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Cytogenetical Comparison Of Mustard Aphids, *Lipaphis Erysimi*(Kaltenbach)Collected From Different Host Plants Of Family Cruciferae

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Abstract

The present work provides a karyological comparison of mustard aphids, ***Lipaphis erysimi****(Kaltenbach) (Homoptera:Aphididae) collected from five different host plants of family Cruciferae. In this species, the normal complement was ascertained as 2n=8 from all host plants such as* ***Brassica campestris, Brassica juncea, Brassica alba, Brassica oleracea*** *var.* ***botyrtis*** *and* ***Raphanus sativus****. From Brassica campestris, the diploid complements show 2n=10, 12; from Brassica juncea 2n=8; from Brassica alba 2n=12; from Brassica oleracea var. botyrtis 2n=8, 10 and from Raphanus sativus 2n=8, 12. In order to compare, their chromosomal morphometrical data, karyotypes and idiograms have been reported in the present work.*

Keywords: *Cruciferae, Mustard aphids, Karyotype, idiogram.*

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Introduction

The common mustard aphid, *Lipaphis erysimi* (Kaltenbach) is the most important pest, causing damage upto 90% crops depending upon the severity of the infestation and crop stage.It is highly vulgar insect, feeding exclusively on the plants of family Cruciferae. Retarded growth, poor seed formation and low oil contents are the phenotypic manifestations of this pest and finally putting source restrictions on *Brassica* oil seeds production (Singhvi*et al.*1973;Bakhetia 1983, 1987; Malik and Anand 1984; Rohilla *et al.*1987). Many workers such as Prasad and Phadke(1988), Bonnemaison (1965) and Liu *et al.* (1997) have reported this insect as an important pest of cruciferous crops. In addition to that this pest also act as a vector of several virus diseases (Guan and Wang 1980; Ahlawat and Chenulu 1982 ; Liu and Yue 2001; Bridges *et al.*2001).

Cytologically, the chromosome number (2n) in *Lipaphis erysimi* vary from 6 to 10 (Gut 1976; Kurl 1978;Kulkarni and Kacker 1979; Khuda-Bukhsh and Datta 1981; Khuda-Bukhsh and Pal 1984 and Kurl 1986 a,b).First of all it was Gut (1976) reported 2n=10 chromosomes in*Lipaphis erysimi* while Kurl (1978) reported the same chromosome number as 2n=10. In 1982,You *et al.* also observed cells with chromosome number 2n=9. Tripathi *et al.* (2013) worked on karyological studies on *L.erysimi* and they determined the karyotypes and diploid chromosome number as 2n=8 and 2n=10 respectively, beside their morphological data. The present paper provides a cytogenetical comparison of mustard aphids, *L.erysimi* (Kaltenbach) collected from five different host plants of family Cruciferae. The paper describes their chromosomal morphometrical data, karyotypes and idiograms for karyological comparison.

Materials And Methods

The aphid samples were collected from different host plants such a *Brassica campestris, Brassica juncea, Brassica alba, Brassica oleracea* var. *botrytis*and *Raphanus sativus* from different villages of Tehsil Modinagar under District Ghaziabad of Western UttarPradesh during 2011-12.The cytological slides were prepared for all the samples collected following th eair-dry method of Kurl and Narang (1978). The aphids (adult apterous and alate) were dissected out in a saline solution onto a slide underdissecting microscope in order to obtain the developing embryos. The ovarioles having embryos were transferred to 0.5% sodium citrate (hypotonic) solution for 10-15minutes. The embryos were fixed in 3:1 methanol: glacial acetic acid for half an hour. Then the fixed early embryos were transferred to a drop of 60% acetic acid onto a clean slide and

the embryos were teased and tapped by a brass rod so that the embryos are broken out. The cell suspension was air dried at room temperature under a table lamp (100 W bulb). The slides were stained by 10% Giemsa stain for 15 minutes. Afterwashing, the slides were dried and permanent mounting in D.P.X. using rectangular cover slips. On drying, the slides were examined under a Binocular microscope having 100 X oil immersion objective. Photomicrographs were taken at the fixed magnification(1000 X) using camera. For metrical data well spread metaphase complements were selected and the actual lengths of chromosomes were measured. From the photomicrographs of well spread metaphase chromosomes the karyotypes and idiograms were prepared for the further comparison.

