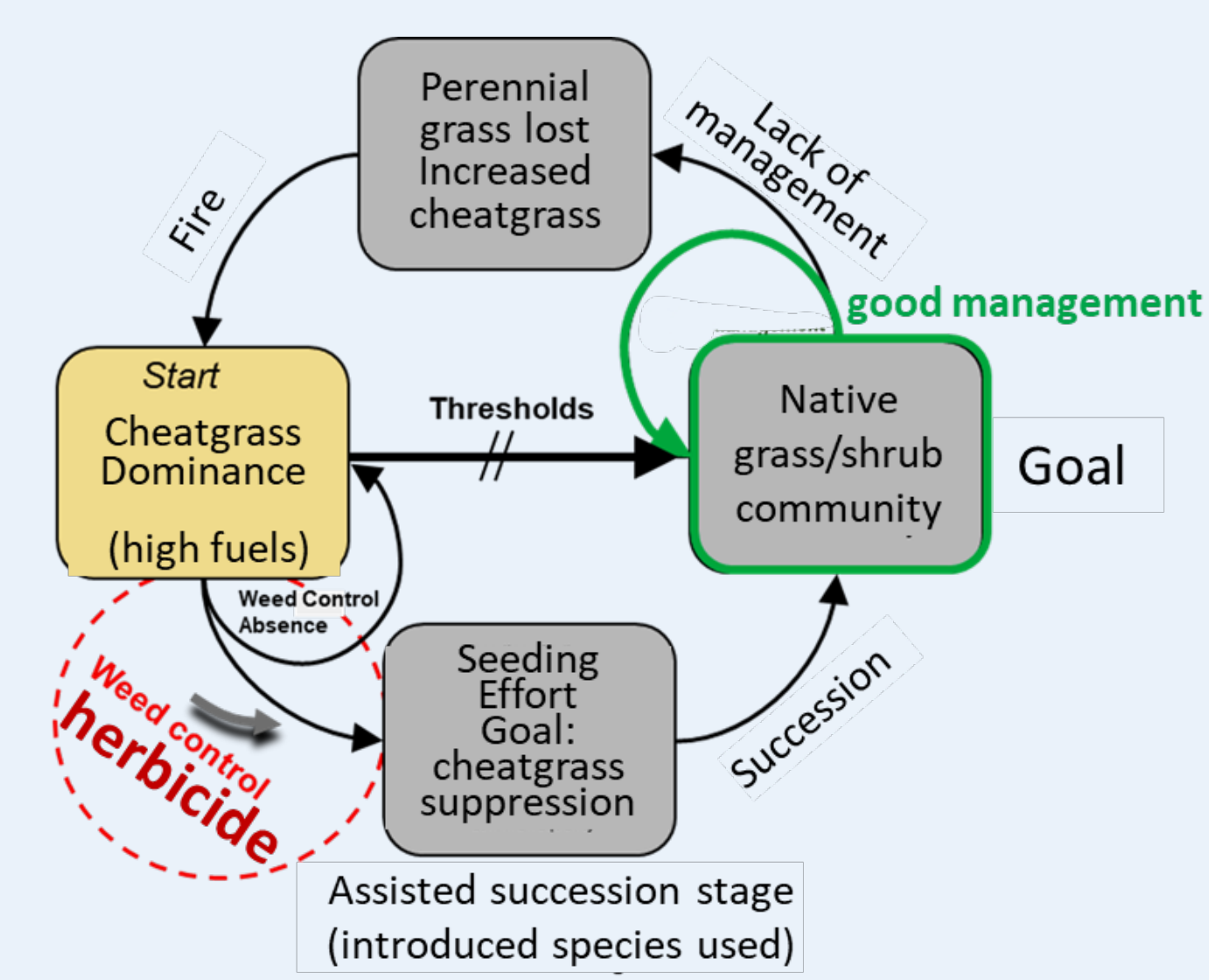


Plant-Soil Relationships: Monitoring Soil Nitrogen and Moisture after Cheatgrass Herbicide Control

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- Pre-emergent herbicides are an effective tool in annual grass Integrated Pest Management programs. They can help to mitigate the deleterious effects of annual grass invasion and subsequent increased wildfires.
- Cheatgrass and other exotic annual grass invasions, can have drastic effects on soil resource cycling that often do not benefit the native flora. By restoring the plant community to perennial dominance many benefits can be observed including plant-soil interactions.
- Pre-emergent herbicides are used to temporarily decrease cheatgrass competition so that competitive perennial grasses can be established, that will “suppress” cheatgrass long term.

