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Atriplex Nummularia (Old Man Saltbush) : A Potential Forage Crop for Arid Regions of Botswana

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Abstract: *Atriplex nummularia* (Old man saltbush) is widely planted on salt affected land to provide a vegetative cover, which can be used as fodder reserve. Such plantations are also perceived as having the capacity to use saline groundwater and hence affect the extent of shallow water tables. *Atriplex spp.* contains high concentrations of nitrogen (N) in winter as compared to summer when it has high concentrations of sodium. The sum of soluble protein-N, amino acid-N, nucleic acid-N and nitrate-N is about half of the total nitrogen. The remainder includes non-soluble protein-N and other N associated with cell membranes and walls. Phosphorus is known to uniformly distribute among pools of inorganic-P, phytate-P, nucleic acid-P and other (residual) fractions. This paper reviews the potentials of *A. nummularia* as a forage for arid areas of Botswana with saline ground water.

Key words: *Atriplex nummularia,* salt affected land, halophytes

Introduction

Animal production practice in Botswana is mainly based on grazing natural vegetation. The native rangelands of the country is greatly affected by annual rainfall precipitation which is irregular and poorly distributed. The rangelands are open shrubs vegetation with a lot of Acacia species. They vary in their green biomass production, distribution and nutritive value from year to year due to mainly, environmental changes. The rangelands are characterized by a short wet/rainy season usually not more than three to four months per year. The palatable and good quality forage always deteriorate or disappear as a result of overgrazing. Therefore, forage scarcity is prevalent and there is an urgent need for increase in feed resources in the arid zones of the country.

Extensive areas of subtropical Botswana are degraded through activities associated with agriculture and grazing, and, to lesser extent mining. Rehabilitation of the degraded land is generally limited by low rainfall, unfavourable soil physical conditions and often by salinity. In these desert terrains or degraded areas there is inadequate pasture or areas where there is some sizeable amounts there is a problem of phosphorus deficiency. It is suggested that *Atriplex spp*. may be more suitable for revegetating very saline soils and also be a good source of productive feed (Hopkins and Nicholson, 1999; Osman and Ghassaeli, 1997).

Atriplex nummularia (old man saltbush) is a halophyte shrub that grows to an average height of 2.0 m. Sheep fed on *Atriplex* species alone will at best maintain live weight, despite the high nitrogen levels found in the leaves (Atiq-Ur-Rehman *et al*., 1994). When supplemented with hay however, sheep fed *Atriplex* exhibit increase in live weight. The complementary interactions of saltbush and hay have been extensively studied and results have shown that the *Atriplex* can be effectively used not just to regenerate saline soils, but also as a source of productive feed (Hopkins and Nicholson, 1999).

Old man saltbush was tried in Bokspits in the Kgalagadi desert in Botswana to stabilize sand dunes and as fodder crop with successful results. *Atriplex nummularia* is known not to affect organoleptic characteristics of meat when fed either alone or supplemented with other sources of nutrition (Hopkins and Nicholson, 1999). *Atriplex spp.* is known to have high levels of nitrogen and phosphorus, characteristic nutrient elements involved in protein synthesis. This paper is to review the importance of *Atriplex nummularia* as forage crop for possible cultivation in saline areas of Botswana.

Plant Description: *Atriplex spp.* originated from Australia and had spread to arid and semi arid parts of the world (Osman and Ghassaeli, 1997). *Atriplex spp.* is an erect shrub belonging to the family *chenopodiaceae*, grows up to 2m high and spreads to 2.4m wide, has white branches, oval to almost round grey leaves up to 2 cm long, small green terminal flowers, and triangular, laterally compressed fruits 1-2 cm. *Atriplex spp*. is often grown as fodder plant in drier areas because of its great resistance to drought and salt tolerance (Abou El Nasr *et al*., 1996). It grows well in deep soils with only 150-200 mm of rainfall annually, but can survive for a year with 50mm of rainfall. Resists temperatures as low as –10 ^{o}C. *Atriplex spp* are not affected by heavy textured and high salinity soils and water. Their frost resistance is high (El Aich, 1987).

