Response of Some Narbon Vetch (*Vicia narbonensis)* Lines to Different Harvesting Stages for Forage Yield and its Components at Two Locations of Sulaimani Governorate

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Abstract

This investigation was carried out at two locations of sulaimani region were Qlyasan and Kanipanka during the winter season of 2017-2018 to study the response of some narbon vetch lines to different harvesting stages for forage yield and its components under rainfed condition, experimental design was split plot with RCBD arrangement in three replications, six lines of narbon vetch were allotted in main plots, and subplots consists of different harvesting stages were (beginning of flowering, 50% flowering and full flowering). Mean comparisons was carried out according to least significant differences (LSD) test at 0.05 significant levels. The results indicated that the effect of varieties on forage yield and its components was significant for dry forage yield, dry matter%, fresh leaf%, fresh stem% and dry leaf%, Maximum values were exhibited by line 2 and line 5 respectively in Qlyasan location. But, in Kanipanka location, line 5 and line 1 gave maximum values respectively, while in the average of both locations, the highest value of dry matter% obtained by line 1. Line 5 recorded the biggest value of fresh and dry leaf%, while line 2 gave maximum fresh stem% in Qlyasan location. But in Kanipanka location, line 3, 2 and 1 had the maximum values of these traits frequently. Considering the average of both locations, line 3, 2 and 5 had the highest percent of fresh leaf, fresh stem and dry leaf respectively. The effect of harvesting stages on all forage yield and its components was significant, harvesting at full flowering stage gave maximum values of fresh, dry forage yield and dry matter% for Qlyasan, Kanipanka and their averages. Regarding fresh leaf%, fresh leaves per stem ratio, dry leaf% and dry leaves per stem ratio, the harvesting stage at the beginning of flowering exhibited the highest values for Qlyasan, Kanipanka and their averages. But maximum value of fresh stem and dry stem% were obtained by harvesting at full flowering stage in Qlyasan, Kanipanka and the averages of both locations. Regarding the effect of locations on all forage yield and its components, Qlyasan location predominated Kanipanka location for most traits except fresh and dry forage yield traits which was found significant in kanipanka location in compare to Qlyasan location.

Keywords: Narbon Vetch; Lines; harvesting stages; forage yield; forage yield components.

استجابة بعض سلالات الكاكوزلمراحل حش مختلفة لحاصل العلف ومكوناته في منطقين بمحافظة السليمانية

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الخلاصة

أجريت هذة الدراسة فى موقعين مختليفين في محافظة السليمانية ، قلياسان و كاني بانكة ، خلال الموسم الشتوي لعام 2017-2018 و ذلك لدراسة أستجابة بعض سلالات الكاكوز في مراحل حش مختلفة لحاصل العلف و مكوناته تحت الظروف الديمية ، بأستخدام نظام القطاعات المنشقة وفق تصميم القطاعات العشوائية الكاملة (CRBD) و بثلاث مكررات ، حيث وضعت ستة سلالات من الكاكوز (ICARDA 2392, ICARDA2384, ICARDA2383, ICARDA2561, ICARDA2380، 2816ICARDA) فى القطع الرئيسية و مراحل حش مختلفة (بدون حش ، حش في بداية التزهير ، حش عند 50% التزهير و حش عند مرحلة التزهير الكامل) في القطع الثانوية. و تم أجراء المقارنة بأستخدام أختبار أقل فرق معنوي (LSD) عند مستوى معنوية (0.05). دلت النتائج الى ان حاصل العلف و مكوناته تأثرت معنويا بالخطوط ، سلالة رقم 2 و رقم 5 أعطت أعلى حاصل من العلف الجاف و نسبة المادة الجافة في موقع قلياسان ، وفي موقع كاني بانكة ، سلالة رقم 5 و رقم 1 أعطت أعلى قمة لهذين الصفتين على التوالي. أما بخصوص متوسط الموقعين ، أعلى نسبة من المادة الجافة تم الحصول عليها بواسطة سلالة رقم 1. أما بخصوص نسبة الأوراق الخضراء و الجافة ، سلالة رقم 5 أعطت أعلى نسبة ، في حين سلالة رقم 2 أعطت أعلى نسبة من الساق الأخضر في موقع قلياسان ، بينما في موقع كاني بانكة ، سلالة رقم 1، 2 و 3 أعطت أعلى قيمة لهذه الصفات. و بخصوص متوسط الموقعين ، سلالة رقم 3، 2 و 5 سجلت أكبر نسبة من الأوراق الخضراء ، ساق الأخضر و الأوراق الجافة على التوالي. حاصل العلف و مكوناته تأثرت معنوياً بمراحل الحش المختلفة ، أذ أعطت الحش عند مرحلة التزهير الكامل أكبر قيمة من الحاصل العلف الأخضر ، حاصل العلف الجاف و نسبة المادة الجافة في موقع قلياسان ، كاني بانكة و متوسط الموقعين على التوالي. أما بالنسبة لصفات : نسبة الأوراق الخضراء ، نسبة الأوراق/السيقان الخضر ، نسبة الأوراق الجافة و نسبة الأوراق الى السيقان الجافة ، كانت عند حشها في مرحلة بداية التزهير قد أعطت أعلى قيمة في كلا الموقعين و متوسط الموقعين. بينما أعلى قيمة من نسبة الساق الأخضر و الجاف تم الحصول عليها بحش المحصول في مرحلة التزهير الكامل في كلا الموقعين و متوسطيهما. أما بالنسبة لتأثير الموقع على حاصل العلف و مكوناته ، تفوقت موقع قلياسان على موقع كاني بانكة في معظم الصفات ماعدا صفة حاصل العلف الأخضر والجاف.

