



Certificate

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This is to certify that:

Dr. Nurhasanah

as Invited Speaker

INTERNATIONAL SEMINAR AND WORKSHOPS OF PLANT INDUSTRY

“Plant Improvement Through Molecular Approach”

November 1st-2nd, 2018, at University of Jember.

Rector,



Moh. Hasan

NIP. 196404041988021001

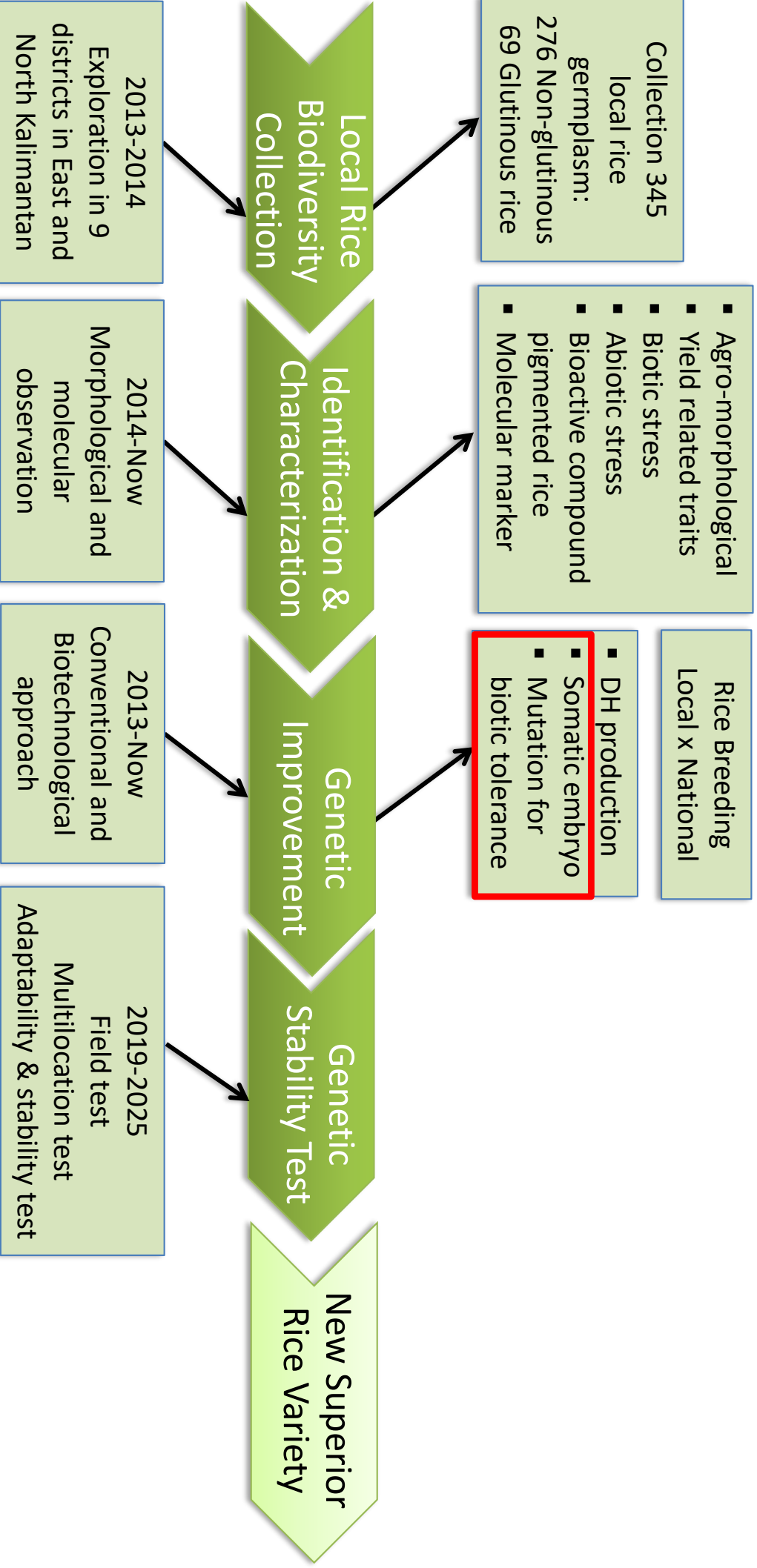


Inducing tolerance against abiotic stress in East Kalimantan local rice cultivars through somaclonal variation and Invitro selection

