

# Products of Latin American Maize Breeding Programs

The principal output of maize breeding programs is improved germplasm, so the first step in documenting the impacts of maize breeding research in Latin America is to compile a complete inventory of germplasm products. Of course, the fact that a particular breeding program has produced a lot of germplasm products in and of itself does not constitute evidence of impact, since it must additionally be shown that these products are finding their way into farmers' fields and contributing to increased productivity at the farm level. But if a particular breeding program is not producing germplasm products, it is safe to say that the program is not having any impact.

During the original CIMMYT maize impacts survey carried out in 1992, detailed descriptive data were collected on the physical characteristics and genetic background of approximately 850 maize varieties and hybrids released in developing countries between 1966 and 1990. Of these, approximately 480 had been released in Latin America, including about 340 released by public breeding programs and about 140 released by private seed companies. Because relatively few private seed companies participated in the 1990 survey, the coverage of public-sector releases was much more comprehensive than that of private-sector releases.

Following the completion of the 1997 maize impacts survey, the varietal releases database was updated and expanded. All public varieties and hybrids released since 1990 were added to the original database, as were a few older (pre-1990) releases that had been missed during the earlier survey. The original list of private-sector releases was similarly updated, and it was greatly expanded as a result of the concerted effort to survey as many of the leading private seed companies as possible.

In interpreting the data on varietal releases presented in the following sections, it is important to remember that the coverage of public- and private-sector materials is not exactly the same. Public breeding programs were asked to provide information about all varieties and hybrids released since 1966, but in the case of private companies this was considered impractical. Many private seed companies that existed during the 1960s and 1970s are no longer in business, and it is simply not possible to obtain information on varieties and hybrids released by defunct companies. Furthermore, few of the currently active companies that date back to the 1960s and 1970s are able to provide information about materials they were selling 20 or 30 years ago. For these reasons, the private seed companies contacted during the 1997 survey were asked to provide information only about the varieties and

hybrids they were currently selling; in most cases these consisted of relatively new hybrids released during the 1990s.

## PUBLIC-SECTOR RELEASES

**Types of materials.** Data on the numbers and types of materials released by public maize breeding programs in Latin America between 1966 and 1997 are shown in Table 12. All told, public breeding programs released 675 cultivars during this period, including 427 varieties and 248 hybrids.

The rate at which cultivars were released by public breeding programs varied through time. The rate

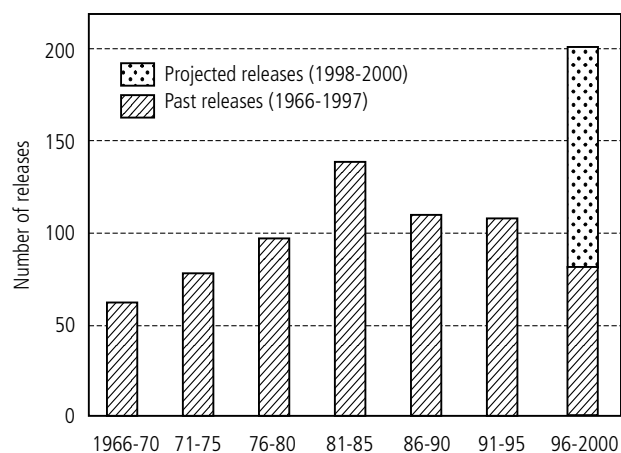
**Table 12. Types and numbers of maize cultivars released by public breeding programs, Latin America, 1966-97**

