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RESEARCH PAPER

The Effect of Harvesting Stages and Locations on Seed Yield and its Components of Some Narbon Vetch (Vicia narbonensis) Lines under Rainfed Condition of Sulaimani Governorate- Iraq

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A B S T R A C T:

This study was carried out at two locations of sulaimani region were Qlyasan and Kanipanka during the winter season of 2017-2018 to determine the effect of harvesting stages and locations on seed yield and its components of some narbon vetch lines under rainfed condition, experimental design was split plot with CRBD arrangement in three replications, six lines of narbon vetch (ICARDA2392, ICARDA2384, ICARDA2383, ICARDA2561, ICARDA2380, ICARDA2816) butting in main plots, and subplots consists of different harvesting stages were (Control, beginning of flowering, 50% flowering and full flowering). The mean of treatments where compare using the least significant differences (LSD) test at 0.05 significant level. As the average both locations, the results revealed that the differences among the narbon vetch lines were highly significant in most yield traits such as biological yield, pod yield and seed yield but not significant on other traits straw yield and harvest index, maximum values for most seed yield traits exhibited by line 4 and 5. Harvesting stages effect on all yield traits of narbon vetch was highly significant, control treatment (without harvesting) recorded the best value due to all traits biological yield, pod yield, seed yield, straw yield and harvest index. The interaction effect between the lines and harvesting stages were highly significant on all yield traits of narbon vetch except harvest index which was not significant, the highest biological yield, pod yield and straw yield produced by the interaction between L2 with control treatment, but the highest seed yield was obtained by association between L5 and control treatment. The effect of locations on all yield in bred lines was highly significant. Kanipanka location predominated Qlyasan location and gave maximum values of biological yield, pod yield, seed yield and straw yield. But, maximum value of harvest index recorded in Qlyasan location. Regarding yield components of narbon vetch, the results of the averages of both location confirmed that the differences among narbon vetch lines were highly significant for both traits no of pod m-2 and 100 seed weight while significant for seeds number pod-1and not significant for pod length and seeds weight pod-1, line1 recorded the highest value of most traits. All yield component traits of narbon vetch responded highly significantly to different harvesting stages, maximum values of most traits exhibited by control treatment. The interaction between the lines and harvesting stages was highly significant on no. of pods m-2 and 100 seed weight while the effect was significant on seeds number pod-1 and seeds weight pod-1 but not significant for pod length. The effect of locations on yield components of narbon vetch were highly significant for all characters. Kanipanka location exceeded Qlyasan location and gave the highest values of these traits no. of pods.m-2, pods length, seeds number pod-1 and seeds weight pod-1, while Qlyasan location had the highest value of 100 seed weight, in compare to Kanipanka location.

Keywords: Narbon Vetch,Lines; Harvesting stages,Seed yield,Yield components.
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1. INTRODUCTION

Narbon vetch (*Vicia narbonensis* L.) is a leguminous species with the potential to become an important grain and straw crop for animal feed in dry temperate areas, drought tolerance, and cold resistance. It is easy to establish because of its large seeds. Seeds could be planted deeper and closer to soil moisture than other *Vicia spp* (Açıkgöz, 2001). It is cultivated in arid and semi-arid regions on the world. It can be sown in either spring or autumn in the Central Anatolia Region in Turkey where semi-arid climate conditions prevail. In eco-friendly agriculture, narbon vetch has a reputation for its low requirements for chemical fertilizers and pesticides. Besides its high crude protein content (Iptas & Karadag, 2009), the plant is also capable of adapting to the shortened spring period. Narbon vetch has greater potential of grain production as livestock feed than other vetch species and the grain contains tannin and trypsin inhibitors that are directly affecting its feed efficiency (Berger *et al*., 2003; Larbi *et al*., 2010), therefore, narbon vetch is cultivated generally for grain production (Buyukburc & Iptas, 2001)

The grain can be used as a less costly source of protein in rations for ruminants (Yu *et al*., 2001; Hadjipanayiotou, 2003), and non-ruminants even though the grain can contain secondary factors such as tannins, trypsin inhibitors and y-glutamyl-S-ethenylcystine which could influence acceptability, nutrient utilization, feed efficiency and animal performance (Larbi *et al*., 2010; Berger *et al*., 2003). The straw could either be used as a protein supplement to, or as a replacement for, low quality cereal–straw basal diets (Abd El-Moneim and Ryan, 2004). Optimal harvest timing depends on the weather, crop sequence, variety and the desired type of forage product. The general "harvest window" during which cereal forages are best harvested is determined by climate and, in some cases, crop rotation. Time for harvesting a specific crop within that general window depends on whether harvest at boot or dough is desired. It also depends on the characteristics of the variety, especially whether it is early, mid or late maturing. Once the decisions about harvest stage and variety are made, the ideal harvest time in terms of forage quality can be determined. Of course weather conditions, intentions to double-crop and harvest logistics may lead to departures from that ideal (Braunwart *et al*., 2001). Purposes of the harvesting stage (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 (Nelson *et al*., 2012)

The objective of this study is to determine the time of harvesting stages and locations on seed yield and its components of in bred line of vetch under rainfed condition of sulaimani governorate.

2. MATERIALS AND METHODS

This experiment was conducted at two different locations, the first was at Qlyasan Agricultural Research Station, College of Agricultural Engineering Sciences -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 during the growing season of 2017-2018 conducted in spilt plot design and the treatments arranged according to randomize complete block design and with three replications. Six different lines (ICARDA2392, ICARDA2384, ICARDA2383, ICARDA2561, ICARDA2380, ICARDA2816) were butting in the main plots and arranged according to CRBD, four harvesting stages (H_0: Control (without harvesting), H_1: harvesting at the beginning of flowering, H_2: harvesting at %50 of flowering and H_3: harvesting at full flowering) were butting in the subplot (Al-Rawi and Khalafalla, 1980), each subplot consist of 4 rows, 2m long with 0.25m a part between rows (Figure1). Sowing was conducted during Dec.5 and Des.6 of 2017 at Qlyasan and Kanipanka location respectively according to the recommended seed rates 120

Kg ha^{-1} for all used lines (Tuna and Orak, 2007) and the recommended dose of Phosphor fertilizer was applied as a triple super phosphate (% 46 P_2O_5) at the rate of 120 kg ha^{-1}. All required agricultural practices were used as needed. 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

*(Agro-Metrological Department- Sulaimani), Bakrajo.

