Effect of GA3 and Growing Media on Seedling Vigour and Physiological Parameter of Custard Apple (Annona squamosa L.)

Sumit Jain, T.R. Sharma, Narayan Lal, N.R. Rangare, Bharat Kumar and Govind B. Shiurkar*

Department of Hort, JNKVV Jabalpur-482002, MP, India

*Corresponding author

ABSTRACT

An investigation was carried out to see the effect of GA3 and growing media on seed germination, survivability and physiological parameters of Custard apple (Annona squamosa L.) from December 2014 to April 2015 at Fruit Research Station, Imalia Farm, Department of Horticulture, College of Agriculture, JNKVV, Jabalpur (M.P.) Amongst different growing media, percent of germination, survivability percentage, Leaf Area Index (LAI), Leaf Area Duration (LAD), Light transmission ratio (LTR), Energy Interception (Ei), Seedling vigour index I (cm) and Seedling vigour index II (g) were found significantly superior under M5 growing media comprising soil + vermicompost + AZO + PSB followed by M2 (soil + vermicompost), M4 (soil + FYM + AZO + PSB), M1 (soil + FYM), M3 (soil + AZO + PSB) and M0 (only soil). Survival of seedling and germination percentage was highest in media M5 which was at par with M4. As regards the interactions, germination percentage, survivability, Seedling vigour index I (cm) and Seedling vigour index II (g) were found not significant. However, G2M5 treatment combination [seed soaked in 400 ppm GA and sown in soil + vermicompost + AZO + PSB] recorded superior and G0M0 combination (control) was found inferior in respect to survival and most of growth parameters. In some physiological parameters like Leaf Area Index (LAI), Leaf Area Duration (LAD), Light transmission ratio (LTR) and Energy Interception (Ei), interaction was found significant. In respect to germination, G3M5 treatment combination [Seeds soaked in 600 ppm GA concentration and sown in soil + vermicompost + AZO + PSB] showed superiority over rest of the treatment combinations whereas minimum was observed in control (G0M0).

Keywords
Germination, Media, Gibberelic acid, Vermicompost, AZO, PSB.

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INTRODUCTION

Custard apple (Annona squamosa L.) belongs to family Annonaceae and is one of the finest fruits gifted to India by tropical America. It is commonly found in India and cultivated an area of 23 thousand ha with production of 176 MT (Anonymous, 2013). Custard apple, popularly known as Sitaphal is grown mainly in the States of Andhra Pradesh, Assam, Tamil Nadu, Madhya Pradesh and grows wild in Deccan plateau and some parts of central India. Custard apple is generally classified as semi wild fruit by virtue of its spontaneous spread in forests, wastelands and other uncultivated places. It is hardy, tolerant to drought, salinity and saline irrigation water to certain extent. It grows very well even on a shallow soil. It also sheds off leaves during stress period to minimize the moisture loss from plant tissues through transpiration and thus a most appropriate fruit crop for rainfed
region. Custard apple is known by varied name like Sitaphal, Sugar apple and Shariffa. It is considered as one of the delicious and nutritionally valuable fruits meant for table purpose. Fruits have an edible, soft, granular, juicy and sugary pulp with mild flavour and with slight acidity. Fruits are considered for their medicinal value besides their general use in ice cream, confectionery, certain milk products and in making preserves as jam, jelly and other products. It is considered as beneficial for cardiac disease, diabetes, hyperthyroidism and cancer. It contains about 28-55% of edible portion consisting of 73.30% moisture, 1.60% protein, 0.30% fat, 0.70% mineral matter, 23.90% carbohydrates, 0.20% calcium, 0.40% phosphorus, 1.0% iron, 12.4-18.15% sugar and 0.26-0.65% acidity with caloric value of 105 KCal/100g. It is generally propagated by seed since there is little variability among seedlings. Maximum germination can be obtained by sowing of freshly extracted seed upto 20-30 days. The seeds of Annonaceae are albuminous ellipsoids and their length varies between 5 and 30 mm. They have a ruminant endosperm (Corner, 1976). The embryo is small, straight, with moderately developed embryonic axis, rudimentary plumule and a flat and thin cotyledon; which develops after the seed is formed (Corner, 1976). Setten and Koek-Noorman (1992) observed that Annonaceae seeds undergoing dispersal have a small embryo that is considered underdeveloped and immature; immaturity requires time to complete embryo growth after seed dispersion. Meanwhile, Hayat (1963) reported that the seeds of A. squamosa have a small embryo with two foliaceous, thin cotyledons that take one to three months to germinate.

