

Productivity of forwarding depending from driving conditions

OSCAR₂ Soil and Machine Workshop

Helsinki University Hyytiälä Forestry Field Station,
November 22-23, 2011

Jānis Gercāns

Joint Stock Company "Latvijas valsts meži"

Andis Lazdiņš

LVMI "Silava"

Riga street 111, Salaspils LV-2169

Phone: 26595586, fax: 67901359

E-mail: andis.lazdins@silava.lv

Targets of the study



norden

Nordic Forest Research
Co-operation Committee (SNS)



- Estimation of productivity of forwarding in different working conditions in commercial thinning.
- Elaboration of productivity and cost curves depending from driving distance and working conditions.
- Estimation of environmental consequences of harvesting and forwarding (damaged trees, soil compaction).



Characteristics of experimental plots

Plot No.	Species composition	Average stem, m ³	Produced stock, m ³ ha ⁻¹	Forwarding distance, m	Distance between strip-roads, m	Machine	
						Hvester	Forvarder
1.	10S+B	0.046	24.9	277	20	JD 1070D	JD 810 B
2.	10S+B	0.041	16.3	164	30	JD 1070D	JD 810 B
3.	10S+B	0.042	16.3	163	30	JD 770D	JD 810 B
4.	5B4S1BA	0.040	31.9	474	20	JD 1070D	JD 810 B
5.	10P	0.061	34.6	246	20	JD 1070D	JD 810 B
6.	8S1B1BA	0.106	71.1	143	20	JD 1070D	MTZ 952
7.	8S1B1BA	0.095	71.1	149	20	JD 1070D	JD 810 E
8.	8S1B1BA	0.093	71.1	142	20	JD 1070D	JD 1010 D
9.	8S1B1BA	0.067	71.1	200	20	JD 1070D	JD 810 D
10.	10S+B	0.071	87.8	605	20	JD 1070D	JD 810 D with tracks
11.	10S+B	0.072	87.8	632	20	JD 1070D	JD 810 D without tracks

Thinning results



norden

Nordic Forest Research
Co-operation Committee (SNS)

