Studies on the Salt Tolerance of Rice and Other Crops in Reclaimed Soil Areas.

1. On the Salt Tolerance of Rice Varieties.

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干拓地에서 水稻 및 其他作物의 耐塩性에 關한 研究

1. 水稻品種의 耐塩性에 關하여

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Abstract

Experiments were conducted by moderate season culture of each of 7 early, medium and late maturing varieties which were considered to be of strong salt tolerance in non-salty, low-and high-salty reclaimed areas (salt content: 0.5 % and 1% at the end of April). The results of the experiments revealed that the early maturing varieties were suffered greatly from salt damage in such reclaimed salty area which is the "fall better type" in the year-round changes of soil salt concentration in Korea. Better yielding varieties in the salty area showed generally a high yield ratio in the salty area compared with the non-salty area.

This indicates that they are strong salt tolerant varieties. It seemed that the salt tolerance could be measured by the number of delaying days in heading, the growth rate of culm length, number of panicles and number of grains per panicle in the salty area to compare with the non-salty area. The effects of salt damage on the yields of each variety at maturing stage and agronomic characteristics in the salty area were compared and discussed with the non-salty area.

Introduction

Some experiments have been conducted in recent years in Korea on the selection of salt tolerant varieties of rice for use on the reclaimed salty areas. According to the report of the Crop Experiment Station[4] (1962), the varieties with strong salt tolerance were in the order of Nongkwang, Iri-265, Yachikogane and Shirogane.

The results of the Rural Development Institute of Kyunggi Province[21] (1966) indicated that the yields of Jaikeun and Kusabue varieties were 20 percent over the Paldal variety, and Kwanok was next.

The results obtained by the Rural Development Institute in Chonnam[7] (1960) and Chonbuk' Provinces[8] (1966) revealed that the yields of Kusabue and Shirogane were higher than other vatieties.

The Japanese Agriculure Experiment Station reported [14] (1954) that Nongrim 6 had a strong salt tolerance. Pearson and Ayers [20] (1960) reported that Agami Montakahab I (Egypt) produced better result than those varieties of Asahi ♯ 1 (Japan), Caloro (USA) and Kala-Rata (India) which have similarity in salt tolerance.

Materials and Methods

21 commercial varieties in Korea were sowed on the seed beds on April 23, 1967. A randomized complete block design was used in silt loam in the high-salty and low-salty area and in the non-salty area. The plot size was 4 m × 3 m with 4 replications. Five plants were planted in each hill with 15 cm and 30 cm spaces between each hill.

The transplantation was completed on June 6. The total fertilizer used was 10 kg of N, 8 kg of P_2O_5 and 8 kg of K_2O/10 a. The basic dressing of 5 kg of N was followed by 3 kg as top dressing for tillering and followed with 2 kg as heading. The standard methods to control insects and plant diseases were carefully followed.

Results

1) Weather and Change of Salt Concentration of the Experimental Farm throughout the Year

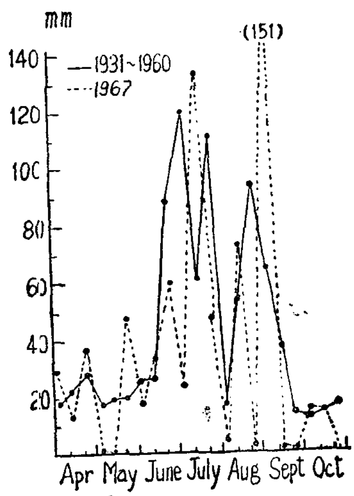


Fig. 1. The average precipitation in 1931-60 and 1967.

The temperature from the tillering and heading stages in June through August was above normal and fine weather continued. Consequently the rice plant grew well and headed rapidly.

The temperature and precipitation of April were similar to those of the average year. The temperature during the 1967 seedling stage in May was observed to be higher by 2 -3°C with less rainfall than the average year. The temperature of June in 1967, was higher with smaller precipitation than the average year and during the latter part of June and in the early part of July in the normal year. The rainy season was 20 days latter this year than average. The mean temperature of August was higher by 2-3°C than that of the normal year with about 70mm of rainfall in the middle of the month. The temperature of September and October was the same as that of the normal year with the largest rainfall in early September of this year which was about three times that of the average year.

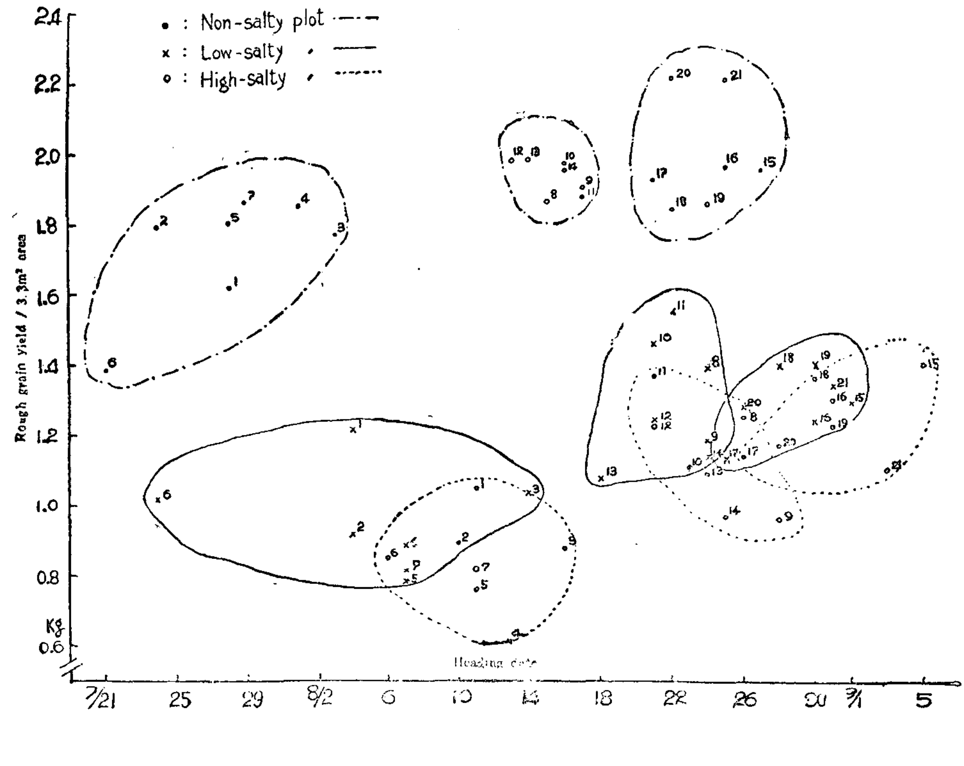
Fig. 2. Seasonal changes of salt content at the experimental farm.

The weather at the maturing stage in September and October was also favorable for rice growing which resulted in the best harvest that had ever been before in the whole area of Kyunggi Province.

The seasonal changes of salt concentration in the soil is one of the most important factors in the farming of salty reclaimed area; i.e., decline of salt content during the growing stage of the rice plants which depends exclusively upon the precipitation, sunlight, evaporation, temperature, etc. The early growth of the rice plant was inhibited, resulting in the favorable late growth, increased panicle weight and ratio of matured grain in this year.

Data on the changes in the salt content of salty reclaimed areas throughout the year in Korea are rare. According to the results of the investigation conducted by Lee[23] in 1963 on the changes of the salt content in the top soil throughout the year in the reclaimed area at Kozan, Shiheung-Kun, Kyunggi Province, 1.3% of the salt in the high-salty area at the end of April dropped to about 0.4% in June and July. Low-salty area of 0.34% of salt also dropped to 0.02-0.05 % from June through August.

Fig. 2 shows the changes in salt content in high-salty area of the experimental farm for the period from April through November salt content of top soil of the high-salty area began to drop along with the increase in rainfall in the later part of May. It was also dropped again to 0.8% with increased rainfall in the middle of July. It steadily dropped to 0.4 % by the middle of September and then began to rise. In the low-salty area, a similar pattern



Heading date

Fig. 3. Relationship between the heading period and grain yields of each varieties. Figures represent the variety number, left circle shows early maturing varieties, middle medium, right late in each salty area.

was observed.

