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優良單交種玉米之親本改良(二)
理想族群之鑑別

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摘要：玉米族群種源之數目繁多，若沒有適當的評估方法去瞭解一個族群是否攜有某些有利基因，將限制了這個族群的利用價值。本研究使用十八個遺傳背景不同之玉米族群，並設定台農1號(TA2808－176×TA3651－377)為待改良之單交種，進行六個環境（3期作x2地區）之評估試驗。資料估算：(1)有利顯性基因相對數目（relative number of favorable dominant alleles,$\bar{lp}_i\mu'$）；(2)不利隱性基因相對數目（relative number of unfavorable recessive alleles,$\bar{jq}_j\mu$ or $\bar{kq}_k\mu$），及(3)親疏關係值（relationship values,（$I_2\times Py$）－（$I_1\times Py$）＋（I_1-I_2）／2。藉著這三項估值之比較，發現Mezcla Amarilla, Tropical Early Yellow Flint, RBS10 C_3, RSSSC C_4及Suwan－Pathology Source等五個族群具有相當多之顯性有利基因數目，而此類有利基因是在單交種TA2808－176×TA3651－377中所不存在的。由親疏關係值看出，僅族群RBS10 C_3與TA3651－377較相近；而族群Mezcla Amarilla, Amarillo Cristalino－2, Tropical Early Yellow Flint, Tropical Early Yellow Dent及Amarillo Cristallio－1與TA2808－176較為接近。綜合評估之下，Mezcla Amarilla及Tropical Early Yellow Dent將作為改良TA2808－176之重要來源；而RBS10 C_3可作為改良TA3651－377之來源。由於相對有利與不利基因數目相近，在進行自交系親本改良過程中，Mezcla Amarilla×TA2808－176、Tropical Early Yellow Dent×TA2808－176及RBS10 C_3×TA3651－377三個組合，可於F_1自交分離，而不必先予回交。Mezcla Amarilla及Tropical Early Yellow Dent不僅可作為台農1號親本TA2808－176之改良來源，同時亦可直接分離自交系，以結合TA3651－377成優良單交種，而為最有價值之二個族群。

關鍵語：玉米、種源、有利顯性基因、不利隱性基因、自交系、單交種、供給親族群。

Improvement of parents of elite single crosses in maize II. Identification of populations with favorable alleles

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Abstract. In maize (*Zea mays* L.) breeding program, a large number of population germplasms are available. The value of maize population has been limited by a lack of methodology for identifying populations containing favorable alleles. Eighteen maize populations were evaluated in six environments (3 crop seasons x 2 locations) for their potential as breeding sources for grain yield. Three estimats, (1)$lp_l \mu$' -relative number of favorable dominant alleles; (2)$j\bar{q}_j \mu$ or $K\bar{q}_k \mu$-relative number of unfavorable recessive alleles; and (3) [(I_1 x Py) - (I_2 x Py) + (I_1 - I_2) / 2] - relationship values were calculated. The populations Mezcla Amarilla, Tropical Early Yellow Flint, RBS10 C_3, RSSSC C_4 and Suwan-Pathology Source had a significant number of dominant favorable alleles for grain yield not present in TA2808-176 x TA3651-377. Based on relationship values only RBS10 C_3 was more closely related to TA3651-377 than TA2808-176. Populations Mezcla Amarilla, Amarillo Cristalino-2, Tropical Early Yellow Flint, Tropical Early Yellow Dent and Amarillo Cristallio-1 were more closely related to TA2808-176 than TA3651-377. Of the populations tested, Mezcla Amarilla and Tropical Early Yellow Dent would be chosen to improve TA2808-176, whereas RBS10 C_3 would be chosen to improve TA3651-377. Backcrosses prior to selfing in the F_1 of Mezcla Amarilla x TA2808-176, Tropical Early Yellow Dent x TA2808-176 and RBS10 C_3 x TA3651-377 are not necessary. Populations Mezcla Amarilla and Tropical Early Yellow Dent were most valuable populations not only for improving TA2808-176 but also as a direct sources of new lines to cross to TA3651-377.

Key words: Maize, Germplasm, Favorable dominant alleles, Unfavorable recessive alleles, Inbred line, Single cross, Donor population.

