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Performance and Industrialization of Chinese (Sichuan) Hybrid Rice (O. sativa L.) in Burundi

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Abstract: In order to identify new hybrid rice variety with high yield and strong resistance suitable for industrialization development in Burundi, an experiment on resistance and yield of 38 hybrid rice materials from members of Sichuan Seed Association (China) was conducted. the main local popular rice variety V3 was used as the local control material (CK1), and the CXY506 as import contrast materials (CK2). The results showed that most of the varieties provided by the association were resistant to the local rice blast, except for TLYYH and TF-137 varieties, more than 90% varieties the yield was higher than that of the CK1, however, half of the varieties tested had poor resistance to bacterial leaf streak, which provided reference and exploration for the future new varieties such as demonstration, commercial extension, seed production, local breeding and so on. And the local seed production was implemented successfully, the key data of CXY506 seed production have been collected. a high yield production model of CXY506 was established after accurate and careful field operation in different growth phase in Burundi, made the industrialization of CXY506 in local Burundi possible. This will be great help for China and other countries breeders to breed adoptable varieties and market managers to avoid mistakes in Burundi. and will useful to improve Burundi local agriculture economic developments.

Keywords: Hybrid Rice, High Yield, Resistance, Industrialization

1. Introduction

China hybrid rice have been applied worldwide today, many researchers have given their research conclusion, opinion and suggestion in different ecology including Africa countries Tanzania [1-2]. Nigeria [3]. Zimbabwe [4]. Cameroon [5-6]. East Timor [7]. Burundi [8] etc. Most research focus on the variety performance only, not establish the seed production localization and variety production industrialization together, our purpose is building a chains of rice production through applicate good variety, produce seed locally and use the local seed to industrialization of the rice production in Burundi.

Rice blast and bacterial leaf streak are the main limiting factors for the extension of hybrid rice in Burundi. In order to test the superiority of Sichuan hybrid rice varieties in the ecological region of Burundi Plain, and speed up the registration and extension of hybrid rice varieties in Burundi, reference the climate influence to the crop [9-10], and other resistance research experience factors, we carry out the

comparison tests for high yield, good blast resistance and bacterial leaf streak resistance of hybrid rice varieties on plains of Burundi on base of researches before from February to July in 2020.

In order to realize the combination of improved variety and good cultivation, we carry out the research on high-yield cultivation technology of CXY506 and form a set of cultivation model. In order to localize and industrialize rice production in Burundi. Learning from China's rice industrialization experience [11]. combining the reality, problems of Africa [12-13]. and some China researcher's conclusion [14-18]. we explored and studied the localization of seed production and the industrial system, and promoted agricultural development and food security in Burundi.

Under the help of Sichuan Seed Association and South-South team, we have collected 38 China Varieties and tested in Burundi successively, and get some encourage successes, but there are still many issues which this study could not be involved need to research for the future.

2. Materials and Methods

2.1. Materials and Field Trial Design

The materials were collected from 38 hybrid rice materials collected from members of Sichuan Seed Association. The main local cultivated conventional rice variety V3 (CK1) and the CXY506 (CK2) were used as double control. The field was arranged by interspecific ratio method with three replicates. The plot area is 16.38 m^2, the plot is 13.1 meters long and 1.25 meters wide. The distance between rows and plants was 25 cm and 20 cm, the number of holes in the plot was 5 rows × 66 nests = 330 holes, the number of protective rows was 5 rows, and CXY506 was planted as the protective rows and around experimental fields. The field operations such as sowing, fertilization, weeding, transplanting, initial panicle, growth period, pest and harvest were recorded, the rice blast and bacterial leaf streak were investigated according to the relevant field identification standards.

2.2. The Trial Site Description

The site is located on the Rugombo farm in Cibitoke Govemorate, in the northern of the Burundi plain, where the rice crop is planted at 28.23.14E-2.792045N, and altitude of 950.34 meters. The plain area of Burundi is the traditional rice-growing area of Burundi. The rainy season is rainy, the temperature and humidity are ideal. The plain area is the heavy and frequent occurrence area of rice blast and bacterial leaf streak, especially rice blast, there was no specific point and line distribution of fungi, and the distribution of fungi was whole field.

