Research Article

MAXIMIZING FODDER YIELD OF TEOSINTE (*Euchlaena mexicana*) THROUGH SOWING DATES AND MIXED FODDER CROPPING MANAGEMENT

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ABSTRACT

Teosinte (*Euchlaena mexicana*) is one of the most popular summer growing cereal fodder, rich in energy, dry matter (DM) and other nutrients, yet productivity of this fodder in Nepal has not been achieved as expected due to several important factors including cultivation management and sowing dates. An experiment was done during April to August 2018 at Directorate of Agricultural Research, NARC, Province-5, Khajura, Banke by using Split Plot design with the objective to identify the appropriate sowing dates in relation to possible combination of local fodder legumes with teosinte. It was expected that best possible combination of fodder legumes with teosinte would increase both herbage mass as well as quality aspects through increased productivity. Accordingly main plot treatments were sowing dates (April 18, May 3, and May 18) and sub-plot treatments were set as combination of fodder cowpea, lablab bean, and rice bean, each with teosinte, and sowing of teosinte as sole crop. Findings revealed that plant height, leaf length, tiller density of teosinte, and number of branches and trifoliate leaves of fodder legumes had contributed significantly to the cumulative herbage mass. Significantly highest green herbage and dry herbage mass ($p<0.001$) was obtained if these fodder species were sown in April 18 as compared to other dates of sowing. The combination of teosinte and cowpea had yielded significantly higher herbage mass ($p<0.001$) compared to others fodder species combinations. Preliminary findings of this research thus indicate the possibility of promoting mixed cultivation of teosinte with fodder cowpea in order to increase both herbage mass and quality.

Key words: teosinte, cowpea, fodder legume, herbage mass, sowing dates

INTRODUCTION

Livestock is an important resource of livelihood in Nepal (Maltsoglou &Taniguchi, 2004). The major reason of low productivity of the livestock is insufficient and low quality feeds and fodders (Tulachan & Neupane, 1999; Osti, 2000). Improved fodder cultivation practices in Nepal are still at the stage of infancy. The production of plentiful quantity of good quality forage/fodder is pre-requisite for an efficient and productive livestock industry. The poor quality of the feed resources available to ruminants is mainly due to availability of low plane of nutrition (Jeremiah et al., 2015). Green forage availability is very important to maintain ruminants' health and productivity. Cereals forage gives high dry matter and low protein, which shows low quality and nutritive value. On the other hand, leguminous fodder/forages are comparatively low dry matter yielder with high quality and rich in protein (Hamdollah et al., 2009). The mixing of fodder/forage legumes with cereals fodder/forages can improve the nutritional value of forage (Zemenchik et al., 2002; Ahmad, 2007) as well as the biomass production (Iqbal et al., 2017; Geren et al., 2008).

Devkota et al. (2015) reported that teosinte has the advantage of giving very high fodder biomass yield mainly due to its profuse tillering capacity, and through its potential multiple cuts. Among the cultivated fodder/ forages during summer in Nepal, teosinte (*Euchlaena maxicana*) is one of the most popular cereal fodder/forage crops, rich in dry matter (DM), energy with its fair contribution to the crude protein content (Upreti & Shrestha, 2006; Devkota et al., 2015). Among different possibilities to increase the fodder/forages supply, teosinte sowing with locally available fodder legumes, at appropriate date(s), could be one of the logical options of low cost forage/ forage production with high forage/fodder mass as well as quality of produce. Locally available, most common and promising fodder/forage legumes in Nepal are: cowpeas (*Vigna unguiculata*), rice bean (*Vigna umbellate*), and lablab bean (*Lablab purpureus*). Introducing legumes such as commonly available fodder/forage legumes with high forage quality (CP and DM) could increase animal productivity (Anele et al., 2011) in general. The presence of fodder/forage legumes in cereal fodder/forage assists the cereal fodder/forages' growth through improved nitrogen supply (Shen & Chu, 2004; Ram & Singh, 2001), and can compensate cereal protein shortage (Rao & Willey, 1980; Mishra et al., 1997; Gebrehiwot et al., 1996; Ibrahim, 2006). Accordingly, this experiment was done with the main objective to identify appropriate dates of sowing teosinte in a mixed crop fashion with available and popular fodder/ forage legumes in order to produce maximum possible herbage harvest with its considerable quality consideration.