前　言

隨著作物育種改良之進展，近年來，各類作物種源的搜集保存已廣受作物育種家們的重視。種源利用潛力之評估工作也陸陸續續地在世界各地進行著，爲期育種工作之突破，作物育種家們莫不急於在種源中尋獲有價值的材料（Sprague 1980）。族群種源的類別相當多，大凡外來族群（exotic population）、天然授粉品種（open－pollinated cultivar）、合成品種（synthetic variety）、綜合品種（composite variety）及已改良族群（improved population）均能成爲育種材料（Hallauer and Miranda 1981）。由外地引進之玉米族群通稱外來族群，外來族群通常有適應較差之現象，但不管如何，每一個

族群之價值端視其被利用之型式而定（Goodman 1965, Lonnquist 1974, Hallauer 1978, 1980）。Brown（1983）及Dudley（1984, 1987）指出，就玉米而言，一個族群可能被直接分離產生許多新的自交系，或與其他族群雜交以增進遺傳變異（genetic variability），或經鑑別爲理想供給親（donor populations with favorable alleles not present in P_1 or P_2 of a single cross）以作爲優良單交種之親本改良（improvement of parents of elite single cross）來源，或供爲基礎族群以行族群內或族群間改良（intrapopulation or interpopulation improvement）。

族群之利用價值往往亦受限於族群評估方式之得當與否。過去學者對族群的評估方式有許多不同的主張，Spencer（1980）及Burton and Davies（1984）贊成評估族群本身。Lonnquist and Gardner（1961）及Eberhart（1971）認爲宜使用族群間之全互交分析法。Kramer and Ullstrup（1959）及Stuber（1978）鑑定族群的價值係以族群與單交種之測交種爲評估對象。Abel and Pollak（1991）則同時評估族群本身及以族群、單交種或自交系爲測試親之測交種。Hallauer與Miranda（1981）以估算族群之遺傳變方作爲鑑別之依據。Dudley（1984）利用單交種之二個自交系爲測試親，估算有利顯性基因相對數目、不利隱性基因相對數目及親疏關係值，作爲鑑別族群提供優良單交種玉米之親本改良來源。Gerloff and Smith（1988）以電腦模擬方式將各種鑑別族群之估值作一比較，結果發現Dudley（1984）提議之方法中基因座等級 j 及 k 頻度相等（$\bar{p}_j = \bar{p}_k$）之假設前提將削弱了其法之運用功能，Dudley（1987）將上述不當之假設前提刪除，另提一修正之介值$l\bar{p}_1\mu'$。其後，Dudley（1988b），Hogan and Dudley（1991）及Pfarr and Lamkey（1992a, 1992b）應用此修正法或將之與其他方法作比較，概肯定$l\bar{p}_1\mu'$在鑑別族群以供優良單交種親本改良上之效能。

台灣省農業試驗所育成之台農 1 號單交種玉米正推廣中，此一品種在產量方面仍有改良空間。目前本所自國內外引進之黃色籽粒飼料玉米族群計有十八個，在將其納入育種計畫前，也須作一適當之評估。因此，本研究之目的將包括：(1)鑑別此十八個族群是否具備改良台農1號（TA2808－176×TA3651－377）之潛力；(2)利用TA2808－176及TA3651－377之既有雜種優勢模式將十八個族群作適當之分群；(3)決定那些族群可直接自交分離產生新的自交系。

材料與方法

台農1號是目前本省栽培面積最廣的一個飼料玉米品種，因此，本研究設定其爲有待改良之單交種。其二個親本TA2808－176及TA3651－377分屬硬粒種及馬齒種，在本所玉米自交系種源中，此二自交系屬於組合力最高之一群（Lee *et al.* 1989）。十八個參試族

群之來源及遺傳背景分述於表1。民國78年秋作，此十八個族群分別與TA2808－176及TA3651－377雜交產生測交種子。爲配合花期，TA2808－176及TA3651－377均分三批播種（每次間隔7天）。授粉方式以TA2808－176及TA3651－377爲花粉親，分別授粉到每一

