Grafting, Scion and Rootstock Effects on Survival Rate, Vegetative Growth and Fruit Yield of High Tunnel-grown Grafted Pepper Plants

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Supplementary Information

Supplementary Tables

Supplementary Table 1. The effects of the grafting process, rootstock genotype and scion genotype on vegetative growth of four pepper cultivars at 30 DAT when grafted as scions onto five rootstocks, self-grafted or as a non-grafted control grown under high tunnel conditions during Season 1.

Effects		Plant height (cm)	No. of branches	No. of leaves	Leaf area (cm^2)
Grafting[z] and rootstock genotype[y]					
	Non-grafted	54.3 cd[x]	19.9 d	41.7 c	713.8 g
	Self-grafted	61.3 b	26.3 bc	50.2 bc	821.4 d
	CCA-4758	58.9 bc	23.9 c	54.3 b	858.5 c
	Budai csipős	48.5 d	18.6 d	51.3 b	782.7 f
	Nourdine	55.8 bc	24.3 c	69.5 a	879.5 b
	52-03 RZ	68.6 a	29.3 ab	69.3 a	801.6 e
	Tan Tan (No: 12G076)	68.3 a	31.7 a	71.4 a	960.8 a
Scion genotype[w]					
	Toronto	51.3 c	25.8 ab	64.5 a	862.4 b
	Zedinca	55.1 c	24.0 bc	57.7 ab	879.8 s
	Kurtovszka Kàpia	62.8 b	22.3 c	52.7 b	765.2 d
	Eigman	68.2 a	27.3 a	58.0 ab	817.2 c
Interactive effects					
	Scion*grafting (Sc*Gr)	0.2182	0.3277	0.6466	<0.0001
	Scion*rootstock (Sc*Rs)	0.0316	0.2824	0.1941	<0.0001

[z]Grafting effects evaluated by contrasting the horticultural performance of self-grafted scion cultivars with that of their non-grafted genotypic counterparts.

[y]Rootstock genotype effects on horticultural performance evaluated by contrasting rootstock means across scion cultivars with each other and with non-grafted control plants.

[x]Main effect means with similar postscripts were not significantly different (p <0.05) according to Fisher's least significant difference test.

[w]Scion effects on horticultural performance were determined by contrasting scion means across all rootstocks including self-grafted and non-grafted controls.

Supplementary Table 2. The effects of the grafting process, rootstock genotype and scion genotype on vegetative growth of four pepper cultivars at 50 DAT when grafted as scions onto five rootstocks, self-grafted or as a non-grafted control grown under high tunnel conditions during Season 1.

Effects		Plant height (cm)	No. of branches	No. of leaves	Leaf area (cm^2)
Grafting[z] and rootstock genotype[y]					
	Non-grafted	94.8 cd[x]	19.9 d	73.7 c	679.3 f
	Self-grafted	102.8 b	26.0 c	87.5 b	766.8 e
	CCA-4758	100.6 bc	29.6 b	87.3 b	771.4 e
	Budai csipős	88.8 d	29.8 b	91.0 b	926.3 a
	Nourdine	102.9 b	29.8 b	94.8 b	872.1 c
	52-03 RZ	113.2 a	37.4 a	114.2 a	910.4 b
	Tan Tan (No: 12G076)	119.2 a	31.8 b	109.1 a	809.3 d
Scion genotype[w]					
	Toronto	88.9 c	27.2 b	92.9 ab	889.0 a
	Zedinca	97.5 b	29.0 ab	88.1 b	846.2 b
	Kurtovszka Kàpia	112.3 a	31.2 a	98.5 a	764.8 d
	Eigman	114.0 a	29.0 ab	96.2 a	777.4 c
Interactive effects					
	Scion*grafting (Sc*Gr)	0.8803	0.9925	0.5286	<0.0001
	Scion*rootstock (Sc*Rs)	0.1518	0.0070	0.0128	<0.0001

[z]Grafting effects evaluated by contrasting the horticultural performance of self-grafted scion cultivars with that of their non-grafted genotypic counterparts.

[y]Rootstock genotype effects on horticultural performance evaluated by contrasting rootstock means across scion cultivars with each other and with non-grafted control plants.

[x]Main effect means with similar postscripts were not significantly different (p <0.05) according to Fisher's least significant difference test.

[w]Scion effects on horticultural performance were determined by contrasting scion means across all rootstocks including self-grafted and non-grafted controls.

Supplementary Table 3. The effects of the grafting process, rootstock genotype and scion genotype on vegetative growth of four pepper cultivars at 30 DAT when grafted as scions onto five rootstocks, self-grafted or as a non-grafted control grown under high tunnel conditions during Season 2.

Effects		Plant height (cm)	No. of branches	No. of leaves	Leaf area (cm^2)
Grafting[z] and rootstock genotype[y]					
	Non-grafted	56.5 d[x]	9.9 bc	35.2 cd	429.4 e
	Self-grafted	58.4 cd	11.2 b	39.6 bc	417.8 f
	CCA-4758	51.5 e	8.1 c	27.0 e	472.5 b
	Budai csipős	60.9 bc	11.0 b	41.2 ab	412.3 f
	Nourdine	57.8 cd	9.9 bc	34.8 d	444.5 d
	52-03 RZ	71.7 a	13.3 a	41.9 ab	521.3 a
	Tan Tan (No: 12G076)	63.9 b	13.5 a	45.1 a	453.0 c
Scion genotype[w]					
	Toronto	45.7 c	10.2 bc	36.0 b	472.6 b
	Zedinca	52.8 b	10.1 c	35.3 b	479.8 a
	Kurtovszka Kàpia	71.6 a	11.7 ab	39.8 a	401.8 d
	Eigman	70.3 a	11.9 a	40.1 a	446.3 c
Interactive effects					
	Scion*grafting (Sc*Gr)	0.4481	0.5477	0.8050	<0.0007
	Scion*rootstock (Sc*Rs)	0.9502	0.3758	0.0574	<0.0001

[z]Grafting effects evaluated by contrasting the horticultural performance of self-grafted scion cultivars with that of their non-grafted genotypic counterparts.

[y]Rootstock genotype effects on horticultural performance evaluated by contrasting rootstock means across scion cultivars with each other and with non-grafted control plants.

[x]Main effect means with similar postscripts were not significantly different (p <0.05) according to Fisher's least significant difference test.

[w]Scion effects on horticultural performance were determined by contrasting scion means across all rootstocks including self-grafted and non-grafted controls.

Supplementary Table 4. The effects of the grafting process, rootstock genotype and scion genotype on vegetative growth of four pepper cultivars at 50 DAT when grafted as scions onto five rootstocks, self-grafted or as a non-grafted control grown under high tunnel conditions during Season 2.

Effects		Plant height (cm)	No. of branches	No. of leaves	Leaf area (cm^2)
Grafting[z] and rootstock genotype[y]					
	Non-grafted	89.4 bc[x]	17.9 d	73.1 bc	346.4 d
	Self-grafted	92.7 b	18.3 cd	80.1 b	331.9 e
	CCA-4758	83.8 c	16.1 d	65.9 c	324.0 e
	Budai csipős	91.6 bc	21.4 bc	93.0 a	368.8 c
	Nourdine	89.3 bc	21.5 b	79.9 b	354.8 d
	52-03 RZ	101.5 a	25.0 a	96.0 a	421.0 a
	Tan Tan (No: 12G076)	96.8 ab	21.7 b	97.0 a	400.3 b
Scion genotype[w]					
	Toronto	73.5 b	18.9 b	84.5 a	443.1 a
	Zedinca	76.0 b	18.8 b	81.4 a	352.7 b
	Kurtovszka Kàpia	109.2 a	21.6 a	83.8 a	337.0 c
	Eigman	110.0 a	21.8 a	84.6 a	322.7 d
Interactive effects					
	Scion*grafting (Sc*Gr)	0.5475	0.7320	0.5286	<0.0001
	Scion*rootstock (Sc*Rs)	0.6964	0.0960	0.0128	<0.0001

[z]Grafting effects evaluated by contrasting the horticultural performance of self-grafted scion cultivars with that of their non-grafted genotypic counterparts.

