

Nutrient and Soil Microbial Dynamics In Kinnow Mandarin Under Integrated Application of Nutrients and Biofertilizers

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Abstract

Modern agriculture relies heavily on use of inorganic fertilizers which not only turns the soil infertile but also has a detrimental impact on the ecosystem stability and sustainability. The research trial was laid to evaluate the effect of inorganic and organic sources of nitrogen along with application of biofertilizers yielded significant effect on plant growth, yield, quality and nutrient content of plant as well as fruits. The results summarized that 25 per cent of recommended dose of nitrogen can be replaced with organic manures augmented with *Azotobacter* which not only improved the growth, yield and quality parameters of Kinnow crop but also helped in soil amelioration by increasing the microbial community population in the rhizosphere. The present study holds promise in minimizing overuse of inorganic fertilizers and overall improvement in soil health that can lead to a prolonged productive life of the fruit orchard.

Keywords: Integrated nutrient management; inorganic fertilizers; biofertilizers; Kinnow mandarin; leaf nutrient content

Introduction

‘Kinnow’, a mandarin hybrid of King and Willow leaf mandarin, is a nutrient-loving plant and its sustained production requires provisioning the plant with nutrients as well as nutrient uptake and their distribution in the plant. Yield and quality are a function of optimum manure and fertilizer application. Among macro-nutrients, nitrogen is the most sought-after nutrient as it is involved in a host of physiological processes besides influencing plant growth (Bakshi *et al.*, 2012). Though Kinnow responds well to nitrogen through inorganic fertilization, overuse of these has resulted in declining productivity of the Kinnow orchards. Nitrogen use efficiency (NUE) has been on a decreasing trend over the world as a result of increased nitrogen application (Karandish and Shahnazari, 2016; Chilundo *et al.* 2018). Conjugated use of organic and inorganic sources of nutrients is a proven technology to

build up fertility status of soil (Bakshi *et al.*,2017). Integration of biofertilizers in nutrition programme can enhance nutrient availability and uptake of nutrients. Long term use of bio-fertilizers has been reported to improve productivity, is more efficient, economical and easily accessible to marginal and small farmers over chemical fertilizers.(Kumaret *al.*,2017). Organic matter decomposition is mediated by soil microbial populations which in turn increase the availability of nutrients to the plant. In this context, a field trial was laid to evaluate the effect of integration of inorganic, organic fertilizers and biofertilizer on performance of Kinnow mandarin and soil microbial population.

Materials and methods

An experiment was carried out at the Fruit Research Farm of SKUAST-Jammu, Udheywalla on seven-year-old Kinnow mandarin (*Citrus nobilisx Citrus deliciosa*) orchard. The treatments consisted of 12 combinations viz., T₁ (100 % N as urea), T₂ (25 % N as FYM and 75 % N as urea), T₃ (50 % N as FYM and 50 % N as urea), T₄ (75 % N as FYM and 25 % N as urea), T₅ (*Azotobacter*@100g+ T₁), T₆ (*Azotobacter*@100g+ T₂), T₇ (*Azotobacter* @100g+ T₃), T₈ (*Azotobacter* @100g+ T₄), T₉ (*Azotobacter* @100g+ 100 % N as FYM), T₁₀ (100% N as FYM), T₁₁ (*Azotobacter*@100ginoculation) and T₁₂ (control).Experiment was laid out in Randomized Block Design and treatments were replicated thrice keeping one tree per replication. Vegetative growth characters of the plant were recorded using standard parameters. Canopy volume was calculated as per the method given by Westwood (1963). Based on number of fruits per tree, yield per plant and total yield per hectare was worked out. Fruit physical characters were recorded using standard procedures. TSS was estimated using Hand refractometer. Titratable acidity, total sugars and reducing sugars were worked out as per method suggested in A.O.A.C (1995). Ascorbic acid was estimated as per the method given by Ruck (1969). The total phenol content of the fruit juices was determined using the Folin-Ciocalteu Colorimetric method (Singleton and Rossi, 1965). Total nitrogen was estimated by Micro-Kjeldhal's method as suggested by Jackson (1973), and results were expressed in per cent nitrogen on the basis of dry weight in leaves. Total phosphorus was determined by Vando-molybdophosphoric acid yellow colour method as suggested by Jackson (1973). Potassium content was estimated by Flame Photometer and results were expressed in per cent. Calcium and magnesium were measured on atomic absorption spectrophotometer and the results were expressed as per cent. Leaf samples were collected from seven-month-old non fruiting spring cycle flush and sample preparation was done as per method described by Piper (1966). *Azotobacter* colonies were cultured using Jensen's

medium (Allen, 1953). Total bacteria in the soil sample were cultured using nutrient agar medium. Total fungal population in the soil sample was isolated using potato dextrose agar medium.

