

## Current State and Prospects of Nut Fruit Species Growing in the World and Republic of Serbia

Svetlana M. Paunovi \*, Aleksandar Leposavi , Ira Milinkovi ,  
Žaklina Karaklaji -Staji , Jelena Tomi , Boris Rilak

Fruit Research Institute, a ak, Kralja Petra I/9, 32000 a ak, Republic of Serbia  
\*E-mail: svetlana23869@gmail.com

Original scientific paper

### SUMMARY

In the Republic of Serbia of nut species the most grown are walnuts, followed by hazelnuts. However, the share of plantations covered by these species is not larger than 4%. Walnut production has a long tradition in Serbia, and its wide range application makes it one of the appreciated fruit species, while hazelnut production has been steadily increasing over the last years. The objective of this study was to evaluate analysis of the current state and prospects of walnut and hazelnut growing in the world and Serbia, for the period 2013-2018. Based on the FAOSTAT (2020), Serbia in 2017/2018 take the sixteenth place in the world by walnuts production, while it does not belong to the group of 25 countries in the world that are most important in the production of hazelnuts. On the other hand, Serbia ranks tenth in Europe in the total production of walnuts, and fifth place by



<p>60 80%, 1 50-60% (Paunovi , 2010; Paunovi et al., 2011).</p>	<ul style="list-style-type: none"> <li>- Walnut grafting is a very complex and expensive process compared to most other fruit species, due to the low rate of callus formation and unsatisfactory percentage of grafting success of 60 to 80 %, while the percentage of class 1 nursery plants of as low as 50-60% of the number of grafted rootstocks (Paunovi , 2010; Paunovi et al., 2011). In terms of hazelnuts, grafting hazelnuts is a less frequently used form of propagation in Serbia, due to technical and environmental demands during and after grafting (Mileti , 2017).</li> </ul>
<p>2017).</p>	<ul style="list-style-type: none"> <li>- Another reason for insufficient production of walnut and hazelnut, even apart from favourable agro-environmental conditions, is a long period from investing until the full yield and investment return, from fifth until eighth year. However, it should be noted that in the last years an increased interest in walnut and hazelnut production were observed in Serbia, as the state stimulates the establishment of new plantations through enabling subsidies through procurement of planting material, appropriate irrigation systems and agricultural machinery.</li> </ul>
<p>(Cerovi et al., 2006; Taha Al-wadaan, 2011; Pourfarzad and Mehrpour, 2017).</p>	<ul style="list-style-type: none"> <li>- Also, the wide range of walnut and hazelnuts application in nutrition, medicine and food, as well as timber and leather industry makes them one of the most appreciated fruit species. Nut fruit species are rich in dietary fiber, vitamins, and minerals, and packed with numerous health promoting phyto-chemicals. Altogether, they help protect from diseases and cancers, reduce risk of heart disease, improve brain function, blood cholesterol and triglycerides and ensure normal body functions (Cerovi et al., 2006; Taha and Al-wadaan, 2011; Pourfarzad and Mehrpour, 2017).</li> </ul>
	<ul style="list-style-type: none"> <li>- Considering the extremely favourable climatic and soil conditions in Serbia and the great importance of nut fruit, it is necessary to progress towards setting up new intensive plantations of walnuts and hazelnuts with contemporary assortment</li> </ul>

and growing technologies developed.

### Walnut and hazelnut production in the World

Demand for walnuts is unlimited on both domestic and international markets, because its wide range application makes it one of the most appreciated fruit species.

According to FAO, walnut is a strategic species for human nutrition and has been included in the list of FAO as a priority crop to cultivate. High fat and protein content, as well as vitamin C determines walnut as the food that plays an important role in the nutrition of the world population. Also, an important walnut advantage is the long life of the trees, including the long productive period.

