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Biomass and essential oil yield of *Ocimum basilicum* L. in south 24 Parganas of West Bengal

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Abstract

The present study was undertaken to study agronomic performance in general and biomass & essential oil yield in particular of sweet basil (*Ocimum basilicum* L.) under mild soil salinity stress (< 1 S/m). The variety seeds of Kushmohak variety was sown in the nursery and transplanted later at 45 x 30 cm spacing at the research farm of the School of Agriculture and Allied Sciences (SAAS), The Neotia University. Essential oil content in the biomass was monitored between 70-115 days after transplanting and it revealed that the oil content initially increased and reached a plateau at 100 days of transplanting. The above ground biomass of the crop was harvested after 115 days of transplanting and various growth parameters like, plant height (cm), No. of branches plant^{-1}, No. of inflorescence branches^{-1}, length of inflorescence (cm), etc. and yield parameters like, total biomass, essential oil content & yield were recorded. The study demonstrated in mild soil salinity conditions high essential oil yield potential of 28.5 kg/ha through cultivation of short duration (115 days) *Rabi* season crop. On development of appropriate steam distillation facility and marketing channels, the crop may emerge as a viable alternative to other competing crop species like, maize, sunflower, etc.

Keywords: soil salinity, biomass, essential oil yield, raw and dry plant, sweet basil

Introduction

Aromatic and medicinal plants have received great attention in the last few years because of their multiple uses, such as sweet basil (*Ocimum basilicum* L.) as it can be used for its essential oil, dry leaves, and flowers and also as an ornamental plant (Baczek *et al.* 2019) [1]. Basil has more than 60 different species that were reported throughout the world, and some of them can have important uses (Rewers *et al.* 2016) [2]. Some of the medicinal properties that basil has are that it can be used to cure coughs, headaches, abdominal aches, and kidney diseases (Simon *et al.* 1990) [3]. Despite the medicinal properties that basil has, there are also a number of other uses, such as it is used in foods and beverages and can be used as insect repellent (Juliani *et al.* 2002) [4]. Another important characteristic is that basil can be used to produce essential oil with high economic value because it contains important components, such as eugenol, chavicol, and their derivates, and terpenoids, like monoterpene alcohol linalool, methyl cinnamate, and limonite. In addition, different chemotypes of *Ocimum basilicum* L. with a specific chemical composition of essential oils were found (Nacar *et al.* 2000) [5]. The essential oil of the plant is also used as perfumery (Bauer et at. 1997) [6]. The leaves and flowering tops of sweet basil are used as carminative, galactogogue, stomachic and antispasmodic medicinal plant in folk medicine (Chiej *et al.* 1988 [7], Duke, 1989 [8]). Antiviral and antimicrobial activities of this plant have also been reported (Chiang *et al.* 2008) [9]. The aromatic and morphological characteristics of the plant are significantly affected by environmental conditions and agronomic techniques (Sims *et al.* 2014) [10]. Plants are challenged by unfriendly conditions of temperature, drought and salinity which disrupt the growing processes (Suprasanna *et al.* 2016) [11]. For most of the plants, these are the main yield constraints of plant productivity. Despite the diverse potential uses of sweet basil, very little has been done to evaluate its performance under a range of agronomic practices in relation to plant growth, total biomass, essential oil yield, and chemical composition. This indicates that the current knowledge about its agronomy is neither complete nor conclusive. To help in filling the aforementioned research and development gaps, this experiment was carried out with the objective of evaluating the yield of essential oil at the different maturity stage of sweet basil (*Ocimum basilicum* L.) and performance of different agronomic parameters like plant height, no. of branches, no. and length of inflorescences, biomass yield, at the harvesting time.

Materials and Methods

The field experiment was established at the research farm of School of Agriculture and Allied Sciences (SAAS), The Neotia University (22.261954°N latitude and 88.196574°E longitudes) in 2021-2022. The soil pH is 6.8 -7.4 and EC of experimental area 4.2 ds m-1. The variety Kushmohak was collected from CSIR-CIMAP, Lucknow U.P (India) and sown on 8th August, 2021, transplanted 7th October, 2021 in a 100 sqmt area. Data were taken on plant height (cm), no. of branches plant^{-1}, no. of inflorescence branches^{-1}, length of inflorescence (cm), total biomass, total moisture content and essential oil yield. The plants were harvested on 20th January, 2022. For the calculation of biomass whole plants were dried in electric oven at ± 90°C. The data was calculated using the following methods.

Plant height was measured from bottom to tip of the plant by using a scale.

Number of branches plant^{-1} and no. of inflorescence branches^{-1} was counted manually.

Above-ground biomass (gm plant^{-1}) was taken after harvesting using top pan balance.

Below-ground biomass (gm plant^{-1}): After harvesting roots were weighed using top pan balance.