Seed germination is the resumption of active growth of embryo that results in the emergence of the young plant. Seeds of many fruit crops remain ungerminated even under favourable conditions. Such kind of dormancy in seeds may be due to presence of hard and impermeable seed coat, germination inhibitors and improper development of embryo. Such seeds may require special treatments like scarification, soaking in water, growth regulators etc. to overcome dormancy. Gibberellins (GA₃) activate the embryonic vegetative growth, weakens the endosperm layer that involves the embryo and restricts its growth, and mobilizes the energetic reserves from the endosperm of cereals (Bewley, 1997; Taiz and Zeiger, 2006). Cereal embryo synthesizes and releases GA during the germination, which leads to the production and/or secretion of several hydrolytic enzymes involved in the solubilization of reserves, including α-amylase and β-amylase (Taiz and Zeiger, 2006).

Growing media is one of the important environmental factors, which plays an important role in growth and survival of seedlings. Several growing media or their combinations are being used for raising the seedling. Different growing media like soil, sand, farm yard manure (FYM) and vermicompost either alone or in different proportion have been found beneficial to influence germination and growth of seedling. A good growing media provides sufficient anchorage or support to the plant, serves as a reservoir for nutrients and water, allows oxygen diffusion to the roots and permits gaseous exchange between roots and the atmosphere outside root substrate. Bio-fertilizers are also beneficial in seed germination and growth of seedling. Bio-fertilizers are the carrier-based preparations containing mainly effective strains of microorganisms in sufficient number, which are useful for nitrogen fixation. Amongst bio-fertilizers Azotobacter strains play a key role in harnessing the atmospheric nitrogen through its fixation in the roots. They have been also reported to improve fertility
condition of the soil. The seed coat of most of the fruit crops is very hard. To break the seed dormancy, either some chemical treatment or long incubation period is required but bio-inoculants like \textit{Azotobacter}, PSB etc. also can be helpful in breaking the seed dormancy by producing various plant growth substances in combination with either farmyard manure (FYM) or vermicompost on seed germination and plant growth.

**Materials and Methods**

The experiment was carried out at Fruit Research Station, Imalia, JNKVV, Jabalpur during the year 2014-2015. Jabalpur is situated in “Kymore Plateau and Satpura Hills” Agro-climatic zone of Madhya Pradesh at 23.9ºN latitude and 79.58º east longitudes and an altitude of 411.78 meters above the mean sea level.

The tropic of cancer passes through the middle of the district. The climate of Jabalpur region is semi-arid and subtropical having warm and dry spring summer and cool winter as main characteristics feature, in general the highest temperature reaches above 45°C and below 5°C respectively. The relative humidity varies from 70-80%.

The average annual rainfall is about 1375, mm, which is mainly distributed from mid-June to first week of October from south-west monsoon with occasional rain during winter. The experiment was laid out with Factorial RBD along with six different growing media and four different concentration of Gibberellic acid with three replications.

**Preparation of growing media**

The media were used to grow seedling in polybags comprising of:

- Only soil
- Soil + FYM – the ratio of 2:1 of soil and fully decomposed FYM.
- Soil + Vermicompost – the ratio of 2:1 of soil and vermicompost.
- Soil + AZO + PSB – soil enrich with AZO and PSB (each 5 g/kg soil).
- Soil + FYM + AZO + PSB – the ratio of 2:1 of soil and FYM enrich with AZO and PSB (each 5 g/kg soil).
- Soil + Vermicompost + AZO + PSB – the ratio of 2:1 of soil and vermicompost enrich with AZO and PSB (each 5 g/kg soil) (Table 1).

