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Old man saltbush (Atriplex nummularia)

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Common names

Old man saltbush, bluegreen saltbush, giant saltbush [English]; arroche nummulaire [French]; tiple [Spanish]; oumansoutbos [Afrikaans]; رغل دائري [Arabic]; 大洋洲滨藜 [Chinese]

Species

Atriplex nummularia Lindl. [Amaranthaceae]

Synonyms

Atriplex johnstonii C. B. Wolf

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- Creeping saltbush (Atriplex semibaccata)

Description

Old man saltbush (*Atriplex nummularia* Lindl.) is a halophyte species and one of the most important forage shrubs suited to alkaline and saline lowlands (DAF, 2011; Emms, 2008). It is a very hardy species, able to thrive under harsh conditions (Le Houérou, 1992). It is considered a drought reserve (DAF, 2011; Emms, 2008). *Atriplex nummularia* is much valued for its ability to provide all-year grazing of green feed by extending feed availability into dry periods (NSW, 2010).

Morphological description

Atriplex nummularia is a perennial, long-lived shrub that reaches 3 m in height and 2.5-3 m in diameter. It is silvery grey in colour. Its habit is variable upon landrace or cultivars. It can be erect or sprawling, and its leaves may be 3 cm or 5 cm long. It is moderately or deeply rooted. The stems are woody, much branched. Leaves are irregularly shaped (oval to round), commonly toothed, scaly on both sides and varying in size. Old man saltbush is regarded as dioecious: male flowers are borne in spikes at the apices and female flowers are axillary borne in clusters, generally on separate plants. The fruits are fan-shaped, 5-10 mm long (DAF, 2011; NSW, 2010; Emms, 2008).

Uses

Old man saltbush is a valuable source of fodder in arid and semi-arid regions, particularly where soils are alkaline or saline. It is recommended for range rehabilitation projects and it is also used as an ornamental shrub in many seaside resorts (Le Houérou, 1992).

Distribution

Atriplex nummularia is native to Australia and thrives in Mediterranean-type climates with hot dry summers and cool winters. It is found in many parts of Oceania (except Tasmania) and in Taiwan. It was introduced into South Africa, the USA, Mexico, Chile, and most North African and Middle-East countries (Le Houérou, 1992). *Atriplex nummularia* is the most important exotic species of the genus *Atriplex* cultivated in the Middle East, Maghreb and Spain (Le Houérou, 1992). In South Africa, it is now considered a weed and requires authorization prior to cultivation.

Atriplex nummularia occurs in lowlands (0-400 m altitude) in both hemispheres. It grows well in places where annual rainfall is between 230 and 650 mm, but will grow where rainfall is as low as 150-200 mm, provided the plant is well established. It survived a drought year with 50 mm of rain in South Africa (Robertson, 2016). It thrives in Mediterranean-like temperatures, where hottest temperatures range from 32 to 37°C and lowest temperatures from 3 to 7°C. Optimal temperature for photosynthesis is high (30-35°C) and the annual mean temperature suitable for old man saltbush is between 15-24°C. Growth stops whenever temperature drops to 10°C. *Atriplex nummularia* can survive light frost (between -5° and -10°C) though its leaves are damaged. Under -15°C the plant dies (Le Houérou, 1992). *Atriplex nummularia* grows on limestone or alluvial soils. It does well on a wide range of soils from sands to clays but prefers those that are deep and well-drained (Le Houérou, 1992). It is outstandingly tolerant of alkaline and saline soils (including those above 16 dS/m) but does not do well under acidic conditions and in soils with high Al^{3+} content (levels above 2% CEC (cation exchange) are unsuitable) (GMS, 2016; NSW, 2010).

Forage management

Establishment

Atriplex nummularia does not establish readily from direct seeding. It is best propagated from transplants (DAF, 2011). In some trials propagation from stem cuttings was successful (Aganga et al., 2003). Planting can be done by hand or mechanically. Establishment is slow and requires careful weeding making cultivation relatively expensive. However, once established the plant remains productive for several decades (DAF, 2011). Optimal sowing density depends on environmental conditions and the desired forage production. It can range from 1000-3000 plants/ha in rows spaced 4-6 m apart, to 10,000 plants/ha for higher production. However, plants sown at higher densities have less resistance to water stress and some balance is necessary between productivity and drought resistance (Le Houérou, 1992). Transplantation should be done at the end of the rainy season, when there is residual moisture in the soil. Transplants should be planted as deep as possible (less than 40% of the plant should be above ground) and the soil surrounding the transplant should be carefully compacted (Louw, 2011). Transplants can be placed at different densities, depending on rainfall conditions. Lower rates should be preferred in low rainfall conditions, higher rates under higher rainfall. Planting can be in rows, allowing enough place between the rows to sow winter-growing grass or legumes that enhance the feed value of the stand (Emms, 2008). Establishment during the cool season allows more water to be available for the plant and hence encourages root development before the warm season.

