International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 04-01-2021; Accepted: 19-01-2021; Published: 11-02-2021
Volume 3; Issue 1; 2021; Page No. 252-255

Assesment of yield loss due to stem canker of pigeonpea at different stages of crop growth

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Abstract
Stem canker of pigeonpea is caused by *Macrophomina phaseolina* is a seed as well as soil borne necrotrophic fungal pathogens infect more than 284 plant species including monocot and dicots throughout the world. It is the most destructive disease and causing severe yield loss in major pigeonpea growing areas of North-Eastern Karnataka. As the disease is more prevalent during hot temperature of 30 to 35 °C and low soil moisture conditions causing huge losses to the pigeonpea production. By considering the importance of the crop and disease, estimation of yield loss due to stem canker of pigeonpea caused by *Macrophomina phaseolina* at different stages of crop growth was need of the hour, particularly in the pulse growing districts of North Eastern Karnataka. Yield loss due to stem canker is estimated by randomly selecting the plants showing stem canker symptoms using disease rating scale. Three major pigeonpea genotypes were selected (Maruthi, TS3R and GRG-811). Among all the three varieties, Maruthi Grade 5 (highly susceptible) plants recorded 514 kg per hectare which shows 40.61 per cent decrease in the yield compared to the healthy plant, In the variety TS3R Grade 5 plants (Highly susceptible) recorded 912 kg per hectare which shows 28.71 per cent decrease in the yield compared to the healthy plant, In the variety GRG-811 Grade 5 plants (Highly susceptible) recorded 904 kg per hectare which shows 34.25 per cent decrease in the yield compared to the healthy plant.

Keywords: Maruthi, TS3R, GRG-811, by *Macrophomina phaseolina*, yield

Introduction
Pigeonpea (Redgram) [*Cajanus cajan* (L.) Millsp.] is a diploid legume crop species ($2n = 2x = 22$) and a member of the tribe *Phaseoleae*. It is commonly known as redgram or arhar or tur, is one of the important legume crops grown in tropics and subtropics. It is grown in almost all states of India which restores soil fertility by fixing atmospheric nitrogen (N_2) and has the ability to solubilize even fixed phosphorus (Ae *et al*., 1990) [1]. The heavy shedding of pigeonpea leaves adds high matter of organic matter to the soil. Pigeonpea has multiple uses such as tender green seeds used as vegetables, stem and roots as fuel wood, besides its main use as dhal.

Fungus exists in two forms, one saprophytic and another is pathogenic. The former (*R. bataticola*) mainly produces microsclerotia and later pathogen is (*M. phaseolina*) where the pathogen mainly produces asexual fruiting body (pycnidia). In pathogenic stage the fungus is in non-host specific and attacks wide range of economically important crops such as maize, common beans, mung bean, soybean and urdbean *etc*., (Dhingra and Sinclair, 1978a) [2].

In pigeonpea field, on the onset of the stem canker disease appears as symptoms ranged from restricted spindle-shaped lesions with grey centre surrounded by brown margin on the stems of the plants, to extended lesions causing drying of the whole plant. Drooping of pod-loaded branches (secondary) is common in affected plants. Scoring for disease was done at podding stage on the basis of severity of symptoms on stem and branches (Anon., 1982) [3].

Material and methods
Three ruling varieties were selected for estimating the yield loss due to *Macrophomina* stem canker *viz*., Maruthi, TS3R and GRG-811. These varieties were grown in plot (size of the plot: 4 m × 7.2 m) with spacing: 90 × 30 cm during *kharif* 2018. The genotypes were obtained from the breeder AICRP Zonal Agricultural Research Station (ZARS).

Rating scale

Table 1: Disease rating scale for Macrophomina stem canker disease of pigeonpea (Modified from Agarwal, 2003) [4]

Grade	Symptoms	Reaction
1	1-10 % incidence with 1-5 lesions/plant	Resistant
2	10-25 % incidence with 10-15 lesions/plant	Moderately resistant
3	25-50 % incidence with 15-20 lesions/plant	Moderately Susceptible
4	50-75 % incidence with 20-25 lesions/plant	Susceptible
5	>75 % incidence with >25 lesions/plant and drying of branches	Highly susceptible

Results and Discussion
Yield loss due to stem canker was calculated by randomly selecting the plants showing stem canker symptoms using disease severity under natural conditions. Based on disease rating scale 10 plants were tagged per each grade, finally seed yield (g) per

plant, seed yield (kg) per plot and seed yield (kg/ha) were calculated and presented in the tables 12, 13 and 14.

Three ruling varieties were selected for estimation the yield loss due to *Macrophomina* stem canker *viz*., Maruthi, TS3R and GRG-811.

