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Integrated disease management of sterility mosaic in pigeonpea [*Cajanus cajan* (L.) Millspaugh]

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ABSTRACT

Sterility Mosaic Disease (SMD) is considered as the most destructive disease caused by Pigeonpea Sterility Mosaic Virus (PSMV). PSMV is transmitted by a vector, eriophyid mite *(Aceria cajani)*, causing a heavy loss in yield under Indian condition. The eriophyid mite, *Aceria cajani,* therefore its control is important to have higher productivity in the crop. Our study showed that spraying of fenopyroximate 5% EC (1.5 ml L^{-1}) at 25, 40 and 55 DAS (Days After Sowing) recorded lowest SMD incidence of 1.47, 25.6 and 35.9 per cent, respectively cumulatively resulting in 49.7 per cent disease reduction (at 55 DAS) over the control. As a result, this treatment yielded maximum (1630 kg/ha). This was followed by with spraying of Propargite 57%EC@1.5 mlL^{-1} (T3) at 25, 40 and 55 DAS (1370 kg/ha).

Key words: Pigeonpea, Pigeonpea Sterility Mosaic Virus, Sterility Mosaic Disease

Pigeonpea [*Cajanus cajan* (L.) Millspaugh] is a hard lived legume belonging to *Cajaninae* sub tribe of the economically most important leguminous tribe *Phaseoleae*. It is a multipurpose grain legume crop grown extensively for food in the Asian and African countries. India is considered as the primary centre of origin for pigeonpea due to the presence of ample variability in local germplasm and wild relatives (Saxena 2008). In recent years, the crop is gaining importance due to its inherent ability to perform well under marginal input conditions and also its adaptability to drought and other abiotic stresses. In India, pigeonpea is cultivated in an area of about 36.3 lakh ha with an annual production of 27.6 lt averaging a productivity of 760.33 kg ha^{-1} (Anonymous 2016). Although India leads the world both in area and production of pigeonpea, its productivity is lower than the world average. This may be attributed to various abiotic (drought, salinity and water-logging) and biotic (*Fusarium wilt*, sterility mosaic and pod borers) factors. Among diseases, *Fusarium wilt* and Sterility Mosaic Diseases are the major constraints to pigeonpea production worldwide. Sterility mosaic disease, considered as the "most destructive disease" caused by Pigeonpea Sterility Mosaic Virus (Jones *et al*. 2004) and the virus is transmitted by the vector eriophyid mite (*Aceria cajani)* (Kannaiyan *et al*. 1984) is one of the major biotic factors in the Indian subcontinent which leads to heavy yield loss when it occurs at crop growth stage (Bhaskaran and Muthiah 2005).

In almost all the pigeonpea growing areas of the country the disease results in significant yield reduction upto 100% (Muniyappa and Chandrashekhariah 1980). In spite of various control measures of SMD, the same disease has continued to be a major constraint in pigeonpea production observed. A lot of variation also exists among the isolates of the virus in different regions. These variations render it difficult to find out a common management strategy to manage SMD. Therefore, it is necessary to know the variability of the virus including the aspects of disease management which will help in devising suitable management strategies.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* 2015 at ZARS, AICRP on pigeonpea, GKVK, Bengaluru. A thrice replicated split-split plot design was used with two main treatments, two sub-treatments and 5 sub-sub treatments. The plot size of 4.0 m × 4.0 m was maintained for each treatment with 60 cm spacing between rows and 20 cm spacing between plants. All standard agronomic practices were followed. The acaricides sprayed at the given concentration at 25, 40 and 55 DAS following sowing of the pigeonpea varieties during June 2nd fortnight and July 2nd fortnight with two varieties BRG 1 (Moderately resistant) and ICP 8863 (Susceptible). The treatments are given herein as under :

I Main : Sowing dates		
	S1	June 2nd fortnight
	S2	July 2nd fortnight
II Sub : Pigeonpea varieties		
	V1	BRG 1(Moderately resistant)
	V2	ICP 8863(Susceptible)
III Sub-sub : Acaricides		
	T1	Dicofol 18.5% EC (2.5 ml/L)
	T2	Fenazaquin 10% EC (1.5 ml/L)
	T3	Propargite 57% EC (1.0 ml/L)
	T4	Fenpyroximate 5% EC (1.5 ml/L)
	T5	Control/untreated

Observations on disease incidence in each replication were recorded, one day before spraying and weekly interval after the first spray. Mite population was recorded on the day of spraying (before) and 10 days after each spray and mean per cent reduction in mite population was counted by collecting 3 leaves randomly in each replication by observing those under stereo binocular microscope. Mite population was calculated by averaging the total counts. The seed yield per plot was recorded by

harvesting each treatment separately.