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
$CaCO_3$	**Active**	117.00	100.00
equivalent g kg^{-1}	**Total**	230.00	195.00
	Ca^{2+}	2.20	1.20
	Mg^{2+}	1.80	1.05
Soluble	**Na^{+}**	0.10	0.19
ions mmol L^{-1}	**K^{+}**	0.13	0.05
	HCO_3^{-}	2.34	3.20
	Cl^{-}	0.80	0.90
	SO_4^{2-}	0.88	0.91
Available	**Zn**	0.450	1.563
micronutrients	**Cu**	4.96	5.07
mg kg^{-1}	**Fe**	3.23	5.15

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

The experiments were harvested for seed yield according to the full maturity on May 29, 2018 at Qlyasan location, while at Kanipanka location all lines were harvested on June 3, 2018 to study:

Seed Yield Traits

Biological Yield (ton ha^{-1}): The total vegetative biomass + total economical organ yield by g m^{-2} then converted to ton/hectare

Pod Yield (ton ha^{-1}): Weight of pods in one square meter was estimated g m^{-2} and then converted to ton/hectare

Seed Yield (ton ha^{-1}): One square meter was harvested for each treatment and converted to ton ha^{-1}

Straw Yield (ton ha^{-1}): Calculated after harvesting by weighing the biological yield without seed yield.

Straw (Hay) Yield (ton ha^{-1}) = Biological yield (ton ha^{-1}) - Seed yield (ton ha^{-1})

Harvest Index: Estimated by separating the seeds from straw yield and weighted to calculate the harvest index according to the following equation:

H.I= Seed yield (ton ha^{-1})/ Biological yield (ton ha^{-1}) (Unkovich *et al*., 2010).

Seed Yield Components:

No. of Pods m $^{-2}$: The means number of pods per m^2

Pod Length (cm): The means length of ten pods was measured using a ruler.

Seeds Number Pod $^{-1}$: The means number of seeds of ten pods was recorded for each plot.

Seeds Weight Pod^{-1} (g): The means seeds weight of ten pods was recorded for each plot.

100 Seed Weight (g): weight of 100 seed randomly recorded for each plot.

RESULTS AND DISCUSSIONS

Result in Table 3 shows the effect of lines on yield traits in bred lines. At Qlyasan location the differences among lines was significant for biological yield and pod yield but not significant due to for the other traits seed yield, straw yield and harvest index, while at Kanipanka location, the effect were highly significant for biological yield and seed yield but for the trite pod yield was significant and not significant for straw yield and harvest index. At the average of both locations, the differences among lines were highly significant for these traits biological yield, pod yield and seed yield and non-significant for straw yield and harvest index (Appendix 1).

In Qlyasan location, maximum biological and pod yield were 3.118 and 1.824 ton ha^{-1}exhibited by L_5 and L_2 respectively, while L_3 gave minimum values of biological and pod yield were 2.440 and 1.267 ton ha^{-1} respectively.

Regarding Kanipanka location, the highest values of biological yield and pod yield were 5.355 and 3.048 ton ha^{-1} obtained by L_4, but maximum seed yield value recorded by L_5. In which, the lowest values of biological yield, pod yield and seed yield showed by L_3 were 4.331, 2.201 and 1.639 ton ha^{-1} respectively.

Concerning the average of locations, L_4 gave maximum biological yield which was 4.218 t ha^{-1}, but maximum pod yield and seed yield values were 2.338 and 1.979 ton ha^{-1} respectively registered by L_5. While minimum values of both traits biological and pod yield were 3.385 and 1.734 ton ha^{-1} respectively exhibited by L_3. The variation among in bred lines of vetch may be return to genetic variation and environmental factors that affect yield traits. This result is agreement with the results that finding (Bolanos *et al.,* 2002) which was indicated that the seed yield variation induced by either environmental conditions or lines. Also previous result confirmed that the differences in seed yield and hay yield were also significant among lines at the level of 0.05 (Iptas and karadag 2008).

Table3: Effect of in bred lines of vetch on yield traits at both locations and their averages.

Lines	Biological Yield (ton.ha^{-1})	Pod Yield (ton.ha^{-1})	Seed Yield (ton.ha^{-1})	Straw Yield (ton.ha^{-1})	Harvest Index
Qlyasan Location					
L_1	3.057	1.691	1.447	1.610	0.496
L_2	3.116	1.824	1.485	1.632	0.399
L_3	2.440	1.267	1.160	1.280	0.496
L_4	3.081	1.599	1.327	1.754	0.389
L_5	3.118	1.744	1.451	1.667	0.422
L_6	2.687	1.408	1.224	1.466	0.419
LSD (P≤0.05)	0.452*	0.364*	N.S	N.S	N.S
Kanipanka Location					
Lines	**Biological Yield (ton.ha^{-1})**	**Pod Yield (ton.ha^{-1})**	**Seed Yield (ton.ha^{-1})**	**Straw Yield (ton.ha^{-1})**	**Harvest Index**
L_1	5.286	2.979	2.294	2.992	0.477
L_2	4.518	2.497	1.728	2.813	0.414
L_3	4.331	2.201	1.639	2.692	0.379
L_4	5.355	3.048	2.443	2.913	0.412
L_5	5.234	2.932	2.506	2.731	0.475
L_6	5.130	2.867	2.253	2.878	0.420
LSD (P≤0.05)	0.558**	0.554*	0.322**	N.S	N.S
Averages of both Location					
Lines	**Biological Yield (ton.ha^{-1})**	**Pod Yield (ton.ha^{-1})**	**Seed Yield (ton.ha^{-1})**	**Straw Yield (ton.ha^{-1})**	**Harvest Index**
L_1	4.171	2.335	1.871	2.301	0.486
L_2	3.817	2.161	1.607	2.222	0.407
L_3	3.385	1.734	1.400	1.986	0.437
L_4	4.218	2.323	1.885	2.334	0.400
L_5	4.176	2.338	1.979	2.199	0.448
L_6	3.909	2.137	1.738	2.172	0.420
LSD (P≤0.05)	0.336**	0.310**	0.269**	N.S	N.S

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

Table 4 illustrate that the effect of harvesting stage on all yield traits of narbon vetch were highly significant at both locations and their averages with the exception of the character harvest index which was significant at Qlyasan location and not significant at kanipanka and the average of both locations (Appendix 1).

