COLLEGE OF SOCIAL & BEHAVIORAL SCIENCES
Women in Science & Engineering

# Bio/Diversity Project
# Lesson Title: Invasive Species in Tucson

Teacher: Kelly McHugh and Skylar Batty

Edited by: Elena Greenberg

Grade Level: *9th*

Time: *50 minutes*

| | |
|---|---|
| **AZ State Science Standard:** | *Essential HS.L2U3.18*<br>• *Obtain, evaluate, and communicate about the positive and negative ethical, social, economic, and political implications of human activity on the biodiversity of an ecosystem.* |
| **Content Objective:** Math, Reading, Science, Writing, Other: | • *Students will be able to identify the negative impact of buffelgrass on the biodiversity of the Sonoran desert*<br>• *Students will be able to explain why buffelgrass is an invasive species and why it is detrimental to the local ecosystem*<br>• *Students will be able to explain the pollination vectors for invasive species of grass and native species of flowers* |
| **Scientist of the Week:** | • *Julio Betancourt*<br>• *Researcher and professor at UA*<br>• *Born in Havana, Cuba and immigrated to the united states at 10 years old*<br>• *Co-founded a non-profit organization in Southern Arizona that is involved in research, education and mitigation of African buffelgrass invasion and its impact on conservation and fire management in the Sonoran Desert* |

| **Vocabulary** | **Materials** |
|---|---|
| • Native species<br>• Non-native species<br>• Invasive species<br>• Ecosystem dependencies<br>• Fertilization | • Alstromeria flowers to dissect<br>• Corresponding worksheet (first 2 pages only) http://mrdocsonlinelab.com/index/XBio_II_files/LAB%20Flower%20Disection%20REV.pdf<br>• Buffelgrass sample<br>• Powerpoint slide<br>• Graphing paper<br>• Colored pencils |

**Guiding Questions:**
- What is an invasive species?
- How do they affect native plants and pollinators?
- How are invasive species relevant to you?

- What can you do to prevent invasive species in your neighborhood?

**Engagement/Introductory Activity:**

- During the previous lesson, ask students to bring in flowers that they find in their neighborhood to class. Remind students of the etiquette around picking flowers that are not in their yard (making sure there are other flowers available near the original source; obtain permission if it is on someone's property etc.)
- Watch the following 1 minute video for an introduction to invasive species:
    - **https://www.youtube.com/watch?v=9tS8aij3jBM**
    - After watching the video ask students the following questions:
        - What are invasive species?
        - Can you think of examples of invasive species here in Tucson?
        - How might invasive species affect humans?
            - Damage crops, clog rivers, cost homeowners and farmer billions of dollars
            - At this point ask if the students have anyone in their life that are farmers, homeowners, or work with water management
- Define native, non-native, and invasive species
    - Native - species indigenous to a region
    - Non-native - species that is not indigenous to a region, does not disrupt ecosystem
    - Invasive - species that is not indigenous to a region, disrupts the ecosystem
- Ask students whether they think the flowers that they brought into class are native, non-native or invasive.
- Describe to students that sometimes a triangular relationship can develop between invasive, non-native, and native organisms - an example of this is the tamarisk, the willow flycatcher, and the tamarisk beetle
    - Share article with students or read out loud as a class: https://www.azcentral.com/story/news/local/arizona-environment/2017/06/19/tamarisk-leaf-beetle-spreads-threatens-endangered-bird-habitats/401836001/
    - Ask/assign students to pick one side to debate: beetle, tamarisk, or bird
        - Within a debate setting, have students think about what conservation techniques they would suggest if they were a researcher in this area and to share 3 reasons why their species is more important to preserve in this ecosystem than the other 2 species

