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Plant Germplasm Registration Notice*

The Plant Germplasm Registration Committee of ICAR in its XXIXth meeting held on May 5th, 2014 at the National Bureau of Plant Genetic Resources, New Delhi approved the registration of following 18 germplasm lines out of 84 proposals considered. The information on registered germplasm is published with the purpose to disseminate the information to respective breeders for utilization of these genetic stocks in their crop improvement programmes. Upon request, the developer(s)/author(s) is/are obliged to distribute the material for crop improvement programme of National Agricultural Research System.

1. AC-42091 Bhundi (JRS-9) (IC0575277; INGR 14025), a Rice (*Oryza sativa*) Germplasm with Elongation Ability of Shoot

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The rice germplasm namely "Bhundi" (IC0575277; INGR14025; AC42091), a landrace was collected from the farmer's field in Village-Sahu sahi, Block-Dhamnagar, District-Bhadrak, Odisha state. Rice, the only cereal crop is grown in flood prone ecosystem. Uncertainty of rainfall is a major factor affecting the rice yield in South and South-east Asia, sometimes flash flood affects the crop stand seriously depending on duration of submergence stress which is considered as the third most important constraint to high yield in India, particularly in the eastern Indian States (Sarkar *et al.,* 2006). Quiescence and elongation are two opposite strategies by which rice adapts to flood depending upon the nature of flooding (Sarkar and Bhattacharjee 2011). The ethylene response factor genes *Snorkel1* (*SK1*) and *Snorkel2* (*SK2*) allow rice to adapt to deep water whereas *Submergence1A-1* (*Sub1A-1*) allows rice to acclimatize under flash flooding. Both *SKs* genes and *Sub1A-1* are connected with gibberellin biosynthesis or signal transduction, yet deep water and submergence-tolerant rice seem to have opposite flooding response; namely, escape by elongation or remain stunted under water until flood recedes (Xu *et al.,* 2006; Hattori *et al.,* 2009; Sarkar and Panda, 2009). However, rice plants that exhibit only limited elongation during submergence often show tolerance to flash flooding. The ideotype is not suitable if water level increases and then (i) stays at that level (ii) recedes only partly or (iii) recedes but then rises again and continues for longer duration (Sarkar *et al.,* 2006). Analysis of flooding pattern in rainfed lowland of South-east Asia reveals that about 20 million ha falls under medium-deep to deep and very deep ecology based on water stagnation. Here the ideal response to flooding is submergence tolerance (survival under water) together with some elongating ability (Sarkar *et al.,* 2006, Sarkar and Bhattacharjee, 2011). Incidences of flooding have been increased in recent years due to the extreme weather events such as unexpected cyclonic heavy rains and outflows of rivers that have inundated wider areas across many regions in Asia. Rice is the only cereal crop that is well adapted to the conditions of water logging or partial flooding or complete submergence. In areas where plant experiences both complete submergence and waterlogging a perfect blend of elongation and tolerance is required. The genotype namely "Bhundi" (IC0575277; INGR14025; AC42091) with SUB1 QTL possesses greater elongation ability and re-emergence growth among the SUB1 lines (Sarkar and Bhattacharjee, 2011). It could be employed for developing varieties for the locations where both submergence and water logging tolerance are required.

The morpho-agronomic traits of the germplasm are described in Table1. Minimal descriptors for characterization and evaluation of rice germplasm

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Table 1. Morpho-agronomic traits of Bhundi (IC0575277)

Characteristics	AC 42091(IC0575277) Bhundi
Early plant vigour	Intermediate
Coleoptile: Anthocyanin colouration	Absent
Basal leaf sheath colour	Green
Leaf blade colour	Pale green
Leaf pubescence	Glabrous
Leaf length (cm)	65.3
Leaf width (cm)	0.73
Ligule length (cm)	2.67
Days to 50 % flowering	123 (highly photo-sensitive)
Panicle exsertion	Well exserted
Stigma colour	White
Apiculus colour	Green
Number of effective tillers	8.7
Culm diameter (cm)	0.37
Plant height (cm)	174
Panicle length (cm)	29.8
Panicle type	Horizontal
Awning	Absent
Days to maturity	153
Seed coat colour (kernel colour)	Light brown
Grain length-breadth ratio	2.3
100 grain weight (g)	3.34
Hull colour (husk colour)	Straw
Threshability	Easy
Aroma	Absent
Grain yield/plant (g)	22.5
Abiotic stress note	Moderately tolerant (SES score= 3-5) to salinity stress at seedling stage

"BHUNDI" (JRS-9, CRRI AC-42091) (As per AICRP data).

