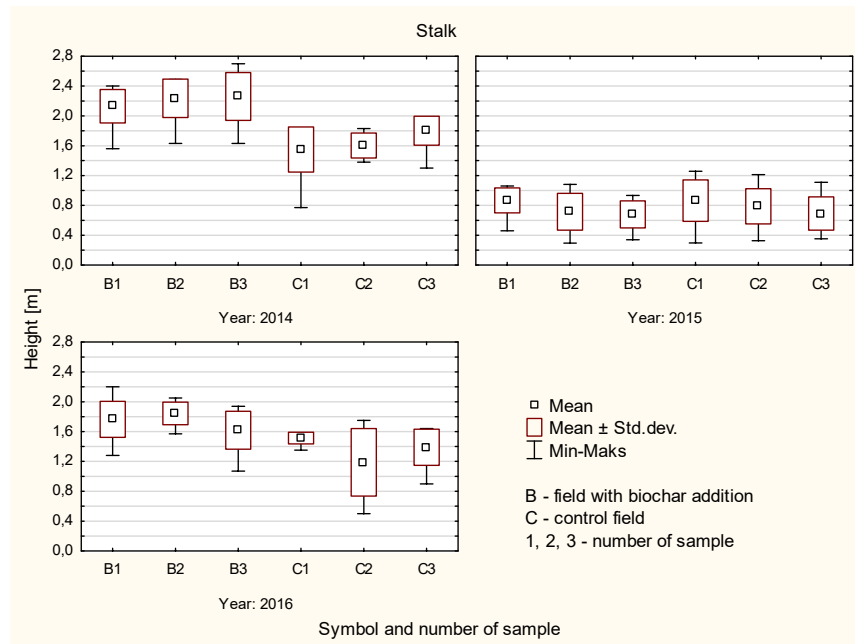**Supplementary data for the manuscript entitled "Biochar improves maize growth but has a limited effect on soil properties: evidence from a three-year field experiment"**

Figure S1. The height of the aboveground part of maize on the field with the addition of biochar and without the addition of biochar (control field) during experiment in 2014, 2015, 2016 years presented for each study block. B1-3 soil treated with PBC, C1-3 – control soil without PBC

Block	2014	2015	2016
B1	10	25	10
B2	10	24	11
B3	10	21	14
Σ	30	71	35
C1	12	18	11
C2	10	20	9
C3	9	22	12
Σ	31	60	32

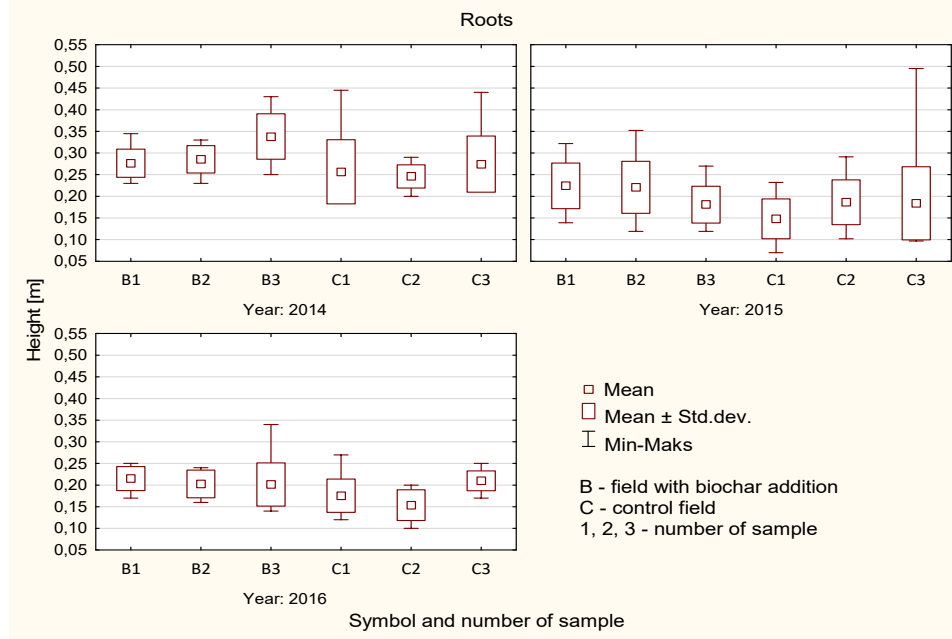| Year	Z	p
2014	3.8302	0.0001
2015	3.8832	0.0001
2016	2.1328	0.0329