الكلمات المفتاحية: الكاكوز، سلالات ، المراحل الحش، حاصل العلف، مكونات حاصل العلف

Introduction

Narbon vetch (***Vicia narbonensis*** L.) is a common forage legume in the rain fed, the semi-arid system of the Mediterranean region (1). Vetch can be used for grazing of livestock, green manure, forage or silage or the grain feed to livestock (2). Narbon vetch is considered by (1) to be one of the most attractive legume species for grain and straw production as feed resources in dry areas. Narbon vetch is a cool season, drought-tolerant, annual legume, with greater potential for grain production as a livestock feed in non-tropical dry areas than common vetch, bitter vetch or woolly-pod vetch (3). In addition (4) found that the Narbon vetch has been proposed in recent decades as a rotation crop in a sustainable agriculture system. Crop rotation has numerous advantages as compared to cereal monoculture, such as improved maintenance of organic matter and status of nitrogen in the soil, also better control of disease and pest, which results in higher production yields. The factors influencing the forage production are many and vary considerably from one area to another. These factors may include plant type, climate, season, soil type and fertility, soil moisture and harvesting time (5).

Purposes of the harvesting time (forage harvest management) optimize yield and quality of forage at the desired levels. In Some point the management of harvest time to supply ecosystem profits and the economic revert can be complementary, but in many cases the desired outcomes are competitive, also should be leaving stubble (5 to 10 cm) to support regrowth (6).

Clipping in the best stage is generally associated with the flowering time. While the aim to develop the forage quality without declining the yields can be obtained by increasing the cut frequency and therefore the number of the cuts per year. The early cut reduces and increases the leaf/stem ratio guaranteeing a higher protein content. However, the excessively early cut regimes are not amenable, because the higher protein content and the better forage digestibility do not compensate for the lower dry matter production and moreover the meadow persistence may be seriously compromised (7).

The objective of this study is to determine the effects of harvest times on forage yield of some Narbon Vetch varieties at two locations of Sulaimani region and to select the varieties that are more adaptable to the region and which harvesting stage are suitable for obtaining the best forage yield .

Materials and Methods

The experiment was conducted on the basis of split plot layout with randomized complete block design (RCBD) with 3 replications. Main plots were six lines of Narbon Vetch (ICARDA 2392, ICARDA2384, ICARDA2383, ICARDA2561, ICARDA2380, ICARDA2816), and three harvesting stages (harvesting at the beginning of flowering, harvesting at %50 of flowering and harvesting at full flowering) were allotted in sub plots. This study was conducted during the winter season of 2017- 2018 at two different locations, the first was at Qlyasan Agricultural Research Station, College of Agricultural Sciences Engineering-University of Sulaimani located (Lat 35˚ 34′ 307″; N, Long 45˚ 21′ 992″; E, 765 masl) 2 Km North West of Sulaimani City, the second was at Kanipanka Nursery Station (Lat 35˚ 22′; N, Long 45˚ 43′; E, 550 masl) in Shahrazoor valley 35 Km East of Sulaimani City (8). To study the response of some Narbon vetch lines to different harvesting stages for forages yield and its components. The area of the experiment was (8m x 35.5m = 284m^2, each replication consists of six main plots, and each main plot containing three subplots, also each sub plots having 3 rows, 2m long and 0.30m apart between rows. Sowing was conducted during 5th, 6th December of 2017 at Qlyasan and Kanipanka locations respectively according to the recommended seed rates 120Kg/ha for six used lines, Phosphorus at the rate of 120 kg P_2O_5 /ha was applied as triple superphosphate as a basal dose. All other input and agronomic practices will carry out uniformly. Other normal agronomic practices for Narbon Vetch production are following. Metrological data and Soil analysis for both locations were shown in table 1 and 2 respectively.

Table.1: The meteorological data of both locations.

Months	Qlyasan Location				Kanipanka Location			
	Mini. Temp. (C°)	Max. Temp. (C°)	Avg. Temp(C°)	Rainfall (mm)	Mini. Temp. (C°)	Max. Temp. (C°)	Avg. Temp(C°)	Rainfall (mm)
October	10.4	33.1	21.2	10.0	22.6	30	15.1	-
November	7.6	23.9	14.2	114.6	14.4	20	8.8	71
December	-2.5	17.8	7.0	22.2	10.2	16.1	4.4	18.5
January	1.4	15.6	7.8	72.4	7.8	12.5	3.1	60
February	-2.3	20.9	8.7	323.0	10.3	14.9	6.1	281
March	1	24.4	13.0	44.6	14.7	21.3	8.1	19

April	2.2	31.6	17.4	98.6	17.1	24	10.5	90.5
May	13	38.1	24.7	70.4	22.2	29.5	15.0	68
Total rainfall				755.8				608

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Table2: Some physical and chemical properties of soil analysis at experimental sites.

Soil Properties		**Soil Samples Qlyasan**	**Soil Samples Kanipanka**
Sand		90.40	214.00
Silt		508.40	540.00
Clay		401.20	246.00
Texture class		Salty Clay	Salty Loam
EC_e g kg^{-1}		0.38	0.16
PH ds m^{-1}		7.80	8.05
O.M $Cmol_c$ kg^{-1}		16.06	22.03
Available P (ppm)		9.61	7.44
$CaCO_3$ equivalent g kg^{-1}	**Active**	117.00	100.00
	Total	230.00	195.00
Soluble ions mmol L^{-1}	**Ca^{2+}**	2.20	1.20
	Mg^{2+}	1.80	1.05
	Na^{+}	0.10	0.19
	K^{+}	0.13	0.05
	HCO_3^-	2.34	3.20
	CI^-	0.80	0.90
	SO_4^{2-}	0.88	0.91
Available micronutrients mg kg^{-1}	**Zn**	0.450	1.563
	Cu	4.96	5.07
	Fe	3.23	5.15

*These analysis were carried out at Natural Resource Department, College of Agricultural Engineering Sciences, University of Sulaimani.

