# THE IDENTIFICATION OF CULTIVATED PLANTS. II.
# THE GENUS TRITICUM L.

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ABSTRACT:

Comparative observations on 26 characters have been recorded for 1, 24 and 27 varieties of Triticum pyramidale Delile, T. durum Desf., and T. vulgare Vill. respectively and used in the construction of dichotomous non-indented keys for their identification. None of the varieties involved are identical, and awn length is the only character found that can roughly separate the varieties of T. durum from those of T. vulgare, being 11 cm or more in the former and 10 cm or less in the latter.

## INTRODUCTION

There are 20 Triticum species with well over 30000 cultivated races and varieties (Airy Shaw, 1973). They are distributed mainly around the Mediterranean basin, although some have been domesticated in a much wider area ranging from the borders of the arctic circle to near the equator (Kent, 1966).

In the most widely accepted classification of the genus (Kent, 1966; Aykroyd and Doughty, 1970), there are 3 main groups incorporating the diploid, tetraploid and hexaploid taxa with 14, 28 and 42 chromosomes respectively. However, the distinction between the classification of wheats and their identification has not been clear since the same arrangement has also provided the main identificatory tool for members of this genus and precious little has so far been done to construct practicable keys for them. Clearly, while chromosome numbers may be useful for classificatory purposes, they can at best be of limited identificatory value because they are far from easily observable and liable to change with various types of natural and artificial stimuli.

Interested as we are in the identification of cultivated plants, we aimed at the generation of dichotomous

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non-indented keys to the wheats grown in Egypt as well as some representative varieties from the main regions where wheat is commercially grown. The general policy adopted in character scoring and key construction has previously been outlined by El-Gazzar (1976). It is hoped that the present work will initiate other urgently needed studies involving as many wheat races and varieties from other parts of the world as possible.

## MATERIAL AND METHODS

Well-authenticated grains of 52 varieties (listed in Table 1) have been collected from various sources, and raised simultaneously under the same environmental conditions at the experimental fields of the Ministry of Agriculture in Bahteem. They belong to Triticum vulgare Vill. (27 varieties), T. durum Desf. (24 varieties) and T. pyramidale Delile (1 variety). Voucher specimens are kept in the herbarium of the Department of Agricultural Botany, Faculty of Agriculture, Al-Azhar University, where this work has been carried out.

Most of the characters recorded for these plants (see Table 2) are of the type that can be easily observed by independent workers (i.e. users of the keys based on them) and require little more than an ordinary magnifying lens and a ruler. However, some features of the glumes and flag leaves necessitated their clearing in warm lactic acid prior to microscopic examination. Pollen grains from mature anthers have been warmed on a slide in 5% KOH solution and stained in 1% safranin, with the use of glycerin-jelly as mounting medium.

## OBSERVATIONS

The following is a brief account of some of the characters recorded comparatively for the 52 varieties of Triticum in Appendix I:

### A. Vegetative morphology

1. The stem:

The hight of the plant has been estimated as the average of 10 measurements of stem length (from stem base to tip of the spike excluding the awns), and ranges from 55 cm in T. vulgare v. PM2R to 175 cm in T. durum v. arotha, although most varieties have stems 85-115 cm high. The number of internodes is constant for each variety and differs from one variety to the next, being 3, 4, 5, 6 or 7. Although the only two varieties with stems consisting of more than 5 internodes have also the highest stems in the present sample (i.e. T. durum vars. minodom and arotha), there seems to be no direct relationship between the hight of the stem and the number of its internodes: For instance, while the stems of the 2

varieties T. durum vars. duker 7 and duker 11 are only 85 and 86 cm high and consist of 5 internodes each, there are 8 varieties whose stems are 115 cm high or more and have only 4 internodes. Therefore, as a contribution from variation in internode length the averages of at least 10 length measurements of each of the terminal and basal internodes for all 52 varieties have been scored. The longest and shortest terminal internodes measure 32 cm in T. durum v. arotha and 10 cm in T. vulgare v. PM2R respectively; these two varieties also have the longest (26 cm) and shortest (3.7 cm) basal internodes respectively. Some duker varieties (e.g. 1-3, 8, 10-15, 49 and 52) have conspicuously basal nodes. As regards stem colour, two categories are easily distinguishable: (i) pure white, yellow to golden yellow, and (ii) pale violet to dark purple.