	Improved OPVs	Hybrids	Total MVs	MVs per million ha maize
<b>Central America</b>	<b>83</b>	<b>44</b>	<b>127</b>	<b>77.3</b>
Costa Rica	11	7	18	1,353.0
El Salvador	3	12	15	51.1
Guatemala	20	13	39	67.8
Honduras	15	5	20	49.2
Nicaragua	19	2	21	74.8
Panama	9	5	14	191.4
<b>Caribbean</b>	<b>18</b>	<b>3</b>	<b>21</b>	<b>74.8</b>
Cuba	6	3	9	121.6
Dominican Republic	6	0	6	140.8
Haiti	6	0	6	23.3
<b>Mexico</b>	<b>104</b>	<b>118</b>	<b>222</b>	<b>28.5</b>
<b>Central America, Caribbean, and Mexico</b>	<b>205</b>	<b>165</b>	<b>370</b>	<b>37.8</b>
<b>Andean Zone</b>	<b>140</b>	<b>53</b>	<b>193</b>	<b>82.5</b>
Bolivia	54	5	59	205.9
Colombia	28	18	46	70.5
Ecuador	22	3	25	43.9
Peru	19	11	30	84.8
Venezuela	17	16	33	76.7
<b>Southern Cone</b>	<b>82</b>	<b>30</b>	<b>112</b>	<b>6.9</b>
Argentina	27	17	44	16.9
Brazil	39	13	52	3.9
Chile	—	—	—	—
Paraguay	16	0	16	49.3
Uruguay	—	—	—	—
<b>South America</b>	<b>222</b>	<b>83</b>	<b>305</b>	<b>16.4</b>
<b>Latin America</b>	<b>427</b>	<b>248</b>	<b>675</b>	<b>23.6</b>

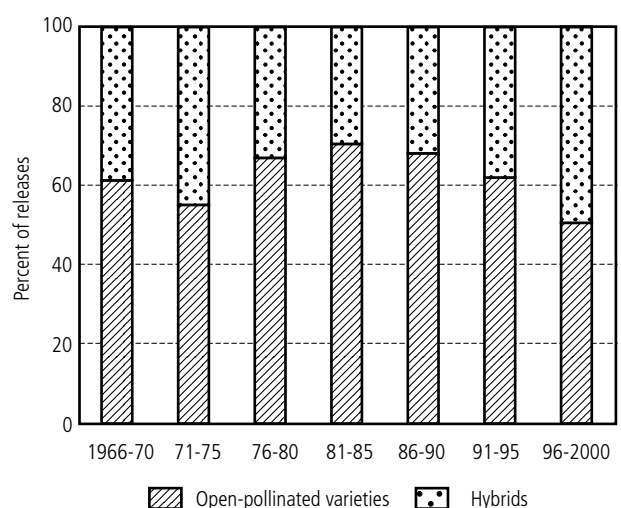
Source: CIMMYT maize impacts survey.

of releases rose steadily during the 1960s and 1970s before peaking during the mid-1980s; since then, it has remained fairly constant (Figure 1).

Summarizing across the entire 1966-97 period, varieties significantly outnumbered hybrids among public-sector releases, although this pattern was less pronounced in some countries (Costa Rica, Venezuela) and was actually reversed in two instances (Mexico, El Salvador). The proportion of hybrids released by public breeding programs has increased steadily through time, however, and during the most recent period for which data are available, more hybrids were released than varieties in many countries (Figure 2).



**Figure 1. Rate of varietal releases by public maize breeding programs, Latin America, 1966-2000.**



**Figure 2. Types of cultivars released by public maize breeding programs, Latin America, 1966-97.**

**Ecological adaptation.** Data on the ecological adaptation of materials released by public maize breeding programs in Latin America between 1966 and 1997 are shown in Table 13.

Materials adapted to lowland tropical environments have dominated public-sector releases; nearly two-thirds (63%) of the 673 materials whose ecological adaptation is known are adapted to lowland tropical environments. Next in importance among public-sector releases have been materials adapted to subtropical/mid-altitude environments (23%), followed at some distance by materials adapted to highland environments (9%) and materials adapted to temperate environments (4%).