2.3. Data Collection

2.3.1. Identification of Resistance to Rice Blast

Field investigation was carried out during the most serious stage of leaf blast and neck blast of cultivated 39 rice varieties. According to the local standard DB51/t 714 - 200 of Sichuan province, "Technical specification for identification of rice blast resistance in the field", evaluation and grading of resistance to leaf blast and panicle blast. The leaf blast was investigated at the peak tillering stage and jointing stage respectively, and the neck blast was investigated at the panicle turning yellow stage. The results of natural resistance identification are shown in Table 1 and Table 2.

2.3.2. Field Investigation and Results of Bacterial Leaf Streak

Field investigation of bacterial leaf streak (BLS) showed that BLS was mainly spread by insects in the field, which was equivalent to insect-borne. It was easy to observe that whether varieties were resistant or not. the total investigate number of leaves was 30 for each variety for each replicate, The investigation period was full tillering stage and booting stage. The resistance level of the tested varieties was classification according to the most serious repeated group, the classification criteria of resistance evaluation are shown in Table 3.

2.3.3. Field Investigation and Result of Test Yield

The trial varieties matured gradually from 5 to 14 July. The trial varieties were hand-harvested, then threshing, drying, removing impurities when moisture up to about 15%, weighting by each plot, and the average yield of the 3 replicate plots as the final experimental yield of the experimental variety. The yield results are shown in table 4.

2.3.4. Seed Production Key Data Explore

We select the CXY506 as the seed production model variety, according to the hybrid rice production progress in China, and some amend according to the Burundi ecology, then collect A line and R line whole life time data just like the sowing season, sowing time, A and R sowing time gap, flower time, and GA3 dosage and usage, the fertilizer and irrigation management etc.

3. Results and Analysis

3.1. The Results of Identification of Rice Blast Resistance

The results of identification of rice leaf blast resistance showed that most varieties were resistant to rice leaf blast, no varieties grade exceed Grade 5, 12.8% tested varieties at Grade 5, 15.38% between grade 4~5, 48.71% between grade 3~4, 33.11% between grade 2~3, no variety lower Grade 2. The local variety V3 have the lowest Grade 2.7, shows the advantages of local varieties. and CXY506 showed some resistance to rice leaf blast (grade 3.7), just like the half of the imported China germplasms, we need do more works to improve CXY506 in leaf rice blast even this variety have been registered in Burundi. (Table 1 and Table 2).

Table 1. *Evaluation of natural resistance to leaf blast of rice.*

variety	Date of investigate	Grade (Rep I)	Grade (Rep II)	Grade (Rep III)	Average	Date of investigate	Grade (Rep I)	Grade (Rep II)	Grade (Rep III)	Average
YXY 2115	4-May	3	3	2	2.7	22-May	3	3	2	2.7
YXY 1998	4-May	3	2	2	2.3	22-May	3	3	2	2.7
YLY 286	4-May	3	2	4	3	22-May	3	2	3	2.7
XLY 619	4-May	5	4	5	4.7	22-May	4	4	4	4
MY 93	4-May	2	3	2	2.3	22-May	3	3	2	2.7
JCY 7021	4-May	3	3	2	2.7	22-May	3	3	3	3
RY 727	4-May	2	3	2	2.3	22-May	2	3	3	2.7
RY 2117	4-May	3	2	2	2.3	22-May	3	3	3	3
171A/HR15	4-May	4	2	2	2.7	22-May	4	4	4	4
YLY 808	4-May	3	3	3	3	22-May	4	4	4	4
XLY 212	4-May	2	2	2	2	22-May	4	2	4	3.3
LY 151	4-May	4	3	2	3	22-May	3	2	3	2.7
SLY 523	4-May	4	4	2	3.3	22-May	4	3	3	3.3
PXYTZ	4-May	3	4	3	3.3	22-May	3	4	3	3.3
QXY 3008	4-May	3	2	2	2.3	22-May	4	3	3	3.3
WLYYHSM	4-May	4	3	3	3.3	22-May	4	3	4	3.7
TLYYHSM	4-May	3	2	3	2.7	22-May	3	3	3	3
HZ-3S	4-May	3	4	3	3.3	22-May	3	3	3	3
Z18Y-2	4-May	4	3	2	3	22-May	4	3	3	3.3
Z2195A/R272	4-May	4	2	2	2.7	22-May	4	3	3	3.3
QXY 9123	4-May	2	2	2	2	22-May	3	3	3	3
QXY 977	4-May	2	2	2	2	22-May	3	3	3	3
FNYHZ	4-May	2	2	2	2	22-May	3	3	3	3
FXXHM	4-May	4	3	3	3.3	22-May	4	2	3	3
N6Y-1116	4-May	3	2	2	2.3	22-May	3	3	2	2.7
DY4923	4-May	5	2	3	3.3	22-May	5	3	3	3.7
IIY602	4-May	5	5	5	5	22-May	4	5	5	4.7
N5Y-H25	4-May	3	2	2	2.3	22-May	4	3	3	3.3
N6Y-107	4-May	4	3	2	3	22-May	3	3	3	3
GY900	4-May	5	5	5	5	22-May	5	5	5	5
GY906	4-May	5	5	5	5	22-May	5	5	5	5
IIY906	4-May	4	5	5	4.7	22-May	4	4	5	4.3
JJD	4-May	5	5	5	5	22-May	5	5	5	5
TF-137	4-May	4	5	5	4.7	22-May	5	5	5	5
HL-NO6	4-May	2	2	2	2	22-May	3	3	3	3
IIY838	4-May	5	5	5	5	22-May	5	5	5	5
ZY-527	4-May	2	2	2	2	22-May	3	3	3	3
CXY-506	4-May	5	3	3	3.7	22-May	5	3	3	3.7
CK1-V3	4-May	3	3	2	2.7	22-May	3	3	2	2.7