Total biomass (gm plant^{-1}) was calculated by adding above ground biomass and below ground biomass.

Moisture (%): The moisture percent was calculated using following formula,

Moisture content = (Fresh weight – Dry weight) × 100

Regular agronomic cultivation package and practices including plant protection measures were followed towards crop maintenance. Data were analyzed using the statistical software XL-Stat, MS Excel 2008.

Result and Discussion

Essential oil yield and biomass evaluation

The essential oil was extracted from the leaves using a custom-built steam distillation unit. About 500 g of fresh plant material (leaves and flowers) was distilled for oil at a temperature of ± 90°C for 90–120 min until no more oil was recovered. The essential oil yield was calculated in terms of percentage, by measuring the volume of oil extracted per weight of fresh plant material.

Different DAT (date after transplanting) led to essential oil variation on both raw and dry plant. Oil content increased after 85 DAT (12.95 kg/hec) and highest at harvesting time i.e. 115 DAT (28.49 kg/ hec) for both raw and dry plant (figure 1 and 2). This explained that in this moment yield of essential oil was maximum and the variety harvested on that time. The oil is rich in methyl chavicol. Similar findings were also obtained by Chang *et al*. 2008 [9] and Fernandes *et al*. 2004 [12]. The market value of this essential oil is Rs. 1500. So, that the expected gross return from this yield will be Rs. 42,735. In this particular area, since water is not a limiting factor and the main crops growing in *kharif* season, kushmohak cultivation may be the good alternative for farmers as short duration (115 days) *rabi* season crops.

Agronomic evaluation

At the time of harvesting, results of the variety Kushmohak of *Ocimum basilicum* indicated, mild to moderate soil salinity significantly effect on growth parameters, biomass yield and essential oil yield. This variety showed average 62.7 cm plant height, 16.3 no. of branches plant^{-1}, 124.3 no. of inflorescence branches^{-1} and 18.35 cm length of the inflorescence (Table 1). Total biomass yield 5.18 ton/hec. dry weight for 100 gm biomass obtained 22.5 gm and moisture content 77.5 gms. Similar trends between the years of the experiments were reported by others (Ekren *et al*. 2012 [13] and Karagiannioy *et al*. 2016 [14]).

Table 1: Performance of different growth and yield parameters of pushmohok cultivar of basil.

Characters	Mean	Standard errors
Plant height (cm)	62.7	±3.00
no. of branches plant^{-1}	16.3	±0.87
no. of inflorescence branches^{-1}	124.3	±12.84
length of inflorescence (cm)	18.35	±1.29
Biomass yield (ton/hec)	5.18	±1.35

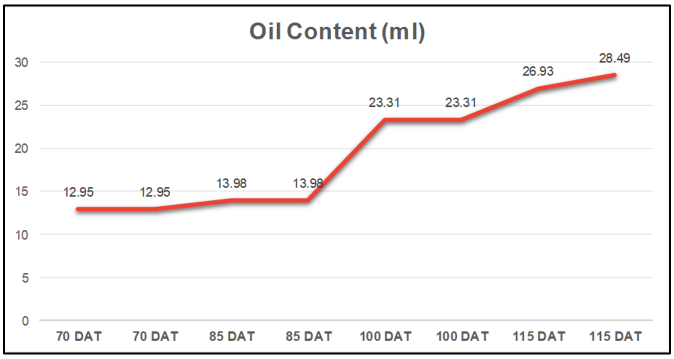

Fig 1: Line Chart Date of transplanting and Oil Content (raw plants)

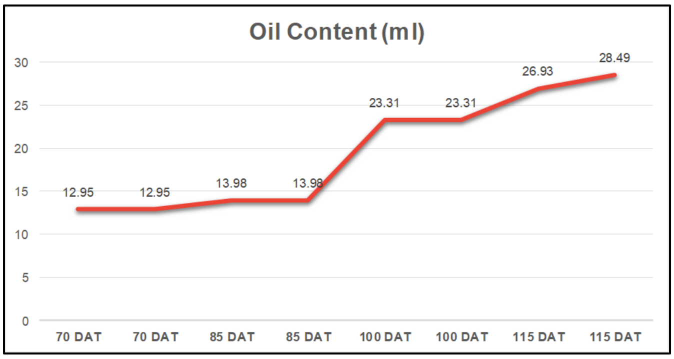

Fig 2: Line chart date of transplanting and oil content (Dry plants)

Conclusion

The study demonstrated in mild soil salinity conditions high essential oil yield potential of 28.5 kg/ha through cultivation of short duration (115 days) *Rabi* season crop. On development of appropriate steam distillation facility and marketing channels, the crop may emerge as a viable alternative to other competing crop species like, maize, sunflower, etc. The environment could have influenced agronomic performance and essential oils composition. Hence, it can be concluded that variation in aromatic compounds and the agronomic behaviour were affected by soil salinity.

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