

A PROPOSAL FOR IDENTIFICATION AND RELEASE OF RICE VARIETY

Uttar Sona (IET 24171)

Submitted to

**STATE VARIETY RELEASE COMMITTEE OF
CROP STANDARDS NOTIFICATION AND
RELEASE OF VARIETIES**



By

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Content

Sl. No.	Item	Table No.	Page No.
1.	Summary of the Proposal	-	2
2.	Proforma for Submission of Proposal for Release of Crop Varieties to State Variety Release Committee	-	3
3.	Grain yield of UBKVR-1 (IET 24171) in IVT-Boro 2013-14, State	1A	14
4.	Grain yield of UBKVR-1 (IET 24171) in IVT-Boro 2014-15, State	1B	15
5.	Grain yield (kg/ha) of UBKVR-1 locationwise in IVT-E-TP during <i>Kharif</i> -2013	1C	16
6.	Overall performance of UBKVR-1 in IVT-E-TP during <i>Kharif</i> -2013 at different locations in India including West Bengal	1D	17
7.	Performance of UBKVR-1 in West Bengal under IVT-E-TP during <i>Kharif</i> , 2013	1E	18
8.	Overall performance of UBKVR-1 (IET 24173) in IVT-E-TP during <i>Kharif</i> , 2013	1F	18
9.	Some morphological and qualitative characters of Uttar Sona (IET 24171) based on the “Guidelines for the Conduct of Test for Distinctiveness, Uniformity and Stability on Rice (<i>Oryza sativa</i> L.)” of PPV&FRA (2007)	2	19
10.	Reaction of IET 24171 against disease tested at Pundibari, UBKV, Cooch Behar West Bengal during testing of IVT-Boro trial 2013-14 and 2014-15	3	20
11.	Reaction of IET 24171 against disease tested at RRS, Pundibari, UBKV, Cooch Behar West Bengal during <i>Boro</i> -2016-17	4	21
12.	Reaction of IET 24171 against insect-pest tested at Pundibari, UBKV, Cooch Behar West Bengal during testing of IVT-Boro trial 2013-14 and 2014-15	5	23
13.	Reaction of IET 24171 against insect-pest tested at RRS, Pundibari, UBKV, Cooch Behar West Bengal during <i>Boro</i> 2016-17	6	24
14.	Grain yield of rice as influenced by different genotypes including UBKVR-1 grown under different levels of N, P ₂ O ₅ and H ₂ O during <i>Boro</i> , 2016-17	7	25
15.	Some yield attributing and grain quality characters of UBKVR-1 (IET 24171) as reported in AICRIP trials	8	26
16.	Tolerance index for different characters (tolerance index was calculated based on the performance of the seedling at PEG6000 @ 80 mg/L	9	27
17.	Performance of the proposed entry IET 24171 in respect of its grain yield under multilocation trials in West Bengal during <i>Boro</i> 2016-17	10	28
18.	Yield (kg/ha) of UBKVR-1 (IET 24171) at farmers’ field during <i>Boro</i> and <i>Kharif</i> seasons	11	29
19.	Performance of the rice entry, IET 24171 in respects of its grain yield under different yield trials	12	30
20.	Any other		
21.	Standard evaluation system for important rice diseases	Annexure-I	22
22.	Comparative DNA fingerprinting of proposed variety, Uttar Sona (UBKVR 1, IET 24171) with standard varieties MTU 7029, Annada and Gontra Bidhan-1 (GB-1)	Annexure-II-A	31
23.	Comparative DNA fingerprinting of proposed variety, Uttar Sona (UBKVR-1/IET 24171) with standard varieties IR 64, MTU 1010, Annada, IET 24173 and Gontra Bidhan-1 (GB-1)	Annexure-II-B	37
24.	Recommended Package of Practice	Annexure-III	40
25.	Justification of the proposed variety to release	Annexure-IV	41
25.	Guidelines for Filling-up the Proforma	Annexure-V	42

Summary of the Proposal (in bullets only)

- The proposed variety- Uttar Sona (UBKVR-1, IET 24171) has been developed from the cross between MTU 7029 × Gontra Bidhan-1.
- The above mentioned entry was tested under All India Coordinated Rice Improvement Project (AICRIP) in IVT-Boro during 2013-14 and 2014-15.
- The entry out yielded national, regional, local and hybrid checks with a yield advantage of 18.57%, 29.03%, 16.36% and 6.63% respectively. It ranked **FIRST** in respect of State Mean of grain yield (kg/ha) and overall it ranked 3rd in IVT Boro 2013-14.
- In respect of mean grain yield, it ranked **THIRD** in West Bengal and **SIXTH** based on overall mean in IVT-Boro 2014-15.
- The entry has also tested under IVT-E-TP during 2013. It ranked **FIRST** in IVT-E-TP 2013. It also stood **first ranked** in Uttar Pradesh, West Bengal, Andhra Pradesh and Tamil Nadu (Coimbatore).
- The entry has also been tested under multi-locational yield trial in West Bengal. Increased in yield over check- Khitish and Nobin was 13.42% and 14.62%, respectively.
- The proposed entry already has been adopted by the farmers of Unishbisha G.P. (Mathabhanga-II block), Patlakhawa G.P. (Cooch Behar-II block), Bamunhat G.P. (Dinhata-II block) and Chotosalbari G.P. (Sitalkuchi block) of Cooch Behar district.
- Disease incidence and insect pest attack were below the thresh hold levels.

Proforma for Submission of Proposal for Release of Crop Varieties to State Variety Release Committee

1.	Name of the Crop and species	:	Rice [<i>Oryza sativa</i> L.]
2. a)	Name of the variety under which tested in the AICRIP trials	:	UBKVR-1 (IET 24171)
b)	Proposed name of the variety	:	Uttar Sona
3.	Sponsoring Institute	:	Uttar Banga Krishi Viswavidyalaya
4. a)	Institution or agency responsible for development of variety (with full Address)	:	Director of Research Uttar Banga Krishi Viswavidyalaya P.O. Pundibari, P.S. Pundibari Cooch Behar district, West Bengal, PIN 736165 Ph. 03582-270987, Fax. 03582-270246 E-mail: ashokc540@gmail.com
b)	Name of persons who helped in the development of variety		
	Developer	:	Dr. Bidhan Roy Department of Seed Science and Technology Uttar Banga Krishi Viswavidyalaya P.O. Pundibari, P.S. Pundibari Cooch Behar district, West Bengal, PIN 736165 Mobile: 8637072242/9434117057 E-mail: bcroy10@yahoo.com
	Collaborators	:	1. Dr. Vikash Kumar Mutation Breeding Research Group, NABTD, BARC, Trombay, Mumbai 2. Dr. Gurinderjit Randhawa Division of Genomic Research, ICAR-NBPGR, Pusa Campus, New Delhi

5. a)	Parentage (with details of pedigree, including the source from which variety/inbred/A, B and R lines of hybrid have been developed)	:	The proposed variety has been developed from a cross between MTU 7029 × Gontra Bidhan-1 MTU 7029 Developed at Maruteru, Andhra Pradesh and notified in 1987 (Rice Knowledge Management Portal, dated 12th September, 2016). It is long duration (140-150 days), semi-dwarf rice variety with short bold grain, and high yield potential (6.5 t/ha) in low input response areas, it is resistant to BLB, but susceptible to leaf blast, sheath blight and gal-midge. Gontra Bidhan-1 Selection from farmers' field, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal. Notified in 2008 by Central Variety Release Committee. Photoperiod insensitive, medium duration, it can be grown in both <i>Boro</i> and <i>Kharif</i> seasons. Plant height 95-100 cm, semi-dwarf; medium slender grains; tolerant to Sh.B, Sh.R, moderately resistant to BPH. Yield: 5.0 t/ ha. It is susceptible to neck blast.
b)	Source of material in case of introduction	:	Not applicable
c)	Breeding method	:	IET 24171 was developed through hybridization followed by selection maintaining the pedigree
d)	Breeding objective	:	Genetic improvement for high yield, medium duration, medium slender grains, resistance to biotic stresses and abiotic stresses
6.	State the varieties which are most closely resemble the proposed variety in general characteristics	:	Neither of the existing released varieties
7.	Recommended production ecology (rainfed/irrigated; high/low fertility; season)	:	This variety may be recommended for both <i>Boro</i> (irrigated) and <i>Kharif</i> (irrigated and/or rain-fed), medium-land situation
8.	Specific areas of its adaptation (zones and states for which variety is proposed) and the recommended production ecology	:	UBKVR-1 performed well in West Bengal, Bihar, Tripura and Assam during IVT-<i>Boro</i> and AVT-1 (<i>Boro</i>) trials (Table 1A, page No. 14 & Table 1B, page No. 15) UBKVR-1 also performed well in IVT-E-TP during <i>Kharif</i> 2012-13 in West Bengal, Andhra Pradesh and Uttar Pradesh (Table 1C, page No. 16; Table 1D, page No. 17; Table 1E, page No. 18; Table 1F, page No. 18)

9.	Description of the Variety		
a)	Plant height	:	105.00 cm (Table 2 , page No. 19 & Table 8 , page No. 26)
b)	Distinguishing morphological character	:	Detail morphological characters based on “Guidelines for the Conduct of Test for Distinctiveness, Uniformity and Stability on Rice (<i>Oryza sativa</i> L.)” of PPV&FRA, New Delhi have been listed in Table 2 , page No. 19.
c)	Maturity (range in number of days) (from seedling/ transplanting to flowering, seed-to-seed)	:	Days to 50% flowering during Kharif: 90 days (Table 8 , page No. 25) Days to maturity (seed to seed) during Kharif: ~120 days
d)	Maturity group (early, medium and late, wherever such classification exists)	:	Mid-early
e)	Reaction to major diseases under field and controlled conditions (reaction to physiological strains/ races/bio-types to be indicated wherever possible.)	:	Disease infection was below the threshold level for all the genotypes tested at RRS, Pundibari, UBKV, Cooch Behar West Bengal during <i>Boro</i> 2013-14, <i>Boro</i> 2014-15 and <i>Boro</i> 2016-17. The proposed entry, IET 24171 showed no infection (score ‘0’) in respect of PB, SR, BLB, RTD and SB, but it showed very low infection (score ‘1’) in respect of LB and BS indicating resistant to LB and BS (Table 3 & 4; Page No. 20 & 21).
f)	Reaction to major pests (under field and controlled conditions including store pests)	:	The proposed entry, IET 24171 was found to have very low incidence of stem borer (0.09-0.10%) indicating its reaction in-between highly resistant to resistant. The said entry did not show any incidence of BPH, WBPH, GM, LF and WM during <i>Boro</i> 2013-14 and 2014-15. But it showed very low incidence of leaf folder (0.37% Damaged Leaf) during <i>Boro</i> 2016-17 (Table 5 & 6; Page No. 23 & 24).
g)	Agronomic features (e.g., resistance to lodging, shattering, fertilizers responsiveness, suitability for early or late sown conditions, seed rate etc.)	:	• Resistance to lodging and shattering • Fertilizer responsiveness: 120 : 60 : 60 of N : P₂O₅ : K₂O in kg/ha (Table 7, page No. 25) • Suitable for early sown conditions • Seed rate is 50 kg/ha (2-3 seedling per hill) • Photoperiod insensitive, can be grown both in <i>Kharif</i> and <i>Boro</i> seasons
h)	Quality of produce	:	

	i) Grain quality		• Medium slender (MS) grains (Table 8, page No. 26) • Excellent cooking qualities • High yield potential • Hulling (%), milling (%) and head rice recovery are 75.00, 66.90 and 57.50, respectively. Optimum amylose content (24.64%) and medium gel consistency (53.00) indicate separable and soft cooked rice as preferred in India (Table 8, page No. 26).
	ii) Fodder quality	:	Not applicable
i)	Reaction to stresses	:	• It was found to be tolerant to drought at seedling stage (Table 9, page No. 27).
10.	Description of the parents in case of hybrid	:	Not applicable
11. a)	Yield data in the coordinated trials (breeding, agronomy, pathology entomology, quality etc.) and regional/inter regional district trials year-wise (level of fertilizer application, density of plant population and superiority over local control/standard variety) to be indicated (to be attached)	:	Yield data in the coordinated trials (breeding): The entry out yielded national, regional, local and hybrid checks with a yield advantage of 18.57%, 29.03%, 16.36% and 6.63% respectively. It ranked FIRST in respect of State Mean of grain yield (kg/ha) in IVT Boro 2013-14 (Table 1A, page No. 14). The performance of this entry during Boro 2014-15 is being given in Table 1B (page No. 15). In respect of mean grain yield, it ranked THIRD in West Bengal and SIXTH based on overall mean in IVT-Boro 2014-15 (Table 1B, page No. 15). The entry UBKVR-1 was significantly superior to all the three checks (Table 1C, page No. 16; Table 1D, page No. 17; Table 1E, page No. 18; Table 1F, page No. 18) at Kaul (5600 kg/ha, 5th), Varanasi (7650 kg/ha, 2nd), Sakoli (3768 kg/ha), Warangal (9013 kg/ha, 1st), Aduthurai (4575 kg/ha, 8th) and Kurumbapet (6500 kg/ha). Against regional and local check it showed superior yield at Ludhiana (6012 kg/ha, 6th). This entry performed exceedingly well over the best check at Punjab (6th, 18.84%), Haryana (5th, 31.76%), Uttar Pradesh (1st, 37.84%), West Bengal (1st, 13.28%), Bihar (9th, 10.37%), Madhya Pradesh (10.14 %), Maharashtra (7th, 7.03%), Gujarat (5.87%), Andhra Pradesh (30.15%), Tamil Nadu (7.19%), Kerala (6.20%) and Pudcherry (10.64%). In the region 4 and 5 it out yielded best checks with 6.96% and 12.19%, respectively. The entry UBKVR-1 ranked FIRST during <i>Kharif</i> 2013 based on overall average yield (5364 kg/ha) under IVT-E-TP (Table 1C, page No. 16; Table 1D, page No. 17; Table 1E, page No. 18; Table 1F, page No. 18). It out yielded national, regional and local checks viz., 8.60%, 47.96% and 14.36%, respectively, on over all mean basis.

			The proposed entry, IET 24171 performed well as compared to local checks in all the location under multi-location trials in West Bengal (Table 10, page No. 28). Yield increased over local checks was 13.42 and 14.62% against Khitish and Nabin, respectively as local check. The yield performance in large scale demonstrations at farmers' field were given in Table 11 (page No. 29). The trials were conducted at four farmers' field during Kharif 2014 and 2015 as well as during Boro 2014-15 and 2015-16. The proposed entry, IET 24171 more than 60% yield advantage over local check for all the test seasons in <i>Boro</i> and <i>Kharif</i>. Fertilizer application: Nutrient dose of 120 : 60 : 60 of N : P₂O₅ : K₂O in kg/ha may be recommended for UBKVR-1 for achieving higher productivity during <i>Boro</i> season in West Bengal (Table 7, page No. 25). Density of plant population: 33 hills/m²
b)	Yield data from national demonstration/ large-scale demonstrations (to be attached)	:	Table 1A (5760 kg/ha, IVT-<i>Boro</i>, 2013-14)- page No. 14 Table 1B (5017 kg/ha, IVT-<i>Boro</i>, 2014-15)- page No. 15 Table 1C & D (5364 kg/ha, IVT-E-TP 2013)- page No. 16 & 17 Table 10 (5410 kg/ha, Multi-location trials in W.B.)- page No. 28 Table 11 (7356 kg/ha, Farmers' Field, <i>Boro</i>)- page- No. 29 Table 11 (6625 kg/ha, Farmers' Field, <i>Kharif</i>)- page- No. 29
c)	Average yield under normal conditions (yield in kg / hectare)	:	Yield during <i>Kharif</i> = 5995 kg/ha (Table 12, page No. 30) Yield during <i>Boro</i> = 6044 kg/ha (Table 12, page No. 30)
12. a)	Agency responsible for maintaining breeder seed	:	Uttar Banga Krishi Viswavidyalaya Pundibari, Cooch Behar 736 165 West Bengal
b)	Quantity of breeder seed in stock (kg)	:	100 kg
13.	Specific recommendations, if any, for seed production (e.g., staggered sowing, planting ratio of parental lines of hybrids in foundation and certified seeds production, probable areas of seed production)	:	Standard seed production guidelines may be followed for seed production.
14.	Vivid presentation (field view, close-up of a single plant and seeds/economic parts)	:	Photograph attached (Fig. 1-4 , page No. 9-13)
15.	Package of practices along with attainable yield levels	:	Annexure-III

16.	Any other pertinent information	:	Entry No. in AICRIP Trial (IVT-Boro) : IET 24171 It may be stated that this variety has potentiality to compete with high yielding medium duration varieties, like, Gautam. IR 64, Rajalakshmi (hybrid check), Sahabdagidhan (Table 1A , page No. 14; Table 1B , page No. 16; Table 1C , page No. 16; Table 1D , page No. 17; Table 1E , page No. 18; Table 1F , page No. 18) and MTU 1010 (Table 11 , page No. 29). Hence the variety may be identified for release.
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Signature of All Contributors

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Fig. 1. Standing crop of UBKVR-1 (IET 24171). **A)** Standing crop at University Research Farm, UBKV, Pundibari, Cooch Behar; **B)** Standing crop at famers' field (Shri Ramkrishina Barman, Paglarhat, Sitalkuchi, Cooch Behar district); **C)** Standing crop at famers' field (Shri Ramen Barman, Paglarhat, Sitalkuchi, Cooch Behar district);



Fig. 2. Farmer Participator Variety Selection. Thirty five advanced lines were grown at Singhimari (Patlakhawa G.P., Cooch Behar-II, Cooch Behar district). Farmers selected UBKVR-1 along with other four advance lines as best performing lines.



