

INTRODUCTION OF HIGH YIELDING PROTEIN RICH PULSE CROP TO THE SEMI ARID TRACTS OF INDIAN SUB-CONTINENT



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Head, AICRP (Minor

Co-workers:

Scheme
millets), ZARS, VC Farm,
Mandya,

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2. Dr. Shamshad Begum
3. Dr. Shwetha B. V

**2013 :INTRODUCED 6 GENOTYPES FROM
NRCG ,
JUNAGADH , 2013 THROUGH
NBPGR,NEW
DELHI**

**2014: EVALUATED 6 GENOTYPES ,POOR
ADAPTATION**

**2014-15: SEED MULTIPLICATION OF
GENOTYPES**

MAJOR CONSTRAINTS

- ▣ Adaptability
- ▣ Poor seed set



EMS Induced mutations using SB-42



mutated

Non mutated



Plate 1: Field view of Bambara groundnut in M₄ generation

Protein and methionine estimation of selected mutants

GENOTYPES	Protein %	Methionine (mg/100gm)
control	17.45	1.73
S 80	25.94	3.56
S 105(Renamed as CGK-SB-42)	26.43	3.40
S -35	18.46	3.80
S -7	17.75	2.75
S-14	17.35	3.10
S-9	17.25	2.80
S-165	25.18	2.95
S-1	21.96	2.45

Nutritional composition of Bambara groundnut in comparison to other pulses :

Crop	Protein (%)	Methionine (mg/100 gm)
Bambara groundnut (<i>Vigna Subterranea</i>)	11.59-25.50	0.73-2.70
S-80	25.94	3.56
S-105(CGK-SB-42)	26.43	3.40
Cowpea (<i>Vigna unguiculata</i>)	24.1	1.84
Green gram (<i>Vigna radiata</i>)	18-24	1.80

Mineral composition of Bambara groundnut

S.N.	Minerals	Estimated quantity (mg/100g)	Reference quantity of Cow pea (mg/100g)*
1.	Ca	260	182.01
2.	P	150.73	510.00
3.	K	1723.25	768.05
4.	Mn	1.4	14.27
5.	Na	75.25	78.15
6.	Fe	3.6	5.66
7.	Cu	0.7	0.60
8.	Zn	2.2	5.66
9.	Na/K ratio	0.04	0.10
10.	Ca/P ratio	1.72	0.35

