Supporting information

Fig. S1 Comparison of beta diversity between core and non-core bacterial communities under different alfalfa returning amount. Different lowercase letters (a, b, c) means significant differences among treatments in core bacterial communities (P <0.05, multiple comparison with Turkey HSD test), Different uppercase letters (A, B, C) means significant differences among treatments in non-core bacterial communities (P <0.05, multiple comparison with Turkey HSD test), Error bars represent the standard errors. Comparison between two groups based on independent sample T-test (***, P<0.001).

Fig. S2 The relative abundance of core and non-core bacteria genus in different alfalfa returning amount. "Others" indicate genus with extremely low abundance or unclassified genus. 0, 25%, 50%, 75%, 100% represent different alfalfa returning amount, respectively.

Fig. S3 Pie charts showing the number of ASVs representing specialists in each different alfalfa returning amounts based on SPEC-OCCU plots.

Fig. S4 Quantifying the relative importance of alpha diversity of key species of core and non-core bacteria to *P. frumentum* biomass under different alfalfa returning amount based on multiple linear regression.

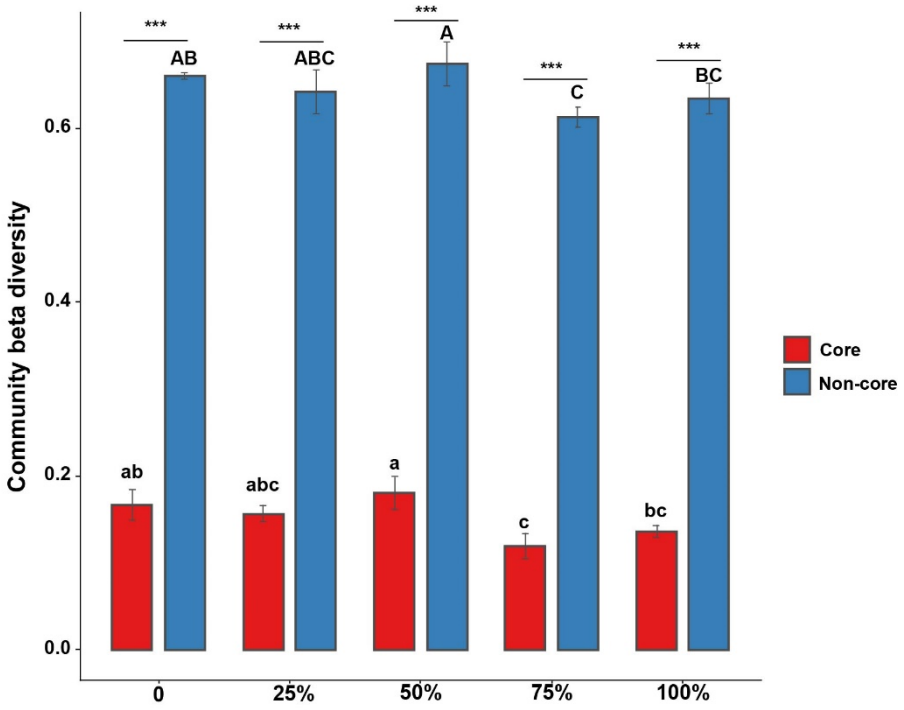
***
***
***
***
***
AB
ABC
A
C
BC
ab
abc
a
c
bc
Community beta diversity
0.0
0.2
0.4
0.6
0
25%
50%
75%
100%
Core
Non-core

