Growth Performance of Psidium Guajava In Fallowland

Sami shrivastava [1], A. K. Jha, [2]
[1]Dept of Botany
[2]Professor, Dept of Botany
[1, 2] Jai Prakash University
Chapra-841301, Bihar, India

Abstract- *The present study was conducted to evaluate the growth performance of Psidium guajava plantations raised in an abandoned fallow land of Jai Prakash University Chapra Campus during the period August 2015 to July 2017.The parameters studied were height, diameter, height diameter ratio and tree volume of 3-year old plantations at three sites .The increase in height ranged from 16 to 38% in 2016 and 19 to 99.3% in 2017;diameter from 40 to 74% in 2016 and 11.5to 43% in 2017;height diameter ratio 20% at one site and decreased from 14 to 16% in 2016 and in 2017decreased by 7 to 16 %; and tree volume increased 136 to 300% in 2016 and in 2017 increased by 100 to 150%.The monthly increment in height in 2015-2016 ranged from 4.08 to 7.85 cm/mon and in 2016-2017 it ranged from 4.7 to 8.2 cm/mon ;and diameter value ranged from 0.81 to 1.16 cm/mon in 2015-2016 and in 2016-2017 it ranged from 0.96 to 1.12 cm/mon. The annual increment in height value in 2015-2016 ranged 48.9 to 94.2cm/yr and in 2016 -2017 from 56.7 to 98.7 cm/yr whereas annual increment in diameter value ranged from 9.7 to 13.9 cm/yr in 2015-2016 and 11.5 to 13.4 cm/yr in 2016-2017. This study indicated that the growth of Psidium guajava is satisfactory in the fallow land of the present study sites.*

Keywords- Psidium guajava growth performance, fallow land, tree volume, H: D

I. INTRODUCTION

Guava *(Psidium guajava L*.) is a dicotyledonous (Family Myrtaceae) shrub or evergreen tree of 3 to10 m height .It is a hardy tree that adapts to a wide range of conditions. The highest yields may be obtained between 23-28^{0c}.It can be grown even from sea level upto 1500-2000 m altitude in tropics. Guava contributed 3.5% of total fruit area and 3.6% of total fruit production during 2009-2010 in India. It is cultivated in Bihar, Maharashtra, U.P, M.P, Karnataka, Gujarat, A.P. etc in India. Bihar is the leading state in guava production. During the period 2012-203 production of guava in India was about 3 million tons. It is popularly known as "Apple of the Tropic". Guava is more drought -resistant than other tropical fruit trees. The growth and production are better in soil having pH 4.5 to 8.2; rich clay loam soils but it can grow in poor soils also (Ecocrop 2015;CABI 2013; Orwa et al .2009). *P.guajava* is a native tree of Colombia, Mexico, Peru and U.S.A but it is an exotic species for other countries. It is commonly grown for fruits and are used in preparation of other food materials (Murray et al 1989;EI Boushy et al 2000).In agroforestry system its cultivation is done in India (CABI2013; Orwa et al.2009).Raturi et al (1993) have reported that guava trees were planted with *Leucaena leucocephala, Cenchrus ciliaris and Styhosanthes fruticosa* in agro- silvi- pastoral systems in Gujarat to increase the productivity and to reclaim eroded, degraded and compacted soils with gullies and rocky areas.

Guava is a rich source of vitamin c, pectin , Ca, P etc. Leaves are used in treating diarrhoea and for dyeing and tanning. Its products are used as food, fuel, timber, tannin or dye stuff, essential oil, alcohol , poison ,medicine, apiculture etc.

Henry and Aarsen (1999); Ducey (2012) and Forrester et al (2017) have suggested that tree height and diameter relationship is a subject of theoretical and empirical research. For forestry and ecological science the tree scaling of the height-diameter relationship is very important because it is used to describe tree growth ,productivity and yield (Parresol 1992).According Zang et al (2009) in forestry research algorithms for scaling the height –diameter relationship for various tree species in different conditions have been developed. Enquist et al (1999) and West et al (1999) have stated that in metabolic ecology it has been proposed that all tree species share an optimal design for the vascular system, which is related to plant physiology, biomass partitioning and population and community dynamics.

The present study was conducted to evaluate the growth performance of 3- year old plantation of *Psidium guajava* raised in the campus of J.P.University ,Chapra during the period 2015-2017.

II. MATERIALS AND METHODS

Location:

The study site is situated between 25^0 36' and 26^0 15' N latitude and $84^0$25' -$85^0$15' E longitude in the southern part of Saran Division of North Bihar. Total annual rainfall values in 2015, 2016 and 2017 were 946.6 mm, 1018.9 mm and 1134.6 mm, respectively .In rainy season in 2015 81.56% of total rainfall occurred whereas in 2016 it was 75.44% and in 2017 77.30%.The rainfall values in rainy season varied in different years. The maximum temperature during the study period in 2015 ranged from 25.6 to 40.3$^{\circ}C$; in 2016 from 25.5 to 42.0$^{\circ}C$ and in 2017 from 27.0 to 38.5$^{\circ}C$.

