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Prasanna Lakshmi Ravuri
SMS (Crop Protection),
Krishi Vigyan Kendra, Kalikiri,
Chittoor, Andhra Pradesh, India

Ganesh Kumar Perneti
Assistant Professor (Extension),
S.V. Agricultural College,
Tirupati, Andhra Pradesh, India

Sahaja Deva
SMS (Crop Production),
Krishi Vigyan Kendra, Kalikiri,
Chittoor, Andhra Pradesh, India

MK Jyotsna
Programme Coordinator,
Krishi Vigyan Kendra, Kalikiri,
Chittoor, Andhra Pradesh, India

Corresponding Author
Prasanna Lakshmi Ravuri
SMS (Crop Protection),
Krishi Vigyan Kendra, Kalikiri,
Chittoor, Andhra Pradesh, India

Assessment of wilt and sterility mosaic disease resistant Pigeonpea variety LRG-105 in Chittoor district of Andhra Pradesh

Prasanna Lakshmi Ravuri, Ganesh Kumar Perneti, Sahaja Deva and MK Jyotsna

Abstract
Pigeonpea is the most important pulse crop in India. Pod fly, Fusarium wilt and sterility mosaic disease are the major biotic constraints in pigeonpea production. On Farm Trials were conducted on wilt and sterility mosaic disease resistant pigeonpea variety LRG-105 against LRG-41 variety during the year 2019 and 2020 in Chittoor district of Andhra Pradesh. LRG-105 variety was released from Acharya N G Ranga Agricultural University, Guntur, Andhra Pradesh under the name Krishna during the year 2019. Wilt incidence was not observed in LRG-105 variety during both the years whereas in LRG-41 variety 58.6% and 51.98% was recorded during 2019 and 2020 respectively. During kharif 2019, 6.38% and 3.42% of sterility mosaic incidence was observed in LRG-105 and LRG-41 respectively whereas during kharif 2020, 5.86% and 5.3% of disease incidence was recorded. Redgram variety LRG-105 recorded an average yield of 409kg/ha and 371kg/ha during 2019 and 2020 respectively whereas LRG-41 recorded 198kg and 158kg per hectare. Rainfall during flowering stage affected crop yield during the year 2020 in both the varieties. Overall, pigeonpea variety LRG-105 performed very well in wilt prone areas and recorded good yield at farmer's fields.

Keywords: Pigeonpea, wilt, sterility mosaic, resistance, LRG-105

Introduction
Pigeonpea is one of the most widely grown pulse crops in India. India is the centre of origin and ranks first in production and consumption in the world. It is a primary source of protein for millions in India (Bressani *et al*., 1986) [1]. It plays an important role in food security, balanced diet and subsistence agriculture because of its diverse usages in food, fuel, soil conservation, integrated farming systems and symbiotic nitrogen fixation (Reddy *et al*., 2005) [14]. Major pigeonpea growing states of India include Maharashtra, Karnataka, Andhra Pradesh, Uttar Pradesh, Madhya Pradesh and Gujarat. In Chittoor district of Andhra Pradesh, Pigeonpea is grown in area of 7000ha mainly during kharif season under rainfed conditions. It is majorly grown as inter crop in groundnut followed by as sole crop in the district. Insect pests like pod borers, pod fly; diseases like Fusarium wilt and sterility mosaic disease are the major constraints in Pigeonpea production in the district.

Out of fifty diseases listed by Nene *et al.* 1981 [9], sterility mosaic, *Fusarium* wilt and *Phytophthora* blight are economically important. Fusarium wilt, caused by fungal pathogen *Fusarium udum*, is one of the major disease causing severe yield losses to the farmers. The yield loss due to this disease also depends upon the stage at which the plant wilt and it can approach over 50% and even up to 100% when wilt occurs at the pre pod stage (Okiror, 2002) [10]. Though the disease goes unnoticed in early stages, the symptoms of yellowing followed by drying of leaves and finally death of few branches or of entire plant are the conspicuous symptoms manifested during flowering or grain development. If wilted plants are uprooted and longitudinally split, a clear vascular browning in tap root extending to upper stem is seen. Infection of the plants in early stage lead to infection of roots, stem cortex and reaching up to vascular bundles where the pathogen multiplies and blocks water and nutrient flow to upper region which lead to yellowing, drying and finally death of the plant. (Sharma *et al.* 2016) [6]. It is a devastating disease of pigeonpea gaining importance day by day due to increasing drought conditions in the country. The chemical control of this disease is not only expensive but also ineffective too because of the seed as well as soil borne nature of the fungus. (Pawar *et al.* 2015) [11].

