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# Harvesting Wood Residues for Energy Production from an Oak Coppice in Central Italy

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**Abstract:** The sustainable management of coppice forests and the valorization of forest residues represent key activities for the development of wood for the energy supply chain. The present study focused on the quantification and the physical/energetic characterization of oak residues (branches and tops) obtained from a coppice stand in central Italy. The study also evaluated the performance of the technologies used for the harvest and chipping operation. The wood residues obtained were mainly tree branches and tops and accounted for 19.8% of the total biomass extracted from the forest. Taking into account the standards of wood chips for energy use, the material produced was included in the quality class B. Summarizing, the results obtained in this work indicated that opportune forest operations can provide a significant amount of wood residues (mainly branches and tops) from oak coppices in central Italy and that the derived material can reach medium commercial features, being exploitable in different bioenergy production scenarios.

**Keywords:** biomass; residues; mechanization; wood chips; branches and tops



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## 1. Introduction

The current EU energy policies support the recovery and utilization of agricultural and forest residues to increase the production of renewable energies. Despite challenging procurement logistics, agro-forest residues may represent a valid resource for generating thermal and/or electrical energy [1]. In Italy, among the sources of forest residues, the biomass derived from coppice woods could be remarkable, as coppice represents almost half of the total Italian forest area. To provide an estimation, about 3.7 million hectares of coppice are present in the Italian peninsula, representing 42% of the total national forest surface and 20% of the total coppice stands present in the European Union [2]. From a strategic point of view, the sustainable management of wood residues coming from these stands may represent a resource to be exploited for the development of the bioenergy sector [3]. However, residues are low-value material requiring low harvest costs to become sustainable. Therefore, producing energy biomass at low costs must necessarily be inspired by an industrial logic, which should rely on highly productive technologies that process large quantities of product in a short time to minimize the production costs. Currently, the adoption of advanced forest machines such as specialized headers, forwarders and advanced chipping systems have become widespread in countries where the forest economy represents an asset, mainly in Northern Europe [4,5], while only in the last years has an increase in the use of these technologies been observed in central and eastern Europe [5–7]. These machines allow differing and transporting wood assortments in an easy way whilst respecting the common forest mechanization strategies, but initial investment and maintenance costs are remarkably high [5–8]. The economic factor restricts the purchase of these machines to only medium and large companies, with an average annual use of about 1400–1600 h [9].

In Italy, access to forests is often difficult or even impossible for heavy machines due to the steep slopes and the absence of adequate forest roads [10]. Additionally, forest land is highly fragmented [11,12], with many landowners and territories portioned in regions, provinces and municipalities. This determines the development of many small-scale companies, operating at the local level with a limited number of employees and machines [13]. Especially in the central and southern regions of the peninsula, the most common level of mechanization is the traditional one, which is based on the use of chainsaws, agricultural tractors equipped with cages for logging [14] and specific accessories such as winches, hydraulic cranes, log grabs, etc., [15]. For these reasons, the valorization of forest residues in Italy appears difficult.

On the other hand, recent policy instruments such as the EU's rural development plans have supported Italian companies to replace traditional mechanization lines with advanced mechanization, introducing disc or felling heads applied to crawler excavators, modern articulated tractors and cableways for harvesting operations in coppice utilization [16].

Inexorably, the smaller volume of biomass available from coppice respect that of high forests implies lower productivity [17], but where it is possible to access coppice forest by these means, the valorization of forest residues become achievable, and there is a significant improvement in security [18]. As part of a national research project, the present study was performed to test an advanced mechanized harvesting system in an oak coppice; the work analyzed the potential recovery of residual biomass generated by forest operations and the performance of the machines utilized. The goal of this study was to contribute to the assessment of forest residue availability in Italian coppice and to evaluate a possible technological solution that will facilitate the process of biomass recovery for energy valorization.

