INTERNATIONAL JOURNAL OF PLANT PROTECTION | VOLUME 7 | ISSUE 1 | APRIL, 2014 | 177-181
e ISSN-0976-6855 | *www.researchjournal.co.in* | Open Access

IJPP

RESEARCH ARTICLE

# Evaluation of sunflower germplasm/cultivars for resistance to sunflower necrosis disease

■ BHARATI N. BHAT[1]* AND S. CHANDER RAO[2]

[1]Department of Plant Pathology, College of Agriculture, Acharya N.G. Ranga Agricultural University, Rajendranagar, HYDERABAD (A.P.) INDIA

[2]Directorate of Oilseeds Research, Rajendranagar, HYDERABAD (A.P.) INDIA

ARITCLE INFO

**Received** : 24.01.2014
**Revised** : 08.03.2014
**Accepted** : 17.03.2014

**K**ey **W**ords :
Sunflower necrosis disease, Germpalsm/ cultivars, Screening, Resistance

***Corresponding author:**
Email: bharatinbhat@gmail.com

ABSTRACT

Cultivation of resistant varieties is the most economical way of managing virus diseases of plants as the control of vector borne virus diseases is very difficult to contemplate. Twenty R lines, 12 CMS A and B lines, 100 germplasm lines and 12 cultivars of sunflower were evaluated against sunflower necrosis disease under artificial inoculated conditions using a six point scale. All R lines and CMS lines showed highly susceptible reaction. Of one hundred germplasm lines screened, 8 were moderately susceptible, 23 were susceptible and 69 were highly susceptible. Of the 12 sunflower cultivars screened, 5 and 7 cultivars exhibited highly susceptible and susceptible reaction, respectively. Based on the type of symptoms produced by the sunflower lines on artificial inoculation, they were classified into seven groups *viz.*, mosaic (twenty eight lines), local lesions (nine lines), necrosis (50 lines), chlorosis (12 lines), mottling or narrow leaves (14 lines), mosaic and local lesions (seven lines), while 36 lines exhibited mixed symptoms.

**How to view point the article :** Bhat, Bharati N. and Rao, S. Chander (2014). Evaluation of sunflower germplasm/cultivars for resistance to sunflower necrosis disease. *Internat. J. Plant Protec.*, **7**(1) : 177-181.

## INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important edible oilseed crop in the country next to groundnut and soybean. The area of this crop is decreasing gradually. One of the major factors for reduction in area of the crop is being attributed to the occurrence of sunflower necrosis disease (SND) resulting in yield loss up to 90 per cent in most of the sunflower growing regions of Southern India (DOR Annual Report, 2001 and Bhat *et al.*, 2002). The disease has now spread to almost all the sunflower growing states of the country. In Andhra Pradesh, SND has been reported to occur in almost all the popular sunflower hybrids grown during *Kharif, Rabi* and summer seasons with varied intensity because of continuous cultivation resulting in both qualitative and quantitative losses. The disease can cause crop losses to an extent of 100 per cent depending on the cultivar /variety and stage of infection and has become a major limiting factor in sunflower production.

Presently all the hybrids / varieties under cultivation have shown more or less susceptibility to this disease (Babu *et al*., 2007, Lokesh *et al.*, 2008, Patil and Shirshikar, 2009). Being a viral disease, it is difficult to combat the disease through spray schedule and cost of insecticide is also a limiting factor. So far, no resistant sources were reported against SND. Hence, screening of various sunflower lines comprising R lines/CMS lines/germplasm/cultivars was undertaken by mechanical sap inoculation of the test virus under insect proof glass house conditions.