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2. AC-42087, Kalaketki (JRS-4) (IC575273; INGR 14026), a Rice (*Oryza sativa*) Germplasm with Submergence Tolerance (20 days)

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The rice germplasm namely "Kalaketaki" (IC0575273; INGR14026; AC42087), a landrace was collected from the farmer's field in Village- Baharbil, Block-Dhamnagar, District-Bhadrak, Odisha state. Excessive rains during monsoon season adversely affect agricultural productivity in large areas of South and Southeast Asia by causing complete submergence of rice plants. The extent of injury and subsequent survival under submergence are influenced by the depth of flood water, the concentration of oxygen dissolved in water, *pH*, pre- and post-submergence carbohydrate content of plant, the degree of turbidity and damage to the photosynthetic apparatus (Panda *et al.,* 2006; Das *et al.,* 2009). In areas where typical flash-floods occur (water recedes to lower levels after complete submergence for 1-2 weeks), reduced underwater elongation is beneficial for survival because the elongating plants exhaust their energy reserves and tend to lodge as soon as the water level recedes (Sarkar *et al.,* 2009). Cultivars with *SUB1* (*e.g.* Swarna-Sub1, IR64-Sub1, Samba Mahsuri-Sub1) tolerate complete submergence for over 2 weeks, depending on floodwater conditions (Das *et al.,* 2009; Sarkar and Bhattacharjee, 2011), whereas some other cultivars withstand 3 weeks of complete submergence with greater variations in plant height and elongation ability under submergence (Table 1). These cultivars maintain greater dry biomass

Table 1. Survey of rice germplasm with *SUB1A* and *SUB1C* specific primers SC3 and ART5, respectively, and plant height, elongation of shoot and survival percentage due to 14 and 20 days of submergence

Cultivars	Primers		Plant Height (cm)		Elongation (%)		Survival (%)	
	SC3	ART5	14 DS	20 DS	14 DS	20 DS	14 DS	20 DS
Swarna-Sub1	(+)	(+)	37 ± 0.8	39 ± 1.3	54 ± 7.4	64 ± 2.5	88 ± 9.0	12 ± 2.5
IR64-Sub1	(+)	(+)	42 ± 4.0	50 ± 3.7	52 ± 11.8	62 ± 1.7	90 ± 3.3	30 ± 8.5
SambaMahsuri-Sub1	(+)	(+)	45 ± 4.1	48 ± 3.0	57 ± 10.6	69 ± 12.1	66 ± 7.8	14 ± 5.0
AC42087	**(+)**	**(–)**	**63 ± 2.2**	**67 ± 2.6**	**78 ± 7.3**	**81 ± 9.4**	**96 ± 5.2**	**85 ± 6.9**
IR42 (Susceptible check)	(–)	(–)	58 ± 3.6	NB	113 ± 12.6	NB	5 ± 1.6	0
FR13A (Tolerant check)	(+)	(+)	56 ± 4.5	59 ± 0.7	61 ± 5.4	63 ± 4.8	93 ± 3.3	78 ± 4.6
LSD*p<0.05			5	6	20	16	10	9

at the end of submergence and re-growth occurs fast during re-emergence. Identification of non-elongating, submergence tolerant cultivars with better agronomic traits is desired to develop new varieties. "Kalaketaki" is one such variety which can withstand up to 20-days of complete submergence and also has good regeneration capacity. This genotype would be of immense use as a valuable gene source in breeding new cultivars tolerant to complete submergence for longer duration. Table 2 presents the agro-botanical traits of Kalaketaki DS, days after submergence; NB, not obtained; Data are presented as mean ± standard deviation based on two years replication average data; Numbers of replication, 3; (+), designates presence; (-), designates absent.

Table 2. Minimal descriptors for characterisations and evaluation of rice germplasm "Kalaketaki" (IC05752273)

Characteristics	JRS-4 (Kalaketaki)
Early plant vigour	Good
Coleoptile	Green
Basal leaf sheath colour	Purple
Leaf blade colour	Green
Leaf Pubescence	Pubescent
Leaf length (cm	55.66
Leaf width (cm)	1.54
Days to 50 % flowering	130
Panicle exsertion	Well exserted
Stigma colour	White
Apiculus colour	Straw
Number of effective tillers	6.2
Plant height (cm)	160.6
Panicle height (cm)	26.1
Panicle type	Intermediate
Awning	Nil
Days to maturity	160
Seed coat colour (kernel colour)	Light Brown
Grain length-breadth ratio (mm)	1.89
100 grain weight (g)	1.72
Hull colour (husk colour)	Brown furrows on straw
Threshability	Intermediate
Aroma	Absent
Grain yield/plant (g)	21.55
Abiotic stress note	Submergence tolerant, Elongation ability and re-generation growth

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3. UAS-334 (IC0599612; INGR 14027), a Wheat (*Triticum aestivum*) Germplasm with Resistance to Foot Rot