## 2. Materials and Methods

### *2.1. Study Area and Mechanization Systems*

The study was conducted in a coppice stand in central Italy in the municipality of Tarquinia (VT), locality of "Scialamate" 42°17′12″ N. 11°51′72″ E. The site was characterized by an average slope of 23% with peaks of 35%. The coppice was characterized by 16–17-year-old tree species such as Turkey oak (*Quercus cerris* L.), Downy oak (*Quercus pubescens* Willd.), Montpellier maple (*Acer monspessulanum* L.) and Flowering ash (*Fraxinus. ornus* L.). The oaks and maple represented the dominant forest layer, while the flowering ash was in the dominated stratum. The shrub layer was mostly irregular in terms of density and degree of development, being characterized by species such as Mock privet (*Phyllirea latifolia* L.), Dogwood (*Cornus mas* L.), Blackthorn (*Prunus spinosa* L.), Butcher's broom (*Ruscus aculeatus* L.), Hawthorn (*Crataegus monogyna* Jacq.), Dog rose (*Rosa canina* L.), Bramble (*Rubus ulmifolius* Sch.), Smilax (*Smilax aspera* L.) and Cyclamen (*Cyclamen* spp.). The cutting of the coppice was carried out in autumn 2019 by applying the principles of mechanized harvesting according to the following scheme (Figure 1):

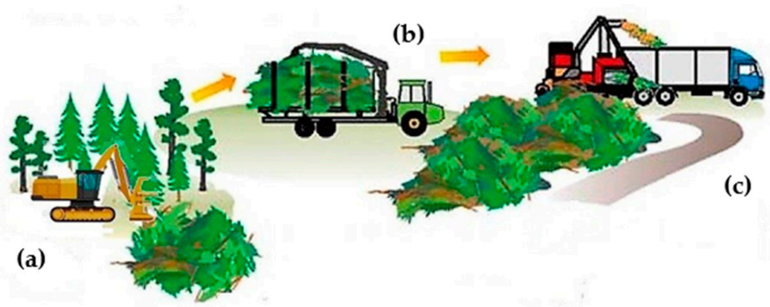


**Figure 1.** (**a**) Felling head mounted on the excavator arm; (**b**) forwarder during extraction operations; (**c**) drum chipper.

The mechanization line adopted included the following machines:

- A 129 kW crawler excavator with a maximum outreach of 9.3 m equipped with a felling head with a hydraulic shear;
- A 136 kW power "Forwarder" articulated load-bearing tractor with 8 driving wheels coupled in rocker axles and with hydrostatic transmission equipped with a telescopic articulated hydraulic arm with a maximum outreach of 7.2 m;
- A towed drum chipper with a dedicated arm connected to the PTO of a 350 kW tractor.

Table 1 shows the technical specifications of the machines used in the test.

**Table 1.** Technical characteristics of the machines.

| Machines | Unit | Excavator/Shears | Forwarder | Tractor/Chipper |
|---|---|---|---|---|
| company | | Hitachi/Westtech | John Deere | CLAAS/Pezzolato |
| model | | ZAXIS 240N/Woodcracker C450 | 1410D eco III | XERION 4500/PTH 1200/1000 |
| Engine | type | Isuzu AR-4HK1X/- | John Deere 6068H | Mercedes-Benz OM 471 LA/- |
| Power | kW | 129/- | 136 | 350/- |
| Weight | kg | 23,100/2350 | 16,600 | 16,570/18,000 |
| Cylinders | n° | 4/- | 6 | 6/- |
| Maximum torque | Nm | 670/- | 780 | 2300/- |
| Load capacity | kg | | 14,000 | |
| Fuel tank volume | L | 330/- | 165 | 740/- |
| Hydraulic tank volume | L | 220/- | 140 | 120/- |
| Felling diameter | mm | -/450–500 | | |
| Drum diameter | mm | | | -/1000 |
| Drum width | mm | | | -/1200 |
| Maximum chipping diameter | mm | | | -/800 |
| Knives | n° | | | -/5 |
| Length | mm | 9750/- | 10,400 | 7593/- |
| Width | mm | 2480/- | 3070 | 3300/- |
| Height | mm | 3020/- | 3700 | 3941/- |

### *2.2. The Potential of Biomass from Branches and Tops*

An experimental area of approximately 0.5 hectares (4911 $m^2$) was identified within the forest area analyzed. The selected area was considered a representative spot of the Mediterranean oak coppice population, commonly present in Italy, France, southern Spain and the Balkans [9]. For the recording of dendrometric parameters such as height and diameter at breast height (DBH), a professional ultrasound Vertex hypsometer mod IV-360KIT and a 40 cm timber caliper Haglof Mantax Blue series (Haglöf, Langsle, Sweden) were used, respectively. The tree diameter was measured by detecting the DBH up to a threshold of 5 cm, while a random sample of 50 trees was selected for the height measurements. The other measurements performed were the total number of stumps and the total number of trees present in the site.

