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Studies on physico-chemical evaluation of tamarind (*Tamarindus indica* L.) genotypes prevailing in bastar region of Chhattisgarh on physical characters

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Abstract
The present investigation entitled "Studies on physico-chemical evaluation of tamarind (*Tamarindus indica* L.) genotypes prevailing in Bastar region of Chhattisgarh" was carried out in the laboratory, Department of Horticulture, College of Agriculture, IGAU, Raipur (C.G.) during the year 2004-05 and 2005-06. The study was carried out with 16 treatments (genotypes) consist of ripe fruits collected from selected trees of tamarind exist in Tokapal and Jagdalpur block of Bastar district (C.G.) under Randomized Block Design with three replications.The highest fruit weight and pulp weight both were recorded by IGTAM-14 which was found remarkably superior than all the other genotypes included in this study. Whereas, the highest pulp per cent, non-reducing sugar and crude fibre was observed in IGTAM-1. The longest fruit as well as the highest seed weight, seed per cent & number of seeds in the fruit were recorded in IGTAM-16.

Keywords: Tamarind, genotype and physico-chemical

Introduction
Tamarind (*Tamarindus indica* L.) is a hardy evergreen monotypic tree which belongs to the family 'Leguminosae' and sub-family Caesalpinaceae and has the chromosome number 2n=24. The name tamarind was derived from the Arabic word 'Tamar-E-Hind' meaning 'Date of India'. It is cultivated throughout the tropics and sub-tropics of the world and has become naturalized at many places.

Tamarind is an economically important tree of India as well as Chhattisgarh. In India, it is abundantly grown in Madhya Pradesh, Bihar, Andhra Pradesh, Tamil Nadu and Karnataka.

In India, tamarind is one of the most important common fruit trees and it is under cultivation for several centuries. Almost every part of it finds some use, but the most important is the fruit pulp which is the richest source of tartaric acid. It is being used in the manufacture of several products such as tamarind juice concentrate, pulp powder, pectin, pickle, chutneys, sauces, soups, jam, syrups, candy, tartaric acid, alcohol, refreshing tamarind drinks and tamarind kernel powder.

In India, few improved varieties of tamarind are in existence, like PKM-1 of Periyakulam, Pratisthan of Maharashtra and Urigam of Tamil Nadu (Geetha, 1995). Looking to the large area of tamarind either in forest or in homestead of tribal people.

Materials and method
The observations were recorded on the ripe fruits collected from the plus trees and replicated thrice. The methods used for the estimation of various physical components of the fruits of 16 tamarind genotypes are given in following sub-heads:

1. Fruit weight
The weight of fruit was measured by the weighing each pod separately and value was recorded as the weight of per fruit and expressed in gram.

2. Fruit length
The length of each pod was measured from the tip of the pod to the base of the pod with the help of a thread and expressed in cm.

3. Fruit width
The width of each fruit was measured by using vernier calipers and the reading was recorded in cm.

4. Thickness of fruit
Vernier calipers was used to measure the thickness of fruit and the reading was expressed in centimetres.

5. Shell weight per fruit
After removal of outer cover of the fruit, weight of the shell was recorded and expressed in gram.

6. Pulp weight per fruit
Immediately after removal of shell, Vein (fibre) and seeds from the fruit, pulp weight was recorded and expressed in gram.

7. Seed weight per fruit
Seed weight was recorded after separation of seeds from the pulp and expressed in gram.

8. Vein (fibre) weight per fruit
The weight of vein was recorded after separating veins from the pulp and expressed in gram.

9. Number of seeds per fruit
The seeds separated from the pods and were recorded as number of seeds per fruit.

10. Pulp per cent
Pulp per cent was calculated by dividing weight of pulp by weight of fruit and multiplied by 100. This was expressed as pulp per cent per fruit.

11. Shell per cent
Shell per cent was calculated by dividing weight of shell by weight of fruit and multiplied by 100 and expressed as shell per cent per fruit.

12. Vein per cent
Vein per cent was calculated by dividing the weight of vein over weight of fruit and multiplied by 100. This was expressed as vein per cent per fruit.

13. Seed per cent
Seed per cent was calculated by dividing weight of seed by weight of fruit and multiplied by 100. This was expressed as seed per cent per fruit.