Results And Discussion

The mitotic prometaphase and metaphase complements of *Lipaphis erysimi* were observed for cytogenetical comparison. Aphids were collected from five different host plants such as *Brassica campestris, Brassica juncea, Brassica alba, Brassicaoleracea* var. *botrytis* and*Raphanus sativus* (Table 1).

Chromosomal details of *Lipaphis erysimi* :

(i) From host plant, *Brassica campestris*:

About thirty (30) samples were analysed for the study of diploid number of chromosomes that was found to be 2n=10 (Fig. 1).Its karyotype (Fig. 2) was prepared that reveals that there are one long-sized pair, three medium-sized pairs, one short-sized pair of chromosomes. The diploid chromosome number 2n=10 were observed earlier by Gut in 1976 and after that the same chromosome number was also observed by Kurl in 1978 and in 1981, Kurland Mishra again observed the complements having chromosome number 2n=10.The measurements of the chromosomes are given in Table 2 and its idiogram is drawn in Fig. 17(A). A few complements were observed that had chromosome number 2n=12 (Fig. 3). and its karyotype (Fig. 4) which depicts the presence of one long-sized pair, three medium-sized pairs and two short-sized pairs of the chromosomes. The complements having chromosome number 2n=12 were observed earlier by Panigrahi and Patnaik (1991). The metrical data are presented in Table 2 and idiogram is shown in Fig. 17(B).

Table 1

The diploid chromosome numbers (2n) for *Lipaphis erysimi* obtained from five different host plants

S.No.	Aphid species	Host Plant	Chromosome number (2n
1.	*Lipaphis erysimi*	*Brassica campestris*	10,12
2.	*Lipaphis erysimi*	*Brassica juncea*	8
3.	*Lipaphis erysimi*	*Brassica alba*	12
4.	*Lipaphis erysimi*	*Brassica oleracea* var. *botrytis*	8,10
5.	*Lipaphis erysimi*	*Raphanus sativus*	8,12

(ii) From host plant, *Brassica juncea*:

The normal complement showed the diploid chromosome number as 2n=8 (Fig. 5). The karyotype (Fig. 6)depicts one long-sized pair, twomedium-sized pairs and one short-sized pair of chromosomes.The normal complement 2n=8 chromosomes were observed for the first time by Chattopadhyay and Roychaudhari (1980) in *L.erysimi*. Many workers such as Khuda-Bukhsh and Datta(1981);Khuda-Bukhsh and Pal (1984);Chen and Zhang (1985); Feng and You (1988); Kar and Khuda-Bukhsh (1991);Panigrahi and Patnaik (1991)worked on the chromosomes of *L.erysimi* and they reported the same chromosome number i.e. 2n=8. The measurements of all chromosomes are given in Table 2 and its idiogram is provided in Fig.17 (C).

(iii) From host plant, *Brassica alba*:

Sixteen samples were analyzed to establish its chromosome number and observed 2n=12 (Fig. 7). Its karyotype (Fig. 8) reveals one long-sized pair, three medium-sized pairs and two short-sized pairs of chromosomes. The metrical data are provided in Table 2 and its idiogram is drawn in Fig. 17 (D). The same chromosome number was observed by Panigrahi and Patnaik (1991).