Dr.sc.agr. Nurhasanah



LOCAL RICE RESEARCH PROJECT



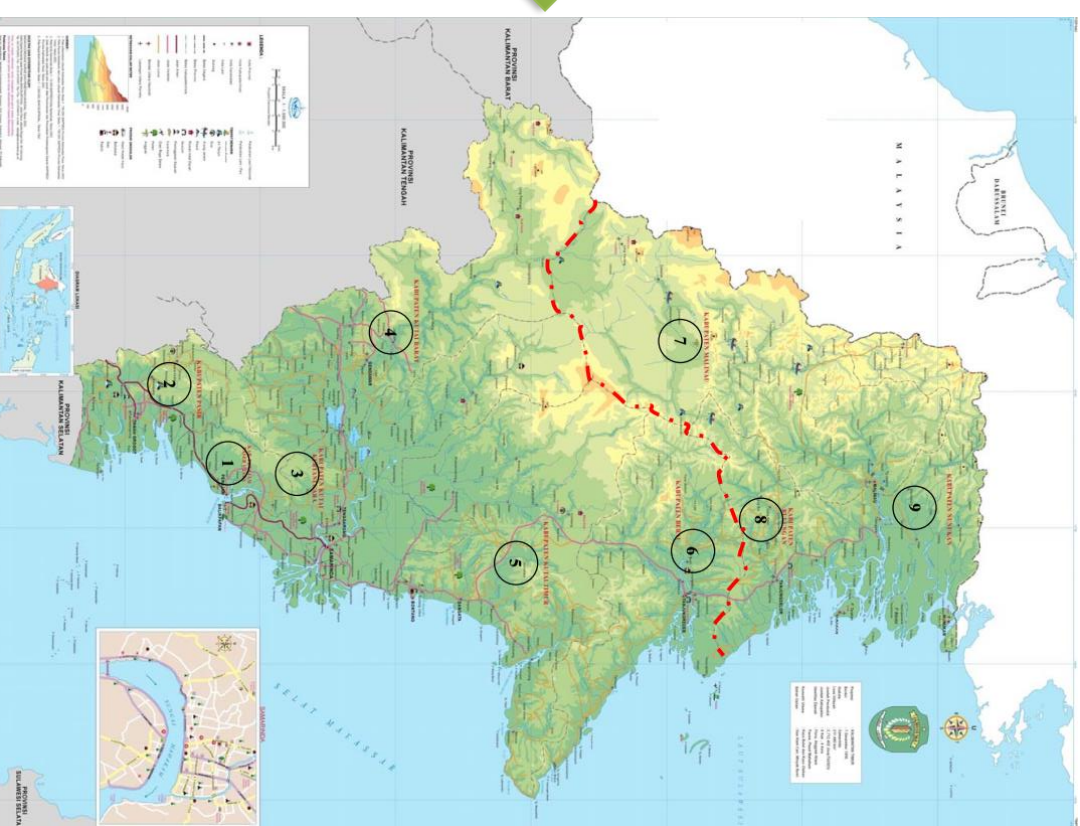


LOCAL RICE EXPLORATION



Collection of 345 cultivars

- PPU (30)
- Paser (41)
- Kutai Barat (44)
- K. Kartanegara (31)
- Kutai Timur (73)
- Bulungan (25)
- Nunukan (44)
- Malinau (33)
- Berau (24)





MORPHOLOGICAL TRAITS CHARACTERIZATION



High phenotypic variations of agro-morphological traits in the population:

- ✓ Plant height (66 to 209.33 cm)
- ✓ Culm number (1 to 41.67)
- ✓ Culm diameter (0.23 to 1.03 cm)
- ✓ Leaf length (39 to 108.33 cm)
- ✓ Leaf width (0.83 to 2.67 cm)
- ✓ Leaf angle (10 to 50 degree)
- ✓ Ligule length (11 to 55 mm)
- ✓ Weight of ten seeds (0.13 to 0.40 gram)



YIELD RELATED TRAITS CHARACTERIZATION



Large variation of yield component in 146 upland rice cultivars:

- ✓ Tiller number (2 - 66 tillers), 25 cultivars >30 tillers.
- ✓ Productive tillers (80% cultivars had more than 70%), 9 cultivars had 100% productive tillers.
- ✓ The panicle length (14.5 cm to 43.5 cm), most were clustered in 20-30 cm.
- ✓ Panicle secondary branch (8.2% cultivars were heavy, 22.6% were sparse).