The present study was conducted in the three year old plantation of *Psidium guajava* raised in the campus of Jai Prakash University Chapra. The study was conducted during the period August 2015 to July 2017.Three year old 30 plants of *Psidium guajava* was selected at three sites .All the selected individuals were marked with paints. The spacing between individuals was 2m$\times$2m.

In the month of August 2015, July 2016 and July 2017 growth parameters such as height and diameter were measured. Further the H: D ratio and tree volume of trees were calculated . The height of seedlings was measured by using tape. The diameter at breast height (DBH) for tall seedlings at 1.34 m was measured. Monthly and annual increments in height and diameter were calculated from the difference between two measurements.

H: D ratio:

H: D Ratio was calculated according to the following formula:

$$\text{H:D ratio(cm)} = \frac{\text{Height(cm)}}{\text{Diameter (cm)}}$$

Tree Volume: Tree volume (m^3) was calculated according to the following formula:

Tree Volume (m^3) =D^2H (Where D represents diameter and H as height).

III. RESULTS AND DISCUSSION

Height (cm):

In case of *Psidium guajava* the values for height at three study sites ranged from 230.1 to 287.9 cm in 2015, 286.8 to 341.6 cm in 2016 and 342.9 to 440.9 cm in 2017 (Table 1).The mean value for three sites for height in 2015 was 255.1 cm; in 2016 321.5 cm and in 2017 395.6 cm .The per cent increment in height during the period 2016 and 2017 ranged from16 to 38% and 19 to 99.3%, respectively. The monthly increment values in height during the period 2015-2016 ranged from 4.08 to 7.85 cm /mon whereas during the period 2016-2017 it ranged from 4.7 to 8.2 cm/mon .The mean value of monthly increment in height was 5.5 cm/mon in 2015-2016 and 6.2 cm/mon in 2016-2017 (Table 2). The annual increment values in height during the period 2015-2016 ranged from 48.9 to 94.2 cm/yr whereas during the period 2016-2017 it ranged from 56.7 to 98.7 cm/yr .The mean value of annual increment in height was 66.4 cm/yr in 2015-2016 and 74.0 cm/yr in 2016-2017 (Table 2).The per cent monthly increment in height during the period 2016-2017compared to 2015-2016 ranged from 0.4% to 37%;and annually from 1% to 36%.

Shrivastava (2019) has reported in case of *Phyllanthus emblica* the values for height at three study sites ranged from 249.9 to 331.7 cm in 2015,341.0 to 398.0 cm in 2016 and 234.6 to 470.0 cm in 2017.The mean value for three sites for height in 2015 was 284.3 cm; in 2016 362.9 cm and in 2017 368.8 cm. The per cent increment in height during the period 2016 and 2017 ranged from 4 to 25% and 14 to 18%, respectively. The monthly increment values in height during the period 2015-2016 ranged from 5.53 to 8.33cm /mon whereas during the period 2016-2017 it ranged from 4.33 to 8.87 cm/mon .The mean value of monthly increment in height was 6.56 cm/mon in 2015-2016 and 6.4 cm/mon in 2016-2017.The annual increment values in height during the period 2015-2016 ranged from 66.3 to 100 cm /yr whereas during the period 2016-2017 it ranged from 52.0 to 106 cm/yr .The mean value of annual increment in height was 78.7 cm/yr in 2015-2016 and 76.8 cm/yr in 2016-2017. According to Shrivastava (2019) in case of *M.indica* the mean value for three sites for height in 2015 was 240.2 cm, in 2016 311.1 cm and in 2017 387.3cm .The per cent increment in height during the period 2016 and 2017 ranged from 7 to 64% and 19 to 32% ,respectively .The monthly increment values in height during the period 2015-2016 ranged from 1.6 to 12.0 cm /mon whereas during the period 2016-2017 it ranged from 4.5 to 10 cm/mon .The mean value of monthly increment in height was 5.9 cm/mon in 2015-2016 and 6.3 cm/mon in 2016-2017 . The mean value of annual increment in height was 70.9cm/yr in 2015-2016 and 75.9 cm/yr in 2016-2017 . Further in case of *S.cumini* ,in another fruit tree according to Shrivastava (2019) the values for height at one site were 158 cm in 2015; 218.5 cm in 2016 and 286.3 cm in 2017. The per cent increment values in height during the period 2016 and 2017 were 38% and 31% ,respectively. The monthly increment value for height during the period 2015-2016 was 5.02 cm /mon

whereas during the period 2016-2017 it was 5.65 cm/mon. The annual increment value for height during the period 2015-2016 was 60.2cm /yr whereas during the period 2016-2017 it was 67.8 /yr. This indicates that the growth in height was more in *P.guajava* compared to other fruit trees such as *M.indica, P.emblica,* and *S.cumini.*