(iv) From host plant, *Brassica oleracea* var. *botrytis*:

Out of 28 complements, nineteen complements had 2n=8 chromosomes (Fig. 9) and nine complements had diploid chromosome number as 2n=10 (Fig. 10). The complements having diploid chromosome number 2n=8 was also observed by Chattopadhyay and Roychaudhari in 1980 and the same

chromosome number were observed by many other workers such as Khuda-Bukhshand Datta(1981); Khuda-Bukhsh and Pal (1984); Chen and Zhang (1985); Feng and You (1988); Kar and Khuda-Bukhsh (1991);Panigrahi and Patnaik (1991).The karyotype is prepared by selecting the homologous pair of chromsomes. The normal complement 2n=8 were observed and its karyotype showed that there are one long-sized pair, two medium-sized pairs, one short-sized pair of chromosomes. The metrical data are given in Table 3 and idiogram is provided in Fig. 18 (A). The other abnormal complement 2n=10, its karyotype depicts one long-sized pair, two medium-sized pairs, one short-sized pair and two unpaired chromomomes. This chromosome number 2n=10 is in conformity with the earlier reports. The measurements of the chromosomes are given in Table 3 and its idiogram is provided in Fig 18 (B).

(v) From host plant, *Raphanus sativus* :

A total of twenty (20) samples were studied to establish its chromosome number from this host plant.11 samples were found to be normal 2n=8 (Fig. 13) and its karyotype (Fig. 14) was prepared which reveals one large-sized pair, two medium-sized pairs, one short-sized pair ofchromosomes. The metrical data of all the chromosomes are given in Table 3 and its idiogram is provided in Fig. 18(C). Nine samples were found to be 2n=12 (Fig. 15) and its karyotype (Fig. 16) which depicts the presence of one long-sized pair, four moderately shorter-sized pairs and one shortest-sized pair of chromosomes. Panigrahi and Patnaik in 1991 also observed the same abnormal chromosome number 2n=12. The metrical data of the chromosomes are given in Table 3 and its idiogram is drawn in Fig.18 (D).

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Table 2: Metrical data of chromosomes (Normal & Abnormal) of *Lipaphis erysimi* collected from different hostplants.

Chromosome Number	*Brassica campestris* (2n=10) (Abnormal)		*Brassica campestris* (2n=12) (Abnormal)		*Brassica juncea* (2n=8) (Normal)		*Brassica alba* (2n=12) (Abnormal)	
	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E
1.	3.95 ± 0.62	9.50 ± 0.12	5.25 ± 0.19	12.75 ±0.27	6.25 ± 0.52	13.27 ±0.27	7.11 ± 0.46	12.94 ± 0.53
2.	3.95 ± 0.62	9.50 ± 0.12	5.25 ± 0.19	12.75 ±0.27	6.25 ± 0.52	13.27 ±0.27	7.11 ± 0.46	12.94 ± 0.53
3.	3.16 ± 0.33	9.00 ± 0.50	4.51 ± 0.18	10.57 ±0.17	5.01 ± 0.47	12.99 ±0.50	6.06 ± 0.18	10.94 ± 0.34
4.	3.16 ± 0.33	9.00 ± 0.50	4.51 ± 0.18	10.57 ±0.17	5.01 ± 0.47	12.99 ±0.50	6.06 ± 0.18	10.94 ± 0.34
5.	2.91 ± 0.14	7.98 ± 0.41	3.87 ± 0.19	9.27 ± 0.15	4.93 ± 0.30	12.32 ±0.46	5.35 ± 0.48	9.76 ±0.54
6.	2.91 ± 0.14	7.98 ± 0.41	3.87 ± 0.19	9.27 ± 0.15	4.93 ± 0.30	12.32 ±0.46	5.35 ± 0.48	9.76 ±0.54
7.	2.21 ± 0.19	4.89 ± 0.22	3.45 ± 0.17	8.53 ± 0.12	2.84 ± 0.36	7.25 ± 0.42	3.99 ± 0.45	7.61 ±0.49
8.	2.21 ± 0.19	4.89 ± 0.22	3.45 ± 0.17	8.53 ± 0.12	2.84 ± 0.36	7.25 ± 0.42	3.99 ± 0.45	7.61 ±0.49
9.	1.26 ± 0.20	3.12 ± 0.41	2.08 ± 0.11	5.51 ± 0.15	–	–	2.43 ± 0.40	4.37 ±0.39
10.	1.26 ± 0.20	3.12 ± 0.41	2.08 ± 0.11	5.51 ± 0.15	–	–	2.43 ± 0.40	4.37 ±0.39
11.	–	–	1.95 ± 0.14	4.83 ± 0.19	–	–	2.14 ± 0.23	4.34 ±0.45
12.	–	–	1.95 ± 0.14	4.83 ± 0.19	–	–	2.14 ± 0.23	4.34 ±0.45
	Mean T.C.L in microns = 25.32 ± 0.45		**Mean T.C.L in microns = 42.08 ±1.93**		**Mean T.C.L in microns = 35.04 ± 1.36**		**Mean T.C.L in microns = 52.95 ± 1.51**	

