Doi: HTTPS://DOI.ORG/10.23910/2/2022.0445

# A Study of Growth Rate and Seed Yield in *Ocimum basilicum* Germplasms

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**Article History**

Article ID: IJEP0445
Received on 12th October, 2021
Received in revised form on 20th February, 2022
Accepted in final form on 24th March, 2022

**Abstract**

The present field experiment was conducted at department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mandsaur in simple Randomized Block Design during 2019-20. This investigation was carried out with twenty germplasms obtained from ICAR-AICRP on MAP, college of Horticulture, Mandsaur. The analysis of variance revealed significant difference in all the growth parameters among the germplasms. However, $G_{19}$ IC-0622541 recorded maximum leaf area (244.50, 1297.09, 4977.09, 7492.67 and 11461.17 $cm^2$ $plant^{-1}$), leaf area index (0.321, 1.307, 3.425 and 3.949) and leaf area duration (25.69, 104.57, 273.97 and 315.90 $cm^2$ $day^{-1}$) during all the growth intervals. While, crop growth rate (0.060, 0.422 g $cm^{-2}$ $day^{-1}$) and relative growth rate (0.052, 0.117 g $g^{-1}$ $day^{-1}$) were higher till 120 days after transplanting in $G_{19}$ IC-0622541 but in later stages to harvest $G_{11}$ IC-0622533 was superior in crop growth rate (1.896, 0.340 g $cm^{-2}$ $day^{-1}$) and relative growth rate (0.152, 0.108 g $g^{-1}$ $day^{-1}$). $G_{14}$ IC-0622536 had maximum seed yield (29.57 g $plant^{-1}$) among the germplasms.

***Keywords:*** Biofuel, fuelwood, fuel, pigeon pea

## 1. Intoduction

The genus Ocimum collectively called "basil" belonging to the family Lamiaceae and also known as sweet basil, French basil or Common basil. It has around 50-150 species of shrubs and herbs from the tropical areas of Asia, Africa and Central and South America. It is usually referred as the "King of the herbs" being widely utilized due to its economic, culinary, industrial, cosmetic and medicinal importance (Erum et al., 2011) and also used for the pharmaceutical industry and in traditional medicines in many parts of the world (Ghoshi et al., 2020). Basil has several medicinal properties and rich source of vitamins, carbohydrates, fibre, protein, phosphorous, calcium, iron, beta-carotene and in essential oils. The major constituents in Ocimum oils include eugenol, linalool, geraniol, citral, camphor, menthol chavicol, safrol, thymol (Kumar et al., 2014). *Ocimum basilicum* Linn. occurs in nature as a tetraploid (2n=48). It grows to a height of 30-90 cm and is an enormous, erect, strongly, aromatic annual herbaceous plant with inverse, ovate-lanceolate, petioles very slender usually slightly hairy leaves, flora born on racemose inflorescences, corolla 0.72 - 1.25 cm long, white, pink or pale-purplish in coloured, bracts are petiolated, flowers are conspicuous, black seeds and ellipsoid which become mucilaginous on moistening (Gingade et al., 2014). In India, cultivation and average yield of basil is low. It may be due to lack of suitable cultivars, genotypes and varieties to a particular region. In basil, the selection is based on fresh herbage, essential oil yield and oil quality along with their constituent characters which would prove very useful. There is urgent need for the evaluation of the genotypes in different agro-climatic conditions to know their performance in terms of yield attributing and oil quality traits.

## 2. Materials and Methods

The field research was carried out with twenty obtained germplasms from ICAR-AICRP on MAPs, College of Horticulture Mandsaur in Randomized Block Design during kharif season of 2019–20 under department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, RVSKVV, Mandsaur (M.P.). The experiment site is located at Malwa plateau in Western part of Madhya Pradesh at 23° 45' North to 24° 13' North and between the meridians of longitude 74° 44' East and 75° 18' East. In this study, five plants were collected from each plot at 30, 60, 90, 120 DAT and at harvest to record all the parameters and later on their mean was calculated. The experimental data were subjected to statistical analysis using analysis of variance technique suggested by Panse and Sukhatme (1985) where the "F" test was found significant at 5% level of significance, the critical differences for the treatment's comparison were worked out.