Per cent disease reduction over control: The per cent disease reduction over control was calculated by using the formula given by Vincent (1947).

$$\text{Per cent disease reduction} = \frac{(C - T)}{C} \times 100$$

Where,

C = Per cent disease in control

T = Per cent disease in treatment

RESULTS AND DISCUSSION

Incidence of Sterility Mosaic Disease: During *Kharif* 2015, June 2nd fort night sown crop was recorded lowest disease incidence at 25, 40 and 55 DAS of 1.69, 27.40 and 45.80 compared to July 2nd fort night sown crop, 2.53, 28.20 and 48.10 per cent respectively. The variety, BRG 1 (V1) recorded lowest mean SMD incidence (1.95, 17.80 and 23.90 per cent at 25, 40 and 55 DAS) over the variety, ICP 8863 (2.27, 37.80 and 70.0 per cent at 25, 40 and 55 DAS, respectively) (Table 1 and Fig. 1).

Significant differences were also observed among the different Acaricides with respect to SMD incidence at 25, 40 and 55 DAS. Spraying of Fenpyroximate 5 % EC (1.5 ml L^{-1}) at 25, 40 and 55 DAS recorded lowest SMD incidence of 1.47, 25.6 and 35.9 per cent, respectively with 49.7 per cent disease reduction over the control variety. The highest SMD incidence of 3.77, 37.90 and 71.50 per cent at 25, 40 and 55 DAS, respectively was recorded in untreated control.

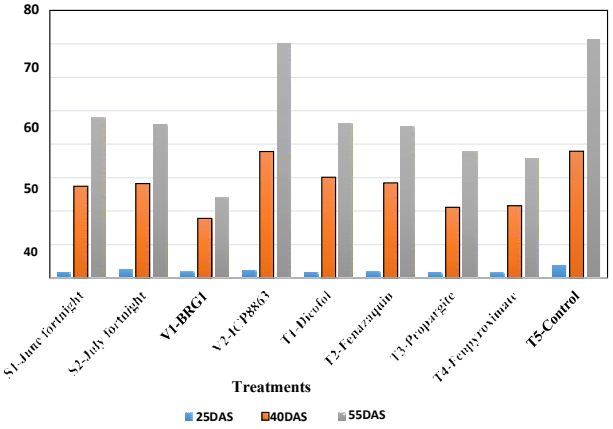

Fig 1. Effect of Acaricides on SMD incidence during *Kharif* 2015-16

Similar results were observed by Pallavi (2014), early stage crop recorded less disease incidence and gradual increase in disease incidence was recorded at later stages of crop growth period. 100 per cent disease incidence was observed at 90 DAS in almost all months except in January and November month sown crop. Less disease incidence in the early stage of crop is due to invasion of a smaller number of mites and source of inoculum in early part of the season. The mite population build-up as the plant grows vigorous in the later stage of crop which could results in attaining maximum disease.

Rajeswari *et al.* 2016 evaluated the efficacy of Acaroids *viz.,* 0.2 per cent dicofol and 0.1 per cent Fenazaquin against SMD and showed that two sprays of