MATERIAL AND METHODS

This experiment was done at Directorate of Agricultural Research, NARC, Province-5, Khajura, Banke, during April to August 2018. The site lies between 81°37" East longitudes and 28° 06" North latitude with an altitude of 181 meters above sea level. The maximum and minimum temperature and monthly total precipitation during the study period has been presented in Table (1).The pH of the soil was 6.5.

Table1. Weather related information of Khajura, Banke during the study period, 2018

Months	Temperature (0^C) Maximum	Minimum	Precipitation (mm)
April	35.29	23.32	77
May	37.08	26.90	39.9
June	36.74	28.83	147.8
July	33.89	27.97	362.8
August	32.54	27.17	400.7

The experiment was conducted by using a Split plot design, based on complete randomized block combination; each treatment with five replications. The main plot comprised of sowing dates whereas commonly available fodder/forage legume with teosinte in combination were set as sub-plot treatments.

The plot size of 12 m^2 was taken as an experimental unit. First sowing was done in April 18, 2018, and the other sowing dates were arranged in each 15 days interval. Likewise four fodder/forage crop combinations used in the sub-plot treatments included: teosinte+cowpea, teopinte+rice bean, teosinte+lablab bean, and sowing of teosinte as a sole crop. Plant geometry was maintained as 50 cm row to row for teosinte fodder/forage. Leguminous fodder/forage was sown in between the row to row spacing of teosinte. Seed rate used was 40kg/ha for teosinte (Agrawal et al., 2012; Relwani, 1979). The fodder/forage legumes' seed rate was maintained as: cowpea (40kg/ha; Agrawal et al., 2012; Relwani, 1979); rice bean (20 kg/ha; Khadka & Acharya, 2009), and lablab bean (40 kg/ha; Pandey & Roy, 2011). Full recommended seed rates of teosinte and half recommend seed rates of fodder/forage legumes was used. Seed ratio of teosinte: fodder/forage legumes was maintained as 100:50. Farm yard manure (FYM) @ 10 t/ha and chemical fertilizer @ 60:40:0 NPK (kg ha^{-1}) was applied. Full dose of FYM, phosphorus and potash, and half dose of nitrogen was applied at the time of final field preparation, and the remaining half doses of nitrogen was applied into two split doses. First half was top dressed at one month after sowing, and the remaining half was used after first harvest.

All important and common agronomic practices (field preparation, irrigation, weeding) was done equally to each treatment and replications. Irrigation was applied at each 8 days interval (total amount of irrigated water 1183 m^3/ha). After first harvest, only one irrigation was applied, than after irrigation was stopped. Indeed, to assure the better germination, first irrigation was applied one day after sowing the seed.

A total of total two harvests were taken. First harvest was done at 70 days after sowing and the second harvest was done one month after first harvest. Teosinte was cut at 10 cm height from the ground and legumes, at 20 cm height from the ground so as to leave buds for satisfactory re-growth. The measurement and recording of growth parameters (plant height, leaf length, tiller number $hill^{-1}$ for teosinte, and number of branches $plant^{-1}$, and number of leaves $plant^{-1}$ for legumes) was done at the time of harvest, and then green herbage mass was estimated accordingly. Dry matter contents of the samples were determined by using hot air oven (at 72°C for 24 hours) in the laboratory of Directorate of Agricultural Research, Khajura, Banke. All the data obtained were analyzed using analysis of variance technique (ANOVA) and mean separation by using R programming version 4.00 (RStudio team, 2020).

RESULTS

Growth parameters of teosinte

The average plant height, leaf length, and tiller (numbers/m^2) of teosinte in teosinte-fodder/forage legume mixture under three levels of sowing dates at harvest period is presented in Table (2). At first harvest, date of sowing had significant effect ($p<0.001$) to the plant height of teosinte. Accordingly, highest per plant height was obtained for 3rd May sowing, but this was statistically similar ($p>0.05$) to the 18th April sowing (Table 2). At this time of measurement, plant height of teosinte with all other fodder/forages legumes in combination remained statistically similar ($p>0.05$). Likewise effect of treatments interaction/combination was also statistically similar ($p>0.05$) at this harvest.

At second harvest, date of sowing had significant effect ($p<0.05$) to the plant height of teosinte. The highest per plant height was obtained for 18th April sowing, but it was statistically similar ($p>0.05$) to the 3rd May sowing and 18th May sowing. Likewise teosinte with all others fodder/forage legume combination and also the effect of treatments interaction/combination on plant height was also statistically similar ($p>0.05$) at second harvest (Table 2).

