



Figure S1. The interaction effects of cultivars and nitrogen levels on relative feed value (RFV) of barley silage. Nitrogen (N0, 0 kg/ha and N1, 62.5 kg/ha). Bars represent standard error of the mean, n=12.

Table S1. Characteristics and genealogy of the cultivars used in the experiment.

Cultivar	Number of rows	Drought tolerance	Pedigree
Goharan	6	High	Rhn-03//L.527/NK1272
Behrokh	2	Low	Novosadski-444
Nik	6	Medium	Lignee 527/NK1272//JLB70-63 (ICB90-0399-17F5-OAP
Fajr30	6	Low	Lignee131/Gerbel//Alger-Ceres/3/Gloria''S''/Copal''s''
Reyhan03	6	High	As46//Avt/Aths
M-92-9	6	High	Ahwaz-12115
CB-84-10	6	Medium	IPA7/4/AwBlack/Aths//Arar/3/9Cr279-07/Roho/5/Rhn-03//
M-93-16	2	High	SLB44-56/Lignee131
M-94-15	6	High	Lignee 527/NK1272//JLB 70-63/6/BST-6(Sadik-10=(3896/1-3/4/1246/1-3/3/
RGT Planet	6	Low	Concerto*TamTam

Table S2. Analysis of variance (ANOVA) for forage yield and silage quality traits of barley cultivars under different environments, soil moisture condition, and nitrogen levels.

SOURCE	Mean Square														
	DF	At the mid-dough stage (Z85)				In silage									
		DMY	SDM	Ash	Crude protein	TSC	ADF	NDF	DIG14	DIG30	pH	DDM	RFV	NE _L	
Environment (E)	1	186047889**	425**	87.1**	3.93*	13.5**	14.3 ^{ns}	1.55 ^{ns}	8891*	1912 ^{ns}	0.003 ^{ns}	8601 ^{ns}	68.3 ^{ns}	0.002**	
Rep(E)	4	4033177	1.42	0.772	469	0.324	13.4	1.18	796	1304	0.014	2062	39.2	50.000	
Soil moisture condition ⁱⁱ (SMC)	1	798667595**	569**	11.7**	1.80*	282**	148**	409**	1141214**	520233**	0.746**	89631**	7598**	0.320**	
E* SMC	1	70207738**	1.68 ^{ns}	0.541 ^{ns}	2.53*	3.64**	0.495 ^{ns}	8.85*	7282**	6943*	0.037 ^{ns}	286 ^{ns}	129 ^{ns}	0.000 ^{ns}	
SMC *Rep(E)	4	1369097	0.623	0.485	0.189	0.052	8.90	1.09	260	381	0.017	1315	17.4	0.000	
Nitrogen ⁱⁱⁱ (N)	1	52609761**	82.9**	124**	65.4**	93.5**	428**	877**	566124**	717211**	0.800**	258012**	17565**	0.021**	