Fig. S1

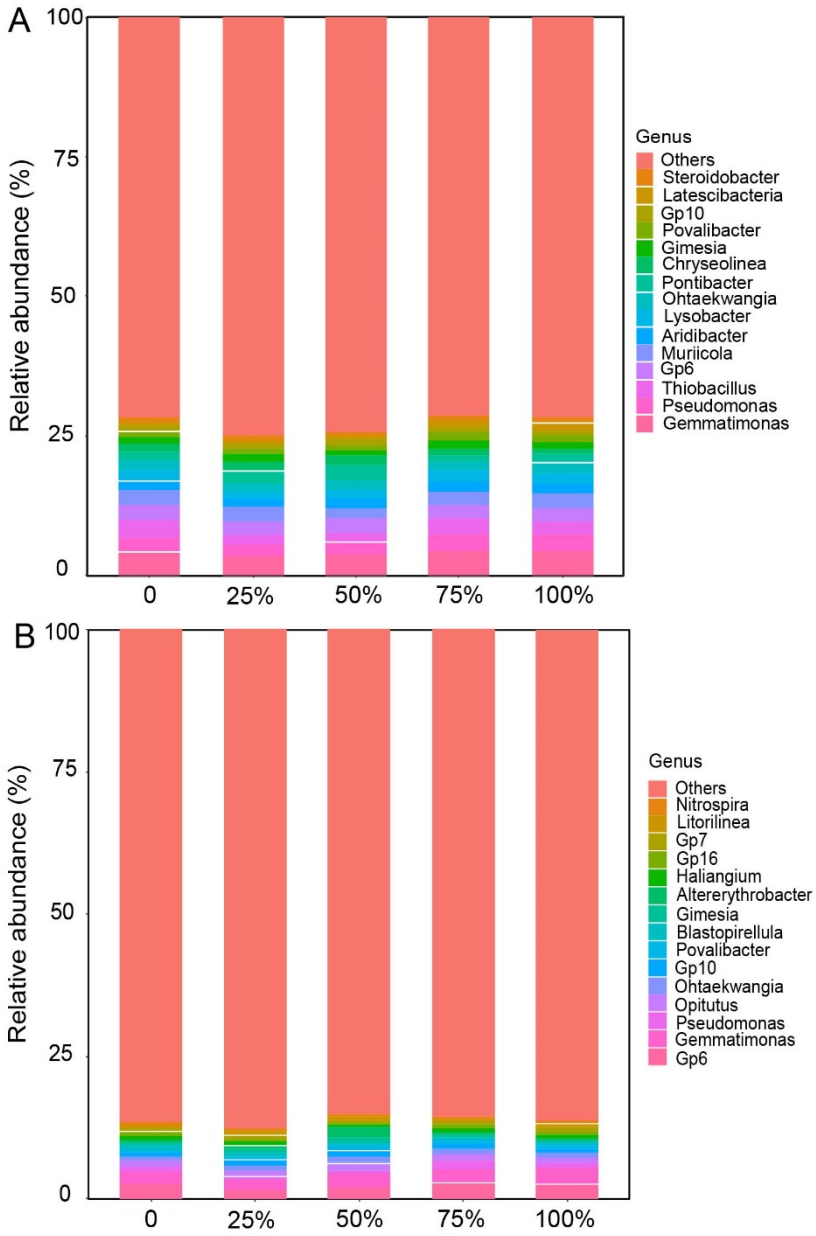
A
100
75
50
25
0
Relative abundance (%)
0
25%
50%
75%
100%
Genus
Others
Steroidobacter
Latescibacteria
Gp10
Povalibacter
Gimesia
Chryseolinea
Pontibacter
Ohtaekwangia
Lysobacter
Aridibacter
Muriicola
Gp6
Thiobacillus
Pseudomonas
Gemmatimonas
B
100
75
50
25
0
Relative abundance (%)
0
25%
50%
75%
100%
Genus
Others
Nitrospira
Litorilinea
Gp7
Gp16
Haliangium
Altererythrobacter
Gimesia
Blastopirellula
Povalibacter
Gp10
Ohtaekwangia
Opitutus
Pseudomonas
Gemmatimonas
Gp6