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Foot rot of wheat caused by *Sclerotium rolfsii* Sacc. is a serious problem mainly in the rainfed ecosystem (Kulkarni, 1979; Naragund, 1981; Reddy *et al.,* 1971). This disease can cause yield loss in the range of 10-30%. Control of soil-borne pathogens is one of the greatest challenges facing agriculture. Soil fumigants can be effective but the cost is prohibitive except with high-value crops. Breeding for host plant resistance is the best strategy in addressing this constraint. In this context, the genotype UAS 334 (SITE/MO/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC) identified from the International Bread Wheat Screening Nursery-2003 (Line No. 227). This genotype exhibited complete resistance to foot rot with only 1-5 percent disease incidence. Further, it exhibited resistance to karnal bunt. Apart from resistance to diseases, this genotype also found to be potential for high grain yield which widens its scope for utilization in breeding programme.

Table.1. Performance of UAS 334 under coordinated multi-location evaluation for yield and foot rot disease resistance

Year	Mean yield (q/ha)			CD at 5%	Foot Rot	
					HS	AV
	UAS 334	GW-322	MACS-6222		UAS 334	
2011	44.8	40.3		5.0	0.9	-
2012	47.7*	44.9	43.20	1.4	3.3	0.7
2013	45.7*	42.3	41.6	1.6	2.7	0.4
Mean	**46.1**	**42.5**	**42.4**			

HS-Highest Score; Av–Average score; **Significant at 5 % level*

Morhpo-agronomic characteristics: The genotype UAS 334 was evaluated along with the check varieties GW 322 and MACS 6222 in Peninsular zone of India over three years from 2010-11 to 2012-13 (Table 1). Based on yield potential, it exhibited significant yield superiority over check varieties and showed about 8.4% yield advantage over GW 322 and 8.7% over MACS 6222. It exhibited distinct features in terms of profused tillering, erect growth habit and green foliage; spikes are tapering with medium in waxiness as well as in density with medium beak length.

Associated characters and cultivation practices: UAS 334 exhibited resistance to stem rust. It possesses stem rust resistant gene *Sr 31*. It has high protein content, hectoliter weight, sedimentation value and better grain appearance than the best check GW 322.

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4. RG-2822 (IC0346626; INGR 14028), a Castor (*Ricinus communis*) Germplasm Resistance to Root Rot (*Macrophomina phaseolina* tassi Goid)

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5. Tukdah-383 (T-383) (IC0610184; INGR 14029), a Tea (*Camellia sinensis*) Clone with Very High Darjeeling Flavour (147:100)

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It is a China Hybrid tea plant (*Camellia sinensis* var. T383) released in 1980 for large scale commercial plantation in Darjeeling hills. The leaf is semi erect, widely spreading frame, large hairy tip with high flavour (Flavour Index 147:100). Ovate shaped leaf, acuminate leaf apex and attenuate leaf base are unique characters of the germplasm (Barman, 2013). The plant is multiplied exclusively by vegetative propagation and genetically a good rooter. The clone is resistant to drought and blister blight disease but susceptible to red spider mite (Singh, 1989).The clone is suitable for planting in mid and low elevation of Darjeeling hills. The variety has been conserved at TTRI Clonal Proving Station, Ging Tea Estate, Darjeeling (altitude of 1200 m.s.l.).

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6. Phoobsering-312 (P-312) (IC0610185; INGR 14030), a Tea (*Camellia sinensis*) Clone with High Darjeeling flavour (141:100)

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P312 – a China Hybrid tea plant (*Camellia sinensis* var. P312) was released in 1970 for large scale commercial plantation in Darjeeling hills (Ann. Sci. Rep., 1970-71). It is a China hybrid progeny and long term agricultural trial was conducted before release at TTRI Clonal Proving Station (CPS) at Ging tea estate (altitude of 1200 m.s.l.) of Darjeeling hills. Leaves are semi erect, dark green having pronounced serration and matty foliage (Sarkar *et al*., 1975). Leaf shape is lanceolate with acuminate apex and attenuate leaf base. Single leaf cuttings are good rooter in the nursery. The tender shoots are slender, densely haired (pubescence) producing golden tippy tea. Volatile flavour compounds like linalool and linalool oxides which produce sweetish flavour of tea liquor were found higher in Darjeeling cultivar P312 (Bhuyan *et al*., 2012). The orthodox made tea has high flavour (Flavour Index 141:100). The clone is conserved at TTRI Clonal Proving Station, Ging T.E., Darjeeling.

