San Joaquin River Improvement Project (SJRIP)
Drainage Water Re-Use Plantings of Jose Tall Wheatgrass

Frequently Asked Questions

1. **What is Jose Tall Wheatgrass and where did it come from? [35]**

   Tall wheatgrass (*Thinopyrum ponticum*) is a member of the tribe of grasses that includes wheat, barley, and rye. It is a perennial grass from Eurasia, in particular the salt marshes and shorelines of the eastern Mediterranean. The species was introduced to the United States by the U.S.D.A plant introduction system in the early 1900s. Cultivars were developed in the mid-1900s for conservation programs to re-vegetate and restore productivity of denuded saline soils. The cultivar Jose was developed in New Mexico from seed obtained in 1944 from the plant introduction system in Australia. In addition to California, the species is seeded for saline pasture and site reclamation in the states of the Intermountain West and western Great Plains. Jose is the most heavily used tall wheatgrass cultivar in the U.S.

2. **How salt tolerant is Jose Tall Wheatgrass? [8, 17, 19, 29, 30, 31, 37]**

   Jose Tall Wheatgrass is recommended for hayland plantings in the western San Joaquin Valley when the electrical conductivity of the irrigation water ranges 5-15 dS/m, considered moderately to strongly saline. The grass has produced good hay crops in fields with soil salinity as high as 17 dS/m. Tall wheatgrass has been evaluated in research trials on all continents, and it ranks among the most salt tolerant grasses. It also performs very well at lower salinities.

3. **What are the salt tolerance mechanisms of Tall Wheatgrass? [11, 14, 18]**

   Tall wheatgrass roots readily uptake sodium ions (salt) to create an osmotic gradient, enabling uptake and transpiration of water through the plant. The plant excludes salts from new shoot growth, allocating it instead to older leaves. The plant produces glycinebetaine, a type of amino acid that prevents the buildup of salt in the plant cell cytoplasm from hindering normal cell functions.

4. **The SJRIP Re-Use Area haylands of Jose Tall Wheatgrass are irrigated with drainage water of moderate to high salinity. Where does the salt go? [7, 19, 22, 24, 26, 27, 28, 33, 34]**

   Nearly all of the salt remains in the drainage water as it passes through the SJRIP Re-Use Area. The average salinity of the drain water applied to the haylands is 5.7 dS/m, a concentration of 5 tons of salt per acre-foot. Jose Tall Wheatgrass consumes and transpires much of the water (some evaporates directly), and the SJRIP Re-Use design expects 27% to seep below the root zone where it is intercepted by tile drainage. The resulting salinity of the drain water from the hayland increases to 21.4 dS/m, a concentration of 20 ton salt per acre-foot. The initial 5 ton salt load moves through the root zone, Jose Tall Wheatgrass (and some surface evaporation) removes 73% of the water including about 1% of the salt, resulting in a substantially smaller volume of concentrated drain water to be conveyed to reverse osmosis, selenium treatment, and evaporation facilities.

   The Jose Tall Wheatgrass planting is part of a coordinated step-wise system to concentrate salts in decreasing volumes of drain water until it can be evaporated and removed. The SJRIP is a regional scale adaptation of the Integrated on-Farm Drainage Management (IFDM) process developed by the University of California, Davis; California State University, Fresno; and USDA scientists working with western San Joaquin Valley farmers, irrigation and drainage districts, and other partners.

The primary function of Jose Tall Wheatgrass is to remove water, withstand saline conditions, and concentrate the salt in a much lower volume of drain water.

5. **The drainage water applied to Jose Tall Wheatgrass contains concentrations of Selenium. Where does the selenium go? [2, 3, 4, 5, 9, 13, 20, 26, 28, 30, 32, 33, 34]**

As with the salt load, nearly all selenium in the drain water applied to the Jose Tall Wheatgrass hayland moves through the soil profile to the subsurface drain water to be conveyed to the final treatment facilities. The drain water applied to the hayland is expected to contain 130 parts per billion (ppb) selenium. Jose Tall Wheatgrass reduces the volume of drain water, and the concentration of selenium in the resulting water leaching to the subsurface drain rises to 320 ppb. The initial drain water contains about one-half pound of selenium per acre foot. The wheatgrass "grows-out" about 3-4% of this amount.

6. **The drainage water applied to Jose Tall Wheatgrass contains concentrations of Boron. Where does the boron go? [5, 15, 16, 20, 21, 26, 28, 30, 32, 33, 34]**

The fate of boron is similar to dissolved salts and selenium. Nearly all the boron in the drain water applied to the Jose Tall Wheatgrass hayland moves through the soil profile to the subsurface drain water to be conveyed to the final treatment facilities. The expected concentration of boron in the water applied to the hayland is 9.1 parts per million (ppm). The hay crop reduces the volume of water by 73% and the concentration of boron in the water leached to the subsurface drain is 30.0 ppm. The initial drain water contains 24.5 pounds of boron per acre-foot. Jose Tall Wheatgrass "grows-out" about 4-5% of this amount.