Table 3: Metrical data of chromosomes (Normal & Abnormal) of *Lipaphis erysimi* collected from different host plants.

Chromosome Number	*Brassica oleracea var. botrytis* (2n=8) (Normal)		*Brassica oleracea* var. *botrytis*(2n=10) (Abnormal)		*Raphanus sativus* (2n=8) (Normal)		*Raphanus sativus* (2n=12) (Abnormal)	
	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E	Mean Actual Length in microns ± S.E	Mean relative percentage length ± S.E
1.	5.26 ± 0.26	13.16 ± 0.37	7.28 ± 0.24	16.15 ± 0.31	6.85 ± 0.32	13.55 ± 0.66	5.45 ± 0.40	12.81 ± 0.16
2.	5.26 ± 0.26	13.16 ± 0.37	7.28 ± 0.24	16.15 ± 0.31	6.85 ± 0.32	13.55 ± 0.66	5.45 ± 0.40	12.81 ± 0.16
3.	4.22 ± 0.52	12.32 ± 0.51	6.25 ± 0.52	13.27 ± 0.27	5.41 ± 0.30	12.78 ± 0.24	4.22 ± 0.52	12.32 ± 0.51
4.	4.22 ± 0.52	12.32 ± 0.51	6.25 ± 0.52	13.27 ± 0.27	5.41 ± 0.30	12.78 ± 0.24	4.22 ± 0.52	12.32 ± 0.51
5.	3.71 ± 0.46	8.67 ± 0.80	6.02 ± 0.18	11.34 ± 0.08	4.85 ± 0.39	11.42 ± 0.37	3.53 ± 0.31	9.21 ± 0.11
6.	3.71 ± 0.46	8.67 ± 0.80	6.02 ± 0.18	11.34 ± 0.08	4.85 ± 0.39	11.42 ± 0.37	3.53 ± 0.31	9.21 ± 0.11
7.	2.39 ± 0.30	7.26 ± 0.43	4.35 ± 0.52	12.44 ± 0.70	4.01 ± 0.24	9.52 ± 0.19	3.31 ± 0.27	8.71 ± 0.16
8.	2.39 ± 0.30	7.26 ± 0.43	4.35 ± 0.52	12.44 ± 0.70	4.01 ± 0.24	9.52 ± 0.19	3.31 ± 0.27	8.71 ± 0.16
9.	–	–	1.55 ± 0.12	3.39 ± 0.16	–	–	2.02 ± 0.45	5.82 ± 0.34
10.	–	–	4.45 ± 0.25	9.86 ± 0.31	–	–	2.02 ± 0.45	5.82 ± 0.34
11.	–	–	–	–	–	–	1.92 ± 0.16	3.48 ± 0.19
12.	–	–	–	–	–	–	1.92 ± 0.16	3.48 ± 0.19
	Mean T.C.L in microns = 31.26 ± 3.20		Mean T.C.L in microns = 53.08 ± 2.04		Mean T.C.L in microns = 40.15 ± 3.30		Mean T.C.L in microns = 40.89 ± 3.51	