**Germination percentage**

The germination in each treatment was recorded at 60 days after sowing. Number of seedlings were counted and expressed as germination percentage.

\[
\text{Germination (\%) } = \frac{\text{Total number of seed germinated}}{\text{Total number of seed sown}} \times 100
\]

**Survival percentage of seedlings**

The survival percentage of each treatment was recorded at 150 days after seed sowing. The survival percentage was calculated by using formula as given below:

\[
\text{Survival Percentage of seedlings = } \frac{\text{No. of survived seedling}}{\text{Total no. of seedlings}} \times 100
\]

**Leaf Area Index**

LAI expresses the ratio of leaf surface considerably to the ground area occupied by the plant or a crop stand worked out as per specification of Gardner et al., (1985),
Total Leaf Area \[ \text{LAI} = \frac{(\text{LA1}+\text{LA2})}{2} \]

Where, the LA1 and LA2 represent the leaf area during the two consecutive intervals and “p” ground area (Watson, 1952).

**Leaf Area Duration (LAD)**

Leaf Area Duration expresses the magnitude and persistence of leaf area of leafiness during the period of crop growth. It reflects the extent of period of crop growth.

It reflects the extent of seasonal integral of light interaction and corrected with yield. LAD was computed as follow (Watson, 1952).

\[ \text{LAD} = \frac{(\text{LA1}+\text{LA2})}{2} \times (t2-t1) \text{ (cm}^2\text{ days)} \]

**Light Transmission Ratio (LTR)**

It was given by Golingai and Mabbayad in 1969.

\[ \text{LTR} = \frac{\text{I}}{\text{I}_0} \times 100 \]

Where,

I = Light intensity at the base of crop canopy and
I\(_0\) = Total incoming radiation

It was calculated by Lux meter (model LX-105)

**Energy interception (Ei)**

It can be calculated by lux meter. Its values were converted in terms of energy as per constants.

The values were recorded at 120 and 150 DAS and then the mean value was worked out.

71 K Lux =1 calorie/cm\(^2\)/min

Ei = total incident energy – transmitted energy

**Seedling vigour index I**

It was calculated by adding the values of root length and shoot length which was randomly selected and multiplying with their corresponding germination percentage and the values were recorded (Abdulbaki and Anderson, 1973).

Seedling vigour index I = germination percentage x [root length (cm) + shoot length (cm)]

**Seedling vigour index II (g)**

It was calculated by multiplying dry weight of seedlings with their corresponding germination percentage.

Seedling vigour index II = dry weight of seedlings (g) x germination percentage

**Results and Discussion**

**Percentage of germination at 60 DAS**

The highest germination percentage (77.50%) was obtained under the media M\(_5\) comprising soil + vermicompost + AZO + PSB. This finding is supported by Sinish et al., (2005) who reported that combined inoculation of AZO, PSB and AMF in the potting mixture induced better germination percentage. Gibberellic acid concentration showed significant effect on percentage of germination at 60 DAS. The maximum germination percentage of 73.89 was recorded.
under G₃ (600 ppm GA) and the minimum germination (59.44%) was recorded under G₀. It might be due to GA₃ which accelerate the activity of specific enzymes such as α-amylase, which have brought an increase in availability of starch assimilation resulting an early germination.

Interaction effect of growing media and gibberellic acid did not show significant effect on seed germination percentage whereas maximum germination percentage (86.67%) was noted under the combination of growing media and gibberellic acid G₃M₅ (soil + vermicompost + AZO + PSB + 600 ppm). It may be due to synergistic effect of both factors.

**Survival percentage of seedlings**

In the present study, growing media and GA₃ significantly influenced the survival percentage of seedling at 150 DAS. Maximum survival percentage (86.01) was recorded under growing media M₅ comprising soil + vermicompost + AZO + PSB and minimum (76.49) under M₁ at 150 days after seed sowing.

These findings are supported by Parasana et al., (2012). Gibberellic acid concentration had significant effect on survival percentage. Maximum survival percentage (83.75) was recorded under G₁ which was at par with G₂ while it was minimum (76.00) under G₀.