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7. Tukdah-246 (T-246) (IC0610186; INGR 14031), a Tea (*Camellia sinensis*) Clone with Unique Darjeeling flavour (138:100)

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Cultivar Tukdah 246 (*Camellia sinensis* var. T246) is a China Hybrid tea clone developed through progeny selection and released in 1973 to the tea industry for large scale plantation in Darjeeling hills (Grice and Bezbarua, 1973). Leaves are large and semi erect spreading frame with thin branching habit. The tender shoots are large in size with thick pubescence (Sarkar *et al*., 1975) and orthodox tea of high flavour (Flavour index 138:100) can be manufactured. The clone is a good rooter yet susceptible to drought (Singh, 1989). The leaf shape is ovate with acuminate leaf apex and obtuse base (Barman, 2013). The clone is susceptible to blister blight disease and red spider mite. It is a suitable clone for planting in both mid and low elevation of Darjeeling hills. The clone is conserved at TTRI Clonal Proving Station, Ging T.E., Darjeeling for further multiplication as and when required.

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8. Ambari Vallai-2 (AV-2) (IC0610187; INGR 14032), a Tea (*Camellia sinensis*) Clone with High Flavour Index (134:100), High Pubescence, Spreading and Dense Frame

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Variety Ambari Vallai 2 (*Camellia sinensis* var. AV2), a China Hybrid was developed through progeny selection and released to the tea industry of Darjeeling in 1973 (Grice and Bezbaruah, 1973). Semi erect leaf, less spreading frame of erect growing habit, high pubescence in the unopened apical buds, good rooting ability are the characteristic features of the clone (Sarkar *et al*., 1975).The leaf shape is lanceolate having acuminate apex and attenuate base (Barman, 2013). The clone has high Darjeeling flavour (Flavour index 134:100) but susceptible to drought and fairly resistant to Red spider mite and blister blight disease. It is a high yielding variety (Sarkar *et al*., 1975) and suitable for planting in mid elevation of Darjeeling hills. The clone is conserved in TTRI Clonal Proving Station, Ging T.E., Darjeeling for multiplication and other use in breeding programme.

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9. Bannockburn-157 (B-157) (IC0610188; INGR 14033), a Tea (*Camellia sinensis*) Clone with High Darjeeling Flavour (131:100)

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Bannockburn 157 (*Camellia sinensis* var. B157), a China Hybrid clone was developed through progeny selection and released in 1970 for large scale commercial cultivation in tea industry of Darjeeling hills (Sarkar *et al*.,1975). The plant has semi erect dark green elliptical leaves with down turn acute apex and obtuse leaf base (Barman, 2013). The bush frame is narrow and compact. The unopened buds and tender leaves bear thick pubescence contributing to the quality of made tea of high flavour (Flavour Index 131:100). The clone is susceptible to frost, mites and blister blight disease but tolerant to drought (Sarkar *et al*., 1975). The clone grows well in high and mid elevations of Darjeeling. The clone is conserved in TTRI Clonal Proving Station at Ging T.E., Darjeeling, for distribution of cuttings to the member estates and further use in research and development works.

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10. Kopati 1/1(K1/1) (IC0610189; INGR 14034), a Tea (*Camellia sinensis*) Clone with High Darjeeling Flavour (129:100) and Early Flusher

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Early flusher clone Kopati 1/1 (*Camellia sinensis* var. K 1/1) was developed through progeny selection and released in 1985 for large scale commercial cultivation in tea industry of Darjeeling hills (Singh, 1985). It is an Assam Hybrid quality cultivar with high Darjeeling flavour (Flavour Index 129:100). Concentrations of quality determining components of Darjeeling orthodox black tea like trans-2-hexanal, linalool oxide II, linalool, methyl salicylate, geraniol and 2-phenyl ethanol were found higher in cultivar K1/1 (Bhuyan *et al*., 2012). The bush frame is compact and moderately spreading. The lanceolate dark green, matte leaf has the acuminate leaf apex and obtuse leaf base. The drought tolerant variety prefers the agro climatic conditions of mid and low elevations of Darjeeling hills (Barman, 2013).The clone is susceptible to mites and blister blight disease (Singh,1985). The plants are conserved in TTRI Clonal Proving Station at Ging T.E., Darjeeling, for distribution of cuttings to the member estates and further use in research and development works.

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Singh ID (1985) Clones for Darjeeling. *Two Bud* **32**:53

11. Bannockburn-688 (B-688) (IC0610190; INGR 14035), a Tea (*Camellia sinensis*) good flavour Darjeeling clone (128:100) with high Geranial content (20.74)

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Cultivar Bannockburn 688 (*Camellia sinensis* var. B 688) was developed through progeny selection and released in 1975 for large scale commercial cultivation in tea industry of Darjeeling hills (Sharma *et al*., 1975). It is a drought tolerant Assam Hybrid variety having lanceolate leaf with down turn acuminate leaf apex and attenuate leaf base (Barman, 2013). The semi-erect leaf has deep leaf bulation which is a unique character of the clone. It has good rooting ability and grows well in mid and low elevations of Darjeeling hills. The clone is susceptible to both mites and blister blight disease (Singh, 1989). Geraniol, linalool, methyl salicylate, 2-phenyl ethanol, trans-2-hexanol, linalool oxide II are the determining component for quality of Darjeeling orthodox black tea which were considerably higher in B 688 (Bhuyan *et al*., 2012). The clone is well protected in TTRI Clonal Proving Station, Ging T.E., Darjeeling for future research on tea improvement programme in Darjeeling hills.

