Examples of Effective Applications

1. *Below*: *Sunburst* Push Cart

Suitable for spot weed control or where maintenance areas are relatively small (e.g., driveways, paths, gravel areas).
Left*:* late stage prototype in use. ***Right****:* established grasses 2 days after 1 treatment. (Ave. rainfall +/40" per yr.)


Below: ***Left***: Current commercial model at 2007 trial plots. ***Right****:* 2007 trial plots in May.
Note untreated strips of dense sod between treatment areas.


Below: ***Left*** and ***Right****:* 2007 trial plots in October (no treatments since May). Newly germinated seedlings after fall rains are easily killed with one treatment.


2. ***Below***: Baseball Infield (Veneta, Oregon; 10 miles west of Eugene; ave. rainfall +/- 40" per yr.)

Left: dead seedling grasses and damaged perennial weeds 1 week after 1st treatment, early April. Note green "control" area (temporarily untreated) in center of field – area received delayed treatment to highlight impact of initial application of Sunburst equipment.

Above: ***Sunburst's*** original boom mounted unit (4'x5') attached to a 55 HP tractor; beginning 3rd treatment to continue removal of well-established grass clumps.

3. ***Below***: Examples of weeds immediately after treatment. Appearance of a fingerprint when leaves are pressed between a thumb and forefinger indicate adequate tissue damage (i.e., treatment is sufficient to cause death of the plant tissues).

4. *Above* – culvert openings freed of dense grass to facilitate the flow of water & to provide improved visibility for implementing ditch maintenance operations that might damage hidden culvert openings (e.g., ditch pulling near the culvert openings). Above results are from 3-4 treatments of dense vegetation (e.g., Reed Canary Grass). With routine application of ***Sunburst*** equipment, *plant growth can be significantly inhibited while also maintaining a living sod, providing multiple benefits*: reduced use of herbicides in water channels, maintenance of optimum flow capacity, reduced clogging of culvert openings from collected debris; helping prevent overflows and erosion damage, clear visibility for maintenance operations around the culvert openings.
(Ave. rainfall +/- 60" per yr.)

5. *Below*: Road Shoulders (Route 99 between Eugene and Cottage Grove, Oregon). (Ave. rainfall +/- 40" per yr.)

a. ***2 Photos at Left*** (same site): 10 days after 1st treatment in April (left) and immediately after 2nd treatment (right); seedling weed growth is an ideal condition for use of ***Sunburst*** equipment.

b. ***2 Photos at Right*** (same site): 10 days after 1st treatment in April of moderately dense, well established weeds (left), and after six applications (right; late June) - well established weeds require several treatments to eradicate them; ***Sunburst*** recommends pulling and blading of shoulders with these conditions, or treatment with herbicides, to remove the existing weed population; timely applications with ***Sunburst*** equipment the following Spring (as in the photos on the Left) will then control shoulder weed development with a minimum number of treatments (typically, 1-4 times per year depending upon site conditions). Routine use of ***Sunburst*** equipment can reduce or even eliminate shoulder pulling and blading operations required for removing unwanted weed growth.

6. ***Below***: ***Left***: (2 different sites, Williams, Oregon)) - blackberry on road shoulders being controlled with ***Sunburst*** equipment (left – 2nd treatment being applied, note: steam, dead canes from 1st treatment, and wilted canes from 2nd treatment; right – 10 days after 1st treatment, dead canes lying on road shoulder). (Ave. rainfall <20" per yr.)

Right: (same site, Triangle Lake, Oregon): effective *control* of Horsetail (resprouts after 1st year of treatment were weak and very slender in diameter; resprouts in 2nd year were further reduced in number, size and vigor). Only 4 out of 8 planned *broadcast* treatments were applied to this road shoulder during the first year because control was so effective. Likewise, only 3 *broadcast* treatments were implemented in the 2nd year. All subsequent treatments (as required by the project protocol) were limited to scattered spot applications where weak sprouts were observed. (Ave. rainfall +/- 60" per yr.)




7. ***Below***: Bridges – Sensitive Areas (between Williams and Grants Pass, Oregon). (Both sites: <20" of annual rainfall.)


a. **Left**: weed growth along railing controlled with 2 applications of ***Sunburst*** equipment. (*Note* herbicide use along irrigation channel).
b. **Right**: weeds on road shoulder and in front of concrete curbing controlled using 2 applications of ***Sunburst*** equipment.

8. ***Below***: Vineyard (south of Eugene, near Lorane, Oregon). (Ave. rainfall +/- 40" per yr.)


Left: before treatment (Spring season). **Right**: About 10 days following 1st treatment. Berms along the vine rows also annually treated with a "spider"-type tilling implement.