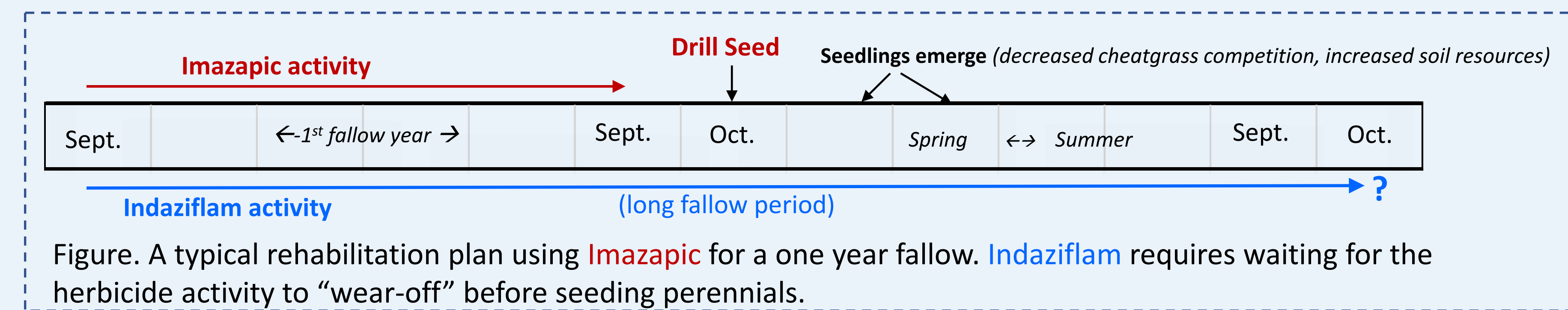
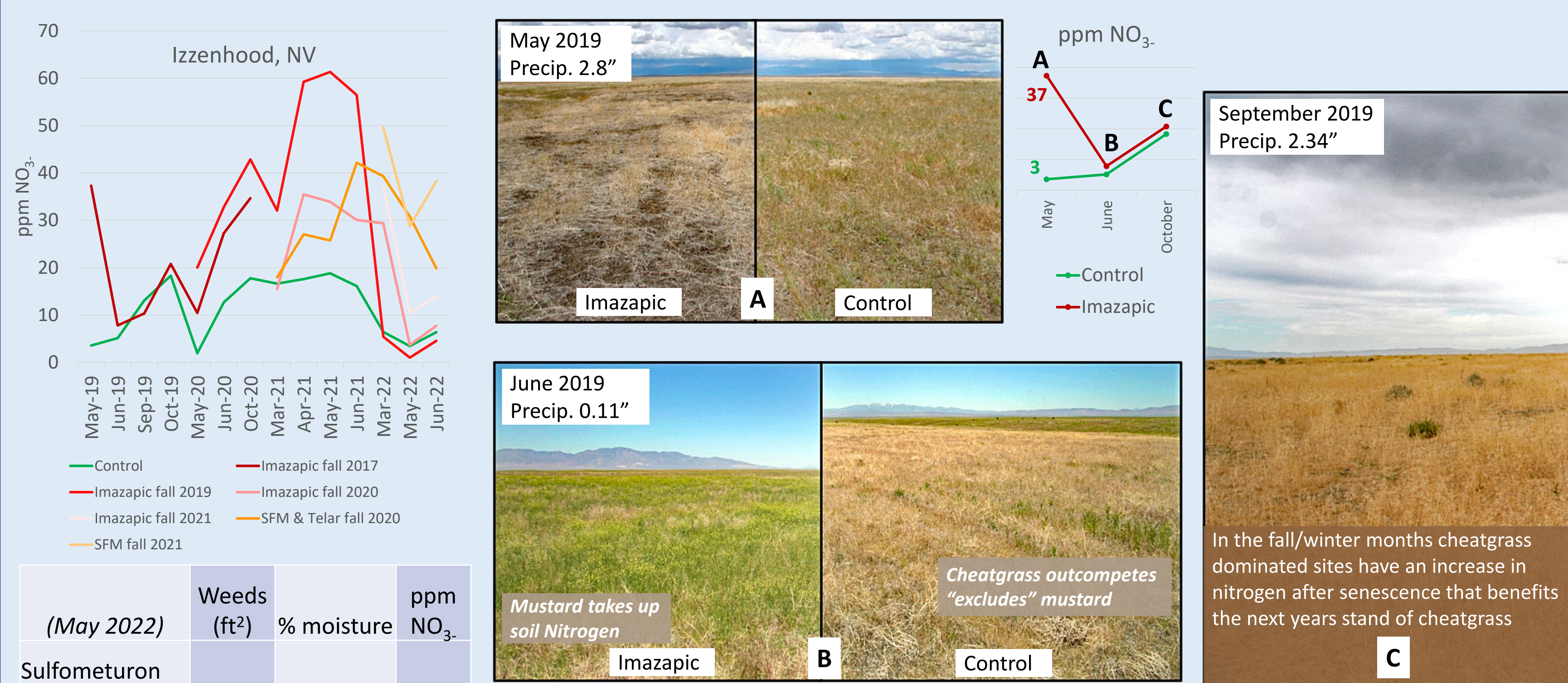