## 3. Results and Discussion

The results revealed that, all the parameters were significantly differed among the germplasm except, crop growth rate and relative growth rate at harvest during all the growth intervals (Table 1 and 2).

The result revealed that germplasm $G_{19}$ IC-0622541 was denoted highest leaf area (244.50, 1297.09, 4977.09, 7492.67 and 11461.17 $cm^2$ $plant^{-1}$), leaf area index (0.321, 1.307, 3.425 and 3.949) and leaf area duration (25.69, 104.57, 273.97 and 315.90 $cm^2$ $day^{-1}$) during all the growth phases of plant. It may be due to improvement pattern in all growth phase of germplasms due to maximum number of leaves and their size leads to highest photosynthetic surface area as resulting by maximum leaf area that increases internally the leaf area index and leaf area duration. Leaf area duration should be integrated over time to take into account the persistence of the leaf region. This basic designation is closely related to the production and yield of dry matter. Similar results were reported by Meena et al. (2013), Patel et al. (2018), Gowda et al. (2019a, 2019b) in Ocimum. Furthermore, the germplasm $G_{19}$ IC-0622541was accumulated maximum crop growth rate (0.060, 0.422 g $cm^{-2}$ $day^{-1}$) at 30-60, 60-90 DAT and $G_{11}$ IC-0622533 (1.189, 0.340 g $cm^{-2}$ $day^{-1}$) at 90-120 and 120 DAT-at harvest, respectively while, higher relative growth rate in $G_{19}$ IC-0622541 (0.52 and 0.117 g $g^{-1}$ $day^{-1}$) at 30-60, 60-90 DAT and $G_{11}$ IC-0622533 (0.152 and 0.108 g $g^{-1}$ $day^{-1}$) 90-120 DAT and 120 DAT-at harvest, respectively. The differences in the growth attribute of germplasms were in consequence of genomic, ecological, and agronomic interaction (Shakthi et al., 2020a). It might be due to greater absorption and use of radiant energy, which eventually contributes to more accumulation of dry matter, number of primary and secondary branches which is attributed to increased magnitude of assimilatory surface area resulting in higher dry matter production and subsequently crop growth rate. The relative rate of growth showed an increase in biomass per unit area per unit time which decreased during the later phases of growth. Similar

Table 1: Mean performance of *Ocimum* germplasms for leaf area index, leaf area duration, crop growth rate and relative growth rate