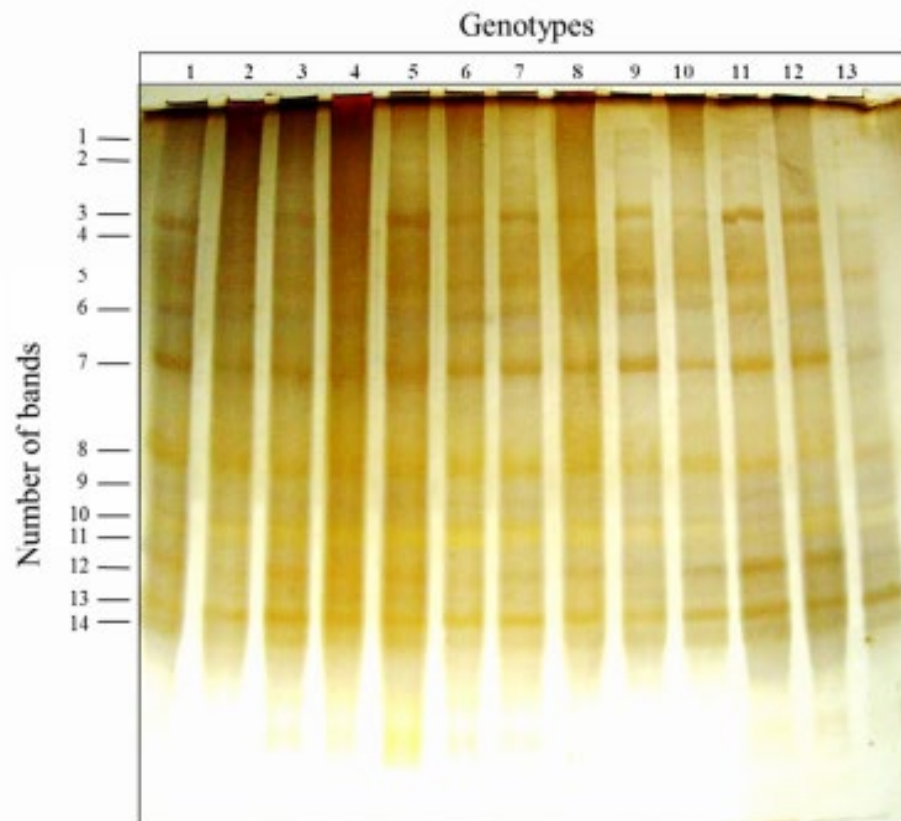


Plate 03: Protein profile of 13 Bambara groundnut genotypes obtained by SDS-PAGE: Lane 1 indicates non mutated sample of SB-42 (Control) & lane 2-13 indicates samples of mutant lines i.e. Lane 2 - F. 10 (2), Lane 3 - F. 3-1 (1), Lane 4 - F. 6-8 (4), Lane 5 - F. 55-1 (4), Lane 6 - F. 7 (2), Lane 7 - F. 3 (3), Lane 8 - F. 8(2), Lane 9 - F. 12 (1), Lane 10 - F. 20 (2), Lane 11 - F. 7 (5), Lane 12 - F. 55-1 (3), Lane 13 - F. 8 (4).

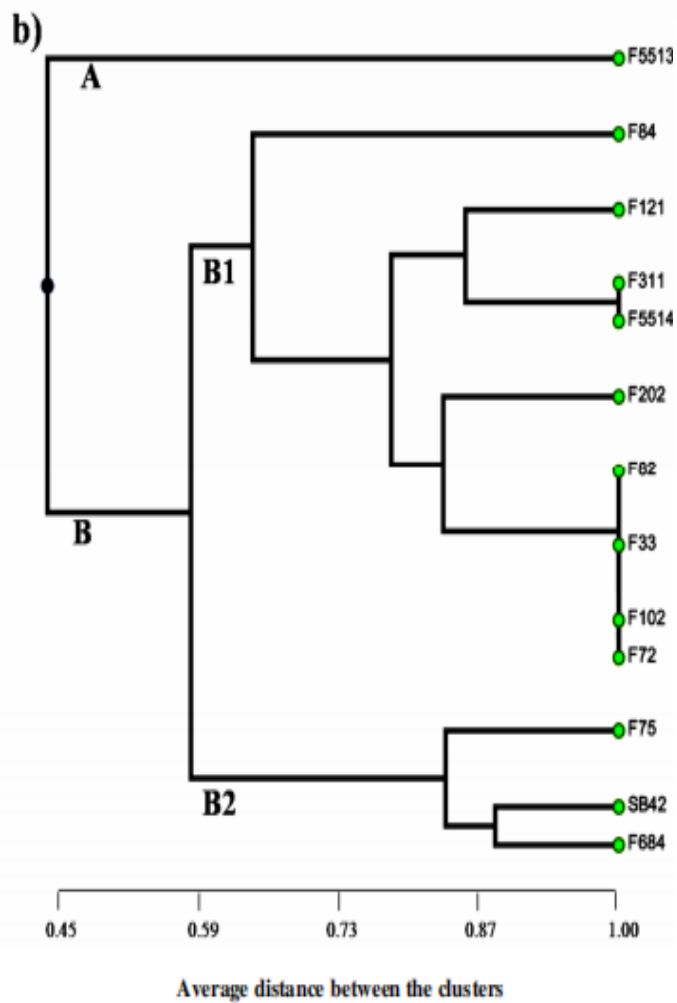


Fig. 06: UPGMA dendrogram showing clustering of 12 selected mutant lines along with control SB-42 of Bambara groundnut based on esterase isozyme profile