The data generated during the course of study was subjected to analysis of variance (ANOVA) and Duncan's multiple-ranged test was performed using SPSS v. 16 software to identify the homogeneous type of the data sets among different treatments for different plant parameters.

Results and Discussion

Plant growth characteristics: Plant growth characters were greatly affected by the rapid availability of nitrogen (Table 1). Since inorganic nitrogen is rapidly available to the plants, maximum increase in plant height (12.74 per cent), plant spread (12.54 per cent NS and 12.94 per cent EW) and canopy volume (38.22 per cent) was recorded under T₅. However, the results obtained under this treatment were closely followed by treatment comprising of 25 per cent nitrogen applied through FYM + 75 per cent through urea + *Azotobacter* (T₆). Nitrogen is vital nutrient for plant growth and plants respond instantly under available nitrogen. The maximum increase in vegetative growth characters of Kinnow mandarin under cent per cent inorganic nitrogen treatment combination is supported by the fact that nitrogen through urea is readily available to the plant, which increased the vegetative growth abruptly contrary to other treatments where nitrogen was released slowly as observed by Ramana *et al.* (2014). Application of nitrogen fixing culture enhances nitrogen fixation and accumulation of carbohydrates, which in turn increases growth of plants (Khehra and Bal, 2014).

Fruit physical characteristics: Fruit physical characteristics showed superior attributes when treated with integrated application of nutrients along with biofertilizers (Table 2). Treatment T₆ maintained the superiority over other treatments *vis-a-vis* fruit length (5.72 cm), fruit diameter (6.44 cm), fruit weight (186.40 g) and fruit volume (186.00 cc). However, treatment T₅ involving application of 100 per cent nitrogen through urea augmented with *Azotobacter* was at par with T₆. Maximum peel thickness (0.54 cm) and specific gravity (1.01) was recorded in T₅. Minimum values for fruit physical characters were recorded under control. The increase in fruit size due to the increased availability of organic sources of nutrients which might have occurred due to balanced availability of macro-micro nutrients and growth promoting hormones produced by bio-fertilizer *Azotobacter* applied with different treatment combinations. This may have led to efficient mobility of photosynthates as influenced by the growth hormones (Gharwal *et al.*, 2014).

Yield characteristics: Integrated nutrient management treatments had a significant effect on the total number of fruits per plant (Table 2). Maximum number of fruits per plant (157.17) was recorded with the combined application of 25 per cent nitrogen through FYM + 75 per cent nitrogen through urea along with application of *Azotobacter*. Based on the average fruit weight and number of fruits, yield was worked out to be maximum yield (29.08 kg per plant) under treatment T₆ followed by treatment T₅ (cent per cent nitrogen through urea augmented with *Azotobacter*). Minimum values for yield characteristics were recorded under control (T₁₂). Beneficial effect of integrated sources on yield of Kinnow mandarin could be attributed to the fact that FYM after proper decomposition and mineralization supplied available nutrients directly to the fruits, which had solublizing effect on fixed forms of nutrient in soil and had improved physico-chemical and microbial environment leading to better expression of response to applied chemical fertilizers. These are important constituents of nucleotides, protein, chlorophyll and enzymes, taking part in various metabolic processes and having direct impact on vegetative and reproductive phases of fruits. These findings are in close conformity with the works of Muhammad *et al.* (2000) and Bhobia *et al.* (2005) in guava.

Chemical characteristics of Kinnow fruit: Table-3 summarizes the effect of integrated nutrient management in Kinnow mandarin. Overall increase in total soluble solids was observed in all the treatments highest being recorded under treatment T₇ (11.43 °Brix) which was at par with T₆ (11.37 °Brix). Lowest titratable acidity (0.70 per cent each) was recorded in treatments T₄ and T₁₀ while highest fruit acidity (0.76 per cent) was found in fruits harvested from plants under T₅. Total sugars ranged between 5.92 per cent and 5.39 per cent recorded in T₆ and control, respectively. T₆ recorded highest reducing sugar (2.81 per cent) and highest non-reducing sugars (3.09 per cent) were recorded under treatment T₅. Ascorbic acid content (26.71 mg per 100 g of fresh fruit) was highest under T₆.