Table S1. Number of plants in selected years in each study blocks B1-3 soil treated with PBC, C1-3 – control soil without PBC.

Table S2. Results of Mann–Whitney U test for values of maize height on the field with the addition of biochar and on control field during experiment in 2014, 2015, 2016 years.

Based on presented results (Figure S1) we can observe higher values of height of plants in 2014 (average value for 3 samples with biochar addition was 2.21 m, while average on control field was 1.63 m) and 2016 (average value was 1.73 m on field with biochar, while on control fields was 1.38 m). In 2015 the average values of plants height were similar: 0.76 m with biochar addition and 0.78 m in control samples. Results

from nonparametric statistical test (Mann–Whitney U test) revealed there are statistical differences between variables: "height" on PBC - S vs. C-S for all years (p=0.0001, p=0.0001, p=0.03) (see Table S2).


Figure S2. The height of roots of maize on the field with the addition of biochar and without the addition of biochar (control field) during experiment in 2014, 2015, 2016 years presented for each study block. B1-3 soil treated with PBC, C1-3 – control soil without PBC.

| Year	Z	p
2014	3.8302	0.0001
2015	3.8832	0.0001
2016	2.1328	0.0329

Table S3. Results of Mann–Whitney U test for values of maize roots on the field with the addition of biochar and on control field during experiment in 2014, 2015, 2016 years.

Based on presented results (Figure S2) we can observe higher values for roots in all years for samples with biochar addition (in 2014: average value for 3 samples with biochar addition was 0.30 m, while average on control field was 0.26 m; in 2015: 0.21 m – biochar addition vs. 0.17 m control samples; in 2016: 0.21 m – biochar addition vs. 0.18 m control samples). Results from nonparametric statistical test (Mann–Whitney U test) revealed there are statistical differences between variables: "height" on PBC-S vs. C-S for all years (p=0.0001, p=0.0001, p=0.03) (see Table S3).
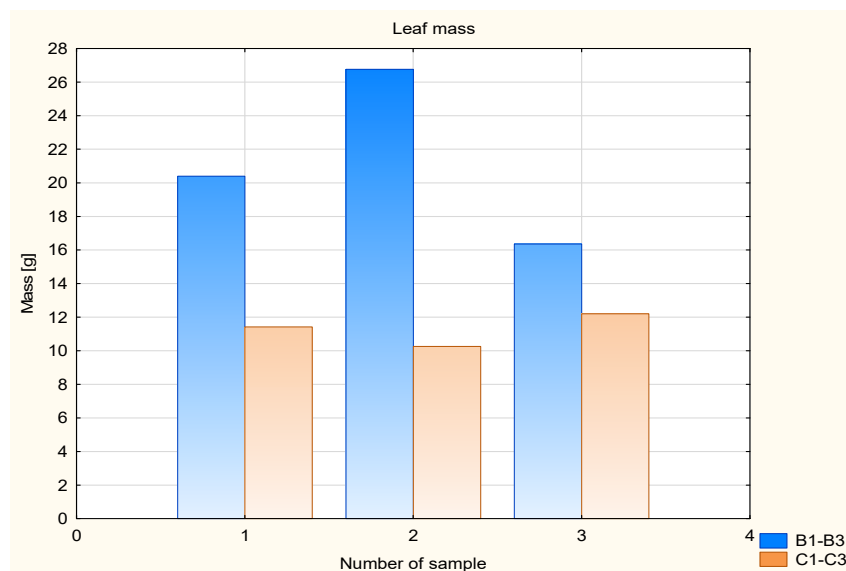
Figure S3. Mass of maize leaves from the first node above the cobs (after drying process), year 2014. B1-3 soil treated with PBC, C1-3 – control soil without PBC.