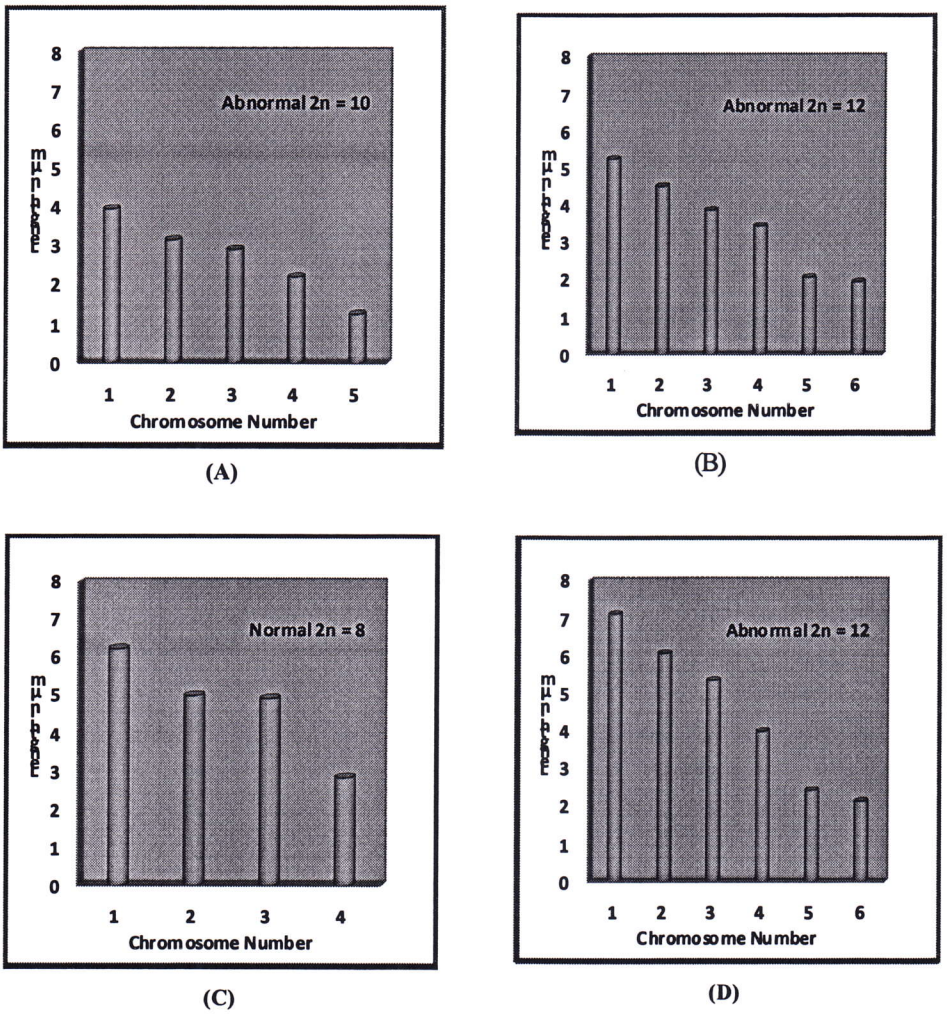

Fig. 17 Idiograms of *Lipaphis erysimi* from host plant *Brassica campestris,* (2n=10, Abnormal) (A) and (2n=12, Abnormal) (B); From*Brassica juncea* (2n=8, Normal) (C); From *Brassica alba* (2n=12, Abnormal) (D).