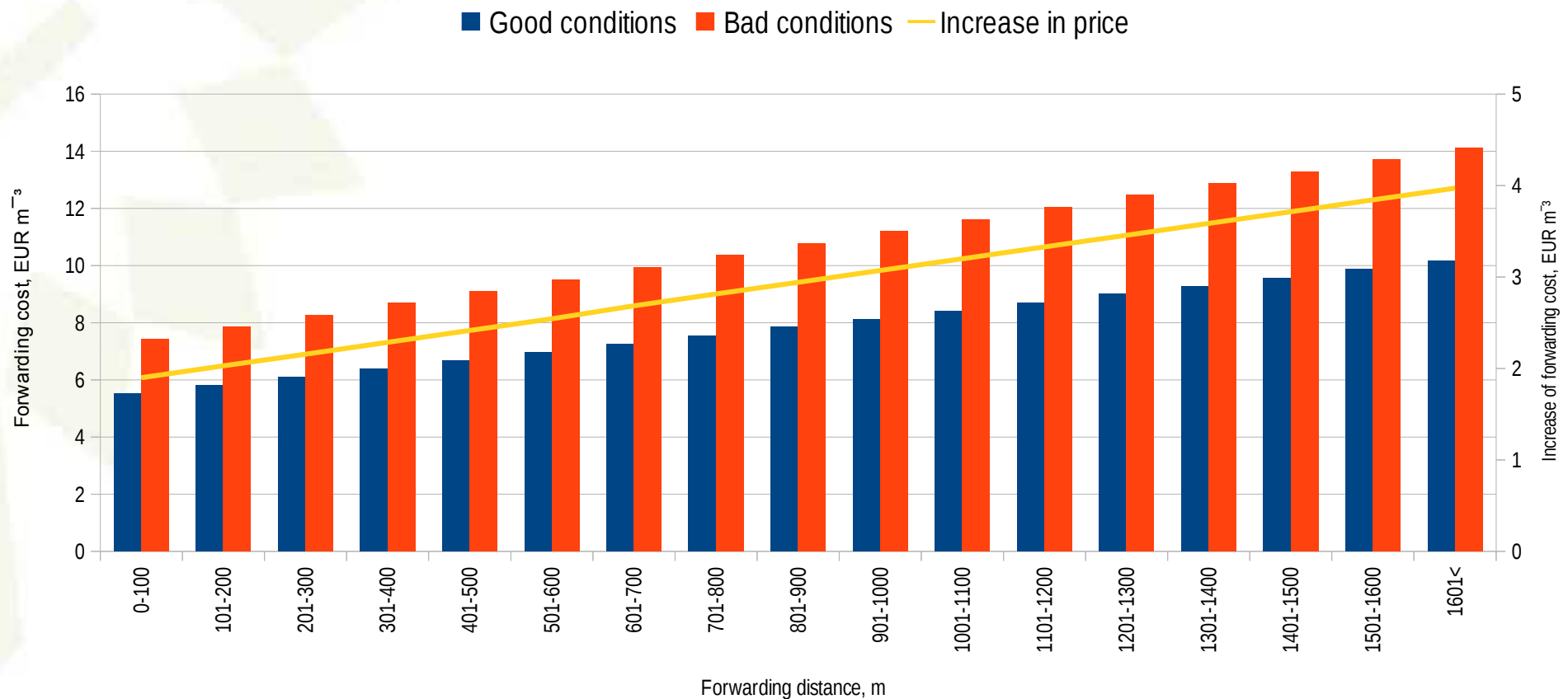


Plot ID	Before			After			Extracted, m ³ ha ⁻¹	Assortiments, m ³ ha ⁻¹	Remainings, m ³ ha ⁻¹
	G, m ² ha ⁻¹	N, gab ha ⁻¹	V, m ³ ha ⁻¹	G, m ² ha ⁻¹	N, gab ha ⁻¹	V, m ³ ha ⁻¹			
1.	22.9	1955	166.2	17.1	1080	125.7	40.5	24.9	15.6
2.	24.1	1655	179.7	17.7	970	133.5	46.2	16.3	29.9
3.	24.1	1655	179.7	17.7	970	133.5	46.2	16.3	29.9
4.	33.1	4220	271.7	20.4	1750	176.6	95.1	31.9	63.2
5.	31.9	1860	259.8	22.5	810	188.3	71.5	34.6	36.9
6.	37.0	2750	322.5	21.4	820	189.4	133.1	71.1	62.0
7.	37.0	2750	322.5	21.4	820	189.4	133.1	71.1	62.0
8.	37.0	2750	322.5	21.4	820	189.4	133.1	71.1	62.0
9.	37.0	2750	322.5	21.4	820	189.4	133.1	71.1	62.0
10.	37.9	1950	361.2	22.6	840	219.6	141.6	87.8	53.8
11.	37.9	1950	361.2	22.6	840	219.6	141.6	87.8	53.8