**Table 13. Ecological adaptation of maize cultivars released by public breeding programs, Latin America, 1966-97**

	Lowland tropical	Subtropical/ mid-altitude	Highland	Temperate
<b>Central America</b>	<b>111</b>	<b>16</b>	<b>0</b>	<b>0</b>
Costa Rica	18	0	0	0
El Salvador	15	0	0	0
Guatemala	26	13	0	0
Honduras	19	1	0	0
Nicaragua	19	2	0	0
Panama	14	0	0	0
<b>Caribbean</b>	<b>20</b>	<b>1</b>	<b>0</b>	<b>0</b>
Cuba	9	0	0	0
Dominican Republic	6	0	0	0
Haiti	5	1	0	0
<b>Mexico</b>	<b>98</b>	<b>104</b>	<b>20</b>	<b>0</b>
<b>Central America, Caribbean, and Mexico</b>	<b>229</b>	<b>121</b>	<b>20</b>	<b>0</b>
<b>Andean Zone</b>	<b>120</b>	<b>37</b>	<b>39</b>	<b>0</b>
Bolivia	30	13	16	0
Colombia	27	8	11	0
Ecuador	10	13	2	0
Peru	20	3	10	0
Venezuela	33	0	0	0
<b>Southern Cone</b>	<b>77</b>	<b>0</b>	<b>0</b>	<b>30</b>
Argentina	9	0	0	30
Brazil	52	0	0	0
Chile	—	—	—	—
Paraguay	16	0	0	0
Uruguay	—	—	—	—
<b>South America</b>	<b>197</b>	<b>37</b>	<b>39</b>	<b>30</b>
<b>Latin America</b>	<b>426</b>	<b>158</b>	<b>59</b>	<b>30</b>

Source: CIMMYT maize impacts survey.

The proportion of public-sector releases adapted to each mega-environment has varied considerably by sub-region, which is consistent with geographical differences in the distribution of maize production. The proportion of releases adapted to lowland tropical environments is particularly high in Central America and the Caribbean, which is not surprising considering that most maize in Central America and the Caribbean is grown in such environments. In contrast, many of the releases from public breeding programs in the Southern Cone countries are adapted to temperate production conditions, reflecting the fact that a significant amount of maize in these countries is grown in temperate environments. Materials adapted to highland conditions have been released only in Mexico and in the countries of the Andean Zone.

Despite the variability that is apparent at the country and sub-regional levels, for Latin America as a whole the proportion of public-sector releases showing adaptation to each of the four major production environments recognized by CIMMYT is similar to the proportion of maize area located in each environment, indicating a close congruency between the pattern of research outputs and the target environments.

**Characteristics.** Data on the grain color and texture of materials released by public maize breeding programs in Latin America between 1966 and 1997 are shown in Table 14.

Marked geographical differences are evident in grain color. In Mexico, Central America, and the Caribbean, the vast majority of the materials released by public breeding programs have been white-grained, reflecting strong consumer preferences for white-grained food maize. In contrast, yellow-grained materials have dominated in South America, reflecting the superiority of these materials for feed use.

Geographical differences also are evident in grain texture. In Mexico, Central America, and the Caribbean, the majority of the materials released by public breeding programs have been dent or semi-dent materials, reflecting local consumer preferences for soft-grained food maize that is easier to process (in many rural areas throughout the region, maize is still ground by hand). In contrast, semi-flint and flint materials have dominated in South America; the popularity of these harder-grained materials can be attributed to the fact that they are not only suitable for use as livestock feed but have the added advantage of storing well.

