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잔디용 김의털의 後代檢定에 의한 匍匐習性에 關한 硏究 第Ⅲ報. Top 交雜에 의한 後代檢定

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An Evaluation of Creeping habit in Various Progenies of Red Fescue (*Festuca rubra* L.)

Ⅲ. Top-Cross Progeny Performance

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Summary

This study was performed to investigate the creeping habit in top-cross progeny, and to determine the relationship among the major agronomic characters in the top-cross progeny testing based on the simple correlation coefficients.

The conclusions of the study were summarized as follows ;

The creeping type crossed with the non-creeping tester was the greatest in width and seed yield. For all three characters, the creeping type crossed with the non-creeping tester and the non-creeping type crossed with the creeping tester were greater than any other combination.

The top-cross method was desirable for the study of general and specific combining ability. The sensitivity of the tester to differentiate the creeping and non-creeping types was better when a non-creeping tester was used.

INTRODUCTION

Turf is one of the blessings of nature. It is both a thing of service and of beauty. The concept of turf as we know it today probably had its origin when man started to domesticate animals. They were herded or tethered to prevent escape and their grazed "islands" conceivably were used by the young of Man for their games and play.

In early use of turf in Asia, vast pleasure gardens and magnificient palaces have been the most expensive luxuries of china's emperors. Emperor Wu Ti (157-87 B.C.) of the Han Dynasty held 30,000 slaves to care for his extensive grounds and buildings. The rarest trees and plants were assembled from throughout his whole empire which extended from Korea to Central Asia[3].

The genus *Festuca* encompasses about 100 species in temperate and cool zones, and several of the perenial species are used widely for forage and turf. These are divided into two morphological types; the broad-leaved s-

pecies and the fine-leaved species.

The broad-leaved species, tall fescue and meadow fescue, are native in Europe and introduced to North America. But the fine-leaved species, red fescue, chewings fescue, sheep fescue, and hard fescue, are native in Alaska[5].

Red fescue (*Festuca rubra*), important lawngrass in the United States as well as in several other countries located within the temperate zone, is especially valued for shade location[1,3,7].

Despite its great importance as a turf and as a seed crop, very little is known about the breeding behavior of the creeping habit and other characteristics in red fescue. As a turfgrass, the creeping habit is important in relation to establishment in lawns, fairways and golf courses.

This study was conducted to investigate the creeping habit in top-cross progeny, and to determine the relationship among the major agronomic characters in the top-cross progeny testing based on the simple correlation coefficients.

MATERIALS AND METHODS

For this study, 6 red fescue parent clones used in top-cross progeny test, were selected from an introduction nursery based on origin, maturity, and creeping habit[4] (Table 1).

Top-cross seed was obtained from the maternal parent clones following mutual pollination with the tester plant in the same manner as the single-cross seed was obtained[4].

Comparisons among eight entries between creeping and non-creeping tester, and between creeping and non-creeping type crossed with creeping or non-creeping tester were made.

All data were subjected to analysis of variance, and the standard error of the mean ($S_{\bar{x}}$), coefficient of variation (C. V.) and L. S. D. 0.05 values were calculated in each analysis when significant differences were observed. Correlation coefficients between three characters were calculated.

The study was arranged in a randomized complet block design with four replications.

Table 1. Identification of the red fescue parent clones used for this study.

Entry number	Anthesis dates	Types of spread	PI number	Origin
1	May 27	Creeping	255-421	Yugoslavia
2	〃	〃	255-423	〃
5	〃	Non-creeping	237-182	Netherland
11	May 21	〃	234-903	Poland
19	〃 27*	Creeping	236- 839	Canada
20	〃 27**	Non-creeping	270-400	Russia

* Creeping tester
** Non-creeping tester

RESULTS

The open-pollinated progeny performance of two testers used in this top-cross progeny test was significantly different for the width and height on each of the five measuring dates, for the seed yield per plant, and for the differences in width and height between measurements. The open-pollinated progeny performance of the creeping tester was greater than those of the non-creeping tester for the above characteristics on each measurement (Table 2).

In the top-cross progeny test, differences among eight entries and between the groups of creeping and non-creeping entries crossed with the non-creeping tester were significant on each of the five measuring dates. There were differences between the two testers except on February 25 measurement and between the group of creeping and non-creeping entries crossed with the creeping tester only on June 26 measurement (Table 3).