Effect of forwarding conditions

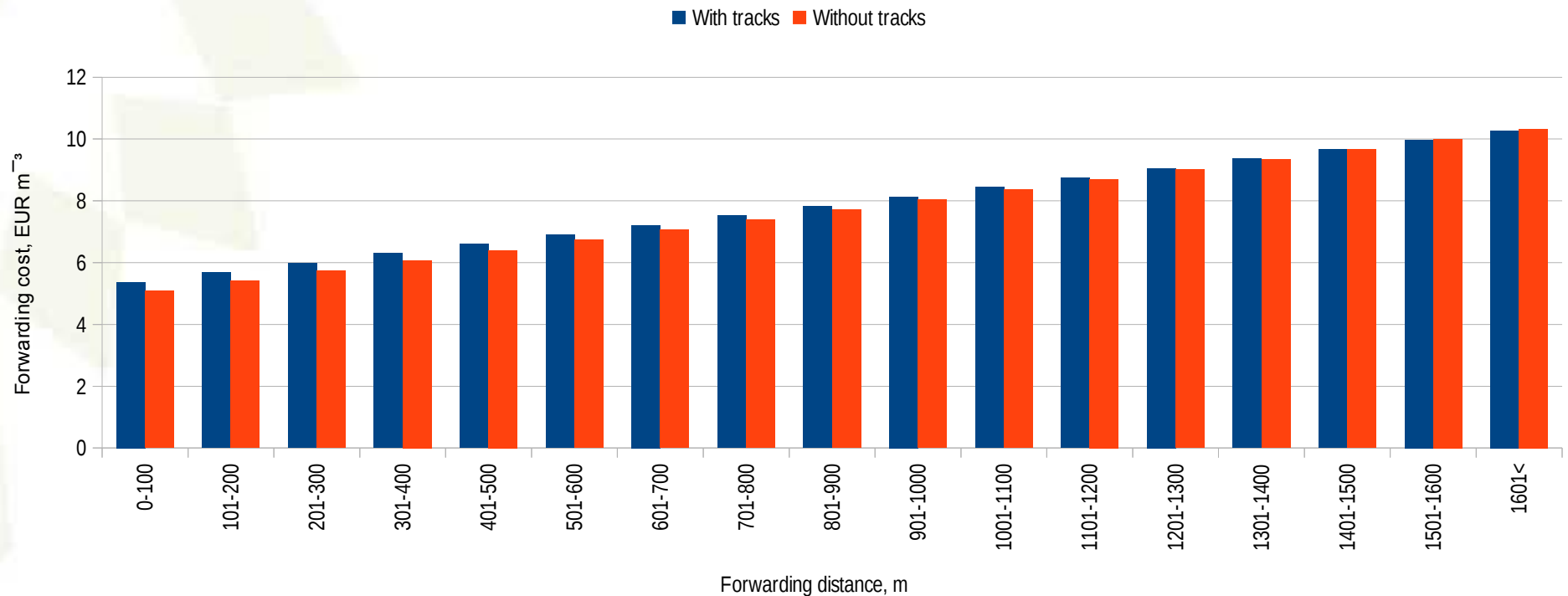
- Main affecting factor:
 - smaller driving speed, which hampers productivity;
 - use of tracks increase fuel consumption.