Table 1. Backgrounds of the eighteen populations evaluated

Population	Description	Origin
Mezcla Amarilla (MA)*	Tropical yellow, semi-flint grain, intermediate maturity, and relatively short plants. Composed basically of Carib-bean germplasm.	CIMMYT
Amarillo Cristalino-2 (AC2)	Tropical yellow, flint to semiflint grain, early maturity, and relatively short plants.	CIMMYT
Amarillo Subtropical (AS)	Subtropical-temperate yellow flint, intermediate maturity, with medium to short plant height.	CIMMYT
Tropical Early Yellow Flint (TEYF)	Broad germplasm base with high yield potential, tolerance to high plant density and stalk rot.	CIMMYT
Tropical Early Yellow Dent (TEYD)	Same as above except yellow dent materials were used in the formation of this pool.	CIMMYT
Subtropical-Temperate Early Yellow Flint (STEYF)	Broad germplasm base with excellent plant type and yield.	CIMMYT
Subtropical-Temperate Early Yellow Dent (STEYD)	Same as above except yellow dent materials were used in the formation of this pool.	CIMMYT
Subtropical-Temperate Intermediate Yellow Flint (STIYF)	Broad germplasm base with relatively uniform in plant height and maturity and has good yield potential.	CIMMYT
Subtropical-Temperate Intermediate Yellow Dent (STIYD)	Broad germplasm base with short plant type, well-placed ears, and good yield potential.	CIMMYT
Amarillo Cristallio-1 (AC1)	Tropical yellow flint, mixture of ETO, Cuban flint, and Tux-peno germplasm, Intermediate plant size and late maturity.	CIMMYT CIMMYT
Amarillo Dentado (AD)	Tropical late maturity, yellow dent, relatively tall plants. Broad germplasm base.	CIMMYT
Cogallero	Tropical-subtropical, yellow-reddish, semiflint to semident, intermediate to late maturity, tall plants. A broad genetic base derived from Caribbean Composite.	CIMMYT
Antiqua Veracruz 181 (AV)	Tropical yellow, semident, intermediate plant height and maturity.	CIMMYT
Blanco Subtropical (BS)	Subtropical, broad genetic base, late maturity, semi-flint grain, relatively tall plants.	CIMMYT
Amarillo Bajio (AB)	Subtropical-temperate, intermediate maturity, yellow dent with broad germplasm base.	CIMMYT
RBS1O C_3	Cycle 3 of reciprocal selection using an inbred tester in an Illinois high-yield environment beginning with BS10(FR)C_4 as C_0.	USA
RSSSC C_4	Composite of four selected versions of Stiff Stalk Synthetic.	USA
Suwan-Pathology Source (SPS)	Random mated population formed by intermating Tailand *Puceinia sorghi* resistant plants from Maize Pathological Population No. 2,4,6,7,10,11 and Suwan DMR Source 11 (S) C_1.	Tailand

*Abbreviations of populations are presented in parenthesis.

族群之花絲上，每一雜交組合授粉150株。成熟時分別收穫每一雜交組合，並自每一果穗取同量種子混合。

上述36個族群測交種（18個族群×TA2808－176及18個族群×TA3651－377）及TA2808－176×TA3651－377進行三期作（春、秋、裡作）兩個地點（農試所霧峰農場及雲林土庫）之評估試驗。所有期作及地點之田間試驗均採逢機完全區集設計，四重複，三行區，行長5m，行株距70×25cm，公頃株數57,143株。肥料施用量爲N：P_2O_5：K_2O=200：90：60 kg / ha，基肥包括N 60kg, P_2O_5及K_2O全量，播種後一個月及雄花抽穗前分別加施N 70kg各一次。其它田間管理，如除草、中耕、培土及灌溉，依一般玉米栽培法進行。爲避免雜交種與自交系間差異懸殊之競爭能力，測交種評估試驗之鄰近田區另行種植十個重複之TA2808－176及TA3651－377，其設計及田間管理與測交種試驗同。每一試驗地點在玉米生育期間均調查株高、穗位高、開花期、吐絲期、及子實產量等。

三期作及二個地區合併爲六個逢機環境進行變方分析。每一族群測交種、TA2808－176×TA3651－377, TA2808－176及TA3651－377在六個環境所得之平均值，依Dudley（1987, 1988a）之方法估算：(1)有利顯性基因相對數目（relative number of favorable dominant alleles,$\bar{lp}_i\mu'$），(2)不利隱性基因相對數目（relative number of unfavorable recessive alleles, $\bar{jq}_j\mu$ or $\bar{kq}_k\mu$），及(3)親疏關係值(relationship values, $(I_2\times Py)-(I_1\times Py)+(I_1-I_2)/2$。本研究中，$I_1$爲TA2808－176，$I_2$爲TA3651－377，每一族群均爲$P_y$。