The highest values of (biological yield, pod yield, seed yield and straw yield) obtained by control treatment or (without harvesting) were 7.657, 4.602, 3.789, and 3.870 ton ha^{-1} respectively at Qlyasan location, and 12.573, 7.027, 5.366 and 7.224 ton ha^{-1} at Kanipanka location and 10.115, 5.814, 4.578 and 5.547 ton ha^{-1} at the averages of both locations for previous traits respectively. While the lowest values of these traits (biological yield, pod yield and seed yield) were achieved by harvesting at full flowering stage were 0.933, 0.283 and 0.295 ton ha^{-1} respectively at Qlyasan location, but minimum value of straw yield was 0.616 recorded by harvesting at 50% flowering in this location. Concerning Kanipanka location and the average of both locations, minimum values of these characters biological yield, pod yield, seed yield and straw yield exhibited by harvesting at 50% flowering stage were 1.673, 0.912, 0.734 and 0.939 ton ha^{-1} at Kanipanka location and (1.379, 0.678, 0.602 and 0.777) ton ha^{-1} at the average of both locations respectively. Regarding harvest index trait, maximum value showed by the treatment of control which was 0.495 at Qlyasan location and 0.462 at the average of both locations recorded by harvesting at 50% flowering, while harvesting

at full flowering gave minimum value of this trait were (0.346 and 0.369) at Qlyasan and the average of both locations respectively. These results indicated that the crop without harvesting gave the highest yield in compare to when harvesting was done. Also previous work found that harvesting stage significantly affected yield, late harvest time resulted in greater biomass production compared to early harvest time; the increase of biomass in late cut is due to the greater light intercepted (Testa *et al*., 2011).

Table 4:- Effect of harvesting stages on yield traits of Narbon vetch at both locations and their averages.

Qlyasan Location					
Harvesting Stages	**Biological Yield (ton ha^{-1})**	**Pod Yield (ton ha^{-1})**	**Seed Yield (ton ha^{-1})**	**Straw Yield (ton ha^{-1})**	**Harvest Index**
H_0	7.657	4.602	3.789	3.870	0.495
H_1	1.990	1.025	0.843	1.148	0.412
H_2	1.085	0.445	0.469	0.616	0.493
H_3	0.933	0.283	0.295	0.639	0.346
LSD (P≤0.05)	0.307**	0.215**	0.272**	0.340**	0.122*
Kanipanka Location					
Harvesting Stages	**Biological Yield (ton ha^{-1})**	**Pod Yield (ton ha^{-1})**	**Seed Yield (ton ha^{-1})**	**Straw Yield (ton ha^{-1})**	**Harvest Index**
H_0	12.573	7.027	5.366	7.224	0.427
H_1	2.919	1.795	1.412	1.507	0.467
H_2	1.673	0.912	0.734	0.939	0.430
H_3	2.739	1.282	1.063	1.677	0.393
LSD (P≤0.05)	0.471**	0.482**	0.271**	0.358**	N.S
Averages of both Location					
Harvesting Stages	**Biological Yield (ton ha^{-1})**	**Pod Yield (ton ha^{-1})**	**Seed Yield (ton ha^{-1})**	**Straw Yield (ton ha^{-1})**	**Harvest Index**
H_0	10.115	5.814	4.578	5.547	0.461
H_1	2.454	1.410	1.127	1.327	0.440
H_2	1.379	0.678	0.602	0.777	0.462
H_3	1.836	0.783	0.679	1.158	0.369
LSD (P≤0.05)	0.276**	0.260**	0.189**	0.243**	0.058**

At Qlyasan location, the highest values of biological yield and pod yield produced by the interaction between Line for with control treatment which was 8.703 and 5.069 ton ha^{-1} respectively, while L_3 when interacted with harvesting at 50% flowering gave minimum value of biological yield 0.656 ton ha^{-1}, but the lowest value of pod yield was 0.152 ton ha^{-1} recorded by interaction between L_2 with harvesting at full flowering stage. Regarding Kanipanka location, the interaction between L_2 and control treatment showed maximum value for the trait biological yield, pod yield and straw yield were 13.405, 7.939 and 8.461 ton ha^{-1} respectively. It was observed that L_5 when associated with control treatment gave the highest seed yield which was 6.313 ton ha^{-1}, and maximum harvest index 0.669 exhibited by the interaction between L_1 with harvesting at the stage 50% flowering. While minimum value of biological yield, pod yield, seed yield and straw yield were 0.846, 0.362, 0.370 and 0.476 ton ha^{-1} respectively recorded by interaction between L_2 with harvesting at the beginning of flowering but regarding harvest index trait Line for associated with harvesting at full flowering stage and gave minimum value 0.326.

As the average of both locations, the highest yield produced by the interaction between L_2 with control treatment were 10.612, 6.340 and 6.152 ton ha^{-1} for biological yield, pod yield and straw yield respectively, but the highest seed yield was 5.159 ton ha^{-1} obtained by

association between L_5 and control treatment, whereas the lowest yield where achieved by interaction between L_3 with harvesting at 50% flowering for biological yield, pod yield, seed yield and straw yield were 0.908, 0.363, 0.420, and 0.488 ton ha^{-1} respectively. Previously showed that the pod and seed dry weight, harvest index, seed to pod dry weight were all significantly affected by temperature, line, and interactions between the two (Craufurd *et al*., 2002).

Table 5a: Effect of interaction between lines and harvesting stages on yields of narbon vetch at Qlyasan locations.

Qlyasan Location						
Harvesting Stages	Lines	Biological Yield (ton ha^{-1})	Pod yield (ton ha^{-1})	Seed Yield (ton ha^{-1})	Straw Yield (ton ha^{-1})	Harvest Index
L_1	H_0	6.956	4.325	3.557	3.399	0.510
	H_1	3.025	1.493	1.147	1.878	0.361
	H_2	1.244	0.599	0.615	0.630	0.571
	H_3	1.004	0.347	0.470	0.534	0.541
L_2	H_0	7.820	4.742	3.976	3.844	0.509
	H_1	1.953	1.600	1.245	0.708	0.626
	H_2	1.847	0.802	0.600	1.247	0.318
	H_3	0.845	0.152	0.117	0.729	0.145
L_3	H_0	6.955	4.135	3.382	3.574	0.487
	H_1	1.343	0.511	0.535	0.808	0.400
	H_2	0.656	0.192	0.436	0.220	0.670
	H_3	0.804	0.228	0.288	0.517	0.426
L_4	H_0	8.703	5.069	4.109	4.594	0.473
	H_1	1.603	0.711	0.525	1.078	0.317
	H_2	1.047	0.361	0.400	0.647	0.464
	H_3	0.972	0.253	0.273	0.698	0.301
L_5	H_0	7.886	4.757	4.006	3.880	0.507
	H_1	2.294	1.299	0.987	1.307	0.424
	H_2	0.987	0.424	0.380	0.607	0.409
	H_3	1.305	0.498	0.431	0.874	0.347
L_6	H_0	7.622	4.582	3.703	3.932	0.486
	H_1	1.724	0.538	0.618	1.106	0.348
	H_2	0.731	0.292	0.385	0.347	0.527
	H_3	0.670	0.221	0.191	0.480	0.315
LSD (P≤0.05)		0.751**	0.528*	N.S	N.S	N.S

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

Table 5b: Effect of interaction between lines and harvesting stages on yields of narbon vetch at Kanipanka location.

