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Full Length Research Paper

Some promising fruition of genotypes of Glory lily (*Gloriosa superba* L.) against leaf blight disease

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The study was conducted on performance of eighteen genotypes of glory lily (*Gloriosa superba* L.) against leaf blight disease under Tamil Nadu conditions. Experiment was laid out in a randomized block design with three replications at the Medicinal Plants Unit, Botanical Garden, Tamil Nadu Agricultural University, Coimbatore. All genotypes expressed significant variations for percent disease index and varied from 21.73 to 64.48%. The genotype GS 07 and genotype GS 05 exhibited the lowest index (21.73%) and highest index (64.48%), respectively. The percent disease index exhibited highly positive significant correlation both at phenotypic and genotypic levels for polyphenol oxidase. But it had negative significant association with peroxidase, total phenol content and catalase activity. The genotype GS 07 exhibited the lowest PDI value and this genotype considered as tolerant to leaf blight.

Key words: Genotypes, glory lily, leaf blight, peroxidase, polyphenol oxidase, catalase.

INTRODUCTION

Gloriosa superba (Liliaceae) is a native of tropical Africa and is found growing naturally in many countries of tropical Asia including Bangladesh, India, Sri Lanka, Malaysia and Myanmar. It is one of the major medicinal plants in India cultivated for its seeds which are exported to developed countries for pharmaceutical use. In India, it is usually found in Himalayan foot-hills, Central India, Tamil Nadu, Andhra Pradesh and Bengal. Seeds and tubers contain valuable alkaloids *viz*., colchicine and colchicoside as the major constituents, which are used to treat gout and rheumatism. Due to the action of colchicoside on spindle fibre formation during cell division, the plant has been identified as a potential anti-cancerous drug. In the Indian Systems of Medicine, the tubers are used as tonic, antiperiodic, antihelmenthic and also against snake bite (Gupta et al., 2005).

Leaf blight disease in Glory lily as observed during 2004 to 2006 in different areas of India and losses in *Gloriosa* were estimated to be 65 to 80% per annum (Maiti et al., 2007). The disease caused by the fungus, *Curvularia lunata* and being an air borne fungus, infects the leaves initially turning the leaf colour into light yellow. Later small black spots are seen which spread to the entire leaf surface. The incidence was reported more during cloudy days coupled with high humidity (Maiti et al., 2007). Plants produce different antimicrobial compounds and peroxidases when pathogen invades them (Sharma et al., 1990). Paramasivam and Arumugam (1991) identified following problems with regard to the cultivation of this crop such as i) scarcity and high cost of planting material, ii) seed tuber has a prolonged period of dormancy, iii) problems in cross pollination and poor seed set and iv) disease incidence particularly leaf blight is high. In view of all these observations, an attempt has been made in the present investigation to compare the performance of leaf blight disease and peroxidase and polyphenol oxidase activities in the elite genotypes of glory lily grown in Tamil Nadu, India with a view to identify the superior genotypes.

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MATERIALS AND METHODS

Eighteen genotypes of *Gloriosa* were grown in the Medicinal Plants Unit, Botanical Garden, Tamil Nadu Agricultural University, Coimbatore during 2007 to 2008 in Randomized Block Design with three replications. Each plot consist of three rows of 5 m length with inter and intra row spacing of 150 and 30 cm, respectively and also having 17 plants / plot. The recommended agronomical practices

Table 1. List of genotypes and percent disease index of *Gloriosa superba.*

S/N	Name of the germplasm	Genotypes / treatment	Percent disease index
1	Nallampalayam cultivated	GS 01	44.34
2	Kallimanthayam cultivated	GS 02	60.22
3	Sathyamangalam wild	GS 03	42.87
4	Aruppukotai wild	GS 04	48.92
5	Aruppukotai cultivated	GS 05	64.48
6	Kankayam cultivated	GS 06	61.54
7	Kallimanthayam wild	GS 07	21.73
8	Ottanchadram cultivated	GS 08	45.50
9	Moolanur cultivated	GS 09	57.70
10	Jeyankondam cultivated	GS 10	42.18
11	Udangudi cultivated	GS 11	40.38
12	Viralimalai cultivated	GS 12	39.64
13	Pudukottai cultivated	GS 13	54.68
14	Andhra cultivated – I	GS 14	30.24
15	Andhra wild	GS 15	33.25
16	Z-Melur cultivated	GS 16	35.83
17	Poondurai wild	GS 17	38.25
18	Andhra cultivated -II	GS 18	52.77
Mean			45.25
SE(d)			0.11
CD (0.05%)			0.22

and plant protection measures were followed to ensure a normal healthy crop. Observations were taken on five randomly selected plants from each genotype for PDI and biochemical traits.