The mass of maize leaves taken from the first node above the cobs is higher for each of three samples in field with biochar addition. It is even doubled. A statistical test was performed to check if there are statistically significant differences between variables. This time a Student's t-test was performed, because the data has normal distribution and variances has normal distribution. The results of the test which are p=0.0326 (t=3.2091) prove statistical differences between variables.
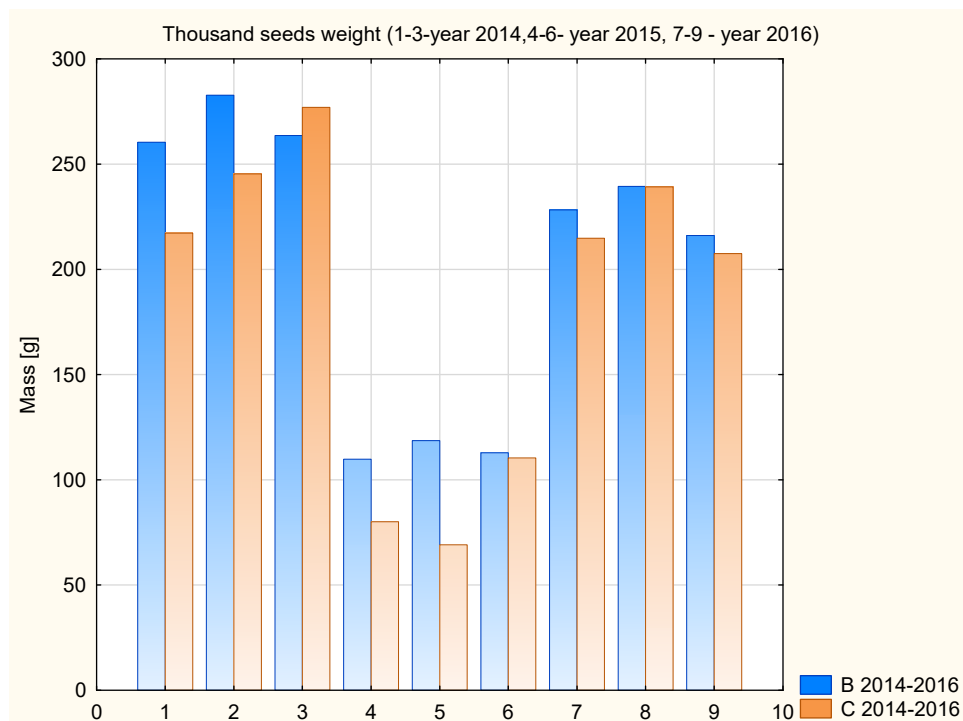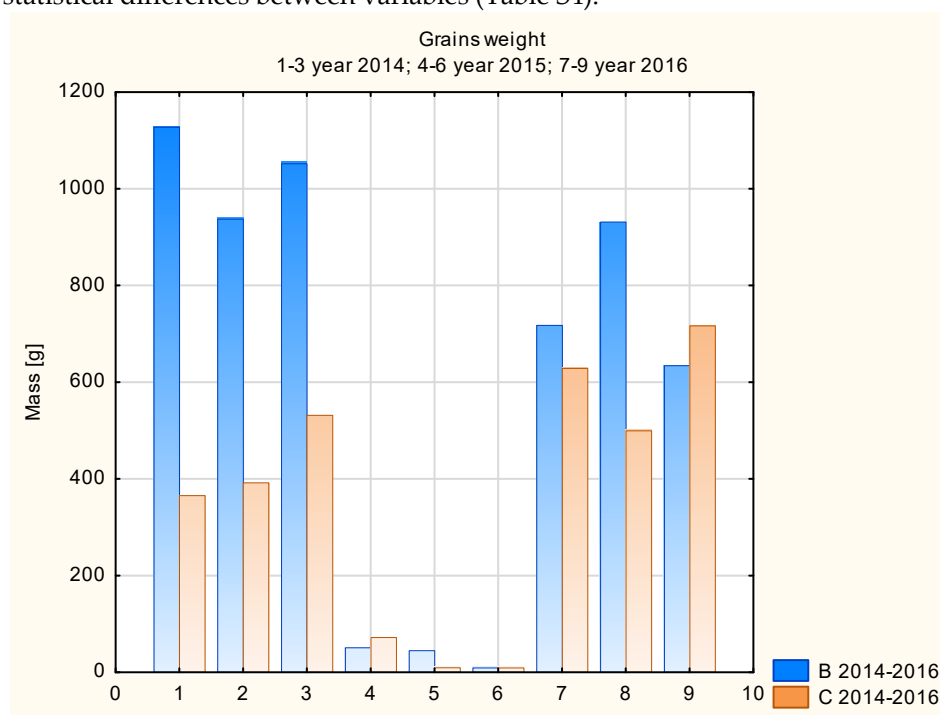

