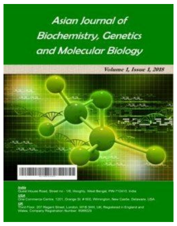

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Mitotic Studies and Genotoxic Assessment of Edible Nigerian Aroids to Selected Oilfield Chemicals

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Authors' contributions

This work was carried out in collaboration between all authors. All the authors participated fully in conducting this research work. They also read and approved the final manuscript.

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ABSTRACT

The genotoxic potentials of two water-based oilfield chemicals on edible aroids were investigated. Five accessions of *Colocasia eculenta* and three accessions of *Xanthosoma maffafa* were exposed to graded concentrations of sodium azide and potassium chromate; while the accessions without any chemical additive were used as controls. Results revealed that the peak periods of cell division were recorded between 12:00 noon to 4:00 pm in both the treated and control accessions. Metaphase cells increased after prophase cells and continued mostly between 10.00 am and 4.00 pm. Variations observed with the treatments included: shifts of metaphase peaks, high percentages of prophase cells, high intensity of cytoplasmic staining and induction of micronuclei among others. Sodium azide was observed to be a stronger genotoxic substance than potassium chromate. Accession NCe 001 had the highest survival rate while NCe 002 recorded the least rate of survival. Statistical evidence revealed that the difference in various mitotic stages and time of harvest between different accessions and treatments was significant at both 5% and 1%. The study provides useful information that would be used to promote cytogenetic researches as well as the exploitation and improvement of this neglected and underexploited economic plant.

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Keywords: Prophase; metaphase; anaphase; telophase; control; treatment; sodium azide; potassium chromate.

1. INTRODUCTION

Cocoyam belongs to the Areceae family; Araceae family is predominantly tropical and sub-tropical in distribution. In Nigeria, the widely cultivated Aroids are *Colocasia* (taro) and *Xanthosoma* (tannia) and have remained relevant as source of food because of its edible corms and cormels. It is one of the most nutritious known root tubers [1,2], has economic value [3] and act as raw material for biofuel production [4,5]. Inspite of these invaluable attributes of this plant species, cocoyam research has received little attention from scholars; this has led to scarce literature and database on this plant. The cocoyam being a root tuber and mostly cultivated in the South-south and South-eastern parts of the country where oil exploration and production activities take place make them prone to oil-related contamination therefore, safety and health concerns arise. To address these concerns, cytogenetic studies need to be carried out on this plant to determine the reactions of their genes to these chemicals. Cytogenetics studies involving this plant species is still at its primary stage and to the best of our knowledge, the only cytogenetic information on this plant species in Nigeria are the ones from [6,7] hence the need for this present study.

Environmental pollution is a problem associated with oil exploration and production activities; drilling operations can introduce oil and a wide range of other complex chemical compounds into the environment through drilling fluids and muds [8]. The introduction of these chemicals into the environment destroys the biological and chemical composition of the soil; this results in growth disturbances and morphogenesis of plants in that [9]. The root systems of plants are usually the first target of any environmental pollution [10], to this end, many scholars have used cytological examinations to study the cytotoxicity potentials of many chemical compounds [11,12]. Sodium azide and potassium chromate are water-based chemicals also used in drilling operations. Mitotic activity studies of some plant species have been carried out by some authors [6,13] to identify the proliferation of cells in their root tips and to identify the right time for root stock harvest for cytological assessments. Recently, study carried out by Willie and Aikpokpodion [14] opined that mitotic indexing can be used to identify differences in cell division when there is a shift in environmental parameter.

It is therefore against this background that this study was structured to identify any difference in the mitotic activities of *Colocasia esculenta* and *Xanthosoma maffafa* accessions exposed to sodium azide and potassium chromate. The genotoxic potentials of these chemicals will also be investigated; data generated is expected to be used to revamp the cytogenetic research and exploitation of this plant.

2. MATERIALS AND METHODS

3 accessions of *Xanthosoma maffafa* (NXs 001, NXs 002 and NXs 003) and 5 accessions of *Colocasia esculenta* (NCe 001, NCe 002, NCe 003, NCe 004 and NCe 005) were identified and collected from the National Root Crops Research Institute (NRCRI), Umudike; NXs stands for Nigeria *Xanthosoma* species while NCe stands for Nigeria *Colocasia esculenta.* The corms of *Xanthosoma* and cormels of *Colocasia* were planted in plastic pots containing 1:1 mixture of saw dust and paper mash. Each accession was exposed to four (4) different concentrations (5, 10, 15 and 20 mg) of sodium azide and potassium chromate while the control experiment was not exposed to any oilfield chemical treatment.

The chemical mixture was thoroughly dissolved in 400 ml of water and applied on the plants immediately after planting. The same mixture was freshly prepared and used in irrigating the plants once every week for one month. Fresh roots from the control and treated accessions were harvested two-hourly intervals starting from 6.00 am to 6.00 pm. The roots were immediately fixed in 3:1 ethanol-acetic acid for 24 hours and preserved in 70% ethanol pending squashing. The roots were hydrolyzed in 0.5 M aqueous HCl (for 4 to 5 minutes) in a watch glass, the hydrolyzed roots were cut off unto clean slides and squashed in a drop of FLP-orcein [15]. Prepared slides were microscopically examined; micrographs were taken with a photomicroscope to reveal different mitotic stages. Numbers of dividing cells at different levels of mitosis were recorded. Mitotic index for each root collection time was calculated using this formula:

$$\frac{\text{Number of dividing cells} \times 100}{\text{Total number of cells}}$$

Generated data were subjected to Microsoft Excel two-way analysis of variance (ANOVA) and the means were compared using the Duncan's multiple range test (DMRT) at 5%.

3. RESULTS

Obtained results revealed active mitotic activities within the time under consideration (6:00 am to 6:00 pm). In both the control and treated accessions, cells at the interphase mitotic stage were the most populous, followed by the cells in the prophase and telophase mitotic stages (Table 1). In the control accessions, the rise in the number of anaphase cells was after the rise in the number of metaphase cells in all the accessions except in accessions, NCe 005 and NXs 001. Cells in the metaphase and anaphase mitotic stages were the least in population when compared to other mitotic stages, but they were considered most important because they represent the peak periods of active cellular divisions. Metaphase cells increased after prophase cells and continued mostly between 12:00 noon and 4:00 pm. The control samples of accessions NCe 001, NCe 005 and NXs 001 had their metaphase peaks at 12:00 noon. Accession NCe 002, NCe 003 and NCe 004 had their metaphase peaks at 4:00 pm while accession NXs 002 and NXs 003 had their peaks at 2 pm. In NCe 001, the chemical treatments shifted the metaphase peak to 2:00 pm (10 and 20 mg of sodium azide treatments and 5, 10 and 15 mg of potassium chromate treatments) and 4:00 pm (20 mg of potassium chromate treatment) while 5 mg of sodium azide treatment did not alter the peak of metaphase cells in this accession. The metaphase peak of NCe 002 was shifted to 2:00 pm by 15 mg of potassium chromate treatment. Treatment with 10 mg of potassium chromate shifted the metaphase peak of NCe 003 to 2:00 pm. In NCe 004, the metaphase peak was shifted to 2:00 pm by 20 mg of sodium azide and 15 mg of potassium chromate treatments. The metaphase peak of NCe 005 was shifted to 2:00 pm by 10 mg of sodium azide and 5 and 10 mg of potassium chromate treatments. Only 20 mg of potassium chromate treatment was observed to shift the metaphase peak of NXs 001 to 2:00 pm. The chemical treatments however, did not alter the metaphase peak of NXs 002. Concentrations 5 and 10 mg of potassium chromate changed the metaphase peak of NXs 003 to 12:00 noon and 4:00 pm respectively. Statistical analysis showed significant effects of time of harvest and treatments on the mitotic activities of the accessions (Table 3).

It appeared that there was a synchrony in the pattern of increase and decrease of cells in each mitotic stage. From observations, it appeared that as interphase cells increased prophase cells decreased; a leap in interphase cells was observed from 6:00 pm and 6:00 am. It appeared however, that during the night there was proliferation of interphase cells. Prophase cells increased towards the evenings and most of the cells were recorded around 6:00 am to 12:00 noon. Metaphase and anaphase cells increased *in tandem*; as it was observed that as metaphase increased, anaphase also increased. More metaphase and anaphase cells were observed around 2:00 pm to 4:00 pm. Telophase cells increased after metaphase cells; further scrutiny revealed that as metaphase cells increased, telophase cells decreased. Telophase peak was observed between 8:00 am to 2:00 pm (Appendix A-1 to A-7).