**Seedling vigour index I (cm)**

The maximum seedling vigour index at 150 days after sowing (3717.73 cm) was computed under growing media comprising soil + vermicompost + AZO + PSB (M₅) and minimum (2670.25 cm) under M₀. The findings are supported by Krishna et al., (2008). All the treatments promoted significantly higher vigour of seedlings, when compared to control. Particularly, treatment with vermicompost recorded highest vigour index-I and vigour index-II. The probable reason of highest seedling vigour in vermicompost can be that it has relatively high content of humus-like compounds, active micro-organisms, enzymes as well as physical and nutritional condition which increased the physiological activities of plant. The findings are supported by Bhardwaj (2014). As regards the GA₃ as well as interaction of media and GA₃ did not showed significant effect on seedling vigour (cm).

**Seedling vigour index II (g)**

In the present study, significantly maximum seedling vigour index II (125.33 g) at 150 days after sowing was computed under M₅ followed by M₂ (106.02 g) and minimum seedling vigour index II (70.98 g) was recorded under M₀. The probable reason is same to seedling vigour index I. The findings are supported by Bhardwaj (2014). The maximum seedling vigour index II (108.99 g) was recorded under G₂ and it was superior over rest of treatments while minimum seedling vigour index II (89.02 g) was recorded under G₀. The seedling vigor significantly differed due to invigouration of seeds.

The highest seedling vigour in GA₃ was attributed to enlarged embryos, higher rate of metabolic activity and respiration, better utilization and mobilization of metabolites to growth points and higher activity of enzymes. Enzymatic and hormonal mechanism stimulate metabolic process such as sugar mobilization, protein hydrolysis, oxidation, etc (Earlplus and Lambeth, 1974), which leads to increase in root length, shoot length and seedling dry weight, in turn increase in seedling vigour. The present results are in conformity with the results of Gurung et al., (2014) (Table 2).
Table 1 Treatment details

| Treatments | Treatment combinations | composition |
|------------|------------------------|-------------|
| T1         | G0M0                   | 0 ppm GA3 + Soil (Control) |
| T2         | G0M1                   | 0 ppm GA3 + (Soil + FYM) |
| T3         | G0M2                   | 0 ppm GA3 + (Soil + Vermicompost) |
| T4         | G0M3                   | 0 ppm GA3 + (Soil + AZO + PSB) |
| T5         | G0M4                   | 0 ppm GA3 + (Soil + FYM + AZO + PSB) |
| T6         | G0M5                   | 0 ppm GA3 + (soil + Vermicompost + AZO + PSB) |
| T7         | G1M0                   | 200 ppm GA3 + Soil |
| T8         | G1M1                   | 200 ppm GA3 + (Soil + FYM) |
| T9         | G1M2                   | 200 ppm GA3 + (Soil + Vermicompost) |
| T10        | G1M3                   | 200 ppm GA3 + (Soil + AZO + PSB) |
| T11        | G1M4                   | 200 ppm GA3 + (Soil + FYM + AZO + PSB) |
| T12        | G1M5                   | 200 ppm GA3 + (soil + Vermicompost + AZO + PSB) |
| T13        | G2M0                   | 400 ppm GA3 + Soil |
| T14        | G2M1                   | 400 ppm GA3 + (soil + FYM) |
| T15        | G2M2                   | 400 ppm GA3 + (Soil + Vermicompost) |
| T16        | G2M3                   | 400 ppm GA3 + (Soil + AZO + PSB) |
| T17        | G2M4                   | 400 ppm GA3 + (Soil + FYM + AZO + PSB) |
| T18        | G2M5                   | 400 ppm GA3 + (soil + Vermicompost + AZO + PSB) |
| T19        | G3M0                   | 600 ppm GA3 + Soil |
| T20        | G3M1                   | 600 ppm GA3 + (Soil + FYM) |
| T21        | G3M2                   | 600 ppm GA3 + (Soil + Vermicompost) |
| T22        | G3M3                   | 600 ppm GA3 + (Soil + AZO + PSB) |
| T23        | G3M4                   | 600 ppm GA3 + (Soil + FYM + AZO + PSB) |
| T24        | G3M5                   | 600 ppm GA3 + (soil + Vermicompost + AZO + PSB) |
Table 2 Effect of growing media and GA3 on germination, survival and seedling vigour index