**Exploratory Activity:**

- Assign students into groups of 2-3, and pass out different store-bought flowers to each group
    - Flowers that works well for dissection are alstromerias (Peruvian lillies), tulips, and daffodils
- Prepare students for flower dissection by handing out the following worksheet and reviewing the anatomy of flower structure
    - http://mrdocsonlinelab.com/index/XBio_II_files/LAB%20Flower%20Disection%20REV.pdf
    - Make sure to emphasize the reproductive parts of plants
    - Review etiquette of microscope use
- Ask students work in groups at their lab desks where the microscopes are already set up.
    - Follow procedure on worksheet
        - Discuss differences between flowers at each diagram picture showing that flowers have same parts but different structures
            - Discuss as a class how different features affect success rate of pollination:
                - What makes this structure good for pollination?
                - What pollinator likely goes to this plant?
                - What issues does might this plant face with getting pollinated?
            - Pass out a sample of buffelgrass to each group, explaining how structures are different and how plant reproduction works with grasses versus flowers

- Ask:
  - How does buffelgrass take pollinators out of the equation?
  - Advantages and disadvantages of being wind pollinated vs pollinated by an animal vector such as a bee?
- Discuss inferences that can be made about handling the buffelgrass and how easily it can spread as an invasive species

**Explain:**

- Use the Powerpoint to visually depict how native species become subject hazards as a result of increasing invasive species
  - Explain the the history of Buffelgrass in the Sonoran Desert
    - Buffelgrass, Fountaingrass, Natalgrass:
      - crowds native plants, competes for water, space, nutrients, prevents seed distribution / pollination, fuel for fire
      - introduced as livestock forage in 1930s / 1940s
  - Watch video on flammability of buffelgrass: https://www.youtube.com/watch?v=76bVQEHIC3U
  - Pass out the following graph that shows data for how easily buffelgrass burns compared to other native desert species (dangers of buffelgrass as a fire hazard and a map of the presence of buffelgrass in tucson (shows how widespread it is throughout the area)
  - Prompt students to analyze what these graphs/data tell us about the buffelgrass problem in Tucson:
    - What are the implications of this invasive species in the Sonoran Desert?
  - Ask students where they have seen buffel grass before:
    - Ask students about what areas this invasive species would affect the most? (National Parks, ranches, homes, etc.)
- Have students do a think pair share regarding the question:
  - Are humans responsible for managing the buffelgrass problem in the Sonoran Desert if humans were the ones who introduced this invasive species?
  - Are humans invasive species too? If so, what damage are we causing to the ecosystem?

**Extension Activity/Questions:**

- Introduce students to ways their actions of removing invasive species projects into the future:
- Raw Data:
  - Different scenarios of buffelgrass density (computer modeling from https://pubs.usgs.gov/fs/2011/3022/pdf/FS11-3022.pdf) :
  - Data collected from study of Catalina Mountains, North Tucson, AZ

| Management Style<br><br>Year | No management | Unlimited Management - Best case | Intermediate Management - Best case | Intermediate Management - Worst case |
|---|---|---|---|---|
| 2010 | 0 | 0 | 0 | 0 |
| 2020 | 900 | 300 | 400 | 500 |
| 2030 | 1,900 | 100 | 800 | 1,000 |
| 2040 | 3,900 | 70 | 1,300 | 2,200 |
| 2050 | 5,500 | 50 | 2,200 | 4,000 |
| 2060 | 6,200 | 25 | 3,000 | 5,000 |

        - Have students use graphing paper to construct a graph from the data provided about managing buffelgrass
        - Use colored pencils for different management scenario
    - Discuss why even under the best case scenario, there is still a lot of area affected
    - Discuss why even under the worst case scenario, it is still better than no management
    - Discuss how this affects the people they know who are involved in careers with agriculture, water management, and homeowners (have students brainstorm ideas about how buffelgrass impacts them directly)
        - homeowners - fire hazard
        - agriculture - land usage
        - water management - after fires more erosion due to faster water flows

**Evaluation Activity:**

- How can students get involved?
    - For an exit ticket, ask students to write down ways they can get involved in the prevention of invasive species
    - Some example of community efforts:
        - Saguaro National Park buffelgrass pulls
        - Weed free trial programs by NPS

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- Researcher and professor at UA
- Born in Havana, Cuba and immigrated to the United States at 10 years old
- Has degrees in Geoscience, Ecology and Evolutionary Biology, Anthropology, and Geography
- Co-founded a non-profit organization in Southern Arizona that is involved in research, education and mitigation of African buffelgrass invasion and its impact on conservation and fire management in the Sonoran Desert