Diameter (cm):

In case of *Psidium guajava* the values for diameter at three study sites ranged from 18.7 to 27.9 cm in 2015 31.1 to 39.3 cm in 2016 and 44.5 to 50.8 cm in 2017 (Table 1).The mean value for three sites for diameter in 2015 was 22.7 cm; in 2016 34.3 cm and in 2017 46.8 cm. The per cent increment in diameter during the period 2016 and 2017 ranged from 40 to 74% and 11.5 to 43%, respectively. The monthly increment values in diameter during the period 2015-2016 ranged from 0.81 to 1.16 cm/mon whereas during the period 2016-2017 it ranged 0.96 to 1.12 cm/mon .The mean value of monthly increment in diameter was 0.97 cm/mon in 2015-2016 and 1.04 cm/mon in 2016-2017 (Table 2). The annual increment values in diameter during the period 2015-2016 ranged from 9.7 to 13.9 cm /yr whereas during the period 2016-2017 it ranged from 11.5 to 13.4 cm/yr .The mean value of annual increment in diameter was 11.7 cm/yr in 2015-2016 and 12.5 cm/yr in 2016-2017 (Table 2).The per cent monthly increment in diameter during the period 2016-2017 compared to 2015-2016 ranged from 1% to 38% except for site III it decreased by 12% .The per cent annual increment in diameter during the period 2016-2017 ranged from 0.8% to 38% except for site III where it decreased by 9% (Table 2).In case of *Phyllanthus emblica* the values for height at three study sites ranged from 249.9 to 331.7 cm in 2015,341.0 to 398.0 cm in 2016 and 234.6 to 470.0 cm in 2017.The mean value for three sites for height in 2015 was 284.3 cm; in 2016 362.9 cm and in 2017 368.8 cm. The per cent increment in height during the period 2016 and 2017 ranged from 4 to 25% and 14 to 18%, respectively. The monthly increment values in height during the period 2015-2016 ranged from 5.53 to 8.33cm /mon whereas during the period 2016-2017 it ranged from 4.33 to 8.87 cm/mon .The mean value of monthly increment in height was 6.56 cm/mon in 2015-2016 and 6.4 cm/mon in 2016-2017.The annual increment values in height during the period 2015-2016 ranged from 66.3 to 100 cm /yr whereas during the period 2016-2017 it ranged from 52.0 to 106 cm/yr .The mean value of annual increment in height was 78.7 cm/yr in 2015-2016 and 76.8 cm/yr in 2016-2017 (Shrivastava 2019). According to Shrivastava (2019) in case of *M.indica* the mean value for three sites for height in 2015 was 240.2 cm, in 2016 311.1 cm and in 2017 387.3cm .The per cent increment in height during the period 2016 and 2017 ranged from 7 to 64% and 19 to 32% ,respectively .The monthly increment values in height during the period 2015-2016 ranged from 1.6 to 12.0 cm /mon whereas during the period 2016-2017 it ranged from 4.5 to 10 cm/mon .The mean value of monthly increment in height was 5.9 cm/mon in 2015-2016 and 6.3 cm/mon in 2016-2017 . The mean value of annual increment in height was 70.9cm/yr in 2015-2016 and 75.9 cm/yr in 2016-2017. Further in case of *S.cumini* ,in another fruit tree according to Shrivastava (2019) the values for height at one site were 158 cm in 2015; 218.5 cm in 2016 and 286.3 cm in 2017. The per cent increment values in height during the period 2016 and 2017 were 38% and 31% ,respectively. The monthly increment value for height during the period 2015-2016 was 5.02 cm /mon whereas during the period 2016-2017 it was 5.65 cm/mon. The annual increment value for height during the period 2015-2016 was 60.2cm /yr whereas during the period 2016-2017 it was 67.8 /yr. This indicates that the growth in height was more in *P.guajava* , compared to other fruit trees such as *M.indica, P.emblica* and *S.cumini.*

H:D ratio:

In case of *Psidium guajava* the values for H:D ratio at three study sites ranged from 10.3 to 13.2 cm in 2015, 8.6 to 10.5 cm in 2016 and 7.7 to 9.7cm in 2017 (Table 1).The mean value for three sites for H:D ratio in 2015 was 11.4 cm; in 2016 9.4 cm and in 2017, 8.4 cm.The per cent decrease in H:D ratio during the period 2015 -2016 and 2016 --2017 ranged from 14 to 20% and 7 to 16 % ,respectively(Table 1).