A combination of inorganic and organic fertilizers augmented with biofertilizer showed significant effect of various treatment combinations on juice content of Kinnow fruits. Maximum juice content (54.22 per cent) was recorded with the application of 25 per cent nitrogen as FYM and 75 per cent nitrogen as urea along with *Azotobacter* (T₆). Highest total polyphenol content (61.45 mg GAE per 100 ml of juice) was recorded in fruits of plants receiving no fertilization (T₁₂) while lowest total polyphenol content (52.61 mg GAE per 100 ml of juice) was recorded in fruits of trees supplied with cent per cent nitrogen through urea

augmented with *Azotobacter* (T₅). Maximum pH (4.57) recorded with the application of cent per cent nitrogen as urea augmented with *Azotobacter* (T₅) while minimum (3.93) was recorded under control (T₁₂).

Due to increase in canopy volume, higher synthesis of assimilates as a result of enhanced rate of photosynthesis might have occurred which led to increased TSS, total sugars, acidity, ascorbic acid content and juice content of the fruits (Nasreen *et al.*, 2013).

Leaf and fruit nutrient status: Effect of integrated nutrient management on leaf and fruit nutrient status is presented in Table 4. Maximum amount of leaf nitrogen (2.56 %) and leaf phosphorus (0.18 %) was recorded in treatment T₆ (25 per cent nitrogen as FYM and 75 per cent nitrogen as urea augmented with *Azotobacter*). Leaf potassium reached to highest level (1.53 %) under the trees treated with 50 per cent nitrogen as FYM and 50 per cent nitrogen as urea augmented with *Azotobacter* (T₇). Highest leaf calcium (4.29 %) and magnesium (0.44 %) was recorded under T₅ (cent per cent application of nitrogen as urea augmented with *Azotobacter*).

Fruit nutrient contents also showed significant variations under different integrated nutrient management treatments. Maximum fruit nitrogen (0.06%) and fruit phosphorus (0.024 %) was recorded under T₆. Fruit potassium attained highest level (0.091 %) under T₇. No definite trend was observed for calcium content of Kinnow mandarin fruits, however, highest calcium content (0.035 per cent) in fruit was observed under treatments T₅, T₆ and T₉ and was statistically at par with T₁₀. Magnesium content in fruits ranged from 0.018 per cent to 0.024 per cent, lowest being observed in control (T₁₂).

In plants which were supplied with only urea as source of nitrogen resulted in to less total phenolic content in fruits whereas with the use of increasing dosage of farm yard manure as a source for nitrogen, the total phenolic content also increased. Variation in the phenolic content of the trees under different treatments can be due to nitrogen stress. The changes in the phenolic composition, mainly related to nitrogen stress are consistent with the carbon/nutrient balance hypothesis. Under stress, a decline in the acquisition of a resource produces a change in the C: N ratio that corresponds with a change in the balance of chemical compounds. Both leaf and fruit nutrient content corresponded to the sustained availability of the nutrients over a longer period of time.

Microbial population in Kinnow rhizosphere: Table 5 presents the findings on microbial populations in rhizosphere as affected by integrated nutrient management practices in Kinnow mandarin. Maximum *Azotobacter* population (28.6×10^6 cfu per gram soil) was

observed in T₉ (cent per cent nitrogen application through FYM augmented with *Azotobacter*) followed by 27.2×10^6 cfu per gram soil with the treatment comprising 75 per cent nitrogen as FYM and 25 per cent nitrogen as urea augmented with *Azotobacter* (T₈) while minimum *Azotobacter* population (5.7×10^6 cfu per gram soil) was observed in control (T₁₂). Maximum bacterial population (29.6×10^6 cfu per gram soil) was observed in T₉ (cent per cent nitrogen application through FYM augmented with *Azotobacter*) followed by 28.9×10^6 cfu per gram soil with the treatment comprising 75 per cent nitrogen as FYM and 25 per cent nitrogen as urea augmented with *Azotobacter* (T₈) while minimum bacterial population (7.1×10^6 cfu per gram soil) was observed in control (T₁₂). Maximum fungal population (26.1×10^5 cfu per gram soil) was observed in T₉ (cent per cent nitrogen application through FYM augmented with *Azotobacter*) followed by 24.3×10^5 cfu per gram soil with the treatment comprising 75 per cent nitrogen as FYM and 25 per cent nitrogen as urea augmented with *Azotobacter* (T₈) while minimum fungal population (3.7×10^5 cfu per gram soil) was observed in control (T₁₂).

