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Research Article

Evaluation of germplasms of *Colocasia esculenta* (L.) Schott and *Xanthosoma sagittifolium* (L.) Schott against leaf blight (*Phytophthora colocasiae* Raciborski.) in Central Western Ghats of Uttara Kannada of Karnataka in India

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Abstract

Colocasia (*Colocasia esculenta* (L.) Schott) and *Xanthosoma sagittifolium* (L.) Schott the arrow leaf elephant ear are common tuber vegetable crops of malnad region in monsoon. They are grown outside year-round in subtropical and tropical areas. They can be grown in almost any temperature zone as long as the summer is warm. Growth of the crop is best at temperature between 20-30°C. This crop is an important source of carbohydrates, vitamins and minerals and its nutritional value is comparable to potato. In Uttara Kannada, Dakshina Kannada, Shimoga and Udupi districts of Karnataka in India, the leaves and tubers of the plants are commonly used for preparation of variety of items *viz*., patrode, soup, chembila curry, Ishtu and Moru curry etc. The crops suffers from severe incidence (16 - 80%) of leaf blight (*Phytophthora colocasiae* Raciborski.) during the monsoon which results in blighting and rotting of leaves, reduction in vigour of the plant with less number or no production of tubers. Eleven germplasms of *C. esculenta* and *X. sagittifolium* were evaluated for their response to leaf blight for two years *viz.*, 2008-09 and 2009-10 along with plant characters. The scale of 0 to 5 wherein 0 grade– No disease, 1 grade -1-10 % disease,, 2 grade -11-25% disease, 3 grade -26-50% disease, 4 grade - 51-75 %, 5 grade >75% % disease was used for disease scoring. The results showed that viz**.,** *Xanthosoma sagittifolium* Acc 1, *Xanthosoma sagittifolium* Acc 2, *Xanthosoma sagittifolium* Acc 6 showed no leaf blight incidence (0 grade). The leaves were free from spots and blight with luxuriant waxy luster green leaves. The disease was less in AAU *Colocasia esculenta* Acc 35 (1 grade) and *Xanthosoma sagittifolium* Acc 7 (1 grade) which is locally known as Sirsi Halgesa and were tolerant to the disease. It was followed by AAU *Colocasia esculenta* Acc 5 and AAU *Colocasia esculenta* Acc 38 (2 grade). Whereas AAU *Colocasia esculenta* Acc 46 (3 grade). Leaf blight incidence was more in AAU *Colocasia esculenta* Acc 32 (3.5 grade). Maximum leaf blight was noticed in *Colocasia esculenta* Acc 4 (4 grade) , *Colocasia esculenta* Acc 3, (4.5 grade). *Colocasia esculenta* Acc 3 is locally known by Makkalakesa and it is a good germ plasm for screening of other germplasms for the disease reaction.

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Keywords: Colocasia leaf blight, *Colocasia esculenta* and *Xanthosoma sagittifolium, Phytophthora colocasiae*

Introduction

Colocasia (*Colocasia esculenta* (L.) Schott) and *Xanthosoma sagittifolium* (L.) Schott the arrow leaf elephant ear are important tropical and subtropical tuber crop grown in several countries in the world. The corms and cormels are consumed as staple or subsistence food in developing countries. They are members of the

Araceae family and are believed to be one of the earliest cultivated tuber crops in the world. Colocasia is now the fifth most-consumed tuber vegetable worldwide.

Colocasia (*Colocasia esculenta* (L.) Schott) and *Xanthosoma sagittifolium* (L.) Schott the arrow leaf elephant ear are common tuber vegetable crops of malnad region in monsoon. They are grown outside year-round in subtropical and tropical areas. They can be grown in almost any temperature zone as long as the summer is warm. Growth of the crop is best at temperatures between 20-30°C. This crop is an important source of carbohydrates, vitamins and minerals and its nutritional value is comparable to potato. In Uttar Kannada, Dakshina Kannada, Shimoga and Udupi districts of Karnataka in India, the leaves and tubers of the plants are commonly used for preparation of variety of items *viz*., patrode, soup, chembila curry, Ishtu and Moru curry etc.

