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FARMERS PERCEPTIONS ON DUAL-PURPOSE SORGHUM AND IT'S POTENTIAL IN ZAMBIA

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Abstract

Food feed crops play a cardinal role in mixed crop-livestock production systems yet views of farmers on their usage are limited. Farmers' perceptions in predominant sorghum growing areas of Zambia were solicited on socio-economic factors affecting sorghum production, awareness and willingness to adopt dual-purpose sorghum cultivars for food and feed. Preferred traits of a "model" dual-purpose cultivar were identified. The aim of the study was to generate information that would support the genetic improvement of dual-purpose sorghum. Questionnaires were used to generate this information. Results showed that less than 50% of sorghum growing SSFs had limited knowledge on the use of sorghum to produce feed silage; however, there was full awareness among the LSFs. Among other traits, farmers' "ideal" variety should combine high grain yield potential (100 %) with high biomass (100 % of LSFs and 80 % of SSFs) and high stem sugar content (100 % of LSF and 70 % of SSFs). All the SSFs and 20 % of the LSFs indicated that adequate production could be hampered by low grain yield, poor access to improved seed and unavailability of farmers'-preferred cultivars.

Keywords: Dual Purpose Sorghum, Farmer Perceptions, Feed, Grain, Silage, Zambia

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Introduction

Within the mixed crop-livestock systems of the tropics, the role of dual-purpose or food-feed crops is an area of substantial interest (Thornton *et al.,* 2003). With ever expanding croplands, small-scale farmers now rely on crop residues as a major source of feed (Sibanda *et al*., 2011). In commercial farming systems, the cattle industry is centered on stocker cattle grazing systems and confined cattle feeding regimes, which utilize hay and silage (Rooney *et al.,* 2007).

Sorghum (*Sorghum bicolor* L. Moench) is an important cereal crop in the semi-arid tropics for human food, animal feed and raw material in commercial food industries. Improving the nutritive value of its stover is an important objective in the tropics where sorghum residues are extensively used for livestock feed (Rattunde *et al*., 2001). However, the comparative advantage of sorghum over the competing crops and technologies has not been clearly identified and although there are no reports of farmer's acceptance and adoption on dual-purpose sorghum incidences have been reported with grain sorghums. Farmers' perceptions that may affect dual-purpose sorghum cultivar adoption and production have also not been reported yet this is important in any breeding program because farmers are the users of the varieties, regardless of the views of the researchers (Röling *et al.,* 2004). The purpose of this study was to generate information from farmers to support the genetic improvement of dualpurpose sorghum for grain and forage by identifying awareness levels, willingness of farmers to use dual purpose sorghum cultivars for food and feed silage and to identify the traits of a "model" dual-purpose cultivar that was desired by farmers in Zambia.

Methodology

Surveys were conducted in the sorghum growing areas of Siavonga, Chisamba, Mazabuka and Masaiti districts in Zambia between February and March 2013. The area represents low (less than 700 mm) to medium (800-1000 mm) rainfall and drought-prone environments in agro ecological zones I and II, respectively. The farmer group Participatory Rural Appraisal (PRA) approach was used in this study. Purposive selection of districts was done in collaboration with the sorghum-breeding programme at the Zambia Agricultural Research Institute (ZARI) while that of small-scale farmers was done in liaison with district extension officers. Fifty five (91.7%) Small Scale Farmers (SSF) (22 in Lusitu, 15 in Chisamba and 18 in Masaiti districts) and five

(8.3%) Large Scale farmers (LSF) (known to make silage from maize and/or sorghum to feed their dairy and beef cattle) were selected as respondents in Mazabuka and Chisamba. Sixty structured questionnaires were administered and data was collected on the farmers' socio-economic status, awareness and perceptions on use and potential of dual-purpose sorghum cultivars for food and feed, types of livestock kept and cropped area, type of feed fed to livestock, benefits and constraints of sorghum production, and the preferred traits for dual-purpose sorghum. Data analysis was based on descriptive and inferential analyses using SPSS 16.0 computer package (SPSS Inc., 2007).

Results and Discussion

Social economic characteristics of interviewed farmers

Factor levels of some of the socio-economic characteristics of farmers are presented in Table 1. More men (70.9%) than women among the SSFs were involved in farming activities due to their position as heads of households and higher access to farmland owing to previous land ownership systems, which discriminated against women. According to Opio (2003), in most parts of Africa, women have traditionally been responsible for producing food for the family on land to which they gain access upon marriage but do not necessarily control. This study observed that all the LSFs were men. Opio (2003) also observed that it was usually men who were responsible for large-scale cash cropping, especially when it was highly mechanized. The high percentage of the farmers that were married (93%) may be as a result of trying to raise families that would supply labour on the farm (Olweny *et al.*, 2013). Approximately 29% of the SSF respondents had secondary level education but all the LSFs had attained some form of tertiary level training. The World Bank (2009) indicates that involving young women and men in training opportunities is a successful strategy in ensuring food security and sustainable livelihoods for households.

