# Pathogenic response on differential hosts of Pigeon Pea against *Fusarium udum* Isolates

**E. Rangaswamy, B. Pushpavathi, G.S. Panduranga and P. Narayan Reddy**

*College of Agriculture, Acharya N.G Ranga Agriculture University, Rajendranagar, Hyderabad-500 030, India.*

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**ABSTRACT**

Among 26 isolates collected from Warangal, Khammam and Ranga Reddy districts of Andhra Pradesh, five isolates were selected based on their morphological characters and were evaluated for pathogenic variability on a set of seven host differentials and three locally growing cultivars. As all the five isolates induced symptoms on the host differentials, they were considered as virulent isolates. However, the isolates varied greatly for virulence, disease incidence, disease reaction, latent period and virulence index. Based on virulence index, among the isolates tested the isolate Fu 15 was found highly virulent and the isolate Fu 24 was weak.

**Key words:** *Cajanus cajan*, *Fusarium udum*, Virulence.

Pigeon pea (*Cajanus cajana* (L) Mills.) is an important pulse crop in semi-arid tropical and sub-tropical farming systems. Though several factors are known to affect its cultivation, the most important being the diseases. Among the diseases, *Fusarium* wilt caused by *F.udum* is the most important soil borne disease. The disease appears on young seedlings but the highest mortality occurs during flowering and podding stage (Patil *et al.*, 2005). In Andhra Pradesh, disease incidence has been increasing year after year and most of the released cultivars became susceptible to the disease indicating the development of more virulent races of the pathogen in major pigeon pea growing areas of the state. So, to know the possible existence of pathological variation of different isolates of *F. udum* collected from major pigeon pea growing areas of Andhra Pradesh were undertaken.

## Materials and Methods

A roving survey was carried out in major pigeon pea growing areas of Andhra Pradesh *viz.*, Warangal, Khammam and Ranga Reddy districts during post rainy season of 2009-2010 to assess the wilt incidence and also to collect the isolates of *F. udum*, when the crop was at flowering to pod filling stage. A total of 26 isolates were collected from all the three districts. Sixteen isolates were collected from mandals of Warangal whereas in Khammam five mandals were surveyed and seven isolates were collected. Three isolates were collected in Ranga Reddy district, one from Tandur and two from ICRISAT. In present study, five isolates among the twenty six isolates for pathogenic variation were used. These five isolates of *F. udum viz.*, *Fu* 2, *Fu* 5, *Fu* 15, *Fu* 19 and *Fu* 24 were collected. Isolate Fu 2 collected from Ranga Reddy, *Fu* 5 from Khammam and all other isolates *viz.*, *Fu* 15, *Fu* 19 and *Fu* 24 were collected from Warangal district.

Spore suspension of all isolates of *F. udum* were prepared in test tubes using sterile distilled water and were adjusted to a concentration having 4-5 spores / field of microscope. One ml of this spore suspension was added to sterile Petri plates into which 2 % water agar medium was poured. After 24 hrs, well isolated germinated single spore picked up along with agar medium and transferred on to PDA slants under aseptic conditions. The slants were then, incubated at 25±2$^0$C in an incubator for

10 days to have sufficient growth of the culture. The inoculum was prepared on sorghum grain. A set of seven host differentials *viz.*, ICP 2376, ICP 8858, ICP 8859, ICP 8862, ICP 8863, ICP 87119 and Bahar along with three locally growing cultivars *viz.*, LRG 30, LRG 41 and WRG 27 were used. The cultures of *F. udum* isolates grown on sorghum grains were thoroughly mixed with sterilized soil separately at 1:4 w/w ratio and filled in 15 cm dia. earthen pots. Pots were sprinkled with water and covered with a polythene bags for incubation for 2 days. On third day, seeds of pigeon pea host differentials were sown in all the pots. Five plants / pot and two pots / replication were maintained for each pigeon pea differential and the pathogen isolate. The pots were watered regularly to maintain 50 % water holding capacity of the soil and were observed daily. The data on wilt incidence and latent period were recorded up to 45$^{th}$ day after sowing. The cumulative disease incidence was taken into consideration to categorize the isolates into different groups.

Further to determine quantitative difference in virulence level of the isolates, virulence index was calculated using following formula

$$\text{Virulence index} = \% \text{ disease incidence} \times \frac{1}{\text{Latent period}}$$

Based on disease incidence, the disease reactions were obtained on host differentials and the isolates were categorized into different virulent groups.