Forage harvesting was done on and conducted at the height (6-8cm) from the soil surface at the beginning of flowering stage 50% flowering and full flowering stage to determine:

Forage yield traits:

Fresh forage yield, dry forage yield (ton/ha) and dry matter%. At harvest, fresh (green) forage weight was determined. The subsamples (100gm) were taken to put it in the oven at 65 C˚ for 72 hours to determine dry matter percent. Forage dry matter yield was recorded and converted in to dry matter production by using the following formula (9).

Dry yield (Kg/ha) = Dry yield in cut plot/ P6lot area * 10000

Forage yield components traits:

Plant height (cm), number of leaves/plant, fresh weight of leaves/plant, dry weight of leaves/plant, fresh weight of stems/ plant, dry weight of stems/ plant and leaves/stem ratio. For recording plant height, 5 plants were randomly selected in each plot, and the height was measured from the ground level to the apex of the main stem, The number of leaves/plant was determined on the same five plants and weighted to record fresh weight of leaves and then dried in oven at 65 C˚ for 72 hours to determine dry weight of leaves; also the same things for stems. Leaves/stem ratio was recorded by:

The weight of leaves/weight of stems.

All data were presented as the mean values of three replicates. The data was statistically analyzed according to the methods of analysis of variance as a general test and combined analysis conducted. The significance differences among means were compared by using Least Significant Difference (LSD) test at significant level of 0.05 (10).

RESULTS AND DISCUSSIONS

Data represented in table 3 and appendix1 confirmed that the effect of lines on forage yield and dry matter percent was significant for both locations and their average with the exception of the character fresh forage yield at both locations and their average and dry forage yield in the average of both locations was not significant. In Qlyasan location, maximum dry forage yield (2.380 ton/ha) and dry matter percent (15.035%) exhibited by line 2 and line 5 respectively, while minimum values for both traits (1.492ton/ha and 13.476%) recorded by L5 and L2 respectively. But in Kanipanka location, line 5 and line1 gave maximum values of dry forage yield and dry matter percent were (4.060 ton/ha and 12.290%) respectively, whereas minimum values (3.258ton/ha and 11.307%) of these two traits recorded by line 1 and 2 respectively. Regarding the average of both locations, the highest value of dry matter percent exhibited by line 1 (13.392%), while the lowest value of this trait was (12.391%) showed by line 2. The differences among narbon vetch lines may be due to the differences in relative performance, in which it is different for each line survival to climatic conditions prevailing the locations. This result agrees with the previous results showed by (11). Previous studies using narbon vetch genotypes under various ecological conditions reported that the fresh forage yield ranged between 24.88 ton ha^{-1} and 38.06 ton ha^{-1}, while dry matter yield varied between 5.44 ton ha^{-1} and 7.37 ton ha^{-1} (12), (13), (14) and (15). Also (16) found that there were statistically significant differences at the level of 0.05 among genotypes for herbage yield.

Table3: Effect of Lines on forage yield traits of Narbon vetch at both locations and their averages.

Qlyasan Location			
Lines	**Fresh Forage Yield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
L_1	14.222	2.051	14.494
L_2	17.719	2.380	13.476
L_3	11.931	1.708	14.316
L_4	16.250	2.322	14.397
L_5	9.955	1.492	15.035
L_6	14.990	2.084	14.076
LSD (0.05)	N.S	0.549	0.729
Kanipanka Location			
Lines	**Fresh Forage Yield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
L_1	23.633	3.258	12.290
L_2	33.328	3.869	11.307
L_3	31.772	3.869	11.964
L_4	30.976	3.528	11.491
L_5	34.366	4.060	11.738
L_6	32.814	3.730	11.393
LSD (0.05)	N.S	0.462	0.627
Averages of both Location			
Lines	**Fresh Forage Yield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
L_1	20.428	2.655	13.392

L_2	25.524	3.125	12.391
L_3	21.852	2.788	13.132
L_4	23.613	2.925	12.944
L_5	22.160	2.776	13.386
L_6	23.902	2.907	12.735
LSD (0.05)	N.S	N.S	0.450

Table 4 and appendix1 showed that the effect of harvesting stages on all forage yield characters was significant at both locations and their averages. The harvesting stage at full flowering gave maximum values for all traits at both locations and their averages were (17.752ton/ha, 2.527ton/ha and 14.471%) at Qlyasan location, and for Kanipanka location were (45.670ton/ha, 5.687ton/ha and 12.431%), but in the average of both locations the values were (31.711ton/ha, 4.107ton/ha and 13.451%) for fresh forage yield, dry forage yield and dry matter percent respectively, while the minimum values for fresh and dry forage yield exhibited by the harvesting stage at the beginning of flowering for both locations and their averages with (10.135 and 1.452) ton/ha in Qlyasan and (21.038 and 2.509) ton/ha in Knipanka and in the average of both locations were (15.586 and 1.981) ton/ha respectively. But concerning dry matter percent, the minimum value recorded by the harvesting stage at 50% flowering was (13.966, 10.536 and 12.251) % for both locations and their averages respectively. Enhancing forage yield with advancing maturity is consistent with results of some researchers (17), (18)and (19), and also agree with the results of previous researches which confirmed that dry matter percent significantly increased at advanced harvest stages (18), (5). Also previous research results showed that the dry matter yield significantly increased at advanced harvest stages, as plants begin to concentrate dry matter in pods and seeds, an enhanced forage yield with advancing maturity (20).