For the harvesting, the company in charge of coppice management applied the Whole Tree System technique (WTS), consisting of the extraction of the entire tree and the total chipping without removing tops and branches. The chips obtained were transported to the energy plant for bio-energy production. The WTS technique is a fast method adopted to maximize the recovery of biomass from a forest site compared to other working systems [19–21]. To establish the potential incidence of branches and tops (BT) generated, a sample of 30 trees from 30 different stumps were randomly selected. Whole trees were separated from branches and tops; then, the stems with the main branches and the branches with the tops were weighed separately with a 1000 kg hook dynamometer (d = 0.2 kg) mod. PCE-CS was supported by the arm of a forest loader.

### 2.3. Technology Performance

For the analysis of the operational performance of the machines used, the work cycles of each machine were observed during the harvest operation. Each work cycle was composed of different activities (temporal elements) as reported in Table 2 [22]. This section is divided by subheadings. It provides a concise and precise description of the experimental results and their interpretation as well as the experimental conclusions that were drawn.

For the analysis of the operational performance of the excavator/shear, 498 tree fellings were observed with a DBH ranging from 5 to 35 cm. For the tree logging, the operational performance of the forwarder was elaborated on the basis of 7 full work cycles, while for the chipper the performance was evaluated on 2 full loads of the truck with a trailer.

Working times were recorded using two centesimal chronometers, and the measurements also took into account downtimes of up to 15 min. A gross average hourly production rate (HPR15) was calculated for each machine on the basis of the material processed (wood tons) in units of time, including all delays up to 15 min (dead times); the net average hourly production rate (HPR0) was calculated excluding all delays.

**Table 2.** Cycle times and time elements studied.

| Machines | Work Cycle Time | Time Elements | Description |
| --- | --- | --- | --- |
| Excavator/Shear | Felling whole trees | Moving | Started when the shear or the boom started to move to a tree and ended when machine head was clamped on the tree. |
| | | Felling | Started when the shear clamped onto the tree stem and ended when the tree touched the ground. |
| | | Bunching | Started when the shear grabbed a log and ended when it dropped the log onto the pile. |
| | | Clearing | The use of a head to remove non-merchantable material. Started when the shear began to clean the area surrounding the trees from the shrub layer higher than one meter and ended when it dropped it on the pile of trees. |
| | | Delay | Any interruption to the harvesting operation spending extra time (e.g., operational, personal, mechanical). |
| Forwarder | Extraction of whole trees | Loading | Started once the forwarder was at the side of the logs piles to be loaded, the displacement is stopped, and the crane arm began to move. It included the time spent after the forwarder finished loading the logs from one pile and moved to the next pile until the forwarder was fully loaded. |
| | | Loaded travel | Once the bunk of the forwarder was full it began to move with the load to the landing. |
| | | Unloading | At the landing, the forwarder used the crane to unload the logs from its bunk. This activity included the small movements required at the landing in order to complete the unloading. |
| | | Empty travel | Started after the unloading of trees at the landing. The forwarder had to return to the work zone once unloaded. |
| | | Delay | Any interruption to the harvesting operation spending extra time (e.g., operational, personal, mechanical). |

**Table 2.** *Cont.*

| Machines | Work Cycle Time | Time Elements | Description |
|---|---|---|---|
| Tractor/Chipper | Chipping of branches and tops | Truck positioning | Time for positioning the truck next to the chipper. |
| | | Moving | Started when the chipper arm moved from the pile of trees to the feeding mouth. |
| | | Chipping | Started when the operator started feeding into the chipper and ended when the wood chips were completely expelled from the gooseneck. |
| | | Delay | Any interruption to the harvesting operation spending extra time (e.g., operational, personal, mechanical). |

The productivity of the excavator/shear ($_{ex}PMH_0{}^{-1}$) was calculated utilizing the following Equation (1) [23]:

$$\text{Productivity } ({}_{ex}PMH_0{}^{-1}) = (\text{volume}/\text{cycle time}) \times 60 \quad (1)$$

where:

- volume ($m^3$)—volume of the tree;
- cycle time (min)—moving, felling and bunching (Table 1);
- $_{ex}PMH_0$—productive time of the excavator with a shear.

