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GENES Intra-Africa Academic Mobility Project
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Mobility for plant genomics scholars to accelerate climate-smart adaptation options and food security in Africa / GENES

Student Project guidelines

Before now, evaluation and identification of genetic variants of interest as well as the selection methodologies were largely based on phenotypic evaluation. Presently, genomics provides breeders with a new set of tools and techniques that allow the study of the whole genome, and which represents a paradigm shift, by facilitating the direct study of the genotype and its relationship with the phenotype. It is expected that the combination of conventional breeding techniques with genomic tools and approaches lead to a new genomics-based plant breeding which is essential to develop more efficient plant cultivars necessary for the new 'greener revolution' needed to feed the world's growing population while preserving natural resources.

Students are to propose an approach to use genomic tools to enhance breeding of selected crops to accelerate climate-smart adaptation options and food security in Africa. A critical component of your application involves the demonstration that new genomic tools are indispensable in the development of improved cultivars that contribute to national food security, economic vibrancy and enhanced resilience against climate impacts in sub-Saharan Africa. Applicants are encouraged to develop a proposal to strategically apply high-throughput DNA sequencing technologies - next generation sequencing (NGS) methods and other genome-wide molecular tools (large collections of markers, high-throughput genotyping strategies, high density genetic maps, new experimental populations, etc.) that can be incorporated into existing breeding methods to increase genetic gains, accelerate product development timetable, and/or improve efficiency. The proposal will state the rationale and approach in the context of principles of plant breeding and should be well integrated into national or regional plan. The crop of focus will be one of the crops identified by each partner (visit project website), depending on university and country of choice.

Topic of interest may include (but not limited to):

- Genome-wide genetic diversity studies capable of capturing the spectrum of variability in natural and breeding populations.
- Identification of molecular markers linked to single genes and QTLs of interest
- Use of marker-assisted selection for improvement of quantitative traits;
- Use of association mapping, 'breeding by design', gene pyramiding, genomic selection (GS), etc

Expected Outline

1) Title (descriptive statement of your focus, including crop common name and Latin genus-species name)

2) Background information on the crop (explain (**in brief)** what is relevant as a backdrop for your proposed strategy so that the merit of your proposal can be assessed by one who has had little previous knowledge of your crop). This might include all/most of the following:

a. crop uses, user groups
b. history of domestication and genetic improvement
c. botany, biology, reproductive mechanisms
    i. is your crop asexually or sexually propagated?
    ii. is it cross- or self-pollinated, or is there apomixis?

iii. is self-incompatibility, male sterility, or genetic control of sex expression important in production or breeding of this crop?
iv. What is the floral morphology and pollination technique for making crosses?

d. cultivar types (are new releases open-pollinated varieties, hybrids, etc.?)
e. known genetic aspects of the crop
i. Ploidy level
ii. Chromosome number
iii. Genetic, physical, or cytological maps
iv. Named genes related to traits of interest
v. Marker sets
vi. Is transformation an option in your crop?
f. germplasm collections
i. What are the centers of origin or centers of diversity for your crop and its related species?
ii. List related species, which intercross with your crop.
g. Key traits (What are the important characteristics of the crop? Which would be necessary for the ideal cultivar to have considering yield, quality and stress resistance?).
i. reasons for importance of the trait
ii. qualitative or quantitative; how many genes involved?
iii. gene action, heritability (as per the literature), GxE
iv. heterosis

3) Rationale (why do you think the proposal will work and that the proposed genomic tool going to enhance conventional breeding in this area)
a. What challenge does the proposal focus on?
b. What previous approach is replaced?
c. Why is the proposed approach better? What efficiencies are gained? Show the specifics of the expected benefit e.g. an increase in genetic gain with the proposed approach? Will it be time saving? Enhance adaptation of crops to marginal areas?

4) Breeding objective addressed (clearly state your relevant breeding objective in light of your product target and your target market region). This sets the stage for explaining how your new application fits in.

5) Proposed approach, which might include all/most of the following:
a. sources of improved germplasm or favorable genes; choice of parents
b. breeding plan
c. breeding methods utilized
d. testing regime: what, how, where?
e. strategy for data analysis
f. timeline
g. technologies included and their use explained

6) This section serves as a summary of sorts. Forecast the outcome and impact of the new application to your breeding program, your organization, your crop end-user, etc.

7) Address risks associated with potential problems in implementing your proposal.

8) Outline budget needs for implementation. Depending on your project focus, you may also wish to describe projected savings with an improved approach.

9) References cited (Use format for Crop Science journal (http://crop.scijournals.org).