Fig. 4. Grain parameters. A) Un-dehusked rice of UBKVR-1 (IET 24171); B) Dehusked rice of UBKVR-1 (IET 24171); c) Length of un-dehusked rice UBKVR-1 (IET 24171); D) Length of dehusked rice of UBKVR-1 (IET 24171) [length: 5.47 cm, breadth: 2.05 mm, L:B ratio- 2.66, grain type- medium slender]



Fig. 3. Ripen crop of UBKVR-1 (IET 24171). A) Standing crop at famers' field (Shri Bharat Barman, Kharikabari, Unishbisha G.P., Mathabhanga-II, Cooch Behar district); **B)** Harvesting of ripen crop of UBKVR-1 (IET 24171).



Fig. 5. Agronomic trail at UBKV, Pundibari, Cooch Behar, West Bengal

V1: UBKVR-15; **V2:** UBKVR-15A; **V3:** UBKVR-36; **V4:** UBKVR-46; **V5:** UBKVR-1; **V6:** Nobin
T1: 160:80:80; **T2:** 120:60:60; **T3:** 100:40:40; **T4:** 60:40:40; **T5:** No fertilizer

Table 1A: Grain yield of UBKVR-1 (IET 24171) in IVT-Boro 2013-14 in different states

IET No.	Assam		Tripura		West Bengal		Bihar		Odisha		Uttar Pradesh		Mean		Yield advantage over checks
	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	
24170	4905	4	8008	6	3813	-	3667	-	4209	-	5933	-	4907	-	-
24171	4959	3	7969	7	5429	1	4667	5	5139	7	7533	9	5760	3	-
24172	4714	6	6433	-	4526	8	4917	1	6082	2	7933	5	5480	4	-
24173	4699	7	9428	1	5101	2	4667	5	7382	1	8200	2	6159	1	-
24174	3910	-	8031	5	3700	-	4583	6	4760	-	8265	1	5107	8	-
24175	4435	-	7119	9	5051	3	3500	-	4966	-	6100	-	5087	-	-
24176	4616	8	7236	8	3553	-	4167	8	-	-	5300	-	4720	-	-
24177	4998	3	6083	-	4735	7	4000	-	-	-	6533	-	5225	7	-
24178	3677	-	3547	-	4858	4	3417	-	-	-	7000	-	4434	-	-
23494	5889	1	8664	3	4262	-	4250	7	5195	6	8133	3	5818	2	-
23499	4187	-	6192	-	4754	5	4750	3	5513	5	7733	8	5258	6	-
23496	4471	-	8197	4	4043	-	4000	-	5136	8	6333	-	5087	-	-
23498	4148	-	2514	-	4278	9	4000	-	4979	9	7867	6	4526	-	-
Gautam (RC)	4056	-	2928	-	4750	6	4750	3	4287	-	6133	-	4464	-	29.03
IR 64 (NC)	4556	9	6978	-	4227	-	3250	-	3272	-	7800	7	4858	-	18.57
LC	4099	-	6883	-	3923	-	3667	-	6007	3	7000	-	4950	-	16.36
Rajalakshmi	4794	5	8781	2	3629	-	4000	-	5569	4	8000	4	5402	5	06.63
Ex. Mean	4536	-	6764	-	4314	-	4132	-	5178	-	7165	-	5132	-	-

NC: National check, RC: Regional check

Source: ICAR-Indian Institute of Rice Research, 2015, Progress Report 2014, Vol. 1, Varietal Improvement, All India Coordinated Rice Improvement Project, ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad 500 003, Telangana State, India, p. 1.343.

Discussion:

The results (Table 1A) revealed that the entry, IET 24171 out yielded national, regional and local checks with a yield advantage of 18.57%, 29.03% and 16.36% respectively. However, it ranked **FIRST** in respect of grain yield (5429 kg/ha) in West Bengal in IVT-Boro 2013-14.

Table 1B: Grain yield of UBKVR-1 (IET 24171) in IVT-Boro 2014-15 in different states

IET No.	Assam		Bihar		Odisha		Tripura		Uttar Pradesh		West Bengal		Mean		Yield advantage over checks
	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	
24173	4684	3	3056	7	3528	-	4891	-	8000	1	9300	1	5353	3	-
24171	4093	6	3611	4	3858	8	6035	1	5223	-	9130	3	5017	6	-
Gautam (RC)	2566	-	3889	3	4378	7	5524	7	5807	-	8395	4	4461	8	12.46
24172	3818	7	3472	5	4909	4	5280	8	6700	6	9295	2	5139	5	-
24177	3181	-	1667	-	2441	-	4550	-	5267	-	3895	-	3420	-	-
23494	4797	2	5417	2	6436	2	5597	5	7600	3	5895	-	5667	1	-
IR 64 (NC)	3421	8	2361		3505	-	5645	4	4600	-	6430	8	4100	-	22.36
24897	3213	-	3889	3	3533	-	4453	-	6033	8	6165	-	4214	-	-
24898	5037	1	5694	1	4618	6	5572	6	7667	2	6595	7	5657	2	-
LC	4373	4	3056	7	5391	3	5986	3	7267	4	5300	-	5015	7	-
24899	3376	-	1250		4668	5	4891	-	6833	5	6995	5	4346	-	-
Rajalakshmi	4144	5	3889	3	6653	1	6010	2	6600	7	6800	6	5298	4	05.30
24900	3642	-	3194	6	2997	-	4502	-	4633	-	5000	-	3906	-	-
Ex. Mean	3873	-	3419		4378	-	5303	-	6325	-	6861	-	4738	-	-

NC: National check, RC: Regional check

Source: ICAR-Indian Institute of Rice Research, 2016, Progress Report 2015, Vol. 1, Varietal Improvement, All India Coordinated Rice Improvement Project, ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad 500 003, Telangana State, India, p. 1.180.

Discussion:

The results (Table 1B) indicated that the entry, IET 24171 ranked **THIRD** in West Bengal (9130 kg/ha) and **SIXTH** over different states (5017 kg/ha) in respect of its grain yield in IVT-Boro 2014-15.

Table 1C: Grain yield (kg/ha) of UBKVR-1 locationwise in IVT-E-TP during *Kharif*-2013

Regions	States	Locations Sl. No.	Locations	UBKVR-1		National Check		Regional Check	
				Yield (kg/ha)	Rank	Yield (kg/ha)	Rank	Yield (kg/ha)	Rank
Region-II	Uttarakhand	1	Pantnagar	1668	-	3590	#\$	2352	-
	Punjab	2	Ludhiana	6012	6 #	5059	\$	4367	-
	Haryana	3	Kaul	5600	5 *#\$	4250	\$	3850	-
	Mean of Region-II	-	-	4427	#\$	4300	#\$	3523	-
Region-III	Odisha	4	CRRI, Cuttack	3400	-	4315	8	3685	-
		5	Jeypore	4697	#	6212	4 #	1939	-
	Mean	-	-	4048	#	5264	1 #	2812	-
	Bihar	6	Patna	5571	9 #	5048	#	2381	-
	West Bengal	7	Chinchurah	5923	1 #	5229	-	4412	-
	Uttar Pradesh	8	Varanashi	7650	1*#\$	5550	\$	5250	-
	Madhya Pradesh	9	Waraseoni	3395	#	2573	#	1325	-
		10	Rewa	3653	#	3826	#	1931	-
		-	Mean	3524	#	3200	#	1628	-
	Mean of Region-III	-	-	4898	2 #	4679	6 #	2989	-
Region-IV	Maharashtra	11	Karjat	5811	4 \$	5192	-	5636	-
		12	Sakoli	3768	*#\$	3110	#	2153	-
		13	Vadagon	4874	-	5202	6	4722	-
		14	Mean	4818	7 *#\$	4501	#	4170	-
	Gujarat	15	Vyra	5165	#	4664	#	2655	-
		16	Dabhoi	4216	#	4118	#	2745	-
		-	Mean	4690	#	4391	#	2700	-
	Mean of Region-IV	-	-	4767	#\$	4457	#	3582	-
Region-V	Andhra Pradesh	17	Maruthuru	3699	7 #	3742	5 #	1205	-
		18	Warangle	9013	1 *#\$	6025	4 #	4391	-
		-	Mean	6356	1 *#\$	4883	4 #	2798	-
	Tamil Nadu	19	Coimbatore	8529	1 #	7813	-	6622	-
		20	Ambasamudram	5875	-	6625	#	5688	-
		21	Adudurai	4575	8 *#\$	3268	#	1471	-
		-	Mean	6326	6 #	5902	#	4593	-
	Kerala	22	Moncompu	2989	#	1618	-	1592	-
		23	Pattambi	4942	#	4365	-	3968	-
		-	Mean	4942	#	4365	-	3968	-
	Karnataka	24	Mandya	7276	8	6793	-	5672	-
		25	Brahmavar	4175	2 #	3687	4	2925	-
		26	Gangavati	8102	#	7716	#	4784	-
		-	Mean	6518	8 #	6065	#	4461	-
	PY	27	KYP	6500	*#\$	5500	#	4500	-
	Mean of Region-V	-	-	6269	1 *#\$	5553	#	4123	-
	Overall Mean	-	-	5364	1 *#\$	4939	#\$	3625	-

*: Superior to NC; #: Superior to RC; \$: Superior to LC

Source:

Directorate of Rice Research, 2014, Progress Report, 2013, Vol.1, Varietal Improvement All India Coordinated Rice Improvement Programme (ICAR) Directorate of Rice Research, Rajendranagar, Hyderabad – 500 030, AP, India. p. viii. & p. 1.96.

Discussion:

The results (Table 1C) revealed that UBKVR-1 ranked first during IVT-E-TP (2013) in West Bengal, Uttar Pradesh and Andhra Pradesh. Based on overall mean also UBKVR-1 ranked first.

Table 1D: Overall performance of UBKVR-1 in IVT-E-TP during *Kharif*-2013 at different locations in India including West Bengal

IET No/ Designation / Cross combination	GY / FD	Yield adv (%) over NC/ RC/LC	Significantly superior to check, location, yield (kg/ha) / rank			% Increase over best check				Overall rank
			Three checks NC, RC, LC	NC & RC	RC & LC #\$	State		Region		
						Rank	% BC	Rank	% BC	
UBKVR-1	5364 90	8.60 47.96 14.36	KUL 5600 (5) VRN 7650 (1) SKL 3768 WGL 9013 (1) ADT 4575 (8) KUP 6500	-	LDH 6012 (6)	PU-6 HA-5 UP-1 WB-1 BI-9 MP MH-7 AP-1 TN-6 KE PY-	18.84 31.76 37.84 13.28 10.37 10.14 07.03 30.15 07.19 06.20 10.64	R5-1	06.96 12.19	1

KUL: Kaul; **VRN:** Varanasi; **SKL:** Sakoli; **WGL:** Warangal; **ADT:** Aduthurai; **KUP:** Kurumbapet; **PU:** Punjab; **HA:** Haryana; **UP:** Uttar Pradesh; **WB:** West Bengal; **BI:** Bihar; **MP:** Madhya Pradesh; **MH:** Maharashtra; **AP:** Andhra Pradesh; **TN:** Tamil Nadu; **KE:** Kerala; **PY:** Pudcherry.

Source:

Directorate of Rice Research, 2014, Progress Report, 2013, Vol.1, Varietal Improvement All India Coordinated Rice Improvement Programme (ICAR) Directorate of Rice Research, Rajendranagar, Hyderabad – 500 030, AP, India. p. viii. & p. 1.96.

Discussion:

The results (Table 1D) revealed that the entry UBKVR-1 was significantly superior to all the three checks at Kaul (5600 kg/ha, 5th), **Varanasi (7650 kg/ha, 2nd)**, Sakoli (3768 kg/ha), **Warangal (9013 kg/ha, 1st)**, Aduthurai (4575 kg/ha, 8th) and Kurumbapet (6500 kg/ha). Against regional and local check it showed superior yield at Ludhiana (6012 kg/ha, 6th). This entry performed exceedingly well over the best check at Punjab (6th, 18.84%), Haryana (5th, 31.76%), **Uttar Pradesh (1st, 37.84%)**, **West Bengal (1st, 13.28%)**, Bihar (9th, 10.37%), Madhya Pradesh (10.14 %), Maharashtra (7th, 7.03%), Gujarat (5.87%), Andhra Pradesh (30.15%), Tamil Nadu (7.19%), Kerala (6.20%) and Pudcherry (10.64%). In the region 4 and 5 it out yielded best checks with 6.96% and 12.19%, respectively.

Table 1E: Performance of UBKVR-1 in West Bengal under IVT-E-TP during *Kharif*, 2013

Grain yield (kg/ha)	Days to 50% flowering	Plant height (cm)	Panicles per m ²
5923 (1)	84	105	325

Table 1F: Overall performance of UBKVR-1 in IVT-E-TP during *Kharif*, 2013

IET/ Designation	Grain yield (kg/ha)	Days to 50% flowering	Yield advantage % over			% increase over best check (Region/ Rank)
			National Check	Regional Check	Local Check	
IET 24173 UBKVR-1	5364	90	8.60	47.96	4.36	R4 (6.96) R5 (1) 12.19
IET 23949 MTU 1159	5248	86	6.26	44.78	11.90	R2 (1)-20.50 R4 (6)-11.31
IET 23354 RP 5125-12-5-3-B	5219	89	5.67	43.97	11.28	R2 (7)-7.84 R4 (2)-15.62
Shabhagidhan (National Check)	4939	85				
Regional (Regional Check)	3625	80				
Local (Local Check)	4690	85				

Source:

Directorate of Rice Research, 2014, Progress Report, 2013, Vol.1, Varietal Improvement All India Coordinated Rice Improvement Programme (ICAR) Directorate of Rice Research, Rajendranagar, Hyderabad – 500 030, AP, India. p. viii. & p. 1.95.

Discussion:

The results (Table 1F) revealed that the entry UBKVR-1 **ranked FIRST** during *Kharif* 2013 based on overall average yield (5364 kg/ha) under IVT-E-TP. It out yielded national, regional and local checks viz., **8.60%**, **47.96%** and **14.36%**, respectively, on over all mean basis.

Table 2. Some morphological and qualitative characters of Uttar Sona (IET 24171) based on the “Guidelines for the Conduct of Test for Distinctiveness, Uniformity and Stability on Rice (*Oryza sativa* L.)” of PPV&FRA (2007)

Sl. No.	Characters	Classification
1.	Coleoptiles: Colour	Colourless
2.	Basal leaf: sheath colour	Green
3.	Leaf: Intensity of green colour	Dark
4.	Leaf: Anthocyanin colouration	Absent
5.	Leaf sheath: anthocyanin colouration	Absent
6.	Leaf: Pubescence of blade surface	Medium
7.	Leaf: Auricle	Present
8.	Leaf: Anthocyanin colouration of auricle	Colourless
9.	Leaf: Collar	Present
10.	Leaf: Anthocyanin colouration of collar	Absent
11.	Leaf: Ligule	Present
12.	Leaf: Shape of ligule	Split
13.	Leaf: Colour of ligule	White
14.	Leaf: Length of blade	Medium
15.	Leaf: Width of blade	Medium
16.	Culm: attitude	Semi-erect
17.	Flag leaf: Attitude of blade (early observation)	Semi-erect
18.	Lemma: Anthocyanin colouration of keel	Absent
19.	Lemma: Anthocyanin colouration of area below apex	Absent
20.	Lemma: Anthocyanin colouration of apex	Absent
21.	Spikelet: Colour of stigma	White
22.	Stem: Length (excluding panicle length)	Very short (105.00 cm)
23.	Stem: Thickness	Medium
24.	Stem: Anthocyanin colouration of nodes	Absent
25.	Stem: Anthocyanin colouration of internodes	Absent
26.	Panicle: Length of main axis	Medium
27.	Panicle: Curvature of main axis	Drooping
28.	Panicle: Number per plant	Medium
29.	Spikelet: Colour of tip of lemma	Yellowish
30.	Lemma and Palea: Colour	Straw
31.	Panicle: Awns	Absent
32.	Panicle: Exertion	Well exerted
33.	Sterile lemma: Colour	Straw
34.	Decorticated grain: Aroma	Absent

Discussion:

Salient features

Coleoptile of IET 24171 (Uttar Sona) is colourless. It bears white coloured split type of ligule. It shows medium tillering ability. Stem length of this variety is very short (excluding panicle length). It has semi-erect culm and droopy panicle, bright straw coloured lemma and palea and well exerted panicle.

