

Annual Research Programme
(2015-16)

Crop Physiology Division

- PROGRAMME AREA : Physiological Aspect of Crop Productivity**
- Implementing Division : Crop Physiology
- Project 1 : Stress tolerance studies of crop mutants/varieties**
- a) Objectives : i) To identify drought/salinity/temperature stress tolerant mutants/lines of cereals, oil seeds and pulse crops
ii) To find out the physiological basis of such tolerances
- b) Personnel assigned : Dr. Md. Tariqul Islam, P.S.O and Head (P.I.)
Dr. Md. Siddique Rahman, S.S.O
Dr. Md. Babul Akter, S.O
Md. Azadul Haque, S.O
Mrs. Roushan Ara Begum, A.S.O
Md. Shawkatul Islam, A.S.O
Md. Rafiqul Islam, SA-II
- c) Status : Some rice, lentil, mungbean and tomato genotypes have been identified which are tolerant to certain levels of water and salinity stress. Climate is changing and air temperature is raising due to increasing concentration of CO₂ and other atmosphere greenhouse gases. The rise in atmospheric temperature causes detrimental effects on growth, yield, and quality of the crop varieties by affecting their phenology, physiology, and yield components. Detail works to be carried out to find out the basis of such tolerances.
- d) Source of fund : GOB
- Experiment 1 : Photosynthesis, grain growth and leaf water parameters of some rice genotypes under water stress**
- Objectives : i) To assess the effect of water stress on photosynthesis and grain growth of rice genotypes and
ii) to identify water stress tolerant genotypes
- ii) Growing season : Aman season 2015 and Aus season 2016
- iii) Treatments : a) Five rice genotypes viz., GSR, N₄/250/P-1(2), N₄/250/P-2(6)-26, N₄/350/P-4(5) and N₁₀/350/P-5-4
b) Water stress at tillering, booting and flowering stages
c) Grain growth studies will be done separately with the rice varieties under control and water stress
- iv) Experimental design with replication : CRD with 3 replications
- v) Location : Mymensingh
- vi) Unit plot size : Pot experiment
- vii) Data to be collected : Leaf water parameters, photosynthesis, leaf area, chlorophyll stability, $\delta^{13}\text{C}$, reducing sugar, NR activity in leaves, absolute growth, root growth, dry mass, yield and yield attributes
- Experiment 2 : Effect of salinity on some physiological and bio-chemical characters of Aus rice genotypes at seedling and reproductive stages**
- i) Objective : To evaluate salt tolerant Aus rice genotypes both physiologically and biochemically and to find out the basis for such tolerance
- ii) Growing season : April –July 2015
- iii) Treatments : (a) Five Aus rice genotypes (Porangi, Kotoktara, BRRIdhan42, BRRIdhan43, NERICA-1 and IR-29 (susceptible check)
(b) Four salinity levels viz. control, 6, 9 and 12 dS/m

- iv) Experimental design with replication : CRD with 3 replications
- v) Location (s) : Mymensingh
- vi) Unit plot size : Pot experiment
- vii) Data to be collected : photosynthesis, transpiration, chlorophyll stability, $\delta^{13}\text{C}$, NR activity, Na, K ions in leaves, root and stem, leaf area, dry matter of roots, leaves, stems, yield and yield attributes

Experiment 3 : Studies of selected local land races rice genotypes for salinity tolerance

- i) Objective : To identify morpho-physiological characters responses against salinity
- ii) Growing season : July to December 2015
- iii) Treatments : a) Four local rice land races
b) Four levels of salinity 0, 6, 9 and 12 dSm⁻¹
- iv) Experimental design with replication : CRD with 3 replications
- v) Location : Mymensingh
- vi) Unit plot size : Hydroponics
- vii) Data to be collected : Survival %, leaf area, dry matter, reduction of root and shoot length, Na and K in root and shoot, chlorophyll, yield and yield attributes

Experiment 4 : Screening of soybean advanced mutants for salinity tolerance based on morpho-physiological characters

- Objectives: : i) to assess the effect of salinity stress on growth and yield of soybean mutants/varieties;
ii) to identify salinity stress tolerant soybean mutants
- Growing season : January to April 2016
- Treatments: : a) 8 mutants/varieties viz., SBM-9, SBM-15, SBM-18, SBM-22, Binasoybean-1, Binasoybean-2, Binasoybean-3 and Binasoybean4
b) 3 soil salinity levels viz. 0, 6 and 9 dSm⁻¹

Experimental design : CRD with 8 replications

Unit plot size : Pot expt.