Figure S4. Thousand seeds weight (TSW) of maize cobs on the field with the addition of biochar and without the addition of biochar (control field) in years 2014-2016. B1-10 soil treated with PBC, C1-10 – control soil without PBC

Year	t	p
2014	1.2036	0.2951
2015	2.1628	0.0966
2016	0.6326	0.5613

Table S4. Results of Student's t-test for values of thousand seeds weight (TSW) of maize on the field with the addition of biochar vs. control field in 2014, 2015, 2016 years.

As we can see above (Figure S4) almost all values of thousand seeds weight in higher for fields with biochar addition (except sample no 3 from year 2014). A statistical test was performed to check if there are statistically significant differences between variables – biochar addition vs. control field. The data have normal distribution and variances have normal distribution, so a Student's t-test was performed. In all years there are no statistical differences between variables (Table S4).

Figure S5 Grains weight of maize cobs on the field with the addition of biochar and without the addition of biochar (control field) in years 2014-2016. B1-10 soil treated with PBC, C1-10 – control soil without PBC.

Seed's weight collected from each of field samples is presented on the Figure S5. Those are wet grains collected and weighted just after harvest. Grains which were dried in 105℃ present other value - thousand seeds weight. In almost all samples (except sample 6) weight of grains were higher on field with biochar addition. A statistical test was performed to check if there are statistically significant differences between variables – grains weight in each year collected from the field with biochar addition vs. control field. The data have normal distribution and variances have normal distribution for 2014 and 2016 year, so a Student's t-test was performed. In 2015 data in control sample didn't have normal distribution, so Mann–Whitney U test were performed. Only in year 2014 the results of the test which are p=0.0012 (8.066) (Table S5) prove statistical differences between variables. In 2015 and 2016 there were no statistical differences between variables (Tables S5-6).

Year	t	p
2014	8,.6626	0.00133
2016	1.3439	0.2501

| Year	Z	p
2015	0,00	1.00

Table S5. Results of Student's t-test for values of thousand seeds weight (TSW) of maize on the field with the addition of biochar vs. control field

Table S6. Results of Mann–Whitney U test for values of thousand seeds weight (TSW) of maize on the field with the addition of biochar vs. control field

Based on these values presented on Figure S5 a yield in each year were calculated.

