Impact of sorting grips and tilting gripper on productivity of forwarding of logs in commercial thinning

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Atbalsts LVMI Silava starptautiskās sadarbības projektiem pētniecībā un inovācijās, Eiropas Reģionālās attīstības fonda projekts (Nr. 1.1.1.5/18/I/010)

Background

- Productivity of forwarding is influenced by:
  - working conditions;
  - type and number of assortments;
  - dimensions of assortments;
  - extracted volume *(concentration of logs)*;
  - forwarding distance;
  - the machine capacity.

Improvement possibilities

- **Sorting grips** can improve productivity by simultaneous loading of different assortments, **tilt gripper** reduces duration of crane movements.
- **Additional grips** do not affect fuel consumption and can increase productivity by 5-8%.
- Productivity of a forwarder equipped with the **tilt gripper** can be higher by 7-10% comparing to the standard grip.
- Professional operator with **tilt gripper** can significantly increase loading productivity and reduce damages to remaining trees.

Research objectives

- The aim of the study is to evaluate the impact of the sorting grip and tilt grip on **forwarding productivity and damages to remaining trees** in thinning in comparison to the standard grip and to evaluate potential areas of application of sorting grip.

Study sites

- **Sorting grip** – 3 Scots pine dominant stands (15.2 ha) on nutrient-poor mineral soils.
- **Tilt grip** – 4 Norway spruce dominant stands (10.5 ha) on nutrient-rich mineral soils.

ID	Area, ha	Growing stock, m^3 ha^{-1}	Height of trees, m	Diameter at breast height, cm	Age in years
Study sites for tilt grip					
710-183-16	2.9	286	20	20	42
710-183-1	6.7	300	13	13	36
710-183-2	0.3	403	21	20	50
710-183-3	0.6	387	22	21	55
Study sites for sorting grip					
703-413 3	4.5	196	12	11	52
703-413 2	7.1	230	13	11	56
703-413 4	3.6	230	13	11	58

John Deere 1110D ECO III forwarder in the **sorting grip** trials

Assortments sorters

John Deere 810D forwarder in the **tilt gripper** trials

- Weight of tilting device – 66 kg.
- Maximum lifting capacity – 3.5 tonnes *(up to 0.28 m³ in a single grip)*.
- Suitable for middle and compact class forwarders.

