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Studies on Physico-chemical evaluation of tamarind (*Tamarindus indica* L.) genotypes prevailing in bastar region of Chhattisgarh on micro nutrient status of tamarind seed

Amit kumar Shukla and Jitendra Singh

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. Higher K content of seed was observed in IGTAM-15 (523.83 mg/100g) and minimum level was observed in IGTAM-10 (263.25 mg/100g). Maximum Na content of seed was noticed in IGTAM-15 (27.62 mg/100g) minimum was recorded in IGTAM-7 (15.15 mg/100g). Maximum Zn content of seed was recorded in IGTAM-15 (1.82 mg/100g) while minimum content was recorded in IGTAM-16 (0.41 mg/100g).

Keywords: Tamarind, iron, magnesium, copper, zinc and sodium

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) [4]. Looking to the large area of tamarind either in forest or in homestead of tribal people.

Materials and method
1. Iron, copper and zinc
Lindsay and Norvell (1978) developed a method using DTPA (Diethylene Triamine Penta Acetic Acid) for the extraction of available Fe, Mn, Cu and Zn.

2. Sodium
Sodium (Na) was determined by flame photometer method as described by Chapman and Pratt (1961).

Results and discussion
1. Iron (seed)
Data obtained on iron (Fe) content of seed are presented in Table 1.

It is obvious from the data that iron content of seed in different genotypes included in this study ranged between 1.66 mg/100g (IGTAM-5) to 6.13 mg/100g (IGTAM-15) during 1st year (2004-05), 1.64 mg/100g (IGTAM-5) to 6.11 mg/100g (IGTAM-15) during 2nd year (2005-06) and 1.65 mg/100g (IGTAM-5) to 6.12 mg/100g (IGTAM-15) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of iron content of seed during 1st year and 2nd year of the study as well as in pooled mean basis.

During 1st year (2004-05), the highest iron content of seed was observed in IGTAM-15 (6.13 mg/100g), which was found better than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (5.55 mg/100g), IGTAM-11 (4.30 mg/100g) and IGTAM-7 (4.26 mg/100g). The lowest iron content of seed was observed in IGTAM-5 (1.66 mg/100g) which was found significantly lower than all the genotypes except IGTAM-13 (1.70 mg/100g).

Table 1: Variation in mineral composition of different Tamarind genotypes (Fe content of seed)

Treatments	Iron (mg/100 g)		
	2004-05	2005-06	Pooled
IGTAM-1	3.21	3.21	3.21
IGTAM-2	2.03	2.08	2.06
IGTAM-3	1.76	1.77	1.77
IGTAM-4	2.21	2.20	2.20
IGTAM-5	1.66	1.64	1.65
IGTAM-6	2.77	2.80	2.78
IGTAM-7	4.26	4.25	4.26
IGTAM-8	3.22	3.22	3.22
IGTAM-9	2.19	2.27	2.23
IGTAM-10	1.95	2.00	1.98
IGTAM-11	4.30	4.30	4.30
IGTAM-12	2.74	2.78	2.76
IGTAM-13	1.70	1.68	1.69
IGTAM-14	3.92	3.90	3.91
IGTAM-15	6.13	6.11	6.12
IGTAM-16	5.55	5.58	5.57
SE(m)±	0.0285	0.0343	0.025
CD (5%)	0.08	0.10	0.07

During 2nd year (2005-06), the maximum iron content of seed was observed in IGTAM-15 (6.11 mg/100g) which was found better than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (5.58 mg/100g), IGTAM-11 (4.30 mg/100g) and IGTAM-7 (4.25 mg/100g). The minimum iron content of seed was recorded in IGTAM-5 (1.64 mg/100g) which was found statistically similar to IGTAM-13 (1.68 mg/100g).

In case of pooled data, the maximum iron content of seed was noticed in IGTAM-15 (6.12 mg/100), which was found excellent than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (5.57 mg/100g), IGTAM-11 (4.30 mg/100g) and IGTAM-7 (4.26 mg/100g). The minimum iron content of seed was recorded in IGTAM-5 (1.65 mg/100g) which was found at par with IGTAM-13 (1.69 mg/100g).

Thus, it is obvious from the data highest iron content of seed was noticed in IGTAM-15 and lowest iron content of seed was recorded in IGTAM-5 in case of 1st year and 2nd year of the study as well as in pooled data.

In present investigation, variations were also observed in magnesium (Mg), Copper (Cu) and iron (Fe) content of seed among the different tamarind genotypes studied (Table 1).

The maximum magnesium content of seed was recorded in IGTAM-15 (39.25 mg/100g) and minimum magnesium content of seed in IGTAM-6 (14.58 mg/100g). The copper (Cu) content of seed varied between 1.79 mg/100 g (IGTAM-4) to 16.14 mg/100g (IGTAM-15). The maximum iron content of seed was recorded in IGTAM-15 (6.14 mg/100g) and minimum iron content of seed was recorded in IGTAM-5 (1.64 mg/100g).