Fig. S2

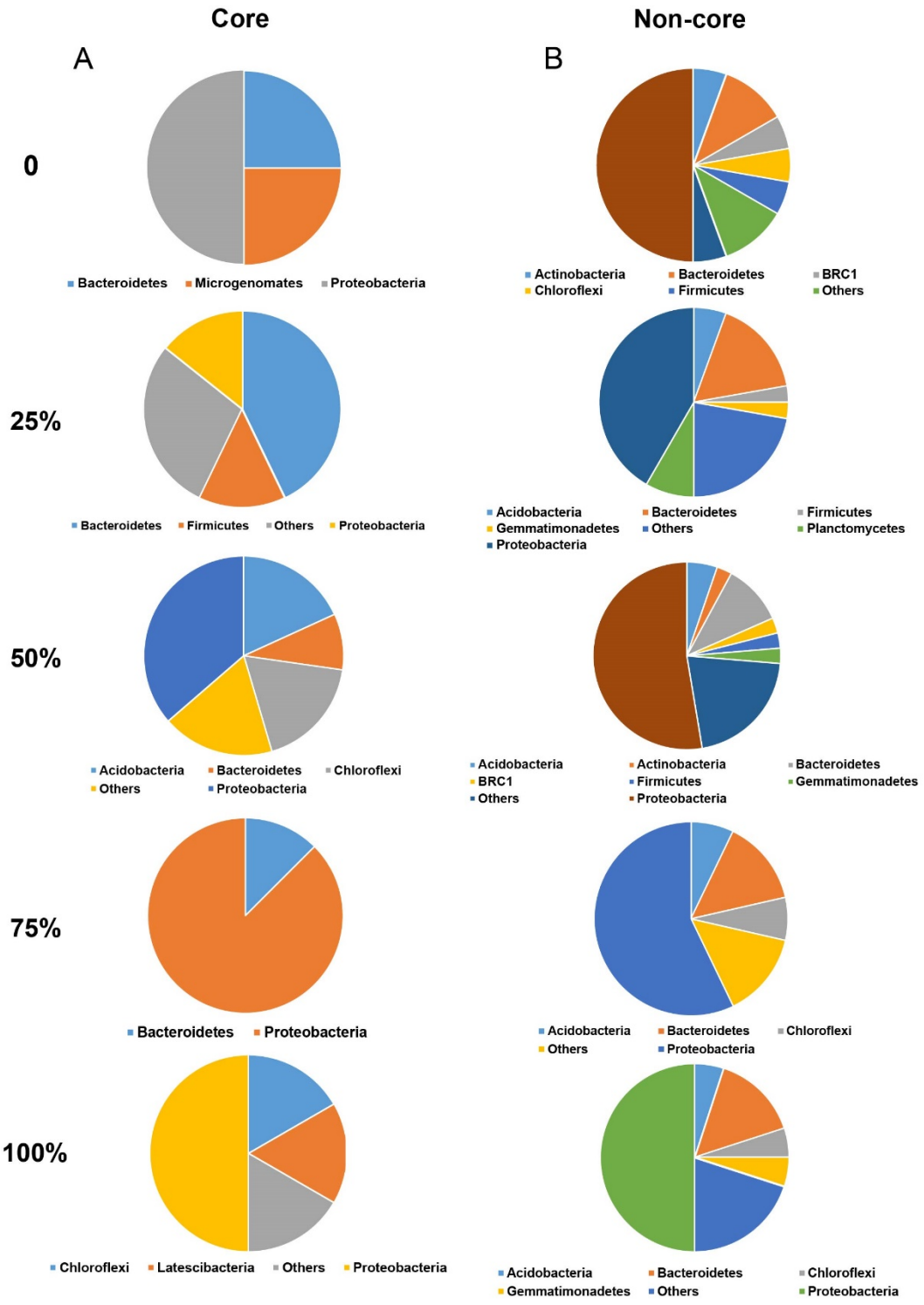
Core
Non-core
A
B
0
Bacteroidetes
Microgenomates
Proteobacteria
Actinobacteria
Bacteroidetes
BRC1
Chloroflexi
Firmicutes
Others
25%
Bacteroidetes
Firmicutes
Others
Proteobacteria
Acidobacteria
Bacteroidetes
Firmicutes
Gemmatimonadetes
Others
Planctomycetes
Proteobacteria
50%
Acidobacteria
Bacteroidetes
Chloroflexi
Others
Proteobacteria
Acidobacteria
Actinobacteria
Bacteroidetes
BRC1
Firmicutes
Gemmatimonadetes
Others
Proteobacteria
75%
Bacteroidetes
Proteobacteria
Acidobacteria
Bacteroidetes
Chloroflexi
Others
Proteobacteria
100%
Chloroflexi
Latescibacteria
Others
Proteobacteria
Acidobacteria
Bacteroidetes
Chloroflexi
Gemmatimonadetes
Others
Proteobacteria