Results and discussion
Physical characters
1. Fruit length
Data recorded on fruit length are presented in Table 1 It is observed that fruit length in different genotypes included in this study varied from 10.47 cm (IGTAM-5) to 22.10 cm (IGTAM-16) during 1st year (2004-05), 10.46 cm (IGTAM-5) to 22.15 cm (IGTAM-16) during 2nd year (2005-06) and 10.47 cm (IGTAM-5) to 22.13 cm (IGTAM-16) in case of pooled data (mean of both the years). Significant differences were observed among the genotypes in respect of fruit length during both the years as well as in pooled data.
During 1st year (2004-05), the highest fruit length was observed in IGTAM-16 (22.10 cm) which was found remarkably better than other genotypes studied in this investigation. This genotype (IGTAM-16) was followed by IGTAM-14 (21.36 cm), IGTAM-15 (20.28 cm) and IGTAM-1 (18.08 cm). The lowest fruit length was recorded in IGTAM-5 (10.47 cm) which was found significantly lower than all the treatments except IGTAM-6 (10.86 cm).
During 2nd year (2005-06), the highest fruit length was observed in IGTAM-16 (22.15 cm) which was found superior than all the genotypes studied in this investigation. This genotype (IGTAM-16) was followed by IGTAM-14 (21.39 cm), IGTAM-15 (20.48 cm) and IGTAM-9 (18.18 cm). The lowest fruit length was recorded in IGTAM-5 (10.45 cm).
In case of pooled data, highest fruit length was observed in IGTAM-16 (22.13 cm) which was found remarkably better than all the genotypes studied in this investigation. This genotype (IGTAM-16) was followed by IGTAM-14 (21.37 cm). IGTAM-15 (20.38 cm) and IGTAM-9 (18.13 cm). The lowest fruit length was observed in IGTAM-5 (10.47 cm), which was found significantly lower than all the treatments except IGTAM-6 (10.86 cm).
Thus, the data recorded on fruit length clearly show that longest fruit was observed in IGTAM-16 and shortest fruit in IGTAM-5 in case of 1st year and 2nd year of the study as well as in pooled data. The result of present investigation (Table 4.1) revealed that fruit length significantly varied from 10.46 cm (IGTAM-5) to 22.15 cm (IGTAM-16). The differences in the length of fruit may be attributed to the genetic make up of each genotypes. The variation regarding fruit length have also been reported by Hernandez-Unzon and Lakshminarayana (1982) as 12-15 cm and maximum 22.5 cm by Kokate (1988) [7] and these findings are in consonance with the present results.

2. Fruit width
Data recorded on fruit width in different genotypes included in this study are presented in Table 1
The range of variation for this character was from 3.12 cm (IGTAM-3) to 4.40 cm (IGTAM-10) during 1st year (2004-05), 3.06 cm (IGTAM-3) to 4.40 cm (IGTAM-10) during 2nd year (2005-06) and 3.09 cm (IGTAM-3) to 4.40 cm (IGTAM-10) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of fruit width during both the years as well as in pooled data.
During 1st year (2004-05), the maximum fruit width was observed in IGTAM-10 (4.40 cm) which was found better than all the genotypes studied in this investigation. This genotype (IGTAM-10) was followed by IGTAM-5 (3.85 cm), IGTAM-12 (3.70 cm) and IGTAM-14 (3.70 cm). The minimum fruit width was recorded in IGTAM-3 (3.12 cm).
During 2nd year (2005-06), the maximum fruit width was observed in IGTAM-10 (4.40 cm) which was found better than all the genotypes studied and it was followed by IGTAM-12 (3.91 cm), IGTAM-5 (3.83 cm) and IGTAM-14 (3.69). The minimum fruit width was recorded in IGTAM-3 (2.97 cm).
In case of pooled data, the maximum fruit width was observed in IGTAM-10 (4.40 cm) which was found better than all the genotypes studied in this investigation and was followed by IGTAM-12 (3.88 cm), IGTAM-5 (3.84 cm) and IGTAM-14 (3.70 cm). The minimum fruit width was recorded in IGTAM-3 (3.09 cm).
Thus, the data recorded on fruit width clearly indicate that highest fruit width was observed in IGTAM-10 while lowest fruit width was observed in IGTAM-3 in case of both the years of the study as well as in pooled data. Among the 16 different tamarind genotypes studied, the fruit width ranged

from 3.06 cm to 4.40 cm with a maximum of 4.40 cm in IGTAM-10 and minimum of 3.06 cm in IGTAM-3. The variation in width of fruit might be due to genetic difference among the selected genotypes. The observation regarding fruit width was 2.40-5.50 cm as reported by Keskar (1989) [6], 2.90 cm by Ilango and Vijayalakshmi (2002) [5] and these findings are in line with the present results.