Location : BINA sub-station, Ishurdi and BINA HQ

Data to be collected: : Root characters, plant height, leaf area, chlorophyll stability, reducing sugar, absolute growth, leaf senescence, dry mass, yield and yield attributes

Experiment 5 : Identification of sesame genotypes for water logging tolerance based on physiological criteria

- Objectives: : i) to assess the effect of water logging on sesame growth and development; and
ii) to identify water log genotypes of sesame
- Growing season : March to May 2016
- Treatments: : a) Five sesame genotypes viz., SM-08, SM-09, SM-058, SM-067 and Binatil-2
b) Four water logged condition will be applied at 45 days after transplanting such as control (no water logging), 24-hour water logging, 36-hour water logging and 48-hour water logging condition

Experimental design : CRD with 8 replications
 Unit plot size : Pot expt.
 Location : BINA HQ, Mymensingh
 Data to be collected: : Root characters, root growth and development, Plant height, leaf number, photosynthesis, chlorophyll, dry matter partitioning of plant parts, yield contributing characters and yield.

Experiment 6 : Effect of different levels of temperature on germination and root growth of rice varieties

i) Objective : to find out the optimum temperatures for germination and seedling growth of rice varieties
 ii) Growing season : July to December 2015
 iii) Treatments : a) Six levels of temperatures viz. 10, 20, 30, 35, 40 and 45°C
 b) Twelve rice varieties viz. Iratom-24, Binashail, Binadhan-4, Binadhan-5, Binadhan-6, Binadhan-7, Binadhan-8, Binadhan-9, Binadhan-10, Binadhan-11, Binadhan-12, Binadhan-13, Binadhan-14 and BRRI dhan29
 iv) Experimental design with replication : CRD with 3 replications
 v) Location : Mymensingh
 vi) Unit plot size : Pot experiment
 vii) Data to be collected : Germination%, root growth, shoot length, root and shoot biomass, photosynthesis, transpiration, leaf conductance, $\delta^{13}\text{C}$, leaf area and chlorophyll stability

Experiment 7 : Effect of high CO₂ concentration on grain yield of high yielding boro rice varieties

i) Objectives : To assess the effect of high CO₂ on grain yield of boro rice varieties
 Growing season : December 2015 to May 2016
 iii) Treatments : a) Five rice varieties viz. Iratom-24, Binadhan-5, Binadhan-6, Binadhan-8 and Binadhan-14
 b) Three CO₂ levels viz. Ambient, 400 ppm CO₂ at flowering stage, 400 ppm CO₂ at grain filling stage
 iv) Experimental design with replication : CRD with 3 replications
 v) Location : BINA farm, Mymensingh
 vi) Unit plot size : Pot experiment
 vii) Data to be collected : Photosynthesis, chlorophyll stability, $\delta^{13}\text{C}$, NR activity in leaves, yield and yield attributes

Project 2 : Morpho-physiological studies of crops for higher yield and quality

a) Objective : a) To assess the qualities of BINA varieties/mutants from architectural, physiological and biochemical point of view and
 b) To suggest criteria for further improvements
 b) Personnel assigned : Mr. Md. Siddique Rahman, S.S.O (P.I.)
 Dr. Md. Tariqul Islam, P.S.O and Head
 Md. Azadul Haque, S.O
 Mrs. Roushan Ara Begum, A.S.O
 Md. Shawkatul Islam, A.S.O
 Md. Rafiqul Islam, SA-II

- c) Status : Preliminary studies of different local varieties/ mutants/ advanced lines developed by Plant Breeding and Crop Physiology divisions were carried out to know their morpho-physiological and biochemical characteristics. Criteria for their improvements had been reported for several crops and some mutants released as varieties having superior qualities. More mutants/crops need to be evaluated for their high yields, better quality and short duration.
- d) Source of Fund : GOB