Based on the FAOSTAT (2020), in 2017/2018, global walnut production was estimated at 3,829,626 tons with an average yield of 3,489 kg/ha, which indicates a consolidating growing trend observed over the previous 10 years. Data collected from all continents show that Asia is the leader in walnut production (2,622,993 tonnes), followed by Americas (820,129 tonnes). In the third place is Europe with 346,862 tonnes, while the smallest production is in Africa (36,992 tonnes) and Oceania (2,650 tonnes). China and United States are the world's top producing countries, accounting for 42% and 29%, respectively (Figure 1). China is the world's biggest producer of walnuts of 1,925,403 tonnes and total yields of 3,930 kg/ha, while United States is second with 571,526 tonnes of production, and average yield of 4,217 kg/ha. Countries with over 100,000 tonnes of walnut production are Iran (12% or 349,192 tonnes), Turkey (6% or 210,000 tonnes), Mexico (4% or 147,198 tonnes) and Ukraine (3% or 108,660 tonnes), whereas Serbia takes the sixteenth place with walnut production of 12,276 tonnes, and average yield from 3,712 kg/ha (FAOSTAT, 2020).

Hazelnut is one of the important

FAOSTAT (2020)

2017/2018 .

3 829 626

3,489 kg/ha,

10

(2 622 993 ),

(820,129 ).

346 862 ,

(36 992 ) (2650 ).

42%

29% ( 1).

1 925 403

3 930 kg/ha,

571 526

4 217 kg/da.

100 000

(12% 349,192

), (6% 210 000 ),

(4% 147,198 )

(3% 108 660 ),

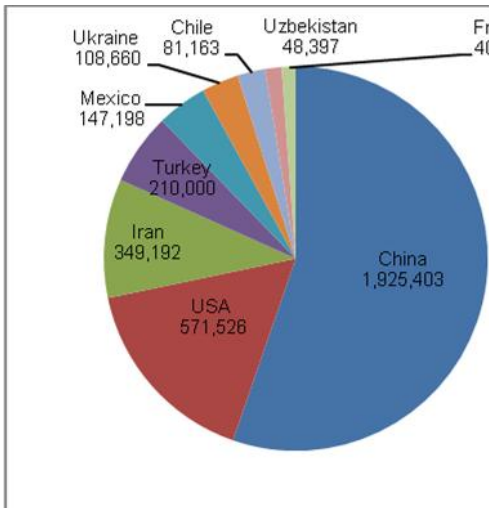
12 276

3 712 kg/ha (FAOSTAT, 2020).

- tree nut crops in the world. Hazelnut fruit is widely used in both the food industry and household on account of its nutritive and aromatic properties. Hazelnuts are a rich source of numerous essential nutrients, containing high amounts of protein, dietary fiber, vitamins and minerals, due to which the worldwide demand for hazelnuts is on the rise, making it a deficient commodity.

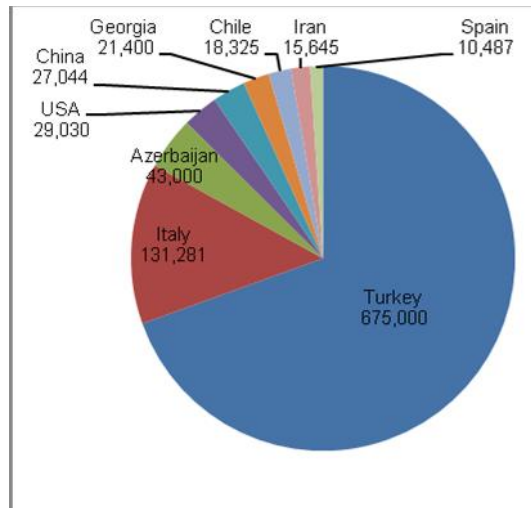
- World production of hazelnuts in 2017/2018, was 1,006,178 tonnes with a yield of 1,497 kg/ha (FAOSTAT, 2020). Data collected from all continents show that Asia is the leader in hazelnut production (792,164 tonnes), followed by Europe for 166,481 tonnes, Americas with 47,355 tonnes, while the smallest production is in Africa (177 tonnes).

2017/2018 . 1 006 178  
 1497 kg/ha (FAOSTAT, 2020).  
 (792 164 ),  
 166 481 ,  
 47 355 ,  
 (177 ).