7. **How much salt is contained in the Jose Tall Wheatgrass hay? [9, 20, 30, 31]**

Jose Tall Wheatgrass grown on SJRIP Re-use haylands can be expected to "grow-out" 5-8% of its dry matter weight in the elements comprising the salts. The ash content of the herbage, another indication of the amount of salt, ranges from 8-10%. Therefore, a four (4) ton per acre hay crop will contain 0.2-0.3 tons of salt. Although this amounts to 200-300 tons per thousand acres, it comprises only 1% of the salt load moving through the Re-Use Area.

8. **What is the effect of Jose Tall Wheatgrass on soil quality in the SJRIP Re-Use Area haylands? [23, 25]**

The effect has not been evaluated at the SJRIP Re-Use Area, but there is a growing body of research on the use of salt tolerant vegetation for bioremediation of saline-sodic soils. Jose Tall Wheatgrass grows an extensive fibrous root system, a characteristic known to improve the poor structure of sodic soils. Roots emit CO_2, releasing sodium ions in the soil, increasing their leaching potential. The soil quality of SJRIP Re-Use Area is expected to improve over the long-term.

9. **How much drainage water does Jose Tall Wheatgrass consume during a growing season? [6, 10]**

The reference evapotranspiration (ETo) rate for the SJRIP area is 56 inches per year. The design Jose Tall Wheatgrass evapotranspiration rate is 80% of ETo, meaning it can consume up to 40-45 acre-inches/acre of drainage water during the growing season. This provides a yardstick for the timing and amount of drain water applied through the irrigation system to meet the 73% consumption target and avoid salt build-up in the soil.

10. **What is the forage production and quality of the Jose Tall Wheatgrass hay grown on the SJRIP Re-Use Area haylands? [5, 6, 12, 17, 29, 30, 31]**

    Under optimum conditions Jose Tall Wheatgrass has produced as much as 6 tons per acre in other parts of the country. It can be expected to produce this amount on less saline soils in the SJRIP Re-Use Area and as much as 4 tons per acre on soils up to 17 dS/cm. The hay crop can provide good forage quality for rations of beef and lactating dairy cows with good values for metabolizable energy, crude protein, neutral detergent fiber, and digestibility. Forage mineral contents for selenium, boron, and sulfur can exceed maximum tolerable levels (MTCs) for ruminant animals, which must be taken into account when mixing feed ration proportions. The forage can be added to feed rations to overcome diet deficiencies of selenium, which occur on the east side of the San Joaquin Valley.

11. **How does Jose Tall Wheatgrass compare to other potentially useful salt tolerant plants? [1, 5, 6, 8, 17, 19, 27, 29, 30, 31, 36, 37, 38]**

    The native counterpart to Jose Tall Wheatgrass is Creeping Wildrye (*Leymus triticoides*). Genetically the two are cousins, both members of the wheatgrass tribe of grasses. The cultivar Rio Creeping Wildrye is sod-forming and very productive, but somewhat less salt tolerant and lower in forage quality. The species is known to exhibit a wide range of salt tolerance, and it is possible there are other more salt tolerant native populations in California that could be developed.

    Alkali sacaton (*Sporobolus airoides*) and seashore paspalum (*Paspalum vaginatum*) are very salt tolerant, but not as productive as Jose Tall Wheatgrass. Forage cultivars of bermudagrass (*Cynodon dactylon*) also have demonstrated potential. These warm season grasses produce strong growth during the summer months. Jose Tall Wheatgrass is a cool-season grass and although relatively a good summer grower, it grows more slowly during the hottest periods. Therefore a combination of fields of Jose Tall Wheatgrass and productive, good quality, salt tolerant warm-season grasses could optimize drainage water consumption and biomass production.

    Saltbushes (*Atriplex*), *Salicornia*, and other similar broad-leaved halophytes are more salt tolerant than Jose Tall Wheatgrass. However, their agronomic potential has not been fully explored and developed.

12. **How does wildlife respond to Jose Tall Wheatgrass haylands? [14, 32, 33, 34, 35]**

    Jose Tall Wheatgrass wildlife habitat value is expected to be relatively limited at the SJRIP Re-Use Area because it is intensively managed for hay production. However, when managed as habitat in other settings, its robust tall growth rates high as escape cover for upland game birds, song birds, small and large mammals.

    Intensive management of Jose Tall Wheatgrass for hay involves cutting stands before or in the early stages of flowering before seed set. Therefore little seed is available as feed to rodents and small mammals. Halophyte seeds also tend to have low salt concentrations. Therefore mineral levels rising in the food chain to toxic levels for wildlife are not expected to occur, although this will be evaluated in more detail.

References

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