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# Effect of Top Dressing and Over Sowing Improved Forages on Biomass Yield and Herbaceous Composition of Grazing Land in Bursa Woreda of Sidama Region

**Worku Bedeke***

*Southern agricultural research Institute (SARI), P.O. Box 06, Hawassa, Ethiopia*

***Corresponding Author:** Worku Bedeke, Southern agricultural research Institute (SARI), P.O. Box 06, Hawassa, Ethiopia.

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## Abstract

Natural pasture productivity is reducing due to shrinkage of grazing land in highlands of crop livestock mixed production system; which is aggravated by poor management and misuse of it. The study was conducted in bursa district of Sidama region in 2018 and 2019 cropping season with objective of identifying effects of urea top dressing and grass and legume over-sowing on herbaceous production, species composition improvement of grazing land. Five different treatments were applied as $T_1$, control, .$T_2$. over sowing phalaris grass, $T_3$, over sowing clover, $T_4$, top dressing 100kg of urea, $T_5$, top dressing 50 kg urea and over-sowing phalaris. All experimental plots were fenced throughout the study period. There was statistically significant difference at ($p \leq 0.05$) among treatments in total dry matter yield; having a DMY of 2.54 tone/ha DM in $T_1$ followed by 2.32 tone/ha in $T_2$. There was no statistically significant difference at ($p \leq 0.05$) in legume dry matter yield among treatments. Species composition was categorized in dry matter base as grass, legumes and herbs; of these grasses dominated in all experimental plots followed by legumes. Statically significant difference at ($p \leq 0.05$) was recorded in year two than year one in all parameters recorded having 1.96 tone/ha and 2.06 tone/ha DM respectively in year one and two. From the identified grass species Setariaverticellata frequently occurred in urea applied plots whereas Trifoliumruppellianum was dominant species in non-urea applied plotsespecially in clover over-sown plots. During field observation, the participants of the grazing land day rated the Urea applied treatment as best because of the high yield of pasture. Finally it could be recommended to top dress urea for increased biomass yield. It would be better to conduct a long-term study to examine the effects of the different treatments on productivity of grazing lands, herbaceous species composition, grazing capacities, livestock and the environment.

***Keywords:*** Dry matter; grazing land; nitrogen; species composition

## Introduction

Grazing is the predominant form of ruminant feeding system in most part of the extensive and smallholder crop-livestock farming areas in Ethiopia Alemayehu, 2004. Pasture lands have been significantly dwindled, highly fragmented, limited to areas where conditions are adverse for cropping due to topographic, edaphic and climatic limitations in the highlands and continuously shrinking due to human and livestock population pressure Fekede (2013),. Despite enormous contribution of livestock to the livelihood of farmers in the highlands, they are faced with multifaceted problems in the production system, among which the major one is the quantitative and qualitative inadequacy of feed supply. The main reason for livestock feed shortage is changing of the pasture land to crop land and over grazing of the grazing land. The natural pasture land which is previously covers 30.5% of the total highland area in Ethiopia is gradually diminishing due to high human population growth (Alemayehu Mengistu, 2006).

Over grazing of the natural pasture and poor pasture management was caused poor species composition and low yield of the pasture land. Study conducted in different places in Ethiopia by Bilatu et al. (2013) and Solomon et al. (2008) indicated that CP level of the natural pasture is insufficient to satisfy the minimum requirements of the animals. Low productivity of indigenous grasses and legumes (Bilatu et al., 2013), poor balance of grass and legume combinations and late harvesting of the natural pasture to obtain high bio-mass yield (Solomon et al. 2008) contributes for lower protein content and digestibility. Pasture management play a useful role in providing a high quality feed during dry season (Zinashi et al., 1995). There are a number of interventions to improve native pasture among these, use of fertilizer, over-sowing or fully replacement of natural pasture by cultivated pasture species are the most practiced activities (Tekleyohannis and Worku, 1999).The application of nitrogen has proved to be effective in maximizing the leaf area and the production of dry matter and nutritional status of grasses (Bonfim-Silva and Monteiro, 2006; Batista and Monteiro, 2008).

Though enclosures produced better biomass than the freely grazed areas, production is still limited. This is probably because of limited plants growth related to nutrient deficiency. Different studies (Bonfim-Silva and Monteiro, 2006; Batista and Monteiro, 2008) indicated that nitrogen enhances plant growth. Authors (Habtemichael, 2010 and Habteslassie 2009) in northern Ethiopia reported nitrogen deficiency in the grazing areas which probably could be the leading constraint for limited plant growth and reduced biomass yield.

Over sowing is the simplest among forage development strategies and can be undertaken at very low cost. It involves broadcasting or sowing improved forage species into common grazing lands, native pastures and degraded areas without any cultivation or other inputs (Alemayehu M. 2002). Legumes provide many benefits to a pasture system. Legumes do not need any nitrogen fertilization. They improve the seasonal distribution of forage dry matter by boosting summer production and they improve protein levels and overall digestibility of the forage. If a pasture mainly composes of unproductive native grasses, there may be a benefit of introducing improved grass species and varieties (Tesfay Atsbha et.al. 2017).