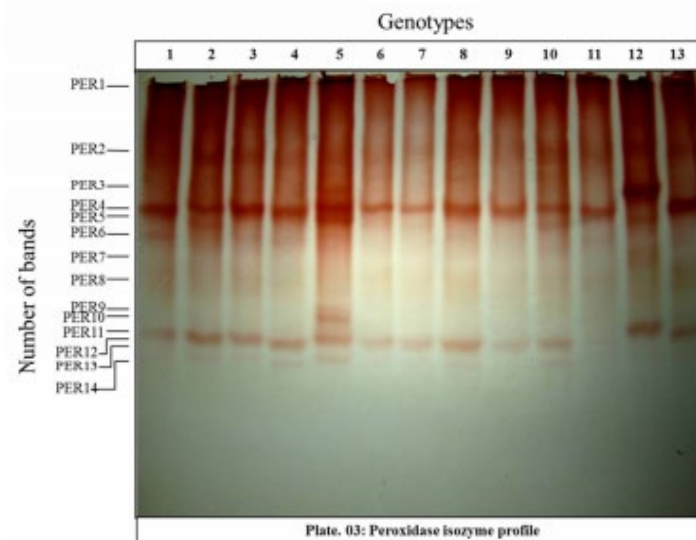


Plate 05: Peroxidase isozyme profile of 13 Bambara groundnut genotypes obtained by Native-PAGE: Lane 1 indicates non mutated sample of SB-42 (Control) & lane 2-13 indicates samples of mutant lines i.e. Lane 2 - F. 10 (2), Lane 3 - F. 3-1 (1), Lane 4 - F. 6-8 (4), Lane 5 - F. 55-1 (4), Lane 6 - F. 7 (2), Lane 7 - F. 3 (3), Lane 8 - F. 8(2), Lane 9 - F. 12 (1), Lane 10 - F. 20 (2), Lane 11 - F. 7 (5), Lane 12 - F. 55-1 (3), Lane 13 - F. 8 (4).

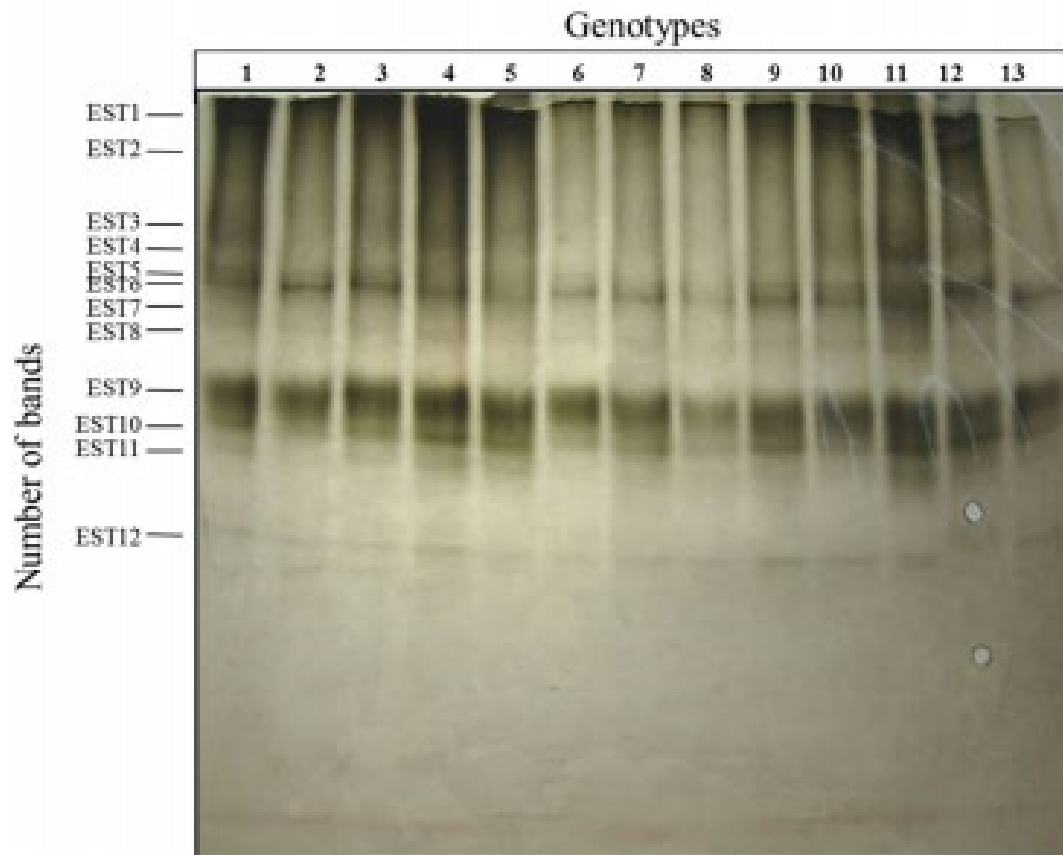


Plate 04: Esterase isozyme profile of 13 Bambara groundnut genotypes obtained by Native-PAGE: Lane 1 indicates non mutated sample of SB-42 (Control) & lane 2-13 indicates samples of mutant lines i.e. Lane 2 - F. 10 (2), Lane 3 - F. 3-1 (1), Lane 4 - F. 6-8 (4), Lane 5 - F. 55-1 (4), Lane 6 - F. 7 (2), Lane 7 - F. 3 (3), Lane 8 - F. 8(2), Lane 9 - F. 12 (1), Lane 10 - F. 20 (2), Lane 11 - F. 7 (5), Lane 12 - F. 55-1 (3), Lane 13 - F. 8 (4).

