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A PRELIMINARY ANALYSIS OF THE KARYOTYPES OF SOME ACCESSIONS OF THE POTATO (*Solanum tuberosum* L) IN JOS

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ABSTRACT
A preliminary analysis of the karyotypes of three potato cultivars (Diamant Nicola, and Roslin Ruaka) grown in Jos was carried out using transmitted light microscopical techniques. Karyotypic analysis of individual chromosomes was performed on the idiograms obtained following standard cytological and Darkroom procedures. Differences between the complements were discerned from comparisons of chromosomal total lengths (p+q), morphology, and the occurrence of secondary constrictions. The first two pairs of chromosomes of Diamant and Nicola were similar in total length but differed by the presence of secondary constrictions in Diamant. It was only in Diamant also that a telocentric chromosome was observed. Chromosomes of Nicola were diffuse, wider, and with imperceptible arms in contrast to those of Diamant found to be discrete and rod-like, most with distinguishable arms. Chromosomes of Diamant ranged between 4.17µm to 1.00µm in size, and were grouped into three classes, whereas those of Nicola ranged between 4.00µm and 1.33µm and were grouped into four classes. Chromosomes of Roslin Ruaka were rod-like, discrete, and shortest, with the longest chromosome approximating in size to chromosome number 20 in Diamant, and chromosomes *22* and 23 in Nicola. Efforts are underway to use *Fluorescence in situ hybridization* method for better resolution and a more detailed characterization of these chromosomes which, we hope, will enable us build a more lucid picture of the adaptive significance of these karyotypic variations as they relate to drought tolerance in this crop.

KEYWORDS: karyotypes, potato cultivars, Diamant Nicola, and Roslin Ruaka *etc*.

INTRODUCTION

Karyotype is the phenotype of the complement; that is, the sum of all the detectable structural features that identify a particular chromosomal set. Such structural features usually include number, size and morphology of the chromosome as seen at mitotic Metaphase and the arrangement of homologous segments as in meiotic pairing. Karyotypes are represented by a diagram called *idiogram* in which the pairs of homologous chromosomes are ordered in a series of decreasing size.

Although the Karyotype of a species is fixed, some individuals may express certain deviations due to any of the following reasons:

1. Centric fission (breakage of the centromere) or by non-disjunction at Anaphase, resulting into aneuploid offspring.
2. Centric fusion i.e. union of telocentric chromosomes.
3. Loss of chromosome during meiosis

A. Multiplication of basic chromosome numbers which could be induced by several factors including shock and chemical treatments.

5. Fragmentation of diffused centromere, polycentric and holocentric chromosomes (agenatoploidy) (Brown, 1974; De Robertis *et al.*, 1975; Wallace *et al.*, 1984).

In plants, genotypic variations have been shown to arise spontaneously (Goodwin, P.B. and G. Brown (I960); Wallace *et al.* (1984) and can have some pronounced effects on phenotypic expressions and consequently, on the physiology of such plants. Thus, detectable alterations in structural features of a complement offer clues in pin-pointing internal changes which may account for a particular way a plant functions in a given habitat (Hai *et al.*, 2006; Vargas *et al.*, 2008).

Much of present day efforts in plant improvement are being devoted to obtaining transformed plants from long cultivated races and recalcitrant species in attempts to increase the number of desirable genes in breeding stocks, particularly those conferring resistance to abiotic stresses. Our increased knowledge of the cytogenetic architecture of economically important species should assume a more important role in these efforts, since such knowledge is vital to the successful introduction of genetic variation in breeding stocks. In this study, an attempt was made to characterize the karyotypes of three potato cultivars (Diamant, Nicola, and Roslin Ruaka) which differ in their transpiration losses under the same environmental conditions of growth, placing Diamant as a relatively more conservative cultivar with respect to their water utilization capacities. Therefore, the results of this study would prove to be quite useful in potato breeding programmes that target the development of drought tolerant potato cultivars, especially, via tissue culture protocols.

MATERIALS & METHODS

Karyotypic analysis of individual chromosomes of each cultivar was carried out using the standard procedures described by Wallace *et* al. (1984). Harvested roots of the three potato cultivars were pretreated in a solution of 0.002M – hydroxyquinoline for 5 hours at a temperature of approximately 18 ^{0}C; fixed in a freshly prepared acid-alcohol fixative (1 part of acetic acid + 3 parts of absolute alcohol) over night, washed in water and then hydrolysed

in 1M HCl warmed to 60 ^{0}C, for 6-8 minutes. Individual root tips (approximately 2cm) were squashed in 2 drops of aceto-orcein on pre-cleaned slides and covered with cover slips before examination. Good preparations were photographed by still projection through an Olympus Vanox research microscope fitted with photo-micrographic equipment. Chromosome sizes were determined using an eyepiece graticule that had been standardized against a 0.01 x 100 =1mm stage micrometer. Large glossy prints were made following the usual Dark-room procedures. Ideograms of the chromosomes were then prepared, and the identification of the individual chromosomes was based on the .criteria of total length (p + q), arm ratio (q/p), and centromeric index (p/p+q).