The average width of the non-creeping tester group was greater than those of the

Table 2. Mean and standard errors of the mean ($S_{\bar{x}}$) for the open-pollinated progeny performance of both testers used in the top-cross of red fescue.

Characters & Measuring Dates	Mean Creeping Tester(19)	Mean Non-creeping Tester(20)	Standard errors of the mean ($S_{\bar{x}}$)
Width (cm.)			
Feb. 25	21.0	9.2	1.6
Mar. 26	26.6	10.6	1.8
Apr. 25	29.9	16.6	1.2
May 30	30.8	13.4	0.7
June 26	29.7	12.5	1.5
Height (cm.)			
Feb. 25	24.5	12.3	1.0
Mar. 26	30.7	18.9	1.6
Apr. 25	51.6	27.5	2.2
May 30	77.1	51.3	2.6
June 26	87.5	65.5	2.2
Seed Yield (gm.)	33.1	10.0	2.4
Difference in Width (cm.)			
Feb. 25 – May 30	10.1	2.8	1.3
Difference in Height (cm.)			
Feb. 25 – Mar. 26	6.2	6.6	1.5
Mar. 26 – Apr. 25	20.9	6.1	1.6
Apr. 25 – May 30	28.0	23.7	2.2

creeping tester group on each of the four measurements except February 25 measurement. The average width of two creeping entries crossed with the non-creeping tester was greater than those of two non-creeping entries crossed with the same tester on each of the five measuring dates. The average width of two creeping entries crossed with the non-creeping tester was greater than either those entries crossed with the creeping tester or those of two non-creeping entries crossed with the creeping tester on each of the five measurements (Table 4).

There were significant differences at the one percent level among entries and between the groups of creeping and non-creeping entries crossed with the non-creeping tester for the difference in width between Feb. 25 and May 30 measurements (Table 7).

The average difference in width between measurements of two creeping entries crossed with the non-creeping tester (8.7cm.) was greater than those of two non-creeping entries

Table 3. Mean square and levels of significance from partial analysis of variance for the mean width per plant in the top-cross progeny test of red fescue on the five measuring dates.

Source of Variation	D. F.	Mean Square and Significant Level Feb. 25	Mar. 26	Apr. 25	May 30	June 26
Replications	3	18.573	3.850	0.596	3.793	0.736
Entries	7	110.526**	278.169**	302.011**	238.914**	302.542**
Between Testers	1	41.594	164.485**	134.955**	144.840**	189.005**
Creeping vs. Non-creeping Within Tester I	1	34.748	49.879	26.131	1.600	54.118*
Creeping vs. Non-creeping Within Tester II	1	668.848**	681.677**	1880.740**	1410.754**	1804.126**
Error	21	10.566	12.576	7.609	9.917	7.891

* F value exceeds the five percent level of significance.
** F value exceeds the one percent level of significance.
Tester I is creeping tester.
Tester II is non-creeping tester.

Table 4. Mean width(cm.) for the different spreading types and testers in the top-cross progeny test of red fescue on the five measuring dates.

	Measuring Dates Feb. 25	Mar. 26	Apr. 25	May 30	June 26
I. Creeping Tester					
1. Creeping Type	11.9	16.0	17.2	17.0	18.0
2. Non-creeping Type	13.9	12.6	16.1	16.4	14.3
Average	12.9	14.3	16.6	16.7	16.1
II. Non-Creeping Tester					
1. Creeping Type	21.7	29.0	31.6	30.4	31.6
2. No n-creeping Type	8.8	8.5	9.9	11.6	10.4
Average	15.2	18.8	20.7	21.0	21.0

Table 5. Mean square and levels of significance from the partial analysis of variance for the mean hight per plant in the top-cross progeny test of red fescue on the five measuring dates.

Source of variation	D. F.	Mean Square and Significant Level				
		Feb. 25	Mar. 26	Apr. 25	May 30	June 30
Replications	3	9.476	6.919	14.720	152.634	57.779
Entries	7	102.899**	152.787**	410.174**	508.058**	544.771**
Between Testers	1	40.158**	10.822	20.003	39.404	34.052
Creeping vs. Non-creeping Within Tester I	1	92.163**	155.003**	804.148**	1996.147**	543.123**
Creeping vs. Non-creeping Within Tester II	1	512.683**	628.630**	1316.057**	804.148**	196.040**
Error	21	2.787	5.770	13.095	27.202	30.584

* F value cxceeds the five percent level of significance.
** F value exceeds the one percent level of significance.
Tester I is creeping tester.
Tester II is non-creeping tester.