Sample	2014 [t/ha]		2015 [t/ha]		2016 [t/ha]	
	PBC-S	C-S	PBC-S	C-S	PBC-S	C-S
1	1.2522	0.4058	0.0560	0.0800	0.7974	0.6984
2	1.0414	0.4353	0.0497	0.0106	1.0346	0.5550
3	1.1687	0.5906	0.0102	0.0103	0.7042	0.7959
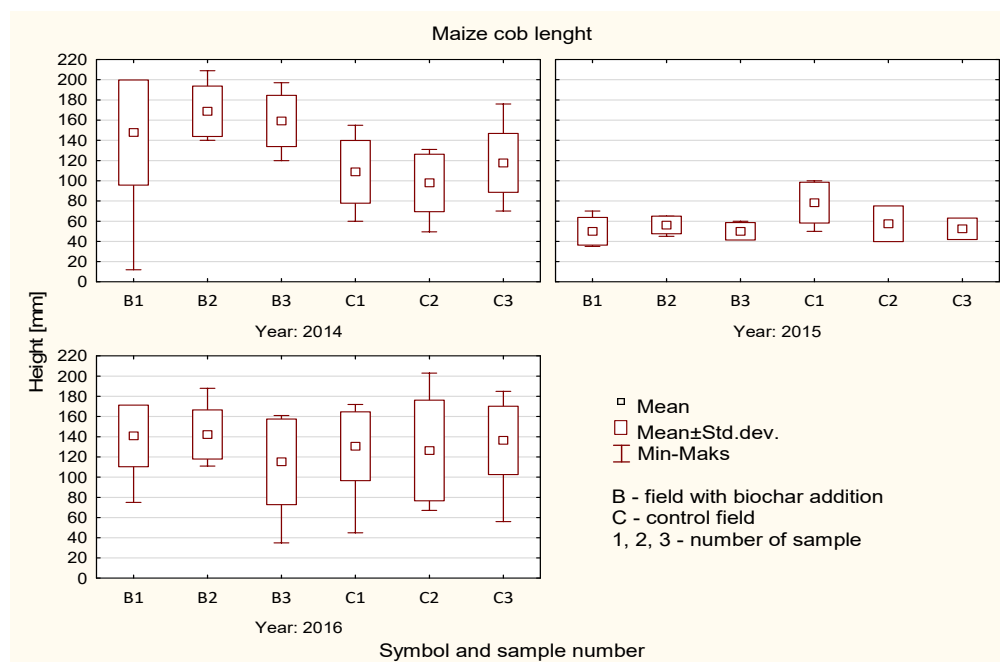
Figure S6. The cob length of maize on the field with the addition of biochar and without the addition of biochar (control field) during experiment in 2014, 2015, 2016 years presented for each study block. B1-3 soil treated with PBC, C1-3 – control soil without PBC.
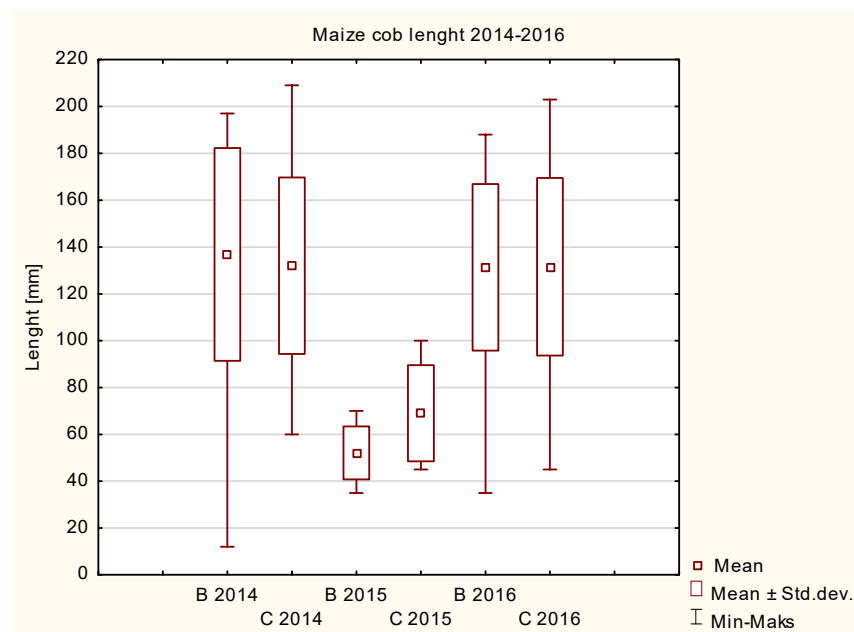
Figure S7. The cob length of maize on the field with the addition of biochar and without the addition of biochar (control field) in years 2014-2016. B2014-2016 soil treated with PBC, C2014-2016 – control soil without PBC.