Propagation: *Atriplex nummularia* can efficiently be propagated from stem cuttings especially during spring as opposed to summer as it would be affected by

Table 1: Mean levels of ash, crude protein(CP), acid detergent fibre(ADF), Neutral detergent fibre(NDF), lignin, and crude fat (CF) in Atriplex species.

Species	Ash (g/kg^{-1})	CP (g/kg^{-1})	ADF (g/kg^{-1})	NDF (g/kg^{-1})	lignin (g/kg^{-1})	CF (g/kg^{-1})
A. nummalaria						
Cut 1	181	92	337	497	104	22.1
Cut 2	247	131	243	405	92	22.2
Cut3	220	91	317	489	93	19.8
Cut4	223	85	306	472	84	22.6
Ave regrowth	230	103	289	455	90	21.5

Source: Watson and O'Leary, 1993

Table 2: Mean levels of sodium(Na), calcium(Ca), potassium (K), magnesium (Mg) and Phosphorus(P) and ratios of Na to K(ionic equivalents) in *Atriplex* species

Species	Na g/kg^{-1}	Ca g/kg^{-1}	K g/kg^{-1}	Mg g/kg^{-1}	P g/kg^{-1}	Na/K Ratio
A. nummalaria						
Cut1	64.2	4.9	19.8	3.6	2.2	5.5
Cut2	75.3	6.8	23.2	4.3	2.6	5.5
Cut3	71.1	4.9	20.4	4.6	2.0	5.9
Cut4	68.8	4.8	17.4	4.9	1.5	6.7
Ave regrowth	71.7	5.5	20.3	4.6	2.0	6.0

Source: Watson and O' leary, 1993

Table 3: Mean *in vitro* apparent digestibility (± SEM) of *Atriplex nummalaria, Atriplex canascens* and *Cassia sturtii*

			In vitro apparent digestibility	
Species	Crude protein	Ash content	DM(%)	OM(%)
Atriplex nummalaria	18.7±0.5	28.3±1.4	73.5±1.2	58.7±1.1
Atriplex canescens	17.3±0.4	18.4±3.3	62.0±1.3	46.7±1.2
Cassia sturtii	13.0±0.3	5.2±0.5	50.9±0.5	47.9±0.4

Source: Benjamin *et al*., 1995

Table 4: Least square means (S.E.D) for muscle pH, meat color measurements (l* lightness, a* redness, b* yellowness) and b* values(b_2*) for subcutaneous fat from lambs fed saltbush/ grain(SG; n=14), saltbush/hay (SH; n=14) and Lucerne (L; n=14)

	SG	SH	L	SED
PH colour measures	5.53^a	5.62^a	5.62^a	0.06
l*	36.2^a	35.7^a	36.7^a	0.72
a*	17.9^a	17.2^a	17.8^a	0.68
b*	6.6^a	6.3^a	6.8^a	0.42
Fat colour (b_2*)	7.0*	6.8^a	7.6^a	0.72

Values followed by the same letters are not significantly different at ($p< 0.05$). Source: Hopkins and Nicholson, 1999.

effective disease pathogens (Malan and Rethman, 1997). Rooting of the new growth plant has also been reported to be more viable than older ones. Arya *et al*., 1993, have shown that *Atriplex spp*. terminal cuttings propagated and treated with IBA have quick rooting and can be transplanted into pots in nurseries. *A. nummualria* may be spaced at 1 m * 5 m and can be grazed by animals when it's 1.5 m high i.e. second or third year of growth (Malan and Rethman, 1997). This kind of propagation has to be done in nurseries and seedlings transplanted when they have grown to the size of a pencil (10-15 cm).

Nutrient composition: Mean levels of ash, crude protein (CP), acid detergent fibre (ADF), Neutral detergent fibre(NDF), lignin and crude fat (CF) in *Atriplex* species are shown in Table 1. *Atriplex nummalaria* is relatively high in protein and ash. The crude protein and ash contents of *A. nummalaria* average 18.2 and 22.7 percent respectively. (EL Aich, 1987).