Kanipanka Location						
Harvesting Stages	Lines	Biological Yield (ton ha^{-1})	Pod yield (ton ha^{-1})	Seed Yield (ton ha^{-1})	Straw Yield (ton ha^{-1})	Harvest Index
L_1	H_0	12.763	6.846	4.994	7.769	0.391
	H_1	3.807	2.401	1.847	1.960	0.483
	H_2	1.913	1.215	1.257	0.656	0.669
	H_3	2.659	1.452	1.077	1.582	0.365
L_2	H_0	13.405	7.939	5.035	8.461	0.376
	H_1	0.846	0.362	0.370	0.476	0.458
	H_2	1.668	0.879	0.667	1.001	0.397

	H_3	2.155	0.810	0.841	1.314	0.424
	H_0	11.493	5.819	4.355	7.138	0.380
L_3	H_1	1.383	0.731	0.547	0.836	0.393
	H_2	1.161	0.535	0.405	0.756	0.351
	H_3	3.290	1.718	1.250	2.040	0.391
	H_0	12.152	7.149	5.806	6.346	0.478
L_4	H_1	4.896	3.213	2.515	2.381	0.512
	H_2	1.631	0.842	0.551	1.080	0.331
	H_3	2.742	0.989	0.899	1.844	0.326
	H_0	13.070	7.437	6.313	6.769	0.483
L_5	H_1	2.941	1.729	1.368	1.573	0.463
	H_2	1.982	1.112	0.845	1.137	0.427
	H_3	2.943	1.451	1.498	1.445	0.525
	H_0	12.555	6.972	5.696	6.861	0.454
L_6	H_1	3.639	2.333	1.825	1.814	0.496
	H_2	1.682	0.887	0.680	1.002	0.405
	H_3	2.645	1.275	0.810	1.835	0.327
LSD (P≤0.05		1.153**	1.181**	0.664**	0.877**	0.150*

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

Table 5c: Effect of interaction between lines and harvesting stages on yields of narbon vetch at averages of both locations.

		Averages of both Locations				
Lines	**Harvesting Stages**	**Biological Yield (ton ha^{-1})**	**Pod yield (ton ha^{-1})**	**Seed Yield (ton ha^{-1})**	**Straw Yield (ton ha^{-1})**	**Harvest Index**
	H_0	9.859	5.586	4.276	5.584	0.451
L_1	H_1	3.416	1.947	1.497	1.919	0.422
	H_2	1.579	0.907	0.936	0.643	0.620
	H_3	1.832	0.900	0.774	1.058	0.453
	H_0	10.612	6.340	4.506	6.152	0.442
L_2	H_1	1.399	0.981	0.808	0.592	0.542
	H_2	1.757	0.841	0.634	1.124	0.358
	H_3	1.500	0.481	0.479	1.021	0.284
	H_0	9.224	4.977	3.868	5.356	0.433
L_3	H_1	1.363	0.621	0.541	0.822	0.396
	H_2	0.908	0.363	0.420	0.488	0.511
	H_3	2.047	0.973	0.769	1.278	0.409
	H_0	10.428	6.109	4.958	5.470	0.476
L_4	H_1	3.249	1.962	1.520	1.730	0.415
	H_2	1.339	0.601	0.476	0.864	0.397
	H_3	1.857	0.621	0.586	1.271	0.314
	H_0	10.478	6.097	5.159	5.325	0.495
L_5	H_1	2.618	1.514	1.178	1.440	0.443
	H_2	1.485	0.768	0.613	0.872	0.418
	H_3	2.124	0.974	0.964	1.160	0.436
	H_0	10.089	5.777	4.700	5.396	0.470
L_6	H_1	2.682	1.435	1.222	1.460	0.422
	H_2	1.207	0.589	0.533	0.674	0.466
	H_3	1.658	0.748	0.500	1.157	0.321
LSD (P≤0.05)		0.676**	0.636**	0.462**	0.594**	N.S

Figure 1 and appendix 1 explain that the effect of locations on all yield traits of narbon vetch were highly significant. Kanipanka location predominated Qlyasan location in these characters biological yield, pod yield, seed yield and straw yield by 41.379%, 42.266%, 37.080% and 44.711%, while Qlyasan location exceeded Kanipanka location in the trait harvest index by 1.831%. The exceeding Kanipanka location due to most yield traits of narbon vetch are good indicator that confirm the suitability Kanipanka location to produce this crop caused by soil fertility. The results of previous work showed that high seed and biological yield can be obtained from narbon vetch especially in years with above- average rainfall (Iptas and karadag 2008)

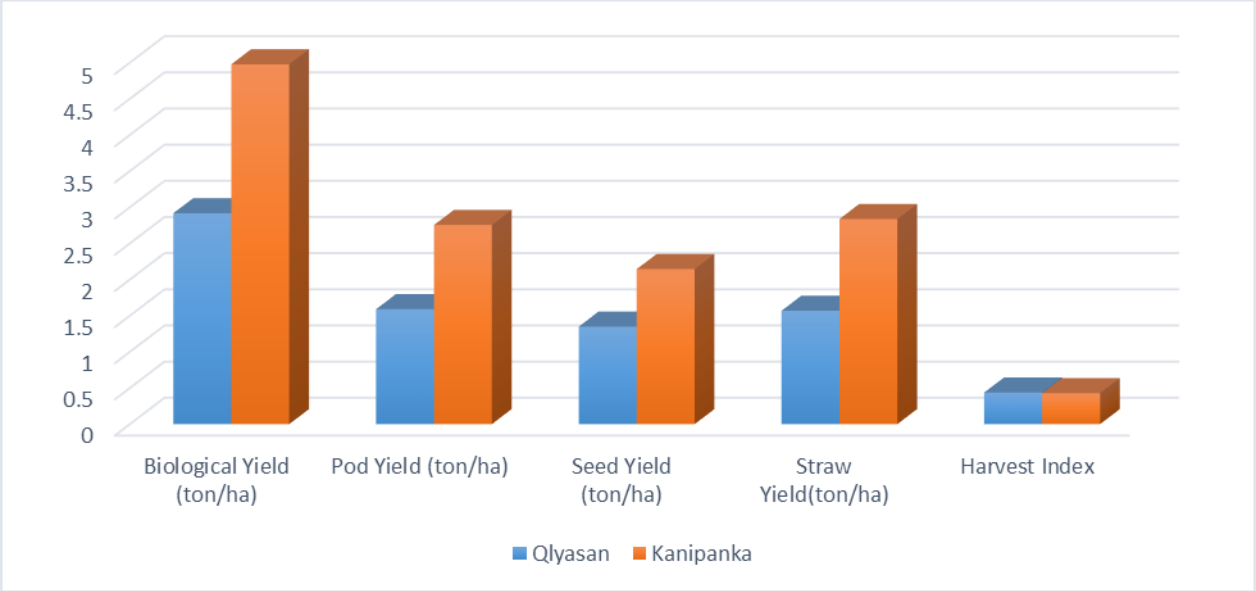

Figure 1: Effect of locations on yield traits of narbon vetch.