[y]Rootstock genotype effects on horticultural performance evaluated by contrasting rootstock means across scion cultivars with each other and with non-grafted control plants.

[x]Main effect means with similar postscripts were not significantly different (p <0.05) according to Fisher's least significant difference test.

[w]Scion effects on horticultural performance were determined by contrasting scion means across all rootstocks including self-grafted and non-grafted controls.

Supplementary Table 5. The effects of the grafting process, rootstock genotype and scion genotype on early yield measured cumulatively from the first 45 days of harvesting of four pepper cultivars when grafted as scions to five rootstocks, self-grafted, or as a non-grafted control grown under high tunnel conditions during Season 1.

Effects		Fruit weight (g)	No. fruits per plant	Yield/m^2 (kg)
Grafting[z] and rootstock genotype[y]				
	Non-grafted	141.5 ab[x]	13.6 b	3.2 b
	Self-grafted	143.5 ab	12.9 b	2.9 b
	CCA-4758	126.7 c	10.3 c	2.1 c
	Budai csipős	137.3 b	14.3 ab	3.1 b
	Nourdine	150.6 a	13.0 b	3.0 b
	52-03 RZ	142.2 ab	16.4 a	3.9 a
	Tan Tan (No: 12G076)	144.7 ab	16.4 a	4.1 a
Scion genotype[w]				
	Toronto	187.5 a	6.5 c	2.4 c
	Zedinca	193.0 a	6.5 c	2.5 c
	Kurtovszka Kàpia	96.7 b	18.5 b	3.6 b
	Eigman	86.4 c	23.9 a	4.2 a
Interactive effects				
	Scion*grafting (Sc*Gr)	0.0195	0.0388	0.1909
	Scion*rootstock (Sc*Rs)	0.0443	0.0527	0.2866

[z]Grafting effects evaluated by contrasting the horticultural performance of self-grafted scion cultivars with that of their non-grafted genotypic counterparts.

[y]Rootstock genotype effects on horticultural performance evaluated by contrasting rootstock means across scion cultivars with each other and with non-grafted control plants.

[x]Main effect means with similar postscripts were not significantly different (p <0.05) according to Fisher's least significant difference test.

[w]Scion effects on horticultural performance were determined by contrasting scion means across all rootstocks including self-grafted and non-grafted controls.

Supplementary Table 6. The effects of the grafting process, rootstock genotype and scion genotype on early yield measured cumulatively from the first 45 days of harvesting of four pepper cultivars when grafted as scions to five rootstocks, self-grafted, or as a non-grafted control grown under high tunnel conditions during Season 2.

Effects		Fruit weight (g)	No. fruits per plant	Yield/m^2 (kg)
Grafting[z] and rootstock genotype[y]				
	Non-grafted	144.7 bc[x]	12.8 b	3.0 abc
	Self-grafted	145.1 abc	16.0 a	3.3 a
	CCA-4758	138.7 c	13.9 ab	2.9 abc
	Budai csipős	140.7 bc	12.1 b	2.8 bc
	Nourdine	146.8 abc	12.0 b	2.6 c
	52-03 RZ	152.8 a	13.2 b	3.3 a
	Tan Tan (No: 12G076)	149.2 ab	13.1 b	3.2 ab
Scion genotype[w]				
	Toronto	194.9 b	6.1 c	2.4 c
	Zedinca	209.1 a	6.0 c	2.5 c
	Kurtovszka Kàpia	98.2 c	17.0 b	3.3 b
	Eigman	79.2 d	24.0 a	3.8 a
Interactive effects				
	Scion*grafting (Sc*Gr)	0.0349	<0.0001	0.0444
	Scion*rootstock (Sc*Rs)	<0.0001	<0.0001	<0.0001

[z]Grafting effects evaluated by contrasting the horticultural performance of self-grafted scion cultivars with that of their non-grafted genotypic counterparts.

[y]Rootstock genotype effects on horticultural performance evaluated by contrasting rootstock means across scion cultivars with each other and with non-grafted control plants.

[x]Main effect means with similar postscripts were not significantly different (p <0.05) according to Fisher's least significant difference test.

[w]Scion effects on horticultural performance were determined by contrasting scion means across all rootstocks including self-grafted and non-grafted controls.

Supplementary Figures

Figure legends

Figure S1: The interactive effects of grafting and rootstocks on vegetative growth [A = number of branches 70 days after transplanting and B = chlorophyll content 60 days after transplanting]. Data are mean ± SD of four pepper scions that were non-grafted (NG), self-grafted (SG) and grafted onto five rootstocks 1) CCA-4758 (CCA), 2) Budai csipős (BC), 3) Nourdine (ND), 4) 52-03 RZ (RZ), and 5) Tan Tan (No: 12G076) (TAN) grown under plastic house conditions during Season 2 (2015).

Figure S2: The interactive effects of grafting and rootstocks on vegetative growth [A = number of branches, B = number of leaves, C = leaf area 70 days after transplanting and D = chlorophyll content 60 days after transplanting]. Data are mean ± SD of four pepper scions that were non-grafted (NG), self-grafted (SG) and grafted onto five rootstocks 1) CCA-4758 (CCA), 2) Budai csipős (BC), 3) Nourdine (ND), 4) 52-03 RZ (RZ), and 5) Tan Tan (No: 12G076) (TAN) grown under plastic house conditions during Season 1 (2014).

Figure S3: The interactive effects of grafting and rootstocks on vegetative growth [A = plant height and B = leaf area 30 days after transplanting] and on vegetative growth [C = number of branches, D = number of leaves and E = leaf area 50 days after transplanting]. Data are mean ± SD of four pepper scions that were non-grafted (NG), self-grafted (SG) and grafted onto five rootstocks 1) CCA-4758 (CCA), 2) Budai csipős (BC), 3) Nourdine (ND), 4) 52-03 RZ (RZ), and 5) Tan Tan (No: 12G076) (TAN) grown under plastic house conditions during Season 1 (2014).

Figure S4: The interactive effects of grafting and rootstocks on vegetative growth [A = leaf area 30 days after transplanting and B = leaf area at 50 days after transplanting]. Data are mean ± SD of four pepper scions that were non-grafted (NG), self-grafted (SG) and grafted onto five rootstocks 1) CCA-4758 (CCA),

2) Budai csipős (BC), 3) Nourdine (ND), 4) 52-03 RZ (RZ), and 5) Tan Tan (No: 12G076) (TAN) grown under plastic house conditions during Season 2 (2015).

Figure S5: The interactive effects of grafting and rootstocks on cumulative yield parameters [A = fruit weight and B = fruit number per plant] collected throughout the experiment. Data are mean ± SD of four pepper scions that were non-grafted (NG), self-grafted (SG) and grafted onto five rootstocks 1) CCA-4758 (CCA), 2) Budai csipős (BC), 3) Nourdine (ND), 4) 52-03 RZ (RZ), and 5) Tan Tan (No: 12G076) (TAN) grown under plastic house conditions during Season 1 (2014).