Table 3. Reaction of IET 24171 against disease tested at Pundibari, UBKV, Cooch Behar West Bengal during testing of IVT-Boro trial 2013-14 and 2014-15

IVT-Boro trial 2013-14								
Source: Annual Report on Rice Research, 2013-14, UBKV, Pundibari, Cooch Behar, W.B.								
Entry No.	IET No.	PB	LB	SR	BS	BLB	RTD	SB
1.	24170	1	3	0	1	0	0	0
2.	24171	0	1	0	1	0	0	0
3.	24172	0	0	0	1	0	0	0
4.	24173	3	1	0	1	0	0	0
5.	24174	0	3	0	1	0	0	0
6.	24175	0	0	0	0	0	0	0
7.	24176	0	3	0	1	0	0	0
8.	24177	3	3	1	3	0	0	0
9.	24178	0	1	0	1	0	0	0
10.	23494	1	3	0	3	0	0	0
11.	23499	0	3	0	1	0	0	0
12.	23496	0	0	0	1	0	0	0
13.	23498	0	0	0	0	0	0	0
14.	Gautam	0	3	0	1	0	0	0
15.	IR 64	1	3	0	3	0	0	0
16.	LC	0	1	0	1	0	0	0
17.	Rajalakshmi	0	3	0	1	0	0	0
IVT-Boro trial 2014-15								
Source: Annual Report on Rice Research, 2013-14, UBKV, Pundibari, Cooch Behar, W.B.								
1.	24173	1	3	0	1	0	0	0
2.	24171	0	1	0	1	0	0	0
3.	Gautam	0	3	0	1	0	0	0
4.	24172	1	3	0	1	0	0	0
5.	24177	3	3	0	3	0	0	0
6.	23494	1	3	0	1	0	0	0
7.	IR 64	1	3	0	1	0	0	0
8.	24899	0	0	1	0	0	0	0
9.	24898	0	1	0	1	0	0	0
10.	LC	0	1	0	1	0	0	0
11.	24899	0	3	0	1	0	0	0
12.	Rajalakshmi	0	3	0	3	0	0	0
13.	24900	1	3	0	3	0	0	0

PB: Panicle Blast; **LB:** Leaf Blast; **SR:** Sheath Rot; **BS:** Brown Spot; **BLB:** Bacterial Leaf Blight; **RTD:** Rice Tungro Disease; **SB:** Sheath Blight.

NB: SES (0-9 scale) denotes that towards 0 scoring means of least infection and towards 9 means highest infection (for detail see the **Annexure-I**)

Table 4. Reaction of IET 24171 against disease tested at RRS, Pundibari, UBKV, Cooch Behar West Bengal during *Boro*-2016-17.

Genotypes	PB	LB	SR	BS	BLB	RTD	SB
UBKVR-15 (IET 24173)	3	0	0	1	0	0	0
UBKVR-15A	0	1	0	3	0	0	0
UBKVR-36	0	0	0	1	0	0	0
UBKVR-46	0	0	0	0	0	0	0
UBKVR-1 (IET 24171)	0	1	0	1	0	0	0
Nobin	0	0	0	1	0	0	0

Source: Annual Report on Rice Research, 2016-17, UBKV, Pundibari, Cooch Behar 736165, West Bengal

PB: Panicle Blast; **LB:** Leaf Blast; **SR:** Sheath Rot; **BS:** Brown Spot; **BLB:** Bacterial Leaf Blight; **RTD:** Rice Tungro Disease; **SB:** Sheath Blight.

NB: SES (0-9 scale) denotes that towards 0 scoring means of least infection and towards 9 means highest infection. Detail given under Annexure-I.

Scale for leaf blast and brown spot

Scale	Host response or reaction
0	: Highly Resistant
1	: Resistant
2 - 3	: Moderately Resistant
4 - 5	: Moderately Susceptible
6 - 7	: Susceptible
> 7	: Highly Susceptible

Discussion:

The results (Table 3 & 4) showed that the disease infection was below the threshold level for all the genotypes tested at RRS, Pundibari, UBKV, Cooch Behar West Bengal during *Boro* 2013-14, *Boro* 2014-15 and *Boro* 2016-17. **The proposed entry, IET 24171 showed no infection (score '0') in respect of PB, SR, BLB, RTD and SB, but it showed very low infection (score '1') in respect of LB and BS indicating resistant to LB and BS.**

Annexure-I

Standard evaluation system for important rice diseases

Scale	Symptom/severity				
	Panicle Blast	Sheath Rot	Sheath Blight	Bacterial Leaf Blight	Rice Tungro Disease
0	No visible lesion	No incidence	No infection observed	No lesions observed	-
1	Lesions on several pedicels or secondary branches	Less than 1%	Lesions limited to lower 20% of the plant height	Small brown specks of pin-point size or larger brown specks without sporulating center	No symptom observed
3	Lesions on a few primary branches or the middle part of panicle axis	1-5%	20-30%	Lesion type is the same as in scale 2, but a significant number of lesions are on the upper leaves	1-10% height reduction, no distinct yellow to yellow orange leaf discoloration
5	Lesion partially around the base (node) or the uppermost internode or the lower part of panicle axis near the base	6-25%	31-45%	Typical blast lesions infecting 4-10% of the leaf area	11-30% height reduction, no distinct yellow to yellow orange leaf discoloration
7	Lesion completely around panicle base or uppermost internode or panicle axis near base with more than 30% of filled grains	26-50%	46-65%	Typical blast lesions infecting 26-50% of the leaf area	31-50% height reduction, with distinct yellow to yellow orange leaf discoloration
9	Lesion completely around panicle base or uppermost internode or the panicle axis near the base with less than 30% of filled grains.	51-100%	More than 65%	More than 75% leaf area affected	More than 50% height reduction, with distinct yellow to yellow orange discoloration

Scale	Symptom/severity	
	Leaf Blast	Brown Spot
0	No lesions observed	-
1	Small brown specks of pin-point size or larger brown specks without sporulating center	No incidence
2	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin	Less than 1%
3	Lesion type is the same as in scale 2, but a significant number of lesions are on the upper leaves	1-3%
4	Typical susceptible blast lesions 3 mm or longer, infecting less than 4% of the leaf area	4-5%
5	Typical blast lesions infecting 4-10% of the leaf area	11-15%
6	Typical blast lesions infecting 11-25% of the leaf area	16-25%
7	Typical blast lesions infecting 26-50% of the leaf area	26-50%
8	Typical blast lesions infecting 51-75% of the leaf area and many leaves are dead	51-75%
9	More than 75% leaf area affected	76-100%

Table 5. Reaction of IET 24171 against insect-pest tested at Pundibari, UBKV, Cooch Behar West Bengal during testing of IVT-Boro trial 2013-14 and 2014-15

IVT-Boro trial 2013-14									
Source: Annual Report on Rice Research, 2013-14, UBKV, Pundibari, Cooch Behar, W.B.									
Entry No.	IET No.	%BPH	%WBPH	%GM	LF		%WM	SB	
					%DL	DS		%DH	%WE
1.	24170	0.00	0.00	0.00	0.00	0	0.00	0.00	0.75
2.	24171	0.00	0.00	0.00	0.00	0	0.00	0.00	0.10
3.	24172	0.00	0.00	0.00	0.85	1	0.00	0.00	0.75
4.	24173	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
5.	24174	0.00	0.00	0.00	0.73	1	0.00	0.00	0.00
6.	24175	0.00	0.00	0.00	0.00	0	0.00	0.00	0.10
7.	24176	0.00	0.00	0.00	0.77	1	0.00	0.00	0.75
8.	24177	0.00	0.00	0.00	0.00	0	0.00	0.00	0.50
9.	24178	0.00	0.00	0.00	1.00	1	0.00	0.00	0.00
10.	23494	0.00	0.00	0.00	0.54	1	0.00	0.00	0.00
11.	23499	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
12.	23496	0.00	0.00	0.00	0.00	0	0.00	0.00	0.10
13.	23498	0.00	0.00	0.00	0.11	1	0.00	0.00	0.20
14.	Gautam	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
15.	IR 64	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
16.	LC	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
17.	Rajalakshmi	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
IVT-Boro trial 2014-15									
Source: Annual Report on Rice Research, 2013-14, UBKV, Pundibari, Cooch Behar, W.B.									
1.	24173	0.00	0.00	0.00	0.00	0	0.00	0.00	0.75
2.	24171	0.00	0.00	0.00	0.00	0	0.00	0.00	0.10
3.	Gautam	0.00	0.00	0.00	0.00	0	0.00	0.00	0.15
4.	24172	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
5.	24177	0.00	0.00	0.00	0.24	1	0.00	0.00	0.00
6.	23494	0.00	0.00	0.00	0.00	0	0.00	0.00	0.10
7.	IR 64	0.00	0.00	0.00	0.17	1	0.00	0.00	0.00
8.	24899	0.00	0.00	0.00	0.00	0	0.00	0.00	0.30
9.	24898	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
10.	LC	0.00	0.00	0.00	0.13	1	0.00	0.00	0.00
11.	24899	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
12.	Rajalakshmi	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
13.	24900	0.00	0.00	0.00	0.21	1	0.00	0.00	0.10

BPH: Brown Plant Hopper; **WBPH:** White Back Plant Hopper; **GM:** Gall Midge; **LF:** Leaf Folder; **DL:** Damaged leaf; **DS*:** Damaged score; **WM:** Whorl Maggot; **SB:** Shoot Borer; **DH:** Dead Heart; **WE:** White Ear Head.

Table 6. Reaction of IET 24171 against insect-pest tested at RRS, Pundibari, UBKV, Cooch Behar West Bengal during *Boro* 2016-17.

Genotypes	%BPH	%WBPH	%GM	LF		%WM	SB*	
				%DL	DS		%DH	%WE
UBKVR-15 (IET 24173)	0.00	0.00	0.00	0.24	1	0.00	0.00	0.18
UBKVR-15A	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
UBKVR-36	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
UBKVR-46	0.00	0.00	0.00	0.50	1	0.00	0.23	0.30
UBKVR-1 (IET 24171)	0.00	0.00	0.00	0.37	1	0.00	0.00	0.09
Nobin	0.00	0.00	0.00	0.00	0	0.00	0.00	0.11

Source: Annual Report on Rice Research, 2016-17, UBKV, Pundibari, Cooch Behar 736165, West Bengal

BPH: Brown Plant Hopper; **WBPH:** White Back Plant Hopper; **GM:** Gall Midge; **LF:** Leaf Folder; **DL:** Damaged leaf; **DS:** Damaged score; **WM:** Whorl Maggot; **SB:** Shoot Borer; **DH:** Dead Heart; **WE:** White Ear Head.

*Percentage of infestation (Stem Borer)	Host response or reaction
0	: Highly Resistant
1-5	: Resistant
6-10	: Moderately Resistant
11-15	: Moderately Susceptible
16-25	: Susceptible
≥ 26	: Highly Susceptible

Discussion:

The result (Table 5 & 6) showed that **the proposed entry, IET 24171 was found to have very low incidence of stem borer (0.09-0.10%) indicating its reaction in-between highly resistant to resistant. The said entry did not show any incidence of BPH, WBPH, GM, LF and WM during Boro 2013-14 and 2014-15. But it showed verly low incidence of leaf folder (0.37% Damaged Leaf) during Boro 2016-17.**

Table 7: Grain yield of rice as influenced by different genotypes including UBKVR-1 grown under different levels of N, P₂O₅ and K₂O during Boro, 2016-17

Genotypes/ Fertilizer dose	Yield (t/ha)					
	T1	T2	T3	T4	T5	Mean
UBKVR-15	7.20	7.20	6.00	5.50	3.40	5.86
UBKVR-15A	3.60	5.10	4.60	3.40	2.20	3.78
UBKVR-36	6.00	6.30	5.50	4.00	3.10	4.98
UBKVR-46	6.10	6.20	4.60	4.00	3.00	4.78
UBKVR-1	6.90	6.80	5.00	4.20	4.00	5.38
Nobin	6.60	6.38	4.50	3.30	2.80	4.72
Mean	6.07	6.33	5.03	4.07	3.08	
	T		V		VT	
C.D. (5%)	0.6025		0.2460		0.2695	

Source: Annual Report on Rice Research, 2016-17, UBKV, Pundibari, Cooch Behar 736165, West Bengal

Season: Boro 2016-17

Production Ecology: Irrigated

Nutrient levels = N : P₂O₅ : K₂O in kg/ha. T1: 160:80:80; **T2:** 120:60:60; **T3:** 100:40:40; **T4:** 60:40:40; **T5:** No fertilizer

Discussion

The results (Table 7) revealed that the proposed entry (IET 24171) recorded the highest grain yield of 6.90 t/ha under 160 : 80 : 80 kg/ha of N : P₂O₅ : K₂O and it was statistically at par with 120 : 60 : 60 kg/ha of N : P₂O₅ : K₂O (6.80 t/ha). Hence, nutrient dose of **120 : 60 : 60 kg/ha** of N : P₂O₅ : K₂O may be recommended for UBKVR-1 for achieving higher productivity during Boro season in West Bengal.

Table 8: Some yield attributing and grain quality characters of UBKVR-1 (IET 24171) as reported in AICRIP trials

Characters	IVT-E-TP 2013	IVT-Boro 2013-14	IVT-Boro 2014-15	Tested at BARC	Mean
Yield attributing characters					
Days to 50% flowering	90.00	133.00	134.00	-	-
Plant height (cm)	112.00	100.00	103.05	-	105.00
Number of panicles per m ²	328.00	305.00	303.00	-	304.00
Grain quality characters					
Hull (%)	-	-	75.00	-	75.00
Mill (%)	-	-	66.90	-	66.90
Head rice recovery (%)	-	-	53.20	61.80	57.50
Kernel length (mm)	-	-	5.47	-	5.47
Kernel breadth (mm)	-	-	2.05	-	2.05
L/B ratio	-	-	2.66	-	2.66
Grain type	-	-	-	-	Medium slender
Grain chalk	-	-	Very occasionally present	-	Very occasionally present
Alkali spreading value	-	-	4.00	-	4.00
Amylose content (%)	-	-	-	21.02	21.02
Gel consistency	-	-	53.00	-	53.00
Test weight (g)	-	-	-	-	21.15

Sources:

1. ICAR-Indian Institute of Rice Research, 2015, Progress Report 2014, Vil. 1, Varietal Improvement, All India Coordinated Rice Improvement Project, ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad 500 003, Telangana State, India, p. 1.341-1.344.
2. ICAR-Indian Institute of Rice Research, 2016, Progress Report 2015, Vil. 1, Varietal Improvement, All India Coordinated Rice Improvement Project, ICAR-Indian Institute of Rice Research, Rajendranagar, Hyderabad 500 003, Telangana State, India, p. 1.182.
3. Directorate of Rice Research, 2014, Progress Report, 2013, Vol.1, Varietal Improvement All India Coordinated Rice Improvement Programme (ICAR) Directorate of Rice Research, Rajendranagar, Hyderabad – 500 030, AP, India. p. viii. & pp. 1.95, 1.119, 1.122, 1.125.

Discussion:

The results (Table 8) revealed that the proposed entry IET 24171 is a medium duration (days to flowering was 90 days during *Kharif*) and medium tall variety (105.00 cm). It bears medium slender (MS) grains. Amylose content is 24.64%.

