SALT tolerance of GRASSES and FORAGE LEGUMES

UNITED STATES DEPARTMENT OF AGRICULTURE
Agriculture Information Bulletin No. 194

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Bernstein, Leon, 1915–

Salt tolerance of grasses and forage legumes. [Washington, U. S. Govt. Print. Off., 1958]

7 p. illus. 27 cm. (U. S. Dept. of Agriculture. Agriculture information bulletin no. 194)

1. Plants, Effect of salt on. [1. Salt—Effect on plants] 2. [Soil, Salts in] I. Title. (Series)

S21.A74 no. 194 633.2 Agr 58–347

U. S. Dept. of Agr. Libr. for Library of Congress 1Ag84Ab no. 194

Washington, D. C. Issued December 1958

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price 5 cents

SALT tolerance of GRASSES and FORAGE LEGUMES

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WHAT IS SALT TOLERANCE?

It is the degree to which a crop can produce a satisfactory yield on salty land.

Soil salinity, or saltiness, is a widespread condition in arid and semiarid areas. The degree of saltiness varies from a low level that allows most crops to grow well, to levels so high that no crops at all can be grown. However, some plants can tolerate much more salt than others. It is important, therefore, to know the salt tolerance of different crops and varieties in order to plant those that will give the best possible yields under saline conditions.

In choosing a crop for saline land, factors in addition to salt tolerance must be considered. Adaptation to climatic conditions is always a critical factor and, for dryland farming, drought resistance may be important.

BN-6225

Test plots for studying the salt tolerance of grasses and forage legumes. Legumes on moderately saline plots are stunted or killed, while those on alternate nonsaline plots are making vigorous growth.

WHY ARE FORAGE CROPS IMPORTANT IN FARMING SALTY LAND?

Forage crops may be low-cost crops for marginal land.

They may improve soil structure of reclaimed land.

They may produce good yields of forage or seed on salty land, provided salt-tolerant species are planted.

Sometimes there is a definite limit to the improvement of salty lands. This is the case when salty irrigation water must be used, or when drainage, for one reason or another, cannot be improved enough to prevent some buildup of salt in the soil. Under such conditions, the grower must farm his salty land as best he can. Obviously, low-cost crops that require minimum expenditures for land preparation, fertilizer, seeding, and weed control will be the most attractive since the risk of loss will be minimized. Forage crops very often meet these cost requirements.

When salt is removed by leaching, the soil may at first tend to seal up and take water slowly. It is necessary to restore good soil structure in the desalted soil before it can grow satisfactory crops. The fibrous roots of grasses are particularly effective in restoring good soil tilth. Grasses are frequently used alone or in combination with forage legumes as the first crop following leaching and prior to planting row crops or orchards.

Since some of the grasses are very salt tolerant, they may be used as forage crops on lands so salty that few other crops would yield satisfactorily. Also, the cover provided by forage crops may be of benefit in reducing soil losses by wind or water erosion.

HOW DOES SALT AFFECT THE GROWTH OF FORAGE CROPS?

The primary effect of salt is to decrease the availability of water.

The main effect of soil salinity on forage crops is to make it difficult for the roots to take up water. The saltier the soil, the less readily available is the water. In appearance, grasses and forage legumes on salty soil are very much like plants on droughty land. They are stunted and bear small leaves that generally have a dark, blue-green color rather than the bright green of plants that have an adequate, readily available, moisture supply. Of course, if the soil water is too salty, the plants will eventually turn brown and die. This is usually the result of extreme moisture deficiency rather than any toxic effect of salinity.

Special nutritional effects may also be involved. Orchard grass, for example, suffers when calcium salts predominate in saline soil. Species also differ in their tolerance to sodium. Most grasses and forage legumes appear to be tolerant enough to sodium. Poor physical condition of sodium soils is the principal reason for crop failure. Soils high in sodium generally take water very slowly, and become hard and crusty when dry. Usually, such soils must be reclaimed before any crop can be grown successfully. Special information is available for the diagnosis and improvement of sodium-affected soil.

In testing for soil salinity where forage crops are involved, it is usually not necessary to analyze the soil for the separate salt constituents. A measure of total salinity is generally sufficient. An extract of the water-saturated soil is made, and its ability to carry an electrical current is measured. This measurement of electrical conductivity is a good index of soil salinity, and is related to the availability of water in the soil under field conditions. Salinity is generally reported in millimhos. Crop response at different salinity levels is indicated below.

Range of salinity in millimhos [1]	*Crop response*
0 to 2	Salinity effects mostly negligible.
2 to 4	Yields of very sensitive crops may be restricted.
4 to 8	Yields of many crops restricted.
8 to 16	Only tolerant crops yield satisfactorily.
Above 16	Only a few very tolerant crops yield satisfactorily.