RESULTS

The karyotypes of the three potato cultivars are presented in Figures 1, 2, and 3 with their corresponding idiograms, while Table 1 presents results of numerical measurements on the individual chromosomes used in the classification given in this report. Certain other chromosomes were diffused, with indistinguishable.

Nicola

1. Total length of chromosomes of this cultivar ranged between 1.33 µrn - 4.00 µm with an average of 2.67+0.17 µm.
2. All the chromosomes of this cultivar are monocentric, with no branching observed.
3. Chromosome number 8 is curved into a "comma" shape
4. The chromosomes of this cultivar are generally very wide
5. On the basis of total length, the following chromosomes are distinguishable for this cultivar:
   i. Two (02} telocentric chromosomes (numbers 2 and 9)
   ii. Two (02) long chromosomes
   iii. Five (05) medium chromosome's
   iv. Seven (07) short chromosomes
   v. Eight (08) very short chromosomes of varying lengths.

Roslin Ruaka

1. Chromosomal total length ranged between 0.60 µrn and 1.57 µrn with an average of 1.33 µrn - 4.00 µm.
2. All the chromosomes are monocentric, and no branching was observed
3. Six (06) chromosomes (numbers 1, 2, 7, 8, 10 and 15 are metacentric
4. On the basis of total length, the following chromosomes of this cultivar are distinguishable:

i. Four (04) long chromosomes
ii. Three (03) medium chromosomes
iii. Eleven (11) short chromosomes
iv. Six (06) very short chromosomes with indistinguishable arms

DISCUSSION

Preliminary analysis of the karyotypes of these potato cultivars revealed that there are certain differences between their complements with respect to size, morphology, and to a lesser extent in the occurrence of secondary constrictions.

TABLE 1: Total lengths (µm) of chromosomes of Diamant, Nicola and Roslin Ruaka derived from their karyoptypes and used in the classification given in this report.

Chromosome Number	Potato Cultivar			Classification	
	Diamant	Nicola	Roslin Ruaka		
1	4.17	4.00	1.57	Diamant	
2	4.17	4,00	1.57	Long;	4.17µm
3	2.93	3.83	1.50	Medium:	2.00-2.93
4	2.83	3.33	1.50	Short::	1.00-1.93
5	2.67	3.33	1.42		
6	2.50	3.17	1.33	Nicola:	
7	2.33	3.17	1.30	Long:	4.00µm
8	2.33	3.17	1,20	Medium:	3.17-3.83
9	2.33	3.17	•1.20	Short:	2.33-2.83
10	2.27	3.17	1.30	Veryshort:	1.33-1.83
11	2.20	2.83	1.17		
12	2.20	2.67	1.17	Roslin Ruaka:	
13	2.17	2.67	1.13	Long:	1.50-1.57
14	2.00	2.50	1.13	Medium:	1.20-1.37
15	2.00	2.50	1.03	Short;	1.00-1.19
16	2.00	2.33	1.00	V.short :	0.6-0.90
17	1.93	2.33	1.00		
18	1.67	1.83	1.00		
19	1.67	1.83	0.90		
20	1.5	1.83	0.90		
21	1.5	1.67	0.87		
22	1.23	1.67	0.83		
23	1.17	1.33	0.80		
24	1.00	1.33	0.60		

The first two pairs of chromosomes of- Diamant and Nicola were similar in their total lengths but differed by the presence of secondary constrictions witnessed in Diamant only (Figures 1 and 2). Furthermore,

chromosomes of Nicola were diffuse, wider, and with imperceptible arms. This appearance contrasts sharply the morphology of most chromosomes of Diamant, which are discrete and rod-like, with distinguishable arms. Also, it was only in Diamant that chromosome number 1 was shown to be telocentric in nature *i.e.* had a centromere situated on the proximal end (as arrowed in Fig. 1).