2. Flag leaves:

The length and width of the flag leaf vary considerably in different varieties ranging in length from 18 to 38.5 cm, and in width between 1.5 and 3.1 cm. The number of main veins entering the base of the flag leaf seems to be constant for each variety and ranges between 38 and 87 in the 52 varieties under investigation, with the majority of them having 50-70 veins per leaf. It is noticeable, however, that the number of veins in flag leaves bears no obvious relationship to their width: 18 varieties have flag leaves 2 cm broad and traversed by 15 of the 30 numbers of veins encountered in the 52 varieties, including the highest and lowest numbers (i.e. 87 and 38 respectively), and the same number of veins (e.g. 46) can be found in varieties (T. durum v. duker 13, T. durum v. duker 49, T. vulgare v. Africa mayo composite IV and T. vulgare v. mabrouk) with flag leaves whose width covers the full range observed in the 52 varieties (i.e. 1.5-3.1 cm).

## B. Spikes and spikelets

Spike and spikelet morphology differs tremendously in different wheat varieties and has a highly discriminative value for members of this genus. Mature spikes (i.e. immediately prior to fertilization) may be fusiform or oblong in outline and erect, curved or drooping in position. They may be richly dense with spikelets, moderately dense or lax. Furthermore, the glumes vary in colour between white to yellowish and brown, with most T. vulgare varieties possessing brown glumes. The range of variation in glume dimensions is 6-10 mm in length, 1.5-4.5 mm in width, with the glume peak length ranging between 0.5 mm and 7.0 mm. However, the glumes of 44 varieties are 7-9 mm long, those of 22 varieties are 2-3 mm broad, with the glume peak 1-3 mm long in 39 varieties. Glume apex is invariably awned in the varieties studied, and varies in

shape between obtuse and acuminate, with some varieties possessing the intermediate case of acute glume apex. Awns may be toothed or toothless, and white-pale yellow or brown-black. Awn length has been scored as the average of 10 measurements of awns taken from different mature spikes for each variety, although fluctuation in awn length in the various spikes is remarkably limited. The longest awns measure 22.0 cm in T. durum v. duker 52 while the shortest are found in T. vulgare v. snova 64 and measure only 5.5 cm. However, awn length of most varieties falls within 7 to 14 cm. It is worth pointing out that awn length provides the only character listed in Table 1 which can help separate (though not absolutely) the varieties of T. durum from those of T. vulgare: 20 of the 23 varieties (i.e. 86.9%) of the former species have awns 11 cm or more in length, whereas of the 26 varieties of the latter no less than 24 (i.e. 92.3%) have awns 10 cm or less in length. The only variety of T. pyramidale studied (baladi 116) has 15 cm long awns.

## C. Kernels

Features recorded from the kernels concern their size and colour. All size measurements (length, thickness and size of 100 kernels) have been taken as the average of 10 readings for each variety. Here again, Kernel dimensions taken from different spikes of the same variety showed only slight fluctuation. Kernel length ranges between 5.5 and 8.5 mm, with most varieties having kernels 6-7 mm long. Similarly, kernel thickness varies from 2.5 mm in T. vulgare vars. MD474, PM2B and chenodo 70 to 3.6 mm in T. durum vars. duker 8 and duker 52. The 4 categories of kernel colour (i.e. yellow, amber yellow, brown and amber brown) commonly recognized in wheats have also been observed in the present sample of varieties.

## D. Pollen grains

With the rapid and simple method used here for the preparation of pollen grains for microscopic examination, the use of some palynological features in wheat identification poses little or no problems. In any case, it will be noticed from the keys presented in this article that we resorted to the single character recorded from pollen grains (pollen diameter) only when it provided the best practical means for the discrimination between some varieties. Appendix I shows that some varieties have pollen grains twice as large as those of others. For example, while the grains of T. vulgare v. inia measure 96 u in diameter, those of 6 varieties (e.g. T. durum v. duker 4, T. vulgare v. PM2R) are only 48 u in diameter.

## THE KEYS

In view of the relatively large number of varieties involved in the present study, they have been divided into 4 groups and a separate key has been constructed for each group.

### Key to groups I-IV

A. Stem 155 cm long or more . . . . . Group I
   Stem 140 cm long or less . . . . . B
B. Basal node swollen . . . . . C
   Basal node not swollen . . . . . Group II
C. Stem white to yellowish . . . . . Group III
   Stem purple . . . . . Group IV

### Group I (5 varieties)

1. Awn toothed, basal internode 17 cm long, 55 veins or less in flag leaf, kernel 2.7 mm thick 2.
   Awn toothless, basal internode at least 23 cm long, at least 60 veins in flag leaf, kernel 3.2 mm thick . . . . . 3.
2. Basal node swollen, spike fusiform, flag leaf 39-veined, glume peak 5 mm long . . . . . Duker 3
   Basal internode not swollen, spike oblong, flag leaf 55-veined, glume peak 1.5 mm . . Duker 4
3. Stem white, no lodging, spike moderately dense, pollen diameter 64 u . . . . . 4.
   Stem purple, lodging present, spike lax, pollen 56 u in diameter . . . . . kubanka
4. Spike curved, glume apex acuminate, flag leaf 65-veined . . . . . arotha
   Spike drooping, glume apex acute, flag leaf 82-veined . . . . . mindom

