Reviewer #1 (Comments to the Author):

This manuscript reports on plant community response to different planting year conditions to gain insight into controls on variable outcomes of ecological restoration. The design used to quantify planting-year factors affecting decadal-established communities involved sowing alternating strips in a former agricultural field to a USDA Conservation Reserve Program grassland mix in two different years, corresponding to the alternating strips. Communities that developed under different planting-year conditions varied in the composition and diversity. These results are not particularly novel, but they contribute to a growing body of literature that is starting to demonstrate the lasting influence of 'year effects' on developing plant communities. To my knowledge, this is the first of such a study from the shortgrass steppe ecosystem, suggesting these effects may be generalizable across grassland systems.

Thank you for taking the time to review the manuscript!

I have several comments/suggestions to improve this manuscript:

1) The most significant recommendation is for the authors to acknowledge 'year effects' other than climate. The second planting in year two was not identical to the prior year in that the wheat crop was not harvest, contributing a layer of mulch to the soil. Climate varied, but other planting conditions varies as well. The authors discuss repercussions of this conundrum in the Discussion, but I think it should extend to the entire manuscript, including the title. There is strong evidence that soil moisture varied between the planting years. This could result from variation in precipitation and variation in litter residue. I think the manuscript would be just as compelling and more direct to cast the title, results, and discussion in context of soil moisture as an underlying cause of 'year effects.'

We included all conceivable year effects in the modeling, including climate, drought (SPEI), soil moisture, and soil temperature. Although we did not directly include model terms for the different harvesting, tillage, and crop residue - as it's impossible to characterize these post hoc beyond their effects on soil moisture and temperature - we did include "year" as a term, but it was not significant in the models. This suggests that the models were better able to capture year effects by directly accounting for climate differences as fixed effects rather than by modeling outcomes simply as a function of year. We have made substantial changes to the manuscript in the introduction and discussion to emphasize these analyses and highlight climate as the key driver.

We changed the title to "Soil climate underpins year effects driving divergent outcomes in semi-arid cropland to grassland restoration"

2) The introduction needs to be condensed, more relevant to the objectives of this work, and more to the ecological emphasis of the journal. I **expected more background on ecological concepts of 'year effects' and filters (drivers) of community assembly**. This manuscript is

not about “novel ecosystems” or carbon emissions (mentioned in the first few sentences) or belowground recovery described extensively in the second paragraph.

The introduction has been extensively revised. We have included more background on ecological drivers of year effects and filters of community assembly. We feel the background on the CRP planting and related improvements to belowground recovery to be essential to this paper as our findings are targeted primarily at restoration efforts - CRP in particular - whose driving motivations are to decrease soil erosion and improve soil health through targeted seeding. The outcomes of which have been notoriously difficult to predict due to considering climate effects too broadly.

3) There are numerous response variables (environmental and species/community related) that are not integrated with the objectives. The objectives are focused on climate variables as drivers of species composition, but many other factors were measured: soil moisture and temperature (climate related), topographic variation (not climate related), and soil nitrogen content (not climate related). Plant responses not covered in objectives: persistence of individual species, functional groups, interspecific interactions, and species correlations. These variables, coupled with climate, collectively describe planting year environmental conditions. I also think the post hoc objective related to the interspecific interaction modeling should go in the objectives, along with the hypothesis.

Lines 123-126 now read: “Our objectives were to characterize the plant community diversity and composition in the two sets of strips, and to model how interannual variation in climate, soil moisture, topography and soil nitrogen content affected long-term persistence of individual species and functional groups, interspecific interactions, and residual species associations.”

4) The Methods contain superfluous information. The authors need to comb through the Methods and remove extraneous information. Example: information about surface runoff observations (lines 165-167).

We removed superfluous and extraneous information from the methods.

5) The discussion needs to frame results in a broader ecological context a little better to make this work more interesting to a broader audience.

We extensively revised the discussion.

I would also refrain from suggesting correlation is causation and positive correlations between species and groups indicating facilitation.

We revised that paragraph. Lines 367-393 now read: “Ecological assembly is thought to be scale dependent, with environmental filtering operating at coarse scales, and biotic interactions operating at fine scales (Mod et al., 2020; Gill et al., 2021). We attempted to account for this by using a nested hierarchical sampling design to capture species interactions at a fine scale by

