THE POSSIBLE WAYS OF SPECIATION IN *PAPAVERACEAE FAMILY*

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Abstract: In *Papaver* genus there exist three chromosomal basic number: X=6, X=7 and X=11. On the basis of karyotype features, we consider that at origin was X=6 and later, by aneuploidy, hibridization and poliploidy, have appeared X=7 and X=11

INTRODUCTION

The *Papaveraceae* family polarize the specialists attention because its pharmaceuitcal, ornamental and alimentary valences (Băra & Wellmann, 1985; Böhm &. Nixdorf, 1983; Duke, 1973; Levy & co., 1980; Nyman & Bruhn, 1979; Philipson, 1983; Saini & co., 1986 Sarkany, 1977; Schultze-Motel, 1979). On the other hand, the species *Papaver somniferum* L. (2n = 22) represents an important source for drugs production and scientists are interested to decrease its spread by illegal cultures.

Opium is the air-dried milky exudation obtained from excised unripe fruits. It is extensively smoked as an intoxicant. Commercial products are called Turkey Opium, Indian Opium, Persian Opium, Chinese Opium, and Egyptian Opium, and they differ in appearance and quality. Opium is largely used for production of morphine, codeine, narcotine, laudenine, papaverine, and many other alkaloids, being the source of the toxic and extremely habitforming narcotic heroin or dimorphine. Its seeds contain no opium and are used extensively in baking and sprinkling on rolls and bread, being a good source of energy. They are also the source of a drying-oil, used for manufacture of paints, varnishes, and soaps, and as salad dressing. Lecithin has been extracted from poppy seed meal. Seedlings are eaten as a potherb in Iran.

Informations about *Papaver somniferum* L are available from neolithic epoch (from NIEDERVIEL – Switzerland, considered as point of poppy species origin in Europe).

1. Other archeological data let us known that the opium was utilized, in CRETA isle, in 18 century before our time. In SPAIN, near GRANADA, were discovered popy capsules of 4000 years old. (Ciulei, 1993). Many other informations about poppy, its culture and its utilizations we have from Egyptians, Greeks and Latins time (Opriş, 1990). In ROMANIA, on the other hand, the poppy was known and utiliyed before our time, by Dacians (Brândză, 1879-1883, 1889; Grecescu, 1898, 1909; Papp, 1956)..

Regarded as analgesic, anodyne, antitussive, aphrodisiac, astringent, bactericidal, calmative, carminative, demulcent, emollient, expectorant, hemostat, hypotensive, hypnotic, narcotic, nervine, sedative, sudorific, tonic, poppy has been used in folk medicine for many diseases like: asthma, bladder, bruises, cancer, catarrh, cold, colic, conjunctivitis, cough, diarrhea, dysentery, dysmenorrhea, enteritis, enterorrhagia, fever, flux, headache, hemicrania, hypertension, hypochondria, hysteria, inflammation, insomnia, leucorrhea, malaria, mania, melancholy, nausea, neuralgia, otitis, pertussis, prolapse, rectitis, rheumatism, snakebite, spasm, spermatorrhea, sprain, stomachache, swelling, toothache, tumor, ulcers, and warts. Opium is mentioned as a remedy for such cancerous conditions as cancer of the skin, stomach, tongue, uterus, carcinoma of the breast, polyps of the ear, nose, and vagina; scleroses of the liver, spleen, and uterus; and tumors of the abdomen, bladder, eyes, fauces, liver, spleen, and uvula. The plant, boiled in oil, is said to aid indurations and tumors of the liver. The tincture of the plant is said to help cancerous ulcers.