Fig. S3

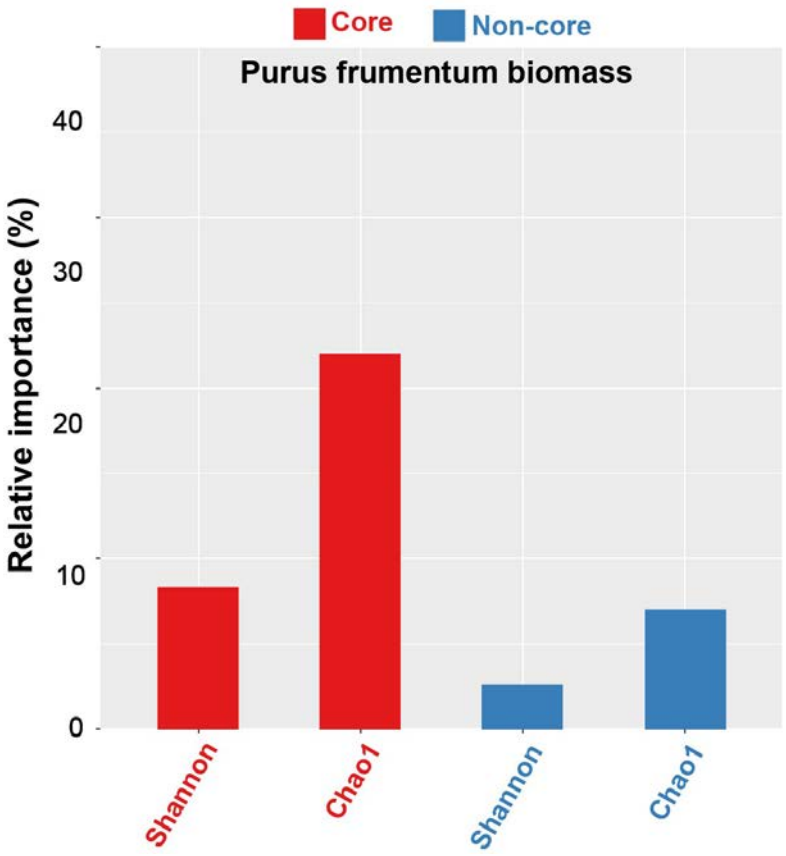
Core
Non-core
Purus frumentum biomass
Relative importance (%)
40
30
20
10
0
Shannon
Chao1
Shannon
Chao1

Fig. S4

Table S1 Comparison of relative abundance of core and non-core dominant bacteria under different alfalfa returning amount in saline alkali soil field experiment