| Treatment          | % of germination at 60 DAS | Survival % of seedling at 150 DAS | Seedling vigour Index-1 (cm) | Seedling vigour Index-II (g) |
|--------------------|-----------------------------|----------------------------------|------------------------------|-----------------------------|
| Gibberellic acid   |                             |                                  |                              |                             |
| G0 (0 ppm)         | 59.44                       | 76.60                            | 3016.23                      | 89.02                       |
| G1 (200 ppm)       | 68.89                       | 3.75                             | 3262.72                      | 99.08                       |
| G2 (400 ppm)       | 72.22                       | 83.73                            | 3372.09                      | 108.99                      |
| G3 (600 ppm)       | 73.89                       | 79.12                            | 3254.77                      | 100.56                      |
| SEm                | 2.604                       | 1.396                            | 117.540                      | 3.758                       |
| CD at 5% level     | 7.436                       | 3.985                            | NS                           | 10.751                      |
| Media              |                             |                                  |                              |                             |
| M0 (Soil)          | 60.00                       | 76.49                            | 2670.25                      | 70.98                       |
| M1 (Soil+FYM)      | 66.67                       | 79.10                            | 3164.39                      | 98.09                       |
| M2 (Soil+VC)       | 72.50                       | 81.96                            | 3414.55                      | 106.02                      |
| M3 (Soil+BF)       | 64.17                       | 77.61                            | 2961.22                      | 91.41                       |
| M4 (Soil+FYM+BF)   | 70.83                       | 82.88                            | 3430.59                      | 104.65                      |
| M5 (Soil+VC+BF)    | 77.50                       | 86.01                            | 3717.73                      | 125.56                      |
| SEm                | 3.189                       | 1.709                            | 143.956                      | 4.602                       |
| CD at 5% level     | 9.107                       | 4.881                            | 411.116                      | 1.143                       |
| Interaction        |                             |                                  |                              |                             |
| G0M0               | 53.33                       | 74.74                            | 2546.03                      | 65.93                       |
| G0M1               | 56.67                       | 76.59                            | 2656.20                      | 74.67                       |
| G0M2               | 60.00                       | 77.38                            | 3029.60                      | 89.17                       |
| G0M3               | 56.67                       | 74.08                            | 3030.33                      | 97.20                       |
| G0M4               | 63.33                       | 77.46                            | 3417.17                      | 97.90                       |
| G0M5               | 66.67                       | 79.37                            | 3418.07                      | 109.23                      |
| G1M0               | 63.33                       | 78.70                            | 2521.47                      | 68.57                       |
| G1M1               | 66.67                       | 81.02                            | 3418.60                      | 99.73                       |
| G1M2               | 73.33                       | 84.72                            | 3615.40                      | 114.73                      |
| G1M3               | 70.00                       | 81.22                            | 2692.47                      | 81.03                       |
| G1M4               | 66.67                       | 88.43                            | 3637.00                      | 105.23                      |
| G1M5               | 73.33                       | 88.43                            | 3691.37                      | 125.17                      |
| G2M0               | 60.00                       | 77.78                            | 2775.27                      | 71.47                       |
| G2M1               | 70.00                       | 80.09                            | 3481.13                      | 124.47                      |
| G2M2               | 76.67                       | 87.04                            | 3691.80                      | 118.90                      |
| G2M3               | 70.00                       | 79.50                            | 3081.47                      | 93.07                       |
| G2M4               | 73.33                       | 86.57                            | 3302.53                      | 109.93                      |
| G2M5               | 83.33                       | 87.83                            | 3900.37                      | 136.13                      |
| G3M0               | 63.33                       | 74.74                            | 2838.23                      | 77.93                       |
| G3M1               | 73.33                       | 78.70                            | 3101.63                      | 93.50                       |
| G3M2               | 80.00                       | 78.71                            | 3321.40                      | 101.22                      |
| G3M3               | 60.00                       | 75.66                            | 3040.60                      | 94.33                       |
| G3M4               | 80.00                       | 79.05                            | 3365.61                      | 105.53                      |
| G3M5               | 86.67                       | 88.43                            | 3861.10                      | 130.80                      |
| SEm                | 6.378                       | 3.148                            | 287.912                      | 9.204                       |
| CD at 5% level     | NS                          | NS                               | NS                           | NS                          |
### Table 3 Effect of GA$_3$ and media on physiological parameters of custard apple