The percentage of disease incidence was calculated along with severity grade by 0-9 scale, where 0, no disease incidence; 1, <1% leaf area affected; 3, 1-10% leaf area affected; 5, 11-25% leaf area affected; 7, 26-50% leaf area affected and 9, >50% leaf area affected (Prasad, 1982). The enzyme activities of peroxidase, catalase, polyphenol oxidase and total phenol were also estimated from all the genotypes.

Polyphenol oxidase (PPO) activity (abs $min^{-1}g^{-1}$)

PPO in tubers was assayed using the modified method of Mayer et al. (1965). Standard reaction mixture contained 1.5 ml of 0.1 M phosphate buffer (pH 6.5), 0.5 ml of the enzyme extract and 0.5 ml of 0.01 N catechol. The changes in the absorbance were recorded at 495 nm at 30 s interval for 3 minutes and expressed as abs $min^{-1}g^{-1}$.

Catalase activity (unit min^{-1} g^{-1} fresh wt)

Catalase activity of tubers was determined by adopting the method of Diby and Sarma (2005). 50 ml of the enzyme extract was taken in sodium phosphate buffer (pH 7.0) (2 ml) and 500 ml of H_2O_2 was added. To this, was added 1 ml of distilled water and the absorbance was read at 230 nm for 3 min with a time interval of 15 s and the enzyme activity expressed as unit min^{-1} g^{-1} fresh wt.

Peroxidase activity (Δ OD 430 nm $min^{-1}g^{-1}$)

The peroxidase activity of tubers was determined by the method Suggested by Perur (1962). Reaction mixture consists of 1.0 ml of enzyme extract, 3 ml of 0.05 M pyrogallol and 0.5 ml of 1% H_2O_2 was added. The enzyme activity expressed as change in OD at 430 nm min^{-1} g^{-1}.

Total phenol content (mg g^{-1})

The total phenol content of the tuber sample was estimated by the method employing folin ciocalteu reagent (Malick and Singh, 1980) and expressed as mg g^{-1} of fresh weight.

All the data regarding the disease incidence and enzyme activities were statistically analyzed by Panse and Sukhatme (1978) and correlation coefficients at phenotypic and genotypic levels were worked out by adopting the standard methods of the analysis as suggested by Johnson et al. (1955).

RESULTS AND DISCUSSION

All genotypes expressed significant variations for percent disease index which varied from 21.73 to 64.48% (Table 1). The genotype GS 07 and genotype GS 05 exhibited the lowest index (21.73%) and highest index (64.48%), respectively. Seven genotypes (GS 02, GS 04, GS 05, GS 06, GS 09, GS 13 and GS 18) exhibited significantly higher index than the general mean value of 45.25%, while ten genotypes (GS 01, GS 03, GS 07, GS 10, GS 11, GS 12, GS 14, GS 15, GS 16 and GS 17) exhibited significantly lower index than the general mean. The genotype GS 07 exhibited the lowest percent disease incidence (PDI) value and this genotype considered as tolerant to leaf blight. Wider variations in *Phytophthora*

Table 2. Mean performance of *G. superba* genotypes for peroxidase, catalase, polyphenol oxidase and total phenol activities.

GP	Peroxidase activity	Catalase activity	Polyphenol oxidase activity	Total phenol
GS 01	0.68	2.20	0.036	0.62
GS 02	0.64	1.70	0.036	0.62
GS 03	0.68	1.70	0.036	0.60
GS 04	0.96	2.60	0.024	0.63
GS 05	0.20	1.40	0.032	0.88
GS 06	0.88	2.20	0.080	0.33
GS 07	2.24	8.20	0.012	1.34
GS 08	0.44	1.67	0.048	0.50
GS 09	0.92	2.40	0.032	0.72
GS 10	1.04	2.60	0.020	0.78
GS 11	1.48	5.60	0.012	1.11
GS 12	1.04	2.60	0.020	0.87
GS 13	1.02	2.60	0.024	0.79
GS 14	1.12	3.10	0.020	1.00
GS 15	1.24	4.10	0.020	1.06
GS 16	1.12	3.10	0.020	1.06
GS 17	1.24	3.10	0.020	1.07
GS 18	1.40	4.77	0.016	1.11
Mean	1.02	3.09	0.028	0.84
SE(d)	0.007	0.05	0.001	0.03
CD (0.05%)	0.014	0.11	0.003	0.07

blight incidence (14.3 to 78.5%) was reported in the several genotypes of *Colocasia esculenta* (Mitra et al., 2007).