結果與討論

六個環境合併之資料，經變方分析結果（表2），兩種族群測交種間之子實產量、穗位高及株高差異並不顯著；而population x TA2808－176之開花期及吐絲期則明顯的較population x TA3651－377遲1.7天。欲接受改良之單交種台農1號（TA2808－176 x TA3651－377）在五項性狀中均有突出之雜種優勢表現，其子實產量7.66t / ha，開花期及吐絲期較二親本自交系早，穗位高及株高則高出甚多。兩個自交系之間差異懸殊，與TA2808－176比較，TA3651－377之開花期及吐絲期較遲（分別差3.8及3.9天），穗位高及株高較矮（分別差31.7cm及46.0cm），公頃子實產量則僅約TA2808－176之一半（1.77t及3.24t）。

每一個族群兩種測交種之子實產量列如表3。十八個族群當中，除RBS10 C_3 x TA2808－176（8.22t / ha）與RBS10 C_3 x TA3651－377之6.63t / ha差異達顯著外，其餘十七個族群之兩種測交種間子實產量差異並不明顯。將每一族群兩種測交種之平均值作一比較，子實產量高於7.0t / ha以上的計有MA、TEYD、RBS10 C_3及RSSSC C_4四個，其

Table 2. Means over all environments for populations x TA2808-176, populations x TA3651-377, TA2808-176 x TA3651-377, TA2808-176 and TA3651-377

Entries	Grain yield (t/ha)	Days to flowering (day)	Days to silking (day)	Ear height (cm)	Plant height (cm)
Populations x TA2808-176	6.53	65.8*	67.3*	92.2	198.3
Populations x TA3651-377	6.37	64.1	65.6	86.7	196.6
TA2808-176 x TA3651-377	7.66	62.3	63.9	109.2	218.5
TA2808-176	3.24	64.2	65.9	82.7	175.2
TA3651-377	1.77	68.0	69.8	51.0	129.2
Standard error					
TA2808-176 x TA3651-377	0.51	1.0	1.1	8.3	9.2
Inbred mean	0.26	0.6	0.7	5.2	5.6

*Difference between populations x TA2808-176 and populations x TA3651-377 means was significant at the 5% probability level using the F test.

Table 3. Mean grain yield (t/ha) of population x line crosses

Populatio	Line		Population	Line	
	TA2808-176	TA3651-377		TA2808-176	TA3651-377
MA	7.01	7.64	AC1	5.96	6.54
AC2	6.34	6.94	AD	5.87	5.78
AS	6.44	6.25	Cogollero	6.36	5.80
TEYF	6.19	6.55	AV	6.36	5.91
TEYD	6.72	7.32	BS	6.78	5.88
STEYF	5.81	5.69	AB	6.07	6.06
STEYD	5.98	5.43	RBS10 C_3	8.22*	6.63
STIYF	6.14	6.20	RSSSC C_4	7.99	6.83
STIYD	6.23	6.21	SPS	7.00	6.93

*Difference between crosses was significantly larger than LSD(0.05) = 1.27.

中尤以RBS10 C_3測交種之7.43t / ha及RSSSC C_4測交種之7.41t / ha最爲高產。由表1中之遺傳背景資料可以瞭解，RBS10 C_3及RSSSC C_4均經3～4個循環之輪迴選拔，就子實產量作了改良，其測交種理應比其他未改良族群之測交種高產一些。子實產量不及6.0t / ha的有STEYF、STEYD及AD三個族群測交種。開花期介於61.8天～68.0天，吐絲期介於63.1天～69.8天，其中均以STEYF測交種最早開花及吐絲，而以SPS測交種最遲開花及吐絲。穗位高介於78.9cm～101.9cm，株高介於186.9cm～218.0cm，其中以STEYD測交種之穗位高及株高最矮，而以RSSSC C_4測交種最高。STEYF及STEYD二族群之測交種均爲典型之早熟矮株低產型，而RSSSC C_4測交種則相對地成爲晚熟高株高產型。

就子實產量而言，有利基因爲顯性，同時顯性爲正的方向(表2)，因此，鑑別理想族群應以正值之$\bar{lp_i}\mu'$爲依據(Dudley 1987, 1988a)。本研究中，計有MA、RBS10 C_3、

