT	SYB	VTE	KHM	SVK	SLV	ATP	CPS
Coordinates									
Latitude	19° 36′	21° 08′	19° 18′	18° 18′	17° 43′	16° 52′	15° 73′	14° 85′	15° 22′
Longitude	103° 37′	101° 39′	101° 57′	102° 44′	104° 85′	104° 59′	106° 25′	106° 97′	105° 12′
Altitude	1050	645	326	171	150	160	168	105	120
Sowing date	23/5/04	14/6/04	27/5/04	2/6/04	28/5/04	5/6/04	25/6/04	15/6/04	9/6/04
Transplanting date	14/6/04	15/7/04	26/6/04	29/6/04	21/6/04	30/6/04	25/7/04	10/7/04	4/7/04
Ave of rainfall (mm)	1312.7	1611	1264	1629.6	2331.7	1650.2	2132.4	1954.4	1977.9
Ave of Sunshine (hrs)	2231.6	1725.3	1818.9	2371.2	2559.5	2428.3	2394.4	2694.1	2455.2
Ave of temperature (C°)	19.9	23.8	25.1	26.6	26.3	26.4	26.7	27.1	27.8
Soil type	Clay	Clay loam	Loamy	Sandy loam	Loam	Loamy sand	Sandy loam	Loamy	Sandy loam

Source: Department of Meteorology and Hydrology, MAF 2004.

XKH = Xiengkhouang; LNT = Luang Namtha; SYB = Sayabouly

VTE = Vientiane Mun; KHM = Khammouan; SVK = Savannakhet

SLV = Salavane; ATP = Attapeu; CPS = Champasak

Table 2 Combined analysis of variances across 9 environments of grain yield in 22 traditional glutinous rice varieties

Source	Mean squares				
	df	Yield (kg/ha)	Maturity (days)	Panicle No.	Plant height (cm)
Environments (E)	8	18750500**	8669.35**	77.81**	8672.41**
		(81.1%)	(68.74%)	(88%)	(75.7%)
Genotype (G)	21	3028990**	3803.55**	7.26**	2449.7**
		(13.1%)	(30.16)	(8.2%)	(21.4%)
G x E	168	877696**	130.32**	1.96**	188.86**
		(3.8%)	(1.03%)	(2.2%)	(1.6%)
Rep./E	27	314122	4.67	0.86	116.36
		(1.4%)	(0.04%)	(1%)	(1%)
Pooled error	567	136373	3.981	0.55	25.70
		(0.6%)	(0.03%)	(0.6%)	(0.2%)
CV%		12.5	1.3	13.1	3.6

Stability parameters are estimated to obtain additional information about the genotype x environment interactions (GEI). Regression method to estimate stability for several crops have been reported (Abou-El-Fittouh et al. 1969; Campbell and Kearn 1982; Chakroun et al. 1990; Peterson et al. 1992; Pfeiffer et al. 1995; Rasamivelona et al. 1995). Yield stability in each genotype of TVs is presented in Table 3. Ten varieties gave high yield, but there were nine varieties i.e. Ikhao, TDK4, Phouangmalay, Bongleuang, Homnangnuan, Meuangnga, Khaola, Takhiet and Khaomeuay rated stable based on the regression coefficients. There were two genotypes: Homdang and Homdo which were rated as unstable due to the regression coefficient being significant greater than unity (Eberhart and Russell, 1966). Therefore, this result showed that high yielding genotypes may not necessarily be yield stable and yield stable genotypes need not be high yielding. On the other hand, based on regression coefficients and standard deviation value, the high yielding but unstable genotypes could be identified for specific environments. Ikhao, TDK4, Phouangmalay, Bongleuang, Khaola, Homphama, Khaonong, Kainoy, Iloup, Makhing, Homthong, Homphouthai and Takhiet are suitable genotypes for growing under favorable environments while Homdang and Homdo gave low regression indicating that they could be adapted to unfavorable environments or poor environments.