Figure S6: The interactive effects of grafting and rootstocks on yield parameters [A = fruit weight and B = fruit number per plant] collected cumulatively for the first 45 days of harvest. Data are mean ± SD of four pepper scions that were non-grafted (NG), self-grafted (SG) and grafted onto five rootstocks 1) CCA-4758 (CCA), 2) Budai csipős (BC), 3) Nourdine (ND), 4) 52-03 RZ (RZ), and 5) Tan Tan (No: 12G076) (TAN) grown under plastic house conditions during Season 1 (2014).

Figure S7: The interactive effects of grafting and rootstocks on yield parameters [A = fruit weight, B = fruit number per plant and C = yield (g/plant)] collected cumulatively for the first 45 days of harvest. Data are mean± SD of four pepper scions. They were non-grafted (NG), self-grafted (SG) and grafted onto five rootstocks 1) CCA-4758 (CCA), 2) Budai csipős (BC), 3) Nourdine (ND), 4) 52-03 RZ (RZ), and 5) Tan Tan (No: 12G076) (TAN) grown under plastic house conditions during Season 2 (2015).

Figure S1

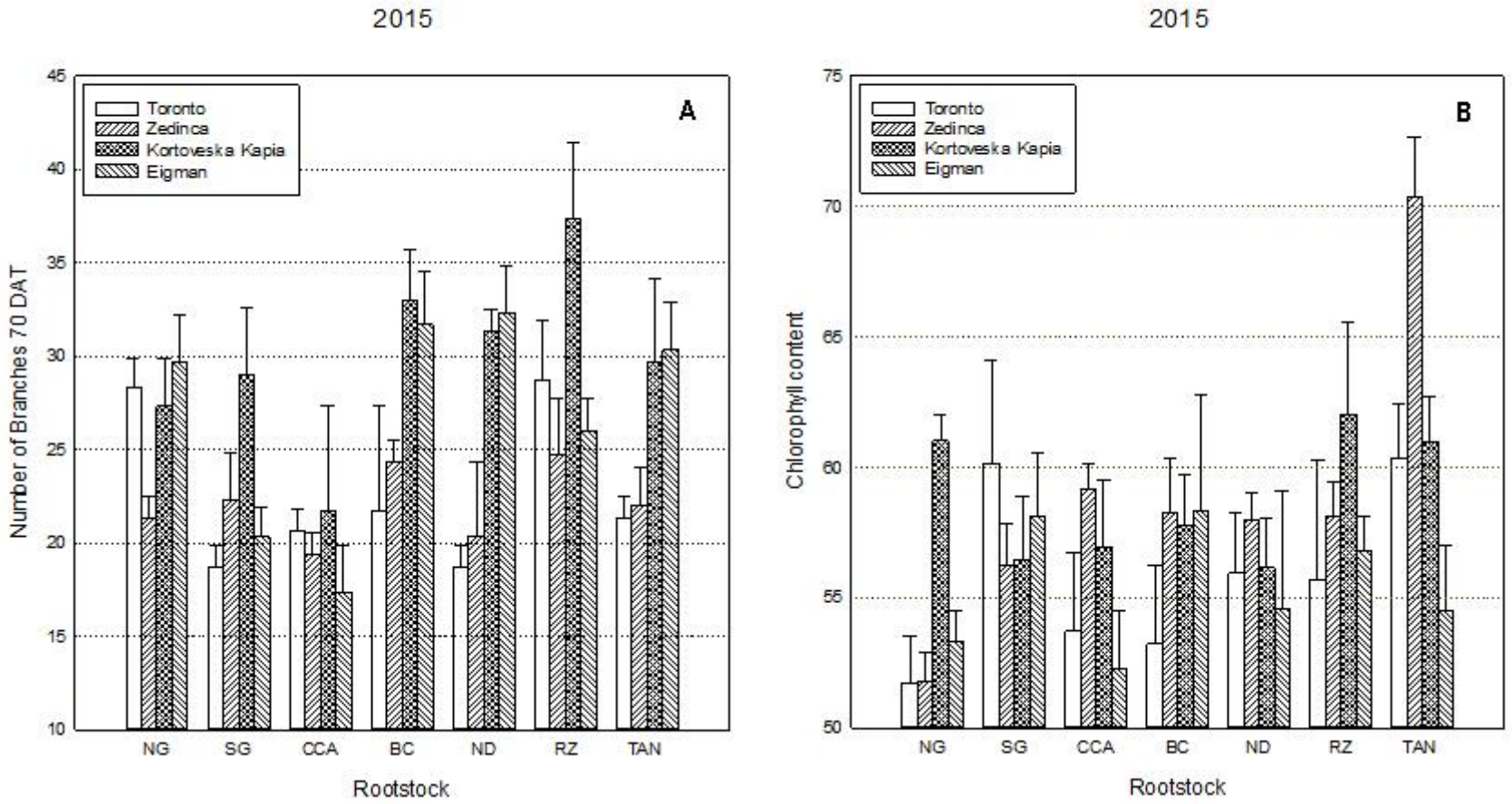
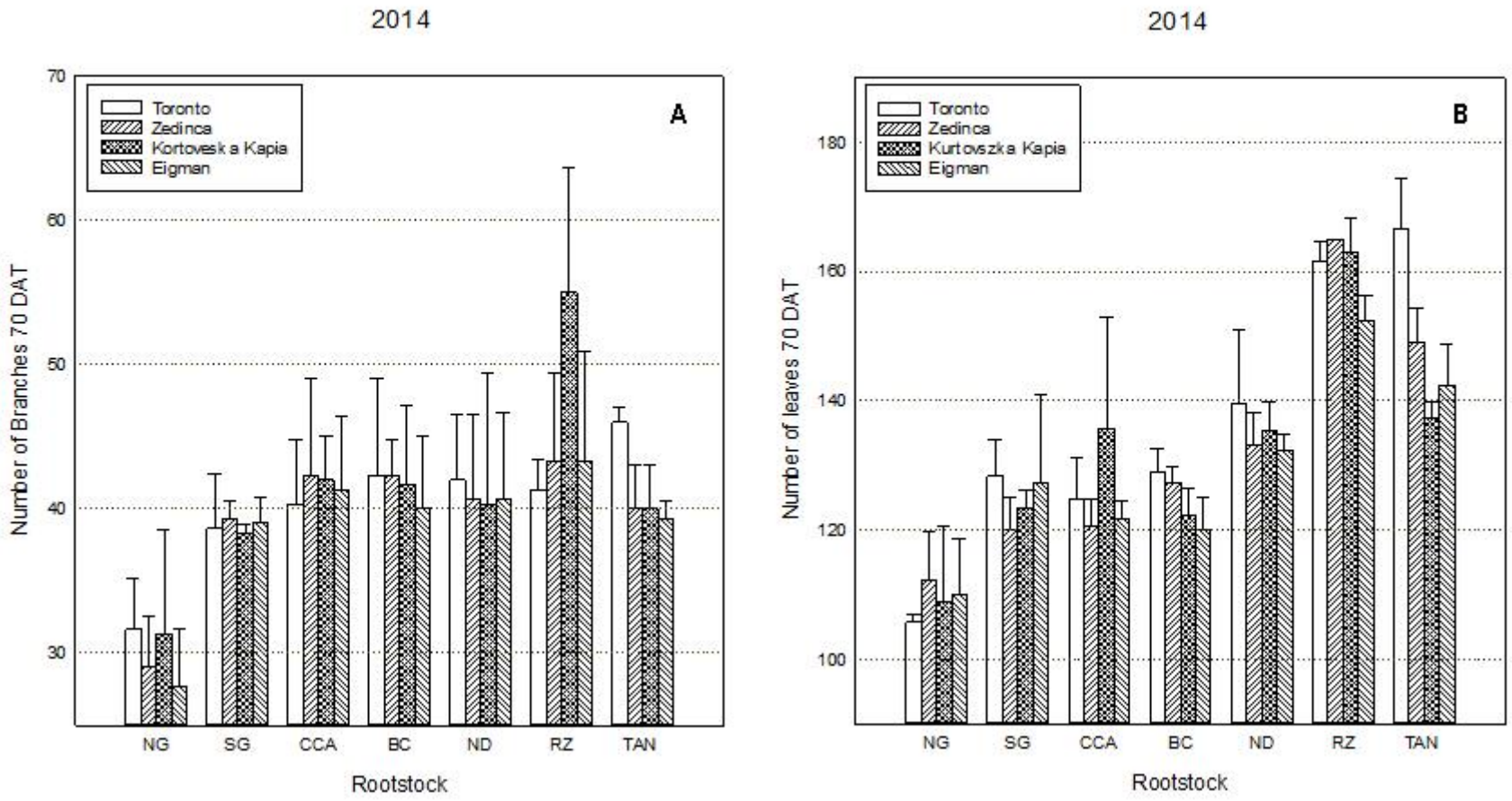
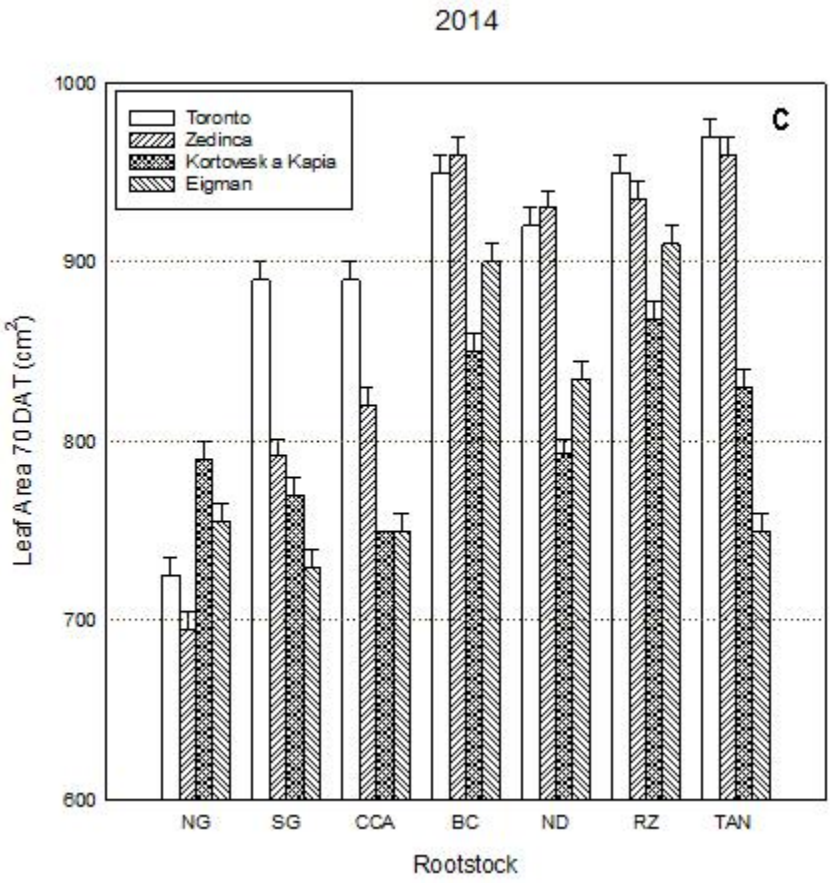

