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RESEARCH ARTICLE

Screening of Piper Species for Resistance to Quick Wilt caused by *Phytophthora capsici* under Glasshouse Condition

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ABSTRACT

Screening of *Piper* species resistant to quick wilt was carried out under glasshouse conditions. *Piper colubrinum, Piper argyrophyllum*, IISR Sakthi and IISR Thevam were used as rootstocks while Panniyur 1 and Karimunda were used as scion and these grafted plants were screened against *Phytophthora capsici.* Among the rootstocks, *Piper colubrinum* showed 'Highly Resistant' reaction, followed by *Piper argyrophyllum* which exihibited 'Resistant' reaction. The cultivated *Piper nigrum* varieties IISR Sakthi and IISR Thevam showed 'Tolerant' reaction and the scions Panniyur 1 showed 'Highly Susceptible' reaction while Karimunda showed 'Resistant' reaction. None of the graft combination screened were susceptible to *Phytophthora capsici*. Highest graft success was observed in *Piper colubrinum*.

Keywords: *Black pepper, Phytophthora capsici, Screening, Piper colubrinum, Grafting.*

INTRODUCTION

Black pepper (*Piper nigrum* L.) belongs to the family Piperaceae and is one of the oldest and most widely used spices in the world (Gordo *et al.*, 2012). Black pepper is recognized as "Black Gold" for its importance and also known as "King of Spices" (Ravindhra *et al.,* 2014). It is originated from tropical evergreen forest of the Western Ghats of India. Black pepper is a globalized condiment used as flavour in all types of cuisines worldwide. *Phytophthora* foot rot caused by *P. capsici* causes serious threat to black pepper cultivation in India. Crop loss due to this disease has been identified as a major constraint in its production (Vandana *et al*., 2014). The productivity of black pepper in its native land Kerala is very low (280 kg / ha) due to various constraints and *Phytophthora* is the major problem (Nybe *et al.,* 2007). In Karnataka crop loss upto 20-30 % was recorded due to *Phytophthora* (Thomas and Naik, 2017). *Phytophthora* foot rot spread rapidly and difficult to control. Plants affected by this pathogen die within 2-3 weeks during rain and adjacent plants may be infected within one or two months (Anh *et al.*, 2018).

Chemical control strategies will lead to increased cost of cultivation, reduction in soil fertility, status, environmental pollution and health hazards. Conventional breeding programmes to develop foot rot resistant black pepper varieties have not been successful so far since high degree resistance is lacking in the available germplasm resources. Another viable option is to exploit this resistant wild species as the rootstock and grafting with the released high yielding cultivars as scions. The variety Panniyur 1 is widely cultivated among Yercaud farmers, but is susceptible to quick wilt. Hence, grafting of Panniyur 1 with quick wilt resistant rootstock will directly aid in controlling the disease and thereby increasing the yield. *P. argyrophyllum* is one of the wild species of *Piper* commonly occur in Shevaroy hills have not been screened so far for its resistance to quick wilt diseases in pepper. Hence, the present study aimed to identify genotypes resistant/ tolerant to quick wilt.

MATERIAL AND METHODS

Screening of different Piper species for quick wilt resistance was carried out from August 2017 to May 2018 at Horticultural Research Station, TNAU, Yercaud. To raise the rootstocks and scion of two node cuttings of *Piper colubrinum, Piper argyrophyllum*, IISR Sakthi, IISR Thevam, Panniyur 1 and Karimunda were planted in polythene bag containing a mixture of sand, soil and FYM (1:2:1) for grafting and screening under glasshouse condition using completely randomized design (CRD) with three replications.

Plants were grafted using the cleft grafting method. The top of rootstock was beheaded while the wood was soft and green. A slit of 5 cm deep was made with the help of sharp knife to accommodate the pre-cured

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scion. The lower portion of the scion was made to a wedge shape with equal faces on both sides to a length of 5 cm. After inserting the scion into the rootstock, the union was kept in position by tying with polythene strips. The scions were covered with a polythene sleeve of 1000 gauge thickness and tied with a thread to keep the scion fresh till the union is completed. When the scions started sprouting (20-30 days after grafting) the polythene sleeves were removed.

Mass multiplication of pathogen

Pure culture of *Phytophthora capsici* was obtained from ICAR- Indian Institute of Spices Research, Calicut. Stock culture was maintained in Carrot agar medium. The culture was inoculated and incubated at 28 ± 2ºC for fourteen days. The pathogen was multiplied in sand maize medium with the ratio of 9:1 (9 part sand and 1 part broken powder maize), moistened and autoclaved at 1.4 kg/cm^2 pressure for two hours. The pathogen was inoculated and multiplied in sand- maize medium for three weeks. The ungrafted and grafted plants were selected and planted in earthen pots containing three kilograms of sterilized pot mixture (sand: soil: FYM in 1:2:1 ratio). One cutting/graft was planted in each pot. The ungrafted/grafted plants were inoculated with *Phytophthora capsici* at the rate of fifty gram of multiplied sand maize medium per pot.

