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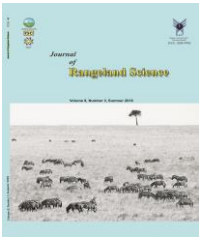

Review and Full Length Article:

Genus *Salsola*: Its Benefits, Uses, Environmental Perspectives and Future Aspects - a Review

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Abstract. Genus *Salsola*, a genus of annual semi-dwarf to dwarf shrubs and woody tree species, is widely distributed across the arid and semi-arid areas of the world. Several features like high fodder value, abundant seed production, tolerance to extreme climatic conditions like high temperature and prolonged drought conditions contributed significantly towards its success as a potential forage species in semi-arid to arid environments. Species of this genus are of significant importance and species like *Salsola soda* are cultivated and consumed as vegetables in Italy, while others (*S. tragus* and *S. baryosoma*) are utilized as livestock fodder in arid and dry areas. The species of genus *Salsola* are grouped as halophytes, which are also useful for rehabilitation and reclamation of degraded saline lands and saline soils, respectively. Many plants of this genus are used in medicines and cosmetics as they are cure for human heart, skin diseases, cough and influenza. This paper comprises a comprehensive review on the important species of *Salsola*, along with its medicinal uses and other useful properties that will aid the researcher in determining the need of future research. We focus on the adaptive features of genus *Salsola* plants for their effective utilization in drought prone semi-arid to arid conditions and also to remediate degraded saline soils.

Key words: Arid, Weed, Forage, Medicinal, Invasive, Saline, Reclamation, Vegetable

Introduction

Insufficient freshwater, salt contamination and soil degradation are considered as one of the major problems in most of the arid and semi-arid regions of the developing countries (Ladeiro, 2012). Halophytic forage shrubs and grasses have the great potential and can be utilized to revegetate degraded saline and/or sodic environments in these drought prone regions (Malcolm, 1994). Genus *Salsola* (Chenopodiaceae) is common in arid, semi-arid and temperate regions worldwide (Rasheed *et al*., 2013). The exact number of species that fall under this genus has not been clearly established yet. It is reported that more than 140 species of genus *Salsola* includes both annual and perennial herbs, shrubs and semi-shrubs with C_3, C_4 or C_3-C_4 intermediate photosynthesis species (Pyankov *et al.,* 2001; Toderich *et al.,* 2012). The genus *Salsola* is from the Latin *Salsus*, meaning "salty" because some of its species grow in salty areas or contain alkaline salts (Mosyakin, 1996). These species are tolerant to water, heat, and salt stresses and about 45% of the desert lands comprise of *Salsola* species (Toderich *et al.,* 2012). Young shoots are palatable, pronghorns and small rodents feed on young shoots (Beckie and Francis, 2009).

Several species are invasive outside their native range of Middle East, Asia, Europe, and Africa (Mabberley, 1997). *Salsola tragus* has been reported as an alien weed in Argentina, Chile, Canada, Mexico, South Africa, Indonesia, Australia, New Zealand and the United States (Holm *et al.,* 1977; Crompton and Bassett, 1985; Young, 1991; Beckie and Francis, 2009). It was introduced by the United States Department of Agriculture because of its fodder values; cattle eat it during the drought period (Khan and Qaiser, 2006). Due to their medicinal and fodder values, the plants are considered as important desert species (Xian-ping and Jian-xue, 2007; Nath and Khatri, 2010). They are a cure for human heart as well as stomach problems (Xian-ping and Jian-xue, 2007). There are several features present in the different species of Salsola that contribute significantly towards its success as potential plants in semi-arid to arid environments. These features include high fodder value (up to 55% digestible proteins), abundant seed production, tolerance to salinity and extreme climatic conditions like high temperature and prolonged drought conditions (Farmer *et al.,* 1976; Khan *et al.,* 2002).

Despite its importance and benefits, the wild Central Asian *Salsola* species are under the threat of extinction due to ongoing climate change and increasing anthropogenic pressures (Toderich *et al*., 2012). Under current conditions of rapid climate change a catastrophic loss of genetic diversity, is likely to occur (Safriel *et al*., 1994; Jump *et al*., 2005). The evidence of current extinctions caused by climate change is limited. However, the studies suggest that the current scenario of climate change could surpass habitat destruction over the next several decades (Leadley *et al.* 2010).