Comparison between different mitotic stages of the controls showed that NCe 001 had the highest number of cells in the prophase, metaphase and telophase stages while NCe 005 had the highest number of cells in the interphase and anaphase stages. Table 1 showed how the chemical treatments affected different accession's total number of cells at each mitotic stage in relation to their respective controls. Statistical evidence also revealed that the differences in various mitotic stages between different accessions and treatments were significant at both 5% and 1% (Table 2).

For both control and treated accessions, cytoplasmic staining was observed but the intensity of the staining was more on the treated accessions than at the control accessions. Potency evaluation of sodium azide and potassium chromate revealed that sodium azide was a stronger genotoxin than potassium chromate as all the accessions generally reacted poorly to sodium azide treatments. 20 mg of sodium azide treatment proved very lethal as no accession survived in this concentration. The lethal quotient of these oilfield chemicals was calculated using the growth inhibition potential of the chemicals; sodium azide had a lethal quotient of 68.75% while potassium chromate had a lethal quotient of 18.75%. Germination rates assessment of different accessions to sodium azide and potassium chromate treatments revealed that NCe 001 had the highest germination rate of 87.5% while NCe 002 and NXs 002 had the least germination rates of 25%.

The widely observable chromosomal abnormality in this study was the induction of micronuclei by the chemical treatments (Plate 2 a and b); the presence of ghost cells was only observed in accession, NCe 002 treated with 5 mg of potassium chromate at 10:00 am (Plate 2c).

Table 1. Effects of oilfield chemicals on the total number of cells at different mitotic stages in different cocoyam accessions

Treatment	Mitotic stage	Accessions							
		NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control	Interphase	1146	1369	1217	631	1563	1034	991	612
	Prophase	417	361	410	296	388	380	409	320
	Metaphase	76	72	64	55	62	55	60	68
	Anaphase	64	48	59	37	69	62	58	52
	Telophase	137	121	113	110	134	76	100	111
Sodium azide 5	Interphase	1491	0	0	0	1700	1221	1318	936
	Prophase	340	0	0	0	367	247	347	277
	Metaphase	16	0	0	0	46	47	56	38
	Anaphase	28	0	0	0	60	43	51	49
	Telophase	117	0	0	0	150	124	187	174
Sodium azide 10	Interphase	1503	0	0	0	1746	0	0	1008
	Prophase	376	0	0	0	268	0	0	214
	Metaphase	17	0	0	0	44	0	0	45
	Anaphase	18	0	0	0	51	0	0	36
	Telophase	109	0	0	0	162	0	0	143
Sodium azide 15	Interphase	0	0	0	0	0	0	0	0
	Prophase	0	0	0	0	0	0	0	0
	Metaphase	0	0	0	0	0	0	0	0
	Anaphase	0	0	0	0	0	0	0	0
	Telophase	0	0	0	0	0	0	0	0
Sodium azide 20	Interphase	1860	0	0	1658	0	0	0	0
	Prophase	355	0	0	235	0	0	0	0
	Metaphase	10	0	0	31	0	0	0	0
	Anaphase	13	0	0	31	0	0	0	0
	Telophase	100	0	0	132	0	0	0	0
Potassium chromate 5	Interphase	1415	1725	1621	1295	1628	1440	1207	1287
	Prophase	389	321	268	316	223	264	315	309
	Metaphase	10	24	33	49	29	42	36	31
	Anaphase	13	29	30	34	32	45	41	44
	Telophase	100	98	152	119	120	149	153	141
Potassium chromate 10	Interphase	1499	0	1861	1442	2008	0	1158	1024
	Prophase	290	0	302	294	224	0	320	257
	Metaphase	12	0	18	50	46	0	32	34
	Anaphase	17	0	23	51	41	0	42	33
	Telophase	97	0	76	144	146	0	184	159
Potassium chromate 15	Interphase	1594	1562	1695	1553	1968	0	0	1188
	Prophase	360	343	336	323	206	0	0	257
	Metaphase	15	23	27	27	27	0	0	36
	Anaphase	20	24	31	37	28	0	0	53
	Telophase	120	97	125	113	121	0	0	133
Potassium chromate 20	Interphase	1725	0	1953	1614	0	1500	1971	1255
	Prophase	323	0	315	285	0	229	201	302
	Metaphase	16	0	22	38	0	46	17	49
	Anaphase	16	0	40	39	0	37	26	42
	Telophase	77	0	98	135	0	148	123	131

Table 2. Analysis of variance on the effects of different treatments on the mitotic stages of various accessions

Sources of variation	df	MS	F-value
Treatments/mitotic stages	35	65645.8	15.47**
Accessions	7	17844.94	4.21**
Error	45	4243.325	
Total	287		

***indicate significance at P=0.05 and P=0.01*

Table 3. Analysis of variance on the effects of treatments and time of harvest on different accessions

Sources of variation	df	MS	F-value
Treatments	8	39966.7	54.13**
Time of harvest/accessions	55	2213.862	3.11 **
Error	440	738.3883	
Total	503		

***indicate significance at P=0.05 and P=0.01*

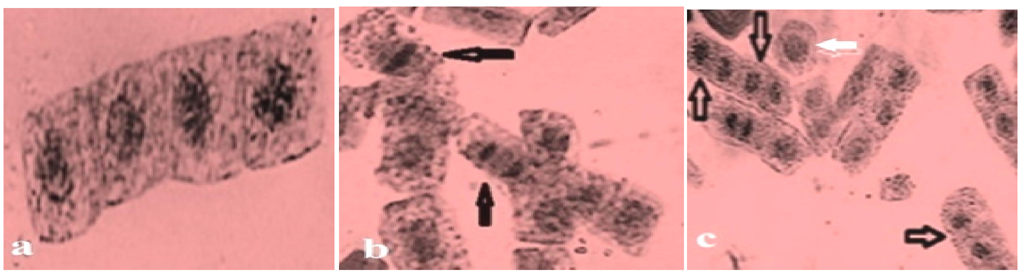

Plate 1. Different mitotic stages of the control

(a) Prophase cells, (b) Metaphase cell (left arrow), Anaphase cell (up arrow), (c) Telophase cells (black arrows), interphase cell (white arrow) [All captured at X40 magnification]

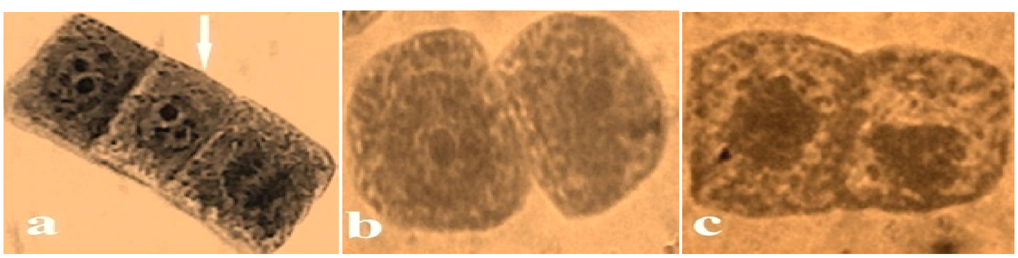

Plate 2. Chromosomal aberrations

a) Micronucleus (white arrow), (b) Micronucleus with deep cytoplasmic staining, (c) Ghost cells in NCe 002 treated with 5 mg of potassium chromate [All captured at X 40 magnification]

4. DISCUSSION

Mitotic activities in plants take place when cells divide during growth and development. Mitotic indexing in plants is therefore used in assessing the proliferation capabilities of cells and tracking any abnormal cell division caused by a change in environmental conditions [14]. Peak periods of cellular divisions recorded between 12:00 noon to 4:00 pm in both treated and control accessions are in line with the findings of Ekanem and Osuji [6], Osuji and Owei [13] and Willie and Aikpokpodion [14]; they agreed that within this time frame, there is high proliferation of cells, accelerated metabolic activities and growth because most plants are at their photosynthetic climax influenced by the availability of sufficient sunlight that triggers the synthesis of energy in the form of ATP.

The shift of metaphase peaks by the chemical treatments two to four hours before or after the metaphase peak of the controls depicts these two chemicals as subtle genotoxic substances as these shifts were still within the limit of the natural cause of event (photosynthetic activity). Sodium azide and potassium chromate though considered subtle affected the percentage of the most active stages of mitosis (metaphase and anaphase stages); this indicates that any chemical additive has a negative effect on plant and the environment even if there is no phenotypic representation of such effect. The ability of the cells of these accessions to proliferate in different mitotic stages even in the midst of high concentrations of these oilfield chemicals affirms the assertion that each of these accessions reacts in a unique way to different environmental conditions [7].

High percentages of prophase cells in the treated accessions are directly associated with the inhibitory properties of the test chemicals. Similar results were reported by Elezaj *et al*. [16] and Udo et al. [17]; Elezaj et al. [16] attributed the phenomenon to prophase-arrest; this is where cells enter into mitosis but are arrested during prophase resulting in a high frequency of prophase cells causing a decline in cell aberrations, without any parallel decline in the mitotic index values.