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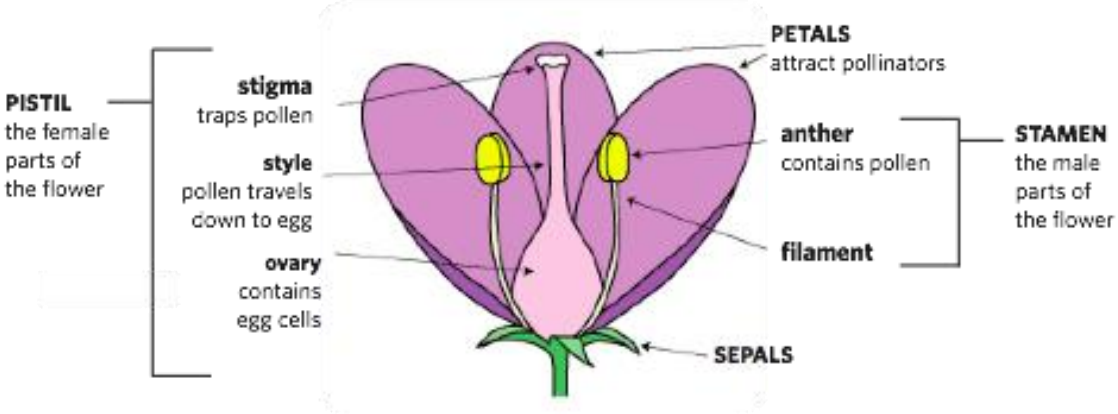
# Love Triangle

| Tamarisk Tree | Willow Flycatcher (Bird) | Tamarisk Leaf Beetle |
|---|---|---|
| Blamed for flood and fire risks where there are trees crowding Gila River | Adapted to the non-native Tamarisk that grows around river | Released by U.S. government to kill exotic trees along Colorado River |
| Imported more than 100 years ago to plant as ornamentals, windbreaks, and riverbank stabilizers | Endangered species of the Southwest | Strips tree of leaves ruining home for birds |
| Occupy riverbeds across Southwest, crowding out native plants by consuming nutrients | Some research suggests no difference in success of nesting in tamarisk vs native willows | More mobile and resilient than predicted |