Table 9. Drought tolerance index for different characters (tolerance index was calculated based on the performance of the seedling at PEG6000 @ 80 mg/L)

Variety	Shoot length	Root length	No. of primary roots per seedling	Seedling fresh weight	Seedling dry weight
IET 24171	90.00*	82.39*	116.67*	82.28*	77.12*
Annada	89.29*	97.00*	91.80*	80.86*	58.27
MTU-1010	75.00*	73.79*	36.36	64.85	82.14*
MTU-1075	51.81	53.92	66.67	57.32	64.81
Nobin	58.06	78.41*	85.71	57.23	69.29*
Kalo Nunia	67.86	58.87	100.00*	39.84	47.10
Kataribhog	58.16	68.00	71.43	43.74	66.67
Bonnidhan	61.11	65.78	120.00*	52.71	58.62
KNS-2-D-3	55.17	69.77*	50.00	62.73	57.14
Jashoya	53.95	49.61	42.86	56.67	58.33
Kalodhayapa	67.65	63.57	75.00	60.29	60.71
Mungamuthi	55.56	73.88*	55.56	58.08	66.67
Bitti-1	61.54	61.54	100.00*	79.60*	68.10*
Tulaippanji	84.13*	57.47	50.00	59.49	65.04
Tulsibhog	80.00*	49.83	120.00*	61.63	76.79*
Malsira	62.50	78.57	150.00*	63.64	60.00
Fulpakri	66.67	46.67	30.00	69.47	57.14
Jaldhyapa	35.71	43.94	66.67	50.76	65.63
Range	35.00-90.00	43.94-97.00	30.00-150.00	39.84-82.28	47.10-82.14

*=Best performing genotypes with respect to different characters per tolerance index, **PEG:** Polyethylene glycol

Source: Sanjib Bhadra, Bidhan Roy, T.S. Ghimiray. 2018. Polyethylene glycol mediated *in vitro* screening of rice (*Oryza sativa* L.) genotypes for drought tolerance. *Indian Journal of Genetics and Plant Breeding*. 78(1): 142-146.

Discussion:

The results (Table 9) revealed that the proposed entry IET 24171 was found to be the best performing genotype in respect of drought tolerance index of all the five characters.

Tolerance index above 70 indicated that the entry is drought tolerant in respect of particular character (Ahadiyat *et al.*, 2012) as mentioned above.

Reference:

Ahadiyat YR, Hidayat P, Susanto U. 2012. Selection of upland rice genotypes on drought tolerance and P efficiency at laboratory and screen house levels. *J. Agril. Technol.*, **8**(2): 453-463.

Table 10: Performance of the proposed entry IET 24171 in respect of its grain yield under multilocation trials in West Bengal during *Boro* 2016-17

Sl. No.	Breeding lines	Locations			Mean yield	Yield increased over check (%)
		RRS, Chinchurah	RRS, Pundibari	RRS, Majhian		
		Yield (t/ha)	Yield (t/ha)	Yield (t/ha)		
1.	UBKVR-1	5.10	5.38	5.76	5.41	-
2.	Local Check					
i.	Khitish	4.30	-	5.23	4.77	13.42
ii.	Nabin	-	4.72	-	4.72	14.62

Sources:

1. Technical Programme of Rice- Boro 2016-17, Rice Research Station, Chinchurah, Hoogly
2. Annual Report on Rice Research, 2016-17, UBKV, Pundibari, Cooch Behar 736165, West Bengal, UBKV, Pundibari, Cooch Behar

Discussion:

The results (Table 10) revealed that the proposed entry, IET 24171 recorded higher grain yield (5.4 t/ha) accounting to about 13.42-14.62% increase in grain yield over local check (4.72-4.77 t/ha) over different locations in West Bengal during Boro, 201617.

Table 11: Yield (kg/ha) of UBKVR-1 (IET 24171) at farmers' field during *Boro* and *Kharif* seasons

Boro 2014-15							Boro 2015-16						Mean of 2014-15 and 2015-16
Designation	F1	F2	F3	F4	Mean	% increased over check	F1	F2	F3	F4	Mean	% increased over check	
UBKVR-1	7483	8350	6331	7225	7347.25	66.24	7530	7386	7490	7050	7364.00	63.58	7356
UBKVR-15	7532	7640	7168	6930	7317.50	65.56	7469	7610	7534	7580	7548.25	67.67	7433
UBKVR-66	6259	6654	5827	6058	6199.50	40.27	6530	6224	6080	6487	6330.25	40.62	6265
UBKVR-36	6517	6558	5639	5772	6121.50	38.50	6183	6340	5830	6502	6213.75	38.03	6168
UBKVR-46	6235	5873	5991	6214	6078.25	37.52	5832	5580	5384	5910	5676.50	26.10	5877
UBKVR-70	5341	5601	4867	5274	5270.75	19.25	5043	4682	4510	5833	5017.00	11.45	5144
UBKVR-91	4613	4709	4648	4518	4622.00	04.58	4380	4820	4583	4460	4560.75	01.31	4591
MTU 1010	4537	4701	4328	4113	4419.75	-	4627	4510	4308	4562	4501.75	-	4461
Kharif 2015							Kharif 2016						
UBKVR-1	6530	6601	6475	7015	6655.25	63.58	6425	6600	6533	6820	6594.50	80.29	6625
UBKVR-15	6820	6488	6721	6940	6742.25	67.67	6822	6910	6586	6610	6732.00	84.05	6737
UBKVR-66	5862	6140	5722	5590	5828.50	40.62	5880	6055	5621	6345	5975.25	63.36	5902
UBKVR-36	6018	5528	5760	5235	5635.25	38.03	5598	5208	5023	6125	5488.50	50.05	5562
UBKVR-46	5205	5622	5188	5508	5380.75	26.10	5264	5300	5610	5480	5413.50	48.00	5397
UBKVR-70	5020	4628	4900	4567	4778.75	11.45	4825	5016	4480	4664	4746.25	29.76	4763
UBKVR-91	4315	4080	4500	4465	4340.00	01.31	4032	3455	3874	3622	3745.75	02.41	4043
MTU 1010	4100	3660	3975	4088	3955.75	-	3865	3590	3766	3410	3657.75	-	3807

F1: Shri Bharat Barman, Village- Kharikabari, Unishbisha G.P., Ghoskadanga, Mathabhnga-II, Cooch Behar dist.; **F2:** Manick Barman, Jayantir Hat, Mathabhnga-II, Cooch Behar dist.; **F3:** Shri Benzamin Oraon, Village- Singhimari (Tribalpara), Patlakhawa G.P., Cooch Behar-II, Cooch Behar dist.; **F4:** Shri Ramkrishna Barman, Village- Petlanepura, Chhoto Salbari G.P., Sitalkuchi, Cooch Behar dist.

Discussion:

The results (**Table 11**) revealed that the proposed entry, IET 24171 recorded higher grain mean yield of 7356 kg/ha accounting to about 63.58% increase in grain over the check variety MTU 1010 (4461) over *Boro*, 2014-15 and *Boro*, 2015-16. The same entry showed about 80.29% increase in grain yield (6625 kg/ha) over the local check, MTU 1010 (3807) over *Kharif*, 2015 and *Kharif*, 2016.

The proposed entry already has been adopted by the farmers of Unishbisha G.P. (Fig. 3), Patlakhawa G.P. (Fig. 2), Chotosalbari G.P. and Dinhata-II of Cooch Behar district.

Table 12: Performance of the rice entry, IET 24171 in respects of its grain yield under different yield trials

Seasons	Name of the yield trials	Grain yield (kg/ha)	Reference
Kharif 2013	IVT-E-TP 2013	5364	Table 1C, 1D, 1F, Page. No. 16, 17, 18 respectively
Kharif 2015 &2016	Farmers' Field	6625	Table 11, Page. No. 29
Mean		5995	
Boro 2013-14	IVT-Boro 2013-14	5760	Table 1A, Page. No. 14
Boro 2014-15	IVT-Boro 2013-14	5017	Table 1B, Page. No. 15
Boro 2014-15	Farmers' Field	7356	Table 11, Page. No. 29
Mean		6044	

Annexure-II-A

Comparative DNA fingerprinting of proposed variety, Uttar Sona (UBKVR-1/IET 24171) with standard varieties MTU 7029, Annada and Gontra Bidhan-1 (GB-1)

(Finger printing was done by Dr. Gurinderjit Randhawa, ICAR-NBPGR, Pusa Campus, New Delhi)

Thirty six highly variable SSR (HvSSR) marker loci with repeat lengths of 51-70 bp located across all the 12 chromosomes of rice were selected. Those 36 HvSSR markers were used for the DNA fingerprinting of UBKVR-1 (IET 24171, Uttar Sona) with standard varieties, namely MTU 7029, Annada, Gontra Bidhan-1 and UBKVR-15 (IET 24173). Out of which, 17 markers (47.22%) were found polymorphic and 19 markers were monomorphic (52.77%). Out of 17 polymorphic markers, only five markers (HvSSR01-41, HvSSR03-37, HvSSR08-19, HvSSR09-55 and HvSSR11-13) showed size based allelic polymorphism whereas, remaining 12 markers (HvSSR01-32, HvSSR01-53, HvSSR02-01, HvSSR02-33, HvSSR03-10, HvSSR03-37, HvSSR06-16, HvSSR06-40, HvSSR07-18, HvSSR07-51, HvSSR09-11 and HvSSR11-58) showed polymorphism based on presence and absence of alleles.

DNA fingerprinting pattern and amplifications of bands/alleles of proposed variety, Uttar Sona (**IET 24171**) with standard varieties MTU-7029, Annada, Gontra Bidhan-1 and UBKVR-15 (IET 24173)

Sl. No.	Primers	Expected size (bp)	Observed alleles	Varieties				
				UBKVR-15 (IET 24173)	MTU-7029	Annada	UBKVR-1 (IET 24171)	GB-1
1.	HvSSR01-41	348	420	1	1	1	1	0
2.	HvSSR03-02	228	300	0	0	0	0	1
3.	HvSSR03-10	280	220	0	1	1	0	1
4.	HvSSR03-19	238	300	1	1	1	1	1
5.	HvSSR03-37	252	350	1	1	1	0	0
6.	HvSSR03-54	352	350	1	1	1	1	1
7.	HvSSR04-46	179	150	1	1	1	1	1
8.	HvSSR05-09	335	300	1	1	1	1	1
9.	HvSSR11-13	285	200	1	0	0	1	1
10.	HvSSR07-51	341	300	1	1	1	1	0
11.	HvSSR12-01	271	350	1	1	1	1	1
12.	HvSSR11-58	371	350	0	1	1	1	0
13.	HvSSR01-32	250	250	1	1	1	1	0
14.	HvSSR02-01	312	300	0	1	1	1	0
15.	HvSSR02-33	355	320	0	1	1	1	0
16.	HvSSR06-40	385	400	1	0	1	1	0
17.	HvSSR12-13	388	350	1	1	1	1	1
18.	HvSSR04-27	318	290	1	1	1	1	1
19.	HvSSR08-19	221	190	1	1	1	1	1
20.	HvSSR10-34	202	200	1	1	1	1	1
21.	HvSSR12-39	289	300	1	1	1	1	1
22.	HvSSR07-18	343	300	1	1	1	1	0
23.	HvSSR08-14	295	300	1	1	1	1	1
24.	HvSSR10-13	169	150	1	1	1	1	1
25.	HvSSR06-03	212	200	1	1	1	1	1
26.	HvSSR11-21	291	250	1	1	1	1	1
27.	HvSSR06-16	368	350	0	1	1	1	0
28.	HvSSR09-11	366	350	0	1	1	1	0
29.	HvSSR09-55	382	250	1	1	1	1	1
30.	HvSSR01-53	274	280	0	1	1	1	1
31.	HvSSR09-26	231	300	1	1	1	1	1
32.	HvSSR02-50	195	190	1	1	1	1	1
33.	HvSSR05-15	275	220	1	1	1	1	1
34.	HvSSR05-30	309	320	1	1	1	1	1
35.	HvSSR10-03	289	250	1	1	1	1	1
36.	HvSSR04-19	265	250	1	1	1	1	1

GB-1: Gontra Bidhan-1

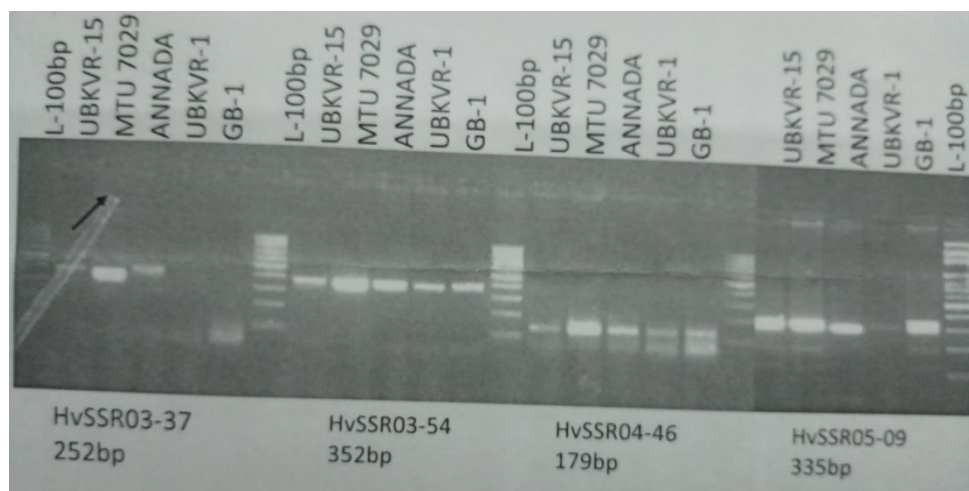


Fig. 1. DNA profile of five rice genotypes with primers HvSSR03-37 (252 bp), HvSSR03-54 (352 bp), HvSSR04-46 (179 bp) and HvSSR05-09 (335 bp); L= 100 bp molecular weight size standard.

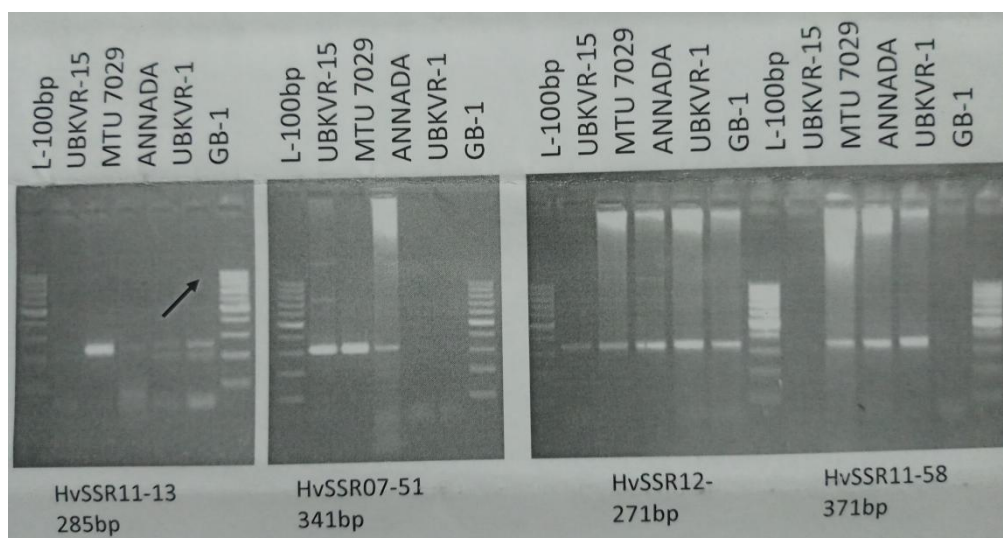


Fig. 2. DNA profile of five rice genotypes with primers HvSSR11-13 (285 bp), HvSSR07-51 (341 bp), HvSSR12 (271 bp) and HvSSR11-58 (371 bp); L= 100 bp molecular weight size standard.