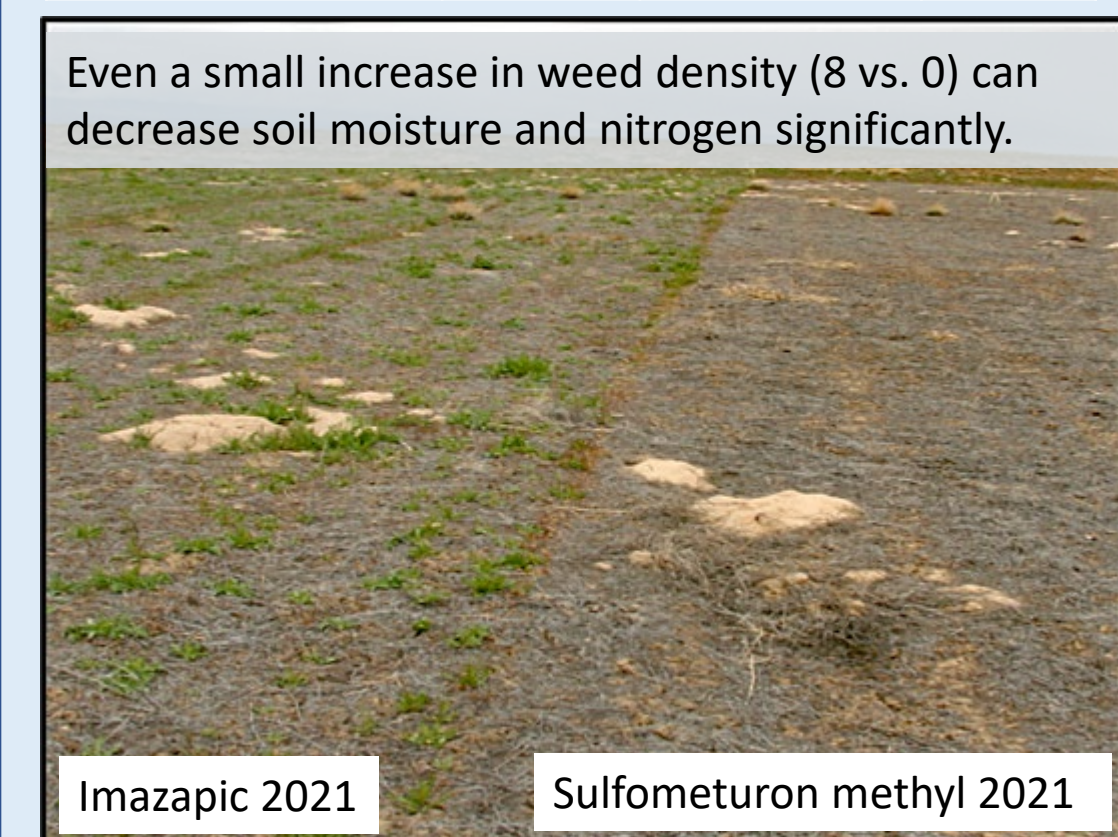
Figure. A typical rehabilitation plan using **Imazapic** for a one year fallow. **Indaziflam** requires waiting for the herbicide activity to “wear-off” before seeding perennials.