The productivity of the forwarder ($_{fw}PMH_0$) was calculated using the following Equation (2) [24]:

$$\text{Productivity } ({}_{fw}PMH_0{}^{-1}) = (60 \times \text{Lcycle})/t_{empty} + t_{loading} + t_{loaded} + t_{unloading} \quad (2)$$

where:

- Lcycle—load for each work cycle (green tons);
- t—time in minutes (empty travel, loading, loaded travel, unloading);
- $_{fw}$PMH0—operative time of the forwarder excluding delays.

The following formula to evaluate the tractor/chipper ($_{ch}PMH0^{-1}$) was not found in the literature, but it was determined considering the load of the truck and working times reported in hours:

$$\text{Productivity } ({}_{ch}PMH_0{}^{-1}) = (60 \times \text{Ltruck})/(t_{positionning} + t_{moving} + t_{chipping}) \quad (3)$$

where:

- Ltruck—load of the truck (tons);
- t—time in minutes (empty travel, loading, loaded travel, unloading);
- $_{ch}$PMH0—operative time of the chipper excluding delays.

The total biomass produced was determined through the weights of the trucks measured at the energy plant.

### *2.4. The Biomass Quality Assessment*

To define the biomass quality of branches and tops, 500 g of chip samples were collected, sealed in plastic bags and transported to the biomass quality laboratory of CREA-IT in Monterotondo (RM), Italy (LASER B Lab). The biomass was characterized according to the requirements of the European standard EN ISO 17225-1-4 [25]; the analysis included the heating values, the bulk density, the granulometric distribution of the wood chips, the moisture content and the ash content [26]. It was pointed out that a period of storage of the whole plant occurred between the felling and chipping operations (2 months), resembling the normal operative conditions of forest companies. For this reason, the biomass quality parameters were referred to as post-infield storage and not as fresh base.

## 3. Results

### *3.1. Site Characterization*

The coppice had an initial density of 1157 plant ha$^{-1}$, with mean DBH and mean height of 13.1 cm and 10.2 m, respectively (Table 3). The main species were Turkey oak 80% (*Quercus cerris* L.), Downy oak 4% (*Quercus pubescens* L.) and Montpellier maple 15% (*Acer monspessulanum* L.). All the trees that reached the coppicing cycle were felled, while about 110 individuals per hectare were left for forest regeneration. The total biomass collected was equal to 114.7 t ha$^{-1}$.

**Table 3.** Results of the forest stand characterization.

| | Unit | |
|---|---|---|
| Density: | | |
| - Stumps | n ha$^{-1}$ | 335 |
| - Total trees | n ha$^{-1}$ | 1157 |
| - Reserve | n ha$^{-1}$ | 110 |
| Average number of trees for stump | n | 3.45 |
| Average DBH | cm | 13.1 |
| Average height | m | 10.2 |
| Basal area | m$^2$ | 15.64 |
| Range volume | m$^3$ | 0.01–0.39 |
| Average biomass harvested | t ha$^{-1}$ | 114.7 |

Figure 2 displays the hypsometric curve and the weight curve of the forest stand. The hypsometric curve shows a good correlation between diameter and height with an $R^2$ = 0.612. On the other hand, the tree weight curve illustrates a variation, as a function of DBH, from a minimum of 0.22 to a maximum of 6.72 quintals (fresh basis) with an $R^2$ = 0.976.