Table4: Effect of harvesting stages on forage yield traits of Narbon vetch at both locations and their average**.**

Qlyasan Location			
Harvesting Stages	**Fresh Forage Yield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
Beginning of Flowering	10.135	1.452	14.460
50% Flowering	14.647	2.040	13.966
Full Flowering	17.752	2.527	14.471
LSD(0.05)	1.929	0.294	0.342
Kanipanka Location			
Harvesting Stages	**Fresh Forage Yield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
Beginning of	21.038	2.509	12.116

Flowering			
50% Flowering	28.237	2.961	10.536
Full Flowering	45.670	5.687	12.431
LSD(0.05)	3.290	0.508	0.293
Averages of both Location			
Harvesting Stages	**Fresh Forage Yield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
Beginning of Flowering	15.586	1.981	13.288
50% Flowering	21.442	2.500	12.251
Full Flowering	31.711	4.107	13.451
LSD(0.05)	1.857	0.286	0.219

Results of table 5 and appendix 2 showed that the effect of lines on forage yield components was significant except fresh leaves per stem ratio, dry stem percent and dry leaves per stem ratio for both locations and their average. In Qlyasan location the biggest fresh leaf percent (62.658%) and dry leaf percent (10.251%) regularly expressed byline 5, while line 2 gave maximum fresh stem percent (42.884%). although the smallest value for all characters (57.126%, 37.375% and 8.795%) showed by L2, L5 and L5 commonly. On the other hand in Kanipanka location, line 3, 2 and 1 had the maximum values of fresh leaf percent, fresh stem percent and dry leaf percent were (59.771%, 43.518% and 8.107%) frequently. At the same time, the minimum values of fresh leaf percent, fresh stem percent and recorded by L2 and L3 (56.531%, 40.243%) respectively, line 2 had the minimum point for dry leaf percent was 7.277%. Considering the average of both locations, the line 3, 2 and 5 had the highest level of fresh leaf percent, fresh stem percent and dry leaf percent were (59.917%, 43.201% and 8.862%) respectively. This variability among Lines in forage yield components may be positively and strongly related to the differences in genetic map and this adaptation the climate, this result were in agreement with the results reported by (21), (11). Previously the results showed that the effects of cultivars were significant in terms of leaf and stem proportion (19). This finding is agreement with our results.

Table5: Effect of Lines on Forage Yield Components of Narbon Vetch at both Locations and their average.

Qlyasan Location						
Lines	**Fresh Leaf %**	**Fresh Stem %**	**Fresh leaves/stem ratio**	**Dry Leaf %**	**Dry stem %**	**Dry leaves/stem ratio**
L_1	59.738	40.287	1.510	9.602	4.892	2.028
L_2	57.126	42.884	1.362	8.795	4.681	1.971
L_3	60.064	39.814	1.533	9.408	4.907	1.986

L_4	60.426	39.636	1.549	9.675	4.722	2.086
L_5	62.658	37.375	1.717	10.251	4.784	2.274
L_6	60.146	39.727	1.548	9.504	4.572	2.111
LSD (0.05)	2.641	2.487	N.S	0.483	N.S	N.S
Kanipanka Location						
Lines	**Fresh Leaf %**	**Fresh Stem %**	**Fresh leaves/stem ratio**	**Dry Leaf %**	**Dry stem %**	**Dry leaves/stem ratio**
L_1	59.694	40.320	1.525	8.107	4.183	1.995
L_2	56.531	43.518	1.318	7.277	4.030	1.852
L_3	59.771	40.243	1.506	7.966	3.981	2.056
L_4	56.907	42.882	1.387	7.468	4.022	1.921
L_5	56.633	43.485	1.319	7.474	4.263	1.772
L_6	56.691	43.040	1.365	7.351	4.042	1.860
LSD (0.05)	2.584	2.126	N.S	0.493	N.S	N.S
Averages of both Location						
Lines	**Fresh Leaf %**	**Fresh Stem %**	**Fresh leaves/stem ratio**	**Dry Leaf %**	**Dry stem %**	**Dry leaves/stem ratio**
L_1	59.716	40.303	1.517	8.854	4.537	2.011
L_2	56.828	43.201	1.340	8.036	4.355	1.912
L_3	59.917	40.028	1.519	8.687	4.444	2.021
L_4	58.667	41.259	1.468	8.572	4.372	2.004
L_5	59.646	40.430	1.518	8.862	4.524	2.023
L_6	58.553	41.383	1.457	8.427	4.307	1.986
LSD (0.05)	1.730	1.531	N.S	0.323	N.S	N.S

Table 6 and appendix 2 illustrated that the effect of harvesting stages on all forage yield traits was significant at both locations and their averages. Fresh leaf percent had the biggest value at the beginning of flowering (63.716%, 61.198% and 62.457%) at Qlyasan, Kanipanka and their averages respectively. Also, fresh leaves per stem ratio recorded the maximum value at the beginning of flowering at Qlyasan, Kanipanka and the averages of both locations were (1.795, 4.833 and 3.314) frequently. Dry leaf percent and dry leaves per stem ratio gave the maximum value at the beginning of flowering (10.401%, 2.635), (8.482%, 2.366) and (9.441%, 2.501) at Qlyasan, Kanipanka and their averages respectively for both traits. On the other hand, fresh stem percent gave the maximum value at the full flowering stage was (41.951%) at Qlyasan location. But in Kanipanka and the averages of both locations, the huge value of fresh stem percent was obtained by 50% flowering stage (45.333% and 43.508%) respectively. Dry stem percent exhibited the biggest value at the full flowering stage were (5.334%, 4.694% and 5.014%) respectively at Qlyasan, Kanipanka and the averages of both locations respectively. When the plants at primary growth stage, the leaves ratio was more than the stem ratio in compare to the stages when plants become or near to mature which the ratio of stem increased and leaves ratio decreased. This result agrees with the result of (22). (19) Reported that the proportion of leaves was continuously decreased depending on advancement in maturity. Also, previously found that the best moment for the cut is generally associated with the flowering time and the early cut increases the leaf/stem ratio (23).