Management of wilt is essential to ensure stable pigeonpea production. One of the best possible ways to reduce yield losses due to Fusarium wilt is to grow resistant pigeonpea varieties (Deepu singh *et al.* 2016) [2].

Sterility mosaic disease caused by Pigeon pea sterility mosaic virus (PPSMV) is widespread and economically important. SMD causes substantial yield losses in India and its neighboring countries. (Kaushik Dipshikha *et al.* 2013) [3, 6]. Pigeon pea sterility mosaic virus transmitted by the eriophyid mite, *A. cajani.* The disease is characterized by the symptoms like bushy and pale green appearance of plants followed by reduction in size, increase in number of secondary and mosaic mottling of leaves and finally partial or complete cessation of reproductive structures.

Some parts of the plant may show disease symptoms and other parts may remain unaffected. The disease is sometimes referred to as the "green plague" because at flowering time, affected plants remain green with more vegetative growth and have no flower or seed pods under congenial conditions (Kumar *et al.* 2003) [7]. The infected plants fail to produce flower and therefore bear no pods leading to enormous losses to the farmers (Jones *et al.* 2004) [5]. Sterility Mosaic has become a potential threat to the cultivation of pigeonpea in Indian subcontinent. Resistant pigeonpea genotype for specific region may be one of the methods to combat the disease and increase the yield. (Dipshikha Kaushik *et al.* 2013) [3, 6].

As the crop is grown mainly as inter crop under rainfed situations, farmers does not adopt any plant protection measures to control pests and diseases resulting in lower yields in the district. Hence, Krishi Vigyan Kendra, Kalikiri conducted On farm trials on wilt and sterility mosaic resistant varieties with a view to improve the pigeonpea production.

Materials And Methods

On farm trail was conducted on wilt and sterility mosaic resistant pigeonpea variety LRG-105 during 2019 and 2020 against susceptible check LRG-41 in 10 locations. For this sick plots of Fusarium wilt were selected to test the varietal performance. Sowing was done during the month of July and harvesting was done during January month in both the years. Inter row spacing of 120 cm and intra row spacing of 20 cm was maintained.

i) Evaluation for *Fusarium* wilt resistance

Plants were scored for wilt incidence from flowering to pod formation stages by counting healthy plants and wilt diseased plants based on the visual observation.

$$PDI = \frac{\text{Number of plants wilted per unit area}}{\text{Total Number of Plants per unit area}} \times 100$$

Table 1: Disease rating scale (AICRP on pigeon pea)

Percent wilt disease incidence	Reaction
0-10	Resistant (R)
>10-30	Moderately Resistant (MR)
>30	Susceptible (S)

Evaluation for Sterility Mosaic Disease resistance

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 [12]. Both partially infected and fully infected plants were taken into consideration. Disease incidence was recorded at pre flowering, flowering and pod formation stages.