Mean levels of sodium (Na), calcium (Ca), potassium (K), magnesium (Mg) and Phosphorus (P) and ratios of Na to K (ionic equivalents) in *Atriplex* species are shown in Table 2.

The digestibility of *Atriplex spp* averages 59% in spring and 46% in Summer. The intake of *atriplex spp* varies in the interval 50-55g Dm/Kg $LW^{0.73}$. Increased consumption of *Atriplex spp* is accompanied by higher water intakes because of the increased water required for urinary excretion of sodium (El Aich, 1987). Sheep grazing *Atriplex vesicaria* consume 7-7.5 Kg/day of water in comparison to 3.2 kg/day on grasslands. *A. nummalria* has high digestibility, the high digestibility is

due to the salt concentration in their leaves (Benjamin *et al*., 1995).
Mean *in vitro* apparent digestibility (± SEM) of *Atriplex nummalaria, Atriplex canascens* and *Cassia sturtii* is shown in Table 3.

Palatability and preference: Palatability is defined as the ratio between the amounts of feed ingested by herbivores and the amount on offer, for a given period of time. Preference is the order in which forage species are selected by herbivores within a given plant community or population, or at a given site, at a given time (Le Houerou, 1991). These concepts, however, are liable to wide variability in time and space, depending, on many variables and parameters that may change with season, site, animals and other local conditions. Some of these variables are linked to the plant, others to the animal, environmental factors. For a given species palatability for a given type of animal varies with phenological stage, the organ concerned and the season (Squires and Ayoub, 1992). As a rule of thumb, the content of crude fibre in forage plays an important role in its selection by livestock. Forages with high fibre content are usually better accepted by cattle, than sheep and goats; also this depends on the high levels of protein in the overall diet (Meyer and Karazov, 1991). The stage of growth and maturity considerably affect the nutritive value, palatability and utilization of *atriplex spp.* Such plants are nutritious in wet season while they are poor during dry season (El Shaer *et al*., 2000). As a supplementary fodder, *atriplex spp* should not take more than 25-30% of the sheep's diet. Casson *et al*. (1996) suggested that the high salt content of saltland forage plants is likely to be the major determinant of palatability and that dilution of salt content through the availability of other feed resource would be necessary to improve intake and performance. Hopkins and Nicholson (1999) reported that there was no effect of feeding *Atriplex* to lambs on tenderness or juiceness and overall panelists ranked the meat samples similarly for acceptability. Finishing lambs on saltbush and either supplemented with hay or grain as used in their study did not present any apparent meat quality problems compared to Lucerne fed lambs (Hopkins and Nicholson, 1999). Table 4 shows least square means for muscle pH, meat colour measurements for lambs from Hopkins and Nicholson (1999).
Atriplex contains considerable amounts of protein (15.5 and/or 21.3%) and crude fibre (20.5%) with digestibility of 52.0 and 39.4%, respectively. Hopkins and Nicholson (1999) reported that sheep fed on saltbush had significant weight gain in western Australia, where the soil is very saline. It has also been observed however, that although animals may maintain live weight while grazing *Atriplex spp*., they invariably loose condition (Casson *et al.,* 1996). This is attributed to a large increase in water intake (Atiq-Ur-Rehman *et al*., 1994), to counter the high amount of sodium and potassium salts found in *Atriplex species* (Wilson, 1996).

Conclusion: *Atriplex nummularia* can be an effective fodder component in mixed diets for livestock. The principal advantages would be that adverse effects due to the high mineral content of the halophyte tissues could be minimized, that animal performance and economic returns might be higher than direct grazing of the shrub species, or in-adequate feed of the dry season in the arid areas . However, the main disadvantage of using *A. nummularia* as one of the feed ingredients would be reduced feed conversion efficiency, due to the dilution effect of minerals on energy density.

Recommendations: Vast areas of salt-affected land will remain unproductive unless efforts are made to rehabilitate them with highly salt-tolerant plants (halophytes). It goes without saying that salty areas such as Kgalagadi and Gantsi areas of Botswana can benefit from being re-vegetated by planting saltbush and farmers can also obtain fodder for their livestock from this halophytic shrub.

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