**Table 14. Grain characteristics of maize cultivars released by public breeding programs, Latin America, 1966-97**

	Grain color		Grain texture				
	White	Yellow <sup>a</sup>	Dent	Semident	Semiflint	Flint	Other <sup>b</sup>
<b>Central America</b>	81	46	32	52	30	12	0
Costa Rica	13	5	0	13	4	1	0
El Salvador	12	3	8	5	1	1	0
Guatemala	20	19	2	17	18	1	0
Honduras	15	5	9	9	1	1	0
Nicaragua	20	1	8	6	5	2	0
Panama	1	13	5	2	1	6	0
<b>Caribbean</b>	0	21	7	2	6	5	0
Cuba	0	9	0	2	4	3	0
Dominican Republic	0	6	6	0	0	0	0
Haiti	0	6	1	0	2	2	0
<b>Mexico</b>	213	9	92	69	41	11	0
<b>Central America, Caribbean, and Mexico</b>	294	76	131	123	77	28	0
<b>Andean Zone</b>	86	107 (3)	17	24	54	59	40
Bolivia	27	31 (1)	15	15	8	14	7
Colombia	20	26	0	0	13	24	9
Ecuador	8	17	1	0	3	11	10
Peru	9	22 (2)	0	4	9	4	14
Venezuela	22	11	1	5	21	6	3
<b>Southern Cone</b>	8	94 (10)	9	35	24	33	3
Argentina	2	42	2	4	13	20	0
Brazil	2	50	5	30	11	3	0
Chile	—	—	—	—	—	—	—
Paraguay	4	2 (10)	2	1	0	10	3
Uruguay	—	—	—	—	—	—	—
<b>South America</b>	94	201 (13)	26	59	78	92	43
<b>Latin America</b>	388	277 (13)	157	182	155	120	43

Source: CIMMYT maize impacts survey.

a Numbers in parentheses indicate cultivars described as "colorado" (meaning "colored").

b Mainly floury types.

Data on the maturity classes of cultivars released by public breeding programs are shown in Table 15. Intermediate and late-maturing materials have dominated public-sector releases; this tendency has been true not only for Latin America as a whole, but for the various sub-regions as well. The preponderance of intermediate- and late-maturing materials is understandable, since materials that take longer to mature usually yield higher. On the other hand, the relatively small number of shorter duration releases may be seen as a cause for concern, given that farmers in drought-prone areas (which account for a significant proportion of Latin America's maize-growing environments) consistently express the need for early maturing materials. Less than 10% of all releases have been classified as early maturing, and less than 2% have been classified as extra-early.

**Table 15. Maturity classes of maize cultivars released by public breeding programs, Latin America, 1966-97**

	Extra-early	Early	Intermediate	Late	Extra-late
<b>Central America</b>	2	14	90	8	12
Costa Rica	0	1	14	3	0
El Salvador	0	3	10	1	0
Guatemala	0	1	27	0	11
Honduras	1	5	12	1	1
Nicaragua	1	3	14	3	0
Panama	0	1	13	0	0
<b>Caribbean</b>	0	4	16	1	0
Cuba	0	2	7	0	0
Dominican Republic	0	0	6	0	0
Haiti	0	2	3	1	0
<b>Mexico</b>	7	30	37	34	112
<b>Central America, Caribbean, and Mexico</b>	9	48	143	43	124
<b>Andean Zone</b>	7	15	82	33	54
Bolivia	5	8	31	13	2
Colombia	1	3	4	2	36
Ecuador	1	2	7	0	15
Peru	0	2	7	18	1
Venezuela	0	0	33	0	0
<b>Southern Cone</b>	0	0	18	82	7
Argentina	0	0	0	39	0
Brazil	0	0	15	30	7
Chile	—	—	—	—	—
Paraguay	0	0	3	13	0
Uruguay	—	—	—	—	—
<b>South America</b>	7	15	100	115	61
<b>Latin America</b>	16	63	243	158	185

Source: CIMMYT maize impacts survey.

