Hazelnuts mechanical harvesting in Calabria: preliminary trials on work productivity

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Abstract
Hazelnut or Corylus avellana is an important species for many Calabrian hilly territories. It represents a key cultivation for those areas where there are no alternative crops, except forestry. However, it would require high levels of mechanization, especially for harvesting, which is currently one of the most expensive processes of the productive cycle; an operation that can engrave up to 40-60% on the sale price of the product, moreover to be time consuming if carried out manually.

Since hazelnuts are fruit that tend to fall spontaneously from the trees, they are mainly harvested using gathering machines from the ground. Hazelnuts mechanical harvesting seems to be efficient even in complex situations. In the surveyed farm, they were first moved into the center of the rows using backpack blowers, and then gathered by mean of “Jolly 2800” harvester. Finally, they were transported to processing site where they were cleaned and dried.

The present paper intends to assess work productivity of a Calabrian farm during mechanical harvesting and preliminary post-harvest processing of hazelnuts. Operational working time and productivity assessment have been made under C.I.O.S.T.A. ranking requirements. Time measurement started when the machine was positioned at the beginning of the row ready to start gathering. The obtained results showed that such machines offer work productivity higher than manual harvesting. A significant decreasing of working times was also reached thanks to an accurate soil management that allows ground leveling and eliminates cultural residues and other impurities eventually present.

Keywords: Corylus avellana, mechanical harvest, work productivity

Introduction
According to ISTAT data (2011), Hazelnut or Corylus avellana cultivation is extended on about 69.898 ha in Italy, from which 66.192 ha produce 1.176.001 quintals, 1.122.860 quintals of them are harvested or collected.

The main important areas of production are Piemonte, Liguria, Lazio, Campania and Sicilia. In Calabria, this cultivation covers 376 ha, situated mainly in the mountainous area of Catanzaro, so that it constitutes a characteristic element of the agricultural and forestry landscape. It is an important species for many Calabrian hilly territories, and represents a key cultivation for those areas where there are no alternative crops, except forestry. However, it would require high levels of mechanization, especially for harvesting, which is currently one of the most expensive processes of the productive cycle; an operation that can engrave up to 40-60% on the sale price of the product, moreover to be time consuming if carried out manually. According to producers, mechanical harvesting is an essential factor for the subsistence of such cultivation (Blandini et al., 2007). Indeed, the necessity to reduce harvesting costs and the relative operating time, have pushed machines industries to realize diverse and ever more innovative models for harvesting from the ground (Pagano, 2008).

Hazelnuts are harvested from August 10th, and on, when the product fall down in the ground, doing one or more passages utilizing self-propelled, trained, and scoped machines. These...
machines permit with little manpower a fast harvesting of hazelnuts from the ground. However, harvesting period has to be as brief as possible; in way to avoid that fallen hazelnuts could have alterations that compromise their commercialization (Ascopiemonte S.C., 2009).

The present paper intends to assess work productivity of a Calabrian farm during mechanical harvesting and preliminary post-harvest processing of hazelnuts.

**Materials and methods**

1. **Harvesting**

Trials have been effectuated during 2011 harvesting campaign (October, 2011 corresponding to the second harvesting), in a hazelnuts orchard of about 1 ha, composed mainly by shrubs of 10 to 12 years old, with a planting distances of 5x5,5m; situated in the municipality of Torre di Ruggiero, Province of Catanzaro, Southern Italy. It is a mountainous area that lies at 590 above sea level. The main cultivated varieties are “*Tonda Gentile Romana*” and “*Tonda Calabrese*”.

![Fig. 01: Hazelnuts orchard subject to trials.](image)

Over the year, the crop is managed as follows:

<table>
<thead>
<tr>
<th>January/February</th>
<th>March</th>
<th>April</th>
<th>May/June</th>
<th>Beginning of August</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pruning</td>
<td>Fertilization with NPK</td>
<td>weeding and/or soil tiling</td>
<td>Fertilization with secondary minerals; 2(^{nd}) weeding and soil cleaning</td>
<td>Soil cleaning and preparation for harvesting before fruit falling</td>
</tr>
</tbody>
</table>

Hazelnuts have been harvested by mean of “Jolly 2800” harvester from the ground. In the surveyed farm, as described by Colorio *et al.* (2011), the fallen nuts which tend to be spread over the whole orchard are usually bushed away from the tree trunks using backpack blowers (Fig. 02), so that the harvester head can get at them easily.