Block	2014	2015	2016
B1	11	9	10
B2	10	6	12
B3	11	3	14
Σ	32	18	36
C1	9	6	11
C2	10	2	9
C3	9	2	12
Σ	28	10	32

Table S7. Number of cobs in selected years in each study blocks

| Year	Z	p
2014	5.1787	0.0000
2015	-2.1096	0.0349
2016	0.1720	0.8634

Table S8. Results of Mann–Whitney U test for values of maize corn length on the field with the addition of biochar and on control field during experiment in 2014, 2015, 2016 years
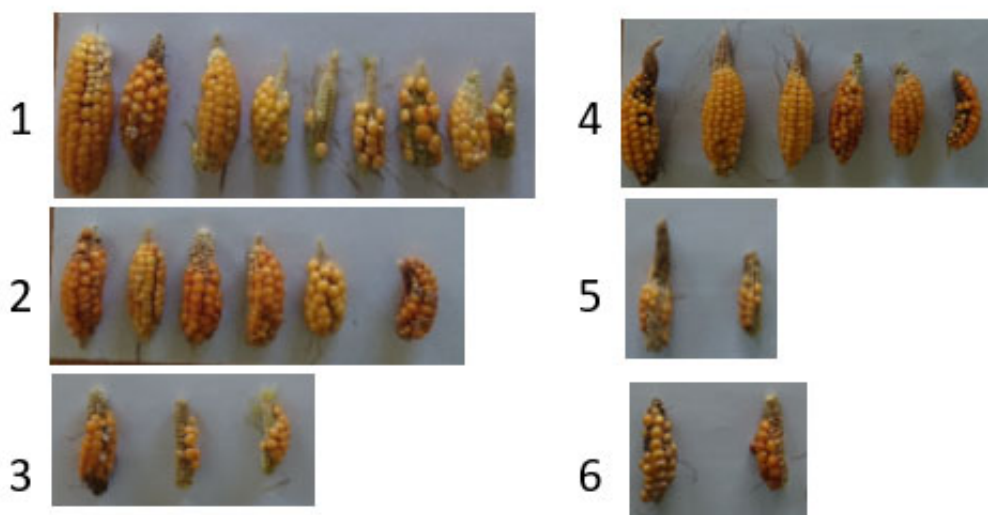
Figure S8. Comparison of maize cobs collected from the field trials containing biochar (left) and a control field (right), year 2015, phot. J.K.