| Treatment          | Leaf Area Index (LAI) | Leaf Area Duration (LAD) | Light Transmission Ratio (LTR) | Energy Interception (Ei) |
|--------------------|-----------------------|--------------------------|--------------------------------|--------------------------|
| **Gibberellic acid** |                       |                          |                                |                          |
| G$_0$ (0 ppm)      | 0.84                  | 7376.60                  | 57.52                          | 0.33                     |
| G$_1$ (200 ppm)    | 0.92                  | 8031.76                  | 49.50                          | 0.40                     |
| G$_2$ (400 ppm)    | 1.11                  | 9715.76                  | 37.22                          | 0.49                     |
| G$_3$ (600 ppm)    | 1.06                  | 9230.46                  | 43.28                          | 0.46                     |
| SEm                 | 0.020                 | 174.140                  | 1.056                          | 0.007                    |
| CD at 5% level     | 0.057                 | 497.317                  | 3.015                          | 0.019                    |
| **Media**          |                       |                          |                                |                          |
| M$_0$ (Soil)       | 0.88                  | 7643.52                  | 55.19                          | 0.34                     |
| M$_1$ (Soil+FYM)   | 0.98                  | 8531.62                  | 50.19                          | 0.40                     |
| M$_2$ (Soil+VC)    | 1.02                  | 8873.76                  | 41.14                          | 0.47                     |
| M$_3$ (Soil+BF)    | 0.94                  | 8233.16                  | 52.10                          | 0.36                     |
| M$_4$ (Soil+FYM+BF)| 1.01                  | 8815.52                  | 46.59                          | 0.43                     |
| M$_5$ (Soil+VC+BF) | 1.08                  | 9434.29                  | 36.65                          | 0.52                     |
| SEm                 | 0.024                 | 213.277                  | 1.293                          | 0.008                    |
| CD at 5% level     | 0.070                 | 609.087                  | 3.692                          | 0.024                    |
| **Interaction**    |                       |                          |                                |                          |
| G$_0$M$_0$         | 0.78                  | 6842.77                  | 67.71                          | 0.26                     |
| G$_0$M$_1$         | 0.84                  | 7308.66                  | 63.95                          | 0.30                     |
| G$_0$M$_2$         | 0.83                  | 7279.54                  | 46.15                          | 0.42                     |
| G$_0$M$_3$         | 0.84                  | 7308.66                  | 64.45                          | 0.28                     |
| G$_0$M$_4$         | 0.88                  | 7716.31                  | 62.63                          | 0.29                     |
| G$_0$M$_5$         | 0.89                  | 7803.67                  | 42.65                          | 0.46                     |
| G$_1$M$_0$         | 0.84                  | 7221.31                  | 58.07                          | 0.29                     |
| G$_1$M$_1$         | 0.83                  | 7716.31                  | 48.21                          | 0.42                     |
| G$_1$M$_2$         | 0.88                  | 7774.55                  | 45.29                          | 0.43                     |
| G$_1$M$_3$         | 0.89                  | 8153.09                  | 59.08                          | 0.30                     |
| G$_1$M$_4$         | 0.93                  | 9317.81                  | 46.70                          | 0.42                     |
| G$_1$M$_5$         | 1.070.92             | 8007.50                  | 39.63                          | 0.51                     |
| G$_2$M$_0$         | 0.97                  | 8473.39                  | 43.80                          | 0.39                     |
| G$_2$M$_1$         | 1.19                  | 10366.07                 | 41.39                          | 0.49                     |
| G$_2$M$_2$         | 1.20                  | 10482.54                 | 32.63                          | 0.55                     |
| G$_2$M$_3$         | 1.01                  | 8822.80                  | 40.60                          | 0.42                     |
| G$_2$M$_4$         | 0.98                  | 8589.86                  | 33.28                          | 0.55                     |
| G$_2$M$_5$         | 1.32                  | 11559.91                 | 31.63                          | 0.56                     |
| G$_3$M$_0$         | 0.92                  | 8036.61                  | 51.18                          | 0.40                     |
| G$_3$M$_1$         | 1.00                  | 8735.45                  | 47.22                          | 0.40                     |
| G$_3$M$_2$         | 1.14                  | 9958.41                  | 40.51                          | 0.48                     |
| G$_3$M$_3$         | 0.99                  | 8648.10                  | 44.28                          | 0.44                     |
| G$_3$M$_4$         | 1.10                  | 9638.11                  | 43.77                          | 0.47                     |
| G$_3$M$_5$         | 1.19                  | 10366.07                 | 32.70                          | 0.55                     |
| SEm                 | 0.049                 | 426.555                  | 2.586                          | 0.017                    |
| CD at 5% level     | 0.139                 | 1218.174                 | 7.385                          | 0.048                    |
Leaf Area Index (LAI) and Leaf Area Duration (LAD)