| Germplasms | LAI | | | | LAD ($cm^2$ $day^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| | 30–60 DAT | 60–90 DAT | 90–120 DAT | 120 DAT-At harvest | 30–60 DAT | 60–90 DAT | 90–120 DAT | 120 DAT-At harvest |
| G1: IC-0622523 | 0.184 | 0.664 | 1.884 | 2.235 | 14.68 | 53.14 | 150.69 | 178.83 |
| G2: IC-0622524 | 0.180 | 0.597 | 1.577 | 1.885 | 14.43 | 47.73 | 126.19 | 150.80 |
| G3: IC-0622525 | 0.145 | 0.529 | 1.309 | 1.561 | 11.64 | 42.35 | 104.71 | 124.86 |
| G4: IC-0622526 | 0.185 | 0.650 | 1.737 | 2.025 | 14.81 | 52.01 | 138.99 | 162.03 |
| G5: IC-0622527 | 0.178 | 0.635 | 1.549 | 1.838 | 14.21 | 50.82 | 123.92 | 147.01 |
| G6: IC-0622528 | 0.162 | 0.493 | 1.113 | 1.393 | 12.96 | 39.41 | 89.02 | 111.42 |
| G7: IC-0622529 | 0.191 | 0.658 | 1.850 | 2.177 | 15.28 | 52.62 | 147.96 | 174.16 |
| G8: IC-0622530 | 0.205 | 0.804 | 2.359 | 2.627 | 16.42 | 64.32 | 188.71 | 210.14 |
| G9: IC-0622531 | 0.153 | 0.496 | 1.246 | 1.640 | 12.27 | 39.64 | 99.68 | 131.16 |
| G10: IC-0622532 | 0.192 | 0.718 | 2.045 | 2.350 | 15.38 | 57.46 | 163.56 | 188.04 |
| G11: IC-0622533 | 0.292 | 1.277 | 3.249 | 3.560 | 23.38 | 102.18 | 259.92 | 284.82 |
| G12: IC-0622534 | 0.209 | 0.799 | 2.295 | 2.840 | 16.73 | 63.91 | 183.62 | 227.19 |
| G13: IC-0622535 | 0.314 | 1.069 | 2.930 | 3.612 | 25.09 | 85.55 | 234.38 | 288.92 |
| G14: IC-0622536 | 0.263 | 1.011 | 2.485 | 2.810 | 21.07 | 80.89 | 198.77 | 224.81 |
| G15: IC-0622537 | 0.189 | 0.678 | 1.885 | 2.218 | 15.09 | 54.23 | 150.81 | 177.41 |
| G16: IC-0622538 | 0.272 | 1.043 | 2.861 | 3.363 | 21.73 | 83.41 | 228.89 | 269.05 |
| G17: IC-0622539 | 0.200 | 0.744 | 2.204 | 2.499 | 15.96 | 59.50 | 176.32 | 199.91 |
| G18: IC-0622540 | 0.208 | 0.767 | 2.290 | 2.620 | 16.63 | 61.37 | 183.19 | 209.58 |
| G19: IC-0622541 | 0.321 | 1.307 | 3.425 | 3.949 | 25.69 | 104.57 | 273.97 | 315.90 |
| G20: IC-0622542 | 0.254 | 0.950 | 2.563 | 2.791 | 20.28 | 76.03 | 205.03 | 223.31 |
| SEm± | 0.004 | 0.017 | 0.044 | 0.046 | 0.33 | 1.36 | 3.49 | 3.70 |
| CD (*p*=0.05) | 0.012 | 0.049 | 0.125 | 0.132 | 0.94 | 3.88 | 9.98 | 10.58 |

Table 1: Continue...

| Germplasms | CGR (mg cm$^{-2}$ day$^{-1}$) | | | | RGR (g g$^{-1}$ day$^{-1}$) | | | |
|---|---|---|---|---|---|---|---|---|
| | 30–60 DAT | 60–90 DAT | 90–120 DAT | 120 DAT-At harvest | 30–60 DAT | 60–90 DAT | 90–120 DAT | 120 DAT-At harvest |
| G1: IC-0622523 | 0.054 | 0.329 | 0.816 | 0.139 | 0.049 | 0.109 | 0.139 | 0.077 |
| G2: IC-0622524 | 0.045 | 0.296 | 0.638 | 0.227 | 0.042 | 0.106 | 0.131 | 0.096 |
| G3: IC-0622525 | 0.034 | 0.305 | 0.612 | 0.230 | 0.033 | 0.106 | 0.130 | 0.096 |
| G4: IC-0622526 | 0.032 | 0.339 | 0.539 | 0.130 | 0.031 | 0.110 | 0.125 | 0.074 |
| G5: IC-0622527 | 0.036 | 0.326 | 0.657 | 0.209 | 0.035 | 0.109 | 0.132 | 0.093 |
| G6: IC-0622528 | 0.042 | 0.309 | 0.717 | 0.196 | 0.040 | 0.107 | 0.135 | 0.090 |
| G7: IC-0622529 | 0.050 | 0.329 | 0.804 | 0.175 | 0.046 | 0.109 | 0.139 | 0.087 |
| G8: IC-0622530 | 0.058 | 0.340 | 0.816 | 0.239 | 0.051 | 0.110 | 0.139 | 0.096 |
| G9: IC-0622531 | 0.047 | 0.323 | 0.740 | 0.207 | 0.044 | 0.108 | 0.136 | 0.090 |
| G10: IC-0622532 | 0.050 | 0.325 | 0.785 | 0.219 | 0.046 | 0.109 | 0.138 | 0.093 |
| G11: IC-0622533 | 0.055 | 0.378 | 1.189 | 0.340 | 0.049 | 0.114 | 0.152 | 0.108 |
| G12: IC-0622534 | 0.058 | 0.342 | 0.933 | 0.173 | 0.051 | 0.110 | 0.144 | 0.079 |
| G13: IC-0622535 | 0.059 | 0.365 | 0.939 | 0.220 | 0.051 | 0.112 | 0.144 | 0.092 |
| G14: IC-0622536 | 0.056 | 0.384 | 1.086 | 0.208 | 0.050 | 0.114 | 0.149 | 0.093 |
| G15: IC-0622537 | 0.054 | 0.344 | 0.872 | 0.179 | 0.049 | 0.110 | 0.141 | 0.080 |
| G16: IC-0622538 | 0.056 | 0.404 | 1.118 | 0.273 | 0.050 | 0.116 | 0.150 | 0.102 |
| G17: IC-0622539 | 0.057 | 0.352 | 1.089 | 0.274 | 0.050 | 0.111 | 0.149 | 0.102 |
| G18: IC-0622540 | 0.060 | 0.360 | 1.023 | 0.338 | 0.052 | 0.112 | 0.147 | 0.109 |
| G19: IC-0622541 | 0.060 | 0.422 | 1.163 | 0.293 | 0.052 | 0.117 | 0.151 | 0.105 |
| G20: IC-0622542 | 0.048 | 0.345 | 0.848 | 0.203 | 0.045 | 0.111 | 0.140 | 0.092 |
| SEm± | 0.002 | 0.009 | 0.052 | 0.053 | 0.002 | 0.001 | 0.002 | 0.010 |
| CD ($p$=0.05) | 0.007 | 0.027 | 0.150 | NS | 0.005 | 0.003 | 0.006 | NS |