In the variety Maruthi, Plants of grade 5 with disease severity (76.50 %) recorded very less seed yield of 514 kg per hectare which shows 40.61 % decrease in the yield compared to the healthy plants, followed by plants of grade 4 with disease severity of (52.00 %) recorded 609 kg per hectare which shows 30.16 % decrease in the yield compared to the healthy plant. Whereas, Plants of grade 1 with disease severity of (8.70 %) recorded more seed yield (872 kg per hectare) compared to plants of grade 4 and 5. whereas healthy plants recorded highest seed yield (921 kg). Maximum yield loss (40.61 %) was observed in plants with grade 5 (Table 12).

In the variety TS-3R, Plants of grade 5 with disease severity (77.75 %) yielded 912 kg per hectare which shows (41.69 %) decrease in the yield compared to the healthy plants, followed by plants of grade 4 with disease severity (53.20 %) yielded 1051 kg per hectare which shows (32.80 %) decrease in the yield compared to the healthy plants, Whereas, Plants of grade 1 with disease severity of (9.15 %) recorded more seed yield (1519 kg per hectare) compared to plants of grade 4 and 5. whereas healthy plants recorded highest seed yield (1564 kg per hectare). Maximum yield loss (41.69 %) was observed in plants with grade 5 (Table 13).

In the variety GRG-811, Plants of grade 5 with disease severity (76.21 %) recorded 904 kg per hectare which shows (34.25 %) decrease in the yield compared to the healthy plants, followed by plants of grade 4 with disease severity (51.25 %) recorded 1011 kg per hectare which shows (28.85 %) decrease in the yield compared to the healthy plants, Whereas, Plants of grade 1 with disease severity of (7.75 %) recorded more seed yield (1375 kg per hectare) compared to plants of grade 4 and 5. whereas healthy plants recorded highest seed yield (1421 kg per hectare). Maximum yield loss (76.21 %) was observed in plants with grade 5 (Table 14).

The present findings are in agreement with Ahmed and Mohammad (1986) [6] reported that yield loss due to dry root rot caused by *R. bataticola* of chickpea at full podding stage have been estimated to the extent of (70.8 %) and at pre harvest stage it is (48.9 %). Similar results were reported by Usha rani *et al*., 2009 [5] in groundnut that the dry root rot caused by *M. phaseolina* causes serious economic losses ranging from 20 to 30 % under dry warm conditions.

The prolonged dry spell, variation in soil temperature and severe moisture stress favours the pathogen particularly at maturity stage of the crop growth. In initial stages slight browning of the stem circumference at the collar region and the appearance of few lesions on the stem. In severe stages severe girdling of the stem, plants breaks, complete drying of the branches and death of plants.

Conclusion

- In the variety Maruthi Grade 5 (highly susceptible) plants recorded 514 kg per hectare which shows 40.61 per cent decrease in the yield compared to the healthy plant, where as healthy plant shows 921 kg seed yield per hectare.
- In the variety TS3R Grade 5 plants (Highly susceptible) recorded 912 kg per hectare which shows 28.71 per cent decrease in the yield compared to the healthy plant, where as healthy plant shows 1564 kg seed yield per hectare.
- In the variety GRG-811 Grade 5 plants (Highly susceptible) recorded 904 kg per hectare which shows 34.25 per cent decrease in the yield compared to the healthy plant, where as healthy plant shows 1421 kg seed yield per hectare

Table 2: Effect of stem canker disease on yield in Maruthi variety

Sl.No.	Grade	Disease severity (%)	Seed yield per plant (g)	Seed yield per plot (Kg)	Seed yield (Kg/ha)	Per cent decrease over healthy plant
1	1	8.70	24.71	2.57	872	5.32
2	2	19.25	21.63	2.25	784	14.88
3	3	35.30	19.70	2.05	713	22.58
4	4	52.00	16.86	1.75	609	30.16
5	5	76.50	14.20	1.48	514	40.61
6	Healthy plant	0.00	25.20	2.62	921	--

Table 3: Effect of stem canker disease on yield in TS-3R variety

Sl.No.	Grade	Disease severity (%)	Seed yield per plant (g)	Seed yield per plot (Kg)	Seed yield (Kg/ha)	Per cent decrease over healthy plant
1	1	9.15	42.06	4.37	1519	2.88
2	2	22.26	38.16	3.97	1439	11.83
3	3	38.40	35.40	3.68	1281	18.09
4	4	53.20	29.10	3.02	1051	32.80
5	5	77.75	25.25	2.62	912	41.69
6	Healthy plant	0.00	43.30	4.50	1564	--

Table 4: Effect of stem canker disease on yield in GRG-811 variety

Sl.No.	Grade	Disease severity (%)	Seed yield per plant (g)	Seed yield per plot (Kg)	Seed yield (Kg/ha)	Per cent decrease over healthy plant
1	1	7.75	38.09	3.96	1375	3.24

2	2	18.85	35.44	3.68	1280	9.92
3	3	35.24	31.15	3.24	1125	20.83
4	4	51.25	27.96	2.91	1011	28.85
5	5	76.21	25.03	2.60	904	34.25
6	Healthy plant	0.00	39.30	4.09	1421	--

Fig 1: Different stages of symptoms of *Macrophomina* stem canker of pigeonpea

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