## PRIVATE-SECTOR (PROPRIETARY) MATERIALS

In interpreting the following tables and figures showing patterns in private-sector (proprietary) releases, it is important to recall that the data are not directly comparable with those presented earlier showing patterns in public-sector releases. Two main points must be kept in mind:

1. Whereas the information collected from public breeding programs relates to all public varieties and hybrids released between 1966 and 1997, the information collected from private seed companies relates only to materials available on the market in 1997. Usually these consisted of commercial hybrids released during the 1990s. Thus, in the case of private-sector materials the temporal coverage is much more limited.
2. Interpretation of the data relating to private-sector materials is complicated by the fact that commercial hybrids are often introduced simultaneously in several countries (especially hybrids developed by multinational seed companies). This is quite different from what happens with materials developed by public breeding programs, which typically are released only in a single country—usually the country in which they were developed. In attempting to discern patterns in the overall set of private-sector materials, it is therefore difficult to avoid multiple counting, since many private-sector materials appear several times in the database. For this reason, Tables 16-19 present country-level results only. Sub-regional and regional totals are not presented, because these are most affected by the multiple-counting problem.

Types of materials. Data on the numbers and types of proprietary materials available on the market in Latin America in 1997 are shown in Table 16. As expected, the product line of most private seed companies was dominated by hybrids; only in three countries (Mexico, Venezuela, and Haiti) were proprietary OPVs available on the market.

The types of hybrids available on the market differed markedly between countries. Technically more sophisticated hybrids (e.g., single-crosses, three way-crosses) were found almost exclusively in countries with well-developed commercial production sectors, such as Argentina, Brazil, Mexico, and Paraguay. Technically less sophisticated hybrids (e.g., double-crosses, top-crosses, varietal crosses) tended to predominate in countries in which maize production is characterized by small-scale, subsistence-oriented production, including most of the countries in Central America, the Caribbean, and the Andean Zone. But these two categories are not mutually exclusive. Seed companies recognize that the presence of a commercial production sector capable of using more sophisticated technologies does not preclude targeting other segments of the market. For this reason, in all of the countries in which single-cross

**Table 16. Types of private-sector (proprietary) maize cultivars available on the market in 1997, Latin America**

	Improved OPVs	Hybrids				Total
		SC	TWC	DC	Other	
<b>Central America</b>						
Costa Rica	0	1	8	4	0	13
El Salvador	0	0	2	5	0	7
Guatemala	0	0	3	8	0	11
Honduras	0	0	11	10	0	21
Nicaragua	0	0	1	4	0	5
Panama	0	1	2	1	0	4
<b>Caribbean</b>						
Cuba	0	0	0	0	0	0
Dominican Republic	0	0	0	0	0	0
Haiti	1	0	0	0	0	1
<b>Mexico</b>	<b>5</b>	<b>46</b>	<b>68</b>	<b>28</b>	<b>8</b>	<b>155</b>
<b>Andean Zone</b>						
Bolivia	0	0	12	4	0	16
Colombia	0	6	13	10	0	29
Ecuador	0	1	3	6	0	10
Peru	0	0	1	7	0	8
Venezuela	9	0	16	40	2	67
<b>Southern Cone</b>						
Argentina	0	67	49	14	0	130
Brazil	0	37	45	37	3	112
Chile	—	—	—	—	—	—
Paraguay	0	25	19	18	1	63
Uruguay	—	—	—	—	—	—

Source: CIMMYT maize impacts survey.

Note: Some varieties and hybrids were being sold in more than one country, so the data do not necessarily refer to *different* cultivars (i.e., the same cultivar may have been counted in more than one country). For this reason, summing the country-level counts will tend to overstate the total number of *different* cultivars on the market. SC = single cross; TWC = three-way cross; and DC = double cross.

and three way-cross hybrids were available, double-cross hybrids and other even less sophisticated types of hybrids were also being sold.

**Ecological adaptation.** Data on the ecological adaptation of private-sector (proprietary) materials available on the market in Latin America in 1997 are shown in Table 17. In all but two countries, the product lines of private seed companies were dominated by lowland tropical materials. The only exceptions were Argentina (in which temperate materials were by far the most common) and Mexico (in which a significant number of subtropical/highland materials and a small number of highland materials were also available).