Table 2: Mean performance of *Ocimum* germplasm for leaf area, dry weight and seed yield

| Germplasms | Leaf area (cm$^2$ plant$^{-1}$) | | | | | Dry weight (g plant$^{-1}$) | | | | | Seed yield (g plant$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | 60 DAT | 90 DAT | 120 DAT | At harvest | 30 DAT | 60 DAT | 90 DAT | 120 DAT | At harvest | |
| G1: IC-0622523 | 109.76 | 771.20 | 2417.18 | 4105.74 | 6624.19 | 3.21 | 7.53 | 33.84 | 88.02 | 99.15 | 23.73 |
| G2: IC-0622524 | 99.70 | 765.94 | 2097.60 | 3573.82 | 5473.89 | 2.17 | 5.73 | 29.44 | 62.29 | 80.48 | 23.53 |
| G3: IC-0622525 | 99.47 | 598.92 | 1942.31 | 3151.22 | 4340.32 | 2.09 | 4.79 | 29.18 | 59.79 | 78.16 | 20.57 |
| G4: IC-0622526 | 103.99 | 784.73 | 2335.57 | 3717.91 | 6003.73 | 2.41 | 4.94 | 32.02 | 64.77 | 75.14 | 22.63 |
| G5: IC-0622527 | 103.94 | 748.95 | 2300.47 | 3686.26 | 5134.56 | 2.51 | 5.35 | 31.39 | 67.24 | 83.97 | 18.60 |
| G6: IC-0622528 | 80.12 | 697.34 | 1667.22 | 3011.18 | 3674.25 | 2.56 | 5.93 | 30.67 | 72.29 | 88.01 | 19.97 |
| G7: IC-0622529 | 115.05 | 801.58 | 2355.68 | 3927.53 | 6521.95 | 2.78 | 6.75 | 33.11 | 83.45 | 97.41 | 16.23 |
| G8: IC-0622530 | 138.04 | 847.28 | 3011.71 | 4297.13 | 8311.15 | 2.89 | 7.51 | 34.74 | 80.90 | 100.03 | 16.87 |
| G9: IC-0622531 | 88.12 | 647.80 | 1730.85 | 3619.47 | 4250.16 | 2.73 | 6.46 | 32.33 | 74.93 | 91.52 | 18.43 |
| G10: IC-0622532 | 118.99 | 804.05 | 2643.39 | 4112.06 | 7170.22 | 2.77 | 6.80 | 32.81 | 78.12 | 95.62 | 26.43 |
| G11: IC-0622533 | 200.19 | 1202.47 | 4928.35 | 6422.14 | 10667.03 | 3.75 | 8.11 | 38.39 | 106.33 | 133.51 | 24.33 |
| G12: IC-0622534 | 137.94 | 866.02 | 2968.38 | 5582.52 | 8049.03 | 3.27 | 7.94 | 35.32 | 96.07 | 109.94 | 25.30 |
| G13: IC-0622535 | 242.00 | 1263.24 | 3869.98 | 7142.33 | 10192.95 | 3.35 | 8.04 | 37.24 | 94.70 | 112.33 | 28.43 |