BIOTIC STRESS TOLERANCE



East and North Kalimantan local upland rice population
can be used as source of vertical or horizontal resistance
genes in rice breeding program

Scale	Infected leaf area (%)	Number of cultivars				Disease severity
		BB*	NBS	BS	SB	
0	0	21	37	64	103	Resistant
1	<1	0	1	2	0	Resistant
2	1 - 3	4	1	9	2	Resistant
3	4 - 5	24	10	12	0	Resistant
4	6 - 10	30	8	10	3	Moderately resistant
5	11 - 15	3	11	4	1	Moderately resistant
6	16 - 25	12	17	5	0	Moderately resistant
7	26 - 50	15	19	2	0	Moderately susceptible
8	51 - 75	0	4	1	0	Susceptible
9	76 - 100	0	1	0	0	Susceptible

* (BB) Bacterial Blight, (NBS) Narrow Brown Spot, (BS) Brown Spot, (SB) Sheath Blight.

Nurhasanah et al., 2018a





ABIOTIC STRESS TOLERANCE



T1

- ✓ Seven of the local rice cultivars were tolerant in high Al concentration (250 ppm
- ✓ Five cultivars were moderately tolerant in an extremely high Al concentration (500 ppm)

Id	Genotype	Rice type	250 ppm AlCl ₃		500 ppm AlCl ₃	
			RTI	Category	RTI	Category
V1	IR 64	Non-glutinous	0.52	Sensitive	0.31	Sensitive
V2	<u>Mekongga</u>	Non-glutinous	0.72	Moderate	0.69	Sensitive
V3	<u>Jala Mengo</u>	Non-glutinous	0.66	Sensitive	0.39	Sensitive
V4	Mayas	Non-glutinous	0.80	Moderate	0.46	Sensitive
V5	<u>Kawit</u>	Non-glutinous	0.94	Tolerant	0.56	Sensitive
V6	<u>Awang</u>	Non-glutinous	0.47	Sensitive	0.32	Sensitive
V7	<u>Bentian</u>	Non-glutinous	1.08	Tolerant	0.72	Moderate
V8	<u>Ritam</u>	Non-glutinous	0.76	Moderate	0.50	Sensitive
V9	<u>Bogor Hitam</u>	Non-glutinous	0.70	Moderate	0.40	Sensitive
V10	<u>Bogor Putih</u>	Non-glutinous	0.71	Moderate	0.48	Sensitive
V11	<u>Sungkai</u>	Non-glutinous	1.03	Tolerant	0.66	Sensitive
V12	<u>Tumiyang</u>	Non-glutinous	0.58	Sensitive	0.38	Sensitive
V13	<u>Melak</u>	Non-glutinous	0.66	Sensitive	0.30	Sensitive
V14	Bogor	Non-glutinous	0.94	Tolerant	0.55	Sensitive
V15	<u>Mayas Kuning</u>	Non-glutinous	0.71	Moderate	0.37	Sensitive
V16	<u>Mayas Putih</u>	Non-glutinous	0.81	Moderate	0.69	Sensitive
V17	<u>Buyung</u>	Non-glutinous	0.91	Tolerant	0.77	Moderate
V18	<u>Serai Gunung</u>	Non-glutinous	0.67	Sensitive	0.29	Sensitive
V19	<u>Ketalun Tawar</u>	Non-glutinous	0.36	Sensitive	0.31	Sensitive
V20	<u>Ketan Putih</u>	Glutinous	0.68	Sensitive	0.39	Sensitive
V21	<u>Ketan Huan</u>	Glutinous	0.40	Sensitive	0.19	Sensitive
V22	<u>Ketan Lekatan</u>	Glutinous	0.28	Sensitive	0.27	Sensitive
V23	<u>Ketan Putek Iting</u>	Glutinous	0.66	Sensitive	0.42	Sensitive
V24	<u>Pulut Mayang</u>	Glutinous	0.68	Sensitive	0.42	Sensitive
V25	<u>Pulut Linjuang</u>	Glutinous	1.19	Tolerant	0.49	Sensitive