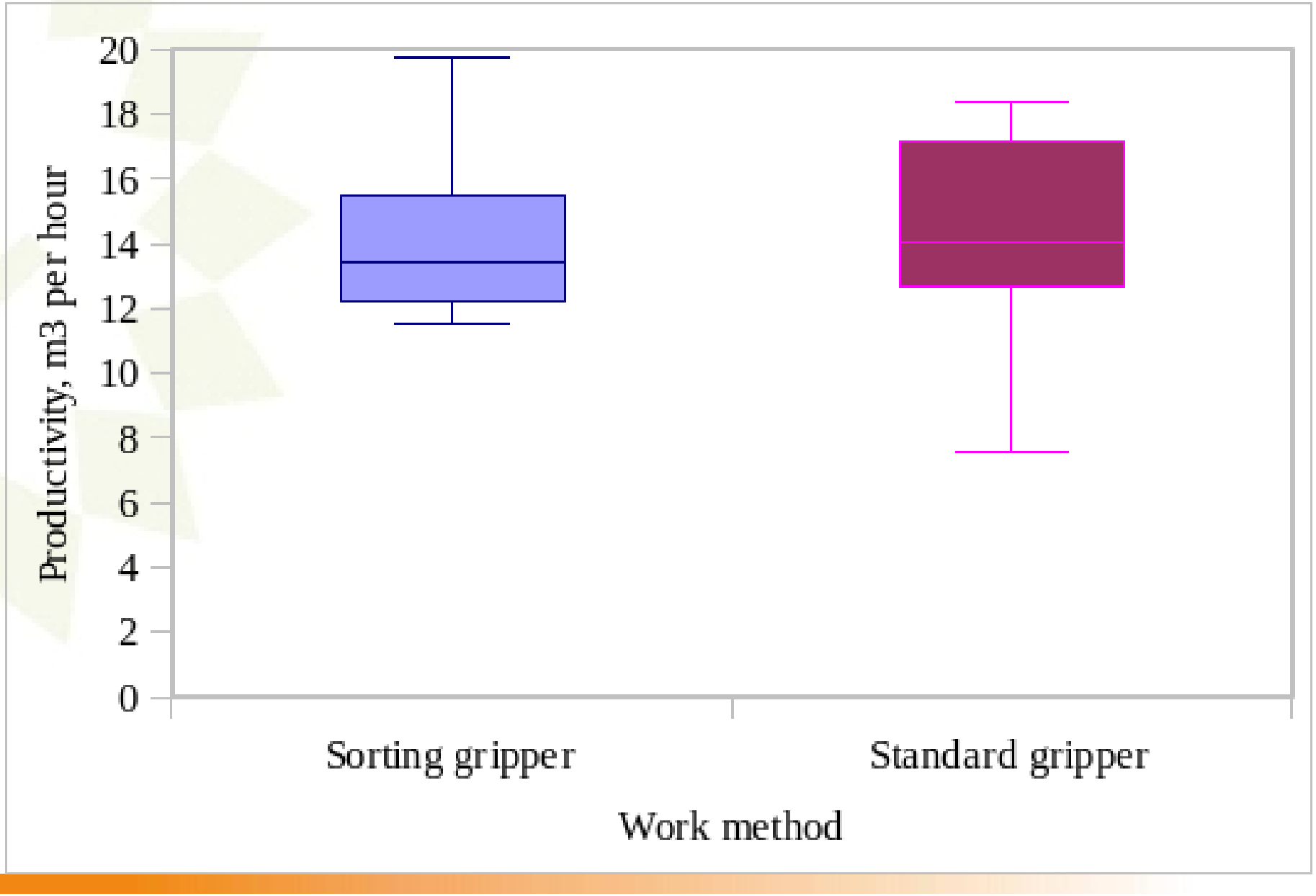
Work methods

- **Sorting grips**:
  - forwarder equipped with sorting grips mounted on standard gripper and functioning in semi-automatic regime, load space is split into compartments by 2 pairs of sorters;
  - forwarder equipped with the standard grapple; load space is not split by sorters.
- **Tilt gripper**:
  - forwarder is equipped with a gripper with the tilt function and operators use this function on demand;
  - standard gripper is mounted and logs are loaded in horizontal gripper position only.