The capsule decoction and an injection of the seed decoction are said to help uterine cancer. Egyptians claim to become more cheerful, talkative, and industrious following the eating of opium. Lebanese use their opium wisely; to quiet excitable people, to relieve toothache, headache, incurable pain, and for boils, coughs, dysentery, and itches. Algerians tamp opium into tooth cavities. Iranians use the seed for epistaxis; a paste made from Linum, Malva, and Papaver is applied to boils. In Ayurvedic medicine, the seeds are considered aphrodisiac, constipating, and tonic; the fruit antitussive, binding, cooling, deliriant, excitant, and intoxicant, yet anaphrodisiac if freely indulged. The plant is considered aphrodisiac, astringent, fattening, stimulant, tonic, and good for the complexion (Duke, 1973,1983).

Its compounds are used in medicine as analgesic, anodyne, antipasmodic, hypnotic, narcotic, sedative, and as respiratory depressants and to relieve severe pain.

The taxonomic position of *Papaver* L genus.

Cormobionta
↓
Spermatophyta
↓
Angiospermatophytina (Magnoliphytina)
↓
Dicotyledonatae (Magnoliatae)
↓
Magnoliidae (Polycarpicae)
↓
Papaverales (Rhoedales)
↓
Papaveraceae
↓
Papaver L
Glaucium
Chelidonium etc.

Pop & co., 1983

The *Papaverales* are related with *Rosales, Ranunculaceae* (Jensen, 1968). The main trait of *Papaveraceae* is their capacity to sintetize various and very complex alkaloids.

Annual or biennial herb, 50–150 cm tall, glabrous or glaucous, sometimes with a few spreading bristles; stems slightly branched, erect leaves large, numerous, ovate to oblong, serrate to dentate-serrate, clasping at base, glaucous, the lower ones pinnatifid; flowers on long peduncles with nodding buds that expand into erect flowers; petals 4–8, white to purplish, in varieties also pink, violet, bluish, or red, 5–7 cm long; sepals glabrous, 1.5–2 cm long; fruit a capsule, ovoid to globose, glabrous, 4–6 cm long, 3.5–4 cm in diameter, with 8–12 rayed sessile stigmas; seeds oily, white, dark gray to black, or bluish. Flowers and fruits nearly year round in tropical areas, elsewhere in spring and summer.

Native and cultivated in Mediterranean region east to Iran; now cultivated in many tropical, subtropical, and warm temperate countries. Presently known to be cultivated for the opium in India, Iran, Turkey, Yugoslavia, Macedonia, Bulgaria, China, Manchuria, and Asia, and in other parts of Europe and India for the seeds. Cultivated in Japan and Australia for medicinal purposes. Poppy is, also, cultivated in Romania.

Propagated from seed. Seeds germinate best at 15°C and are less sensitive to temperature than most poppy species. Seed sown in shallow furrows, at rate of 4–6 kg/ha. In some areas poppy seed, mixed with sand, is often broadcast over tilled fields in early autumn at rate of about 0.5 kg/ha, as in Asia Minor. Then fields are weeded in the spring when the poppy has grown to about 15 cm tall, and plants are thinned then to stand about 60 cm apart. They flower in April and May and the capsules are ripe in June to July. Optimum yields are obtained when plants are spaced 10 cm between plants and rows 32 cm apart, thus allowing space for mechanical cultivation. Yields of seeds are slightly higher when plants are spaced 30 cm apart than when 40 cm apart. Thinning and spacing do not affect the oil content of the seeds. Fertile soil is essential for good growth and land should be fertilized accordingly.

While nearly all parts of the poppy plant contain a white milky juice or latex, the unripe capsules, containing the juice in abundance, are used for extraction of morphine and other alkaloids. Minor alkaloids are extracted from the straw also. The capsule wall is traversed by a network of branching and anastomosing lactiferous vessels which contain the latex. In the green unripe capsule, the latex is richest in morphine; but as they turn yellow and ripen, the morphine content diminishes and the codeine and narcotine contents increase. Shortly after the petals and stamens fall, usually in the late afternoon or early morning while the temperature is low, transverse oblique or ventral incisions are made in the unripe capsules with a single-bladed knife having one saw edge or a several-bladed knife, care being taken not to cut through the inner wall of the capsule lest valuable juice be lost and the seeds injured. The white juice exudes and soon hardens in the outside wall of the capsule into brownish masses which are scraped off the following day on a wooden tray. The scrapings are later transferred to earthen vessels or larger trays or dumped on the ground, where the opium is kneaded by hand to a uniform consistency. It is then shaped into balls, cakes, or sticks, ready for marketing. Crude opium from the 3 or 4 lancings should be separated for medicinal use since it contains a higher percentage of morphine. Codeine content in poppy shows significant variation as a result of weather and heredity. Morphine content is highest during period 10–30 days after flowering.