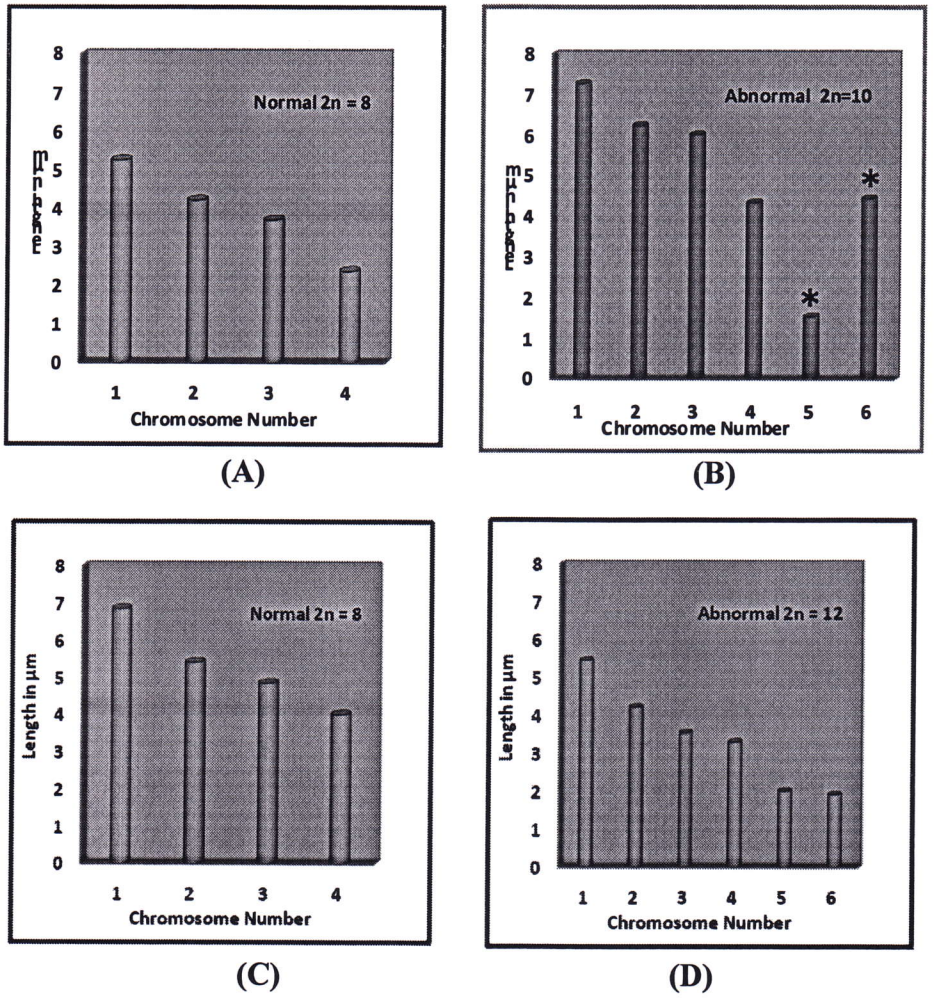

Fig. 18 Idiograms of *Lipaphis erysimi* from host plant *Brassica oleracea* var.*botrytis* (2n=8, Normal) (A) and (2n=10, Abnormal) (B); From *Raphanus sativus*(2n=8, Normal) (C) and (2n=12, Abnormal) (D).

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References

Ahlawat, Y.S. and. Chenulu, V.V. 1982. Studies on the transmission of raddish mosaic virus by aphid. Lipaphis erysimi. **Indian Phytopathol35: 633-638.**

Bakhetia, D.R.C. 1983. Losses in rapeseed and mustard due to Lipaphis erysimi (Kaltenbach) in India-A literature study.**Int. Rapeseed conf. 6: 6-12.**

Baketia, D.R.C. 1987. Insects pests of rapeseed-mustard and their management. In: Veerbhadra Rao, M. and Sithanathan, S. (eds). **Plant Protection in field Crops.** PPAI, Rajendranagar, pp.249-259.