	0			25%			50%			75%			100%		
	Core	Non-core	t (*p*)	Core	Non-core	t (*p*)	Core	Non-core	t (*p*)	Core	Non-core	t (*p*)	Core	Non-core	t (*p*)
Gemmatimonas	0.04	0.02	6.85***	0.03	0.02	12.11***	0.04	0.02	5.9***	0.04	0.02	15.3***	0.04	0.03	8.74***
Gp6	0.03	0.03	-0.33	0.02	0.02	3.73*	0.03	0.02	1.71	0.03	0.03	-1.93	0.03	0.03	-0.18
Pseudomonas	0.02	0.01	6.2***	0.02	0	6.04***	0.02	0.01	7.59***	0.03	0.02	6.24***	0.03	0.01	10.38***
Ohtaekwangia	0.02	0.01	4.52**	0.02	0.01	2.46	0.02	0.01	3.69*	0.01	0.01	5.38**	0.02	0.01	3.12*
Gimesia	0.01	0.01	4.6**	0.01	0.01	5.88***	0.01	0.01	1.06	0.01	0	9.76***	0.01	0.001	13.69***
Povalibacter	0.01	0.001	3.56*	0.01	0.01	2.29	0.01	0.01	-0.65	0.01	0.01	3.13*	0.01	0.01	2.76*
Gp10	0.01	0.01	1.54	0.01	0.01	-0.69	0.01	0.01	0.35	0.01	0.01	-0.68	0.01	0.01	1.6

Note: 0, 25%, 50%, 75%, 100% represent different alfalfa returning amount, respectively. *, P <0.05; **, P< 0.01; ***, P<0.001.

Table S2 Relationship between soil physicochemical properties and *P. frumentum* biomass based on spearman correlation analysis

	pH (H_2O)	EC ($\mu S \cdot cm^{-1}$)	SOC ($g \cdot kg^{-1}$)	TN ($g \cdot kg^{-1}$)	AN ($mg \cdot kg^{-1}$)	TP ($g \cdot kg^{-1}$)	AP ($mg \cdot kg^{-1}$)
Biomass	-0.54*	0.32	0.26	0.06	0.14	-0.23	-0.51

Note: 0, 25%, 50%, 75%, 100% represent different alfalfa returning amount, respectively; Biomass, *P. frumentum* biomass; EC, conductivity; SOC, soil organic carbon; TN, soil total nitrogen; AN, alkali-hydrolyzable nitrogen; TP, soil total phosphorus; AP, available phosphorus. *, $P < 0.05$.

Table S3 Abundance of potential ecological functions of core bacteria under different alfalfa returning amount in saline alkali soil field experiment

	Function	0	25%	50%	75%	100%
Energy source	aerobic chemoheterotrophy	14.86(0.27)ab	13.89(0.42)a	15.41(0.58)a	14.49(0.06)ab	14(0.33)a
Carbon cycle	methanotrophy	0.16(0.04)b	0.19(0.02)ab	0.26(0.04)a	0.1(0.01)b	0.14(0.02)b
	chitinolysis	1.89(0.12)a	1.11(0.08)c	1.52(0.14)b	2.07(0.11)a	1.77(0.08)ab
	cellulolysis	2.25(0.2)bc	3.15(0.17)ab	3.62(0.67)a	1.66(0.09)c	1.96(0.11)c
	fermentation	1.91(0.16)a	1.45(0.06)bc	1.18(0.09)c	1.76(0.12)ab	1.83(0.19)ab
Nitrogen cycle	aerobic ammonia oxidation	0.27(0.04)a	0.25(0.04)a	0.24(0.04)a	0.24(0.02)a	0.26(0.02)a
	aerobic nitrite oxidation	0.49(0.07)a	0.55(0.01)a	0.26(0.02)b	0.43(0.02)a	0.53(0.02)a
	nitrogen fixation	0.21(0.01)a	0.13(0.02)b	0.13(0.03)b	0.16(0.01)ab	0.14(0.01)b
	nitrite respiration	0.31(0.04)ab	0.26(0.02)ab	0.29(0.09)ab	0.41(0.03)a	0.24(0.01)b
	nitrate respiration	1.12(0.09)ab	0.83(0.05)b	0.89(0.18)b	1.42(0.09)a	1.07(0.08)ab
	nitrate reduction	0.24(0.03)a	0.28(0.07)a	0.27(0.11)a	0.25(0.05)a	0.34(0.04)a
Sulfur cycle	sulfate respiration	0.38(0.08)ab	0.52(0.13)a	0.22(0.01)b	0.5(0.07)a	0.57(0.01)a
	sulfur respiration	0.62(0.1)ab	0.55(0.04)b	0.22(0.03)c	0.88(0.13)a	0.83(0.12)ab
	sulfite respiration	0.05(0.01)ab	0.08(0.02)a	0.01(0.01)b	0.08(0.02)a	0.09(0)a
	dark sulfide oxidation	3.35(0.5)a	1.63(0.21)c	1.6(0.15)c	2.91(0.17)ab	2.25(0.14)bc

