



## EVALUATION OF *ZINGIBER OFFICINALE* ROSCOE (GINGER) OIL AND ITS PRODUCTIVITY UNDER *GMELENA ARBOREA* BASED AGROFORESTRY SYSTEM

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### ABSTRACT

The field experiments were conducted under *Gmelina arborea* based agroforestry system at experimental plot of TFRI, Jabalpur, M.P. The *Zingiber officinale* (Ginger), a shade loving commercially cash crop was grown under seven year old plantation of *Gmelina arborea*. The observations were recorded on growth and yield parameters of *Z. officinale* during the study period. The study revealed that growth and yield of Zinger crop was higher under intercropping system and lower in monoculture (Sole) system. Ginger oil was found maximum in monoculture (Sole) system while it was lower in intercropping system. The study indicates that *Gmelina* shade favours only yield of Ginger not for its active ingredient i.e. essential oil, which is important component in several medicinal drugs.

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## INTRODUCTION

The term agroforestry refers to the efficient sustainable land use and crop management system that basically aims to increase yield on sustainable basis by integrating woody perennials / tree crop with arable crops and livestock simultaneously on same piece of land. Agroforestry has got immense potential to enhance productivity and maintain fertility of land while adopting proper silvicultural management practices. *Zingiber officinale* Roscoe (Ginger) is one of the important spice that is being cultivated in India as well as all over the world in form of fresh vegetable and as dried spice (Saunth). Ginger is obtained from the rhizomes of *Zingiber officinale*. The area under Ginger cultivation accounts for 107.54 thousand ha and the total production of the country is 385.33 thousand tons. The overall production of Ginger in the world is 1683.00 thousand tons with total average of 310.43 thousand ha (2010-11). The top producers in the world include China, India, Nepal and Thailand ([www.apeda.in](http://www.apeda.in)). The optimum temperature for storing fresh ginger is 7.5 - 10°C with relative humidity of 75 %.

Also, the storage period of fresh ginger is 16 – 24 weeks. Ginger oil its therapeutic effects and used as analgesic, expectorant, carminative, bactericidal and many more (Purseglove *et al.*, 1981). Pandey *et al.*, 2017, assessed growth and yield of *Z. officinale* (L.) under Sapota – *Jatropha* based agroforestry systems in south Gujarat. Hence, the present study was carried out to evaluate the ginger oil along with its yield and productivity under *G. arborea* based agroforestry system in Madhya Pradesh.

## MATERIALS AND METHODS

The field experiment was conducted during 2019 and 2020 at Agroforestry experimental plot of Tropical Forest Research Institute, Jabalpur, Madhya Pradesh to evaluate the growth, yield and also estimated its Ginger oil under *Gmelina arborea* based agroforestry system.

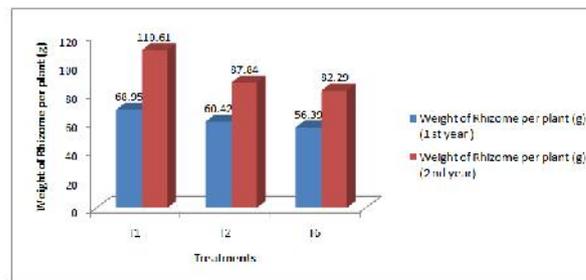
Geographically, Jabalpur is situated at 23°06'04.77"N latitude, 79°59'18.04"E longitude and an altitude of 403 meters above the mean sea level. The soil was sandy loam with pH ranging from 6.9 - 7.1. The experiment was laid out in Randomized Block Design (RBD) with three replications and three treatments (see table 1).