Table 3 Mean of yield average and agronomic characters from 9 location with regression coefficient and standard deviation

Variety	Maturity (days)	Plant height (cm)	Panicles No.	Yield (kg/ha)	Regression coefficient	Standard deviation
Leuathet	152	141	5.3	2984 bcdef	0.956ns	0.468
Homdo	139	137	6.4	2878 cdefg	0.331*	0.238
Yuando	140	134	5.4	2978 bcdef	0.727ns	0.437
Homphama	136	135	5.6	2868 cdefg	1.245ns	0.292
Meuangnga	156	148	5.6	3126 abcd	0.953ns	0.244
Takhiet	153	149	5.4	3105 abcde	1.229ns	0.317
Ikhao	147	138	5.8	3379 a	1.021ns	0.302
Khaonong	137	135	4.7	2733 fg	1.244ns	0.442
Bongleuang	157	143	5.9	3171 abc	1.250ns	0.380
Khaola	158	141	5.8	3126 abcd	1.049ns	0.312
Khaomeuay	155	147	6.1	3080 abcde	0.864ns	0.385
Kainoy	135	124	5.2	2235 i	1.234ns	0.513
Homnangnuan	159	136	5.9	3159 abc	0.951ns	0.339
Dokphao	163	140	5.3	2402 hi	0.749ns	0.354
Dokmay	149	140	5.8	2706 fgh	0.881ns	0.405
Phouangmalay	155	151	5.8	3256 ab	1.101ns	0.403
TDK4	157	114	6.0	3258 ab	1.203ns	0.415
Iloup	161	145	5.2	2787 efg	1.104ns	0.275
Makhing	155	139	5.4	2963 bcdef	1.255ns	0.311
Homthong	129	137	5.8	2808 defg	1.153ns	0.450
Homphouthai	161	146	5.3	2556 ghi	1.128ns	0.283
Homdang	137	137	6.8	3206 ab	0.373*	0.186
Mean	150	139	5.7	2944		
LSD.05	5.3	6.4	0.7	436		

Means followed by the same letter are not significantly different (DMRT P=0.05)

*, ** Indicate regression coefficients significantly different from 1.0 or deviation sum of squares significantly greater than zero, respectively. All tests were at the 0.05 and 0.01 probability level, respectively.

Predicted heritability (H) indicated the repeatability of the trial. If the value is higher than 0.5, it is indicated that the number of location and replication are acceptable. The results from this study revealed that for the G x E interaction study in the Lao PDR, at least at 5 locations with 4 replications are need to be conducted so that we can get an acceptable repeatability (Table 4).

However, the result in Table 5 indicated that these 22 varieties have been selected from different agricultural regions: northern, central and southern regions as their origin. Ikhao showed good adaptation to almost 3 regions, it gave 3648 kg/ha in the north, 3457 kg/ha in the central (its origin) and 3033 kg/ha in the south, respectively. Kainoy was well adapted to only its original northern region 3197 kg/ha and showed very poor adaptation to central and southern regions with 1550 kg/ha in the central and 1957 kg/ha in the south. In addition, the result indicated that some TVs: Ikhao, Phouangmalay, Bongleuang, Homnangnuan, Meuangnga, Khaola, Takhiet, Homdang, Khaomeuay, Leuathet, Yuando and Makhing had yield performance as good as improved variety TDK4.

These testing locations are differ in climate, topography and soil characteristics. In the north, elevations of 600 to 2,818 m are not uncommon in the mountainous region but central to southern areas consist of flat to gently undulating lowland, alluvial plains and terraces adjacent to the Mekong River at an elevation of 130 to 300 m. The correlation among regions: northern, central, southern and combined central-southern by mean grain yield (Table 6), showed a quite small correlation between central and northern regions only r = 0.36. In addition there was high correlated between central and southern regions (r = 0.71) but no correlation between north and south. On the other hand, combined central-south showed high correlation to central and south by r = 0.95 and r = 0.89 respectively. Therefore, if it is necessary to reduce the experimental sites, at least two regions one in the northern and one in the central or southern could be used for testing.