Table 6 showed that the differences between lines due to yield components traits was highly significant for the character 100 seed weight and significant for no. of pods m^{-2}, but not significant on the rest at Qlyasan and Kanipanka locations. As the average of both locations, the differences between lines were highly significant for both traits no. of pods m^{-2} and 100 seed weight but significant only on the trait seeds number pod^{-1} and on the other traits were not significant (Appendix 2).

In Qlyasan location, maximum value of number of pods m^{-2} 199.583 and 100 seed weight 22.078 g exhibited by L_1 and L_5 respectively, while minimum values for both traits 118.472 and 19.017 g recorded by L_3 and L_2 respectively. But in Kanipanka location, line 6 and L_1 gave maximum values of no. of pods m^{-2} and 100 seeds weight were 354.167 and 21.770 g respectively, whereas minimum values 289.444 and 17.811 of these traits recorded by L_3 and L_6 respectively. Regarding the average of both locations, the highest value of number of pod m^{-2} exhibited by L_1 which was 270.903, while the lowest value of this trait was 203.958 showed by L_3. Maximum values of seeds number pod^{-1} 4.055 and 100 seed weight 21.900g exhibited by L_4 and L_1 respectively, while minimum value for both traits 3.625 and 18.813 g recorded by L_3 and L_2 respectively. The difference among narbon vetch lines due to yield component traits may be referred to the differences in their performance and to their response to the climate conditions prevailing in the region. Results of previous research revealed that the differences in the pod number of Narbonne vetch were not statistically significant among lines, although the differences for the lines in thousand seed weight were significant at the level of 0.01 (Nizam *et al*., 2011).

Table6: Effect of lines on yield components of narbon vetch at both locations and their averages.

Lines	No. of pods m^{-2}	Pod Length (cm)	Seeds Number pod^{-1}	Seeds Weight $Pod(g)^{-1}$	100 Seed Weight(g)
Qlyasan Location					
L_1	199.583	5.376	3.379	0.770	22.029
L_2	190.278	4.948	3.923	0.805	19.071
L_3	118.472	5.082	3.317	0.789	21.835
L_4	159.722	5.006	3.811	0.812	21.293
L_5	186.528	5.163	3.833	0.860	22.078
L_6	144.028	5.665	3.642	0.814	21.474
LSD (P≤0.05)	48.587*	N.S	N.S	N.S	1.241**
Kanipanka Location					
Lines	**No. of pods m^{-2}**	**Pod Length (cm)**	**Seeds Number pod^{-1}**	**Seeds Weight $Pod(g)^{-1}$**	**100 Seed Weight(g)**
L_1	342.222	5.401	3.958	0.872	21.770
L_2	298.056	5.175	4.171	0.781	18.556
L_3	289.444	5.365	3.933	0.814	20.038
L_4	351.944	5.488	4.300	0.931	20.688
L_5	331.389	5.357	3.950	0.866	20.361
L_6	354.167	5.128	4.367	0.798	17.811
LSD (P≤0.05)	51.468*	N.S	N.S	N.S	1.862**
Averages of both Location					
Lines	**No. of pods m^{-2}**	**Pod Length (cm)**	**Seeds Number pod^{-1}**	**Seeds Weight $Pod(g)^{-1}$**	**100 Seed Weight(g)**
L_1	270.903	5.388	3.669	0.821	21.900
L_2	244.167	5.062	4.047	0.793	18.813
L_3	203.958	5.224	3.625	0.802	20.937
L_4	255.833	5.247	4.055	0.871	20.991
L_5	258.958	5.260	3.892	0.863	21.219
L_6	249.097	5.396	4.004	0.806	19.643
LSD (P≤0.05)	33.131**	N.S	0.301*	N.S	1.047**

The control treatment (Non-harvesting) gave maximum values for all traits at Qlyasan location, 449.259, 5.713cm, 4.011, 0.975g and 24.197g respectively. But the harvesting stage at full flowering for no. of pods.m^{-2}, pod length, seed number pod^{-1} and 100 seed weight respectively. But the harvesting stages at full flowering gave minimum values for no. of pods m^{-2}, seeds number pod^{-1} and seeds weight pod^{-1} were 43.426, 3.109 and 0.644g respectively, while for pod length, the minimum value 4.961cm recorded at the beginning of

flowering, and the minimum value of 100 seed weight was 19.289g produced by harvesting at 50% of flowering. In Kanipanka location, no. of pods m^{-2}, pod length and 100 seed weight recorded the highest value at control treatment were 762.870, 5.692cm and 21.880g respectively and seeds weight pod^{-1} had the maximum value 0.942g when harvesting at the beginning of flowering, but the pod length had the minimum value 5.109cm at the harvesting of 50% flowering. Whereas the harvesting stage at full flowering recorded the minimum values for seeds weight pod^{-1} and 100 seed weight were 0.701g and 17.060g respectively. Concerning the average of both locations, the highest value for no. of pods m^{-2}, pod length, seeds weight pod^{-1} and 100 seed weight recorded by the treatment of control were 606.065, 5.703cm, 0.925g, 23.039g respectively. While seeds number pod^{-1} had the highest value 4.136 when harvesting at the beginning of flowering. But the lowest values of no. of pods m^{-2}, pod length 83.889 and 5.078 cm exhibited by harvesting at 50% flowering. Regarding the characters seeds number pod^{-1}, seeds weight pod^{-1} and 100 seed weight, minimum values were 3.523, 0.673g and 18.653g respectively exhibited by harvesting at full flowering stage. Obtaining higher yields

requires that the plants are healthy and that carbohydrate root reserves are adequate for plant regrowth following harvest (Wiersma *et al*., 2007).

Table7: Effect of harvesting stages on yield components of Narbon vetch at both locations and their averages.