Remarks: standard of leaf Blast: Grade 1: only small needle-size brown spots. Grade 2: larger brown spots Grade 3: small round to slightly longer brown necrotic gray spots, 1-2 mm in diameter. Grade 4: typical rice blast spot or ellipsoid, 1-2 cm, usually limited between two leaf veins, the lesion area less than 2% of the leaf area. Grade 5: typical rice blast spot, the affected area is less than 10%. Grade 6: typical rice blast spot with 10-25% damaged area. Grade 7: typical rice blast spot with 26-50% damaged area. Grade 8: typical rice blast spot, the affected area is 51-75%. Level 9: all leaves are dead.

The results of identification of rice neck blast resistance showed that all varieties have good resistant to rice neck blast, no varieties grade exceed Grade 3, 23.07% tested varieties at Grade 3, 51.28% at grade 1, 25.65% between grade 1~3, The local variety V3 have no infected, shows the advantage of natural selection. and CXY506 showed low resistance to rice neck blast (grade 3), we should pay attention to this fact for the future application of this variety in Burundi to avoid yield decrease, no matter by improve the variety or take the chemical ways.

Table 2. *Evaluation of natural resistance to Neck blast of rice.*

variety name	Date of investigate	Grade (Rep I)	Grade (Rep II)	Grade (Rep III)	average
YXY 2115	24-Jun	1	1	1	1
YXY 1998	24-Jun	1	1	1	1
YLY 286	24-Jun	1	1	1	1
XLY 619	24-Jun	3	3	3	3

variety name	Date of investigate	Grade (Rep I)	Grade (Rep II)	Grade (Rep III)	average
MY 93	24-Jun	1	1	1	1
JCY 7021	24-Jun	1	1	1	1
RY 727	24-Jun	3	1	1	1.7
RY 2117	24-Jun	3	1	1	1.7
171A/HR15	24-Jun	1	3	1	1.7
YLY 808	24-Jun	1	1	1	1
XLY 212	24-Jun	1	1	1	1
LY 151	24-Jun	1	1	1	1
SLY 523	24-Jun	1	3	1	1.7
PXYTZ	24-Jun	1	1	1	1
QXY 3008	24-Jun	1	1	1	1
WLYYHSM	24-Jun	1	1	1	1
TLYYHSM	24-Jun	1	1	1	1
HZ-3S	24-Jun	1	1	1	1
Z18Y-2	24-Jun	1	1	1	1
Z2195A/R272	24-Jun	1	1	1	1
QXY 9123	24-Jun	1	1	1	1
QXY 977	24-Jun	1	3	1	1.7
FNYHZ	24-Jun	1	1	1	1
FXXHM	24-Jun	1	1	1	1
N6Y-1116	24-Jun	1	3	1	1.7
DY4923	24-Jun	3	3	3	3
IIY602	24-Jun	3	3	3	3
N5Y-H25	24-Jun	1	1	1	1
N6Y-107	24-Jun	1	1	1	1
GY900	24-Jun	3	3	3	3
GY906	24-Jun	3	3	3	3
IIY906	24-Jun	3	3	3	3
JJD	24-Jun	3	3	3	3
TF-137	24-Jun	1	3	3	2.3
HL-NO6	24-Jun	1	3	1	1.7
IIY838	24-Jun	3	3	3	3
ZY-527	24-Jun	1	1	1	1
CXY-506	24-Jun	3	3	3	3
CK1-V3	24-Jun	0	0	0	0

Remarks: Standard for neck blast: according to the infected panicles rate: Grade 0: no infected; Grade 1: less than 5%; Grade3: 5.1-10%; Grade5: 10.1-25%; Grade7: 25.1-50%; Grade9: 50.1-100%.