## MATERIAL AND METHODS

**Screening of sunflower cultivars / hybrids and germplasm lines :**

For glasshouse screening, the entries comprising of 20 R lines, 12 CMS A and B lines, 100 germplasm lines and 12 hybrids / varieties were raised in earthen pots (6" diameter)

@ 5 seeds per pot in two replications under insect proof conditions. Ten days old (2 leaf stage) seedlings were inoculated with freshly prepared standard extract of virus inoculum @1: 50 concentration. Uninoculated plants served as control. Observations on type of symptoms, time taken for local and systemic infection, per cent disease incidence (PDI) and disease severity (DS) were recorded.

$$PDI = \frac{\text{Number of plants inf ected}}{\text{Total number of plants}} \times 100$$

**Disease reaction :**

Based on per cent disease incidence, the test lines were categorized into six distinct categories using 0-5 scale as described by Chander Rao and Santha Lakshmi Prasad (2009).

| Per cent disease incidence | Reaction category |
|---|---|
| 0 | Immune |
| 1-10 | resistant (R) |
| 11-25 | Moderately resistant (MR) |
| 26-50 | Moderately susceptible (MS) |
| 51-75 | Susceptible (S) |
| > 75 | Highly susceptible (HS). |

**Disease severity :**

The disease severity (DS) was scored based on the symptom intensity of the infected plants following five point scale (1-5) as described by Chander Rao and Santha Lakshmi Prasad (2009).

| Grade | Symptom intensity |
|---|---|
| 1. | No symptoms (Healthy) |
| 2. | Necrosis on inoculated leaves only |
| 3. | Systemic chlorotic symptoms |
| 4. | Systemic chlorotic and necrotic symptoms |
| 5. | Severe chlorosis and necrosis and premature death of the plant |

$$DS = \frac{\text{Sum of all the numerical ratings of plants}}{\text{Total number of plants scored}} \times \frac{100}{\text{Maximum grade}}$$

## RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

**Screening sunflower cultivars / germplasm lines against SND under inoculated conditions :**

Twenty R lines, 12 each CMS A and B lines, 100 germplasm lines and 12 cultivars were tested for SND resistance by mechanical sap inoculation under insect proof conditions. The results indicated that reaction of sunflower cultivars / R lines / CMS lines / germplasm lines widely varied under artificially inoculated conditions. Out of 156 genotypes tested for their resistance to SND under glass house

**Table 1 : Reaction of sunflower R lines to SND under high disease pressure through sap inoculation**

| Sr. No. | R line | Days taken to appearance of symptoms | | Types of symptoms | Disease incidence (%) | Disease reaction* | Disease severity (%) |
|---|---|---|---|---|---|---|---|
| | | Primary | Systemic | | | | |
| 1. | R-843 | 6 | 16 | TN, M | 100 | HS | 80.0 |
| 2. | RES-834-1 | 7 | 15 | TN | 100 | HS | 95.0 |
| 3. | RHA-856 | 6 | 16 | M | 100 | HS | 80.0 |
| 4. | RHA-441 | 7 | 17 | Nrl | 80 | HS | 77.5 |
| 5. | RHA-418 | 5 | 13 | CN | 100 | HS | 85.0 |
| 6. | RHA-272 | 7 | 17 | Mo, RLS | 100 | HS | 87.5 |
| 7. | RHA-272-2 | 6 | 16 | TN | 100 | HS | 95.0 |
| 8. | RHA-272-I | 6 | 15 | TN | 100 | HS | 90.0 |
| 9. | RHA-288 | 6 | 15 | M, Mo | 100 | HS | 90.0 |
| 10. | RHA-298 | 5 | 15 | M, CL | 100 | HS | 95.0 |
| 11. | RHA-341 | 7 | 17 | M, TN | 100 | HS | 95.0 |
| 12. | RHA-346 | 7 | 17 | NL, Cl | 100 | HS | 85.0 |
| 13. | RHA-348 | 6 | 16 | Mo, NL | 100 | HS | 90.0 |
| 14. | RHA-354 | 7 | 17 | TN, CL | 100 | HS | 95.0 |
| 15. | NDLR-1 | 5 | 13 | CN | 100 | HS | 95.0 |
| 16. | RHA-02 | 5 | 14 | TN, Cl | 100 | HS | 90.0 |
| 17. | RHA-6D1 | 6 | 15 | RLS, Cl | 100 | HS | 82.5 |
| 18. | RHA-16 | 8 | 16 | M | 80 | HS | 87.5 |
| 19. | RHA-17 | 8 | 16 | M, CL | 100 | HS | 82.5 |
| 20. | RHA-23 | 8 | 17 | M, RLS | 100 | HS | 85.0 |