An inspection of Table 1 revealed another feature of interest regarding the relativity of sizes. Whereas the chromosomes of Nicola showed gradual gradation from 4.0 µm to 1.33 µm, giving rise to the classification given in Table 1, chromosomes of Diamant showed somewhat an abrupt gradation from the longest chromosome (4.17 µm) to the shortest chromosome (1.00 µm). Strictly, no chromosomes of this cultivar fell between the 3.83 µm - 3.17 µm range observed in chromosomes of Nicola. Relatively, chromosomes of Roslin Ruaka were much smaller and shorter with imperceptible arms. The longest chromosome of this cultivar (chromosome number 1) was only 1.57 µm long, corresponding in size, to chromosome number 20 in Diamant, and intermediate between chromosomes 22 and 23 in Nicola. Since chromosomes are the bearers of genes in organisms, it is speculated that the observed differences in these chromosomes would also differentially affect the physiology of these cultivars, including their water utilization capacities.

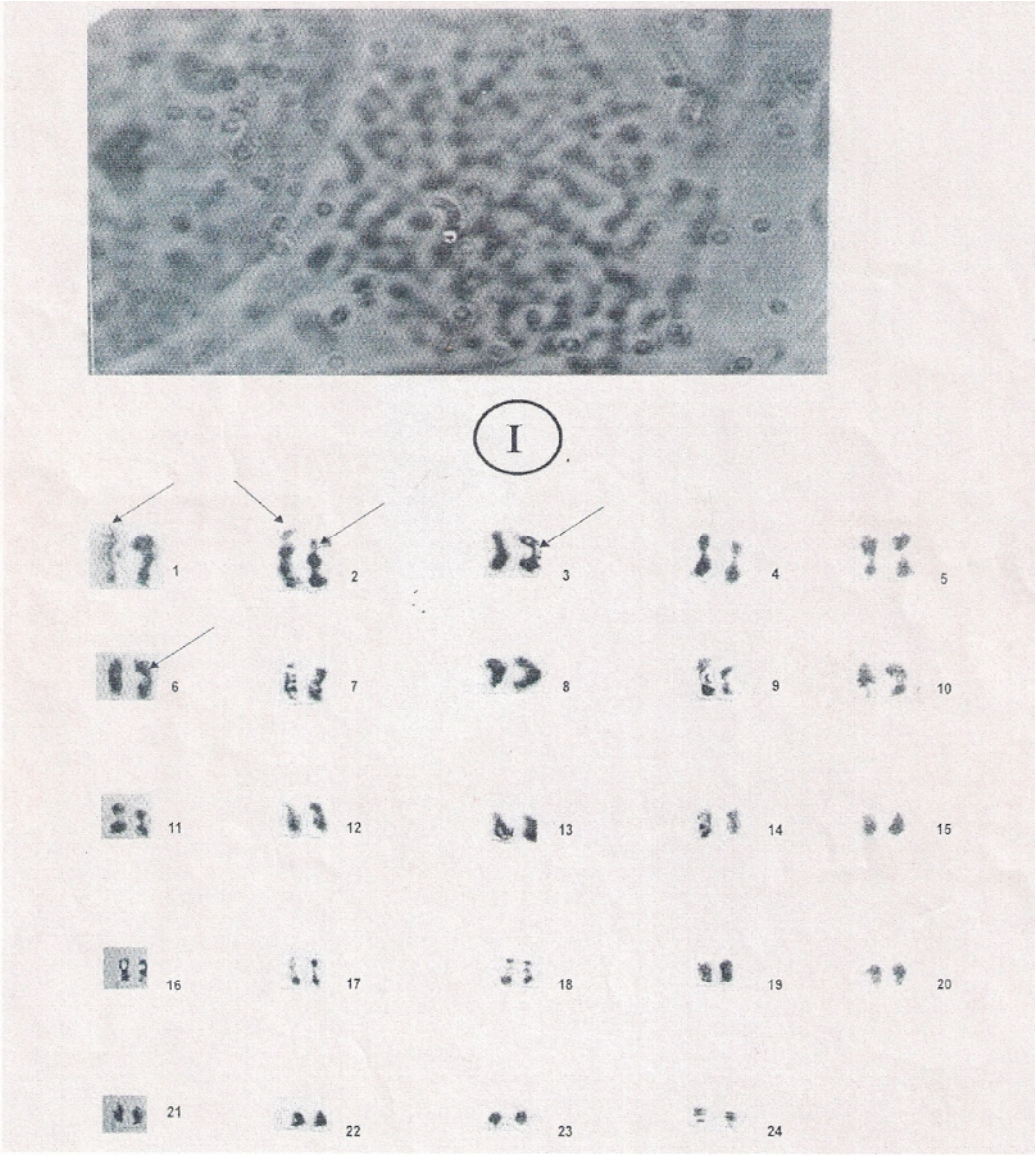
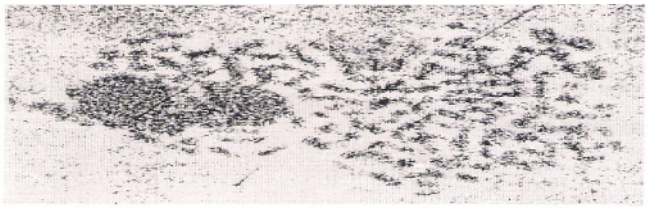