3.2. The Results of Field Natural Inoculation Test of Bacterial Leaf Streak

The results of field natural inoculation test of bacterial leaf streak showed that most of the tested varieties were susceptible to bacterial leaf streak, 15 varieties (38.46%) are sensitive (S), 14 varieties (35.89%) are tolerative (T), and 10 varieties (25.64%) are resistance (R). the local V3 have good resistance (Grade 0.7), the nature selection advantage was identified once again. No variety avoid infect including local V3, just a less degree of injury, and 70% or so import verities have poor resistance to the bacteria leaf streak. In another words, we should put the bacteria leaf streak into the main breeding target when you plan to breeding new verities for Burundi application. (Table 3).

Table 3. *The result of resistance of Bacterial leaf streak inoculated naturally.*

Variety	Date	Rep I	RepII	RepIII	Resistance level	Date	Rep I	RepII	Rep III	Resistance level	Comprehensive evaluation
YXY 2115	4-May	5	5	5	5.0	22-May	5	7	5	5.7	S
YXY 1998	4-May	5	0	5	3.3	22-May	5	5	5	5.0	S
YLY 286	4-May	3	3	5	3.7	22-May	5	3	3	3.7	T
XLY 619	4-May	5	7	5	5.7	22-May	5	5	5	5.0	S
MY 93	4-May	3	3	5	3.7	22-May	5	5	5	5.0	S
JCY 7021	4-May	7	5	5	5.7	22-May	7	5	5	5.7	S
RY 727	4-May	5	3	3	3.7	22-May	5	5	5	5.0	S
RY 2117	4-May	5	5	1	3.7	22-May	5	5	3	4.3	T
171A/HR15	4-May	5	3	3	3.7	22-May	5	3	3	3.7	T

Variety	Date	Rep I	RepII	RepIII	Resistance level	Date	Rep I	RepII	Rep III	Resistance level	Comprehensive evaluation
YLY 808	4-May	5	3	3	3.7	22-May	3	3	5	3.7	T
XLY 212	4-May	7	5	5	5.7	22-May	7	5	5	5.7	S
LY 151	4-May	3	3	5	3.7	22-May	3	5	7	5.0	S
SLY 523	4-May	3	5	5	4.3	22-May	3	5	5	4.3	T
PXYTZ	4-May	5	5	1	3.7	22-May	5	5	5	5.0	S
QXY 3008	4-May	1	0	1	0.7	22-May	1	0	1	0.7	R
WLYYHSM	4-May	1	1	1	1.0	22-May	1	1	1	1.0	R
TLYYHSM	4-May	1	1	1	1.0	22-May	1	1	1	1.0	R
HZ-3S	4-May	5	3	3	3.7	22-May	5	3	3	3.7	T
Z18Y-2	4-May	1	1	1	1.0	22-May	1	1	1	1.0	R
Z2195A/R272	4-May	5	5	5	5.0	22-May	5	5	5	5.0	S
QXY 9123	4-May	1	3	1	1.7	22-May	1	3	1	1.7	R
QXY 977	4-May	1	1	1	1.0	22-May	1	2	2	1.7	R
FNYHZ	4-May	5	5	3	4.3	22-May	5	5	5	5.0	S
FXXHM	4-May	5	3	5	4.3	22-May	5	3	7	5.0	S
N6Y-1116	4-May	3	5	5	4.3	22-May	3	5	5	4.3	T
DY4923	4-May	5	3	3	3.7	22-May	5	3	5	4.3	T
IIY602	4-May	3	5	3	3.7	22-May	3	5	3	3.7	T
N5Y-H25	4-May	3	1	3	2.3	22-May	3	3	3	3.0	T
N6Y-107	4-May	1	3	1	1.7	22-May	1	1	1	1.0	R
GY900	4-May	3	5	1	3.0	22-May	3	5	3	3.7	T
GY906	4-May	1	1	3	1.7	22-May	1	3	5	3.0	T
IIY906	4-May	1	3	3	2.3	22-May	1	3	1	1.7	R
JJD	4-May	1	3	3	2.3	22-May	1	3	5	3.0	T
TF-137	4-May	1	1	1	1.0	22-May	1	1	1	1.0	R
HL-NO6	4-May	5	7	5	5.7	22-May	1	1	1	1.0	S
IIY838	4-May	1	3	5	3.0	22-May	1	3	5	3.0	T
ZY-527	4-May	1	5	3	3.0	22-May	1	5	1	2.3	T
CXY506	4-May	5	5	5	5.0	22-May	5	5	5	5.0	S
CK1-V3	4-May	1	0	1	0.7	22-May	1	0	1	0.7	R

