Research Journal of Medicinal Plant

ISSN 1819-3455

Academic Journals Inc.

www.academicjournals.com

Research Journal of Medicinal Plant 4 (1): 21-25, 2010
ISSN 1819-3455

Assessment of Different Glory Lily (*Gloriosa superba* L.) Accessions for Biochemical Traits

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Abstract: *Gloriosa superba* is a medicinal climber, its seeds and tubers contain valuable alkaloids viz., colchicine and colchicoside as the major constituents, which are used to treat gout and rheumatism. Eighteen accessions of *Gloriosa superba* collected from various geographical regions of the important *Gloriosa* growing states viz., Tamil Nadu and Andhra Pradesh were evaluated for total sugar, starch, protein, total phenol, peroxidase, catalase and poly phenol oxidase at Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore to assess its suitability for seed yield as well as tolerance to leaf blight. The accessions exhibited remarkable variations for all the traits studied. The maximum peroxidase, catalase and minimum poly phenol oxidase were observed in GS 15 while GS 12, recorded the highest total sugar content. The accession GS 15 excelled in the accumulation of starch, soluble protein and total phenol in tuber and thus can be utilized for extraction of colchicine and colchicoside.

Key words: *Gloriosa superba*, total sugar, starch, soluble protein, peroxidase, catalase, polyphenol oxidase

INTRODUCTION

Glory lily (*Gloriosa superba* L.) of family Liliaceae, also known as Creeping lily or Flame lily, 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. In India, it is usually found in Himalayan foot-hills, Central India, Tamil Nadu, Andhra Pradesh and Bengal. Tamil Nadu holds monopoly in production of glory lily with an annual production of about 600 tones of seeds in an area about 6000 acres (Mohan, 2008). Seeds and tubers contain valuable alkaloids viz., colchicine and colchicoside as the major constituents, which are used to treat gout and rheumatism. In the Indian systems of medicine, the tubers are used as tonic, antiperiodic, antihelmenthic and also against snake bite (Gupta *et al*., 2005).

Crop performance depends on optimal growth and development of the concerned plant and functional attributes such as physiological and biochemical processes. Biochemical studies in relation to the growth and development of medicinal plants are rather not many. In plants, which are propagated through specialized vegetative structures such as bulb, corm, tuber, tuberous root, rhizome and pseudo bulb, the size and weight of planting material greatly influence the growth and development (Bose and Yadav, 1989). The primary function of these structures is the storage of food for plant's survival during adversity (Hartmann and

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Table 1: Accessions details of *Gloriosa superba* collected in 2007

Name of the germplasm	Accessions
Nallampalayam cultivated	GS 01
Kallimanthayam cultivated	GS 02
Sathyamangalam wild	GS 03
Aruppukotai wild	GS 04
Aruppukotai cultivated	GS 05
Kankayam cultivated	GS 06
Kallimanthayam wild	GS 07
Ottanchadram cultivated	GS 08
Moolanur cultivated	GS 09
Jeyankondam cultivated	GS 10
Udangudi cultivated	GS 11
Viralimalai cultivated	GS 12
Pudukottai cultivated	GS 13
Andhra cultivated-I	GS 14
Andhra wild	GS 15
Z-Melur cultivated	GS 16
Poondurai wild	GS 17
Andhra cultivated-II	GS 18

Kester, 1989). When the above ground portion dies at the end of a growing season, these specialized structures bearing one or more buds remain dormant till the next growing season. When growth is resumed, the stored food in these structures aids the growth and development of plants at the initial stage. *Gloriosa superba* is unique in this respect as tuberization and vegetative growth occur simultaneously followed by flowering and fruiting (Chitra and Rajamani, 2009). The mean performance of biochemical characters and its association with seed yield as well as tolerance to leaf blight is very much important as it indirectly affects its associated traits. Hence, the present study was conducted.