Table 1. Socio-economic characteristics of the farmers interviewed in the survey

Variables	factors	Counts (%)	
		SSF	LSF
Gender	Female	16 (29)	0
	Male	39 (71)	5 (100)
Age	≥ 35	6 (15) M / 2 (12.5) F	0
	36 to 49	18 (46) M / 12 (75) F	3 (60) M
	50 ≤	15(39) M / 2 F	2 (40) M
Marital status	Married	39 (100) M / 12 (75) F	5 (100) M
	Single	0 M / 2 (12.5) F	0
	Widowed	0 M / 2 (12.5) F	0
	Divorced	0 M / 0 F	0
Education	Primary	28 (72) M / 11 (69) F	0
	Secondary	11 (28) M / 5 (31) F	0
	Tertiary	0 M / 0 F	5 (100) M
Occupation	Farming only	39 (100) M / 16 (100) F	0
	Farming & trading	18 (46) M / 9 (56) F	0

SSF-Small scale farmers
LSF- Large scale farmers

Other than practicing agriculture alone as a source of livelihood, some of the SSFs were also involved in the business of trading (Table 1). Conroy and Sutherland (2004) reported that economic activities among small-scale farmers included many farming enterprises ranging from crop production to animal husbandry designed to minimize or spread the risk of crop failure due to drought and other constraints to production.

Livestock ownership, cropped area and feeding regimes followed by farmers

The results of interrelationships (integrated crop-livestock) as presented in table 2 showed significant differences ($P < 0.05$ and $P < 0.001$)) in means of area under crop and number of livestock kept by SSFs and LSFs. All the SSFs indicated that their prominent feed for livestock was pasture and crop residues (100%) followed by hay at 51% (Fig.1). According to Sibanda *et al.* (2011) and Mativavarira *et al.* (2011), the reliance of small-scale farmers on crop residues for animal feed is a serious constraint, which prevents them from adequately feeding their animals throughout the year. The informal group discussions revealed that SSFs ran out of feed for the animals three months after harvest, which was consistent with the findings of Mapiye *et al.* (2006). All the LSFs indicated that silage, hay and green chop were important feed sources (Fig. 1).

Table 2. Means of cropped area and number of livestock kept by farmers in the survey

Variables	Mean		$T\ test_{0.05}$
	SSF	LSF	2 tailed
Area under maize (ha)	2.1 ± 0.512	11 ± 2.64	0.002
Area under sorghum (ha)	0.8 ± 0.403	7.8 ± 1.92	0.001
Area under Millet (ha)	0.25 ± 0.00	4.5 ± 2.12	0.016
Area under legumes (ha)	0.48 ± 0.318	7.25 ± 1.26	0.002
No. of large ruminants	12.39 ± 7.93	1154 ± 599	0.005
No. of small ruminants	17.32 ± 9.99	1522 ± 1620	0.000
No. of non ruminants	25 ± 18	2700 ± 1131	0.000

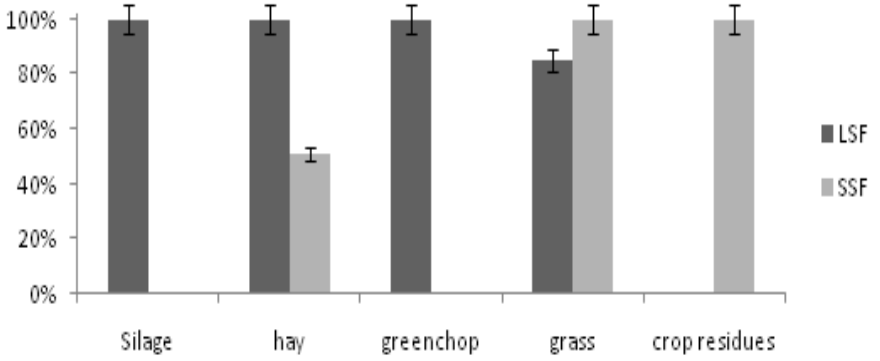

Fig.1. Feeding regimes followed by interviewed farmers' who keep large ruminants

Respondent's knowledge, attitude and practice on the use of sorghum to produce silage

The results in Table 3 showed the respondent's knowledge, attitude and perceptions on the use of sorghum as feed silage which suggested that a significant number of SSFs (54%) were not aware that sorghum could be used for production of silage or that such varieties of sorghum existed indicating that the technology requires a sustained promotion through demonstrations and trainings in the area. The SSFs' willingness to grow sorghum solely as a silage crop varied considerably with 76.4% saying they could do it while 12.7% were unsure but 10.9% of the farmers were sure that they could not (Table 3). The results indicated that farmers were willing to change their practices when exposed to appropriate technologies that met their needs. Moreover, the literacy levels (Table 1) of people in the area gave a strong combination characteristic that when fully utilized would lead to high awareness and hence high adoption and productivity of technologies. Marsalis (2011) argued that improvements in varieties and a better understanding of proper management could lead to a greater acceptance and willingness to grow sorghum as an alternative silage crop; He, however, identified lack of water and desperation as likely the main drivers behind any major cropping changes. The high percentage (100%) of awareness among the LSFs was due to high access to information. The World Bank (2009) reported that the overwhelming majority of SSFs were not clients for private extension services but relied on public extension services and farmer-to-farmer information exchange.