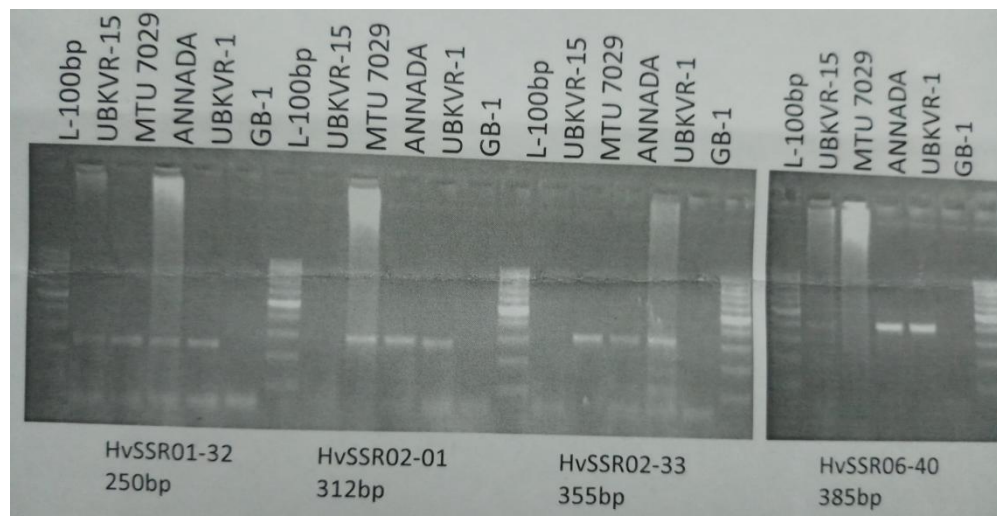


Fig. 3. DNA profile of five rice genotypes with primers HvSSR01-32 (250 bp), HvSSR02-01 (312 bp), HvSSR02-33 (355 bp) and HvSSR06-40 (385 bp); L= 100 bp molecular weight size standard.

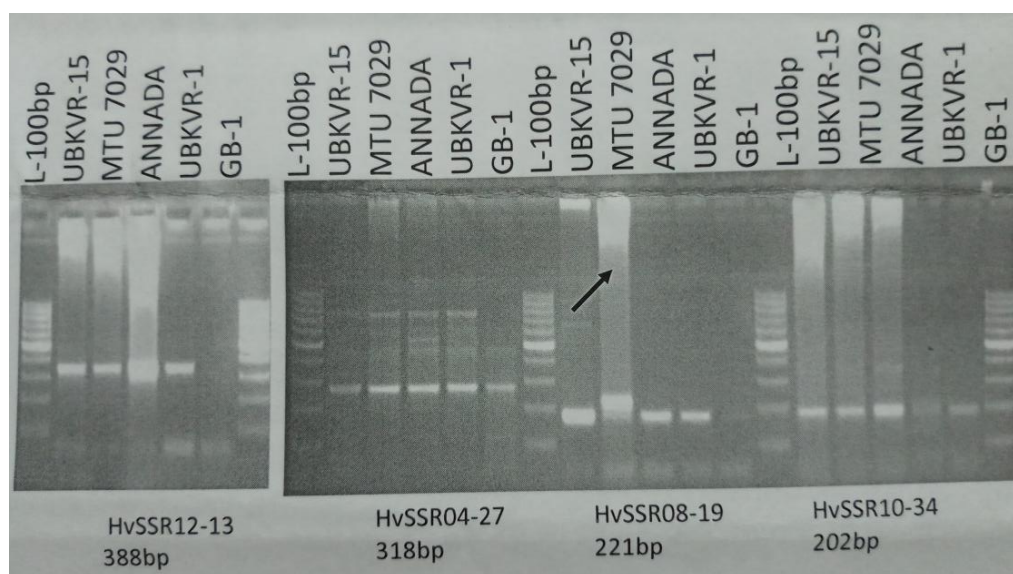


Fig. 4. DNA profile of five rice genotypes with primers HvSSR12-13 (388 bp), HvSSR04-27 (318 bp), HvSSR08-19 (221 bp) and HvSSR10-34 (202 bp); L= 100 bp molecular weight size standard.

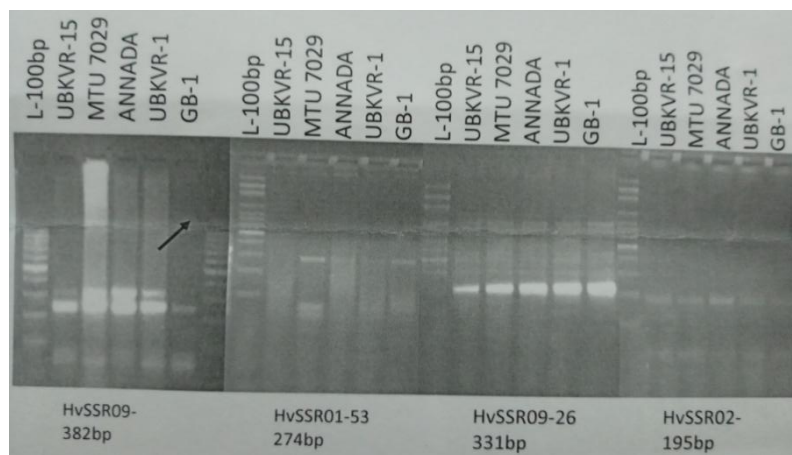


Fig. 5. DNA profile of five rice genotypes with primers HvSSR09 (382 bp), HvSSR01-53 (274 bp), HvSSR09-26 (331 bp) and HvSSR02 (195 bp); L= 100 bp molecular weight size standard.

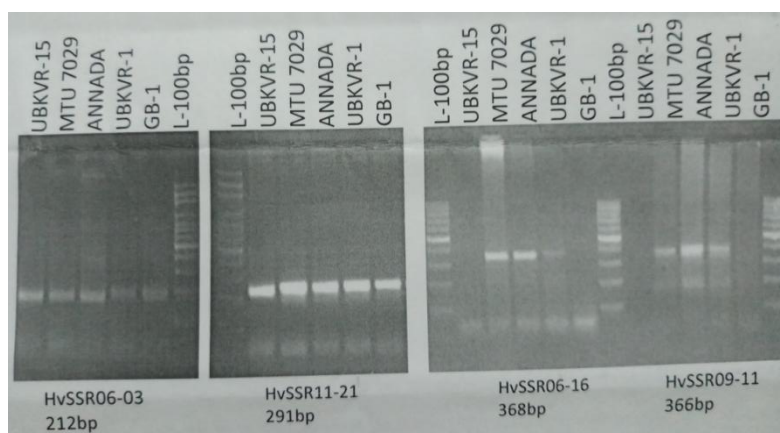


Fig. 6. DNA profile of five rice genotypes with primers HvSSR06-03 (212 bp), HvSSR11-21 (291 bp), HvSSR06-16 (368 bp) and HvSSR09-11 (366 bp); L= 100 bp molecular weight size standard.



Fig. 7. DNA profile of five rice genotypes with primers HvSSR12-39 (289 bp), HvSSR07-18 (343 bp), HvSSR08 (295 bp) and HvSSR10-13 (169 bp); L= 100 bp molecular weight size standard.



Fig. 8. DNA profile of five rice genotypes with primers HvSSR05-15 (275 bp), HvSSR05-30 (309 bp), HvSSR10-03 (289 bp) and HvSSR09-19 (169 bp); L= 100 bp molecular weight size standard.

Annexure-II-B

Comparative DNA fingerprinting of proposed variety, Uttar Sona (UBKVR-1/IET 24171) with standard varieties IR 64, MTU 1010, Annada, IET 24173 and Gontra Bidhan-1 (GB-1)

(Finger printing was done by Dr. Vikash Kumar, BARC, Tromby, Mumbai)

Sl. No.	Markers	IR64	MTU1010	Annada	GB-1	UBKVR 1 (IET 24171)	UBKVR 15 (IET 24173)
1.	RM 495	148	148	148	148	160	148
2.	RM 455	141	130	129	128	129	126
3.	RM29	195	191	193	191	191	195
4.	RM 433	281	270	291	299	266	287
5.	RM 7434	125	123	123	125	119	121
6.	RM585	255	250	174	173	229	177
7.	RM3562	155	153	145	156	148	156
8.	RM 552	176	178	177	178	186	175
9.	RM 418	288	288	315	298	291	296
10.	RM 205	136	133	129	128	133	133
11.	RM 452	213	177	178	170	180	205
12.	RM 124	-	158	154	157	164	188
13.	RM 507	-	136	126	128	127	120
14.	RM 133	237	246	237	235	239	237
15.	RM 162	216	214	215	213	214	214
16.	RM 125	121	121	121	122	122	123
17.	RM 284	141	141	141	142	142	142
18.	RM 316	202	202	201	201	200	201
19.	RM 215	128	126	113	113	-	112
20.	RM 277	126	120	122	121	120	122

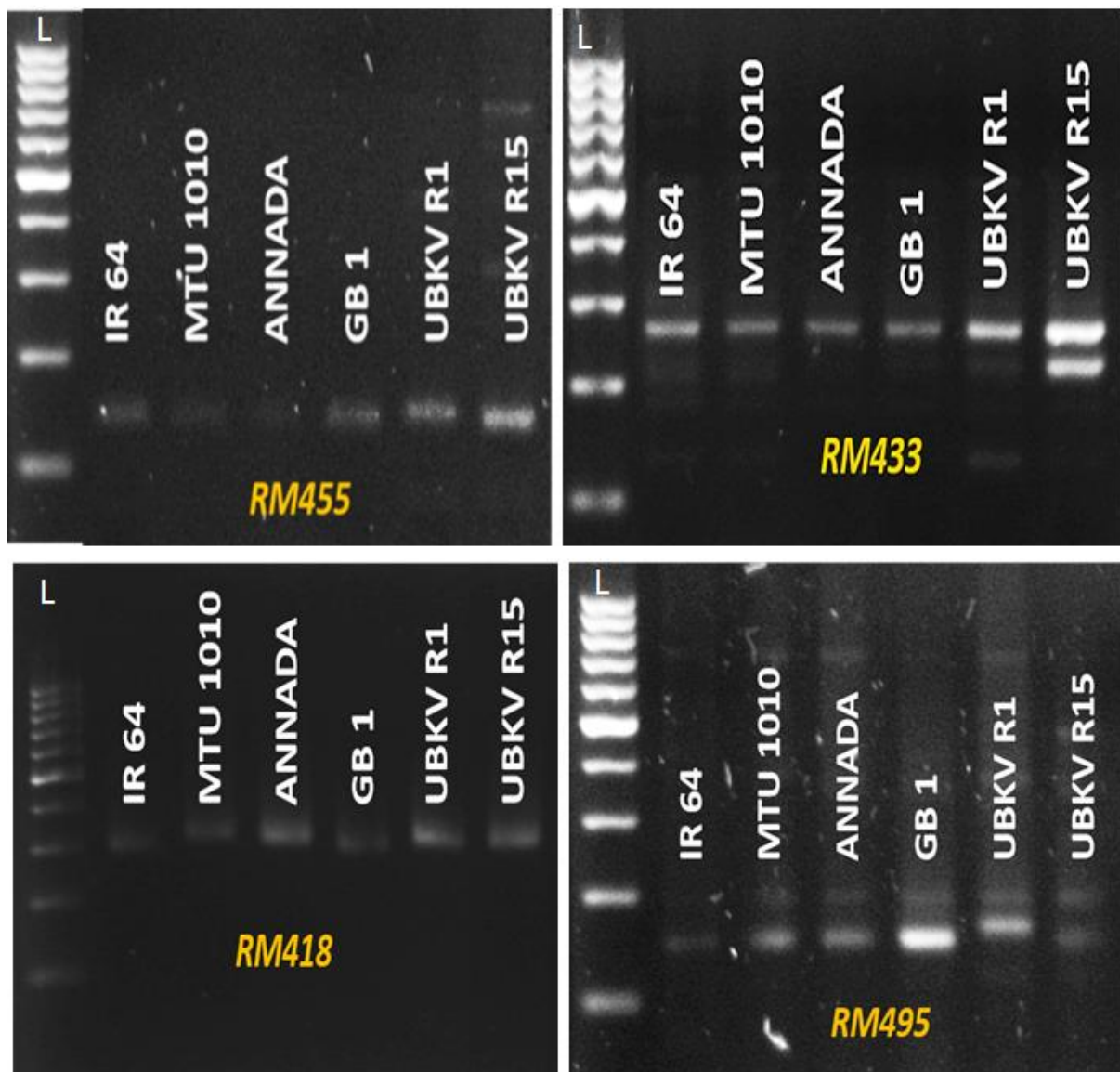


Fig. 9. DNA profile of six rice genotypes with primers RM455, RM433, RM418 and RM495; L= 100 bp molecular weight size standard.

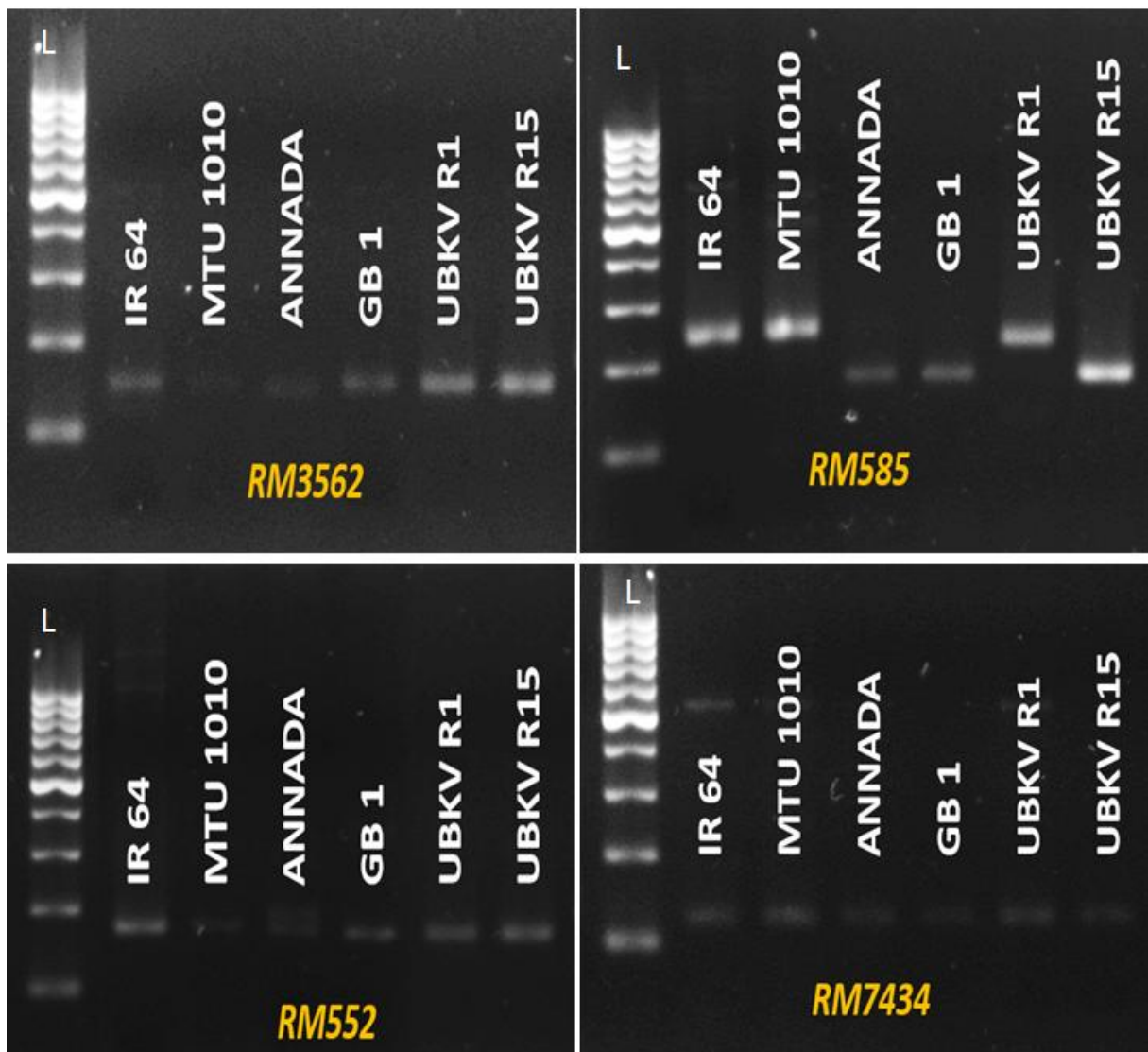


Fig. 10. DNA profile of six rice genotypes with primers RM3562, RM585, RM552 and RM7434; L= 100 bp molecular weight size standard.