**Results and Discussion**

The isolates found pathogenic were used to study the variability in pathogenicity and virulence levels by using a set of host differentials. The isolates of *F.udum* from various areas showed wide range in their pathogenicity. Some were pathogenic to all the host cultivars and others to a single cultivar of pigeon pea. In the present investigation, all the isolates showed highly aggressive and virulent reaction on cultivar Bahar and LRG 30 whereas none of the host differentials showed the resistant reaction against all the isolates. This shows the ability of the pathogen to develop new virulence genes against resistant cultivars. Variability among the isolates of *Fusarium* in respect of their cultural and growth inhibition was reported by Gangwar *et al.* (2004); Piscal and Dake (2004).

Considerable variation was found in % disease incidence among the isolates of *F.udum* across the host differentials. Among the five isolates evaluated, highest mean disease incidence was recorded with the isolate *Fu* 5 (57.6%), followed by *Fu* 15 (55.3%) and the lowest was observed with the isolate *Fu* 24 (39.3%), across the host cultivars. However, there was no significant difference between *Fu* 5 and *Fu* 15. All five isolates showed highly aggressive and virulent reaction on cv. Bahar and LRG 30. This shows the ability of the pathogen to develop new virulence genes against resistant cultivars. However, majority of the isolates were less aggressive on ICP 8858, ICP 8863, ICPL 87119, WRG 27 and moderately aggressive on ICP 2376, ICP 8859, ICP 8862, and LRG 41 (Table1) indicating the presence of an array of resistance genes in the host cultivars to the corresponding virulence genes in isolates (Chauhan *et al.*, 2001). Although, all *Fusarium* isolates proved pathogenic, the degree of virulence, latent period and virulence index varied substantially with each other. It is indicated that the isolates *Fu* 5 and *Fu* 15 were highly virulent, *Fu* 2 and *Fu* 19 were moderately virulent, and isolate *Fu* 24 was the least virulent. However, pathogenic variation in *Fusarium* was well explained. Singh and Dubey (2005) indicated high degree of cultural divergence for virulence in *Fusarium* populations enabling them to match resistant genes rapidly in the host cultivars. However, pathogenic variation was the major drawback in the development of pigeon pea varieties resistant to wilt. Similar results on variabilities were reported by Singh *et al.* (2008).

Shortest mean latent period was observed with highly aggressive isolate (*Fu* 15) and longest latent period was associated with least aggressive isolate *Fu* 24. Across the cultivars lowest mean latent period was observed in LRG 30 (26.33 days) while

**Table 1.** Disease incidence (%) of five isolates of *Fusarium udum.*

| Isolates | Disease incidence (%) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ICP 2376 | ICP 8858 | ICP 8859 | ICP 8862 | ICP 8863 | ICPL 87119 | BAHAR | LRG 30 | LRG 41 | WRG 27 | Mean |
| *Fu*2 | 73.3 | 23.3 | 36.6 | 33.3 | 20.0 | 23.3 | 90.0 | 96.6 | 56.6 | 23.3 | 47.66 |
| *Fu*5 | 56.6 | 33.3 | 50.0 | 86.6 | 23.3 | 20.0 | 90.0 | 76.6 | 63.3 | 76.6 | 57.66 |
| *Fu*15 | 76.6 | 40.0 | 56.6 | 66.6 | 13.3 | 33.3 | 93.3 | 83.0 | 60.0 | 23.3 | 55.33 |
| *Fu*19 | 50.0 | 30.0 | 36.6 | 86.6 | 6.6 | 20.0 | 80.0 | 73.3 | 36.6 | 23.3 | 44.33 |
| *Fu*24 | 56.6 | 23.3 | 36.6 | 23.3 | 26.6 | 26.6 | 66.6 | 90.0 | 13.3 | 30.0 | 39.32 |
| Mean | 62.66 | 29.99 | 43.32 | 59.32 | 17.99 | 24.66 | 83.8 | 83.9 | 45.9 | 35.3 | |
| | S.Ed ± | | C.D. (P=0.05) | | | | | | | | |
| Isolates | 3.37 | | 6.61 | | | | | | | | |
| Host cultivars | 4.77 | | 9.34 | | | | | | | | |
| Interaction | 10.66 | | 20.90 | | | | | | | | |