In addition, the salt content of the reclaimed salty area is constantly changing even in the deep layers. According to Lee's[23] (1963) report, the salt content dropped abruptly in June to July of 1963. The rooting and tillering were not seriously interrupted.

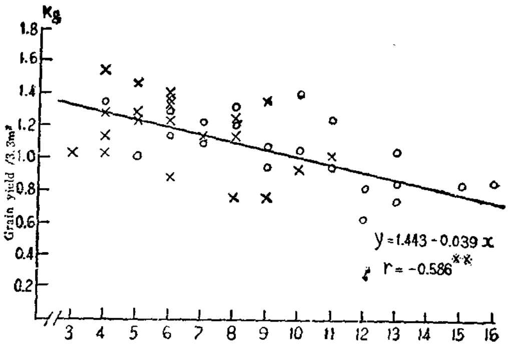
Reviewing the changes of salt content this year, the salt content was low from early August to early in October. As mentioned above, the early growth of the rice plants was inhibited but the latter growth was favorable in 1967.

It is considered very important to take proper measures to prevent salt damage using the complete knowledge about the seasonal changes of salt content in the soil.

2) Delay of Heading and Maturing Periods

The heading period of rice varieties is usually later when grown in salty areas. As shown in Tables 1, 2 and 3, the heading and maturing periods were delayed in more salty areas. This delay may be assumed to be caused by the delay at rooting and tillering. The early maturing variety was delayed for 7.6 days on the average in heading, medium varieties for 6.5 days and late varietes for 5.1 days in the low salty area. In the high salty the same trends were observed; i.e., the heading of the early maturing varieties were delayed for 13.4 days on the average, medium varieties for 8.6 days and the late varieties for 7.3 days.

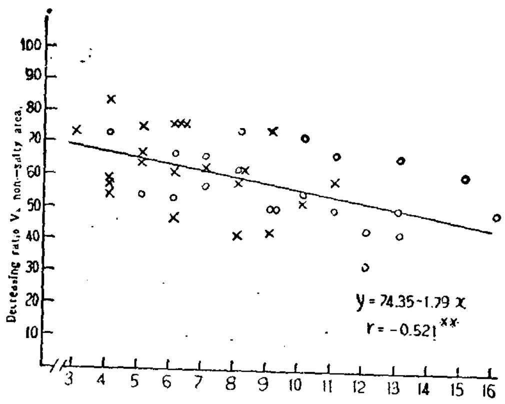
Figure 3 shows the relationship between the heading period and the production of rough grain per 3.3 m^2 area. Rough grain yields of the medium and late maturing varieties were greater than the early maturing varieties in the non-salty area. Rough rice yields of the late maturing varieties were slightly more than the medium varieties. The rough rice yields of the early maturing varieties were found to be less when growth in the low-salty area than in non salty, the medium and late maturing varieties less than that of the non-salty area but always produced more than the early varieties. The early varieties in low-salty area produced 56% of rough grain, and the medium and late varieties produced 66% than the non-salty area. In the high-salty area, the early varieties produced 50%, the medium 58% and the late growing varieties 62% than the non salty area. The early varieties which have a rapid maturing period



Number of delaying days

x : Low salty area, o : High salty area.

Fig. 4. Relationthip between the number of delaying for heading and the grain yields in each variety.



Number of delaying days

x : Low salty area, o : High salty area.

Fig. 5. Relationship between the number of delaying days for heading and the decreasing ratio of grain yields in salty areas versus non-salty area.

produced less grain than the medium and late varieties. The average production on both high-and low-salty areas was 53% of the early, 62% of the medium and 64% of the late varieties, respectively.

Between the rough rice production and maturing periods, there was a 5 percent significant relationship in the non-salty area and percent in each of low and high salt concentration areas.

A study of the maturing period and production (grain yield) of rice varietes indicates that early varieties in the salty area had light panicle (weight) with many broken grains. The relationship of grain production and the heading period of varieties are shown in Fig. 4 and 5. Correlation of the delaying dates of heading with the decreasing rough rice production per 3.3 m^2 in both low-and high-salty areas and also the correlations of the former with the decreased yielding ratio in salty area vs. non-salty areas were significance at the 1 % level. It is assumed that the effect of various salt concentration on the delay in heading of varieties can be used to estimate the decrease in yielding ratio which will result.

3) Rough Rice Yield

There was observed 5 percent significance between the rough rice yields and the maturing period, and 1 percent between varieties, in non-salty area.

There was a significance of 1 percent between the maturing periods and between the varieties with the grain yields in the low salty area. The varieties which produced good yields were in the following order; Kwanok, Yachikogane, Iri-265, Hokwang, Jaikeun, Kinmase, Nongrim-6 and Kusabue. The varieties giving low yields in the low-salty areas were Miyoshi, Dongbuk-72, Suwon-118 and Suwon-82.

In the high-salty areas there was an equally 1 percent significance between the maturing periods and between varieties, respectively.

The good yielding varieties in the high salty area were as follows; Nongrim-6, kwanok Hokwang, Ayanishiki, Jaikeun, Shirogane, Iri-265 and Kusabue. The low-yielding varieties were Suwon-118, Miyoshi, Dongbuk-72 and Fujisaka-5.

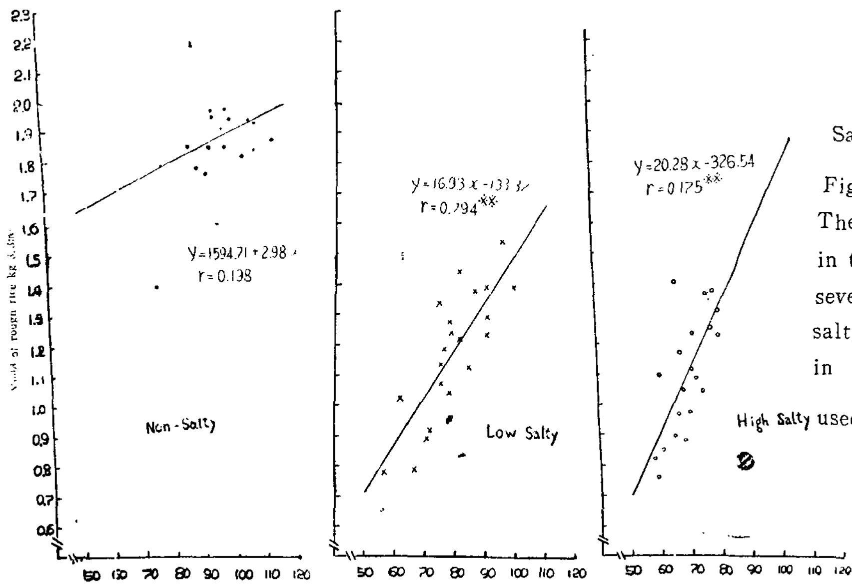
Table 4 shows the decreased yielding ratio of each variety grain in·the salty areas. The early maturing varieties have a low ratio and moderate for both medium and late maturing varieties. There seemed to be no correlation between the yield of each variety in the non-salty area and salty areas. There was observed the correlation of r=0.357. However, since it should be r=0.433 to show the correlation at the 5 percent level, there is no correlation between the two. This suggests that those varieties which produce a large yield in the non-salty area do not always bring about large production in the salty areas but depend greatly upon the salt tolerance peculiar to each variety.

The decreasing yields of five strong and weak salt tolerant varieties in the non-salty, low- and high-salty areas were compared. The data are shown in Fig. 6. The decreased yields in the salty areas were varied. The yields of the weak salt tolerant varieties decreased in the low-salty areas and there was little difference of yields between the low-and high-salty areas, while the decreased yields ratio of the strong salt tolerant varieties was not great in the low-salty area. It is considered that the point of the salt concentration at which yields decline might be at a higher salt concentration. However, the weak salt tolerant varieties may be considered to have a remarkably decreased in yield in salt concentrations in above the low-salty area.

Table 2 and 3 show the average yield of each variety in both low-and high-salty areas. Seven early varieties produced 53% of the yield on the non-salty areas than on the non-salty areas, medium varieties 63 % and the late varieties 64 %, The rough rice production of all

Table 1. Yields and Agronomic Characteristics of Each variety in the Non-Salty Area.

