The Andhra Agric. J 67 Spl: (IARD-2020): 56-60

# Pathological Basis of Tikka Leaf Spot Tolerance in Groundnut Cultivars under Hydroponics

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**ABSTRACT**

Tikka leaf spot (late) caused by *Phaeoisariopsis personata* has been endemic in major groundnut growing areas of the world. Comparison was made between susceptible (cv. K-6) and tolerant (cv. Kadiri Harithandhra) cultivars grown in hydroponics with respect to pathological basis of infection such as incubation period, latent period, lesion diameter and lesion number on quadrifoliate leaf upon artificial inoculation with conidial suspension @ $1x10^6$ conidia/ml concentration. Incubation period of both the cultivars was 7 days under green house conditions but latent period of Kadiri Harithandhra (17 days) was higher compared to K-6 (14 days). Besides latent period, lesion number and lesion diameter on quadrifoliate leaf were found to be higher in susceptible K-6,*i.e.,* 36 and 3.1mm respectively when compared to tolerant Kadiri Harithandhra (19 and 1.62 mm). Thus, disease tolerance in cultivar to late tikka leaf spot disease in groundnut was appeared to be governed by reduced number of secondary infection cycles with in crop season due to lesser number of lesions with lesser lesion diameter and higher latent period.

**Key words**: *Groundnut late tikka leaf spot, Incubation period, Latent period, Tolerance, hydroponics.*

Groundnut, cultivated during *kharif* and *rabi*-summer, is the major oil seed crop in India and it plays a major role in bridging the vegetable oil deficit in the country. Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan and Maharashtra are major groundnut growing states contributing about 80 per cent area and production in India. The average yield of *rabi*-summer groundnut is around 1600 kg/ha, whereas *kharif*-groundnut is around 1000 kg/ ha which is lower than that in major groundnut growing countries. This may be attributed to the rainfed nature of cultivation of this crop coupled with attack by a variety of diseases and insect pests.

Among the foliar fungal diseases, early leaf spot caused by *Cercospora arachidicola* Hori. and late leaf spot caused by *Phaeoisariopsis personata* Berke. & Curt. commonly called as 'tikka leaf spot disease' occurs in all major groundnut growing areas. The magnitude of yield losses caused by these diseases is very high ranges from 10 to 70% all over the world, but vary considerably from place to place and between seasons (Ghewande, 1983;1985;1990;Subrahmaniyam and McDonald, 1983). Tikka leaf spot (late)(LSS) caused by *Phaeoisariopsis personata* has endemic nature in major groundnut growing areas of the world. LLS causes severe defoliation and reduces both haulm and pod yields by more than 50% (McDonald,1985).

Managing late leaf spot disease using systemic chemicals after incidence of disease may not be economically viable and environmentally safe. Use of resistant and tolerant varieties/cultivars is a viable alternative as it will reduce disease incidence as well as infection frequency. Components of resistance such as incubation period, latent period, number of leaf spots, and lesion diameter play an important role in calculating infection frequency (Chiteka, 1988). Hence, present investigation was designed to compare susceptible (K-6) and tolerant (Kadiri Harithandhra) cultivars for studying pathological basis of tolerance.

## MATERIALS AND METHODS

The cultivars, *viz*., Kadiri Harithandhra (tolerant) and K-6 (susceptible) were selected to grow hydroponically for the late leaf spot screening study. Screening study was carried out during *rabi* 2019 under green house conditions at the Department of Plant Pathology, Agricultural College, Bapatla. Medium coarse quartz sand of diameter 1.00 mm was taken in transparent beakers of 1000 ml volume. Beakers were covered with brown sheet and black polythene bag to avoid algal growth as quartz sand with Hoagland solution is congenial for algal growth when exposed to sun. Nutrient solution was prepared (Hoagland and Arnon (1950) and added to beakers with quartz sand. Seeds of the two cultivars were sown at medium depth - each with two sets (one set for pathogen inoculation and another for distilled water) in five replications. Nutrients were supplied at weekly intervals.