Thrives in rich, well-manured soil, in hot to warm regions. Deep, warm, moderately moist, medium heavy soils, well cultivated, and limed meet the requirements for poppy growing. Soils with pH neutral or slightly alkaline preferable. Ranging from Cool Temperate Wet Steppe to Wet through Subtropical Dry to Moist Forest Life Zones, poppy is reported to tolerate annual precipitation of 3.1 to 17.3 dm (mean of 34 cases = 16.0), annual temperature of 5.6 to 23.5°C (mean of 34 cases = 10.9), and pH of 4.9 to 8.2 (mean of 25 cases = 6.5). It does poorly in the humid tropics.

THE AIM OF INVESTIGATIONS

We aimed to find some relations between chromosomes behaviour (karyotype traits) and the possible ways of filiation, in *Papaver* genus.

RESULTS AND DISCUSSIONS

Opium poppy has been cultivated for several thousand years and many cultivars have resulted, differing in flower color, opium production, color of seeds, oil content of seeds, and cultural requirements. Many variants are named, the best known are the "White Poppy" and the "Black Poppy" ("Blue Poppy"), named for color of seeds. "White Poppy" has white to silvery-gray flowers, white seeds, and the capsule is somewhat flattened both at top and bottom. "Black Poppy" usually has violet flowers, seeds a slate color, and the capsule is smaller and and more globular. Many new hybrids being produced and classified according to seed yield, morphine content, and oil content. Hybridizes with *P. setigerum* and *P. bracteatum. P. ssetigerum* DC is one of the allotetraploids of *P. somniferum*, and is, perhaps, one of the ancestors of the cultivated opium poppy. Reported from the Mediterranean, Central Asian, and Near Eastern Centers of Diversity, it is reported to tolerate drought, frost, high pH, heat, limestone, low pH, slope, and virus

In every genus, family or class, there was one or more ancestral species from which, subsequent, has derived all actual and extincted species. By chromosomal and/or genomical mutations, combined with hybridizations, it was possible to appear, from one fundamental number of chromosomes, many others numbers, each of them for a genus. Now, the species of *Papaveraceae* family have X (fundamental number of chromosomes) = 6, 7, 9, 10 and 11. To establish the ancestral species, sometimes there were utilized serological data (Băra & Wellmann, 1985; Jensen, 1968; Stebbins, 1974), other times were utilized chromosomal ones (Băra & co., 1992; Lavania & co, 1999). But, till now, in literature, does not exist unanimous accepted explanations about the ancestral species and about the speciation ways in this family.

Seeds are reported to contain moisture, 4.3–5.2; protein, 22.3–24.4; ether extract 46.5–49.1; nitrogen-free extract, 11.7–14.3; crude fibre, 4.8–5.8; ash, 5.6–6.0; calcium, 1.03–1.45; phosphorous, 0.79–0.89%; iron, 8.5–11.1 mg/100 g; thiamine, 740–1,181; riboflavin, 765–1,203; and nicotinic acid, 800–1,280 □g/100 g. Carotene is absent. Minor minerals in the seeds include: iodine, 6 □g/kg; manganese, 29 mg/kg; copper, 22.9 mg/kg; magnesium, 15.6 g/kg; sodium, 0.3 g/kg; potassium, 5.25 g/kg; and zinc, 130 mg/kg; the seeds also contain lecithin, 2.80%; oxalic acid, 1.62%; pentosans, 3.0–3.6%; traces of narcotine and an amorphous alkaloid; and the enzymes diastase, emulsin, lipase, and nuclease. Poppy seed oil cakes were estimated to have 88 feed units per 100 kg, 27.5% digestible crude protein and 25.6% digestible true protein. Per 100 g the seed is reported to contain 533 calories, 6.8 g H_2O, 18.0 g protein, 44.7 g fat, 23.7 g total carbohydrate, 6.3 g fiber, 6.8 g ash, 1448 mg Ca, 848 mg P, 9.4 mg Fe, 21 mg Na, 700 mg K, a trace of □-carotene equivalent, 0.95 mg thiamine, 0.17 mg riboflavin, and 0.98 mg niacin.