Grazing

Atriplex nummularia can be grazed once it is well established. First grazing can occur 12 or 18 months after transplantation. Heavy grazing at high stocking rates should be done for 4-6 week periods, at 6-8 months intervals to allow good regrowth. Continuous grazing is deleterious to the stands as it removes all leaves and does not allow regrowth (DAF, 2011). It has been recommended for stand survival that it should be grazed only once a year, during the 1-2 month period of forage scarcity in dry years. However, in wet years it could be grazed twice a year (Correal et al., 1990 cited by Ben Salem et al., 2010). However, set-stocking management over long periods (250 days) or rotational management are possible (Norman et al., 2010a). In Australia, open grazing destroyed large areas of *Atriplex nummularia* in the late 19th century (DAF, 2011). In order to maintain stand quality, old man saltbush requires careful grazing management. If no grazing occurs the plants become woody and they sprawl becoming inaccessible to livestock (Emms, 2008). Because old man saltbush is not very palatable it is important to graze it even if other forages are available. This is best achieved by short grazing periods at high stocking rates (Emms, 2008). Typical stocking rates are 125 sheep/ha or 15 steers/ha (DAF, 2011). The plants can be slashed to a height of 30 cm to encourage rejuvenation of the stands if the plants have become woody (Emms, 2008). In Argentina, old man saltbush profitably replaced alfalfa and grazing appeared to be economical (Guevara et al., 2005).

Old man saltbush can also be cut, chopped and given to small ruminants, fresh or dried. Ensiling has been tested but without success (cost and time) (Ben Salem et al., 2010).

Yield

Forage production from rainfed old man saltbush under optimal management was reported to be about 2-4 tons/ha per year in Maghreb and the Middle-East. Under irrigation with water at 10-15 dS/m, forage yield was about 10-16 tons DM/ha (Le Houérou, 1992).

Environmental impact

Erosion control, soil binder, windbreak and firebreak

Atriplex nummularia is valued for rehabilitating scorched and eroded soils (NSW, 2010). It helped binding sand dunes in Botswana (Aganga et al., 2003). Once well established, it grows fast and is tolerant of salty coastal winds. It is thus used as shelter and windbreak for others plants. As a fire retardant, old man saltbush is planted around homes and buildings to protect them from fire (NSW, 2010).

Road security

The silvery grey colour of *Atriplex nummularia* makes it readily visible at night. It is thus used for roadside plantings in Australia (NSW, 2010).

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Nutritional attributes

Atriplex nummularia has a very particular composition. Its protein content is often high but variable as it ranges from 9% to more than 22% of DM. It contains fibre, in highly variable proportions (ADF 14-34% of DM). It is notable for its important mineral content, which amounts to between 16 and 34% of DM. It contains large amounts of sodium and chlorine (more than 5% of each), potassium (more than 2%) and other minerals. Due to the high mineral content, the gross energy is lower than for other forages (about 15 MJ/kg).

Potential constraints

Oxalates and NaCl

No toxicity has been reported from *Atriplex nummularia* (September 2016), but some plants can contain high levels of oxalates that may be deleterious for hungry animals (DAF, 2011). Levels of Na and Cl can be higher than the levels tolerated by ruminants (3-6%), pigs and poultry (2-3%) (NRC, 2005), and rabbits (Gidenne et al., 2010).

Ruminants

Cattle

No information found (2016).

Sheep

Palatability

In a cafeteria test, *Atriplex nummularia* was the most preferred shrub among 6 shrub species offered fresh to sheep (Ben Salem et al., 2000).