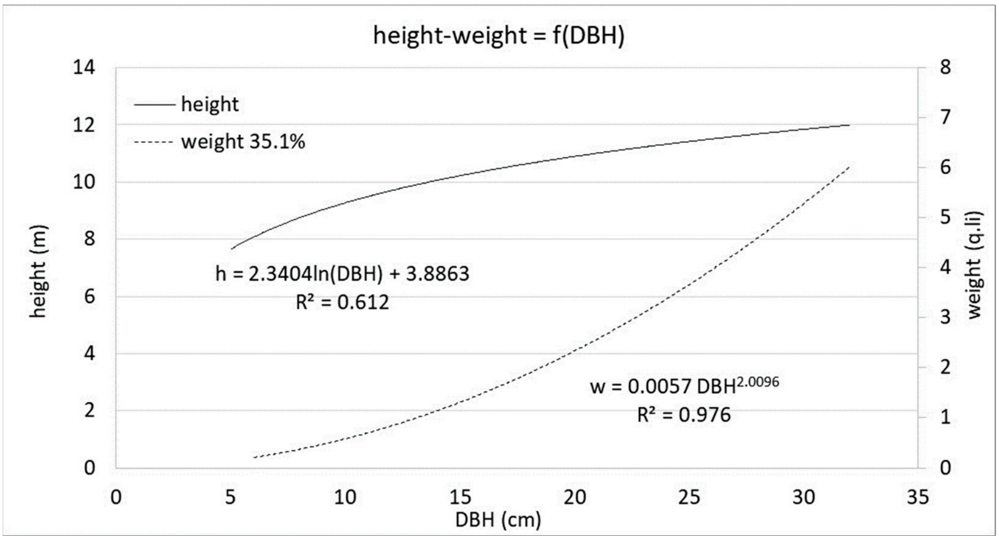


**Figure 2.** Height and weight curves for the studied oaks as a function of diameter at breast height (DBH).

### *3.2. Residual Biomass Potential of Tree Branches and Tops*

The study of the residual biomass potential revealed that BT accounted for 19.8% of the total biomass harvested. In detail, for the 5–15 cm diameter classes, the average potential recoverable biomass was 24.2% of the full trees; for the classes 15–25 cm, the recovery was equal to 18.3% of the full trees, while for diameters greater than 30 cm, the residues represented 15.7% of the full tree biomass. Figure 3 shows how the recovery percentage of BT varied as a function of the DBH.

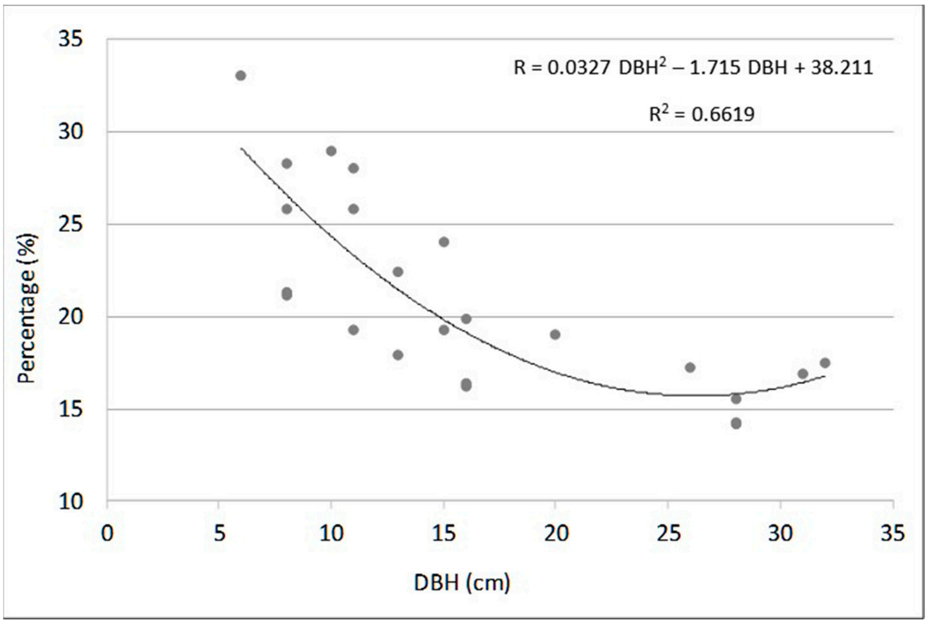


**Figure 3.** Percentage of recovered branches and tops (BT) as a function of the DBH.

*3.3. Performance of the Technology*

The first machine analyzed was the excavator with a forest shear; this machine exhibited a PMH15 equal to 8.32 t $h^{-1}$ and a PMH0 equal to 9.25 t $h^{-1}$. Considering only the principal operations (moving, felling and bunching), the average processing time of a single tree was equal to 0.98 min, corresponding to a $PMH_{15}$ of 11.7 t $h^{-1}$ and PMH0 of 13.67 t $h^{-1}$. The analysis of the entire work cycle of the exavator/shear showed that the clearing phase accounted for 29.2% of the operative time, while downtime was equal to 10.0% (Figure 4).