Phytophthora colocasiae Raciborski a oomycetous pathogen cause the most destructive fungal disease and is responsible for causing leaf blight and lead to heavy yield losses (25 to 50%) of taro in India (Joshi, 2003). It was first reported from Java in 1900 and this disease alone brought a 30-50% decline to colocasia cultivation and production in Solomon Islands, Paupa, New Guinea, Philippines, Indonesia, China, Malaysia, Japan, India and countries of Africa and Caribbean. In India, this disease is more prominent in Northern and Eastern parts, which are potential areas for colocaisa production. The pathogen not only causes loss in field but also continues to cause a serious post- harvest decay of taro corms (Misra, 1997).

Pathogen penetrates as mycelium present in seed corms and crop residues act as primary source of inoculum and the secondary spread in the fields takes place mainly through elongated, lemon or pear shaped sporangia carried to the healthy plants by wind or rain splashes. The pathogen become active and infection starts with the onset of monsoon and continues its activity till the end of monsoon. The disease initiates as small, water soaked spots that increase in area and eventually spread to healthy plants during pathogenesis.

With the advancement of the disease, lesions enlarge and become irregular in shape and dark brown in colour with yellow margin. The infected leaves die within 20 days and yield losses of 30-50% are common during favorable conditions The whole leaf area is destroyed by blighting and rotting within few days. Under cloudy weather conditions with intermittent rains and temperature around 28 ºC, the disease spreads at tremendous speed and the entire field gives a blighted and rotted appearance of leaves and stunted growth of the plant (Gadre and Joshi, 2003). Waxy layer on the cuticle plays an important role in overcoming the retention of moisture and also act as barrier for entry of germinated zoospores. Management of the disease through fungicides does not give satisfactory control due to susceptible cultivars, prolonged congenial weather conditions and fast multiplication of pathogen in huge quantity and easily spread of the pathogen. Hence, genetic resistance is the need of the hour to manage the disease. Hence, an attempt was made to screen colocasia (*Colocasia esculenta* (L.) Schott) and *Xanthosoma sagittifolium* (L.) Schott germplasms against the disease under high disease pressure in field conditions.

Materials and Methods

An field experiment was conducted at Horticulture Research Station (University of Horticultural Sciences, Bagalkot), Sirsi in Uttara Kannada District of Karnataka during 2008-09 and 2009-10 successively for two years. The region is situated at 516 MSL. The soil was lateritic with 5.5 to 6.5 pH. range. The average rain fall of the region is 2500 mm with 108 rainy days and major monsoon was observed during the months of June, July, August and September which coincides with growth stage of the crop where as maturity of the crop coincides with post monsoon. The relative humidity during the rainy days was ranged from 82 to 100 per cent with temperature around 20^0C to 22^0C. The climatic conditions were highly conducive for infection, development and spread of the *Phytophthora colocasiae.* There were eleven germplasms under screening for leaf blight under field condition. The crop was sown during June in replicated beds of 3X1 m size. The crop was cultivated under natural condition with boarder rows of highly susceptible germplasms. Colocasia accession 3 which is locally named as Makkalakesa. A scale from 0 to 5 was used for assessing the disease for estimation of leaf blight where in, 0 grade– No disease, 1 grade -1-10 % disease, 2 grade -11-25% disease, 3 grade -26-50% disease, 4 grade - 51-75 %, 5 grade >75% % disease. Standard statistical procedure was followed for analysis of data.

Results and Discussion

The results showed that during 2008-09 in the Table 1 for the disease reaction of germplasms, *Xanthosoma sagittifolium* Acc 1, *Xanthosoma sagittifolium* Acc 2,

Xanthosoma sagittifolium Acc 6 showed no leaf blight incidence (0 grade) wherein plants exhibited leaves which were free from spots and blight with luxuriant waxy luster green leaves. The disease was less in AAU *Colocasia esculenta* Acc 35 (1 grade) and *Xanthosoma sagittifolium* Acc 7 (1 grade) which is locally known as Sirsi Halgesa and were tolerant to the disease. It was followed by AAU *Colocasia esculenta* Acc 5 and AAU *Colocasia esculenta* Acc 38 (2 grade). Whereas AAU *Colocasia esculenta* Acc 46 (3 grade). Leaf blight incidence was more in AAU *Colocasia* Acc 32 (3 grade). Maximum leaf blight was noticed in *Colocasia esculenta* Acc 4 (4 grade) , *Colocasia esculenta* Acc 3, (4 grade). *Colocasia esculenta* Acc 3 is locally known by Makkalakesa and it is a good germ plasm for screening of other germplasms for the disease reaction (Table 1).