PIGMENTED RICE



No.	Districts	Non-Glutious Rice		Glutious Rice	
		Brown	Black	Black	Brown
1.	PPU	1	0	1	1
2.	Paser	0	0	0	0
3.	Kutai Barat	2	0	1	0
4.	Kutai Kartanegara	1	0	1	1
5.	Kutai Timur	0	0	2	1
6.	Bulungan	0	1	2	0
7.	Nunukan	6	2	4	1
8.	Malinau	5	3	1	0
10.	Berau	0	0	3	1
	TOTAL	15	6	15	5



PIGMENTED RICE



Beras Merah Krayan

Beras hitam "Cempo Ireng"

Beras Hitam Malinau

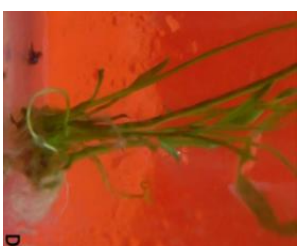
Beras Hitam Krayan



GENETIC IMPROVEMENT



- Conventional breeding program
- Non-conventional breeding program



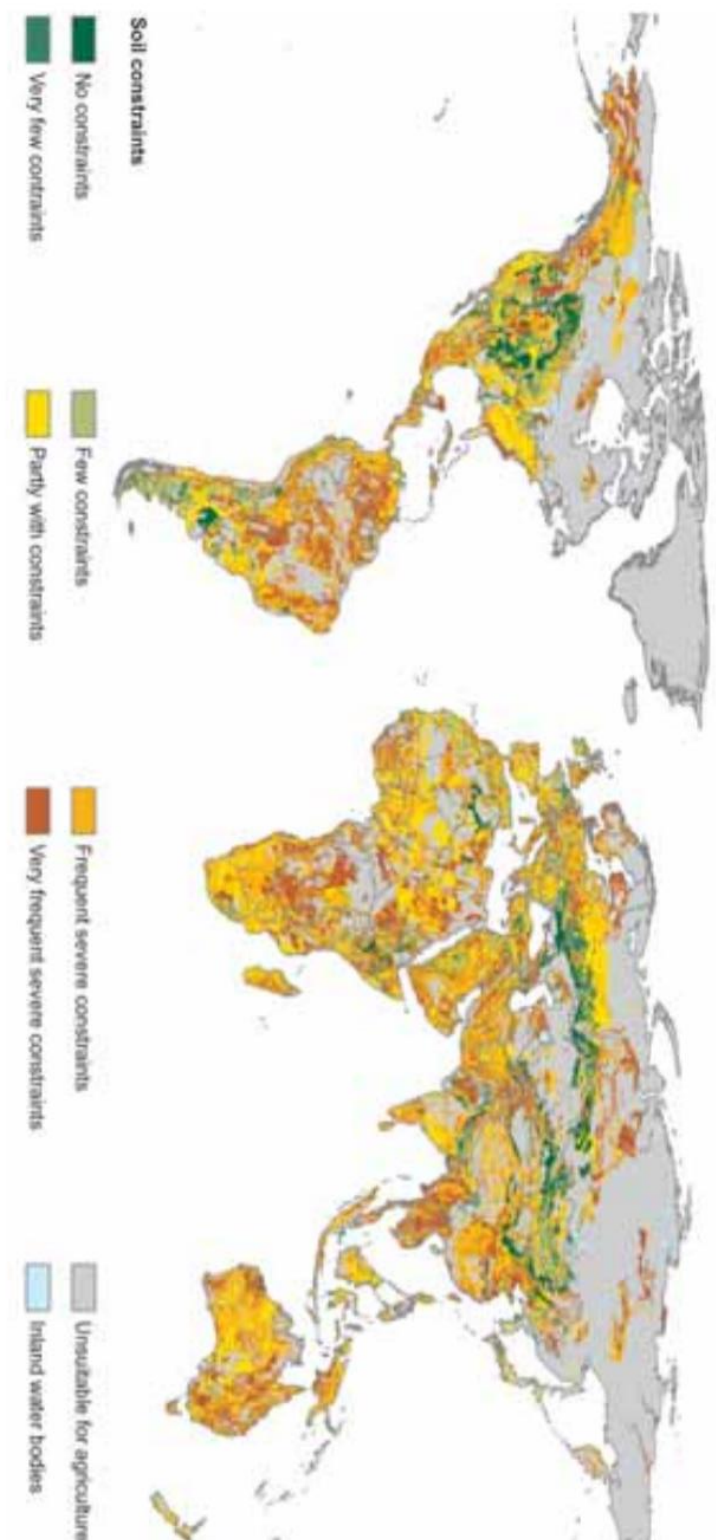


INDUCTION OF TOLERANCE AGAINST ABIOTIC STRESS



FAO report stated that only 3.5% of the global land area is not affected by some environmental constraint.