Late leaf spot (LLS) diseased leaves were collected from field at 70 DAS. Conidia of *Phaeoisariopsis personata* were collected into sterile distilled water under aseptic conditions. Conidial

**Table 1. Late leaf spot lesion number on susceptible and tolerant cultivars at 7 and 21 days after inoculation (DAI)**

| Sl. No | Variety (A) | Lesion number (7 DAI) | | Mean | Lesion number (21 DAI) | | Mean |
|---|---|---|---|---|---|---|---|
| | | Without inoculation | With inoculation | | Without inoculation | With inoculation | |
| 1 | KADIRI HARITHANDHRA | 1.8 *(1.65**) | 39.6 (6.35) | 20.7 (4.0) | 2.0 (1.72) | 57.2 (7.62) | 29.6 (4.6) |
| 2 | K-6 | 7.0 (2.81) | 87.2 (9.38) | 47.1 (6.1) | 8.0 (2.95) | 106 (10.33) | 57.0 (6.6) |
| | Mean | 4.4 (2.2) | 63.4 (7.8) | | 5.0 (2.3) | 81.6 (8.9) | |
| | | A | B | A*B | A | B | A*B |
| S Em (±) | | 0.11 | 0.11 | 0.16 | 0.12 | 0.12 | 0.17 |
| CD (P=0.05) | | 0.34 | 0.34 | 0.48 | 0.36 | 0.36 | 0.51 |
| CD (P=0.01) | | 0.47 | 0.47 | 0.66 | 0.49 | 0.49 | 0.7 |
| CV (%) | | 7.16 | | | 6.75 | | |

* Mean lesion number from five replications
** Figures in parenthesis are square root transformed values

concentrations were determined with a haemocytometer. Conidial load in suspension was adjusted to $1x10^6$ conidia/ml and is applied to hydroponically grown groundnut cultivars at 40 DAS in one set. Another set of two cultivars were sprayed with distilled water. Immediately after spraying conidial suspension, plants were covered with transparent plastic sheets to maintain suitable conditions for disease development. Disease development was monitored starting from first day of inoculation. The parameters studied as the components of resistance are explained there under and data was taken from five replications and was analyzed using factorial CRD method.

**Components of resistance to LLS**

1. The incubation period (IP), defined as days from inoculation to appearance of the first lesion, was recorded on each leaf every day from 2 DAI to 21 DAI.
2. Latent period (LP), defined as days from inoculation to the appearance of the first sporulating lesion, was recorded on each leaf every alternate day from 7 to 21 DAI by scraping lesions.
3. Lesion number (LN), the average number of lesions on three quadrifoliate leaves, was counted at 7 and 21 DAI.
4. Lesion diameter (LD), the average diameter (in mm) of five randomly selected lesions on each quadrifoliate leaf, was measured at 13, 17 and 21 DAI.

## RESULTS AND DISCUSSION

The results on comparison provided a clear-cut differentiation between susceptible and tolerant cultivars based on artificial inoculations with spore concentration @ $1x10^6$ conidia/ml.

**Incubation period and latent period**

Incubation period of both the cultivars grown hydroponically was seven days under greenhouse conditions showing pin head sized spots on abaxial surface of leaf. Spots became more prominent on adaxial surface of K-6 leaf at eight days after inoculation (DAI) whereas spots on Kadiri Harithandhra became prominent at 10DAI. Latent period of Kadiri Harithandhra (17 days) was higher compared to K-6 (14 days). Lesions on K-6 cultivars took seven days for sporulation, while lesions on Kadiri Harithandhra took 10 days for sporulation from the day of first symptom appearance.

Incubation period did not appear to be a useful component for resistance to late leaf spot as there was no difference in incubation periods recorded. Chiteka *et al.* (1988) reported that incubation periods did not vary among the 116 genotypes tested under green house conditions against late tikka leaf spot. However, variation existed among the test genotypes in terms of latent period. Seventy two genotypes in the field and 68 genotypes in the greenhouse had latent period value of 22 days or less. Further, Deshmukh *et al.* (2018) reported that the mean incubation and latent periods in modified detached leaf assay were the longest in

**Table 2. Late leaf spot lesion diameter on susceptible and tolerant cultivars at 13,17 and 21days after inoculation (DAI)**

| S. No. | Variety (A) | Lesion diameter in mm (13 DAI) | | Mean | Lesion diameter in (17 DAI) | | Mean | Lesion diameter in mm (21 DAI) | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Without inoculation | with inoculation | | without inoculation | with inoculation | | without inoculation | with inoculation | |
| 1 | KADIRI HARITHANDHRA | 1.0* (1.41**) | 1.0 (1.39) | 1.0 (1.40) | 1.0 (1.41) | 1.3 (1.51) | 1.2 (1.46) | 1.6 (1.60) | 1.7 (1.64) | 1.7 (1.62) |
| 2 | K-6 | 1.2 (1.48) | 1.4 (1.54) | 1.3 (1.51) | 1.6 (1.61) | 1.8 (1.67) | 1.7 (1.64) | 1.8 (1.67) | 3.1 (2.02) | 2.5 (1.84) |
| | Mean | 1.1 (1.44) | 1.2 (1.46) | | 1.3 (1.51) | 1.6 (1.59) | | 1.7 (1.63) | 2.4 (1.83) | |
| | | A | B | A*B | A | B | A*B | A | B | A*B |
| S Em (±) | | 0.04 | 0.04 | 0.05 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.04 |
| CD (P=0.05) | | NS | NS | NS | 0.06 | 0.06 | NS | 0.09 | 0.09 | 0.13 |
| CD (P=0.01) | | NS | NS | NS | 0.09 | 0.09 | NS | 0.13 | 0.13 | 0.18 |
| CV (%) | | 9.08 | | | 4.52 | | | 5.9 | | |

