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Genetic variability and improvement of long awned rice genotypes for areas vulnerable to elephant depredation

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ABSTRACT

Genetic variability of traditional long awned rice genotypes were studied for improving their yield attributes with a view to alleviate the problems faced by the rice farmers in areas vulnerable to elephant depredation. Some of the long awned rice cultivars studied are AC-8105, AC-12152, ARC-12759, ARC-11410, ARC-3162, ARC-12806, AC-6019, AC-3159, BJ-1, AC-2605, AC-20389, AC-1054, ARC-14632, AC-8611 and ARC-11511.

Ten breeding linels viz. Vandana x ARC 12806, Vandana x AC 12152, Pooja x AC 1054,Pusa Basmati x ARC 14632, Shatabdi x ARC 11511, Shatabdi x ARC 12806, Swarna x ARC 12759, Swarna x ARC 11511, Lalat x AC 12152 and Lalat x Tilak Chandan were identified with long awn and potential yield which can be adopted by the farmers in areas vulnerable to depredation by elephants.

Key words: *long awned rice, elephant depredation, storage structure*

Forests have been destroyed and the vegetation has become thin in many parts of the country during the recent past. It is also a matter of great concern that due to developmental pressure, elephant habitats are severely being threatened. The wild animals, more specifically the elephants do not get sufficient food and adequate shelter for their livelihood. So they come out of the dense forests and trample the rice fields of adjoining villages. The elephants also demolish the traditional storage structures. This causes a hostile attitude in the farmers to kill the elephants. The conservation of wild animals as well as biodiversity is of great importance to maintain equilibrium and harmony. In this context, it is necessary to help the farmers of such areas to protect their paddy crop by providing various inputs, which in turn can help conserve the wild elephants as well.

There has been a belief among the farmers that elephants do not relish the traditional, primitive, long awned rice cultivars as they sting their tongues and give them severe pain and irritation. Hence, growing long awned paddy varieties in these areas may be one of the important inputs to protect the crop from elephants, wild boars, pigs and other herbivorous animals. Therefore, studies were undertaken to select the long awned rice varieties after screening the rice germplasm to develop high yielding varieties with long awns for different rice ecosystems on the basis of on-farm trials through participatory varietal selection in Assam and Orissa and to test the RCC storage bins developed at Central Rice Research Institute (CRRI), Cuttack in areas vulnerable to elephant depredation. The RCC ring bin is a mini silo suitable for storage of grains at farmer's level.About 500 to 600 kg of paddy can be stored in such paddy storage structures (Mishra *et al.*, 2003). It is made of pre-fabricated concrete rings available commercially for making water tanks. The same rings were used for construction of storage bins in the villages for on-farm trials (Mishra, 2003).

The long awned rice cultivars viz. AC-8105 (Adukkurasi), AC-12152 (Rechi), ARC-12759 (Jakmeremba), ARC-11410 (LPV-3), ARC-3162 (T-2156), ARC-12806 (Kumnup), AC-6019 (Saranchakua), AC-3159, BJ-1, AC-2605, AC-20389 (Kusumal), AC-1054 (Mohubanki), ARC-14632 (Bardhan), AC-8611 and ARC-11511 (Yamuk) were selected from the germplasm stock of CRRI, for growing in the elephant depredation areas during wet season.Rainfed upland and lowland are the two vulnerable ecosystems where elephant attack is more. In order to increase the yield potential of the long awned rice cultivars, they were hybridized with the existing

high yielding varieties. Crosses were attempted involving the recipient parents having high yield potential with ideal plant type to suit the ecosystems. Varieties like Vandana and Kalinga III were identified as recipient parent with maturity duration within 100 days for upland, whereas for medium land the varieties identified were IR 64, Lalat, Shatabdi and Jaya with duration within 130 days. Similarly for lowland the promising varieties like Pooja, Gayatri, Swarna and Savitri were selected with maturity duration of more than 140 days.

The present investigation on characterization, relative performance and evaluation of genetic variability among the long-awned rice genotypes were carried out in the experimental plots of CRRI, Cuttack during wet season 2005. The test genotypes were transplanted in a randomized block design with 3 replications. Each entry was transplanted with a spacing of 20 cm x 15 cm. Farm yard manure @ 10 t ha^{-1} was uniformly applied in the field and fertilizers were given with a dose of 80:40:40 kg of N: P_2O_5: K_2O ha^{-1} in the form of urea, single super phosphate and muriate of potash, respectively. Other crop husbandry practices were followed as per the recommended package. Observations were recorded on qualitative characters like early plant vigour, basal leaf sheath colour, leaf blade colour, leaf pubescence, panicle exsertion, secondary branching, stigma colour, apiculus colour, panicle type, grain shape, size and threshability. Observations were also taken on the 13 quantitative characters like days to 50% flowering, days to maturity, leaf length, leaf width, number of effective tillers, plant height, panicle length, grain length, grain breadth, length and breadth ratio, hundred-grain weight, awn length for biometrical studies. Five randomly selected plants of each treatment were tagged for collection of data on various biometrical parameters.