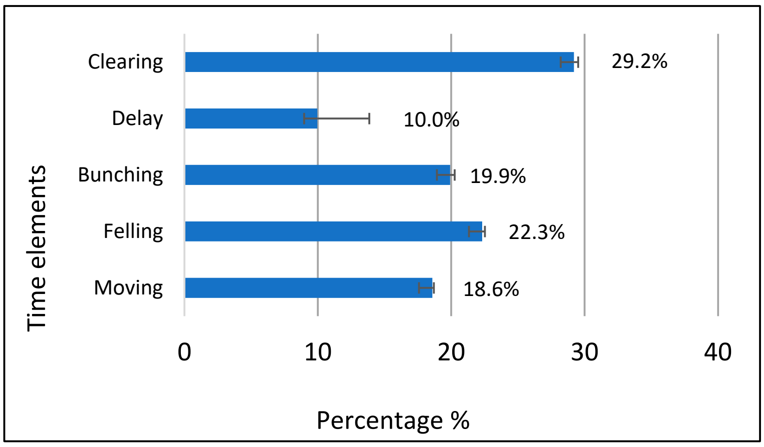


**Figure 4.** Study of the time elements of the excavator/shear.

The second machine analyzed was the forwarder. On the basis of the seven work cycles analyzed, the machine displayed an average duration of 0.85 h (51 min), with seventy-one plants removed per cycle. The temporal elements that most influenced the work cycle were the travel time at full load (36.1%) and the travel time with an empty load (23.2%). The distance covered from the experimental site to the truck pick-up point was 800 m.

On the other hand, the loading and unloading phases accounted for 18.4% and 11.3%, respectively, while positioning and delays contributed to about 5% of the operative time. The PMH15 of the forwarder resulted in 9.10 t $h^{-1}$, while the PMH0 resulted in 10.21 t $h^{-1}$ (Figure 5). The mean speed of the machine during loading and unloading were 2.6 and 3.5 km $h^{-1}$, respectively.

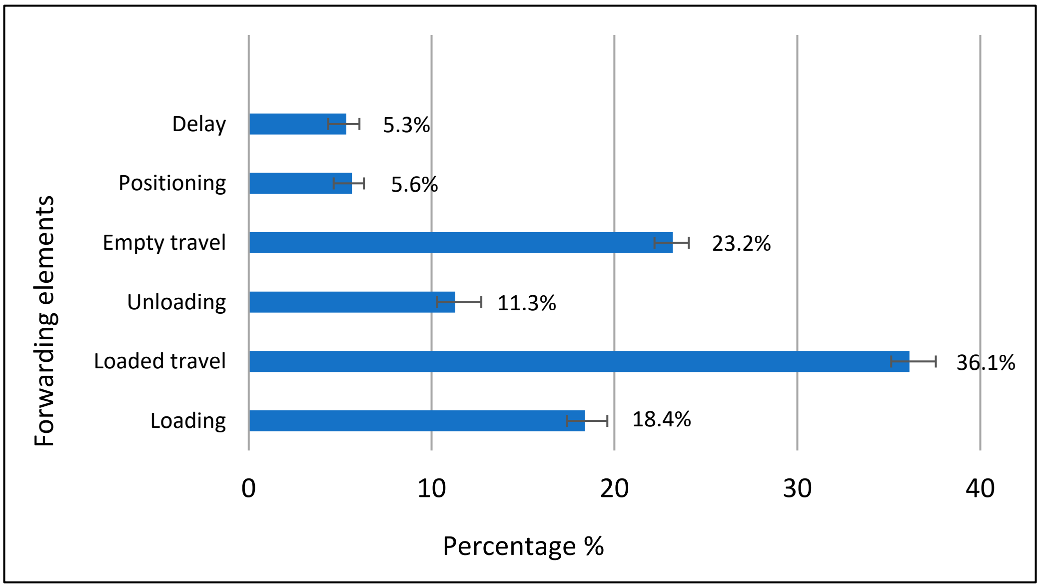


**Figure 5.** Performance of forwarder during the work cycle.

The operating results of the chipper indicated how this process was conditioned by the phases of the chipping and moving of the woody material, which accounted for 65.6 and 22.1%, respectively (Figure 6). Taking into account the load of two trucks, the working-time analysis revealed a PSH15 of 33.9 t $h^{-1}$ and a PSH0 of 37.37 t $h^{-1}$ for the chipping operation.