Growing media significantly influenced the Leaf Area Index (LAI) and Leaf Area Duration (LAD). The Leaf Area Index (1.08) and Leaf Area Duration (9434.29 cm².days) was higher under treatment M₅ comprising soil + vermicompost + AZO + PSB at 150 days after sowing. The growing media had higher magnitude for LAD over remaining treatments which was attributed to increase in LA and LAI influenced by treatment. It might be due to role of nitrogen enhancing persistence and longevity of LA, which is a key factor in terms of photosynthesis productivity of the plants, that assimilates higher amount of photosynthates production and if the mobilization is proper to the sink, it will enhance the economic productivity. The findings are supported by Peng et al., (2013). The effect of GA₃ had significant effect on Leaf Area Index and Leaf Area Duration Significantly maximum Leaf Area Index (1.11) and Leaf Area Duration (9715.76) were noted under 400 ppm (G₂).

This was higher ascribed to higher magnitude increases in parameter associated with the LA. The finding was supported by Munde and Gajbhiye (2010). The treatment combination G₀M₀ was recorded maximum Leaf Area Index (1.32) and Leaf Area Duration (11559.9). However, minimum Leaf Area Index and Leaf Area Duration were noted under treatment combination G₂M₅. The increase of Leaf Area Index due to rich source of nutrient present in media comprising soil + vermicompost + AZO + PSB with 400 ppm GA₃.

Light Transmission Ratio (LTR)

In the present study, significantly maximum Light Transmission Ratio 55.19 at interval of 120 and 150 days after sowing was computed under M₀ media and the minimum Light Transmission Ratio 36.65 was recorded under M₅. The findings of Munde and Gajbhiye (2010) are close conformity with present findings. The maximum Light Transmission Ratio (57.52) was recorded under G₀ and minimum (37.22) was recorded under treatment G₂. The findings are supported by Munde and Gajbhiye (2010).

The interaction of growing media and GA₃ showed significant effect on Light Transmission Ratio. The significantly maximum Light Transmission Ratio (67.71) was obtained under treatment combination of G₀M₀ and minimum Light Transmission Ratio (31.63) was obtained under treatment combination of G₂M₅.

The results were significantly correlated with the LAI which exhibited the lowest and highest magnitude for the above treatments. The low light transmission through the crop canopy is reflected in higher value of LAI, more the canopy size more light interception and less transmission through the canopies (Thakur and Kaur, 2001) (Table 3).

Energy Interception (EI)

In the present study, all the treatment growing media, gibberellic acid concentration and their combination effect showed significant effect on the experiment concern.

The probable reason may be that Interception of light by a crop canopy is strongly related to total leaf area. A crop will thus intercept more PAR and hence grow faster if it develops leaf area rapidly. Similar findings were reported by Maddonni and Otegui (1996).

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