During second year 2009-10 disease reaction of germplasms indicated that germplasms viz**.,** *Xanthosoma sagittifolium* Acc 1, *Xanthosoma sagittifolium* Acc 2, *Xanthosoma sagittifolium* Acc 6 showed no leaf blight incidence (0 grade). The plants were healthy with luxuriant waxy luster green leaves which were free from spots and blight. The disease was less in AAU *Colocasia esculenta* Acc 35 (1 grade) and *Xanthosoma sagittifolium* Acc 7 (1 grade) which is locally known as Sirsi Halgesa and exhibited tolerant reactions to the disease. It was followed by AAU *Colocasia esculenta* Acc 5 and AAU *Colocasia esculenta* Acc 38 (2 grade). Whereas AAU *Colocasia esculenta* Acc 46 (3 grade). Maximum leaf blight was noticed in *Colocasia esculenta* Acc 4 (4 grade) AAU *Colocasia* Acc 32 (4 grade)., *Colocasia esculenta* Acc 3, (5 grade). (Table 1).

Pooled data for the two years indicated that germplasms *viz***.,** *Xanthosoma sagittifolium* Acc 1, *Xanthosoma sagittifolium* Acc 2, *Xanthosoma sagittifolium* Acc 6 showed no leaf blight incidence (0 grade). The leaves were free from spots and blight with luxuriant waxy luster green leaves. The disease was less in AAU *Colocasia esculenta* Acc 35 (1 grade) and *Xanthosoma sagittifolium* Acc 7 (1 grade) which is locally known as Sirsi Halgesa and were tolerant to the disease. It was followed by AAU *Colocasia esculenta* Acc 5 and AAU *Colocasia esculenta* Acc 38 (2 grade). Whereas AAU *Colocasia esculenta* Acc 46 (3 grade). Leaf blight incidence was more in AAU *Colocasia* Acc 32 (3.5 grade). Maximum leaf blight was noticed in *Colocasia esculenta* Acc 4 (4 grade), *Colocasia esculenta* Acc 3, (4.5 grade). *Colocasia esculenta* Acc 3 is locally known by Makkalakesa and it is a good germplasm for screening of other germplasms for the disease reaction (Table 1).

Plant characters were presented in the Table 2. Among the germplasms with respect to plant characters, *Xanthosoma sagittifolium* Acc 2 showed maximum plant height (176.20 cm) with leaf length of 96.60 cm and leaf breadth of 69.80 cm and also exhibited maximum number of functional leaves (8.40 nos.), more number of tillers (1.20 nos) and maximum yield (20.37 t/ha). This was closely followed by *Xanthosoma sagittifolium* Acc 1 where in plant height was 124.00 cm with large leaves (leaf length of 58.50 cm and leaf breadth of 40.60 cm), more number of leaves (6.60 nos.), more number of tillers (1.20 nos.) and higher yield (18.48t/ha). *Colocasia esculenta* Acc 3 and Acc 4 exhibited similar plant characters with respect to height (135.38 cm and 135.38 cm respectively), medium large leaves (leaf length 27.43 cm and 43.18 cm respectively and leaf breadth 22.35 cm and 39.62 cm respectively) and more number of leaves (3.80 nos. and 4.20 nos.), more tillers (1.0 nos and 1.0 nos respectively) and less yield (8.16 t/ha and 8.19 t/ha respectively). AAU *Colocasia esculenta* Acc 35 exhibited less height (98.60 cm), less leaf length (50.90 cm), leaf breadth (41.10 cm), less number of leaves (3.20 nos), less number of tillers (1.40 nos.) and higher yield (18.25 t/ha).

Resistant varieties have been identified in India which can be used in breeding for resistance as opined by Raj Shekhar Misra *et. al.*, 2008. They also opined that the impact of colocasia leaf blight and the subsequent loss of colocasia genetic resource was the major impetus behind the development of colocasia genetic resource. Genetic variations among the colocasia can be used to solve the potential effects of leaf blight of colocasia. Different varieties respond differentially to *P. colocasiae* with varying degrees of infection. (Lakhanpaul *et. al.* 2003).

