TECHNICAL PROGRAMME - 2016 - 2017

I. COLLECTION, CONSERVATION, CATALOGUING AND EVALUATION OF GENETIC RESOURCES OF TUBER CROPS

Exploring the biodiversity in tropical tuber crops from the unexplored areas in the different regions for collecting germplasm having unique character genes for quantitative and qualitative traits, particularly for high yield and tolerance/resistance to biotic and abiotic stress.
Centres: All participating Centres

II. TESTING OF GENETIC RESOURCES AT VARIOUS AGRO CLIMATIC ENVIRONMENTS

II.1.Cassava

II. 1.1. IET on Cassava mosaic resistant varieties (2016) (1st Year)
Centres: Yethapur, Peddapuram, Thiruvanathapuram, Imphal, Dapoli,Jagdalpur
Entries: Thiruvananthapuram (10 entries), Jagdalpur (2 entries)

II.1.2. URT on K-efficient Cassava lines (2014) (1stYear)
Centres: Yethapur, Peddapuram, Imphal, Thiruvananthapuram
Entries: TCa14-1, TCa14-3, TCa14-4, TCa14-5, TCa14-6, SreeAthulya, Local

II.1.3. URT on cassava for culinary use (2013) (2ndyear)
Centres: Thiruvananthapuram, Imphal&Jagdalpur
Entries: TCa 13-1, TCa 13-2, TCa 13-3, TCa 13-4, TCa 13-5, TCa13-6, TCa13-7, SreeVijaya and M 4 (control)

II.1.4. MLT on short duration cassava varieties (2012) (1stYear)
(To be harvested at 6 months)
Centres: Thiruvananthapuram, Yethapur, Peddapuram
Entries: TCa12-5, TCa12-6, TCa12-9, Sree Jaya, Local

II.2.Sweet potato

II. 2.1. IET on orange flesh sweet potato (2016) (1st Year)
Centres: Dholi, Peddapuram, Kalyani,Jagdalpur,Faizabad, Coimbatore, Navsari, Dharwad, Udaipur, Bhubaneswar, Imphal, Rajendarnagar, Ranchi
Entries: Peddapuram (3entries), Jagdalpur (2entries), Dharwad (5entries), Faizabad (1), Imphal (1)

II.2.2. URT on sweet potato for weevil resistance (2012) (2ndYear)
Centres: Bhubaneswar, Thiruvananthapuram, Kalyani, Dholi, Rajendra Nagar
Entries: TSp12-3, TSp12-4, TSp12-5, TSp12-6, TSp12-13, TSp12-14, Kishan, Local

II. 2.3. URT on sweet potato (2012) (2ndYear)
Centres: Kalyani, Barapani& Dharwad
Entries: TSp12-4, TSp12-6, TSp12-7, TSp12-8, TSp12-9, TSp12-10, TSp12-12, SreeBhadra, Local

II.3.Yams

II.3.1. IET on Greater yam (2016) (Planting by Feb - March 2017)
Centres: Kovvur, Jorhat, Kalyani, Dapoli, Jagdalpur, Udaipur, Thiruvananthapuram, Imphal
Entries: Kovvur (1), Jorhat (1), Dapoli (1), Jagdalpur (2), Udaipur (1), Thiruvananthapuram (4),Imphal (1)

II. 3.2. IET on Greater Yam (2014) (2ndYear)

Centres: Thiruvananthapuram, Dapoli, Udaipur, Jagdalpur, Imphal, Jorhat, Kovvur
Entries: TGy14-1, TGy14-2, TGy14-3, TGy14-4, TGy14-5, TGy14-6, TGy14-7, TGy14-8, TGy14-9, TGy14-10, TGy14-11, TGy14-12, TGy14-13, TGy14-14, SreeKarthika, local

II. 3.3. URT on *Dioscoreabulbifera*(2013) (2ndYear)

Centre: Jagdalpur, Ranchi, Dapoli
Entries: TDb 13 -1, TDb 13 -3, TDb 13 -4, TDb 13 -5, TDb 13 -6, TDb 13 -10, Local