Qlyasan Location					
Harvesting Stages	**No. of pods m^{-2}**	**Pod Length (cm)**	**Seeds Number pod^{-1}**	**Seeds Weight Pod m^{-1} (g)**	**100 Seed Weight (g)**
H_0	449.259	5.713	4.011	0.975	24.197
H_1	117.130	4.961	3.922	0.900	21.455
H_2	55.926	5.046	3.560	0.715	19.289
H_3	43.426	5.108	3.109	0.644	20.245
LSD (P≤0.05)	33.587^{**}	0.520^{*}	0.333^{**}	0.094^{**}	1.177^{**}
Kanipanka Location					
Harvesting Stages	**No. of pods m^{-2}**	**Pod Length (cm)**	**Seeds Number pod m^{-1}**	**Seeds Weight Pod^{1} (g)**	**100 Seed Weight (g)**
H_0	762.870	5.692	4.044	0.874	21.880
H_1	197.315	5.254	4.350	0.942	20.531
H_2	111.852	5.109	4.122	0.857	20.012
H_3	239.444	5.220	3.936	0.701	17.060
LSD (P≤0.05)	31.411^{**}	0.253^{**}	N.S	0.096^{**}	1.039^{**}
Averages of both Location					
Harvesting Stages	**No. of pods m^{-2}**	**Pod Length (cm)**	**Seeds Number pod m^{-1}**	**Seeds Weight Pod^{1} (g)**	**100 Seed Weight (g)**
H_0	606.065	5.703	4.028	0.925	23.039
H_1	157.222	5.108	4.136	0.921	20.993
H_2	83.889	5.078	3.841	0.786	19.651
H_3	141.435	5.164	3.523	0.673	18.653
LSD (P≤0.05)	22.601^{**}	0.284^{**}	0.232^{**}	0.066^{**}	0.772^{**}

The interaction effect between lines and harvesting stages on yield components of Narbon vetch represented in table 8a,b and c was highly significant for the characters seeds number pod^{-1} and 100 seed weight, but on the character seeds weight pod^{-1} was significant and on the rest the interaction effect was not significant at Qlyasan location, while at Kanipanka location the interaction between lines and harvesting stage was highly significant due to both traits no. of pods m^{-2} and 100 seed weight but on the other traits were not significant. As the averages of both locations, the interaction effect also highly significant for the characters no. of pods m^{-2} and 100 seed weight, in which for the traits seed number pod^{-1} and seeds weight pod^{-1} were significant only and not significant for the character pod length. (Appendix 2).

The interactions between L_2 with harvesting stage 50% flowering and L_5 with harvesting at the beginning of flowering gave the maximum values of seed number/pod 4.567. Regarding the seed weight trait the highest value recorded by L_5 when associated with harvesting stage at the beginning of flowering 1.117 g, but maximum 100 seed weight 26.627g produced by the interaction between L_3 with control treatment. The minimum values of this traits seeds number pod^{-1}, seeds weight/pod and 100 seed weight exhibited by L_2 when interacted between with harvesting at full flowering stage were 2.407, 0.403 g and 13.755g respectively.

Table 8a: Effect of interaction between lines and harvesting stages on yield components of narbon vetch at Qlyasan location.

Lines / Harvesting Stages		Qlyasan Location				
		No. of Pods m^{-2}	Pod Length(cm)	Seeds Number Pod^{-1}	Seeds Weight Pod^{-1} (g)	100 Seed weight (g)
L_1	H_0	483.333	6.390	3.650	0.927	25.025
	H_1	163.333	4.953	4.067	0.887	21.187
	H_2	78.333	5.300	3.200	0.648	20.090
	H_3	73.333	4.860	2.600	0.616	21.815
L_2	H_0	458.333	5.390	4.550	0.963	21.345
	H_1	168.333	5.007	4.167	0.937	21.780
	H_2	106.111	5.290	4.567	0.917	19.403
	H_3	28.333	4.107	2.407	0.403	13.755
L_3	H_0	358.889	5.690	3.800	0.992	26.627
	H_1	55.556	4.680	3.333	0.850	22.220
	H_2	26.111	4.863	2.833	0.598	18.865
	H_3	33.333	5.095	3.300	0.718	19.630
L_4	H_0	460.556	5.727	4.167	1.044	24.069
	H_1	92.778	4.970	4.067	0.826	18.670
	H_2	53.333	4.583	3.360	0.602	17.090
	H_3	32.222	4.743	3.650	0.777	25.345
L_5	H_0	491.667	5.333	3.867	0.850	22.350
	H_1	139.444	5.263	4.567	1.117	23.213
	H_2	48.333	4.857	3.600	0.762	21.463
	H_3	66.667	5.200	3.300	0.710	21.283
L_6	H_0	442.778	5.747	4.033	1.073	25.767
	H_1	83.333	4.893	3.333	0.781	21.660
	H_2	23.333	5.380	3.800	0.762	18.825
	H_3	26.667	6.640	3.400	0.641	19.645
LSD (P≤0.05)		N.S	N.S	0.816^{**}	0.230^{*}	2.883^{**}

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

Kanipanka location which was shown in table 8b, the interaction between L_2 with control treatment gave the highest value of no. of pods m^{-2} 829.444, while the lowest value of this character 47.778 was obtained by interaction between L_2 with harvesting stage at the beginning of flowering. Regarding the trait 100 seeds weight, the highest weight produced by association L_5 and control treatment which was 24.143 g, whereas the lowest weight 14.443g exhibited by L_5 when interacted with harvesting at full flowering stage.

Table 8b: Effect of interaction between lines and harvesting stages on yield components of narbon vetch at Kanipanka location.

Lines / Harvesting Stages		Kanipanka Location				
		No. Of Pods m^{-2}	Pods Length(cm)	Seeds Number Pod^{-1}	Seeds Weight Pod^{-1} (g)	100 Seed weight (g)
L_1	H_0	770.000	6.260	3.800	0.867	22.387
	H_1	250.000	5.333	4.400	0.976	22.103
	H_2	146.667	4.993	4.167	0.947	22.033
	H_3	202.222	5.017	3.467	0.698	20.557
L_2	H_0	829.444	5.700	4.300	0.910	20.673