3. Fruit thickness

Data recorded on fruit thickness are presented in Table 3 It is observed that fruit thickness in different genotypes included in this study varied from 1.24 cm (IGTAM-7) to 2.17 cm (IGTAM-11) during 1st year (2004-05), 1.25 cm (IGTAM-7) to 2.11 cm (IGTAM-11) during 2nd year (2005-06) and 1.25 cm (IGTAM-7) to 2.14 cm (IGTAM-11) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of fruit thickness during both the years as well as in pooled data.

During 1st year (2004-05), the highest fruit thickness was observed in IGTAM-11 (2.17 cm) which was found significantly superior than all the genotypes studied in this investigation. This genotype (IGTAM-11) was followed by IGTAM-4 (2.05 cm), IGTAM-15 (1.99 cm) and IGTAM-12 (1.76 cm). The lowest fruit thickness was recorded in IGTAM-7 (1.24 cm).

During 2nd year (2005-06), the highest fruit thickness was observed in IGTAM-11 (2.11 cm) which was found at par with IGTAM-4 (2.06 cm) and IGTAM-15 (2.05 cm) followed by IGTAM-12 (1.75 cm) and IGTAM-3 (1.70 cm). The lowest fruit thickness was observed in IGTAM-7 (1.25 cm), which was found significantly lower than all the treatments except IGTAM-8 (1.28 cm).

In case of pooled data, highest fruit thickness was observed in IGTAM-11 (2.14 cm) which was found significantly superior than all the genotypes studied in this investigation. This genotype (IGTAM-11) was followed by IGTAM-4 (2.05 cm), IGTAM-15 (2.03 cm) and IGTAM-12 (1.76 cm), whereas IGTAM-10 (1.61 cm), IGTAM-13 (1.60 cm), IGTAM-2 (1.59 cm), IGTAM-6 (1.59 cm), IGTAM-5 (1.58 cm) and IGTAM-16 was found at par to each other. The lowest fruit thickness was observed in IGTAM-7 (1.25 cm).

Thus, the data recorded on fruit thickness clearly show that highest fruit thickness was observed in IGTAM-11 and lowest fruit thickness was observed in IGTAM-7 in case of 1st and 2nd year of the study as well as in pooled data. The fruit thickness also varied among the genotypes studied in this investigation. Maximum fruit thickness was recorded in IGTAM-11 (2.17 cm) and lowest fruit thickness was recorded in IGTAM-7 (1.24 cm). The observations regarding fruit thickness was 1.31 cm to 1.70 cm by Hanamashetti and Sulikeri (1997) [4] and 1.41 cm by Shivanandam (1980) [11]. The present findings are in agreement with the earlier reports.

4. Fruit weight

Data recorded on fruit weight are presented in Table 2 It is observed that fruit weight in different genotypes included in this study varied from 14.11 g (IGTAM-5) to 36.89 g (IGTAM-14) during 1st year (2004-05), 14.12 g (IGTAM-5) to 36.83 g (IGTAM-14) during 2nd year (2005-06) and 14.12 g (IGTAM-5) to 36.86 g (IGTAM-14) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of fruit weight during both the years as well as in pooled data.

During 1st year (2004-05), the maximum fruit weight was observed in IGTAM-14 (36.89 g) which was found remarkably better than all the genotypes studied in this investigation. This genotype (IGTAM-14) was followed by IGTAM-10 (35.16 g), IGTAM-16 (31.80 g) and IGTAM-15 (31.27 g). The minimum fruit weight was recorded in IGTAM-5 (14.11 g).

During 2nd year (2005-06), the maximum fruit weight was observed in IGTAM-14 (36.83 g) which was found superior than all the genotypes studied in this investigation. This genotype (IGTAM-14) was followed by IGTAM-10 (35.16 g), IGTAM-16 (31.87 g) and IGTAM-13 (31.09 g). The minimum fruit weight was recorded in IGTAM-5 (14.12 g).

In case of pooled data, maximum fruit weight was observed in IGTAM-14 (36.86 g) which was found remarkably better than all the genotypes studied in this investigation. This genotype (IGTAM-14) was followed by IGTAM-10 (35.16 g), IGTAM-16 (31.84 g) and IGTAM-13 (31.08 g). The minimum fruit weight was observed in IGTAM-5 (14.12 g).

Thus, the data recorded on fruit weight clearly show that heaviest fruit was observed in IGTAM-14 and lightest fruit was in IGTAM-5 in case of 1st year and 2nd year of the study as well as in pooled data. Among the 16 different genotypes studied, the fruit weight varied from 14.11g (IGTAM-5) to 36.89 g (IGTAM-14). The difference in fruit weight in the present study may be attributed to number of seeds, seed weight, pulp content, shell weight among the different genotypes. Similar variation in fruit weight of seedling origin tamarind trees was noticed by Shivanandam (1980) [11] and Mastan *et al*. (1997) [8].

