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Merits of Alfalfa Production in the Desert Southwest

Alfalfa is a major crop in Arizona, the desert Southwest, and most parts of the United States. Alfalfa has been planted to the largest acreage of any crop in Arizona for several years with about 260,000 acres being grown in 2023 (USDA, 2023 and Table 1).

Alfalfa is an extremely important crop due to its rich nutritional value as feed for animals, particularly cattle, horses, and sheep. In Arizona and the desert Southwest alfalfa has high value as nutritious feed for dairy and beef cattle. Most fresh dairy products are sold within about 300 miles of their point of origin.

Arizona's population of 7.3 million people has a high demand for fresh dairy products. Arizona has 90% of the population living in urban areas. Over 6 million people in Arizona reside in Maricopa, Pinal, and Pima counties in the central and southern part of the state (82% of Arizona's population). It is not surprising that there is a high concentration of dairies in central Arizona and alfalfa is grown near the dairies to provide a local source of high-quality forage.

Alfalfa is often demonized as a very poor crop choice in Arizona and the desert, usually by people outside of agriculture who are probably well-intentioned but not well-informed. These attitudes and opinions serve to remind us of Dwight D. Eisenhower's statement at Bradley University in September 1956 when he said, "You know, farming looks mighty easy when your plow is a pencil, and you're a thousand miles from the corn field."

People who criticize and complain about alfalfa production in Arizona should consider their needs for fresh dairy products. If they are drinking milk, eating ice cream, yogurt, and butter they are consuming alfalfa as secondary consumers after the dairy cattle have rendered fresh milk from a healthy diet including alfalfa. Thus, Arizonans are the direct beneficiaries of local alfalfa production.

In the case of alfalfa, it is in fact an excellent crop for Arizona and the desert Southwest and a favorite among agronomists (crop and soil scientists), farmers, and farm managers (Putnam, 2015; Mostafa, 2015; and Yost, 2020). Alfalfa is an important crop in the desert Southwest and it provides important contributions to crop production system efficiency agronomically, economically, and environmentally. Several good reasons for growing alfalfa in the desert are summarized in the following points:

- Alfalfa is a perennial crop that is well suited to the long growing seasons in the desert environment.

- It is heat tolerant.

- Alfalfa is relatively salt tolerant.

- Alfalfa is well-adapted to the desert environment, and it responds well to good care and management.

    - Irrigated alfalfa is much more productive per unit area of land than non-irrigated areas.

    - For example, in 2022 the USDA reports for Arizona crop production Arizona alfalfa yields averaged 8.2 tons per acre, the highest in the country, and more than 2.5 times the national average of 3.2 tons/acre.

- Alfalfa is a leguminous crop that naturally fixes nitrogen from the atmosphere in a symbiotic relationship with a species of *Rhizobium* bacteria.

    - Thus, it does not require nitrogen fertilization and alfalfa serves to enhance residual soil nitrogen that benefits subsequent crops in that field.

    - The enrichment of bio-available nitrogen in the root zone also enhances the growth and activities of the soil microbial community, which contributes to good soil health.

- This is a crop with an extensive and deep rooting system that increases soil aggregation and soil structure, which improves water infiltration and penetration through soil profile and improves soil aeration that is important for a healthy soil environment.

    - More than half of the dry matter of the crop is below ground in the root system.

    - The contribution of alfalfa root systems to the soil is extremely beneficial to soil health by enhancing soil structure that benefits air and water exchange in soils and the soil microbial life.

    - Alfalfa has a long taproot that penetrates more deeply into the soil profile than most other crops, most of which commonly have more fibrous, shallow roots. Alfalfa roots commonly reach depths of 6-10 feet but in some cases they can extend over 20 feet deep (Figure 1).