Table. 6. Mean height (cm.) for the different spreading types and testers in the top-cross progeny of red fesuue on the five measuring dates.

	Measuring Dates				
	Feb. 25	Mar. 26	Apr. 25	Mar 30	June 26
I. Creeping Tester					
1. Creeping Type	17.0	19.4	31.2	58.2	71.1
2. Non-creeping Type	21.8	25.7	45.4	80.5	82.7
Average	19.4	22.5	38.3	69.4	76.9
II. Non-creeping Tester					
1. Creeping Type	22.8	27.6	45.8	74.3	90.0
2. Non-creeping Type	11.5	15.1	27.7	60.2	79.0
Average	17.2	21.4	36.7	67.2	85.5

Table 7. Mean square and levels of significance from the partial analysis of variance for the mean difference in height and in width between the measurements in the top-cross progeny test of red fescue.

Source of Variation	D. F.	Mean Square and Significant Level			
		Height			Width
		Feb. 25– Mar. 26	Mar. 26 – Apr. 25	Apr. 25 – May 30	Feb. 25 – May 30
Replications	3	1.327	10.051	137.116	43.287
Entries	7	15.368**	77.943**	70. 302*	28.795**
Between Testers	1	19.391**	0.102	3.277	28.956
Creeping vs. Non-creeoing Within Tester I	1	9.456	286.202**	263.251**	19.274
Creeping vs. Non-creeping Within Tester II	1	21.692**	125.552**	62.489	124.155**
Error	21	2.256	5.923	25.562	7.115

* F value cxeeeds the five percent level of significance.
** F value cxceeds the one percent level of significance.
Tester I is creeping tester.
Tester II is non-creeping tester.

crossed with the same tester (3.1cm.) or those of two non-creeping entries crossed with the creeping tester (2.9cm.) (Table 8).

There were significant differences among eight entries and between the groups of creeping and non-creeping entries crossed with the creeping or non-creeping tester. Difference between two testers was significant only on Feb. 25 measurement (Table 5).

The average height of either the non-creeping type crossed with the creeping tester or the creeping type crossed with non-creeping tester was greater than either those of the creeping type crossed with the creeping tes-

Table 8. Mean difference(cm.) in height and in width between the measurements for the different spreading type types and testers in the top-cross progeny test of red fescue.

	Characters and Measuring Dates			
	Difference in Height		Difference in Width	
	Feb. 25 – Mar. 26	Mar. 26 – Apr. 25	Feb. 25 – May 30	Feb. 25 – May 30
Ⅰ. Creeping Tester				
1. Creeping Type	2.4	11.3	27.0	5.1
2. Non-creeping Type	4.0	19.8	35.1	2.9
Average	3.2	15.5	31.1	4.0
Ⅱ. Non-Creeping Tester				
1. Creeping Type	5.9	18.2	28.5	8.7
2. Non-creeping Type	3.6	12.6	32.4	3.1
Average	4.8	15 4	30.4	5.9

Table 9. Partial analysis of variance for the open-pollinated seed yield per as harvested from the top-cross progeny nursery of red fescue under natural conditions.

Source of Variation	S. S.	D. F.	M. S.	F
Replications	180.921	3	61.307	
Entries	5075.821	7	725.117	15.0029**
Between Testers	108.965	1	108.965	2.2545**
Creeping v. . Non-creeping Within Tester Ⅰ.	1044.744	1	1044.744	21.6162**
Creeping vs. Non-creeping Within Tester Ⅱ.	3712.465	1	3712.465	76.8125**
Error	1014.962	21	48.432	
Total	6271.703	31		

** F value exceeds the one percent level of significance.
Taster Ⅰ is creeping tester.
Tester Ⅱ is non-creeping tester.

ter the non creeping type crossed with the non-creeping tester on each of the five measuring dates.

