

Cytogenetic Exploration of *Plantago lagopus* Linn. – Hare's-foot Plantain

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Abstract- The genus *Plantago* of family Plantaginaceae includes about 483 species. These are small, annual or perennial herbaceous plants with various medicinal properties. The word *Plantago* is taken from the “planta” which means “sole of the foot”. The *Plantago lagopus* is a wild plant.

The meiotic studies of *Plantago lagopus* plants revealed 12 chromosomes. The various stages of meiosis viz; Pachytene, Diplotene, Diakinesis, Metaphase and Anaphase were observed. The number of Rod Bivalents was 06, absence of Ring Bivalents & Nucleolar Chromosomes were 02 in *P.lagopus*. The Chiasmata Frequency was calculated at Metaphase-I (PMC=02, /II=1.0) and at Diakinesis was (PMC=12, /II=02). The other parameters studied included Recombination Index and Terminalization Coefficient. The Recombination Index at Diakinesis of *P. lagopus* was 18 and at Metaphase was 08 respectively. The Terminalization Coefficient was 0.5 in *P.lagopus*. The Anaphase-I was irregular in some of the PMCs. The number of late separating bivalents was 01.

Index Terms- *Plantago lagopus*, Meiosis, Recombination Index, Terminalization Coefficient, Chromosomes

I. INTRODUCTION

The genus *Plantago* of family Plantaginaceae comprises about 483 species [1]. The genus is the prevalent of the three genera on which family Plantaginaceae is based. Although the centre of diversity of plantagos is deemed to be positioned somewhere in central Asia, some species have now become widespread far and wide with utmost concentration in temperate regions [2]. A few species proliferate even in tropical zones where they either grow wild or are cultivated. The *Plantagos* are small, annual and perennial herbs of warm temperate, sandy provinces and are widely allocated.

The *Plantago lagopus* is an annual, small, stemless herb, up to 50 cm tall. Leaves are rosettes, decumbent to ascendent, membranous to papery, flexible, broad lanceolate, 12-15 (-18) cm long, 0.6-2 (-3) cm broad, tapering at both ends, acute, with base attenuated into narrow petioles, nerves 3-5, pilose to glabrous. The Scapes are \pm flexuose, arcuate, ascendent, 10-20 (-45) cm long. The Spikes of this herb are dense, ovoid, later becoming short cylindrical, 1.5-3 (-4) cm long. The Bracts are lanceolate to ovate-lanceolate, 3-4 mm long, hirsute-pilose, carinate. The Anterior sepals are connate. The Corolla is bilobed, lobes 02 mm long, acuminate. The Capsules are 2.25-2.5 mm long, ellipsoid with two oblong Seeds. The Flowering period starts from April to June. The Habitat of the plant is Sandy soils, road edges, fields and

uncultivated places. The plant is distributed all over the Mediterranean region to Aegean and Mediterranean part of Turkey Afghanistan and Pakistan. [3], [4], [5]. According to P. K. Sharma [6], [7] *Plantago lagopus* is a Mediterranean species with $2n=12$. Previous cytological knowledge of *Plantago* L. has revealed that this genus has three different basic chromosome numbers of $x=4$, 5 and 6. The basic number of $x=6$ is the original number from which $x=5$ & $x=4$ have been derived. The *Plantago lagopus* L. is considered a refreshing form of food besides it has huge ethno botanic medicinal usage in diverse countries [8], [9], [10]. Beforehand, nutrient composition of *P. lagopus* was shown in addition to the occurrence of iridoid and phenyethanoid glycosides [11]. Based on the ethnobotanical value of *P. lagopus*, DPPH radical scavenging and cytotoxic activities of this plant against MCF-7 cell line were also determined previously [12], [13]. The cytotoxic and radical scavenging activities of *P. lagopus* many be effective against diseases for instance, inflammation, cancer, ischemic disorders and dementia [14].