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12. Tukdah-78 (T-78) (IC0610191; INGR 14036), a Tea (*Camellia sinensis*) Clone with High Darjeeling Flavour (121:100). Suitable for Mid & Low Elevation of Darjeeling

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Tukdah 78 (*Camellia sinensis* var. T78)-a China Hybrid tea variety was developed through progeny selection and released in 1978 for large scale commercial cultivation in tea industry of Darjeeling hills (Bezbaruah and Awasthi, 1979). It is a drought tolerant China Hybrid clone which bears Lanceolate leaf with acuminate leaf apex and attenuate leaf base. The clone is very vigorous in growth with erect leaf of dark green colour, easy rooting ability, thick but almost smooth leaf lamina (Singh, 1989). The yield potential is 54 % higher than the Darjeeling seed stock Nandadevi TS378 (Bezbaruah and Awasthi, 1979) and flavour index is 121:100. It is fairly tolerant to blister blight disease and Red spider mite but resistant to pink mite (Singh, 1989).It grows well particularly in

the mid and low elevations of Darjeeling hills (Barman, 2013). The cultivar is conserved in TTRI Clonal Proving Station at Ging T.E., Darjeeling for distribution of cuttings among planters of Darjeeling who are keen to propagate for planting and future breeding program for cultivar development.

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13. Teesta Valley-1 (TTV-1) (IC0610192; INGR 14037), a Tea (*Camellia sinensis*) Clone with Good Darjeeling Flavour (117:100)

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Teesta Valley 1 (*Camellia sinensis* var. TTV1)-a China Hybrid tea variety was developed through progeny selection and released in 1987 for large scale commercial cultivation in tea industry of Darjeeling (Singh, 1987). It is a clone of erect growth habit of moderately spreading frame having semi erect, yellowish green, medium size leaf. The clone bears Lanceolate leaf with acuminate leaf apex and obtuse leaf base and suitable for planting in mid and low elevations of Darjeeling hills (Barman, 2013). It has a moderately spreading frame with semi erect medium size leaves (Singh, 1989). The drought tolerant clone having good Darjeeling flavour (Flavour Index 117:100) with good rooting ability grows well in mid and low elevations of Darjeeling hills. The clone is susceptible to red spider mite and Blister blight disease. The clone has been conserved in TTRI Clonal Proving Station at Ging T.E., Darjeeling for distribution and multiplication as and when required.

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14. Tukdah-145 (T-145) (IC0610193; INGR 14038), a Tea (*Camellia sinensis*) Clone with Above Average (110:100) Darjeeling flavour

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Tukdah 145 (*Camellia sinensis* var. T145)-an Assam Hybrid tea variety was developed through progeny selection and released in 1970 for large scale commercial cultivation in tea industry of Darjeeling (Ann. Sci. Rep., 1970-71). Spreading frame, flat leaf, thin plucking point in the plucking surface of the bush, low pubescence, average yield, good rooting ability are some of the morphological features of the cultivar (Sarkar *et al*., 1975). Quality of the clone is above average and Flavour Index is 110:100. Higher concentrations of flavour compounds like hexanal and t-2-hexanal were reported in T145 (Bhuyan *et al*., 2012). Leaf shape is Lanceolate with acuminate leaf apex

and attenuate leaf base.The clone is tolerant to drought (Barman, 2013) but susceptible to red spider, scarlet mite and blister blight disease (Singh, 1989). The clone is extensively cultivated in both mid and low elevations of Darjeeling hills. The plants of the variety have been conserved at TTRI Clonal Proving Station, Darjeeling for multiplication through vegetative propagation and for future breeding program in tea research and development in Darjeeling.