Salinity is one of the major problems in arid and semi-arid regions, where soil salt content is high and precipitation is insufficient for their leaching (Heidari-Sharifabad and Mirzaie-Nodoushan, 2006). In these regions, planting salt-tolerant species as well as drought tolerant species, is the most useful approach in rehabilitating drought prone salt-affected degraded lands (Oba *et al.,* 2001). Genus Salsola is usually ignored and people are not familiar with their importance. Most of the research is done on its pollen morphology (Toderich *et al*., 2010) and species identification (Boulos, 1991), but very limited information is available on the adaptive features of genus *Salsola* plants for their effective utilization in drought prone semi-arid to arid conditions and also to remediate degraded saline soils. Therefore, we present here a broad review of genus

Salsola covering the taxonomy, origin, distribution, agricultural impact, utilization and benefits. This comprehensive review also provides future directions for research on this genus in arid environments.

Distribution

The plants of genus *Salsola* are widely distributed across the hypersaline, semi-arid, and arid areas of the world (Kuhn *et al*., 1993). These plants are known to thrive best on sandy and saline soils (Scoggan, 1957). *Salsola* is native to Africa, Europe and Asia and is invasive species in the north and South America and Australia (Botschantzev 1969; Lavrenko 1962; Kuhn 1993). The genus is the ancestor of 40 to 50 related genera containing over 350 species (Botschantzev, 1969, 1974, 1975, 1976; Kuhn, 1993; Willis, 1973). The regions where numerous species of this genus are found are described in the Tables 1 and 2.

Table 1. Distribution of species of genus *Salsola* across the globe

Region	No of species	References
Australia	3	Chinnock, 2010
China	36	Zhu *et al.*, 2003
Egypt	15	Elsharabasy *et al.*, 2013
Palestine Territory	12	Halevy, 1989
North America	6	Mosyakin, 1996
Pakistan	22	Khan and Qaiser, 2006
Saudi Arabia	8	Mandaville, 1990
South Africa	60	Pyankov *et al.*, 2002
Uzbekistan	48	Toderich, 2008

Table 2. Genus Salsola (spp.) in different countries across the world

Regions	Species
North America	*S. vermiculata, S. soda, S.tragus, S.kali, S. collina, S.paulsenii.*
China	*S.aperta, S.komarovii, S.soda, S.collina, S.zaidamica, S.monoptera, S.tamariscina, S.rosacea, S.chinghaiensis, S.praecox, S.paulsenii, S.pellucida, S.sinkiangensis, S.ikonikovii, S.nepalensis, S.tragus, S.brachiata, S.foliosa, S.implicata, S.affinis, S.subcrassa, S.heptapotamica, S.lanata, S.korshinskyi, S.ferganica, S.sukaczevii, S.arbuscula, S.junatovii, S.abrotanoides, S.laricifolia, S.arbusculiformis, S.passerina, S.orientalis, S.dshungarica, S.micranthera, S.nitraria.*
Palestine Territory	*S.soda, S.tragus, S.incanescens, S.jordanicola, S.inermis, S.tetrandra, S.oppositifolia, S.schweinfurthii, S.orientalis, S.boissieri, S.vermiculata, S.cyclophylla,*
Saudi Arabia	*S.imbricata, S.gaetula. S.schweinfurthii, S.jordanicola, S.cyclophylla, S.drumondii, S.volkensii, S.baryosoma, S.vermiiculata, S.arabica.*
South Africa	*S. acocksii, S. aellenii, S. albida, S. albicephala,S. angolensis, S. aphylla, S. araneosa, S. arborea, S. armata, S. barbata, S. calluna, S. campyloptera, S. cauliflora, S. columnaris, S. cryptoptera, S. dealata, S. denudate, S. dolichostigma, S. etochensis , S. garubica, S. gemmata, S. gemmifera, S. giessii, S. glabra, S. glabrescens, S. henriciae, S. hoanabica, S. hottentottica, S. humifusa,S. kalaharica, S. kleinfonteini, S. koichabica, S. luederitzensis, S. marginata, S. melanantha, S. merxmuelleri, S. mirabilis, S. namibica, S. nollotensis, S. okaukuejensis, S. omaruruensis, S. parviflora, S. pilansii, S. procera, S. ptiloptera, S. rabieana, S. robinsonii, S. ruschii, S. schreiberae, S. scopiformis, S. seminude, S.sericata, S. seydelii, S. spenceri, S. swakopmundi, S. tuberculata, S. tuberculatiformis, S. ugabica, S. unjabica, S. zeyheri.*
Pakistan	*S.arbuscula, S.chorassanica, S.collina, S.crassa, S.cyclophylla, S.drummondii, S.graffithii, S.imbricata var. 317mbricate, S.imbricata var. hirtitepala, S.incanescens, S.makranica, S.nitraria, S.orientalis, S.paulsenii, S.richteri, S.sclerantha, S.tomentosa and S.tragus*, 4 new species added are: *S.foetida, S.soda, S.kalii and S. stocksii.*
Australia	*Salsola australis, S.tragus, S.kali.*