E*N	1	7871692*	11.7**	0.810 ^{ns}	0.040 ^{ns}	0.393 ^{ns}	4.90*	32.2**	20521**	14720*	0.001 ^{ns}	2101*	247**	0.001**	
SMC *N	1	17343513**	3.99*	0.789 ^{ns}	0.028 ^{ns}	0.123 ^{ns}	2.67 ^{ns}	0.287 ^{ns}	7702*	7141 ^{ns}	0.008 ^{ns}	1722 ^{ns}	44.2 ^{ns}	0.000 ^{ns}	
E* SMC *N	1	6355 ^{ns}	9.74**	0.350 ^{ns}	0.769 ^{ns}	0.000 ^{ns}	0.376 ^{ns}	13.1**	17642**	216 ^{ns}	0.017 ^{ns}	214 ^{ns}	97.8*	0.000 ^{ns}	
Rep (E* SMC *N)	8	1021683	0.555	0.476	0.492	0.100	4.69	0.599	1295	1863	0.019	338	11.2	0.001	
Cultivars (C)	9	6598591**	46.1**	10.7**	0.447**	18.2**	337**	115**	81733**	86641**	0.944**	22803**	2028**	0.002 ^{ns}	
C*E	9	1501589 ^{ns}	41.7**	3.64**	0.606**	11.9**	606**	87.3**	91832**	86954**	0.284**	40730**	1913**	0.005 ^{ns}	
C* SMC	9	2976510**	10.8**	2.40**	0.168 ^{ns}	3.9**	4.51 ^{ns}	2.45 ^{ns}	6844 ^{ns}	2145 ^{ns}	0.088 ^{ns}	292 ^{ns}	18.1 ^{ns}	0.000 ^{ns}	
C*N	9	252299 ^{ns}	2.13 ^{ns}	0.301 ^{ns}	0.182 ^{ns}	0.357 ^{ns}	9.77 ^{ns}	11.7**	7162 ^{ns}	2151 ^{ns}	0.012 ^{ns}	646 ^{ns}	109**	0.000 ^{ns}	
C*E* SMC	9	740477 ^{ns}	4.36**	0.521 ^{ns}	0.138 ^{ns}	2.49**	18.6 ^{ns}	5.32**	8225*	5412 ^{ns}	0.269**	1262 ^{ns}	68.5*	0.000 ^{ns}	
C*E*N	9	238011 ^{ns}	3.33	0.821 ^{ns}	0.058 ^{ns}	0.461 ^{ns}	6.11 ^{ns}	6.12**	4941 ^{ns}	1223 ^{ns}	0.063 ^{ns}	419 ^{ns}	38.2 ^{ns}	0.000 ^{ns}	
C* SMC *N	9	187178 ^{ns}	1.06 ^{ns}	0.359 ^{ns}	0.093 ^{ns}	0.269 ^{ns}	4.26 ^{ns}	2.57 ^{ns}	2893 ^{ns}	1615 ^{ns}	0.021 ^{ns}	294 ^{ns}	36.4 ^{ns}	0.000 ^{ns}	
C*E* SMC *N	9	256979 ^{ns}	1.20 ^{ns}	0.800 ^{ns}	0.126 ^{ns}	0.558 ^{ns}	5.44 ^{ns}	0.57 ^{ns}	3294 ^{ns}	851 ^{ns}	0.051 ^{ns}	368 ^{ns}	5.14 ^{ns}	0.000 ^{ns}	
Error	144	774242	1.43	0.860	0.402	0.742	1.71	1.99	3831	3561	0.083	1032	30.3	0.002	
CV		9.75	3.97	7.79	4.93	13.2	4.79	3.25	2.97	2.73	7.0	1.5	3.75	3.48	