### Group II (20 varieties)

1. Stem purple . . . . . 2.
   Stem white . . . . . 8.
2. Basal node swollen . . . . . 3.
   Basal node not swollen . . . . . 4.
3. Spike curved, terminal internode 27 cm long Duker 1
   Spike erect, terminal internode 16 cm long Duker 2
4. Glumes and awns brown . . . . . 5.
   Glumes and awns white . . . . . 6.
5. Awn toothed, 12 cm long, spike drooping, flag leaf 26 cm long, 87-veined, glume peak 0.5 mm long . . . . . Duker 7
   Awn toothless, 6.5 cm long, spike erect, flag leaf 18 cm long, 46-veined, glume peak 4 mm long . . . . . Mabrouk

6. Awn toothless, no lodging . . . . . Bajio 67
   Awn toothed, stem lodging . . . . . 7.
7. Spike drooping, kernel amber yellow, stem 60 cm long, glume peak 4 mm long, pollen 64 u in diameter . . . . . PM2B
   Spike curved, kernel brown, stem 85 cm long, glume peak 1.5 mm, pollen diameter 56 u . . . PM12
8. Awn dark-coloured . . . . . 9.
   Awn white-yellow . . . . . 10.
9. Spike oblong, curved, glumes and kernel brown, stem 95 cm long, glume peak 6 mm long . . . . PM8
   Spike fusiform, erect, glumes white, kernel amber yellow, stem 75 cm long, glume peak 2 mm long . . . . . blue silver
10. Awn 10-15 cm long . . . . . 11.
    Awn 5-9 cm long . . . . . 12.
11. Awn toothless, spike curved, kernel amber brown, glume 4x6 mm, obtuse, stem 115 cm long, terminal internode 22 cm long, basal 15 cm long, flag leaf 38-veined . . . . . Duker 7
    Awn toothed, spike erect, kernel yellow, glumes 10x1.5 mm, acute, stem 65 cm long, terminal internode 14 cm long, basal 8 cm long, flag leaf with more than 50 veins . . Duker 9
12. Awn toothless, glume peak 1 mm long . . . . 13.
    Awn toothed, glume peak 2-3 mm long . . . . 16.
13. Spike fusiform, pollen 64-96 u in diameter . 14.
    Spike oblong, pollen diameter 48 u . . . . . 15.
14. Stem 110 cm long with 5 internodes, flag leaf 27 cm long, 46-veined . Africa mayo composite IV
    Stem 70 cm long with 3 internodes, flag leaf 24 cm long with 71 veins . . . . . inia 66
15. Spike erect, terminal internode 16 cm long, flag leaf 50-veined . . . . . giorgiop-I
    Spike drooping, terminal internode 26 cm long, flag leaf 71-veined . Africa mayo composite III
16. Stem 85-90 cm long, flag leaf at least 24 cm long . . . . . 17.
    Stem 55-60 cm long, flag leaf less than 20 cm long . . . . . 19.
17. Internodes 5, basal and terminal ones 8 and 13 cm long respectively, kernel brown . . . Duker 6
    Internodes 3, basal and terminal ones 6 and 14 cm long respectively, kernel yellow . . . 18.
18. Awn 5.5 cm long, spike curved, glumes acuminate . . . . . chenob 70
    Awn 8.0 cm long, glumes acute, spikes erect . . . . . kushal 69
19. Kernel brown, glumes acute, pollen 48 u in diameter . . . . . PM2R

Kernel amber yellow, glumes acuminate, pollen diameter 64 u . . . . . PM4

Group III (9 varieties)

1. Stem 86 cm long or less . . . . . 2.
   Stem at least 110 cm long . . . . . 4.
2. Flag leaf 34 cm long . . . . . 3.
   Flag leaf 29 cm long . . . . . Duker 14
3. Glumes brown, stem 86 cm long with 5 internodes, spike curved, pollen 64 u . . . Duker 11
   Glumes white, stem 60 cm long with 3 internodes, spike erect, pollen 48 u . . . . mag 54
4. Stem 135 cm long, with 5 internodes and lodging, spike moderately dense . . . . . ACME
   Stem 118 cm long or less, with 4 internodes, no lodging, spike lax (dense in Giza 145). . 5.
5. Awn less than 10 cm long, flag leaf 41-veined 6.
   Awn at least 14 cm long, flag leaf with at least 46 veins . . . . . 7.
6. Spike fusiform, dense, erect, terminal internode 13.6 cm long . . . . . Giza 145
   Spike oblong, lax, curved, terminal internode c.20 cm long . . . . . improved mokhtar
7. Glumes brown, acute, flag leaf 46-veined . . Duker 13
   Glumes white, acuminate, flag leaf with at least 59 veins . . . . . 8.
8. Awn toothed, kernel amber yellow, pollen 56 u in diameter . . . . . seven stars
   Awn toothless, kernel brown, pollen diameter 80 u . . . . . inia 156