5. Pulp weight

Data obtained on pulp weight of various genotypes are presented in Table2

It is evident from the data that pulp weight in different genotypes varied from 6.48 g (IGTAM-5) to 17.73 g (IGTAM-14) during 1st year (2004-05), 6.40 g (IGTAM-5) to 17.70 g (IGTAM-14) during 2nd year (2005-06) and 6.44 g (IGTAM-5) to 17.72 g (IGTAM-14) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of pulp weight during both the year as well as in pooled data.

During 1st year (2004-05), the maximum pulp weight recorded in IGTAM-14 (17.73 g) which was found superior than all the genotypes of the present study and it was followed by IGTAM-10 (17.17 g), IGTAM-13 (16.37 g) and IGTAM-1 (14.32 g). The minimum pulp weight was observed in IGTAM-5 (6.48 g).

During 2nd year (2005-06), the higher pulp weight was recorded in IGTAM-14 (17.70 g) which was found superior than all the genotypes of the present study and was followed by IGTAM-10 (17.18 g), IGTAM-13 (16.29 g) and IGTAM-1 (14.42 g). The minimum pulp weight was recorded in IGTAM-5 (6.40 g).

In case of pooled data, highest pulp weight was observed in IGTAM-14 (17.72 g) which was found remarkably better than all the genotypes studied in this investigation. This genotype (IGTAM-14) was followed by IGTAM-10 (17.17 g), IGTAM-13 (16.33 g) and IGTAM-1 (14.32 g). The lowest pulp weight was observed in IGTAM-5 (6.44 g).

Thus, the data obtained on pulp weight clearly reveal that highest pulp was observed in IGTAM-14 and lowest pulp weight was recorded in IGTAM-5 in both the years as well as in pooled data. The maximum pulp weight 17.73 g and minimum 6.40 g per fruit was recorded in IGTAM-14 and IGTAM-5, respectively. Such variation in pulp weight of fruit may be attributed to difference in fruit length, breadth and thickness. The pulp weight is positively correlated to fruit weight in tamarind (Shivanandam and Thimmaraju, 1988). Similar results of variation in pulp weight were reported by various workers (Shivanandam, 1980; Challapilli, 1992; Hanamashetti and Sulikeri, 1997; Mastan *et al*., 1997 and Singh *et al*., 1997) [11, 4, 8, 12, 8, 12] in tamarind.

6. Seed weight

Data in respect of seed weight are presented in Table 2

A perusal of data indicates that seed weight in different genotypes included in this study varied from 3.78 g (IGTAM-5) to 9.74 g (IGTAM-16) during 1st year (2004-05), 4.16 g (IGTAM-5) to 9.71 g (IGTAM-16) during 2nd year (2005-06) and 3.97 g (IGTAM-5) to 9.73 g (IGTAM-16) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of seed weight during both the years as well as in pooled mean basis.

During 1st year (2004-05), the highest seed weight was observed in IGTAM-16 (9.74 g) which was found higher than the other genotypes studied in this investigation. This genotype (IGTAM-16) was followed by IGTAM-14 (9.28 g), IGTAM-15 (8.33 g) and IGTAM-7 (8.07 g). The lowest seed weight was recorded in IGTAM-5 (3.78 g).

During 2nd year (2005-06), the maximum seed weight was observed in IGTAM-16 (9.71 g) which was found higher than all the other genotypes study in this investigation. This genotype (IGTAM-16) was followed by IGTAM-14 (9.28 g), IGTAM-15 (8.28 g) and IGTAM-7 (8.09 g). The minimum seed weight was observed in IGTAM-5 (4.16 g).

In case of pooled data, highest seed weight was recorded in IGTAM-16 (9.73 g) which was found higher than all the other genotypes studied. This genotype (IGTAM-16) was followed by IGTAM-14 (9.28 g), IGTAM-15 (8.31 g) and IGTAM-7 (8.08 g). The lowest seed weight was observed in IGTAM-5 (3.97 g).

