

Should Indaziflam (Rejuvra™) Be Sprayed on Front Range Parks and Open Space land?

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The Chemical

Rejuvra™ is a proprietary formulation of active ingredient (indaziflam, 19%) and the rest undisclosed adjuvants. It was approved in mid-2020 by the Trump Administration EPA for weed control on rangelands ¹.

Another product, Esplanade 200c™, is also 19% indaziflam and has been marketed by the same company since at least 2014. The only difference between Esplanade™ and Rejuvra™ is that the last is labeled for application on pasture or rangeland which will be grazed. Previously, the same formulation, marketed as Esplanade, carried this restriction: “Do not graze or feed forage, hay, or straw from treated areas to livestock”. The relaxing of this restriction for Rejuvra™ is based on EPA judgement concerning the likelihood of indaziflam and daughter chemical residues in food reaching levels above thresholds of concern.

When sprayed onto the land surface, this synthetic petrochemical binds to the topsoil a few inches below the surface. It thereby prevents germination of all shallow-rooted annual species (including, for example, cheatgrass). The chemical degrades under typical environmental conditions to other daughter (by-product) chemicals, but only slowly; it continues to poison all annual seedlings for up to 4 years.

It is a pre-emergent herbicide. It stops seedlings from sprouting and does not kill most already-green vegetation. Perennial plants sending up shoots from roots below the indaziflam barrier are unaffected. Persistence in the soil layer over at least several years is important for the objective: suppressing annual plants and allowing perennials to grow instead.

The Target

The benefit of this relatively newly invented chemical for weed control along the Colorado Front Range is that it inhibits annual plants and may allow more perennial grass to grow. This requires, however, that such plants and deep seeds and roots are already present in treated areas or that reseeding is accomplished. The herbicide treatment can thereby improve rangeland productivity by providing better forage for cattle. After the annual non-native grasses and plants, such as cheatgrass, are controlled, the perennial grasses can, potentially, take their place.

Front Range, Colorado parks and open space lands include large parcels that are managed for plant and animal conservation. The goal in such properties is to maintain “natural” vegetation and wildlife, reduce negative effects from past land use such as overgrazing and soil erosion, and also, where possible, reduce risk to surrounding areas from wildfire.

In regard to the last, cheatgrass is well-known for its “fire ecology” in the arid sage brush-dominated areas of Utah, Nevada, and other states. After cheat invasion, previously nearly bare-ground desert soils host dense, monocultural stands of cheat. This is prone to fires after it dies in mid-summer. After wildfires occur, leaving bare soil, the cheat then re-invades. Cheat provides some benefit, however, to local herds of antelope, bighorn sheep and other herbivores: important forage in the spring. It was planted by ranchers in the mid-20th century in some of these arid lands to provide more cattle forage. However, there is increased risk to local human settlements from wildfire: the cheatgrass provides fuel for such where there was very little before.

Cheat is non-native and considered a noxious weed in most western states, but efforts to eradicate it where it is present have been largely unsuccessful. Climate change may be favoring its further spread, as may also be the case for human-related disturbance in urban fringes. Unlike in arid sagebrush ecosystems, cheatgrass is not invasive in healthy Front Range grasslands and shrublands. It mainly colonizes bare ground. Where dense monocultural patches of it occur, this is commonly due to prior disturbance that has suppressed vegetation and provided bare soil areas for cheatgrass germination. Compared to native grasslands and shrublands, cheatgrass provides a lower fuel loading. Dry grass of any species, however, poses a fire hazard risk when growing adjacent to homes or farm storage structures. In such hazardous locations along the Front Range, replacing cheat with perennial grass does not reduce this risk because the latter is also seasonally dry and brown.

The barbed seeds (awns) of cheatgrass can harm cattle or horses that feed on it. Around urban areas also, pets can suffer from the seeds being embedded in noses, mouths, paws, and ears. Like many native plants, cheat is prickly, and perennial grasses are more desirable in settled areas.

The Product Label

The question now to be addressed is: should the cheatgrass growing in Front Range open space natural landscapes be controlled by Rejuvra™ applications?

The EPA-approved product label ¹ includes relevant information. On it, the maker warns about the persistence in the environment, the chemical’s ability to be transported off-site, and the bare-ground issue. It states that a reseeding program is needed when treating cheatgrass. From the product label:

- “This product is classified as having a high potential for reaching surface water via runoff for several months or more after application.”
- “DO NOT apply when powdery dry soil or light or sandy soils are known to be prevalent in the area to be treated. Treatment of powdery dry soil and light sandy soils, when there is little likelihood of rainfall soon after treatment, may result in off target movement and possible damage to susceptible crops and desirable vegetation.
- Injury to crops or desirable vegetation may result if treated soil is washed, blown, or moved onto land used to produce crops or land containing desirable vegetation.
- Applications should be made only when there is little or no risk of spray drift or movement of applied product into sensitive areas. Sensitive areas are defined as bodies of water (ponds, lakes, rivers, and streams), habitats of endangered species and non-labeled agricultural crop areas.
- Removal of dense stands of annual grasses or other weeds in degraded areas with few perennial species remaining may result in large areas of bare ground devoid of vegetation. Before making applications in such areas, a multi-year restoration management plan should be in place.