Group IV (18 varieties)

1. Stem 118 cm long or less . . . . . 2.
   Stem at least 130 cm long . . . . . 15.
2. Glume peak 6-7 mm long . . . . . 3.
   Glume peak 0.5-3.0 mm long . . . . . 4.
3. Spikes oblong, curved, moderately dense, awn toothed, kernel yellow, flag leaf 19 cm long . . . . . Giza 150
   Spikes fusiform, erect, dense, awn toothless, kernel brown, flag leaf twice as long . . . PM9
4. Glumes white-yellow . . . . . 5.
   Glumes brown . . . . . 9.
5. Spike dense . . . . . 6.
   Spike lax . . . . . 8.
6. Stem 80 cm long, terminal internode 11.2 cm long, flag leaf 50-veined, pollen diameter 72 u . . . . . snova 64
   Stem 107-115 cm long, terminal internode 17 cm long or more, flag leaf with 61-63 veins, pollen 56 u in diameter . . . . . 7.

7. Flag leaf 23 cm long . . . . . Giza 144
   Flag leaf 30 cm long . . . . . Giza 148
8. Spike fusiform, kernel brown, glume acuminate, awn 7.5 cm long, flag leaf with 58 veins . . . . . PM11
   Spike oblong, kernel yellow, glume obtuse, awn twice as long, flag leaf 70-veined . . . baladi 116
9. Stem with 5 internodes . . . . . montana
   Stem with 3 or 4 internodes . . . . . 10.
10. Spike lax, oblong, erect, awn toothless . . Duker 52
    Spike dense or moderately dense, curved or drooping, fusiform, awn toothed . . . . 11.
11. Stem 118 cm long . . . . . L64 skevart
    Stem less than 95 cm long . . . . . 12.
12. Awns dark brown or black, 6.5 cm long, pollen 80 u in diameter . . . . . PM14
    Awns white-yellow, at least twice as long, pollen 48-56 u in diameter . . . . . 13.
13. Glumes acuminate, stem 93 cm long, terminal internode 18 cm long, basal one 12 cm long, flag leaf 56-veined . . . . . Duker 10
    Glumes acute, stem 85 cm long, terminal internode 12 cm long, basal one 7 cm long, flag leaf with 77-78 veins . . . . . 14.
14. Kernel amber yellow, awn 12 cm long . . . . Duker 12
    Kernel amber brown, awn 17 cm long . . . . Duker 15
15. Lodging present . . . . . 16.
    Lodging absent . . . . . 17.
16. Glumes brown, obtuse, flag leaf with 46 veins, pollen diameter 56 u . . . . . Duker 49
    Glumes white, acute, flag leaf with 78 veins, pollen diameter 72 u . . . . . spelemer
17. Spike lax, kernel amber yellow, glumes obtuse, awn 16.6 cm long . . . . . Duker 8
    Spike dense, kernel brown , glumes acuminate, awn 7 cm long . . . . . MD 474

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Table 1. The 52 varieties of Triticum durum, T. vulgare and T. pyramidale studied, with each variety given a serial number.

| | |
|---|---|
| **T. durum** | |
| 1. Duker 1 | 2. Duker 2 |
| 3. Duker 3 | 4. Duker 4 |
| 5. Duker 5 | 6. Duker 6 |
| 7. Duker 7 | 8. Duker 8 |
| 9. Duker 9 | 10. Duker 10 |
| 11. Duker 11 | 12. Duker 12 |
| 13. Duker 13 | 14. Duker 14 |
| 15. Duker 15 | 16. Duker 49 |
| 17. Duker 52 | 18. giorgiop-I 210861 |
| 19. arotha | 20. mindom |
| 21. ACME | 22. spelemer |
| 23. L64 skevart | 24. kubanka |
| **T. vulgare** | |
| 25. africa mayo composite III | 26. africa mayo compositeIV |
| 27. MD 474 | 28. bajio 67 |
| 29. mabrouk | 30. PM2B |
| 31. PM2R | 32. PM4 |
| 33. PM8 | 34. PM9 |
| 35. PM11 | 36. PM12 |
| 37. PM14 | 38. blue silver |
| 39. chenob 70 | 40. kushal 69 |
| 41. Giza 144 | 42. Giza 145 |
| 43. Giza 148 | 44. Giza 150 |
| 45. inia 66 | 46. improved mokhtar |
| 47. mag 54 | 48. snova 64 |
| 49. montana | 50. seven stars |
| 51. inia 156 | |
| **T. pyramidale** | |
| 52. baladi 116. | |