Note: 0, 25%, 50%, 75%, 100% represent different alfalfa returning amount, respectively; EC, conductivity; SOC, soil organic carbon; TN, soil total nitrogen; AN, alkali-hydrolyzable nitrogen; TP, soil total phosphorus; AP, available phosphorus. Additionally, different lowercase letters (a, b, c) mean significant differences among treatments (P <0.05, multiple comparison with Turkey HSD test). Error bars represent the standard errors.

Table S4 Abundance of potential ecological functions of non-core bacteria under different alfalfa returning amount in saline alkali soil field experiment

	Function	0	25%	50%	75%	100%
Energy source	aerobic chemoheterotrophy	14.43(0.88)ab	14.3(0.61)ab	18.17(2.15)a	14.31(0.73)ab	11.58(0.83)b
Carbon cycle	methanotrophy	0.62(0.08)a	0.74(0.04)a	0.68(0.22)a	0.53(0.1)a	0.6(0.1)a
	chitinolysis	0.69(0.02)a	0.53(0.02)a	0.46(0.07)a	0.57(0.03)a	0.52(0.14)a
	cellulolysis	0.69(0.03)b	1.34(0.2)ab	1.76(0.55)a	1.3(0.25)ab	0.63(0.18)b
	fermentation	2.37(0.12)a	2.3(0.12)a	2.75(0.46)a	2.77(0.44)a	2.31(0.03)a
Nitrogen cycle	aerobic ammonia oxidation	0.21(0.12)a	0.17(0.05)a	0.25(0.11)a	0.25(0.02)a	0.12(0.04)a
	aerobic nitrite oxidation	0.66(0.09)a	0.47(0.09)a	0.41(0.12)a	0.55(0.01)a	0.62(0.15)a
	nitrogen fixation	0.16(0.05)a	0.14(0.05)a	0.1(0.05)a	0.23(0.1)a	0.09(0.03)a
	nitrite respiration	0.17(0.04)ab	0.06(0.04)c	0.08(0.01)bc	0.28(0.04)a	0.11(0.02)bc
	nitrate respiration	0.46(0.04)b	0.24(0.01)c	0.41(0.08)b	0.62(0.05)a	0.23(0.04)c
	nitrate reduction	1.65(0.16)a	1.66(0.19)a	1.69(0.14)a	1.49(0.12)a	1.28(0.1)a
Sulfur cycle	sulfate respiration	1.47(0.29)ab	1.58(0.3)ab	0.71(0.08)b	1.48(0.25)ab	2.08(0.33)a
	sulfur respiration	0.33(0.05)a	0.18(0.05)ab	0.07(0.01)b	0.39(0.15)a	0.4(0.01)a
	sulfite respiration	0.12(0.05)ab	0.12(0.07)ab	0.08(0.02)b	0.16(0.05)ab	0.27(0.04)a
	dark sulfide oxidation	0.01(0.01)a	0.01(0.01)a	0.01(0.01)a	0.01(0.01)a	0.03(0.02)a

Note: 0, 25%, 50%, 75%, 100% represent different alfalfa returning amount, respectively; EC, conductivity; SOC, soil organic carbon; TN, soil total nitrogen; AN, alkali-hydrolyzable nitrogen; TP, soil total phosphorus; AP, available phosphorus. Additionally, different lowercase letters (a, b, c) mean significant differences among treatments (P <0.05, multiple comparison with Turkey HSD test). Error bars represent the standard errors.