Performance of Pigeonpea (*Cajanus cajan*) varietiesagainst Sterility Mosaic Disease(SMD) for rainfed regions of Prakasam District

Abstract:

Pigeonpea is one of the most significant grain legumes in India, accounting for 90 per cent of global production. It is primarily farmed and consumed in poor nations, with India being a major producer.The area under Red gram crop in Prakasam district is about 1,00,000 hectares, which is under Rainfed cultivation during *Kharif* season, as a sole crop. The occurrence of Sterility Mosaic Disease has resulted in significant yield loss over the last three years in Prakasam District. Therefore, the present study has been undertaken to study the performance of seven varieties for the disease incidence and yield attributes that are suitable for rainfed region of Prakasam district were evaluated. Among the varieties evaluated, no disease incidence was observed in BSMR 736 (842 kg/ha), ICPL87119 (816 kg/ha) followed by TRG 59 with disease incidence of 8.67 per cent and yield of 756 kg/ha. The variety GRG 152 recorded disease incidence of 4.47 per cent and yield of 610 kg/ha. The variety LRG 105 recorded disease incidence of 26.33 per cent and yield of 546 kg/hawhich was found to be moderately resistant. These results are significant for selecting resistant genotypes and can be utilized in the future validation and development of more SMD resistant pigeonpea genotypes.

Keywords: Pigeonpea, Sterility mosaic disease, Percent disease incidence,Moderately Resistant, Resistant, Susceptible.

Introduction:

Pigeonpea, (*Cajanus cajan* [L.] Millsp) is one of the most versatilegrain legume crop grown in the semi-arid tropical and subtropicalregions between 25º N and 30º S in Asia, Africa and America (Van derMaesen, 1990).Pigeonpea is a major source of proteinenriches soil; provides fodder and fuel wood; and it is beneficial forarresting soil erosion (Saxena *et al*., 2002).It is consumed on a large scale in South Asia and is a major source of protein for the population of the Indian subcontinent. Globally, redgram is grown in an area of 63.57 lakh hectares with a production of 54.75 lakh tonnes and productivity of 861.25 kg/ha (FAO STAT, 2021).India ranks first in redgram production globally with 43.4 lakh tonnes cultivated under 49.8 lakh hectares with productivity of 871 kg/hectare in 2021-22 (agricoop.nic.in).

Pigeonpea in India is mainly grown in the semi-arid regions of thestates of Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh,Tamil Nadu and Uttar Pradesh because of its drought tolerance.Thesimultaneous use of pigeonpea for food, fodder and fuel, its ability toameliorate soils and its use as a hardy crop on marginal soils fitting intomany intercropping systems makes pigeonpea an important crop in thesemi-arid tropics.In Kharif 2022, production of redgramwas 38.9 lakh tonnes (1stadvance estimates) in an area of 46.2 lakh hectares (agricoop.nic). Maharashtra and Karnataka are the major producing states with an area of 12.98 and 12.40 lakh hectares, respectively. Andhra Pradesh produced 0.66 lakh tonnes of redgram cultivated in an area of 2.52 lakh hectares. Uttar Pradesh, Maharashtra and Telangana were found superior in terms of productivityof redgram. In Andhra Pradesh, redgram production (0.3 lakh tonnes) is highest in Prakasam district and area(63,000 ha) is highest in Kurnool district. The productivity of redgram is observed to be highest in the Guntur district (744 kg/ha).

Although, India leads the world both in area and production ofpigeonpea, its productivity is lower than the world average because productionis amenable for many biotic and abiotic constraints (e.g. drought, salinity and water-logging) andbiotic (e.g. diseases like Fusarium wilt, sterility mosaic and insects likepod borers) factors. Among diseases, Fusarium wilt and sterility mosaic disease (SMD) are the major threat which are drastically reducing theyield. Sterility mosaic disease (SMD), considered as the "green plague ofpigeonpea" caused by pigeonpea sterility mosaic virus (PPSMV) (Jones *etal*., 2004) and it is transmitted through eriophyid mite *Aceriacajani*.*Aceriacajani*ChannaBasavannais one of themajor biotic factors, which leads to heavy yield losses and hence poses abig challenge for pigeonpea production in the Indian subcontinent(Kannaiyan *et al*., 1984). Morethan 90 per cent of the crop would be lost if it occurs at the early stage ofthe crop growth (Bhaskaran and Muthiah, 2005).Pigeonpea sterility mosaic virus (PPSMV), a species of the genus *Emaravirus*, is the causal agent of sterility mosaic disease (SMD). This disease, dubbed the 'green plague', as the infected plants remain in the vegetative state without flower production, has been reported from India and a few other SouthEast Asian countries. SMD is estimated to result in an annual yield loss of over US$300 million in India alone (Basavaprabhu Patil *et al.*, 2008).Very few of the pigeonpea genotypes were found tocontain broad-based resistance to SMD, identification of pigeonpeasources that possess broad-based multiple resistance is vital to enhancethe pigeonpea production. Wild relatives of cultivated plant species havebeen suggested to contain useful resistant genes for diseases and pests(Remanandan, 1981).Breeding for resistant varieties is considered tobe one of the most effective and economic methods of reducing croplosses and has received top priority and this is most economical, inexpensive and eco-friendly for resource poor farmers. Therefore, present study was aimed to evaluate different pigeonpea genotypes for the sterility mosaic disease under rainfed conditions.

