









You will notice on the above list, that several of the fast moving markers are multi-copy markers, which are very valuable, since they change more rapidly.

A multi-copy marker is one where several copies of the marker exist on the Y chromosome. The name of a multi-copy marker includes small letters, such as a or b, following the marker DYS name.

When selecting the markers for our various tests, Family Tree DNA included 1 or 2 multi-copy markers in each panel, corresponding to the four Y-DNA tests available. The 12 marker Y DNA test has 1 multi-copy marker. The upgrade to 25 markers adds 2 multi-copy markers, and the upgrades to 37 markers and then to 67 markers each include 2 more multi-copy markers. Inclusion of these multi-copy markers is important based on both scientific attributes of the marker as well as the genealogical implications.

Test	Multi-Copy Markers
====	=====
12 Marker	385a, 385b
25 Marker Upgrade	459a, 459b and 464a, 464b, 464c, 464d
37 Marker Upgrade	YCA II a, YCA II b and CDY a, CDY b
67 Marker Upgrade	395S1a, 395S1b and 413a, 413b

For markers to have value to genealogical research, they must be stable, but not so stable that they can't differentiate lineage, and also change, but not change so quickly that closely related persons don't match. A well-formed panel includes a range of markers which change more rapidly and markers which change less rapidly.

Multi-copy markers tend to change more rapidly. Markers which change more rapidly are valuable to genealogical applications of DNA testing, to differentiate lines or branches, or identify persons who are not related. Rapidly changing markers are valuable in differentiating unrelated individuals using a small number of markers.

Marker DYS464 is a rapidly changing Y chromosome marker and a multi-copy marker. It most often has four copies, which are labeled: DYS464a, DYS464b, DYS464c, DYS464d. Marker DYS464 is also known to occur more than four times. Additional copies of DYS464 are called: DYS464e, DYS464f, and so forth. When more than four copies of DYS464 are found in a DNA sample, the results for all the copies are provided by Family Tree DNA.

When testing a random sample of 679 males for DYS464, scientists have found that the result 15,15,17,17 occurred in 10.6% of those tested, 15,15,16,17 occurred in 7.5% of the samples, and all the other results occurred less than 5% of the time, with over half these results only occurring once. This illustrates that marker DYS464 is valuable in differentiating unrelated persons.

The results for a multi-copy marker are reported in ascending order. For example, here are some results for DYS464:

11 11 14 16  
12 14 15 16

Since the results are reported in ascending order for multi-copy markers, this must be taken into account when comparing the results of the markers between individuals. For example, consider the following results:

Example 1: 15 15 17 17  
Example 2: 13 13 15 17

At a glance, you may see 3 differences, but there are really only 2. To correctly interpret the results for this multi-copy marker, the results that match are not counted as differences. The 15 in the first example above matches a 15 in the second example, so the 15 is not counted as a difference, even though the two 15's do not line up in the display of the results. A 17 from the first example matches the 17 in the second example. The two 13's in the second example do not have a match in the first example, so in comparing these two results, we find 2 differences.

Since multi-copy markers change more rapidly, these markers are an excellent tool to identify branches or lines, or to identify persons who are not related in a genealogical time frame.