The *Papaver* genus is the biggest one in the *Papaveraceae* family (has more than 80 species; e.g *Papaver rhoeas, Papaver bracteatum, Papaver orientale, Papaver pseudo-orientale, Papaver somniferum* etc.). It is, on the other hand, the genus with species strong differentiated as kariologycal, morphologycal, physiologycal, biochemical and serological traits. Only on the basis of morhological and floral traits the genus was parceled out in 9 sections. Subsequent, by geographycal and morphologycal criteria (Lavania & Srivastava, 1999) there were established only 4 cladistic groups inside these sections.

In *Papaver* genus there are only 3 fundamental chromosomal numbers (X = 6, 7 and 11; *Papaver pavoninum 2n=12, Papaver rhoeas 2n=14, Papaver bracteatum 2n=14, Papaver orientale 2n=28, Papaver pseudo-orientale 2n=42, Papaver somniferum 2n=22;* Duke, in 1978,

has mentioned and 2n=20). So, for establish the possible ways of speciation, is very important to know the initial basic chromosomal number (or numbers) and the ways by which there was possible to appear the others basic numbers. Some auhors (Lavania & Srivastava, 1999) estimate that initial basic numbers were 3 and 4. Subsequent, by hybridization between those species followed of poliploidy, have appeared the basic number 7 (X = 7, n = 7, 2n = 14)

We do not agree this opinion and appreciate that X = 6 have appeared before to X = 7. To explain the appearance of X = 7 and X = 11 (n = 11, 2n = 22, characteristc for the *Papaver somniferum* species), we are proposing the following hypothesis (relied on our cytogenetical investigations – Bără & co., 1975- 2005)

Individuals of species with X = 6, n = 6, 2n = 12, by aneuploidy, have produced n = 5, n= 6 and n = 7 gametes. By random fusion of gametes have appeared the individuals with 2n = 10, 11, 12, 13 or 14 chromosomes, like in following table.

The tetrasomic ones (2n = 14) has survived more easy than 2n = 10 or 11.

Table 1. The gametes occured by aneuploidy

GAMETES		♂		
		n=5	n=6	n=7
♀	n = 5	2n = 10	2n = 11	2n = 12
	n = 6	2n = 11	**2n = 12**	2n = 13
	n = 7	2n = 12	2n = 13	2n = 14

From 2n=11 individuals, by poliploidy, it was possible to appear 2n=22 (n=11) individuals. On the other side, the 2n=14 (n=7, X=7) individuals, being tetrasomics, could survive easier like 2n=10 or 2n=13..

Table 2. Chromosome traits of different *Papaveraceae* species

The species	The number of chromosomes			The length of haploid set (mμ)	The difference between average length of chromosomes from first and last pair (mμ)		
	X	n	2n		Short arm	Long arm	Entire chromosome
Chelidonium majus	6	6	12	15.93	0.25	0.65	0.96
Glaucium flavum	6	6	12	8.82	0.16	0.30	0.496
Papaver rhoeas	7	7	14	24.42	0.25	0.54	0.87
Papaver bracteatum	7	7	14	18.84	0.165	0.865	0.87
Papaver pseudoorientale	7	21	42	84.31	0.465	1.165	1.635
Papaver somniferum	11	11	22	33.87	0.45	1.33	1.83