recording cover and occurrence in 0.1 m2 plots, nested within 25 m2 plots that captured environmental variation. There were positive residual associations between grasses and forbs in both introduced annual groups (Group 1) and native species groups (Group 2) (Fig. 5). This could suggest facilitation, or it could be simply that three common invasive annuals took advantage of spaces where natives did not establish. Grass-forb mutualisms may be an adaptation to interannual climate variability in grasslands (Hallett et al., 2019). Native grasses positively associated with each other in Group 2 may indicate facilitation between species, and it may be possible to determine if planting particular groups of species together would increase their probability of persistence. Future research over a broader geographical range that includes more species, coupled with experimental work, could examine inter-specific associations in greater detail, and provide insight on which species to seed together in order to incorporate facilitative interactions with different climatic responses to improve restoration outcomes. Positive association of non-seeded native forbs with native grasses within Group 2 (Fig. 6) highlights the potential for low-diversity CRP treatments, such as that included in this study, to facilitate volunteer establishment of native plants from nearby areas or from the seed bank over long periods of time. Positive residual correlations also existed between B. tectorum and B. scoparia (Group 1), and this group had negative associations with the mostly native Group 2. This suggests that introduced annual forbs may play a role in facilitating the persistence and dominance of introduced annual grasses. Even though we designed our sampling method to maximize the possibility that observed residual correlations in occurrence would be meaningful proxies of interactions, they should still be viewed with caution because they are not definitive evidence of mechanistic interactions between species (Blanchet, Cazelles and Gravel, 2020). With this in mind, we used abundance data to explore the interaction between B. tectorum and P. smithii in more detail."

Last, there is redundancy toward the end in recommendations and implications of this work.

6) Table 1 is not very informative. I recommend extracting panel A from figure 1 as a stand-alone figure demonstrating climate differences and adding other climate variables (those depicted in Figure 3).

Table 1 is now table S5

Editorial:

Specify the age of the communities in the methods.

Lines 170-172 now read: "Each of the 12 strips had about 7 plots, with 49 plots in the strips seeded in 2014, and 39 plots sampled for the strips sampled in 2013 (Figure S1), making the communities 8 and 9 years old, respectively."

Specify the number of strips per planting year in the methods.

Lines 159-160 now read: “One set of 6 alternating crop strips (Fig. 1B) was planted on April 29, 2013, and the second set of 6 was planted on May 1, 2014, with no post-seeding management interventions”

Specify species and PLS seeding rates.

PLS Seeding rates are in Table S1 and S3. This is indicated on line 158

Line 173: use “co-located”

Accepted Suggestion

Lines 212-213: I think of cover data as describing species composition.

We agree. Lines 206-207 now read: “, and another after converting the abundance matrix to a binary matrix to examine species occurrence.”

Generally, tables and figures are not referred to in the discussion.

The discussion has been extensively revised with more in text citations to the figures.

Tables and figures: Species names need to be italicized and somewhere the nomenclature used needs to be defined and date accessed (e.g., USDA Plants Database).

We fixed non-italicised names in Table S1, Figure S2, and Figure S4. Caption for Table S1 now reads: “Nomenclature follows the United States Department of Agriculture’s Plant Database (https://plants.usda.gov).”

Figure 2: C and D are obscured by the y axis.

This is now fixed

Figures 3 and 4: Could these be transposed to spell out species names and groups?

It is possible to do this, but space is at a premium in these figures. We think it is reasonable to rely on abbreviations to allow the reader to more clearly see the information in the figure.

Figure S5 seems more appropriate as a Figure in the manuscript (not supplemental).

Figure S5 is now Figure 5.

Abbreviations in figures need to be spelled out in all legends.

These are all spelled out now.

Typos in some supplementary information figure legends.

These are now fixed

Reviewer #3 (Comments to the Author): [Original Reviewer 2 was not able to review a revised manuscript]

This manuscript describes a very interesting study of how weather conditions influence species establishment (i.e., community assembly) in a restoration context. The same species mix was planted in a dry year and in an average year and the resulting plant communities were quite different.

The introduction clearly sets up the need for studying cropland to grassland restoration and the difficulties currently faced by restoration practitioners. It would be good to include some information about the ecological theory of community assembly, especially relating to the abiotic filter of precipitation. Describing some theory around priority effects would also be useful here and in the discussion, especially in relation to creating a more invasion-resistant community.

The methods and results are clearly written and well-supported by the tables and figures in the manuscript and the supplement. **The discussion addresses the main findings from the experiment well but would benefit from a few more citations tying the results to the broader literature and the community establishment/priority effects theory mentioned earlier.**

We revised the discussion extensively

Still, the authors have done a good job generalizing their findings beyond this experiment and have very useful suggestions for restoration practitioners on how to apply these findings to future projects.

Thank you!

Abstract:
I found the manuscript much more interesting than I expected based on reading the abstract. Revise the abstract to include more of your discussion and less of your results by focusing on the main points from the discussion section. In the concluding sentence(s), describe in more detail how land managers should consider conditions and how they could adjust their management accordingly. The approaches you describe at the end of the discussion/conclusions would be a good guide.

We have modified the abstract accordingly.

Methods:

How were the species in your planting mix chosen? Is such a low diversity mix typical of CRP plantings in your region?

Lines 158-159 now read “The mix was a typical low-diversity mix used in the area, recommended by the NRCS.”

Discussion:
In the paragraph beginning on line 354, don’t use the “G2” abbreviation. It is confusing and not used anywhere else in the document.

Changed all instances of G1 and G2 to Group 1 and Group 2

Figures:
Re-define abbreviations (like SPEI) in figure captions.

Accepted suggestion

Tables:
Table 1 can probably be moved to the supplement, because the most important information is represented in Figure 1.

Table 1 is now Table S5.