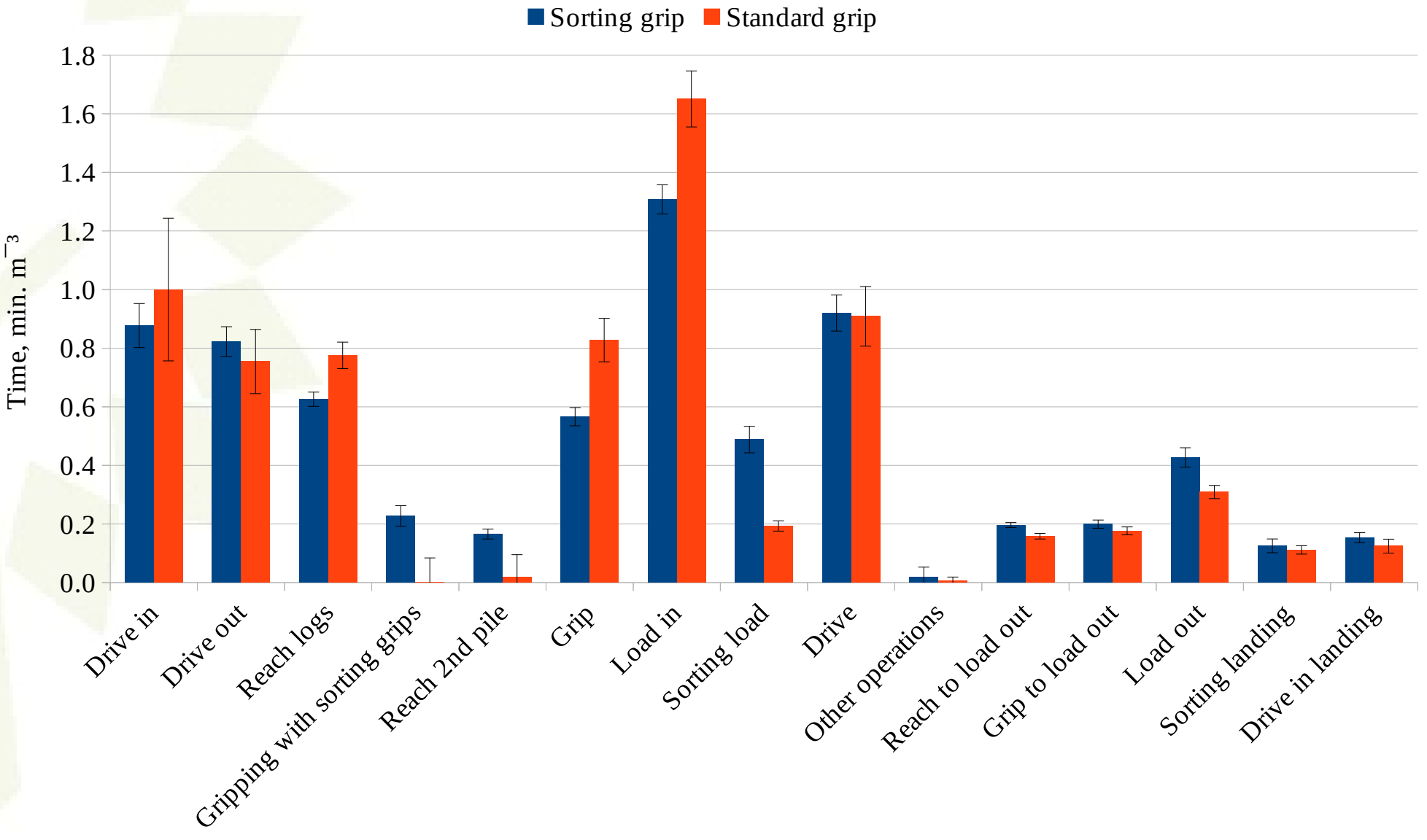
Results of trials

- **Sorting grip**:
  - 424 m³ of logs (200 m³ with the 1st and 224 m³ with the 2nd method) or 49 loads were forwarder;
  - average load size – 8.7 m³;
  - forwarding distance – 775 m;
  - the average number of assortments per load – 2.8.
- **Tilt grip**:
  - 470 m³ of logs (258 m³ with the 1st and 212 m³ with the 2nd method) or 72 loads were forwarder;
  - average load size – 6.5 m³;
  - forwarding distance – 450 m.

