

# Aviation Management Tech Tips

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## Helimulching—Equipment and Techniques

*Bob Skeen, Helitack Supervisor, Sante Fe National Forest*

*Ryan Becker, Mechanical Engineer, San Dimas Technology & Development Center*

### Introduction

Helimulching (the aerial delivery of straw mulch from helicopters) is becoming common practice for the treatment of landscape-size burn areas. Specialists have tried and tested several types of equipment and techniques, with varying levels of success. Most of these techniques involve the use of commonly available equipment in nonstandard (other than intended) ways.

This publication, written by Bob Skeen, helitack supervisor, from the U.S. Department of Agriculture Forest Service Southwest Region's Santa Fe National Forest, discusses two helimulching methods using equipment in nonstandard ways. The information will be useful for Forest Service employees, cooperators, and other land management agency personnel involved with the rehabilitation of burned areas.

All of the helimulching techniques to date involve the nonstandard use of equipment. The Forest Service's Missoula Technology and Development Center is working on developing specialized equipment for helimulching. Until such equipment is available, this publication discusses the current best practices and provides technical guidance for the aviation personnel tasked with aerial mulching projects.

### Project Planning

Appropriate aviation personnel need to be involved in the planning process as early as possible. The project begins with a project aviation plan covering the required elements in the *Interagency Helicopter Operators Guide*, chapter 3. Project planners may complete a stand-alone job hazard analysis (JHA) or incorporate a JHA into the risk analysis of the project aviation plan. The author of the plan should be either a unit aviation officer or someone qualified at the helicopter-manager level. Forest Service employees may access sample

project safety plans through the San Dimas Technology and Development Center (SDTDC) Intranet Web site: <http://fsweb.sdtc.wo.fs.fed.us/programs/aviation/index.shtml>.

During the project, the helibase manager or a helicopter manager should control helispot operational layout and all activity, including traffic management. Locating helispots and staging areas for straw determines the efficiency and cost of the project more than any other factor. The sites should be as close to the project area as possible. Even small reductions in turn-around times can result in significant savings after a few turns. If a site is workable only with site improvements, the time and money spent on those improvements can significantly increase production and efficiency. Sites must allow access for the trucks that will deliver straw, with adequate room for turn-arounds or pull-throughs. At least three-fourths of an acre, with a clear helicopter departure path, will work for most projects. If more than one helicopter works at a time, each needs the same amount of space.

The helibase will operate like any incident helibase, with parallel personnel and logistical needs except for the addition of extra personnel and equipment for loading straw. In addition, the cargo area for staging and loading straw will be very large. Project managers need to use *Interagency Helicopter Operators Guide*, appendix B, Helibase Management forms and checklists to cover all required helibase management elements.

Other items to consider during project planning include:

- Adequate room for straw storage.
- Water drainage, mud, stable ground, etc.
- Bridge load limits (for supporting a tractor trailer with a full load of straw).



**For additional information, contact:** Aviation Management Program Leader, San Dimas Technology & Development Center, 444 East Bonita Avenue, San Dimas, CA 91773-3198; Phone 909-599-1267; TDD; 909-599-2357; FAX: 909-592-2309  
Lotus Notes: Mailroom WO SDTDC@FSNOTES • Intranet (web site): <http://fsweb.sdtc.wo.fs.fed.us> • Internet e-mail: [mailroom\\_wo\\_sdtc@fs.fed.us](mailto:mailroom_wo_sdtc@fs.fed.us)

- Gates, ditches, etc. (for tractor trailer access).
- Public interest and crowd control.
- Adequate communications.
- Flight hazards, power lines, special use airspace, etc.
- Dust abatement (from vehicle and foot traffic).
- Consultation with resource managers on presence of noxious weeds, impacts to wildlife habitat, and cultural resource impacts.
- Location of helicopter fueling areas (away from straw storage and riparian areas).