Table 2: Continue...

| Germplasms | Leaf area ($cm^2$ $plant^{-1}$) | | | | | Dry weight (g $plant^{-1}$) | | | | | Seed yield (g $plant^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAT | 60 DAT | 90 DAT | 120 DAT | At harvest | 30 DAT | 60 DAT | 90 DAT | 120 DAT | At harvest | |
| G14: IC-0622536 | 182.23 | 1082.26 | 3771.24 | 5333.41 | 8155.05 | 4.10 | 8.54 | 39.24 | 109.52 | 126.15 | 29.57 |
| G15: IC-0622537 | 112.96 | 792.46 | 2461.13 | 4057.47 | 6587.40 | 3.25 | 7.57 | 35.06 | 90.53 | 104.85 | 27.53 |
| G16: IC-0622538 | 217.13 | 1086.91 | 3917.63 | 6326.88 | 9815.94 | 4.02 | 8.51 | 40.86 | 108.47 | 130.31 | 28.63 |
| G17: IC-0622539 | 123.68 | 833.92 | 2736.18 | 4151.66 | 7843.15 | 3.63 | 8.19 | 36.36 | 101.52 | 123.45 | 27.43 |
| G18: IC-0622540 | 130.96 | 866.74 | 2815.37 | 4398.30 | 8176.25 | 3.48 | 8.30 | 37.08 | 91.84 | 118.91 | 26.57 |
| G19: IC-0622541 | 244.50 | 1297.09 | 4977.09 | 7492.67 | 11461.17 | 4.26 | 9.05 | 42.83 | 112.40 | 135.86 | 27.63 |
| G20: IC-0622542 | 168.29 | 1048.68 | 3513.17 | 4610.26 | 8788.64 | 2.98 | 6.86 | 34.48 | 86.05 | 102.28 | 25.67 |
| SEm± | 4.58 | 19.70 | 76.48 | 86.93 | 185.13 | 0.18 | 0.07 | 0.76 | 1.61 | 4.18 | 0.93 |
| CD ($p$=0.05) | 13.11 | 56.39 | 218.95 | 248.86 | 530.01 | 0.53 | 0.20 | 2.18 | 4.60 | 11.95 | 2.67 |

findings were reported by Meena et al. (2013), Gowda et al. (2019b) in Ocimum species. The germplasm $G_{19}$ IC-0622541 was assessed maximum total dry weight (4.26, 9.05, 42.83, 112.40 and 135.86 g $plant^{-1}$) at 30, 60 90, 120 DAT and at harvest, respectively. It may be due to heritable characteristics and efficient use of photosynthetic active radiation resulting in higher leaf area which eventually contributes to cumulate maximum dry matter. These results were confirmed by Ibrahim et al. (2015) in Ocimum species. Among yield and yield components, higher seed yield was recorded in germplasm $G_{14}$ IC-0622536 (29.57 g $plant^{-1}$) amid the germplasm. The similar findings were observed by Meena et al. (2013) and Gowda et al. (2019a, 2019b) in Ocimum and Shakthi et al. (2020b) in fenugreek.

## 4. Conclusion

Out of twenty germplasms, $G_{19}$ IC-0622541 and $G_{14}$ IC-0622536 proved to be most superior which performed better and should be used further for breeding programme of Ocimum germplasms.

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