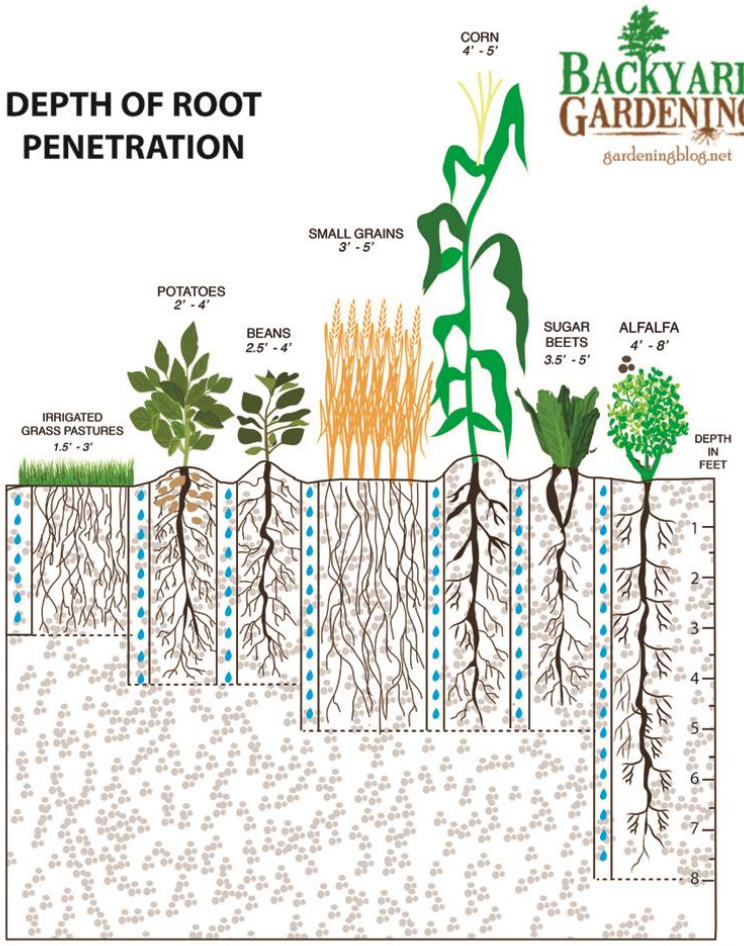

Figure 1. Alfalfa rooting depth compared to several other common crops. Source: Backyard Gardening Blog

- On a daily basis, alfalfa is a good crop in terms of water use efficiency.
    - Water use efficiency (WUE) is defined as the ratio of the yield of the crop per unit of water lost through evapotranspiration of the crop (crop consumptive use).
- Although alfalfa uses significant amounts of irrigation water on an annual basis, it does not actually use any more water than most other crops on a daily basis. Even vegetable crops like broccoli would use a similar amount of water if it were grown year-round (Table 1).
    - A 90-day broccoli crop will consume approximately 19.7 acre-inches of water. If this growing season were extended to a full year, 365 days, it would consume approximately 80 acres of water. That is more than an alfalfa crop would consume (Table 1).

    - Most crops are grown for periods of three to six months, compared to 12 months for alfalfa. If grown on an annual basis, other crops would use similar amounts of water, or more, as is used in producing alfalfa.

- Compared to other crops harvested less frequently, alfalfa's ratio of harvestable biomass/water applied shows it is very water efficient.

- With alfalfa the entire above-ground portion of the plant is harvested as many as twelve times per year in the desert Southwest.

- Most of the irrigation water used in alfalfa is recycled back into the environment.

- Alfalfa can tolerate more drought stress than other crops and survive.

    - It can go into short-term dormancy if it encounters significant water stress.

    - It can be revived with subsequent irrigations following a period of water stress.

- Due to the perennial nature of alfalfa, it can be planted and maintained as a stable crop for several years, often up to five years or more.

    - This reduces tillage, soil disturbance, and dust generation.

- Alfalfa is an excellent rotational crop with warm and cool season annual crops (i.e., vegetable crops, wheat, corn, cotton, melons, sorghum, beans, chiles, etc.).

- The crop ecology of an agricultural crop community is affected by the inclusion of alfalfa, usually positively, due to support of a diverse insect population in the alfalfa fields.

- Farmers have more marketing options with alfalfa than most other crops.

    - Farmers can sell alfalfa in bulk on the open market.

    - A large amount of Arizona-grown alfalfa is sold by the bale to people who maintain horses.

    - If the market is not strong, farmers have the option of feeding it to cattle themselves.

- Arizona and desert-grown alfalfa is a very high-quality product and under high demand.

Alfalfa production supports other food products, primarily dairy and meat. Reductions in alfalfa acres will in turn require a greater reliance on food from non-local sources, including those imported from abroad. This will likely increase food prices and extend the supply chain.