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15. A-9/69 of IISR (IC0537218; INGR 14039), a Nutmeg (*Myristica fragrans*) Germplasm with Bold Nut a, High Sabinene and Myrecene Content

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Nutmeg (*Myristica fragrans* Houtt.) is an important tree spice, yielding two spices, namely, the nutmeg (dried seed) and the mace (dried aril surrounding the seed). It is an evergreen, conical tree reaching a height of 10 metres, belonging to the family Myristicaceae. Dried nutmeg and mace are used as spice and also for extracting oil and oleoresins. Nutmeg has a tremendous potential in the spice industry for flavouring food and beverages and in the manufacture of value added products. It has immense medicinal properties and is used by the pharmaceutical industry. It is also used by the perfume industry to a limited extent. Myristicin, elemicin, sabinene and safrole constitute 80% of both these oils. Myristicin, elemicin and safrole are hallucinogenic compounds in nutmeg and mace oils and sabinene imparts sweetness to the produce. A large extent of variability exists in the composition and proportion of the major components in both nutmeg and mace oil. Based on the proportion/quantity of these compounds they can be utilized in various industries. The major applications of nutmeg and mace oils are in the pharmaceutical, food and perfume industry.

The main mandate of Indian Institute of Spices Research (IISR), Calicut, is collection, conservation, cataloguing and evaluation of germplasm in spices. The institute has conserved 484 accessions of nutmeg germplasm in the field repository. Nutmeg accession IC0537218 (INGR14039) was registered with NBPGR, New Delhi, as an unique germplasm. This germplasm is a selection from open pollinated seedling progeny raised from seeds collected from an elite mother tree from Burliar, Nilgiris and Tamil Nadu and conserved and evaluated at IISR, Kozhikode. This nutmeg fruit has very thick, entire, dark red coloured mace and very bold nut. Besides, it also has an added advantage of high sabinene and myrcene in the mace and nut oils. The fresh weight of IC0537218 mace ranges from 4.5 to 6.0 g and seed weight from 13to16 g in. The mace and nut of IC0537218 is rich in sabinene and myrcene (35.4% in nut oil and 29.4 % in mace oil). The morphological and quality parameters of this accession are given in Table 1.

Table1. Characterization and evaluation of IC0537218 accession of nutmeg

Plant characters	
Plant height of graft	4.5 to 5.0 m at 10 years
Stem girth at 60 cm	25.00 cm
Leaf size	Medium
Leaf shape	Elliptic
Flowering	Profuse
Male flowers (%)	0
Female flowers (%)	100
Age at first flowering of graft	4 years after planting
Arrangement of flowers	Single, rarely seen in clusters of 2
Colour of ripe fruit	Yellow
Colour of aril	Dark red
Colour of seed	Brownish black
Shape of fruit	Elongate/oblong
Size of nut	Bold
Mace	Entire, thick, dark red
Yield characters	
Fresh weight of fruit	75-100 g
Fresh weight of nut	13-16 g
Dry recovery of nut	70%
Fresh weight of aril	4.5 to 6.0
Dry recovery of aril (mace)	35%
Mean yield/graft at 10 year after planting	2000 fruits
Essential oil in nut	5.9
Dry nut yield/graft at 10 th year after planting	21 kg
Mace yield/graft at 10 th year after planting	4.2 kg
Essential oil in nut (%)	5.9
Essential oil in mace (%)	7.5
Oleoresin in nut (%)	9.1
Myristicin in nut oil (%)	1.6
Myristicin in mace oil (%)	9.4
Elemicin in nut oil (%)	1.4
Elemicin in mace oil (%)	0.07
Total fat content (%)	24.9
α- Pinene in nut oil (%)	7.1
A-Pinene in mace oil (%)	4.7
Sabinene+ Myrcene in nut oil (%)	35.4
Sabinene+ Myrcene in mace oil (%)	29.4

16. PSRKK-11287 (IC0436231; INGR 14040), a Chilli (*Capsicum annuum*) Germplasm with Purple Phenotype as a Morphological Marker

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Chilli (*Capsicum annuum* L.) with long history of cultivation, natural selection pressure and adaptability to different environments led to the origin of a great diversity of forms. Many landraces of chilli have been recorded in India, varying in shape, colour, size and pungency. As such there is a large scope for selection and breeding from *Capsicum* genetic resources for developing varieties suitable to different climates in India (Pandravada *et al*., 2007). Systematic characterization and evaluation of germplasm collections facilitate estimation of genetic diversity, identification of promising accessions and elite material for utilization in crop improvement programmes (Chapman, 1989). A number of landraces/ primitive cultivars were utilized either directly as a pure line selection for release as a variety and/ or as parental material in chilli improvement after proper characterization and evaluation (Gupta and Rai, 1994).

While characterizing and evaluating chilli germplasm at NBPGR Regional Station, Rajendranagar, Hyderabad, an interesting accession IC0436231 which was completely purple was observed. This accession has purple pigmentation in whole/ stripes on stem, node, leaf, pedicel, corolla, style, calyx and fruit and is also characterized by its erect flowers and fruits as well (Anonymous, 2006a, 2006b and 2010). This particular accession PSRKK-11287 (IC0436231) was collected from Mopidevi Village and Mandal, Krishna District, Andhra Pradesh and appeared to be a naturally occurring landrace with purple pigmentation (Pandravada, 2004). This genotype was characterized/ evaluated for a total of 54 qualitative and quantitative descriptors/states developed by IPGRI and NBPGR (IPGRI, AVRDC and CATIE, 1995 and Srivastava *et al*., 2001).