2015
A
Toronto
Zedinca
Kortoveska Kapia
Eigman
Number of Branches 70 DAT
45
40
35
30
25
20
15
10
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock
2015
B
Toronto
Zedinca
Kortoveska Kapia
Eigman
Chlorophyll content
75
70
65
60
55
50
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

Figure S2


2014
A
Toronto
Zedinca
Kortovesk a Kapia
Eigman
Number of Branches 70 DAT
70
60
50
40
30
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock
2014
B
Toronto
Zedinca
Kurtovszka Kapia
Eigman
Number of leaves 70 DAT
180
160
140
120
100
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock


2014
C
Toronto
Zedinca
Kortoveska Kapia
Eigman
Leaf Area 70 DAT (cm2)
1000
900
800
700
600
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

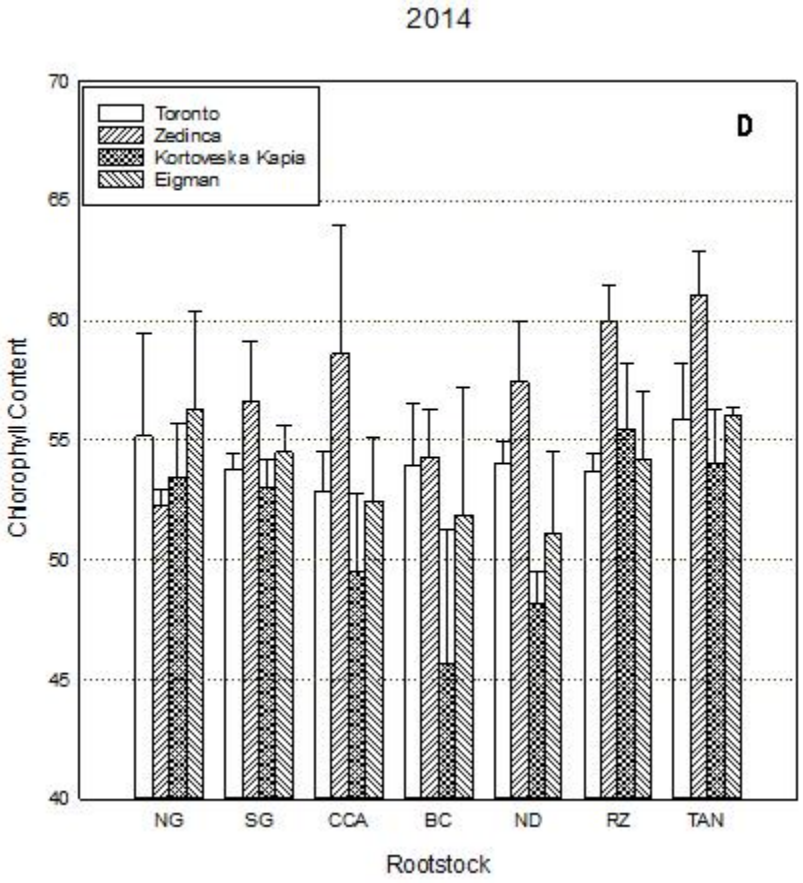
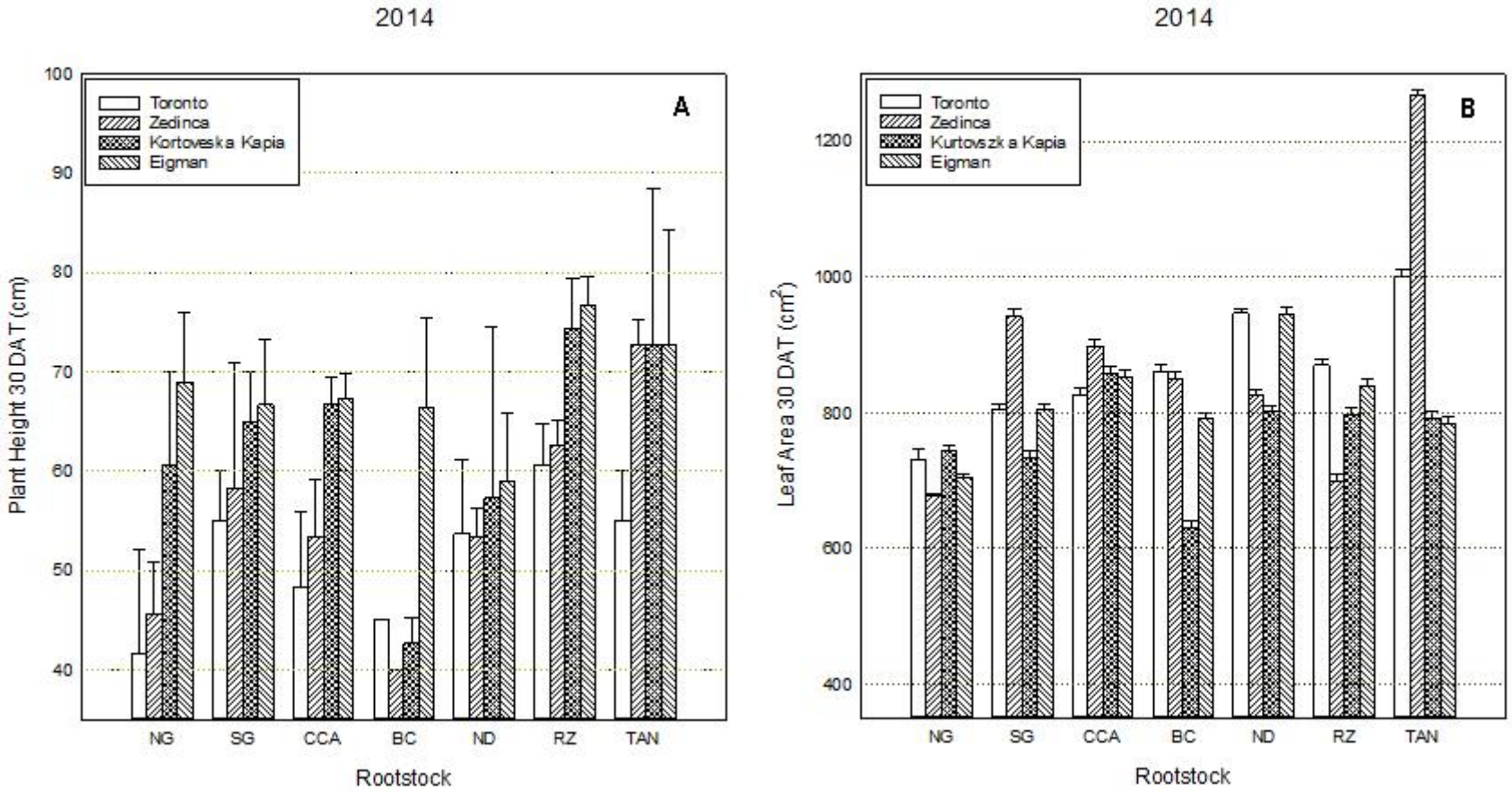
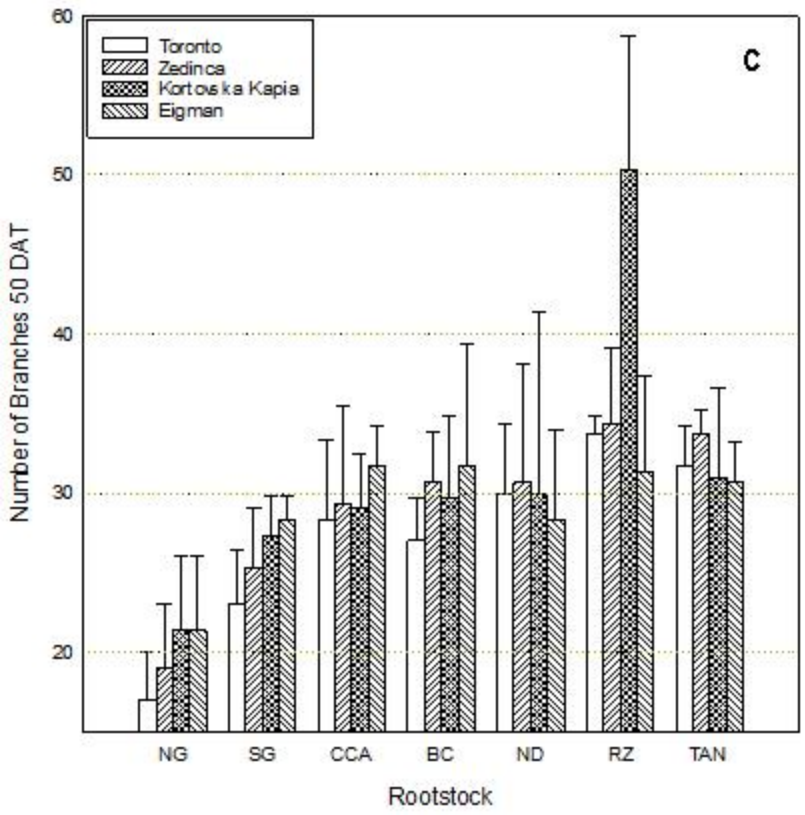

2014
D
Toronto
Zedinca
Kortoveska Kapia
Eigman
Chlorophyll Content
70
65
60
55
50
45
40
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

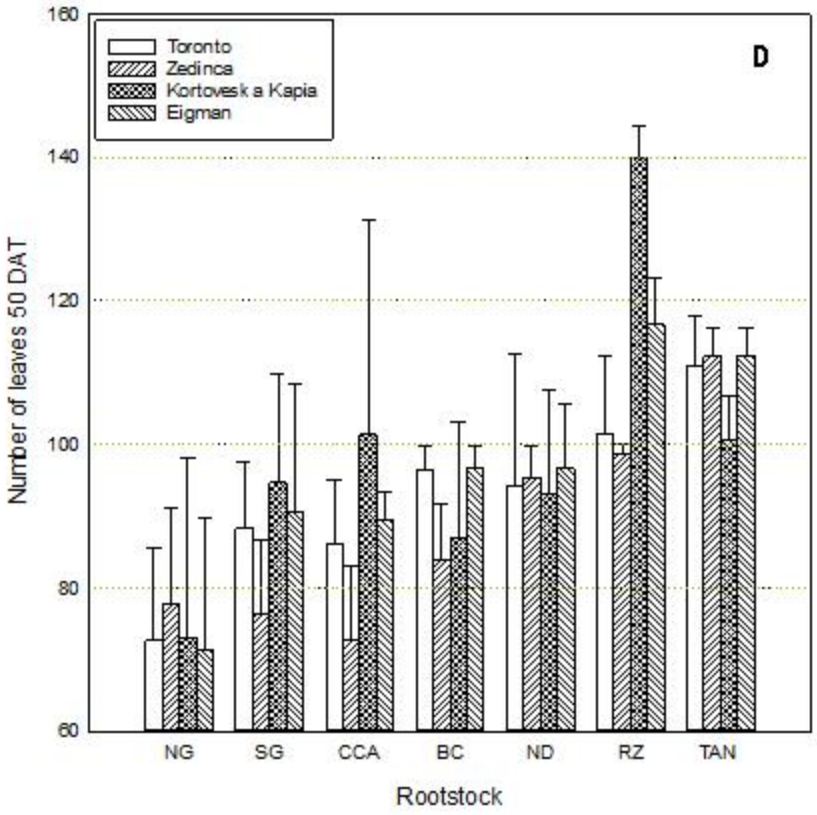
Figure S3


2014
Toronto
Zedinca
Kortoveska Kapia
Eigman
A
Plant Height 30 DAT (cm)
100
90
80
70
60
50
40
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock
2014
Toronto
Zedinca
Kurtovszk a Kapia
Eigman
B
Leaf Area 30 DAT (cm2)
1200
1000
800
600
400
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