9. ***Below***: Alaska Railroad (Ave. rainfall +/- 50" per yr.)


Above: hi-rail truck outfitted with two four foot, boom-mounted thermal units and 1 eight foot wide center, frame-mounted thermal unit. **Left**: preparing for work. **Right**: at work: note spray from perimeter watering system. Mounting of units to booms and set-up of supporting systems provided to the railroad by a fabricator in Anchorage, Alaska. Initial training of work crews and consulting to railroad staff with respect to effective use of equipment provided by ***Sunburst***.


Above: dense, established weeds, trees, and brush after initial treatment. The Alaska RR has many miles of severely overgrown track due to a prohibition of herbicide use since 1985 and lack of effective alternatives following abatement of routine spraying. (Ave. rainfall +/- 50" per yr.)

A demonstration project instituted by the railroad in 1998 tested 3 different thermal weed control systems, resulting in the railroad's decision to purchase ***Sunburst*** equipment. However, while ***Sunburst's*** thermal units have been proven to be cost-effective, the railroad has returned to reliance on extensive, routine use of inexpensive hand methods implemented by large inmate labor crews.

Wide-scale use of Sunburst's equipment has been seriously inhibited by (1.) factors related to labor union contract terms, and (2.) an inability to respond to the critical nature of the timing requirements of thermal weed control treatments (largely due to the availability and limited access-flexibility of only one large truck for 500 mi of track, much of which winds through remote locations).

Based on Sunburst's experience with the demonstration project in 1998, and with initial use of the AK RR's vehicle, we estimate that a thermal treatment program employing a contractor with several crews (e.g., 3) that could simultaneously treat the entire rail system 2-3 times per year would be very cost-effective (given prior removal of the existing well-established vegetation – which would best be accomplished by a spray program in support of an intensive initial thermal weed control treatment regime).

10. ***Below***: Saint Lawrence & Atlantic Railway, Northeastern Vermont. ("NE Kingdom"; ~ 40-50" precip./yr.)


Left - Thermal units attached to a "Ballast Regulator"; treating the ballast side slope. ***Right*** and ***Below***: Well-maintained track where 1 treatment provided full control of new weeds invading the ballast.

In Vermont, numerous track locations were less weedy than the area seen in the right hand photo above. These lightly weeded areas required very limited or no treatment at all during the project (well-built & maintained track ballast is resistant to weed development due to the difficult growing conditions inherent in its physical structure). Sporadic development of weeds reduces treatment requirements, resulting in higher productivity and lower costs per track mile.

Due to delays in preparation of the ballast regulator, treatments were initially applied relatively late in the growing season (end of June). An earlier, more timely application (early-mid May) would have eliminated weeds before they had an opportunity to grow in size and nearly reach maturity, thus increasing average working speed and helping minimize seed development and dispersal ("seed rain") which could significantly exacerbate future control requirements.

(Note: Sunburst field trials in 2006 & 2007 in western Oregon demonstrated that Fall and even Winter treatments can be highly effective as part of a routine thermal weed control program, and, where feasible should be evaluated in treatment trials to determine an optimal thermal application schedule. Sunburst's trials are an on-going effort to help determine the best timing and methods for applying thermal control treatments in a variety of resource management settings.)

Timely treatments are a necessity for thermal weed control methods to be cost-effective. This fundamental principal pertains not only to current operations by limiting the size and establishment potential of existing weeds, but to future operations through prevention of seed development and distribution. Further, management of adjacent areas is also critical to prevent the development and dispersal of seeds (e.g., mowing of vegetation alongside road shoulders or railway verges).

Likewise, well maintained sites, almost universally - whether these are railway ballast, road shoulders, baseball infields, running tracks, gravel parking areas, etc. – are not uniformly invaded by weeds (i.e., weeds tend to occupy sites in an "uneven" manner; that is to say the distribution of invading weeds is not uniform over the managed site; weeds tend to grow more in some areas, less in others; in some cases, weeds take a long time to occupy particular sites/areas).

This naturally occurring "patchy" distribution of weeds facilitates control operations by limiting the need for treatment, enhancing productivity, and reducing costs. With careful observation and recording over time, "chronic" weed control problem areas and those that resist weed development can be identified. Mapping of weed distribution and growth patterns can assist with planning and implementing weed control programs. Today's availability of GPS/GIS systems, computer mapping programs, and other modern tools make implementation of such management assets relatively easy.


Above (left & right): Note old rails along the verge (interface of the ballast and the adjacent vegetation).
By design, ***Sunburst's*** equipment can often support implementation of treatments even where obstacles are present.