Cytoplasmic staining was also reported in *Musa sp*. [18], *Xanthosoma* and *Colocasia spp*. [6], *Treculia africana* [13]; they suggested that cytoplasmic staining is caused by the diffusion of some nuclear contents and the release of chromatin- associated structures into the cytoplasm. High intensity of cytoplasmic staining observed in the treated accessions means that the chemicals profusely released chromatin-associated structures into the cytoplasm.

Sodium azide is a chemical mutagen if used in small quantity induces variability in plants during breeding programs [19,20,21]. The negative effects of this chemical on the accessions could be that an elevated quantity was applied to the accessions; this triggered the arrest of auxin metabolism and carriers which increased the cross-linking of pectin in the middle lamellae. Cross-linking is believed to be responsible for the inhibition of cell expansion and growth which directly or indirectly affect auxin metabolism and carriers hence, causing a decrease in growth, survival and yield of several crops [22].

The induction of micronuclei is a genotoxic aberration that has been widely reported in *Lens culinaris* [23], *Tradescantia pallida* [16], *Allium cepa* [24], *Vigna unguiculata* [22] and in *Vicia faba* [12]. Micronucleus formation is said to be the characteristic behaviour of laggard chromosomes that fail to incorporate into either of the daughter nuclei during telophase of the mitotic cells [25]. Ismail and Morsi [12] affirmed that micronucleus analysis is one of the most economical, quickest and most effective ways of determining the genotoxicity of different chemicals.

The observation of ghost cells as reported in this work is not new as this phenomenon was first reported by Fatemeh and Khosro [24]; they described it as dead cells with visible outline but with unstainable nucleus and cytoplasmic structures. In their study, they observed the presence of this cell with a high concentration of the root extract of *Arctium lappa* on *Allium cepa*. However in this study, the presence of these ghost cells was observed with the least concentration of potassium chromate in accession, NCe 002. This is not surprising as this particular accession was observed to be very weak and had poor germination quotient. According to Adegbite and Sanyaolu [26], the presence of aberrant cells indicates the genotoxic potential of any substance.

5. CONCLUSION

These observations suggest that these two chemicals have cytotoxic effects on cocoyam species; the arrest of cell division by these chemicals further induced micronuclei formation in all the treated accessions. It can therefore be affirmed that these chemicals have both cytotoxic and genotoxic effects on cocoyam species; therefore, careful handling of these chemicals must be stressed in order to ensure the safety of our environment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Table A-1. Effects of sodium azide and potassium chromate on the mitotic index of cocoyam accessions at 6:00 am

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control		Interphase	70.03^{b}	79.93^{b}	75.57^{b}	68.97^{b}	78.29^{b}	79.08^{b}	75.69^{b}	71.13^{b}
		Prophase	20.88^{dk}	13.16^{dk}	16.41^{dk}	17.24^{dk}	17.14^{dk}	17.57^{dk}	19.27^{dk}	19.72^{dk}
		Metaphase	0.67^{g}	0^{g}	0.38^{g}	2.3^{g}	0.29^{g}	0^{g}	0.46^{g}	0^{g}
		Anaphase	1.68^{g}	0.33^{g}	1.15^{g}	0^{g}	1.43^{g}	0.84^{g}	0.92^{g}	0^{g}
		Telophase	6.73^{fm}	6.58^{fm}	6.49^{fm}	11.49^{fm}	2.86^{fm}	2.51^{fm}	3.67^{fm}	9.15^{fm}
Sodium azide	5	Interphase	75.25^{c}	0^{c}	0^{c}	0^{c}	81.36^{c}	81.4^{c}	78.78^{c}	72.86^{c}
		Prophase	20.34^{fm}	0^{fm}	0^{fm}	0^{fm}	13.56^{fm}	13.64^{fm}	14.39^{fm}	0.48^{fm}
		Metaphase	0^{g}	0^{g}	0^{g}	0^{g}	0.56^{g}	0.83^{g}	0.72^{g}	0.48^{g}
		Anaphase	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0.41^{g}	1.08^{g}	0.95^{g}
		Telophase	4.41^{gm}	0^{gm}	0^{gm}	0^{gm}	4.52^{gm}	3.72^{gm}	5.04^{gm}	10.48^{gm}
	10	Interphase	79.88^{d}	0^{d}	0^{d}	0^{d}	85.25^{d}	0^{d}	0^{d}	89.56^{d}
		Prophase	19.24^{gm}	0^{gm}	0^{gm}	0^{gm}	8.74^{gm}	0^{gm}	0^{gm}	8.24^{gm}
		Metaphase	0^{g}	0^{g}	0^{g}	0^{g}	0.27^{g}	0^{g}	0^{g}	0^{g}
		Anaphase	0^{g}	0^{g}	0^{g}	0	0.82^{g}	0^{g}	0^{g}	0^{g}
		Telophase	0.87^{g}	0^{g}	0^{g}	0^{g}	4.92	0^{g}	0^{g}	2.2^{g}
	15	Interphase	89.53^{dk}	0^{dk}	0^{dk}	90.57^{dk}	0^{dk}	0^{dk}	0^{dk}	0^{dk}
		Prophase	9.09^{g}	0^{g}	0^{g}	6.29^{g}	0^{g}	0^{g}	0^{g}	0^{g}
		Metaphase	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}
		Anaphase	0^{g}	0^{g}	0^{g}	0.31^{g}	0^{g}	0^{g}	0^{g}	0^{g}
		Telophase	1.38^{g}	0^{g}	0^{g}	2.83^{g}	0^{g}	0^{g}	0^{g}	0^{g}
	20	Interphase	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}
		Prophase	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}
		Metaphase	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}
		Anaphase	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}
		Telophase	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}	0^{h}
Potassium chromate	5	Interphase	82.27^{a}	87.76^{a}	85.85^{a}	80.43^{a}	93.13^{a}	80.91^{a}	83.2^{a}	78.78^{a}
		Prophase	17.38^{el}	10.75^{el}	7.72^{el}	15.22^{el}	6.25^{el}	12.94^{el}	15.57^{el}	13.88^{el}
		Metaphase	0^{g}	0^{g}	0.32^{g}	0.87^{g}	0^{g}	0.65^{g}	0^{g}	0^{g}
		Anaphase	0^{g}	0^{g}	0.96^{g}	0^{g}	0^{g}	1.29^{g}	0^{g}	0.82^{g}
		Telophase	0.35^{fm}	1.49^{fm}	5.14^{fm}	3.48^{fm}	0.63^{fm}	4.21^{fm}	1.23^{fm}	6.53^{fm}

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
	10	Interphase	86.06^{b}	0^{b}	90.17^{b}	82.8^{b}	89.38^{b}	0^{b}	76.61^{b}	83.25^{b}
		Prophase	11.15^{fl}	0^{fl}	8.99^{fl}	12.19^{fl}	6.99^{fl}	0^{fl}	17.34^{fl}	12.44^{fl}
		Metaphase	0^{g}	0^{g}	0^{g}	1.08^{g}	0.52^{g}	0^{g}	0.4^{g}	0^{g}
		Anaphase	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0.48^{g}
		Telophase	2.79^{gm}	0^{gm}	0.84^{gm}	3.94^{gm}	3.11^{gm}	0^{gm}	5.65^{gm}	3.83^{gm}
	15	Interphase	83.66^{b}	84.87^{b}	83.74^{b}	85.71^{b}	93.6^{b}	0^{b}	0^{b}	81.86^{b}
		Prophase	12.96^{fl}	13.35^{fl}	12.47^{fl}	13.35^{fl}	5.52^{fl}	0^{fl}	0^{fl}	13.5^{fl}
		Metaphase	0^{g}	0.3^{g}	0.27^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0.42^{g}
		Anaphase	0.28^{g}	0^{g}	0.27^{g}	0^{g}	0^{g}	0^{g}	0^{g}	0.42^{g}
		Telophase	3.1^{gm}	1.48^{gm}	3.25^{gm}	0.93^{gm}	0.87^{gm}	0^{gm}	0^{gm}	3.8^{gm}
	20	Interphase	89.9^{b}	0^{b}	89.46^{b}	90.52^{b}	0^{b}	88.49^{b}	93.05^{b}	82.33^{b}
		Prophase	10.1^{tm}	0^{tm}	10^{tm}	7.34^{tm}	0^{tm}	6.58^{tm}	6.15^{tm}	16.87^{tm}
		Metaphase	0^{g}	0^{g}	0^{g}	0.31^{g}	0^{g}	0.33^{g}	0^{g}	0.4^{g}
		Anaphase	0^{g}	0^{g}	0^{g}	0.31^{g}	0^{g}	0.33^{g}	0^{g}	0^{g}
		Telophase	0^{g}	0^{g}	0.54^{g}	1.53^{g}	0^{g}	4.28^{g}	0.8^{g}	0.4^{g}