Annexure-III

Recommended Package of Practice

Name of the proposed variety: Uttar Sona (IET 24171)

Adaptability state: West Bengal

Production condition: *Boro* season, Medium land and rain-fed during *Kharif* season

Sl. No.	Particulars	Practices
1.	Suitability of the variety for the area (Recommended area)	Irrigated during <i>Boro</i> Irrigated and/or during <i>Kharif</i>
2.	Selection of land/land preparation	Medium and upland situations
3.	Seed treatment	Carbendazim 50% WP @ 2 g/kg of seed
4.	Sowing time	Middle of November to middle of the December during <i>Boro</i> season Middle of June to middle of July during <i>Kharif</i> season
5.	Seed rate	50 kg/ha
6.	Seedling age for transplanting	35-40 days during <i>Boro</i> 25 days during <i>Kharif</i>
7.	Fertilizer	Recommended doses Boro: 120 : 60 : 60 of N : P ₂ O ₅ : K ₂ O in kg/ha Kharif: 80: 40: 40 of N : P ₂ O ₅ : K ₂ O in kg/ha Basal: ¼ N + Full P ₂ O ₅ + ¾ K ₂ O 1st topdressing: ½ N at 15-20 DAT 2nd topdressing: ¼ N + ¼ K ₂ O at Panicle initiation stage
8.	Spacing	20 cm × 15 cm
9.	Weed control measure	Butachlor @ 1.5 kg a.i./ha on 3-5 DAT Hand weeding as per requirement
10.	Pest and Disease control	Need based application of pesticide Spray Hexaconazol immediately after completion of grain filling @ 0.75 ml/liter of water during seed production
11.	Irrigation	Need based during <i>Boro</i> -season to keep the plot saturated condition
12.	Harvesting	At 80% of the grain maturity

Annexure-IV

Justification of the proposed variety to release

- The proposed entry, IET 24171 (Uttar Sona) out yielded national, regional, local and hybrid checks with a yield advantage of 18.57%, 29.03%, 16.36% and 6.63% respectively. It ranked **FIRST** in respect of State Mean of grain yield (kg/ha) and overall it ranked 3rd in IVT *Boro* 2013-14.
- In respect of mean grain yield, it ranked **THIRD** in West Bengal and **SIXTH** based on overall mean in IVT-*Boro* 2014-15.
- It ranked first in IVT-E-TP during *Kharif* 2013 and also stood first ranked in Uttar Pradesh, West Bengal, Andhra Pradesh and Tamil Nadu (Coimbatore).
- It is being preferred by the farmers for its yield and cooking quality.
- The proposed entry can be cultivated both in *Boro* as well as *Kharif* seasons.
- It is moderately tolerant to insect pest and diseases. No disease or insect pest was found above the threshold level.

Annexure-V

GUIDELINES FOR FILLING-UP THE PROFORMA

(Checklist for Proforma for Submission of Proposal for Identification of Crop Varieties/ ~~Hybrids~~ by Workshops)

Details/documents	Attached
Parentage with details on pedigree, including the source from which variety/inbred/A,B and R lines of the hybrid has been developed	Yes
Source of the material in case of introduction (IC/EC numbers provided by the NBPGR)	Not applicable
Flow chart of details of development of variety/parental lines of hybrids	Not applicable
Molecular/DNA profile of variety/ hybrid/A,B,R lines of the hybrid vis-à-vis check variety/line (details of unique amplicons that distinguish markers) with photographs	Yes
Detailed description of the parental lines of the variety/ hybrid	Yes
Yield data and other data on diseases, insect-pests, quality, etc. from the coordinated trials	Yes
Yield data from the national demonstration/large-scale demonstrations	Yes
Specific recommendations, if any, for seed production (eg., staggered sowing, planting ratio of parental lines of hybrids in foundation and certified seeds production, probable areas of seed production etc.)	Yes
Vivid presentations (field view, close-up of a single plant and seeds) with photographs of the Variety)	Yes
Package of practices	Yes
Proforma signed by all co-authors and Head of Organization	Yes
Any other pertinent information	Not applicable

Director of Research
Uttar Bnaga Krishi Viswavidyalaya
Pundibari, Cooch Behar 736165, West Bengal

VARIETY RELEASE PROPOSAL OF TURMERIC

UBKV HALUD-2 (TCP-64) (IC-0615130)

POPULAR NAME: UTTARRUPANJANA



**SUBMITTED TO STATE VARIETAL RELEASE
COMMITTEE**



UTTARBANGA KRISHI VISWAVIDYALAYA

Pundibari, Coochbehar

Pin: 736165, West Bengal

Email :ubkvdr@gmail.com. Ph no. 9932395544

OBJECTIVES

Development of Turmeric genotype with

- 1. Very High dry matter content – 23.31%**
- 2. Bold rhizome**
- 3. Moderately resistant to leaf spot and leaf blotch diseases**
- 4. High yield potential - 43.25 /ha(26.16t/ha)**



**TCP-64 -UBKV TURMERIC-2
(UTTARRUPANJANA)**

**PROFORMA FOR SUBMISSION OF PROPOSAL OF RELEASE OF CROP
VARIETY TO STATE VARIETY RELEASE COMMITTEE**

1.	Name of the crop and species	Turmeric (<i>Curcuma longa</i> L)
2.	(a) Name of the variety under which tested (b) Proposal name of variety.	(a) TCP-64 (IC-0615130) (b) UBKV Turmeric-2 (UTTARRUPANJANA)
3.	Sponsored by	Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal.
4.	(a) Institution or agency responsible for developing variety (with address). (b) Name of the persons who helped in the development of variety (Developers) (c) Name of Cooperators	Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, Pin 736165, West Bengal. Soumendra Chakraborty, Suchand Datta, Anamika Debnath, Sekhar Bandopadhyaya, Jagadish Jana, Surajit Khalko, Bharat Chandra Saha, Susanta Dash Dilip Kumar De, Pranab Hazra Nandita Sahana, Mrigendra Nath Ghosh, Murari Krishna Roy and Samsul Haque UBKV, Bhaskarjyoti Datta, Pundibari; D Prasath, B Sasikumar, HJ Akshitha, IISR, Kozhikode; Happy Dev Sharma, Meenu Gupta and Vipin Sharma YSPU H&F, Solan; Parshuram Sial, High Altitude Research Station, OUAT Pottangi; Dipak Kumar Ghosh, BCKV, West Bengal, Anupam Pariari, BCKV, West Bengal.
5.	(a) Parentage with details of its pedigree	The variety has been developed through clonal selection from genotype TCP-64 (IC-0615130) from Birpara Tea Estate Basti in the Aliporeduar district of West Bengal in the year 2000.
	(b) Source of material in case of introduction IC/EC No./ Designation of parental lines should be clearly mentioned. In case the variety has been developed from local landrace/traditional variety its source (village, district, State, be	The variety TCP-64 (IC-0615130) Uttarrupanjana has been developed from local landrace which was collected from Birpara Tea Estate Basti (26.71 ⁰ N 88.89 ⁰ E; 104 m above sea level) in the district of Aliporeduar of West Bengal in the year 2000.

	given) (c) Breeding method used.	(c) Clonal selection
	(d) Breeding objective.	(d) Identification of turmeric genotype with high dry recovery percentage, bold rhizome, moderately tolerate to leaf spot and leaf blotch diseases.
6.	State the varieties which most closely resemble proposed variety in general characteristics.	TCP-2 (Suranjana), Borjora local, Kakdeep local, Birnagar local- Please see the Annexure-1
7.	a) Whether recommended by seminar/ conference/workshop/ SVRS b) If so, its recommendations with specific justification for the release of proposed variety. (c) Specific areas of its adoption.	NA NA (c) Terai region, Red lateritic region, New alluvial zone, Coastal saline zone of West Bengal
8.	Recommended Ecology	Turmeric growing areas both under irrigated and rainfed conditions of the state West Bengal.
9.	Description of variety/hybrid. (a) Plant height (Range) (b) Distinguishing morphological characteristics. (c) Maturity (range in number of days) Seeding/transplanting to flowering, seed to seed (d) Maturity group (early, medium and late- wherever such classification exists (e) Reaction of major diseases (under field and controlled conditions). (f) Reaction to major pests (under field and	(a) 90-98 cm.(Table 8, Page 23; Table 10, page 28) (b) Bold size, high single rhizome wt., single large mother rhizome, long secondary rhizome with prominent secondary rhizome. (c) Maturity – 210-220 days (d) Maturity group- medium (e) Moderately resistant to leaf spot and leaf blotch diseases (Table 3, page 16) (f) A trial was conducted with TCP-64 and all the entries during the years (2007-08 to 11-12 in

	controlled conditions including store pests). (g) Agronomic features (e.g. Resistance to lodging, shattering, fertilizer responsiveness, suitability for early or late sown conditions, seed rate etc.). i) Sowing time ii) Seed rate and spacing iii) Irrigation iv) Fertilizers and manures v) Quality of produce	terai region, 2013-14 to 2015-16 in red lateritic zone, new alluvial zone and coastal saline zone). But no pest was observed during those trials in all the regions. (g) Detailed in Annexure –II (Package of Practices) i) April-May. ii) Whole or split mother and finger rhizomes are used for planting. A seed rate of 2,000 kg of rhizomes is required for planting one hectare. Spacing for raised bed system: 20 cm × 30 cm. (20 cm row –row ; 30 cm. plant –plant) iii) In the case of irrigated crop, depending upon the weather and the soil conditions, about 3 irrigations are to be given in soils. iv) a) FYM should be applied 2-3 t/bigha one to two month before planting the rhizomes in the field. Inorganic fertilizer like single super phosphate of 50 kg and MOP of 10 kg should be applied in the last ploughing of field just before the planting of rhizomes. b) First spilt dose of fertilizer like urea is applied 45-50 day after sowing and second dose is applied after 90 days after sowing. Dose of urea should be 13 kg and for muriate of potash 5 kg is required. v) The primary constituent of turmeric is an important secondary metabolite which is curcumin, oleoresin and essential oils. Curcumin percentage was
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	(g) Quality of produce of grain, forage/fibre including nutritive value wherever relevant.	found 4.95 which is highest and local check Suranjana was found 4.76 across the environments (Table-5, page 18). In Pundibari, it was found 5.30 which is higher than local check TCP-2 (4.90) (Table-5, page 18). The variety is stable for yield and highest dry recovery percentage (23.31%), (22.30%) (Table-4, page-17) and (Table-13, page 31) was found along with high curcumin content (4.95%) (Table-5, page 18) and (Table-13, page no. 31), high essential oil content (6.74%) (Table-7, page 20), high oleoresin content (11.85%) (Table-6, page 19) and (Table-13, pageno31). In Oleoresin content across environments, TCP-64 was found to have 11.85% which is third among the list of genotypes across India. It is also found highest among the locals in the zonal trials of West Bengal. In All India CVT trials it was found to have moderate leaf spot (18.84 PDI) and leaf blotch disease resistant (18.25 PDI) across environments (Table: 3, page no 16). g) NA
10.	Description of parents	Clonal selection of TCP-64 (IC-0615130) which was collected from Birpara tea estate (26.71 ⁰ N 88.89 ⁰ E; 104 m above sea level) in Aliporeduar district of West Bengal.

11.	a) Yield data in regional/inter-regional/district trials year wise (levels of fertilizer application, density of plant populations and superiority over local/standard varieties to be indicated. b) Yield data from National demonstration/ large scale demonstrations c) Average yield under normal conditions	(a) Gross area rhizome yield of 23.61 -29.67t/ha (Net area rhizome yield of 39.03- 49.05t/ha) [Table-10, page 28 & Table-9 page 25; Table-1&8]. (b) Gross area rhizome yield of 26.85t/ha (net area rhizome yield 44.39t/ha) (Table-2, page 14) c) Average gross area rhizome yield 26.16 t/ha (net area rhizome yield of 43.25t/ha) (Table-11, page 29) under normal conditions.
12.	(a) Agency responsible for maintaining breeder seed (b) Quantity of breeder seed in stock	(a) Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal. Pin 736165. (b) 1000kg.
13.	Information on acceptability of variety by farmers/consumers/industry	The variety Uttarrupanjana has very high dry recovery percentage and high yield in four agro climatic zones of i) New alluvial zone, ii) Red lateritic zone, iii) Coastal saline zone and iv) Terai zone of West Bengal. It also performed well in all India Co-ordinated trials. Quality parameters like dry matter percentage, curcumin percentage, and medium resistance to leaf spot and leaf blotch disease are important and it out yielded the local check Suranjana by in the overall yield.
14.	Specific recommendations, if any for seed production	Nil
15.	Any other pertinent information.	DNA fingerprinting in underway
16.	Vivid presentation of the variety with the help of photographs of the variety is to be submitted by the breeder	Photographs of the variety enclosed
17.	National identity number	IC-0615130

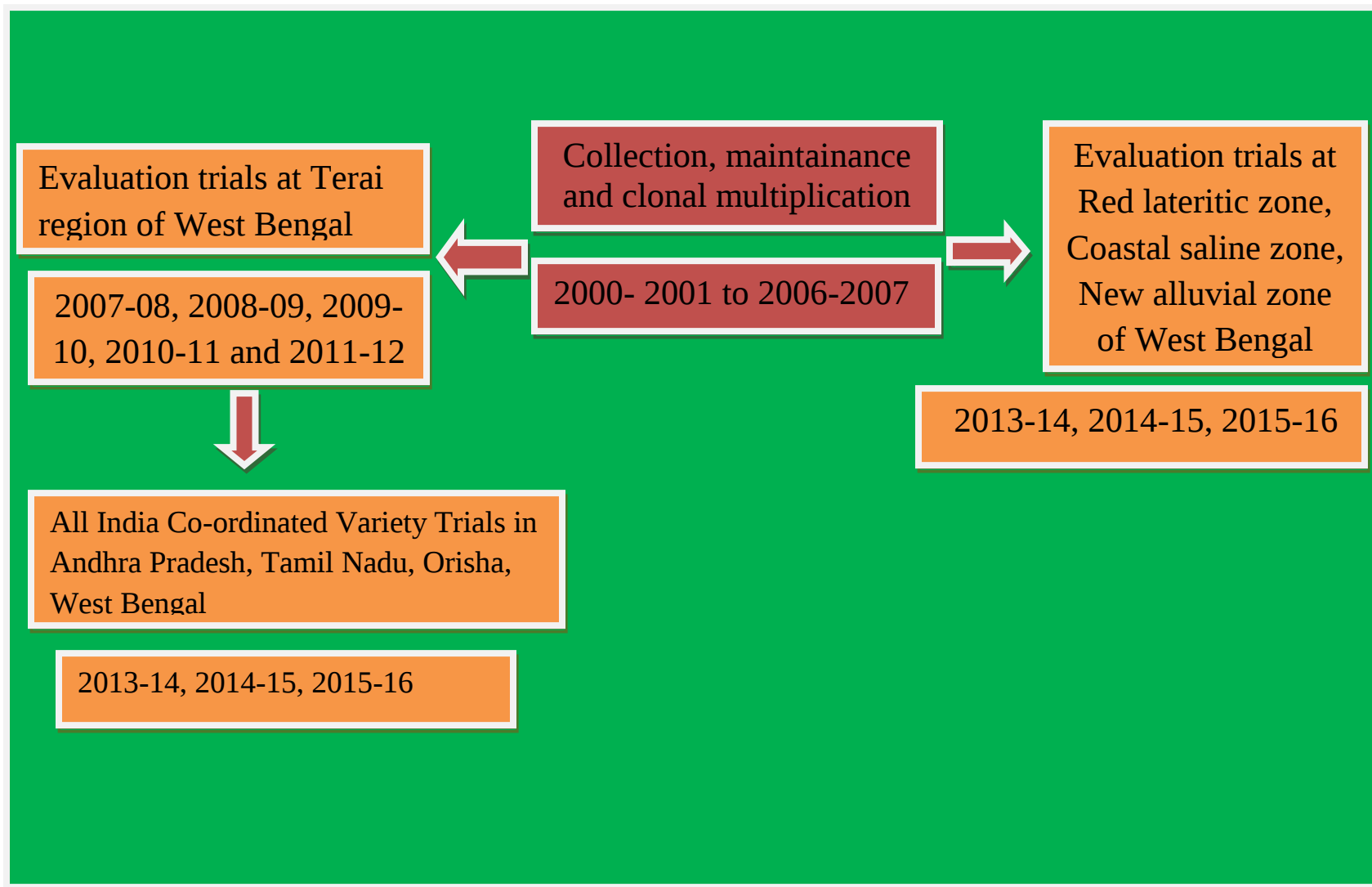
Signature of the Breeder

Signature of the In-charge, AICRP on Spices

Signature of Director of Research

Signature of the Head of the Institution

Testing of the entry, TCP 64 under different Trials



Evaluation of TCP-64 at different Zones of West Bengal

Terai Region of West Bengal



Initial Evaluation Trials- 2007-08, 2008-09, 2009-10, 2010-11and 2011-12 at Terai Region of West Bengal

No. of treatments / genotypes with details: 17 + 1 (Check)

Local check : TCP-2 (Suranjana)

Design: Randomized Block Design

Genotypes: **TCP-11, TCP-54, TCP-57, TCP-64, TCP-70, TCP-72, TCP-84, TCP-97, TCP-104, TCP-107, TCP-119, TCP-128-1, TCP-129, TCP-139, TCP-140, TCP-160, ABN-1, TCP-02 (Check)**

Replications: Three

Plot Size/spacing: Planting was done in raised beds of 3 m × 1 m plot size with a spacing of 30 cm row to row and 20 cm plant to plant.