The *Boulder County Weed Management Plan* is now in review. Clearly, it should be responsive to these and other warnings on the product label. There are dense stands of cheatgrass in some areas. They have been and are the target of Rejuvra™ spraying campaigns, including from the air. Application of the chemical in any areas that will not be reseeded or otherwise managed to prevent cheatgrass return violate the EPA product label: which sets a minimum standard for legal use. Where applications have occurred without such a multi-year restoration management plan, they are in violation of the product label, and potentially against federal law.

In this regard, cheatgrass does provide some ecosystem services. Where it grows on sloping land, it reduces runoff and erosion. In areas managed for nature, it may be more desirable than no vegetation cover. The long term goal is expansion of perennial native grasses into these treated areas. But simply spraying the Rejuvra™ cannot accomplish this. Instead, as noted, reseeding and a restoration plan to prevent the chemically-induced bareground from becoming overgrown with cheatgrass is necessary. However, the cost for this over large areas of thousands of acres may be too high to be practical.

Other Ecosystem and Public Health Effects

The native flora consists of both deep- and shallow-rooted species; all of the latter will be controlled. This includes threatened and endangered Colorado species if they are present

in the treated acreage. In lands managed for conservation of natural ecosystems, the potential loss of such species must be of major concern.

Some examples of undesirable effects:

1. From a Boulder County-sponsored study ²: "For (short-lived) native species, in burned areas, richness was 75% lower in sprayed areas than unsprayed areas, and this difference was highly significant" (page 11). The study also documents significant losses in species richness for native long-lived forbs in sprayed *unburned* areas. Native long-lived grasses as well exhibited decreased richness in sprayed parcels. The spraying mainly favored perennial non-native grasses (see their Table 4)². The chemical applications in this case actually favored non-native species
2. Such results agree generally with those of other field studies from other western U.S. locations which show pervasive and undesirable plant ecological effects ^{3,4, 5}. Meanwhile, inventories of native plants on Boulder County open space lands document the many native species that will be controlled if they are within the area treated by Rejuvra™ ⁶.
3. Potential negative effects on local aquatic ecosystems and soil microbiota are expected and have been observed in some studies. It is especially concerning that indaziflam is being stored in the tissue of aquatic organisms such as mussels. In some cases, however, it is the surfactant or other non-active ingredients that are the cause of negative effects ⁷⁻¹⁰.
4. Indaziflam itself is newly determined to be a potent amoebicide ¹¹ and is thus expected to poison this component of soil microbiota ¹².
5. There may also be undesirable indirect ecological effects from the point of view of wildlife conservation. The decimation of all annual plant species in the areas to be treated could have major effects on local native insect and bird species ^{13,14}. Cheatgrass has for many decades been resident in the Front Range foothills ecosystem. It provides a food source for deer, elk, and bighorn sheep at a potentially critical time in early spring ^{15,16}. If we are to expend major effort in attempting local eradication of cheat, evaluation of the expected benefits versus the expected losses is clearly in order.
6. Finally, the product was considered not likely to be carcinogenic to humans according to the EPA standards when it was approved. However, a new study demonstrates that in fact it is genotoxic to standard Hep2 (human) cells ¹⁷. Because of how recently indaziflam was approved for use, and its persistence in the environment and ability to be transported after rainstorms into drainages, this potential new hazard is important. It is likely that the tolerance thresholds for indaziflam residues in food could in the future be set much lower if further studies

confirm such findings, and in this case also the approval for rangeland use would require reconsideration.

Rejuvra™ in Boulder County's Version 2 Weed Management Plan

Many of these concerns have been previously raised with the agency (Boulder County Parks and Open Space) charged with preparing a revision to Boulder County's Weed Management Plan. A helicopter spraying campaign against cheatgrass using Rejuvra™ has now been modified to aerial drone applications. However, in the version 2 Plan, this spraying campaign has so far been otherwise left as is. It would treat an additional 3000 acres of open space land for cheatgrass in the name of "biodiversity", without acknowledgement of any negative effects on the ecosystem or public health. It also is not accompanied by a restoration program designed to address the bare ground issue. Here below is text quoted from this Draft Plan:

"Since 2019, BCPOS has successfully conducted treatments on about 4,300 acres of cheatgrass infestation within High Biodiversity Areas. And now, populations of cheatgrass within those treatment areas have been largely eradicated. Without competition from that cheatgrass, native plant communities in the treatment areas have rebounded from native seed source still present in the soil.

These past treatments have consisted of broadcast herbicide application to infested areas accompanied by ongoing monitoring. Going forward, drone application is planned for foothills areas where access is challenging due to steep and/or rocky terrain. These properties are identified with an asterisk () in the list below and identified on Implementation Map B-4b, Drone Application for Biodiversity Preservation. The drone application areas are about 3,000 acres in total."*

This text asserts that 4300 acres of cheatgrass have been "largely eradicated" where sprayed, and that native plant communities are rebounding. These already-treated areas are not, however, mapped, nor is any evidence presented for the resurgence of native plants on them.