Comparison of Ancillary characters of selected mutant (High protein and high methionine) CGK-SB-42 and check SB-42

Sl. No.	Character	CGK-SB-42	SB-42(Check)
1.	Days to 50% flowering	50.71	54.28
2.	Plant Height (cm)	27.57	15.57
3.	Plant Spread (cm)	59.74	25.71
4.	No.of Branches	40.28	22.28
5	No.of Pods/Plant	20.14	7.71

Isolated stabilized mutant CGK-SB -42 with 250 pods per plant



The selected mutant

- ▣ **CGK-SB- 42: Proposed for Farm Trials, in the pipeline to be released as variety at UAS,GKVK,Bengaluru.**

CGK-SB-42

- **120 days duration**
- **High Yielding**
- **Suitable for *Kharif* & Summer**

Experiments on Nodulation



Single seeded pod in SB-42 variety



Double seeded mutant

Plate 5: SB-42 pure variety and the mutant having double seeded pods at 200 Gy+0.3 per cent EMS.



Plate 6. Mutation observed for seed mottling at 200 Gy+0.3 per cent EMS.



SB-42 pure variety



High nodulating mutant of SB-42 variety

Plate 7: SB-42 parent and high nodulating mutant in Bambara groundnut

Molecular screening for MYMV



Plate 1: Yellow mosaic virus disease susceptible plant



Plate 2: Yellow mosaic virus disease resistant plant

STUDIES ON REPRODUCTIVE BIOLOGY

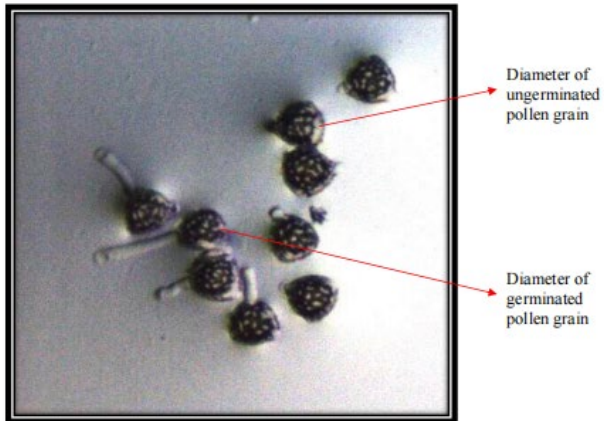


Plate 7. Pollen germination of Bambara groundnut pollen grain in pollen tube growth media

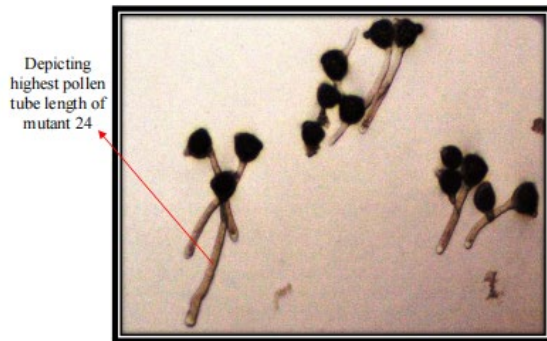


Plate 8. Pollen tube growth of Bambara groundnut pollen grain in pollen tube growth media

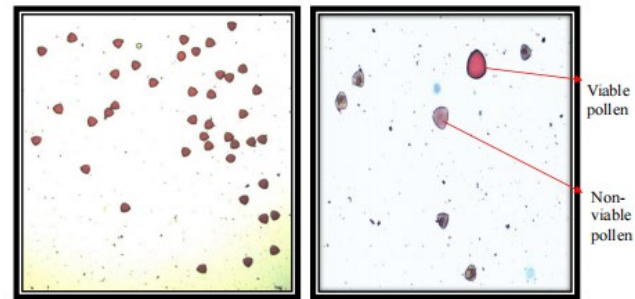


Plate 9. Maximum Pollen viability of SB-42 at 1 a.m.

Plate 10. Minimum Pollen viability of SB-42 at 1 p.m.