[1] Conductivity of saturation extract (millimhos per centimeter at 25° C.).

HOW MUCH SALT CAN DIFFERENT GRASSES AND FORAGE LEGUMES TOLERATE?

Such crops can tolerate from as little as 2 to 3 millimhos, up to 12 millimhos or more.

For most of the salt-sensitive or moderately salt-tolerant species there is no "safe limit" of salinity. Yields fall off even at low levels of salinity, and the higher the salinity level, the greater is the decline in yield. Assuming that a minor decrease in yield can be accepted, the salt-tolerance limits for forage crops can be given for irrigated areas.

In the salt-tolerance list that follows, species are divided into tolerant, moderately tolerant, and sensitive groups. Within each group the species are ranked in order of decreasing salt tolerance, although a difference of two or three places in the ranking may not be significant. Thus, alkali sacaton generally produces well if salinity does not exceed 12 millimhos, but for good yields of birdsfoot trefoil, salinity should not exceed 6 millimhos. On soils high in gypsum, salinity levels at which a definite reduction in yield generally occurs are 2 millimhos higher than those indicated in the list. For example, alkali sacaton could tolerate salinity up to 14 millimhos, and birdsfoot trefoil up to 8 millimhos in soils that contain gypsum. Seed yields are usually less sensitive to salinity than forage yields. This is particularly true for the more tolerant grasses.

Good Salt Tolerance

(12 to 6 millimhos)

Alkali sacaton (*Sporobolus airoides*)
Saltgrass (*Distichlis stricta*)
Nuttall alkali-grass (*Puccinellia nuttalliana*)
Bermuda grass (*Cynodon dactylon*)
Tall wheatgrass (*Agropyron elongatum*)
Rhodes grass (*Chloris gayana*)
Rescue grass (*Bromus catharticus*)
Canada wildrye (*Elymus canadensis*)
Western wheatgrass (*Agropyron smithii*)
Tall fescue (*Festuca arundinacea*)
Barley (hay) (*Hordeum vulgare*)
Birdsfoot trefoil (*Lotus corniculatus*)

Moderate Salt Tolerance

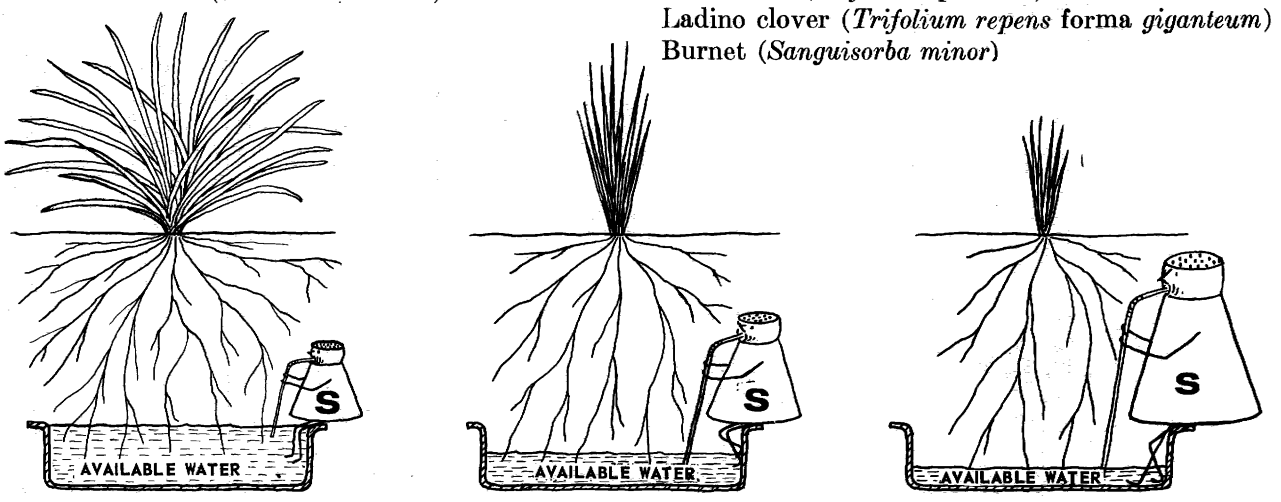
(6 to 3 millimhos)