Table 4. Population x inbred cross means averaged over inbreds for grain yield, days to flowering, days to silking, ear height and plant height

Populations	Grain yield (t/ha)	Days to flowering (day)	Days to silking (day)	Ear height (cm)	Plant height (cm)
MA	7.33	67.7	69.4	94.2	200.7
AC2	6.64	65.3	66.8	87.1	194.7
AS	6.35	65.2	66.9	88.4	197.3
TEYF	6.37	64.0	65.1	91.3	196.1
TEYD	7.02	64.2	65.7	91.8	200.5
STEYF	5.75	61.8	63.1	84.2	187.4
STEYD	5.71	63.0	64.2	78.9	186.9
STIYF	6.17	65.3	67.1	84.9	192.2
STIYD	6.22	65.0	66.8	86.9	194.1
AC1	6.25	64.6	66.4	87.4	193.0
AD	5.83	62.4	63.6	82.6	186.9
Cogollero	6.08	65.1	66.7	89.9	199.3
AV	6.14	64.4	66.0	85.5	195.9
BS	6.33	64.6	65.8	91.8	198.5
AB	6.07	63.7	65.0	88.3	193.4
RBS1O C_3	7.43	67.0	68.6	95.4	207.1
RSSSC C_4	7.41	67.8	69.5	101.9	218.0
SPS	6.97	68.0	69.8	99.2	212.3
LSD(0.05)	0.42	1.3	1.5	4.2	6.1

TEYD、RSSSC C_4及SPS五個族群之$l\bar{p}_i\mu'$爲顯著正值(表5)，表示這五個族群具有某些與子實產量相關而在TA2808－176 x TA3651－377並不存在之有利基因可資利用。另就親疏關係值觀之，Dudley（1987）曾以$(I_2 \times P_y)-(I_1 \times P_y)+(I_1-I_2)/2$以估算$(j\mu\bar{p}_j+k\mu\bar{q}_k)$－$(j\mu\bar{p}_j+k\mu\bar{q}_k)$，當其爲正值時，表示$P_y$與$I_1$之關係較與$I_2$之關係爲密切；若爲負值，則表示$P_y$與$I_2$之關係較與$I_1$之關係爲密切。本研究中，BS、RBS10 C_3及RSSSC C_4三個族群之$(I_2 \times P_y)-(I_1 \times P_y)+(I_1-I_2)/2$爲負值，唯BS及RSSSC C_4二個族群之值並未顯著異於0；其餘十五個族群中，唯MA、AC2、TEYF、TEYD及AC1五個族群之$(I_2 \times P_y)-(I_1 \times P_y)+(I_1-I_2)/2$爲顯著正值。由此結果獲知，族群RBS10 C_3與TA3651－377之關係較與TA2808－176之關係密切；而MA、AC2、TEYF、TEYD及AC1五個族群與TA2808－176之關係則較與TA3651－377密切。TA3651－377源自（B68 x MV source）BC_5, B68屬於Iowa Stiff Stalk Synthetic（BSSS）系統，因此，TA3651－377與RSSSC C_4之關係本來應該最爲密切，而事實上，卻與以Iowa 2－ear Synthetic # 1爲基礎經伊利諾大學相互輪迴選拔改良後之RBS10 C_3更爲密切。TA2808－176源自Cuban flint，族群AC2、TEYF及TEYD均含Cuban flint種源，其關係特別密切則是預料中事。

作爲親本改良用之族群，必爲與此親本關係最爲密切者。由以上結果得知，RBS10

Table 5. Estimates of relative number of favorable dominant alleles ($l\bar{p}_l\,\mu'$), relative number of unfavorable recessive alleles ($i\bar{q}_j\mu$ or $k\bar{q}_k\mu$), and relationship values [$(I_2 \times Py) - (I_1 \times Py) + (I_1 - I_2)/2$] for grain yield (t/ha)

Populations	$l\bar{p}_l\,\mu'$	$(I_2 \times Py) - (I_1 \times Py) + (I_1 - I_2)/2$	$j\bar{q}_j\mu$ or $k\bar{q}_k\mu$⊕
MA	0.94*	1.36*	0.95
AC2	0.60	1.34*	0.96
AS	0.50	0.55	0.41
TEYF	0.46	1.09*	1.20#
TEYD	0.79*	1.33*	1.02
STEYF	0.19	0.61	1.17#
STEYD	0.27	0.18	1.39#
STIYF	0.36	0.81	1.09#
STIYD	0.40	0.71	1.12#
AC1	0.40	1.33*	0.96#
AD	0.22	0.64	1.16#
Cogollero	0.46	0.18	1.39#
AV	0.46	0.29	1.33#
BS	0.67	−0.17	1.11#
AB	0.32	0.72	1.12#
RBS1O C_3	1.36*	−0.84*	1.08
RSSSC C_4	1.28*	−0.42	1.11
SPS	0.78*	0.67	1.14

* Larger than 2 x SE.