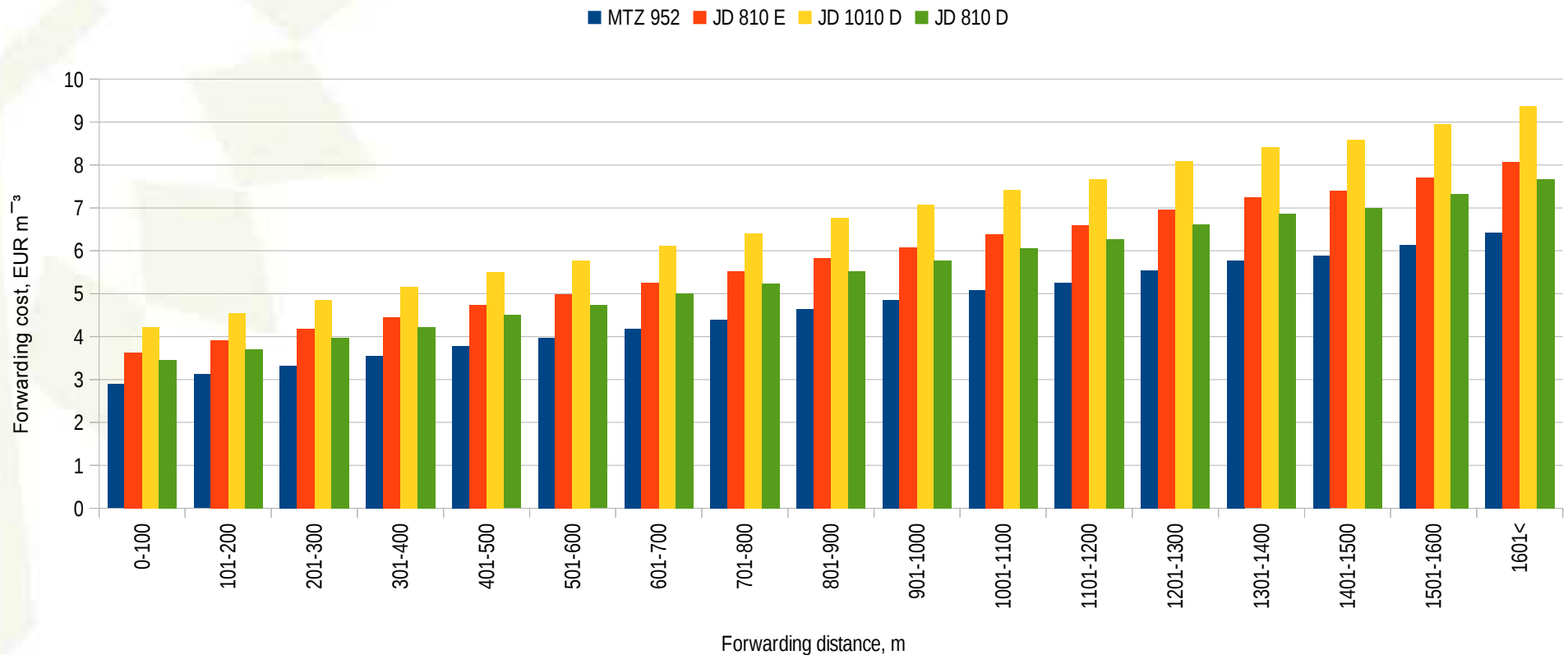
Effect of use of tracks

- There is no statistically significant difference in prime costs due to use of tracks; however:
 - fuel consumption increases by 200 g per engine hour;
 - productivity decrease by 0.7 % due to smaller speed.



Average prime costs of different forwarders

- The smallest production costs has MTZ 952 forwarder (agricultural tractor), because of:
 - small fuel consumption – 3.9 L per engine hour;
 - considerably smaller investments.