The average height of two non-creeping entries crossed with the creeping tester was not different from those of two creeping entries crossed with the non-creeping tester (Table 6).

There were significant differences among entries for the differences in height between three measurements, i. e. Feb. 25 – Mar. 26, Mar. 26 – Apr. 25, and Apr. 25 – May 30. Differences between two groups of testers were significant for the same character on Feb. 25 – Mar. 26measurements. Differences between two groups of creeping and non-creeping entries crossed with the creeping tester on Mar. 26 – Apr. 26 and Apr. 25 – May 30 were significant. The same comparison crossed with the non-creeping tester were significant on Feb. 25 – Mar. 26 and Mar. 26 – Apr. 25 (Table 7).

Table 10. Mean seed yield per plant (gm.) in the top-cross progeny test of red fescue.

Top – Crosses	Seed Yield Per Plant (gm.)
Ⅰ. Creeping Tester	
1. Creeping Type	13.01
2. Non-creeping Type	29.17
Average	21.09
Ⅱ. Non-Creeping Tester	
1. Creeping Type	40.02
2. Non-creeping Type	9.55
Average	24.78

Table 11. Simple correlation coefficients between three characters in the top-cross progeny test of red fescue.

Correlation	r	N[1]
Height[2] – Width[2]	.9380**	8
Height –Seed Yield	.9190**	8
Width – Seed Yield	.9370**	8

[1] Number of paired observations
[2] Measurement on June 26
** Significant at 1% level

There were significant differences at the one level among eight entries, between the groups of creeping and non-creeping entries crossed with the creeping tester or the non-creeping tester (Table 9).

The average seed yield of two non-creeping entries crossed with the creeping tester (29.2 gm.) was greater than either those of two creeping entries crossed with the same tester (13.0gm.) or those of two non-creeping entries crossed with the non-creeping tester (9.55 gm.). The average seed yield of two creeping entries crossed with the non-creeping tester (40.0gm.) was the greatest and different from the other top-crosses (Table 10).

All correlation coefficients between three characters were positive and significant at one percent level (Table 11).

DISCUSSION

In this study, the width of creeping types crossed with the non-creeping tester was the greatest group and significantly different from other groups. The smallest group in width was non-creeping type crossed with the non-creeping tester, and it was significantly smaller than others in the later measurements (Apr. 25, May 30, and June 26).

The height and seed yield of the non-creeping type crossed with the creeping tester and the creeping type crossed with the non-creeping tester was greater than those of the creeping type crossed with the creeping tester. The non-creeping type crossed with the non-creeping tester was the smallest.

The difference between the non-creeping type within creeping tester and the creeping type within the non-creeping tester was not significant.

As in the open-pollinated progeny test, the correlation coefficients between characters were positive and significant.

The difference between the creeping and non-creeping type crossed with the non-creeping tester was significant for width, height and seed yield. Therefore, it might be said in a relative sense that the non-creeping tester was more sensitive and useful as a tester than the creeping tester.

摘 要

本 硏究는 Top交雜에 의한 김의털의 匍匐習性을 觀察하고, 單純相關係數에 의한 Top交雜의 後代檢定을 通하여 主要 特性들간의 關係를 알아보기 위해 實施되었다. 그 結果는 다음과 같다.

非匍匐型의 檢定親과 交雜된 匍匐型들의 株幅이 가장 넓었으며, 다른 群들과 有意差가 있었다. 가장 株幅이 좁은 群은 非匍匐型 檢定親과 交雜된 非匍匐型이었다.

草長과 種子收量은 匍匐型 檢定親과 交雜된 非匍匐型과 非匍匐型 檢定親과 交雜된 匍匐型이 匍匐型 檢定親과 交雜된 匍匐型이 더 길고 많았다. 그리고, 非匍匐型 檢定親과 交雜된 非匍匐型이 가장 짧고 적었다.

放任受粉과 같이 草長과 株幅, 草長과 收量, 株幅과 收量間엔 正의 相關關係가 있었으며, 有意差를 나타내었다.

株幅, 草長, 種子收量(收量)에 있어서, 非匍匐型 檢定親과 交雜된 匍匐型과 非匍匐型間에는 有意差가 있었다. 그러므로 檢定親으로는 匍匐型보다 非匍匐型을 使用하는 것이 바람직하다고 思料된다.

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