Based on presented results (Figure S6) we can observe higher values of cobs for length in 2014 (average value for 3 samples with biochar addition was 158 mm, while average on control field was 107.8 mm. In 2015 the average values for length on the field with biochar addition was 52.06 mm while on control field was 69.00 mm. In 2016 average value for each field was similar 131.33 mm (B) and 131.59 (C). Results from nonparametric statistical test (Mann–Whitney U test) revealed there are statistical differences between variables: "length" on PBC-S vs. C-S for two years (p=0.0000, p=0.0349) (see Table S8). In 2016 there are no statistical differences between variables. The quantity of cobs from each sample is presented in Table S7. In all years the quantity was higher for fields with biochar addition: 2014 – 32 vs. 28; 2015 – 18 vs. 10; 2016 – 36 vs. 32.
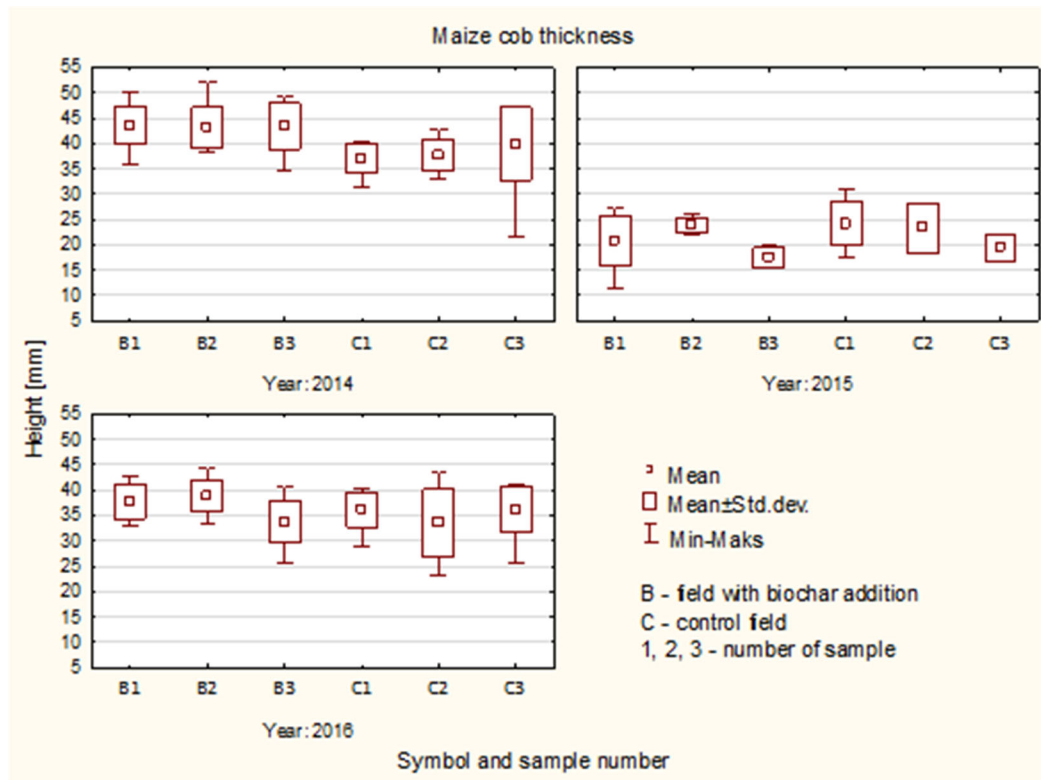
Figure S9. The cob thickness of maize on the field with the addition of biochar and without the addition of biochar (control field) in years 2014-2016. B1-3 soil treated with PBC, C1-3 – control soil without PBC.
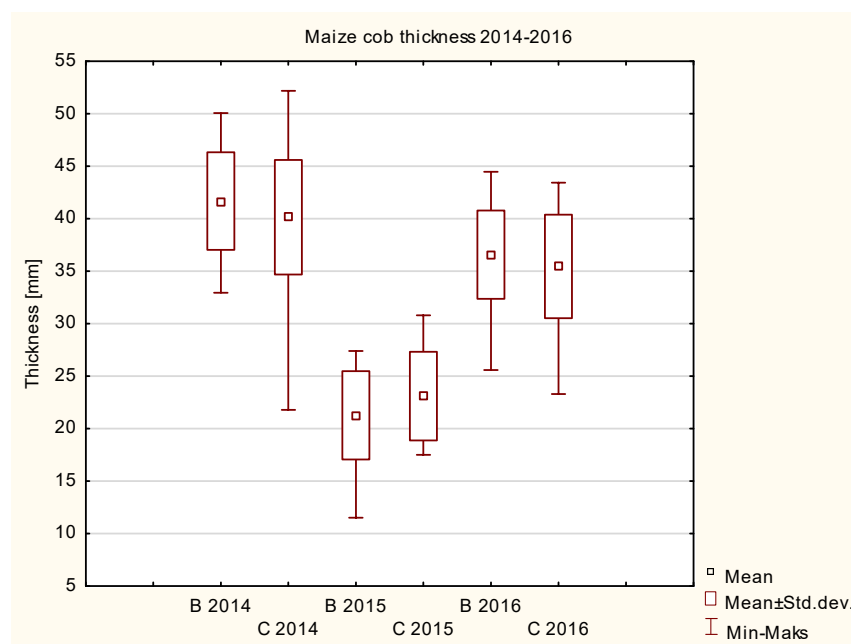
Figure S10. The cob thickness of maize on the field with the addition of biochar and without the addition of biochar (control field) in years 2014-2016. C2014-2016 – control soil without PBC.