. 1.  
 ( )

**Fig. 1. Production of walnut in the World (tonnes)**



. 2.  
 ( )

**Fig. 2. Production of hazelnut in the World (tonnes)**

675 000 ) , ( 67%  
 131 574 ), ( 20%  
 , 80%

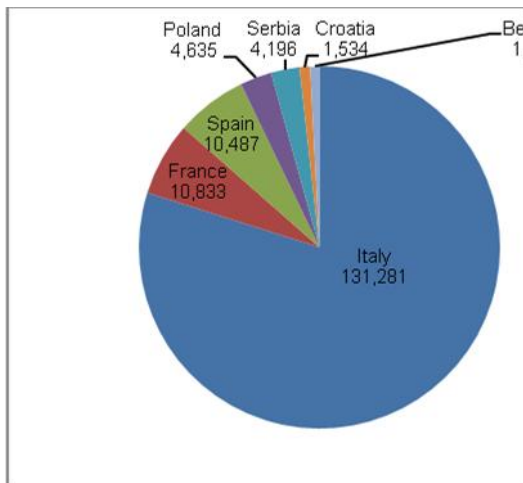
- In spite of the high number of producing countries, the hazelnut crop is still concentrated in two Mediterranean countries, Turkey (nearly 67% or 675,000 tonnes) and Italy (nearly 20% or 131,574 tonnes), covering more than 80% of the world production, followed by Azerbaijan,



2876 kg/ha 2013 .  
 3217 kg/ha 2017 .  
 27 335 kg/ha, (20  
 059 kg/ha), (8,049 kg/ha)  
 3 712 kg/ha.  
 2013-2017 .  
 146 706 166 481  
 (FAOSTAT, 2020).  
 131 281 ,  
 2029 kg/ha ( 5 6).  
 -  
 (10 833 ),  
 (10 487 ), (4635  
 ) (4 196 ).  
 FAOSTAT (2020)  
 -  
 (1 304 kg/ ha).

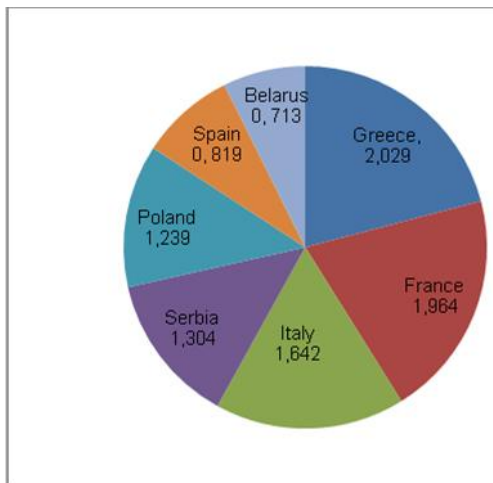
in 2013 to 2,876 kg/ha in 2017. Romania is the top country by the yield of walnuts with 27,325 kg/ha, followed by Slovenia (20,059 kg/ha), Ukraine (8,049 kg/ha) and Serbia with the total yield of 3,712 kg/ha.

The annual production of hazelnuts in the European countries for the period 2013-2017 has increased from 146,706 tonnes to 166,481 tonnes (FAOSTAT, 2020). Italy is the leader in production of hazelnuts which amounts to 131,281 tonnes, while Greece is the top country by the yield of hazelnuts with 2,029 kg/ha (Figures 5 and 6). The top five countries by production of hazelnuts are also France (10,833 tonnes), Spain (10,487 tonnes), Poland (4,635 tonnes) and Serbia (4,196 tonnes). Based on the FAOSTAT (2020), Serbia is the fifth country by production of hazelnuts, and the fourth country by the yield of hazelnuts (1,304 kg/ha).



5. ( )

Fig. 5. Production of hazelnuts in Europe (tonnes)



6. (kg/ha)

Fig. 6. Yield of hazelnuts in Europe (kg/ha)

**Walnut and hazelnut production in Serbia**

- Nut fruits are relatively neglected fruit species in the Republic of Serbia.
- The most important nut fruits are walnut,

4%

(2018 .)

426 ha,  
2 798 ha,

1.53%

2013 .  
2018 .

1628 ha (

7).

whereas hazelnut is the less prevalent. In recent years, areas of walnut orchards are being decreased, while the hazelnut growing areas are being increased. The share of plantations covered by these species is not larger than 4% of the total fruit plantations.

Walnut production in Serbia is not even close to capacities which can provide by climate and soil conditions. Although walnut is grown in all parts of Serbia, extensive plantations are mostly represented, with a low level of agrotechnics or even without any measures in plantations. The most common reason why intensive growing, even apart from favourable agro-environmental conditions is relatively neglected is a long period of investments and late fruiting, from fifth until tenths year. Therefore, walnuts are planted in small areas or individual self-sown trees.

