Coordination meeting to review the progress of the field trials

RAS5070: Developing Bioenergy Crops to Optimize Marginal Land Productivity through Mutation Breeding and Related Techniques (RCA)

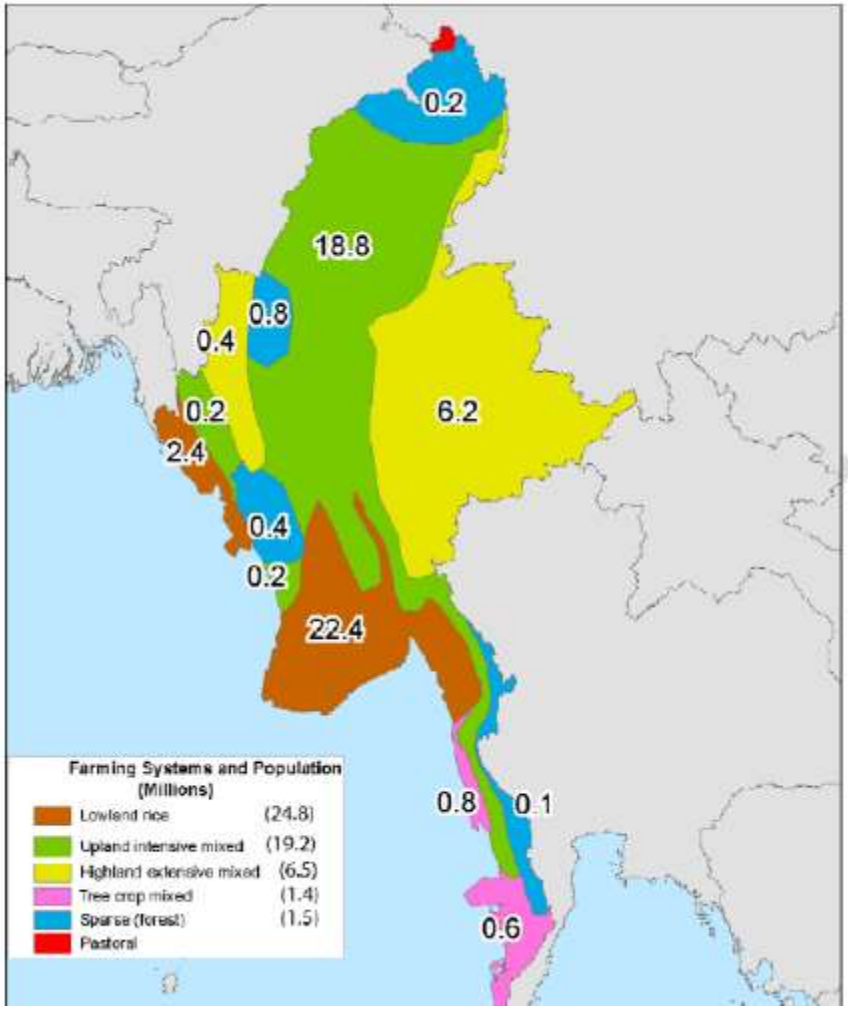
Current Status on Mutation Induction of Sorghum

By
Dr. Myat Minn
Agricultural Biotechnology Research Division
Biotechnology Research Department