Experiment 8 : Morpho-physiological studies of some Aus rice (local and HYV) varieties

- i) Objective : To identify the physiological causes of lower yield in local genotypes compared to HYV
- ii) Growing season : April to July 2015
- iii) Treatment : Six mutants/varieties viz. Porangi, Kotoktara, BRRIdhan48, Parija, N₁₀/350/P-5-4 and N₄/350/P-4(5)
- iv) Experimental design with replication : RCBD with 4 replications
- v) Locations : Magura sub-station and Mymensingh
- vi) Unit plot size : 6 m × 4 m
- vii) Data to be collected : Chlorophyll, CGR, NAR, photosynthesis, leaf area index, root parameter, yield and yield components, days to maturity (transplanting to harvesting) and weather data.

Experiment 9 : Physiological evaluation of summer mungbean mutants/varieties

- i). Objective : To assess the physiological potentiality compared to the released varieties of summer mungbean
- ii) Growing season : February – May 2016
- iii) Treatment : Four mutants viz., MB-1, MB-2, MB-13, MB-17 along with two varieties, Binamoog-7 and Binamoog-8
- iv) Experimental design with replication : RCBD with 3 replications
- v) Unit plot size : 3 m × 3 m
- vi) Locations : Magura and Ishurdi sub-stations
- vii) Data to be collected : Canopy analysis, chlorophyll, branch orientation, branch growth habit, stem colour, stem shape, leaf number, leaf shape and size, leaf orientation, leaf area index, leaf area ratio, photosynthesis, dry matter partitioning of plant parts, pod maturity habit, flower colour, shape and size, yield contributing characters and yield

Experiment 10 : Physiological evaluation of lentil mutants/varieties

- i). Objective : To assess the physiological potentiality compared to the released varieties of lentil
- ii) Growing season : November 2015 – March 2016
- iii) Treatment : Eight mutants/varieties viz., N₃M-320, N₄I-404, N₄I-411, N₄M-412, N₄M-540, E₃M-819, N₅M-560 and Binamasur-4
- iv) Experimental design with replication : RCBD with 3 replications
- v) Unit plot size : 3 m × 2 m
- vi) Locations : Magura and Ishurdi sub-stations
- vii) Data to be collected : Canopy analysis, branch number, branch orientation, branch Growth habit, stem color, stem shape, leaf number, leaf shape and size, leaf orientation, leaf area index, leaf area ratio, photosynthesis, dry matter partitioning of plant parts, flower colour, shape and size, yield contributing characters and yield

- Experiment 11** : **Determination of Amylose and protein content of rice mutants**
- i). Objective : To find out the status of amylase and protein content of selected mutants
- ii) Growing season : Boro, T. Aman and Aus
- iii) Treatment : Two rice mutants
- iv) Experimental design : CRD with 4 replications
with replications
- v) Unit plot size : Lab analysis
- vi) Location : Mymensinghy
- vii) Data to be collected : Amylase and protein content

Experiment 12 : **Nucleus seed production**

A. Binadhan-13

- i) Objective : To produce the nucleus seeds of Binadhan-13
- ii) Growing season : July – December 2015
- iii) Cultural operations : Vigorous rouging, weeding
- iv) Locations : Rangpur, Comilla, , Jamalpur, Nalitabari sub-stations and Mymensingh
- v) Unit plot size : 25 m × 20 m
- vi) Data to be collected : Grain yield, time to 50% maturity, crop duration.

B. Binamasur-3

- i) Objective : To produce the nucleus seeds of Binamasur-3
- ii) Growing season : November 2015 – March 2016
- iii) Cultural operations : Vigorous rouging, weeding and thinning
- iv) Locations : Magura and Ishurdi
- v) Unit plot size : 25 m × 20 m
- vi) Data to be collected : Seed yield, time to 50% maturity, crop duration.

C. Binamasur-4

- i) Objective : To produce the nucleus seeds of Binamasur-4
- ii) Growing season : November 2015 – March 2016
- iii) Cultural operations : Vigorous rouging, weeding and thinning
- iv) Locations : Magura and Ishurdi
- v) Unit plot size : 25 m × 20 m
- vi) Data to be collected : Seed yield, time to 50% maturity, crop duration.