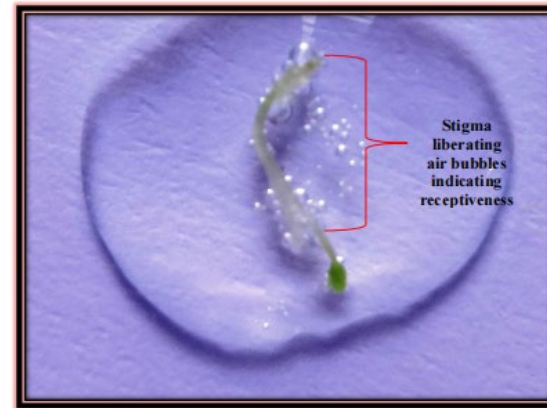


Plate 11. Peroxidase activity on *Vigna subterranea* stigma indicating receptiveness by liberating air bubbles



*Molecular , Nutritional and Environmental Evaluation of Bambara groundnut
Vigna subterranea(L.Verdc.) for food production in the Indian Sub-
continent”*





Details of student Research on Bambara groundnut

Name	Title of Research	Remarks
Chitti bharatkumar	Genetic improvement of bambara groundnut (<i>Vigna subterranea</i> (L.) verdc) through mutation breeding	
CHANDANA, B. S.	Studies on biochemical parameters in bambara groundnut [<i>Vigna subterranea</i> (L.) verdc.]	
PRANESH	Variability studies in m3 generation and Screening for yellow mosaic virus disease Resistance in isolated mutants of Bambara groundnut [<i>Vigna subterranea</i> (L.) verdc.]	
SMITA SUBHASH VEERAGHAN TI	Studies on Genetic Variability in M3 generation of Bambara groundnut (<i>Vigna subterranea</i> (L.) Verdc.) treated with gamma rays.	
UMESHA NAIK	Correlation and path coefficient analysis between seed yield and its component characters in m4 and m5 generations of Bambara groundnut (<i>Vigna subterranea</i> (L.) Verdc.)	
KHAJABAND ENAWAJ	Evaluation of bambara groundnut (<i>Vigna subterranea</i> (L.) verdc.) mutants for yield, protein and related characters.	
PUSHPALATH A	Effect of induced mutation on economic traits and nodulation in bambara groundnut (<i>Vigna subterranea</i> (L.) Verdc).	
KAILASH CHANDRA	Studies on reproductive biology and nutritional analysis in bambara groundnut (<i>Vigna subterranea</i> (L.) Verdc.)	
Vijayakumara	Gamma irradiated variability studies in bambara groundnut (<i>Vigna subterranea</i> (L.)Verdc.)	

Major Constraint

- ▣ Farmers acceptance?
- ▣ Marketability?
- ▣ How to use ?
- ▣ Seed Processing?

Training Programmes to farm women development of value added products of bambara groundnut



Training programmes on Bambara groundnut



Delivered tangibles

Standardization of management practices

Developed economically important mutants-High yield,protein and YMV resisitance(using heterologous probes

Sequencing of gene for YMV resistance

-----“”-----

----- Field trials of the crop along with Participatory varietal selection and molecular work like and PCR -----

-----“”-----

Estimating the potential Bambara groundnut as inter crop and sole crop

-----“”-----

Development of value added products

Popularization of the crop and its value aded bi-products.

Project proposed to KHT

OBJECTIVES

- 1). To identify suitable agro-ecological zones and seasons for the cultivation of Bambara groundnut and its potential in different dryland production systems as sole crop and also as intercrop for higher production per unit area.
- 2). Screening mutants for yellow mosaic virus using heterologous probes and sequencing the resistant gene, isolating High yield and High protein (Leucine and methionine) mutants.
- 3). Participatory varietal selection of Bambara groundnut.
- 4). Evaluating Nutritional Value and Development of value added bi- products of Bambara groundnut like Bambara flour, Bambara milk and Bambara dal.
- 5). Popularizing Bambara groundnut to the semi- arid tracts of Indian sub-continent

Results of station trials and multi location trials.



Pooled data of Pod yield in Station trial and MLT (q/ha)

Sl. No.	Genotype	Station trial			MLT			Mean	% increase over Check SB 42
		<i>Kharif</i> 2017	<i>Kharif</i> 2018	<i>Kharif</i> 2019	GKVK, Bengaluru	Hadonahalli KVK	Balajiga pade		
1	CGK-SB42	17.03	13.94	17.25	17.25	24.3	7.905	15.88	353.71
3	SB 42	3.086	4.45	4.17	4.17	(no germination)	1.962	3.50	
Mean		9.86	9.51	10.34	10.34	22.55	4.933		
F value		**	**	**	**	**	**		
SEm±		0.592	0.469	0.547	0.469	-	0.246		
CD@5%		1.844	1.461	1.703	1.461	-	0.766		
CV%		15.844	13.041	13.989	13.041	-	12.701		