Higher microbial population was observed at lower levels of inorganic nitrogen which may be due to the fact that organic matter serves as an energy source for growth and multiplication in the soil (Mandal, 2013). Mir *et al.* (2015) also reported a significant increase in soil microbial biomass of the rhizosphere soil with the conjoint application of organic manures, inorganic manures and biofertilizers as compared to control and only inorganic fertilizer treatments.

The research findings on integrated nutrient management in Kinnow mandarin revealed that 25 per cent of inorganic nitrogen can be replaced through well rotten Farm Yard Manure along with augmentation of *Azotobacter*. It not only produces a comparable growth, yield and quality of fruits vis-à-vis inorganic fertilization but also enhances the soil health by promoting the soil microbial population in the rhizosphere. The nutrient dynamics in the plant also showed improvement as compared to all other treatments that were incorporated in the study.

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Table-1: Effect of FYM, urea alone and in combination with *Azotobacter* on vegetative characters in Kinnow mandarin

Treatments	Increase in plant height (%)	Increase in plant spread (%)		Increase in canopy volume(%)
		NS	EW	
T ₁	12.28 ^f	10.48 ^{ef}	11.07 ^e	35.66 ^{ef}
T ₂	10.58 ^{de}	8.69 ^{cd}	10.30 ^e	31.67 ^{de}
T ₃	10.05 ^{de}	8.19 ^{bcd}	8.86 ^{cd}	28.53 ^{cd}
T ₄	9.29 ^{cd}	7.47 ^{bc}	8.21 ^{bc}	21.94 ^b
T ₅	12.74 ^f	12.54 ^g	12.94 ^f	38.22 ^{de}
T ₆	12.39 ^f	12.37 ^g	12.66 ^f	35.79 ^{bc}
T ₇	10.98 ^e	10.97 ^f	11.10 ^e	33.11 ^{ab}
T ₈	9.62 ^{cd}	9.45 ^{de}	9.94 ^{de}	23.44 ^{ab}
T ₉	8.39 ^{bc}	7.88 ^{bc}	7.62 ^{abc}	21.63 ^{ab}
T ₁₀	7.70 ^b	7.07 ^{ab}	7.32 ^{ab}	20.44 ^f
T ₁₁	7.21 ^{ab}	6.86 ^{ab}	6.87 ^{ab}	18.93 ^{ef}
T ₁₂	6.20 ^a	5.85 ^a	6.15 ^a	16.15 ^a

Table-2: Effect of FYM, urea and *Azotobacter* on physical characteristics and yield of Kinnow mandarin fruit

Treatments	Fruit length (cm)	Fruit width (cm)	Peel thickness (cm)	Fruit weight (g)	Fruit volume (cc)	Specific gravity	No. of fruits per plant	Yield (kg/plant)
T ₁	5.41 ^d	6.09 ^e	0.49 ^d	176.00 ^h	177.67 ^g	0.99 ^{cd}	121.67 ^g	21.41 ^f
T ₂	5.58 ^g	6.25 ^g	0.52 ^{fg}	176.62 ^{gh}	178.33 ^g	0.99 ^{cd}	118.83 ^f	20.99 ^f
T ₃	5.45 ^e	6.17 ^f	0.50 ^e	167.73 ^f	169.83 ^e	0.99 ^c	114.17 ^e	19.15 ^e
T ₄	5.37 ^c	5.93 ^d	0.48 ^d	159.77 ^d	162.00 ^c	0.99 ^c	111.17 ^d	17.76 ^d
T ₅	5.67 ^h	6.38 ^h	0.54 ^{hi}	183.45 ⁱ	182.17 ^h	1.01 ^e	149.00 ⁱ	27.33 ^h
T ₆	5.72 ⁱ	6.44 ⁱ	0.53 ⁱ	186.40 ⁱ	186.00 ^h	1.00 ^e	157.17 ^j	29.08 ⁱ
T ₇	5.64 ^h	6.35 ^h	0.53 ^{gh}	172.10 ^g	172.50 ^f	1.00 ^{de}	132.00 ^h	22.71 ^g
T ₈	5.51 ^f	6.21 ^g	0.52 ^f	164.90 ^e	165.00 ^d	1.00 ^{de}	114.67 ^e	18.91 ^e
T ₉	5.41 ^d	6.04 ^e	0.48 ^d	153.95 ^c	153.50 ^b	1.00 ^e	112.33 ^{de}	17.30 ^d
T ₁₀	5.31 ^b	5.84 ^c	0.47 ^c	152.07 ^{bc}	154.17 ^b	0.99 ^c	107.33 ^c	16.32 ^c
T ₁₁	5.30 ^b	5.63 ^b	0.46 ^b	151.42 ^b	155.67 ^b	0.97 ^b	101.67 ^b	15.40 ^b
T ₁₂	5.06 ^a	5.31 ^a	0.43 ^a	146.40 ^a	152.83 ^a	0.96 ^a	97.67 ^a	14.30 ^a

