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Assessment of crop loss due to leafhopper, *(Empoasca kerri* Pruthi) in pigeonpea

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ABSTRACT

An experiment was conducted at Agriculture Research Station, Kalaburagi, Karnataka, India during *kharif*, 2015-16 to understand the effect of differential population of leafhoppers, on growth and yield parameters of pigeonpea under field conditions with seven level of population load. Maximum of 26.16 hoppers/3 leaves were found at 12 pairs release plot which was at par with 10 pairs (22.21) and 8 pairs (24.96) released which were statistically significant. The average hopper count @ 4 and 6 pairs released plots were 13.14 and 16.15 per 3 leaves respectively and were at par among themselves and significantly higher than 2 pairs release and lower than 8 pairs release plots. This was a clear indication that the differential population of leafhopper had impact in reduction of growth and yield parameters with. Reduction in yield to the tune of 3.12, 5.29, 10.05, 17.99, 24.63 and 31.91 % at 2, 4, 6, 8, 10 and 12 pairs released plots, respectively. From the present investigation it was clear that the 5.59 to 5.77 leafhoppers aggregated in top leaf at 90 to 120 days aged crop of medium duration variety will cause 10 per cent reduction in yield.

Key words: Crop loss estimation, *Empoasca kerri*, Leafhopper, Pigeonpea.

INTRODUCTION

Among biotic factors, insect pests are the key elements contributing for the economic loss of pigeonpea (*Cajanus cajana* L.) both in field and storage. More than 250 species of insect and non-insect pests have been found feeding on pigeonpea (Gopali, *et al.* 2010), however in recent past noticed lot of changes in pest status insect feeding on this crop. In this pigeonpea bowl many minor or not at all pests on this crop started attaining major status, *viz.,* Maruca, Grapholita and sucking pests like podbugs (Sharma *et al.*, 2011). More recently green leafhopper *Empoasca kerri* started appearing on this crop every year since from 2012 in severe form in patches initially and to spreading larger area on pigeonpea crop which was not a major pest on this crop and it seems to cause economic damage to pigeonpea (Rachappa *et al*., 2016). Both nymphs and adults suck the plant sap from the ventral surface of leaves and mainly it prefers the first three terminal leaves, while feeding inject toxic saliva into plant tissues (Singh *et al*., 2008) and cause phytotoxic symptoms like yellowing of the foliage that begins at the tip, cupping of leaves and later if pest population is more than leads to cause the hopper burn and plant become stunted in okra. The economic crop loss caused leafhopper *(Empoasca fabae)* in potato was 54 % (Johnson *et al.,* 1986). *Emoasca, terminalis* caused an average yield loss of 26% in soyabean (Nasruddin *et al*., 2014) and 48.57% yield losses in pods of groundnut due to major insect pests including leafhopper (Dabhade *et al.,* 2012). However there is no documented quantified information on economic loss of pigeonpea caused due to this pest which is very much important to take decision for management of pest on pigeonpea crop. Hence, the investigations are planned with objectives to assess pigeonpea crop loss due to the damage of green leafhopper.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* 2015-16 at Agricultural Research Station, Kalaburagi in RCBD with three replications and seven treatments. The pigeonpea variety TS-3R was sown with a spacing of 60 x 60cms in order get 4 plants in one leafhopper proof nylon mesh of size 1.2 cubic meter on 60 days aged crop to avoid the movement of hoppers from one treatment to others.. In total 21 such small plots were maintained with a walking space of one meter in all the sides of the plot. Before caging, the care was taken to raise the crop free from green leafhopper and other sucking insects by spraying of imidacloprid 17.8SL @ 60 g.a.i. per ha at 30 days before release and one more spray was given at 15 days before release hoppers with commercial neem based pesticide. The crop was sprayed with enough quantity of clean water one day before caging in order to minimize or avoid the residue effect of the pesticides on crop canopy (Shivayogiyappa 2016). Release of differential leafhopper population mentioned in the Table 1 was made after caging the plants. The leafhoppers were collected from the pure culture maintained for the purpose and were released at 60 days after sowing. Observations were recorded on leafhoppers count, plant height, number of primary and secondary branches were recorded at 30, 60 and 90 days after hopper release. The chlorophyll content was recorded on top 10

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randomly selected leaves per plant when the leafhopper population was maximum (115 DAS) by SPAD chlorophyll meter At the time of harvest the observations were recorded on yield parameters *viz.,* number of pods per plant, grain yield per plant, and total dry matter production per plant. The per cent yield loss was calculated for each treatment over no release treatment. The data was analyzed by Web Agri Stat Package -2 (WASP-2) developed by ICAR Complex Goa, India (WASP-2, 2014).