The trend of utilization of grazing land in Sidama high land is enclosure based which is most of the time individually owned; similarly, they practice rotational grazing type. Therefore, it is possible to use fertilizer and practice of over sowing through removing unwanted species from grazing/pasture land. Despite, favorable conditions; the productivity of grazing lands in the Sidama Region is very low due to poor management interventions on grazing land. Hence, this study was designed with the following objectives to identify best method of grazing land productivity increasing practice and to introduce grazing land management practices to farmers.

## Materials and methods

### *Study site*

The study was conducted in Bursa 01 Kebele, Bursa is bordered on the south by Hula, on the west by AletaWendo, on the northwest by Wensho, on the northeast by Arbegona, and on the southeast by Bona Zuria. The altitude of the area is 2560 masl with annual average rainfall of 869 mm and mean daily temperature ranging between 12-24$^0$C. Its geographical coordinates are 6° 35’ 0” North, 38° 36’ 0” East. The rainfall is bi-modal with the *belg* rain (short rains) occurring in March to May and main rain season occurs from June to September. The major crops those grown in the study area include wheat, barley, bean, potato, onion and fruits.

### *Treatments and Experimental Design*

The study was conducted using 5 treatments in randomized complete block design replicated four times under farmers’ management practice. The plot size consisted of an area of 25 m$^2$ (5m x 5 m) and the space between block and plot was 3m. The total experimental area was (21 m x 35 m) the natural pasture was fenced from April to October. Determination of species composition and harvesting was done at first week of October.

### *Treatments*

- Removal of unwanted species.

- Removal of unwanted species and over sowing phalaris grass.
- Removal of unwanted species and over sow clover species.
- Removal of unwanted species, top dressing urea 100kg.
- Removal of unwanted species, 50% top dressing urea and over sowing phalaris grass.

### *Sampling Procedures*

Vegetation from each treatment was sampled using a quadrant of 0.25 $m^2$ (0.5 m x 0.5 m) size during a predetermined sampling period. The material was harvested with a sickle at a height of >10 cm above ground. The quadrant was randomly thrown four times per plot and the average weight of the four harvests per plot was used for determination of pasture yield. Following harvesting the forage samples from each plot was weighed, labeled and air dried under shade. Identification of species was undertaken in situ by using an illustrated field guide for grasses (B. Forman et. al. 1974) and legumes. The relative proportion of botanical composition of the grasses, legumes and other herbage species in the treatment plots was determined by relating the weights of each species group to the weight of the whole sample.

### *Data Collection and Sampling Procedures*

### *Pasture yield*

The pasture yield was determined on dry matter basis by harvesting forage sample by using a quadrant of 0.25 $m^2$ (0.5 m x 0.5 m) which was randomly thrown three times per plot. The average weight of the forage in the quadrant was used and extrapolated in to dry matter yield per hectare (t/ha). Forage samples within the quadrant area was harvested with a sickle and weighed immediately. Sub-samples representing 500g of the whole forage samples harvested from the treatments were taken for determination of dry matter yield and oven dried at $105^0$C for 24 hours at Hawassa Agricultural research center soil laboratory.

### *Species Composition*

The botanical composition with regard to relative proportion of the grasses, legumes and other herbages in the treatment plots on weight basis was determined by relating the weights of each group to the weight of the whole samples and converted to tone base in a hectare.

### *Statistical Analysis*

The experimental data was subjected to analysis of variance using the General Linear Model SPSS ver. 25). LSD test applied for mean comparisons and statistically significant differences were accepted at $P<0.05$.

## Results and Discussions

### *Dry matter yield*

Dry matter yield was significantly ($P<0.005$) affected by urea application (table 1). Higher result was obtained from application of 100kg urea, followed by 50 kg urea and phalaris applied plots. Increase in DM yield due to fertilizer application was greater in year two than in year one which could be due to high moisture availability leading to better pasture growth in year two than year one. The lower DM yield in year one is might be due presence of frost prior to harvesting in year one. Over sowing grasses and legumes have lesser effect on DMY of grazing land might be due to low soil disturbance of grazing land in the area which resulted in increased probability for emergence of existing pasture rather for growth and computing of over sown improved forages. In the current study, relatively lower total dry matter yield was obtained (2.54 t/ha) than (Tessema T. et.al. 2019 and Aule E. et.al, 2017), this might be due to application phosphrus fertilizer in their experiment.