D. Binamoog-7

- i) Objective : To produce the nucleus seeds of Binamoog-7
- ii) Growing season : February – May 2016
- iii) Cultural operations : Vigorous rouging, weeding and thinning
- iv) Locations : Magura and Ishurdi
- v) Unit plot size : 25 m × 20 m
- vi) Data to be collected : Seed yield, time to 50% maturity, crop duration.

E. Binatomato-6 and Binatomato-7

- i) Objective : To produce the nucleus seeds of Binatomato-6 and Binatomato-7
- ii) Growing season : October 2015 – February 2016
- iii) Locations : Rangpur, Ishurdi, Jamalpur sub-stations and Mymensingh
- v) Unit plot size : 35 m × 35 m
- vi) Data to be recorded: : Fruit yield and seed collection

- Project 3** : **Growth analysis and assimilate distribution of crop varieties/mutants**
- a) Objective : To assess the photosynthetic and translocation efficiency for better crop management and plant breeding applications
- b) Personnel assigned : Dr. Sakina Khanam, S. S. O. (P. I.)
Dr. Md. Tariqul Islam, P.S.O. and Head
Md. Azadul Haque, S. O.
Mrs. Roushan Ara Begum, A.S.O
Md. Shawkatul Islam, A.S.O
Md. Rafiqul Islam, SA-II
- c) Status : Study of growth analysis may be useful to overcome the problem of excessive vegetative growth and increase crop productivity of different varieties/lines of rice, mungbean and lentil
- d) Source of fund : GOB
- Experiment 13** : **Growth analysis and assimilate distribution of local and HYV aus rice varieties**
- i) Objective : To determine the translocation barrier among the aus rice genotypes
- ii) Growing season : April- July 2016
- iii) Treatment : Six mutants/varieties viz., BRR1 dhan48, Parija, N₄/250/P-1(2), N₄/250/P-2(6)-26, N₄/350/P-4(5) and N₁₀/350/P-5-4)
- iv) Experimental design with replications : CRD (pot expt.) & RCBD (field expt.) with 3 replications
- v) Locations: : Mymensingh (pot expt.), sub-stations Rangpur, Magura and Jamalpur
- vi) Unit plot size : 4 m × 5 m
- vii) Data to be collected : Photosynthesis, chlorophyll, canopy structure related parameters, Leaf Area Index, yield attributes and molecular dissection of some data
- Experiment 14** : **Growth analysis and assimilate distribution of aman rice varieties/mutants**
- i) Objective : To determine the translocation barrier among the aman rice genotypes
- ii) Growing season : July- December 2015
- iii) Treatment : Two cultivars (Binadhan-16, Binadhan-17) and four advanced lines (N₄/250/P-1(2), N₄/250/P-2(6)-26, N₄/350/P-4(5) and N₁₀/350/P-5-4)
- iv) Experimental with replications : CRD (pot expt.) & RCBD (field expt.) with 3 replications
- v) Locations: : Mymensingh (pot expt.), sub-stations Rangpur, Comilla and Magura
- vi) Unit plot size : 4 m × 3 m
- vii) Data to be collected : Photosynthesis, chlorophyll, carbon distribution pattern, canopy structure related parameters, yield attributes and molecular dissection of some data
- Experiment 15** : **Relationships of temperature, light and humidity with dry matter partitioning and yield in soybean genotypes**
- i) Objective : To determine the optimum canopy of soybean for higher yield
- ii) Growing season : January - May 2016
- iii) Treatment : Four soybean genotypes (Binasoybean-3, Binasoybean-4, SBM-18 and SBM-22)
- iv) Experimental with replications : CRD (pot expt.), RCBD (Field expt.) with 4 replications
- v) Location: : Mymensingh, Noakhali and Gopalganj sub-stations
- vi) Unit plot size : 3 m × 3 m
- vii) Data to be collected : Photosynthesis, dry matter distribution, canopy structure related parameters, leaf area and yield attributes