By investigations effectuated on different populations we are able to pointed out a great similitude between karyotype of *Chelidonium majus* and *Papaver somniferum* species and between *Chelidonium majus* and *Papaver bracteatum* species karyotype (see the table 2)

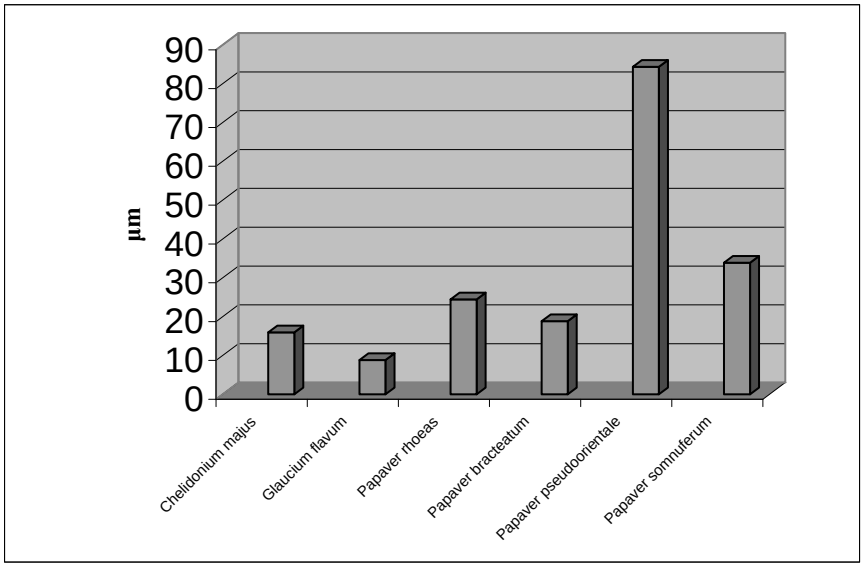

Figure 1. The length of haploid set in some *Papaveraceae* species

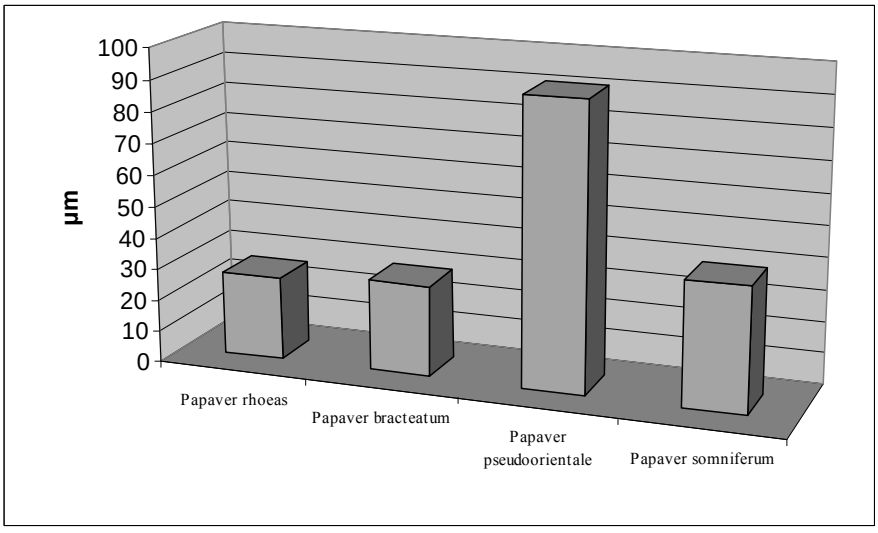

Figure 2. The average length of haploid set in some *Papaver* species (personal data + literature data) / 2