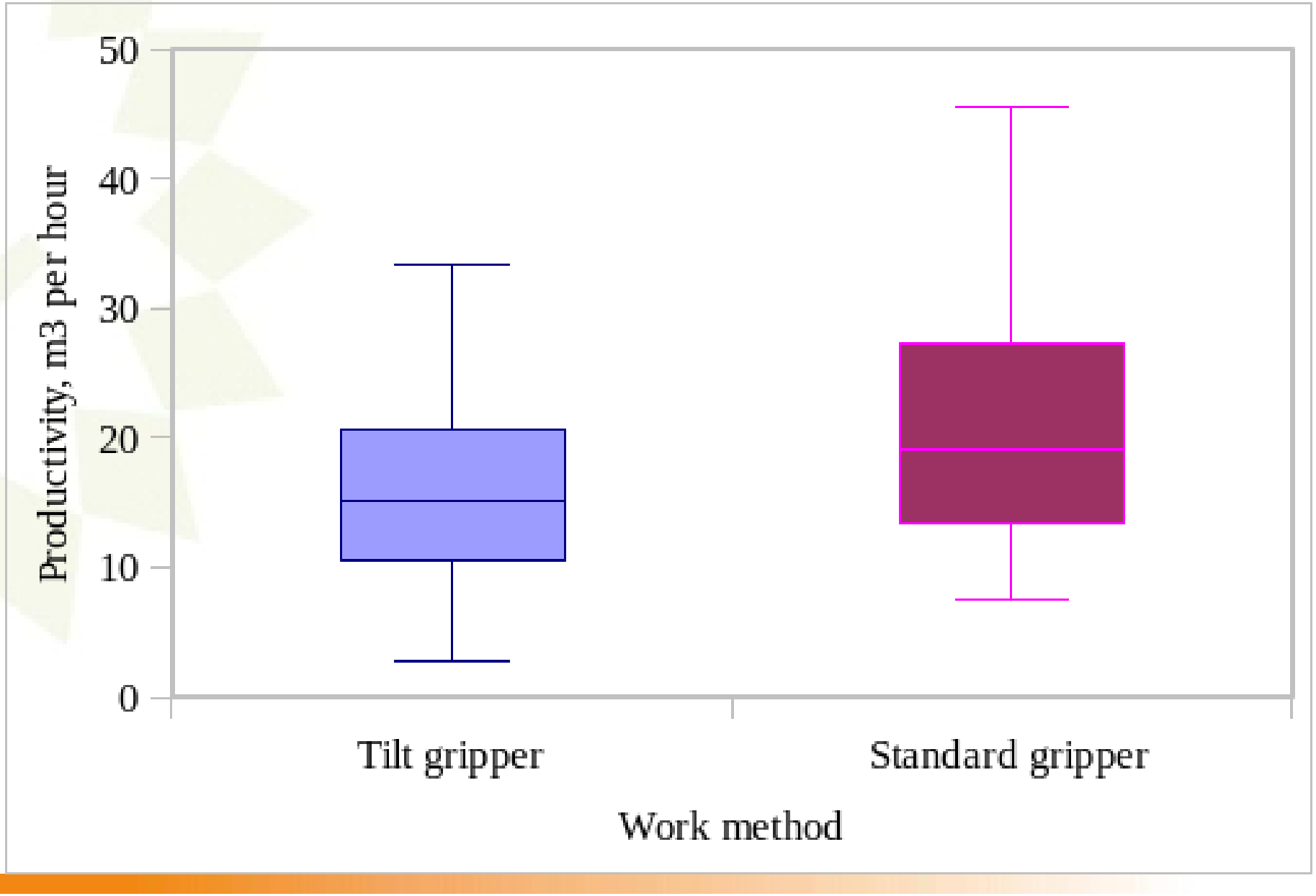
Comparison of productivity – sorting vs. standard gripper