Thus, the data gathered on seed weight clearly show that highest seed weight was observed in IGTAM-16 while lowest seed weight in IGTAM-5 in case of 1st year and 2nd year of the study as well as in pooled mean basis.Maximum seed weight per fruit was recorded in IGTAM-16 (9.74 g), whereas, minimum seed weight per fruit was recorded in IGTAM-5 (3.78 g). The difference in seed weight may be attributed to the difference in the number and size of seeds among the genotypes studied. Similar divergence in seed weight was recorded in tamarind by David (1907), Shivanandam (1980) [11], Challapilli (1992), Hanamashetti and Sulikeri (1997) [4], Azhakiamanavalan and Vadivel (1997) [2], Mastan *et al*. (1997) [8], Singh *et al*. (1997) [12] and Prabhushankar *et al*. (2004) [9].

7. Vein weight

Data obtained on vein weight are presented in Table 3.

It is evident from the data that vein weight in different genotypes included in this study varied from 0.47 g (IGTAM-5) to 2.36 g (IGTAM-14) during 1st year (2004-05), 0.48 g (IGTAM-5) to 2.34 g (IGTAM-14) during 2nd year (2005-06) and 0.48 g (IGTAM-5) to 2.35 g (IGTAM-14) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of vein weight during both the years as well as in pooled data.

During 1st year (2004-05), the maximum vein weight was observed in IGTAM-14 (2.36 g) which was found significantly higher than all the other genotypes studied in this investigation. This genotype (IGTAM-14) was followed by IGTAM-16 (1.72 g), IGTAM-10 (1.61 g) and IGTAM-7 (1.46 g). The minimum vein weight was observed in IGTAM-5 (0.47 g).

During 2nd year (2005-06), the highest vein weight was recorded in IGTAM-14 (2.34 g) which was found significantly higher than all the genotypes studied in this investigation. This genotype (IGTAM-14) was followed by IGTAM-16 (1.72 g), IGTAM-10 (1.61 g) and IGTAM-7 (1.46 g). The lowest vein weight was recorded in IGTAM-5 (0.48 g).

In case of pooled data, highest vein weight was observed in IGTAM-14 (2.35 g) which was found significantly higher than all the genotypes studied in this investigation. This genotype (IGTAM-14) was followed by IGTAM-16 (1.72 g), IGTAM-10 (1.61 g) and IGTAM-7 (1.46 g). The lowest vein weight was observed in IGTAM-5 (0.48 g).

Thus, the data obtained on vein weight clearly show that maximum vein weight was observed in IGTAM-14 and minimum vein weight was observed in IGTAM-5 in case of both the years as well as in pooled data. The vein weight per fruit varied from 0.47 g (IGTAM-5) to 2.36 g (IGTAM-14). The difference in the fibre weight among the selected tamarind genotypes may be due to difference in the rate of development of vascular tissues in fruit (Challapilli, 1992). These results are in close conformity with the findings of Mastan *et al*. (1997) [8], who recorded wide range of variation in fibre (vein) weight ranging from 0.37 g to 4.30 g for 52 different seedling populations of tamarind in Chitoor and Anantpur district of Andhra Pradesh.

The weight of shell per fruit showed significant variation among the different genotypes considered for the present study. Maximum weight of the shell per fruit (8.99 g) was recorded in IGTAM-10, while minimum shell weight per fruit (3.47 g) was recorded in IGTAM-5. The difference in shell weight could be clearly attributed to the differences in size of the fruit. The supporting reference have been reported by Mastan *et al*. (1997) [8].

8. Shell weight

Data regarding shell weight are presented in Table 3

Data revealed that shell weight in different genotypes included in this study varied from 3.47 g (IGTAM-5) to 8.99 g (IGTAM-10) during 1st year (2004-05), 3.55 g (IGTAM-5) to 8.95 g (IGTAM-10) during 2nd year (2005-06) and 3.51 g (IGTAM-5) to 8.97 g. (IGTAM-10) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of shell weight during both the years as well as in pooled data.

During 1st year (2004-05), the maximum shell weight was observed in IGTAM-10 (8.99 g) which was found significantly higher than all the genotypes studied in this investigation. This genotype (IGTAM-10) was followed by IGTAM-14 (7.55 g), IGTAM-16 (7.35 g) and IGTAM-7 (6.95 g). The minimum shell weight was recorded in IGTAM-5 (3.47 g).

During 2nd year (2005-06), the maximum shell weight was recorded in IGTAM-10 (8.95 g) which was found significantly higher than all the genotypes studied in this investigation. This genotype (IGTAM-10) was followed by IGTAM-14 (7.54 g), IGTAM-16 (7.36 g) and IGTAM-7 (6.93 g). The minimum shell weight was observed in IGTAM-5 (3.55 g).