Global land area with soil constraints



Land with soil constraint, including soil depth, chemical, drainage, texture and miscellaneous land

<http://www.fao.org/docrep/010/a1075e/a1075e00.htm>



INDUCTION OF TOLERANCE AGAINST ABIOTIC STRESS



- Abiotic stress is an important factor limiting crop production worldwide.
- It is a primary constraint limiting land available for farming, as well as in the utilization of marginal land as agricultural conversion areas.
- The use of tolerant varieties is considered as the most affordable and effective approach for improving rice productivity in affected areas.



INDUCTION OF TOLERANCE AGAINST ABIOTIC STRESS



- Somaclonal variation and in vitro selection is one of the typically advised approaches for developing new germplasm with improved character.
- It is considerably more efficient compared to conventional or transgenic breeding programs.
- This technique has been applied in several rice breeding programs for abiotic stress tolerance characteristics.
- The in vitro selection will minimize the environmental variations and apply homogeneity of stress treatment.



SOMATIC EMBRYOGENESIS

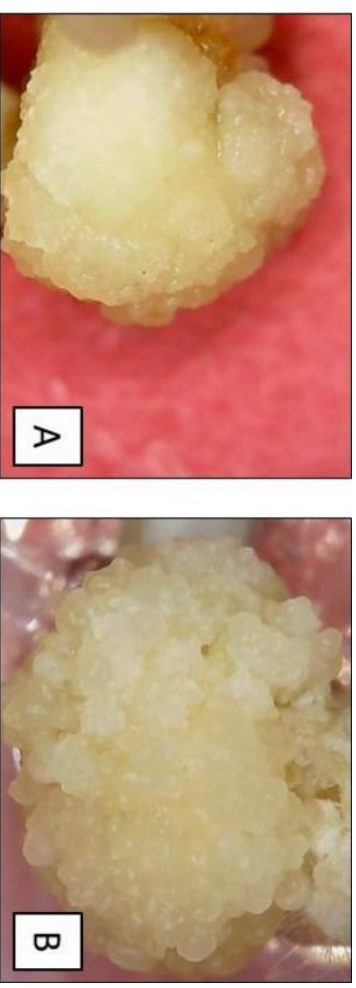
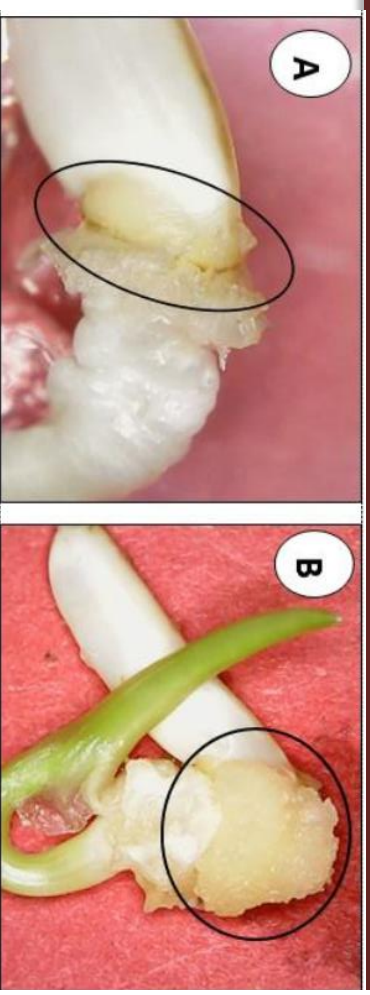


➤ Somatic embryo induction is an in vitro plant propagation techniques that is very important for plant developmental purposes

➤ Response of each variety differed to embryosomatic induction, indicated by callus induction rate and callus quality

➤ Callus formation time range from 8-13 days

➤ The rate of callus induction varied from 60 to 98.5 %





SOMACLONAL VARIATION INVITRO SELECTION



IRON STRESS TOLERANCE

➤ The somatic embryos from four indica rice varieties, Mayas Pancing, Gedagai, Siam, and Serai Gunung.