II. 3.4.URT on greater yam (2012) (2ndYear)

Centre: Thiruvananthapuram, Bhubaneshwar, Jagdalpur, Kovvur& Udaipur
Entries: TGy12-1, TGy12-2, TGy12-3, TGy12-4, TGy12-5, TGy12-6, SreeKarthika, Local

II.3.5. MLT on greater yam (2ndYear)

Centres: Imphal, Jorhat, Navasari, Jagdalpur
Entries: IGDA-2, Da-25, IGDa-4, SreeKarthika, Local

II. 4.Colocasia

II.4.1. IET on Colocasia (2016) *(Planting by Feb - March 2017)*

Centres: Dholi, Jorhat, Kalyani, Dapoli, Jagdalpur, Faizabad, Ranchi, Coimbatore, Thiruvananthapuram, Rajendranagar, Imphal, Barapani, Kovvur.
Entries: Dholi(3), Jorhat (1), Kalyani (1), Dapoli (1), Jagdalpur (3), Faizabad (1), Ranchi (1), Imphal(1), Barapani (1), Lembucherra (1), Udaipur (1)

II. 4.2. IET on Colocasia (Bunda) (2016) *(Planting by Feb - March 2017)*

Centres: Dholi, Jorhat, Kalyani, Jagdalpur, Faizabad, Ranchi, Barapani
Entries: Dholi (4), Jorhat (1), Jagdalpur (2), Ranchi (1), Barapani (1)

II. 4.3. URT on *Colocasia* (2012) (2ndYear)

Centres: Kalyani, Barapani, Dholi, Ranchi, Coimbatore & Port Blair
Entries: TTr12-1, TTr12-2, TTr 2-4, TTr12-5, TTr12-7, TTr12-8, Muktakeshi, Local

II. 4. 4. URT on *Colocasia* entries for *Phytophthora* leaf blight resistance/tolerance (2012) (2ndyear).

Centres : Kalyani, Dholi, Dapoli, Rajendranagar
Entries : TC bl 12-1, TC bl 12-2, TC bl 12-3, TC bl 12-4, TC bl 12-5, TC bl 12-6,TC bl 12-7, Muktakeshi, Telia

II. 4. 5. IET on Swamp Taro (2015) (2ndYear)

Centres: Jorhat, Kalyani, Imphal
Entries: BCST-1, BCST-3, BCST-5, BCST-13, BCST-14, AAUST-1, AAUST-2, AAUST-3, CAUST-1, CAUST-2

II.5. Elephant foot yam

II.5.1.IET on Elephant foot yam (2016) *(Planting by Feb - March 2017)*

Centres: Dholi, Kovvur, Kalyani, Jagdalpur, Faizabad, Navsari, Udaipur, Thiruvananthapuram
Entries: Dhoil(2), Kalyani (1), Navsari(1), Udaipur (1), Thiruvananthapuram (2)

II.6. Tannia

II.6.1.IET on Tannia (2015) (2ndYear)

Centres: Rajendranagar, Jorhat, Thiruvananthapuram, Imphal, Kalyani,Jagdalpur
Entries: TTn14-1, TTn14-2, TTn14-3, TTn14-5, TTn14-7, TTn14-8, TTn14-9, local

II. 7.Yam bean

II. 7.1. URT on Yam bean (1st year)

Centres: Bhubaneswar, Dholi, Kalyani

Entries: TYb 14-3, TYb 14-5, TYb 14-7, TYb 14-8, TYb 14-9, TYb 14-10, TYb 14-11, RM-1 (Check)

II.8.Collection and conservation of minor tuber crops available in the respective location of the centres

Centres: All centres

III. AGRO TECHNIQUES

III. 1. Farming system studies in NE region and tribal areas

Centres: Ranchi, Bhubaneswar, Jagdalpur, Jorhat, Barapani, Imphal, PortBlair, Lembuchera, Palampur

Observations

1. Existing cropping /farming system prior to the studies including the farm revenue, B: C ratio and employment days.
2. Yield from different crops/output from different components on **per ha** basis.
3. Gross and net income generated/expected from **one ha**.
4. B: C ratio.
5. Generation of employment per year.