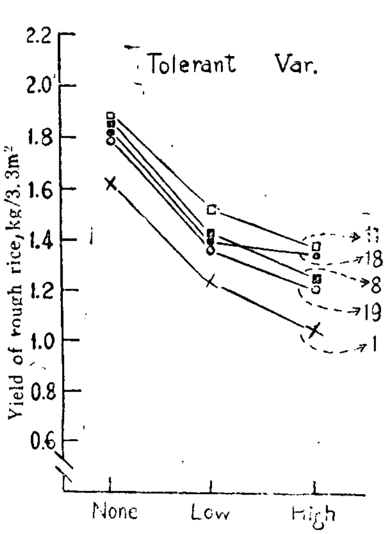
Variety	Date of heading	Date of maturing	Culm length cm	Length of panicle cm	No. of panicle	Wt. of panicle gr	1,000 grain weight gr
V_1. Nongrim—17	7.28	9.24	97.1	19.3	12.9	1.73	23.5
V_2. Suwon—82	7.24	9.15	90.2	17.8	15.0	1.66	23.1
V_3. Shin—2	8.30	9.21	93.3	20.3	13.6	1.77	22.8
V_4. Suwon—118	8. 1	9.11	94.2	20.1	12.3	1.58	22.9
V_5. Miyoshi	7.28	9.18	78.1	19.8	14.8	1.69	23.1
V_6. Fujisaka—5	7.21	9.20	76.5	17.3	11.2	1.72	24.8
V_7. Dongbuk—72	7.29	9.21	87.0	19.4	15.3	1.69	22.1
Average (early)			**88.1**	**19.0**	**13.6**	**1.69**	**23.3**
V_8. Jaikeun	8.15	10.4	99.3	21.0	16.2	1.60	23.7
V_9. Jinheung	8.17	10.3	95.2	22.0	13.3	1.98	27.2
V_{10}. Yachikogane	8.16	9.30	100.5	21.5	14.0	1.94	23.1
V_{11}. Kwanok	8.17	10.3	115.4	21.7	14.9	1.75	25.8
V_{12}. Shirogane	8.13	10.3	94.5	20.7	15.7	1.98	22.8
V_{13}. Susung	8.14	10.6	89.5	21.9	14.4	1.92	26.3
V_{14}. Shinpung	8.16	10.3	95.0	22.1	13.9	1.95	26.9
Average (medium)			**99.0**	**21.5**	**14.6**	**1.87**	**25.2**
V_{15}. Nongrim—6	8.27	19.18	108.7	18.5	18.6	1.45	23.7
V_{16}. Ayanishiki	8.25	10.18	106.9	19.5	16.4	1.65	25.2
V_{17}. Nongkwang	8.21	10.13	97.9	20.6	13.7	1.94	25.5
V_{18}. Hokwang	8.22	10.14	104.9	20.8	15.2	1.67	24.1
V_{19}. Iri-265	8.24	10. 8	198.7	19.5	13.8	1.86	25.3
V_{20}. Kusadue	8.22	10.10	87.6	19.2	15.7	1.54	25.6
V_{21}. Kinmase	8.25	10.20	87.7	18.2	17.2	1.76	29.6
Average (late)			**100.3**	**19.5**	**15.8**	**1.70**	**25.2**
Total Average			**96.1**	**19.3**	**14.7**	**1.75**	**24.6**

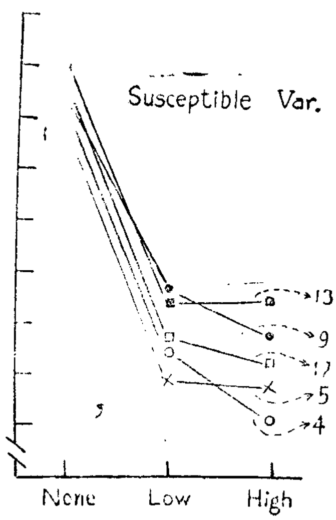


Salt concentrations

Fig. 6. The difference of pattetns in the salt tolerance of several varieties in each salty area. Variety numbers in this experiment were used.

No. of grains per panicle	Ratio of matured grain(%)	Wt. of rough rice kg/10a	Wt. of brown rice kg/10a	Milling out turn (%)	Wt.of broken rice kg/10a	Straw weight kg/3.3m²	Rough rice/ straw wt. (%)
79	88.0	484	365	77.4	21.1	1.99	81
74	88.2	538	412	76.5	23.6	1.81	60
84	86.4	530	416	78.4	18.9	1.94	91
68	81.9	557	418	75.0	36.5	1.77	105
76	84.4	540	418	77.4	24.8	1.79	101
75	85.5	416	321	77.3	15.5	1.62	86
85	82.0	558	410	73.5	49.8	2.47	75
77	**85.2**	**518**	**395**	**76.5**	**27.2**	**1.91**	**91**
80	76.7	559	426	76.3	30.3	2.59	72
80	84.5	570	440	77.2	27.4	2.80	67
93	80.2	587	445	75.9	34.0	2.20	87
77	79.4	563	429	76.1	46.3	2.63	81
64	84.4	596	461	77.3	26.8	2.42	92
79	82.6	596	456	76.5	32.3	1.98	101
81	85.8	589	462	78.4	28.2	2.41	81
83	**81.9**	**591**	**446**	**76.8**	**32.2**	**2.44**	**82**
66	89.3	583	468	80.2	20.0	2.76	70
69	89.5	595	456	77.9	32.2	3.64	54
82	89.6	575	450	78.2	31.3	3.78	51
81	75.6	549	419	79.3	51.8	3.07	60
81	80.1	555	422	76.9	41.0	2.90	60
62	92.2	660	522	79.1	29.1	3.00	73
67	93.1	660	527	79.8	30.2	3.68	57
73	**86.6**	**595**	**466**	**78.2**	**33.7**	**3.27**	**61**
78	**84.6**	**568**	**436**	**77.5**	**31.0**	**2.54**	**74**





Culm length, *cm*
Fig 7. Relatxionship between the culum length and rough rice production.

Table 2. Yields and Agronomic Characteristics of Each Variety in the Low-salty Area.

Variety	Heading stage delayed days	Maturing stage delayed days	Culm length (%)	Panicle length (%)	No. of panicle (%)	Panicle weight (%)	1,000 grain weight (%)
V_1, Nongrim-17	—6	—2	(83)	(104)	(87)	(87)	(68)
V_2, Suwon-82	—10	—7	(76)	(69)	(83)	(62)	(99)
V_3, Shin-2	—11	—5	(82)	(98)	(80)	(78)	(98)
V_4, Suwon-118	—6	—14	(74)	(89)	(80)	(79)	(81)
V_5, Miyoshi	—9	—8	(72)	(87)	(69)	(61)	(91)
V_6, Fujisaka-5	—3	—4	(80)	(95)	(96)	(77)	(88)
V_7, Dongbuk-72	—8	—3	(75)	(94)	(67)	(62)	(95)
Average (early)	**—7.6**	**—6.1**	**(78)**	**(95)**	**(79)**	**(72)**	**(93)**
V_8, Jaikeun	—9	—3	(84)	(88)	(80)	(92)	(96)
V_9, Jinheung	—7	—2	(79)	(86)	(74)	(93)	(94)
V_{10}, Yachikogane	—5	—5	(78)	(89)	(88)	(85)	(109)
V_{11}, Kwanok	—4	—6	(80)	(91)	(79)	(105)	(99)
V_{12}, Shirogane	—8	—2	(81)	(93)	(63)	(60)	(99)
V_{13}, Susung	—4	—3	(74)	(85)	(64)	(84)	(97)
V_{14}, Shinpung	—8	—5	(78)	(83)	(76)	(77)	(98)
Averge (medium)	**—6.4**	**—3.7**	**(79)**	**(88)**	**(75)**	**(89)**	**(99)**
V_{15}, Nongrim-6	—5	—2	(82)	(92)	(67)	(94)	(103)
V_{16}, Ayanishiki	—5	—3	(83)	(93)	(62)	(102)	(102)
V_{17}, Nongkwang	—4	—4	(85)	(87)	(70)	(84)	(95)
V_{18}, Hokwang	—6	—4	(84)	(83)	(74)	(108)	(104)
V_{19}, Iri-265	—6	—6	(89)	(97)	(78)	(96)	(102)
V_{20}, Kusabue	—4	—3	(87)	(78)	(78)	(94)	(98)
V_{21}, Kinmase	—6	—8	(83)	(95)	(70)	(78)	(91)
Average (late)	**—5.1**	**—4.3**	**(85)**	**(91)**	**(73)**	**(95)**	**(99)**
Total Average	**—6.4**	**—4.7**	**(81)**	**(91)**	**(76)**	**(85)**	**(97)**

* The figures of each article in parenthesis indicate the percentage in each salty area versus non-salty area.