* Mean lesion number from five replications

** Figures in parenthesis are square root transformed values

resistant cultivar GPBD 4 (16 and 19.5 DAI), moderate in ICGV 13193 (13 and 17.3 DAI) and the shortest in susceptible cultivar (8 and 13 DAI) at 24 $^0$C and 85% relative humidity.

**Lesion number and lesion diameter**

Lesion number and lesion diameter on qua drifoliate leaf were found to be higher in susceptible K-6, *i.e.*, 36 and 3.1 mm respectively when compared to tolerant Kadiri Harithnndhra (19 and 1.62 mm)

Lesion number of three quadrifoliate leaves was higher in susceptible K-6 with inoculation than without inoculation,*i.e.*,87 and 7 respectively, when compared to tolerant Kadiri Harithandhra (39 and 2) at 7 DAI. At 21 DAI, lesion number in K-6 (106) was higher, *i.e.*, than that in Kadiri Harithandhra (57). Lesion number on susceptible and tolerant cultivars as well as varietal and inoculation interaction showed significant difference at 7 and 21 DAI (Table 1, Plate 1).

Lesion diameter of late leaf spot was higher in susceptible K-6 with inoculation than without inoculation, *i.e.*, 3.1 and 1.8 respectively when compared to tolerant Kadiri Harithandhra (1.8 and 1.7) at 21 DAI. There was significant difference in the lesion diameter in the two test cultivars and varietal and inoculation interaction at 21 DAI, however, lesion diameter was significant while varietal and inoculation interaction was non-significant at 17 DAI. Lesion diameter at 13DAI on different cultivars was non-significant (Table 2).

Lesion number and lesion diameter in susceptible and tolerant cultivars showed significant difference at 21 DAI. Inoculation has significant difference on lesion diameter at later period of infection, *i.e.*, 21 DAI but initially, this difference was not significant at 13 DAI.

These results were in accordance with Deshmukh *et al.* (2018) who reported smaller lesion diameter of 1.4 mm in resistant cultivar GPBD 4 compared to the largest lesions (4.7 mm) in susceptible cultivar TMV 2.

Parameters like longer latent period and lesser lesion number with lesser lesion diameter contribute to tolerance in Kadiri Harithandhra as these components delay the progress of disease development. Ricker *et al.* (1985) reported that genotypes with longer latent periods and fewer sporulating lesions generally had a longer period until leaflet defoliation. Chiteka *et al.* (1988) observed that resistant genotypes had smaller lesions and longer latent periods. Dwivedi *et al.* (2002) opined that resistance to LLS was due to longer incubation and latent periods, lesser lesions per leaf, smaller lesion diameter, lower sporulation index, and lesser leaf area damage and disease score.

Among different methods used to screen genotypes for disease tolerance, components of resistance studied in hydroponically grown plants under greenhouse conditions were more appropriate than detached leaf assay as disease development of late leaf spot caused by the hemibiotroph *Phaeoisariopsis*

**Susceptible K-6 cultivar at 7 DAI**

**Tolerant Kadiri Harithandhra cultivar at 7 DAI**

**Susceptible K-6 cultivar at 21 DAI**

**Tolerant Kadiri Harithandhra cultivar at 21 DAI**

**Plate 1. Late leaf spot disease incidence on susceptible and tolerant cultivars at 7 and 21 days after inoculation (DAI)**

*personata* was more akin to the disease development under field conditions. Izge *et al.* (2007) too recommended that development or selection of tolerant varieties to leaf spot should be based on their level of incidence which is based on components of resistance to LLS.

## CONCLUSION

To screen for tolerance hydroponically grown plants was proven to be more reliable method. Disease tolerance in selected groundnut cultivar was governed by lesser number of lesions with lesser lesion diameter and higher latent period as these components delay the onset of disease and progress of disease development.

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