FINAL REPORT TO FLORA FOUNDATION OF AUSTRALIA

Sporobolus virginicus (L.) Kunth. - a native grass for saline soils.

Introduction

The objective of this project was to investigate the potential of *Sporobous virginicus* in the turf grass industry for use in saline or salt affected areas. Two distinct forms of the species occur naturally in coastal areas of NSW however this study considered only the smaller form described as type 1 by Smith-White (1988) and as var. minor by others.
Variation in the type1 form is known to be considerable in both a plastic, environment influenced, sense and a genetic sense with NSW populations forming part of an Australia wide polyploidy complex (Smith-White 1979, 1981, 1988, Smith-White and Adam 1988, 1990).

For the species use as a lawn grass in saline situations specific qualities are important. These include a physiological ability to tolerate high salt concentrations and appropriate morphological traits such as stoloniferous habit, leaf size, “mowability” and turf forming character. This current trial investigated some of the genetically controlled morphological traits that are likely to be beneficial in lawn formation. It did not consider variation in salt tolerance as multiple treatment regimes could not have been physically managed on this occasion without reducing the number of clonal samples compared.

Methods

Thirty six accessions (clones) of the grass were collected from the NSW coast between Lake Wonboyn, near the Victorian border and Nambucca Heads in northern NSW (Table 1). Clonal individuals were established and cultivated in sand in a glasshouse at the University of NSW. During this period of establishment, young root tip samples were removed for cytologically examination to determine ploidy.
Individual plants of similar size were then placed into course sand in a 800ml plastic pots. Drain holes were covered with fiberglass matt to retain sand and allow for free drainage.
The experiment design included six blocks with the 36 plants randomized within each block. Plants were watered twice weekly with seawater diluted 1:1 with tap water to give a 50% concentration.

Following a growth period of ten weeks the trial was terminated and measurements of each plant recorded.

Characters measured	**method**
Height of tillers	mean height from sand surface
Number of tillers	count of vertical stems
Number of stolons	count of major stolons
Stolon length	main stolons plus side branches (mean of five leaves per plant)
Leaf width	(third leaf from tip of tiller measured)
Leaf length	mean of five leaves per plant (third leaf from tip of tiller measured)
Dry mass tillers	oven dried and weighed
Dry mass stolons	oven dried and weighed
Dry mass roots	oven dried and weighed

Quantitative data recorded was subjected to Multivariate Analysis (PCA).
Other data not able to be analysed by the above means was treated separately.

Stoloniferous branching was also recorded.
Individuals were scored using the following method:

Character	score
No stolons	0
A stolon with no side branches	1
A stolon with 2 – 4 branches	4
A stolon with 5 or more branches	8

For each clone the sum score for all replicates was derived and plotted against other characters as a means of observing trends in the data.

Table 1 Accession origins on NSW coast

Collection Number	Location origin in NSW
22654	Lake Wonboyn
22655	Curalo Lake. Eden
22656	Wallagoot Lake
22657	Hancocks Bridge, Bega River, Tathra
22658	Bithny Inlet
22659	Wapengo Creek
22660	Lake Wapengo (road to Picnic Point)
22661	Cuttagee Bridge
22662	Wallaga Lake
22663	Mystery Bay
22664	Wagonga Inlet, Narooma
22665	Coila Inlet, Tuross
22666	Tuross (edge of lake/roadside)
22667	Moruya
22668	Durras Lake
22669	Lake Tabouri
22670	Lake Burrill
22671	St Georges Basin
22672	Coolangatta, Shoalhaven Heads
22673	Minnamurra River, north of Kiama
22653	Nth Maroubra (headland)
22652	Careel Bay, Pittwater
22651	Hexam Bridge
22650	Karuah
22649	Tea Gardens
22648	Elizabeth Beach, Wallis Lake
22647	Manning Point
22645	Scott’s Ck Bridge, Oxley to Mitchell Island
22644	Wallabi Point
22643	Lansdowne Bridge, Coopernook
22642	Laurieton
22639	Blackman’s Point, Port Macquarie
22638	Spencers Ck Bridge, 4km South West Rocks
22637	Macksville
22635	Bellwood Park, Nambucca Heads
22633	Yellow Rock Road, 20km north of Nambucca

Results

Chromosome number

The cytological examination of root tip cells determined that five of the samples were diploid (2n=20), thirteen were triploid and eighteen tetraploid. The geographic distribution of these chromosome races followed that previously determined by Smith-White (1988) with the diploid coming from the south of the State, the tetrapoids from the north and the triploids forming a hybrid zone between.