21 varieties in both salty areas was 60 % of the non-salty areas.

The varieties giving the least decrease in production on both salty areas when compared with the rough rice production in the non-salty area were in order of Kwanok (78 %), Hokwang (75 %), Jaikeun (71 %), Iri-265(71%) and Nongrim 17 (70 %). These varieties may be recognized as those of strong salt tolerance and produced better on salty areas.

4) **Varietal Differences of the Agronomic Characteristics in Response to Salty Condition**

a) **The Culm and Panicle Length**

The average culm length of each variety used

Grains per panicle(%)	Ratio of matured (%)	Wt. of rough rice (%)	Wt. of brown rice (%)	Milling out turn (%)	Wt. of broken rice (%)	Straw weight (%)	Rough rice/ straw wt.(%)
(90)	(106)	(76)	(74)	(97)	(56)	(77)	(99)
(64)	(106)	(52)	(52)	(101)	(62)	(71)	(72)
(76)	(102)	(59)	(59)	(100)	(129)	(76)	(78)
(100)	(109)	(47)	(47)	(97)	(68)	(62)	(76)
(74)	(101)	(43)	(40)	(93)	(76)	(80)	(53)
(84)	(103)	(74)	(68)	(92)	(145)	(62)	(119)
(61)	(108)	(42)	(42)	(99)	(52)	(41)	(103)
(78)	**(105)**	**(56)**	**(55)**	**(97)**	**(84)**	**(67)**	**(68)**
(83)	(118)	(74)	(78)	(104)	(43)	(70)	(107)
(93)	(111)	(63)	(63)	(101)	(63)	(63)	(101)
(74)	(117)	(75)	(77)	(104)	(35)	(81)	(93)
(97)	(119)	(83)	(86)	(104)	(33)	(76)	(101)
(83)	(110)	(62)	(63)	(102)	(42)	(61)	(90)
(81)	(113)	(54)	(55)	(102)	(15)	(72)	(74)
(72)	(112)	(58)	(59)	(101)	(37)	(73)	(80)
(83)	**(114)**	**(66)**	**(69)**	**(103)**	**(40)**	**(70)**	**(94)**
(79)	(104)	(67)	(66)	(99)	(48)	(84)	(70)
(99)	(105)	(64)	(64)	(100)	(38)	(55)	(115)
(79)	(106)	(59)	(59)	(100)	(27)	(52)	(114)
(91)	(116)	(76)	(78)	(102)	(22)	(69)	(115)
(91)	(110)	(76)	(77)	(101)	(37)	(68)	(117)
(94)	(104)	(58)	(58)	(100)	(23)	(56)	(104)
(96)	(98)	(61)	(60)	(98)	(40)	(73)	(88)
(90)	**(106)**	**(66)**	**(66)**	**(100)**	**(43)**	**(65)**	**(103)**
(84)	**(108)**	**(63)**	**(63)**	**(100)**	**(53)**	**(67)**	**(94)**

was longer on those grown in the non-salty area. Those grown in the low-salty area were next and those the shortest culms were grown in the high-salty area. The culm length of the early varieties was generally short, while the culm length of the late varieties was long. The culm growth was 80% of the non-salty areas when grown on the low-salty areas and about 70 % in the high-salty area, respectively.

The correlation of the culm length and rough rice production is indicated in Figure 7. There was no significant correlation in the non-salty area but it appeared that there was a correlation at 1 percent level for both low-and high-salty areas. The longer the culm length the more grain was produced in the salty areas.

The panicle length of the early and medium varieties is generally longer in the non-salty

Table 3. Yields and Agronomic Characteristics of Each variety in the *High-salty Area.*

	Heading stage delayed days	Maturing stage delayed dags	Culm length (%)	Panicle ldngth (%)	No. of panicle (%)	Panicle weight (%)	1,000 grain weight (%)
V_1, Nongrim-17	—13	—2	(70)	(103)	(85)	(71)	(93)
V_2, Suwon-82	—16	—8	(70)	(100)	(83)	(60)	(88)
V_3, Shin-2	—13	—5	(74)	(99)	(73)	(67)	(91)
V_4, Suwon-118	—12	—14	(66)	(93)	(78)	(56)	(79)
V_5, Miyoshi	—13	—8	(65)	(93)	(86)	(26)	(86)
V_6, Fujisaka-5	—15	—7	(76)	(103)	(96)	(62)	(88)
V_7, Dongbuk-72	—12	—5	(67)	(95)	(71)	(62)	(87)
Average (early)	**—13.4**	**—7.0**	**(70)**	**(98)**	**(79)**	**(63)**	**(87)**
V_8, Jaikeun	—11	—5	(78)	(97)	(78)	(85)	(99)
V_9, Jinheung	—11	—6	(69)	(92)	(77)	(66)	(83)
V_{10}, Yachikogane	—71	—0	(71)	(93)	(82)	(69)	(100)
V_{11}, Kwanok	—4	—7	(68)	(100)	(86)	(88)	(99)
V_{12}, Shirogane	—8	—4	(75)	(97)	(73)	(75)	(95)
V_{13}, Susung	—10	—3	(73)	(93)	(83)	(67)	(98)
V_{14}, Shinpung	—9	—5	(73)	(64)	(78)	(64)	(90)
Average(medivm)	**—8.6**	**—5.7**	**(72)**	**(95)**	**(80)**	**(73)**	**(85)**
V_{15}, Nongrim-6	—10	—3	(61)	(108)	(77)	(94)	(93)
V_{16}, Ayanishiki	—6	—4	(76)	(110)	(81)	(82)	(90)
V_{17}, Nongkwang	—5	—6	(75)	(103)	(90)	(66)	(100)
V_{18}, Hokwang	—8	—6	(72)	(107)	(79)	(95)	(96)
V_{19}, Iri-265	—7	—9	(74)	(110)	(76)	(85)	(94)
V_{20}, Kusabue	—6	—6	(77)	(104)	(72)	(93)	(92)
V_{21}, Kinmase	—9	—5	(69)	(94)	(74)	(67)	(87)
Average (late)	**—7.3**	**—5.6**	**(72)**	**(105)**	**(78)**	**(83)**	**(93)**
Total Average	**—9. 8**	**—6.1**	**(71)**	**(99)**	**(79)**	**(73)**	**(92)**

* The figures of each article in parenthesis indicate the percentage in each salty area Versus non-salty area.

area, short in the low-salty area and medium in the high-salty area. However, the late varieties produced longer panicle lengths in the high-salty area than in the non-salty area but shorter in the low-salty area.

b) Number of Panicle

The number of panicle per hill of the late maturing varieties was larger than the number of panicle on the medium maturing ones which was also larger than the early vareties in non-salty area. The average number of panicles of the seven early varieties was 13.6, medium 14.6 and late 15.8. Almost the same trend may be seen in both low-and high-salty areas