Values with different superscripted alphabets within column are significantly different at 5%

Table A-2. Effects of sodium azide and potassium chromate on the mitotic index of cocoyam accessions at 8:00 am

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control		Interphase	68.97^{l}	74.66^{l}	71.99^{l}	66.08^{l}	73.48^{l}	68.92^{l}	68.09^{l}	64.19^{l}
		Prophase	17.24^{er}	15.2^{er}	19.87^{er}	18.71^{er}	17.96^{er}	20.27^{er}	22.98^{er}	20.27^{er}
		Metaphase	1.03^{t}	1.01^{t}	0.65^{t}	2.34^{t}	0.83^{t}	0.9^{t}	1.7^{t}	2.03^{t}
		Anaphase	1.03^{t}	1.69^{t}	0.98^{t}	0.58^{t}	1.66^{t}	2.7^{t}	2.13^{t}	4.05^{t}
		Telophase	11.72^{nz}	7.43^{nz}	6.51^{nz}	12.28^{nz}	6.08^{nz}	7.21^{nz}	5.11^{nz}	9.46^{nz}
Sodium azide	5	Interphase	72.82^{p}	0^{p}	0^{p}	0^{p}	78.71^{p}	73.6^{p}	74.29^{p}	66.51^{p}
		Prophase	21.14^{nz}	0^{nz}	0^{nz}	0^{nz}	14.01^{nz}	15.6^{nz}	15.71^{nz}	16.75^{nz}
		Metaphase	0.34^{t}	0^{t}	0^{t}	0^{t}	0.56^{t}	1.6^{t}	1.07^{t}	1.91^{t}
		Anaphase	0.67^{t}	0^{t}	0^{t}	0^{t}	1.12^{t}	2.8^{t}	2.14^{t}	1.91^{t}
		Telophase	5.03^{tz}	0^{tz}	0^{tz}	0^{tz}	5.6^{tz}	6.4^{tz}	6.79^{tz}	12.92^{tz}
	10	Interphase	79.06^{er}	0er	0er	0er	82.07^{er}	0er	0er	85.56^{er}
		Prophase	16.88^{tz}	0^{tz}	0^{tz}	0^{tz}	9.24^{tz}	0^{tz}	0^{tz}	9.09^{tz}
		Metaphase	0.31^{t}	0^{t}	0^{t}	0^{t}	0.54^{t}	0^{t}	0^{t}	0^{t}
		Anaphase	0.31^{t}	0^{t}	0^{t}	0^{t}	1.36^{t}	0^{t}	0^{t}	0.53^{t}
		Telophase	3.44^{t}	0^{t}	0^{t}	0^{t}	6.79^{t}	0^{t}	0^{t}	4.81

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
	15	Interphase	84.47 ^{er}	0 ^{er}	0 ^{er}	86.98 ^{er}	0 ^{er}	0 ^{er}	0 ^{er}	0 ^{er}
		Prophase	13.08 ^{t}	0 ^{t}	0 ^{t}	7.62 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}
		Metaphase	0 ^{t}	0 ^{t}	0 ^{t}	0.63 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}
		Anaphase	0 ^{t}	0 ^{t}	0 ^{t}	0.32 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}
		Telophase	2.45 ^{t}	0 ^{t}	0 ^{t}	4.44 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}
	20	Interphase	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}
		Prophase	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}
		Metaphase	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}
		Anaphase	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}
		Telophase	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}
Potassium chromate	5	Interphase	80.2 ^{x}	85.71 ^{x}	83.01 ^{x}	75.1 ^{x}	87.19 ^{x}	78.32 ^{x}	78.75 ^{x}	77.42 ^{x}
		Prophase	17.75 ^{yv}	12.5 ^{yv}	8.97 ^{yv}	15.18 ^{yv}	7.81 ^{yv}	13.59 ^{yv}	17.08 ^{yv}	15.32 ^{yv}
		Metaphase	0 ^{t}	0 ^{t}	0.64 ^{t}	1.95 ^{t}	0 ^{t}	0.97 ^{t}	0.42 ^{t}	0 ^{t}
		Anaphase	0.34 ^{t}	0 ^{t}	0.96 ^{t}	1.17 ^{t}	0.94 ^{t}	1.62 ^{t}	0 ^{t}	1.21 ^{t}
		Telophase	1.71 ^{nz}	1.79 ^{nz}	6.41 ^{nz}	6.61 ^{nz}	4.06 ^{nz}	5.5 ^{nz}	3.75 ^{nz}	6.05 ^{nz}
	10	Interphase	82.47 ^{i}	0 ^{i}	88.1 ^{i}	78.69 ^{i}	86.05 ^{i}	0 ^{i}	71.98 ^{i}	78.67 ^{i}
		Prophase	13.06 ^{nv}	0 ^{nv}	9.63 ^{nv}	13.4 ^{nv}	8.27 ^{nv}	0 ^{nv}	17.51 ^{nv}	13.74 ^{nv}
		Metaphase	0 ^{t}	0 ^{t}	0 ^{t}	1.37 ^{t}	1.03 ^{t}	0 ^{t}	0.78 ^{t}	0.47 ^{t}
		Anaphase	0.34 ^{t}	0 ^{t}	0.28 ^{t}	1.72 ^{t}	0.52 ^{t}	0 ^{t}	1.56 ^{t}	1.42 ^{t}
		Telophase	4.12 ^{tz}	0 ^{tz}	1.98 ^{tz}	4.81 ^{tz}	4.13 ^{tz}	0 ^{tz}	8.17 ^{tz}	5.69 ^{tz}
	15	Interphase	82.51 ^{i}	82.1 ^{i}	83.38 ^{i}	84.66 ^{i}	90.8 ^{i}	0 ^{i}	0 ^{i}	82.33 ^{i}
		Prophase	12.54 ^{nv}	14.2 ^{nv}	9.62 ^{nv}	13.42 ^{nv}	6.32 ^{nv}	0 ^{nv}	0 ^{nv}	14.22 ^{nv}
		Metaphase	0 ^{t}	0.62 ^{t}	0.58 ^{t}	0 ^{t}	0.29 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}
		Anaphase	0.29 ^{t}	0.93 ^{t}	0.87 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}	0 ^{t}	1.72 ^{t}
		Telophase	4.66 ^{tz}	2.16 ^{tz}	5.54 ^{tz}	1.92 ^{tz}	2.59 ^{tz}	0 ^{tz}	0 ^{tz}	1.72 ^{tz}
	20	Interphase	86.55 ^{i}	0 ^{i}	87.2 ^{i}	85.63 ^{i}	0 ^{i}	83.22 ^{i}	90.86 ^{i}	78.95 ^{i}
		Prophase	11 ^{nz}	0 ^{nz}	10.67 ^{nz}	10 ^{nz}	0 ^{nz}	8.56 ^{nz}	6.72 ^{nz}	16.19 ^{nz}
		Metaphase	0 ^{t}	0 ^{t}	0 ^{t}	0.63 ^{t}	0 ^{t}	0.68 ^{t}	0 ^{t}	0.81 ^{t}
		Anaphase	0.24 ^{t}	0 ^{t}	0.27 ^{t}	0.94 ^{t}	0 ^{t}	1.03 ^{t}	0 ^{t}	1.21 ^{t}
		Telophase	2.2 ^{t}	0 ^{t}	1.87 ^{t}	2.81 ^{t}	0 ^{t}	6.51 ^{t}	2.42 ^{t}	2.83 ^{t}

Values with different superscripted alphabets within column are significantly different at 5%

Table A-3. Effects of sodium azide and potassium chromate on the mitotic index of cocoyam accessions at 10:00 am