The difference in mineral (Fe) content of seeds may be due to genetic nature of the genotypes. The results are also in close agreement with the findings of Ishola *et al*. (1990) [5], who reported that tamarind seed contain iron (6.50 mg/100g). Similar results on Fe content of tamarind seed was also reported by Bhattacharya *et al*. (1994) [2].

2. Copper (seed)

Table 2: Variation in mineral composition of different Tamarind genotypes (Cu content of seed)

Treatments	Copper (mg/100 g)		
	2004-05	2005-06	Pooled
IGTAM-1	9.55	9.51	9.53
IGTAM-2	5.35	5.32	5.34
IGTAM-3	2.05	2.08	2.06
IGTAM-4	1.84	1.79	1.81
IGTAM-5	3.17	3.23	3.20
IGTAM-6	2.00	2.01	2.01
IGTAM-7	5.41	5.39	5.40
IGTAM-8	6.23	6.24	6.24
IGTAM-9	2.48	2.45	2.47
IGTAM-10	5.40	5.39	5.40
IGTAM-11	8.40	8.38	8.39
IGTAM-12	6.27	6.27	6.27
IGTAM-13	10.10	10.11	10.11
IGTAM-14	11.32	11.31	11.32
IGTAM-15	16.14	16.12	16.13
IGTAM-16	14.28	14.29	14.29
SE(m)±	0.0188	0.0177	0.0093
CD (5%)	0.05	0.05	0.03

Data gathered on copper (Cu) content of seed are furnished in Table 2.

The data revealed that copper content of seed in different genotypes included in this study ranged from 1.84 mg/100g (IGTAM-4) to 16.14 mg/100g (IGTAM-15) during 1st year (2004-05), 1.79 mg/100g (IGTAM-4) to 16.12 mg/100g (IGTAM-15) during 2nd year (2005-06) and 1.81 mg/100g (IGTAM-4) to 16.13 mg/100g (IGTAM-15) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of copper content of seed, during 1st year and 2nd year of the study as well as in pooled basis.

During 1st year (2004-05), the maximum copper content of seed was recorded in IGTAM-15 (16.14 mg/100g), which was found excellent than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (14.28 mg/100g), IGTAM-14 (11.32 mg/100g) and IGTAM-13 (10.10 mg/100g). The minimum copper content of seed was recorded in IGTAM-4 (1.84 mg/100g).

During 2nd year (2005-06), the highest copper content of seed was recorded in IGTAM-15 (16.12 mg/100g), which was found excellent than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16(14.29 mg/100g), IGTAM-14 (11.31 mg/100g) and IGTAM-13 (10.11 mg/100g). The lowest copper content of seed was observed in IGTAM-4 (1.79 mg/100g).

In case of pooled data, maximum copper content of seed was recorded in IGTAM-15 (16.13 mg/100g), which was found significantly excellent than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-16 (14.29 mg/100g), IGTAM-14 (11.32 mg/100g) and IGTAM-13 (10.11 mg/100g). The minimum copper content of seed was observed in IGTAM-4 (1.81 mg/100g).

Thus, the data presented on copper content of seed clearly show that higher copper content of seed was recorded in IGTAM-15 and lower copper content of seed was observed in IGTAM-4 in case of 1st year and 2nd year of the study as well as in pooled data.

In present investigation, variations were also observed in magnesium (Mg), Copper (Cu) and iron (Fe) content of seed among the different tamarind genotypes studied (Table 1).

The maximum magnesium content of seed was recorded in IGTAM-15 (39.25 mg/100g) and minimum magnesium content of seed in IGTAM-6 (14.58 mg/100g). The copper (Cu) content of seed varied between 1.79 mg/100 g (IGTAM-4) to 16.14 mg/100g (IGTAM-15). The maximum iron content of seed was recorded in IGTAM-15 (6.14 mg/100g) and minimum iron content of seed was recorded in IGTAM-5 (1.64 mg/100g).

The difference in mineral (Cu) content of seeds may be due to genetic nature of the genotypes. The results are also in close agreement with the findings of Ishola *et al*. (1990) [5], who reported that tamarind seed contain magnesium (17.50–118.30 mg/100g), Similar results on Cu content of tamarind seed was also reported by Bhattacharya *et al*. (1994) [2].

3. Zinc (seed)

The zinc (Zn) content of seed was determined for all the genotypes included in this study during both the years and it was observed that zinc content of seed was found nil in all the genotypes studied in this investigation except IGTAM-15, IGTAM-8, IGTAM-9 and IGTAM-16. Thus, the data on zinc content of seed are not presented.

During 1st year (2004-05), maximum zinc content of seed was observed in IGTAM-15 (1.82 mg/100g) which was followed by IGTAM-8 (0.58 mg/100g), IGTAM-9 (0.55 mg/100g) and IGTAM-16 (0.38 mg/100g).

During 2nd year (2005-06), highest zinc content of seed was recorded in IGTAM-15 (1.80 mg/100g), which was followed by IGTAM-8 (0.57 mg/100g), IGTAM-9 (0.54 mg/100g) and IGTAM-16 (0.41 mg/100g).