DMY, dry matter yield; SDM, silage dry matter content; TSC, total soluble carbohydrate; ADF, acid detergent fiber; NDF, neutral detergent fiber; DIG14, digestibility after 14 hours; DIG30, digestibility after 30 hours; DDM, digestible dry matter; RFV, relative feed value; NEL, net energy for lactation. ⁱEnvironment 1 (22 Oct. 2017) and Environment 2 (4 March, 2018), ⁱⁱSoil moisture condition (control, 55% MAD and stress, 85% MAD), ⁱⁱⁱNitrogen (N0, 0 kg/ha and N1, 62.5 kg/ha). **, * are significant, respectively, at 1 and 5% probability levels and ^{ns} is non-significant.

Table S3. The interaction effects of environments and cultivar on ash, crude protein, ADF, DIG30 and DDM in barley.

Cultivars	In silage									
	Ash (g/kg)		Crude protein (g/kg DM)		ADF (g/kg)		DIG30 (g/kg)		DDM (g/kg)	
	E1 ⁱ	E 2	E1 ⁱ	E 2	E1 ⁱ	E 2	E1 ⁱ	E 2	E1 ⁱ	E 2
Goharan	104±4.7 ^l	127±3.9 ^{b-d}	132± 6.1 ^{ab}	128± 5.8 ^{b-c}	292± 6.2 ^b	260± 4.3 ^{gh}	702±10.1 ^{cd}	711± 7.2 ^{bc}	662± 5.1 ⁱ	693± 3.3 ^{cd}
Behrokh	114±3.2 ^{fj}	119± 2.6 ^{e-h}	132± 8.5 ^{a-c}	127± 9.0 ^{e-c}	228± 4.2 ^j	310± 7.2 ^a	671± 8.2 ^{fg}	660± 10.2 ^g	713± 3.1 ^a	651± 6.2 ^j
Nik	112±2.4 ^{h-k}	121± 4.8 ^{c-f}	134±8.8 ^{±a}	126± 8.3 ^c	273± 5.8 ^{d-f}	288± 5.9 ^{bc}	682± 8.0 ^{ef}	670± 8.1 ^{fg}	682± 4.2 ^{c-g}	663± 5.1 ^{hi}
Fajr30	118±2.7 ^{e-i}	125± 2.7 ^{b-c}	129±10.3 ^{b-c}	127± 8.9 ^{b-c}	276± 9.3 ^{de}	263± 5.6 ^{f-h}	713± 8.0 ^{bd}	693± 7.3 ^{de}	675± 7.1 ^{fg}	680± 4.2 ^{c-e}
Reyhan03	105±2.8 ^{kl}	125± 2.4 ^{b-c}	131± 7.3 ^{a-d}	128± 6.2 ^{b-c}	311± 7.8 ^a	280± 5.3 ^{cd}	671±11.5 ^{fg}	732± 9.0 ^a	672± 6.0 ^{gh}	652± 4.3 ^j
CB-84-10	116±3.0 ^{fj}	128± 2.9 ^{bc}	126± 8.5 ^{de}	126± 6.7 ^{de}	247± 5.1 ⁱ	267± 5.3 ^{c-g}	644±8.4 ^h	685±12.4 ^{ef}	703± 4.0 ^b	681± 4.0 ^{d-f}
M-92-9	110±4.7 ^{j-l}	129± 4.5 ^b	125± 8.1 ^c	128± 7.9 ^{b-c}	288± 5.9 ^{bc}	290± 4.4 ^{bc}	683± 7.0 ^{ef}	684±8.2 ^{ef}	663± 5.2 ^{hi}	664± 3.2 ^{hi}
M-93-16	127±2.3 ^{bc}	144± 3.4 ^a	129± 8.6 ^{b-c}	129± 9.5 ^{a-c}	255± 3.9 ^{hi}	260± 4.3 ^{gh}	721± 8.2 ^{ab}	64.3± 7.3 ^h	690± 3.2 ^{bc}	690± 3.1 ^{cd}
M-94-15	110±2.5 ^{j-l}	120± 4.1 ^{d-g}	131± 6.6 ^{a-d}	126± 8.3 ^c	275± 6.1 ^{de}	255± 5.9 ^{hi}	725± 7.1 ^{ab}	721±7.2 ^b	674± 5.5 ^{fg}	693± 5.2 ^{bc}
RGT-Planet	113±4.5 ^{g-k}	111± 3.2 ^{i-l}	130± 7.2 ^{a-c}	128± 8.4 ^{b-c}	258± 5.6 ^{gh}	280± 6.1 ^{cd}	722± 8.2 ^{ab}	704±10.3 ^{cd}	694± 4.1 ^{cd}	672± 5.2 ^{gh}

ADF, acid detergent fiber; DIG30, digestibility after 30 hours; DDM, digestible dry matter. ⁱE1 (22 Oct. 2017) and E2 (4 March, 2018). In each trait, numbers followed by the same letter are not significantly different ($P<0.05$)

Table S4. The interaction effects of cultivars, environments and soil moisture condition on SDM, TSC, NDF, DIG14, pH and RVF of barley silage.