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control		Interphase	61.39 ^{d}	70.77 ^{d}	63.71 ^{d}	61.4 ^{d}	70.75 ^{d}	62.45 ^{d}	61.25 ^{d}	47.44 ^{d}
		Prophase	18.92 ^{mr}	17.61 ^{mr}	24.32 ^{mr}	23.39 ^{mr}	17.61 ^{mr}	22.36 ^{mr}	25.42 ^{mr}	28.85 ^{mr}
		Metaphase	4.63 ^{s}	3.52 ^{s}	2.32 ^{s}	4.09 ^{s}	3.58 ^{s}	4.22 ^{s}	3.33 ^{s}	4.49 ^{s}
		Anaphase	3.86 ^{s}	2.82 ^{s}	2.7 ^{s}	2.34 ^{s}	2.39 ^{s}	5.06 ^{s}	2.92 ^{s}	4.49 ^{s}
		Telophase	11.2 ^{xq}	5.28 ^{xq}	6.95 ^{xq}	8.77 ^{xq}	5.67 ^{xq}	5.91 ^{xq}	7.08 ^{xq}	14.74 ^{xq}
Sodium azide	5	Interphase	72.38 ^{k}	0 ^{k}	0 ^{k}	0 ^{k}	76.54 ^{k}	75.3 ^{k}	67.94 ^{k}	63.13 ^{k}
		Prophase	18.88 ^{xq}	0 ^{xq}	0 ^{xq}	0 ^{xq}	15.92 ^{xq}	12.75 ^{xq}	18.12 ^{xq}	18.43 ^{xq}
		Metaphase	0.35 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	1.4 ^{s}	2.39 ^{s}	2.79 ^{s}	1.38 ^{s}
		Anaphase	1.4 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	1.4 ^{s}	1.59 ^{s}	2.79 ^{s}	2.3 ^{s}
		Telophase	6.99 ^{sq}	0 ^{sq}	0 ^{sq}	0 ^{sq}	4.75 ^{sq}	7.97 ^{sq}	8.36 ^{sq}	14.75 ^{sq}
	10	Interphase	69.31 ^{m}	0 ^{m}	0 ^{m}	0 ^{m}	80.86 ^{m}	0 ^{m}	0 ^{m}	75 ^{m}
		Prophase	22.41 ^{sq}	0 ^{sq}	0 ^{sq}	0 ^{sq}	11.43 ^{sq}	0 ^{sq}	0 ^{sq}	12 ^{sq}
		Metaphase	1.03 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	1.71 ^{s}	0 ^{s}	0 ^{s}	1 ^{s}
		Anaphase	1.03 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	1.14 ^{s}	0 ^{s}	0 ^{s}	2 ^{s}
		Telophase	6.21 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	4.86 ^{s}	0 ^{s}	0 ^{s}	9.5 ^{s}
	15	Interphase	78.64 ^{mr}	0 ^{mr}	0 ^{mr}	78.82 ^{mr}	0 ^{mr}	0 ^{mr}	0 ^{mr}	0 ^{mr}
		Prophase	16.91 ^{s}	0 ^{s}	0 ^{s}	11.21 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}
		Metaphase	5.34 ^{s}	0 ^{s}	0 ^{s}	1.25 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}
		Anaphase	0.59 ^{s}	0 ^{s}	0 ^{s}	1.56 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}
		Telophase	3.56 ^{s}	0 ^{s}	0 ^{s}	7.17 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}	0 ^{s}
	20	Interphase	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}
		Prophase	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}
		Metaphase	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}
		Anaphase	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}
		Telophase	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}	0 ^{p}
Potassium chromate	5	Interphase	71.6 ^{y}	81.14 ^{y}	78.03 ^{y}	68.78 ^{y}	81.09 ^{y}	76.95 ^{y}	71.98 ^{y}	71.48 ^{y}
		Prophase	21.79 ^{tc}	14.37 ^{tc}	11.15 ^{tc}	18.14 ^{tc}	10.9 ^{tc}	11.04 ^{tc}	18.29 ^{tc}	16.41 ^{tc}
		Metaphase	0.39 ^{s}	0.6 ^{s}	1.64 ^{s}	2.53 ^{s}	0.32 ^{s}	1.95 ^{s}	0.78 ^{s}	0.78 ^{s}
		Anaphase	0.39 ^{s}	0 ^{s}	1.31 ^{s}	2.11 ^{s}	1.6 ^{s}	2.6 ^{s}	1.95 ^{s}	1.95 ^{s}
		Telophase	5.84 ^{xq}	2.99 ^{xq}	7.87 ^{xq}	8.44 ^{xq}	6.09 ^{xq}	7.47 ^{xq}	7 ^{xq}	9.38 ^{xq}
	10	Interphase	78.09 ^{d}	0 ^{d}	82.51 ^{d}	76.22 ^{d}	82.46 ^{d}	0 ^{d}	72.11 ^{d}	66.17 ^{d}
		Prophase	14.13 ^{xc}	0 ^{xc}	12.24 ^{xc}	13.29 ^{xc}	5.5 ^{xc}	0 ^{xc}	15.94 ^{xc}	15.92 ^{xc}

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
		Metaphase	0.35^{s}	0^{s}	0.58^{s}	1.4^{s}	1.57^{s}	0^{s}	1.59^{s}	1.99^{s}
		Anaphase	0.71^{s}	0^{s}	1.17^{s}	2.45^{s}	2.09^{s}	0^{s}	1.2^{s}	2.99^{s}
		Telophase	6.71^{sq}	0^{sq}	3.5^{sq}	6.64^{sq}	8.38^{sq}	0^{sq}	9.16^{sq}	12.94^{sq}
	15	Interphase	73.26^{d}	71.76^{d}	77.94^{d}	78.9^{d}	84.73^{d}	0^{d}	0^{d}	74.39^{d}
		Prophase	18.32^{xc}	20.39^{xc}	13.82^{xc}	15.58^{xc}	9.8^{xc}	0^{xc}	0^{xc}	10.57^{xc}
		Metaphase	0.73^{s}	1.57^{s}	1.47^{s}	0.65^{s}	0.86^{s}	0^{s}	0^{s}	2.44^{s}
		Anaphase	0.73^{s}	1.57^{s}	1.47^{s}	0.97^{s}	0.86^{s}	0^{s}	0^{s}	2.85^{s}
		Telophase	6.96^{sq}	4.71^{sq}	5.29^{sq}	3.9^{sq}	3.75^{sq}	0^{sq}	0^{sq}	9.76^{sq}
	20	Interphase	82.12^{d}	0^{d}	82.89^{d}	80.31^{d}	0^{d}	77.03^{d}	87.5^{d}	74.42^{d}
		Prophase	14.85^{xq}	0^{xq}	12.83^{xq}	12.5^{xq}	0^{xq}	11.15^{xq}	8.72^{xq}	14.73^{xq}
		Metaphase	0^{s}	0^{s}	0.53^{s}	1.56^{s}	0^{s}	1.69^{s}	0.29^{s}	2.33^{s}
		Anaphase	0^{s}	0^{s}	1.07^{s}	0.31^{s}	0^{s}	1.35^{s}	0.58^{s}	2.71^{s}
		Telophase	3.03^{s}	0^{s}	2.67^{s}	5.31^{s}	0^{s}	8.78^{s}	2.91^{s}	5.81^{s}

Values with different superscripted alphabets within column are significantly different at 5%

Table A-4. Effects of sodium azide and potassium chromate on the mitotic index of cocoyam accessions at 12:00 noon

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control		Interphase	51.79^{p}	65.83^{p}	60.39^{p}	56.4^{p}	66.77^{p}	55.5^{p}	51.71^{p}	40.11^{p}
		Prophase	24.7^{ay}	21.22^{ay}	25.49^{ay}	25^{ay}	15.65^{ay}	25.69^{ay}	28.63^{ay}	35.59^{ay}
		Metaphase	7.97^{u}	5.04^{u}	5.1^{u}	5.81^{u}	5.75^{u}	8.26^{u}	4.27^{u}	7.91^{u}
		Anaphase	7.57^{u}	4.32^{u}	5.88^{u}	6.98^{u}	3.83^{u}	6.88^{u}	6.84^{u}	6.78^{u}
		Telophase	7.97^{jr}	3.6^{jr}	3.14^{jr}	5.81^{jr}	7.99^{jr}	3.67^{jr}	8.55^{jr}	9.6^{jr}
Sodium azide	5	Interphase	68.27^{g}	0^{g}	0^{g}	0^{g}	69.03^{g}	68.02^{g}	63.58^{g}	58.85^{g}
		Prophase	21.03^{jr}	0^{jr}	0^{jr}	0^{jr}	16.27^{jr}	16.6^{jr}	18.54^{jr}	15.79^{jr}
		Metaphase	1.85^{u}	0^{u}	0^{u}	0^{u}	4.99^{u}	5.26^{u}	3.97^{u}	3.35^{u}
		Anaphase	2.95^{u}	0^{u}	0^{u}	0^{u}	2.36^{u}	3.64^{u}	3.97^{u}	3.83^{u}
		Telophase	5.9^{ur}	0^{ur}	0^{ur}	0^{ur}	7.35^{ur}	6.48^{ur}	9.93^{ur}	18.18^{ur}
	10	Interphase	71.15^{a}	0^{a}	0^{a}	0^{a}	76.85^{a}	0^{a}	0^{a}	63.84^{a}
		Prophase	17^{ur}	0^{ur}	0^{ur}	0^{ur}	10.68^{ur}	0^{ur}	0^{ur}	17.41^{ur}
		Metaphase	1.58^{u}	0^{u}	0^{u}	0^{u}	3.56^{u}	0^{u}	0^{u}	4.02^{u}
		Anaphase	2.37^{u}	0^{u}	0^{u}	0^{u}	2.67^{u}	0^{u}	0^{u}	3.13^{u}
		Telophase	7.91^{u}	0^{u}	0^{u}	0^{u}	6.23^{u}	0^{u}	0^{u}	11.61^{u}