At both harvests, date of sowing had significant effect ($p<0.01$) to the leaf length of teosinte. Accordingly, highest per leaf length was obtained for 18th April sowing, but this was statistically similar to the 3rd May sowing at both harvest (Table 2). At this time of measurement, leaf length of teosinte with all other fodder/forages legumes in combination remained statistically similar ($p>0.05$) at both harvests. Likewise effect of treatments interaction/ combination on leaf length was also statistically similar ($p>0.05$) at both harvest.

Date of sowing had significant effect ($p<0.05$) at first harvest and at second harvest ($p<0.001$) to tiller density (numbers/m^2) of teosinte. Accordingly, highest tiller density of teosinte was obtained for 18th April sowing and the lowest was obtained for 18th May sowing (Table 2). At first harvest, tiller density of teosinte for 18th April sowing was similar ($p>0.05$) to 3rd May sowing whereas at second harvest, tiller density was highest for 18th April sowing which was significantly different ($p<0.05$) to the rest of the sowing dates (Table 2). On the other hand effect of treatments interaction/combination on tiller numbers was statistically similar ($p>0.05$) at both harvests.

Table 2. Plant height, leaf length, and tiller density (numbers/m^2) of teosinte in teosinte-fodder legume mixture, under three levels of sowing dates, at Directorate of Agricultural Research, NARC, Khajura, Banke, 2018

Treatments	Plant height (cm)		Leaf length (cm)		Tiller density (numbers/m^2)	
	First harvest	Second harvest	First harvest	Second harvest	First harvest	Second harvest
Date of sowing						
First sowing (18th April)	148.582^a	137.927^a	107.815^a	95.926^a	122.80^a	145.00^a
Second sowing (3rd May	151.275^a	128.440^b	102.333^a	91.797^a	118.20a	137.80^b
Third sowing (18th May)	123.998^b	129.498^b	88.168^b	80.818^b	108.60b	124.30^c
Fodder species						
Teosinte	141.521	132.858	100.253	89.559	117.067	138.133
Teosinte+cowpea	140.796	131.414	99.358	89.969	117.067	136.800
Teosinte+rice bean	141.483	131.587	100.151	89.430	116.267	133.467
Teosinte+lablab bean	141.339	131.961	97.993	89.098	115.733	134.400
Mean	141.285	131.955	99.439	89.514	116.533	135.700
Analysis of Variance						
Sowing date (A) (d.f.= 2)						
SEM for sowing date	8.678	3.001	5.853	4.508	4.183	6.067
F probability	***	*	**	**	*	***
$LSD_{0.05}$	11.001	6.553	8.361	7.986	9.287	6.896
Fodder species (B) (d.f.= 3)						
SEM for fodder species	0.1676	0.3219	0.5218	0.1800	0.3266	1.0727
F probability	NS	NS	NS	NS	NS	NS
$LSD_{0.05}$	7.308	5.839	5.185	4.062	4.535	6.079
Interaction/combination(A×B) (d.f.= 6)						
SEM for A×B	3.7109	1.2940	2.5673	1.9316	1.8246	2.6684
F probability	NS	NS	NS	NS	NS	NS
$LSD_{0.05}$	12.658	10.114	8.981	7.037	7.855	10.530

Note: ***, ** and * denotes significant at 0.001, 0.01 and 0.05; NS=no significant difference at $p<0.05$, SEM=standard error of the mean, d.f.=degrees of freedom, and LSD=least significant difference

Growth parameters of legumes fodder

Density of branches (numbers/m^2) and trifoliate leaves (numbers/m^2) for cowpea, rice bean and lablab bean in teosinte-fodder legume mixture under three levels of sowing dates is presented in Table (3). Sowing dates had significant effect to the density of branches (numbers/m^2) of associated leguminous fodders at first harvest ($p<0.01$) as well as second harvests ($p<0.001$) (Table 3). At both harvests, least numbers of branches (numbers/m^2) was obtained for third date of sowing, but it remained statistically similar ($p>0.05$) to the first and second dates of sowing.

At both the harvests, fodder species combination, such as teosinte and cowpea had produced significantly ($p<0.001$) higher number of branches per m^2, and it was lower for teosinte and lablab bean mixture (Table 3).

The interaction/combination of fodder species with dates of sowing at first harvest had significant ($p<0.001$) effect to this component where teosinte plus cowpea sown in 18th April resulted significantly higher number of branches per m^2 (Table 3). At second harvest, the interaction/combination of fodder species with dates of sowing had also significant ($p<0.001$) effect to this component where teosinte plus cowpea sown in 3rd May resulted significantly higher number of branches per plant, but it was at par with teosinte plus cowpea and teosinte plus rice bean sown at 18th April (Table 3).