In case of pooled data, highest shell weight was recorded on IGTAM-10 (8.97 g) which was found significantly higher than all the genotypes studied in this investigation. This genotype (IGTAM-10) was followed by IGTAM-14 (7.54 g),

IGTAM-16 (7.36 g) and IGTAM-7 (6.94 g). The lowest shell weight was observed in IGTAM-5 (3.51 g).
Thus, the data revealed that maximum shell weight was recorded in IGTAM-10 and minimum shell weight in IGTAM-5 in case of 1st year and 2nd year of the study as well as in pooled data.

9. Number of seeds
Data recorded on number of seeds per fruit are presented in Table 3
It was observed that number of seeds per fruit in different genotypes included in this study varied from 4.14 seeds per fruit (IGTAM-5) to 10.07 seeds per fruit (IGTAM-16), during 1st year (2004-05), 4.16 seeds per fruit (IGTAM-5) to 10.09 (IGTAM-16) seeds per fruit during 2nd year (2005-06) and 4.15 seeds per fruit (IGTAM-5) to 10.08 (IGTAM-16) seeds per fruit in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of number of seeds per fruit during both the years as well as in pooled basis.
During 1st year (2004-05), the maximum number of seeds per fruit was recorded in IGTAM-16 (10.07) which was found higher than all the genotype studied in this investigation. This genotype (IGTAM-16) was followed by IGTAM-11 (9.79), IGTAM-14 (8.91) and IGTAM-15 (8.18). The minimum number of seeds per fruit was observed in IGTAM-5 (4.14).
During 2nd year (2005-06), the maximum number of seeds per fruit was observed in IGTAM-16 (10.09) which was found higher than all the genotypes studied in this investigation. This genotype (IGTAM-16) was followed by IGTAM-11 (9.81), IGTAM-14 (8.87) and IGTAM-15 (8.23). The minimum number of seeds per fruit was recorded in IGTAM-5 (4.16).
In case of pooled data, highest number of seeds per fruit was observed in IGTAM-16 (10.08) which was found higher than all the genotypes studied in this investigation. This genotype (IGTAM-16) was followed by IGTAM-11 (9.80), IGTAM-14 (8.89) and IGTAM-15 (8.21). The lowest number of seeds per fruit was recorded on IGTAM-5 (4.15).
Thus, the data recorded on number of seeds per fruit clearly indicate that maximum number of seeds per fruit was observed in IGTAM-16 and minimum number of seeds per fruit was recorded in IGTAM-5 in case of both the years as well as in pooled data. Maximum number of seeds per fruit was recorded in IGTAM-16 (10.09) whereas minimum number of seeds per fruit was recorded in IGTAM-5 (4.14). The difference in seed number may be attributed to difference in length of pod and ovule fertility. In conformity of this Bailey (1947) also reported in tamarind that long pods contains seeds ranging from 6 to 12 but in short pods, the number of seeds varies from 1 to 4. Similar results have also been reported by several workers (Cowen, 1970; Shivanandam 1980; Challapilli 1992; Keskar *et al.*, 1989; Hanamashetti and Sulikeri 1997; Azhaiamanavaln and Vadivel 1997; Mastan *et al.*, 1997; Singh *et al.*, 1997; Benjamin and Seegobin, 1999) [11, 6, 4,].

10. Pulp per cent
The data on per cent of pulp per fruit are given in Table 4 A perusal of data indicate that pulp per cent per fruit in different genotypes included in this study ranged between 40.18 per cent (IGTAM-7) to 53.98 per cent (IGTAM-1) during 1st year (2004-05), 40.23 per cent (IGTAM-7) to 53.98 per cent (IGTAM-1) during 2nd year (2005-06) and 40.20% (IGTAM-7) to 53.98 per cent (IGTAM-1) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of pulp per cent per fruit during both the years as well as in pooled basis.
During 1st year (2004-05), the highest pulp per cent was observed in IGTAM-1 (53.98%) which was found exceptionally best than all the genotypes studied in this investigation. This genotype (IGTAM-1) was followed by IGTAM-13 (51.62%), IGTAM-2 (50.66%) and IGTAM-10 (48.82%). The lowest pulp per cent was recorded in IGTAM-7 (40.18%) which was at par with IGTAM-16 (41.23%).
During 2nd year (2005-06) the maximum pulp per cent was observed in IGTAM-1 (53.98%) which was found exceptionally best than all the genotypes studied in this investigation. This genotype (IGTAM-1) was followed by IGTAM-13 (52.38%), IGTAM-2 (50.68%) and IGTAM-10 (48.87%). The minimum pulp per cent was recorded in IGTAM-7 (40.23%).
In case of pooled data, the highest pulp per cent was observed in IGTAM-1 (53.98%) which was found exceptionally best than all the genotypes studied in this investigation. This genotype (IGTAM-1) was followed by IGTAM-13 (52.00%), IGTAM-2 (50.67%) and IGTAM-10 (48.85%). The lowest pulp per cent was recorded in IGTAM-7 (40.20%).
It is obvious from the data obtained on pulp per cent per fruit clearly show that maximum pulp per cent was observed in IGTAM-1 and minimum pulp per cent in IGTAM-7 in case of 1st year and 2nd year of the study as well as in pooled data.