Benefits, uses, impact on agriculture and medicinal properties

1-Medicinal uses

Genus *Salsola* is considered as genera of plants containing antioxidants compounds in their leaves having low caloric composition. The alkaloid extracts are usually helpful in controlling obesity, diabetes and Alzheimer's disease (Yildiztugay *et al.*, 2008; Tundis *et al.*, 2009). Some plants of this genus also possess the healing properties. Many plants are traditionally used as antibacterial, anticancer agents, antihypertensive and cure for tape worm infestation (Rasheed *et al*., 2013). Medicinal properties of various species of Genus *Salsola* have been described in Table 3.

Table 3. Medicinal properties of various species of Genus *Salsola*

Specie name	Plant part used	Medicinal value	References
S. kali	Powder of whole plant	Cures cough	Nath and Khatri, 2010
S. foetida	Tyrosinase compounds	Used for curing skin diseases related to hyper pigmentation, Used in cosmetics for whitening and protection against sunburns	Khan *et al.*, 2003
		Used to cure hypertension alkaloid compounds are used in Chinese medicines to cure high blood pressure and hypertension.	Xiang *et al.*, 2007
		Salsola tragus contains salsolin and salsolidin which cure hypertonia by stimulating sleep activity.	Munir *et al.*, 2014
S. tragus	Alkaline salt	is important in regulating the blood pressure, vaso constrictive effects on the uterus, treatment of cancer, cathartic, diuretic, emmenagogue, vermifuge, treatment of dropsy and excrescences, treatment of influenza and smallpox, intestinal obstructions, hardness of the liver and spleen and expelling a dead child	Loizzo *et al.*, 2007
S. kali	Poultice of the chewed plant	Applied on ant, bee and wasp stings According to Hartwell (1967–1971), the plants are used in folk remedies for that cancerous condition he termed as superfluous flesh.	Hartwell, 1969
S. richteri	Alkaloids salsoline and salsolidine in its leaves, flowers and fruits	The alkaloids are used in treating hypertension.	Pakanaev *et al.*, 1980.
S. tubercultiforis	A molecular compound	Seems to have an anti-inflammatory effect equivalent to Dexa methasone, without having the same type of side-effects commonly associated with Dexame thasone and Cortisone treatments.	Swart *et al.*, 2003 Beyaoui *et al.*, 2012
S. tetrandra	Roots contains two new phytochemical compounds Tetranins A and B.	This compound, so far only known as compound A, holds some promise as basis for the development of treatments for rheumatoid arthritis and autoimmune conditions. Exhibited significant antioxidant activity. Vascular hypertension.	Hassan *et al.*, 2005. Hammiche and Maiza, 2006.
S. imbricata	Ashes of aerial parts mixed with sugar	Abdominal distention, constipation and dyspepsia.	Ahmed *et al.*, 2014
S. baryosoma		In Middle East Is used against inflammation and as Diuretic agent	Al- Saleh *et al.*, 1993

2-As a Fodder

One of the major problems of arid environments is the availability of fodder/forage for the animals. Most of the arid regions comprise very scarce vegetation, out of which only a few of the shrubs and bushes have fodder value and are source of good nutrition for livestock (Thomas and Sumberg, 1995). Annual *Salsola* species may be used as partial

substitute for feed concentrates, especially in autumn and winter in deserts (Gintzburger *et al.,* 2003). In Cholistan desert of Pakistan, the plants are a promising camel fodder (Ali *et al.,* 2009). Numerous features like high nutritional values, prolific seed production, tolerance to high temperature and prolonged tolerance to drought conditions contributed greatly towards its success as potential forage specie in arid environments (Fowler *et al.,* 1992) (Tables 4 and 5).