Bonnemaison, L. 1965. Insects pests of crucifers and their control. **Annu. Rev. Entomol.10: 230-256.**

Bridges, M.; Jones, M.E.; Bones, A.M.; Hodgson, C.; Cole, R.; Bartlet, E.; Wallsgrove, V.; Karapapa, K.V.; Watts, N. and Rossitter, J.T. 2001. Special organization of the glucosinate-myrosinase system in Brassica specialist aphids is similar to that of the host plant. **Proc. R. Soc.Lond. Ser B 233: 1-5.**

Chattopadhyay, D. and Raychaudhuri, D.N. 1980. Chromosomal studies on aphids (Homoptera : Aphididae). **Science and Culture Vol. 46 (9): 326-328.**

Chen, X.S. and Zheng, G.X. 1985. Comparison and analysis on the chromosome C-banding pattern of Lipaphis erysimi(Kaltenbech) and Aphis craccivora Koch. **Acta. Entomol. Sinica 28: 271-273.**

Feng, H.T. and You, B.Y. (1988). Studies on host plant related chromosome polymorphism in the Turnip aphid, Lipaphis erysimi. **Plant ProtectionBulletin 30: 135-147.**

Guan, Z. H. and Wang, S. 1980. The influence of the aphid (Lipaphis erysimi, Myzus persicae) saliva on the infectivity of TPMV (Turnip Mosaic Virus) on Chinese Cabbage. **Acta. Chem. Sin. 1: 83-85.**

Gut, J. 1976. Chromosome number of parthenogenetic females of fiftyfive species of Aphididae (Homoptera) new to Cytology.**Genetica 60:139-150.**

Kar, I. and Khuda-Bukhsh, A.R. 1991. Nucleolar Organizer Regions (NORs) in the chromosomes of an aphid Lipaphis erysimiKalt. (Homoptera: Aphididae) with variable chromosome numbers. **Cytologia56: 83-86.**

Khuda-Bukhsh, A.R. and Datta, S. 1981. Somatic chromosomes of four species of aphids (Homoptera: Aphididae). **Perspectives in Cytology** and Genetics (eds G.K. Manna and U. Sinha). Hindesia Publisher, Delhi Vol.1: 121-124.

Khuda-Bukhsh. A.R. and Pal, N.B. 1984). A further cytological investigation on *Lipaphis erysimi* (Homoptera: Aphididae): Chromosomal variations. Perspectives in Cytology and Genetics (eds. G.K. Manna & U. Sinha), Hindesia Publisher, Delhi Vol. 4: 403-409.

Kulkarni, P.P. and Kacker, R.K. 1979. Chromosomes of four species of aphids (Homoptera:Aphididae). Bull. Zool. Surv. India 2(1): 1-2.

Kurl, S. P. 1978. Chromosome number of ten species of aphids.Chromo. Inf. Serv 25: 17-18.

Kurl, S.P. 1986a. Variation in chromosome numbers and structural heterozygosity in ten species of aphids (Homoptera: Aphididae) from Meghalaya.Proc. 2nd. Nat. Symp. Recent Trends in Aphidological Studies.: 327-331.

Kurl, S.P. 1986b. Variation in chromosome numbers and structural heterozygosity in ten species of aphids (Homoptera: Aphididae) from Meghalaya. Proc. 2nd. Nat. Symp. Recent Trends in Aphidological Studies (Editor S.P. Kurl): 327-331.

Kurl, S.P. and Misra. S.D. 1981. Studies on the mitotic chromosomes of two species of aphids (Homoptera:Aphididae). Proc. III. All India Congress, Cytology and Genetics. Hissar, 1978 as Perspectives in Cytology and Genetics(Eds. G.K. Manna & U. Sinha) Vol.3: 125-130.

Kurl, S. P. and Narang, R. C. 1978. An air dry method for cytologicalpreparations of aphids (Homoptera: Aphididae). **Curr. Sci. 47:**837-838.