Table 2. Summary of 26 characters as coded and recorded comparatively for 52 varieties of Triticum durum, T. vulgare and T. pyramidale in Appendix I.

| A. Qualitative characters |
|---|
| 1. Stem white + / purple -. |
| 2. Basal node swollen + / not so -. |
| 3. Stem lodging present + / absent -. |
| 4. Spike fusiform + / oblong -. |
| 5. Awn toothed + / toothless -. |

Table 2 (cont.)

6. Glumes white-yellowish + / brown -.
7. Awn white-yellow + / brown-black -.

B. Exclusive multistate characters

8. Number of internodes (5 categories: 3, 4, 5, 6 and 7).
9. Spike density (3 categories: dense 1 / moderately dense 2 / lax 3).
10. Spike position (3categories: erect 1 / curved 2 / drooping 3).
11. Kernel colour (4 categories: yellow 1 / amber yellow 2 / brown 3 / amber brown 4).
12. Glume apex (3 categories: obtuse 1 / acute 2 / acuminate 3).

C. Quantitative characters

13. Stem length (55-175 cm).
14. Length of terminal internode (10-32 cm).
15. Length of basal internode (3.7-26.0 cm).
16. Awn length (5.5-22.0 cm).
17. Number of veins in flag leaf (38-87).
18. Length of flag leaf (18.0-38.5 cm).
19. Width of flag leaf (1.5-3.1 cm).
20. Kernel length (5.7-8.5 mm).
21. Kernel thickness (2.5-3.6 mm).
22. Size of 100 kernels (26-29 $cm^3$).
23. Glume length (6-10 mm).
24. Glume width (1.5-4.5 mm).
25. Length of glume peak (0.5-7.0 mm).
26. Pollen diameter (48-96 u).

## APPENDIX I

Comparative observations on 26 characters of 52 varieties of *Triticum durum*, *T. vulgare* and *T. pyramidale*. Serial numbers assigned to varieties and to characters correspond with those given in Tables 1 and 2 respectively. Symbols used to denote character states are in accordance with those in Table 2. Missing and inapplicable attributes are represented by points.

| vars. | Qualitative and multistate characters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | - | + | - | + | + | + | + | 4 | 3 | 2 | 2 | 3 |
| 2 | - | + | - | + | + | + | + | 5 | 3 | 1 | 2 | 3 |
| 3 | - | + | - | + | + | + | . | 5 | 3 | 2 | 2 | 3 |
| 4 | - | - | - | - | + | + | + | 5 | 2 | 2 | 2 | 2 |
| 5 | + | - | - | + | - | + | + | 4 | 3 | 2 | 4 | 1 |

Appendix I (cont.)

