Ten commandments for Ph D aspirants

At the very first thought doing a Ph D should be considered as fun and rewarding given that you can spend all your energy and time on exploring the unexplored and pursuing your ideas and getting paid for this in return. But as the saying goes 'Nothing is what it seems'. Truly enough, most Ph D students end up on a 'no man's land'. As a consequence, only a few of them are able to fulfil their dreams of becoming recognized scientists. The main reason for this is that a Ph D degree is considered as a fortifying requirement for getting highly paid jobs and not as a training ground for discovering new things and making breakthroughs. Moreover, the ever-increasing pressure on universities to roll out as many Ph Ds as possible leads to enrolment of far too many students, without actually informing them clearly what a doctorate should entail.

Additionally, as only limited funds are associated with Ph D programmes, students generally end up joining for Ph D with a meagre amount of scholarship or worst, without any. Thus students have to rely totally on their research guides for funds. And this is exactly where they unknowingly surrender all their dreams and aspirations, ultimately setting themselves on a path of despair and disappointment.

So, I address a few pointers to a prospective Ph D student so that he/she can avoid this path.

1. First of all and most importantly, choose a subject of your interest.
2. Research is like climbing a mountain and your research supervisor is your trek guide; make sure he/she is a seasoned mountaineer and is equipped with all required climbing gears. In other words, choose a research guide who is known for his/her work in your area of interest and who is well supported by grants and departmental infrastructure.
3. Think 'out of the box'. Learn how to get out of old thought patterns and develop innovative thinking habits. Do not look at your Ph D as a road map laid down by your research guide.
4. Have a fetish for reading. Do a sound literature survey before taking up any project; it will only help you cruise through the initial phase of decision-making. The more you read the more you know.
5. Be a keen observer. Every invention starts with a strange and unique observation. Look for clues, they are out there.
6. 'The important thing is not to stop questioning' said Albert Einstein. Be curious. Ask penetrating questions. Think about what you are doing and why? And look around for better ways to go about it.
7. Make sure that your research guide is accessible. Have discussions as and when possible. Remember – two brains are always better than one.
8. Implement your ideas, even the crazy ones! You never know some of them might just click.
9. 'If it's not documented it's not done'. Always maintain a good record book and update it regularly.
10. Believe in hard work. And do take breaks; it will only help you in revitalizing yourself.

To be a good researcher you need to be intelligent, learned, motivated, passionate, creative, hardworking and lucky. You cannot depend on your luck alone, so better focus on the others aspects as well.

ASHOK PATEL

Pharma Division,
MUICT, Matunga,
Mumbai 400 019, India
e-mail: prashokgoa@yahoo.com

Hybrid sterility in mosquitoes

A comprehensive review by Mishra and Singh[1] on hybrid sterility in *Drosophila* led us to review our data on mosquitoes that represent some of the best studied taxa at various levels of genetic organization. Much work has been done on the *Aedes* (*Stegomyia*) *scutellaris* group of mosquito species that have insular pattern of distribution in the islands of the South Pacific, and offer opportunity to study speciation events as a function of evolutionary timescale[2]. Owing to their unique zoogeography and medical importance as vectors of lymphatic filariasis, a wealth of data has been accumulated on experimental hybridization, chromosomal differentiation, population genetics, mate-choice experiments as indicators of ethological divergence, and molecular organization of genomes[3,4].

There are over 30 closely related species in the *Ae. scutellaris* group, many of which can easily be brought into laboratory culture and cross-mated to ascertain the hybrid fertility based on backcrosses to either parent. It was observed that in many of the interspecific crosses, hybrids exhibited differential fertility when backcrossed to each of the two parents. For example, hybrid males from the cross *Ae. kesseli* females × *Ae. polynesiensis* males yielded lower fertility (< 50% of egg hatch) irrespective of the female parent used, whereas in the reciprocal cross, hybrid males resulted in lower fertility when backcrossed to females of *Ae. polynesiensis* than of *Ae. kesseli* (Table 1)[5]. Similarly, hybrid males from the cross *Ae. pseudoscutellaris* females × *Ae. kesseli* males resulted in lower fertility when backcrossed to females of *Ae. kesseli* than of *Ae. pseudoscutellaris*. Such differential hybrid fertility data were also recorded in several other member species of this group[6].