The purple chilli landrace (IC0436231) identified will be very promising as a distinct morphological marker. The purple pigmentation which acts as a gene marker is a dominantly inherited trait in the segregating progeny (Ahmad Nazeer *et al*., 1992). Hence, this accession assumes importance in the wake of plant variety protection as a parental material for crossing, wherein uniqueness and distinctiveness has to be brought in to the phenotypic/ morphological traits of varieties for differentiation between varieties already released and proposed for release. This accession can also be used as an inbred line for developing new varieties with the purple morphological marker as a trait for distinctiveness, uniformity and stability. There are a total of 13 accessions of chilli Registered under ICAR/ NBPGR (*www.nbpgr.ernet.in/ inventory of Registered Crop Germplasm/ reports*) and 96 chilli/ *Capsicum* Varieties/ Hybrids released in India (*www.nbpgr.ernet.in/ norv/ reports*) and none of them have this trait of purple pigmentation in the phenotype.

Morpho-agronomic characteristics: The brief morpho-agronomic description of the chilli accession IC0436231 is as follows: stem cylindrical, sparsely pubescent, length 20.7 cm and diameter 1.0 cm; plants erect, height 59.8 cm and canopy width 42.2 cm; branches 5.2; leaf ovate-lanceolate, sparsely pubescent, margin undulate, length 6.7 cm and width 2.9 cm; calyx margin dentate, annular constriction absent and sepals 5; corolla rotate and petals 5; anther blue; stigma exserted; fruit set low, erect, singular, small conical thick/stout and dark red on maturity; fruit length 2.9 cm, width 1.5 cm, pedicel length 1.9 cm and fruit weight 1.8 g; fruit shape at pedicel attachment obtuse and blunt at blossom end with smooth fruit surface; neck at fruit base and fruit blossom end appendage absent; pedicel persistent with fruit and stem; days to flowering 89 and maturity 146; fruits 31.7 and yield 55.8 g/plant.

The other traits of potential value include, purple stem; dark purple node; purple leaf; erect and solitary flower; purple pedicel; pigmented calyx; white with purple margin corolla and purple spot colour; purple style; purple fruit with anthocyanin spots when immature. The reaction of the genotype to different biotic/abiotic stresses is moderate to tolerant.

This accession can be grown in all chilli cultivating areas by adapting the local recommended package of practices. The purple genotype IC0436231, identified through characterization and evaluation enables as a

parent the incorporation of genes for several phenotypic traits which are purple and highly heritable as morphological markers (stem colour; nodal anthocyanin; leaf colour; flower/ fruit position; pedicel pigmentation; corolla colour; style colour; fruit colour at intermediate stage etc.) to bring in distinctness in the phenotype by genetic enhancement.

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17. SBT-12549 (IC0570408; INGR 14041), a Chilli (*Capsicum annuum*) Germplasm immune to Anthracnose caused by *Colletotrichum capsici*

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Chilli (*Capsicum annuum* L.) is a tropical and sub-tropical vegetable-cum-spice crop and India contributes towards major share of the world's production. Anthracnose caused by *Colletotrichum capsici* is one of the most devastating diseases in chilli growing ecosystems. The disease can cause losses up to 50% in the form of pre and post-emergence damping-off, premature fruit drop, mummification of unripe green fruits and fruit rot (Pakdeevaraporn *et al*., 2005). As the crop has lot of export potential, effective disease management following eco-friendly approach by growing resistant cultivars is a good alternate strategy. Although research workers identified certain resistant sources earlier, commercial cultivars of *C. annuum* resistant to anthracnose are yet to be developed. Therefore, the present investigation was carried out to identify diversified sources of resistance for utilization in resistance breeding programmes.

Chilli germplasm consisting of *C. annuum* (22) and *C. frutescens* (3) was screened in the greenhouse of NBPGR Regional Station, Hyderabad, for sources of resistance against anthracnose disease with "Pusa Jwala" as the susceptible check. The accessions were grown up to one month in the greenhouse and spray inoculated with a high spore load (5 x 10^6 conidia/ml) in an isolated chamber. At the time of spraying, it was ensured that ten seedlings were present in each pot and three such replications were screened. The seedlings in control pots were sprayed with sterile water only. Optimum conditions required for disease development were maintained.