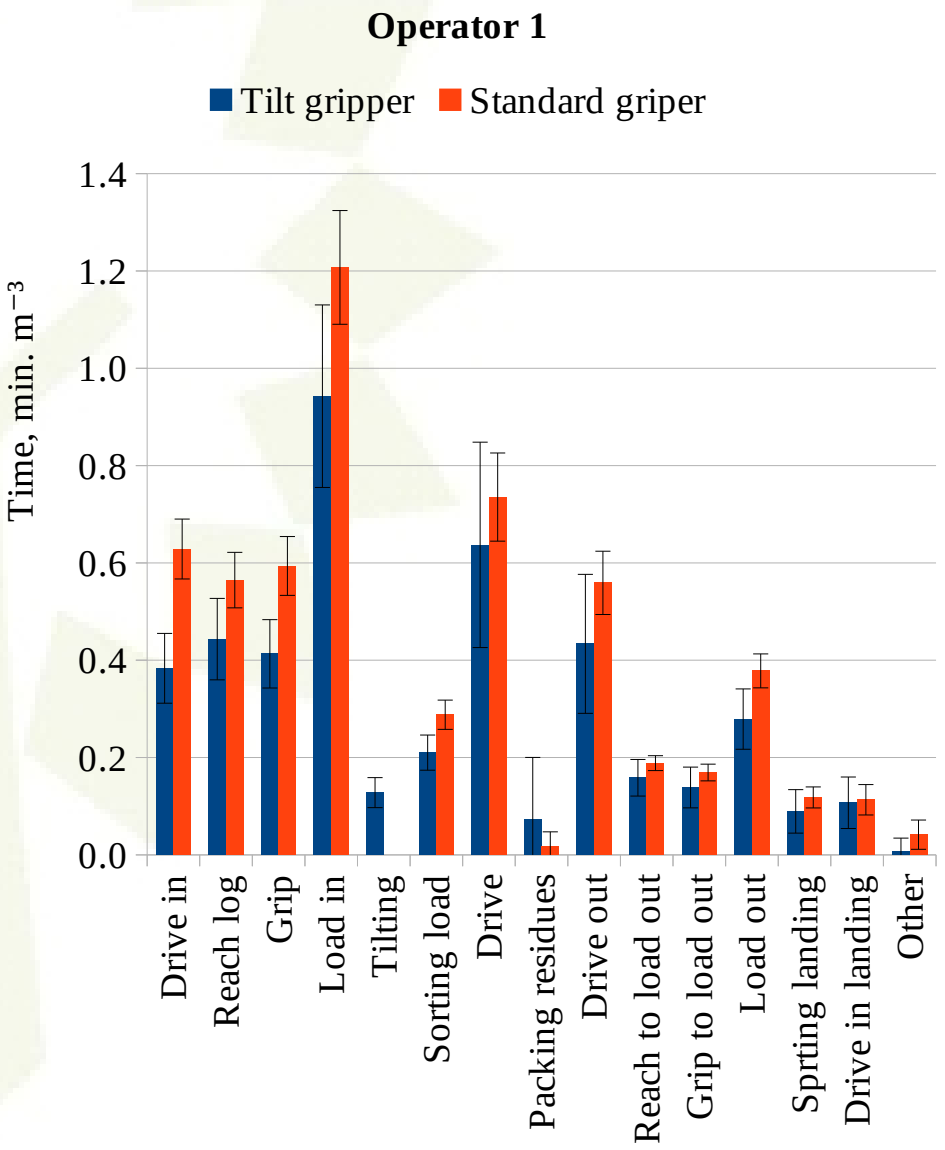
Impact on productivity – sorting gripper