Intake

Voluntary DM intake of sheep fed only *Atriplex nummularia* is very variable, ranging from 40 to 115 g/kg $BW^{0.75}$ (Ben Salem et al., 2010), with a typical value around 70-90 g/kg $BW^{0.75}$. Voluntary intake of *Atriplex nummularia* is generally greater than that of cereal straw (Abu-Zanat et al., 2006). In Australia, it was found that the digestible DM intake of *Atriplex nummularia* was sufficient for maintenance in sheep, provided that fresh water was available (Wilson, 1966). It may be a good supplement to high-fibre, low N diets such as straw (Chriyaa et al., 1997). High sodium concentration may be a major determinant of halophytes palatability, and leads to very high water intake to counter the high concentrations of Na and K (Atiq-Ur-Rehman et al., 1994). The amount of water drunk is frequently between 6 and 10 L/kg DM of *Atriplex nummularia* consumed (Ben Salem et al., 2010). To counteract this high content of sodium and large drinking water requirement, it is recommended not to exceed 30% of old man saltbush in sheep diets (Aganga et al., 2003; Ben Salem et al., 2010), particularly during periods of water shortages. In ewes fed on a barley straw-concentrate diet (50:50), replacing 100% of the barley straw by dried and chopped old man saltbush increased voluntary DM intake from 63 to 70 g/kg $BW^{0.75}$ (+11%), but with no effect on BW gain nor on milk production (Abu-Zanat et al., 2006). A similar intake level of 70-73 g/kg $BW^{0.75}$ was observed in Barbarine wethers fed a diet comprising 80% of *Atriplex nummularia*. Intakes as high as 105 g/kg $BW^{0.75}$ have also been observed on sheep fed on straw, *Atriplex nummularia* representing only 26% of the diet (Chriyaa et al., 1997). Supplementing old man saltbush-based diets with grain always enhanced sheep performance (Franklin-McEvoy et al., 2007; Ben Salem et al., 2010).

Digestibility

The average *in vitro* DM digestibility reported was close to 60-65%, within a range of 48 to 72% (Benjamin et al., 1995; Chriyaa et al., 1997; Norman et al., 2004; Ben Salem et al., 2010; Revell et al., 2013). *In vitro* OM digestibility was consistently lower than DM digestibility due to the very high ash content (Benjamin et al., 1995). *In vivo* OM digestibility of leaves of *Atriplex nummularia* fed alone to sheep had an average OM digestibility close to 70% (61-78%), but lower values have been reported (50%) (Ben Salem et al., 2010). In sheep fed on straw, providing 26% of the diet as *Atriplex nummularia* increased OM digestibility from 40 to 46%. Metabolizable energy concentration ranged between 6.3 and 11.4 MJ/kg DM (Khalil et al., 1986; Ben Salem et al., 2010).

Methane

Including *Atriplex nummularia* in sheep diets increased *in vitro* and *in vivo* production of enteric methane, which was not related to the high salt content (Mayberry et al., 2009). This may explain the low efficiency of rumen fermentation, low feed conversion efficiency and low animal performance on sheep receiving high amounts of *Atriplex nummularia*.

Grazing

In Australia, average daily weight gain of sheep (116 g/head/d) and clear wool production per hectare (17 kg/ha) were similar between rotational grazing and set-stocking management over a 250 days period. Sheep selected old man saltbush in their diet at a rate of 13 to 54% of DM intake according to the season (Norman et al., 2010b). On rangeland, sheep exhibited preferences for some specific plants of *Atriplex nummularia*, but with no clear relationship with any chemical constituent. Most preferred plants had slightly greater protein (15.4 *vs.* 12.7% DM) and nitrate (249 *vs.* 98 mg/kg DM) contents than the least preferred plants (Norman et al., 2004). In South Africa, indoors cafeteria tests also showed sheep preference for high-N and low-fibre plants, with no relationship with rumen degradability parameters (van Niekerk et al., 2009).

Meat quality

Numerous studies have shown the inability of saltbush systems for finishing lambs because they are unable to gain weight when fed on saltbush alone. Sheep grazed on saltbush had a high muscle fluid content, because of the high water intake due to the elevated consumption of salt (Pearce et al., 2010). Feeding *Atriplex nummularia* did not appear to affect the organoleptic characteristics and apparent meat quality of finishing lambs, compared to lucerne-fed lambs (Hopkins et al., 1999). However, it may lower the proportion of fat, and increase the proportion of lean and vitamin E in carcasses (Pearce et al., 2010). These authors reported that some suppliers may claim for a niche market for saltbush meat because it is considered to be of superior quality.