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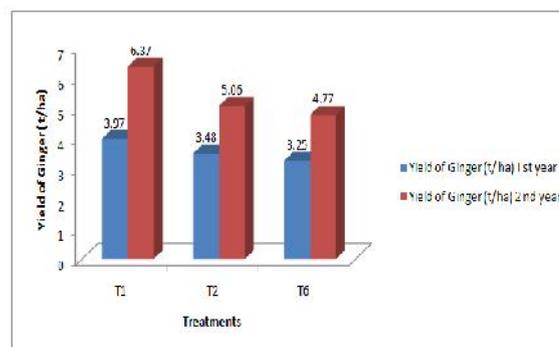
**Table 1. Details of the experimental treatments**

| Treatment No.  | Treatment Details   |
|----------------|---|
| T <sub>1</sub> | <i>Gmelina arborea</i> + <i>Curcuma longa</i> + <i>Piper betle</i> + <i>Zingiber officinale</i> |
| T <sub>2</sub> | <i>Gmelina arborea</i> + <i>Zingiber officinale</i> + <i>Piper betle</i>                        |
| T <sub>6</sub> | <i>Zingiber officinale</i> (Sole)   |

The rhizomes of *Z.officinale* (Suprabha cv.) was planted on raised beds of 25 cm x 25 cm intercropped under seven old plantation of *G.arborea* spaced at 5 m x 5 m during kharif season. Mature Ginger crop was harvested during February 2020 and yield data were recorded treatment wise. Fresh rhizomes were chopped into small pieces. Ginger oil was obtained using steam distillation. The dried rhizomes were ground to small pieces and then were placed into round bottom flask. The steam was passed that resulted into extraction of volatile oil components. The steam was then condensed with cold water. As the steam got condensed, the oil got separated out of the steam water and thereafter oil got collected. The whole process under experiment took time period of six hours with constant temperature of 45°C. The oil was extracted from oil distillation unit (Fig.4) (Adamade et al., 2017).



**Fig 1. Weight of Ginger rhizomes per plant (g) under various treatments of *Gmelina arborea* based agroforestry system**



**Fig 2. Yield of Ginger (t ha<sup>-1</sup>) under various treatments of *Gmelina arborea* based agroforestry system**

## RESULTS AND DISCUSSION

The results related to the growth, yield and amount of Ginger oil extracted is represented by Table no.2, 3 and 4.

**Table 2: Growth parameters of *Zingiber officinale* (Ginger) grown under *G. arborea* based agroforestry system**

| Treatments     | 1 <sup>st</sup> Year |        |                | 2 <sup>nd</sup> Year |        |                |
|----------------|----------------------|--------|----------------|----------------------|--------|----------------|
|                | Crop (cm)            | Height | No. of tillers | Crop (cm)            | Height | No. of tillers |
| T <sub>1</sub> | 37.8                 | 2      | 90             | 37.8                 | 2      | 90             |
| T <sub>2</sub> | 33.4                 | 2      | 50             | 33.4                 | 2      | 50             |
| T <sub>6</sub> | 23.72                | 2      | 47             | 23.72                | 2      | 47             |

**Table 3. Yield of *Zingiber officinale* (Ginger) under *Gmelina arborea* based agroforestry system**

| Treatments     | Weight of Rhizome per plant (g) |                      | Yield of Ginger (t ha <sup>-1</sup> ) |                      |
|----------------|---------------------------------|----------------------|---------------------------------------|----------------------|
|                | 1 <sup>st</sup> Year            | 2 <sup>nd</sup> Year | 1 <sup>st</sup> Year                  | 2 <sup>nd</sup> Year |
| T <sub>1</sub> | 68.95                           | 110.61               | 3.97                                  | 6.37                 |
| T <sub>2</sub> | 60.42                           | 87.84                | 3.48                                  | 5.06                 |
| T <sub>6</sub> | 56.39                           | 82.29                | 3.25                                  | 4.77                 |