	H_1	47.778	4.657	3.700	0.740	18.065
	H_2	48.333	5.120	4.233	0.805	19.440
	H_3	266.667	5.225	4.450	0.670	16.045
	H_0	714.444	5.300	3.800	0.693	20.740
L_3	H_1	94.444	5.557	4.133	0.860	19.903
	H_2	82.222	5.197	3.733	0.816	19.913
	H_3	266.667	5.407	4.067	0.887	19.597
	H_0	757.222	6.050	4.233	1.027	23.690
L_4	H_1	307.778	5.603	5.167	1.217	23.070
	H_2	120.000	5.063	3.967	0.794	19.163
	H_3	222.778	5.233	3.833	0.685	16.830
	H_0	746.111	5.520	3.700	0.908	24.143
L_5	H_1	201.667	5.270	4.100	0.929	21.113
	H_2	143.333	5.280	4.167	0.946	21.743
	H_3	234.444	5.357	3.833	0.681	14.443
	H_0	760.000	5.323	4.433	0.842	19.647
L_6	H_1	282.222	5.103	4.600	0.930	18.930
	H_2	130.556	5.003	4.467	0.831	17.780
	H_3	243.889	5.080	3.967	0.588	14.887
LSD (P≤0.05)		76.943**	N.S	N.S	N.S	2.546**

Concerning the average of both locations which was shown in Table 8c, L2 without harvesting (control) showed the biggest value of no. of pod m^{-2} 643.889, in which the smallest value of this character was (54.167) recorded by the interaction L3 with harvesting stage at 50% flowering. Regarding to seeds number pod^{-1}, L2 when harvesting at 50% flowering stage gave maximum number 4.400, the minimum number of seeds pod^{-1} was 3.033 recorded by interaction between L1 with harvesting at full flowering stage. On the other hand, the highest value of seeds weight pod^{-1} and 100 seed weight were 1.035and 23.880 g respectively observed by association L4 and control treatment, while L2 interacted with harvesting at 50% flowering stage and gave the lowest values 0.536g and 14.900g for both traits seeds weight pod^{-1} and 100 seed weight respectively.

Table 8c: Effect of interaction between lines and harvesting stages on yield components of narbon vetch at average of both locations.

		Average of both Locations				
Harvesting Stages	**Lines**	**No. Of Pods m^{-2}**	**Pod Length(cm)**	**Seeds Number Pod^{-1}**	**Seeds Weight Pod^{-1} (g)**	**100 Seed weight (g)**
	H_0	626.667	6.325	3.725	0.897	23.706
L_1	H_1	206.667	5.143	4.233	0.931	21.645
	H_2	112.500	5.147	3.683	0.798	21.062
	H_3	137.778	4.938	3.033	0.657	21.186
	H_0	643.889	5.545	4.425	0.936	21.009
L_2	H_1	108.056	4.832	3.933	0.839	19.923
	H_2	77.222	5.205	4.400	0.861	19.422
	H_3	147.500	4.666	3.428	0.536	14.900
	H_0	536.667	5.495	3.800	0.842	23.683
L_3	H_1	75.000	5.118	3.733	0.855	21.062
	H_2	54.167	5.030	3.283	0.707	19.389
	H_3	150.000	5.251	3.683	0.802	19.613
	H_0	608.889	5.888	4.200	1.035	23.880
L_4	H_1	200.278	5.287	4.617	1.021	20.870

	H_2	86.667	4.823	3.663	0.698	18.127
	H_3	127.500	4.988	3.742	0.731	21.087
	H_0	618.889	5.427	3.783	0.879	23.247
L_5	H_1	170.556	5.267	4.333	1.023	22.163
	H_2	95.833	5.068	3.883	0.854	21.603
	H_3	150.556	5.278	3.567	0.695	17.863
	H_0	601.389	5.535	4.233	0.958	22.707
L_6	H_1	182.778	4.998	3.967	0.855	20.295
	H_2	76.944	5.192	4.133	0.797	18.303
	H_3	135.278	5.860	3.683	0.614	17.266
LSD (P≤0.05)		55.360**	N.S	0.568*	0.162*	1.890**

Figure 2 and appendix 2 confirmed that the effect of locations on yield components of narbon vetch were significant for all characters. Kanipanka location exceeded Qlyasan location in these traits no. of pods.m^{-2}, pod length, seeds number pod^{-1} and seeds weight pod^{-1} by 47.663%, 2.106%, 11.233%, and 4.265% respectively, Regarding the 100 seed weight, Qlyasan location predominated Kanipanka location by 6.696%. Soil fertility of Kanipanka location caused the superiority of most yield component traits in this location in compare to other location. Previously, Iptas and karadag (2008) reported that the annual rainfall and its distribution significantly affect seed yield and yield components of narbon vetch in semi-arid regions (250-500mm).

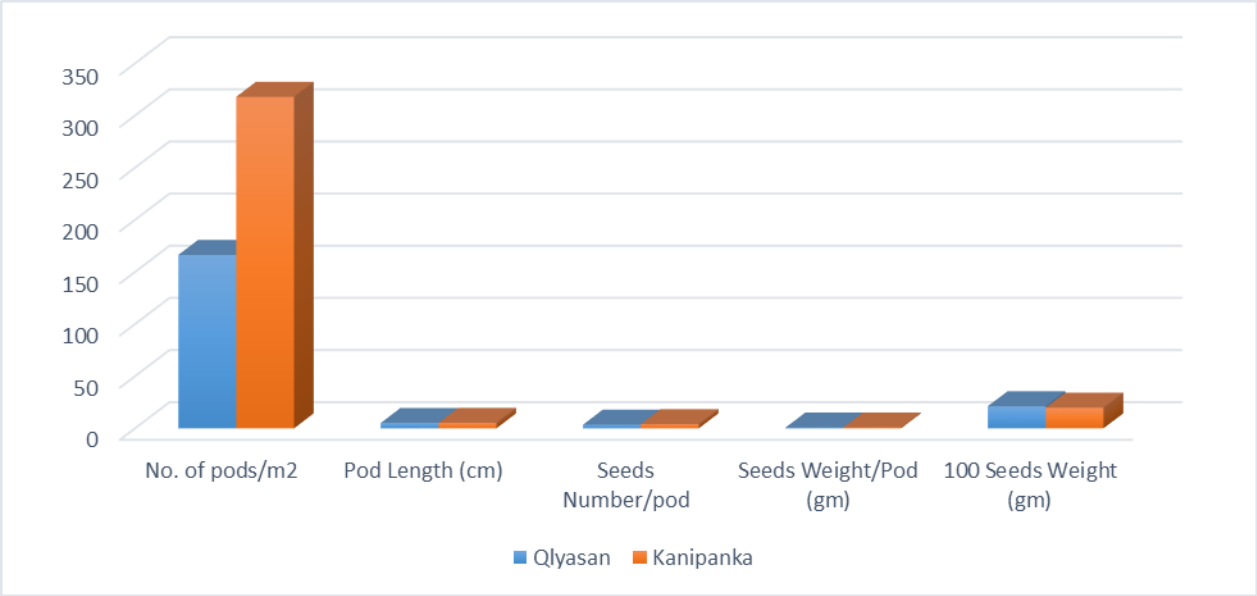

Figure 2: Effect of locations on yield component traits of narbon vetch

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Appendix1: Mean squares of yield traits of Narbon vetch at Qlyasan, Kanipanka and their averages.