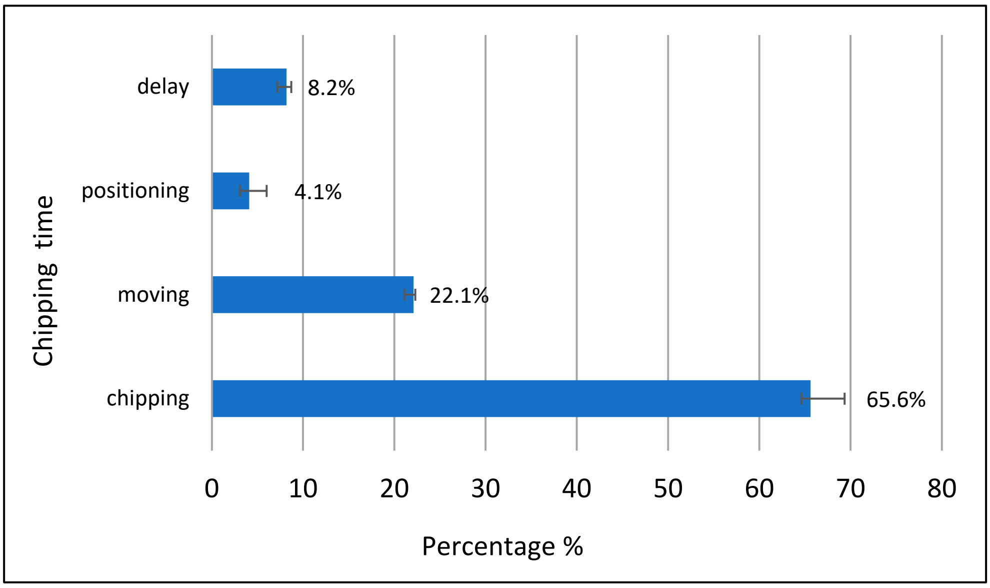


**Figure 6.** Performance of chipper during the work cycle.

### 3.4. Biomass Characterization

The biomass characterization obtained from branches and tops revealed that the chip quality fell in the "B" class according to the European standard (EN ISO 17225-4). Concerning the particle size distribution, 81.5% of the fraction was between 16 and 31.5 mm, classifying the product in the P31 dimensional class (Table 4). The fine fraction was equal to 8.3% (F10 class), while the coarse fraction with "P" greater than 45 mm was equal to 4.25%, remaining within the maximum tolerance of the standard (≤6%); in any case, all chips displayed a dimension below 150 mm.

**Table 4.** Particle size distribution of the woodchips obtained from tree branches and tops.

| Fraction | Sieve Size (mm) | Volume, w-% | Measured Fraction (Requirement Pursuant to the EN ISO 17225-1:2014 Standard) | Class |
|---|---|---|---|---|
| Fines | <3.15 | 8.3 | 8.3% (F10) | F10 |
| Main fraction | 3.15–8<br>8–16<br>16–31.5 | 20.26<br>36.00<br>25.24 | 81.5% (≥60%) | P31 |
| | 31.5–45 | 5.86 | Belongs to the main fraction | P31 |
| Coarse fraction | 45–63<br>63–100<br><100 | 0.25<br>0.22<br>3.78 | 4.25% (≤6% more than 45 mm)<br>All under 150 mm | P31 |

The moisture content of the biomass was 35.15% and the bulk density was 330 kg $m^{-3}$. The ash content of the chips was equal to 3.46%, making the product classifiable as A5.0, while the HHV resulted in 17.57 MJ $kg^{-1}$ (Table 5).

**Table 5.** Higher heating value, ash content and CHN of the samples analyzed.

| Sample | HHV (MJ $kg^{-1}$) | Ash (%) | C (%) | H (%) | N (%) |
|---|---|---|---|---|---|
| 1 | 17.09 | 3.20 | 53.44 | 9.12 | 1.43 |
| 2 | 17.72 | 3.47 | 56.56 | 8.94 | 1.34 |
| 3 | 17.36 | 3.72 | 53.91 | 9.15 | 2.56 |
| 4 | 17.74 | 3.34 | 51.98 | 9.11 | 1.93 |
| 5 | 17.93 | 3.59 | 52.38 | 8.76 | 1.96 |
| Mean | 17.57 | 3.46 | 53.65 | 9.02 | 1.84 |
| SD | 0.34 | 0.21 | 1.80 | 0.17 | 0.49 |