Goats

In a cafeteria test, goats exhibited no clear preference for *Atriplex nummularia* compared to 5 other shrubs of less digestibility (Ben Salem et al., 2000). In young kids, replacing alfalfa hay by more than 20% *Atriplex nummularia* hay in the diet reduced intake and weight gain (Meneses et al., 2012).

Camelids

The total protozoal count (x103) per millilitre was reported to be significantly higher for camels fed rations that contained *Atriplex nummularia* than for those fed rations containing *Acacia saligna* and treated rice straw (Kewan, 2003).

Poultry

Saltbush leaf meal has a high but variable protein content. The ME value in broilers is very low (4.5 MJ/kg) but would be higher in bird species with better fibre digestion, as illustrated by an ME value of 7.1 MJ/kg in ostriches (Cilliers et al., 1999). Protein digestibility appears to be low (Abd El-Galil et al., 2014a).

Broilers

In broilers, no reduction in growth and feed conversion was observed with 5% saltbush leaf meal in the diet, but performance was lower with 10 and 15% inclusion levels (Furtado et al., 2011). Saltbush leaf meal can be used in slow growing chickens at moderate levels if formulation is adequate (i.e. adequate digestible protein content).

Layers

Good quality saltbush leaf meal (20% protein content) provided maintenance of egg output when added to the diet at 8%, but production decreased when higher levels were used. Some negative effects were noticed in haematological parameters and blood biochemistry, possibly due to the mineral (salt) content of saltbush (Abd El-Galil et al., 2014b).

Rabbits

In Australia, *Atriplex nummularia, especially young plants,* is considered highly susceptible to browsing by feral rabbits (Parer, 1977; Sandell et al., 1986). Therefore, it should be considered as palatable for rabbits. Wilted *Atriplex nummularia* was used as green forage in rabbits at 25% of the diet, as a supplement to concentrates, without significant effects on reproductive performance, growth, digestion coefficients or carcass characteristics (Abdel-Samee et al., 1994). When rabbits were fed with up to 100% saltbush leaves, growth and reproductive performance were altered compared to a 100% alfalfa diet (Al-Diwan et al., 2008). However, this depression was most probably the consequence of nutritional imbalances (Khalil et al., 1986; Aganga et al., 2003; Abd El-Galil et al., 2014a). The high level of sodium (3-7% of DM) is about 4 to 10 times the level considered as the acceptable maximum in rabbit feeds (Gidenne et al., 2010). *Atriplex nummularia* is also deficient in sulphur-containing amino acids and threonine, with saltbush leaf protein providing only about 40% of requirements (Lebas, 2004). Nevertheless, dried *Atriplex nummularia* foliage was introduced in balanced diets for growing rabbits at up to 25% without changing performance (Abd El-Galil et al., 2001). In practice, *Atriplex nummularia* foliage or leaf meal may be used safely at 20-25% of the diet for rabbits as a source of protein and fibre, provided that its nutritional imbalances are taken into account.

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Tables of chemical composition and nutritional value

- Saltbush (Atriplex nummularia), aerial part, fresh
- Old man saltbush (Atriplex nummularia), aerial part, dry

Avg: average or predicted value; SD: standard deviation; Min: minimum value; Max: maximum value; Nb: number of values (samples) used

Saltbush (Atriplex nummularia), aerial part, fresh

Main analysis	Unit	Avg	SD	Min	Max	Nb
Dry matter	% as fed	28.7	4.6	23.1	33.8	5
Crude protein	% DM	14.7	3.9	8.5	21.3	20
Crude fibre	% DM	20.1	7.3	10.3	31.5	8
NDF	% DM	40.3	6.7	29.9	49.7	15
ADF	% DM	22.5	6.5	14.4	33.7	14
Lignin	% DM	9.6	1.9	7.6	14.4	11
Ether extract	% DM	2.6	1.8	1.1	7.7	10
Ash	% DM	24.6	5.8	15.8	34.4	20
Gross energy	MJ/kg DM	15.2				*