Table 1. Effect of acaricides on SMD incidence during *Kharif* 2015-16

Treatments	Disease incidence (per cent)			Per cent reduction over control at 55 DAS	Yield (kg/ha)
	25 DAS	40 DAS	55 DAS		
Sowing dates					
S1-June 2nd fortnight	1.69(1.3)	27.4(31.0)	45.1(44.3)	-	1970
S2-July 2nd fortnight	2.53(1.8)	28.2(31.2)	48.1(44.0)	-	1490
S.Em±	0.29	0.10	0.26	-	111
CD (p=0.05)	1.82	0.62	1.63	-	632
CV (%)	7.50	12.02	15.12		1100
Pigeonpea varieties					
V1-BRG 1	1.95(1.5)	17.8(24.3)	23.9(28.6)	-	1680
V2-ICP 8863	2.27(1.9)	37.8(37.8)	70.0(58.7)	-	1250
S.Em±	1.49	19.60	33.20	-	067
CD (p=0.05)	5.87	77.30	13.50	-	214
CV (%)	17.60	23.30	27.30	-	1450
Acaricides					
T1-Dicofol	1.74(1.7)	30.08(32.6)	46.1(42.5)	35.52	1060
T2-Fenazaquin	1.98(1.3)	28.4(31.8)	45.4(42.0)	36.50	1130
T3-Propargite	1.59(1.3)	21.1(26.7)	38.9 (35.7)	46.90	1370
T4-Fenpyroximate	1.47(1.3)	25.6(26.4)	35.9 (35.4)	49.70	1630
T5-Control	3.77(2.3)	37.9(38.0)	71.5(62.6)	-	819
SEm(+/–)	0.16	0.21	0.44	-	090
CD (p=0.05)	0.48	0.62	1.27	-	198
CV (%)	7.80	12.60	13.20	-	905
Interaction					
SEm(+/–)	0.33	0.43	0.88	-	141
CD (p=0.05)	NS	NS	NS		NS

Figures in parenthesis are angular transformed values, NS = Non-significant

0.1 per cent Fenazaquin at 30 and 45 days after sowing recorded the lowest disease incidence (8.8%) as compared to untreated control (46.1%) with the disease reduction of 80.9 per cent over the control.

Effect of different Acaricides on yield of pigeonpea: June 2nd fortnight sown crop recorded highest grain yield (19.7q/ha) compared to July 2nd fort night sown crop (14.9q/ha) during *Kharif* 2015 (Table 1 and Fig 1). A significant difference was observed for yield between two varieties, BRG 1 (V1) and ICP 8863 (V2). The variety, BRG 1 was recorded significantly higher yield (16.8 q/ha) over the variety, ICP 8863 (12.5 q /ha). A significant difference was observed among the different acaricides with respect to yield. Spraying of Fenpyroximate 5% EC (1ml/L) at 25, 40 and 55 DAS (T1) recorded the significantly maximum yield (16.3q/ha) followed by spraying of Propargite 57% EC @ 1.5ml/L (T3) at 25, 40 and 55 DAS (13.7q/ha). The lowest yield was recorded for untreated control (8.19q/ha).

The similar results were found in findings of Sudharani *et al.* 2017 who reported that Wettable Sulphur 50 WP (3g/L) spray also influenced to record the highest yield of 16.25 q/ha as against 3.56 q/ha in untreated plot and therefore, Wettable Sulphur and dicofol could be the best alternative for the management of SMD in pigeonpea under field conditions. Manjunatha *et al.* 2012 reported that spraying of Wettable Sulphur and combination of Dicofol+ Fenazaquin recorded yield of about 1312.5 and 1368.7 kg/ha respectively.

Effect of different Acaricides on mite population: June 2nd fort night sown crop recorded least number of mite population of 1.54, whereas, July 2nd fortnight sown crop recorded highest mite population of 1.96. The significant difference between the sub-treatments, BRG 1 (V1) and ICP 8863 (V2) per taining to mite population after first spray (25DAS). The variety, BRG 1 recorded least mean number of mite population of 1.68 over the variety, ICP 8863 which recorded higher mite population of 1.82. However, the interaction effects between main and sub-treatments on mite population were found to be non-significant. There sultsa represented in Table 2.

A significant difference was observed within main treatments in reducing the mite population, the spraying of Fenpyroximate 5% EC@1.5ml/L (T4) recorded least mean number of mite population of 0.69. The highest mean number of mite population of 4.30 was recorded in the untreated control (T5). After second spray (40DAS), June 2nd fort night sown crop recorded least mean number of mite population of 4.24, July 2nd fortnight sown crop recorded highest mite population of 4.27. The variety, BRG 1 recorded least mean number of mite population of 3.80 over the variety, ICP 8863 which recorded higher mite population of 4.72

Spraying of Fenpyroximate 5% EC@1.5ml/L (T3) recorded least mean number of mite population of 3.25 the highest mean number of mite population of 6.58 was recorded in the untreated control (T5). However, the interaction effects between main and sub-treatments on mite population were found to be non-significant. After