**Table 17. Ecological adaptation of private-sector (proprietary) maize cultivars available on the market in 1997, Latin America**

	Lowland tropical	Subtropical/ mid-altitude	Highland	Temperate
<b>Central America</b>				
Costa Rica	11	1	0	0
El Salvador	7	0	0	0
Guatemala	11	0	0	0
Honduras	18	0	1	0
Nicaragua	5	0	0	0
Panama	4	0	0	0
<b>Caribbean</b>				
Cuba	0	0	0	0
Dominican Republic	0	0	0	0
Haiti	1	0	0	0
<b>Mexico</b>	<b>84</b>	<b>56</b>	<b>6</b>	<b>1</b>
<b>Andean Zone</b>				
Bolivia	16	0	0	0
Colombia	29	0	0	0
Ecuador	10	0	0	0
Peru	5	2	0	1
Venezuela	67	0	0	0
<b>Southern Cone</b>				
Argentina	4	0	0	129
Brazil	118	0	0	4
Chile	–	–	–	–
Paraguay	56	0	0	7
Uruguay	–	–	–	–

Source: CIMMYT maize impacts survey.

Note: Some varieties and hybrids were being sold in more than one country, so the data do not necessarily refer to different cultivars (i.e., the same cultivar may have been counted in more than one country). For this reason, summing the country-level counts will tend to overstate the total number of different cultivars on the market.

Even though lowland tropical environments predominate throughout much of Latin America, the number of proprietary cultivars adapted to these environments seems disproportionately large. This suggests one of two possibilities: either private seed companies have concentrated their breeding efforts on lowland tropical environments at the expense of other environments, or, if private-sector breeding efforts have been distributed across the entire range of production environments, relatively few commercial materials have been developed showing good adaptation to subtropical/mid-altitude and highland conditions.

**Characteristics.** Data on the grain color and texture of private-sector (proprietary) materials available on the market in Latin America in 1997 are shown in Table 18. Private seed companies clearly are

**Table 18. Grain characteristics of private-sector (proprietary) maize cultivars available on the market in 1997, Latin America**

	Grain color		Grain texture			
	White	Yellow <sup>a</sup>	Dent	Semident	Semiflint	Flint
<b>Central America</b>						
Costa Rica	7	5	2	3	6	1
El Salvador	6	1	1	1	2	3
Guatemala	7	4	2	2	2	5
Honduras	18	1	1	5	6	7
Nicaragua	5	0	0	1	1	2
Panama	1	3	2	2	0	0
<b>Caribbean</b>						
Cuba	0	0	0	0	0	0
Dominican Republic	0	0	0	0	0	0
Haiti	0	1	0	0	0	1
<b>Mexico</b>	<b>135</b>	<b>20</b>	<b>7</b>	<b>55</b>	<b>37</b>	<b>52</b>
<b>Andean Zone</b>						
Bolivia	1	18	7	8	1	0
Colombia	1	15	18	7	1	3
Ecuador	2	8	4	2	2	2
Peru	0	8	5	1	0	2
Venezuela	49	18	6	39	7	15
<b>Southern Cone</b>						
Argentina	1	126	57	24	23	25
Brazil	2	120	28	54	11	27
Chile	–	–	–	–	–	–
Paraguay	0	63	22	25	3	11
Uruguay	–	–	–	–	–	–

Source: CIMMYT maize impacts survey.

Note: Some varieties and hybrids were being sold in more than one country, so the data do not necessarily refer to *different* cultivars (i.e., the same cultivar may have been counted in more than one country). For this reason, summing the country-level counts will tend to overstate the total number of *different* cultivars on the market.

a Including materials described as "colorado" (meaning "colored").

sensitive to demand factors, and their product lines reflect the well-known geographical differences in consumer preferences. The majority of the proprietary cultivars available on the market in Mexico, Central America, the Caribbean, and the Andean Zone were white-grained materials suitable for use in preparing local food dishes. In contrast, the materials marketed in the Southern Cone countries were almost exclusively yellow-grained feed materials. Grain texture was quite variable, however, and in most countries a wide range of grain textures was on offer.