This genus serves as important fodder plant after the first autumn rains and frosts when the rain leaches down the fodder becomes edible. In the second half of winter they serve as security fodder stock as pastures when other fodder plants become in- accessible for cattle (Boller *et al.,* 1999). According to a survey in Tank district of Peshawar, Pakistan *Salsola foetida* was reported as popular fodder as mentioned by 60% of the respondents (Badshah and Hussain, 2011). Its importance as a fodder could be analyzed by its dry matter values of crude protein, acid detergent lignin, nitrates and water soluble oxalates. (Tables 4 and 5).

By keeping in view all the above fodder properties we may say that this species? is capable of solving the issues of fodder shortage.

Table 4. Respective nutritive values of dry matter (Hageman *et al.*, 1987):

Contents	% on dry matter
Crude proteins	5.4 to 22.3
Acid detergents fiber	20.1 to 48.4
Acid detergents lignin	3.1 to 10.4
Nitrate	0.1 to 5.1
Water soluble oxalate	0.2 to 9.1

Table 5. Fodder species of Genus Salsola

Plant type	Specie name	Fodder properties	References
Summer annual	*S. tragus*	Young plants of *Salsola tragus* serve as useful fodder, as long as they are not too high in nitrites or oxalic acids. *Salsola tragus* serves as a source of forage in arid regions of the Great Plains and Canadian prairies	Fowler *et al.*, 1992 Moyer 1992; Richter *et al.* 2002; Berglund and Zollinger 2003.
Perennial	*S. vermiculata*	The foliage is of high forage quality, containing 13.1% crude protein and 9% digestible protein.	Murad and Tadros, 2000
	S. baryosoma	High palatability and available for grazing in monsoon and winter	Ali *et al.*, 2009

Weed properties and control strategies

Many species of genus *Salsola* are reported as noxious weeds in various parts of the world. Following are the major weed species of this genus (Table 6).

Table 6. Weed plants from Genus *Salsola* and their control

Specie name	Weed properties	Control	References
S. iberica	Most common weed of US Found in grass lands and desert communities	**Biocontrol:** Division of Plant Industry's Biological Pest Control Section has two moth species, *Coleophora klimeschiella* and *C. parthenica*, that may be available for redistribution. **Mechanical:** Mowing or pulling young plants can be used to control Russian thistle. However this process may have to be repeated for several years to be successful. **Cultural:** Prescribed burning is not recommended for control of Russian thistle, since it favors disturbed communities and readily decolonizes burned areas. **Herbicides:** Dicamba at 0.5 lb., 2,4-D at 1 lb, or glyphosate at 1.5 lb. ai/acre, have been used to successfully control Russian thistle. Chlorsulfuron 17.5 to 140 g/ha was applied as post-harvest herbicide to control this weed in wheat crop.	Young and Gaely, 1986.
S. kali	Host plant of the Sugar Beet Leafhopper. This insect carries curly-top virus, a disease affecting sugar beets, tomatoes, and beans.	**Chemical:**2,4-D or bromoxynil used in combination with dicamba. Metribuzin used in Combination with chlorsulfuron gave 95 to 100 percent control.	Burrill *et al.*, 1989. Young and White sides, 1968.
		Biological: *Trichosirocalus horridis* has been successfully introduced in Canada for Russian-thistle control	Leen and Rosemary, 1991
S. vermiculata	Found as a weed of various agricultural and horticultural crops including mainly sugarbeet, tomatoes and melons	**Cultural Control**: Burning to the ground has been seen to kill plants under experimental conditions	Creager ,1988 ;1990
		Chemical control: Chemicals like chlorsulfuron, hexazinone and metribuzin resulted in complete killing of *Salsola vermiculata* plants.	Beckie and Francis, 2009
S. tragus	Weed of small grain cereals specially spring wheat in USA.	When triazine herbicides were applied as post emergence, they were effective in controlling this weed in cereals.	Anderson and Greb, 1987

3-As food/host plant for some insects:

Salsola species are used as food plants by the larvae of some Lepidoptera species including *C. salsolella*, which feeds exclusively on *S. vermiculata* (Gangwere *et al.,* 1998). *Salsola tragus* is a host to false root knot nematodes (Gray *et al.,* 1997).