Table 6: Effect of harvesting stages on forage yield components of Narbon vetch at both locations and their averages.

Qlyasan Location						
Harvesting Stages	**Fresh Leaf %**	**Fresh Stem %**	**Fresh leaves/stem ratio**	**Dry Leaf %**	**Dry stem %**	**Dry leaves/stem ratio**
Beginning of Flowering	63.716	36.228	1.795	10.401	4.059	2.635
50% Flowering	58.315	41.683	1.410	9.080	4.886	1.868
Full Flowering	58.048	41.951	1.403	9.137	5.334	1.725
LSD(0.05)	1.241	1.020	0.162	0.258	0.330	0.277
Kanipanka Location						
Harvesting Stages	**Fresh Leaf %**	**Fresh Stem %**	**Fresh leaves/stem ratio**	**Dry Leaf %**	**Dry stem %**	**Dry leaves/stem ratio**
Beginning of Flowering	61.198	38.791	4.833	8.482	3.634	2.366
50% Flowering	54.670	45.333	4.388	6.603	3.932	1.699
Full Flowering	57.380	42.619	4.777	7.737	4.694	1.664
LSD(0.05)	2.074	1.922	0.166	0.400	0.284	0.226
Averages of both Location						
Harvesting Stages	**Fresh Leaf %**	**Fresh Stem %**	**Fresh leaves/stem ratio**	**Dry Leaf %**	**Dry stem %**	**Dry leaves/stem ratio**
Beginning of Flowering	62.457	37.510	3.314	9.441	3.846	2.501
50% Flowering	56.493	43.508	2.899	7.841	4.409	1.783
Full Flowering	57.714	42.285	3.090	8.437	5.014	1.695
LSD(0.05)	1.177	1.060	0.113	0.232	0.212	0.174

Table 7a confirmed that the interaction between lines and harvesting stages on forage yield of Narbon vetch were significant for dry matter percent only at Qlyasan location. The interaction between L2 with harvesting stage (50% flowering) gave the maximum percent of dry matter

(15.343%) while the interaction between L1 with harvesting stages (50% flowering and full flowering) recorded minimum values of dry matter percent were (13.313%).

Table 7a: Effect of Interaction between Lines and Harvesting Stages on Forage Yields of Narbon Vetch at Qlyasan Location.

Qlyasan Location				
Harvesting Stages \ Lines		**Fresh ForageYield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
L_1	**Beginning of Flowering**	18.456	2.560	13.846
	50% Flowering	18.872	2.497	13.313
	Full Flowering	11.913	1.588	13.313
L_2	**Beginning of Flowering**	15.745	2.233	14.163
	50% Flowering	9.741	1.508	15.343
	Full Flowering	19.967	2.694	13.536
L_3	**Beginning of Flowering**	12.921	1.919	14.850
	50% Flowering	24.361	3.294	13.326
	Full Flowering	9.787	1.479	14.966
L_4	**Beginning of Flowering**	17.444	2.468	14.413
	50% Flowering	6.904	1.044	15.056
	Full Flowering	11.126	1.650	14.890
L_5	**Beginning of Flowering**	11.289	1.673	14.786
	50% Flowering	9.924	1.349	13.790
	Full Flowering	14.093	2.056	14.670
L_6	**Beginning of Flowering**	15.562	2.266	14.616
	50% Flowering	13.219	1.925	14.706
	Full Flowering	13.878	1.909	13.803
LSD (0.05)		N.S	N.S	0.838

Table 7b showed that the interaction between lines and harvesting stages on forage yields of Narbon vetch were significant except fresh forage yield was not significant at kanipanka locations. The interaction between L3 with harvesting at the full flowering stage exhibited the biggest value of dry forage yield (4.856 ton/ha). In which the interaction between L6 with the harvesting stage (beginning of flowering) recorded the minimum value of dry forage yield was

(2.878 ton/ha). Regarding the dry matter percent, the interaction between L5 with the harvesting stage at the beginning of flowering gave the maximum value was 12.845%. But the minimum value of dry mater percent (10.143%) was obtained by the interaction between L2 with the harvesting at beginning of flowering.

Table 7b: Effect of Interaction between Lines and Harvesting Stages on Forage Yields of Narbon Vetch at Kanipanka location.

Kanipanka Location				
Harvesting Stages \ Lines		**Fresh ForageYield (ton/ha)**	**Dry Forage Yield (ton/ha)**	**Dry Matter %**
L_1	**Beginning of Flowering**	31.153	3.704	11.803
	50% Flowering	28.066	3.103	10.953
	Full Flowering	31.441	3.798	11.786
L_2	**Beginning of Flowering**	32.892	3.318	10.143
	50% Flowering	41.201	4.574	10.936
	Full Flowering	35.020	3.749	10.633
L_3	**Beginning of Flowering**	25.511	3.105	12.223
	50% Flowering	46.144	5.537	11.560
	Full Flowering	37.403	4.856	12.676
L_4	**Beginning of Flowering**	36.302	4.389	11.973
	50% Flowering	35.887	4.359	12.006
	Full Flowering	36.142	3.996	11.066
L_5	**Beginning of Flowering**	23.236	2.966	12.845
	50% Flowering	25.773	2.967	11.407
	Full Flowering	26.472	2.953	11.380
L_6	**Beginning of Flowering**	23.734	2.878	12.356
	50% Flowering	26.010	3.245	12.271
	Full Flowering	27.281	3.445	12.480
LSD (0.05)		N.S	0.793	0.718

Table 7c illustrated that the effect of interaction between lines and harvesting stages on forage yield Narbon vetch were significant for dry matter percent only at the averages of both locations. The interaction between L2 with harvesting stage (beginning of flowering) gave the highest value of dry matter percent (14.130%), while the lowest value of dry matter percent (11.720%) was obtained by interaction between L6 with harvesting stage at full flowering. the dry matter percent depends on the stage of maturation at the time of harvest and it increases as plant mature these results were in agreement with the results of (17), (20). (24) Found that dry matter yield of forage sorghum varieties decreased with delayed harvesting time from early head to soft dough stage.