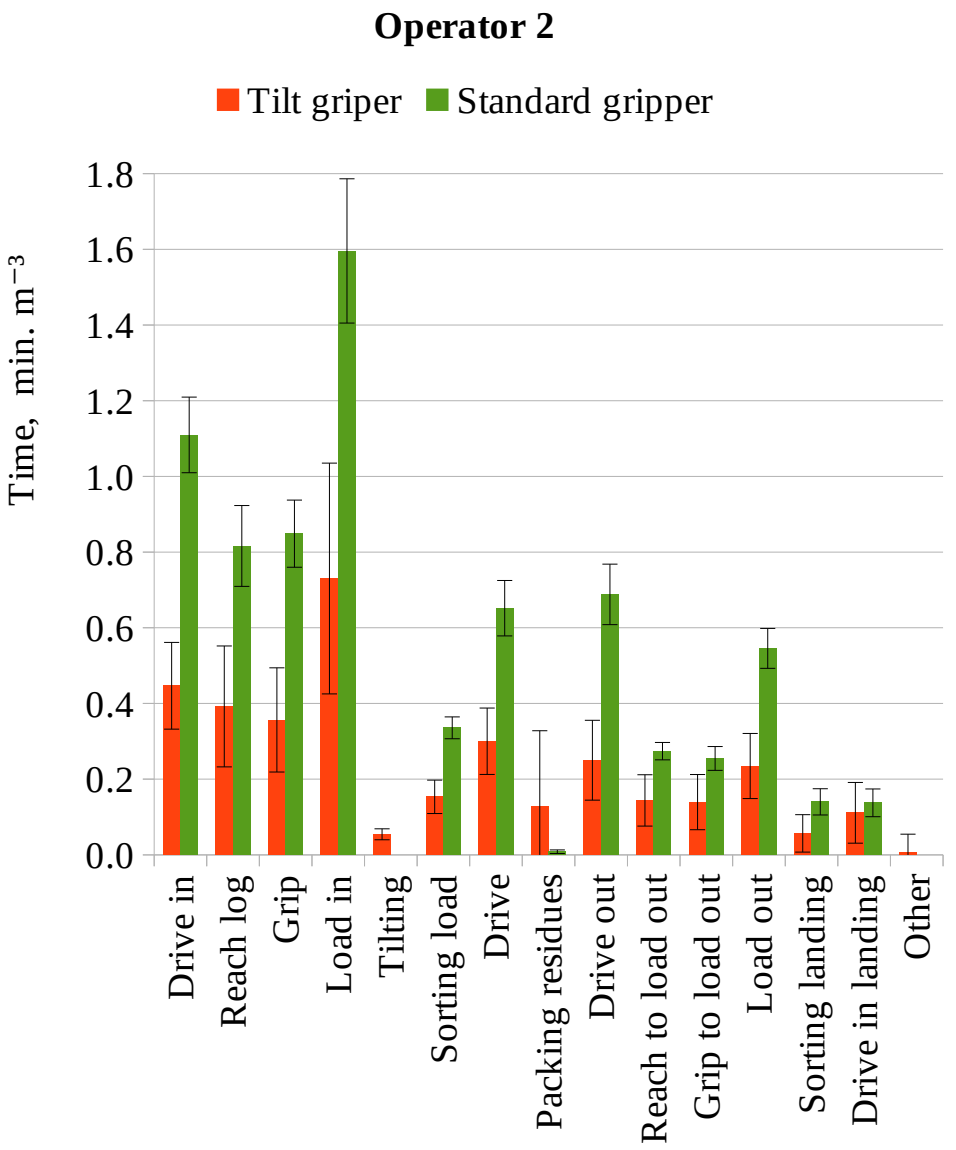


Comparison of productivity – tilting vs. standard gripper



Impact on productivity – tilt gripper





Tilt gripper – mechanical damages to remaining trees

- Number of trees damaged during harvesting and forwarding did not differ significantly, if tilt gripper is used *(2.9% of damaged trees with tilt gripper and 3.6% – with standard griper)*.

Impact of operators

- Sorting grip:
  - The average productivity is higher for the second operator (by 2% or 9.7 m³);
  - The second operator spent 72% less time for the operation “grip with additional grips”.

Conclusions

- No significant productivity difference is found between both work methods – with sorting or standard gripper.
- The most probable reason for the different working approach by operators is the conditions in the study area – relatively small number of assortments (2.8 per load) and small concentration of logs around the strip roads.
- Replacement of the standard gripper with sorting gripper does not affect the proportion of damaged trees; however, in spruce dominant stands the impact could be more visible.
- Sorting gripper demonstrated advantages in loading operation if experienced and motivated operator is employed.
- No significant difference was found in productivity if standard or tilting gripper was used in trials; however, impact on damages of remaining trees is significant.

Thank you for attention!

Pētījums veikts a/s "Latvijas valsts meži" un LVMI Silava
2011. gada 11. oktobra memoranda
"Par sadarbību zinātniskajā izpētē" ietvaros

LATVIJAS VALSTS MEŽI