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Participatory On - Farm Evaluation and Demonstration of Improved Legume Forage Species in Benatsemay Woreda of South Omo Zone

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Abstract
Participatory field experiment was conducted at Kako and Chali peasant associations of Bena Tsemay woreda, South Omo Zone in the 2012 to 2013 main cropping seasons under rain fed conditions using the forage legume species to identify adaptable and high biomass yielding forage legume species. The field experiment was laid out in a randomized complete block design /RCBD/ with three replications where trial Agro pastoralists were considered as replications. The forage species used were Lablab intoritum, Lablab purepureus and Cow pea Legume. Each legume was planted in a single plot area of 3 m x 4 m = 12 m^2. Dry matter production potential of the tested species in kako peasant association is 4.5, 5.6 and 5.20 t/ha and 3.4, 5.0, and 3.68 t/ ha for cropping year one and two respectively and where as the dry matter production potential of tested forage species trial location (Chali) is 5.2, 4.4 and 10 t/ha and 4, 3.2 and 5t/ha in year 2012 and 2013 respectively for Labalab purpureus, Lablab intoritum Cow pea. The result of for dry matter yield (DMY) revealed that there was no significant difference ($P > 0.05$) was observed among the tested forage legume species in the 2012 cropping season in Kako peasant association however, there was significant difference ($P < 0.05$) declared between Lablab *purepureus* and Lablab *intoritum* and Lablab intortum and Cow pea in the second cropping season. Out of the tested forge species over two years, the one which gave consistently the maximum dry matter yield was Lablab intoritum, which gave (10 tones ha^{-1}), in the first cropping season and (5 tones ha^{-1}) in the second cropping season is advisable for the study areas and their vicinities. Hence, use of the best performing forage species is important in the test community even though further testing is important by including their feeding value under different intervention and chemical composition to put the recommendation on strong basis.
Keywords: Cow pea legume, forage dry matter yield, forage species, Lablab intortum, Lablab purepureus.

INTRODUCTION

Ethiopia has a large livestock population which is estimated to be 50.8 million cattle, 25.9 million sheep and 21.9 million goats (CSA, 2010). Among different problems of animal production, shortage of feed quantity and quality are the most limiting factors in livestock production. Livestock feed resources in Ethiopia are mainly natural grazing and browsing, crop residues, and to some extent improved pasture, forage crops and agro-industrial by-products. At present, stock are fed almost entirely on natural pasture and crop residues. Grazing is on permanent grazing areas, fallow land and cropland after harvest (Alemayehu, 2003). To feed the increasinghuman population by continuous cereal growing, available grazing is on the decline and not productive. Crop residues and agro-industrial by-products are not adequately utilized. Cultivation of forage is not widely adopted. Availability and quality of improved forages are not favorable year round and hence animal weight gains made in the wet season are totally or partially lost in the dry season (Alemayehu, 2003). One way of improving the livestock production and productivity is by improved forage development and proper supplementation with leguminous forages (Poppi and McLennan 1995). Forage legumes offer several advantages to tropical farming systems. First, leguminous cover reduces soil erosion and runoff. This cover is able to conserve soil, improve organic matter content and compete with weeds (Humphreys 1995; Schaffhausen 1963ab). Tropical improved forage legumes are rich in protein, which are usually the most limiting nutrients in tropical Animal diets. Forage legumes can be grazed, harvested and fed fresh or stored as hay or silage (Harricharan et al 1988). Lablab has been widely distributed to many tropical and subtropical countries (Purseglove 1968) and it is grown as an annual or a short-lived perennial (Whyte et al 1953). In these areas, the seed and immature pods are used for human food while the herbage is used as green manure, for erosion control, and as a feed supplement for cattle grazing mature pasture in the dry season (Hendricksen and Minson 1985b). Lablab is drought hardy, and has been grown in arid, semi-arid and humid regions with rainfalls between 200 and 2500 mm (Hendricksen and Minson 1985b; Cameron, 1988). It needs rainfall or irrigation (minimum of 10 to 20 mm) during germination and early establishment, although once established it is extremely resistant to drought (Mayer et al 1986; Schaffhausen 1963ab). Dry matter yield per hectare varies with rainfall, soil condition and time of seeding and it could be yield 3-5tone / DM per ha (Cameron 1988; Mayer et al 1986). Conversely, Cowpea (*Vigna unguiculata* (L.) Walp) is one of the most important legume food and feed crops (Aryeetey, 1971; Bennett-Lartey and Ofori, 1999). It can be utilized in various ways ranging from the use of