Table-3: Effect of FYM, urea and *Azotobacter* on chemical characteristics of Kinnow mandarin

Treatments	TSS (°Brix)	Titratable acidity (%)	TSS/Acid ratio	Total Sugars (%)	Reducing sugars (%)	Non- Reducing Sugars (%)	Ascorbic acid (mg/100g of pulp)	Juice content (%)	Total polyphenol content (mg GAE per 100 ml of juice)	pH
T ₁	10.68 ^c	0.75 ^d	14.34 ^b	5.64 ^{de}	2.57 ^b	2.92 ^{de}	24.17 ^j	53.26 ^j	54.81 ^{bcd}	4.45 ^{fg}
T ₂	10.85 ^d	0.71 ^b	15.28 ^e	5.86 ^g	2.65 ^e	3.05 ^{fg}	24.46 ⁱ	52.27 ⁱ	55.36 ^{cd}	4.42 ^f
T ₃	11.00 ^e	0.71 ^b	15.49 ^f	5.71 ^f	2.61 ^c	2.94 ^e	24.81 ^g	51.34 ^g	59.84 ^{ef}	4.15 ^{bc}
T ₄	10.72 ^c	0.70 ^a	15.42 ^{ef}	5.66 ^e	2.62 ^{cd}	2.88 ^{cd}	25.11 ^e	49.98 ^e	59.75 ^{ef}	4.20 ^c
T ₅	11.22 ^f	0.76 ^e	14.86 ^c	5.82 ^g	2.58 ^b	3.09 ^g	24.40 ^h	53.78 ^k	53.53 ^{ab}	4.57 ^d
T ₆	11.37 ^g	0.73 ^c	15.68 ^g	5.92 ^h	2.81 ^h	2.95 ^e	24.99 ^f	54.22 ^k	52.61 ^a	4.53 ^b
T ₇	11.43 ^g	0.73 ^c	15.77 ^g	5.85 ^g	2.69 ^f	3.00 ^f	25.90 ^d	51.73 ^h	54.21 ^{bc}	4.48 ⁱ
T ₈	11.13 ^f	0.71 ^b	15.68 ^g	5.71 ^f	2.70 ^g	2.86 ^{bc}	26.72 ^c	50.26 ^f	56.04 ^d	4.27 ^{hi}
T ₉	10.50 ^b	0.71 ^b	14.79 ^c	5.61 ^{cd}	2.72 ^g	2.74 ^a	26.76 ^b	48.55 ^d	58.70 ^e	4.33 ^{gh}
T ₁₀	10.47 ^b	0.70 ^a	15.02 ^d	5.60 ^c	2.64 ^{de}	2.81 ^b	25.89 ^k	48.39 ^c	60.44 ^{fg}	4.27 ^d
T ₁₁	10.47 ^b	0.73 ^c	14.44 ^b	5.55 ^b	2.57 ^b	2.83 ^b	23.18 ^k	46.97 ^b	60.94 ^{fg}	4.13 ^e
T ₁₂	10.15 ^a	0.73 ^c	13.90 ^a	5.39 ^a	2.53 ^a	2.71 ^a	21.13 ^a	45.80 ^a	61.45 ^g	3.93 ^a