RESULTS AND DISCUSSION

Leafhopper population built up: Highest built up hopper population of 35.86, 34.17 and 8.44 per top three leaves was recorded on 30, 60 and 90 days after release, respectively in released with 12 pair per plant. But, the two pair per plant release plot had built up significantly less 9.09, 9.42 and 3.64 leafhoppers per top three leaves at 30, 60 and 90 days after release, respectively. However the leafhopper population density in other levels of release was in between the above mentioned treatments. Average of above three observations indicates that significantly maximum of 26.16 at 12 pairs release plot was at par with 10 and 8 pairs released plots which recorded 24.96 and 22.21 hoppers per three leaf. As the initial population was low i.e., two pairs/plant released plots recorded significantly lesser average hopper count (7.38/3 leaves). The average hopper count at 4 and 6 pairs released plots were 13.14 and 16.15 per 3 leaves respectively and were at par with each other and significantly higher than 2 pairs release and lower than 8 pairs release plots. These studies indicated that there was influence of population density allowed initially at the time of caging which led to proportionate built up population (Table 1). These results clearly indicate that the leafhopper preferred the early stage of crop (60-120 days aged) for its development. The 45 to 100 days cotton crop was most preferred than aged crop for leafhopper colonization and damage (Sreenivasa 1993)

Growth parameters: Data obtained for 60 days after sowing release treatments on the growth parameters *viz.,* plant height (cm), number of primary and secondary branches showed significant difference among the different population levels of release. Maximum plant height 173.33 cm was noticed in no release treatments and least 143.61 cm was noticed in twelve pair per plant release treatment (Table 2). Similar trend was noticed with respect to number of primary branches, secondary branches.

The results of the present investigation clearly indicated that the leafhopper population has influence on

Table 1: Leaf hopper density on pigeonpea at varied intervals after release

Leaf hoppers/plant released at 60 DAS	Numbers of leafhoppers/top 3 leaves at 30 DAR	60 DAR	90 DAR	Average
T1: No release	0.00(0.70) [a]	0.00(0.70) [a]	0.00(0.70) [a]	0.00 (0.71)a
T2: 2 pairs	9.09 (3.03) [b]	9.42(3.14) [b]	3.64(2.02) [b]	7.38 (2.81)b
T3: 4 pairs	16.79(4.14) [c]	17.32(4.20) [c]	5.31(2.40) [c]	13.14 (3.69)c
T4: 6 pairs	19.83(4.48) [c]	23.60(4.89) [d]	6.10(2.56) [cd]	16.51 (4.12)c
T5: 8 pairs	29.27(5.44) [d]	30.68(5.57) [e]	6.67(2.66) [cd]	22.21 (4.77)d
T6: 10 pairs	34.89(5.95) [d]	32.24(5.69) [e]	7.74(2.84) [de]	24.96 (5.05)d
T7: 12 pairs	35.86(6.02) [d]	34.17(5.86) [e]	8.44(2.96) [e]	26.16 (5.16)d
S.Em ±	0.22	0.14	0.10	0.15
CD @ 5 %	0.65	0.43	0.31	0.45
CV (%)	8.53	5.55	7.59	7.13

Means followed by same alphabet in columns did not differ significantly (p=0.05) by DMRT.
DAS: Days after sowing, DAR: Days after release. Values in parenthesis are "x+0.5 transformed

Table 2: Effect of differential population load of leafhopper on growth parameters of pigeonpea