# Flower Dissection

## INSIDE A FLOWER




## CROSS-POLLINATION

1. The **pollinator** receives **pollen** from the **stamen** of the first flower.

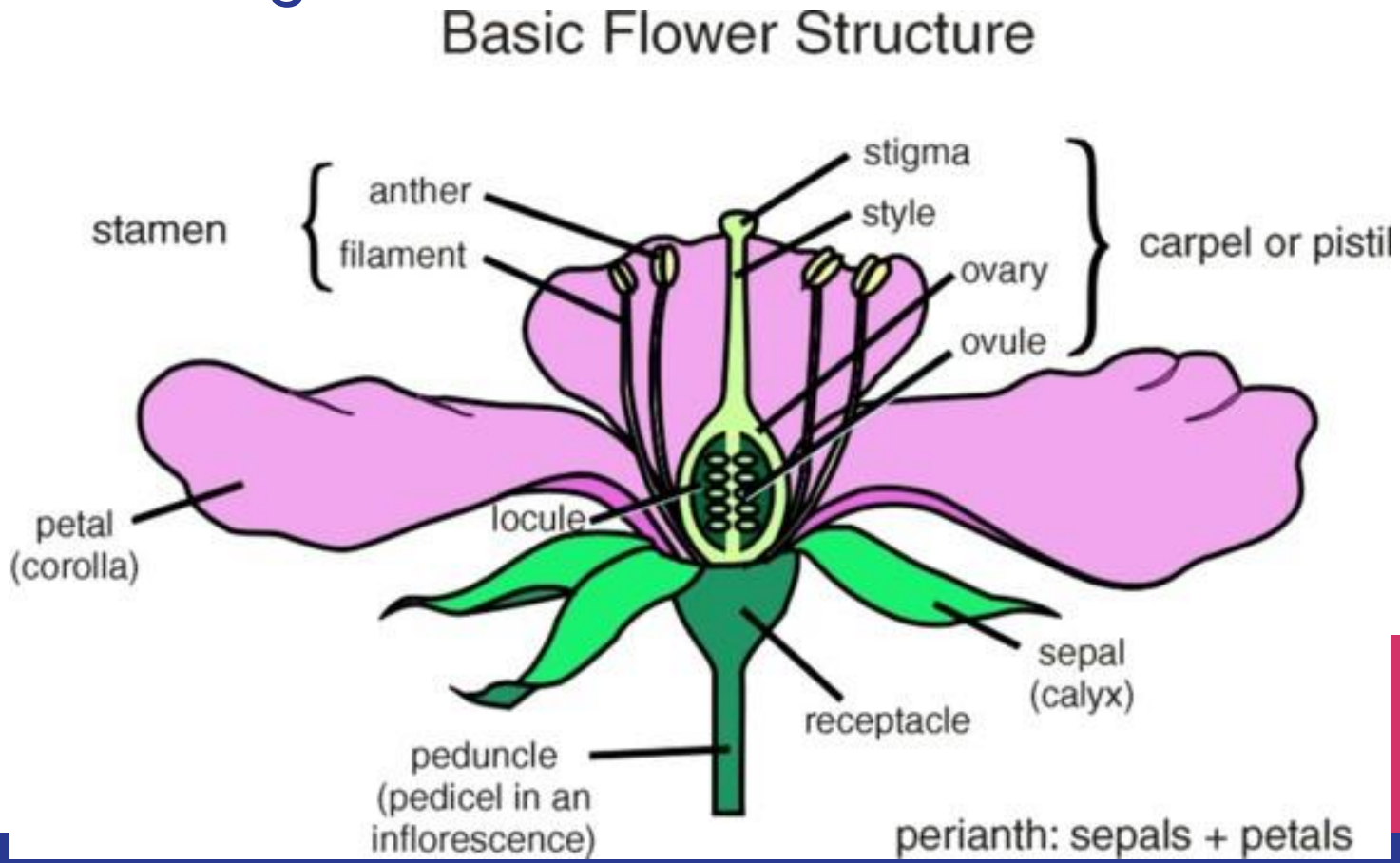
(The pollen brushes onto the pollinator's body while the pollinator drinks nectar from deep inside the base of the flower.)

2. And deposits it on the **stigma** of the next flower.

(This also happens while the pollinator drinks **nectar**.)

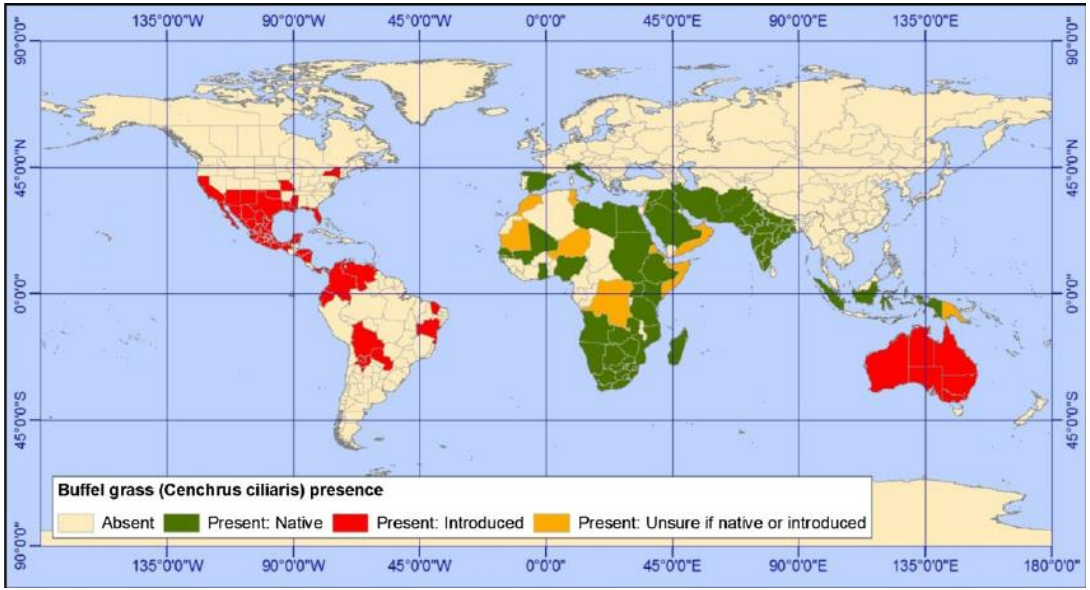
3. The **pollen** moves down the **style** to join with the **ovules** in the **ovary**.