In the Republic of Serbia walnut is grown at about 1.53% of the total orchard area. According to the Statistical Office of the Republic of Serbia (2018), the total area under walnut was 4,426 ha in 2013, while in 2018, total area was 2,798 ha, which indicates a significant decreased by 1,628 ha (Figure 7).

The reasons for reduced areas are that the plantations below walnuts are mostly extensive or that walnuts are grown by amateurs, usually as single trees. Also, clearing of old walnut orchards and establishment of small number of new ones resulted in less land areas under walnuts. However, the encouraging fact about this is that even though a small number of new walnut orchards are established, they are modern with irrigation system, which is adjusted to the conditions and biological requirements of the grown cultivars. This is good considering that the main aim of walnut production is to achieve higher yields.

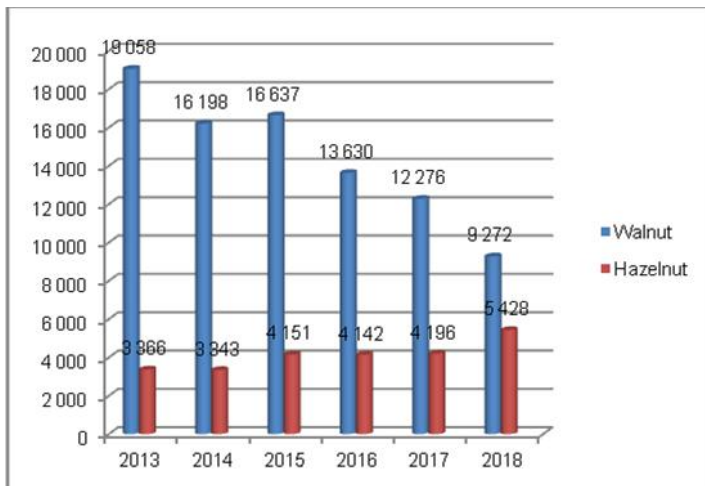




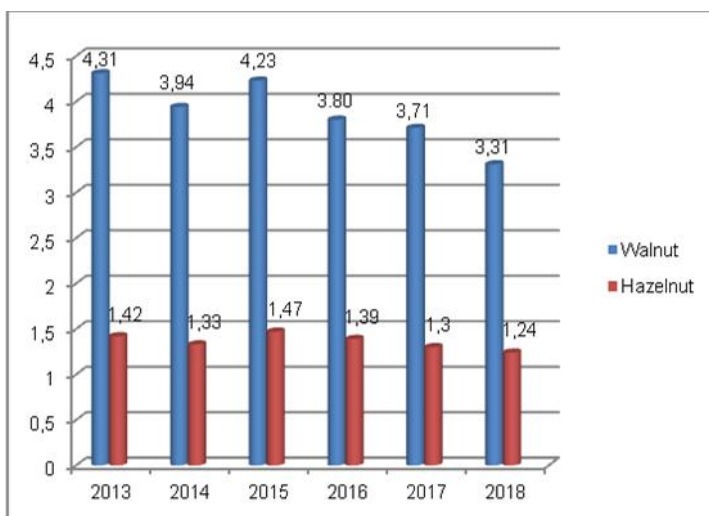
2013-2018 . 14 511,8  
 ( 8).  
 (2019 .)  
 19 058 2013 . 9  
 272 2018 .,  
 9 876  
 2013-2018 .  
 3.88  
 4.31 t/ha  
 (2013), - 3.31 t/ha (2018).  
 -  
 1.0 t/ha ( 9).  
 ,  
 43.19%  
 ,  
 32.58%  
 ( ,)  
 24.22%  
 ( 10).

might become one of the world's leading producers of this fruit species.

The average annual walnut production in the Republic of Serbia in the period 2013-2018 was 14,511.8 tonnes (Figure 8). According to the data of the Statistical Office of the Republic of Serbia (2019) production of walnut varied between 19,058 tonnes in 2013 up to 9,272 tonnes in 2018, which represents a decrease in production of 9,786 tonnes. On average, for the period 2013-2018, the yields obtained in Serbia were 3.88 t per hectare. The highest reported yield was 4.31 t/ha (2013) and the lowest – 3.31 t/ha (2018). The yield under walnut orchards is reduced by 1.0 t/ha (Figure 9). Data on walnut production by regions in the observed period showed that it significantly decreased in all regions of Serbia. Out of the total production, more than 43.19% of walnuts were produced in the Region of Šumadija and Western Serbia, while 32.58% of walnuts were produced in Northern Serbia (Belgrade and Vojvodina regions), and 24.22% in the Region of Southern and Eastern Serbia (Figure 10).