Date of sowing: April- May

Season: Kharif

Date of Harvesting: March

Recommended package of practices were followed and observations were recorded on various morphological, yield and yield contributing characters. The data were subjected to statistical analysis (Panse and Sukhatme, 1978).

Table-1: Pooled growth parameters of Turmeric under IET in different years (2007-08, 2008-09, 2009-10, 2010-11 & 2011-12) in terai region of West Bengal (AICRP Trial No: TUR/CI/3.2: Initial Evaluation Trial 2006)

Entries	Plant height	Tiller No.	Leaf No	Leaf length	Leaf breadth	Pseudo stem girth	Yield	Wt of clump	Wt of mother clump	Length of mother finger (cm)	No. of mother finger / clump	No. of Primary fingers	Wt of Primary fingers (g)	Length of Primary fingers (cm)	No. of secondary fingers	Wt of secondary fingers(g)	Length of secondary fingers	Gross area rhizome yield (t/ha)	Net area rhizome yield (t/ha)
	Mean (cm)	Mean	Mean	Mean (cm)	Mean (cm)	Mean (cm)	Mean Kg/3m ²	Mean (gm)	Mean (gm)	Mean (cm)	(Mean)	Mean	Mean (gm)	Mean (cm)	Mean	Mean (gm)	Mean (cm)	Mean (t/ha)	Mean (t/ha)
TCP-11	83.20	2.10	7.21	39.53	9.46	6.60	6.33	239.11	42.87	18.14	1.17	4.64	8.33	8.33	10.01	6.01	12.70	12.77	21.1
TCP-54	84.51	2.26	7.78	42.30	9.94	6.82	5.95	163.24	38.50	16.01	1.10	4.17	8.93	7.79	6.25	6.25	11.94	12.00	19.83
TCP-57	108.23	1.71	7.64	53.05	10.94	8.97	6.84	208.90	49.46	18.56	0.95	4.84	8.67	5.89	11.45	5.45	11.42	13.78	22.80
TCP-64	92.93	2.49	7.49	43.95	10.67	7.52	12.72	286.37	65.84	20.28	2.23	8.14	9.36	12.27	17.88	7.80	13.34	25.64	42.40
TCP-70	83.23	2.29	7.85	42.58	9.84	7.93	7.45	169.17	37.49	16.83	0.99	4.43	8.80	9.06	8.22	7.22	15.35	15.02	24.83
TCP-72	77.62	2.30	7.67	38.47	9.44	6.29	6.35	181.02	38.99	17.37	1.22	3.83	9.00	10.38	6.61	6.61	9.94	12.80	21.16
TCP-84	81.32	2.21	7.82	40.46	10.08	7.75	6.33	166.33	39.00	15.83	1.15	4.31	8.27	5.62	7.07	7.07	13.25	12.76	21.10
TCP-97	80.79	2.12	7.59	41.32	10.27	6.90	5.77	141.49	35.63	15.74	1.01	3.92	8.33	6.27	7.38	7.38	10.01	11.63	19.23
TCP-104	86.33	1.99	7.70	39.15	9.14	6.79	5.37	172.53	46.28	16.19	1.09	4.73	8.80	7.62	9.44	5.44	13.47	10.82	17.90
TCP-107	97.24	2.24	7.46	46.28	10.55	8.25	6.84	218.10	46.64	16.77	1.04	5.28	8.67	8.80	11.72	6.72	15.37	13.52	22.80
TCP-119	80.43	2.28	7.35	41.63	10.07	6.60	4.90	149.29	31.94	14.42	0.93	4.17	8.07	5.84	7.47	7.47	13.02	9.88	16.33
TCP-129	86.40	2.25	7.80	43.87	10.64	7.25	7.62	194.60	40.74	17.82	1.08	4.94	9.27	6.42	8.38	7.38	12.08	15.36 ¹²	25.40
TCP-139	81.51	2.44	7.22	41.82	10.07	6.46	5.69	180.43	48.11	19.10	1.26	4.14	8.93	5.58	8.04	5.04	11.64	11.48	18.96

TCP-140	80.94	2.12	7.77	40.69	9.71	6.61	4.86	156.75	36.16	17.35	0.91	3.78	8.27	5.61	7.55	7.55	13.21	9.80	16.20
TCP-160	86.60	2.34	7.43	42.82	10.02	6.35	6.32	183.56	31.27	14.72	1.09	3.73	8.27	5.14	7.21	7.21	9.88	12.74	21.06
ABN-01	77.15	2.42	7.57	35.85	8.78	5.87	6.09	222.20	42.04	18.35	1.41	4.57	9.13	5.11	9.98	6.98	13.70	12.28	20.30
TCP-128-1	100.73	2.00	7.52	51.50	10.34	8.99	4.99	170.27	38.00	16.31	0.96	4.75	7.8	5.80	10.46	7.46	14.47	10.07	16.63
TCP-02	72.37	2.41	7.31	34.84	8.55	5.97	7.09	174.77	26.47	15.45	1.26	4.02	9.2	4.56	8.48	6.48	13.41	14.30	21.10
S.Em (±)	6.55	0.21	0.31	3.71	0.61	0.82	1.20	34.96	10.03	2.19	0.18	0.68	0.35	22.89	2.02	2.02	3.09	2.43	3.24
CD (at 5%)	13.07	0.43	0.61	7.41	1.22	1.64	3.39	69.75	20.02	4.37	0.35	1.36	0.99	5.77	4.03	4.03	6.17	4.85	7.96
C.V. %	21.32	4.32	1.21	15.61	2.86	3.58	7.80	26.32	16.80	9.32	4.10	3.68	5.63	11.42	10.43	13.65	20.45	23.46	25.80

Results and discussion: Analysis of pooled data showed that TCP-64 was recorded highest yield (12.32 kg/3m²) (gross area rhizome yield of 25.64t/ha) (net area rhizome yield of 42.40 t/ha) over all the other genotypes. It has highest wt of single rhizome over the other genotypes (286.37 gm). It has highest wt of mother clump 65.84gm with highest length of mother clump (20.28cm). Number of mother clumps are 2.23. Wt of primary fingers are highest (9.36 gm) each and length of primary finger are highest (12.27 cm). Wt of secondary fingers are also highest (7.80 gm). So TCP-64 is highest in all quality rhizome parameters and chosen for All India CVT trials.

Table-2: Rhizome(t/ha) as influenced by different Genotypes of turmeric grown under All India Coordinated Trials across location throughout India (Pooled over three years, 2013-14, 2014-15 and 2015-16) TUR/CI/2.5: CVT on Turmeric 2013

Fresh Rhizome yield (t/ha)								
Turmeric Genotypes	Chintapalle	Coimbatore	Kammarpalli	Kozhikode	Kumarganj	Pundibari	Navsari	Mean
Acc 48	38.83 (64.20)	34.04 (56.28)	27.12 (44.84)	51.79 (85.63)	23.93 (39.62)	14.57 (24.09)	22.57 (37.31)	30.40 (50.26)
Acc 79	29.98 (49.57)	32.22 (53.27)	24.79 (40.98)	40.01 (66.15)	23.06 (38.12)	16.48 (27.24)	21.23 (35.10)	26.82 (44.34)
SLP 389/1	24.27 (40.12)	30.67 (50.71)	21.80 (36.04)	26.60 (43.98)	22.06 (36.47)	18.59 (30.73)	15.78 (26.09)	22.82 (37.73)
NDH 8	40.15 (66.38)	27.97 (46.24)	27.79 (45.94)	31.58 (52.21)	27.26 (45.07)	18.43 (30.47)	19.72 (32.60)	27.55 (45.55)
NDH 79	35.74 (59.09)	28.25 (46.70)	25.85 (42.74)	30.45 (50.34)	26.00 (42.98)	14.89 (24.61)	26.23 (43.36)	26.77 (44.26)
NDH 98	46.22 (76.42)	29.17 (48.23)	25.79 (42.64)	48.85 (80.77)	31.18 (51.55)	31.99 (52.89)	33.72 (55.75)	35.27 (58.31)
TCP 64	25.96 (42.92)	30.43 (50.31)	27.96 (46.23)	26.34 (43.55)	27.37 (45.25)	24.19 (39.99)	25.72 (42.52)	26.85 (44.39)

PTS 12	29.33 (48.49)	33.39 (55.20)	22.47 (37.15)	32.31 (53.42)	21.96 (36.30)	17.40 (28.76)	24.67 (40.79)	25.93 (42.87)
PTS 8	31.34 (51.81)	27.63 (45.68)	17.37 (28.72)	37.93 (62.71)	21.02 (34.75)	18.65 (30.83)	25.79 (42.64)	25.67 (42.44)
PTS 55	27.87 (46.08)	28.61 (47.30)	23.95 (39.59)	34.02 (56.25)	23.67 (39.13)	15.51 (25.64)	24.42 (40.37)	25.43 (42.04)
Prathiba	27.68 (45.76)	23.78 (37.63)	21.28 (35.18)	27.82 (45.99)	22.00 (36.37)	13.84 (22.88)	25.10 (41.5)	23.07 (36.51)
Local	19.08 (31.54)	32.28 (53.37)	31.58 (52.21)	20.77 (34.34)	23.43 (38.74)	16.87 (27.89)	24.47 (40.45)	24.06 (39.78)

Figures in the parentheses are net area rhizome yield and outside the parentheses gross area rhizome yield

Results and Discussion: The results (Table-2) showed that the test entry, TCP-64 recorded highest gross area rhizome yield of 26.85t/ha (net area rhizome yield of 44.39t/ha) over many other genotypes [gross area rhizome yield of 22.82t/ha (net area rhizome yield of 37.73t/ha) – gross area rhizome yield of 26.85t/ha (net area rhizome yield of 44.34t/ha)] except NDH-8, ACC-48 and NDH 48 [gross area rhizome yield of 27.55 (net area rhizome yield of 45.55t/ha) – gross area rhizome yield of 35.27 (net area rhizome yield of 58.31 t/ha)].

Table:-3 Evaluation of leaf spot and leaf blotch diseases against the entry TCP-64

TUR/CI/2.5: CVT on Turmeric 2013

Entries	Leaf Spot (PDI)	Leaf Blotch (PDI)
Acc 48	19.65	26.53
Acc 79	13.41	29.60
SLP 389/1	9.98	26.02
NDH 8	8.16	24.11
NDH 79	15.07	28.28
NDH 98	10.12	21.42
TCP 64	18.84	18.25 Ist rank
PTS 12	7.795	21.85
PTS 8	14.98	29.37
PTS 55	13.15	24.01
Local check (Suranjana)	13.59	29.74

Percentage Disease Index

Percent disease index is calculated from random sample of 50 leaves and rated on a **0-4 scale** Where 0= no disease; 1= 1-10% area damaged; 2 = 11-20% area damaged; 3 = 21-30% area damaged; and 4 = > 30% area damaged were calculated.

0% PDI (No reaction) -Total Resistant to the disease

1-10% PDI- Highly resistant or tolerant to the disease

11-20% PDI - Moderately resistant or tolerant to the disease

PD 21-30% PDI- Highly susceptible to the disease

31% PDI>- Extremely susceptible to the disease

Results and discussion: The results (Table-3) revealed that the test entry, TCP-64 showed the lowest PDI of 18.25 against leaf blotch disease. The said entry showed PDI of 18.84 against leaf spot disease. The results indicate that the entry, TCP-64 is moderately resistant against to leaf spot and leaf blotch diseases of turmeric.

Table- 4: Dry recovery (%) of genotypes across locations against the entry TCP-64 (TUR/CI/2.5: CVT on Turmeric 2013)

	Coimbatore	Chintapalle	Pundibari	Mean	Rank
NDH-8	18.20	14.40	27.17	20.04	
NDH-79	20.55	14.70	31.00	20.88	
NDH-98	17.05	20.70	32.17	21.58	
ACC-48	18.45	12.60	24.00	18.59	
ACC-79	18.15	13.50	26.17	19.15	
SLP 389/1	15.45	23.40	23.84	20.37	
TCP-64	22.00	20.20	21.77	23.31	Ist rank
PTS-12	16.95	22.00	31.34	21.46	
PTS-8	19.05	23.20	31.00	22.06	
PTS-55	18.35	18.40	31.84	21.80	
Local check (Suranjana)	18.20	19.50	28.00	21.37	

Results and discussion: The results (Table-4) revealed that the test entry, TCP-64 showed highest dry recovery percentage (23.31%) over other varieties including local check Suranjana. The results indicated that the entry, TCP-64 has highest economic advantage over the other varieties for dry recovery percentage.

Table 5: Curcumin percentage of entries across India against the entry TCP-64 estimated at Solan (TUR/CI/2.5: CVT on Turmeric 2013

	Kumarganj	Pundibari	Coimbatore	Chintapalli	Mean	Rank
NDH-8	4.55	4.30	5.10	4.3	4.55	
NDH-79	4.50	4.60	4.60	4.6	4.58	
NDH-98	4.00	4.80	4.60	4.8	4.55	
ACC-48	4.80	4.70	4.45	4.8	4.69	
ACC-79	5.05	4.30	5.10	5.3	4.94	
SLP 389/1	5.20	4.40	4.60	5.1	4.83	
TCP-64	5.05	5.30	4.55	4.9	4.95	1st rank
PTS-12	4.15	5.30	4.40	4.7	4.64	
PTS-8	5.10	4.80	4.05	4.3	4.56	
PTS-55	5.00	5.10	4.95	4.4	4.86	
Suranjana (Local Check)	5.20	4.90	3.65	5.3	4.76	

Results and Discussion: The results (Table-5) revealed that the test entry, TCP-64 showed highest curcumin percentage (4.95) over other varieties. The results indicated that the entry, TCP-64 has highest percentage of curcumin over all varieties which is one of the important quality parameters for determining the quality of a turmeric variety.

Table: 6-Oleoresin content (%) of genotypes across locations against the entry TCP-64 at Solan

TUR/CI/2.5: CVT on Turmeric 2013

	Kumarganj	Pundibari	Coimbatore	Chintapalli	Mean
NDH-8	11.69	11.83	10.89	10.51	11.23
NDH-79	11.70	10.59	10.85	10.78	10.98
NDH-98	12.48	11.92	10.23	10.47	11.28
ACC-48	11.95	12.33	11.67	11.49	11.86
ACC-79	11.88	12.57	11.33	11.76	11.89
SLP 389/1	11.75	11.92	12.25	11.83	11.94
TCP-64	12.08	11.70	11.93	11.70	11.85
PTS-12	11.35	11.83	12.34	11.92	11.86
PTS-8	11.65	10.59	11.81	12.33	11.62
PTS-55	11.50	11.92	12.42	12.57	12.10
Pratibha	11.45	12.33	12.45	11.92	12.04
Local	11.23	12.57	11.34	10.59	11.43

Results and Discussion: The results (Table-6) revealed that the test entry, TCP-64 showed oleoresin percentage (11.85) over other varieties. The results indicated that the entry, TCP-64 has highest percentage of curcumin over other varieties which is one of the important quality parameters for determining the quality of a turmeric variety.

Table 7: Estimation of essential oil content (%) across India against the entry TCP-64 (TUR/CI/2.5: CVT on Turmeric 2013)

Entries	Kumarganj	Pundibari	Coimbatore	Chintapalli	Mean	Rank
NDH-8	6.85	6.70	6.80	6.70	6.76	
NDH-79	6.65	6.10	6.40	6.10	6.73	
NDH-98	6.65	6.40	6.70	6.40	6.54	
ACC-48	6.90	6.80	6.50	6.80	6.73	
ACC-79	6.55	6.20	6.80	6.20	6.51	
SLP 389/1	6.50	6.60	6.30	6.60	6.43	
TCP-64	6.95	6.30	6.90	6.60	6.74	III
PTS-12	6.35	6.50	6.80	6.50	6.46	
PTS-8	6.60	6.70	6.40	6.70	6.58	
PTS-55	6.35	6.30	6.70	6.30	6.49	
Local	6.30	6.60	6.70	6.30	6.48	

Results and Discussion: The genotype TCP-64 was found to have 6.74 % essential oil content which is higher than local check 6.48% across India.