➤ Five levels of iron concentrations were applied in the selection media 0; 27.8; 55.6; 83.4, and 111.2 mg.l-1 of $\text{FeSO}_4.7\text{H}_2\text{O}$.

➤ The putative tolerant plants derived from Siam and Serai Gunung cultivars against the toxic iron concentration (three and four folds of normal iron concentration).





SOMACLONAL VARIATION INVITRO SELECTION



SALINITY STRESS TOLERANCE

- Salinity selection medium contained NaCl 0 mM; 50 mM; 100 mM; 150 mM; 200 mM .
- More than 70% of somatic embryos were tolerant against salinity (NaCl 200 mM).
- The tolerant plants regenerated only from Serai Gunung cultivar.
- Six tolerant plants derived from salinity selection medium containing 50 mM NaCl and 200 mM NaCl.





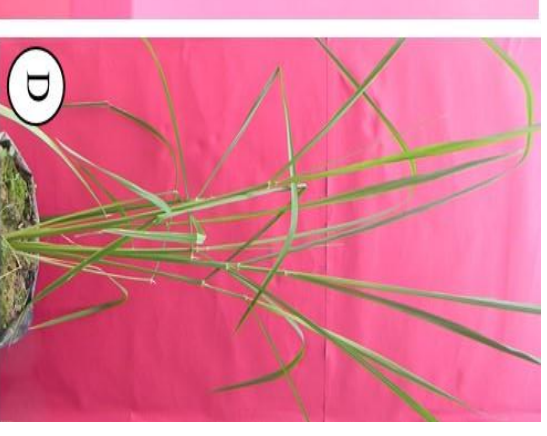
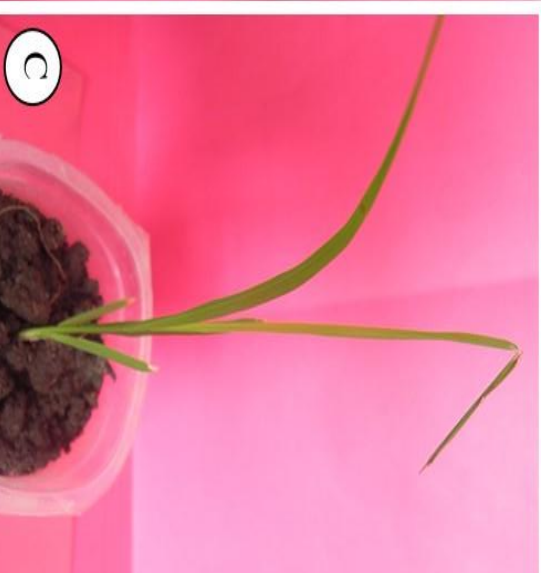
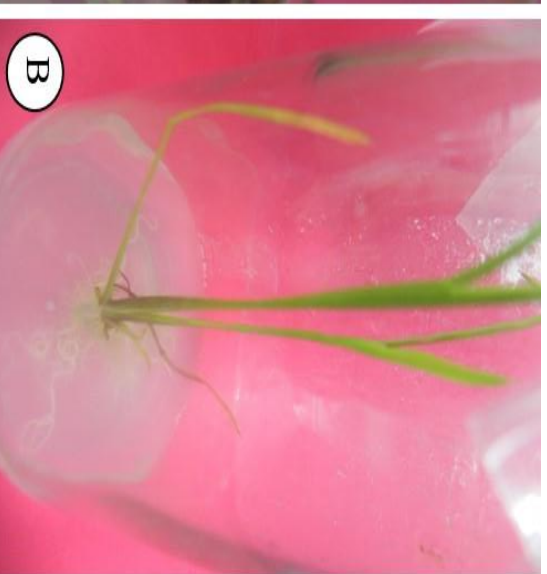
SOMACLONAL VARIATION INVITRO SELECTION



DROUGHT STRESS TOLERANCE

- The drought tolerant East Somatic embryo of East Kalimantan was obtained using in vitro selection medium with PEG concentrations of 5%, 10%, 15% and 20%.
- As many as 59 plantlets were regenerated from 27 tolerant calli, with an average of 2.19 plantlets per explant.

- Large variation of the putative drought tolerant plants growth were observed in which plant height ranged from 64 to 101 cm; leave length ranged from 32 to 53.5; tiller number ranged from 2 to 10; productive tiller ranged from 1 to 8 per plant.





Acknowledgement

Thanks to plant biotechnology
laboratory member:





Thank You