The crew was composed by four laborers: the harvester driver and three laborers charged to windrow hazelnuts.
a) Harvester description
In the Certificate n°17-008, the ENAMA (2004) describe the harvester G.F. model “Jolly 2800” as follow: It is an agricultural operating machine semi-scoped by the tractor with power takeoff (PTO) and three-point hitch at the front. It is destined to almonds, nuts, hazelnuts and chestnuts harvesting from the ground, on both, bare soil and tiled one; and their subsequent transfer, after a mechanical sorting, in bags set up on a work platform. Functioning principle of such machine is based on the presence of a rotating brush for nuts collection from the ground, set frontally and transversally to advancement direction. Moreover, the machine has separate chambers that insure the harvested product cleaning by mean of mechanical devices.

b) Operational working time
The experimental plot was composed by three rows of about 119 m of length. We considered that each row constitute a replicate. Then, three rows replicates have been achieved. Time assessment taken by the observed tasks in the current study has been made under C.I.O.S.T.A. ranking requirements (Bolli et al., 1987). Time measurement started when the harvester was positioned at the beginning of the first row, ready to start gathering. And it finished at the end of the last row. Time measurements concerned the following tasks:
After harvesting, hazelnuts have been transported to processing site where they were cleaned and dried.

2. Cleaning and drying
Once harvested, hazelnuts are passed in suitable cleaners that with the aid of air flow separate the fruit from eventual stones, dust, leaves and branches. So, hazelnuts can carry on with draying phase, in the surveyed farm, this task took 10.57,85 min for 50 kg of the harvested product.

Nowadays many farm that produce hazelnuts, have acquired industrial dryers having a capacity of 20-30 quintals of hazelnuts. These equipments effectuate a forced drying utilizing a hot air of 45 degrees and the continuous movement of hazelnuts, in heating phase. Hazelnuts so dried can be stored in the farm under different ways: in bulk, in jute bags, or in cases as shows Fig. 05 (Ascopiemonte S.C., 2009)
Results and discussion
The obtained results show that the operative time \( TO = TE + TA \), in the previous conditions of trials had an average value of 3.50 h/ha which is higher than operative working time registered by ENAMA (2004): 2.61 (h/ha). The effective working time had an average value of 2.88 h/ha corresponding approximately to the results obtained by ENAMA (2.48 h/ha). The TAV, instead, had a mean value of 0.40 h/ha and accessory time for handling TAC of 0.36 h/ha, occurred just when the harvester driver had to check an eventual problem.

According to the harvested production, the value obtained during trials was about 1.30 quintals/h.

After hulling, the extracted 500 g contained 184 g of net product (hazelnuts), whose moisture was of 14.5%, instead, shell moisture was of 10.7%. To be properly stored and commercialized by the time, hazelnuts must have a moisture percentage not higher than 8-10% for the shell and less than 6% for the unshelled hazelnut (Ascopiemonte S.C., 2009). The 184 g of hazelnuts contained 14 g of rotten product, and 8 g of spotted one. Therefore, from 500 g of the harvested product, the proper and usable one weighted 158 g.

Conclusion
The present paper constitutes a description of the state of art of hazelnuts mechanical harvesting in Calabria. The carried out trials have to be consolidate by more experiments including more farms and different devices for harvesting. However, it illustrated that, hazelnuts mechanical harvesting from the ground by mean of the above described harvester could be suitable to be used even in complex situations. Indeed, such machines offer work productivity 3 or 4 times higher that manual harvesting (Pellizzi, 1986); therefore a significant decreasing of working times can be reached. Prior weeding and hazelnuts windrowing in the fields allow 20% time saving in harvesting phase. Mechanical harvesting of windrowed hazelnuts increase harvested yields up to 39% and advancement speed up to 48% (Blandini et al., 2007).

*The authors have contributed equally to the present work.

References:

Blandini G., Schillaci G., 2007. La raccolta delle nocciole può essere meccanizzata. Supplemento all’Informatore Agrario, n°27. 11-13


Colorio G., Pagano M., 2011. Sistemi innovativi per la raccolta della frutta-Innovation in fruit harvesting: robot eyes, robot arms. MMW n.3. 64-69