III. 2. Micronutrient studies in Tuber Crops

III. 2. 1. Cassava

Centres: Yethapur, Peddapuram, Dapoli, Kalyani

Treatments:

1. POP recommendation (NPK+FYM) specific to the location
2. POP + Soil application of $MgSO_4$@ approx. 20 kg ha^{-1}
3. POP + Soil application of $ZnSO_4$@ approx. 12.5 kg ha^{-1}
4. POP + soil application of Borax@ approx. 10 kg ha^{-1}
5. POP + $FeSO_4$
6. POP+ $MgSO_4$+Zn SO_4+Borax
7. POP+ $MgSO_4$+Zn SO_4+Borax+ $FeSO_4$
8. Absolute control

$MgSO_4$, $ZnSO_4$ and borax may be applied after top dressing of NPK fertilizers and within 2 months of planting cassava.

$FeSO_4$ may be given as stake dipping for 15 minutes and foliar application (0.5% $FeSO_4$ solution) 3-4 times at weekly intervals on appearance of the symptoms.

(Dosage of micro nutrients may be fixed after assessing the initial status of micro nutrients in soil samples)

III. 2. 2. Sweet potato

Centres: Dharwad, Rajendranagar, Kalyani, Dholi, Udaipur, Ranchi

Treatments:

T1: Recommended dose of FYM and NPK

T2: Recommended dose of FYM and NPK + Soil application of MgSO4 @ approx. 20 kg/ha after top dressing

T3: Recommended dose of FYM and NPK + Soil application of Borax @ approx. 1.5 kg/ha after top dressing

T4: Recommended dose of FYM and NPK + Dip the cuttings in 2-4% zinc sulphate ZnSO47H2O for 15 minutes before planting+ foliar spraying of 1.5% zinc sulphate heptahydrate solution after top dressing.

T5: Recommended dose of FYM and NPK + Mg+B+Zn treatments

T6: Absolute control

Design: RBD Replication: 4

(Dosage of micro nutrients may be fixed after assessing the initial status of micro nutrients in soil samples)

Observations

1. Initial nutrient status of the soil (pH, organic carbon, available N,P,K, Ca, Mg, Fe, Zn, B)
2. Biometric characters of the plant (plant height, stem girth, number of fallen and retained leaves, leaf area) at 3,6 MAP and at harvest for cassava and Vine length, branching height, no. of branches, no.of leaves, leaf area at 2,3 MAP and at harvest for sweet potato.
3. Tuber yield par plant and per ha and yield attributes (number of tubers, tuber length, tuber girth) at harvest
4. Tuber quality attributes (cyanogenic glucosides for cassava, starch, tuber dry weight)
5. Economic parameters.(cost of cultivation, gross income, net income, net profit, B:C ratio)

III.3. Intercropping in greater yam

*Centres:*Jagdalpur, Kovvur, Jorhat, Coimbatore, Dapoli, Navsari

Treatments:

(1) Greater yam sole crop (90cm x 90 cm) non-staking
(2) Pigeon pea sole crop (60 cm x 30 cm) non-staking
(3) Maize sole crop (60 cm x 30 cm) non-staking
(4) Jowar sole crop (60 cm x 30 cm) non-staking
(5) Greater yam + Pigeon pea (1:2) additive
(6) Greater yam + Maize (1:2) additive
(7) Greater yam + Jowar (1:2) additive
(8) Greater yam sole (90cm x 90 cm) staking individual plants

In intercropping, pigeon pea, Maize and Jowar* to be grown in intra rows of greater yam. Thus the intercrops spacing will be (90 cmx 30 cm)

(Sl. No. 5, 6, 7 – Trailing can be done on the respective intercrop)

**Okra at Imphal*

Design: RBD
Replications: 3
Plot size 9m x 5.4 m
Harvesting: 7 months after planting

<u>Observations</u>

(1) Maize: Plant height, no. of leaves/plant, LAI at 30, 60 and 90 days after planting (Harvesting)
(2) Jowar: Plant height, no. of leaves/plant, LAI at 30,60, 90 and120 days after planting (Harvesting)
(3) Pigeon pea: Plant height, no. of leaves/plant, LAI at 1, 3, 5 and 7 months after planting.