Table 4 **Estimated variance component and predicted heritability (H) for grain yield over locations**

Q^2_g	Q^2_{gl}	Q^2_e	No. of sites	No. of rep	H
59758	185331	136373	1	4	0.21
			3	4	0.45
			5	4	0.58
			7	4	0.66
			9	4	0.71

Table 5 **Mean yields of 22 glutinous traditional varieties at 3 regions Northern, Central and Southern regions in WS 2004**

Variety	yield (kg/ha)				
	Origin	North	Central	South	Ave
Meuangnga	N	3254	3065	3059	3126
Takhiet	N	3288	2999	3028	3105
Khaonong	N	3530	2437	2231	2733
Bongleuang	N	3239	3209	3066	3171
Khaola	N	3213	3053	3112	3126
Khaomeuay	N	3197	2855	3189	3080
Kainoy	N	3197	1550	1957	2235
Average across origin		3274	2738	2806	2939
Ikhao	C	3648	3457	3033	3379
Dokmay	C	3222	2351	2545	2706
TDK4	C	3289	3315	3170	3258
Homthong	C	3064	2260	3100	2808
Homdang	C	3520	3072	3027	3206
Leuathet	C	3698	2382	2872	2984
Homdo	C	3004	2833	2796	2878
Yuando	C	3694	2632	2611	2979
Homphama	C	3182	2592	2830	2868
Homnangnuan	C	3186	2980	3311	3159
Average across origin		3351	2787	2930	3023
Dokphao	S	2675	1795	2736	2402
Phouangmalay	S	3267	3292	3210	3256
Iloup	S	3178	2316	2868	2787
Makhing	S	3465	2394	3031	2963
Homphouthai	S	2978	2080	2613	2557
Average across origin		3113	2375	2892	2793
Mean		3112	2375	2892	2944

Table 6 **Correlation among regions: Northern, Central, Southern and combined Central-Southern by mean grain yield**

Region	North	Central	South
North			
Central	0.360ns		
South	-0.003ns	0.71**	
Central-South	0.233ns	0.955**	0.889**

The result of combined analysis of yield showed significant differences among varieties. However location x variety interaction was not significant. (Table 7), this indicated that good TVs can be recommended across locations between central and southern region. The significant differences among varieties and location x variety interaction were found (Table 8). This indicated that some good TVs can not be recommended across locations between central-south and north. They had good adaptation only in their origins.

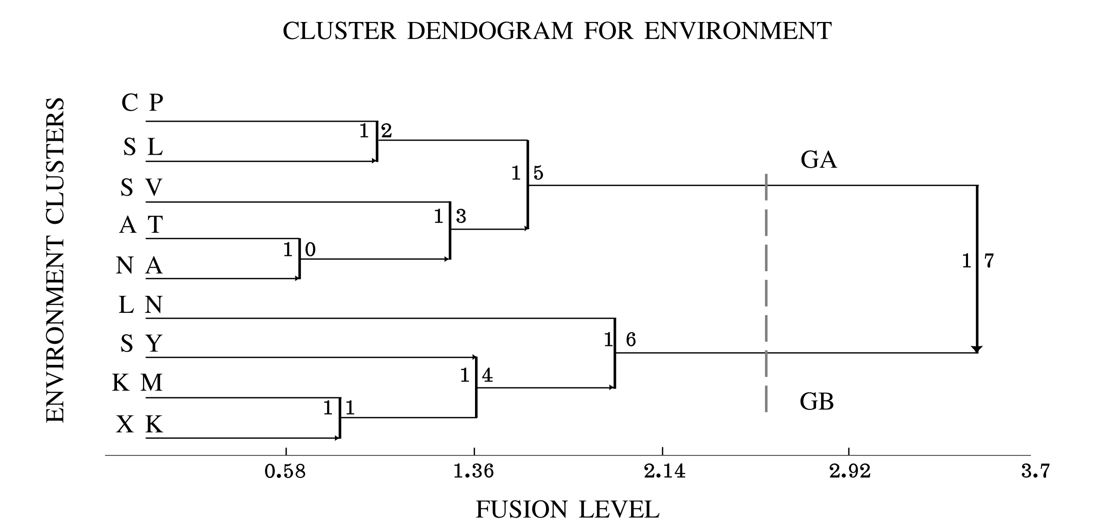
Pattern analysis was done to reduce the genotypes and environments to groups with similar interaction patterns. The number of clusters was made similar to the one generated in data set (Fig. 1), indicated two groups of environments. Group A with 5 sites located in central and south while group B with four sites located in the north except site of KM (central) mixed with this group which might be have similar environment reaction. Four genotype groups were generated (Fig. 2), group I had seven genotypes while group II had nine genotypes, group III had four and group IV had only two genotypes. Varieties within a group had similar interaction pattern. However, varieties within a group could differ greatly in their yield performance. For instance, group I had seven genotypes: Leuathet, Homdo, Yuando, Ikhao, Khaola, Makhing and Homdang which showed wide adaptation to almost all regions while group IV had only two genotypes: Kainoy and Khaonong showed good adaptation to only their northern origin.