Remarks Standard for Bacterial leaf streak: according to the infected leaf area; Grade 0: no infected; Grade 1: few small dot, less than 1%; Grade3:1-5%; Grade5: 6-25%; Grade7: 26-50%, Grade9: more than 50%; Sensitive (S) > grade 5, Tolerance (T) > Grade 3, Resistance (R) < grade 3.

3.3. The Results of Yield Performance

The results of yield test showed that the yield of 36 varieties were increased significantly compared with the control variety V3 (CK1), The increase range from 6.97%-48.5%, only TLYYHSM, TF-137 two varieties yield less than V3 (CK1), the decrease range from 3.23% (TLYYHSM)-11.94% (TF-137). The data show that most of the introduced varieties from China have significant advantages in high yield.

The results of yield test also showed that only 11 varieties have increased yield compared with CXY506 (CK2), The increase range from 0.93%-11.38%, 27 varieties yield less than CXY506 (CK2), the decrease range from 0.37%-33.96%, the CXY506 (CK2) still have improve requirement and possibility to achieve a higher yield. (Table 4).

Table 4. *The yield performance of trial 39 varieties.*

Rank (descending)	variety name	sowing date	80% flowering	days (seed to seed)	Rep-I (kg)	Rep-II (kg)	Rep-III (kg)	yield (kg/ha)	contrast CK2 (%)	contrast CK1 (%)
1	N6Y-107	27-Feb	10-Jun	135.1	15.3	15.6	16.9	9719.16	11.38	48.5
2	N5Y-H25	27-Feb	3-Jun	130.9	15.8	15.2	16.4	9654.04	10.63	47.51
3	DY4923	27-Feb	5-Jun	131.2	15.1	14.6	16	9295.88	6.53	12.04
4	MY 93	27-Feb	4-Jun	130.3	14.1	15.5	15.5	9181.92	5.22	40.3
5	QXY 3008	27-Feb	9-Jun	134.1	14.6	15.6	14.6	9100.52	4.29	39.05
8	N6Y-1116	27-Feb	11-Jun	135.5	14.3	14.9	15.1	9019.12	3.36	37.81
7	QXY 977	27-Feb	3-Jun	130.2	13.5	16.8	14	9019.12	3.36	37.81
6	LY 151	27-Feb	9-Jun	134.7	16.1	14.3	13.9	9019.12	3.36	37.81
9	HL-NO6	27-Feb	11-Jun	135.6	16.1	13.7	14.3	8970.28	2.8	37.06
10	PXYTZ	27-Feb	11-Jun	135.9	15	13.7	14.8	8856.32	1.49	35.32
11	FNYHZ	27-Feb	13-Jun	138.1	11.4	17.2	14.7	8807.48	0.93	34.58
12	CXY506 (CK2)	27-Feb	13-Jun	135.4	13.2	14.4	15.3	8726.08	0	33.33
13	SLY 523	27-Feb	31-May	127.2	14.8	14	13.9	8693.52	-0.37	32.84
14	QXY 9123	27-Feb	13-Jun	135.7	12.4	16.5	13.7	8660.96	-0.75	32.34
15	IIY906	27-Feb	9-Jun	132.2	15.7	13.9	12.3	8530.72	-2.24	30.35
16	YLY 808	27-Feb	11-Jun	135.4	14.6	13.1	14	8481.88	-2.8	29.6
17	YXY 2115	27-Feb	7-Jun	133.2	14.3	12.7	14	8351.64	-4.29	27.61

