PROFORMA FOR SUBMISSION OF RESEARCH PROJECTS

PART –1 : GENERAL INFORMATION

200	**Project code**	
2001	Institute Project Code No.	**IGFRI CI 5.4**
2002	ICAR Project Code No.	
201	**Name of Institute and Division**	
2011	Name & Address of Institute	Indian Grassland and Fodder Research Institute Jhansi – 284003 India
2012	Name of Division/section	Crop Improvement Division
2013	Location of Project	IGFRI, Jhansi
202	**Project Title**	**Basic studies on apomixis and generating cytogenetic stocks in *Pennisetum* and *Panicum* agamic complex**
203	**Priority area**	Genetic improvement of forage crops
2031	Research Approach	Applied Research 01; Basic Research 02; Process /or technology Development 03; Transfer of Technology 04 **02 and 03**
204	**Specific area**	Forage crop improvement
205	**Duration of Project**	
2051	Date of start	2010
2052	Date of completion	2015
206	**Total cost /expenditure incurred**	21.5 Lakh
2061	**Foreign Exchange component (if any)**	No
207	**Project profile summary**	Please see annexure
208	**Key words**	Guinea grass, Pearl millet, cytogenetics, ploidy-levels, *Pennisetum*, interspecific hybridisation, alien introgression

Part - II: Investigator Profile

210	**Principal investigator**	
2101	Name	**Dr. Mridul Chakraborti**
2102	Designation	Scientist
2103	Division/section	Crop Improvement
2104	Location	Jhansi
2105	Institute Address	IGFRI Jhansi – 284003

211	**Co-investigator**	
2111	Name	**Dr. D. R. Malaviya**
2112	Designation	Principal Scientist
2113	Division/section	Seed Technology Division
2114	Location	Jhansi
2115	Institute Address	IGFRI Jhansi – 284003

212	**Co-investigator**	
2121	Name	**Dr. A. K. Roy**
2122	Designation	Principal Scientist
2123	Division/section	GSM Division
2124	Location	Jhansi
2125	Institute Address	IGFRI Jhansi – 284003

Part - III: Technical Details

220 Introduction and objectives:

2201 Origin of the project: (Problem identification)

The development of new approaches to improve breeding efficiency of tropical forage grasses is of great importance. Screening for apomixis in progeny and in the wild, to detect the type of apomixis and to analyze the principal morphological and functional regulation of apomictic seed formation is one such component. Apomixis is an asexual mode of plant reproduction through seeds. A common feature of all apomicts is the autonomous development of embryos and the generation of progenies that are exact genetic replicas of the mother plant. The aims of studying apomixis are to unlock the diversity of apomictic plants and to make it feasible to transfer apomixis to agriculturally important genotypes. Molecular techniques will be useful to study the organization of agamic complex of apomictic plants and to identify the genes responsible for apomixes. *Pennisetum* and *Panicum* agamic complex can be utilized for such detailed characterization.

Pearl millet (*Pennisetum glaucum* L.) is a dual purpose crop (food and fodder) popular amongst farmers because of its productivity, drought tolerance and nutritional quality. It is also a preferred crop for cytogenetic analysis because of its low chromosome number ($2n$=14), shorter life cycle, protogynous flowering, large number of seeds per plant and high responsiveness to artificial pollination. One of the approaches for pearl millet improvement is to conduct studies on genetic and genomic make up through interspecific hybridisation. Most of the species, with potential for pearl millet improvement, are wild, polyploid and belong to secondary and tertiary genepool, which limits the success of interspecific hybridisation with diploid pearl millet. Enhancement in ploidy status in cultivated pearl millet to tetraploid level has proved useful for improving success rate in hybridisation. Further, such interspecific hybrids are important resources to develop alien addition lines, which in turn may provide desirable material for genome analysis, gene introgressions and molecular mapping studies. Further, induced polyploids when coupled with appropriate hybridisation schemes may yield a variable ploidy series with increments on haploid genome dose whose study may yield information on ploidy dependent gene regulation. In view of these, a project on generation of cytogenetic stocks in pearl millet for interspecific hybridisation and alien gene introgressions in envisaged.

Ploidy series from 3x to 9x and mapping population from the cross of sexual and apomictic guinea grass is already available. This may be useful for study of ploidy

2212: Methodology:

- Ploidy modification: colchicine treatment (varied strength) to seeds and/or seedlings
- Identification of polyploids using flow cytometry and microscopy
- Crossing attempts with artificial pollination utilizing protogyny of female parent
- Testing hybrid performance of tetraploids in diallel fashion
- Molecular analysis of parental lines with RAPD/SSR/RFLP markers
- Cytological studies utilizing meiotic/mitotic /flowcytometric preparations

2213: Plan of action:

The execution of project will involve following steps:

- Ploidy modifications following colchicine treatment and hybridisations
- Performance of tetraploids vis-a-vis diploid cultivars.
- Crossability of wild species with tetraploid or higher pearl millet
- Evaluation of segregants from *P. glaucum* x *P. squamulatum* crosses vis-a-vis competitive grasses.
- Production of alien chromosome addition lines.
- Molecular studies on segregating progenies of (apo x sex, High BIII x sex and reciprocal) intervarietal and interspecific crosses in *Pennisetum* and *Panicum.*

2214: Time schedule for activities (milestones)

Description of activity	**Time (months)**
Ploidy modifications following colchicine treatment and hybridisations	48
Performance of tetraploids vis-a-vis diploid cultivars.	36
Crossability of wild species with tetraploid or higher pearl millet	36
Hybrid performance of tetraploids	48
Evaluation of segregants from *P. glaucum* x *P. squamulatum* crosses	36
Molecular studies on segregating progenies	48