Grains per panicle	Ratio of matured grain(%)	Wt. of rough rice (%)	Wt. of brown rice (%)	Milling out turn(%)	Wt. of broken rice (%)	Straw weight (%)	Rough rice/ straw wt. (%)
(84)	(95)	(66)	(63)	(97)	(60)	(64)	(102)
(70)	(89)	(49)	(45)	(92)	(111)	(63)	(79)
(83)	(79)	(50)	(44)	(88)	(132)	(75)	(66)
(50)	(95)	(33)	(31)	(93)	(71)	(58)	(57)
(76)	(93)	(40)	(40)	(95)	(74)	(73)	(57)
(73)	(98)	(61)	(60)	(99)	(134)	(97)	(63)
(74)	(85)	(44)	(59)	(89)	(112)	(50)	(88)
(73)	**(90)**	**(50)**	**(49)**	**(93)**	**(99)**	**(66)**	**(73)**
(83)	(112)	(67)	(68)	(102)	(55)	(70)	(96)
(76)	(105)	(50)	(51)	(100)	(74)	(31)	(163)
(65)	(112)	(57)	(59)	(104)	(46)	(84)	(69)
(83)	(112)	(73)	(76)	(104)	(30)	(79)	(93)
(78)	(103)	(62)	(64)	(103)	(39)	(81)	(67)
(63)	(110)	(55)	(56)	(102)	(27)	(83)	(66)
(53)	(101)	(50)	(49)	(99)	(31)	(57)	(88)
(72)	**(108)**	**(59)**	**(60)**	**(102)**	**(43)**	**(69)**	**(92)**
(100)	(91)	(72)	(69)	(96)	(71)	(89)	(80)
(103)	(90)	(67)	(65)	(98)	(39)	(50)	(131)
(63)	(96)	(54)	(53)	(69)	(48)	(48)	(112)
(89)	(113)	(74)	(75)	(100)	(31)	(53)	(140)
(102)	(108)	(66)	(67)	(101)	(33)	(69)	(103)
(100)	(98)	(53)	(53)	(99)	(19)	(64)	(83)
(81)	(92)	(50)	(47)	(94)	(71)	(72)	(72)
(91)	**(98)**	**(62)**	**(51)**	**(98)**	**(45)**	**(64)**	**(103)**
(79)	**(99)**	**(57)**	**(57)**	**(98)**	**(62)**	**(67)**	**(89)**

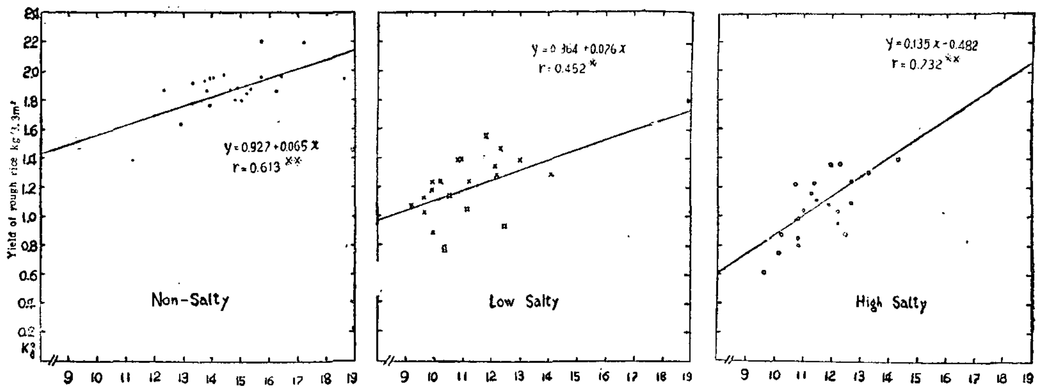
(i.e., the number of panicles of the early variety was small and that of the late variety was large).

The inhibition of tillers by salt was decreased 76 to 79 % in the salty areas. The rough rice production in the salty areas depends greatly upon the number of panicles produced.

Figure 8 shows that the correlation between the number of panicles and rough rice weight in each experiment is significant at the 1 percent level in the non-salty and high-salty areas and is significant at the 5 percent level in the low-salty area.

Table 4. Comparison of the Yields in the Non-salty Areas and the Decreased Yielding in Each of the two Salty Areas.

Variety	Yield in non-salty Kg/10a	Ave. yield in salty Kg/10a	Decreased yield in salty area kg/10a	Percentage of yield in salty vs. non-salty
Early				
V_1 Nongrim-17	483.6	340.2	143.4	70
V_2 Suwnn-82	538.2	271.8	266.4	41
V_3 Shin-2	530.7	287.4	242.7	54
V_4 Suwon-118	556.8	225.6	231.2	41
V_5 Miyoshi	539.7	232.8	206.9	43
V_6 Fujisaka-5	415.8	230.7	174.9	69
V_7 Dongbuk-72	557.7	240.9	316.8	43
Average (early)	**510.5**	**270**	**254.7**	**53**
Medium				
V_8 Jaikeun	558.6	397.8	160.8	71
V_9 Jinheung	570.3	321.9	248.4	56
V_{10} Yachikogane	586.5	385.2	201.3	66
V_{11} kwanok	563.4	437.7	125.7	78
V_{12} Shirogane	595.8	369.9	225.9	62
V_{13} Susung	596.1	324	270.9	54
V_{14} Shinpung	589.2	317.7	271.5	54
Average (medium)	**579.9**	**363.8**	**214.8**	**63**
Late				
V_{15} Nongrim-6	582.9	404.4	178.5	69
V_{16} Yachikogane	574.5	381.9	203.4	66
V_{17} Nongkwang	575.1	325.5	246.9	57
V_{18} Hokwang	549	414	135	75
V_{10} Iri-265	554.4	392.4	162	71
V_{20} Kusabue	663	366.6	293.4	56
V_{21} Kinmase	659.7	366	293.1	55
Average (late)	**593.7**	**378.6**	**216**	**64**
Total Average	**563.7**	**337.5**	**228.5**	**60**



Number of panicles per hill

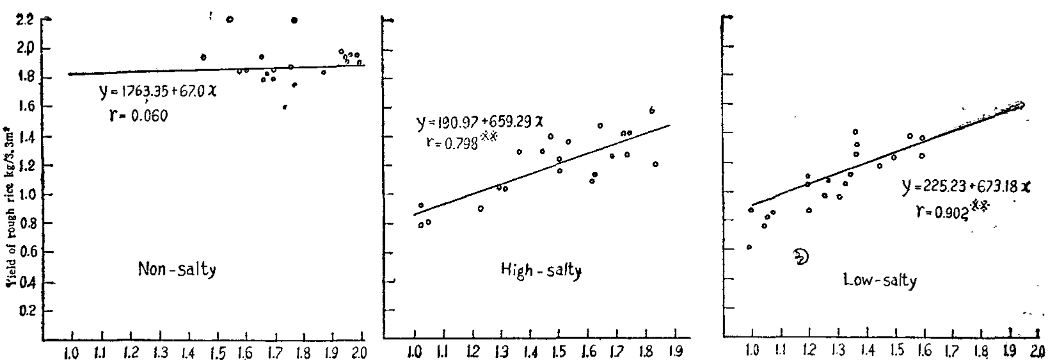
Fig. 8. Relationship between the number of panicles and the weight of rough rice grown various salt concentrations.

c) **Panicle Weight**

The panicle weights were observed as heavy in the non-salty area, moderately heavy in the low-salty area and light in the high-salty area The total average of the 21 varieties was 1..75 grams in the non-salty area, 1.45 in the low-salty area and 1.26 in the high-salty area. The panicle weight of the early maturing varieties was very light in both salty areas being about 60 % of the panicles of non-salty area. The medium and late varieties were about 90 to 95 % and 70 to 80 % respectively of the non-salty areas produced panicle weight in the low-and high-salty areas.

Nongrim-17, an early maturing Kwanok and Shirogane, medium maturing varieties and Hokwang, Iri-265, late maturing varieties, produced better yields this year with relatively heavy panicles in the low-and high-salty areas, respectively.

The correlation of the panicle weight and rough rice production in yield is shown in Figure 9. No significant difference was obseved in the non-salty area but 1 percent significance



Weight of a panicle, Gr.

Fig. 9. Relationship between the weight of a panicle and rough rice yield.

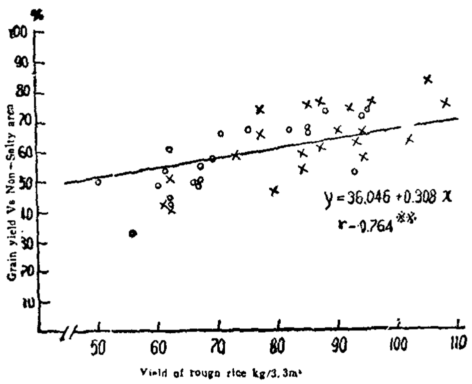
was observed in both low-and high-salty areas.