Rank (descending)	variety name	sowing date	80% flowering	days (seed to seed)	Rep-I (kg)	Rep-II (kg)	Rep-III (kg)	yield (kg/ha)	contrast CK2 (%)	contrast CK1 (%)
19	IIY838	27-Feb	9-Jun	132.3	13	13.4	14	8221.4	-5.78	25.62
18	RY 2117	27-Feb	9-Jun	130.6	12.8	13.1	14.5	8221.4	-5.78	25.62
20	HZ-3S	27-Feb	12-Jun	136.5	13.7	15	11.6	8188.84	-6.16	25.12
21	Z2195A/R272	27-Feb	13-Jun	136.6	12.6	15.4	11.8	8107.44	-7.09	23.88
22	IIY602	27-Feb	9-Jun	132.8	12.5	13.7	13.4	8058.6	-7.65	23
23	YLY 286	27-Feb	10-Jun	135.7	13.5	14.3	11.6	8026.04	-8.02	23.13
24	GY900	27-Feb	29-May	125.3	13.1	13.5	12.3	7928.36	-9.14	21.14
25	FXXHM	27-Feb	14-Jun	136.6	12.2	14	12.7	7912.08	-9.33	20.9
26	Z18Y-2	27-Feb	4-Jun	129.2	12.5	13.7	12.4	7846.96	-10.07	19.9
27	YXY 1998	27-Feb	6-Jun	132.4	12.6	12.1	13.8	7830.68	-10.26	19.65
28	WLYYHSM	27-Feb	11-Jun	135.3	13.1	12.1	13.1	7798.12	-10.63	19.15
29	JCY 7021	27-Feb	31-May	126.7	13.4	12.4	12.3	7749.28	-11.19	18.41
30	ZY-527	27-Feb	9-Jun	132.2	12.1	12.6	13	7651.6	-12.31	16.92
31	RY 727	27-Feb	9-Jun	130.2	11.8	11.4	14.2	7619.04	-12.69	16.42
32	GY906	27-Feb	29-May	125.3	12.1	13.8	11.5	7602.76	-12.87	16.17
33	171A/HR15	27-Feb	28-May	121.1	12.2	11.1	11.9	7163.2	-17.91	9.45
34	JJD	27-Feb	10-Jun	132.5	13.9	10.7	10.3	7114.36	-18.47	8.71
35	XLY 212	27-Feb	11-Jun	135.5	11.9	10.8	11.8	7016.68	-19.59	7.21
36	XLY 619	27-Feb	6-Jun	129.3	11	12.2	11.1	7000.4	-19.78	6.97
37	CK1-V3	27-Feb	19-Jun	145.5	10.7	11.3	10.2	6544.56	-25	0
38	TLYYHSM	27-Feb	10-Jun	135.8	11.3	9.4	10.4	6332.92	-27.43	-3.23
39	TF-137	27-Feb	10-Jun	135.1	11.1	9.4	7.8	5763.12	-33.96	-11.94

3.4. The CXY506 F1 Seed Production

The CXY506 F1 seed production get a 1500 kg/ha yield, and we have got a proper A-line and R-line best planting season and proper sowing time gap for synchronization flowering, and also the GA3 usage and dosage during the seed production. we can start next localization seed production and industrialization of CXY506. We also trained some farmers to grasp the key technology for the seed production during the seed production.

3.5. The CXY506 High-Yield Cultivation Model Establish

In order to commercialization of CXY506, we implement the high-yield cultivate model research, including key technical terms for strong seedling (figure 1), proper transplanting density, reasonable fertilizer use, Water management (figure 2, and figure 3) etc. key factors. Successfully established a set of high-yield model for CXY506 planting in Burundi. and have shift the key technology to the farmer by field meeting and training course. The operation manual, which including the entire field operation technology, is printed and distributed to farmers and agricultural managers in rice-growing regions. to ensure the effective implementation of technical measures.