# Indicates difference from $lp_l\,\mu' > 2 \times SE$.

⊕ $jq_j\mu$ when $(I_2 \times Py) - (I_1 \times Py) + (I_1 - I_2)/2$ is positive (TA2808-176 is to be improved); $kq_k\mu$ when negative (TA3651-377 is to be improved).

C_3可爲TA3651－377改良之來源；而MA、AC2、TEYF、TEYD及AC1可爲TA2808－176改良之來源。至於改良過程中是否需要回交或逕行自交即可，則可比較$l\bar{p}_l\mu'$與$j\bar{q}_j\mu$或$k\bar{q}_k\mu$間之離差來加以評定，當$(I_2 \times P_y) - (I_1 \times P_y) + (I_1 - I_2)/2$爲正值時，TA2808－176爲被改良的對象，則將$j\bar{q}_j\mu$與$l\bar{p}_l\mu'$比較；反之，爲正值時，TA3651－377爲被改良的對象，則將$k\bar{q}_j\mu$與$l\bar{p}_l\mu'$比較。離差值達顯著者，表示不利隱性基因數目與有利顯性基因數目相差甚大，族群與自交系之雜交後裔應先行回交一次以上，以增進優良個體之選拔機率。本研究中，TEYF、STEYF、STEYD、STIYF、STIYD、AC1、AD、Cogollero、AV、BS及AB等十一個族群作爲改良來源時，其族群x自交系之後裔均在必須回交之列；而MA、AC2、AS、RBS10 C_3、RSSSC C_4及SPS作爲改良來源時，其族群x自交系後裔則可直接自交分離（表5）。綜合$l\bar{p}_l\mu'$、$(I_2 \times P_y) - (I_1 \times P_y) + (I_1 - I_2)/2$及$j\bar{q}_j\mu$或$k\bar{q}_k\mu$值，MA及TEYD可作爲改良TA2808－176之重要來源；RBS10 C_3可作爲改良TA3651－377之來源，因相對有利與不利基因數目相近。因此，在進行自交系親本改良過程中，MA x TA2808－176、TEYD x TA2808－176及RBS 10 C_3 x TA3651－377三個組合，可於F_1自交分離，而不必先予回交。

運用Dudly（1987, 1988a）之方法，當假設有利基因爲完全顯性（complete dominance, a＝1），I_2在基因座等級i及k均攜有顯性基因，而I_1則在基因座等級i及j攜有顯性基因。因之，一個新的自交系如欲與I_2有很好的組合，其基因座等級j及l必須具備有利顯性基因；而一個新的自交系如欲與I_1有很好的組合，則其基因座等級k及l應具備有利顯性基因。據此，一個族群不作爲改良單交種親本之來源，而僅作爲直接分離自交系之來源時，此族群欲分離自交系與I_2結合成優良單交種，則其$l\bar{p}_i\mu' + j\bar{p}_j\mu$（以$I_2$ x $P_y - I_2$估算此值）必大；族群欲分離自交系與I_1結合成單交種，則其$l\bar{p}_i\mu' + k\bar{p}_k\mu$（以$I_1$ x $P_y - I_1$估算此值）也必大。利用此種比較方法及依照台農1號既有的雜種優勢模式（heterosis pattern），同時也能將十八個族群作適當的分群。本研究資料顯示，適合分離自交系與TA2808－176結合的族群僅有RBS10 C_3一個，而其餘十七個族群則適合分離自交系與TA3651－377結合（表6）。以分群的觀點而言，則僅RBS10 C_3一個族群屬於TA3651－377之一群，而其餘十七個族群皆屬TA2808－176的一群。將$l\bar{p}_i\mu' + k\bar{p}_k\mu$或$l\bar{p}_i\mu' + j\bar{p}_j\mu$值按大小順序排列，並作比較，可以發現MA及TEYD不僅可作爲TA2808－176之改良來源，同時亦適合分離自交系以結合TA3651－377成更優良之單交種（表6）。