Sowing dates had significant effect to the density of leaves (numbers/m^2) of associated leguminous fodders at first as well as second harvests (Table 3). At first harvests, the maximum numbers of leaves per plant was obtained for first sowing ($p<0.01$). At second harvest, the lowest number of leaves per m^2 was obtained for third date of sowing, but it remained statistically similar ($p>0.05$) to the number of leaves per m^2 for first and second date of sowing.

At both the harvests, fodder species combination, such as teosinte and cowpea had produced significantly ($p<0.001$) higher number of leaves per m^2. The interaction/combination of fodder species with dates of sowing at first harvest had significant effect to this component where teosinte plus cowpea sown in 18th April resulted significantly ($p<0.05$) higher number of leaves per m^2. However at second harvest, significant effect to this component where teosinte plus cowpea sown in 18th April resulted significantly ($p<0.001$) higher number of leaves per m^2 (Table 3).

Table 3. Density of branches (numbers/m²) and trifoliate leaves (numbers/m²) for cowpea, rice bean, and lablab bean in teosinte-fodder legume mixture under three levels of sowing dates, at Directorate of Agricultural Research, NARC, Khajura, Banke, 2018

Treatments	Density of branches (numbers/m^2)		Density of leaves (numbers/m^2)	
	First harvest	Second harvest	First harvest	Second harvest
Sowing date (A)				
First sowing 18th April sowing (A1)	41.427[a]	20.066[a]	323.413[a]	85.473[a]
Second sowing 3rd May sowing (A2)	37.720[a]	20.066[a]	273.707[b]	80.013[a]
Third sowing 18th May sowing (A3)	33.667[b]	5.587[b]	227.480[c]	26.427[b]
Fodder species (B)				
Teosinte +cowpea (B1)	43.853[a]	20.707[a]	317.347[a]	88.340[a]
Teosinte+rice bean (B2)	38.840[b]	13.920[b]	269.960[b]	58.693[b]
Teosinte+lablab bean (B3)	30.120[c]	11.093[c]	237.293[c]	44.880[c]
Interaction/combination (A×B)				
A1B1	52.52[a]	22.44[ab]	400.20[a]	95.38[a]
A1B2	41.04[b]	21.56[ab]	320.56[b]	90.80[ab]
A1B3	30.72[d]	16.20[c]	249.48[de]	70.24[cd]
A2B1	42.04[b]	22.92[a]	300.48[bc]	90.36[ab]
A2B2	39.60[bc]	20.20[b]	263.64[cd]	85.28[ab]
A2B3	31.52[d]	17.08[c]	257.00[cd]	64.40[d]
A3B1	37.00[c]	16.76[c]	251.36[de]	79.28[bc]
A3B2	35.88[c]	0.0[d]	225.68[de]	0.0[e]
A3B3	28.12[d]	0.0[d]	205.40[e]	0.0[e]
Mean	37.604	15.240	274.867	63.971
Analysis of variance				
Sowing date (A) (d.f.=2)				
SEM for sowing date	2.2409	4.8267	27.6996	18.8383
F probability	**	***	**	***
$LSD_{0.05}$	3.8236	1.9494	43.7290	12.2428
Fodder species (B) (d.f.=2)				
SEM for fodder species	4.0123	2.8525	23.2393	12.8203
F probability	***	***	***	***
$LSD_{0.05}$	2.1933	1.2406	25.3784	6.9030
Interaction/combination (A×B) (d.f.=4)				
SEM for A×B	2.4598	2.9965	19.4863	12.5362
F probability	***	***	*	***
$LSD_{0.05}$	3.7989	2.1488	43.9567	11.9564

Note: *** , ** and * denotes significant at 0.001, 0.01 and 0.05; NS=no significant difference, SEM=standard error of the mean, d.f.=degrees of freedom and LSD=least significant difference

Cumulative fodder production

Herbage mass harvested (kg/m^2) at different dates, and cumulative herbage mass (kg/m^2) under different sowing dates is presented in Table (4). Green herbage mass at first harvest and second harvest was significantly higher ($p<0.001$) if fodder/forages were sown in 18th April compared to the other dates whereas it was lower for 18th May sowing. Likewise combination of teosinte with cowpea produced highest ($p<0.001$) green herbage mass compared to the other combination of fodder/forages at both harvests (Table 4). The effect of treatments interaction/combination on green herbage mass production at first harvest was statistically significant ($p<0.05$) when teosinte in mixture with cowpea was sown in 18th April but it was similar ($p>0.05$) at second harvest (Table 4).