Cultivar	Environment ⁱ	Soil moisture condition	In silage		
			SDM (g/kg)	TSC (mg/gDW)	NDF (g/kg)
Goharan	E1	Control	288±4.1n-q	6.3±0.32h-m	431±6.6g-j
		Stress	319±6.8e-i	9.7±0.45a	450±7.4ef
	E2	Control	283±7.0o-r	7.1±0.64d-i	401±10.0o-q
		Stress	307±4.4i-l	9.9±0.49a	439±7.5f-h
Behrokh	E1	Control	275±2.9q-u	6.2±0.25i-m	377±6.7rs
		Stress	300±5.9k-m	7.8±0.37c-e	389±6.4q-s
	E2	Control	282±7.3p-s	3.8±0.52t	430±19.0g-k
		Stress	318±5.2e-i	5.2±0.36n-r	471±14.0cd
Nik	E1	Control	281±3.7p-t	4.3±0.34q-t	442±10.6fg
		Stress	312±2.5f-k	7.4±0.34d-g	484±14.7a-c
	E2	Control	31±5.1f-j	6.2±0.57i-m	410±13.5m-o
		Stress	343±4.9bc	6.4±0.35g-l	441±10.0f-h
Fajr30	E1	Control	265±5.3uv	4.2±0.12q-t	461±12.3de
		Stress	291±1.1m-p	7.0±0.21e-i	482±18.7bc
	E2	Control	326±6.2d-f	4.4±0.33q-t	426±9.4i-m
		Stress	357±4.4ab	7.5±0.49d-f	460±11.3de
Reyhan03	E1	Control	252±3.8vw	5.2±0.31n-q	472±5.0cd
		Stress	299±7.0k-n	6.5±0.17f-k	499±5.9a
	E2	Control	247±5.1w	5.6±0.63k-o	423±9.9i-n
		Stress	328±4.4de	8.1±0.50cd	464±11.6de
CB-84-10	E1	Control	297±3.9l-o	4.8±0.16o-s	374±7.2s
		Stress	324±5.5d-g	5.5±0.32l-o	383±4.2rs
	E2	Control	344±6.6a-c	5.8±0.61j-n	426±7.5i-m
		Stress	357±5.6a	6.7±0.42f-j	453±8.8ef
M-92-9	E1	Control	267±3.1u	5.4±0.45m-p	452±9.3ef
		Stress	299±4.9k-n	8.6±0.34bc	489±12.1ab
	E2	Control	284±4.9o-r	5.4±0.58m-p	439±16.3f-h
		Stress	308±8.1h-k	6.6±0.42f-k	462±15.7de
M-93-16	E1	Control	269±4.7s-u	4.4±0.29p-t	412±8.9l-o
		Stress	277±5.1p-u	8.0±0.19cd	417±1.0j-n
	E2	Control	318±4.9e-i	4.1±0.45st	391±13.0qr
		Stress	350±4.0ab	7.3±0.55d-h	427±8.1g-l
M-94-15	E1	Control	268±4.9tu	7.5±0.37d-f	413±4.8l-o
		Stress	281±1.2p-t	9.6±0.17ab	437±6.6f-i
	E2	Control	311±4.7g-k	4.2±0.54r-t	419±9.5j-n
		Stress	336±4.3cd	7.2±0.53d-h	442±9.8f-h
RGT-Planet	E1	Control	272±6.6r-u	6.9±0.58e-i	393±10.9p-r
		Stress	321±5.9e-h	9.4±0.39ab	420±8.8j-n
	E2	Control	274±5.2r-u	6.5±0.56g-k	409±15.7n-p
		Stress	304±5.8j-m	7.4±0.41d-g	415±10.5k-o

NDF, neutral detergent fiber; SDM, silage dry matter content; TSC, Total Soluble Carbohydrate. ⁱE1 (22 Oct. 2017) and ⁱⁱE2 (4 March, 2018), ⁱⁱⁱIrrigation regime (control, 55% MAD and stress, 85% MAD). In each trait, Numbers followed by the same letter are not significantly different ($P<0.05$).

Table S4. (Continued)

