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EFFECT OF SEED PROPORTIONS ON MORPHOLOGICAL CHARACTERISTICS OF FORAGE MIXTURE IN NORTH GONDAR, ETHIOPIA

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ABSTRACT: The experiment was carried out on forage mixture triticale (X Triticosecale wittmack) and vetch (Vicia vilosa R.) under rain fed condition of Dembya district. Forage mixture grown under different seeding rates during 2016 cropping season in the study area. The objectives of the research were; to evaluate the optimum seeding rates for maximum forage biomass yield of the mixture and to assess the morphological and phenological efficiency of forage biomass yield in the mixture. The experimental design employed during the research was a randomized complete block design (RCBD) with five treatments and replicated five times with the total of 25 treatments/plots. The forage treatment include with five different proportions of seeding rates (SP) in the ratio of (triticale /vetch) 100:0 (SP1), 75:25 (SP2) 50:50 (SP3) 25:75 (SP4) and 0:100 (SP5) and the plot size was 2m x 5m width and length. Data was subjected to analysis as variance using MSTATC statistical procedure for morphological characteristics of forage yield and quality parameters. Higher forage DMY of the mixture (11.85t/ha) was observed at SP3. The research depicted that, SP3 for triticale was found to have highly significant at (P<0.01) in leaf area, leaf length and leaf to stem ratio than any other SPs in the forage mixture. With all these findings the experiment result of this study was found the combination of SP3 could be considered as the best association of triticale/vetch for better forage mixture as it resulted in highest, leaf area, leaf length and leaf to stem ratio and better DMY would be a benefit for forage biomass production in the mixture.

Keywords: Effect, Seed Proportions, Morphology, Mixture, Ethiopia

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INTRODUCTION

Land resource stress in the tropics and sub-tropical countries has increased as the number of people supported by the land has risen. Thus, cultivation of uplands, which are marginally suited to annual crops, has led to diminishing of soil fertility and crop yields (Bimrew, 2008). Continuous cultivation of the same types of crop has led to the development of intransigent problems of diseases, pest and weed infestation (Dawit, 2013). Tropical forages are playing a vital role in the development of sustainable cropping system, and a best methods of forage improvement has arisen by using intercropping of annuals crops and perennial legumes in sole cropping patterns makes it possible to manipulate the outcome of competition (Humphrey, 1994).

Livestock production in the tropics can be increased through increasing the productivity per animal and per unit of area land. A major factor in increasing livestock productivity will be the improvement of animal nutrition and feed supplies, especially in case of ruminant animals that must provide better nutrition (Whitman et al., 1980). Natural grazing land of the area consists of largely wide range of grasses, legumes and other herbaceous species. According to Daniel (1990) the existing feed stuffs in Ethiopia, native pasture and crop residues are poor in quality and provide insufficient protein, energy, vitamins and minerals. Animals' thrive predominantly on high-fiber feeds,

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which are incomplete in nutrients (nitrogen, sulfur, phosphorus, etc) necessary for microbial fermentation (Osuji et al., 1993).

If the price of animal products rises, farmers may adjust their planting schedules in favor of forage crops and commercial livestock production could be only achieved through the feeding of quality forage (FAO, 2011). Moreover, the important feature of the mixture is enhancement of seasonal distribution of forages, because legumes remain green long in the dry season (Prasad and Singh, 1991). The performance of the mixture depends on their compatibility and initial seed rate proportions of grass and legume species (Willey and Rao, 1980). Low seed rate results in a poor stand and prolonged time required for development of satisfactory grass-legume mixed pasture and high seed rates are in conspicuous because it incurs higher cost (Prasad and Singh, 1991).

Even thought, information on their agronomic management of optimum level of seeding rate for maximum biomass production for mixed pastures to improve yield and quality of forage is generally inadequate. In addition, the ministry of agriculture for adoption by dairy cattle owners is testing the different legume species (Charles et al., 2012). The mixture has been identified to have a promising potential for pasture improvement. Therefore, this study was designed with the following specific objectives:

1-To study the optimum seeding rates for maximum biomass yield of forages in the mixture.

2-To assess the morphological and phonological efficiency of forage yield and quality in the mixture.