This point was illustrated in the following written testimony provided by the Family Farm Alliance to the U.S. House of Representatives Subcommittee on Water, Wildlife and Fisheries in March 2023 (U.S. House of Representatives Natural Resources Committee, 2023):

"The Western U.S. is a critical part of what has long been a proud national agricultural powerhouse, where our country consistently has run an agricultural trade surplus. But in 2019, for the first time in more than 50 years, the U.S. agriculture system ran an agricultural trade deficit, importing more than it exported. The USDA forecasts the U.S. will again run a deficit in 2023 for the third time since 2019. This growing deficit is driven primarily by our dependence on imported Mexican fruits and vegetables (Politico Pro DataPoint). Increased reliance on foreign food has never been, and should never be a policy our Nation has intentionally embraced."

Agri-Environmental Scheme of Agriculture

It is interesting to note that alfalfa is recognized as an important crop in what is often referred to as "sustainable agriculture" or "regenerative agriculture" that emphasizes the use of natural systems for enhancing soil health and plant community ecology.

Alfalfa has been a popular a crop rotation component in Europe, and encouraged globally, as an element of the Agri-Environmental Scheme (AES), which is intended to reduce the impacts of "commercial" agriculture intensification on the environment (Gonzalez del Portillo, et al. 2022).

The Agri-Environmental Scheme (AES) offers the following attributes of alfalfa which are consistent with our basic agronomic understanding for many decades:

- Alfalfa also may help reduce the impacts of climate change due to canopy cover of the soil for a longer period than any other crop, alfalfa is envisioned as a leading option for soil carbon sequestration, also known as "regenerative agriculture," especially with the need to decrease carbon emissions and introduce the carbon credits initiative.
- Alfalfa is a rich habitat for wildlife allowing for a diversity of local niches and preserving many endangered species from different animal families.
- Alfalfa fields are important contributors to the biodiversity of agricultural systems by functioning as insectaries for beneficial insects, many of which are pollinators or natural enemies that play important roles in the low desert agroecosystem.
- Beneficial insects move from alfalfa fields into other crops, where they play crucial roles in pollination and biological control.
- These roles reduce the reliance on synthetic insecticides, which if used incorrectly could have negative impacts on human, animal, and environmental health.

- Western alfalfa production, due primarily to irrigation and the vigorous plants that grown, provides a rich habitat for insects, which enhances the crop ecology.
- The year-round insectary characteristic allows alfalfa to play an important role in insecticide resistance management by serving as a refuge, i.e., aphids and whiteflies.

Arizona Crop Acreages 2022

Crop	Seasonal Water Use (inches)	Total Acres (2022)
Alfalfa	74.3	260,000
Cotton	41.2 32-36**	86,000
Wheat	25.8	
Corn	32	44,000
Lettuce	8.5	27,000
Broccoli	19.7	11,600
Cauliflower	18.6	6,000
Lemons	39.1	6,700
Spring Cantaloupes	20.5	6,000

*Seasonal water use estimates from Erie, et al. 1981 unless otherwise noted.
**Norton and Silvertooth, 2001

References:

Del Portillo, D.G, B. Arroyo & M.B. Morales (2022) The adequacy of alfalfa crops as an agri-environmental scheme: A review of agronomic benefits and effects on biodiversity. Journal for Nature Conservation 69(2):126253.

Erie, L.J., O.A French, D.A. Bucks, and K. Harris. 1981. Consumptive Use of Water by Major Crops in the Southwestern United States. United States Department of Agriculture, Conservation Research Report No. 29.

Fischer, H. 4 October 2023. Arizona cancels a lease for farm that exports alfalfa to Middle East. Tucson Daily Star.

Norton, E.R. and J.C. Silvertooth. 2001. Evaluation of a drip vs. furrow irrigated cotton production system. Cotton, A College of Agriculture Report Series P-125, University of Arizona, Tucson, AZ. p. 126-132.

Mostafa, A.M. 2015. The Benefits of Alfalfa to the Southwest Ecosystem. Arizona Agriculture.

Putnam, D. 2015. Why alfalfa is the best crop to have in a drought. University of California-Davis. Alfalfa and Forage News.

U.S. House of Representatives Committee on Natural Resources; The Water, Wildlife and Fisheries Subcommittee. Farm Family Alliance written testimony, March 2023.

USDA. 2022. State Agriculture – Arizona.

USDA. 2023. News Release: NASS, 30 June 2023 Arizona crop report.

USDA. 2023. October 2023 Pacific Region crop production report.

Yost, M., N. Allen, E. Creech, D. Putnam, J. Gale & G. Shewmaker. 2020. Ten Reasons Why Alfalfa is Highly Suitable for the West. Utah State University Extension.