Cultivar	Environment ⁱ	Irrigation ⁱⁱ	In silage		
			DIG14 (g/kg)	pH	RFV
Goharan	E1	Control	682±11.2e-j	3.7±0.10jk	144±3.2j-m
		Stress	643±8.2o-s	3.98±0.089f-j	136±3.6n
	E2	Control	652±6.1l-r	4.1±0.78d-i	161±4.3de
		Stress	610±4.4vw	3.9±0.10f-j	145±3.7i-l
Behrokh	E1	Control	673±9.1h-m	3.4±0.12k	177±3.7a
		Stress	632±10.2r-v	3.9±0.14h-j	170±3.9bc
	E2	Control	715±12.2bc	4.1±0.08c-h	144±5.8j-m
		Stress	671±16.4h-m	3.8±0.12ij	126±5.8p
Nik	E1	Control	692±12.5c-g	4.1±0.19f-j	145±4.2i-l
		Stress	643±10.1n-r	4.2±0.09b-h	129±5.6op
	E2	Control	670±7.0g-k	4.2±0.12b-h	153±5.2f-h
		Stress	623±8.1s-v	4.07±0.094f-j	140±4.8l-n
Fajr30	E1	Control	741±13.1a	4.6±0.14a	139±4.4l-n
		Stress	711±8.0bc	4.1±0.12c-i	129±7.1op
	E2	Control	680±8.3e-i	4.21±0.096b-g	151±3.7g-i
		Stress	592±8.3w	4.18±0.081b-h	138±5.1mn
Reyhan03	E1	Control	690±11.2c-f	4.65±0.083a	129±2.0op
		Stress	643±11.4p-t	4.4±0.12a-e	119±2.8q
	E2	Control	703±4.1c-e	4.47±0.080ab	150±3.9g-j
		Stress	654±9.2l-r	4.43±0.089a-d	134±4.7no
CB-84-10	E1	Control	700±17.0b-d	3.85±0.089h-j	175±3.2ab
		Stress	654±9.1j-p	4.0±0.12f-j	168±2.3c
	E2	Control	723±5.3ab	4.44±0.085a-d	150±3.5g-j
		Stress	690±15.3c-f	4.1±0.17d-i	139±4.1l-n
M-92-9	E1	Control	651±11.4k-q	4.4±0.11a-c	139±3.6l-n
		Stress	631±15.4q-v	4.1±0.11d-i	126±4.7pq
	E2	Control	692±7.0d-h	4.23±0.078b-f	143±5.7 ^{k-m}
		Stress	653±16.1m-r	4.12±0.070d-i	134±5.6no
M-93-16	E1	Control	673±9.3g-l	3.90±0.083g-j	157±4.2ef
		Stress	610±12.3u-w	3.8±0.13ij	153±5.1f-h
	E2	Control	660±5.0i-n	4.04±0.084f-j	165±5.4cd
		Stress	624±6.0s-v	3.9±0.20g-j	149±3.5h-k
M-94-15	E1	Control	695±10.5d-h	4.64±0.091a	153±2.6f-h
		Stress	643±9.1n-r	4.1±0.10e-i	143±3.4k-m
	E2	Control	670±10.1g-l	4.1±0.10f-j	156±3.9e-g
		Stress	614±14.3u-w	4.04±0.063f-j	144±4.9j-m
RGT-Planet	E1	Control	635±14.5p-t	4.22±0.091b-g	165±5.1cd
		Stress	613±11.4t-v	4.1±0.11e-i	152±4.7f-h
	E2	Control	660±7.1i-o	4.1±0.11f-j	155±6.6f-h
		Stress	631±14.3q-u	4.00±0.092f-i	151±4.7g-i

DIG14, digestibility after 14 hours; RFV, relative feed value. ⁱE1 (22 Oct. 2017) and E2 (4 March, 2018), ⁱⁱIrrigation regime (control, 55% MAD and stress, 85% MAD). In each trait, Numbers followed by the same letter are not significantly different ($P<0.05$).

Table S5. Analysis of variance (ANOVA) for acetic, lactic, propionic and butyric acid content in barley cultivars under different environments and soil moisture condition.

Source	DF	acetic	lactic	propionic	butyric
Environment ⁱ (E)	1	81.2**	217**	0.419**	0.003**
Rep (E)	4	0.477	1.28	0.003	0.000
Soil moisture condition ⁱⁱ (SMC)	1	60.9**	1442**	0.990**	0.029**
E* SMC	1	1.47 ^{ns}	14.4**	0.061*	0.000 ^{ns}
I*Rep (E)	4	0.779	0.316	0.003	0.000
Cultivars (C)	3	5.92 ^{ns}	143**	0.327**	0.002**
C*E	3	2.22 ^{ns}	67.0**	0.012 ^{ns}	0.000 ^{ns}
C* SMC	3	1.48 ^{ns}	13.80 ^{ns}	0.002 ^{ns}	0.000 ^{ns}
C*E* SMC	3	0.14 ^{ns}	4.08 ^{ns}	0.007 ^{ns}	0.000 ^{ns}
Error	24	2.61	9.71	0.020	0.003
CV		12.3	8.18	7.63	10.3

ⁱEnvironment 1 (22 Oct. 2017) and Environment 2 (4 March, 2018), ⁱⁱSoil moisture condition (control, 55% MAD and stress, 85% MAD); **, * are significant, respectively, at 1 and 5% probability levels and ^{ns} is non-significant.