Testing the disease severity of Piper species against P. capsici

Each Piper species were checked for disease severity every week for 30 days on a scale from 1- 5 , on leaves the disease lesion rating where score of 1 was given to Highly Resistant (no lesion), 2 was given to Resistant (1-5mm), 3 was given to Tolerant (6-20 mm), 4 was given to Susceptible (21-30 mm) and 5 was given to Highly Susceptible (> 31 mm) and root rot rating where score of 1 was given to Highly Resistant (no root rotting), 2 was given to Resistant (Hypersensitive fleck), 3 was given to Tolerant (6-24%), 4 was given to Susceptible(25-75%) and 5 was given to Highly Susceptible (> 75%) was recorded by using the following scale adopted by Sarma *et al.,* (1982).

RESULTS AND DISCUSSION

In the present investigation, screening studies were carried out against *Phytophthora* using the ungrafted plants *viz., P. colubrinum, Piper argyrophyllum,* IISR Sakthi and IISR Thevam as rootstocks and the cultivars Panniyur1 and Karimunda as scions and also on grafted plants of these varieties.

Table 1. Reaction of rootstocks and scions of Piper species to Phytophthora capsici

Treatments		Status	Lesion rating	Root rot incidence (%)*	Reaction category against *Phytophthoracapsici* *
Piper colubrinum	Root stocks	Untreated control	-	-	-
Piper argyrophyllum			-	-	-
IISR Sakthi			-	-	-
IISR Thevam			-	-	-
Karimunda	Scions		-	-	-
Panniyur 1			-	-	-
Piper colubrinum	Root stocks	*Phytophthora* inoculated	0	0	HR
Piper argyrophyllum			1	0	R
IISR Sakthi			1.4	10	T
IISR Thevam			1.5	13	T
Karimunda	Scions		1.3	4	R
Panniyur 1			5.4	70	HS

* HR- Highly Resistant R-Resistant T- Tolerant HS- Highly Susceptible

When the susceptible vines were removed from the soil and washed with sterile distilled water. The lesion grade revealed that all the rootstocks and scion of Karimunda has the lowest lesion size of 1.3 mm whereas Panniyur 1 recorded the highest lesion size of 5.4 mm. Similarly, the root rot incidence was obsereved in Sakthi (10 per cent), IISR Thevam (13 per cent), Karimunda (4 per cent) and Panniyur 1 (70 per cent). This

indicates that *Piper colubrinum* was Highly Resistant (HR) whereas *Piper argyrophyllum* and Karimunda showed resistance reaction (R), IISR Sakthi and IISR Thevam were tolerant (T) and Panniyur 1 was classified under 'Highly Susceptible' reaction (HS) to *Phytophthora capsici* based on score chart (Table 1).

Under grafted condition all the four rootstocks and Karimunda expressed very less symptoms or attained no root rotting, thus the scoring reaction category as 'resistant'. Further, screening of the graft combinations using these three species for *P. capsici* also manifested 'resistant' reaction in this study (Table 2). Several screening studies conducted earlier proved that *P. colubrinum* is 'Highly Resistant' to *Phytophthora* (Purseglove *et al.*, 1981; Vanaja *et al.*, 2007, Janani 2009). Panniyur 1 expressed 70% of root rotting and was classified under the reaction category of 'susceptible'. Stem inoculation with an inoculum disc of the pathogen at the 3rd internodes showed that Karimunda was resistant to *P.capsici* (Bhai *et al.*, 2007) and earlier finding were also showed the same results that Karimunda as resistant and Panniyur 1 as susceptible to *P. capsici* (Divya and Sharada, 2014). IISR Thevam was a germplasm selection from the local black pepper cultivar Thevanmundy which has shown field tolerance to *Phytophthora* foot rot disease coupled with high yield (Sasikumar *et al.*, 2004). New varieties IISR Thevam and IISR Shakti released from Indian Institute of Spices Research (IISR), Calicut were tolerant but not resistant to foot rot disease.