Principal Components Analysis

Nine character values subjected to Principal Components Analysis are shown Table 2. From the Table cumulative percentages of the first three eigenvalues accounted for 79.8% of the total variation. The first component accounting for 34.6 % of the variation defines a trend in stoloniferous habit as “stolon length”, “dry mass of stolons” and “number of stolons” have highest loadings. The second component accounting for a further 28.4 % of the variation defines a trend in tillering vigour and root vigour as “dry mass of tillers”, “number of tillers” and “dry mass of roots”, have highest loadings. The third component accounting for a further 16.8% defines a trend in tiller habit and leaf size with “tiller height” and “number of tillers” and “leaf width” and “leaf length” having highest loadings.

Table 2 Eigenanalysis of the Correlation Matrix

Eigenvalue	3.1180	2.5517	1.5114	0.9703	0.3175	0.2289	0.2141	0.0653	0.0228
Proportion	0.346	0.284	0.168	0.108	0.035	0.025	0.024	0.007	0.003
Cumulative	0.346	0.630	0.798	0.906	0.941	0.966	0.990	0.997	1.000

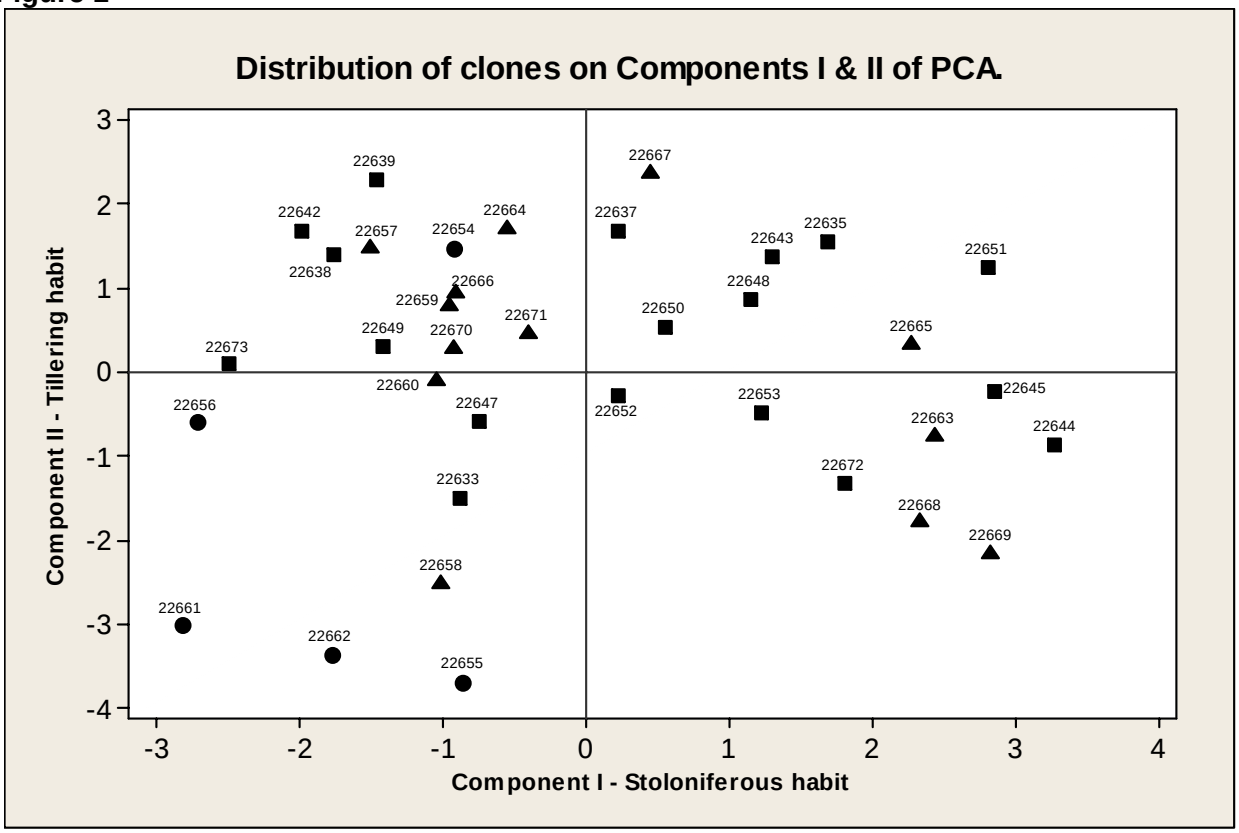
Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	PC9
tiller ht	0.003	0.398	0.521	-0.221	-0.613	0.019	-0.235	-0.298	-0.017
No. tillers	-0.056	0.458	-0.462	-0.257	0.082	0.149	0.451	-0.524	0.027
No. stolons	0.504	0.085	0.092	-0.128	0.154	-0.810	0.132	-0.094	-0.088
stolon length	0.539	0.070	0.099	0.056	-0.016	0.430	0.214	0.159	-0.660
leaf width	-0.258	0.025	0.511	0.588	0.238	-0.038	0.403	-0.318	-0.059
leaf length	-0.241	0.257	0.409	-0.554	0.535	0.086	0.062	0.323	-0.013
DM tillers	-0.178	0.528	-0.150	0.280	-0.300	-0.202	0.282	0.615	0.027
DM stolons	0.533	0.094	0.171	0.094	0.059	0.291	0.156	0.093	0.740
DM roots	0.109	0.515	-0.128	0.356	0.396	0.041	-0.638	-0.102	-0.059