Fig. 10 shows the relationship between the ratio of panicle weight in the salty areas vs. non-salty area and the decreased yield ratio of the rough rice production in the salty areas. There was observed 1 % significance of $r=0.764$. This suggests that a decrease of the panicle weight is caused by salt and is a factor of the decreased yield in the salty areas.

The relationship between the number and weight of panicles in each experimental plot is as shown in Fig. 11. There was observed a negative correlation of 1 % significance in the non-and low-salty areas;., an increase of the number of panicles brings about a decrease in the panicle weight. However, a positive correlation of 1% significance was observed in the high-salty area. This phenomenon possibly resulted from enlarging the space between plants due to the loss of circumferential hills.

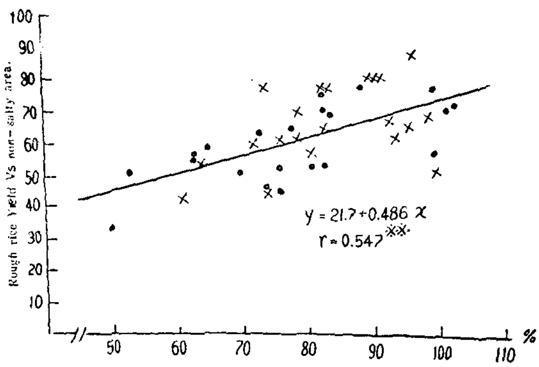
d) Number of Grains per Panicle and Weight of One-thousand Grains

The number of grains per panicle in the non-salty, low- and high-salty areas is 78, 65 and 61, respectively. The number of grains per panicle was clearly decreased by 16 % and 21 % respectively in both low- and high-salty areas when compared with the non-salty area.



Panicle weight vs. non-salty area
× ; Low-salty area, O ; High-salty area.

Fig. 10. Relationship between the decreasing ratio of panicle weight and grain yield in the salty areas as compared with the non-salty area.



Nember of grains vs. non-salty area.
× ; Low-salty area, ○ ; High-salty area.

Fig. 12. The relationship between the decreasing ratio of number of grains per panicle in each salty area compared to the non-salty area and the decreasing ratio of rough rice yields.

The effect of the decreasing ratio of the number of grains per panicle of each variety to the decreased yields of rough rice in different salty areas is shown in Figure 12. An 1 percent significance ($r=0.547$) was observed beween the two. A decrease in the number of grains per panicle is one of the factors decreasing the grain yields in the salty areas.

The weight of one-thousand grains varies with each variety and its salt tolerance. In the non-salty, low-and high-salty areas, the early varieties are generally smaller in weight than the medium and late maturing varieties. However, the decreasing weights of one-thousand grains from the salty areas when compared with the non-salty area 1 to 7% on the average in the low-salty areas and 5 to 13% in the high-salty areas, respectively. The yields from salt damage was found to decrease from 7 to 13% for the

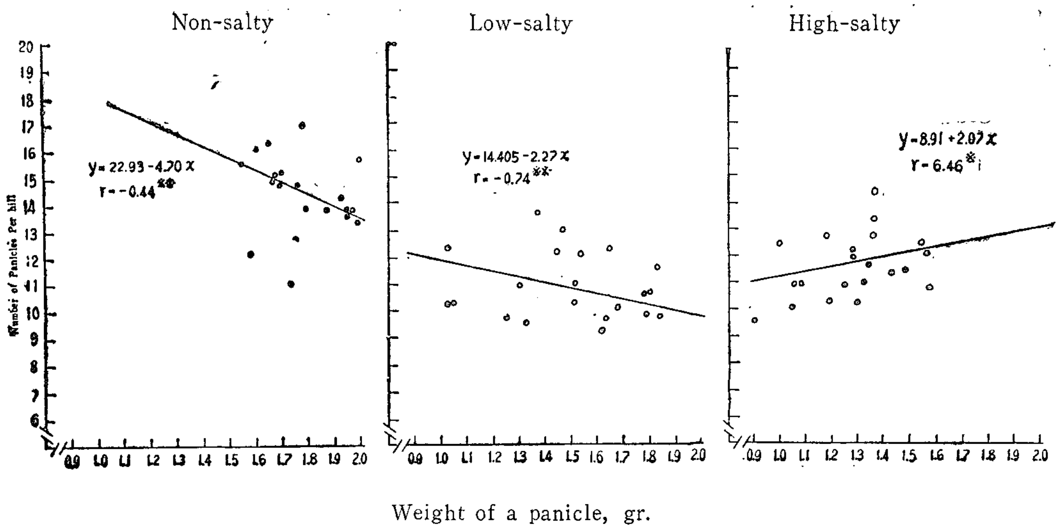


Fig. 11. The relationship between the weight of a panicle and the number of panicles per plant.

early variety and 1 to 5% for the medium and late varieties. It was considered that the decrease in the weight of one-thousand grains is one of the decreased yielding factors of the early maturing variety in the salty areas.

e) The ratio of Matured Grain, Millirg Recovery and Broken Grain Pnoduction.

The matured grain produced by the seven early varieties was 85.2%, medium 81.9% and the late 86.6% in the non-salty area. The ratio of matured grains of the medium varieties somewhat declined as compared with other maturing varieties. The total average of the non-salty areas was 84.6%.

The average matured grain ratio the eariy varieties was 88.9%, medium 93.4% and late 91.5 % in the low-salty area.

The total average matured grain ratio in the high-salty area was 83.4% for the average of 21 varieties. The early varieties were 77.1 % medium 88.2 % and the late 84.8 % on the average. The medium varieties were the best. The high-salty area were characterized by lower matured grain ratios than the non-salty area. The matured grain ratios of early variety were especially low.

The matured grain ratio of the early varieties was poor in the salty areas while those in the medium varieties group were remarkably better. The late varieties were also well matured as a whole.

It was observed that the early varieties declined and the medium and late varieties were equally high in their milling recovery percentage from the non-salty areas. This trend was also observed in both low- and high-salt concentration areas. The total average milling recovery percentage of the whole 21 varieties was almost the same for the non-salty as for both low- and high-salty areas. In other words, there was observed no variation of the milling percentage due to salt damage, but there seemed to be a difference in the matured grain ratio according to the maturing period.

The average weight of broken rice was 31 grams per 3.3m^2 in the non-salty areas, 14.7 grams in the low-salty areas and 17.9 grams in the high-salty areas. The amount of broken rice is remarkably small in the salty areas. However, the weight of broken rice of the early varieties is generally 2 times that of the medium and late varieties in the salty areas. Therefore, the milling recovery percentage of the early varieties declines in the salty areas and the amount of broken rice increases.

f) Straw Weight and Rough Rice Weight vs. Straw Weight

Data in Table 4 indicates that the straw production was restricted in the salty areas as compared with the production in the non-salty area. There was no difference in the straw weight per area of $3.3m^2$ in both low-and high-salty areas. The straw weight of the early varieties was low in the non-salty and both of the salty areas. The medium maturing varieties were intermediate in weights and the late varieties were high.

The ratio of rough rice weight vs. straw weight of early varieties was high in the non-salty area but declines as the salt content rises. The ratio of the early varieties was high in the non-salty area and the value of the late varieties was small. This treand was generally observed in the salty areas, while the ratio of the medium varieties was slightly higher than that of other varieties in the high salty area.

Table 5. Straw Weight and weight of Rough Rice vs. Straw Weight.

Description	Straw weight ($kg/3.3m_2$)				Wt. of rough rice vs. straw weight (%)			
	Early	Medium	Late	Aver.	Early	Medium	Late	Aver.
Non-salty area	1.91	2.44	3.27	2.54	91	69	61	74
Low-salty area	1.26	1.70	2.10	1.69	77	75	63	72
Hihg-salty area	1.28	1.66	2.05	1.66	66	72	62	67
Average	1.48	1.93	2.47	1.96	78	72	62	71

Discussion

Kapp [19] (1947), Ota and Yasue [26] (1958), Pearson[27][28] (1959 a, b) and Kaddah[18][19] (1961, 1963) reported that salt tolerance of rice plants is the weakest during the seedling stage and the tolerance increases with increase of age. There are differences between varieties in varietal tolarance to salt concentration.