Table 7c: Effect of Interaction between Lines and Harvesting Stages on Forage Yields of Narbon Vetch at the average of both Locations.

Average of both Location				
Harvesting Stages \ Lines		Fresh Forage Yield (ton/ha)	Dry Forage Yield (ton/ha)	Dry Matter %
L_1	Beginning of Flowering	13.917	1.887	13.822
	50% Flowering	20.429	2.448	12.571
	Full Flowering	26.937	3.630	13.783
L_2	Beginning of Flowering	18.042	2.182	12.537
	50% Flowering	35.431	4.601	12.930
	Full Flowering	13.740	1.784	13.375
L_3	Beginning of Flowering	19.299	2.323	12.355
	50% Flowering	32.516	4.258	13.666
	Full Flowering	32.516	4.258	13.666
L_4	Beginning of Flowering	32.516	4.258	13.666
	50% Flowering	15.985	2.101	13.598
	Full Flowering	22.085	2.598	12.445
L_5	Beginning of Flowering	32.770	4.076	12.790
	50% Flowering	16.026	1.954	13.322
	Full Flowering	18.609	2.238	12.708
L_6	Beginning of Flowering	31.845	4.135	14.130
	50% Flowering	15.808	1.977	13.075
	Full Flowering	25.132	2.803	11.720
LSD (0.05)		N.S	N.S	0.537

Data represented in table 8a,8b and 8c showed that the effect of interaction between lines and harvesting stages on all forage yield components traits of Narbon vetch at Qlyasan ,Kanipanka and the averages of both locations were not significant with the exception of the character dry leaf percent which was found to be significant at Qlyasan and Kanipanka location. Concerning Qlyasan location the highest value of dry leaf percent (10.596%) exhibited when L4 interacted with the harvesting at 50% flowering gave the lowest value of dry leaf percent was 8.070%. But regarding Kanipanka location maximum percent of dry leaf (8.823%) was obtained by interaction between L6 with harvesting at the beginning of flowering, in which the interaction between L2 with the harvesting at the beginning of flowering stage recorded minimum value of dry leaf percent (5.960%). Previous study confirmed that the effect of cultivars x harvesting time interaction was significant in terms of leaf proportion (19).

Table 8a: Effect of Interaction between Lines and Harvesting Stages on Forage Yield Components of Narbon Vetch at Qlyasan Location**.**

Qlyasan Location							
Lines / Harvesting Stages		Fresh Leaf %	Fresh Stem %	Fresh leaves/stem ratio	Dry Leaf %	Dry stem %	Dry leaves/stem ratio
L_1	Beginning of Flowering	57.090	42.943	1.345	8.873	4.973	1.816
	50% Flowering	57.616	42.390	1.373	8.836	4.476	2.001
	Full Flowering	59.623	40.366	1.524	8.906	4.406	2.139
L_2	Beginning of Flowering	56.910	43.106	1.322	9.093	5.070	1.812
	50% Flowering	61.516	38.556	1.598	10.300	5.043	2.072
	Full Flowering	57.246	42.773	1.366	8.866	4.670	1.937
L_3	Beginning of Flowering	59.330	40.723	1.463	9.730	5.120	1.936
	50% Flowering	53.283	46.740	1.140	8.070	5.256	1.548
	Full Flowering	61.830	38.213	1.622	9.813	5.153	1.941
L_4	Beginning of Flowering	61.123	38.900	1.607	9.740	4.673	2.129
	50% Flowering	65.263	34.736	1.969	10.596	4.460	2.689
	Full Flowering	64.210	35.793	1.819	10.450	4.440	2.387
L_5	Beginning of Flowering	62.796	37.196	1.721	10.203	4.583	2.330
	50% Flowering	60.480	39.523	1.572	9.480	4.310	2.365
	Full Flowering	58.740	40.863	1.453	9.506	5.163	1.878
L_6	Beginning of Flowering	63.246	36.903	1.718	10.193	4.423	2.318
	50% Flowering	61.196	38.833	1.584	9.856	4.850	2.059
	Full Flowering	58.983	40.616	1.459	9.196	4.606	2.010
LSD (0.05)		N.S	N.S	N.S	0.633	N.S	N.S

Table 8b: Effect of Interaction between Lines and Harvesting Stages on Forage Yield Components of Narbon Vetch at Kanipanka Location.