Data on the maturity classes of private-sector (proprietary) materials available on the market in Latin America in 1997 are shown in Table 19.

**Table 19. Maturity classes of private-sector (proprietary) maize cultivars available on the market in 1997, Latin America**

	Extra-early	Early	Intermediate	Late	Extra-late
<b>Central America</b>					
Costa Rica	0	0	7	5	0
El Salvador	0	1	5	1	0
Guatemala	0	0	11	0	0
Honduras	0	1	11	5	2
Nicaragua	0	0	4	1	0
Panama	0	0	3	1	0
<b>Caribbean</b>					
Cuba	0	0	0	0	0
Dominican Republic	0	0	0	0	0
Haiti	0	1	0	0	0
<b>Mexico</b>	<b>11</b>	<b>21</b>	<b>50</b>	<b>38</b>	<b>29</b>
<b>Andean Zone</b>					
Bolivia	0	1	7	7	1
Colombia	0	1	14	4	10
Ecuador	2	0	2	3	0
Peru	0	0	2	2	0
Venezuela	3	4	49	10	1
<b>Southern Cone</b>					
Argentina	3	14	32	57	27
Brazil	3	25	39	48	5
Chile					
Paraguay	2	15	22	21	3
Uruguay					

Source: CIMMYT maize impacts survey.

Note: Some varieties and hybrids were being sold in more than one country, so the data do not necessarily refer to *different* cultivars (i.e., the same cultivar may have been counted in more than one country). For this reason, summing the country-level counts will tend to overstate the total number of *different* cultivars on the market.

Intermediate and late-maturing materials predominated in most countries, except in the Southern Cone countries, where the product lines of private seed companies were fairly evenly distributed across a range of maturity classes.

**Overall patterns in private-sector (proprietary) materials.** In an effort to get around the multiple-counting problem, a “single-entry database” was constructed containing all of the proprietary materials available on the market in Latin America in 1997. In the single-entry database, redundant entries for individual OPVs or hybrids were eliminated. (For example, even though Pioneer Hybrid 3001 was being sold in six countries, the single-entry database contains only one record for Pioneer Hybrid 3001.) The single-entry database cannot be used to examine patterns at the level of individual countries, since materials listed in the database are not associated with specific countries. However, the single-entry database can be used to analyze patterns in the overall set of private-sector (proprietary) materials available throughout Latin America in 1997, and it permits direct comparisons with the aggregate results presented earlier relating to public-sector releases.

Summary statistics relating to the overall set of private-sector (proprietary) materials available on the market in Latin America in 1997 appear in Figure 3.

As expected, the vast majority (97%) of all proprietary cultivars being sold in Latin America in 1997 were hybrids. The preference of the private sector for marketing hybrids is plainly based on commercial considerations, including the following: (1) many farmers who plant hybrids are large-scale commercial growers who require large quantities of seed; (2) farmers who