young green seedling as vegetables and also forage for livestock to its consumption as beans (Kay, 1979). It is an excellent source of protein which is enriched by amino acids, lysine and tryptophan. Cowpea is widely grown and planted under rain fed conditions in in sub- Saharan Africa (Allen, 1983). A mean temperature of 27oC is optimum for god pod formation and seed yield though it performs better in region with rainfall of 250-100mm per annum. Loamy soil is considered the best for the cultivation of cowpea with pH value of 6-7 for optimum growth. In the study district, Cultivation and utilization of improved forage is not practiced and adopted due to absence research on evaluation and introduction of improved forage research has been done due to remoteness and mobile nature of pastoralists, , lack of adequate strategic feeding practice, lack of viable improved forage seed and seed multiplication technologies, poor livestock extension services and low emphasis on importance of forage production in improving the income and livelihood of pastoral communities. These lead livestock to undernourishment, slow growth rate, low daily body weight gain, loss of body condition and prolonged time to reach marketable weight which makes less benefits of the pastoral communities from livestock production in the area. Therefore, this study was designed with objectives to identify on farm high yielding improved legume species and demonstrate it to pastoral communities.

MATERIALS AND METHODS

Experimental Site

Participatory field experiment was conducted at Kako and Chali peasant associations of Benatsemay woreda of south Omo zone in 2012 to 2013. The area has mean annual temperature of 33^{o}C during the early dry season (December – February) and 18^{o}C and during main rainy season of the year (Mid March – end of June) and short rainy seasons Mid July – November. Its annual rainfall ranges 350 to 1500mm with altitude of 550-1550 m above sea level**.**

Selection of trial site and Agro pastoralists

Two peasant associations namely Kako and Chali were selected from Benatsemay woreda of South omo zone in collaboration with woreda pastoral affairs' office experts and agricultural developmental agents after discussions on the objectives and benefits of the on farm participatory research implementation on Agro Pastoral livelihood. Accordingly, three trial Agro Pastoralists' households were selected pre each peasant association (PAs) after community meeting delivered. The criteria for selection of trial Agro Pastoralists were availability of land, suitability of site for experimental trial, interest of Agro Pastoralist in technology adoption and experience of Agro Pastoralists to new Agricultural technologies.

Training and Establishment of Agro Pastoralists' Research Group (APRG)

Two Agro pastoralists research groups(APRG) were established per each peasant associations(PAs) which comprised seven household (five Men and two women) per each Agro pastoral research groups after training delivered to agricultural extension experts and workers and Agro-pastoralists research group member involved in participatory research trial on forage production, forage development, forage management aspect, participatory research approach and importance of gender consideration in Agricultural research activities .

Experimental Design and Treatment

After delivery of the training, each trial Agro pastoralist contributed a 0.125 ha of experimental land. Each trial Agro pastoralists had planted Lablab intoritum, Lablab purepureus and Cow pea (*Vegina ungulata*). Each legume species was planted on area of 3 m x 4 m = 12 m^2 plots having five rows arranged length wise in an east North - West direction, spacing 50cm distance between each row and 30 cm distance between each plants with replicate three times per each species, in completely randomized block design (RCBD) arrangement and trial Agro pastoralist considered as replicate across each trial site.

Crop management and Data Collection

The crop management practice like hoeing, weeding were practice as required. Monitoring was done once a week during the whole trial period. At 50 % flowering stage (blooming stage), in all trial location two randomly selected middle row with net area of 2.5m2 at two month age for Cow pea (*Vegina ungulata*) and Lablab purepureus and three month age for Lablab intoritum were harvested and the fresh biomass weight was taken right in the field by using field balance and weighted right at field to determine fresh weight of samples. The harvested herbage samples per species was manually chopped in to small pieces using sickle and the chopped herbage of the three replication was pooled and mixed in to one representative subsample per each species.

Then it allotted in oven dried at 105 ^{o}c for 24 hrs after transported to the Jinka Agricultural Research Center (JARC) Animal nutrition sample analyses laboratory in order to determine the absolute dry matter (ADM). Conversely, the Agro pastoralists were allowed to cut and fed their Animals the herbage of species remaining in the experimental plots. Finally, the Pastoralists perception (need assessment) and concurrently preference of animal to tested species was recorded with different selection criteria that prepared by researchers with their local language (Banagna language). Pertaining to animals preference assessment, four local animals allowed fasting over night + for hour and let them in to the tested species after cut and carry and measured left over on the ground and record their preference accordingly.