Kanipanka Location							
Harvesting Stages \ Lines		Fresh Leaf %	Fresh Stem %	Fresh leaves/stem ratio	Dry Leaf %	Dry stem %	Dry leaves/stem ratio
L_1	Beginning of Flowering	58.090	41.910	1.398	7.533	4.270	1.780
	50% Flowering	57.023	42.976	1.339	7.066	3.886	1.907
	Full Flowering	60.920	39.083	1.600	7.850	3.936	2.131
L_2	Beginning of Flowering	50.006	49.343	1.027	5.960	4.183	1.458
	50% Flowering	53.513	46.820	1.146	6.723	4.213	1.595
	Full Flowering	53.773	46.226	1.163	6.573	4.060	1.633
L_3	Beginning of Flowering	61.730	38.276	1.163	8.236	3.986	2.070
	50% Flowering	53.960	46.040	1.184	7.116	4.443	1.603
	Full Flowering	60.013	39.993	1.504	8.510	4.166	2.052
L_4	Beginning of Flowering	56.836	43.166	1.329	7.623	4.350	1.765
	50% Flowering	57.280	42.723	1.343	7.613	4.393	1.767
	Full Flowering	57.406	42.593	1.390	7.246	3.820	1.972
L_5	Beginning of Flowering	59.263	40.773	1.554	8.552	4.293	2.135
	50% Flowering	58.610	41.540	1.432	7.647	3.760	2.047
	Full Flowering	58.380	41.653	1.414	7.540	3.840	1.986
L_6	Beginning of Flowering	63.880	36.136	1.806	8.823	3.533	2.541
	50% Flowering	59.106	40.913	1.468	8.086	4.184	1.953
	Full Flowering	59.703	40.300	1.542	8.233	4.246	1.976
LSD(0.05)		N.S	N.S	N.S	0.981	N.S	N.S

Table 8c: Effect of Interaction between Lines and Harvesting Stages on Forage Yield Components of Narbon Vetch at the average of both Locations.

Average of both Locations							
Varieties / Harvesting Stages		Fresh Leaf %	Fresh Stem %	Fresh leaves/stem ratio	Dry Leaf %	Dry stem %	Dry leaves/stem ratio
L_1	Beginning of Flowering	64.561	35.498	1.840	9.984	3.838	2.640
	50% Flowering	56.066	43.935	1.284	7.906	4.665	1.685
	Full Flowering	58.521	41.478	1.428	8.673	5.110	1.709
L_2	Beginning of Flowering	59.976	40.115	1.525	8.722	3.815	2.347
	50% Flowering	56.025	43.975	1.286	8.010	4.920	1.652
	Full Flowering	63.601	36.236	1.766	9.605	3.770	2.577
L_3	Beginning of Flowering	58.983	41.018	1.448	8.015	4.340	1.861
	50% Flowering	57.168	42.831	1.344	8.443	5.223	1.625
	Full Flowering	57.168	42.831	1.344	8.443	5.223	1.625
L_4	Beginning of Flowering	57.168	42.831	1.344	8.443	5.223	1.625
	50% Flowering	61.990	37.781	1.691	9.648	3.950	2.484
	Full Flowering	56.595	43.413	1.342	8.068	4.376	1.837
L_5	Beginning of Flowering	57.416	42.583	1.372	8.000	4.790	1.691
	50% Flowering	62.178	38.051	1.718	9.451	3.870	2.529
	Full Flowering	57.440	42.560	1.366	8.178	4.530	1.805
L_6	Beginning of Flowering	59.320	40.680	1.470	8.958	5.171	1.735
	50% Flowering	62.436	37.376	1.704	9.238	3.836	2.426
	Full Flowering	55.388	44.611	1.256	7.506	4.213	1.775
LSD(0.05)		N.S	N.S	N.S	N.S	N.S	N.S

Data represented in table 9 confirmed that the effect of locations were significant on all forage yield traits of Narbon vetch. Regarding fresh forage yield and dry forage yield, Kanipanka location predominated Qlyasan location and gave maximum values for both traits (31.648 and 3.719) ton/ha respectively, while minimum values of fresh and dry forage yield were obtained in Qlyasan location with (14.178 and 2.006) ton/ha commonly. But concerning dry matter percent Qlyasan location gave maximum percent (14.299%) in compeer to Kanipanka location which was (11.694%). The superiority of forage yield value may refer to the suitability of Kanipanka location to growth this crop because the soil condition of Kanipanka was better than Qlyasan location in organic matter content. Previous studies using narbon vetch genotypes under various ecological conditions reported that the fresh forage yield ranged between 24.88 t ha^{-1} and 38.06 ton ha^{-1}, while dry matter yield varied between 5.44 ton ha^{-1} and 7.37ton ha^{-1} (12), (13), (14) and (15).

Table 9 : Effect of locations on forage yield traits of Narbon vetch.

Locations	Fresh Forage Yield (ton/ha)	Dry Forage Yield (ton/ha)	Dry Matter %
Qlyasan	14.178	2.006	14.299
Kanipanka	31.648	3.719	11.694
LSD(0.05)	9.257	1.071	1.071

Table 10 showed that the effect of locations on forage yield components of Narbon vetch was significant for all characters. Qlyasan location exceeded Kanipanka location and gave the highest values of (fresh leaf percent, fresh stem percent, fresh leaves per stem ratio, dry leaf percent, dry stem percent and dry leaves per stem ratio) were (60.027%, 39.954%, 1.537, 9.540%, 4.760% and 2.077) respectively, in which the lowest values of these traits exhibited by Kanipanka location were (57.750%, 28.042%, 1.404, 7. 608%, 4.087% and 1.910) frequently these result confirm that the Qlyasan location is more suitable for all of the traits related to forage yield component in compare to Kanipanka location because the precipitation amount in Qlyasan was higher than Kanipanka location during the growth period. This finding agrees with previous results which revealed that the amount of precipitation can strongly affect regrowth after cut for pasture thus drought decreased growth, but rainfall increased growth (25). Previous results confirmed that the variations in yield and yield components can occur because of variations in genetic, soil, weather, and other growing conditions (11).

Table 10: Effect of locations on forage yield components of Narbon vetch.

Locations	Fresh Leaf %	Fresh Stem %	Fresh leaves/stem ratio	Dry Leaf %	Dry stem %	Dry leaves/stem ratio
Qlyasan	60.027	39.954	1.537	9.540	4.760	2.077
Kanipanka	57.750	28.042	1.404	7.608	4.087	1.910
LSD(0.05)	4.155	4.128	0.261	1.115	0.234	0.332

APPENDICES

Appendix (1) Mean squares of variance for forage yield traits of Narbon vetch at Qlyasan, Kanipanka and their averages.