Minerals	Unit	Avg	SD	Min	Max	Nb
Calcium	g/kg DM	9.6	4.7	4.8	18.0	16
Phosphorus	g/kg DM	2.2	1.0	0.8	5.0	15
Potassium	g/kg DM	27.3	7.4	17.4	38.3	10
Sodium	g/kg DM	65.3	12.9	38.8	79.0	12
Chlorine	g/kg DM	115.6	34.9	61.0	158.0	5
Magnesium	g/kg DM	6.3	2.0	3.6	9.9	10
Manganese	mg/kg DM	116	39	72	170	6
Zinc	mg/kg DM	39	17	19	57	6
Copper	mg/kg DM	12	8	7	24	4
Iron	mg/kg DM	228	106	106	420	6

Amino acids	Unit	Avg	SD	Min	Max	Nb
Alanine	% protein	3.8				1
Arginine	% protein	5.3				1
Aspartic acid	% protein	6.0				1
Cystine	% protein	0.7				1
Glutamic acid	% protein	6.9				1
Glycine	% protein	3.5				1
Histidine	% protein	1.5				1
Isoleucine	% protein	3.3				1
Leucine	% protein	5.0				1
Lysine	% protein	5.4				1
Methionine	% protein	0.9				1
Phenylalanine	% protein	3.2				1
Proline	% protein	3.2				1
Serine	% protein	3.1				1
Threonine	% protein	2.9				1
Tryptophan	% protein	0.6				1
Tyrosine	% protein	2.0				1
Valine	% protein	3.7				1

Secondary metabolites	Unit	Avg	SD	Min	Max	Nb
Tannins (eq. tannic acid)	g/kg DM	1.2		0.9	1.4	2
Tannins, condensed (eq. catechin)	g/kg DM	2.0				1

Ruminant nutritive values	Unit	Avg	SD	Min	Max	Nb
OM digestibility, ruminants	%	55.4	6.3	47.8	62.7	6
Energy digestibility, ruminants	%	48.3				*
DE ruminants	MJ/kg DM	7.3				*
ME ruminants	MJ/kg DM	5.9				*
Nitrogen digestibility, ruminants	%	68.9	14.7	52.0	78.8	3
a (N)	%	44.4				1
b (N)	%	45.4				1
c (N)	h-1	0.057				1
Nitrogen degradability (effective, k=4%)	%	71				*
Nitrogen degradability (effective, k=6%)	%	67				*

The asterisk * indicates that the average value was obtained by an equation.

References

Alibes et al., 1990; Ben Salem et al., 2000; Benjamin et al., 1995; Brünnich, 1931; Chriyaa et al., 1997; Franklin-McEvoy et al., 2007; Hassan et al., 1979; Henrici, 1935; Kaitho et al., 1997; Kaitho et al., 1998; Khalil et al., 1986; Norman et al., 2004; Norman et al., 2010; Pozy et al., 1996; Watson et al., 1993

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Old man saltbush (Atriplex nummularia), aerial part, dry

Main analysis	Unit	Avg	SD	Min	Max	Nb
Dry matter	% as fed	88.0	5.8	76.8	92.5	6
Crude protein	% DM	19.0	3.9	12.8	22.6	6
Crude fibre	% DM	8.9	8.6	2.8	21.5	4
NDF	% DM	38.0		35.2	40.7	2
ADF	% DM	22.3		17.1	27.5	2
Lignin	% DM	5.1				1
Ether extract	% DM	3.5	0.1	3.5	3.6	3
Ash	% DM	23.5	3.3	19.9	28.3	6
Gross energy	MJ/kg DM	15.4				*

Minerals	Unit	Avg	SD	Min	Max	Nb
Calcium	g/kg DM	15.0	3.7	11.0	19.9	4
Phosphorus	g/kg DM	2.7	1.4	0.9	4.0	4
Potassium	g/kg DM	35.8	8.8	27.8	48.2	4
Sodium	g/kg DM	60.7	24.6	29.6	89.6	4
Chlorine	g/kg DM	47.8				1
Magnesium	g/kg DM	1.9	3.3	0.0	5.6	3
Zinc	mg/kg DM	50	4	46	53	3
Copper	mg/kg DM	44	29	27	78	3
Iron	mg/kg DM	21		20	21	2

The asterisk * indicates that the average value was obtained by an equation.

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Abd El-Galil et al., 2014; Abu-Zanat et al., 2006; CIRAD, 1991; Meneses et al., 2012

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