4-As fuel

The desert areas do not have proper provision of gas at homes. As plants of genus *Salsola* are woody in nature, so these are used for fuel purpose in homes. The sticks are burnt and cooking is done on it. It is a source of fuel in arid regions. The plants are dried and burnt; the dried woody parts are a good source of fire as they easily lit up and make up a source of fuel (Dagar, 1995). As the plants of this genus are known to be succulent with low water consumption, they germinate quickly on minimally disturbed soils, and are relatively free of diseases and parasites, *Salsola tragus* has been suggested as a fuel source for arid lands. It is also reported to be investigated in Turkey as a source of biomass fuel (Yumak *et al.,* 2010).

Protection against land erosion

The desert areas are prone to land degradation. High winds and tornadoes blow across the deserts eroding land

away with them as a result top fertile soil is lost. About 60% of the land degradation in arid areas occurs through wind erosion (Sharma and Tiwari, 2001). The natural vegetation of desert serves as soil cover and roots hold the soil in place as result losses through erosion are minimized. E.g: *S. paletzkiana*, is used as soil cover (Toderich *et al.*, 2008). Integration of *S. vermiculata* in desert areas will minimize the problem of land degradation (Guma *et al*., 2009). The plants of genus *Salsola* which are found abundantly growing in the Cholistan desert of Pakistan could be grown as wind shields, they bind the soil as a result the danger of wind erosion is lowered (Table 7).

Creation of multi-use protected areas

Perennial species represent valuable germplasm resources for applications such as fixation of shifting sands and improvement of degraded rangelands and salt affected marginal lands, remediation of salt affected soils and serve as an excellent component for the creation of multiple-use protected land (Toderich *et al.*, 2012). As these plants forms colony as a result land is protected (Young, 1988). For example *Salsola tragus* and *Salsola iberica* act as surface cover and prevent erosion where? (Schillinger and Young, 2000) (Table 7).

Table 7. Utilization of *Salsola spp* for land rehabilitation and reclamation

Specie	Use	Reference
S. imbricata	Stabilizes sand dunes and has ability to restore degraded oil polluted lands in Persian gulf and Kuwait deserts	Hegazy, 1997 Radwan *et al.* 1998
S. passerina	Showed Pb tolerance and ability to phyto-remediate and stabilize Pb contaminated arid lands in china	Hu *et al.* 2012
S. vermiculata	Utilized for improvement of degraded rangelands of Syria	Osman et al. 2006
S. soda	It is cultivated in Southern Europe to reclaim brackish swamps near coastal areas	Mendelsohn and Balick, 1997
S. affinis	Inhabits harsh saline desert of Northwest China	Wei et al. 2008
S. soda	It was used as a companion plant with pepper, where it lowered the EC and increased the total yield, biomass and marketable yield of pepper. This specie is also reported to be grown on soils with heavy deposits of Selenium, boron and Sodium, where it accumulated high concentrations of these heavy metals and remediated the soils.	Colla *et al.*, 2006 Centofanti and Banuelos, 2015
S. kali	This plant has capability to show tolerance against Cadmium.	De la Rosa *et al.*, 2004& 2005

Allelopathic effect and presence of phenolic

Salsola is a genus of species which are allelopathically active. During their decaying process they decrease the growth of associated species (Sokolowska *et al*., 2009). In leaves of *Salsola kali* some phenolic were found like caffeic, ferulic, chlorogenic, iso cholorogenic and neo chlorogenic (Lodhi 1979). These phenolics are important from botanical and pharmaceutical point of view:

1-Botanical importance of phenolic

The phenolic can be associated as regulatory molecule in plant defense; they protect them against pathogens, infections and improve plant's germination and growth. These phenolic are found in leaves and stem where they absorb the UV radiations (Dixon and Paiva, 1995).

2-Pharmaceutical importance of phenolic

The free radical scavenging and inhibition of lipid per oxidation are the

most important antioxidant properties of phenolic in *Salsola*; this makes them important from pharmaceutical and the therapeutic point of view (Marimuthu *et al*., 2008).

Availability of Phosphorus

Field and green house experiments were conducted by Cannon et al. (1995) to determine that the oxalate produced by *Salsola tragus* and added oxalic acid would solubilize Phosphorus from in the inorganic Phosphorus in soil and make it available to plant (*Stipa pulchra*). From their experiments, they noticed that both the oxalate leached down by canopy of *Salsola* and added oxalic helped in increasing the availability of P. A significant increase in *Stipa* shoot P in response to *Salsola* leachates and added oxalates was observed. These results concluded that oxalate has an important role in P cycling, and on disturbed soils where *Salsola* grows it may facilitate establishment of several seral plants e.g *Stipa*, by providing availability of Phosphorus.