Leaf hoppers/plant released at 60 DAS	Plant height (cm)*	Branches/plant* primary	Branches/plant* secondary	Total dry mater/ plant (in g)**	Chlorophyll content (µg/cm²)***
T1: No release	173.33 [a]	10.81 [a]	13.86 [a]	259.25 [a]	60.99 [a]
T2: 2 pairs	165.07 [ab]	11.03 [a]	13.50 [ab]	254.86 [a]	56.78 [ab]
T3: 4 pairs	163.12 [ab]	10.57 [ab]	13.10 [ab]	240.37 [ab]	54.66 [b]
T4: 6 pairs	161.19 [ab]	9.57 [bc]	12.07 [bc]	229.25 [abc]	53.62 [b]
T5: 8 pairs	160.11 [ab]	8.53 [c]	11.23 [c]	220.81 [bc]	51.63 [b]
T6: 10 pairs	149.25 [bc]	8.83 [cd]	10.93 [c]	207.02 [c]	40.25 [c]
T7: 12 pairs	143.61 [c]	7.50 [d]	10.47 [c]	201.06 [c]	39.83 [c]
S.Em ±	5.40	0.40	0.54	10.14	2.39
CD @ 5 %	16.19	1.20	1.62	30.42	7.18
CV (%)	5.70	7.10	7.46	7.43	8.04

Means followed by same alphabet in columns did not differ significantly (p=0.05) by DMRT.
DAS: Days after sowing, *Observed at 150 days aged plants, ** Observed at harvest.
***Chlorophyll content measured at 120 days aged plants.

the plant growth parameters. The present findings were partially in line with the report on cotton by Kulkarni and Raodeo (1986) found that except for sympodial branches, all the growth parameters including seed cotton yield were reduced due to leafhopper attack.

The total dry matter production per plant recorded was high in no release (259.25 gm per plant) treatment which was statistically at par with two pair per plant (254.86 g) treatment and least dry matter accumulation (201.06 gm per plant) seen in twelve pair per plant release treatment. Total dry matter production per plant decreased with the increase in leafhopper population (Table 2).

The chlorophyll present in plant has been depicted in Table 2 revealed that differential population of leafhoppers released. Maximum (60.99 µg/cm²) chlorophyll was recorded in no release treatment followed by (56.78 µg/cm²) in two pair per plant release treatment. Accordingly, the significantly least chlorophyll content was recorded in the maximum (12 pair per plant) release treatment (39.83 µg/cm²). The results clearly indicate that the population of leafhopper had negative effect on chlorophyll content of the leaves. As there was an increase in the leafhopper population in higher leafhopper released treatments, the damage was more which was indicated by msignificantly lower value of chlorophyll content. The present findings were closely supported by earlier worker who observed the decrease in the chlorophyll content of leaves with increase in the leafhopper population on cotton (Sreevani 2011).

Yield and yield parameters: As the growth parameters were affected due to leafhopper population, certainly the yield parameters were also influenced accordingly. The data obtained on yield parameters have shown a significant difference among various levels of differential population. Significantly maximum number of pods (245.92 per plant) was recorded in no release treatment followed by the two pair per plant (233 per plant) and so on. Significantly least (147.52 per plant) number of pods recorded in the maximum initial population of 12 pair per plant. However, the number of pods per plant increased with the decrease in the leafhopper population. These results indicate that the differential population released has shown an impact on number of pods. Certainly the yield recorded in no release treatment was significantly maximum of 1246.90 kg per ha which was followed by T2 (2 pairs), T3 (4 pairs) and T4 (6

Table 3: Impact of differential population load of leafhopper on yield of pigeonpea

Leaf hoppers/plant released at 60 DAS	Number of pods/ plant	Grain yield		% Yield loss over no release	Monitory loss (Rs.)
		Per plant (in g)	Per ha (in kg)		
T1: No release	245.92 [a]	101.00 [a]	1246.90 a	0.00 (0.62)* a	0.00
T2: 2 pairs	233.00 [ab]	88.51 [b]	1092.72 b	3.12 (10.16) b	9251
T3: 4 pairs	232.50 [ab]	85.64 [b]	1057.28 b	5.29 (13.15) b	11377
T4: 6 pairs	221.25 [b]	81.73 [bc]	1009.01bc	10.05 (18.45) c	14273
T5: 8 pairs	201.77 [c]	75.33 [cd]	930.00cd	17.99 (25.03) d	19014
T6: 10 pairs	173.33 [d]	71.82 [de]	886.66de	24.63 (29.72) e	21614
T7: 12 pairs	147.52 [e]	65.99 [e]	814.69e	31.91 (34.37) f	25920
S.Em ±	6.41	3.81	32.90	1.15	
CD @ 5 %	19.22	8.44	98.60	3.48	
CV (%)	5.19	7.90	7.90	10.40	

DAS: Days after sowing, *values in the parenthesis are arc sine transformed.
Means followed by same alphabet in columns did not differ significantly (p=0.05) by DMRT.