Vietnam
3-7 , July , 2017

Agro-ecosystem of Myanmar

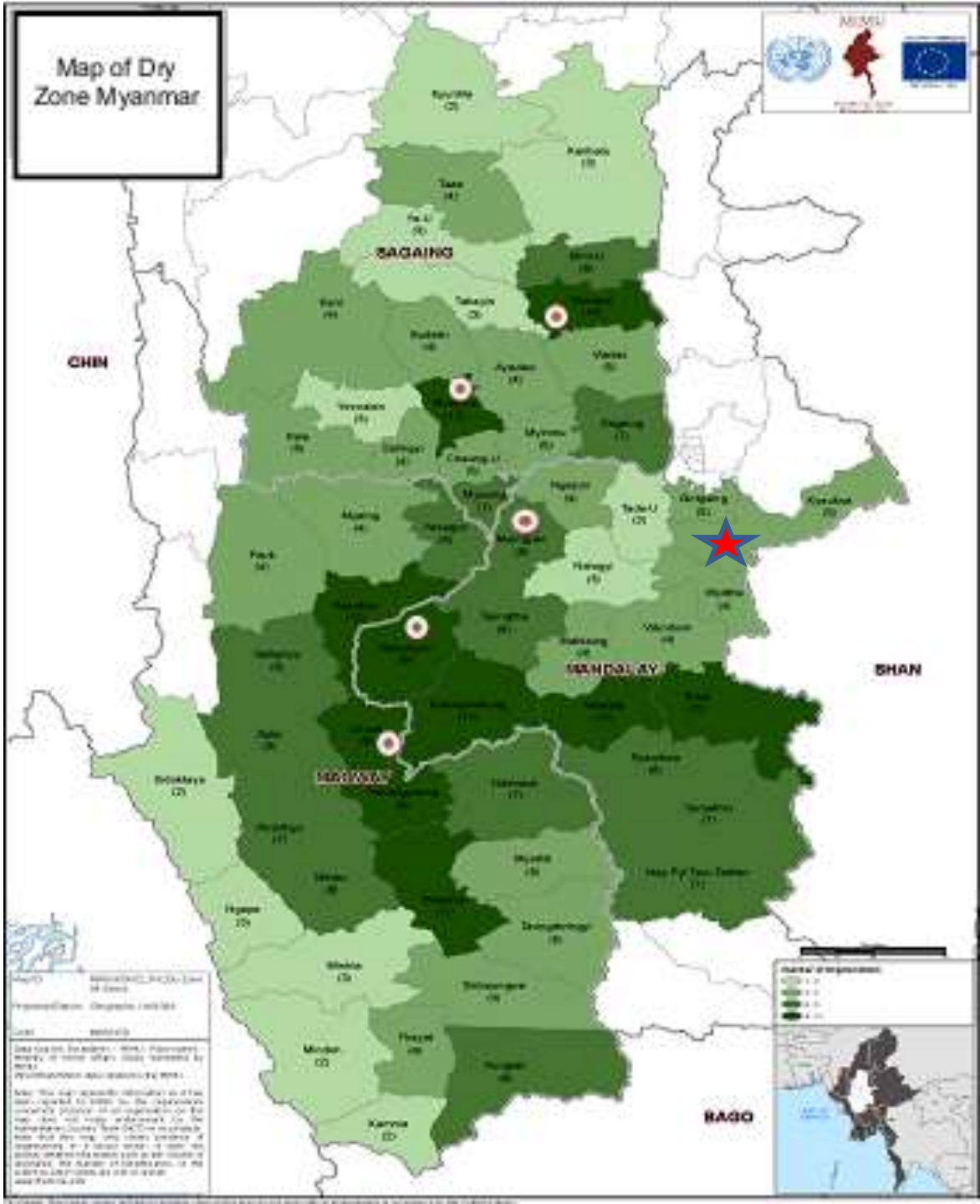
Total	**67.6 mha**
Alluvial and swampy soils	the delta and coastal zone, (405,000 hectares)
Vertisols (heavy clay soils)	the central dry zone.(Alluvial lowlands dominate agricultural production areas)
The hill zones and Shan plateau	Fruit and horticultural Crops
Virgin and fallow land" or "cultivable wasteland"	5.67 million hectares



*** Sorghum ; Area harvested = 228,000 ha (2016)

Dry Zone of Myanmar

- one of the most climate sensitive and natural resource poor regions
- lies between latitudes 19º 20” and 22º 50” north and longitudes 93º 40” and 96º 30” east
- covers approximately 54,390 square kilometers , about 10% total land area.
- 18 million people, constituted 34% of the country’s total population of about 53 million in 2003.
- characterized by low annual rainfall that ranges between 508 and 1016 mm per annum
- about 27˚ C in average and the temperature often rises to about 43˚ C in the summer period.
- led to conditions of growing food insecurity and severe environmental degradation



•**Background:** Sorghum is an important stable food for more than 300 million people and feed for cattle in Asia and Africa.

•Sorghum is a high biomass and sugar yielding crop with high photosynthetic efficiency and has the potential of becoming a useful energy crop.

•Crops that are chosen for future energy production should thus be able to produce both food and energy.

•In the dry zone areas of Myanmar, sweet sorghum is also a promising new crop for bioethanol production.

•Growing areas in Myanmar is 210,000ha, cultivated in (Mandalay, Sagaing, Kayar and Magway Division)