This phenomenon could in part be accounted for based on anomalous cytology of reciprocal hybrids characterized by asynaptic bivalents, aneupolid cells, and crossover products of paracentric inversion heterozygotes (Table 1)[7]. Amongst the three bivalents ($2n = 6$), generally the smallest chromosome pair which possesses the locus for sex determination, was asynaptic. The extent of asynapsis was representative of genetic dissimilarity between species that could be attributed to paracentric inversion(s), deletion or duplication in one of the homologues characterized by chromosome length differences resulting in formation of unequal bivalents, and

Table 1. Backcross fertility and cytology of interspecific hybrids of the *Aedes* (*Stegomyia*) *scutellaris* group of mosquitoes[a]

Cross[b]				Fertility		Hybrid male cytology			
Females	x	Males	*N*[c]	No. of eggs	Per cent egg hatch	Per cent asynapsis (achiasmate bivalents)	Mean chiasma ± SE per cell	Per cent aneuploid cells (2*n* – 1)	Per cent cells abnormal at anaphase-I
PO	x	F_1 (PO × KE)[d]	2	896	43	69	3.31 ± 0.06	9.92	13[e]
KE	x	F_1 (PO × KE)	1	790	74				
PO	x	F_1 (KE × PO)	3	3042	43	68	3.09 ± 0.06[g]	0	95[f]
KE	x	F_1 (KE × PO)	3	4381	45				
PS	x	F_1 (PS × KE)	1	1153	78	54	3.35 ± 0.06	33.5	41[e]
KE	x	F_1 (PS × KE)	2	2049	23				

[a]Source: References 5, 7.
[b]PO, *Ae. polynesiensis*; PS, *Ae. pseudoscutellaris*; KE, *Ae. kesseli.*
[c]N, Number of replicates.
[d]The first named species in parenthesis was used as the female parent.
[e]Dicentric bridge (DB) + acentric fragment (AF).
[f]DB + AF, and chromosomal breakages.
[g]Significantly different from reciprocal hybrids at 0.05 level.

mean chiasma frequency differences. Moreover, chromosomal breakages in certain species of hybrids observed only in one of the reciprocal crosses were suggestive of the interaction between the cytoplasm of one parent with the genome of another. For example, the cytology of male hybrids between *Ae. kesseli* females × *Ae. polynesiensis* males was highly anomalous when compared to reciprocal hybrids. At anaphase-I, 95% of the primary spermatocytes of the former interspecific cross had chromosomal breakages and/or dicentric bridges accompanied by acentric fragments, while only 13% of cells were abnormal in reciprocal hybrids[7]. Apparently greater proportions of sperms of the (KE × PO) hybrids were non-functional or led to postzygotic lethality, resulting in lower fertility. The chromosomal breakages could not be attributed to chromosomal rearrangements alone, but must ensue from some interaction between cytoplasm of female parent and genome of male parent, which contributed to overall genetic isolation between species. Such differential fertility in interstrain crosses have also been documented in *Drosophila*, referred to as dysgenic trait[8]. The cytoplasmic/genomic interaction was further affirmed by non-reciprocal fertility observed between several other species of this group, a phenomenon that was ascertained to be a key factor for restricting gene flow[9,10]. In *Ae. scutellaris*, it was also established that non-reciprocal fertility/unidirectional incompatibility, when observed, was complete and permanent, and showed strictly maternal mode of inheritance.

In conclusion, we believe that hybrid male sterility that ensued from postzygotic reproductive isolation was attributable to chromosomal changes, which together with cytoplasmic differentiation have been potent factors in evolution and speciation in mosquitoes. Interestingly, it was the morphological characteristics of the male terminalia of adults that were diagnostic for species identification, which could be related to ethological isolation between species otherwise morphologically inseparable[11,12].

1. Mishra, P. K. and Singh, B. N., *Curr. Sci.*, 2005, **89**, 1813–1819.
2. Belkin, J. N., *The Mosquitoes of the South Pacific*, University of California Press, Berkeley, 1962, 2 vols, p. 608 and 412.
3. Rai, K. S., *J. Genet.*, 1999, **78**, 163–169.
4. Rai, K. S. and Black IV, W. C., *Adv. Genet.*, 1999, **41**, 1–33.
5. Dev, V. and Rai, K. S., In Proceedings of the Symposium on the Evolutionary Significance of Insect Polymorphism (eds Stock, M. W. and Bartlett, A. C.), Univ. of Idaho, Moscow, 1982, pp. 89–105.
6. Dev, V. and Rai, K. S., *Ann. Trop. Med. Parasitol.*, 1985, **79**, 325–331.
7. Dev, V. and Rai, K. S., *Genetica*, 1984, **64**, 83–92.
8. Kidwell, M. G., Kidwell, J. F. and Sved, J. A., *Genetics*, 1977, **86**, 813–833.
9. Dev, V., *Experientia*, 1986, **42**, 803–806.
10. Sherron, D. A. and Rai, K. S., *J. Med. Entomol.*, 1983, **20**, 520–525.
11. Huang, Y. M. and Hitchcock, J. C., *Contrib. Am. Entomol. Inst.*, 1980, **17**, 1–107.
12. McLain, D. K., Rai, K. S. and Rao, P. N., *Evolution*, 1985, **39**, 998–1108.

VAS DEV[1,*]
KARAMJIT S. RAI[2]

[1]*National Institute of Malaria Research (ICMR),*
P.O. Sonapur,
Assam 782 402, India
[2]*Jaswant Singh Rai Nagar,*
P.O. Randhawa, Masandan,
Jalandhar 144 004, India
**e-mail: mrcassam@hotmail.com*