Table 3. Awareness and willingness of farmers to use sorghum as a silage feed crop

Variables	Farmer Category	Responses (%)		
		Yes	No	Maybe
Awareness on use	SSF	25.5	74.5	0
	LSF	100	0	0
Awareness on existence of varieties	SSF	47.3	52.7	0
	LSF	100	0	0
Willingness to grow silage crop	SSF	76.4	10.9	12.7
	LSF	100	0	0
capacity to produce silage	SSF	61.8	38.2	0
	LSF	100	0	0
Willingness to promote use of silage	SSF	100	0	0
	LSF	100	0	0
Willingness to be contracted to produce silage	SSF	100	0	0
	LSF	100	0	0

Benefits and constraints of cultivating sorghum

The results of farmers perception on the benefits and challenges associated with use of sorghum as a food and feed crop are presented in Fig. 2 and 3 respectively. The farmers in this study indicated that drought tolerance was a major advantage of sorghum in comparison to other cereals such as maize (Fig.2). Marsalis *et al.* (2010) reported that the drought and heat tolerance of forage sorghum combined with the ability to resume growth after drought made the crop an ideal candidate for silage systems in dry climates. Reddy *et al*. (2011) also indicated that drought tolerance made sorghum especially important in dry regions and that it was among the climate resilient crops that could better adapt to climate change conditions. The farmers (50% SSFs and 20% LSFs) also reported that sorghum was a high energy feed crop owing to its nutritious stover and that livestock fed on sorghum had more energy than when fed on other cereal residues. In contrast, Marsalis *et al*. (2010) observed that the perception that all sorghums are low in nutritive value and that they are more difficult to manage than maize were the main arguments against sorghum given by producers and feeders. Results presented in figure 3 indicated that major constraints faced by both SSFs and LSFs in sorghum production were associated with low yield, limited availability of improved sorghum varieties, poor access to improved seed, inconsistent grain market for the crop and pests and diseases. Muui *et al*. (2013) also reported similar results including lack of inputs. The poor grain yields in sorghum were partly due to the SSFs consistent use of unimproved seed and cultivation on small parcels of land. Ochieng *et al.* (2011) reported low sorghum grain yields ranging from 0.5 to 2.5 t ha^{-1} for 92% of the SSFs interviewed compared to the research potential yield of ≥ 4 t ha^{-1}. Most SSFs in sub-Saharan Africa who plant unimproved varieties (landraces) used on-farm produced and saved seed whose quality was usually poor (Ashiono *et al.*, 2005). The challenge of inconsistent sorghum markets in Zambia was raised by 79% of the SSFs and 60% of the LSFs. This was one reason why all the LSF who produced sorghum in this study used it as animal feed while the SSFs used it both as food and feed. A study be Ochieng *et al.*, (2011) also reported that all the farmers interviewed acknowledged the adaptability of the crop in the region but its production was constrained by lack of its marketability.