- Project 4** : **Assessment of crop varieties/mutants with emphasis on physiological criteria**
- a) Objectives : To evaluate existing advanced mutant lines of field crops on the basis of plant ideotype, physiological parameters, ¹⁴C and ¹⁵N tracer technique and yield
- b) Personnel assigned : Dr. Monjurul Alam Mondal, PSO (PI)
Dr. Md. Tariqul Islam, P.S.O and Head
Dr. Md. Babul Akter, SO
Md. Azadul Haque, S.O
Mrs. Roushan Ara Begum, A.S.O
Md. Rafiqul Islam, SA-II
- c) Status : On going
The yield of rice is lower than the potential due to 10-40% grain sterility. It is widely accepted that yield of rice can be increased, if sterility could be reduced. The yield of rice is an integrated result of various processes including canopy photosynthesis, conversion of assimilates to biomass and partitioning of assimilates to grains. Understanding the physiological factors and mechanisms involve in source-sink relationship will contribute to efficient filling rate in the developing grain.
For modern improved rice cultivars, late developing tillers (secondary and tertiary) are unfavorable to grain yield, early tillers produce more grains than late forming ones. The physiological reason to poor yield in late forming tillers, need to be studied. Findings from this study would indicate a possible direction for rice breeding program aiming at improving quality of rice crop and understood the mechanism of poor translocation and partitioning of assimilates into rice grains which subsequently improve the grain filling, thereby increase yield potential.
- d) Source of fund : GOB
Expt. 16 : **Measures to reduce grain sterility in rice based on physiological criteria**
- Objectives**
- a) To study the relationship between dry matter production in ontogeny and the partitioning of assimilates into grain formation in rice; and
b) To investigate the potential causes of poor grain filling of modern rice varieties.
- ii) Growing season : July to December 2015 for *Aman* season
December 2015 to May 2016 for *Boro* Season
March to June 2016 for *Aus* season
- iii) Treatment : a) Four rice mutants/varieties *viz.*, GSR-3, Binadhan-7, Binadhan-15 and Binadhan-16 for *Aman* season
b) Six *Boro* rice mutants/varieties *viz.*, B-10, B-11, RM-40-10-11, Binadhan-5, Binadhan-14 and BRRRI dhan-29 for *Boro* season
c) Four rice mutants/varieties *viz.*, B-10-40(C)-1-1-3, B-10-40(C)-1-1-5, B-10-40(C)-1-1-7 and BRRRI dhan43 for *Aus* season
- iv) Experimental design with replications : RCBD with 3 replications
- v) Location : BINA HQs farm and BINA sub-station, Ishurdi and Comilla
- vi) Unit plot size : 2.5 m × 2.5 m

vii) Data to be collected : Total dry mass, leaf area index and leaf area duration at four growth stages of tillering, booting, heading and during grain filling period. Chlorophyll and photosynthesis of flag leaves will be taken at booting, from heading to ripening with five days' interval. At harvest, filled and unfilled grain number, yield contributing characters and grain yield will be recorded.

Experiment 17 : Physiology of tillering ontogeny and assimilate partitioning control in elite rice mutants/varieties

i) Objectives : To investigate the control mechanism involve in assimilate partitioning competition among different classes of tillers.

ii) Growing seasons : July to December 2015 for *Aman* season
December 2015 to May 2016 for *Boro* Season
March to June 2016 for *Aus* season

iii) Treatment : a) Four rice mutants/varieties viz., GSR-3, Binadhan-7, Binadhan-15 and Binadhan-16 for *Aman* season
b) Six *Boro* rice mutants/varieties viz., B-10, B-11, RM-40-10-11, Binadhan-5, Binadhan-14 and BRRI dhan-29 for *Boro* season
c) Four rice mutants/varieties viz., B-10-40(C)-1-1-3, B-10-40(C)-1-1-5, B-10-40(C)-1-1-7 and BRRI dhan43 for *Aus* season

iv) Experimental design with replications : RCBD with 3 replications

v) Locations : BINA HQs farm

vi) Unit plot size : 2.5 m × 2.5 m

vii) Data to be collected : The tiller production dynamics will be monitored and recorded at all growth stages. Percent yield contribution of tiller classes will be calculated. Chlorophyll and photosynthetic rate of flag leaves for main culm, primary, secondary and tertiary tillers will be taken beginning at heading to ripening with five days' interval. Finally, at harvest yield and yield related parameters will be collected tiller wise.