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

Table 2: Disease rating scale for Sterility Mosaic Disease (AICRP on pigeon pea)

Percent SMD incidence	Reaction
0-10	Resistant (R)
>10-30	Moderately Resistant (MR)
>30	Susceptible (S)

Results and Discussion

1. Wilt incidence

There is significant difference between the varieties during both the years where wilt incidence is not observed in Pigeonpea variety LRG-105 during both the years *i.e.*, 2019 and 2020 where as in LRG-41 variety 58.66% and 51.98% of wilt incidence was recorded during 2019 and 2020 respectively. Wilt incidence was observed in LRG-41 during peak flowering stage and the plants were completely dried. Pooled analysis revealed that there is no significant difference between the years regarding wilt incidence and the interaction of years and treatments was also non-significant. Pawar *et al.* 2015 [11] reported that few Germplasm lines showed resistance to wilt disease in sick plots where susceptible checks were highly infected with wilt disease and the level of incidence was depending on variety and growing season. Jimineez Diaz *et al.* 1993 [4] reported resistant cultivars are the most effective and cheap means of control of Fusarium wilt disease. Sharma *et al.* 2016 [6] reported that environment also influences genotype resistance to Fusarium wilt.

Table 3: Percent wilt incidence in pigeonpea varieties

Year	Treatments	Per cent wilt mean incidence (PDI)	Disease reaction	Standard deviation	t-value	p-Value
2019	LRG-105	0.00	R	0.000	-21.493**	0.000
	LRG-41	58.66	S	6.103		
2020	LRG-105	0.00	R	0.000	-12.592**	0.000
	LRG-41	51.98	S	9.230		

Table 4: Pooled analysis

Source	F-Value	p-Value
Years	1.372^{NS}	0.275
Years * treatments	1.372^{NS}	0.275
Treatments	744.48**	0.000

2. Sterility Mosaic Disease incidence

During the year 2019, 6.38% and 3.42% of sterility Mosaic disease incidence was recorded in LRG-105 and LRG-41 respectively. Whereas in during the year 2020, 5.86% and 5.32% of sterility mosaic disease incidence was recorded in LRG-105 and LRG-41 respectively.

Table 5: Percent SMD incidence in pigeonpea varieties

Year	Treatments	Per cent SMD incidence (PDI)	Standard deviation	t-value	p-Value
2019	LRG-105	6.38	1.44	3.154^{NS}	0.014
	LRG-41	3.42	1.51		
2020	LRG-105	5.86	1.00	0.975^{NS}	0.358
	LRG-41	5.32	0.72		

Table 6: Pooled analysis

Source	F-Value	p-Value
Years	0.991^{NS}	0.349
Years * treatments	3.06^{NS}	0.119
Treatments	27.030**	0.001

There is no significant difference between the varieties regarding sterility mosaic disease incidence during both the years. Resistant variety LRG-105 and susceptible variety LRG-41 both showed resistant reaction to sterility mosaic disease. This might be due to unfavourable conditions like higher rainfall during pre flowering and flowering stages which affected mite vector *Aceria cajani*. Dipshikha kaushik *et al*. (2013) [3, 6] reported negative correlation of mites population and heavy rainfall as it will not allow rapid multiplication of mites. Reddy *et al*. (1993) [13] reported season to season variation in the incidence of sterility mosaic of pigeon pea in the farmer's field in most part of India. Roy Abhay Nath, Kumar Birendra **(**2018) [15] reported three resistant genotypes and twelve moderately resistant genotypes to sterility mosaic disease against check variety.

3. Yield

Pigeonpea variety LRG-105 recorded an average yield of 409 kg/ha and 371kg/ha during the years 2019 and 2020 respectively. Whereas LRG-41 variety recorded 198kg/ha and 158Kg/ha during 2019 and 2020.

There is significant difference between the varieties during both the years with respect to yield. Niwar cyclone during the month of November, 2020 resulted in Flower drop and hence lower yields were recorded during the year 2020. Maheswaran *et al.* 2019 reported higher yield of new improved variety CO7 over local check variety.

Table 7: Average yield of Pigeonpea varieties

Year	Treatments	Mean Yield	Standard deviation	t-value	p-Value
2019	LRG-105	409	11.402	27.826**	0.000
	LRG-41	198	12.550		
2020	LRG-105	371.0	132.30	3.53**	0.08
	LRG-41	158.0	25.6		

Conclusion

Overall, pigeonpea variety LRG-105 performed very well under wilt prone areas with high yield and suitable for intercropping systems also. The variety was well accepted by famers and it could be considered as a better option for achieving higher productivity of pigeonpea.

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