| Treatments | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Control | 1.64[D] | .031 | 1.573 | 1.699 |
| Over-sow phalaris grass | 1.83[C] | .031 | 1.767 | 1.893 |
| Over sow clover species | 1.72[C] | .031 | 1.661 | 1.787 |
| Top dress 100Kg of urea | 2.54[A] | .031 | 2.473 | 2.599 |
| Top 50 kg urea &Over sow phalaris | 2.32[B] | .031 | 2.257 | 2.383 |

***Table 1:*** Effect of different treatments on Dry matter yield of grazing land tone/hectare.

The dominance of grass is due to higher response to nitrogen than legume which was reported by (Tesfaye et. al, 2015, Tessema et. al, 2019). The increase in the proportion of grass reflects the role of nitrogen fertilizer in influencing the grass-legume botanical composition in favor of grass growth. This agrees with results of Adane (2003) and Finn et al. (2013).

| Year | Mean | Std. Error | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Year 2018 | 1.955[B] | .020 | 1.916 | 1.995 |
| Year 2019 | 2.063[A] | .020 | 2.023 | 2.103 |

***Table 2:*** Effect of year on biomass yield of grazing land.

### *Species Composition*

The species composition of natural pasture land in Dry matter base in the study area is indicated in figure 1.Higher grasses species composition was recorded across all treatments though, there is significant variation at ($p \leq 0.05$) was observed in urea applied plots. Grass species composition was higher for urea applied plots than other treatments. This result agrees the reports on similar studies by (Ashagre, 2008 and Tessema et, al, 2019) who stated that in case of legumes, the average legume proportion was higher in the unfertilized plots.

With regard to legume (Clover species) over-sowing in the study area relatively lower total biomass, legume yield and its contribution for species diversity was low which is in contrary to reports by (Tesfay A. et.al 2017 and J. N. Clat worthy 1984) in Tigrai region higher yield was recorded on pasture land over sown with Vicia sativa) and Viciadayscarpa and in Zimbabwe, increased dry matter production of a natural pasture over sown with Disodium uncinatum (Silver leaf desmodium). Similarly, (A. B. Lwoga, 1983, Tesfaye et al., 2015; Yossif & Ibrahim, 2013 had reported also increased in pasture production when suitable pasture legumes were successfully incorporated.

The most common herbaceous species recorded in the whole experimental plots were Hyperheniarufa (Grass), Cyperusrotundus (SegeSpp), Digitariaabyssinica (grass), Dicrocephala integrifolia (herb), Bidens macroptera (herb), Eragrostistenuifolia and cynodon-dactylon. Of which *Setariaverticellata* frequently occurred in urea applied plots where as *Trifolium ruppellianum* was dominant species in non-urea applied plots especieally in Clover applied plot. Similar report was indicated by Abule E. et, al. 2017 and Tesfay A. et, al., 2020). Less herb and unwanted species were recorded this is mainly due to removal of this species from the experimental plots before applying treatments.

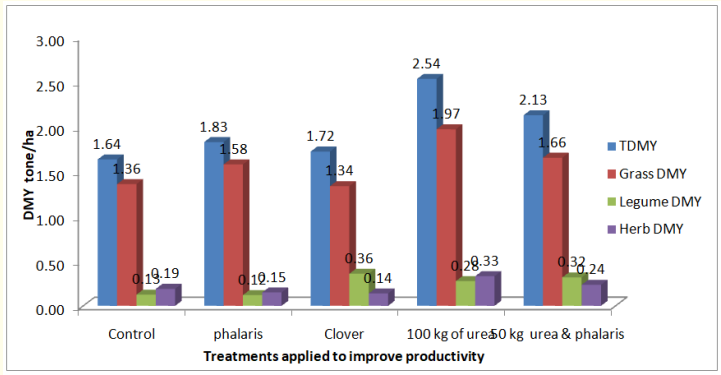


***Figure 1:*** Effect of treatment on species composition and their DMY tone/ha$^{-1}$.

### *Farmers' preference*

Assessment was conducted during over-sowing to final data collection, indicated that 70% of farmers were interested with application of Urea and with increase in biomass; whereas the rest 30% became neutral due to fear of cost of urea and its competition with crops. But those own cross breed cattle and practice fattening were interested in the technology. The feedback from farmers indicated that it is better to observe long term effect of legume and grass over sowing through better soil disturbance before planting.

## Conclusion

The results of the current study showed that dry matter yield is significantly affected at ($P<0.05$) in urea applied plot and higher results were obtained for 100kg of urea, followed by 50% urea and 50% recommended rate of Palmaris per hectare of land. Similarly, higher grasses species composition was found in higher rate of urea applied experimental plots of the land. The current study indicated that over-sowing legumes and grass alone on grazing land had low impact as compared to urea top dressing. Therefore high dry matter yield was obtained in 100kg urea applied pots than other studied plots in the area. Further study like application of dung and better soil disturbance before over sowing grass and legume has to be in the study area to increase productivity with minimum cost of production. On the other hand introduction of improved breeds need due attention in order to divert concern of farmers towards grazing land and forage.

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