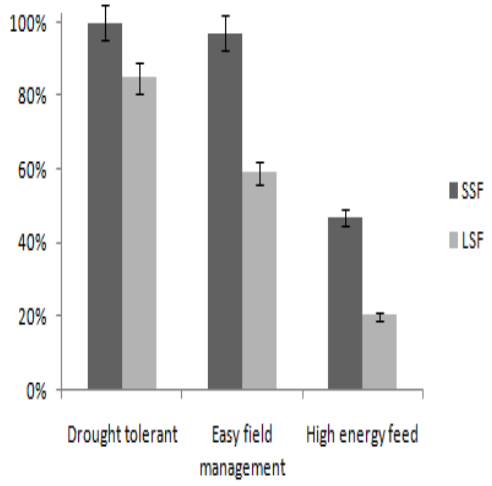

Fig. 2. Views of farmers on the benefits of sorghum production

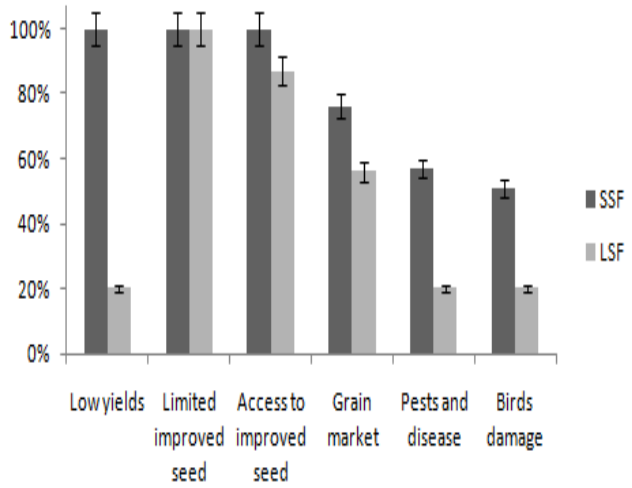

Fig.3. Views of farmers on the constraints of sorghum production

Farmer preferred quality attributes for dual purpose sorghums

The results of farmer perceptions on desired food and feed quality traits for dual-purpose sorghum cultivars are presented in Fig. 4. Both LSFs and SSFs regarded grain yield and biomass as top traits of importance in dual-purpose sorghum cultivars for grain and forage. Similar results were observed in a study done by Mativavarira *et al.* (2011) in Zimbabwe where results of farmer preference rankings pointed to grain yield being more important to 75% of the farmers' needs than biomass production, although for a sub-set of farmers (25% of total) this preference was the reverse. Other observed traits of interest were the stay green trait which is essentially a trait associated with post rainy drought tolerance in sorghum. Delaying the onset of leaf senescence and reducing its rate were two elements of the stay-green trait, which offered an effective strategy for increasing grain production, fodder quality and crop residues particularly under water-limited conditions (Reddy *et al.*, 2007).

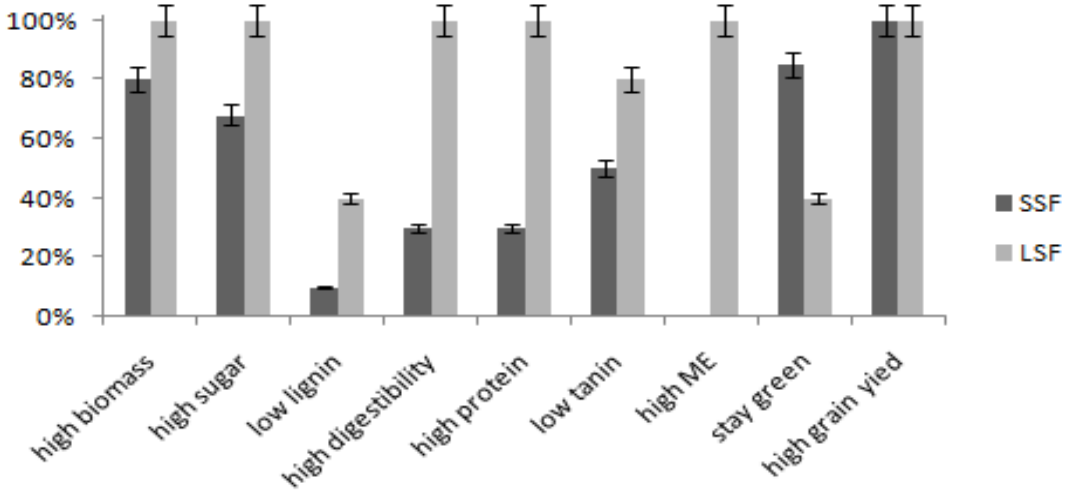

Fig. 1. Farmer perceptions of desired quality traits for dual purpose sorghum cultivars

High stem sugar was also indicated as a desirable trait in dual purpose sorghum as it makes feed more palatable as was observed by Kumar *et al.* (2010) where the daily intake and digestibility were high in large ruminants when sweet sorghum was fed directly as forage. All the LSFs and 35% of the SSFs indicated high digestibility of sorghum as desirable because livestock performance was improved by increasing digestibility of feeds as was observed by Casler and Vogel (1999).

It was observed in this study that the attributes that farmers chose were closely related to utilization. LSFs preferred to use sorghum as a bioenergy feed crop and they were able to meet the huge investment costs associated with silage production given the large number of animals that they owned. However, SSFs clearly used sorghum first as food then feed hence most of them indicated that they wanted high grain yield. Their interest in the stay green trait as well as high biomass showed that they also used sorghum stover and hay as animal feed. However, even though the SSF relied on stover and hay, they were still not able to feed their animals adequately throughout the year because the varieties that they planted did not have sufficient biomass. Hence, the direction for technology delivery could be to enhance production, reduce postharvest losses, store feed in forms that it can stay for long periods while maintaining nutritional benefits, breed cultivars for such purposes as high grain yield, high biomass, sweet stems and stay green. The potential to use such cultivars was high as evidenced by the type of quality attributes desired justifying the need for the breeding programmes to address these demands.

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