Vidyasekaran (1997) reviewed that peroxidase and poly phenol oxidase activity would be more in the plants infected by pathogen and has great role in inhibition on the pathogenesis. Vidyasekaran (2000) reported that phenolics may not accumulate to fungi toxic levels but pathogens may produce toxins that suppress the host polyphenol oxidases. The highest peroxidase and catalase activity of 2.24 Δ OD 430 nm min^{-1} g^{-1} and 8.20 ΔA at 240 nm g^{-1} min^{-1} respectively was observed in the genotype GS 07 and lowest value of 0.20 Δ OD 430 nm min^{-1} g^{-1} and 1.40 ΔA at 240 nm g^{-1} min^{-1}, respectively was recorded in the genotype GS 05 (Table 2).

Accumulation of phenolic compounds in host parasite reaction is the general phenomenon of resistance and breakdown of these compounds determined the degree of resistance (Farkas and Kirlay, 1962; Sindhan and Parashar, 1984). Post infectional increase of phenols might be due to the tendency of phenols to accumulate at the site of infection which is involved in the defense mechanisms of plants through the interference in the metabolic activities of pathogens (Farkas and Kirlay, 1962). Phenolic substances and their oxidation products, quinones have been reported to play an important role in imparting resistance against pathogens (Kosuge, 1966; Goodman et al., 1967).

Host enzyme like polyphenol oxidase, catalase and peroxidase play an important role in disease resistance. These enzymes are responsible for degradation and synthesis of phenolics and quinones respectively. Peroxidases have been implicated in the regulation of cell wall elongation, phenol oxidation, polysaccharide cross-linking, indole-3-acetic acid (IAA) oxidation, cross linking of extension monomers, oxidation of hydroxyl-cinnamyl alcohols onto free radical intermediates and wound healing (Vidhyasekharan, 1997).

The phenotypic and genotypic correlation co-efficient were analyzed to understand the direction and magnitude of relationship between biochemical and percent disease index among the genotypes. In general, the genotypic correlation co-efficient was slightly higher than the phenotypic correlation co-efficient (Table 3). The percent disease index exhibited highly positive significant correlation both at phenotypic and genotypic levels for polyphenol oxidase. But it had negative significant association with peroxidase, total phenol content and catalase. Regarding inter correlation of the biochemical characters, the peroxidase activity had negative highly significant association with polyphenol oxidase and also had highly significant positive association with total phenol content and catalase. Polyphenol oxidase showed negative correlation with total phenol content and catalase. But total phenol content had positive highly significant association with catalase.

Knowledge about association of various characters help in selection of genotypes and also suggests the

Table 3. Correlation among host enzymes activity and percent disease index of 18 genotypes of *G. superba*.

Character		Peroxidase	Poly phenol oxidase	Total phenol	Catalase	Percent disease index
Peroxidase	P	1.000	-0.822**	0.754**	0.941**	-0.541**
	G	1.000	-0.822**	0.758**	0.941**	-0.541**
Poly phenol oxidase	P		1.000	-0.798**	-0.632**	0.544**
	G		1.000	-0.802**	-0.633**	0.544**
Total phenol	P			1.000	0.643**	-0.566**
	G			1.000	0.646**	-0.569**
Catalase	P				1.000	-0.485*
	G				1.000	-0.485*
Percent disease index	P					1.000
	G					1.000

*, Significant at 5% level; **, significant at 1% level.

advantage of a selection method for more than one character at a time, which could be explained that improvement of one character results in the simultaneous improvement of all other positively related characters. In disease resistance breeding programmes, knowledge of association between the incidence of these diseases and other characters is a must particularly when the breeder wishes to keep a balance between disease resistance and agronomic traits.

In this investigation, percent disease incidence (PDI) registered highly significant positive correlation with poly phenol oxidase and exhibited significant negative correlation with peroxidase, total phenol and catalase. These results were similar to earlier findings in chillies by Markose (1996), tomato by Jamou (2002), pea by Luhova et al. (2006) and taro by Mitra et al. (2007). Considering all the aspects it can be concluded that the genotypes GS 07, GS 14, GS 15, GS 16, GS 17, GS 12, GS 11 and GS 10 considered as tolerant to leaf blight.

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