Table 2. Effect of Acaricides on mite population during *Kharif* 2015

Treatments	Average number of mite population/trifoliate leaves Mite population/leaf* (unit)						Per cent reduction over control at 55DAS
	25DAS		40DAS		55DAS		
DOS	Before Spray	After Spray	Before spray	After spray	Before spray	After Spray	
June 2nd fortnight	1.69(1.27)	1.54(1.18)	4.27(2.95)	2.78(1.51)	4.96(2.89)	2.99(1.86)	-
July 2nd fortnight	2.53(1.69)	1.96(1.76)	4.24(2.92)	2.89(1.71)	3.43(2.64)	3.76(2.12)	-
SEm(+/–)	0.29	0.05	0.17	0.06	0.01	0.01	-
C.D. (P=0.05)	1.82	0.34	1.06	0.39	0.09	0.09	-
CV (%)	7.51	17.40	22.40	12.50	1.98	19.20	-
Pigeonpea varieties							
BRG 1	1.95(1.56)	1.68(1.22)	3.8(2.72)	2.65(1.22)	3.87(1.96)	3.28(1.88)	-
ICP 8863	2.27(1.68)	1.82(1.35)	4.72(2.98)	3.02(1.98)	4.52(2.12)	3.47(1.12)	-
SEm(+/–)	1.49	1.24	3.01	2.01(1.26)	2.97(1.86)	1.97(1.29)	-
C.D. (P=0.05)	5.87	4.88	11.8	7.89(4.67)	11.6(7.12)	11.6(7.1)	-
CV (%)	3.76	8.63	8.73	8.80(4.92)	7.80(5.6)	9.79(6.2)	-
Acaricides							
Dicofol	1.74(1.25)	1.54(1.12)	4.30(3.1)	2.84(1.68)	4.8(2.48)	4.58(2.24)	29.1
Fenazaquin	1.98(1.46)	1.46(1.18)	4.39(3.8)	2.47(1.48)	3.98(1.98)	3.64(1.98)	42.6
Propargite	1.59(1.28)	0.77(0.87)	2.90(1.89)	1.56(1.64)	2.09(1.84)	1.86(1.14)	70.7
Fenpyroximate	1.47(1.1 4)	0.69(0.80)	3.25(2.2)	1.46(1.12)	3.53(2.4)	1.76(1.1)	72.2
Control	3.77(2.91)	4.31(3.1)	6.44(3.99)	5.84(3.65)	6.58(4.2)	6.35(4.1)	-
SEm(+/–)	0.16	0.093	0.11	0.12	0.134	0.13	-
C.D. (P=0.05)	0.48	0.26	0.34	0.35	0.38	0.39	-
CV (%)	27.82	18.30	9.60	14.90	10.90	14.16	-
Interaction							
SEm(+/–)	0.33	0.186	0.23	0.24	0.26	0.27	-
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	-

* Average number of mite/trifoliate leaf

third spray (55DAS), spraying of Fenpyroximate 5%EC@1.5 ml/L (T3) recorded least mean number of mite population of 1.76 and 72.20 per cent reduction in mite population over the control. The highest mean number of mite population of 6.35 was recorded in the untreated control (T5). The significant difference between the sub-treatments, BRG 1 and ICP 8863 pertaining to mite population after third spray (55DAS). The variety, BRG 1 recorded least mean number of mite population of 3.28 over the variety, ICP 8863 which recorded higher mite population of 3.47. However, the interaction effects between main and sub-treatments on mite population were found to be non-significant.

These results were compared with findings of Pallavi, 2014 revealed the presence of highest number of mites in June, May, April and March month sown crop. This is due to the presence of favorable weather conditions *viz*., mean temperature of 22 to 27°C with relative humidity of 65 to 72% and rainfall of 2.50mm. Pallavi and Ramappa, 2014 observed highest number of mites (56.7 mites/trifoliate leaf) on vegetative bud of upper canopy and lowest mite population (12.9 mites/trifoliate leaf) on leaves of lower canopy. Manjunatha *et al.* (2012) Wettable Sulphur was applied at 25, 40 and 60 days after sowing and found that all the chemicals were effective except seed treatment with imidacloprid and control plots. Among them, Wettable Sulphur showed 96.85 per cent reduction of mite population and combination of Dicofol+Fenazaquin decreases the mite population by 96.54 per cent.

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