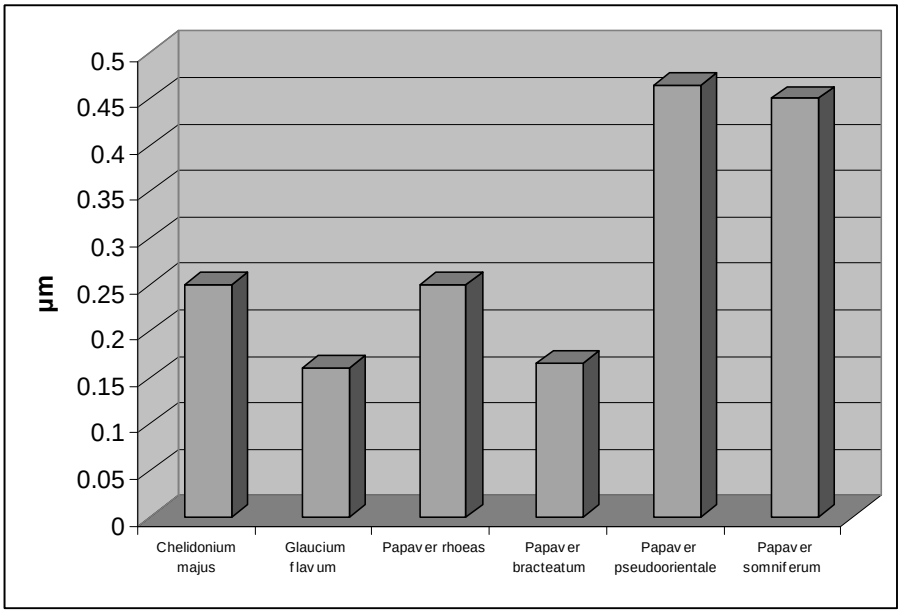

Figure 3. The difference between average length of short arms, of first and last chromosomes pair (mµ)

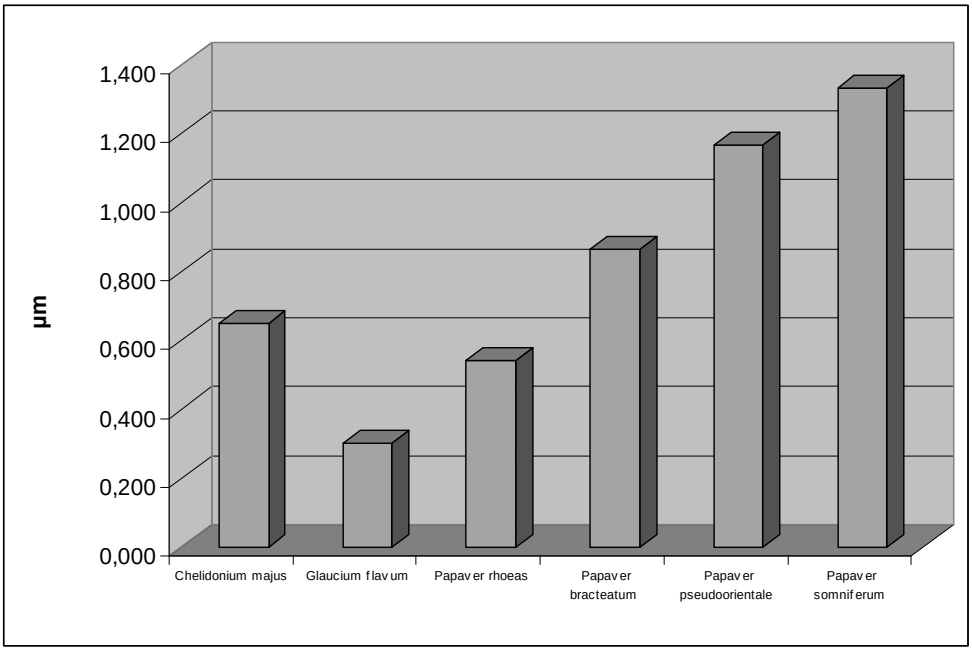

Figure 4. The difference between average length of long arms, of first and last chromosomes pair (mµ)