The growth parameters viz., plant height, number of functional leaves per plant, tuber weight per plant, tuber yield per plot and tuber yield per ha were significantly varied among the genotypes of *Colocasia esculenta*. and *Xanthosoma sagittifolium* genotypes as reported by Nagesh Naik *et. al*., 2010. Germplasms *viz.*, *Xanthosoma sagittifolium* Acc 1, *Xanthosoma sagittifolium* Acc 2, *Xanthosoma sagittifolium* Acc 6 exhibited no leaf blight incidence (0 grade) wherein plants exhibited leaves which were free from spots and blight with luxuriant waxy luster green leaves. The mechanism of defense reaction to the pathogen might be due to presence of waxy layer which might have helped

Table1 Leaf blight incidence of in *Colocasia esculenta* (L.) Schott) and *Xanthosoma sagittifolium* (L.) Schott germplams (2008-09 and 2009-10)

Sl. No.	Germplasms Accessions No.	Leaf blight (grade)		Mean
		2008-09	2009-10	
1.	*Xanthosoma sagittifolium* Acc 1	0	0	0.00
2.	*Xanthosoma sagittifolium* Acc 2	0	0	0.00
3.	*Colocasia esculenta* Acc 3	4	5	4.50
4.	*Colocasia esculenta* Acc 4	4	4	4.00
5.	*Xanthosoma sagittifolium* Acc 6	0	0	0.00
6	*Xanthosoma sagittifolium* Acc 7	1	1	1.00
7	AAU *Colocasia esculenta* Acc 5	2	2	2.00
8	AAU *Colocasia esculenta* Acc 32	3	4	3.50
9	AAU *Colocasia esculenta* Acc 35	1	1	1.00
10	AAU *Colocasia esculenta* Acc 38	2	2	2.00
11	AAU *Colocasia esculenta* Acc 46	3	3	3.00
	SEm ±			0.2
	CD @5%			0.64
	CV%			14.30

Table 2 Plant Characters of *Colocasia esculenta* (L.) Schott) and *Xanthosoma sagittifolium* (L.) Schott

Sl. No.	Germplasms Accessions No.	Plant Height (cm)	Leaf length (cm)	Leaf Breadth (cm)	Number of leaves (no)	No. of tillers (no.)	Yield tonnes/ha	Salient Plant characters
1.	*Xanthosoma sagittifolium* Acc 1	124.00	58.50	40.60	6.60	1.20	18.48	Waxy Green gingntic leaves and tall plants
2.	*Xanthosoma sagittifolium* Acc 2	176.20	96.60	69.80	8.40	1.20	20.37	Tall plants with gigantic waxy Green leaves and tall plants
3.	*Colocasia esculenta* Acc 3	135.38	27.43	22.35	3.80	1.00	8.16	Medium tall Popular land race and also known as Makkalakesa
4.	*Colocasia esculenta* Acc 4	135.38	43.18	39.62	4.20	1.00	8.89	Medium tall and red type of leaves and locally known as Karikesa
5.	*Xanthosoma sagittifolium* Acc 6	122.40	94.60	63.20	7.40	1.00	18.53	Medium tall with waxy red type of gigantic leaves
6	*Xanthosoma sagittifolium* Acc 7	132.64	37.59	32.71	1.80	1.00	20.10	Medium tall Popularly known as Sirsi Halgesa with waxy type of gigantic leaves
7	AAU *Colocasia esculenta* Acc 5	81.30	31.70	23.10	4.20	1.20	12.78	Medium tall with less vigorous plants
8	AAU *Colocasia esculenta* Acc 32	93.44	34.60	32.34	3.40	1.40	13.76	Medium tall with less vigorous plants and more tillers
9	AAU *Colocasia esculenta* Acc 35	98.60	50.90	41.10	3.20	1.40	18.25	Medium tall with less vigorous plants and more tillers
10	AAU *Colocasia esculenta* Acc 38	101.66	44.28	38.14	3.80	1.40	13.72	Medium tall with less vigorous plants and more tillers
11	AAU *Colocasia esculenta* Acc 46	99.40	44.00	37.10	4.40	2.00	11.18	Short height with less vigorous plants and more tillers

in avoiding infection by germinated zoospores due to lack of sufficient moisture and wax layer itself acted as barrier between pathogen and host.

Present study concluded that *Xanthosoma sagittifolium* Acc 1, *Xanthosoma sagittifolium* Acc 2, *Xanthosoma sagittifolium* Acc 6 showed resistance to leaf blight. Hence, these potential genetic resources as germplasms could be used in the breeding programme or biotechnological means to transfer the genes responsible for imparting resistance to the host against the pathogen for further improvement of agronomically superior varieties with respect to *Phytophthora* leaf blight. *Colocasia esculenta* Acc 3 is locally known by Makkalakesa and it is a good germ plasm for screening of other germplasms for the disease reaction.

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