Cl – Chlorosis, CL – Chlorotic lesions, CN – Complete necrosis, M – Mosaic, Mo – Mottling, NL -Necrotic lesions, Nrl – Narrow leaves, TN – Tip necrosis, RLS – Reduced leaf size, *HS : Highly susceptible

conditions, none of them was found to be highly resistant or resistant or moderately resistant against SND.

**Screening of R lines :**

Out of 20 R lines screened for SND resistance, all the lines were highly susceptible and per cent disease incidence was 80 per cent in RHA-441 and RHA-16 (Table 1). RHA-441 recorded minimum disease severity of 77.5 per cent followed by RHA-856 and R-843 (80 %). Six lines *viz*., RES-834-1, RHA-272-2, RHA-298, RHA-341 (dwarf), RHA-354 and NDLR-1 recorded highest disease severity (95 %).

The time taken for local and systemic symptom expression ranged from 5-8 days and 13-17 days, respectively. Symptoms produced by all the R lines were chlorotic lesions, chlorosis, mosaic, mottling, necrotic lesions and tip necrosis.

**Screening of CMS lines :**

Artificial screening of 24 CMS lines (12 each A and B) revealed that all CMS lines were highly susceptible to SND (Table 2). The per cent disease incidence ranged from 80-100 per cent. CMS-1A recorded minimum per cent disease incidence (80 %). Disease severity ranged from 80 per cent (CMS-1A) to 95 per cent (CMS-7-1A, CMS-10-A, CMS-17-B, CMS-300-A, CMS-300-B, CMS -302-A, CMS -338B, CMS -339/1A, CMS- 343/A, CMS- 343/B, CMS-378A, CMS-378B, CMS-607A and CMS-607B).

Time taken for primary and systemic symptom expression varied from 5-8 days and 10-12 days, respectively.

**Screening of germplasm lines :**

Out of 100 germplasm lines tested, none of the lines was found resistant to SND. Eight lines *viz*., GMU- 329, 355, 385, 535, 1002, 1064, 1094 and 1178 were found to be moderately susceptible which recorded 40 per cent disease incidence. Disease severity of germpasm lines tested ranged from 20 per cent (GMU-329, 535 and 1178) to 60 per cent (GMU-342).

Time taken for primary symptom expression ranged from 5 days to 6-7days. Time taken for systemic symptom expression ranged from 11 days (GMU- 364, 386, 395, 522, 1002 and GMU-1033) to 17 days (GMU-329).

**Screening of hybrids/varieties :**

Out of 12 cultivars (hybrids/varieties) screened for SND resistance, seven cultivars *viz*., GK-2002, GK-2008, Sunbred-