| vars. | Qualitative and multistate characters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 6 | + | - | - | + | + | + | + | 5 | 1 | 3 | 3 | 2 |
| 7 | - | - | - | + | + | - | - | 4 | 1 | 3 | 2 | 2 |
| 8 | - | + | - | - | + | + | . | 5 | 3 | 2 | 2 | 1 |
| 9 | + | - | - | + | + | + | + | 4 | 3 | 1 | 1 | 2 |
| 10 | - | + | - | + | + | - | + | 4 | 1 | 2 | 1 | 3 |
| 11 | + | + | - | + | + | - | . | 5 | 1 | 2 | 1 | 2 |
| 12 | - | + | - | + | + | - | + | 4 | 1 | 2 | 2 | 2 |
| 13 | + | + | - | - | + | - | . | 4 | 3 | 1 | 1 | 2 |
| 14 | + | + | - | + | + | - | + | 4 | 3 | 2 | 1 | 1 |
| 15 | - | + | - | + | + | - | + | 4 | 2 | 3 | 4 | 2 |
| 16 | - | + | + | + | - | - | + | 5 | 2 | 2 | 1 | 1 |
| 17 | - | + | + | - | - | - | + | 4 | 3 | 1 | 1 | 2 |
| 18 | + | - | - | - | - | + | + | 3 | 3 | 1 | 3 | 3 |
| 19 | + | + | - | - | - | + | + | 7 | 2 | 2 | 2 | 3 |
| 20 | + | + | - | - | - | + | + | 6 | 2 | 3 | 2 | 2 |
| 21 | + | + | + | - | - | + | + | 5 | 2 | 2 | 2 | 2 |
| 22 | - | + | + | + | - | + | + | 5 | 2 | 2 | 2 | 2 |
| 23 | - | + | - | + | + | - | . | 4 | 1 | 2 | 4 | 3 |
| 24 | - | + | + | - | - | + | + | 5 | 3 | 2 | 2 | 2 |
| 25 | + | - | - | - | - | + | + | 4 | 2 | 3 | 4 | 2 |
| 26 | + | - | - | + | - | + | + | 5 | 1 | 3 | 4 | 3 |
| 27 | - | + | - | - | + | + | + | 5 | 1 | 2 | 3 | 3 |
| 28 | - | - | - | + | - | + | + | 4 | 1 | 3 | 3 | 3 |
| 29 | - | - | - | + | - | - | - | 4 | 1 | 1 | 1 | 3 |
| 30 | - | - | + | + | + | + | + | 3 | 1 | 3 | 2 | 3 |
| 31 | + | - | + | + | + | + | + | 3 | 1 | 3 | 3 | 2 |
| 32 | + | - | + | + | + | + | + | 3 | 1 | 3 | 2 | 3 |
| 33 | + | - | + | - | + | - | - | 3 | 2 | 2 | 3 | 3 |
| 34 | - | + | - | + | - | + | + | 3 | 1 | 1 | 3 | 3 |
| 35 | - | + | - | + | - | + | + | 3 | 3 | 2 | 3 | 3 |
| 36 | - | - | + | + | + | + | + | 3 | 2 | 2 | 3 | 2 |
| 37 | - | + | - | + | + | - | - | 3 | 1 | 2 | 3 | 2 |
| 38 | + | - | + | + | + | + | - | 3 | 1 | 1 | 2 | 2 |
| 39 | + | - | + | - | + | + | + | 3 | 2 | 2 | 1 | 3 |
| 40 | + | - | + | - | + | + | + | 3 | 1 | 1 | 1 | 2 |
| 41 | - | + | - | - | - | + | + | 5 | 1 | 1 | 1 | 3 |
| 42 | + | + | - | + | - | + | + | 4 | 1 | 1 | 1 | 2 |
| 43 | - | + | - | - | - | + | + | 4 | 1 | 1 | 2 | 3 |
| 44 | - | + | - | - | + | + | + | 3 | 2 | 2 | 1 | 3 |
| 45 | + | - | - | + | - | + | + | 3 | 1 | 2 | 3 | 2 |
| 46 | + | + | - | - | - | + | + | 4 | 3 | 2 | 2 | 3 |
| 47 | + | + | - | + | . | + | . | 3 | 1 | 1 | 2 | 2 |
| 48 | - | + | - | - | - | + | + | 3 | 1 | 2 | 3 | 3 |
| 49 | - | + | - | + | - | - | + | 5 | 2 | 1 | 1 | 3 |
| 50 | + | + | - | - | + | + | + | 4 | 3 | 1 | 2 | 3 |
| 51 | + | + | - | - | - | + | + | 4 | 3 | 1 | 3 | 3 |
| 52 | - | + | + | - | - | + | + | 3 | 3 | 2 | 1 | 1 |

Appendix I (cont.)