Project 5 : Evaluation of crop varieties/mutants based on genetic and physiological criteria

a) Objectives : To evaluate existing varieties and advanced mutant lines of rice on the basis of plant ideotype, genetic, physiological parameters and yield

b) Personnel assigned : Dr. Md. Babul Akter, SO (PI)
Dr. Md. Tariqul Islam, P.S.O and Head
Dr. Monjurul Alam Mondal, PSO
Md. Azadul Haque, S.O
Md. Shawkatul Islam, A.S.O
Md. Rafiqul Islam, SA-II

c) Status : New

d) Source of fund : GOB

Expt. 18 : Evaluation of same duration aman rice varieties based on morpho-physiological criteria

i) Objectives : To find out the morpho-physiological superiority for higher yield and elucidate the physiological mechanisms of potential grain weight.

- ii) Growing season : July 2015 to November 2015
- iii) Treatment : Four modern aman rice varieties viz., Binadhan-7, Binadhan-17, BRRI dhan33 and BRRI dhan39
- iv) Experimental design with replications : RCBD with 3 replications
- v) Location : BINA HQs farm, BINA sub-station, Ishurdi and Magura
- vi) Unit plot size : 2.5 m × 2.5 m
- vii) Data to be collected : Plant sampling at four growth stages: Tillering, panicle initiation, booting and heading. Climatic parameters (especially temperature to calculate thermal time), Plant height, tillering ontology, cell structure of stem and leaf, root structure, total dry mass, leaf area index, Chlorophyll content, photosynthesis capacity, total sugar, ovary size, grain moisture content, grain filling rate, grain filling duration, grain width and grain length, number of endosperm cell, number grains per panicle, individual grain weight considering different grain positions of the panicle and 1000 grain weight will be recorded.

Expt. 19 : Evaluation of same duration boro rice varieties based on morpho-physiological criteria

- i) Objectives : To find out the morpho-physiological superiority for higher yield and elucidate the physiological mechanisms of potential grain weight.
- ii) Growing season : December 2015 to May 2016
- iii) Treatment : Five modern boro rice varieties viz., Binadhan-8, Binadhan-10, Binadhan-14, BRRI dhan28 and BRRI dhan45
- iv) Experimental design with replications : RCBD with 3 replications
- v) Location : BINA HQs farm, BINA sub-stations Chapai Nawabganj and Magura
- vi) Unit plot size : 2.5 m × 2.5 m
- vii) Data to be collected : Plant sampling at four growth stages: Tillering, panicle initiation, booting and heading. Climatic parameters (especially temperature to calculate thermal time), Plant height, tillering ontology, cell structure of stem and leaf, root structure, total dry mass, leaf area index, Chlorophyll content, photosynthesis capacity, total sugar, ovary size, grain moisture content, grain filling rate, grain filling duration, grain width and grain length, number of endosperm cell, number of grains per panicle, individual grain weight considering different grain positions of the panicle and 1000 grain weight will be recorded.

Head of Crop Physiology Division

CSO (RC)

Director (Research

Research Budget for Crop Physiology Division, 2015-2016 (in 000 Taka)

Projects	No. of Expts.	Labour	Chemicals/ Glasswares	Travel	Inputs	Project total
1. Stress tolerance studies of crop mutant/varieties	7	80	60	120	180	440
2. Morpho-physiological studies of crops for higher yield and quality	5	130	70	250	200	650
3. Growth analysis and assimilate distribution of crop varieties/mutants	3	110	30	60	200	300
4. Assessment of crop varieties /mutants with emphasis on physiological criteria	2	30	40	120	240	430
5. Evaluation of crop varieties/mutants based on genetic and physiological criteria	2	30	30	100	80	240
Total	19	380	230	650	900	2060

* Labour wage will be paid from the institute centrally

Head of Crop Physiology Division

CSO (RC)

Director (Research)