Figure 1: Mitotic Metaphase in Diamant; (I) is its derived karyotype. X 2,500



II

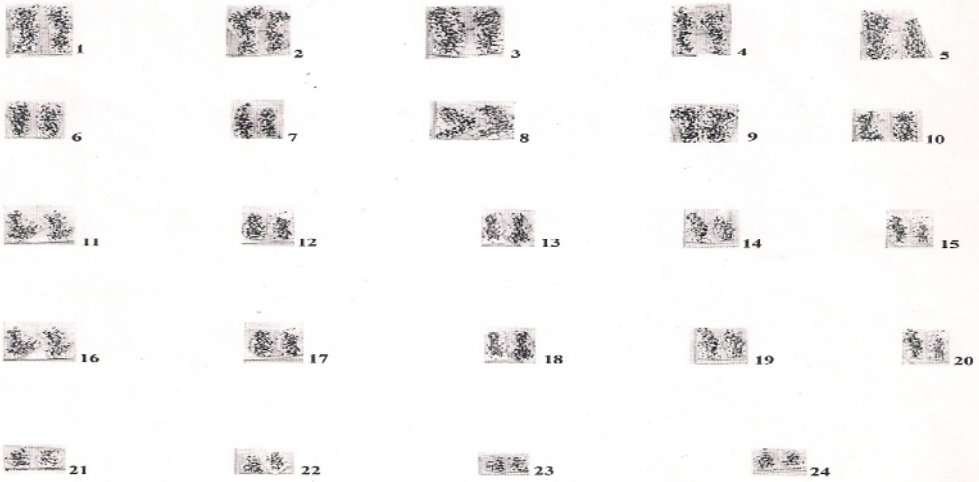
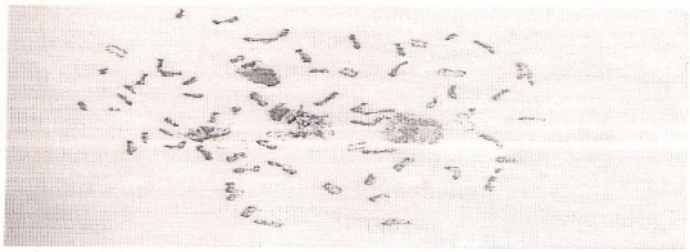


Plate XXIIIb: Mitotic Metaphase in Nicola; (ii) is its derived Karyotype



III

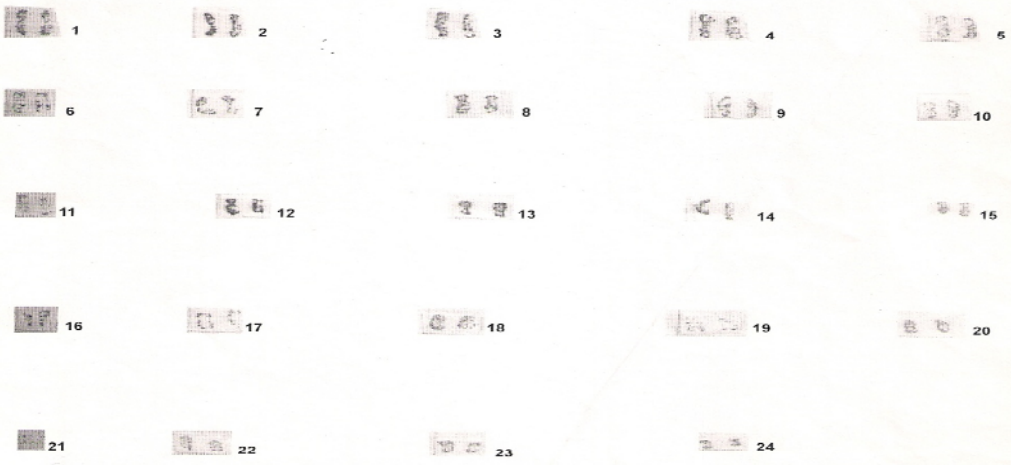


Plate XXIIIC: Mitotic Metaphase in Nicola; (iii) is its derived karyotype. X 2,500

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