Evaluation of the Variety in Red Lateritic Zone

Bankura (Borjhora)(State Seed Farm)

Borjhora Farm TCP-64 trial



Table-8: Evaluation of TCP-64 at State seed farm Borjhora Bankura over three years (2013-14, 2014-15 and 2015-16)

Entries	Plant height	Tiller No.	Leaf No	Leaf length	Leaf breadth	Pseudo stem girth	Yield	Wt of clump	Wt of mother clump	Length of mother finger (cm)	No. of mother finger / clump	No. of Primary fingers	Wt of Primary fingers (g)	Length of Primary fingers (cm)	No. of secondary fingers	Wt of secondary fingers(g)	Length of secondary fingers	Rhizome yield (t/ha)
	Mean (cm)	Mean	Mean	Mean (cm)	Mean (cm)	Mean (cm)	Mean Kg/3m ²	Mean (gm)	Mean (gm)	Mean (cm)	(Mean	Mean	Mean (gm)	Mean (cm)	Mean	Mean (gm)	Mean (cm)	Mean (t/ha)
TCP-64	90.80	2.31	6.76	40.82	9.60	7.30	12.42	437.30	60.80	7.28	2.89	9.00	18.92	12.27	20.63	8.42	6.34	25.03 (41.38)
Borjhora local	78.71	2.78	7.15	33.67	8.92	7.93	10.34	202.46	24.36	5.14	1.36	8.02	16.42	7.23	7.20	5.32	3.20	20.84 (34.45)
TCP-02	81.37	2.58	7.20	30.74	8.40	6.62	9.18	353.78	20.40	9.45	1.26	10.02	15.2	9.56	13.32	8.30	5.41	18.50 (30.58)

Figures in the parentheses indicate net area rhizome yield and outside the parentheses gross area rhizome yield

Results and discussion: The results (Table-8) indicated that the entry, TCP-64 recorded the highest gross area rhizome yield of 25.03 t/ha (net area rhizome yield of 41.38t/ha) as compared to Borjhora local [gross area rhizome yield of 20.84t/ha (net area rhizome yield of 34.45t/ha)].

Evaluation of the Variety in New Alluvial Zone
MONDOURI FARM

Table-9: Evaluation of TCP-64 at New Alluvial Zone along with locals at Mondouri over three years (2013-14, 2014-15 and 2015-16)

Entries	Plant height	Tiller No.	Leaf No	Leaf length	Leaf breadth	Pseudo stem girth	Yield	Wt of clump	Wt of mother clump	Length of mother finger (cm)	No. of mother finger / clump	No. of Primary fingers	Wt of Primary fingers (g)	Length of Primary fingers (cm)	No. of secondary fingers	Wt of secondary fingers(g)	Length of secondary fingers	Rhizome yield (t/ha)
	Mean (cm)	Mean	Mean	Mean (cm)	Mean (cm)	Mean (cm)	Mean Kg/3m ²	Mean (gm)	Mean (gm)	Mean (cm)	(Mean	Mean	Mean (gm)	Mean (cm)	Mean	Mean (gm)	Mean (cm)	Mean (t/ha)
TCP-64	95.84	2.48	7.56	43.82	9.60	7.58	14.72	418.3	65.84	7.28	2.64	9.00	28.92	12.27	17.88	8.42	7.30	29.67 (49.05)
Birnagar local	67.71	2.03	6.10	25.60	6.92	6.90	10.36	202.46	24.40	5.00	1.48	7.64	16.40	7.20	13.21	6.14	3.68	20.88 (34.45)
TCP-02	75.30	2.58	7.20	34.84	8.55	5.97	7.09	353.78	26.47	8.40	1.22	10.24	24.22	9.42	20.32	8.48	6.41	14.29 (23.62)

Figures in the parentheses indicate net area rhizome yield and outside the parentheses gross area rhizome yield

Results and discussion: The results (Table-9) indicated that the entry, TCP-64 recorded average gross area rhizome yield of 29.67 t/ha (net area rhizome yield of 49.05t/ha) as compared to Birnagar local {20.88t/ha (net yield 34.52t/ha)}.



Mondouri farm TCP-64 trial

Evaluation of the Variety in Coastal Saline Zone

Kakdeep

Table-10: Evaluation of TCP-64 at Coastal saline zone at Kakdeep over three years (2013-14, 2014-15 and 2015-16)

Entries	Plant height	Tiller No.	Leaf No	Leaf length	Leaf breadth	Pseudo stem girth	Yield	Wt of clump	Wt of mother clump	Length of mother finger (cm)	No. of mother finger / clump	No. of Primary fingers	Wt of Primary fingers (g)	Length of Primary fingers (cm)	No. of secondary fingers	Wt of secondary fingers(g)	Length of secondary fingers	Rhizome yield (t/ha)
	Mean (cm)	Mean	Mean	Mean (cm)	Mean (cm)	Mean (cm)	Mean Kg/3m ²	Mean (gm)	Mean (gm)	Mean (cm)	Mean	Mean	Mean (gm)	Mean (cm)	Mean	Mean (gm)	Mean (cm)	Mean (t/ha)
TCP-64	97.80	2.31	6.76	36.82	9.60	7.21	11.72	520.31	56.84	7.30	2.30	9.20	23.26	10.12	13.88	8.31	6.20	23.61 (39.03)
Kakdeep local	78.71	2.78	7.15	33.67	8.90	7.93	9.30	202.46	55.42	5.24	1.46	8.22	26.42	7.23	14.58	5.30	3.26	18.32 (30.29)
TCP-02	80.30	2.42	7.20	30.84	8.55	5.98	8.09	353.78	26.47	9.45	1.26	10.02	25.22	10.46	20.32	8.48	5.41	17.30 (28.60)

Figures in the parenthesis are net fresh rhizome yield and outside the parentheses gross rhizome yield

Results and discussion: The results (Table-10) indicated that the entry, TCP-64 recorded the gross area rhizome yield of 23.61 t/ha (net area rhizome yield 39.03 t/ha) as compared to Kakdeep local [gross area rhizome yield of 18.32 t/ha (net area rhizome yield of 30.29 t/ha)].

Table 11: Average fresh rhizome yield (t/ha) of TCP-64 under normal conditions

Trials (t/ha)												
	Terai region (Table-1)		Red lateritic zone (Table-8)		New Alluvial Zone (Table-9)		Coastal Saline Zone (Table-10)		AICRP Trial (Table-2)		Mean	
Entry	TCP 64 Uttarrupanja na	Terai local	TCP-64 Uttarrupanj ana	Borjhora local	TCP-64 Uttarrup anjana	Birnagar local	TCP-64 Uttarrup anjana	Kakdeep local	TCP- 64 Uttarrup anjana	Local	TCP-64 Uttarrupa njana	Local
	25.64 (42.40)	14.30 (21.10)	25.03 (41.38)	20.84 (34.45)	29.67 (49.05)	20.88 (34.42)	23.61 (39.03)	18.32 (30.29)	26.85 (44.39)	24.06 (39.78)	26.16 (43.25)	19.68 (32.00)

Figures in the parentheses indicate gross area rhizome yield and outside the parentheses net area rhizome yield

Results and discussion: The results (Table-10) indicated that the entry, TCP-64 recorded average gross area rhizome of 26.16t/ha (net area rhizome of 43.25t/ha) across locations in West Bengal and throughout India.

Table: 12- Evaluation of leaf spot and leaf blotch disease in Red lateritic zone, new alluvial zone and coastal saline zone in West Bengal

Entries	Leaf Spot (PDI)	Leaf Blotch (PDI)
TCP 64	13.84	19.52 Ist rank
Borjhora local	28.79	26.85
Nadia Local	24.98	29.37
Sundarban local	23.15	33.01

Results and Discussion: The results (Table-12) indicated that the entry, TCP-64 recorded 13.84 PDI in leaf spot and 19.52 PDI in leaf blotch among disease resistance character. The results indicated that the entry, TCP-64 showed moderate resistance against leaf spot and leaf blotch diseases of turmeric. All the other three land races were found highly susceptible to leaf spot and leaf blotch diseases.

Table: 13-Evaluation of Dry recovery percentage, curcumin percentage and oleoresin percentage in different zones of West Bengal

Entries	Dry recovery Percentage	Rank	Curcumin percentage	Rank	Oleoresin percentage	Rank
TCP-64	22.30	1st	4.95	1st	11.85	2nd
Borjhora local	19.15		4.32		11.68	
Nadia local	18.45		4.88		11.52	
Sudarban local	15.45		4.22		12.02	
(Suranjana) Terai zone local	18.20		4.76		11.43	

Results and Discussion: The results (Table-13) indicated that the entry, TCP-64 recorded highest dry recovery percentage (22.30%) with curcumin content (4.95%) and oleoresin content (11.85%) over other entries of locals four zones.

**Comparison of Rhizomes of TCP-2(SURANJANA-terai Region), (Borjhora local), (Coastan saline zone-
Kakdeep Local) and (Birnagar Local –New Alluvial Zone) with TCP-64 (Uttarrupanjana)**



Fig.1: TCP-64-Uttarrupanjana



Fig.2: Borjhora Local



Fig. 3: Birnagar local



Fig.4: TCP-2(Suranjana)



Fig.:5 Kakdeep -Local

Salient Features of Uttarrupanjana



BOLD RHIZOME



**HIGH DRY RECOVERY
PERCENTAGE- 23.31%**

**HIGH YIELD POTENTIAL-
43.25t/ha(26.16t/ha)**

Annexure -1

Distinguishable DUS Characters

S No.	Characteristics	States	SURAN JANA (Terai)	Borjhora local (Red Lateritic)	Nadia local (New Alluvial)	Sundarban local (Coastal saline)	TCP-64 (Uttarrupan jana)
1	Plant: Pseudo stem habit	Compact	Open	open	compact	compact	Compact
		Open					
2	Plant: Height (cm)	Short (<85)	Medium	Short	Short	Short	Medium
		Medium (85-100)					
		Tall (>100)					
3	Plant: Number of shoots	Few(<3)	Few	Few	Medium	Medium	Few
		Medium (3-5)					
		Many (>5)					
4	Plant: Number of leaves on main shoot	Few (<5)	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
		Intermediate (5-10)					
5	Plant: Leaf disposition	Erect (<45°)	Erect	Erect	Erect	Erect	Erect
		Semi-erect (45-85°)					
		Horizontal (>85°)					
6	Leaf: Petiole length (cm)	Short (<15)	Long	Long	Long	Long	Long
		Intermediate (15-25)					
		Long (>25)					
7	Leaf: Lamina length (cm)	Short (<30)	Long	Long	Long	Long	Long
		Medium (30-40)					
		Long (>40)					
8	Leaf: Lamina	Narrow (<10)	Broad	Medium	Medium	Broad	Medium

	width (cm)						
		Medium (10-15)					
		Broad (>15)					
9	Leaf: Venation pattern	Close	Distant	Distant	Distant	Distant	Distant
		Distant					
10	Leaf: Margin	Even	Wavy	Wavy	Wavy	Wavy	Wavy
		Wavy					
11	Rhizome: Habit	Compact	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
		Intermediate					
		Loose					
12	Rhizome: Shape	Straight	Straight	Straight	Straight	Straight	Straight
		Curved					
13	Primary Rhizome Length (cm)	Short (< 5 cm)	Medium	Medium	Medium	Medium	Medium
		Medium (5 - 10 cm)					
		Long (> 10 cm)					
14	Rhizome: Internode pattern (cm)	Close (< 1)	Close	Close	Close	Close	Close
		Distant (>1)					
15	Rhizome: Status of tertiary rhizome	Absent	Present	Present	Present	Present	Present
		Present					
16	Rhizome: Inner core colour	Orange	Reddish Yellow	Orange	Orange	Redish yellow	Orange
		Lemon Yellow					
		Radish Yellow					
17	Dry recovery (%)	Low (<15)	Intermediate	Intermediate	Intermediate	Intermediate	High
		Intermediate (15-20)					
		High (>20)					
		Intermediate (15-20)					
		High(>20)					

Annexure -II

Package of practices-Turmeric

One of the most important spices which is required and used in our day-to-day life is turmeric. Not only it is used as spices, but it is also used as beautification and perfumatory products for commercial uses. When high yielding and highly developed varieties are used scientifically, they can be very much economically useful for farmers very good return. Turmeric can be grown in the fields where coconut, arecanut and fruit trees are grown with sufficient shades in the field.

Climate: Turmeric is crop which is mainly grown in tropical countries. They can be grown upto 1250 mt. above sea level. 20⁰-30⁰C temperature is ideal range of temperature in any region of West Bengal. At first higher temperatures are required but when rhizomes are formed in good shape, near about 20⁰C is required for proper development and growth.

Soil: High level, well drainage facility, fertile, sandy-clayey loam or clayey loam soil are required for cultivation of turmeric in any region. Water stagnation in the soil is very much detrimental for the growth of this plant. Due to this reason, rhizome rot disease is occurred in the rhizome. The soil ph should be maintained within 5-7 range for good production of turmeric in this region.

Variety: Local cultivars like landraces along with Suranjana variety along with birnagar local ,borjhora local and kakdeep local are mostly cultivated in most of the regions of West Bengal.

Preparation of field: The proper field should be identified and prepared by thorough ploughing up to the depth of 20-25 cm and leveling by a leveler. The field is free from weed and previous crop residue and is cleaned enough for the turmeric cultivation.

Time of sowing: Generally April-May months are suitable for sowing. Mother rhizomes are generally used as seed purpose and fingers are also used for sowing purpose. Usually 30-35 gm of rhizome and pieces of rhizome are used for sowing purpose. Minimum 2-3 buds should be present in the rhizome. In case of one hectare land, 2.5-3.00 tonnes of mother rhizomes are required. In other case for secondary rhizomes, 2.0-2.5 t/ ha of rhizomes are required.

Processing of rhizome prior to sowing: The rhizomes is soaked for 30 minutes with 2.5 Diethane-M-45 for 30 m and then dried in shades.

Fertilizer: As turmeric is rhizome and draws a lot of nutrient from the soil, the following application of fertilizers is done in this region:

- i) FYM should be applied 2-3 t/bigha one to two month before planting the rhizomes in the field. Inorganic fertilizer like single super phosphate of 50 kg and MOP of 10 kg should be applied in the last ploughing of field just before the planting of rhizomes.

- ii) First split dose of fertilizer like urea is applied 45-50 day after sowing and second dose is applied after 90 days after sowing. Dose of urea should be 13 kg and for muriate of potash 5 kg is required.

Sowing: Turmeric is sown as ridge and furrow method in plot or in continuous plot having 1 mt width and where there is predominance of rainfall. It can also be sown 3mx1 m plots with raised beds of about 15 cm ht with 30 cm space between the lines and 20 cm between the rhizomes. The distance from one ridge to another is 40-45 cm. In each ridge the rhizomes are sown 20-25 cm apart from each other. The rhizomes are sown at about 5 cm depth in the lines of the plot with uniformity.

Intercultural operation: Mulching is done in all the plots after sowing. Generally 2-3 times mulching should be done. It is done with dried paddy straw or dried leaves. The soil is loosened up by applying khurpis and weeding is done at the time of sowing in this region.

Irrigation: If there is not moisture in the soil, irrigation should be done immediately after sowing in the field. After the rainfall season, if there is scarcity of water in the field, irrigation is done for proper germination of plants from the rhizome.

Harvesting: Generally, rhizomes are taken out from the soil 7-9 months after sowing. Early type genotypes or varieties are generally harvested 7 months after sowing and late types are 9 months after sowing. When the leaves are dried in the field, then it is ideal for harvesting turmeric. The plants along with leaves are cut off in the field and a light irrigation is applied just 3-4 days before harvesting. Then the rhizomes are taken out from the field and roots and soils stuck to rhizomes are separated carefully.

Yield: Generally 15-20t/ha of rhizomes are produced in this region. In high yielding varieties, upto 30 t/ha of yield is also recorded.

Post harvest operation: After harvesting from the field, the rhizomes are soaked with fungicides like Di-ethane M-45 and dried for 3-4days in shade. Then after drying rhizomes become hard and they are kept in storage houses.

Diseases: Rhizome rot disease is found here in this region. If it is found, then Bordeaux mixture (1%) or Mancozeb (2.5-3 gm per lit in water) should be used or Carbendazim (1gm/lit) is used for curing of this disease.

Pest: Stem borer is found which bores the stems inside out so the plant becomes dry and ultimately died. 1.5-2 ml Quinolpos or Diamethoete should be sprayed to avoid this infestation in this region.