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
	15	Interphase	76.01^{ay}	0^{ay}	0^{ay}	74.59^{ay}	0^{ay}	0^{ay}	0^{ay}	0^{ay}
		Prophase	16.2^{u}	0^{u}	0^{u}	13.03^{u}	0^{u}	0^{u}	0^{u}	0^{u}
		Metaphase	0.62^{u}	0^{u}	0^{u}	1.95^{u}	0^{u}	0^{u}	0^{u}	0^{u}
		Anaphase	1.25^{u}	0^{u}	0^{u}	2.28^{u}	0^{u}	0^{u}	0^{u}	0^{u}
		Telophase	5.92^{u}	0^{u}	0^{u}	8.14^{u}	0^{u}	0^{u}	0^{u}	0^{u}
	20	Interphase	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}
		Prophase	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}
		Metaphase	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}
		Anaphase	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}
		Telophase	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}	0^{b}
Potassium chromate	5	Interphase	69.5^{k}	74.68^{k}	72.08^{k}	71.79^{k}	75.09^{k}	68.06^{k}	64.55^{k}	66.03
		Prophase	21.24^{vw}	17.21^{vw}	16.61^{vw}	15.71^{vw}	12.45^{vw}	15.21^{vw}	17.27^{vw}	18.7^{vw}
		Metaphase	1.16^{u}	1.62^{u}	2.83^{u}	2.5^{u}	2.26^{u}	4.56^{u}	3.64^{u}	3.44^{u}
		Anaphase	0.77^{u}	1.95^{u}	2.12^{u}	1.43^{u}	1.51^{u}	4.18^{u}	3.18^{u}	1.91^{u}
		Telophase	7.34^{jr}	4.55^{jr}	6.36^{jr}	8.57^{jr}	8.68^{jr}	7.98^{jr}	11.36^{jr}	9.92^{jr}
	10	Interphase	76.05^{p}	0^{p}	79.19^{p}	68.97^{p}	82.45^{p}	0^{p}	60.57^{p}	63.26^{p}
		Prophase	15.59^{jw}	0^{jw}	15.22^{jw}	15.52^{jw}	8.08^{jw}	0^{jw}	19.92^{jw}	17.67^{jw}
		Metaphase	0.38^{u}	0^{u}	1.55^{u}	2.41^{u}	2.51^{u}	0^{u}	2.85^{u}	2.33^{u}
		Anaphase	1.52^{u}	0^{u}	1.55^{u}	3.1^{u}	1.39^{u}	0^{u}	3.66^{u}	2.79^{u}
		Telophase	6.46^{ur}	0^{ur}	2.48^{ur}	10^{ur}	5.57^{ur}	0^{ur}	13.01^{ur}	13.95^{ur}
	15	Interphase	69.4^{p}	68.8^{p}	74.5^{p}	73.24^{p}	81.42^{p}	0^{p}	0^{p}	67.76^{p}
		Prophase	22.06^{jw}	21.2^{jw}	17.79^{jw}	18.06^{jw}	9.02^{jw}	0^{jw}	0^{jw}	13.88^{jw}
		Metaphase	1.07^{u}	1.2^{u}	1.01^{u}	1.67^{u}	2.19^{u}	0^{u}	0^{u}	2.86^{u}
		Anaphase	0.71^{u}	2.4^{u}	2.35^{u}	2.01^{u}	1.64^{u}	0^{u}	0^{u}	2.45^{u}
		Telophase	6.76^{ur}	6.4^{ur}	4.36^{ur}	5.02^{ur}	5.74^{ur}	0^{ur}	0^{ur}	13.06^{ur}
	20	Interphase	71.1^{p}	0^{p}	76.29^{p}	73.45^{p}	0^{p}	72.56^{p}	82.87^{p}	68.38^{p}
		Prophase	20.91^{jr}	0^{jr}	14.57^{jr}	17.59^{jr}	0^{jr}	14.29^{jr}	6.46^{jr}	16.54^{jr}
		Metaphase	0.76^{u}	0^{u}	0.86^{u}	2.07^{u}	0^{u}	2.63^{u}	1.4^{u}	3.31^{u}
		Anaphase	1.14^{u}	0^{u}	1.71^{u}	1.72^{u}	0^{u}	3.01^{u}	1.4^{u}	2.94^{u}
		Telophase	6.08^{u}	0^{u}	6.57^{u}	5.17^{u}	0^{u}	7.52^{u}	7.87^{u}	8.82^{u}

Values with different superscripted alphabets within column are significantly different at 5%

Table A-5. Effects of sodium azide and potassium chromate on the mitotic index of cocoyam accessions at 2:00 pm

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control		Interphase	50^{r}	59.22^{r}	50.84^{r}	33.33^{r}	65.87^{r}	54.42^{r}	49.57^{r}	43.39^{r}
		Prophase	27.62^{sc}	27.06^{sc}	31.09^{sc}	43.41^{sc}	17.06^{sc}	28.37^{sc}	29.49^{sc}	31.75^{sc}
		Metaphase	8.57^{a}	5.88^{a}	6.72^{a}	10.08^{a}	4.44^{a}	6.05^{a}	7.69^{a}	10.05^{a}
		Anaphase	6.19^{a}	3.92^{a}	5.04^{a}	7.75^{a}	5.8^{a}	5.12^{a}	5.98^{a}	5.29^{a}
		Telophase	7.62^{hl}	3.92^{hl}	6.3^{hl}	5.43^{hl}	6.83^{hl}	6.05^{hl}	7.26^{hl}	9.52^{hl}
Sodium azide	5	Interphase	75.19^{b}	0^{b}	0^{b}	0^{b}	65.24^{b}	63.75^{b}	60.15^{b}	59.26^{b}
		Prophase	12.78^{hl}	0^{hl}	0^{hl}	0^{hl}	19.21^{hl}	16.67^{hl}	19.19^{hl}	21.3^{hl}
		Metaphase	1.5^{a}	0^{a}	0^{a}	0^{a}	3.05^{a}	4.58^{a}	5.17^{a}	4.63^{a}
		Anaphase	2.26^{a}	0^{a}	0^{a}	0^{a}	5.79^{a}	4.58^{a}	3.69^{a}	5.09^{a}
		Telophase	8.27^{al}	0^{al}	0^{al}	0^{al}	6.71^{al}	10.42^{al}	11.81^{al}	9.72^{al}
	10	Interphase	63.6^{s}	0^{s}	0^{s}	0^{s}	64.67^{s}	0^{s}	0^{s}	54.46^{s}
		Prophase	23.9^{al}	0^{al}	0^{al}	0^{al}	15.33^{al}	0^{al}	0^{al}	20.09^{al}
		Metaphase	2.57^{a}	0^{a}	0^{a}	0^{a}	4.33^{a}	0^{a}	0^{a}	7.14^{a}
		Anaphase	1.47^{a}	0^{a}	0^{a}	0^{a}	5^{a}	0^{a}	0^{a}	5.36^{a}
		Telophase	8.46^{a}	0^{a}	0^{a}	0^{a}	10.67^{a}	0^{a}	0^{a}	12.95^{a}
	15	Interphase	70.42^{sc}	0^{sc}	0^{sc}	65.73^{sc}	0^{sc}	0^{sc}	0^{sc}	0^{sc}
		Prophase	19.29^{a}	0^{a}	0^{a}	17.74^{a}	0^{a}	0^{a}	0^{a}	0^{a}
		Metaphase	1.61^{a}	0^{a}	0^{a}	3.63^{a}	0^{a}	0^{a}	0^{a}	0^{a}
		Anaphase	1.93^{a}	0^{a}	0^{a}	1.61^{a}	0^{a}	0^{a}	0^{a}	0^{a}
		Telophase	6.75^{a}	0^{a}	0^{a}	11.29^{a}	0^{a}	0^{a}	0^{a}	0^{a}
	20	Interphase	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}
		Prophase	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}
		Metaphase	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}
		Anaphase	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}
		Telophase	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}	0^{y}
Potassium chromate	5	Interphase	62.87^{d}	69.93^{d}	70.91^{d}	67.68^{d}	73.48^{d}	64.68^{d}	56.67^{d}	66.41^{d}
		Prophase	21.69^{tq}	18.84^{tq}	15.64^{tq}	20.15^{tq}	14.77^{tq}	16.67^{tq}	21.67^{tq}	20.23^{tq}
		Metaphase	1.47^{a}	2.17^{a}	2.18^{a}	3.42^{a}	3.41^{a}	3.97^{a}	4.58^{a}	2.67^{a}
		Anaphase	2.21^{a}	2.9^{a}	2.91^{a}	2.66^{a}	2.27^{a}	2.38^{a}	5.42^{a}	4.2^{a}
		Telophase	11.76^{hl}	6.16^{hl}	8.36^{hl}	6.08^{hl}	6.06^{hl}	12.3^{hl}	11.67^{hl}	6.49^{hl}
	10	Interphase	67.98^{r}	0^{r}	75.8^{r}	65.87^{r}	75.85^{r}	0^{r}	55^{r}	59.24^{r}
		Prophase	19.76^{hq}	0^{hq}	17.52^{hq}	18.09^{hq}	13^{hq}	0^{hq}	23.33^{hq}	21.33^{hq}