2014


Toronto
Zedinca
Kortoska Kapia
Eigman
C
Number of Branches 50 DAT
60
50
40
30
20
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

2014


Toronto
Zedinca
Kortovska Kapia
Eigman
D
Number of leaves 50 DAT
160
140
120
100
80
60
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

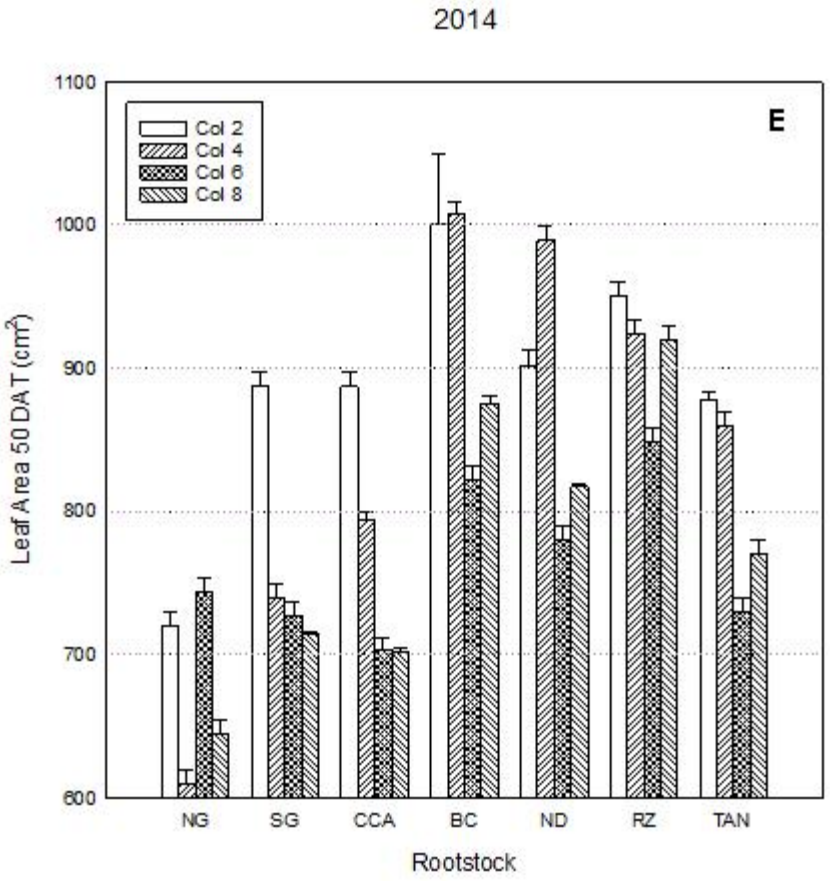

2014
E
Col 2
Col 4
Col 6
Col 8
1100
1000
900
800
700
600
Leaf Area 50 DAT (cm²)
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

Figure S4

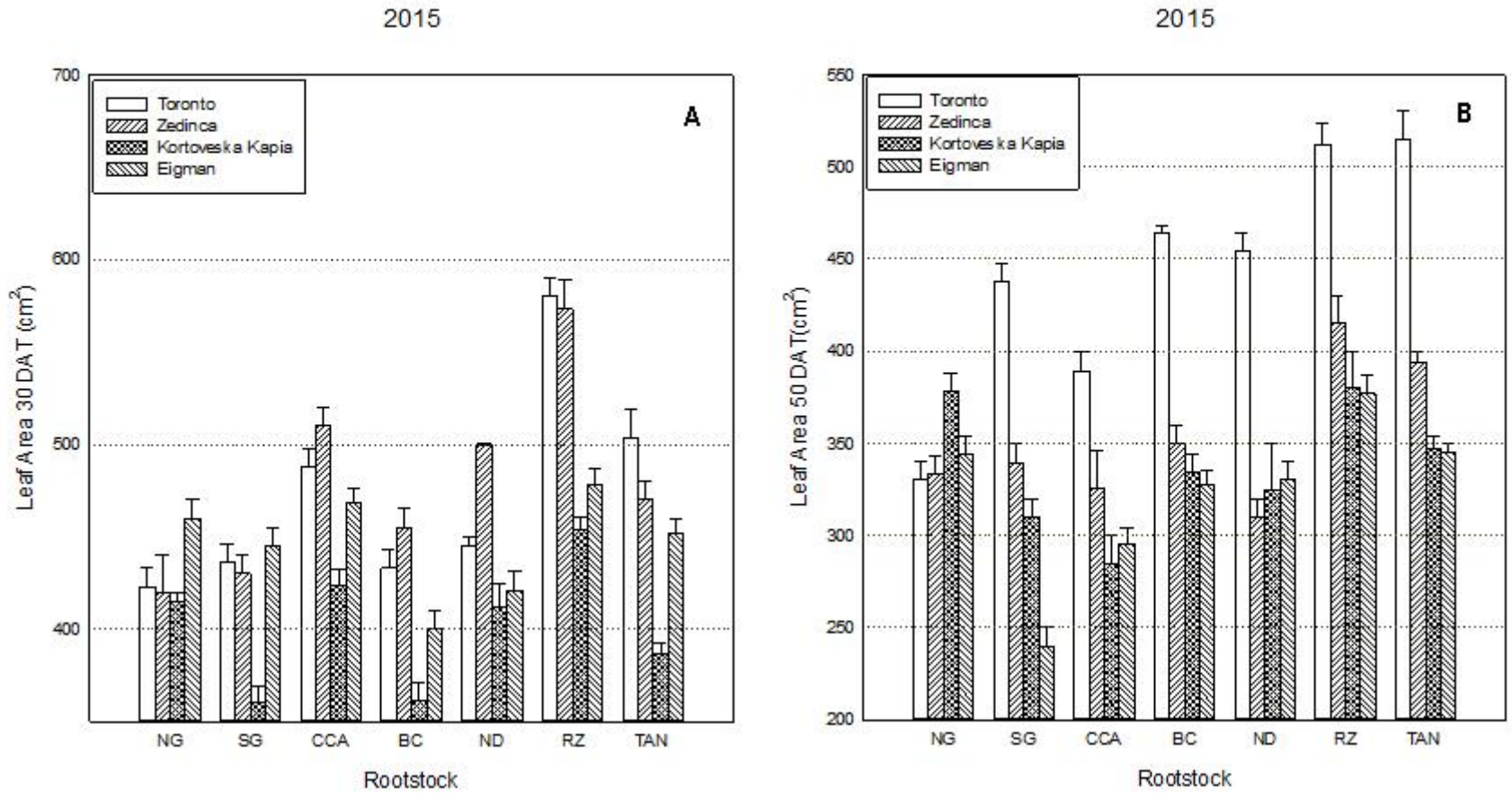

2015
Toronto
Zedinca
Kortoveska Kapia
Eigman
A
Leaf Area 30 DAT (cm2)
700
600
500
400
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock
2015
Toronto
Zedinca
Kortoveska Kapia
Eigman
B
Leaf Area 50 DAT(cm2)
550
500
450
400
350
300
250
200
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