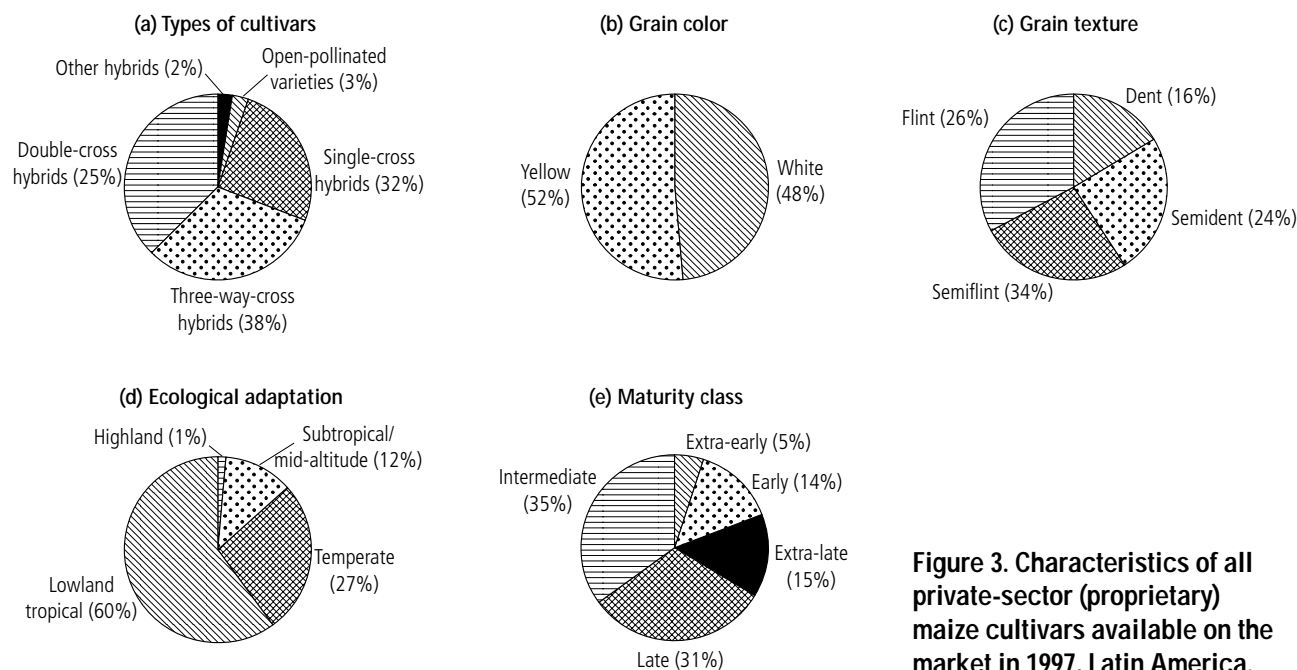
plant hybrids tend to purchase fresh seed every year; and (3) hybrid seed commands higher prices than OPV seed and thus provides increased profit opportunities for seed companies.

Among all proprietary cultivars, yellow-grained materials slightly outnumbered white-grained materials, reflecting the importance assigned by private seed companies to addressing the needs of commercial feed grain producers. The predominance of yellow-grained materials among proprietary cultivars contrasts sharply with the pattern observed among public-sector releases, which were dominated by white-grained materials suited for the preparation of local food dishes.

Proprietary cultivars included a wide range of grain textures, with the distribution skewed slightly toward the harder (flint) end of the spectrum. This pattern, which is quite similar to that observed among public-sector releases, presumably indicates that private seed companies, like public breeding programs, make an effort to offer a wide range of grain textures to meet diverse local preferences.

Lowland tropical materials dominated the product lines of Latin American seed companies, accounting for more than 60% of all proprietary cultivars being sold in 1997. In terms of its domination by lowland tropical materials, the overall set of proprietary cultivars resembled the overall set of public-sector releases. Beyond that, however, the relative emphasis placed on different mega-environments differed markedly. Temperate materials ranked second in importance among private-sector materials, no doubt due to the emphasis being placed on meeting the needs of commercial producers in Argentina. Materials adapted to highland production environments made up a minuscule 1% of all proprietary cultivars available on the market.

Intermediate- and late-maturing materials dominated the product lines of private seed companies, just as they did in the case of public-sector releases. But at the same time, private seed companies clearly recognize that there is demand for early maturing materials, and their product line indicates that they are making an effort to meet this demand: nearly 20% of all proprietary materials were classified as early or extra-early.



**Figure 3. Characteristics of all private-sector (proprietary) maize cultivars available on the market in 1997, Latin America.**