**Table 2.** Latent period (days) of five isolates of *Fusarium udum.*

| Isolates | Expression of symptoms (Days) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ICP 2376 | ICP 8858 | ICP 8859 | ICP 8862 | ICP 8863 | ICPL 87119 | BAHAR | LRG 30 | LRG 41 | WRG 27 | Mean |
| *Fu*2 | 25.66 | 34.00 | 30.00 | 36.66 | 38.33 | 38.33 | 25.33 | 24.66 | 29.66 | 37.33 | 32.59 |
| *Fu*5 | 30.33 | 33.66 | 34.33 | 27.33 | 38.00 | 38.66 | 26.00 | 29.00 | 30.00 | 28.00 | 32.39 |
| *Fu*15 | 29.00 | 31.33 | 29.66 | 31.66 | 29.00 | 39.00 | 26.33 | 25.33 | 30.66 | 39.33 | 31.19 |
| *Fu*19 | 36.33 | 37.66 | 38.00 | 26.66 | 41.00 | 41.66 | 26.00 | 25.66 | 34.66 | 39.33 | 34.73 |
| *Fu*24 | 33.66 | 41.66 | 38.33 | 40.33 | 33.00 | 39.33 | 31.33 | 26.00 | 26.33 | 38.00 | 35.93 |
| Mean | 30.99 | 35.66 | 34.06 | 32.52 | 35.86 | 39.39 | 26.99 | 26.53 | 30.26 | 36.39 | |
| | S.Ed ± | | C.D. (P=0.05) | | | | | | | | |
| Isolates | 1.73 | | 3.40 | | | | | | | | |
| Host cultivars | 2.45 | | 4.81 | | | | | | | | |
| Interaction | 5.49 | | 10.77 | | | | | | | | |

highest mean latent period was exhibited on ICP 87119 (39.39 days) (Table 3). Similar results were obtained from the *F. oxysporum* f.sp.*ricini* where highly virulent isolates produced wilt symptoms with minimum time of the incubation period when compared to least virulent isolates with high latent period (Minnatullah & Kumar 2005).

In this study, virulence index used to indicate the relative potentials of individual isolates by combining the two independent pathogenicity parameters, disease incidence and latent period. It is quite variable among the isolates, across the host cultivars indicating the presence of different virulent genes in the pathogen populations to the corresponding resistance genes in the host differentials. Maximum isolates had highest virulence index on Bahar and LRG 30, lowest on ICP 8863 and ICP 87119, and variable on the remaining host cultivars (Table 3). Host cultivars on which the virulence index was lower across a number of isolates would probably be more stable than those with higher virulence index values. Across the isolates it was highest on LRG 30 (3.18) and lowest on ICP 8863 (0.52). Bardia and Rai (2008) isolated 6 isolates *F.O.* and $A_3$ isolate was

**Table 3.** Virulence index of five isolates of *Fusarium udum*.

| Isolates | Host differentials | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ICP 2376 | ICP 8858 | ICP 8859 | ICP 8862 | ICP 8863 | ICPL 87119 | BAHAR | LRG 30 | LRG 41 | WRG 27 | Mean |
| *Fu*2 | 2.89 | 0.71 | 1.22 | 0.91 | 0.52 | 0.61 | 3.58 | 3.91 | 1.91 | 0.62 | 1.68 |
| *Fu*5 | 1.93 | 1.03 | 1.50 | 3.22 | 0.83 | 0.43 | 3.43 | 2.64 | 2.16 | 2.75 | 1.82 |
| *Fu*15 | 2.64 | 1.27 | 1.93 | 2.14 | 0.30 | 0.94 | 3.56 | 3.58 | 1.96 | 0.59 | 1.89 |
| *Fu*19 | 1.48 | 0.88 | 1.03 | 3.33 | 0.15 | 0.47 | 3.08 | 2.89 | 1.05 | 0.62 | 1.49 |
| *Fu*24 | 1.77 | 0.57 | 0.97 | 0.57 | 0.82 | 0.69 | 2.13 | 3.48 | 0.53 | 0.79 | 0.96 |
| Mean | 2.14 | 0.89 | 1.33 | 2.03 | 0.52 | 0.62 | 3.15 | 3.18 | 1.52 | 1.07 | |
| | | S.Ed ± | C.D. (P=0.05) | | | | | | | | |
| Isolates | | 0.37 | 0.74 | | | | | | | | |
| Host cultivars | | 0.53 | 1.04 | | | | | | | | |
| Interaction | | 1.19 | 2.34 | | | | | | | | |

found to be most virulent showing 8% wilt incidence of cumin.

The differential host response to *F. udum* observed for all host cultivars except ICP 8858, BAHAR and LRG 30. There was variation in the reactions of differential cultivars (Table 2). It was also in chickpea, reported earlier Patil *et al.* (2005) that the lines with resistance to one race of *Fusarium* spp but susceptible to another race, which suggested that different resistance genes confered resistance to different races. Such lines could be useful as race differentials to facilitate identification of races based on host × pathogen interactions. So, before selection of a resistance line for a particular location, it is necessary to screen pigeon pea cultivars separately at different locations. In conclusion, the pathogenic races of *F. udum* of *Fu* 15 and *Fu* 5, *Fu* 2 and *Fu* 19, and *Fu* 24 were three distinct types. This is useful to identify pigeon pea varieties resistant to wilt at different regions.

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