<u>Yield attributes & yield</u>

(1) Greater yam: HI at senescence, Yield/plant, yield/ha
(2) Maize: no. of cobs/plant, grains/cob, test weight (100 grain weight) and yield/ha

(3) Pigeon pea: No of pods/plant, seeds/pod, test weight, and yield/ha
(4) Jowar: no of ear head/plant, seeds/ ear head, test weight and yield data
(5) Land equivalent ratio (LER)

Economics

(1) Cost of Cultivation, Gross income, Net income, and B : C ratio, Income equivalent ratio (IER)

Soil

Pre-plant and post-harvest soil nutrient status (N, P, K), OC, and pH.

III. 5. Validation of organic farming technologies in tuber crops

III. 5.1. Elephant foot yam

Centres: Dholi, Kalyani, Dapoli, Faizabad, Navsari, Ranchi, Kovvur

No. of treatments: 3; No. of locations: 7; Plot size: 5 cents/treatment; Var. Gajendra

Treatment details

Notation	Treatments	Description of treatments
T_1	Conventional	FYM @ 25 t ha^{-1}+ NPK @ 100:50:150 kg ha^{-1}
T_2	Traditional	Existing farmers practice
T_3	Organic	Seed treatment in FYM + neem cake + *Trichoderma harzianum* slurry. Application of FYM @ 36 t ha^{-1} (FYM: neem cake mixture (10:1 ratio) incubated with *Trichoderma harzianum*) + *in situ* green manuring with cowpea (green matter @ 20-25 t ha^{-1}) + neem cake @ 1 t ha^{-1}+ ash @ 3 t ha^{-1}

Observations

- Growth characters: Plant height, pseudostem girth, canopy spread at 2,4 and 6 MAP
- Corm yield**per ha**
- Corm quality: Dry matter(%), starch(%), crude protein(%), oxalate content (mg/100g)
- Soil chemical properties: pH, organic C, available N, P and K (initial & final)
- Economics: Net income, B:C ratio

III. 5.2. Greater Yam

Centres: Udaipur, Jorhat, Imphal, Kovvur, Kalyani, Coimbatore, Jagdalpur

No. of treatments: 3; No. of locations: 7; Plot size: 5 cents/treatment; Var. Available improved/local

Treatment details

Notation	Treatments	Description of treatments
T_1	Conventional	FYM @ 10 t ha^{-1}+ NPK @ 80:60:80 kg ha^{-1}
T_2	Traditional	Existing farmers practice
T_3	Organic	FYM @ 15 t ha^{-1}+ green manuring to generate 15-20 t $ha^{-1}$of green matter in 45-60 days + neem cake @ 1 t ha^{-1}+ ash @ 1.5 t ha^{-1}+ biofertilizers (*Azospirillum* @ 3 kg ha^{-1}, mycorrhiza @ 5 kg $ha^{-1}$and phosphobacteria @ 3 kg ha^{-1})

Observations

- Tuber yield per ha
- Tuber quality: Dry matter (%), starch(%), crude protein(%)
- Soil chemical properties: pH, organic C, available N, P and K (initial & final)
- Economics: Net income, B:C ratio

III.5.3. Taro

Centres: Jorhat, Kalyani, Faizabad, Coimbatore, Ranchi, Rajendranagar, Imphal

No. of treatments: 3; No. of locations: 7; Plot size: 5 cents/treatment; Var. Available improved/local

Treatment details

Notation	Treatments	Description of treatments
T_1	Conventional	FYM @ 12 t ha^{-1}+ NPK @ 80:25:100 kg ha^{-1}
T_2	Traditional	Existing farmers practice
T_3	Organic	FYM @ 15 t ha^{-1}+ green manuring to generate 15-20 t $ha^{-1}$of green matter in 45-60 days + neem cake @ 1 t ha^{-1}+ ash @ 2.0 t ha^{-1}+ biofertilizers (*Azospirillum* @ 3 kg ha^{-1}, mycorrhiza @ 5 kg $ha^{-1}$and phosphobacteria @ 3 kg ha^{-1})