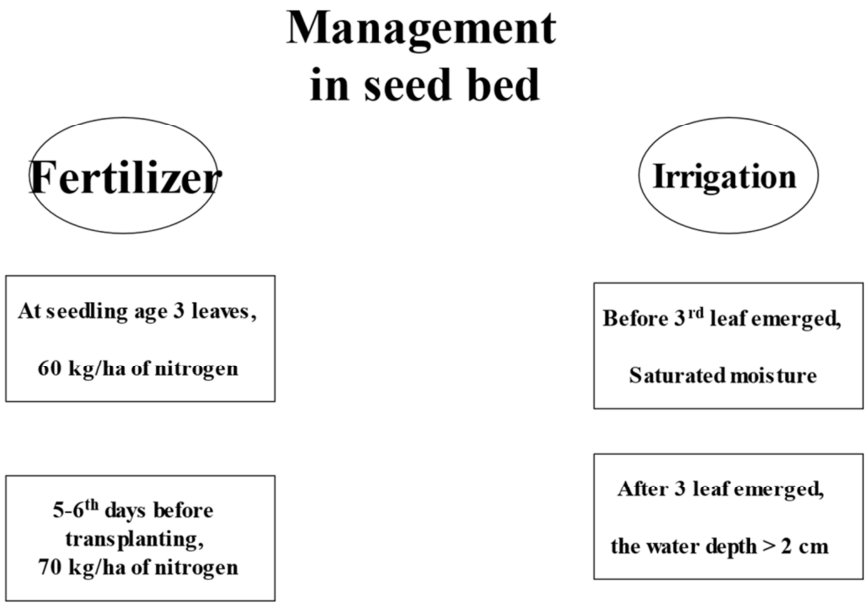

Figure 1. *Strong seedling incubates fertilizer and irrigation.*

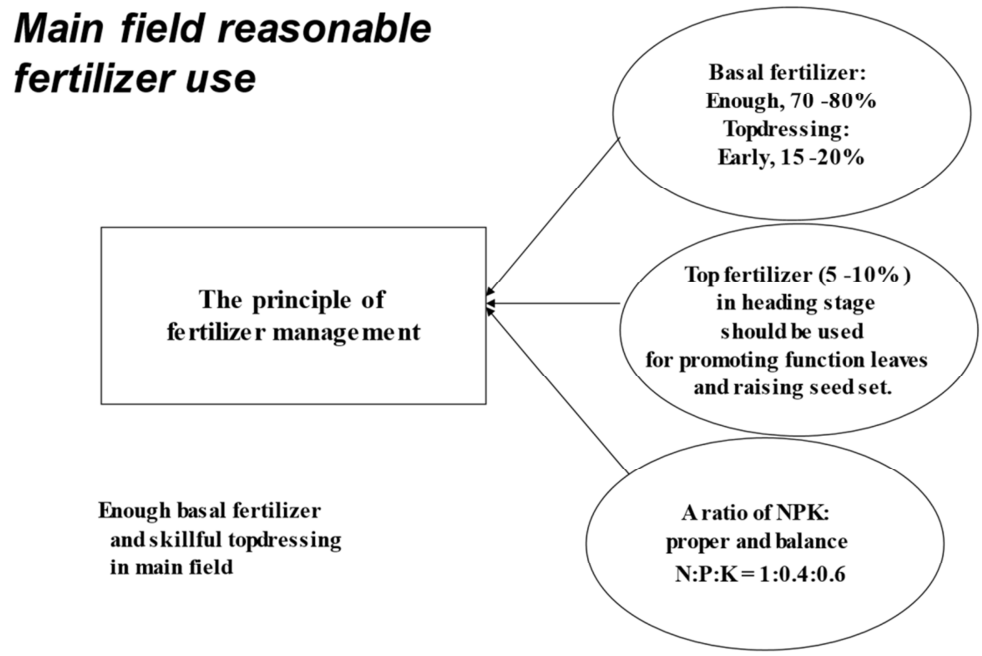

Figure 2. *The principle of fertilizer management map.*

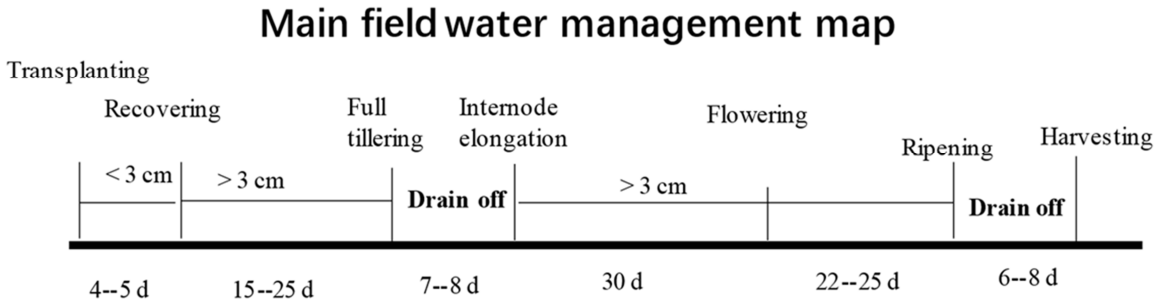

Figure 3. *The main field water manage map.*

4. Discussion

4.1. Adaptability of Tested Varieties

All the 38 varieties (except local CK1) provided by China showed good adaptability, no varieties failed to blossom and bear fruit, and the growth process was similar to that of China. Almost all the imported variety have good yield performance than local variety (CK1) (except TLYYHSM, TF-137), the Maxum increase to 48.5%, and most of the China rice have good resistance to leaf blast, no variety has disease grade more than 5. And have good resistance to neck blast, no variety has disease grade more than 3. But there is big difference in resistance of Bacterial stripe disease, 40% are sensitive (more than Grade 5), 34% are tolerance (between grade 3 to grade 5), only 26% have some resistance (less than grade 3). No variety resistance of Bacterial stripe disease better than local V3 (CK1 (Grade 0.7) among 38 imported varieties.

We should pay more attention to rice breeding on the resistance of the Bacterial stripe disease for the Burundi ecology, take the resistance plant sample, apply molecular Biotechnology to analysis the source of resistance, found the resistance gene, location and cloning the resistance gene, and then introduce to target varieties, gather the yield and resistance trait together scientifically, to obtain high yield and good resistance varieties. Base on rice resistance breeding achievement [19-21]. At present, we have finished the sample preparation, primary analysis is going on, some key different have been confirmed, the molecular analysis will be done soon.

In future, we should take the quality of the rice into consideration according to the Burundi consumer habit and other potential issues not covered in this article.

4.2. CXY506 Localization and Industrialization

We have made CXY506 field high yield cultivation model after six-year cultivation experience in Burundi, all key seed production of CXY506 related data (A-ling and R-line) have been collected and got a success seed production, we can get the seed locally, we have trained the farmer and shift the key cultivation technology and management experience to related persons, and we can production CXY506 under this model in large scale, and we can extend the industrial chains of CXY506 from grain to rice or rice production, increase the

income of local farmers, and promote regional agricultural development and food security.

At present, the cost of seed production is high in China, the climate change risk is high, and companied with long-distance, environment uncontrollable transportation, the risk of seed quality change, and other comprehensive factors, the China seed supplier export seeds to Africa is a huge risk.