族群之評估方式，因利用方式之不同，而有頗多主張（Kramer and Ullstrup 1959, Lonnquist and Gardner 1961, Eberhart 1971, Stuber 1978, Spencer 1980, Hallauer and Miranda 1981, Burton and Davies 1984, Dudley 1984, Abel and Pollak 1991），

Table 6. Value of populations as direct sources of inbred lines to cross with TA2808-176 or TA3651-377 for grain yield

Population	Line parent	Grain yield+ (t/ha)	Rank
MA	TA3651-377	5.87	1
AC2	TA3651-377	5.17	3
AS	TA3651-377	4.48	9
TEYF	TA3651-377	4.78	7
TEYD	TA3651-377	5.55	2
STEYF	TA3651-377	3.92	17
STEYD	TA3651-377	3.66	18
STIYF	TA3651-377	4.43	11
STIYD	TA3651-377	4.44	10
AC1	TA3651-377	4.77	8
AD	TA3651-377	4.01	16
Cogollero	TA3651-377	4.03	15
AV	TA3651-377	4.14	13
BS	TA3651-377	4.11	14
AB	TA3651-377	4.29	12
RBS1O C_3	TA2808-176	4.98	6
RSSSC C_4	TA3651-377	5.06	5
SPS	TA3651-377	5.16	4

+ Larger of $l\bar{p}_i\ \mu' + k\bar{p}_k\mu$ or $l\bar{p}_i\mu' + j\bar{p}_j\ \mu$.

每一種主張或各有其假設前提。應用Dudley（1987）的方法，亦有三個假設前提：有利顯性基因爲完全顯性（a＝1）；μ在每一個基因座爲常數（constant），μ爲二同型結合體間差值的一半；及無上位性（no epistasis）。Dudley（1988a）曾討論此三種假設前提之符合性，當a＜1及a＝0時，$l\bar{p}_l\mu'$值可能因偏差（biased）而低估；而當a＞1時，亦可能因偏差而導致高估。至於μ爲常數及無上位性之假設所造成之效應，並不十分明瞭。不過，除非參試族群間l基因座等級之μ值差異特別大，否則每一基因座μ等值對供給親族群之選定應當沒有很大的影響。Hogan and Dudley（1991）及Pfarr and Lamkey（1992a, 1992b）曾分別將數種估算族群有利基因數目的方法作一比較，結果發現在顯性爲有利的一些性狀中，$l\bar{p}_l\mu'$估值確能發揮其鑑別理想族群的功效。Dudley（1987, 1988a）的方法，參與評估的材料並不需要包括族群本身，與其他方法比較之下，試驗規模尚屬適中。本所進行玉米育種工作，目標之一爲利用族群中之有利基因改良自交系，以增進台農1號之產量潛力，在鑑別理想族群上，應用Dudley（1987, 1988a）之$l\bar{p}_l\mu'$應爲目前最佳的選擇。

準確地鑑定理想族群，將有助於不適應族群或外來族群在玉米育種上之利用，更可因集中精力於幾個比較有希望的族群，而提高育種效率。本研究中僅就子實產量部分作較詳細的討論，其他性狀則供參考。由於一般視產量相關之有利基因爲顯性，因此估算$l\bar{p}_l\mu'$比較族群優劣；有些性狀之有利基因或爲隱性（如抗病、抗蟲、抗倒伏等性狀），則應改以

$\bar{q}_l\mu$或$k\bar{q}_k\mu$值作比較標準。綜合本試驗結果，Mezcla Amarilla及Tropical Early Yellow Dent將作爲本所改良TA2808－176之重要來源；而RBS10 C_3可作爲改良TA3651－377之來源。改良過程中，此三個族群與其欲改良自交系之雜交F_1將逕行自交分離，而不必回交。將十八個族群依TA3651－377及TA2808－176既有之雜種優勢模式分群，其中僅RBS10 C_3屬TA3651－377之一群，餘皆爲TA2808－176群。除作爲改良TA2808－176之供給親外，Mezcla Amarilla及Tropical Early Yellow Dent亦適合直接分離自交系，以結合TA3651－377成比台農1號更優良之單交種，爲本研究中最有價值之二個族群。

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