Some Agronomic characteristics of Yesin – 7 and Shweni-15

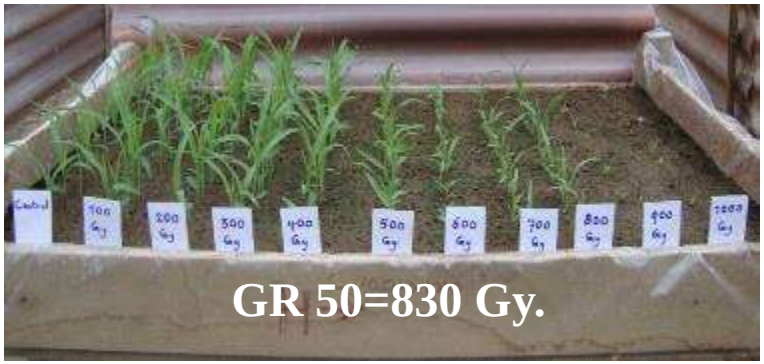
Characters/ var.	**Yesin-7**	Shweni-15
Line no. / origin	Yn 212-1-2-1	Local cultivar
Life period	120-130day	120-130day
Plant height	183-305 cm	213.36cm- 228.6 cm
50% of flowering	75-80 day	65-70 day
No. of Grain per panicle	580-600 seeds	380-400 seeds
1000 grain weight	18-22 g	20-25 g
Stalk yield	30-60 ton /ha	3-4.5 ton/acre 35-70 ton/hectre

Summary of Activities

Var.	Target Traits	Activities			
		2013	2014	2015	2016
Yezin -7 Shweni -15	Higher sugar content . Early maturity And Better yield	Gamma irradiation mutagenesis. M1 generation 100-1000Gy	M2 generation Selection of the promising mutants for improved target traits ***Selected*** *12 mutant plants from Yezin-7 and 15 mutant plants from Shweni -15*	M3 generation Evaluation of Mutant Lines in *Stability Check* ***Cultivated*** *12 mutant lines from Yezin-7* *12 mutant lines from Shweni -15* ***Selected*** *2 mutant line from Yezin-7* *3 mutant lines from Shweni -15*	M4 generation Evaluation of Mutant Lines in *Preliminary Yield Trial.* ***Cultivated*** *2 mutant line from Yezin-7* *3 mutant lines from Shweni -15* ***Selected*** *2 mutant line from Yezin-7* *2 mutant lines from Shweni -15*

M1 generation

- Radiation : Gamma ray from ^{60}Co source
- Dose : 100Gy to 800 Gy
- Cultivation period : Mid of August to End of December (or first week of January)
- Irrigation : Twice; soil preparation and before flowering (Yesin-7 /70 DAS and Shwe-15 /60 DAS)
- Fertilizer utilization : Basal application and top dressing (N 30 Kg ha^{-1} , P 10Kgha^{-1})
- Soil Type : Silty clay loam
- Radiosensitivity Test : GR 50
- bulk Harvest



M2 Generation

Time	- growing season, 2014
Harvesting	- individual plant selection
Selection	- Biomass, yield characters and brix value
	- 27 mutant plants

M3 Generation (July – 2015)

Handling

- 24 mutants plants in the experimental field (from M2 seeds)
- Panicle to Row (one panicle in three row)
- Sowing on ridges with a spacing of 45 cm between rows and 15 cm within rows or (18" x 5-6")
- Performance and Stability Check
- screened and selected the promising mutants lines for some target traits

Results on some promising mutant lines of Yesin 7 in M3 generation

Sr.No.	Promising mutants	Dosage (Gy)	Stalk weight per plant (g)	Brix %	Juice volume(ml)	Yield per plant (g)
1	SYY-1	400 Gy	467.00^{a}	21.00^{c}	99.3^{abc}	18.52^{a}
2	SYY-2	300 Gy	370.33^{def}	18.29^{de}	69.94^{f}	16.48^{bc}
3	SYY-3	400 Gy	459.87^{a}	18.28^{de}	80.8^{def}	17.26^{abc}
4	SYY-4	500 Gy	341.00^{ef}	18.48^{d}	66.94^{f}	16.40^{cd}
5	SYY-5	300 Gy	400.97^{bcd}	18.19^{de}	71.45^{ef}	18.41^{ab}
6	SYM-1	300 Gy	382.60^{cde}	17.09^{f}	76.00^{ef}	18.09^{abc}
7	SYM-2	400 Gy	379.80^{cde}	22.61^{a}	74.20^{ef}	17.17^{abc}
8	SYE-1	200 Gy	397.8^{bcde}	20.84^{c}	89.65^{bcde}	14.51^{de}
9	SYE-2	600 Gy	440.83^{ab}	22.26^{ab}	103.66^{ab}	18.16^{abc}
10	SYE-3	400 Gy	320.57^{f}	21.45^{bc}	83.67^{cdef}	13.70^{ef}
11	SYE-4	100 Gy	430.07^{abc}	21.05^{c}	113.86^{a}	13.27^{ef}
12	SYE-5	500 Gy	420.60^{abcd}	21.15^{c}	98.40a^{abcd}	16.28^{cd}
13	Control	0 Gy	340.53^{ef}	17.36^{ef}	81.8^{cdef}	12.29^{f}