Also, the 7300 total acres likely does include local drainages and wetlands, and rare and endangered plants. There is no detailed surveying of such, and no establishment of the critical buffers needed for drainages and local wetlands; at least not published in any of the associated planning documents. Given the acute toxicity of this chemical to aquatic invertebrates, fish, and (very likely though untested) amphibians and reptiles, this is an glaring omission in a Plan purporting to be about protecting biodiversity.

To emphasize this point, it is also the case that in the version 2 Plan there is no evaluation of any negative effects of this past and proposed chemical treatment whatsoever. This is surprising: even in the cheat control studies in which indaziflam is one of the chemicals used, and which include conclusions that it is a useful tool in rangeland restoration, there

is included abundant information on negative effects on non-target species¹⁸. The science is there to consider such effects and incorporate into decision-making, but the Weed Management Plan is silent on them.

To summarize:

- There is no long-term restoration plan for the treated acres described,
- There is no monitoring program described for evaluating where and which native plants are returning, and
- No monitoring is described for Rejuvra™ and daughter chemical levels in the soils and runoff and the soil and aquatic biota.

Recommendations

Rejuvra™ should not be sprayed on Front Range parks and open space land before demonstration that the expected ecological benefits will outweigh the expected negative effects. This is necessary work that should proceed any large scale spraying campaign of this chemical. Per the product label, it should also not be sprayed without specific long term management plans directed at re-establishing the vegetation cover.

After several years of chemical use on these properties already, there are still no data concerning whether (or not) any of the chemical has found its way into local wetlands or surface water after storm events. No assays have been performed. After completion of the planned work, a total of 7300 acres of land will have been aerially sprayed with this chemical formulation absent any assessment of the benefits and the drawbacks. This should be unacceptable given that the goals of such work are ecological in character.

Badly needed are metrics to assess progress towards specific ecological goals. Thoughtful study and analysis of fundamental questions could be accomplished, to address questions such as: 1) Where is the target species (cheatgrass) actually providing a net ecosystem service and need not be controlled at all. Where is its growth instead indeed posing an actual ecological threat? 2) What are the long term plant succession prospects in “pure” cheatgrass stands in typical Front Range grasslands and shrublands? Are they now fixed in cheatgrass cover, or will other shrubs and grasses eventually be established without any control interventions? Finally, 3) Are climate change and urban fringe-related NOx pollution now promoting rapid cheatgrass spread? Land management for ecological restoration purposes requires efforts to answer such urgent but difficult questions.

Two Sample Recommendations From Other Agencies

Even state extension services that accept chemical weed control as a central tool for cheatgrass control provide clear guidance about the steps that need to be taken to accomplish the management objective. For this (cheatgrass) weed target, spraying campaigns alone do not work.

Below is one such guidance from the Montana State University extension service. It highlights several matters detailed above: the persistence of this herbicide in the environment, the accompanying need for post-spraying monitoring, and the requirement for long term management plans including reseeded.

“If planting desired species into areas treated with Rejuvra™, avoid planting for at least 8 months and then conduct a field bioassay to determine residual herbicide effects on desirable species. The active ingredient persists, which is ideal for annual grass control, but needs to be taken into consideration if revegetation is necessary as part of an integrated weed management plan”

<https://www.montana.edu/extension/judithbasin/crops-and-livestock/news-and-alerts/rejuvra-epa-approval-rangeland.html>”

Also see a review jointly conducted by the Massachusetts Department of Environmental Protection Office of Research and Standards and the Massachusetts Department of Agricultural Resources regarding indaziflam applications in rights-of-way. It describes the critical importance of determining areas where aquatic species as well as amphibians and reptiles may be in residence and thus directly affected by applications of this chemical. Again, these are concerns that are entirely absent from the version 2 Boulder County Weed Management Plan but which certainly should be included. From that governmental agency review:

“However, impacts to amphibians and reptiles are based on surrogate toxicity information for fish and birds respectively, and as such have additional uncertainty. Therefore, additional precautions should be taken as warranted to identify potentially significant amphibian and reptilian habitat prior to application. Sensitive non-target plant species have been identified as organisms of concern. Given that herbicides are designed to control plants, this is not surprising. This information, coupled with the fact that indaziflam is moderately mobile and some of its metabolites are highly mobile strongly indicates that application of indaziflam should be targeted as much as possible to avoid impacts on non-target plants. Measures that minimize drift should be used in applying this product. In addition, as with any application, a preliminary field survey should be conducted prior to application to identify any plants on the endangered species list and/or any other plant species that are important to that ecosystem.”

<https://www.mass.gov/doc/indaziflam-2022/download#:~:text=Based%20upon%20the%20available%20database,Rights%2Dof%2DWay%20Regulations.>

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