MATERIALS AND METHODS

Description of the study area

The investigation was conducted at Dembia district of North Western part of Ethiopia, 736 km North of Addis Ababa, and 36 km from Gondar to Gorgora Tana road. The area experiences one main rainy (unimodal) with long rainy season extending from half of March to the mid October, but the effective rainfall is from May to half October. The mean annual rainfall was 1150 mm with a peak in June and July having an average of 105 rainy days. The area lies at an altitude of 2004 m.a.s.l. between. The major criteria used for the selection of the experimental area were the proportion of livestock especially local dairy cows and crossbred dairy cattle are more available in the study area at the radius of 5km from the farming area to the town, in addition there is a shortage of improved forage species and due to grazing land has been shifting of in to crop land as human population increased as geometric rate. Topography of the site was gentle slope and well drained in which the farmer used the area to frequently cultivated for crop alternatively in year round (CSA, 2011).

Land preparation and sowing

The varieties of forages were triticale (x *Tritico secale witt mack*): Vetch (*Vicia vilosa* r.) using 120 kg and 25 kg seed rate for triticale and vetch correspondingly. In both varieties the plot size was 2m x 5m for the treatments. The seed was purified; select the weed, and other dead, irregular in shape for to increased germination percentage. Therefore, the seed was mixed according to their respective seed proportion treatment combination and broadcasted on a well-prepared seedbed on the experimental site.

Experimental design and treatments

The experiment was conducted with five seed rate proportions on well prepared plots of mixed soil type and replicated five times with the total of 25 treatments were put in randomized complete block design (RCBD) in the study area.

Treatments of the seed proportion

Triticale alone which were; 100% (SP1), Triticale 75% + 25% Vetch which was (SP2), Triticale 50% + 50% Vetch (SP3), Triticale 25% + 75%Vetch (SP4) and Vetch alone 100% (SP5).

Seedling and tiller counts

Seedling counts for both species were done one week after emergence from the quadrants having (0.5 m x 0.5 m) area from each plot. It was carried out initial plant stand after seven days of growth by measuring quadrants and summarized the mean value at the different seed proportion treatments taken from each plot for both triticale and vetch mixture. Tillering count for triticale was measured at 45 days of growth by taking 0.5m x 0.5m sample area from each the entire plots and count the number of tillers found from individual plants.

Plant height, dry matter accumulations and heading date

Ten plants of triticale and ten plants of vetch were harvested every 20 days from ground level, to measure the height, fresh and dry matter weight and measured to assess the rate of change of height and dry matter

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accumulation over the growing period and height was expressed in centimeters by every 20 days of interval of plant growth. Dry matter accumulation was also determined every 20 days of plant growth and measured the changes in g/10 plants. For dry matter yield determination, the fresh weight of each plot was measured in the field using 20 kg measuring capacity balance in the field just after cutting. Sub-samples of each treatment were dried in the oven at 65 ^{0}C for 72 hours to determine the dry matter contents of the forages at Holeta Animal Nutrition Laboratory Tilahun (2002).

RESULTS AND DISCUSSION

Number of leaves for Triticale and branches for Vetch

The number of leaf for triticale significantly affected (P<0.01) by the different seed proportion (Table 1). SP1 with seed proportion two did not showed significant variations (P>0.05) in the number of leaves for triticale. The number of branches for vetch was significant different (P<0.01) in the different seed proportion and the highest and the lowest number of branches of vetch were measured SP5 and SP2 respectively. As the seed proportion of triticale decreased the numbers of branches of vetch become increased (Melese et al., 2014).

Seedling count for both forages and tiller counts in the mixture

Seedling counts after one week of emergency for both forage species showed significant variation (P<0.01) at the different seed proportions combination in Table 2. Higher seedling counts for triticale was obtained at SP1 and the lower seedling count at SP4 with values ranging from 135 to 44 seedlings /m^2 with a difference of 91 seedlings. The highest seedling count of vetch was measured at SP5 with the value of 55 seedling / m^2 but SP2 and SP3 did not indicate statistically significant variation at (P>0.05) in the seedling count of legume species. Analysis of variance data indicated that, tillering capacity of triticale in the growing period was significantly affected (P<0.01) by the different seed proportion treatments. The tillering capacity of triticale increased as the proportion of vetch increased and the maximum number of tiller was recorded at SP4 and the lower number of tiller at SP1 with the values of 210 and 135 tillers / m^2 respectively (Yeshitila et al., 2008).