Local seed production is the best choice to reduce the risk. The climatic characteristics in the plain of Burundi show that the temperature changes little in the four seasons of a year. During the seed production of hybrid rice, the risk of parents meeting each other in florescence due to climatic factors is low, and the temperature and humidity in the plain are ideal all year round, suitable for hybrid rice seed production. The pests and diseases are light and the sunlight is sufficient, which is beneficial to high yield and harvest.

Base on the CXY506 high-yield cultivation model which we have established after six years research, and combine with CXY506 F1 seed production locally technology, efficient training course, key technology successful transfer, field demonstration and promotion, a chain have formed from seed production to grain produce perfectly. let produce the seed and use the seed for large scale grain production locally in Burundi possible, this is benefit for Burundi in region agriculture development and food security.

5. Conclusion

5.1. Variety Select and Future Breeding for Burundi

The China (Sichuan) varieties have significant yield advantage contrast with Burundi local variety but resistance have different performance, we should focus on the resistance from the variety breeding genetic background and realistic performance to make decision, especially for bacterial leaf streak resistance, how to ultimate this variety in Burundi ecology safety.

We should pay more attention to the local resistance material collect and analyses, found the local resistance genetics and molecular mechanisms of resistance origin, combining the techniques of natural hybridization, transgenic or gene editing with the yield advantages of Chinese hybrid rice, we can breed the varieties with good comprehensive characters and adapt to Burundi ecology, then increase farmer income and avoid the yield lost risk.

5.2. Industrialization Promotion

China government encourage enterprise go abroad and we have got the good CXY506 cultivate model for Burundi, this is a chance for all the China company to production grain in large scale in Burundi, we should use good variety combine with good cultivate model by actively organize, reasonable division of labor, strengthen supervision, timely measures in place to promote localization and industrialization. We can not only to promote local rural economic development and food security, we can also build an oversea rice production base for China domestic requirements or other third party whenever needed. This is positive to get ride of poverty and guarantee the region society peace, while also enhancing the friendship between the two countries.

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