MATERIALS AND METHODS

The material consisted of eighteen accessions, collected from different places of Tamil Nadu and Andhra Pradesh subjected to diversity analysis, are listed in Table 1. Field experiment was conducted in a randomized block design with three replications at the Medicinal Plants Unit, Botanical Garden, Tamil Nadu Agricultural University, Coimbatore during 2007-2008. Each plot consist of three rows of 5 m length with inter and intra row spacing of 150 and 30 cm, respectively. The recommended agronomical practices and plant protection measures were followed to ensure a normal healthy crop. The observations were recorded for seven characters viz., starch content (McCready *et al*., 1950), total sugar (Sadasivam and Manickam, 1996), soluble protein (Lowry *et al*., 1951), peroxidase (Perur, 1962), catalase (Paul and Sarma, 2005), polyphenol oxidase (Mayer *et al*., 1965) and total phenol (Malick and Singh, 1980) in tubers. The statistical parameters like mean, standard error and critical difference for all the characters were worked out by adopting the standard methods of the analysis as suggested by Sukhatme and Amble (1985).

RESULTS

Significant variation among different accessions for biochemical characters was observed (Table 2). The accession GS 15 registered the highest mean value for dry seed yield/plant (93.90 g) where as the accession GS 14 exhibited the lowest per cent disease index (21.73%). The accession GS 17 had lowest starch content (3.06 mg g^{-1}) whereas GS 15 recorded highest starch content (53.10 mg g^{-1}).

Table 2: Mean performance of biochemical characters of *Gloriosa superba* accessions

GP	DSYP	PDI	ST	TS	SP	TP	POX	CAT	PPO
GS 01	36.27	44.34	16.56	3.51	3.30	0.62	0.68	2.20	0.036
GS 02	41.40	60.22	29.52	1.09	3.50	0.62	0.64	1.70	0.036
GS 03	42.00	42.87	24.30	3.51	3.50	0.60	0.68	1.70	0.036
GS 04	5.07	48.92	3.24	1.02	2.17	0.63	0.96	2.60	0.024
GS 05	14.80	64.48	8.46	1.96	2.70	0.88	0.20	1.40	0.032
GS 06	80.23	61.54	36.17	1.81	10.20	0.33	0.88	2.20	0.080
GS 07	39.30	21.73	23.22	3.71	3.30	1.34	1.12	3.10	0.020
GS 08	21.00	45.50	10.08	1.02	2.80	0.50	0.44	1.67	0.048
GS 09	13.60	57.70	6.12	1.81	2.50	0.72	0.92	2.40	0.032
GS 10	19.83	42.18	11.88	3.01	3.17	0.78	1.04	2.60	0.020
GS 11	14.67	40.38	7.38	1.91	2.60	1.11	1.48	5.60	0.012
GS 12	21.87	39.64	16.19	5.21	3.20	0.87	1.04	2.60	0.020
GS 13	21.87	54.68	14.40	1.71	3.10	0.79	1.02	2.60	0.024
GS 14	38.53	30.24	22.86	1.96	3.30	1.00	2.24	8.20	0.012
GS 15	93.90	33.25	53.10	1.41	10.60	1.06	1.24	4.10	0.020
GS 16	14.80	35.83	6.84	1.08	2.50	1.06	1.12	3.10	0.020
GS 17	4.97	38.25	3.06	1.06	1.50	1.07	1.24	3.10	0.020
GS 18	73.80	52.77	30.77	1.03	3.90	1.11	1.40	4.77	0.016
Mean	33.22	42.25	18.01	2.10	3.77	0.84	1.02	3.09	0.028
SE(d)	1.75	0.11	0.09	0.005	0.07	0.03	0.007	0.05	0.001
CD (0.05%)	3.56	0.22	0.19	0.011	0.15	0.07	0.014	0.11	0.003

DSYP: Dry seed yield/plant (g); PDI: Percent Disease Index (%); ST: Starch content (mg g^{-1}); TS: Total sugar content (mg g^{-1}); SP: Soluble protein (mg g^{-1}); TP: Total Phenol (mg g^{-1}); POX: Peroxidase (Δ OD 430 nm min^{-1} g^{-1}); CAT: Catalase (ΔA at 240 nm g^{-1} min^{-1}); PPO: Poly phenol oxidase (abs min^{-1} g^{-1})

The mean performance of the accessions for total sugar content ranged from 1.02 mg g^{-1} (GS 04 and GS 08) to 5.21 mg g^{-1} (GS 12). Among the accessions, GS 17 recorded the lowest soluble protein (1.50 mg g^{-1}), while the highest soluble protein (10.60 mg g^{-1}) was found in GS 15. The accession GS 15 also recorded the highest total phenol content (1.34 mg g^{-1}).