Liu, S.S.; Wang, X.G.; Wu, X.J.; Z.H.; Chen, Q.H. and Hu, X.X. (1997). Population fluctuation of aphid on crucifer vegetables in Hangzhou suburbs, **China. Acta. Appl. Ecol. 8 : 510-514.**

Liu, T. and Yue, B. 2001. Comparison of some life history parameters between alatae and apterous forms of turnip aphid (Homoptera:Aphididae) on cabbage under constant temperatures. **Florida Entomol. 84**:239-242.

Malik, R.S. and Anand, I.J. (1984). Effect of aphid infestation on the oil yielding attributes in *Brassica*. **J. Oilseeds Res. 1**:147-155.

Panigrahi, C.B. and Patnaik. S.C. 1991. Chromosome number in twenty species of Indian aphids (Aphididae: Homoptera:Insecta). Nat Acad. Sci. Letters.14(1): 37-39.

Prasad, S.K. and Phadke, K.G. 1988. Population dynamics of Lipaphis erysimi (Kaltenbach) on different varieties of *Brassica* species. **Indian J.Entomol. 42:** 54-63.

Rohilla, H.R.; Singh, H.; Kalra, V.K. and Kharub, S.S. 1987. Losses caused by mustard aphid Lipaphis erysimi (Kaltenbach) in different Brassica genotypes. **Proc. Int. Rapeseed Congr. 7**: 1077-1084.

Singhvi, S.M.; Verma, N.D. and Yadav, T.P. 1973. Estimation of losses in rapeseed (Brassica campestris L.var. toria) and mustard, Brassica juncea (L.)**Ann.Biot.16:145-148.**

Tripathi, N.K.; Jangral, S.; Kaur, P. and Poonam 2013. Karyological studies on Aphis nerii and Lipaphis erysimi (Insecta : Homoptera) from Jammu and Kashmir (Western Himalayas), India. **Asian Academic Research Journal of Multidisciplinary. 1(15):**

You, B.Y.; Feng, H.T. and Wang, T.C. 1982. Study on the insecticides resistance of turnip aphid Lipaphis erysimi (Kaltenbach) I. 2N=8+1. N=integer, 1=B-chromosome. **Plant Prot. Bull. 24: 294** (Abstr., in Chinese).

Legends

Figs. 1 and 2 *of Lipaphis erysimi collected from Brassica campestris; Abnormal complement (2n=10) (Fig. 1), its karyotype (2n=10) (Fig. 2).*

Figs. 3 and 4 *of Lipaphis erysimi collected from Brassica campestris; Abnormal complement (2n=12) (Fig. 3), its karyotype (2n=12) (Fig. 4).*

Figs. 5 and 6 *of Lipaphis erysimi collected from Brassica juncea; Normal complement (2n=8) (Fig. 5), its karyotype (2n=8) (Fig. 6).*

Figs. 7 and 8 *of Lipaphis erysimi collected from Brassica alba; Abnormal complement (2n=12) (Fig. 7), its karyotype (2n=12) (Fig. 8).*

Figs. 9 and 10 *of Lipaphis erysimi collected from Brassica oleracea; Normal complement (2n=8) (Fig. 9), its karyotype (2n=8) (Fig. 10).*

Figs. 11 and 12 *of Lipaphis erysimi collected from Brassica oleracea; Abnormal complement (2n=10) (Fig. 11), its karyotype (2n=10) (Fig. 12).*

Figs. 13 and 14 *of Lipaphis erysimi collected from Raphanussativus; Normal complement (2n=8) (Fig. 13), its karyotype (2n=8) (Fig. 14).*

Figs. 15 and 16 *of Lipaphis erysimi collected from Raphanussativus; Abnormal complement (2n=12) (Fig. 15), its karyotype (2n=12) (Fig. 16).*