White sweetclover (*Melilotus alba*)
Yellow sweetclover (*Melilotus officinalis*)
Perennial ryegrass (*Lolium perenne*)
Mountain brome (*Bromus marginatus*)
Harding grass (*Phalaris tuberosa* var. *stenoptera*)
Beardless wildrye (*Elymus triticoides*)
Strawberry clover (*Trifolium fragiferum*)
Dallis grass (*Paspalum dilatatum*)
Sudan grass (*Sorghum sudanense*)
Hubam clover (*Melilotus alba* var. *annua*)
Alfalfa (*Medicago sativa*)
Rye (hay) (*Secale cereale*)
Wheat (hay) (*Triticum aestivum*)
Oats (hay) (*Avena sativa*)
Orchard grass (*Dactylis glomerata*)
Blue grama (*Bouteloua gracilis*)
Meadow fescue (*Festuca elatior*)
Reed canary (*Phalaris arundinacea*)
Big trefoil (*Lotus uliginosus*)
Smooth brome (*Bromus inermis*)
Tall meadow oatgrass (*Arrhenatherum elatius*)
Milkvetch (*Astragalus* species)
Sourclover (*Melilotus indica*)

Poor Salt Tolerance

(3 to 2 millimhos)

White Dutch clover (*Trifolium repens*)
Meadow foxtail (*Alopecurus pratensis*)
Alsike clover (*Trifolium hybridum*)
Red clover (*Trifolium pratense*)
Ladino clover (*Trifolium repens* forma *giganteum*)
Burnet (*Sanguisorba minor*)



Salinity checks the growth of most forage crops.

Rhodes Grass

Perennial Ryegrass

Smooth Brome

Meadow Foxtail

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Effect of salinity on the growth of grasses.

Some varieties of forage crops are more sensitive to salt than others. The coarse-leaved strains of smooth bromegrass are generally more tolerant than the fine-leaved strains, and some varieties of barley are more salt tolerant than others. Narrow-leaf birdsfoot trefoil is more tolerant than the broad-leaved variety. Alfalfa varieties, on the other hand, do not appear to differ appreciably in salt tolerance. For most forage species, there is very little reliable information on varietal differences in salt tolerance.

HOW DOES SALINITY AFFECT THE QUALITY OF FORAGE?

The effect varies with the species.

Some grass species take up large amounts of salt from saline soils and may become unfit for feeding. Rhodes grass, for example, may cause scours in cattle because it takes up so much salt when grown on salty lands. Since salinity checks vegetative growth, the forage may actually be richer in certain vitamins and nutrients than forage from nonsaline land. The decrease in yield, however, more than offsets the enrichment in nutrients. Furthermore, the checking of growth may cause the forage to become tougher and less palatable than forage on nonsaline land. For example, the salt-tolerant tall wheatgrass and tall fescue become tough and wiry on saline land, whereas the less tolerant perennial ryegrass remains more palatable.

HOW SHOULD THE SALT-TOLERANCE INFORMATION BE USED IN SELECTING A FORAGE CROP FOR A GIVEN SITUATION?

Salt tolerance is only one of several factors to be considered.

The State Agricultural Extension Services and the Soil Conservation Service can recommend forage species adapted to local conditions. They will take into account the temperatures during the growing season, the severity of winters and soil factors such as moisture (rainfall, irrigation), texture, fertility, and drainage. From the list of suitable forages, the individual grower can choose those which have adequate salt tolerance to produce satisfactory yields at the salinity level which he finds in his land. For example, on poorly drained, wet lands in the Mountain States, the water-tolerant strawberry clover may be preferred to the more salt-tolerant birdsfoot trefoil.

HOW CAN SALTY LAND BE MANAGED TO IMPROVE YIELDS?

Proper land leveling, leaching, irrigation, and drainage will improve yields on salty lands.

Water management is the key to salinity control. Under dryland conditions the grower can do little to remedy a saline condition except to provide for maximum penetration of rainfall by reducing runoff. Under irrigation, the possibilities for salinity control are much better. Good land leveling is essential for uniform water penetration and for preventing the buildup of salt in high spots in the field. Salts brought in by the irrigation water may tend to build up to very high levels in the soil, but adequate irrigation generally prevents such a buildup. The salt removed by leaching or heavy irrigation must eventually be carried off in natural or artificial drainageways.

Between irrigations, water is taken up by the plants and also evaporates from the soil. As a result, the water remaining in the soil becomes more and more salty. More frequent irrigation tends to keep the soil water from becoming excessively salty. Yields may often be considerably improved by frequent irrigation, provided drainage is adequate.

Because of the presence of salt, less soil moisture is available to plants. Irrigation may be required on salty soil even though the soil still has a "good" moisture content. This remaining soil moisture may be almost completely unavailable to the plants.

POINTS TO REMEMBER

1. Select salt-tolerant crops for salty land. Some grasses and forage legumes are much more salt tolerant than others.
2. Irrigate adequately to keep the salt moving down through the soil.
3. Irrigate frequently. Don't let salty land "dry out" between irrigations.

U. S. GOVERNMENT PRINTING OFFICE: 1958 O—470863