IFAR 2005 Professional Development Program

Completion Report

[800 words]

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Please check if Thalwitz Scholarship ***Yes***

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Sponsoring CGIAR Center	**ICRISAT**

IFAR-PROGRESS REPORT

Background work

Salinity affects plant growth, development and yield in approximately 100 M ha of arable land worldwide. Besides the various management options available, the introduction of salinity tolerant varieties in such areas could partly ease the increasing global food demand. To set up a screening method for salinity tolerance, six groundnut (ICGS 10, ICGS 44, ICGS 76, ICGV 86031, JL 24, and TAG 24) and six pigeonpea (ICPL 88039, ICPL 88034, ICPL 87119, ICPL 96058,ICP 7035 and ICPL 366) genotypes were screened by conducting two experiments, in soil treated with five different NaCl (mM) concentrations (0, 50, 100, 125, 150) and (0, 50, 75, 100, 150) respectively for both the crops, under controlled conditions. Salt concentration of 100-125 mM was found to be critical to screen groundnut genotypes and 75 mM for pigeonpea. In case of groundnut, tolerant genotypes showed a relatively lower reduction in leaf area compared to control. For pigeonpea, SCMR was positively associated with higher biomass under salinity and could be used as an early indicator for salinity tolerance.

PERFORMANCES OF 288 GROUNDNUT AND 300 PIGEONPEA GENOTYPES FOR SALINITY TOLERANCE:

Plant growth:

Using the protocol defined earlier, a large set of pigeonpea and groundnut genotypes have been screened for salinity tolerance at ICRISAT. For groundnut we have included mini-core collection of ICRISAT (188 accessions), 34 genotypes have been selected from an area affected by salinity (Chaco area of Argentina, Paraguay, and Bolivia), and 64 breeding lines. Some varieties released in India and other countries and some registered breeding lines have also been included in this study. In case of pigeonpea, the materials were 150 genotypes of the mini core collection maintained by genetic resource unit at ICRISAT, 68 different wild accessions, 69 accessions selected from salinity prone areas worldwide (Bangladesh, Taiwan, Ethiopia, Indonesia, Argentina, Iran, and Brazil), and 13 genotypes from breeding material (breeding lines and cytoplasmic male sterile lines; derivatives of different wild species).

Groundnut experiment was planted on 19 April, 2005 under rain out shelter in alpha lattice design (18x16) in three replications with two treatments (100 mM NaCl and control)

Design and statistical analysis:

The pigeonpea experiment was planted on 31July, 2005 under rainout shelter in alpha lattice design (30X10) in three replications with two treatments (75 mM NaCl and control). The soil was fertilized with DAP and also treated with carbofuran to prevent fungal and trips infestation in soil. The stressed pots were also treated with saline solution in to three split doses. The field capacity of pots was maintained throughout the experiment, NaCl was applied at fixed rate in g kg^{-1} of soil i.e. required salt was dissolved in water needed to saturate the soil to field capacity (23 w/w).

The groundnut and pigeonpea experiments were harvested on 24 June, 2005 and 8 October, 2005 respectively. At the time of harvest plants were separated in to leaves and stems. There were very little flowering and pod setting, except in the case of short duration pigeonpea genotypes, so that pods were not considered for statistical analysis. For groundnut, both shoot and pod biomass, and pod number were included in the analysis.

The shoot biomass of pigeonpea and shoot biomass and pod number of groundnut were analyzed using the statistical procedure of residual maximum likelihood (ReML) by treating the replication and replication x block effect as fixed for the best linear predictions (BLUPs) of the performances of all the genotypes of each crop. To assess the salinity tolerance we have calculated the percent relative reduction under saline conditions compare to control and the salinity susceptibility index by using the formula SSI= $(1-Y_{SS}/Y_{NS})/SII$, where Y_{SS} and Y_{NS} are the mean biomass of a given accession in saline and non saline conditions respectively. SII is the salinity intensity index, was calculated as SII=$1-X_{SS}/X_{NS}$, where X_{SS} and X_{NS} are the mean of all accessions under salinity stressed and non- stressed environments (Fisher and Maurer, 1978). The genotypes with less than 50 % relative reduction and with their SSI values ranging between 0-0.75 were considered as tolerant. The genotypes which were having relative reduction more than 50% and less than 70% and SSI values ranged between 0.76-1.05, assumed as moderately tolerant and those which had relative reduction ranged between 70-90% and SSI values 1.06-1.37 considered as moderately susceptible. The genotypes with more than 90% relative reduction in biomass and SII ranged between 1.38-1.52 assumed as highly susceptible.

Results

Four genotypes of groundnut were found very tolerant based on the SSI (Salinity Susceptibility Index) values, i.e. ICG 4890, ICG 4911, ICG 4955 and ICG 4998. The first two were from Argentina and Malawi. There was a set of eleven highly susceptible genotypes namely ICG 334, 10036, 7000, 12727, 1617, 14985, 11598, 11144, 14466, 15309, and 6022, these were also of diverse origin. To estimate the Na^+ and K^+ amount in leaves and stems samples were sent to the wet chemistry laboratory, and results are expected. One breeding line, ICGV92206 also showed high pod production under salinity. A repeat of this experiment is planned for early 2006, in which plants will be tested for yield under salinity.

In pigeonpea, we found very large range of variation for percent relative reduction in biomass (2-100%) among wild relatives. ICPW 87 and ICPW 94 were most tolerant to salinity with SSI value 0.03 and 0.28 and their relative biomass reduction was very small (2.0 and 18.6%). Both genotypes belong to the *C. scaraboides*. One accession (ICPW 68) of *C. platycarpus* had also low SSI value 0.37 and only 24.3% of relative reduction in biomass.
For the accessions selected from different places the variation ranged from 42-100% for relative reduction in biomass and 0.64 to 1.52 for SSI values, which also show a very large genotypic variation to identify contrasting entries for salinity tolerance. In this set ICP 13991, 14974, 13997, and 11412 were tolerant and ICP 13625, 13996, 14175, 11414 and 11420 showed high susceptibility. Among the mini-core collection of pigeonpea the range of variation for biomass relative reduction was 15-100% and for SSI it ranged between 0.23-1.52. Out of 150 genotypes of mini core 13 were considered as tolerant *viz* ICP 8860, 7803, 7260, 6815,10654,3046, 2746,7426,10559, 7057, 6049, 6859 and ICP 7 and four ICP 15493, 15382, 1071 and 6739 were assumed as salinity susceptible based on their SSI and percent relative reduction in biomass. Finally, for the set of wild derivatives of pigeonpea the range varied between 42-83.77% biomass reduction and their SSI values 0.75-1.52. Out of them ICPB 2051, 2030 and 2039 were tolerant and ICPB 2032 was highly susceptible. A repeat of this trial will be done for evaluation of yield under salinity.

Conclusion

We have found a large variation for salinity tolerance in groundnut and pigeonpea. A confirmation of these contrasts is needed before crossing contrasting materials.

Report Budget utilization including whether budget was spent as planned (maximum length: 100 words)

The budget was spent as planned on the following items.

1.	Applicant (living expenses)	US$ 2,000.
2.	Research Consumables (to cover part of chemical analysis, pots, and screening facilities etc.,)	US$ 3,000.
3.	Technical support (partial payment for full time technician)	US$ 2,000
4.	Travel (for traveling to the NARS & follow-up the material evaluation in farmers fields)	US$ 1,500.
5.	Overhead 18%	US$ 1,500
	Total	**US$10,000**