| | Quantitative characters | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 1 | 125 | 27.0 | 16.0 | 14.0 | 72 | 38.5 | 2.5 | 7.5 | 3.5 | 28 | 9.0 | 3.0 | 2.0 | 64 |
| 2 | 115 | 16.0 | 10.0 | 11.0 | 74 | 26.0 | 2.0 | 6.5 | 3.4 | 28 | 8.0 | 3.0 | 3.0 | 72 |
| 3 | 155 | 28.0 | 17.0 | . | 39 | 32.0 | 1.7 | 6.5 | 2.7 | 27 | 9.0 | 4.0 | 5.0 | 56 |
| 4 | 157 | 26.0 | 17.0 | 16.0 | 55 | 31.0 | 1.9 | 7.0 | 2.7 | 27 | 9.0 | 2.0 | 1.5 | 48 |
| 5 | 115 | 22.0 | 15.0 | 11.5 | 38 | 20.0 | 2.0 | 7.0 | 3.3 | 27 | 6.0 | 4.0 | 0.5 | 56 |
| 6 | 85 | 13.0 | 8.0 | 8.5 | 67 | 24.0 | 2.2 | 6.4 | 2.8 | 28 | 9.0 | 4.0 | 2.0 | 56 |
| 7 | 85 | 13.0 | 8.0 | 12.0 | 87 | 26.0 | 2.0 | 6.6 | 2.8 | 29 | 8.0 | 2.5 | 0.5 | 56 |
| 8 | 139 | 23.0 | 18.0 | 15.6 | 71 | 33.0 | 2.4 | 7.7 | 3.6 | 29 | 9.0 | 3.5 | 2.0 | 56 |
| 9 | 64 | 14.0 | 8.0 | 14.0 | 52 | 20.0 | 1.9 | 7.7 | 3.4 | 28 | 10.0 | 1.5 | 1.0 | 64 |
| 10 | 93 | 18.0 | 12.0 | 16.0 | 56 | 32.0 | 2.0 | 7.2 | 3.0 | 27 | 9.0 | 4.0 | 3.0 | 56 |
| 11 | 86 | 12.0 | 8.0 | 18.0 | 60 | 34.0 | 2.3 | 8.0 | 3.3 | 29 | 9.0 | 4.0 | 2.0 | 64 |
| 12 | 84 | 12.0 | 7.0 | 12.0 | 78 | 28.0 | 2.5 | 8.5 | 3.3 | 29 | 9.0 | 3.7 | 1.5 | 56 |
| 13 | 111 | 23.0 | 9.0 | 14.0 | 46 | 28.0 | 2.0 | 8.5 | 3.4 | 27 | 10.0 | 4.0 | 1.0 | 56 |
| 14 | 85 | 17.0 | 8.0 | 14.0 | 59 | 29.0 | 2.3 | 6.5 | 3.5 | 28 | 7.5 | 3.0 | 0.5 | 64 |
| 15 | 85 | 12.0 | 7.0 | 17.0 | 77 | 29.0 | 2.0 | 7.5 | 2.8 | 28 | 7.5 | 2.0 | 0.5 | 48 |
| 16 | 130 | 23.6 | 17.0 | 18.0 | 46 | 34.0 | 3.1 | 7.3 | 2.9 | 27 | 8.0 | 4.0 | 1.5 | 56 |
| 17 | 115 | 20.0 | 12.0 | 22.0 | 59 | 31.0 | 2.6 | 8.4 | 3.6 | 29 | 9.0 | 3.6 | 2.0 | 56 |
| 18 | 95 | 16.0 | 9.0 | 6.5 | 50 | 25.0 | 2.0 | 6.7 | 3.4 | 27 | 6.5 | 4.0 | 1.0 | 48 |
| 19 | 175 | 32.0 | 26.0 | 11.0 | 65 | 30.0 | 2.0 | 7.5 | 3.2 | 29 | 9.0 | 3.0 | 1.0 | 64 |
| 20 | 170 | 30.0 | 25.0 | 13.0 | 82 | 30.0 | 2.0 | 7.5 | 3.2 | 28 | 9.0 | 4.0 | 2.0 | 64 |
| 21 | 135 | 25.0 | 16.5 | 12.0 | 69 | 31.0 | 2.0 | 6.3 | 2.7 | 27 | 9.0 | 4.0 | 1.0 | 64 |
| 22 | 135 | 25.0 | 16.3 | 15.0 | 78 | 28.0 | 1.8 | 8.0 | 3.0 | 27 | 10.0 | 3.0 | 1.0 | 72 |
| 23 | 118 | 21.1 | 17.8 | 18.0 | 54 | 31.5 | 2.5 | 7.6 | 3.5 | 28 | 9.0 | 3.0 | 1.0 | 64 |
| 24 | 160 | 29.3 | 23.1 | 9.0 | 61 | 32.0 | 2.3 | 7.0 | 3.2 | 26 | 10.0 | 2.0 | 1.5 | 56 |
| 25 | 104 | 26.0 | 11.0 | 6.5 | 71 | 27.0 | 1.5 | 6.0 | 3.0 | 27 | 7.0 | 3.0 | 1.0 | 48 |
| 26 | 110 | 19.0 | 12.0 | 6.5 | 46 | 27.0 | 1.5 | 6.2 | 3.1 | 28 | 7.5 | 3.0 | 1.0 | 64 |