8. ( )  
 Fig. 8. Production of walnut and hazelnut in the Republic of Serbia (tonnes)



9. (t/ha)  
**Fig. 9. Yield of walnut and hazelnut in the Republic of Serbia (t/ha)**

2013-2018 . 4 1044,3 .  
 (2018 .)  
 3.366 2013 . 5.428  
 2018 ,, 2.062  
 ( 8).  
 2013-2018 . 1.36  
 . -  
 1.24 t/ha (2018), - - 1.47  
 t/ha (2015).  
 - ,  
 -  
 1.24 t/ha 1.42 t/ha  
 ( 9).  
 , , ,  
 .  
 ,

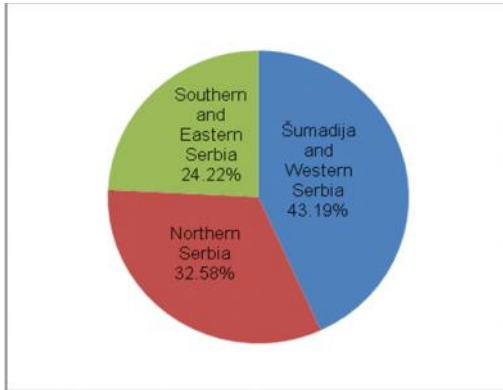
The average annual hazelnut production in the Republic of Serbia in the period 2013-2018 was 4,104.3 tonnes. According to the data of the Statistical Office of the Republic of Serbia (2018) production of hazelnut varied between 3,366 tonnes in 2013 up to 5,428 tonnes in 2018, which represents an increase in production of 2,062 tonnes (Figure 8). On average for the period 2013-2018, the yields obtained in Serbia were 1.36 t per hectare. The lowest reported yield was 1.24 t/ha (2018) and the highest – 1.47 t/ha (2015). Namely, the hazelnut yield in the first three observed years was higher than the average, and in the last three years lower, and varied between 1.24 t/ha and 1.42 t/ha (Figure 9). Oscillations in the yield can occur as consequences of temperature changes during the period of dormancy, as well as the spring frost damage, drought, hail, surface water and alternate bearing.

Data on hazelnut production by regions in the observed period showed an increase in all regions of Serbia.

Although natural conditions of different parts of central Serbia are favourable for

56.16%

(  
) , 22.35%  
21.48%  
(  
11).

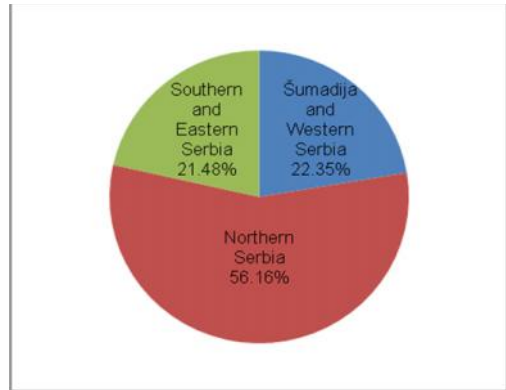


. 10.

**Fig. 10. Region involvement in walnut production**

hazelnut growing, most plantations of this species are in Vojvodina regions.

Out of the total production, 56.16% of hazelnut were produced in Northern Serbia (Belgrade and Vojvodina regions), 22.35% in Šumadija and Western Serbia, and about 21.48% in Southern and Eastern Serbia (Figure 11).



. 11.

**Fig. 11. Region involvement in hazelnut production**

„Šejnovno“, „Rasna“, „Šampion“, „Kasni Rodni“, „Ov ar“, „Geisenheim 139“, „Geisenheim 251“, „Jupiter“ „Elit“.

„Chandler“, „Fernor“, „Fernette“, „Franquette“, „Lara“, „Pedro“

- One of the most serious problems in extending the production of walnut and hazelnut in our country is a shortage of high quality planting material. Walnut cultivar assortment is relatively old, changing slowly, and it is not dynamic like the ones of other fruit species. In Serbia, a lot has been done to create new walnut cultivars, but not enough to introduce modern technologies.