Projects handled on Bambara groundnut

1. Directorate of Research: UAS,GKVK,Bengaluru: Development of High yielding protein rich Bamabara groundnut.
2. PPV & FRA, Govt of India :Development of DUS Guidelines for Bambara groundnut

- 1. Project Number: DR Number** No.DR/STA/RP-90(2021-22)/2022-23 Dated: 23.04.2022
- 2. Department** Department of Genetics and Plant Breeding, UAS, GKVK, Bengaluru, Karnataka 560065
- 3. Project title** “Development of Guidelines to Conduct DUS test in Bambara Groundnut (*Vigna subterranea* (L.) Verdc)”
- 5. Location** Department of Genetics and Plant Breeding, University of Agricultural Sciences, GKVK Campus, Bengaluru
- 6. Funding Agency** PPV & FRA, Govt. of India

6. **Objectives**
1. Collection of germplasm accessions from IITA Nigeria and its evaluation.
 2. Development of test guidelines and identification of DUS traits in Bambara Groundnut.
 3. Characterization and evaluation of germplasm accessions for different traits of Bambara Groundnut on **DUS traits** identified.
 4. Creation of data base and publication of the information generated under the project.

7. Duration of the investigation	Year of start	Year of end
	2022-23	2023-24

8 **Budget (Ab/Ac No. 8256)** Total budget outlay of the project for 2 years is Rs. 18 Lakhs