Results on some promising mutant lines of Shweni-15

Sr.No.	Promising mutants	Dosage (Gy)	Stalk weight per plant (g)	Brix %	Juice volume(ml)	Yield per plant (g)	Remark
1	SSE-1	300 Gy	474.10^{a}	17.54^{b}	107.2^{a}	38.43^{b}	(uniform)
2	SSE-2	400 Gy	459.87^{a}	17^{bc}	92.3^{d}	29.15^{c}	-
3	SSE-3	400 Gy	446.47^{ab}	17.58^{b}	88.21^{de}	29.10^{c}	(uniform)
4	SSE-4	600 Gy	431.67^{abc}	16.16^{cd}	87.05^{de}	28.59^{c}	-
5	SSE-5	200 Gy	441.53^{ab}	19.01^{a}	88.13^{de}	37.48^{b}	-
6	SSY-1	300 GY	420.77^{cd}	15.02^{dc}	97.30^{c}	48.14^{a}	-
7	SSY-2	300 Gy	430.63^{bcd}	15.86^{cde}	77.67^{g}	40.02^{b}	-
8	SSY-3	300 Gy	430.87^{bcd}	16.19^{cd}	102.21^{b}	39.98^{b}	-
9	SSY-4	300 Gy	411.83^{cd}	16.03^{cd}	85.12^{ef}	36.07^{b}	-
10	SSY-5	600 Gy	407.90^{cd}	14.71^{e}	83.13^{ef}	38.35^{b}	-
11	SSM-1	400 Gy	384.77^{d}	13.09^{f}	80.20^{fg}	29.05^{c}	White seed
12	SSM-2	400 Gy	370.03^{d}	15.96^{cde}	62.15^{i}	26.23^{c}	Early
13	Control	0 Gy	374.60^{d}	12.87^{f}	67.2^{h}	26.06^{c}	

Summarized results of Yesin-7 and Shwe Ni-15

Sr.No.	Yesin-7		Shwe Ni-15	
	Promising Mutants	Traits	Promising Mutants	Traits
1	SYE-2	Biomass, Brix, Juicy	SSE-1	Biomass, Brix, Juicy, yield
2	SYE-4	Brix, Juicy	SSE3	Brix, Juicy, yield
3			SSM-2	Early maturity

M4 Generation (July – 2016)

Handling

- planted 4 mutants lines from each varietiesin the experimental field (from M3 seeds)
- 1.5 x 5 meter , RCBD with 3 Replicates
- Sowing on ridges with a spacing of 45 cm between rows and 15 cm within rows or (18" x 5-6")
- Performance and Stability Check

M4 Generation experiment area

Soil type	Silty clay loan
GW pH	>8.7
pH (1: 2.5)	> 8.5 (extremely alkaline
Total Nitrogen	Very low
Changeable cation	High (K+)
Avalable nutrients	
P	Low
K	medium

M4 Selection for Yield (Shweni-15)

Treatments	Plant Height (cm)	Stem Width (cm)	No. of Leaves	Stalk Weight (G)	Brix %	Juice (l)	Panicle Length (cm)	Panicle Width (cm)	No. of Seeds	100 Grain Weight (g)	Yield per plant (g)
Control	154.25[a]	4.07[b]	9.97[a]	138.32[b]	9.33[b]	32.30[b]	22.02b[b]	9.88[b]	815.07[b]	2.27[a]	18.03[b]
SSE 1	154.42[a]	4.41[a]	10.22[a]	176.82[a]	13.16[a]	40.67[a]	25.48[a]	11.04[a]	1075.90[a]	2.30[a]	24.81[a]
SSE3	154.90[a]	4.11[a b]	10.22[a]	141.73[b]	12.92[a]	36.30[a b]	24.09[a]	10.06[b]	889.60[b]	2.36[a]	20.75[b]

M4 Selection for Yield (Yezin 7)

Treatments	Plant Height (cm)	Stem Width (cm)	No. of Leaves	Stalk Weight (G)	Brix %	Juice (l)	Panicle Length (cm)	Panicle Width (cm)	No. of Seeds	100 Grain Weight (g)	Yield per plant (g)
Control	276.65[b]	4.62[a]	9.65[b]	187.55[a]	12.08c	31.50 c	25.14[b]	13.87[b]	904.37[b]	1.29[a]	12.53[b]
SYE2	308.13[a]	4.69[a]	10.33[a]	207.78[a]	13.57[b]	37.27[b]	29.18[a]	15.87[a]	1379.90[a]	1.31[a]	18.59[a]
SYE4	303.03[a]	4.61[a]	7.78[b]	194.98[a]	15.43[a]	41.33[a]	29.19[a]	14.16[b]	1119.40[a b]	1.34[a]	14.80[a b]