11. Shell per cent
The data gathered on shell per cent per fruit are presented in Table 4
It is evident from the data that shell per cent per fruit in different genotypes ranged from 17.93 per cent (IGTAM-15) to 25.58 per cent (IGTAM-10) during 1st year (2004-05), 18.69 per cent (IGTAM-15) to 25.45 per cent (IGTAM-10) during 2nd year (2005-06) and 18.45 per cent (IGTAM-15) to 25.51 per cent (IGTAM-10) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of shell per cent per fruit during both the years as well as in pooled mean basis.
During 1st year (2004-05), the highest shell per cent per fruit was observed in IGTAM-10 (25.58%) which was found significantly higher than all the genotypes studied in this investigation except IGTAM-7 (25.19%) and IGTAM-5 (24.58%), which was followed by IGTAM-8 (23.59%) and IGTAM-9 (23.46%). The lowest shell per cent per fruit was recorded in IGTAM-15 (17.93%) which was found significantly lower than all the other treatments except IGTAM-1 (18.72%).
During 2nd year (2005-06), the maximum shell per cent per fruit was observed in IGTAM-10 (25.45%) which was found significantly higher than all the genotypes studied in this investigation except IGTAM-7 (25.16%) and IGTAM-5 (25.13%), which was followed by IGTAM-9 (23.65%) and IGTAM-8 (23.52%). The lowest shell per cent per fruit was recorded in IGTAM-15 (18.69%) which was significantly lower than all the treatments except IGTAM-1 (18.98%).
In case of pooled, data highest shell per cent per fruit was observed in IGTAM-10 (25.51%) which was found significantly higher than all the genotypes studied in this investigation except IGTAM-7 (25.18%) and IGTAM-5 (24.85%) which was followed by IGTAM-8 (23.56%) and IGTAM-9 (23.56%). The lowest shell per cent per fruit was recorded in IGTAM-15 (18.45%) which was found significantly lower than all the treatments except IGTAM-1 (18.71%).

Thus, the data recorded on shell per cent clearly show that maximum shell per cent per fruit was observed in IGTAM-10 and minimum shell per cent per fruit was recorded in IGTAM-15 in case of both the years as well as in pooled data.
The pulp content varied from 40.18 per cent (IGTAM-7) to 53.98 per cent (IGTAM-1) and the shell content ranged from 17.93 per cent (IGTAM-15) to 25.58 per cent (IGTAM-10). The variation in pulp content and shell content might be due to the distinct feature of different genotypes. Similar variations with respect to pulp content and shell content were also observed in tamarind by Shivanandam (1980) [11], Challapilli (1992), Rao (1995), Hanamashetti and Sulikeri (1997) [4], Mastan *et al*. (1997) [8], Sivakumar (2000), Vennila (2000) and Prabhushankar *et al*. (2004) [9].

12. Seed per cent

Data obtained on seed per cent per fruit are presented in Table 5.
It was observed that seed per cent per fruit in different genotypes included in this study varied from 20.97 per cent (IGTAM-1) to 30.62 per cent (IGTAM-16) during 1st year (2005-06), 20.93 (IGTAM-1) to 30.48 per cent (IGTAM-16) during 2nd year (2005-06) and 20.95 per cent (IGTAM-1) to 30.55 per cent (IGTAM-16) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of seed per cent per fruit during both the years as well as in pooled mean basis.
During 1st year (2004-05), the maximum seed per cent per fruit was observed in IGTAM-16 (30.62%) which was found significantly higher than all the genotypes studied in this investigation except IGTAM-3 (29.92%) and IGTAM-6 (29.89%), which was followed by IGTAM-8 (29.57%) and IGTAM-7 (29.28%). The lowest seed per cent per fruit was recorded in IGTAM-1 (20.97%) which was found significantly lower than other all the treatments except IGTAM-10 (21.31%).
During 2nd year (2005-06) the highest seed per cent per fruit was observed in IGTAM-16 (30.48%) which was found significantly higher than all the genotypes studied in this investigation except IGTAM-3 (29.82%) and IGTAM-8 (29.52%), which was followed by IGTAM-7 (29.37%) and IGTAM-12 (28.74%). The lowest seed per cent per fruit was recorded in IGTAM-1 (20.93%) which was significantly lower than other treatments except IGTAM-10 (21.22%).
In case of pooled data, maximum seed per cent per fruit was observed in IGTAM-16 (30.55%) which was found significantly higher than all the genotypes studied in this investigation except IGTAM-3 (29.87%) and IGTAM-8 (29.55%) which was followed by IGTAM-7 (29.32%) and IGTAM-6 (29.14%). The lowest seed per cent per fruit was recorded in IGTAM-1 (20.95%) which was found significantly lower than all the treatments except IGTAM-10 (20.95%).
Thus, the data revealed that maximum seed per cent per fruit was observed in IGTAM-16 and minimum seed per cent per fruit was recorded in IGTAM-1 in case of 1st year and 2nd year of the study as well as in pooled mean basis.