Table 8. commercially utilized *Salsola* species

Specie name	Minerals found	Commercial uses	References
S. stocksii		Source of Sodium Carbonate	Akad *et al.,* 1997
S. kali	high alkali content	Plant ash is used to make soaps for cleaning clothes.	Tite *et al.,* 2006
		On account of its high alkali content, the plant has also been used in making glass	Watt and Breyer Brandwijk ,1962
S. imbricata	produces alkali	Widely used in industries	Khan *et al.,* 2007
S. rigida	Ionic composition	The studies done on chemical composition of *Salsola rigida* revealed that these halophytic plants have high concentration of Na, N,P and Cl and low levels of Ca, K and Mg.	Jafari *et al.,* 2011

Environmental threats to this genus

Climatic conditions are changing worldwide, and these changing conditions are affecting the flora as well. Currently, there is a gradual but serious decrease in the size and the number of natural populations of many *Salsola* species, which ultimately lowers their surviving rates under current conditions of climate change (Toderich *et al.,* 2012). Populations of wild *Salsola* species of central Asia may become extinct due to ongoing climate changes and increasing anthropogenic pressure (like pollution, release of toxic substances, salinity, increasing sand mining and degradation and exploitation of habitats). The plant populations are under the threat of habitat destruction due to changing environmental conditions which may leads towards extinction of species. Under current conditions of rapid climate change a catastrophic loss of genetic diversity, is likely to occur (Jump *et al.*, 2005).

Conclusions

Plants are unable to adapt quickly to the changing climatic conditions as a result the species are becoming extinct. Appropriate measures for conservation of this genetic diversity should be taken as this genus has many benefits and uses specially for remediation of salt affected soils, a potential to be grown on Na, selenium and Boron laden soils making these soils sustainable for crop production, as well as a fodder in arid areas. Scientists should design its production technology keeping in view its fodder properties so that the farming and livestock owning community of desert areas could cultivate these species as a fodder. Studies on specie identification, morphological variations, genetic diversity and its nutritional values

are still questions to be examined. Further research is required to get better knowledge about the uses and benefits of various plants of this genus. Moreover an integrated weed management technology should be designed for controlling the weed species of genus *Salsola*.

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جنس گونه گیاهی سالسولا، فواید، کابردها، خصوصیات محیطی و مروری بر آینده آن

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چکیده. جنس سالسولا گیاهی است با گونه‌های مختلف از یکساله گرفته تا بوته‌ای و درختی چوبی بصورت وسیعی در مناطق خشک و نیمه خشک دنیا پراکنده شده است. خصوصیات متعدد آن از جمله ارزش غذایی بالا، تولید بذر زیاد، مقاوم به تغییرات شدید محیطی به لحاظ درجه حرارت بالا و خشکی شدید باعث شده است که از آن به عنوان منبع علوفه در مناطق مختلف خشک و نیمه خشک دنیا برای دامها نام برده شود. گونه‌های مختلف این جنس بسیار مهم هستند مانند گونه *Salsola soda* در کشور ایتالیا کشت شده و مانند سبزی به مصرف می‌رسد، در حالی که دیگر گونه‌های آن نظیر *S. tragus* and *S. baryosoma* برای علوفه دامهای اهلی در مناطق خشک بکار می‌روند. گونه‌های سالسولا به عنوان هالوفیت و یا گیاهان نمک دوست شناخته می‌شوند که برای بازسازی و احیاء اراضی شور تخریب شده و نیز خاکهای شور مفید می‌باشند. گونه‌های زیادی از این جنس به عنوان گیاه دارویی بکار برده می‌شوند چرا که برای سلامتی قلب و بیماری‌های پوستی و سرماخوردگی مفید می‌باشند. این مقاله مروری با دیدی تفسیری و مقایسه‌ای به اهمیت گونه‌های این جنس به لحاظ کاربردهای دارویی و دیگر خواص مفید می‌پردازد که برای تحقیقات آینده محققین مناسب است. همچنین این مقاله بر روی سازگاری این جنس برای بهره‌برداری موثر در مناطق با وضعیت خشکی و خاکهای شور تخریب یافته تاکید دارد.

کلمات کلیدی: خشک، علف هرز، علوفه، دارویی، مهاجم، شوری، احیاء، گیاه مرتعی