Ground cover and Vigor Scores for Triticale and Vetch

Analysis of variance of data indicated that, the ground cover decreased with the decrease in the relative proportions of the seeds of each crop in the forage mixture and similar findings with Zewdie (2010).

The ground cover for different seed proportions of triticale were significantly affected by one to the other and higher at SP1 than SP3 and SP3 were also higher than SP4. The ground cover of vetch was also significantly affected (P<0.01) by the various seed proportion, however, SP5 was higher than that of SP2, SP3 and SP4. But seed proportion one with seed proportion two and seed proportion two with seed proportion three did not indicate statistically significant effect (P>0.05) on the vigorousity of triticale in the growing period.

Height, heading and Flowering Days of Triticale and Vetch

Data revealed that, heading days for triticale significantly affected (P<0.01) by the different seed proportion. Significantly higher result was obtained at SP3 with the value of 70.06 days. But SP1 and SP2 did not showed significant variation (P<0.01).

Flowering days for vetch also showed significantly influenced at (P<0.01) by the different seed proportions. However, SP3 and SP4 did not showed significant different at (P>0.05) one to the other and SP2 obtained higher flowering days as compare to the other SP. The lower days for flowering of vetches components at SP5 might be the higher proportion of vetch inclusion with triticale may enhance the growth and the plant could attain early maturing of its full development. Analysis of variance indicated that the height of triticale at the 20th days of cutting showed significant variation at (P<0.01) at the various seed proportions. The highest and the lowest height of triticale were observed at SP1 and SP2 with the values of 26.33 and 22.11cm correspondingly, this finding had a similar output with Malede (2013).

At the 40th days of plant growth plant height also significantly affected by the different seed proportion and the highest height of triticale was recorded at SP1 and the lowest at SP2 which measured 44.45 and 40.33 cm respectively. Analysis of variance data revealed that, there was statistically significant variation (P<0.01) in the height of triticale at the 60th days of plant growth. The highest height was also found at SP1and the lowest at SP3 measuring with the value of 75.89 and 68.67 cm indicated with the different of 7.22 (Chinedum and Evans, 2001).

Analysis of variance data at the 20th days measurement, the height of vetch indicated that, there was significantly affected at (P<0.01) in the different SP and the highest height was measured at SP5 and the lowest at SP2. Seed proportion three, seed proportion four and five indicated statistically non-significant different (P>0.05) from each other.

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At the 40th days of plant height measurement statistically significant variation (P<0.01) was found at the different seed proportion and the highest and the lowest plant height were measured at SP5 and SP4 with the value of 43.33 and 38.89 cm correspondingly. In the 60th days of plant growth height indicated significant different (P<0.01) in the various seed proportion.

Significantly higher leaf area was obtained at seed proportion three as compared to the other seed proportions. Leaf area showed an increasing tendency from seed proportions one to seed proportion three with the value of 18.44 to 26.54 cm^2. Analysis of variance data discovered that leaf length significantly influenced (P<0.01) by the different seed proportions. The highest leaf length was measured at seed proportion two and the lowest at seed proportion one measuring with the value of 45.64 and 38.60 cm respectively (Tsige, 2000).

Table 1 - Number of leaves for triticale and vetch as affected by seed proportion

Seeding rates (SP)	Number of leaf for triticale	Number of branches for vetch
SP1	3.03^{c}	-
SP2	3.0^{c}	11.04^{c}
SP3	4.03^{a}	13.00^{b}
SP4	3.65^{b}	13.64 ^{b}
SP5	-	14.62^{a}
Mean	3.43	13.10
SE(±)	0.03	0.01
LSD	0.03	1.07
CV (%)	3.17	5.34

SE = standard error, LSD = Least significant Different CV = Coefficient of Variations, Seed Proportion from 1 to 5, means with different letter within the columns are indicated significant different, whereas means with the same letter showed no significant variation.