**Table 2 : Reaction of sunflower CMS lines to SND under high disease pressure through sap inoculation**

| Sr. No. | CMS line | Days taken to appearance of symptoms | | Types of symptoms | Disease incidence (%) | Disease reaction* | Disease severity (%) |
|---|---|---|---|---|---|---|---|
| | | Primary | Systemic | | | | |
| 1. | CMS-1A | 6-7 | 10 | M | 80 | HS | 80 |
| 2. | CMS-1B | 5 | 10 | N | 100 | HS | 90 |
| 3. | CMS-7-1A | 6 | 11 | M, Mo | 90 | HS | 95 |
| 4. | CMS-7-1B | 6 | 10 | M, N | 100 | HS | 90 |
| 5. | CMS-10-A | 6 | 10-12 | M, N | 100 | HS | 95 |
| 6. | CMS-10-B | 6 | 10 | N | 100 | HS | 90 |
| 7. | CMS-17-A | 6 | 10 | N | 100 | HS | 85 |
| 8. | CMS-17-B | 5-6 | 10 | M, N | 100 | HS | 95 |
| 9. | CMS-300-A | 6 | 10 | M, Mo | 100 | HS | 95 |
| 10. | CMS-300-B | 6 | 10 | M | 100 | HS | 95 |
| 11. | CMS 302-A | 6 | 10-11 | M, Mo | 100 | HS | 95 |
| 12. | CMS 302-B | 6-7 | 10 | M | 100 | HS | 85 |
| 13. | CMS 335A | 8 | 11 | M | 90 | HS | 85 |
| 14. | CMS 335B | 7 | 11 | M | 100 | HS | 90 |
| 15. | CMS 338A | 7 | 10 | N | 95 | HS | 90 |
| 16. | CMS 338B | 7 | 11 | M | 95 | HS | 95 |
| 17. | CMS 339/1A | 6 | 10 | M | 90 | HS | 95 |
| 18. | CMS 339/1B | 6 | 10 | M | 100 | HS | 90 |
| 19. | CMS 343/A | 6 | 10 | N | 100 | HS | 95 |
| 20. | CMS 343/B | 6 | 10 | M | 100 | HS | 95 |
| 21. | CMS-378A | 6 | 10 | M, N | 100 | HS | 95 |
| 22. | CMS-378B | 6 | 11 | M, Nrl | 100 | HS | 95 |
| 23. | CMS-607A | 6 | 11 | M | 100 | HS | 95 |
| 24. | CMS-607B | 5 | 10 | M, N | 100 | HS | 95 |

M – Mosaic, Mo – Mottling, N – Necrosis, Nrl – Narrow leaves *HS : Highly susceptible

**Table 3 : Reaction of sunflower cultivars (hybrids / variety) to SND under high disease pressure through sap inoculation**

| Sr. No. | Cultivar | Days taken to appearance of symptoms | | Type of symptoms | Disease incidence (%) | Disease reaction* | Disease severity (%) |
|---|---|---|---|---|---|---|---|
| | | Primary | Systemic | | | | |
| 1. | Morden | 6-7 | 15-20 | CL, NL | 100 | HS | 68.3 |
| 2. | KBSH-1 | 7-8 | 18-20 | Cl | 83.3 | HS | 53.3 |
| 3. | KBSH-41 | 7-8 | 15-18 | N | 76.6 | HS | 46.6 |
| 4. | KBSH-44 | 7-8 | 15-18 | N | 80.0 | HS | 45.0 |
| 5. | KBSH-53 | 8-10 | 20-22 | Cl | 73.3 | S | 45.0 |
| 6. | GK-2002 | 10-12 | 20-22 | Cl | 63.3 | S | 33.3 |
| 7. | GK-2008 | 10-12 | 20-22 | Cl | 60.0 | S | 40.0 |
| 8. | S-275 | 8-10 | 15-20 | CL | 63.3 | S | 36.6 |
| 9. | S-207 | 8-10 | 15-20 | CL | 60.0 | S | 33.3 |
| 10. | N X 00997 | 12-13 | 20-25 | Cl | 56.6 | S | 31.6 |
| 11. | DRSH-1 | 8-10 | 15-18 | Cl | 73.3 | S | 46.6 |
| 12. | DRSF-108 | 8-10 | 15-20 | Cl | 76.6 | HS | 45.0 |

Cl – Chlorosis, CL – Chlorotic lesions, NL – Necrotic lesions, N- Necrosis *HS : Highly susceptible , S : Susceptible

**Table 4 : Grouping of sunflower R lines, CMS A and B lines, germplasm lines and cultivars based on symptomatology**

| Sr. No. | Type of symptoms | No. of lines |
|---|---|---|
| 1. | Mosaic | 28 |
| 2. | Local lesions | 9 |
| 3. | Necrosis | 50 |
| 4. | Chlorosis | 12 |
| 5. | Mottling/narrow leaves | 14 |
| 6. | Mosaic and local lesions | 7 |
| 7. | Mixed symptoms ( 2+3 ) | 36 |

275, Sunbred-207, N X 00997, KBSH-53 and DRSH-1 were susceptible (Table 3). Whereas, five cultivars *viz*., Morden, KBSH-1, KBSH-41, KBSH-44 and DRSF-108 recorded more than 75 per cent disease incidence and showed highly susceptible reaction.