Pre and post harvest application of leaf extract of the plants like Begunia (*Vitex negundo*), Neem (*Azadirachta indica*), Castor (*Ricinus communis*), Parasi (*Cleistanthus collinus*) and *Lippia geminata* were applied to distract the elephants from feeding the grains. Twenty R.C.C. ring bins of CRRI design were constructed in farmers' houses of four villages namely Bhola and Kujimahal of Khurda district in Orissa and Rangagora and Hatiimora villages in the district of Sonitpur in Assam. The stored paddy grains in these bins were tested for variation in moisture content, germination and insect pest infestation at one month interval.

As regards awn characteristics, 6 genotypes namely AC 2605, BR 23, ARC 11511, AC 12152, Tilak Chandan and ARC 12806 possessed long and full awns while the rest had long partial awns (Table 1). Except ARC 14632, all others had straw-coloured awn; the former possessed purple coloured awns. The variability in grain shape and size was very much conspicuous. It

Table 1. Mean and range values for major characteristics of long awned rice genotypes

Characteristics	Range		Mean
Leaf length (cm)	1.02 - (ARC 12806)	2.07 (AC 3159)	65.38
Leaf width (cm)	35. 20 - (Tilak Chandan)	86.30 (AC 8611)	1.53
Plant height (cm)	95.17 - (Tilak Chandan)	206.48 (AC 1054)	158.50
No. of Effective Tillers	8.09 - (AC 1054)	14.80 (ARC 14632)	11.40
Days to 50% flowering	89.50 - (ARC 12759)	110.50 (AC 1054)	98.00
Days to maturity	120.50 - (ARC 11511)	149.50 (AC 1054)	132.60
Panicle length (cm)	22.26 - (Tilak Chandan)	35.49 (ARC 11511)	28.98
Grain length (mm)	7.40 - (AC 20389)	9.20 (AC 8105)	8.30
Grain breadth (mm)	2.20 - (AC 26850)	3.50 (AC 1054)	3.10
Length breadth ratio	2.12 - (AC 20389)	3.65 (AC 26850)	2.68
Awn length (cm)	3.52 - (AC 26859)	6.96 (AC 2605)	5.17
100-grain weight (gm)	1.70 - (Tilak Chandan)	3.32 (AC 26679)	2.59
Grain yield $hill^{-1}$	17.50 - (Tilak Chandan)	42.50 (AC 1054)	25.71

Table 2. Promising breeding lines of rice identified from F_5 generation for elephant depredation areas

Name of cross	Awn length (cm)
Vandana x ARC 12806	10.8
Vandana x AC 12152	10.1
Pooja x AC 1054	9.6
Pusa Basmati x ARC 14632	8.8
Shatabdi x ARC 11511	8.6
Shatabdi x ARC 12806	8.3
Swarna x ARC 12759	8.1
Swarna x ARC 11511	8.0
Lalat x AC 12152	8.9
Lalat x Tilak Chandan	9.1

was short and slender in Tilak Chandan; short bold in BR-23 and AC 20389; medium bold in AC 1054 and ARC 14632, whereas medium slender in rest of the genotypes. Threshability of the genotypes tested was low.

Ninety cross combinations were attempted for hybridization. The F_1 seeds were long fully awned having good plant vigour. Generation advancement of breeding material up to 5th generation was carried out in the experimental farm of CRRI. Single plant selections were made with desirable plant type for different ecosystem with long awns. Ten promising breeding lines could be identified with long awn and potential yield which can be adopted by farmers of elephant depredation areas (Table 2).

The seed moisture content range of the stored paddy in the RCC ring bin varied from 12-14%, seed germination 80-96% and the storage insect pest infestation varied from 0-2%.

The F_5 seeds were not fully homozygous. The farmers accepted these long-awned rice varieties from elephant attack point of view. But, as per the yield and other parameters like quality and threshability they faced difficulties. However, improved threshers are available to thresh such long-awned rice varieties.

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