Scripts and methods for tag production

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This note describes the methods we use to generate and manufacture a variety of barcoded tags and labels for use in the field and seed room.

Generation. A set of Perl scripts and modules that generate barcoded plant tags, seed packet labels, row tags, inventory labels, harvest tags, cross tags, and leaf emergence tags has been written. All scripts take a comma-delimited file dumped from a spreadsheet or database and are easily adapted for different tag layouts, barcode encodings, and other media. Several libraries have been written, including subroutines that lay out boxes on several different types of Avery labels to guide the placement of elements and others that typeset genotypes. The current versions of the scripts and sample input and output files are available at http://www.maizelesions.org/scripts.html.

The scripts rely on several freely available open source packages in addition to Perl: LaTeX, GNU barcode, and any PostScript or PDF viewer. Like Perl, these packages are available for any platform (Unix, MacIntosh, Windows, VMS, etc.), often as binaries, and their installation is straightforward (GNU barcode requires a simple compilation in C). Linux users running the KDE windowing environment and not wishing to edit Perl scripts may wish to try KBarcode (http://www.kbarcode.net/).

All scripts generate a 128-bit barcode to make it more robust to degradation. Each barcode is accompanied by an alphanumeric translation for people. For labelling plants, a 15-character barcode is used. Rows, seed packets, bags, sleeves, and boxes are labelled with a 6-character barcode; the first character is a prefix denoting the type of object (r, p, a, v, and x, respectively). Depending on the use of the tag or label, successive tags are printed vertically or horizontally; the vertical arrangement lets a stack of tags fit in an apron pocket. Each stack is labelled with a number to help keep the tags in order.

Plant Tags. We use an 8-up 8.5 x 14 in perforated sheet of tags to label plants, available from the University of Missouri print shop. These have three sections: a long section that is wrapped around the stem, pulled through a hole in the tag, and twisted to lock the tag in place; and two smaller tear-off tags. Barcodes, rowplant identifiers, crop, and genotypes are repeatedly printed on the three sections.

We use the tear-off tags during pollinations to label the bags with female and male parents; in the seed room these are removed from the pollination bag and stapled together to form the harvest tag. (A simple staple remover can be built by trimming a flexible, soft-handled putty knife with tin snips to form a tongue just narrower than the staple; a file is used to bevel the front of the tongue and dress the other edges.) Though these labels are quite robust to the weather, some barcodes do degrade to illegibility to the scanner or eye and must be replaced before constructing the composite harvest tag in the seed room. A separate script prints the equivalent of the tear-off, cross tags, together with the maternal numerical genotype, on 8.5 x 11 in card stock in 30-up layout.

While the current design is very useful, our experience this past summer has suggested several improvements. The most important is to increase the robustness of the design to errors in feeding the tag stock through the printer. If the sheets are not laid snugly in the tray, tear-off tag barcodes can be clipped by the perforations; thus, quality output depends on vigilant monitoring of the printing. I am currently modifying the layout to improve robustness, to enable all the redundant barcodes on the long section to function as tear-off tags, and to improve the abbreviation of genotypes on the tag. The modified script should be available this winter and a notice will be posted on the web page.

Seed Packet Labels. The script prints the packet barcode, numerical genotype, row number, sleeve number of the source ear, number of kernels, and row length on Avery 30-up 1 x 2 5/8 in labels (# 5160).

Row Tags. These have the row number, crop, investigator name and address, field, and family. In the 2006 season we printed these on the 2 x 4 in labels and mounted the labels on wire-threaded shipping tags. For the 2007 season we printed these directly on card stock. I may modify this to include the row's barcode for harvest management; if so, the revised script and a notice will be posted to the web page.

Harvest Tags. These have the maternal and paternal barcodes, the numerical and abbreviated symbolic genotypes of the parents, ear number, and the date of pollination. For the 2006 crop we printed the tags on Avery 10-up 2 x 3.5 in (# 5871) business card stock; we now print these on card stock. A subroutine to print lines to guide the cutting is available for this label arrangement; if useful it will be extended to other tags printed on card stock.

Inventory Labels. Barcodes to identify bags and sleeves for seed and ear storage are printed on the small 30-up labels. The bag labels are affixed to a shipping tag or a leaf emergence tag, and the sleeve labels are pasted directly on the inside back of the sleeve. During inventory, the harvest tag and the bag or sleeve label are scanned. The box labels are printed in pairs on Avery 20-up 1 x 4 in (# 5161) labels. The left label gives the investigator's surname, crop, and box number. The right label has room for a description and the box's barcode. During inventory, each bag or sleeve is scanned with its box. Thus, each ear or packet is located to its sleeve and box.

Leaf Emergence Tags. To help monitor the emergence of leaves, we printed the plant's barcode, row-plant identifier, and a table of leaf numbers on the small 30-up labels. The table has space to write the date the leaf emerged; the observer only scans the tag when a new leaf appears in the whorl. The labels were affixed to our manufactured leaf emergence tags. These tags can also serve as pollination tags in a pinch.

Manufacture. In organizing our manufacture of tags, we balance ease of printing, the number of steps in construction, and cost. For example, we could print the labels directly on the seed packets, rather than on labels that must then be transferred to the packets. However, feeding packets through the printer is slower

and more tedious than sheets of labels. Whenever feasible, we print the data directly on 54 lb card stock, then drill and cut the stock. This stock is the heaviest that Hewlett-Packard laser printers are designed to feed. We use a straight-through paper path to minimize wear; periodically refilling the paper tray helps pace the printing so that the printer can cool. This path also lets us avoid punching the chad from the plant tag sheets before printing. Harvest and replacement tear-off tags are simply cut; row and leaf emergence tags must first be drilled to accommodate a twist tie and cut apart.

To drill holes, a cardboard or thin plywood template is prepared and the stack of printed stock clamped tightly between it and another piece of wood. A long 1/4 in augur bit in an electric drill is used. For cutting, a backsaw, knife, or paper cutter can be used; sawing requires the stock be tightly clamped on both sides of the saw, but is fastest if the number of sheets is large. Drilling and cutting can also be performed at many office supply stores on relatively short notice.

We use twist ties to attach tags to plants or mesh bags. The leaf emergence tags have two holes approximately an inch apart for reinforcement; the tag is folded between them and the twist tie threaded through and tightly twisted. The label is affixed; tags for each row are threaded onto another twist tie; and the bundles are hung from a coat hanger in row sequence for transport to the field. In our summer nursery we only attach row tags to mesh bags at harvest; tags for rows without pollinations are set aside for monitoring the completeness of the harvest.

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