Pearson et al. [30] (1965) also reported that salt inhibited germination by 50 % one week after soaking the seeds in 21.2-30.5 mmhos in the salt tolerance experiment performed with 14 varietes such as Bluebonnet, Caloro and Zenith, and 50% decrease in the weight of dry matter at the seedling stage is 6.4 mmhos on the average and the salt damage at the seedling stage is over three times less than that at germination.

After transplantation immediate rooting is one of the most important problems in the rice culture under salt conditions in Korea. According to Pearson[23] (1959), the 3-week and 6-week old seedlings of Caloro rice endure generally in 9 mmhos (salt cont 0.58 per cent) and 14 mmhos respectively.

The rice seedlings were 44 days old when transplanted on June 6th. The salt concentration of the experimental plots at this time was 0.65 to 0.7% in the low-salty area and 0.9 to 1% in the high-salty area.

From the results of Pearson, the rice seedlings the above seemed to endure salt concentrations. In spite of the proper irrigation and drainage of the experimental plot, however, there was observed a number of withered hills even in the low-salty area due to relatively higher temperature and prolonged drought in the month of June. In the average year, the salt content usually falls from the latter part of June. However, it began to fall from the latter part of July in the present experimnetal plot this year as mentioned previouly in the section of the weather. Consequently, there was produced a decreased yields by withering in the salt paddy fields where irrigation and drainage were not thoroughly carried out. Even though the seedlings were relieved from being withered, the tillering was inhibited and decreased the number of panicles.

The wet season following immediately after transplantation is one of the most important weather conditions for rice culture in reclaimed salty area because it makes dropping of the salt concentretion and activates the rooting, tillering and vegetative growth.

Ehlig[10] (1960) reported that salt damage under the condition of high temperature is great. However, under rainy or cloudy weather condition, the water temperature is relatively low and the transpiration may be balanced.

Active irrigetion and drainage are necessary as the salt concentration rises in the salty areas. Even in the high-salty area of 1% salt content in spring, there is usually frequent precipitation during the period of rooting, tillering and panicle formation, there by salt content drops 0.4 to 0.5 percent. Therfore, if irrigation and drainage are sufficiently carried out for two or three weeks, rooting and tillering will be readily active.

According to Eaton[9] (927), Bernstein[9,11] (1958, 1961) and Lagerwerff[22] (1961), the osmotic pressure of plant body rises under the condition of high osmotic pressure and the difference of osmotic pressure of the inside and outside of plant body is continuously maintained constant at all times. However, Hayward et al.[12,13] (1944 a, b) claimed that the interruption by plants is primary factor of salt damage under salt conditions.

As mentioned above rooting follows immediately after transplantation and includes the problems incurred in the growth of seedlings in the nursery beds. In other words, it is important to plant healthy seedlings and also to give careful attention to the irrigation and drainage for one or two weeks after transplantation. Those seedlings suffering from severe damage at this stage can not readily recover and produce high yields efficiently.

According to Pearson[27,28] (1959 a, b), salt damage to the production of rough rice is greater than that to the vegetative growth. In other words, the plant height decreases 20 % in the salt concentration of 11 mmhos, straw weight 45 % and the number of panicle 30 %. He cited a decrease in the number of panicle and inhibition of pollen germination as another important effects of salt damage on rice production. He also reported that 8mmhos (0.51 percent) is the 50 percent point of decreasing yield of Caloro rice through its growing stage.

The average salt concentrations of high- and low-salty areas of the present experimental farm from June to the end of October was 11.9 mmhos (0.76 percent) and 9.1 mmhos (0.58 percent), respectively. The plant height of 21 varieties at the maximum tillering stage and culm length at the maturing stage were 63.8 and 68.6% respectively on the average of the high-salty areas, 69.8 and 77.7% of the low-salty areas in comparison with the non-salty area. These results indicate little growth as compared with data obtained by Pearson. This may be considered attributable to the prolonged dry weather in the months of June and July.

Choi et al.[3,4,5,6] (1962 a, b, 1963 a, b) reported that the average heading period in salty areas was delayed 7 to 10 days. The heading dates of the whole 21 varieties in this experiment were delayed 6.4 days and 9.8 days respectively, on the average in low-and high-salty areas as compared w th non- salty areas. In salty areas the average number of days delayed in heading compared with non-salty area was longer in order of early, medium and late maturing varieties.

It seems that production of rough rice is related to the heading dates. Those varieties which headed rapidly produce low yields comparing to the non-salty areas. The salt concentrations of both salty areas dropped below 0.55% salt after August 25th. The medium and late maturing varieties head thereafter were reduced not so much as early varieties in the porduction of rough rice while the decreased yields of the early maturing varieties headed at the time of high-salt concentration in the beginning of August was 50 to 56% of rough rice in both salty areas comparing to non-salty area. The growing period of early maturing varieties was short and afflicted with high-salt concentrations in early growth. Consequently, it remained inactive vegetatively and headed early without recovering from the salt damage.

It can be readily understood, therefore, that the decreased yields of early maturing variety is great in such area of the "fall better type" in growth as the reclaimed soil area in Korea where the salt concentration becomes high at the early growth stage and low at the late growth stages of rice.

The longer the delaying dates of heading in salty areas comparing to the non-salty area, the lower is the production of rough rice in the salty areas. The heading dates of the early maturing varieties are delayed especially in comparison with plants grown in the non-salty areas It is assumed that the varieties of longer delay heading dates are those of weak absolute salt tolerance. The heading of these varieties might be delayed by a great inhibition of growth due to salt damage;i.e., they are quite sensitive to salt.

According to Francois and Bernstein[11] (1964), safflower in the salty areas produce a decreased yield as the number of panicles are decreased. They also reported that although the number of seeds is not decreased in the salty area, the weight of each seed decreases remarkably due to salt damage during the growth cycle. The results of the present experiment show a significant relationship between the number of panicles per hill and the production of rough rice in the non-salty and low-and high-salty areas.

In the present experiment the salt concentrations at the heading and blooming stages of the early maturing varieties in the low-and high-salty areas in the early of August were higher than that at the heading and blooming stages of the medium and late maturing varieties in the latter part of August. It can be understood, therefore, that this is the cause of the small panicles of the early maturing varieties.

The number and weight of panicles per 3.3 m^2showed the correlation to be negative at 1% significance in the non-salty and low-salty areas, respectively. This indicates that those varieties that have a large number of panicles produce lighter-weight panicles. However, they showed a positive correlation in the high salty areas. This seems attributable to the space caused by withered individuals per hill and lower leaf areas due to high-salt concentrations at the early stage of growth and because of the dropping of salt concentration, active tillering of the strong salt tolerance varieties resulted in their heavy-weight of panicles.

It may be further considered that the decreased numder of grains per panicle had a great effect on the decreased yields of rough rice of each variety produced in the salty areas and the decreased ratio in number of grain per panicle produced in the salty areas comparing to non-salty area was correlated highly significant with decreased ratio of grain yield. The number of grains per panicle of the early maturing varieties and as the salt concentration rises was decreased.

Choi et al.[5][6] (1963a, b) reported a decrease of the thousand grain weight in the salty areas although it does not affect the yield in particular. According to Shimoyama and Ogo[31] (1956), a decrease of grain weight damage has a great effect on the panicles produced.

In the present experiment, the decrease of the one-thousand grain weight of rough rice was considared to be one of the cause of a decreased yield in the salty areas. The one-thousand grain weight is reduced as the salt concentration of the soil rises, especially in the group of early matuing varieties than that of the medium and late maturing varieties in each salt concentration area. It was assumed that a decrease of the one-thousand grain weight resulted in a severe decrease in yields of the early maturing varieties in the salty areas. There was no difference in the one thousand grain weight of the medium and late maturing varieties in the low- and high-salty areas. Some varieties produced one thousand grain weight with better yield in the low-and high-salty areas than in the non-salty area.