Materials and Methods:

Field experiment was conducted to evaluate yield response of redgram varieties in shallow soils of Krishnazone under rainfed conditions during *Kharif*,2022 at Agricultural Research Station, Darsi (Prakasam District) of Andhra Pradesh. The soil of the experimental site was red sandy loam with shallow depth, low in organic carbon (0.29%) and low in available nitrogen (85 kg ha^{-1}), medium in available phosphorous (28 kg ha^{-1}) and potassium (418 kg ha^{-1}).The experiment was laid out in large size plots as observational trial.The treatments consisted of seven varieties *viz.*, T_1: ICPL 87119 (Asha), T_2: BMR-736, T_3:GRG 152, T_4: GRG 811, T_5: TS3R, T_6: TRG 59 and T_7: LRG 105. The experimental field was prepared by working with a tractor drawn disc plough and then tractor drawn cultivator was drawn along the field. Healthy seeds of redgram varieties with good germination percent (95%) used for sowing purpose. Sowing was taken up as per the treatments. The seeds were sown by dibbling at a depth of 5 cm and were covered immediately after sowing and compacted sufficiently for better germination. Each genotype was sown in an area of $100m^2$ with a spacing of 180 x 20 cm. Thinning was done at 15 DAS by retaining one healthy seedling $hill^{-1}$. The recommended dose of 20 and 100 kg N and P_2O_5 ha^{-1} was applied through urea and single super phosphate respectively. Thinning and gap filling was done wherever necessary, weeding and hoeing were taken up depending on the intensity of weeds at critical stages of crop weed competition.Two hand weedings were done and all other cultural practices were uniform for all treatments.

Observationon the incidence ofSMD (%),days to 50% flowering (DFF), days to maturity (DM), Plant height (PH; cm), Numberof branches per plant, Numberof pods per plant, Seed yield (Kg/ha) andhundredseed weight (HSW; g) were recorded from ten randomly selected plants of eachgenotype.Data on sterility mosaic disease was recorded by counting total no. of plants per unit area and sterility mosaic disease infected plants in that area considering the visual symptoms described by Reddy *et al.* (1990). Both partially infected and fully infected plants were taken into consideration. Disease incidence was recorded at pre flowering, flowering and pod formation stages.

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$$PDI= \frac{\text{Number of SMD infected plants per unit area}}{\text{Total number of plants per unit area}} \times 100$$

Disease rating scale of sterility mosaic disease as described by AICRP on pigeonpea is followed which is mentioned below.

Per cent SMD Incidence	**Reaction**
0-10	Resistant (R)
10.10-30	Moderately Resistant (MR)
>30.10	Susceptible (S)

Results and Discussion:

Plant height in different redgram varieties differed significantly at the time of harvest. Maximum plant height was recorded by BSMR 736 (146.40 cm)which was comparable and on par with TRG 59 (143.20 cm) followed by LRG105 (137.20 cm), ICPL87119 (134.40 cm), GRG 811 (126.00 cm), GRG 152 (125.00 cm) and least plant height with 97.50 cm was observed in TS3R variety. Growth rate in redgram was slower during the first 60 days and later it was rapid. Seedling growth is slow in early stage of growth might be due to negative drymatter accumulation. This was followed by a relatively short exponential phase and later the linear growth phase is for longer period during which drymatter increases are at a constant rate for longer periods. The end result is that plant tends to fill the space available to them. Further, the growth points are in the apical meristem and apical growth tends to produce length which require an added source of growth hormones and this is the result of interaction of numerous internal growth influencing factors mostly those under genetic controlTirumala Rao (2011).

Branching ability in pigeonpea is an important trait for seed production. Number of branches plays a major role in determining pigeonpea yield since it is closely related to number of pods per branches in single plant.In the present study, wide range was observed for number of branches plant per plant (8.60 to 18.60 per plant). Highest number of branches per plant with 18.60 was recorded in BSMR 736 variety and lowest in TRG 59 (8.6/ plant). Similar results were obtained by Sawargaokar *et al.* (2011) and Niranjan Kumar (2013) who identified stable genotypes for this trait and variation in the number of branches depending on the environments.