## 4. Discussion

The oak coppice object of study revealed species composition and dendrometric characteristics (DBH and height distribution) typical of the Mediterranean region as verified in vegetational analysis and silvicultural studies [27,28]. The amount of residual biomass (BT) was 19.8%, but it varied according to the plant diameters, being 24.2% for the diametric classes between 5–15 cm and 18.3% for the classes between 15–25 cm. These results were comparable with a similar study that analyzed the biomass components in coppice oak forests of Turkey. The work indicated that for medium diameter forest (DBH 8–20 cm) the amount of branches and foliage accounted for 22.14% [29]. However, despite the good potential of the residues identified, it must be stressed that the recovery of BT in poorly fertile stations can generate negative repercussions in the soil, as indicated by Kreutzweiser [30]. Repercussions related to environmental sustainability and long-term site productivity were identified because the collection of residues determines the removal of potential nutrients for forests [31]. A contradictory observation was noted, as during the logging operations part of the biomass (mainly shrubs, leaves and thin branches) was left in the forest, and this should enable the excessive depletion of the forest soil. However, this observation should find a scientific bases in specific and long-term studies, where the yearly quantification organic fraction should be performed after the removal of tree branches and tops. Furthermore, the WTS technique is a good practice for fire prevention compared to other harvest methods that leave large quantities of residues in the forest [32].

Regarding the performance of the excavator/shear, the results were in line with the study proposed by Tolosana [33] for the mechanized felling of oak coppices. In some cases, the presence of multiple suckers on the same stump limited the movement of the shear and made the operation difficult; this aspect represents an obstacle to the introduction of mechanized felling in coppices as already stressed by Suchomel and Purfürst [34,35]. However, for McEwan [36], the felling of coppice can be mechanized if the right technology is applied with sufficient skill. In fact, other studies show that the technical preparation of the operator can influence up to 40% of the final productivity in the use of advanced forestry equipment [35,37].

Regarding the forwarder, the limited speed of the machine was the limiting factor affecting the productivity, as also stressed by Lileng [38]. In the transport during loading, the wet ground conditions and the continuous changes in slope forced the operator to reduce the forward speed; this was due to continuous slipping and a loss of stability, which determine the risk of overturning. Some studies have shown that the main factors determining the productivity of a forwarder are the transport distance and the size of the load [39], the slope [40] and the operator's experience [41].

For the forest chipper, previous findings have displayed that a machine's performance is mainly influenced by the cutting apparatus and chip size produced [42–44]. In the present case, the chipping was performed with a knives system apparatus, and this influenced the work time by 65.6%. Regarding the delays, different studies have displayed that the factors negatively affecting the idle time in wood chipping are a longer distance between the chipper and the material, a limited number of operators involved in the operation and organizational delays [44–47]. Beside the impact of the main operation (chipping), the performance in this study was also influenced by the moving phase (22.1%) and, in particular, by the repeated small movements of the hydraulic arm needed to collect and accumulate the material that fell on the ground during biomass movement. Another factor influencing the moving phase was the conveying the of the material, and the trees with branches and tops were probably much more voluminous with respect to standard conditions.

The chip characterization demonstrated that the WTS in the described conditions allowed the producing of B-quality-class chips. The factor that prevented entrance into the A2 class was the ash content, which resulted in only 0.46% above the limit of 3%. This very low difference coupled with the limited presence of coarse fractions suggested that the product could be safely used not only in industrial combustion plants but also in small domestic plants after mixing it with wood chips with a lower ash content. Although an optimal range for biomass-for-combustion purposes has not yet been identified, the study of the CHN suggested the good aptitude of the harvested biomass for being converted, which was identified through the indirect estimation of the heating value [48,49]. This was also confirmed by the good response of the direct heating value measurement, whose values were in line with those of traditional wood chips and wood species used for combustion purposes [50,51].

## 5. Conclusions

The present study aimed at evaluating the productivity and quality of biomass residues obtained from a representative oak coppice in central Italy. The mechanization systems utilized in this study allowed the recovering of 22.7 t $ha^{-1}$ of residue, corresponding to 19.8% of the total biomass harvested in the area. The quality of the biomass obtained fell in the B quality class, with good energy potential and characteristics for being utilized both in domestic plants (mixed with A quality class chips) and medium/large-sized industrial power plants. In conclusion, the study highlighted the opportunity of utilizing advanced forest mechanization to achieve the collection of forest residues and demonstrated the good potential of typical Mediterranean oak coppices to provide additional and valuable energy products with respect to the traditional wood assortments utilized. Future studies will focus on the economic analysis of WTS to evaluate the convenience of adopting this system in relation to the biomass quality and quantity produced.

**Author Contributions:** Conceptualization, A.D.G. and E.S.; methodology, A.D.G.; formal analysis, E.P. and F.G.; writing—original draft preparation, A.D and A.S.; writing—review and editing, A.S. All authors have read and agreed to the published version of the manuscript.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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