## Methods

With several rigging methods possible, many vendors performing end-product contracts have developed their own equipment and methods. The Forest Service has developed and extensively tested two basic methods on several projects. The Rodeo-Chedeki Burned Area Emergency Response (BAER) Project in Arizona refined a method used on projects in Utah and other areas. The Rodeo method, which uses cargo nets available in the cache system, has been used on several projects in Arizona and New Mexico with more minor refinements. For the Biscuit Fire in Oregon, researchers developed a method that uses commercially available cargo nets. This method has worked on projects in Montana, Idaho, and Utah. Both methods involve keeping the net--and its associated hardware--after releasing the load of straw.

Both the Rodeo and Biscuit methods utilize the same basic longline/remote hook configuration. The longest line with which the pilot feels comfortable will be the best (100-foot minimum) and it will minimize the downwash and dust for personnel on the ground. Both methods also use a continuous electrical contact swivel (Canam swivel) installed between the end of the longline and the remote hook. Users can attach the Canam swivel either with clevises (a U-shaped metal piece with holes in each end through which a pin or bolt is run) or with a Canam universal joint adapter.



Figure 1—Remote hook and Canam swivel.

## Rodeo Method

This method uses standard cache system cargo nets. Both 12- by 12-foot or 15- by 15-foot nets work, depending on the size of the straw bales. Generally, the larger 15- by 15-foot net is preferred because it will hold either size bale.

To use the Rodeo method, attach a retrieval line to the cargo net. Attach a standard 12-foot leadline or 15-foot nylon sling (tow strap) to the center of the net--on what will be the bottom of the net. To locate the center, count the squares of the net. Attach the snap hook of the leadline or tow strap through the four bights of rope that make up the center square. Pull the net and the line tight and securely tape the snap hook to the loops of net using fiber-filament tape. Use enough tape so that the hook cannot rub or move against the nylon cord. If the hook is allowed to move against the fibers of the net, it will wear through the net, causing the net to fail. If the tow strap does not have a snap hook, use steel carabiners to attach the strap. This part of the retrieval system will remain with the net. One leadline or tow strap is required for each net.

The rest of the retrieval system consists of a nylon sling and swivel attached to the longline and remote hook. The length of the sling is dictated by the length of the retrieval line used on the net. Use a 10-foot sling or choker if using a 12-foot leadline, and a 6-foot sling if using a 15-foot tow strap. Fold the sling in half and attach it to the cage of the remote hook using a half hitch. Attach a swivel to the free ends of the strap. This part of the retrieval system will remain attached to the remote hook.

Whichever specific equipment is used, 17 to 18 feet of total retrieval line is required. An alternate method is to attach a 3- or 5-foot sling between the remote hook and Canam swivel with a clevis. This method eliminates the concern of using an unrated protective cage for a nonstandard use. However, to date, there have been no documented problems with attaching the retrieval line to the cage. The helicopter manager and vendors need to evaluate carefully the suitability of a specific cage when deciding which method to use.

Spread out the net into a square to load straw. Stretch out the retrieval line underneath the net. Load straw into the middle of the net. A 15-foot net will be at maximum capacity at 1,200 to 1,500 pounds, and a 12-foot net at 750 to 1,100 pounds. Large bales require mechanized equipment (hay squeeze, fork lift, or front-end loader) to load. A fork lift or loader requires a hay-fork modification for lifting straw. Small bales can be loaded by hand. After the bales are loaded, strings on the bales are cut and removed. Pocket knives or diagonal wire cutters work well for cutting the strings.



Figure 2—Rodeo method, showing attachment of retrieval lines to remote hook.



Figure 3—Rodeo method, retrieval line is stretched out under net.



Figure 4—Rodeo method, net ready for hook up. The retrieval line attaches to cage of remote hook and rings on net attach directly into remote hook.

After the straw is loaded and ready to go, the net can be attached to the remote hook. The net's metal rings are attached directly into the remote hook without a swivel. The retrieval line on the net is attached to the swivel on the short retrieval line and then attached to the hook. If using a leadline or sling without a snap hook as a retrieval line, a steel carabiner is required to attach the line to the swivel. The hook-up procedure may be accomplished with one person, but using two people is faster and more efficient.

### Biscuit Method

The Biscuit method uses commercially available square cargo nets without self-pursing drawlines. The nets used for the Biscuit BAER project were 16- by 16-foot flat-webbing nets from a local surplus store. However, this system is easily adaptable to any size square net available.