The mean value of catalase activity ranged from 1.40 ΔA at 240 nm g^{-1} min^{-1} in GS 06 to 8.20 ΔA at 240 nm g^{-1} min^{-1} in GS 14. The range for peroxidase activity varied from 0.20 Δ OD 430 nm min^{-1} g^{-1} in GS 06 to 2.24 Δ OD 430 nm min^{-1} g^{-1} in GS 14. Among the eighteen accessions, GS 11 and GS 14 recorded lowest PPO activity (0.012 abs min^{-1} g^{-1}).

DISCUSSION

The mean performance and spectrum of genetic variation would help to identify the superior genotypes among the existing populations. Allard (1960) suggested that the selection should be applied mainly in the lines exhibiting high mean and variability. According to Finker *et al.* (1973), crosses or families with the highest mean could be effectively utilized to identify the superior segregates. The mean performance served as a primary criterion for selecting desirable plants (Kumar *et al.*, 1979).

The mean performance of eighteen accessions revealed that certain accessions exhibited their superiority over others for different traits. The accession GS 15 performed better than other accessions for all the biochemical parameters studied viz., soluble protein, starch, crude protein and total phenol in tubers. Starch is deposited in amyloplasts of the growing tubers and is composed of amylase and amylopectin. Mitra *et al.* (2007) studied the starch (dry weight basis) content of the *Colocasia esculenta* tubers who reported that the content varied within the cultivars ranged between 29.5-45.7%. According to Datta (1994), the first formed assimilate in the plant will be the simple sugars which will be used for the plant metabolic activities and the excess be stored in their reserve organs. Increased total sugars

in tubers may be attributed to the high partitioning efficiency and increased efficiency of the sink to accumulate assimilates in the tubers. Longe (1978) also reported similar findings in cassava.

Protein is the immediate product of gene expression following transcription and translation (Purcell *et al*., 1978) and in the present study, soluble protein content in tubers showed highly significant positive association with seed yield. This result is in agreement with the findings of Splittstoesser *et al*. (1973) in yam, Bhagat and Jadega (2003) in Safed musli and Cheema *et al*. (2007) in arvi.

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). The accession GS 14 exhibited the lowest PDI value and this accession considered as tolerant to leaf blight. Wider variations in *Phytophthora* blight incidence (14.3-78.5%) was reported in the several genotypes of *Colocasia esculenta* (Mitra *et al*., 2007). In the present study, the accession GS 14 recorded highest amount of peroxidase, catalase and lowest amount of poly phenol oxidase.

Host enzyme like polyphenol oxidase, catalase and peroxidase play an important role in disease resistance. Lodh *et al.* (1973), Sasikumaran *et al.* (1979) and Ragupathi (1995) reported an increased activity of PO and PPO in TLCV infected leaves of tomato.

The correlation between enzyme *viz.,* peroxidase and catalase activity change and susceptibility of pea cultivars to *Fusarium oxysporum* or *Fusarium solani* was observed by Luhova *et al*. (2006). Mitra *et al.* (2007) reported that high peroxidase and low polyphenol oxidase activity was found in the *Phytophthora* blight resistant Taro genotypes.

CONCLUSION

The results obtained from the present study revealed that the accession GS 15 (Andhra wild) excelled in the accumulation of starch, soluble protein and total phenol in tubers. Earlier it had been reported that the accession GS 15 excelled in dry seed yield (Chitra and Rajamani, 2009). Considering all the aspects it can be concluded that the accession GS 15 might serve as ideal parent for developing hybrids with high seed yield.

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