- During the “fallow period” while the herbicide is actively controlling cheatgrass, soil resources like moisture and nitrogen can increase as cheatgrass isn’t up-taking the soil resources.
- This will increase the success of seeded perennial plant establishment the following year.

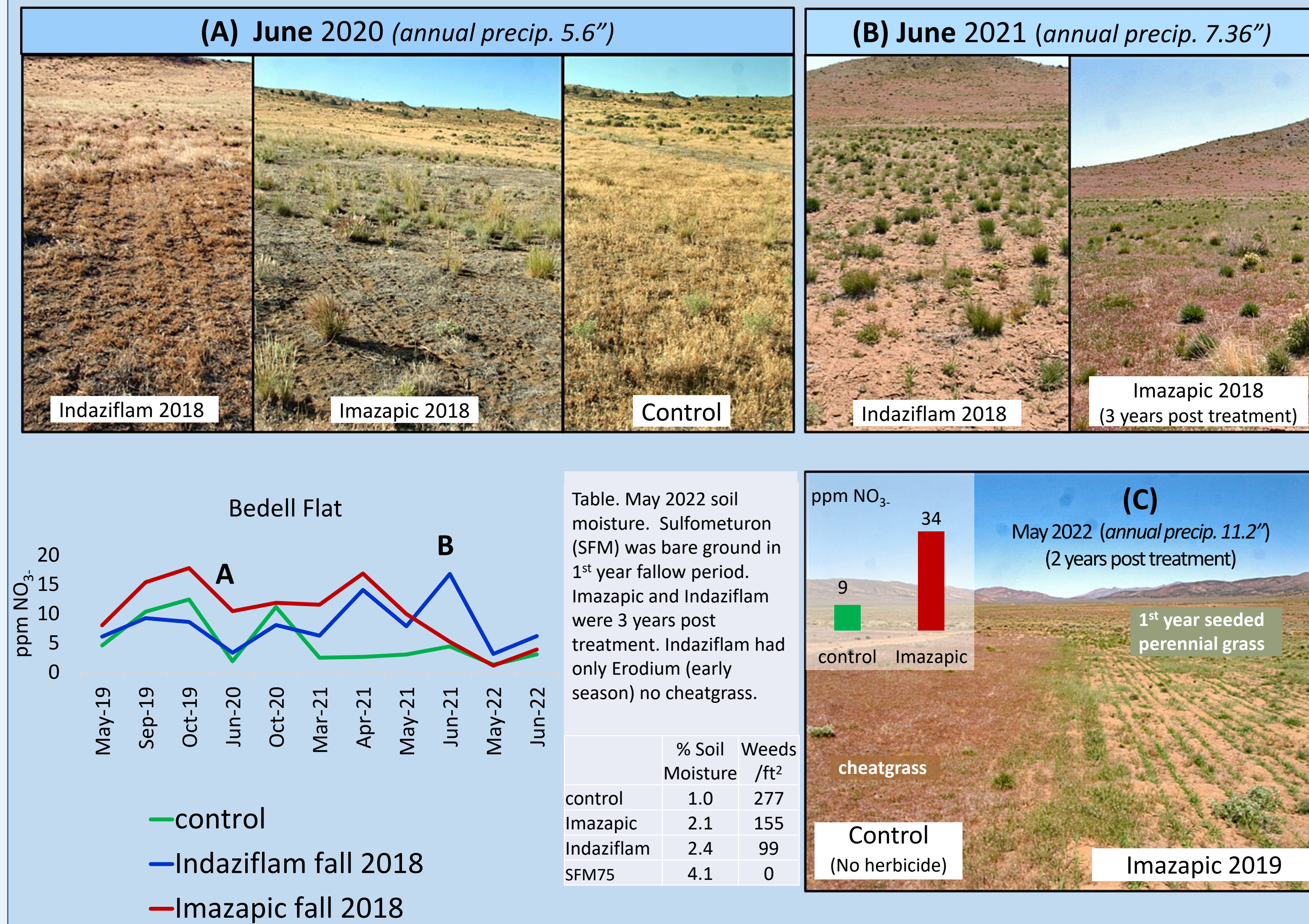
Cheatgrass Control, Lower Successional Weeds and Soil Resources (Izzenhood, NV)