Figure S5

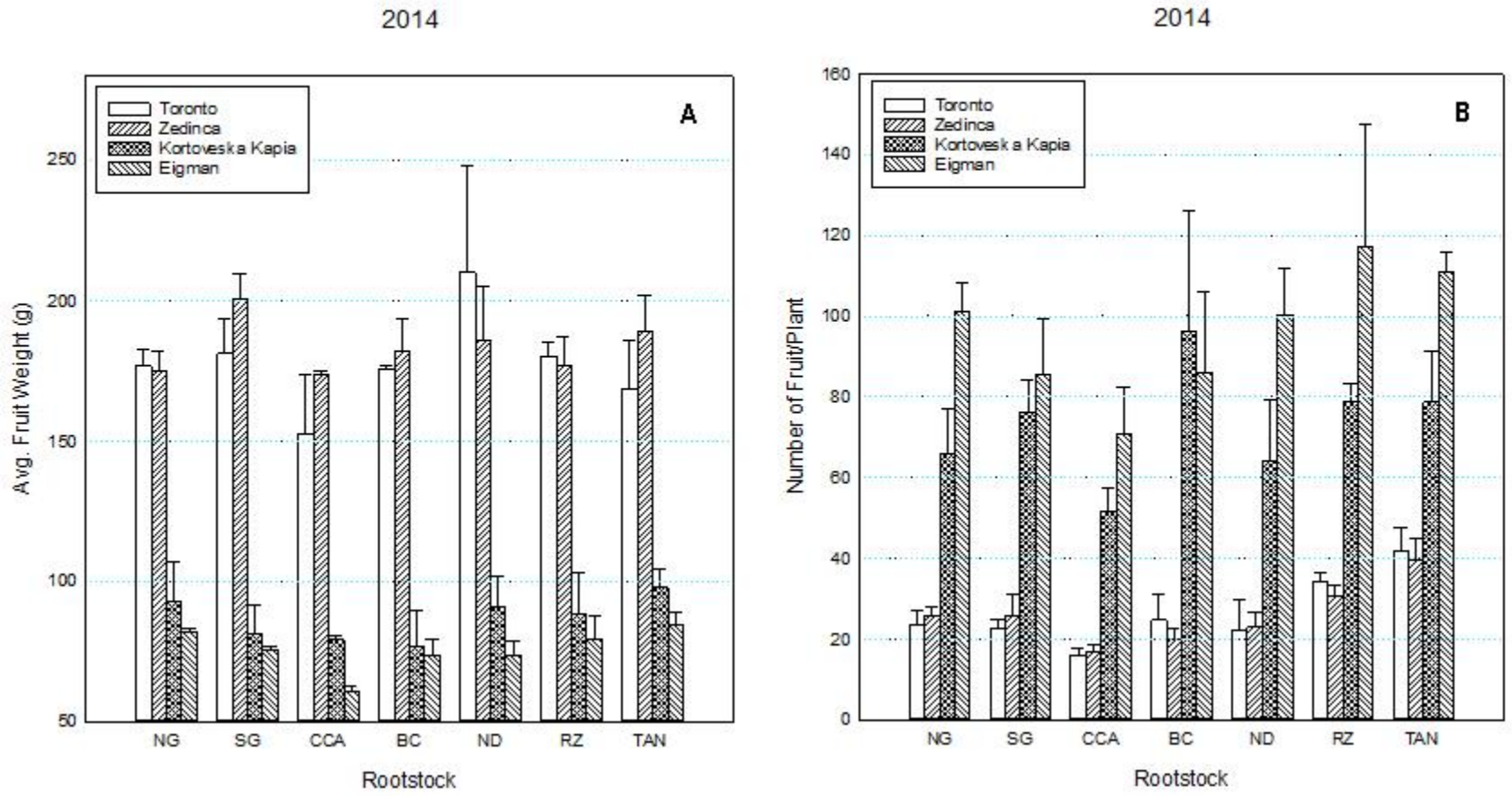

2014
A
Toronto
Zedinca
Kortoveska Kapia
Eigman
Avg. Fruit Weight (g)
250
200
150
100
50
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock
2014
B
Toronto
Zedinca
Kortovesk a Kapia
Eigman
Number of Fruit/Plant
160
140
120
100
80
60
40
20
0
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