Summary of Activities

Var.	Target Traits	Activities			
		2013	2014	2015	2016
Yezin -7 Shweni -15	Higher sugar content . Early maturity And Better yield	Gamma irradiation mutagenesis. M1 generation	M2 generation Selection of the promising mutants for improved target traits ***Selected*** *12 mutant plants from Yezin-7 and 15 mutant plants from Shweni -15*	M3 generation Evaluation of Mutant Lines in *Stability Check* ***Cultivated*** *12 mutant lines from Yezin-7* *12 mutant lines from Shweni -15* ***Selected*** *2 mutant line from Yezin-7* *3 mutant lines from Shweni -15*	M4 generation Evaluation of Mutant Lines in *Preliminary Yield Trial.* ***Cultivated*** *2 mutant line from Yezin-7* *3 mutant lines from Shweni -15* ***Selected*** *2 mutant line from Yezin-7* *2 mutant lines from Shweni -15*

List of publication

1. Khaing Wah Htun, Myat Minn and Nay Chi Win ; “Effect of different doses of gamma ray on multifunctional plant, sorghum” the fifth international conference on science and engineering, Inya lake hotel, yangon, Myanmar, December 29-30,2014
2. Khaing Wah Htun, Myat Minn and Nay Chi Win; “ The improvement of sorghum (Sorghum bocolor L.) for high yield through induced mutation, the fifth ISERD International Conference.ISBN: 978-93-85465-36-9. Convenient Grand Hotel, Bangkok, Thailand, June 17, 2016.
3. Khaing Wah Htun, Myat Minn and Nay Chi Winn:” Evaluation of genetic valuability for agronomic traits in M2 generation of sorghum through induced mutation, International Journal of Technical Research and Applications e-ISSN: 2320-8163, www.ijtra.com Volume3, Issue6, pp.145-149.November-December, 2015.
4. Nang Htwe Kham, Nay Chi Win and Myat Minn:“ Study on the effects of gamma radiation or sorghum for the improvement of variety (Shweni-15), the fifth international conference on science and engineering, Inya lake hotel, yangon, Myanmar, December 29-30,2014
5. Nang Htwe Kham, Nay Chi Win and Myat Minn:“ The improvement of local cultivar sorghum (Shweni-15) with the aim of bioethanol production through gamma radiation”International conference on food and agricultural sciences, Convenient Grand Hotel, Bangkok, Thailand, June 17, paper ID:ISD-FASBNGK-17065-08 2016
6. Nang Htwe Kham, Nay Chi Win and Myat Minn:“ Study on the variability of induced mutation for imorovement of local cultivar sorghum(Shweni-15), International Journal of Technical Research and Applications e-ISSN: 2320-8163, www.ijtra.com Volume3, Issue6, pp.145-149.November-December, 2015 e-ISSN: 2320-8163,p-ISSN: 2321-7332

Training Receives

1. Reginal Training Course on Application of Invitro Techniques in Mutation breeding of bioenergy crops, jakartar, Indonesia, 2016

2. Regional Training course on Nutrient and water Management for bioenegy crop in marginal land, Nepal ,2016

3. RTC on Methodologiess and Mechanisms for screening against Abiotec Stresses Using Mutation Breeding and Molecular Markers, Thiland.

Future work

1. Continue Yield trial for mutant lines for new variety released
2. Grain quality Analysis
3. Multilocation Trail in Marginal areas and Register (2018-2019)

Requirement

-Technical training for Bio-energy Production

EBD Test

Character	EBD	non EBD
Vegetative vigor (1 weak to 9 strong)	strong	medium
Age / maturity (U)	145 Days	145 Days
Plant height (cm)	120 -125	120-125
Plant type (erect/semi-erect/prostrate)	Semi –erect	Semi –erect
Number of panicles per square meter (U)	350 (7%)	325
Actual Yield (baskets/acre)	92 (31%)	75
Scoring Disease	Observation	observation
Bacterial leaf blight	+	+
Blast	-	+
False smut		
Sheath Blight	+	+
Brown spot	-	-
Scoring Insect		
Stem borer	< 0.2%	0.2- 0.5%
Brown plant hopper	10-15 %	15-20%
Hispa	-	-
leaf folder	-	+
Gandhi bug		

Variety – Machando
Sowing date- 2-6-2016
Transplanted date – 1-7 -2016
Harvest – 14-11-2016
Spacing – 20 x 20 cm

EBD

Non-EBD


Thank you