The favorable matured grain ratio in the salty areas was closely related to the salt concentrations of the soil and prevailing weather conditions. The salt concentration in the early of July, one month prior to the early maturing vareties in the high salty area was more or less 0.85%, and was lower than at one month before the varieties of other salty areas and the respective over all maturing periods. It is considered that not withstanding the same weather and soil conditions, the matured grain ratio of the early maturing varieties was decreased because of high salt concentrations during the period from the panicle differentiation stage to the heading stage. It may be assumed, therefore, that the dropping of the salt concentrations and favorable weather condition before and after the heading stage of the medium and late maturing varieties in the latter part of August resulted in good matured grain ratio in the salty areas.

According to Ayers et al.[1] (1960), there is almost no salt damage to development and maturing of seed in maturing period of barley and wheat. However, Shimoyama and Ogo[31] (1956), Iwaki[15] (1956) and Ota et al.[25] (1955) reported that the matured grain ratio decreases remarkably in the salty areas. Choi et al.[5] (1963) also reported that the matured grain ratio declined in the salty areas. Shimoyama and Ogo[31] (1956) reported that salt damage at the panicle formation stage and at the miosis stage is guite severe. According to Ota et al.[25] (1955), salt damage greatly affects the pollen germination and thereby produces a great deal of grain inmaturity.

The matured grain ratio of 21 varieties in the low-salty area vs. the non-salty area was 108 % on the average. This indicates that the former is 8 % better than that of the latter. In the high-salty area it was 99 % which shows similar results from non-salty area. The matured grain ratio of the medium maturing varieties in both salty areas were very good. Pearson and Bernstein[27] (1959), Iwaki[15)16] (1956a, b), Shimoyama and Ogo[31] (1956) reported that salt damage is not very effective at the maturing stage. It is assumed that the ratio of milling percentage, broken rice grain weight and the one-thousand grain weight in the salty areas do not decline as compared with that in the non-salty area due to a sharp dropping of the salt concentration at the maturing stage. It is considered that the enhancement of photosynthesis per unit area under low-salty condition is also one of the active main factors in such salt concentrations as claimed by Kling[20] (1954) and Nieman[24] (1962).

Summarizing the effects on the yields of brown and rough rice in the salty areas, number of panicles, number of grains per panicle, one-thousand grain weight and maturing ratio are the most significant factors affecting yields. The capacity of each variety to resist the effect of salt is important. Also the number of panicles to be made up of as an early security of rooting and number of tillers is more peculiar and important factors than those of the non-salty area. It is especially so in Korea where the wet season comes relatively late in most years.

In the consideration of an intense variation of the salt concentration of soil throughout the year and a great difference of sensitivity to salt damage according to the rice growing stage, the present experiment was carried out in the hope that some varieties in each maturity period would be free from salt damage. The early maturing variety brought about very poor result in the culture under salt condition, while the results of the medium and late maturing varieties were favorable. The medium maturing variety produced somewhat better result than the late maturing variety in the panicle weight and matured grain ratio in the salty area. The production of brown and rough rice was similar to both maturing varieties on the average in the low-salty area, while the late maturing variety produced 27 kg more per 10 a in the high-salty area. The varieties which produced the largest quantity of rough rice in each salty area were as follow:

In low-salty areas: kwanok, Yachikogane, Iri-265, Hokwang, Jaikeun, Kinmase, Nongrim-6 and Kusabue. In high-salty areas: Nongrim-6, Kwanok, Hokwang, Yachikogane, Jaikeun, Shirogane, Iri-265 and Kusabue. Therefoe, the varieties of Kwonok, Hokwang Nongrim-6, Jaikeun, Iri-265 and Kusabue produced good result equally in both salty aseas. The order of varieties by the weight of rough rice produced in both salty areas is (1) Kwanok (2) Hokwang (3) Nongrim-6 (4) Jaikeun (5) Iri-265

The production ratio of rough rice of the above 5 varieties in the salty area versus non-salty area is 69 to 78%. These varietes have the highest salt tolerance value (herein after referred to as "salt tolerance") and rice production in the salty areas versus nonsalty areas. This means that they have higher inherent production capacity in the salty areas but has high-salt tolerance and not high productivity in the non-salty areas. Therefore these varieties are considered to be the so-called "salt tolerant varieties."

摘 要

低鹽分區와 高鹽分區 (各四月末 0.5%와 1%의 鹽分濃度)에서 各品種들의 收量과 收量要因들에 미치는 鹽分濃度의 影響을 보며 또한 鹽分干拓地의 鹽分濃度가 季節에 따라 또는 氣象條件 等에 따라 變動되므로 水稻의 熟期와 收量과의 사이에 깊은 關係가 있을 것을 勘案하며 早生種 中生種 및 晩生種을 各各 7品種씩 供試하여 無鹽分區와 比較한 圃場實驗을 하였던 바 結果는 아래와 같다.

1. 高 및 低兩鹽分區에서 生産된 精租重의 傾向과 平均으로 보아 耐鹽性이 强한 品種은 關玉, 湖北, 農林6號, 再建 및 裡里 265號이였다.

2. 鹽分區에서의 精租生産과 熟畓區에서의 生産과의 사이에는 相關이 없었다. 卽 熟畓區에서의 多產品種은 鹽分區에서의 多產品種이 아니며 多收品種은 熟畓區에서의 生産에 比한 鹽分區에서의 減收率이 낮은品種 卽 耐鹽性 品種 들이었다.

3. 早生種은 中 및 晩生種에 比하여 一般的으로 耐鹽性이 弱하여 鹽分區에서 顯著히 減收되었다. 早生種은 千粒重, 穗當粒數, 穗實率 및 精玄比率이 中 및 晩生種에 比하여 떨어졌으며 屑米가 많았다.

4, 鹽分區에서는 水稻의 出穗가 熟畓區에 比하여 低鹽分區에서는 大體로 5~8日 遲延되였으며 高鹽分區에서는 大體로 7~13日 遲延 되었다. 早生種의 出穗遲延이 中 및 晩生種에 比하여 더 컷다.

5. 各 品種의 鹽分區들에서의 出穗遲延日數와 熟畓區에 比한 鹽分區들에서의 精粗減收率과의 사이에는 高度의 有意性이 있는 相關을 나타냈다. 卽 熟畓出穗에 比한 어떤 品種의 出穗遲延日數로서 鹽分地에서의 減收率을 推定할수 있을 것으로 생각되었다.

6. 稈長은 熟畓區에 比하여 低鹽分區는 80%, 高鹽分區는 70%程度 자랐다. 그리고 鹽分區들에서는 一般的으로 稈長과 精粗生産과의 사이에는 有意性있는 相關을 나타냈다. 따라서 熟畓의 稈長에 對한 鹽分地 들에서의 稈長의 길이로 그 品種의 鹽分地에서의 精租生産이 추측될 것으로 생각되었다.

7. 鹽分區들에서의 穗數는 熱畓區에 比하여21~24% 程度 減少되었다. 熱畓區 低 및 高鹽分區에서 다같이 穗數와 精粗量과의 사이에는 有意性 있는 相關을 나타냈다.

8. 鹽分區들에서는 穗重과 精粗生産과의 사이에 各 品種에서 有意性있는 相關을 나타냈으나 熟畓區에서는 相關이 없었다. 穗重과 穗數와는 熟畓區 및 鹽分區에서 다같이 負의 相關을 나타냈다.

9. 低鹽分區와 高鹽分區는 熟畓區에 比하여 穗當粒數가 平均에서 각각 16% 및 21%씩 粒數가 줄었다. 熟畓區에 對한 鹽分區들에서의 穗當粒數 減少率과 精粗生産의 減收率과는 高度의 有意性있는 相關을 나타냈다.

10. 稔實率은 大體로 低鹽分區에서 顯著히 높았다. 그리고 早生種이 낮으며 中生種에서 높은 傾向 이었다.

11. 精玄比率은 熟畓區와 鹽分區들에서 거의 같았으며 屑米는 熟畓區에 比하여 鹽分區들에서 顯著히 적었으며 또한 中및 晩生種들에 比하여 早生種들이 많았다

12. 藁重은 鹽分區에서 적었으며 熟畓區 및 鹽分區에서 다같이 早生種이 적었고 中, 晩生種의 順으로 많았다. 精租/藁重은 鹽分區들에서는 熟畓區에 比하여 적

은 傾向이었으며 熟畓區와 鹽分區들에서 다같은 傾向으로 早生種이 크고 中生種 晩生種 順으로 적었다.

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