Effect of increase of distance between corridors

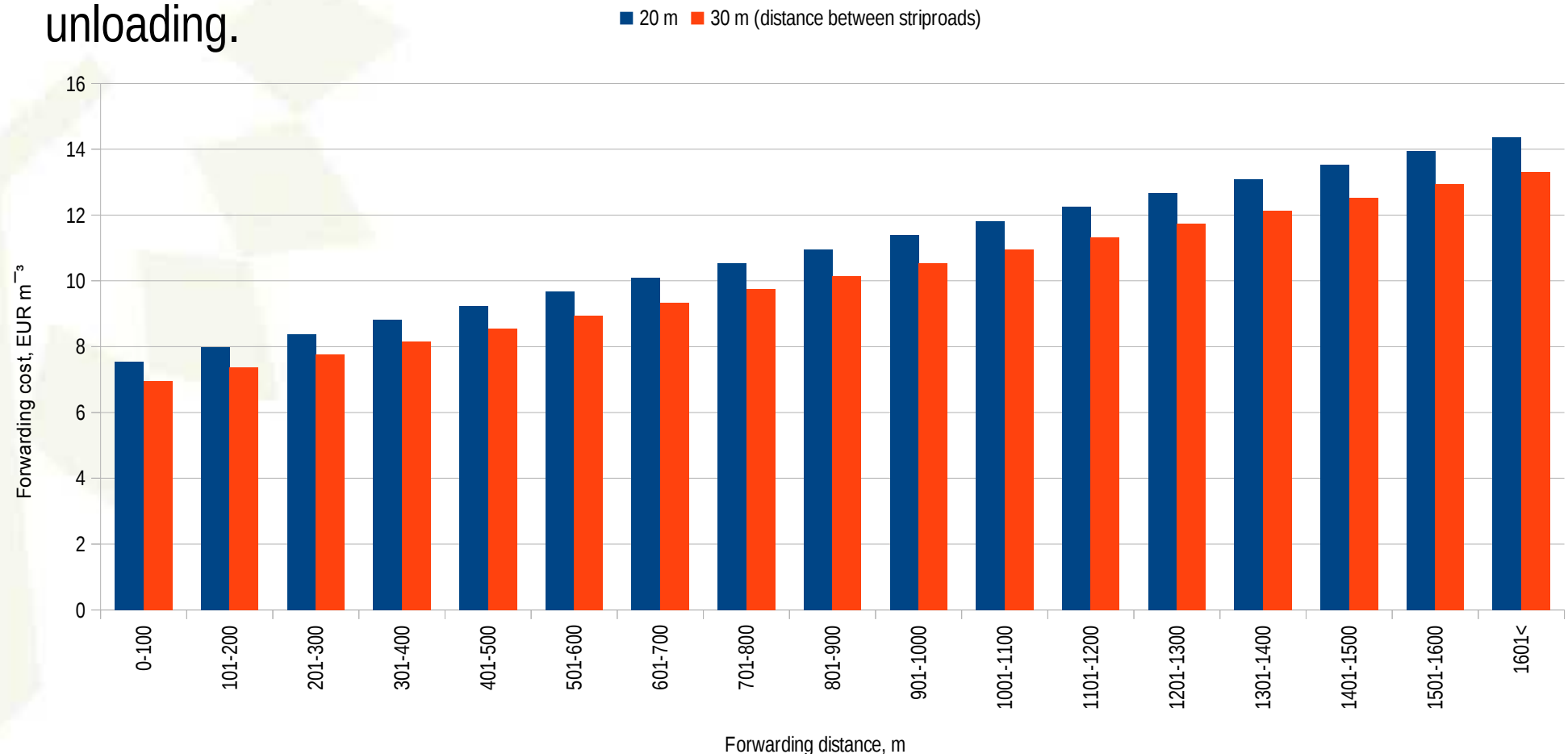


norden

Nordic Forest Research
Co-operation Committee (SNS)



- Ghost corridors were established every 10th meter, leaving space between forwarding corridors 30 m.