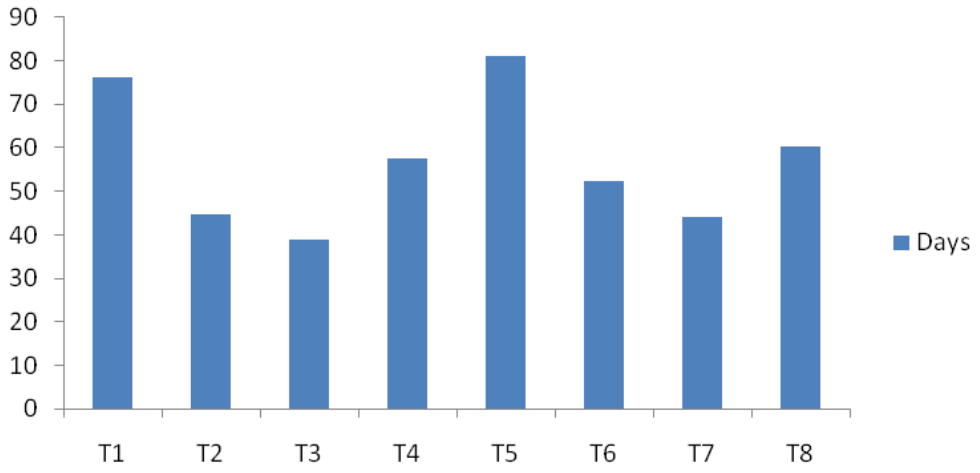
Table 2. Reaction of grafted plants of Piper species to Phytophthora capsici

Treatments	Status	Lesion rating	Root rot incidence (%)	Reaction category against *Phytophthora capsici* *
Panniyur 1 on *Piper colubrinum*	Untreated control	-	-	-
Panniyur 1 on *Piper argyrophyllum*		-	-	-
Panniyur 1 on IISR Sakthi		-	-	-
Panniyur 1 on IISR Thevam		-	-	-
Karimunda on *Piper colubrinum*		-	-	-
Karimunda on *Piper argyrophyllum*		-	-	-
Karimunda on IISR Sakthi		-	-	-
Karimunda on IISR Thevam		-	-	-
Panniyur 1 on *Piper colubrinum*	*Phytophthora* inoculated	0	0	HR
Panniyur 1 on *Piper argyrophyllum*		1.0	0	R
Panniyur 1 on IISR Sakthi		1.2	11	T
Panniyur 1 on IISR Thevam		1.1	10	T
Karimunda on *Piper colubrinum*		0	0	HR
Karimunda on *Piper argyrophyllum*		1.1	0	R
Karimunda on IISR Sakthi		1.3	9	T
Karimunda on IISR Thevam		1.1	12	T

*HR- Highly Resistant R- Resistant T-Tolerant

The graft success observed on 90 days after grafting elucidated variations in different treatments significantly. The highest grafting success of 81.2 per cent was recorded in T_5 (Karimunda scion grafted on *P. colubrinum* rootstock) followed by T_1 (76.2 per cent) (Panniyur 1 scion grafted on *P. colubrinum* rootstock). The least success rate of 38.9 per cent was observed in T_3 (Panniyur 1 scion grafted on IISR Sakthi rootstock) at 90 days after grafting (Fig 1). Vanaja *et al.* (2007) revealed that the rootstock of *Piper colubrinum* and scion of Karimunda performed better than other varieties during the month of February. While grafting success percentage with *P. colubrinum* at Calicut was 62-63 per cent (Mathew *et al.*, 2000). The results indicated that environment plays major role in rooting ability of the rootstocks and grafting success. Grafting success and the survival of the grafted plant depends on the cohesion between rootstock and scion (i.e., callus formation, vascular bundle differentiation and connectivity at the graft interface) that insures the balanced development of both scion and rootstock as reported by Ogata *et al*. (2005). Oda *et al.* (2005) stated that poorly connected grafts limit

water and xylem sap transfer at the graft union; low hydraulic conductance causes impaired stomatal activity, defoliation and a loss of shoot vigour (scion growth), yield and quality.



T_1 - *Piper colubrinum* + Panniyur 1; T_2 - *Piper argyrophyllum* + Panniyur 1; T_3 - IISR Sakthi + Panniyur 1; T_4 - IISR Thevam +Panniyur 1; T_5 - *Piper colubrinum* + Karimunda ; T_6 - *Piper argyrophyllum* + Karimunda ; T_7 - IISR Sakthi + Karimunda ; T_8 - IISR Thevam + Karimunda

Figure 1. Effect of different Piper species grafting success percentage

CONCLUSION

The findings of the present study revealed that *Piper colubrinum* recorded the highest graft success percentage. *Piper colubrinum* and *Piper argyrophyllum* rootstocks were resistant to *Phytophthora* foot rot. The commercially cultivated variety of Yercaud region, Panniyur 1 was susceptible to *Phytophthora capsici,* which was widely cultivated variety of Yercaud region. Hence, to overcome susceptibility of Panniyur 1 and to control foot rot disease the resistant rootstocks of *P. colubrinum* (exotic wild species) and *Piper argyrophyllum* (native species to Yercaud) can be effectively utilized.

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