Minimum per cent disease incidence was recorded in NX 00997 (56.6 %) followed by Sunbred-275 and Sunbred-207 (60 %) on artificial inoculation. Disease severity was minimum in NX 00997 (31.6 %) followed by Sunbred -207 and GK-2002 (33.3 %) and maximum in Morden (68.3 %).Time taken for expression of primary symptoms ranged from 6-13 days.

**Grouping of sunflower R lines, CMS A and B lines, germplasm lines and cultivars based on symptomatology :**

When the lines were screened under high inoculum pressure, also expressed different types of symptoms of SND. Based on the type of symptoms produced by the sunflower lines/cultivars on artificial inoculation, they were classified into seven groups (Table 4). The genotypes tested for SND reaction exhibited different types of symptoms *viz*., chlorotic lesions, necrotic lesions, complete necrosis, top necrosis, mosaic etc. Similar type of difference in symptom expression was observed in various genotypes of groundnut and sunflower indicating that not all the cultivars were equally susceptible to TSV (Lava Kumar *et al*., 2008).

In the present study, none of the R lines /CMS lines / germplasm lines /cultivars of sunflower screened under artificial inoculated conditions using sap of the test virus were immune or resistant or moderately resistant to the SND. The results are in agreement with the earlier findings of DOR Report (2000) and Patil and Shirshikar (2009) which revealed that most of the tested sunflower germplasm / cultivars were susceptible to SND.

## REFERENCES

**Babu, S.S., Reddy, A.V., Reddy, K.R., Sekhar, M.R., Reddy, N.P.E., Reddy, K.B., and Ismail. (2007).** Screening of sunflower genotypes against sunflower necrosis disease under field conditions. *Crop Res.*, **33**(1) : 223-225.

**Bhat, A.I., Jain, R.K., Kumar, A., Ramiah, M. and Varma, A. (2002).** Serological and coat protein sequence studies suggest that necrosis disease on sunflower in India is caused by strain of *Tobacco streak Ilarvirus*. *Archives Virol.*, **147** (3) : 651-658.

**Chander Rao, S. and Santha Lakshmi Prasad, M. (2009).** Screening methodology for Alternaria leaf blight and sunflower necrosis disease (SND). *Training manual.* Directorate of Oilseeds Research, Hyderabad, 42 pp.

**DOR Annual Report, (2000).** Annual progress report of AICRP on oilseeds-sunflower, 2000-01, Directorate of Oilseed Research, Hyderabad, 204 pp.

**DOR Annual Report, (2001).** Annual progress report of AICRP on oilseeds-sunflower, 2001-02, Directorate of Oilseed Research, Hyderabad, 196 pp.

**Lava Kumar, P., Prasada Rao, R.D.V., Reddy, A.S., Jyothirmai Madhavi, K., Anitha, K. and Waliyar, F. (2008).** Emergence and spread of *Tobacco streak virus* menace in India and control strategies. *Indian J. Pl. Prot.*, **36** (1) : 1-8.

**Lokesh, B.K., Nagaraju Jagadish, K.S. and Shadakshari, Y.G. (2008).** Disease reaction of sunflower genotypes against sunflower necrosis virus disease and its vector, *Thrips palmi* under field condition. *Environ. & Ecol.*, **26**(4) : 1552-1556.

**Patil, S.V. and Shirshikar, S.P. (2009).** Evaluation of sunflower germplasm against sunflower necrosis disease. *J. Soils & Crops*. **19**(2) : 283-286.