Table 7 **Analysis of variance of variety and variety x region interaction for yield of 22 traditional glutinous rice varieties between Central and Southern regions in WS 2004**

Source of variance	Numerator df	Denominator df	F-test	Pr>F
Region (R)	1	4	0.32ns	0.60
Variety (V)	21	84	3.62**	<.0001
R x V	21	84	0.76ns	0.76

Table 8 **Analysis of variance of variety and variety x region interaction for yield of 22 traditional glutinous rice varieties between Northern and Central-Southern regions WS 2004**

Source of variance	Numerator df	Denominator df	F-test	Pr>F
Region (R)	1	7	2.78ns	0.139
Variety (V)	21	147	2.53**	<.0006
R x V	21	147	1.63*	0.045



XK = Xiengkhouang; LN = Luang Namtha; SY = Sayabouly; NA = Vientiane Mun; KM = Khammouan; SV = Savannakhet; SL = Salavane; AT = Attapeu; CP = Champasak

Fig. 1 Dendrogram of environments structured by interaction pattern of 22 traditional glutinous varieties

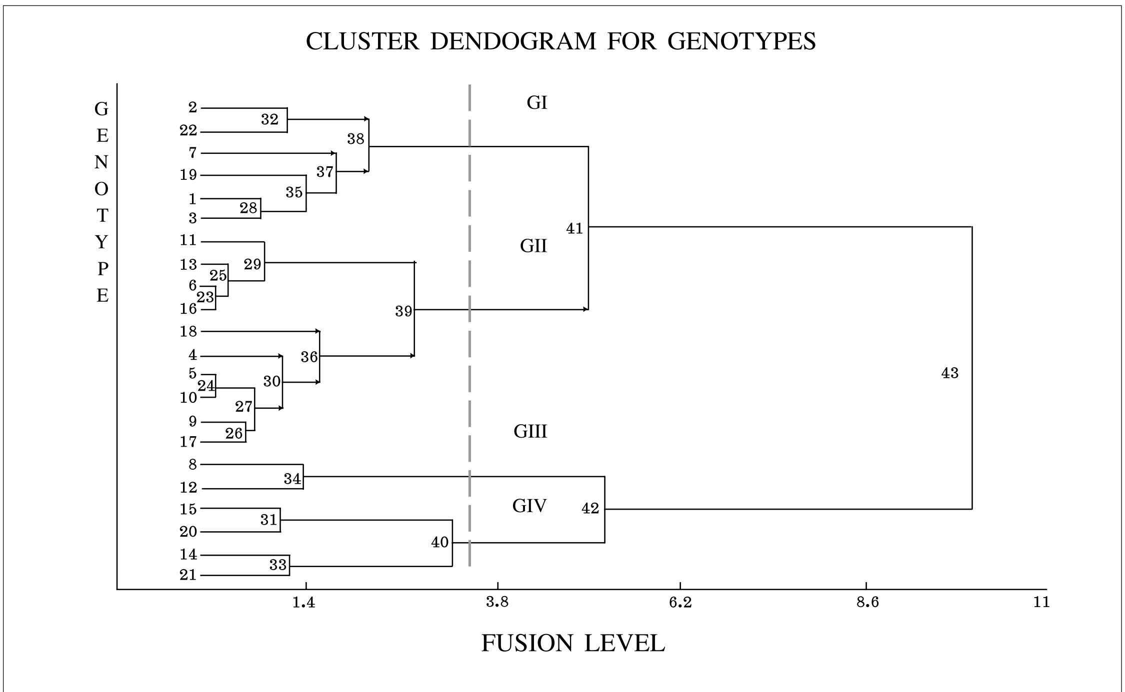


Fig. 2 Dendrogram of genotypes structured by interaction pattern of 22 traditional glutinous varieties

The results of some physical and chemical grain properties of 22 traditional glutinous rice varieties also have been considered for evaluating the eating quality (Table 9). The result indicated that 1000-grain weight ranged from 21 g to 36 g. Most had big grains with intermediate shape (I). Percentage of white grain (%wg) varied from 61.2% to 74.2% while percentage of head rice ranged from 37.7 to 67.5%. The TVs' grain quality were as good as improved variety TDK4. The alkali digestion was almost same as TDK4 because these TVs had good eating quality (soft).