- Forwarding is considerably faster with 30 m corridors due to more efficient unloading.



Conclusions about effect of working conditions



norden

Nordic Forest Research
Co-operation Committee (SNS)

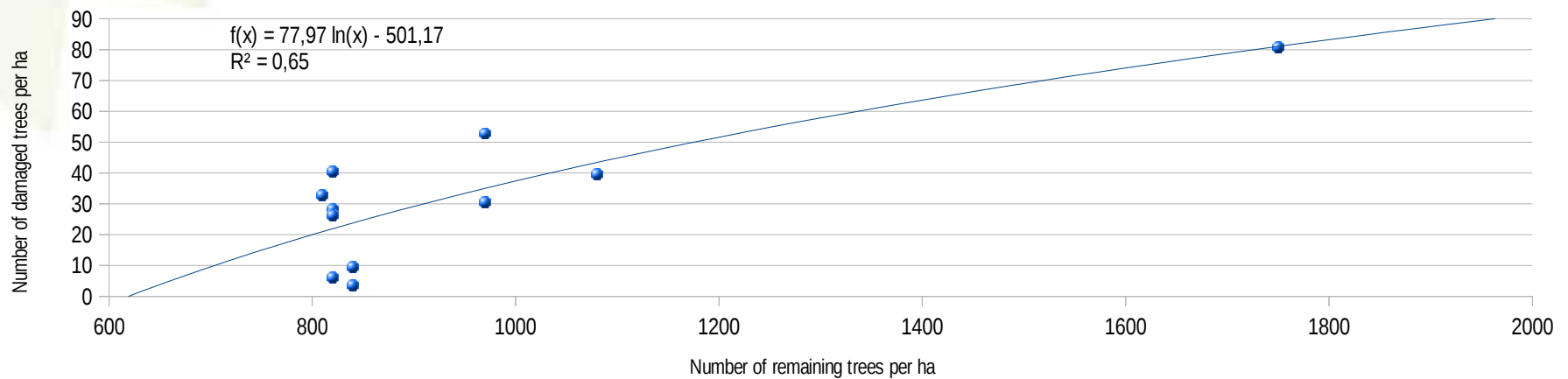
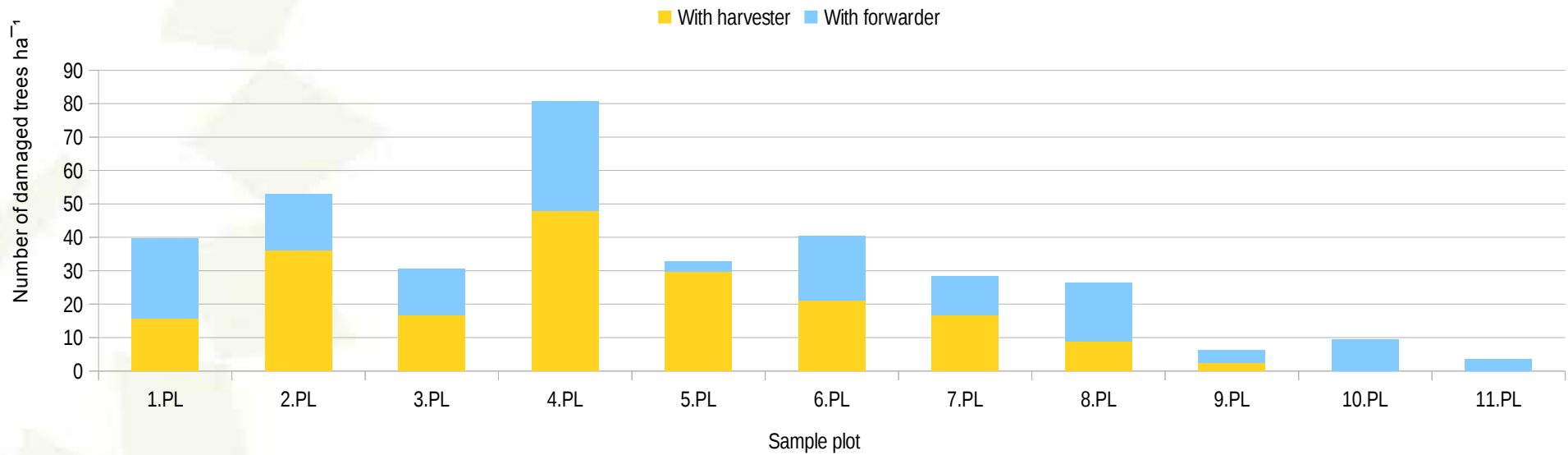