| 27 | 137 | 25.4 | 17.5 | 7.0 | 62 | 34.0 | 2.0 | 6.0 | 2.5 | 27 | 7.5 | 3.0 | 1.0 | 56 |
| 28 | 90 | 13.7 | 7.0 | 7.5 | 67 | 24.5 | 1.5 | 6.2 | 3.1 | 27 | 8.0 | 3.5 | 1.0 | 72 |
| 29 | 105 | 17.0 | 9.0 | 6.5 | 46 | 18.0 | 2.0 | 7.3 | 2.7 | 27 | 6.5 | 3.0 | 4.0 | 56 |
| 30 | 60 | 10.1 | 4.2 | 6.5 | 75 | 21.0 | 1.7 | 7.0 | 2.5 | 28 | 9.0 | 4.0 | 4.0 | 64 |
| 31 | 55 | 10.0 | 3.7 | 7.0 | 59 | 19.0 | 1.7 | 7.0 | 3.2 | 28 | 8.0 | 3.0 | 3.0 | 48 |
| 32 | 60 | 10.5 | 4.3 | 9.0 | 50 | 19.5 | 1.6 | 7.0 | 3.2 | 29 | 9.0 | 3.5 | 3.0 | 64 |
| 33 | 95 | 15.0 | 8.5 | 10.0 | 67 | 20.0 | 1.9 | 6.6 | 3.0 | 28 | 8.5 | 4.5 | 6.0 | 85 |
| 34 | 95 | 15.0 | 8.0 | 9.5 | 62 | 37.0 | 3.0 | 6.4 | 2.8 | 27 | 8.0 | 3.0 | 6.0 | 56 |
| 35 | 90 | 14.2 | 7.2 | 7.5 | 58 | 27.5 | 2.3 | 6.4 | 3.0 | 28 | 8.0 | 3.0 | 2.5 | 64 |
| 36 | 85 | 11.9 | 7.5 | 7.5 | 70 | 18.0 | 2.0 | 6.4 | 3.5 | 26 | 7.0 | 4.0 | 1.5 | 56 |
| 37 | 90 | 14.1 | 7.0 | 6.5 | 51 | 38.0 | 2.0 | 7.3 | 2.8 | 28 | 8.5 | 4.0 | 2.5 | 80 |
| 38 | 75 | 12.0 | 5.0 | 6.5 | 49 | 21.0 | 1.8 | 7.5 | 3.2 | 29 | 9.0 | 3.0 | 2.0 | 72 |
| 39 | 90 | 14.0 | 6.0 | 5.5 | 68 | 28.5 | 2.0 | 6.5 | 2.5 | 28 | 7.0 | 3.0 | 3.0 | 56 |
| 40 | 90 | 14.0 | 6.0 | 8.0 | 60 | 28.0 | 2.0 | 6.4 | 3.3 | 29 | 8.0 | 4.0 | 3.0 | 56 |
| 41 | 107 | 17.0 | 9.0 | 10.0 | 63 | 23.0 | 2.0 | 6.5 | 3.0 | 27 | 9.0 | 3.1 | 3.0 | 56 |
| 42 | 113 | 13.6 | 12.1 | 9.5 | 41 | 30.0 | 2.3 | 6.5 | 3.4 | 28 | 9.0 | 4.0 | 2.5 | 56 |
| 43 | 115 | 20.0 | 10.5 | 10.0 | 61 | 30.0 | 2.3 | 7.0 | 3.0 | 28 | 9.0 | 3.5 | 2.0 | 56 |
| 44 | 100 | 16.0 | 9.0 | 7.5 | 70 | 19.0 | 2.0 | 7.0 | 3.5 | 29 | 9.0 | 4.0 | 7.0 | 64 |
| 45 | 70 | 15.0 | 11.2 | 6.5 | 71 | 24.0 | 1.7 | 6.6 | 3.0 | 28 | 9.0 | 3.1 | 1.0 | 96 |
| 46 | 115 | 20.1 | 12.4 | 7.5 | 41 | 25.0 | 1.7 | 7.1 | 3.0 | 28 | 8.0 | 3.0 | 2.0 | 56 |

Appendix I (cont.)

| | Quantitative characters | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 47 | 60 | 10.6 | 5.0 | . | 62 | 34.0 | 3.0 | 6.5 | 3.5 | 27 | 10.0 | 3.5 | 3.0 | 48 |
| 48 | 80 | 11.2 | 6.0 | 5.5 | 50 | 30.0 | 3.0 | 5.7 | 3.5 | 27 | 8.0 | 4.0 | 3.0 | 72 |
| 49 | 110 | 17.0 | 10.0 | 6.5 | 61 | 30.0 | 1.5 | 7.1 | 3.3 | 28 | 8.0 | 3.5 | 1.5 | 56 |
| 50 | 116 | 20.3 | 11.0 | 17.0 | 70 | 29.4 | 2.2 | 6.0 | 2.5 | 27 | 9.0 | 4.0 | 4.0 | 56 |
| 51 | 118 | 21.3 | 12.0 | 20.0 | 59 | 30.4 | 2.4 | 7.0 | 3.2 | 28 | 9.0 | 3.0 | 5.0 | 80 |
| 52 | 95 | 16.0 | 9.2 | 15.0 | 70 | 31.0 | 2.2 | 7.0 | 3.2 | 29 | 7.0 | 2.0 | 0.5 | 56 |