Table 9 The physical grain property of 22 traditional glutinous rice varieties

Variety	1000 grw (g)	%Brg	Length (mm)	BrS	Shape	%wg	Head rice (%)	AlkD
Leuat Het	32	78	6.89	2.3	I	70	59.76	7
Homdo	22	77.28	6.17	2.5	I	67.84	58.68	7
Yuando	34	76.96	7.08	2.5	I	68	37.76	6.9
Homphama	33	79.12	6.48	2.9	I	70.8	57.6	7
Meuang Nga	35	79.36	6.64	2.2	I	71.28	51.44	7
Takhiet	34	75.68	6.55	2.1	I	68.08	54	7
Ikhao	34	79.76	7.79	2.8	I	70.24	59.52	7
Khao Nong	27	75.52	6.07	2.1	I	64.72	55.6	7
Bong Leuang	27	77.92	7.17	2.7	I	71.04	59.68	7
Khaola	34	78.32	7.52	2.9	I	61.2	42.32	7
Khao Meuay	31	78.64	7.01	2.4	I	68.72	50.08	6
Kai Noy	21	80.08	4.94	1.6	B	71.68	60.16	7
Homnangnuan	28	74.72	7.58	3.4	SL	65.76	56.8	7
Dokphao	33	78.88	7.49	2.9	I	72.32	67.52	7
Dokmay	36	78.56	7.33	2.7	I	71.68	65.68	7
Phuangmalay	33	80.8	6.69	2.1	I	72.48	44.64	6.9
TDK 4	28	76.32	7.39	3.4	SL	68.72	59.52	7
Iloup	34	78.56	6.57	2.1	I	72.32	64.8	7
Makhing	28	80.64	7.08	2.6	I	74.24	63.6	7
Homthong	32	78.88	7.35	2.9	I	70.72	57.84	6.4
Homphouthai	32	77.44	7.44	2.8	I	70.08	64.48	7
Homdeng	23	76.8	6.53	2.6	I	65.76	53.6	7

%Brg = % brown rice, BrS = Brown rice shape, I = Intermediate, SL = Slender, B = Bold, 1000 grain weight (g), % wg = whole white grain after milling, % head rice, AlkD = Alkili digestion.

Conclusion

Twenty-two TVs were used in this study which was conducted at nine locations. These varieties, with good adaptation and high yield to the Lao rainfed lowland conditions were selected from LRG using TDK4 as a check variety. The trials were laid out in RCB design with four replications.

The objectives were to examine the stability of TVs in terms of yield and some agronomic characters. The result revealed that grain yield had very high variation among TVs, the yields ranging from 3379 kg/ha (Ikhao) to 2235 kg/ha (Kainoy). There were 12 varieties: Ikhao, Phouangmalay, Bongleuang, Homnangnuan, Meuangnga, Khaola, Takhiet, Khaomeuay, Homdang, Leuathet, Yuando and Makhing showed non-significant different and had yield performance as good as improved variety TDK4.

The days to maturity ranged from 129 to 163 days, which are acceptable for rainfed lowland rice environment for different toposequence positions. The number of panicles per hill varied from 4.7-6.8 panicles, which was quite suitable for traditional varieties and plant height ranged from 114 to 152 cm. This means all traditional varieties are tall plant type. Ikhao, TDK4, Phouangmalay, Bongleuang, Khaola and Takhiet are suitable genotypes for growing under favorable environments while Homdang and Homdo gave low regression indicating that they could be adapted to unfavorable environments or poor environments. Ikhao showed good adaptation to 3 regions but Kainoy was well adapted to only its northern origin. The correlation among regions by mean grain yield showed a quite small correlation between central and north, high correlation between central and south but no correlation for north and south. The good TVs can be recommended across locations between central and south, but can not be recommended across locations between central-south and north as they have only good adaptation to their origin. Pattern analysis to groups with similar interaction patterns showed there were two groups of environments and four genotype groups were generated.

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