- Costs estimated by the study are relevant to those existing in contracts, therefore no corrections were used.
- Forwarding costs are considerably higher on soils with low bearing capacity.
- Forwarding with agricultural tractor is the cheapest operation, however, this machinery has other drawbacks.



Damaged trees

- Damages caused by harvester and forwarder.

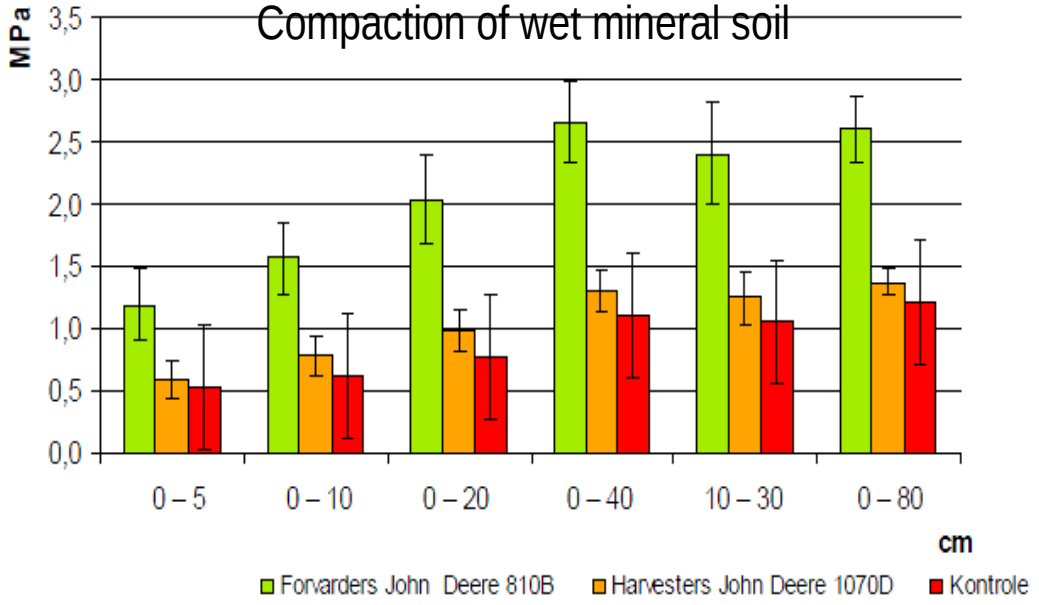
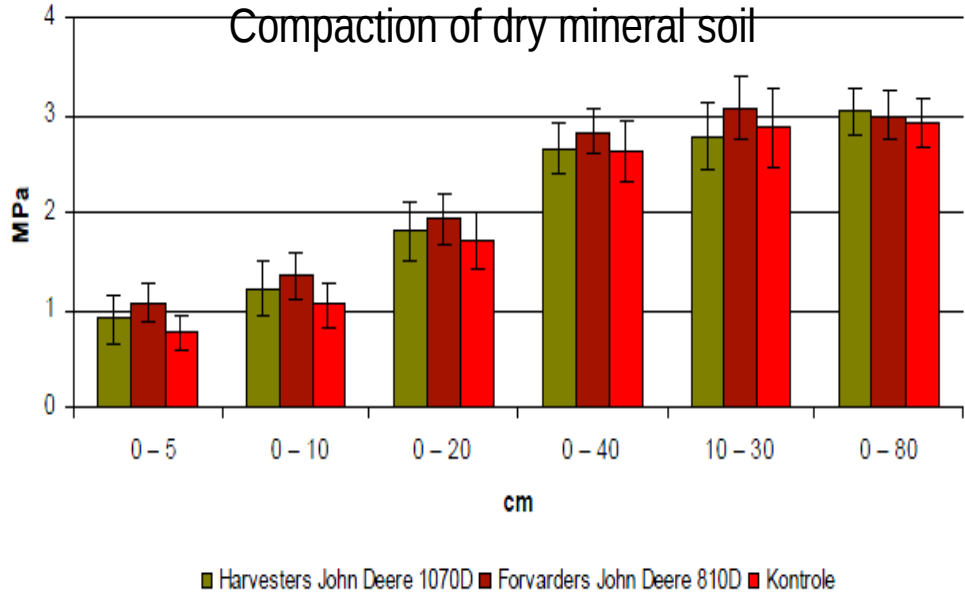