Qlyasan Location				
S.O.V	**d.f**	**Fresh Forage Yield ton ha^{-1}**	**Dry Forage Yield ton ha^{-1}**	**Dry matter%**
R	2	37.376	0.107	0.364
A	5	72.691$^{n.s}$	1.082*	2.370*
Error(a)	10	54.563	0.274	0.482
B	2	264.067**	5.213**	1.497**
A*B	10	9.448$^{n.s}$	0.136$^{n.s}$	0.881**
Error(b)	24	7.863	0.185	0.248
Kanipanka Location				
S.O.V	**d.f**	**Fresh Forage Yield ton ha^{-1}**	**Dry Forage Yield ton ha^{-1}**	**Dry matter%**
R	2	562.862	0.534	0.318
A	5	66.931$^{n.s}$	0.737*	1.267*
Error(a)	10	65.044	0.194	0.357
B	2	2887.386**	53.188**	18.568**
A*B	10	37.060$^{n.s}$	0.521*	0.850**
Error(b)	24	22.874	0.222	0.182
Average of both Location				
S.O.V	**d.f**	**Fresh Forage Yield ton ha^{-1}**	**Dry Forage Yield ton ha^{-1}**	**Dry matter%**
Location	1	56703.375**	885.303*	18243.993**
R(Ea)	4	300.119	0.321	0.341
A/L	10	69.811	0.910	1.818
A	5	58.156$^{n.s}$	0.471$^{n.s}$	2.752**
A*L	5	81.465	1.348	0.885
Error(b)	20	59.804	0.234	0.420
B/L	4	1575.726	29.201	10.033
B	2	2398.454**	44.227**	15.256**
B*L	4	376.499	7.087	2.405
AB/L	20	23.254	0.328	0.865
AB	10	20.335$^{n.s}$	0.268$^{n.s}$	0.583**
AB*L	10	26.173	0.388	1.148
Error(c)	48	15.368	0.203	0.215

N.S: Not Significant *: Significant (P≤0.05) **: Highly Significant. (P≤0.01)

Appendix (2) Mean squares of variance for forage yield Components of Narbon vetch at Qlyasan, Kanipanka and their averages.

Qlyasan Location							
S.O.V	**d.f**	**Fresh leaf %**	**Fresh Stem %**	**Fresh Leaves Stem ratio^{-1}**	**Dry Leaf %**	**Dry Stem %**	**Dry Leaves Stem ratio^{-1}**
R	2	3.137	2.600	0.180	0.198	0.173	0.186
A	5	28.075*	27.934*	0.115$^{n.s}$	1.981**	0.149$^{n.s}$	0.112$^{n.s}$
Error(a)	10	6.327	5.608	0.106	0.212	0.403	0.270
B	2	184.100**	187.754**	0.906**	10.033**	7.530**	4.315**
A*B	10	2.323$^{n.s}$	2.550$^{n.s}$	0.010$^{n.s}$	0.428*	0.207$^{n.s}$	0.060$^{n.s}$
Error(b)	24	3.258	2.200	0.056	0.141	0.231	0.162
Kanipanka Location							
S.O.V	**d.f**	**Fresh leaf %**	**Fresh Stem %**	**Fresh Leaves Stem ratio^{-1}**	**Dry Leaf %**	**Dry Stem %**	**Dry Leaves Stem ratio^{-1}**
R	2	4.425	3.091	0.299	1.591	0.212	0.588
A	5	21.474**	21.442*	0.075$^{n.s}$	1.063*	0.110$^{n.s}$	0.097$^{n.s}$
Error(a)	10	6.056	4.099	0.093	0.221	0.218	0.167
B	2	193.594**	194.462**	0.720**	16.113**	5.382**	2.815**
A*B	10	10.824$^{n.s}$	11.707$^{n.s}$	0.043$^{n.s}$	0.830*	0.048$^{n.s}$	0.086$^{n.s}$
Error(b)	24	9.090	7.807	0.059	0.339	0.171	0.109
Average of both Location							
S.O.V	**d.f**	**Fresh leaf %**	**Fresh Stem %**	**Fresh Leaves Stem ratio^{-1}**	**Dry Leaf %**	**Dry Stem %**	**Dry Leaves Stem ratio^{-1}**
Location	1	374527.444**	182447.010**	233.515**	7938.735**	2113.309**	429.09**
R(Ea)	4	3.781	2.846	0.239	0.894	0.192	0.387
A/L	10	24.775	24.688	0.095	1.522	0.130	0.104
A	5	24.200*	24.308**	0.086$^{n.s}$	1.749**	0.160$^{n.s}$	0.032$^{n.s}$
A*L	5	25.349	25.067	0.104	1.296	0.099	0.177
Error(b)	20	6.192	4.853	0.100	0.217	0.311	0.218
B/L	4	188.847	191.108	0.813	13.073	6.456	3.565
B	2	357.366**	361.723**	1.565**	23.534**	12.278**	7.032**
B*L	4	10.164	10.247	0.031	1.306	0.317	0.049
AB/L	20	6.573	7.128	0.026	0.629	0.128	0.073
AB	10	6.630$^{n.s}$	6.962$^{n.s}$	0.024$^{n.s}$	0.423$^{n.s}$	0.104$^{n.s}$	0.038$^{n.s}$
AB*L	10	6.517	7.295	0.029	0.835	0.152	0.109
Error(c)	48	6.174	5.004	0.057	0.240	0.201	0.136

N.S: Not Significant *: Significant ($P \le 0.05$) **: Highly Significant. ($P \le 0.01$)

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