9 **Material** 90 germplasm accessions

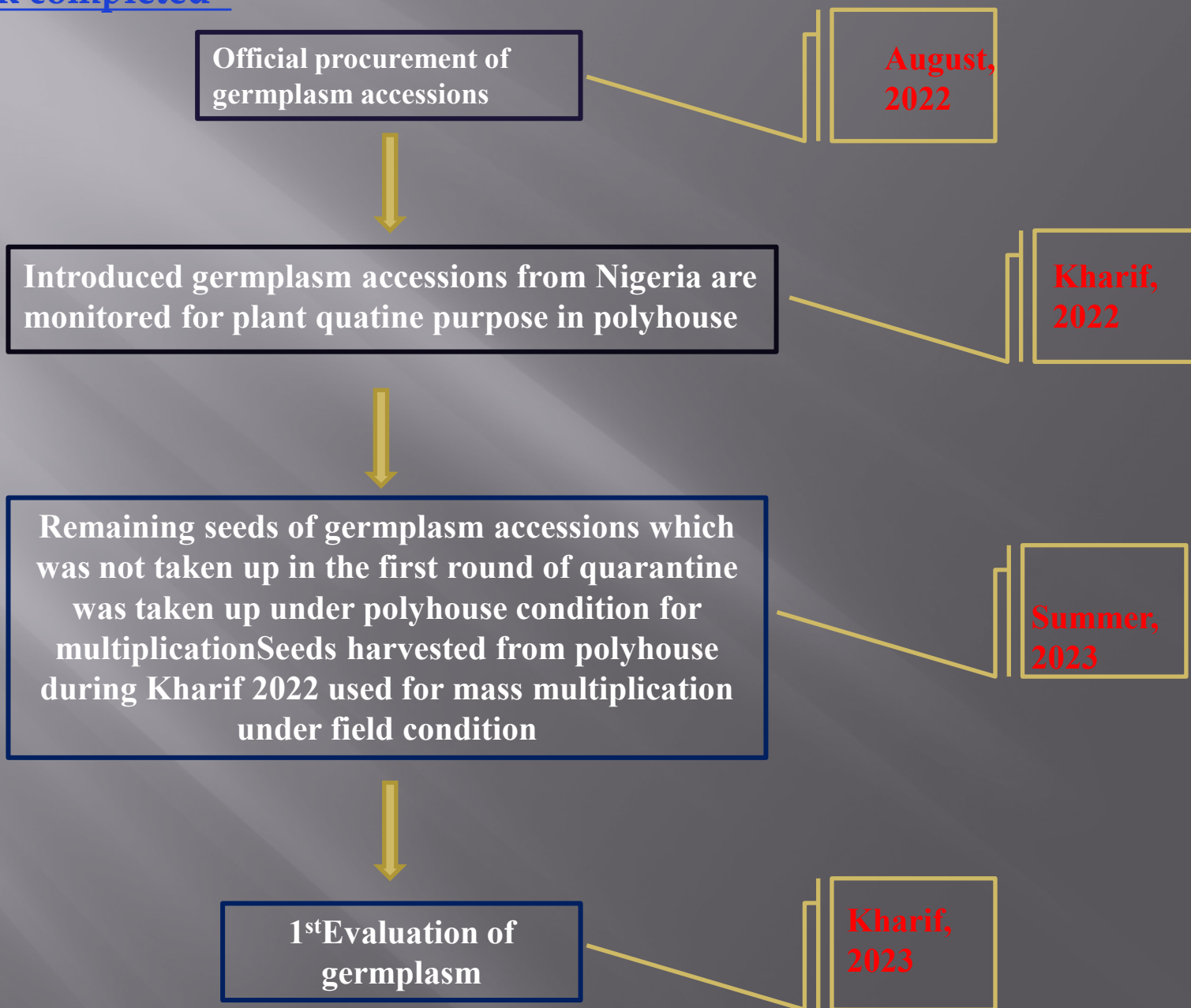
Plant Discriptors of Bambara Groundnut

1. Peduncle length(mm)
2. Plant height (cm)
3. Plant spread(cm)
4. Number of leaves
5. Terminal leaflet length(mm)
6. Terminal leaflet width(mm)
7. Petiole length(mm)
8. Photoperiodic reaction type
9. Number of days for first flowering
10. Number of flowers per peduncle
11. Days to 50% flowering
12. Dark pigmentation on wings and banner
13. Pod length [mm]
14. Pod width [mm]
15. Pod shape
16. Pod color
17. Pods per plant
18. Pod texture
19. Seed shape
20. Seed color/ pattern
21. Seeds per pod
22. Seed yield per plant (g)
23. Seed length(mm)
24. Seed width(mm)
25. Shelling percentage (%)
26. Test weight (g)
27. Protein %
28. Carbohydrate %..

Genotypes introduced:

Sl no.	Genotype	Sl no.	Genotype	Sl no.	Genotype	Sl no.	Genotype
1	TVSu 1887	26	TVSu 1614	51	TVSu 633	76	TVSu 1829
2	TVSu 1321	27	TVSu 62	52	TVSu 217	77	TVSu 1648
3	TVSu 1631	28	TVSu 6	53	TVSu 303	78	TVSu 1123
4	TVSu 1737	29	TVSu 1448	54	TVSu 565	79	TVSu 138
5	TVSu 536	30	TVSu 541	55	TVSu 106	80	TVSu 367
6	TVSu 1394	31	TVSu 1388	56	TVSu 1940	81	TVSu 1431
7	TVSu 1379	32	TVSu 270	57	TVSu 1069	82	TVSu 989
8	TVSu 1034	33	TVSu 455	58	TVSu 878	83	TVSu 1459
9	TVSu 328	34	TVSu 11	59	TVSu 158	84	TVSu 1693
10	TVSu 574	35	TVSu 1068	60	TVSu 458	85	TVSu 1108
11	TVSu 1260	36	TVSu 132	61	TVSu 5	86	TVSu 1403
12	TVSu 235	37	TVSu 591	62	TVSu 698	87	TVSu 1668
13	TVSu 1833	38	TVSu 1633	63	TVSu 1606	88	TVSu 1051
14	TVSu 545	39	TVSu 885	64	TVSu 425	89	TVSu 975
15	TVSu 926	40	TVSu 627	65	TVSu 275	90	TVSu 334
16	TVSu 592	41	TVSu 287	66	TVSu 884		
17	TVSu 1364	42	TVSu 1408	67	TVSu 1272		
18	TVSu 330	43	TVSu 329	68	TVSu 1972		
19	TVSu 740	44	TVSu 598	69	TVSu 1641		
20	TVSu 44	45	TVSu 975	70	TVSu 1038		
21	TVSu 283	46	TVSu 1253	71	TVSu 1049		
22	TVSu 723	47	TVSu 1451	72	TVSu 1662		
23	TVSu 1620	48	TVSu 640	73	TVSu 611		
24	TVSu 445	49	TVSu 505	74	TVSu 442		
25	TVSu 1721	50	TVSu 1684	75	TVSu 702		

"Work completed"



- ▣ Germplasms from IITA,Ibadan, Under quarantine



Visit by NBPGR



TVSu-740

General view of experimental area



Genotypes having more number of branches



TVSu-6



Disease screening using markers continued.....