Table-4: Effect of FYM, urea and *Azotobacter* on leaf and fruit nutrient content of Kinnow mandarin

Treatments	Leaf nutrients(% Dry Weight)					Fruit nutrients(% Dry Weight)				
	N	P	K	Ca	Mg	N	P	K	Ca	Mg
T ₁	2.50 ^f	0.11 ^b	1.45 ^{cd}	4.25 ^{gh}	0.37 ^{bc}	0.05 ^{ef}	0.020 ^c	0.070 ^c	0.033 ^c	0.022 ^c
T ₂	2.49 ^f	0.12 ^b	1.47 ^e	4.24 ^{tgh}	0.38 ^c	0.04 ^{de}	0.021 ^d	0.073 ^d	0.033 ^c	0.022 ^c
T ₃	2.46 ^e	0.12 ^{bc}	1.49 ^f	4.14 ^e	0.39 ^c	0.04 ^{cd}	0.021 ^d	0.076 ^e	0.033 ^c	0.022 ^c
T ₄	2.36 ^c	0.12 ^c	1.52 ^{gh}	4.00 ^d	0.37 ^{bc}	0.04 ^{bc}	0.019 ^b	0.076 ^e	0.033 ^c	0.022 ^c
T ₅	2.55 ^h	0.17 ^d	1.46 ^{de}	4.29 ^h	0.44 ^d	0.06 ^{fg}	0.022 ^f	0.082 ^g	0.035 ^d	0.024 ^d
T ₆	2.56 ^h	0.18 ^d	1.51 ^g	4.24 ^{tgh}	0.44 ^d	0.06 ^h	0.024 ^h	0.087 ^h	0.035 ^d	0.024 ^d
T ₇	2.52 ^g	0.17 ^d	1.53 ^h	4.18 ^{ef}	0.44 ^d	0.05 ^g	0.022 ^g	0.091 ^k	0.033 ^c	0.024 ^d
T ₈	2.40 ^d	0.13 ^c	1.52 ^g	4.20 ^{fg}	0.43 ^d	0.04 ^{de}	0.022 ^f	0.090 ^j	0.032 ^b	0.021 ^b
T ₉	2.37 ^c	0.12 ^{bc}	1.51 ^{gh}	3.92 ^c	0.44 ^d	0.04 ^{cde}	0.021 ^e	0.089 ⁱ	0.035 ^d	0.024 ^d
T ₁₀	2.33 ^b	0.12 ^c	1.45 ^{bc}	3.91 ^c	0.37 ^c	0.03 ^b	0.019 ^c	0.078 ^f	0.032 ^d	0.022 ^c
T ₁₁	2.33 ^b	0.11 ^b	1.44 ^b	3.78 ^b	0.34 ^b	0.03 ^b	0.018 ^b	0.066 ^b	0.032 ^{bc}	0.022 ^c
T ₁₂	2.29 ^a	0.09 ^a	1.39 ^a	3.37 ^a	0.26 ^a	0.02 ^a	0.015 ^a	0.060 ^a	0.026 ^a	0.018 ^a

Table-5: Effect of urea, FYM alone and in combination with *Azotobacter* on microbial population in rhizosphere of Kinnow mandarin

stnemtaerT	<i>Azotobacter</i> counts (x 10⁶ cfu)	Bacterialcounts (x 10⁶ cfu)	Fungalcounts (x 10⁵ cfu)
T ₁	10.0 ^b	11.7 ^b	10.7 ^b
T ₂	11.2 ^c	12.7 ^c	12.1 ^c
T ₃	12.2 ^d	13.4 ^{cd}	12.8 ^d
T ₄	13.8 ^e	13.8 ^{de}	14.9 ^e
T ₅	20.5 ^g	15.6 ^f	19.7 ^g
T ₆	24.6 ^h	25.5 ^g	22.0 ^h
T ₇	26.3 ⁱ	27.3 ^h	22.7 ⁱ
T ₈	27.2 ^j	28.9 ⁱ	24.3 ^j
T ₉	28.6 ^k	29.6 ⁱ	26.1 ^k
T ₁₀	15.2 ^f	14.3 ^e	15.3 ^e
T ₁₁	20.6 ^g	15.8 ^f	19.1 ^f
T ₁₂	5.7 ^a	7.1 ^a	3.7 ^a