Exchange visit and Field day program

Exchange visit program carried out among the Agro pastoralists research group(APRGs) members in order to swap over experience and plug up an imperative gaps among the Agro pastoralist members. Each trial Agro pastoralist trial farm was monitored and each group work in each Agro pastoral research group was visited and relevant comment and suggestions was made on how they are managed their trial farm (site) within and among the group starting from the planting to data collection. The field day program was arranged and celebrated successfully among the Agro pastoral research group, none Agro pastoral research group, political leaders, and None governmental organizations(NGO) and the Agro pastoralists research groups with total of 250 participants(150 Male and 100 Female) were participated and research work performed by each Agro pastoralist research group which was opened and presented to invited participants and important comments raised from participants and discussion carried out . Finally, the tested species systematically evaluated and ranked by the attendance in field day celebration according to different selection criteria and strong base recommendation had been drawn in order to demonstrate species scale out to the pastoral communities in large ..

Data Analysis

The data obtained was analyzed using One Way Analysis of Variance (ANOVA) in a completely Randomized Block Design (RCBD). Analysis of variance of dry matter, effect of season on dry matter yield (DMY) and treatment effect on dry matter yield (DMY) was performed using the General Linear Models (GLM) procedure of SAS (Statistical Analysis System) version 9.1 with following model and differences between dry matter yield (DMY) (means) in t/ha were compared and separated by using the Duncan's Multiple Range Test and least significance difference were declared at P = 0.05.

$X_{ij} = \mu + Y_i + V_i + () + e_{ij;}$

Where; X_{ij} = Over all mean of dry matter yield;

μ = is mean of individual species;

Y_i = the effect of year (season);

$Y_i * V_i$ = The interaction effect of treatment;

e_{ij} = The random experimental error .

RESULTS AND DISCUSSION

The result of for dry matter yield (DMY) revealed that there was no significant difference($P > 0.05$) was observed among the tested forage legume species in the first year in Kako peasant association however, there was significant difference ($P < 0.05$) declared between Lablab *purepureus* and Lablab *intoritum* and Lablab intortum and Cow pea in the second cropping season (Table 1). Dry matter production potential of the tested species in kako peasant association is 4.5, 5.6 and 5.20 t/ha and 3.4, 5.0, and 3.68 t/ ha for Lablab purepureus,Lablab intoritum and Cow pea in cropping both cropping season respectively.

Table1. Dry matter yield (DMY) (kg/plot) and Standard error for tested forage species at 50% flowering stage in two 2012 and 2013 cropping seasons .

Tested species	Kako Peasant association				Chali peasant association			
	DMY/kg/plot + SE in 2012	Average DMY +SE in 2012	DMY/kg/plot + SE in 2013	Average DMY +SE in 2013	DMY/kg/plot + SE in Year 2012	Average DMY + SE in year 2012	DMY/kg/plot + SE in year 2013	Average DMY + SE in year 2013
Lablab purepureus	0.116±0.017[a]	0.13±0.09[a]	0.085[a]	0.101+0.45	0.13±0.16[a]	0.16±0.09[a]	0.089[b]	0.094[b]
Lablab intoritum	0.14±0.017[a]		0.125[b]		0.25±0.16[b]		0.115[b]	
Cow pea	0.132±0.01[a]		0.092[a]		0.11±0.16[a]		0.079[a]	

(Means with the bear with same letter in column for oven dried weight base are not significantly different ($P<0.05$)

Key. SE = Stand for standard error, DMY = Dry matter yield

Pertaining to the trial location two (Chali PA) the dry matter yield measured revealed that there was significant difference among the tested forage species in two cropping seasons. The dry matter production potential of tested forage species trial location (area) is 5.2, 4.4 and 10 t/ha and 4, 3.2 and 5t/ha in year 2012 and 2013 respectively for Labalab purpureus, Cow pea (vegina *ungulata*) and Lablab intoritum. The dry matter yield obtained in trial location one (kako PA) for Cow pea species in two cropping season ranges 3.2 to 4.4 t/ha which is comparable to the study that reported by Alemayehu M.(2003) and Bilatu e ta al.(2012) where as in trial location two (Chali) ranges 3.68 to 5.28 t/ha which is corroborated to previous finding that reported by Alemayehu M.(2003) ; Bilatu e ta al.(2012) and (Aikins and Afuakwa (2008) for 2012 cropping seasons and slightly higher recorded which is unlikely to previous study that reported by Aikins and Afuakwa (2008) in 2013 cropping season. Conversely, dry matter yield recorded in the current study for Lablab purepureus in current study corroborated previous finding by different authors (Amodu *et al*., (2005); Cameron 1988; and Mayer et al 1986) in both location in 2012 and 2013 cropping seasons. However, Lablab intirtum produced largest dry matter yield than Lablab purepureus and Cow pea in 2012 cropping season in trial location two than trial location one (Kako) which is two time higher (10 t/ha) than what Alemayehu M.(2003); Geleti D et al.,