II. MATERIALS & METHODS

MEIOTIC STUDIES:

The seeds of *P. lagopus* were sown and maintained in pots in the Department of Biotechnology, University of Jammu, Jammu. For studying meiosis in anthers of male plant, young spikes were fixed at early morning at RT for 24 hours in a mixture of 4 parts chloroform, 3 parts ethyl alcohol, and 1 part acetic acid and a pinch of ferric chloride. Thereafter, they were washed in tap water and stored in 70% ethyl alcohol inside refrigerator at 4° C. The meiotic details in pollen mother cells were studied by squashing anthers in 1% acetocarmine and observations were made under the light microscope.

During meiotic studies, Chiasmata frequency & Recombination index was calculated at Diakinesis and Metaphase- I. The Terminalization coefficient was also calculated.

These were calculated by applying the following formulae:

Recombination index= n +Chiasmata frequency/cell,

Where n is the number of bivalents.

Terminalization coefficient=

Average number of terminalized chiasmata per PMC

Average number of total chiasmata per PMC

All the cytological observations were made from temporary mounts and observations were noted down.

III. RESULTS & DISCUSSION

This wild herb has a relatively wide distribution in



northern Africa [15]. The meiotic chromosomes of these plants revealed 12 chromosomes. This chromosome count of $2n=12$ agrees with the counts reported by McCullagh [16] and Badr [17]. McCullagh [16], Zohary [18] Briggs [19], Badr & El-Kholy [20], Mastuo & Noguchi [21], Badr [17] Bassett & Crompton [22], and Fujiwara [23], [24] who gave the chromosome numbers of *P. lagopus* L. as $2n=12$. An evaluation between preceding reports and current results revealed that the chromosome numbers for this plant is similar.

The cytological data is of great significance for the understanding of relationship and evolution in angiosperms. The various stages of meiosis viz; Pachytene, Diplotene, Diakinesis, Metaphase and Anaphase were observed. The number of Rod Bivalents was 06, absence of Ring Bivalents & Nucleolar Chromosomes were 02 in *P.lagopus*. The Chiasmata Frequency was calculated at Metaphase-I as 02/PMC & 01/Bivalent and at Diakinesis was 12/PMC & 02/Bivalent. The other parameters studied included Recombination Index and Terminalization Coefficient.

Europe, Mediterranean regions of Turkey, Iran, Caucasus, Siberia, Afghanistan, Pakistan, Palestine, Iraq, Syria and

TABLE1. DETAILS OF PMC MEIOSIS IN PLANTAGO LAGOPUS

GAMETIC NUMBER OF CHROMOSOMES		06
NUMBER OF NUCLEOLAR CHROMOSOMES		02
NUMBER OF RING BIVALENTS		00
NUMBER OF ROD BIVALENTS		06
DIAKINESIS	NUMBER OF CHIASMATA	12
	PER PMC	02
	PER BIVALENT	18
METAPHASE- I	NUMBER OF CHIASMATA	02
	PER PMC	01
	PER BIVALENT	08
	RECOMBINATION INDEX	0.5
ANAPHASE -I	REGULAR/IRREGULAR	REGULAR/ SOMETIMES IRREGULAR
	NUMBER OF LATE SEPARATING BIVALENTS	01

The Recombination Index at Diakinesis of *P. lagopus* was 18 and at Metaphase was 08. The Terminalization Coefficient was 0.5 in *P.lagopus*. The Anaphase-I was irregular in some of the PMCs. The number of late separating bivalents was 01. The genus *Plantago* is tribasic; X=4,5 and 6 [25] with X=06 as the primary base number and others as the secondary derivatives of it. The conclusion of current research work is identical with the results reported by the earlier workers from time to time with minor differences [26], [27], [28], [29].

IV. CONCLUSION

The *Plantago lagopus* is very important plant with strong cytotoxic and radical scavenging activities protect cells against free radical injuries in addition to inhibition of cancer cells proliferation due to presence of pro-oxidant effect of phenolics in higher concentrations. The cytological and genomic investigations of this wild plant will throw more light on its important properties. Consequently, the investigation of chromosome evolution might provide auxiliary knowledge in order to ascertain the evolutionary location of a species within a genus and for an enhanced understanding of the interspecific relationships in a family.

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