Observations

- Growth characters: Plant height, No. of leaves (standing & fallen) @ 2,4 and 6 MAP
- Yield: No. of mother corms & cormels, yield of mother corms & cormels (per plant and per ha)
- Cormel quality: Dry matter(%), starch(%), crude protein(%), oxalate content (mg/100g)
- Soil chemical properties: pH, organic C, available N, P and K (initial & final)
- Economics: Net income, B:C ratio

III. 6. Validation of 'e-crop' for sweet potato

Centres: Dholi, Kalyani, Rajendranagar

IV. PESTS AND DISEASE MANAGEMENT

IV.1. Integrated management of sweet potato weevil

Centres: Dharwad, Rajendranagar, Kalyani, Dapoli, Dholi, Udaipur, Ranchi

Treatment -01

- Dipping the planting material in 0.02% chlorpyriphos (20 EC) for 10 min.
- Earthing up along with weeding and fertilizer application
- Intercrops sweet potato with local crop* (2:1 ratio)
- Spray the bio pesticide *Nanma* at 15, 30, 45, 60, 75 DAP
- Timely harvest

Treatment -02

- Dipping the planting material in 0.02% chlorpyriphos (20 EC) for 10 min.
- Earthing up along with weeding and fertilizer application
- Incorporation of cassava leaf/or available leaf (2-3 kg per mount) at 30 DAP
- Spray the bio pesticide *Nanma* at, 45, 60, 75 DAP
- Timely harvest

Treatment -03

- Dipping the planting material in 0.02% chlorpyriphos (20 EC) for 10 min.
- Earthing up along with weeding and fertilizer application
- Spray 0.02% chlorpyriphos (20 EC) at 30 & 60 DAP
- Spray Nanma at, 45, 75 DAP
- Timely harvest

Treatment -04

- Earthing up the ridges to avoid cracks in the ridges.
- Spray the biopesticide*Nanma* at, 30, 45, 60, 75 DAP
- Timely harvest

Treatment -05

- Dipping the planting material in 0.02% chlorpyriphos (20 EC) for 10 min.
- Earthing up along with weeding and fertilizer application
- Spray chlorpyriphos (20 EC) 30, 60 DAP
- Timely harvest

Treatment -06

- Untreated control

No of treatment- 6; Replication 04; No. of Plots- 24;

Gross Plot size - 4.8 x 1.4 m (6.72 sq. m)
Net plot size: 3.6 x 1 (3.6 sq. m)
Spacing (60 x 20 cm)
No. of plants in net plot- 30
*Local crop: coriander/garlic

Observations to be taken

Weevil Incidence (Annexure I), Marketable tuber yield (tha-1), Total yield (tha-1), Net income, B: C ratio.

1. **Incidence of weevil**

   Randomly select 10 plants per replication and observe the collar region (the region just above the ground level) for weevil infestation.

   Observations are to be taken on 30, 60 DAP and at harvest. Plants need not be uprooted for 30 & 60 DAP.

Score	Intensity of infestation
0	No infestation
1	< 10%
2	11-20%
3	Over 20% (the collar region is highly swollen due to infestation.)

2. **Tuber damage by weevil (*Ebregt et al 2007*)**

   On harvest segregate the tubers based on weevil infestation and give scores as given below and take weight

Score	Intensity of infestation
0	No infestation
1	< 10% (usually seen at the neck of the tuber)
2	11-20% (The infestation spreads form neck region to the middle of the tuber)

3	Over 20% (The entire tuber will be infested)

IV.2.Evaluation of sex pheromone traps on the infestation pattern of weevil and sweet potato tuber yield

Centres: Dharwad, Rajendranagar, Kalyani, Dapoli, Dholi, Udaipur, Ranchi

Treatments:

1. Installation of pheromone traps @ one per 100 m^2 (This treatment should be minimum 50 mts away from Treatments 2 to 5).
2. Neem oil spray 5 ml/litre, at 45, 60 and 75 DAP
3. Emamectin benzoate 5 SG @ 11 g ai/ha (220g /ha, 0.55 g/litre of water) at 45 and 65 DAP
4. Best Practice obtained in the IPM of SPW (in previous AICRP trials)
5. Control

Notes:

- Design: RBD, Treatments 5, Replications: 4
- Plot size 3x4 meters for treatments 2 to 5.
- Plot size of 10x10 meters for treatment 1
- Install pheromone traps in T1 at 10 DAP and change the lure at 60 DAP. This treatment should be 50 m away from Treatments 2 to 5.
- In all treatments, the standard POP has to be followed except crop protection measures.

Observations/Data to be collected

Weevil infestation on the collar region at 30, 60 and 90 DAP

	No. of weevils in collar region (grubs and adults)/5 plants				
Treatment	**R1**	**R2**	**R3**	**R4**	**Mean**
1					
2					
3					
4					
5					

Note: Uproot the plant, take only 5 cm portion of the collar region from base of the plant.

Weevil infestation of the tuber 60, 75 and 90 DAP

	No. of weevils in tubers (grubs and adults)/5 plants				
Treatment	**R1**	**R2**	**R3**	**R4**	**Mean**
1					
2					
3					
4					
5					

Note: Uproot the plant, detach the tubers, split open the tuber with knife, and count the weevil adults and grubs. The grubs are in white colour, 1 to 2mm size.

Weevil infestation at the time of harvest

Treatment	**Infested tuber (Kg)**				**Total infested (Kg)**	**Uninfected tuber (Kg)**
	Not infested	**Low <25%**	**Medium 25-50%**	**High >50%**		
T1						
T2						
T3						
T4						
T5						

Note: Uproot the plant, detach the tubers, split open the tuber with knife, and count the weevil adults and grubs. The grubs are in white colour, 1 to 2mm size.

IV. 3.Refinement of anthracnose management in greater yam

Centres : Rajendranagar, Udaipur, Jagdalpur
Design: RBD
Treatments: 4
Replications: 5

T1: Soil application with *Trichoderma asperellum* + Tuber treatment with *Trichoderma asperellum* + Spray (three times) (Foliar spraying of Carbendazim @0.05%(1g Bavistin/ litre) three times at 15 days interval after initiation of the symptom)

T2: Soil application with *Trichoderma asperellum* + Tuber treatment with *Trichoderma asperellum* + Spray (seven times)
(Foliar spraying of Carbendazim @0.05% (1g Bavistin/ litre) three times at 15 days interval after initiation of the symptom and further 4 sprays at monthly interval)

T3: Only foliar spraying of Carbendazim @0.05% (1g Bavistin/ litre) three times at 15 days interval after initiation of the symptom and further 4 sprays at monthly interval

T4: Control

Note

- Soil treatment with *Trichoderma asperellum* @ 50 g of 10^7 cfu g^{-1} two times; one at the time of planting and another at third month.
- Tuber treatment with *Trichoderma asperellum* @5 g in fresh cow dung slurry per kg of tuber

<u>Standard package of practices:</u>
Use Healthy tubers for planting
Spacing: 90cm x90 cm
Fertilizer: 80: 60:80 kg NPK/ ha

Plot size may be 5.4x3.6 m (24 plants /plot (Observations from 8 plants in net plot))

IV. 4. Survey and surveillance of pests and diseases of root and tuber crops

Centres: All Centres

V. PLANTING MATERIAL PRODUCTION

Centres: All Centres
Quality planting material production and distribution

VI. RESEARCH EXTENSION FARMERS LINKAGE

Centres: All Centres

VI. 1. Popularization and Demonstration of tuber crops in Urban &Peri- urban and non-traditional areas for food and feed.

VI. 2. Value addition and Women empowerment- Demonstrations

VI. 3. Documentation of status of tuber crops in India

VI. 4. Demonstration plots of White Yam

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