Table 3. Results of Powder Tests (3.5 gram Samples).

Charcoal Type	Ave. Velocity (ft/s)	Ave. Peak Pressure (psi)
Skylighter Air Float(Hubing)	70	—
Carolina Buckthorn (Judd)	226	117
Aspen (Hubing)	237	—
Thinleaf Alder	270	240
Ailanthus	328	396
Alder Buckthorn (Fielder)	445	762
Black Willow (Fielder)	473	819

Note that the best powders in Table 3 outperform those in Table 2. If the Aspen performance is used as a baseline, the values for speed in Table 3 should be multiplied by 1.6 to obtain the expected speed if 5 grams had been used.

Results

Powder performance was determined using a test apparatus designed to simulate the approximate conditions in the firing of aerial shells.[14] Results are shown in Tables 2 and 3. The interpretation is rather straightforward, and only a few comments are needed. The best performance was obtained first from the Willow charcoal obtained from Guy Lichtenwalter and the Black Willow based powder from Jack Fielder. The author's NLC based powder was a significant performer as well. Note that Goex brand Black Powder gives results that are lower than most of the handmade samples. The Fielder Buckthorn-based powder and the author's Ailanthus-based powder also performed respectably.

Future Research

The production of the best charcoal from Carolina Buckthorn and Alder Buckthorn is still being studied. It is possible that these Buckthorn varieties require more careful drying before pyrolysis than other types of wood. The high performance of Ailanthus also merits more research to elucidate the relationship between the physical and chemical properties of the wood with the charcoal produced from it.

There have been numerous pyrogolf competitions over the past few years, and it is quite likely that the best charcoal from any one wood species has yet to be made. One PGI pyrogolf participant very nearly won the first event with a Maple based lift powder. Another participant made a very good powder from Red Cedar.

The author plans to obtain scanning electron micrographs of several of the charcoals discussed here. A heuristic method of determining the degree of graphite structure in the charcoal will then be applied. In a related study, the volatile components of a particular charcoal could potentially be removed with solvents. Then the charcoal would be compared to itself, with and without these volatile components. Oglesby[16] indicates that powder made from so-called "stripped" charcoal is just as fast as or faster than the original.

The effects of the various pressing methods also need to be studied. It is clear that, in general, the lower the density of the grains, the faster the powder.

Another aspect of a given charcoal is the percentage used to produce the powder. All of the experimental lift powders discussed in this work and by O'Neill[17] use the 15/3/2 Waltham Abbey proportions, but a given charcoal may produce better results in a 6/1/1, 25/5/4 or even 5/1/1 mixture. This has not been studied.

Finally, a significant aspect of commercial Black Powder should be examined. Namely, Goex brand powder burns significantly cleaner than the handmade lift powders discussed here.