Days to flowering and maturity, in addition to grain yield, are important characteristics of crops that are considered before the release of a variety. Early flowering, maturity, and grain yield performance of the crops ensure the advantage of a given variety in the crop production system. The development of early maturing variety is not only important for pigeon pea crop improvement but also for climate mitigation as a drought escaping mechanism for areas with marginal rainfall patterns (Hanumanthappa*et al.,* 2020). In the present study, the varieties GRG 152, TS3R and LRG 105 showed significantly the shortest duration of 50% flowering (100 days) with days to maturity of 145, 146 and 150 respectively. The varieties with no incidence of SMD (BSMR 736, ICPL 87119) recorded days to 50 per cent flowering at 135 and 130 days with maturity of 180 and 178 days respectively. Present findings are in accordance with Patel *et al.* (2009), Vannirajan (2007) who identified genotypes with average responsiveness and also genotypes with higher environmental sensitivity. Further, the results with variation in flowering and days to maturity was also reported by Zeru *et al.* (2020).

Number of pods per plant were significantly varied among the genotypes with highest number of pods per plant was recorded in BSMR736 (116pods) followed by ICPL87119 (114), GRG 811 (112), GRG 152 (109), TRG 59 (102) and least in TS3R with 82 pods per plant respectively. Variability for days to 50% flowering, days to maturity, number of pod per plant and number of seed per pod was also reported by (Chattopadhyay and Dhiman, 2006; Dahat *et al.*, 2006) Such widevariations indicated the scope of improving for these traits. With respect to 100 seed weight among the varieties, BSMR 736 recorded 12.0g followed by ICPL 87119 and TRG 59 with 11.0g. Lowest 100 seed weight of 9.8g was recorded in the variety GRG 152. These findings are in accordance with earlier reports of Sharma *et al.*, (2012), Nagy *et al.*, (2013) and Rao *et al.*, (2013). They revealed that genetic variability indicated that the genotypes are genetically diverse and that variations are due to presence of inherent genetic differences among the genotypes.

Disease incidence of SMD was recorded in the varieties tested and among the them there was no disease incidence was observed in BSMR 736, ICPL87119 and GRG 811varieties and recorded as resistant. Whereas, GRG 152 and TRG 59 recorded 4.47, 8.67 per cent disease of SMD which were also found to be resistant. The variety LRG 105 recorded disease incidence of 26.33 per cent and was found to be moderately resistant and highest disease incidence of 42.33 per cent was recorded in TS3R and was found to be susceptible variety. This might be due to unfavourable conditions like higher rainfall during pre flowering and flowering stages which affected mite vector *Aceriacajani*. Dipshikhakaushik*et al.* (2013) reported negative correlation of mites population and heavy rainfall as it will not allow rapid multiplication of mites. Further,Vijaya Bhaskar (2016) and Roy Abhay Nath, Kumar Birendra (2018) also reported three resistant genotypes and twelve moderately resistant genotypes to sterility mosaic disease against check variety.

Highest yield of 842 kg/ha was recorded in the variety BSMR 736 followed by ICPL 87119 (816 kg/ha) and differed statistically. The varieties TRG 59, GRG 811, GRG 152 recorded 756, 693 and 610 kg/ ha respectively. The highest disease incidence with lowest yield was recorded in the variety TS3R with 393 kg/ha.The infected plants fail to produce flower and therefore bear no pods leading to enormous losses to the farmers (Jones *et al.*, 2004). Similarly, Manjunatha *et al.* (2013)evaluated pigeonpea genotypes against SMD and found that seven entries *viz.*, ICP 7035, BRG 3, ICPL 87091, IPA 8F, IPA 15-F, GT 101 and JKM 189 were resistant. Further, Pallavi (2014) also reported five genotypes *viz.*, ICP 7035, GAUT- 001, BAHAR, BRG-3, and IPA 8F showed resistance, eight genotypes showed moderately resistance and 261 genotypes showed susceptible reaction. Jaggal *et al.* (2014)reported that 24 accessions were found to be resistant for both fusarium wilt and SMD under field condition.It was noticed that Pigeon pea varieties have different yield and yield characteristics according their duration in rainfed region (Dhanalakshmi, 2017).

Table 1: Performance of Redgram varieties against SMD and quantitative traits

SlNo.	Name of the variety	SMD incidence(%)	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/ plant	No. of pods/plant	100 seed weight (g)	Seed yield (kg/ha)
1	ICPL87119	0.00	130	178	134	15.8	114	11.0	816
2	BSMR 736	0.00	135	180	146	18.6	116	12.0	842
3	GRG 152	4.47	100	145	125	11.8	109	9.7	610
4	GRG 811	0.00	109	151	126	11.0	112	10.0	693
5	TS3R	42.33	100	146	97	9.8	82	9.8	393
6	TRG 59	8.67	103	148	143	8.6	102	11.0	756
7	LRG 105	26.33	100	150	137	9.4	98	10.0	542
	S.Em ±	**1.56**	**0.85**	**1.30**	**0.70**	**0.80**	**2**	**0.06**	**7**
	CD (0.05)	**4.71**	**2.48**	**4.00**	**2.00**	**2.40**	**6**	**0.17**	**21**
	CV(%)	**11.54**	**14.21**	**12.48**	**10.61**	**9.57**	**12.36**	**10.55**	**14.82**

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