In case of pooled mean (mean of both the years), maximum zinc content of seed was observed in IGTAM-15 (1.81 mg/100g) which was followed by IGTAM-8 (0.56 mg/100g), IGTAM-9 (0.55 mg/100g) and IGTAM-16 (0.40 mg/100g).

Thus, it was observed that IGTAM-15 had highest zinc content of seed which was followed by IGTAM-8, IGTAM-9, and IGTAM-16 in case of both the years as well as in pooled mean.

The zinc (Zn) content of seed was recorded maximum in IGTAM-15 (1.82 mg/100g) and minimum zinc content of seed was recorded in IGTAM-8 (0.38 mg/100g).

In the present investigation, it was observed that zinc content of seed among different genotypes of tamarind studied was found nil in 16 genotypes out of 16 genotypes studied and only four genotypes had recorded zinc content of seed. The observation regarding zinc (Zn) content of tamarind seed was 2.80 (mg/100g) as reported by Ishola *et al*. (1990) [5] and these results are in line with the present findings.

As regards Zinc (Zn) content of seed in the present investigation, it was observed that Zinc content of seed found nil in all the genotypes included in this study. Similar results were also reported by Ishola *et al*. (1990) [5] and Bhattacharya *et al*. (1994) [2]

4. Sodium (seed)

The data pertaining to sodium (Na) content of pulp are furnished in Table 3.

A perusal of data indicates that sodium content of seed in different genotypes included in this study varied from 15.15 mg/100g (IGTAM-7) to 27.5 mg/100g (IGTAM-15) during 1st year (2004-05), 15.35 mg/100g (IGTAM-7) to 27.62 mg/100g (IGTAM-15) during 2nd year (2005-06) and 15.28 mg/100g (IGTAM-7) to 27.56 mg/100g (IGTAM-15) in case of pooled data (mean of both the years). Significant difference was observed among the genotypes in respect of sodium content of seed during 1st year and 2nd year of study as well as in pooled data.

During 1st year (2004-05), the maximum sodium content of seed was recorded in IGTAM-15 (27.50 mg/100g), which was found significantly superior than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-8 (25.34 mg/100g), IGTAM-16 (25.33 mg/100g) and IGTAM-9 (24.34 mg/100g). The minimum sodium content of seed was noticed in IGTAM-7 (15.15 mg/100g).

During 2nd year (2005-06), the highest sodium content of seed was recorded in IGTAM-15 (27.62 mg/100g), which was found significantly excellent than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-8 (25.31 mg/100g), IGTAM-16 (25.29 mg/100g) and IGTAM-9 (24.38 mg/100g). The lowest sodium content of pulp was observed in IGTAM-7 (15.35 mg/100g) which was found at par with IGTAM-3 (15.42 mg/100g) and IGTAM-4 (15.50 mg/100g).

In case of pooled data, the maximum sodium content of seed was recorded in IGTAM-15 (27.56 mg/100g), which was found significantly better than all the genotypes studied in this investigation. This genotype (IGTAM-15) was followed by IGTAM-8 (25.55 mg/100g), IGTAM-16 (25.32 mg/100g) and IGTAM-9 (24.36 mg/100g). The minimum sodium content of seed was observed in IGTAM-7 (15.28 mg/100g) which was found significantly lower than all the genotypes except IGTAM-3 (15.52 mg/100g).

Table 3: Variation in mineral composition of different tamarind genotypes (Na content of seed

Treatments	Sodium (mg/100 g)		
	2004-05	2005-06	Pooled
IGTAM-1	22.87	22.39	22.63
IGTAM-2	20.93	20.37	20.65
IGTAM-3	15.69	15.42	15.52
IGTAM-4	15.69	15.50	15.60
IGTAM-5	18.38	18.30	18.34
IGTAM-6	21.27	21.24	21.26
IGTAM-7	15.15	15.35	15.28
IGTAM-8	25.34	25.31	25.55
IGTAM-9	24.34	24.38	24.36
IGTAM-10	21.21	21.24	21.23
IGTAM-11	19.26	19.28	19.27
IGTAM-12	23.75	23.42	23.58
IGTAM-13	18.18	18.17	18.18
IGTAM-14	17.33	17.17	17.25
IGTAM-15	27.50	27.62	27.56
IGTAM-16	25.33	25.29	25.32
SE(m)±	0.1743	0.0617	0.0964
CD (5%)	0.50	0.18	0.28

Thus, the data presented on sodium content of seed clearly show that highest sodium content of seed was observed in IGTAM-15 and lowest sodium content of seed was recorded in IGTAM-7 in case of both the years as well as in pooled data

The data presented in Table 3. indicates significant variation among the genotypes included in this study in respect of sodium (Na) content of tamarind seed.

The sodium content of seed varied between 15.15 mg/100g (IGTAM-7) to 27.62 mg/100g (IGTAM-15).

The difference in mineral (Na) content of seed might be due to genetic nature of the genotypes. These results are supported by the findings of Ishola *et al*. (1990) [5], who reported that tamarind seed contain potassium 272.80 to 610.00 mg/100g and sodium 19.20-28.80 mg/100g. Similar result on K and Na was also reported by Bhattacharya *et al*. (1994) [2].

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