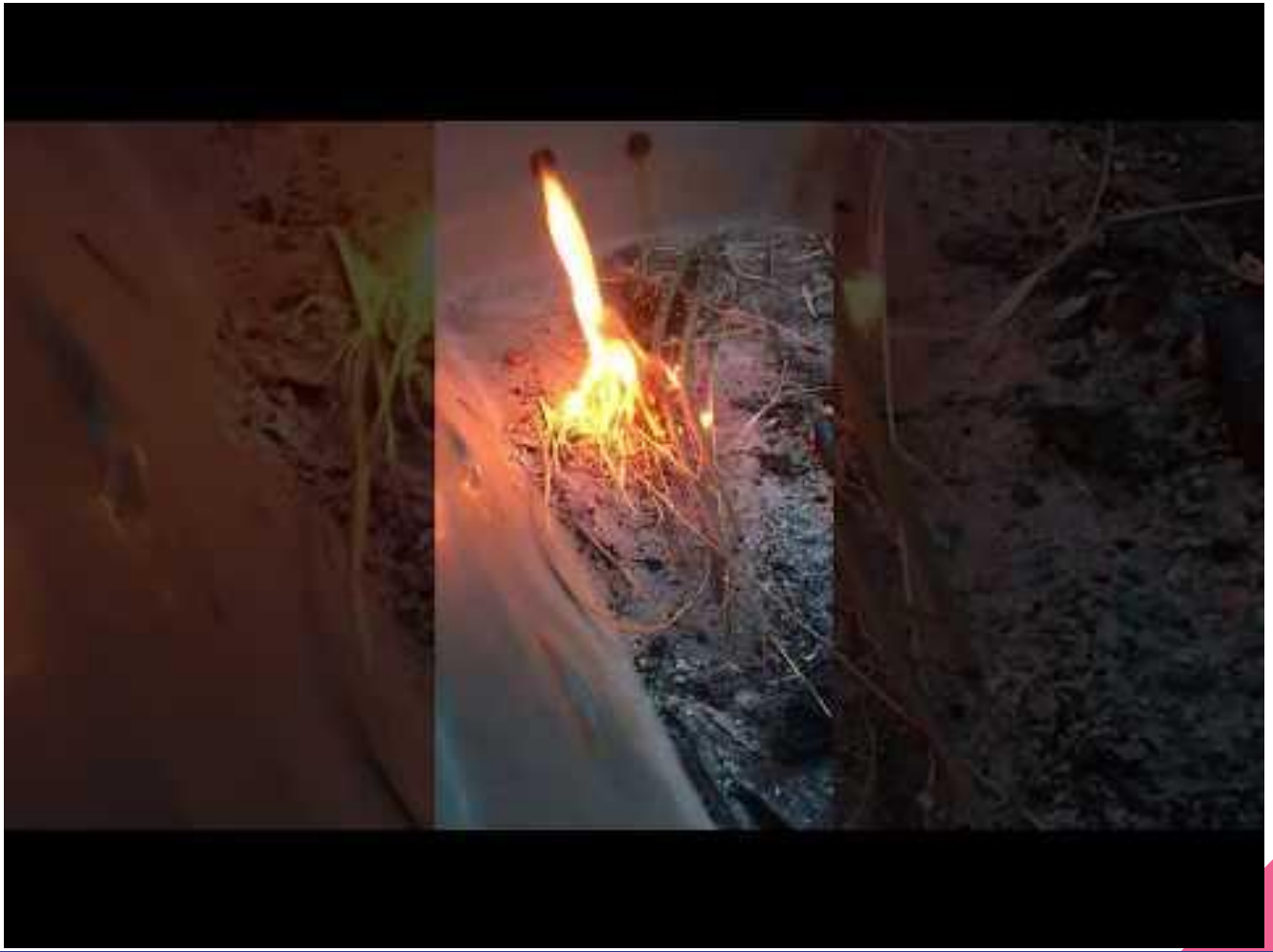
# Flower Diagram



# Buffelgrass History

- Buffelgrass is native to Africa, Arabia, Canary Islands, Indonesia, northern India, Madagascar, and Pakistan
- Buffelgrass was introduced to the United States **by humans** in 1930s for livestock forage
- Began rapid expansion in the 1980’s

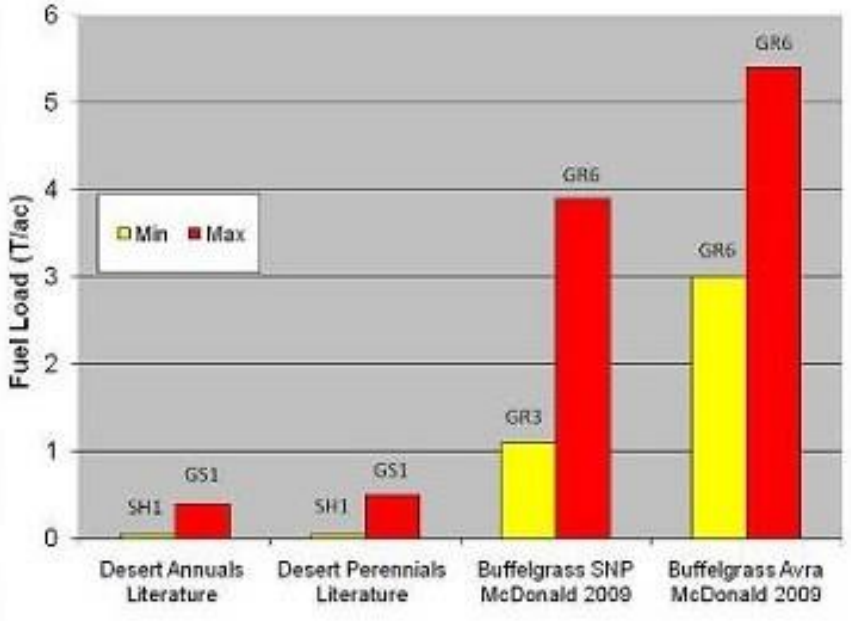




Buffelgrass burns hot enough to burn most metals! (1600 degrees F)

# Buffel Grass Burning

- Buffelgrass evolved with fire and thrives under repeated burning. In the event of a desert fire, native plants would be killed or injured, while buffelgrass would survive and resprout
- Graph shows the amount of fuel native plants provide for a fire vs. Buffelgrass
- What trends do you notice on this graph?
- How do these trends support the detrimental effects buffelgrass has on the sonoran desert ecosystem?



# Graph the following data:

| Management Style<br><br>Year | No management | Unlimited Management - Best case | Intermediate Management - Best Case | Intermediate Management - Worst case |
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# Buffelgrass in Tucson

- Where have you seen buffelgrass?
- What characteristics of buffelgrass make it such a threatening invasive species?
- What impact does buffelgrass have on people in Tucson?
- How is buffelgrass detrimental in an urban environment?

# Buffelgrass affects us because..

- Inhibits growth of native species
- Is a huge fire risk (urban setting)
- Decrease available land for farmers to use
- Creates water management issues

# Buffel Grass Prevention in Tucson

- **February 28th 2019:** Arizona Native Plant Society/Catalina State Park Buffelslayers 8am-1pm (volunteer opportunity)
- **March 2nd 2019:** Catalina State Park Buffel Slayers, 8am-12pm (volunteer opportunity)
- For additional opportunities visit Tucson Clean & Beautiful Inc. website
- Sonoran Desert Museum and Saguaro National Park websites also have resources for volunteering to help with buffelgrass prevention!