Bambara groundnut CGK-SB-42

INSHHORT
2015



SIKKIM UNIVERSITY
(A Central University established by an Act of Parliament of India, 2007)
Department of Horticulture | School of Life Sciences

Certificate of Best Paper

This best paper award is presented to Dr. / Mr. / Ms. R. NANDINI, Assistant Professor, UAS for SECOND outstanding best paper entitled "*STUDIES ON REPRODUCTIVE BIOLOGY AND NUTRITIONAL ANALYSIS IN BAMBARA GROUNDNUT Vigna subterranea (L.)VERDC.*" for the oral presentation category during the International Symposium on "Next Generation Approaches for Sustainable Development of Hill and Upland Horticulture" held on 5th - 7th November 2015 at Sikkim University, Gangtok, Sikkim, India.

Dr. S. MANIVANNAN
Organizing Secretary
INSHHORT - 2015

Co-organized by

Department of
Horticulture



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List of publications on Bambara groundnut studies

1. SMITA, NANDINI, R., 2014, Trait Association and path analysis for yield and related traits in Bambara groundnut (*Vigna subterranea*), Trends in Biosciences, 7(10), 955-957
2. SMITA, NANDINI, R., 2014, Genetic enhancement of protein content in Bambara groundnut (*Vigna subterranea*) through induced mutagenesis, Trends in Biosciences, 7(10) 918- 920
3. CHITTI BHARATKUMAR AND NANDINI, R., 2015, Mutagenic effectiveness and efficiency of ethyl methane sulphonate in bambara groundnut (*Vigna subterranea* (L.) Verdc.), MJAS, 49(2), 253-257.
4. NANDINI, R, CHITTI BHARATH, VIJAYAKUMARI AND MUTHURAJU, 2015, Variability studies in Bambara groundnut (*Vigna Subtterranea* (L.) Verdc.) due to gamma irradiation, Bioinfolet, Vol12, No.4 (A) 786-794
5. CHITTI BHARATH AND NANDINI, R, 2015 Mutagenic effectiveness and efficienc of ethyl methane Sulphonete in Bambara groundnut (*Vigna subtterranea*), MJAS, 49(2) 253-257
6. CHITTI BHARATH, NANDINI, R, DHANAPAL, G.N, SHASHIDHAR, H. E., AND SAVITHRAMMA, D. L, 2015 Genetic enhancement of protein methionine content in Bambara groundnut mutation breeding, International Journal of Research in Agriculture and Forestry, Vol.2 (11), 1-11

7. PRANESH, NANDINI, R. AND RAGHAVENDRA, P., 2016, Assessment of genetic variability, heritability and genetic advance in M3 generation of Bambara groundnut (*Vigna Subterranea* (L.) Verdc.) *Advance in Life Sciences*. 5(9):1499-1502.
8. KAILASH CHANDRA, R. NANDINI, PRANESH AND CHITTI BHARATH KUMAR, 2017, A protein rich legume, XXXI Flower, Vegetable and fruit show, Department of Agriculture, Farm Fest 2017, Govt. of Pondicherry, 27th-29th Jan 2017, Pg 94-96
9. KAILASH CHANDRA, NANDINI, R., PRANESH, CHITTI BHARATH AND GOBU, R., 2017 Improving the nutritional security of India through a Potential Underutilized Legume Bambara Groundnut (*Vigna subterranea*(L)Verdc), *Environment and Ecology*, 35(2):606-610.
10. PRANESH, NANDINI, R., KAILASH CHANDRA, RANGAIAH, S AND NAGARAJU, N., 2017, Character Association and Path Analysis of Yield and Yield components in M3 Generation of Bambara groundnut (*Vigna subterranea* (L.).Verdc.) treated with Ethyl Methane Sulphonate (EMS), *Int.J.Pure App.Biosc.*, 5(3):306-311.
11. PRANESH, NANDINI, R., KAILASH CHANDRA AND N. NAGARAJU, 2018, Screening of Bambara Groundnut (*Vigna Subterranea*) mutant Lines for yellow mosaic virus Disease resistance using SSR markers, *International Journal of Current microbiology and Applied Sciences*, Vol 7 : 4 : 2872 - 2880
12. KAILASH CHANDRA, NANDINI, R., GOBU, R., PRANESH, CHITTI BHARATH KUMAR AND MUTHURAJU, R., 2019, Insight into the floral biology and ancillary characteristics of underutilized legume-Bambara groundnut (*Vigna subterranea*). *Legume Research*, 42:96-101



THANK YOU