- Lower successional weeds, like tumble mustard can have a large effect on soil resources. Tap-rooted broadleaf’s are less susceptible to pre-emergent herbicides than fibrous-rooted annual grasses, since herbicide root uptake is required for control. Tap roots quickly grow below the soil herbicide layer, sometimes escaping herbicide effects.
- An example above shows (A) wet May (2.8”) increases nitrification with 10x higher NO₃ in Imazapic plot with no plant uptake. (B) May moisture brings about mustard plants that aren’t affected by the herbicide. In the control plot the cheatgrass keeps the mustard “out” so that by June NO₃ doesn’t differ between control and Imazapic plots. (C) Wet September (2.34”) increases soil nitrification, annual weeds have senesced so no uptake of nitrogen or moisture.



Herbicide Activity Period and Soil Resources (Bedell Flat, NV)



- When pre-emergent herbicides are active in the soil, all newly germinated seedlings with their roots in the shallow herbicide soil zone will be controlled.
- Imazapic (Plateau) has an activity period of about 12-15 months while the more recently developed Indaziflam (Rejuvra) can last multiple years and can have a slower “initial” weed control.

(A) Initial (2019 & 2020) weed control and increased nitrogen was greatest in Imazapic plots. (B) By the 3rd growing season after treatment Indaziflam had greater annual grass control and increased soil nitrogen compared to Imazapic which showed little difference in soil resources from the control plot. This demonstrates the “window of opportunity” to seed perennial grasses with increased soil resources and how that can vary. (C) Perennial grasses seeded after a 1 year (Imazapic) fallow, note the almost 4-fold increase in nitrogen in herbicide plot (9 vs. 34 ppm NO₃).

Mean ppm NO₃ all sample dates (TS Ranch, NV)

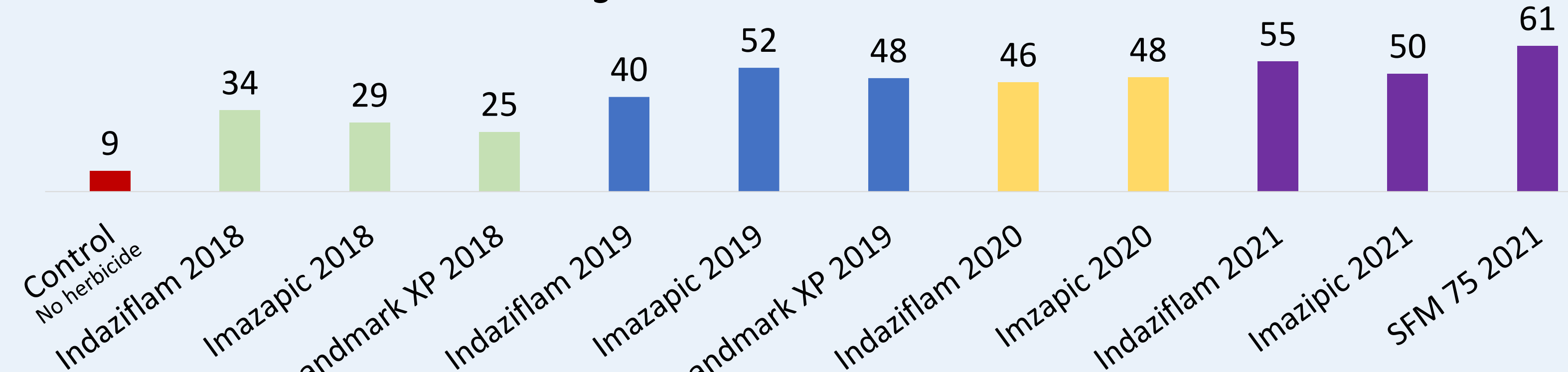


Figure. Mean of all sample dates from September 2018 to November 2022 at TS Ranch. The 2018 applications are still showing increased nitrogen 4-years after application, even though Imazapic and Landmark XP (Sulfometuron & Chlorsulfuron) are no longer active. Indaziflam (Rejuvra) 2018 remains active and still shows weed control 4-years later.

Sample dates: Sep-18, Mar-19, Apr-19, May-19, Jun-19, Sep-19, Oct-19, Apr-20, May-20, Jun-20, Sep-20, Oct-20, Mar-21, Apr-21, May-21, Jun-21, Mar-22, Apr-22, May-22, Jun-22, Nov-22