Year	Z	p
2014	4.1415	0.00004
2016	0.6328	0.5269

Year	t	p
2015	1.0527	0.3026

Table S9. Results of Student's t-test for values of maize cob thickness on the field with the addition of biochar vs. control field.

Table S10 Results of Mann–Whitney U test for values of maize cob thickness on the field with the addition of biochar vs. control field.

Based on presented results (Figure S9) we can observe higher values of cobs for thickness in 2014 (average value for 3 samples with biochar addition was 43.40 mm, while average on control field was 38.18 mm. In 2015 the average values for thickness on the field with biochar addition was 21.27 mm while on control field was 23.10 mm. In 2016 average value for each field was similar 36.57 mm (B) and 35.46 (C). Results from statistical test revealed there are statistical differences between variables: "thickness" on PBC-S vs. C-S only for year 2014 (p=0.0000) (see Table S9). In 2015 and 2016 there are no statistical differences between variables.

Air temperature ⁰C	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2014	0.9	4.5	7.1	11.1	13.8	16.7	21.2	18	15.7	11.3	7.3	2
2015	2.1	1.7	5.5	9	13.7	17.6	21.3	23.1	15.8	8.8	6.5	5.2
2016	-1.3	4.4	4.7	9.2	15.2	18.8	19.9	18.7	17	8.6	4.4	1.1
2017	-3.8	1	7	8.1	14.2	18.9	19.3	20.3	13.7	10.6	5.4	2.9
2018	2.7	-2.4	1.8	14.3	17.3	19	20.8	21.8	16.3	11.5	6.1	2.4

Air humidity %	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2014	86.4	77.7	74.7	75.6	77.4	72.9	73.5	78	83.5	83.8	84.6	81.4
2015	80.7	78	69.7	65	68.2	65.3	60.6	57.1	67.4	77.1	80.6	81.5
2016	82.2	80	79.7	70.5	68.8	70.8	72.5	70.7	71.9	86	84.4	86.5
2017	77.5	79.7	72.4	73	73.2	65.6	71.9	69.1	82.3	82.6	83	80.6
2018	79.3	76.6	70.1	60.3	66.5	68.4	66.8	65.3	72.2	74	80.4	85.9

Precipitation [mm]	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2014	35.6	3.5	24.6	44.8	82.1	80.7	112	34.4	96.6	53.3	14.1	12.7
2015	46.9	15.9	39.7	21.2	28.1	32.6	29.2	8.1	26.7	22.9	67.5	19.6
2016	37.5	66.4	33.7	39	86.9	44.9	85.6	25.4	10.4	56.1	39.3	34.9
2017	17.2	23.5	39.1	106.1	32.6	56.8	93.9	36.2	120.2	72.9	51.5	15.3
2018	11.3	8.1	19.4	18.6	29.3	69	48.2	52.5	94.2	45.7	13.8	57.2

Snow cover [cm]	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2014	10	0	0	0	0	0	0	0	0	0	0	5
2015	11	3	0	0	0	0	0	0	0	0	1	0
2016	20	0	2	0	0	0	0	0	0	0	1	1
2017	29	12	0	1	0	0	0	0	0	0	0	4
2018	1	5	4	0	0	0	0	0	0	0	2	3

Table S11. Weather conditions during field experiment (mean monthly air temperature, humidity, precipitation and number of days with snow cover) during experiment period years 2014 – 2016 and post-treatment years 2017 and 2018.