Significantly highest cumulative green herbage mass was produced if fodder/forage sown in 18th April and teosinte sown with cowpea (Table 4). The effect of treatments interaction/combination on cumulative green herbage mass production was statistically significant ($p<0.05$) if teosinte were mixed with cowpea and sown in 18th April (Table 4).

Dry herbage mass at both harvests was significantly higher ($p<0.001$) if fodder/forages were sown in 18th April compared to the other dates whereas it was lowest for 18th May sowing. Likewise at both the harvests, combination of teosinte with cowpea produced highest ($p<0.001$) dry herbage mass compared to the other combination of fodder/forages (Table 4).

The effect of treatments interaction/combination on dry herbage mass production was statistically significant ($p<0.05$) at first harvest (Table 4). Accordingly, at first harvest lowest dry herbage mass was produced for teosinte sole fodder when sown in 18th May. Likewise, effect of treatments interaction/combination on dry herbage mass production was statistically similar ($p>0.05$) for fodder combination when teosinte plus cowpea and teosinte plus rice bean were sown in 18th April. However, treatments interaction/combination effect on dry herbage mass production was statistically similar ($p>0.05$) at second harvest (Table 4).

Significantly highest ($p<0.001$) cumulative dry herbage mass was produced if fodder/forage were sown in 18th April, and if cowpea were sown in combination with teosinte (Table 4). The cumulative dry herbage was statistically higher ($p<0.05$) when teosinte plus cowpea were sown at 18th April (Table 4).

Table 4. Herbage mass harvested (kg/m^2) at different dates, and cumulative herbage mass (kg/m^2) under different sowing dates and fodder/forage combination, at Directorate of Agricultural Research, NARC, Khajura, Banke, 2018

Treatments	Green herbage mass (kg/m^2)			Dry herbage mass ((kg/m^2)		
	First harvest	Second harvest	Cumulative green herbage mass (kg/m^2)	First harvest	Second harvest	Cumulative dry herbage mass (kg/m^2)
Sowing date (A)						
First sowing 18th April (A1)	4.216^a	3.124^a	7.340^a	0.941^a	0.664^a	1.605^a
Second sowing 3rd May (A2)	3.878^b	2.782^b	6.660^b	0.824^b	0.574^b	1.398^b
Third sowing 18th May (A3)	3.421^c	2.303^c	5.724^c	0.720^c	0.474^c	1.194^c
Fodder species (B)						
Teosinte (B1)	3.109^d	2.557^c	5.666^d	0.688^d	0.533^c	1.221^d
Teosinte+cowpea (B2)	4.391^a	2.907^a	7.298^a	0.936^a	0.609^a	1.545^a
Teosinte+rice bean (B3)	4.025^b	2.765^b	6.790^b	0.863^b	0.579^b	1.442^b
Teosinte+lablab bean (B4)	3.828^c	2.716^b	6.544^c	0.825^c	0.562^b	1.387^c
Combination/Interaction effect (A×B)						
A1B1	3.350^{fg}	2.892	6.242^f	0.770^d	0.619	1.389^{de}
A1B2	4.773^a	3.275	8.048^a	1.040^a	0.700	1.740^a
A1B3	4.484^b	3.195	7.679^b	1.00^a	0.676	1.676^{ab}
A1B4	4.257^c	3.133	7.390^c	0.953^b	0.659	1.612^{bc}
A2B1	3.177^g	2.514	5.691^g	0.681^f	0.517	1.198^f
A2B2	4.465^b	2.935	7.400^c	0.947^b	0.608	1.555^c
A2B3	4.072^d	2.870	6.942^d	0.852^c	0.596	1.448^d
A2B4	3.797^e	2.808	6.605^e	0.815^c	0.577	1.392^{de}
A3B1	2.800^h	2.266	5.066^h	0.615^g	0.463	1.078^g
A3B2	3.934^{de}	2.510	6.444^{ef}	0.820^c	0.518	1.338^e
A3B3	3.519^f	2.230	5.749^g	0.737^{de}	0.466	1.203^f
A3B4	3.429^f	2.208	5.637^g	0.707^{ef}	0.449	1.156^f
Mean	3.838	2.736	6.575	0.828	0.571	1.399
Analysis of Variance				**Analysis of Variance**		
Sowing date (A) (d.f.= 2)				**Sowing date (A) (d.f.= 2)**		
SEM for sowing date	0.2304	0.2379	0.4684	0.0638	0.0549	0.1186
F probability	***	***	***	***	***	***
LSD $_{0.05}$	0.1519	0.1192	0.1855	0.0560	0.0246	0.0640
Fodder species (B) (d.f.= 3)				**Fodder species (B) (d.f.= 3)**		
SEM for fodder species	0.2695	0.0720	0.3409	0.0519	0.0160	0.0676
F probability	***	***	***	***	***	***
LSD $_{0.05}$	0.1026	0.1086	0.1571	0.0250	0.0242	0.0374
Interaction/combination(A×B) (d.f.= 6)				**Interaction/combination(A×B) (d.f.= 6)**		
SEM for A×B	0.1729	0.1102	0.2699	0.0388	0.0252	0.0622
F probability	*	NS	*	*	NS	*
LSD $_{0.05}$	0.1777	0.1881	0.2721	0.0433	0.0419	0.0648