The retrieval line is a short nylon sling attached with a clevis between the remote hook and Canam swivel. The length of the sling is sized so that it hangs down inside the cage of the remote hook about level with the bottom of the hook. This short sling will stay attached.

A simpler, alternate method of attaching a corner of the net to the cage of the remote hook provides one less piece of equipment that could fail or cause problems. If the nets used do not have steel rings attached at each corner they will need to be modified by attaching an oval, pear, or round ring to each corner. You will need to load three rings onto the remote hook, so choose rings that will fit the best without the possibility of jamming upon release. Attach one corner of the net to the retrieval line or remote hook cage. Attach the steel rings to the corners of the net with clevises, shackles, or directly into the net with half hitches. Consider using a snap hook or swivel instead of a ring for what will become the retrieval corner. Otherwise, use a steel carabiner.

When the net is loaded with straw and ready to fly, attach the retrieval corner of the net to the short retrieval line of the longline/remote hook or cage using a steel carabiner, snap hook, or swivel. Attach the remaining three rings and the remaining corners directly into the remote hook.





Figure 5—Biscuit method, one steel ring is attached to the cage of the remote hook. The other three rings are attached directly into the remote hook.

### Safety Considerations

The large number of personnel, combined with the use of mechanized equipment, creates hazards not normally found in regular cargo transport operations. Personnel need a full briefing on the operation, including these safety hazards:

- Establish a safety area outside the safety circle for personnel and equipment when helicopters are hovering over the loading area.
- Establish a standard escape route for personnel hooking up the loads. (Personnel not involved in hooking up the load should be in the safety area.)
- Ensure the escape route is free of straw bales or other obstacles.
- Always bring the remote hook to the rings to be hooked up. (This gives the hook-up person positive control over the remote hook and end of the longline.)
- Never climb or step over the longline or rigging attached to the longline.
- Always leave a way out. Do not get into a position with the load between you and the escape route.
- Never get directly behind a piece of mechanized equipment.
- Ensure that all mechanized equipment has backup warning systems installed.
- Never work directly between mechanized equipment and immobile objects (large bales, other vehicles, trees).

### Straw

Many types of straw bales have worked successfully. Composition and size vary, often dictated by availability. Large bales of wheat or barley straw weigh between 800 and 1,400 pounds. Large bales of rice straw weigh about 800 pounds. These weights vary according to moisture content, size, and compactness.

Size of straw bales makes no difference in treatment effectiveness—both large and small bales are effective. Moisture content is the most important factor. Moisture content needs to be less than 15 percent. To keep the straw as dry as possible, personnel must never store straw on the ground in an area prone to pooling water. Always cover the straw if there is the least chance of rain. Accept only rice straw chopped to 6- to 8-inch lengths and wheat/barley straw chopped to 8- to 12-inch lengths.

Although large bales require mechanized equipment and equipment operators to move and load them into nets, straw-supplier vendors generally have this equipment available. Small bales weigh from 40 to over 100 pounds. Although personnel can load small bales by hand, they are much more labor intensive to manage. Therefore, try to keep the weight of small bales under 70 pounds. Using small bales allows project personnel to adjust payloads for maximum helicopter efficiency.

### Nets

With dry straw, a 15-foot net will be at maximum capacity at 1,200 to 1,500 pounds, and a 12-foot net will be at maximum capacity at 750 to 1,100 pounds. The number of bales that a net can carry will vary by the size of both the bales and the nets. A good average is five to eight 70-pound bales or one 3- by 4- by 8-foot 1,000-pound bale for a 12-foot net. Fifteen-foot nets have been known to hold 16 to 20 50-pound bales, 12 to 15 70-pound bales, or a large bale of almost any size. A 20-foot net works for two 800-pound bales or 20 70-pound bales. With a little use, the nets will stretch and accommodate more straw. New nets, therefore, will hold a little less than used nets.