Figure S6

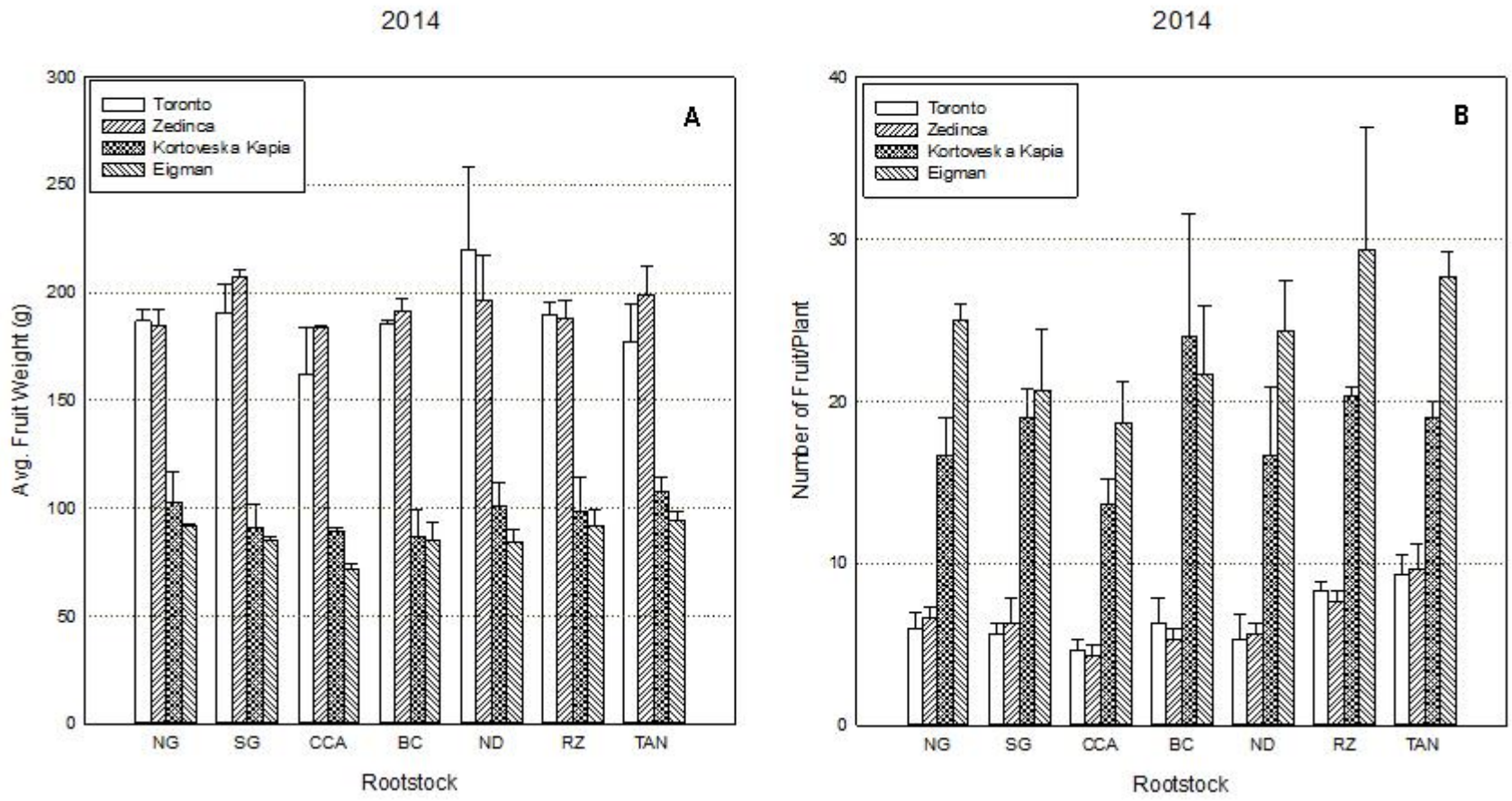
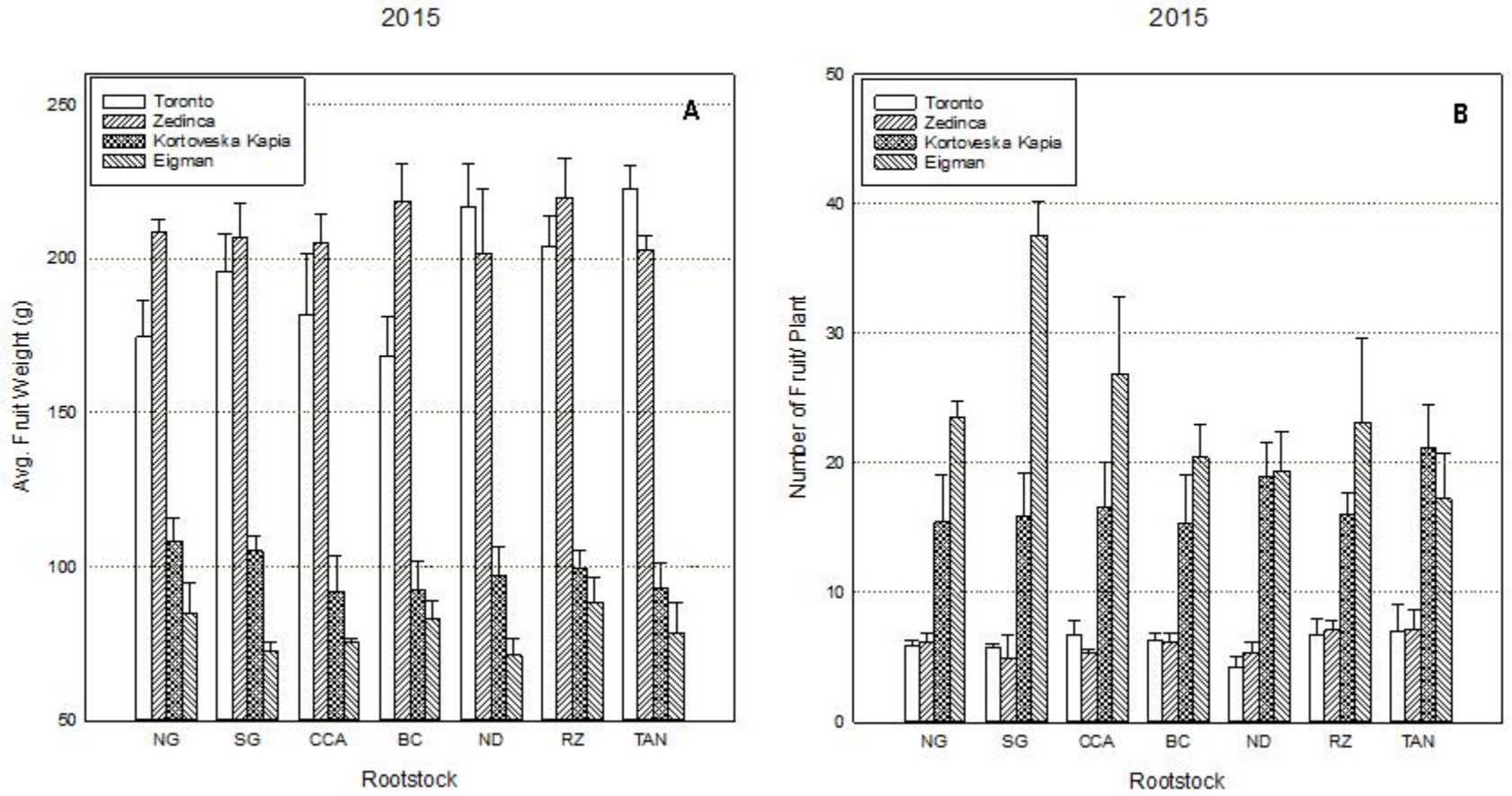
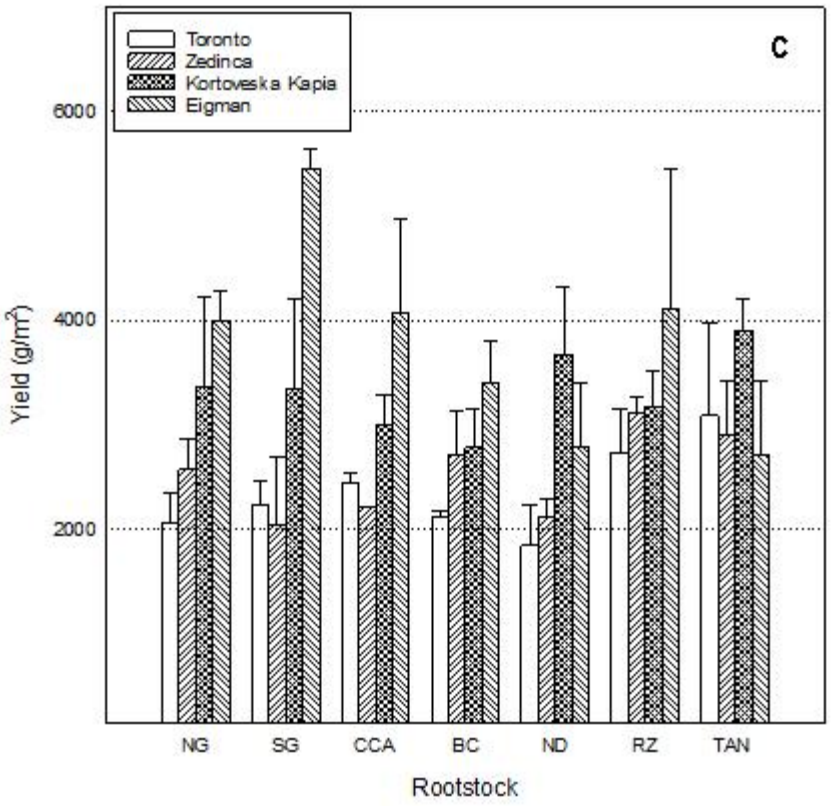

2014
A
Toronto
Zedinca
Kortoveska Kapia
Eigman
Avg. Fruit Weight (g)
0
50
100
150
200
250
300
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock
2014
B
Toronto
Zedinca
Kortovesk a Kapia
Eigman
Number of Fruit/Plant
0
10
20
30
40
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

Figure S7


2015
Toronto
Zedinca
Kortoveska Kapia
Eigman
A
Avg. Fruit Weight (g)
250
200
150
100
50
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock
2015
Toronto
Zedinca
Kortoveska Kapia
Eigman
B
Number of Fruit/ Plant
50
40
30
20
10
0
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock

2015


Toronto
Zedinca
Kortoveska Kapia
Eigman
C
6000
4000
2000
Yield (g/m2)
NG
SG
CCA
BC
ND
RZ
TAN
Rootstock