Tree volume (m^3):

In case of *Psidium guajava* the values for tree volume at three study sites ranged from 0.09 to 0.22 m3 in 2015 ,0.28 to 0.52 m3 in 2016 and 0.68 to 1.04 m3 in 2017 (Table 1).The mean value for three sites for tree volume in 2015 was 0.14 m3 ; in 2016 0.39 m3 and in 2017 0.87 m3.The per cent increment in tree volume during the period 2015-2016 and 2016-2017 ranged from 154 to 300 % and 100 to 150% ,respectively.

The present study indicated satisfactory growth performance in *P.guajava* in terms of growth in height, diameter and tree volume during the period 2015-2017 in fallowland of J.P.University Chapra campus.

IV. ACKNOWLEDGEMENT

We are thankful to the Head Department of Botany and other Faculty members help for during the study period .

Table -1 Growth performance in *Psidium guajava* during the period 2015-2017

Growth Parameters	2015				2016				2017			
	Site I	Site II	Site III	Mean	Site I	Site II	Site III	Mean	Site I	Site II	Site III	Mean
Height (cm) (% increase)	207.9	230.1	247.4	233.1	358.8 (18%)	286.8 (24%)	341.6 (38%)	321.3	403.6 (66.8%)	342.9 (19%)	440.9 (69.3%)	395.8
Diameter (cm) (% increase)	27.9	21.4	18.7	22.7	59.3 (40%)	51.1 (45%)	32.6 (74%)	34.3	50.8 (11.5%)	44.3 (45%)	45.2 (38%)	48.8
H/D Ratio (% decrease)	10.3	10.8	13.2	11.4	8.8 (-16%)	9.2 (-14%)	10.3 (20%)	9.4	7.8 (-8%)	7.7 (-16%)	9.7 (-7%)	8.4
Tree Volume (m^3) (% increase)	0.22	0.11	0.09	0.14	0.52 (136%)	0.28 (154%)	0.36 (300%)	0.39	1.04 (100%)	0.88 (142%)	0.90 (150%)	0.87

Table - 2 Monthly (cm/mom) and annual increment (cm/yr) in height and diameter in *Psidium guajava*

Growth Parameters	2015-2016				2016-2017			
	Site I	Site II	Site III	Mean	Site I	Site II	Site III	Mean
Monthly increment in height (cm/mon)	4.08	4.68	7.85	5.5	5.6	4.7	8.2	6.2
Monthly increment in diameter (cm/mon)	0.95	0.81	1.16	0.97	0.96	1.12	1.03	1.04
Annual increment in height (cm/yr)	48.9	56.1	94.2	66.4	66.8	56.7	98.7	74.0
Annual increment in diameter (cm/yr)	11.4	9.7	13.9	11.7	11.5	13.4	12.	12.5

REFERENCE

[1] CABI, (2013). Invasive Species Compendium. Wallingford, UK: CAB International.

[2] Ducey, M. J. (2012). Evergreenness and wood density predict height–diameter scaling in trees of the northeastern United States. Forest Ecology and Management, 279, 21-26.

[3] Ecocrop, (2015). Ecocrop database. FAO, Rome, Italy.

[4] El Boushy, A. R. Y. ; van der Poel, A. and F. B.,(2000). Handbook of poultry feed from waste: processing and use. Springer-Verlag New York, 428 p.

[5] Forrester, D. I., Benneter, A, Bouriaud, O., and Bauhus, J. (2017). Diversity and competition influence tree allometric relationships - developing functions for mixed-species forests. *Journal of Ecology*, 105, 761-774.

[6] Henry, H. A. L., and Aarssen, L. W. (1999). The interpretation of stem diameter-height allometry in trees: biomechanical constraints, neighbor effects or biased regression? *Ecology Letters*, 3, 89-97.

[7] Murray, M. J. ;and Campbell, C. A., (1989). Guava and passionfruit as commercial crops in Florida. *Proceedings of the Florida State Horticultural Society*. 102: 212-213.

[8] Orwa, C.; Mutua, A.; Kindt, R.; Jamnadass, R.;and Anthony, S.,(2009). Agroforestree Database: a tree reference and selection guide version 4.0. *World Agroforestry Centre, Kenya*.

[9] Parresol, B. R. (1992). Baldcypress height-diameter equations and their prediction confidence intervals. *Canada Journal of Forest Research*, 22, 1429-1434.

[10] Shirivastava (2019) Growth and phenological study of plantation raised in J.P. University Campus Chapra. 313pp.

[11] West, G. B., Brown, J. H., and Enquist, B. J. (1999). A general model for the structure and allometry of plant vascular systems. *Nature*, 400, 664-667.

[12] Zhang, L., Ma, Z., and Guo, L. (2009). An evaluation of spatial autocorrelation and heterogeneity in the residuals of six regression models. *Forest Science*, 55, 533-548.