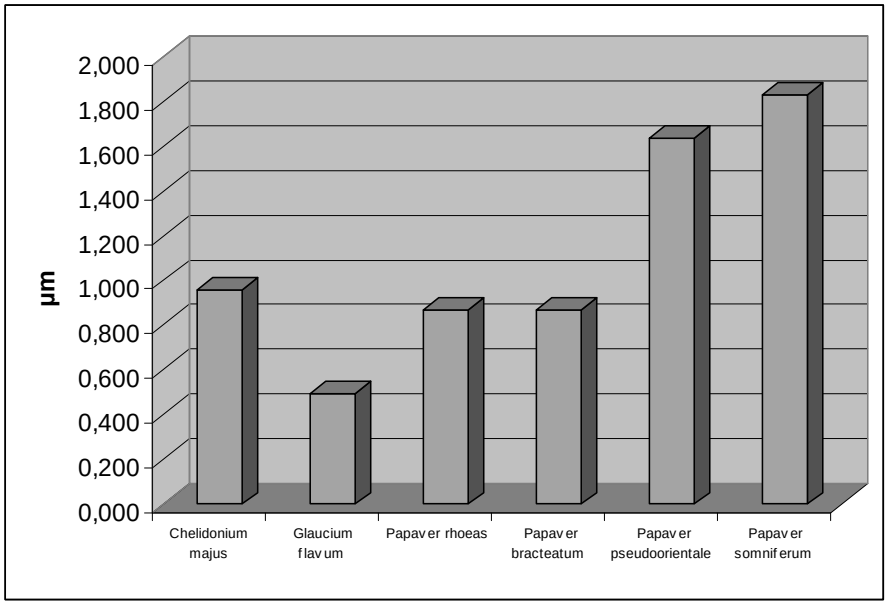

Figure 5. The difference between average length of entire chromosomes length of first and last pair (mµ)

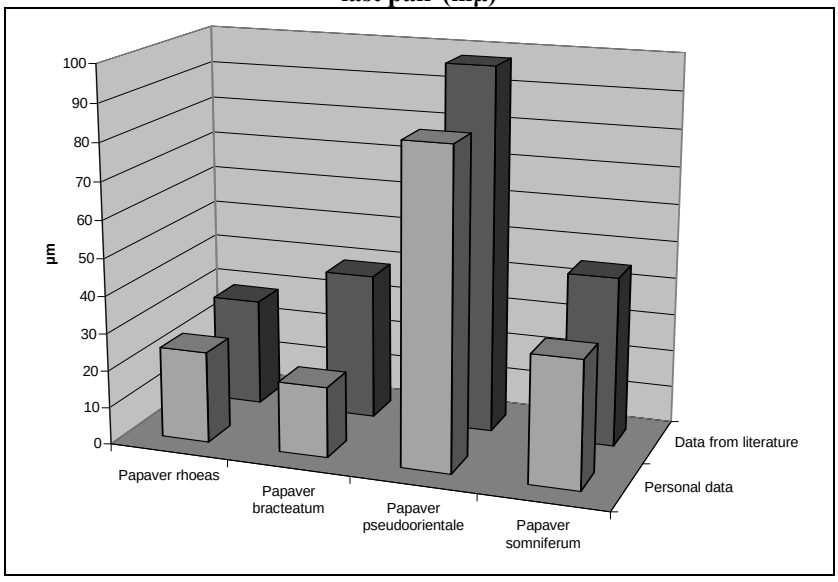

Figure 6. The haploid set average length

CONCLUSIONS

Papaver genus is one of the ricest as species number in *Papaveraceae* family
His species are characterized, as fundamental chromosome number, by X=6, X=7 and X=11.

There is oppinions that the former number was X=7, considering that it appeared by hybridization between a species with X=3 and the other with X=4.
On the basis of karyotype traits and haploid set length (see figure 5), we consider that from X=6 have derived X=7 and X=11.
Ther are some differences between chromosome traits, in our investigations comparative with literature data (see figure 6).

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