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
		Metaphase	2.37[a]	0[a]	2.23[a]	3.75[a]	3.72[a]	0[a]	3.75[a]	3.79[a]
		Anaphase	1.98[a]	0[a]	1.27[a]	4.44[a]	2.79[a]	0[a]	5[a]	2.37[a]
		Telophase	7.91[al]	0[al]	3.18[al]	7.85[al]	4.64[al]	0[al]	12.92[al]	13.27[al]
	15	Interphase	66.4[r]	63.97[r]	66.54[r]	67.96[r]	79.76[r]	0[r]	0[r]	63.22[r]
		Prophase	23.36[hq]	23.08[hq]	21.29[hq]	18.66[hq]	10.57[hq]	0[hq]	0[hq]	17.77[hq]
		Metaphase	1.82[a]	2.43[a]	1.9[a]	3.17[a]	1.81[a]	0[a]	0[a]	3.72[a]
		Anaphase	2.55[a]	2.83[a]	0.76[a]	3.17[a]	3.02[a]	0[a]	0[a]	5.79[a]
		Telophase	5.84[al]	7.69[al]	9.51[al]	7.04[al]	4.83[al]	0[al]	0[al]	9.5[al]
	20	Interphase	64.16[r]	0[r]	71.29[r]	68.09[r]	0[r]	65.94[r]	77.01[r]	61.4[r]
		Prophase	23.01[hl]	0[hl]	14.19[hl]	18.79[hl]	0[hl]	17.03[hl]	9.2[hl]	18.6[hl]
		Metaphase	1.33[a]	0[a]	1.98[a]	2.84[a]	0[a]	5.07[a]	1.72[a]	4.91[a]
		Anaphase	2.21[a]	0[a]	2.97[a]	2.48[a]	0[a]	3.26[a]	2.59[a]	3.51[a]
		Telophase	9.29[a]	0[a]	9.57[a]	7.8[a]	0[a]	8.7[a]	9.48[a]	11.58[a]

Values with different superscripted alphabets within column are significantly different at 5%

Table A-6. Effects of sodium azide and potassium chromate on the mitotic index of cocoyam accessions at 4:00 pm

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control		Interphase	55.46[k]	60.35[k]	59.46[k]	37.41[k]	64.69[k]	56.94[k]	56.58[k]	48.66[k]
		Prophase	28.38[ln]	20.35[ln]	22.97[ln]	36.73[ln]	19.58[ln]	30.09[ln]	28.95[ln]	27.81[ln]
		Metaphase	6.55[x]	9.12[x]	8.11[x]	10.2[x]	3.85[x]	4.17[x]	6.14[x]	9.09[x]
		Anaphase	4.8[x]	3.16[x]	3.72[x]	5.44[x]	5.24[x]	4.17[x]	3.51[x]	6.95[x]
		Telophase	4.8[eh]	7.02[eh]	5.74[eh]	10.2[eh]	6.64[eh]	4.63[eh]	4.82[eh]	7.49[eh]
Sodium azide	5	Interphase	71.48[z]	0[z]	0[z]	0[z]	64.71[z]	66.67[z]	60.46[z]	56.54[z]
		Prophase	17.78[eh]	0[eh]	0[eh]	0[eh]	18.69[eh]	17.12[eh]	19.01[eh]	24.77[eh]
		Metaphase	1.11[x]	0[x]	0[x]	0[x]	2.08[x]	3.15[x]	4.18[x]	3.74[x]
		Anaphase	2.59[x]	0[x]	0[x]	0[x]	4.84[x]	3.6[x]	2.66[x]	6.07[x]
		Telophase	7.04[xh]	0[xh]	0[xh]	0[xh]	9.69[xh]	9.46[xh]	13.69[xh]	8.88[xh]
	10	Interphase	75.67[l]	0[l]	0[l]	0[l]	66.78[l]	0[l]	0[l]	59.35[l]
		Prophase	12.93[xh]	0[xh]	0[xh]	0[xh]	16.43[xh]	0[xh]	0[xh]	19.63[xh]
		Metaphase	0.76[x]	0[x]	0[x]	0[x]	2.8[x]	0[x]	0[x]	5.61[x]
		Anaphase	1.14[x]	0[x]	0[x]	0[x]	3.5[x]	0[x]	0[x]	4.21[x]
		Telophase	9.51[x]	0[x]	0[x]	0[x]	10.49[x]	0[x]	0[x]	11.21[x]

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
	15	Interphase	70.67^{ln}	0^{ln}	0^{ln}	73.06^{ln}	0^{ln}	0^{ln}	0^{ln}	0^{ln}
		Prophase	21.91^{x}	0^{x}	0^{x}	14.39^{x}	0^{x}	0^{x}	0^{x}	0^{x}
		Metaphase	0.71^{x}	0^{x}	0^{x}	2.21^{x}	0^{x}	0^{x}	0^{x}	0^{x}
		Anaphase	1.06^{x}	0^{x}	0^{x}	2.95^{x}	0^{x}	0^{x}	0^{x}	0^{x}
		Telophase	5.65^{x}	0^{x}	0^{x}	7.38^{x}	0^{x}	0^{x}	0^{x}	0^{x}
	20	Interphase	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}
		Prophase	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}
		Metaphase	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}
		Anaphase	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}
		Telophase	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}	0^{u}
Potassium chromate	5	Interphase	68.44^{v}	72.24^{v}	67^{v}	64.08^{v}	68.17^{v}	71.31^{v}	59.62^{v}	66.67^{v}
		Prophase	21.99^{iy}	15.72^{iy}	18.18^{iy}	21.13^{iy}	14.53^{iy}	14.75^{iy}	20.38^{iy}	18.48^{iy}
		Metaphase	0.71^{x}	2.34^{x}	3.03^{x}	4.23^{x}	2.77^{x}	2.46^{x}	3.4^{x}	2.9^{x}
		Anaphase	1.06^{x}	3^{x}	1.68^{x}	3.17^{x}	3.46^{x}	3.28^{x}	4.53^{x}	3.26^{x}
		Telophase	7.8^{eh}	6.69^{eh}	10.1^{eh}	7.39^{eh}	11.07^{eh}	8.2^{eh}	12.08^{eh}	8.7^{eh}
	10	Interphase	72.69^{k}	0^{k}	73.85^{k}	63.6^{k}	72.91^{k}	0^{k}	58.87^{k}	56.48^{k}
		Prophase	20.77^{ey}	0^{ey}	16.54^{ey}	17.65^{ey}	13.38^{ey}	0^{ey}	21.65^{ey}	25^{ey}
		Metaphase	1.54^{x}	0^{x}	1.15^{x}	4.78^{x}	3.68^{x}	0^{x}	2.6^{x}	4.63^{x}
		Anaphase	1.54^{x}	0^{x}	2.31^{x}	3.68^{x}	3.68^{x}	0^{x}	4.33^{x}	4.17^{x}
		Telophase	3.46^{xh}	0^{xh}	6.15^{xh}	10.29^{xh}	7.02^{xh}	0^{xh}	12.55^{xh}	9.72^{xh}
	15	Interphase	70.96^{k}	71.28^{k}	67.01^{k}	64.44^{k}	78.55^{k}	0^{k}	0^{k}	58.45^{k}
		Prophase	19.12^{ey}	17.73^{ey}	20.49^{ey}	18.52^{ey}	7.27^{ey}	0^{ey}	0^{ey}	24.2^{ey}
		Metaphase	1.47^{x}	1.77^{x}	2.78^{x}	2.96^{x}	2.55^{x}	0^{x}	0^{x}	3.65^{x}
		Anaphase	1.84^{x}	1.42^{x}	2.78^{x}	4.81^{x}	2.18^{x}	0^{x}	0^{x}	5.48^{x}
		Telophase	6.62^{xh}	7.8^{xh}	6.94^{xh}	9.26^{xh}	9.45^{xh}	0^{xh}	0^{xh}	8.22^{xh}
	20	Interphase	75.3^{k}	0^{k}	71.06^{k}	62.76^{k}	0^{k}	71.26^{k}	73.88^{k}	55.66^{k}
		Prophase	16.7^{eh}	0^{eh}	17.36^{eh}	16.9^{eh}	0^{eh}	15.71^{eh}	14.18^{eh}	22.17^{eh}
		Metaphase	2.79^{x}	0^{x}	2.89^{x}	4.14^{x}	0^{x}	4.21^{x}	1.49^{x}	5.43^{x}
		Anaphase	1.59^{x}	0^{x}	3.86^{x}	5.17^{x}	0^{x}	2.68^{x}	2.61^{x}	4.07^{x}
		Telophase	3.59^{x}	0^{x}	4.82^{x}	11.03^{x}	0^{x}	6.13^{x}	7.84^{x}	12.67^{x}