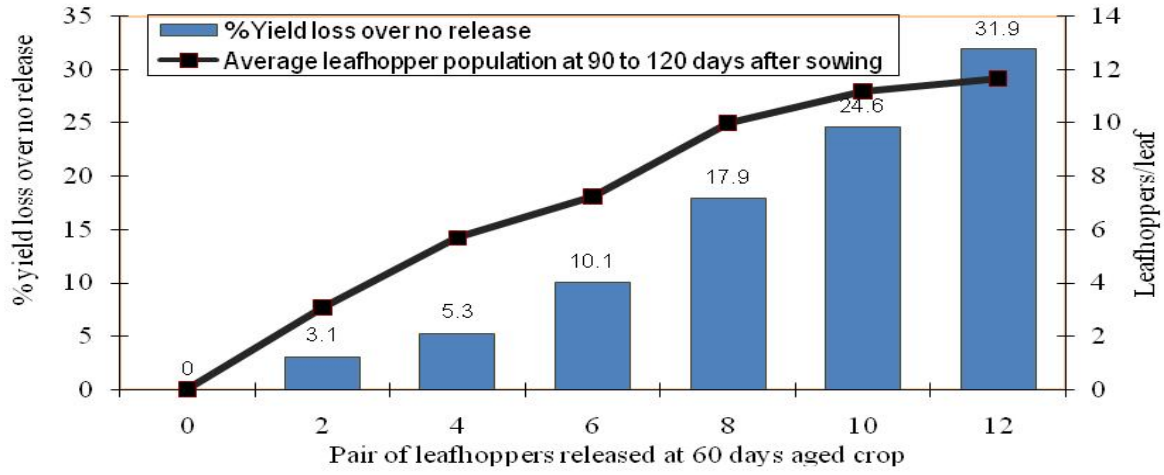

Fig 1: Effect of leafhopper population on per cent yield reduction over no release

pairs) which were recorded 1092.72, 1057.28 and 1009.01 kg/ha respectively and were on par with each other. Significantly lowest garin yiled of 814069 kg/ha was registered from 12 pairs released plot which was at par with ten pair released plot (Table 3).

The results of the present investigation clearly indicates that the leafhopper population has influence on the yield parameters. Studies on cotton leafhopper (Nageswara Rao and Ramana Rao 1984, Neelakantan *et al*., 1961,Jackson *et al*., 1965) and reported that heavy incidence of leafhoppers reduces fruiting capacity, number of bolls retained per plant and seed cotton per plant and quality of lint. The loss due to leafhopper was more during early stage of the crop growth (Sreenivasa and Patil 1996).

Yield loss (%): Yield loss was considerably affected by the differential population of leafhopper released. Significantly highest yield loss (31.91%) was recorded in maximum release treatment (12 pair per plant) followed by ten pair per plant release treatment which have shown 24.63 per cent yield loss and least (3.2 %) was noticed in one pair per plant release treatment which significantly differed from no release treatment (Table 3). Maximum monitory loss of Rs. 25920 was from 12 pair released plot and was minimum of Rs. 9251 was from 2 pairs released plot. The yield loss was significantly increased with increase in leafhopper population released (Fig 1). These present investigations are in conformity with the findings of Shreevani 2011 who reported the yield loss of 55.93% due to leafhopper in cotton, *Empoasca fabae* in potato 54 % yield loss (Johnson *et al*., 1986) and *Emoasca, terminalis* caused 26% in soyabean (Nasruddin *et al.,* 2014) and 48.57% yield losses in case of groundnut due to major insect pests including leafhopper (Dabhade *et al.,* 2012).

It may thus be concluded from present findings that the leafhopper damage to pigeon causes economic yield loss to at crop age of 90 to 120 days if the hopper population per top fully opened trifoliate exceeds 5 that will cause more than 10 per cent yield loss in pigeonpea.

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