13. Vein per cent

The data on per cent of vein per fruit are given in Table 5
A perusal of data indicates that vein per cent per fruit in different genotypes included in this study ranged between 3.20 per cent (IGTAM-3) to 6.39 per cent (IGTAM-14) during 1st year (2004-05), 3.37 per cent (IGTAM-3) to 6.35 per cent (IGTAM-14) during 2nd year (2005-06) and 6.37 per cent (IGTAM-14) to 3.16 (IGTAM-3) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of vein per cent per fruit during both the years as well as pooled basis.
During 1st year (2004-05), the highest vein per cent per fruit was recorded in IGTAM-14 (6.39%) which was found significantly higher than all the genotypes studied in the investigation. This genotypes (IGTAM-14) was followed by IGTAM-6 (5.65%), IGTAM-4 (5.58%) and IGTAM-16 (5.42%). The lowest vein per cent per fruit was observed in IGTAM-3 (3.20%) which was found significantly lower than all the other treatments except IGTAM-5 (3.24%).
During 2nd year (2005-06), the maximum vein per cent per fruit was recorded in IGTAM-14 (6.35%) which was found significantly higher than all the genotypes studied in this investigation except IGTAM-11 (6.13%), which was followed by IGTAM-6 (5.76%), IGTAM-4 (5.56%) and IGTAM-16 (5.39%). The minimum vein per cent per fruit was observed in IGTAM-3 (3.37%) which was found significantly lower than all the treatments except IGTAM-12 (3.58%).
In case of pooled data, highest vein per cent per fruit was recorded in IGTAM-14 (6.37%) which was found at par with IGTAM-6 (5.70%) and was found significantly higher than all the genotypes studied in this investigation. This genotype was followed by IGTAM-4 (5.57%), IGTAM-16 (5.42%) and IGTAM-7 (5.31%). The lowest vein per cent per fruit was observed in IGTAM-3 (3.16%) which was found statistically similar with IGTAM-5 (3.31%).
Thus, the data recorded on vein per cent clearly show that maximum pulp per cent per fruit was observed in IGTAM-14 and minimum vein per cent per fruit in IGTAM-3 in case of both the years as well as in pooled data. As regards to the seed per cent, IGTAM-16 (30.62%) reported maximum seed per cent and IGTAM-1 (20.93%) gave minimum seed per cent. The variations in seed content might be due to the difference in length of pod and ovule fertility. The present results are also in agreement with the findings of Shivanandam (1980) [11], Challapilli (1992), Rao (1995), Hanamashetti and Sulikeri (1997) [4], Mastan *et al*. (1997) [8], Anon (2000), Vannila (2000) and Prabhushankar (2004) [9] in tamarind.
As regards to the vein per cent IGTAM-14 (6.39%) recorded maximum vein per cent and IGTAM-3 (3.20%) recorded minimum vein per cent. The variations with respect to vein content might be due to the distinct feature of the different genotypes.
Similar variations with respect to vein content were also reported by Shivanandam (1980) [11], Challapilli (1992), Rao (1995), Hanamashetti and Sulikeri (1997) [4], Mastan *et al*. (1997) [8] and Prabhushankar *et al*. (2004) [9] in tamarind.
Birdar and Hanamashetti (2001) evaluated the correlation among different pod characters (pod length, pod width, pod thickness, pod weight, pulp weight, shell weight, vein weight, number of seeds and seed weight) of 17 tamarind genotypes. The significant and positive correlations were observed among the various pod characteristics studied.

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