2012; Gizachwe L. et al., 1988) reported which yielded 3-5 t/ha in Ethiopian and however, there was concurrent decreased in dry matter yield half observed for trial location one (kako). The interaction effect across location and year on the dry matter yield revealed that there was variability in dry matter yield among the within and among the cropping season, trial locations and Variety potential this is might be linked to difference in crop management practice which related to study by different investigators (Anele UY. et al., 2011a; Rivas -Vega et al., 2006; Anele UY. et al. , 2011b). However, there was no significance difference was also observed in terms of dry matter yield between Lablab purepureus and Cow pea (vegina ungulata) respectively for second cropping year. On the other hand, the results from analysis of variance for herbage dry matter yield for effect of season b/n varieties revealed that there is no significance difference between Lablab purepureus and Cow pea in 2012 and 2013 cropping season ($p > 0.05$) in the both trial location. This resemblance in result b/n two species is might be linked to similarity in environmental variables like amount and distribution of rain fall, Soil profile, temperature of in to the area and other agro ecological variables.

Agro pastoralists' perception toward species

Pertaining to Agro pastoralists' perception toward the tested forage species in both trial locations attested that, Lablab *intoritum* was perceived to the Lablab purepureus and Cowpea with 43% in line with its higher in the dry matter yield production potential and disease/pest resistance capacity. On the other hand, the species Lablab purepureus was less preferred (11%) by Agro pastoralists to Lablab intoritum and Cowpea by pastoralist due to its highly susceptibility to pest and relatively low dry matter yield (DMY) production to their Animal. conversely, Agro pastoralists also perceived the species on the basis of palatability to the Animal which is more imperative than the disease/pest resistance and seed yield potential due to the species that produce is highly palatable to Animal, this leads to encourage them to produce more forage species on their farm level. A few Agro-pastoralists were selected Cow pea for its palatability and dual purpose than lablab purepureus and lablab intoritum. Lablab intoritum have low seed yield potential and it takes prolonged time to reach its maturity. This is one of the shortcomings of Lablab intoritum, for Pastoral areas where rain fall is erratic type and highly variable with high coefficient of variations. In general, the Pastoralists involved in species evaluation process around 38% prioritized Animal preference which is attached with the statement that if we are producing for our animals they should feed on it freely and it has to be highly palatable. On the other hand, some of the Agro-pastoralists which is about 25.8% selected tested species, with they put some assumption which is astonishing idea, they says we have reared large number of livestock; if it is relatively palatable and high yielding, our animals feed it by competition; hence, they selected high yielding tested species. Conversely, the other group which is about 19% selected resistance to disease, they put some compromising idea that they said that if the crop is not resistance to disease and pest how to sustain its prospect, so, it must be resistance to environmental factors.

Table 2. Agro pastoralists criteria for selection of varieties (according to agro pastoralists ranking 5= highest, 4 = Moderate, 3 = Medium, 2 = Fair and 1 = lowest).

Selection Criteria	**Kako Peasan association**			**Chali Peasant association**		
	Lablab Intoritum	**Lablab Purepureus**	**Cow pea**	**Lablab Intoritum**	**Lablab Purepureus**	**Cow pea**
Biomass yield	5	4	3	5	3	3
Animal preference	1	2	5	1	3	5
Disease/pest resistance	5	1	3	5	3	4
Seed Yield	1	5	5	1	3	5

CONCLUSION AND RECOMMENDATION

In the study area, the three tested species variable dry matter yield due to variability in climatic factor like rainfall distribution, soil fertility variation, location difference and Agro pastoralists' management across the study area. Even though, dry matter yield variability, tested forage species performed well and it is recommended to the tested agro ecologies accordingly to it adaptability potential, Lablab intoritum, Lablab purepureus and Cow pea respectively. The result reported in the current study is from data of two cropping season. However, for the forage species yield may be variable in other seasons, it is therefore, imperative to evaluate the tested species for more than the tested seasons under similar conditions. Moreover their feeding value and chemical composition should be evaluate in order to put the strong bases. Moreover, Agro pastoralists' perceptions to the new agricultural technologies need to be studied to incorporate local technical knowledge which is very equally important scientific knowledge. Therefore, it is in future forage species/variety evaluation and testing trials and to confirm suitability of the varieties under farmer circumstances. Since in the study area the shortage of feed in quantity and quality number one prioritized problem, so it is recommended that the information obtained would benefit in promotion of the forage species in wider scale out through pre-scale-up and scale - out programs.

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