Table 2 - Seedling counts (m^2) for both crops and tillering for triticale

Seeding rates (SP)	Emergency		Tillering
	Triticale /m^2	Vetch /m^2	Triticale /m2
SP1	135^{a}	-	135^{c}
SP2	115^{a}	18^{c}	195^{b}
SP3	91^{b}	25^{c}	210^{ab}
SP4	44^{c}	40^{b}	231^{a}
SP5	-	55^{a}	-
Mean	96.25	34.5	192.75
SE(±)	0.123	0.824	2.451
LSD	23.561	6.586	28.661
CV (%)	11.36	9.6	8.6

Table 3 - Ground cover and the vigorous of after one month of seed proportion

Seeding rates (SP)	Ground cover		Vigor	
	Triticale	Vetch	Triticale	Vetch
SP1	4.5^{a}	-	4.5^{a}	-
SP2	4.2^{b}	2.5^{c}	4.1^{ab}	3.4^{a}
SP3	3.8^{c}	3.8^{b}	3.8^{bc}	3.1^{a}
SP4	3.0^{d}	3.8^{b}	3.5^{cd}	3.6^{a}
SP5	-	4.2^{a}	-	4.0^{a}
Mean	3.88	3.58	3.98	3.53
SE(±)	0.354	0.417	0.1254	0.834
LSD	0.201	0.102	0.585	NS
CV (%)	13.51	13.51	13.51	13.51

SE = standard error, LSD = Least significant Different CV = Coefficient of Variations, Seed Proportion from 1 to 5, means with different letter within the columns are indicated significant different, whereas means with the same letter showed no significant variation.

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Table 4 - Days to heading for triticale and days to flowering for vetch

Seeding rates (SP)	Heading days Triticale	Flowering days Vetch
SP1	60.22^{c}	-
SP2	62.56^{c}	95.66^{a}
SP3	70.06^{a}	91.84^{b}
SP4	67.00^{b}	90.88^{c}
SP5	-	88.86^{c}
Mean	65	91.81
SE(±)	1.03	0.86
LSD	3.52	2.552
CV (%)	11.99	5.365

SE = standard error, LSD = Least significant Different CV = Coefficient of Variations, Seed Proportion from 1 to 5, means with different letter within the columns are indicated significant different, whereas means with the same letter showed no significant variation.

Table 5 - Plant height (cm) for triticale as affected by seed proportions

Seeding rates (SP)	Harvesting days			
	20	40	60	80
SP1	26.33^{a}	44.45^{a}	75.89^{a}	-
SP2	22.11^{b}	40.33^{b}	70.35^{b}	-
SP3	25.34^{a}	41.00^{ab}	68.67^{b}	110.27^{a}
SP4	23.33^{b}	44.22^{a}	69.22^{b}	123.00^{a}
SP5	-	-	-	-
Mean	24.3	42.5	71.03	120.1
SE(±)	0.243	0.786	0.66	3.546
LSD	1.270	3.821	3.721	NS
CV (%)	3.45	6.56	3.88	12.12

Table 6 - Plant height (cm) of vetch as affected by seed proportions

Seeding rates (SP)	Harvesting date			
	20	40	60	80
SP1	-	-	-	-
SP2	20.56^{b}	39.56^{b}	67.22^{b}	114.22^{a}
SP3	21.86^{ab}	41.11^{ab}	66.33^{b}	118.67^{a}
SP4	22.22^{ab}	38.89^{b}	72.11^{a}	116.86^{a}
SP5	24.56^{a}	43.33^{a}	72.33^{a}	112.78^{a}
Mean	22.3	40.72	69.5	115.63
SE(±)	1.85	0.86	1.46	3.52
LSD	3.31	3.34	4.62	NS
CV (%)	10.58	8.52	4.99	11.64

Table 7 - Leaf area, leaf length and leaf to stem ratio of triticale

Seeding rates (SP)	Leaf area (cm)	Leaf length (cm)	Leaf to stem ratio
SP1	18.44^{d}	38.60^{d}	0.84^{b}
SP2	24.21^{c}	45.64^{a}	1.04^{b}
SP3	26.54^{a}	42.64^{b}	1.44^{a}
SP4	25.04^{b}	40.20^{c}	1.01^{b}
SP5	-	-	-
Mean	23.60	41.80	1.08
SE(±)	1.06	1.04	0.44
LSD	0.82	0.55	0.26
CV (%)	4.84	12.00	7.12

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Conflict of interests

The authors have not declared any conflict of interests.

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