Qlyasan Location						
S.O.V	**d.f**	**Biological Yield tonha^{-1}**	**Pod Yield ton ha^{-1}**	**Seed Yield ton ha^{-1}**	**Straw Yield ton ha^{-1}**	**Harvest Index**
R	2	0.083$^{n.s}$	0.122$^{n.s}$	0.010$^{n.s}$	0.034$^{n.s}$	0.017$^{n.s}$
A	5	0.978*	0.546*	0.217$^{n.s}$	0.345$^{n.s}$	0.027$^{n.s}$
Error(a)	10	0.247	0.160	0.272	0.119	0.018
B	3	183.698**	74.402**	48.562**	43.482**	0.093*
A*B	15	0.699**	0.240*	0.145$^{n.s}$	0.377$^{n.s}$	0.037$^{n.s}$
Error(b)	36	0.206	0.102	0.162	0.253	0.022
Kanipanka Location						
S.O.V	**d.f**	**Biological Yield tonha^{-1}**	**Pod Yield ton ha^{-1}**	**Seed Yield ton ha^{-1}**	**Straw Yield ton ha^{-1}**	**Harvest Index**
R	2	0.561$^{n.s}$	0.584$^{n.s}$	0.696*	0.031$^{n.s}$	0.005$^{n.s}$
A	5	2.292**	1.326*	1.637**	0.154$^{n.s}$	0.018$^{n.s}$
Error(a)	10	0.376	0.371	0.126	0.178	0.006
B	3	467.190**	148.380**	84.461**	155.795**	0.017$^{n.s}$
A*B	15	2.299**	1.399**	0.790**	1.166**	0.019*
Error(b)	36	0.485	0.509	0.161	0.280	0.008
Average of both Location						
S.O.V	**d.f**	**Biological Yield tonha^{-1}**	**Pod Yield ton ha^{-1}**	**Seed Yield ton ha^{-1}**	**Straw Yield ton ha^{-1}**	**Harvest Index**
Location	1	2242.551**	679.179**	439.195**	698.422**	26.998**
R(Ea)	4	0.322	0.353	0.353	0.033	0.011
A/L	10	1.635	0.936	0.927	0.250	0.022
A	5	2.448**	1.301**	1.096**	0.361$^{n.s}$	0.024$^{n.s}$
A*L	5	0.822	0.572	0.757	0.139	0.021
Error(b)	20	0.312	0.265	0.199	0.148	0.012
B/L	6	325.444	111.391	66.512	99.639	0.055
B	3	615.874**	215.995**	130.188**	180.908**	0.068**
B*L	3	35.015	6.787	2.836	18.370	0.041
AB/L	30	1.499	0.819	0.468	0.771	0.028
AB	15	1.582**	0.774**	0.511**	0.730**	0.026$^{n.s}$
AB*L	15	1.416	0.864	0.424	0.813	0.029
Error(c)	72	0.345	0.305	0.161	0.266	0.015

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

Appendix2: Mean squares of variance for yield components of Narbon vetch at Qlyasan, Kanipanka and their averages.

Qlyasan Location						
S.O.V	**d.f**	**No. of pods m^{-2}**	**Pods Length(cm)**	**Seeds Number Pod^{-1}**	**Seeds Weight Pod^{-1} (g)**	**100 Seeds Weight (g)**
R	2	$640.345^{n.s}$	$0.524^{n.s}$	$0.037^{n.s}$	$0.021^{n.s}$	$4.328^{n.s}$
A	5	11804.624^{*}	$0.872^{n.s}$	$0.764^{n.s}$	$0.012^{n.s}$	15.396^{**}
Error(a)	10	2853.006	0.651	0.340	0.032	1.861
B	3	658584.949^{**}	2.114^{*}	3.029^{**}	0.425^{**}	81.414^{**}
A*B	15	$1938.360^{n.s}$	$0.701^{n.s}$	0.684^{**}	0.049^{*}	17.908^{**}
Error(b)	36	2468.321	0.591	0.243	0.019	3.031
Kanipanka Location						
S.O.V	**d.f**	**No. of pods m^{-2}**	**Pods Length(cm)**	**Seeds Number Pod^{-1}**	**Seeds Weight Pod^{-1} (g)**	**100 Seeds Weight (g)**
R	2	$3524.564^{n.s}$	$0.249^{n.s}$	$0.308^{n.s}$	$0.009^{n.s}$	$0.722^{n.s}$
A	5	15253.831^{*}	$0.230^{n.s}$	$0.445^{n.s}$	$0.038^{n.s}$	25.237^{**}
Error(a)	10	3201.438	0.200	0.159	0.045	4.188
B	3	1365618.643^{**}	1.184^{**}	$0.553^{n.s}$	0.188^{**}	74.361^{**}
A*B	15	20441.254^{**}	$0.233^{n.s}$	$0.369^{n.s}$	$0.039^{n.s}$	7.414^{**}
Error(b)	36	2158.990	0.140	0.245	0.020	2.363
Average of both Location						
S.O.V	**d.f**	**No. of pods m^{-2}**	**Pods Length(cm)**	**Seeds Number Pod^{-1}**	**Seeds Weight Pod^{-1} (g)**	**100 Seeds Weight (g)**
Location	1	8448709.335^{**}	3988.354^{**}	2170.007^{**}	98.309^{**}	61012.281^{**}
R(Ea)	4	2082.454	0.386	0.173	0.015	2.525
A/L	10	13529.227	0.551	0.604	0.025	20.316
A	5	12902.637^{**}	$0.364^{n.s}$	0.882^{*}	$0.027^{n.s}$	30.924^{**}
A*L	5	14155.818	0.738	0.327	0.023	9.709
Error(b)	20	3027.222	0.426	0.249	0.038	3.024
B/L	6	1012101.796	1.649	1.791	0.307	77.887
B	3	1930456.068^{**}	3.140^{**}	2.598^{**}	0.525^{**}	129.486^{**}
B*L	3	93747.523	0.158	0.984	0.088	26.289
AB/L	30	11189.807	0.467	0.527	0.044	12.661
AB	15	8575.338^{**}	$0.550^{n.s}$	0.531^{*}	0.042^{*}	9.380^{**}
AB*L	15	13804.275	0.384	0.523	0.046	15.942
Error(c)	72	2313.655	0.366	0.244	0.020	2.697

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