Observations were recorded at weekly intervals on symptom development and seedling mortality and each seedling was given a score based on 0-4 scale (Bansal and Grover, 1969). Disease symptoms were observed 7 days after inoculation and observations were recorded up to 30 days. The per cent disease index (PDI) was calculated per replication and the mean of three replications was taken as the final score. Grouping of accessions based on PDI was as given in Table 1. The PDI among the accessions ranged from 0.0 (IC570408/ SBT-12549) to

Table 1. Reaction of chilli accessions based on artificial screening with *C. capsici* inoculum in green house conditions

Scale	Per cent disease index (PDI)	Accessions*	Reaction
0	0	IC570408	Immune
1	1- 5	–	Resistant
2	6 - 25	CA-960, SNTV-87	Moderately resistant
3	26 - 50	IC572480, PBC-474, Pusa Jwala, EC391082, EC628901	Susceptible
4	> 50	EC390030, EC391083, EC399574, EC596920, EC596940, EC599969, EC599992, IC255896, IC436231, IC570369, IC572469, IC572472, IC572475, IC570484, IC572490, IC572498, SNTV-88	Highly susceptible

100 (EC399574, EC599969, SB-12693 and SR-6428) at the end of four weeks after inoculation. It was observed that in all the accessions disease progressed gradually with time except in IC570408, which was completely free from disease throughout the screening period inspite of the heavy inoculum load used. The highly susceptible accessions (EC391083, EC599969, SB-12693 and SR-6428) with PDI of 100 were completely defoliated and dried within one month after inoculation.

The present investigation resulted in identifying an accession SBT-12549 (IC570408) as a promising diversified donor for incorporating resistance against anthracnose in to the backgrounds of existing promising varieties/elite material of chilli (Narendra Varma *et al*., 2012), which are lacking.

Morpho-agronomic characteristics of chilli (*Capsicum annuum* L.) accession (INGR-14041) IC570408 (SBT-12549)

The distinguishing morpho-agronomic characters of the chilli accession IC570408 are as follows: Stem colour (Green with purple stripes); Stem shape (Cylindrical); Stem pubescence (Sparse); Nodal anthocyanin (Dark Purple); Plant growth habit (Erect); Plant height (59.7 cm); Plant canopy width (44.3 cm); Branches (4); Leaf colour (Dark green); Leaf shape (Ovate-lanceolate); Leaf pubescence (Sparse); Leaf density (Dense); Flowers/axil (1); Flower position (Pendent); Pedicel pigmentation (Green); Corolla colour (White); Corolla spot colour (White); Petals (5); Anther colour (Pale blue); Filament colour (White); Style colour (White); Stigma exsertion (Exserted); Calyx pigmentation (Absent); Anthocyanin spots/stripes on fruits (Absent); Fruit colour at intermediate stage (Green); Fruit set (High); Fruit position (Pendent); Fruits/axil (1); Fruit colour at mature stage (Red); Fruit shape (Medium long slender); Fruit length (9.3 cm); Fruit width (1.6 cm); Fruit pedicel length (3.5 cm); 10 Dry fruit weight (17.2 g); Fruit shape at pedicel attachment (Obtuse); Fruit shape at blossom end (Pointed); Fruit surface (Wrinkled); Days to flowering (77); Days to maturity (134); Fruits/plant (63.3); Fruit yield/plant (108.9 g); Reaction to Anthracnose (immune).

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18. CNA-5 (IC0597395; INGR 14005), a Cotton (*Gossypium arboreum*) Germplasm inter-racial pigmented arboreum

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CNA-5 (Pigmented arboreum) is an inter-racial cross developed through introgression breeding. It has been derived from progenies of the cross between *G. arboreum* race indicum and *G. arboreum* race burmanicum through single plant selection.

By virtue of being derivative of races of cultivated species of *Gossypium viz. G. arboreum*, it is highly stable and tolerant to jassids and bollworms which do not require chemical insecticidal sprays thereby apt for organic cultivation of cotton. The unique feature of this genotype is that it possesses pigmented plant body which forms a morphological marker for its identification and easily differentiation from other genotypes even at seedling stage. At flowering it could be very well identified with its red colour flower (Table 1).

Table 1. Characteristic features of *G.arboreum* (IC0597395; CNA -5):

Trait	Feature
Plant height (cm)	115
Seed cotton yield (kg/ha)	1950
Lint colour	white
Boll weight (g)	2.89
Fibre length (2.5% SL length mm)	26.7
Fibre strength (g/tex)	18.1
Uniformity ratio	54
Micronaire value (Fineness)	4.8
GOT (%)	38
Tolerant to jassids, bollworm, bacterial blight and grey mildew	

The unique feature of this genotype is that it possesses pigmented plant body which forms a morphological marker for its identification. Pigmented plant body can easily differentiate it from other genotypes even at seedling stage. At flowering it could be very well identified with its red colour flower.