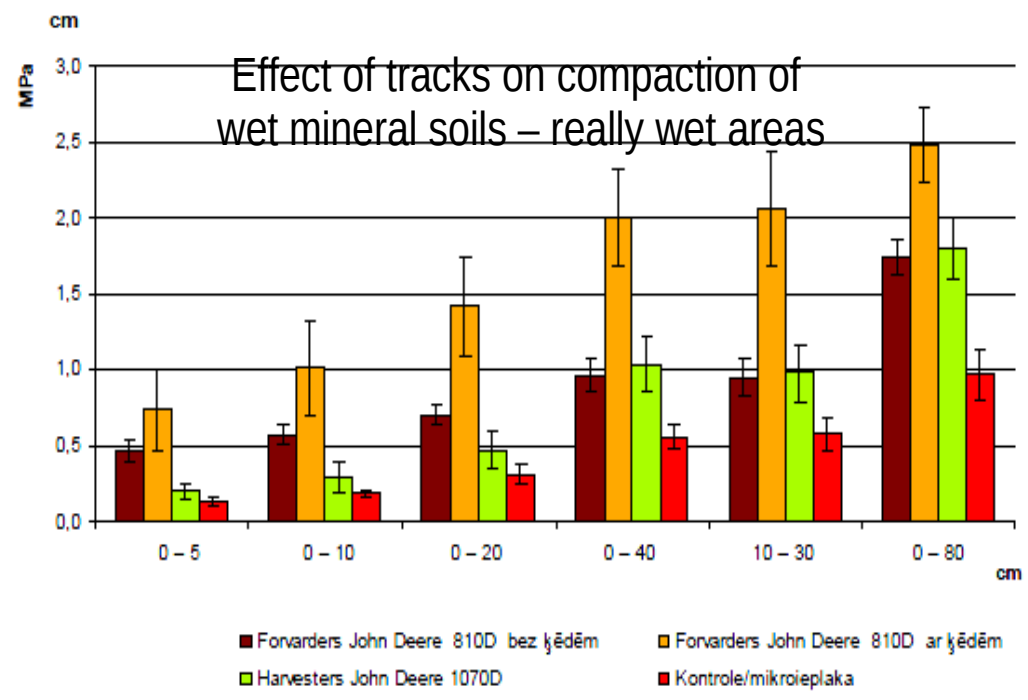
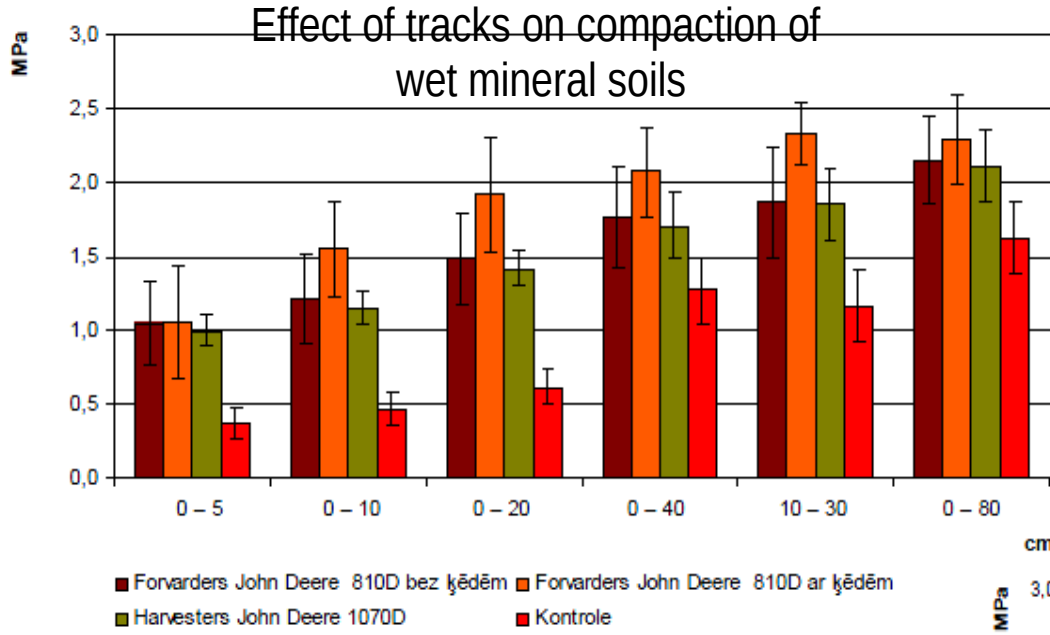
Conclusions about damages

- Smaller harvesters cause less damages, especially if “ghost corridors” are used.
- Number of damaged trees increase, if:
 - non-professional machinery (agricultural tractors) are used;
 - thinning is done in summer or spring;
 - forwarder is supplied with tracks in summer time;
 - large forwarders are used in thinning.
- Advanced construction itself do not guaranties less damages to the stand – operator's skills is the most important factor.

Compaction of soil – dry and wet soils



Compaction of soil if tracks are used



Conclusions (and assumptions) about compaction of soils



norden

Nordic Forest Research
Co-operation Committee (SNS)



- Growth of root is damaged is durability of soil is more than 3 MPa, than growth of roots is hampered for 2-5 years.
- In dry sites compaction occur to less extend than in wet mineral soils; therefore, heavy machinery do not cause considerable damages in such conditions.
- Tracks reduce depth of “ditches”, but cause considerably higher compaction of soil; however, tracks are still on safe side of the soil durability values. More studies are necessary on temporal effect off such considerable changes in soil structure.
- According to other studies, compaction disappears after 4-5 years after thinning. Needs to be checked using mechanical and biologic methods.

General evaluation of utilized forwarders



norden

Nordic Forest Research
Co-operation Committee (SNS)



Forwarder	Costs	Soil damages	Tree damages	Total
MTZ 952	+	-	-	1
JD 810 E	-	-	-	0
JD 1010 D	-	-	-	0
JD 810 D	-	+	+	2

Questions, comments?