Note: *** , ** and * denotes significant at 0.001, 0.01 and 0.05; NS=no significant difference, SEM=standard error of the mean, d.f.=degrees of freedom and LSD=least significant difference

DISCUSSION

The combination of teosinte with cowpea sown in April 18th yielded the highest cumulative green and dry herbage mass (Table 4). This might be due to favorable environmental effects that might have helped to increase the growth parameters and yield components. This has been well reflected through tiller density of teosinte as well as number of branches and leaves of the legume component (Table 2, 3, and 4). The high dry matter yield was also due to high green forage yield in fodder combinations. Cowpea yielded highest fodder/ herbage mass than others legumes in our study. Mahapatra and Pradhan (1992) reported that out of various legumes, cowpea had produced the highest fodder yield of good quality. Hendrikson (1965) also reported the highest yield of cowpea from two cuttings when first cutting was at or after flowering. It was better to leave 4-6 buds per plant for satisfactory regrowth of cowpea. Bhatti (1996) concluded that maize in a mixture with cowpea could be an appropriate combination for producing more herbage mass compared to the other possible combination. Sharma et al. (2009) suggested that cowpea might be intercropped with sorghum in obtaining higher forage yields

We found that sowing date affected significantly to the both green as well as dry herbage mass yield. This clearly shows about the importance of sowing times if higher herbage mass harvest is expected. This sort of findings is also reported by other researchers (Bunting, 1968; Van Roekel & Coulter, 2012). Shrestha et al. (2016) reported that in spring season, first week of April could be optimum planting time for higher growth rate, higher yield and its attributing characters of maize as it could be better facilitated by relatively favorable temperature. Adoption of the sowing date of 15th to 23rd April could be one of the effective strategies for obtaining higher herbage biomass yield of teosinte in western mid hills of Nepal that can contribute substantially in mitigating the energy deficit situation to the ruminants (Devkota et al., 2017). Abd El Lattief (2011) reported that date of sowing had significant effect for growth parameters and fodder yield of pearl millet (*Pennisetum glaucum*) with June planting, having lower yields than earlier plantings in Egypt.

In deed sowing date could effect on growth parameters of fodders crop. Our study findings revealed that the growth parameter affected on yield. Hussain et al. (1993) reported that the fresh forage yield of oat differ due to difference in leaves per tiller and plant height. Devkota et al. (2017) reported that varied sowing dates had significant influence on the growth parameters of teosinte fodder, such as plant height, numbers of leaves plant^{-1}, number of tillers hill^{-1} and dried fodder yield.

Teosinte with lablab bean marked the lowest green and dry herbage mass production as compared to others teosinte-legume mixed cropping, in our study that might be due to contribution of least additional fodder by lablab bean. Teosinte sole fodder crop, yielded significantly least cumulative green and dry herbage mass that might be due to no additional fodder production from legume. This sort of finding are also well reported by several researchers (Iqbal et al., 2017; Ram & Singh, 2001).

CONCLUSION

This study was conducted to understand the effect of sowing dates and mixed cropping on herbage mass yield and yield components of selected fodder species. Findings revealed that the different fodder species as well as planting date affected to the cumulative green herbage mass and dry herbage mass. The highest cumulative green and dry herbage mass was obtained from teosinte and cowpea mixture, sown in 18th April whereas the lowest herbage mass was obtained from sole fodder crop of teosinte sown in 18th May. Preliminary findings of this research thus indicate the possibility of promoting mixed cultivation of teosinte with fodder cowpea in order to increase both herbage mass and quality.

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