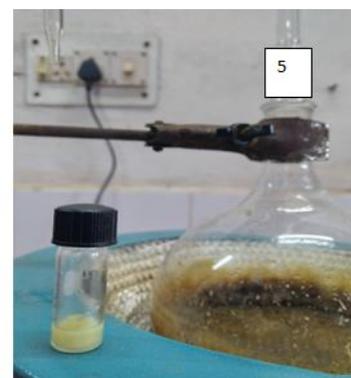
**Table 4. Amount of Oil extracted under different treatments of *Gmelina arborea* based agroforestry system**

| Treatments     | Weight of rhizomes (g) | Amount of Oil extracted (ml) |
|----------------|------------------------|------------------------------|
| T <sub>1</sub> | 212.38                 | 0.2                          |
| T <sub>2</sub> | 215.12                 | 1.0                          |
| T <sub>6</sub> | 219.07                 | 1.9                          |

From the Table 2, it is clear that crop height was recorded highest in intercropping system T<sub>1</sub> (highest with mean value accounting for 61.58 cm). While for monocropping (sole) system height was recorded lowest (mean value accounting for 37.95 cm under T<sub>6</sub>).The sequence follows: T<sub>1</sub> >T<sub>2</sub> >T<sub>6</sub>. Findings of the experimental study were similar to the results as reported and obtained by Chaudhary et al., (1998); Prajapati et al., (2007) and Vanlalhluna and Sahoo (2010). The results for the yield parameters revealed that with subsequent year

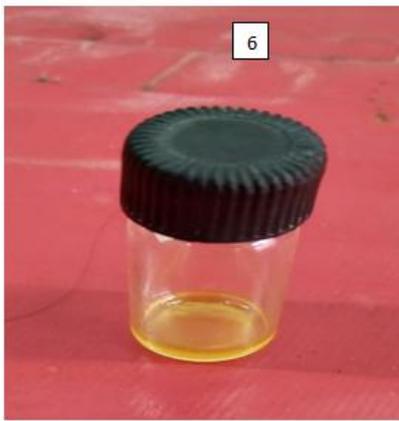


**Fig.3 & 4. Fresh rhizomes of Ginger**



**Fig.5: Extraction of Ginger oil by distillation process**

yield of rhizome was found increased. In the year 2019, it was found maximum T<sub>1</sub> (3.97 t ha<sup>-1</sup>) followed by T<sub>2</sub> (3.48 t ha<sup>-1</sup>) and then T<sub>6</sub> (3.25 t ha<sup>-1</sup>). Similarly, in the year 2020, it was recorded highest in T<sub>1</sub> (6.37 t ha<sup>-1</sup>) followed by T<sub>2</sub> (5.06 t ha<sup>-1</sup>) and then T<sub>6</sub> (4.77 t ha<sup>-1</sup>). From the Table 4, it is clear that weight of rhizomes was recorded highest in treatment 6 (219.07 g). The order follows T<sub>6</sub> > T<sub>2</sub> > T<sub>1</sub>.



**Fig.6. Ginger oil extracted from respective Ginger rhizomes**

The amount of oil extracted was found maximum in treatment 6 (1.9 ml) followed by treatment 2 (1 ml) and treatment 1 (0.2 ml). The oil content in intercrop might have been lower due to partial shade provided by *Gmelina arborea* trees and so ginger crop remained active physiologically for longer duration of time. Similar findings have been reported by Pandey *et al.*, (2018). In addition, Hossain *et al.*, (2019) recorded highest fresh rhizome weight (21600 kg ha<sup>-1</sup>) under Mango based system.

## CONCLUSION

The study was conducted during the time period of 2019 and 2020 concluded that *Gmelina arborea* based agroforestry system in semi arid region i.e. tropical climate of Madhya Pradesh can be incorporated on farmer's field with commercial cash crop like Ginger so that farmer can get intermediate income besides maintaining woody perennials till its maturity. Apart from using Ginger as spice, income can be generated from ginger yield as well as extracting of Ginger oil. The results are highly encouraging for motivating farmers towards adoption of *Gmelina* based agroforestry system especially in Madhya Pradesh.

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