2215: Annual Targets for each activity:

Description of activity	**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**
Ploidy modifications following colchicine treatment and hybridisations	Establishment of induced tetraploid lines	Attempt to induce colchiploidy, their establishment and crossings	Attempt to induce colchiploidy, their establishment and crossings	Establishment of ploidy series	Compilation of data and report writing
Hybrid performance of tetraploids	Procurement, establishment and multiplication of tetraploids	Attempt crosses in possible combinations between tetraploid pearl millet lines	Testing hybrid performance	Testing hybrid performance	Compilation of data and report writing
Evaluation of tetraploid Bajra vis a vis diploid	Procurement, establishment and multiplication of tetraploids	Station trial	Station trial	Compilation of data and report writing	

Crossability of wild species with tetraploid or higher pearl millet		Study crossability of pearl millet at different ploidy levels with polyploid species specially *P. purpureum*	Study crossability of pearl millet at different ploidy levels with polyploid species specially *P. purpureum*	Test of hybrid performance of tetraploid level crosses.	Test of hybrid performance of tetraploid level crosses. Compilation of data and report writing
Evaluation of segregants from *P. glaucum* x *P. quamulatum* crosses	Production/ multiplication of selected plants	Study of reproductive behaviour of selected plants. Station trial	Study of reproductive behaviour of selected plants. Station trial	Station trial	Compilation of data and report writing
Molecular studies on segregating progenies	Evaluation of different types of molecular markers in the selected species	Identification of polymormphic/ informative marker	Evaluation of segregating progenies with selected set of markers	Identification of linked marker	Validation of identified markers in the population. Compilation of data and report writing
Characterization of segregating progenies of apo x sex lines of guinea grass and ISH in *Pennisetum*	Embryosac analysis, flow cytometry,	Embryosac analysis, flow cytometry,	Embryosac analysis, flow cytometry,	Embryosac analysis, flow cytometry,	Compilation of data and report writing

2216: Estimated man-months: 30

222 Proposed Research details:

2221 Importance of the Proposed Project (gaps in knowledge/products/process technology) to the institute mandate.

Carrying out basic and strategic research on development of high yielding varieties of forage crops is the mandate of the division and the institute. The information generated in this project may provide useful insights into the mechanism of apomixis in *Pennisetum* and *Panicum* agamic complex besides a detailed genome analysis in the genus *Pennisetum* that contains many important crops for food and fodder purpose. The project fits well into mandate that includes basic as well as strategic research, especially on cytogenetic status of forage crops. It will help in formulating pathways for pre-breeding, generating information and products facilitating interspecific hybridization as well as our understanding on the regulation of traits that are dependent on ploidy levels especially apomixis.

2222 Questions attempted to be answered.

Effect of ploidy on interspecific compatibility, heterosis and expression of apomixis.

2361 Field preparation/planting/harvesting (man days/cost)
2362 Inter cultivation & dressing (man days/cost)
2363 Animal maintenance :
2364 Any other item
2365 Justification of above
237 Equipments:
2371 Equipments already available to be used in the project with cost:
2372 Equipments to be purchased with cost (already in plan document)
2373 Justification for each additional equipment
2374 Equipment to be imported
2375 Justification for import
238 Additional infrastructure facilities(if needed)
239 Financing organization: IGFRI, Regular budget

Part V : DECLARATION

This is to certify that:

- The research work proposed in the scheme/project does not in any way duplicate the work already done or being carried out in the institute project.
- The same project has been / has not been submitted to any other agency for financial support
- The investigator/co-investigator have been fully consulted in the development of project and have fully undertaken the responsibility to carry out the programme as per the technical programme.

31/7/10

Mridul Chakraborti
Principal Investigator

31/7/10

D. R. Malaviya
Co-investigator

A. K. Roy
Co-investigator

RPFI is as per IRC decision

Signature & Comments of the Head of the Division /section

2/8/10

Forwarded
Sanjay Kumar
05.08.10

Signature & Comments of the Director

PMER.

Annexure

207 Project profile summary: The development of new approaches to improve breeding efficiency of tropical forage grasses is of great importance. Screening for apomixis in progeny and in the wild, to detect the type of apomixis and to analyze the principal morphological and functional regulation of apomictic seed formation is one such component. Molecular techniques will be useful to study the organization of agamic complex of apomictic plants and to identify the genes responsible for apomixes. *Pennisetum* and *Panicum* agamic complex will be utilized in the present study for such detailed characterization.

Pearl millet (*Pennisetum glaucum* L.) is a dual-purpose crop (food and fodder), popular amongst farmers because of its productivity, drought tolerance and nutritional quality. It is also a preferred crop for cytogenetic analysis because of its low chromosome number ($2n$=14), shorter life cycle, protogynous flowering, large number of seeds per plant and high responsiveness to artificial pollination. One of the approaches for pearl millet improvement is to conduct studies on genetic and genomic make up through interspecific hybridisation. Ploidy manipulation in such cases will be very much useful for alien introgression from tertiary gene pool and developing cytogenetic stocks that will be useful for carrying out basic studies on genome analysis, gene introgressions and molecular mapping. Further, induced polyploids when coupled with appropriate hybridisation schemes may yield a variable ploidy series with increments on haploid genome dose whose study may yield information on ploidy dependent gene regulation.

In view of these, this project on basic studies on apomixis and generating cytogenetic stocks in *Pennisetum* and *Panicum* agamic complex have been developed.