- Leading cultivars and selections in walnut orchards are 'Šejnovno', 'Rasna', 'Šampion', 'Kasni Rodni' and 'Ov ar' and pollinators 'Geisenheim 139', 'Geisenheim 251', 'Jupiter' and 'Elit'. Modern plantations of walnut should be planted with healthy planting material produced exclusively by vegetative propagation including prospective cultivars and selections such as 'Chandler', 'Fernor', 'Fernette', 'Franquette', 'Lara', 'Pedro' etc.

„Ennis“, „Tonda Gentile delle Langhe“, „Tonda di Gifoni“, „Istria Long“, „Mogul“, „Multiflorum“, „Cosford“, „Lambert“, „Tonda Gentile Romana“, „Noccione“, „Hall's Giant“.

- Also, the expansion of hazelnut growing in Serbia should be further supported by the cultivars of good biological and economic value that will be adequate for growing under our agro-ecological conditions.
- Leading hazel cultivars in orchards are 'Ennis', 'Tonda Gentile delle Langhe', 'Tonda di Gifoni', 'Istria Long', 'Mogul', 'Multiflorum', 'Cosford' and 'Lambert', and pollinators are 'Tonda Gentile Romana', 'Noccione' and 'Hall's Giant'. Grown cultivars respond to the requirements of the confectionery industry, which presupposes the expansion of cultivars with smaller and rounder fruits.

## CONCLUSIONS

2018 . . . . . 2013 . . . . .

- The comparison of total yields of nut crops from 2013 to 2018 in the Republic of Serbia, shows a decline in walnut production, and increase in hazelnut production.

- Our fruit farmers are interested in producing nut fruit, although these species require greater investment and a longer period of exploitation until full birth.

- From the economic point of view, the favourable environmental conditions and the ability to export provide great opportunities. Therefore, modern plantations of walnut and hazelnut should be planted with healthy planting material produced by vegetative propagation.

- Also, it is necessary to introduce new cultivars, new agro- and pomo-technical measures, and increasing area with installed irrigation systems and anti-hail nets. In addition, it is also important to emphasize the support of the state in production modernization through enabling subsidies for establishment of new plantations, procurement of planting material, procurement of appropriate irrigation systems and agricultural machinery.

## / REFERENCES

1. **Cerovi , S., J. Nini -Todorovi , B. Gološin and S. Bijeli ,** 2006. Walnut and hazelnut environmental sustainable food. *Letopis nau nih radova*, 1, 105-109 (Sr).
2. **Development Strategy of Agriculture and Rural Development of the Republic of Serbia for the period 2014–2024.** <http://www.minpolj.gov.rs/download/strategija-poljoprivrede-i-ruralnog-razvoja-republike-srbije-za-period-2014-2024-godine/?script=lat>  
<http://popispoljoprivrede.stat.rs/?p=4763&lang=en>
3. **FAOSTAT FAO Statistics Division.** <http://faostat.fao.org/site/567/default.aspx#ancor>, 2020.
4. **Mileti , R.,** 2017. Hazelnut. Fruit Research Institute, a ak, Republic of Serbia, 1-154 (Sr).
5. **Paunovi , M.S. and R. Mileti ,** 2013. Walnut. Fruit Research Institute, a ak, Republic of Serbia, 1-162 (Sr).
6. **Paunovi M.S.,** 2010. Stratification and growth rate of grafted walnut. M. Sc. Thesis. University of Kragujevac Faculty of Agronomy, a ak, 1-103 (Sr).
7. **Paunovi , M.S., R. Mileti , M. Mitrovi and D. Jankovi ,** 2011. Effect of callusing conditions on grafting success in walnut (*Juglans regia* L.). *Journal of Fruit and Ornamental Plant Research*, 19(2), 5-14.
8. **Pourfarzad, A. and R.G. Mehrpour,** 2017. Health benefits of hazelnut. *EC Nutrition*, 8.3, 101-105.
9. **Statistical Office of the Republic of Serbia, Belgrade,** 2018. <https://www.stat.gov.rs/en-US/>
10. **Taha, A.N. and A.M. Al-wadaan,** 2011. Utility and importance of walnut, *Juglans regia* Linn: A review. *African Journal of Microbiology Research*, 52(32), 5796-5805.