The distribution of individual clones with respect to components I and II and I and III is illustrated graphically in Figures 1 and 2 respectively.
Clonal reference numbers refer to specimen ID in John Waterhouse Herbarium, UNSW
Ploidy: ●, 2n=20; ▲, 2n=30; ■, 2n=40

Scatter Plots

Scatter plots for leaf size and for branching habit of stolons are shown in Figures 3, 4 and 5 respectively.
Clonal reference numbers refer to specimen ID in John Waterhouse Herbarium, UNSW
Ploidy: ●, 2n=20; ▲, 2n=30; ■, 2n=40

Figure 1


Distribution of clones on Components I & II of PCA.
Component II - Tillering habit
Component I - Stoloniferous habit
3
2
1
0
-1
-2
-3
-4
-3
-2
-1
0
1
2
3
4
22639
22642
22638
22657
22654
22664
22666
22659
22671
22649
22670
22673
22660
22656
22647
22633
22658
22661
22662
22655
22667
22637
22643
22635
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22648
22650
22665
22653
22652
22645
22663
22644
22672
22668
22669

Figure 2

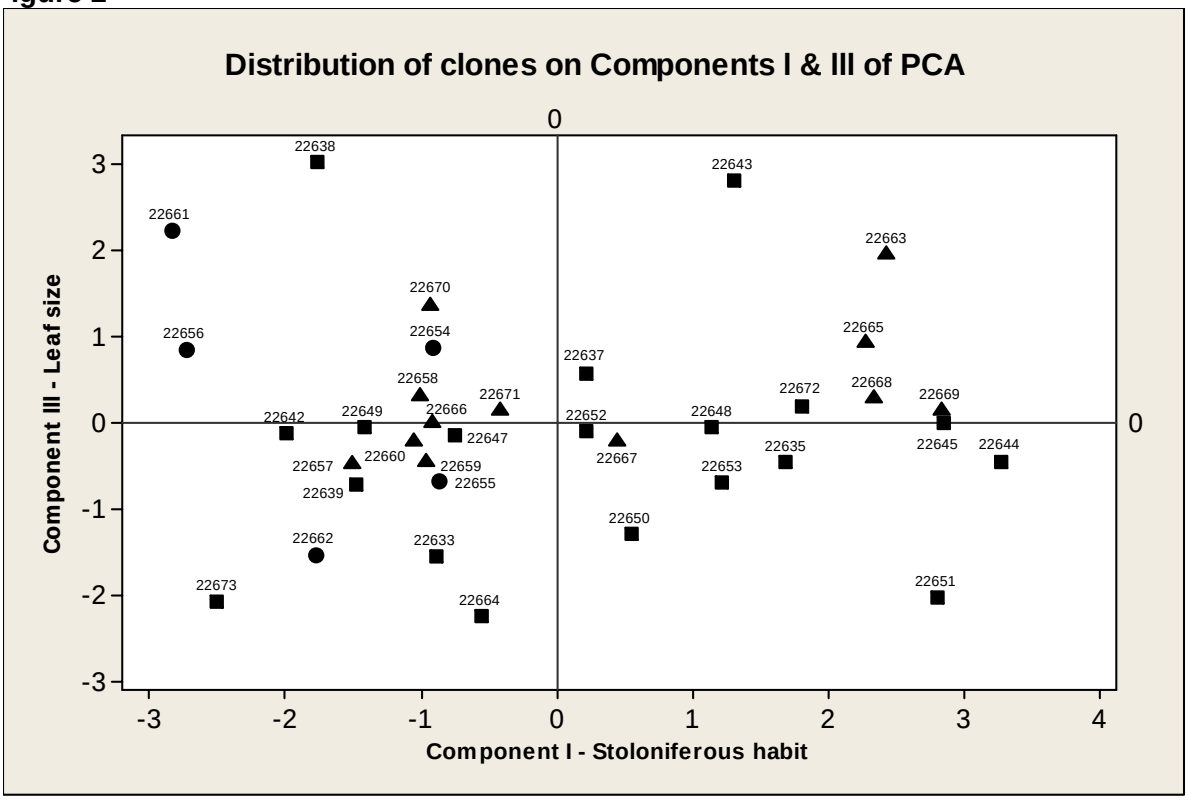


Figure 3

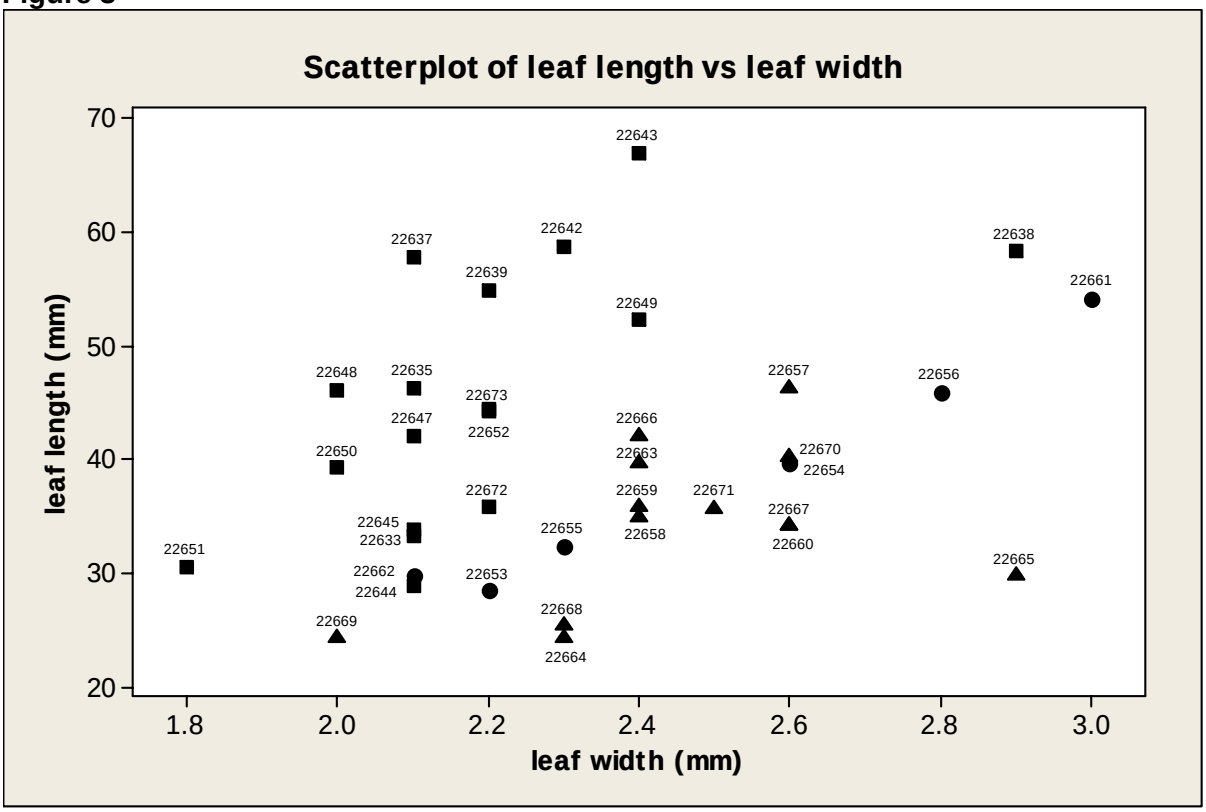


Figure 4

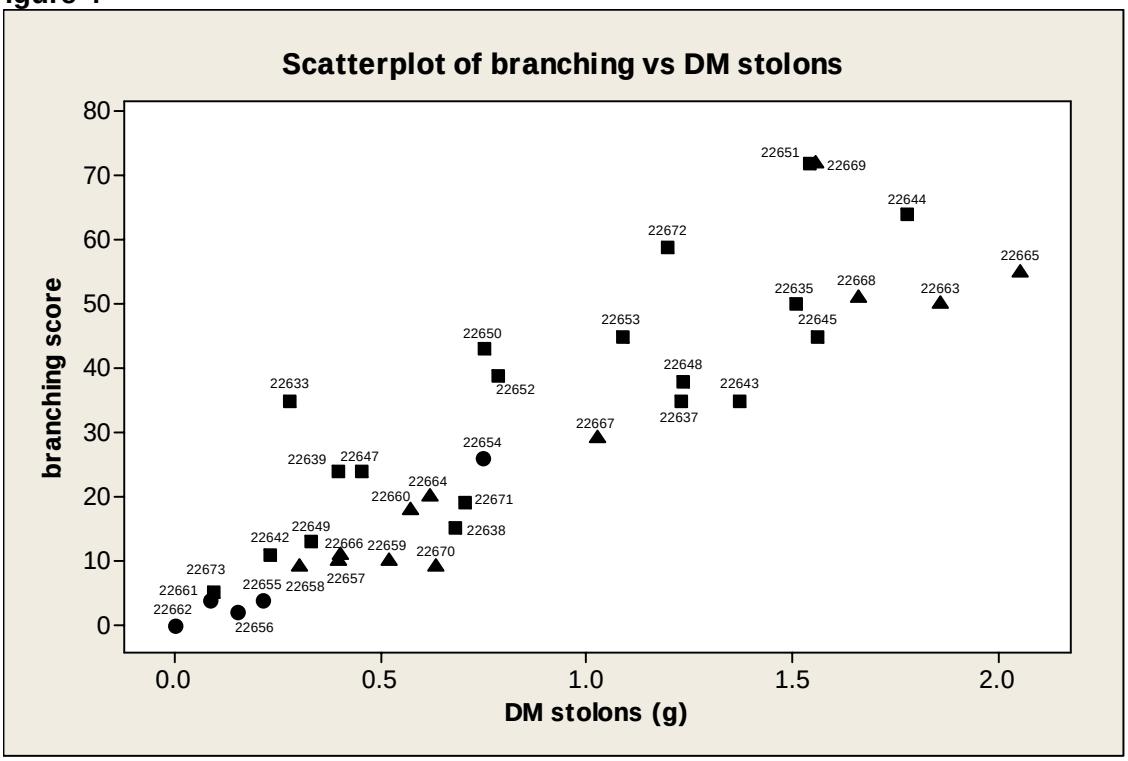
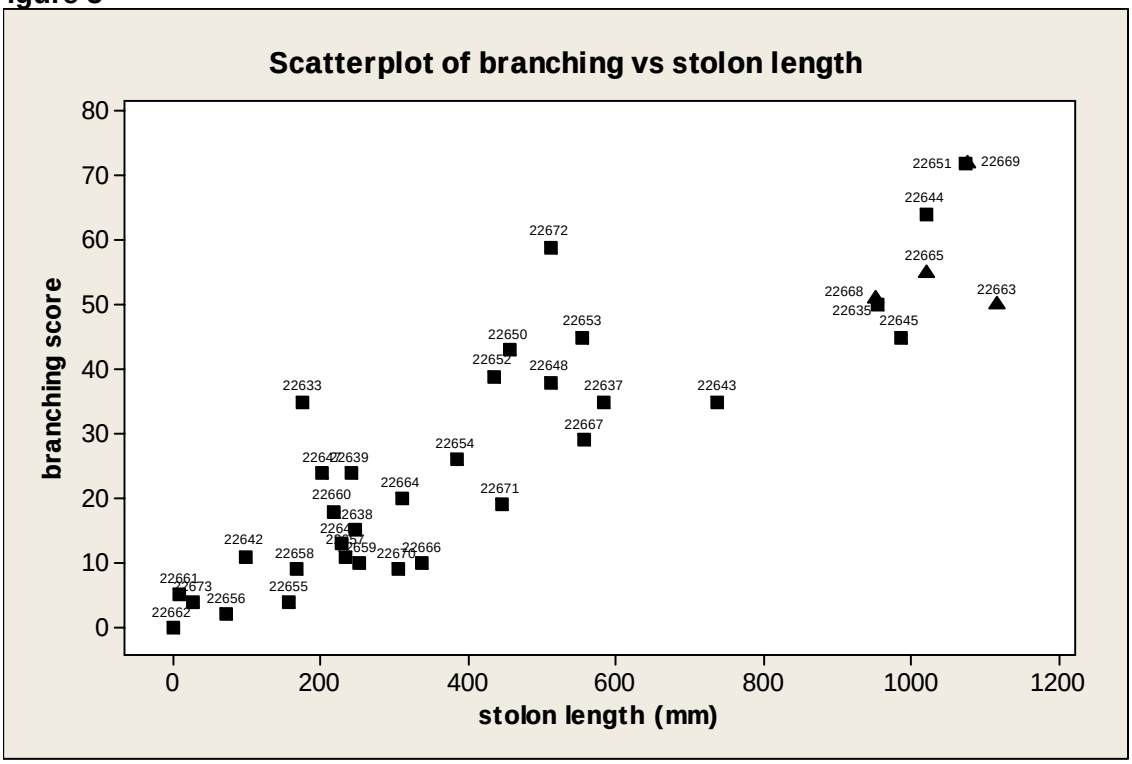