Values with different superscripted alphabets within column are significantly different at 5%

Table A-7. Effects of sodium azide and potassium chromate on the mitotic index of cocoyam accessions at 6:00 pm

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
Control		Interphase	71.38 ^{a}	73.61 ^{a}	73.98 ^{a}	59.39 ^{a}	71.84 ^{a}	70.38 ^{a}	66.81 ^{a}	59.76 ^{a}
		Prophase	23.36 ^{cg}	14.87 ^{cg}	14.63 ^{cg}	24.85 ^{cg}	17.69 ^{cg}	22.31 ^{cg}	21.83 ^{cg}	25.61 ^{cg}
		Metaphase	1.97 ^{b}	1.49 ^{b}	0.81 ^{b}	1.21 ^{b}	1.44 ^{b}	1.15 ^{b}	2.18 ^{b}	4.88 ^{b}
		Anaphase	0.99 ^{b}	1.12 ^{b}	3.25 ^{b}	1.21 ^{b}	2.17 ^{b}	2.69 ^{b}	2.62 ^{b}	2.44 ^{b}
		Telophase	2.3 ^{dh}	8.92 ^{dh}	7.32 ^{dh}	13.33 ^{dh}	6.86 ^{dh}	3.46 ^{dh}	6.55 ^{dh}	7.32 ^{dh}
Sodium azide	5	Interphase	87.25 ^{e}	0 ^{e}	0 ^{e}	0 ^{e}	75.39 ^{e}	79.13 ^{e}	65.47 ^{e}	67.84 ^{e}
		Prophase	7.84 ^{dh}	0 ^{dh}	0 ^{dh}	0 ^{dh}	12.89 ^{dh}	10.43 ^{dh}	19.06 ^{dh}	19.1 ^{dh}
		Metaphase	0.65 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	0.78 ^{b}	1.74 ^{b}	2.16 ^{b}	2.51 ^{b}
		Anaphase	0.33 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	3.52 ^{b}	1.3 ^{b}	1.8 ^{b}	3.02 ^{b}
		Telophase	3.92 ^{bh}	0 ^{bh}	0 ^{bh}	0 ^{bh}	7.42 ^{bh}	7.39 ^{bh}	11.51 ^{bh}	7.54 ^{bh}
	10	Interphase	79.08 ^{c}	0 ^{c}	0 ^{c}	0 ^{c}	76.78 ^{c}	0 ^{c}	0 ^{c}	66.05 ^{c}
		Prophase	17.38 ^{bh}	0 ^{bh}	0 ^{bh}	0 ^{bh}	12.36 ^{bh}	0 ^{bh}	0 ^{bh}	14.88 ^{bh}
		Metaphase	0 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	0.75 ^{b}	0 ^{b}	0 ^{b}	2.79 ^{b}
		Anaphase	0.35 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	1.87 ^{b}	0 ^{b}	0 ^{b}	1.4 ^{b}
		Telophase	3.19 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	8.24 ^{b}	0 ^{b}	0 ^{b}	14.88 ^{b}
	15	Interphase	85.84 ^{cg}	0 ^{cg}	0 ^{cg}	82.41 ^{cg}	0 ^{cg}	0 ^{cg}	0 ^{cg}	0 ^{cg}
		Prophase	12.43 ^{b}	0 ^{b}	0 ^{b}	10.42 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}
		Metaphase	0 ^{b}	0 ^{b}	0 ^{b}	1.3 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}
		Anaphase	0 ^{b}	0 ^{b}	0 ^{b}	1.63 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}
		Telophase	1.73 ^{b}	0 ^{b}	0 ^{b}	4.23 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}	0 ^{b}
	20	Interphase	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}
		Prophase	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}
		Metaphase	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}
		Anaphase	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}
		Telophase	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}	0 ^{i}
Potassium chromate	5	Interphase	78.01 ^{k}	75.4 ^{k}	80.69 ^{k}	73.66 ^{k}	79.39 ^{k}	76.47 ^{k}	67.83 ^{k}	71.48 ^{k}
		Prophase	19.86 ^{fj}	13.92 ^{fj}	11.84 ^{fj}	16.03 ^{fj}	11.45 ^{fj}	11.76 ^{fj}	15.73 ^{fj}	15.97 ^{fj}
		Metaphase	0 ^{b}	1.29 ^{b}	0.62 ^{b}	3.05 ^{b}	1.91 ^{b}	1.18 ^{b}	1.75 ^{b}	1.9 ^{b}
		Anaphase	0 ^{b}	0.97 ^{b}	0.31 ^{b}	2.29 ^{b}	1.53 ^{b}	1.18 ^{b}	1.4 ^{b}	3.42 ^{b}
		Telophase	2.13 ^{dh}	8.41 ^{dh}	6.54 ^{dh}	4.96 ^{dh}	5.73 ^{dh}	9.41 ^{dh}	13.29 ^{dh}	7.22 ^{dh}

Treatment	Conc (mg)	Mitotic stage	NCe 001	NCe 002	NCe 003	NCe 004	NCe 005	NXs 001	NXs 002	NXs 003
	10	Interphase	82.73^{a}	0^{a}	78.61^{a}	73.33^{a}	77.81^{a}	0^{a}	70.34^{a}	68.85^{a}
		Prophase	12.59^{dj}	0^{dj}	14.16^{dj}	13.7^{dj}	10.03^{dj}	0^{dj}	14.07^{dj}	13.52^{dj}
		Metaphase	0^{b}	0^{b}	0.3^{b}	2.96^{b}	1.22^{b}	0^{b}	1.14^{b}	2.46^{b}
		Anaphase	0.36^{b}	0^{b}	0.9^{b}	2.59^{b}	1.82^{b}	0^{b}	1.52^{b}	1.23^{b}
		Telophase	4.32^{bh}	0^{bh}	6.02^{bh}	7.41^{bh}	9.12^{bh}	0^{bh}	12.93^{bh}	13.93^{bh}
	15	Interphase	78.46^{a}	83.62^{a}	78.27^{a}	71.21^{a}	76.11^{a}	0^{a}	0^{a}	70.33^{a}
		Prophase	13.83^{dj}	11.3^{dj}	13.42^{dj}	12.84^{dj}	12.68^{dj}	0^{dj}	0^{dj}	14.63^{dj}
		Metaphase	0.32^{b}	0.56^{b}	0.96^{b}	1.17^{b}	0.59^{b}	0^{b}	0^{b}	2.03^{b}
		Anaphase	0.64^{b}	0^{b}	1.6^{b}	2.33^{b}	0.88^{b}	0^{b}	0^{b}	3.66^{b}
		Telophase	6.75^{bh}	4.52^{bh}	5.75^{bh}	12.45^{bh}	9.73^{bh}	0^{bh}	0^{bh}	9.35^{bh}
	20	Interphase	78.24^{a}	0^{a}	81.45^{a}	70.92^{a}	0^{a}	75.09^{a}	80.8^{a}	72.47^{a}
		Prophase	14.5^{dh}	0^{dh}	12.17^{dh}	12.77^{dh}	0^{dh}	9.43^{dh}	10.87^{dh}	14.17^{dh}
		Metaphase	1.53^{b}	0^{b}	0.58^{b}	1.42^{b}	0^{b}	2.26^{b}	0.36^{b}	2.02^{b}
		Anaphase	1.15^{b}	0^{b}	2.32^{b}	2.48^{b}	0^{b}	1.89^{b}	1.09^{b}	2.02^{b}
		Telophase	4.58^{b}	0^{b}	3.48^{b}	12.41^{b}	0^{b}	11.32^{b}	6.88^{b}	9.31^{b}

Values with different superscripted alphabets within column are significantly different at 5%

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