The current consensus is that larger nets work best. Depending on payload capability, a 15-foot cache net will work with most high-performance type III helicopters under typical conditions (i.e., a 1,500-pound payload). For larger payloads, an 18- to 20-foot net is optimal. The current net of choice for use with the Biscuit method is the Brownell 18-foot four-corner net. Normally, flat nets will have one ring and three hooks on the corners of the net. Nets with this configuration will need modification, i.e., replacing the hooks with rings so that they will fit into the remote hook. Managers should specify steel rings instead of hooks when ordering nets.



Figure 6—Brownell four-corner nonpursing net--required for Biscuit method.



Figure 7—Preferred steel rings for Brownell nets.

During loading, the string will need cutting and removing after the net is drawn up. If loading several small bales, load the bottom tier of bales into the net. Cut and remove the string from the inside bales that cannot be reached later. The straw will be held in place by the outside bales. Load the second tier of bales and purse the net up. Cut and remove the remaining strings. Generally, it will be easier to remove the strings on the lower tier first.

### Airspeed and Drop Height

Both airspeed and drop height affect the dispersal of the straw mulch. Optimum airspeed and drop height will vary according to the dispersal characteristics of the straw. In general, an airspeed of about 50 knots and a drop height between 150 and 500 feet are a good place to start. Initially, a ground observer will help give the pilot feedback on the desired coverage. By trial and error, the pilot will learn to determine the optimum airspeed and drop height. Managers have reported

that small bales disperse better at lower airspeeds—an important consideration for confined areas where airspeed needs limiting.

Pilots report that releasing a load of straw is similar to releasing water from a bucket. Occasionally, pilots report very hard jolts when releasing straw. This problem likely results from the straws' becoming hung up in self-pursing nets. To date, no one knows the effect of repeated shocks to the airframe of a helicopter. The Biscuit method does not seem to generate the same hard shocks as occasionally reported by pilots using the Rodeo method. Consequently, aviation managers should prefer the Biscuit method.



Figure 8—Dispersion of straw dropped from 150 feet at 50 knots.

### Crew

The number of required personnel will vary by the number of aircraft involved in the project, the duration of the project, and the size of the straw bales used. The project needs an appropriately qualified helibase manager and helicopter manager for each helicopter. At least two qualified helitack personnel are necessary for hook ups and handling hardware for each helicopter. With large bales, equipment operators have to handle each piece of equipment. Having at least two pieces of loading equipment is wise. To mitigate possible equipment down time, the project will need 8 to 10 people for loading nets by hand. For a project of long duration, 20 people optimally can maintain productivity and prevent injury and burnout. Although the loaders need not be helitack, they should have some basic aviation safety training. In addition the project needs someone to operate radios, to track bales of straw delivered, and to track helicopter time.

## Equipment Sources

### Vendor

Field Support Services  
770-454-1130  
<http://www.helifire.com>

Northern Tool & Equipment Co.  
800-221-0516  
<http://www.northerntool.com>

Brownell & Company  
P.O. Box 362  
Moodus, CT 06469  
860-873-8625  
<http://www.brownellco.com>

Cargo Systems, Inc.  
P.O. Box 81098  
Austin, TX 78708-1098  
888-350-3127  
512-837-1300  
<http://www.cargosystems.com>

Indusco  
1200 West Hamburg Street  
Baltimore, MD 21230  
800-727-0665  
410-727-0665  
<http://induscowirerope.com>

Arctic Wire Rope and Supply  
6407 Arctic Spur Road  
Anchorage, AK 99598-1545  
800-478-0707  
907-562-0707  
<http://www.arcticwirerope.com>

### Equipment

Canam swivel, square cargo nets, universal adapter

Slings, tow straps, tree savers

Square cargo nets

Hardware, nets, slings

Hooks, shackles

Cargo nets, hardware, slings

SDTDC's national publications are available on the Internet at:

<http://www.fs.fed.us/eng/pubs/>

Forest Service and U.S. Department of the Interior Bureau of Land Management employees also can view videos, CDs, and SDTDC's individual project pages on their internal computer network at:

<http://fsweb.sdtdc.wo.fs.fed.us/>

For additional information on helimulching, contact Ryan Becker at SDTDC. Phone: 909-599-1267 ext 260. E-mail: [ryanbecker@fs.fed.us](mailto:ryanbecker@fs.fed.us)



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