Figure 5



Discussion

Stolonifery

The distribution of clones on components I and II of the PCA (Fig 1) illustrates contrasting growth strategies with respect to tillering and stolon production. For turfing purposes, it is likely that a stoloniferous character such as that displayed by clones 22633, 22644, 22645, 22665, 22668, 22669 and 22672 would be advantageous.

Leaf size

Grasses with broad leaves are considered more likely to be preferred in the industry because of their greater ground cover potential. Clones displayed in Figure 2, distributed on components I and III of the PCA, show variation in leaf size with respect to stoloniferous habit. Clones that were most stoloniferous and had the broadest leaves included 22643, 22645, 22663, 22665, 22668, 22669 and 22672.
Further analysis of leaf size in the scatter plot of leaf length versus width (Fig 3) clearly distinguished the character of the triploid clone 22665 as having the shortest and broadest leaves.

Branching habit

The branching habit of clones was plotted against the total dry mass of stolons and also stolon length (Figs 4 & 5). There was an obvious correlation between stolon mass and stolon length but the plots did distinguish those clones that have long branched stolons. Specifically four triploid clones (22663, 22665, 22668 & 22669) and four tertraplod clones (22635, 22644, 22645 & 22651) all displayed vigorous stolon growth with a high level of branching.

This small trial has clearly demonstrated a high level of genetically controlled morphological variation within this species that is available for horticulturalists to draw on for special purposes. For the specimens used in the trial the one standing out as having real potential for cultivation as a lawn grass is the triploid number 22665. This clone was collected from an estuarine sand habitat at the mouth of Coila River in southern NSW.
Ecotypic adaptation in this species is very developed and for any serious attempt to utilize naturally occurring accessions for specific purposes larger trials using greater plant numbers and with a range of differing salinity treatments would seem essential.
Clonal spread in all chromosome races is predominately by rhizomatous growth and whilst both diploid and tetraploid races are sexually fertile, the triploid race is sexually sterile. Tripoids however may at times produce seed by agamospermy (Smith-White 1988). Should a triploid accession be used for cultivation it would have the advantage of being genetically isolated and therefore retain its character over time. The morphological variation recorded in both the diploid and tetraploid chromosome races was expected due to their capacity for out breeding however that recorded in the triploid populations probably reflects multiple origins when the two former races were sympatric.

References

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