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Population Trend, Crop Loss Assessment & Acaricidal Management of *Polyphagotarsonemus latus* (Banks) (Acari: Tarsonemidae) Infesting Mungbean Under Gangetic Basin Of West Bengal, India

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Abstract

Mungbean (*Vigna radiata* (L.) Wilczek), also known as green gram, is one of the important pulse crops grown in West Bengal, India. Mungbean is affected by various insect and non-insect pests, among which the yellow mite, *Polyphagotarsonemus latus* (Banks) plays an important role amounting huge crop loss. The peak population of the mite (23.2 mites/sq.cm leaf area) encountered during the initial budding stage of the crop and declined thereafter at the end of flowering stage. A tune of 50–80 % crop loss was estimated due to its infestation. Among seven acaricides tested, Dicofol, Diafenthiouron and Spiromesifen showed higher efficacy against the mite than the other acaricides used. The yellow mite is a regular and major pest of mungbean which appeared in a severe form in the farmer field especially during pre-kharif season which can be manage successfully by application of two successive round of acaricides like diafenthiouron or dicofol at 10 days interval during early reproductive stage of the crop that ensure the flowering and fruit setting of the crop giving satisfactory yield. The present study provides an important finding regarding the peak season of infestation by yellow mite and the effective measures to be taken against it which will help the mung bean growers to combat the loss from this havoc.

Introduction

The mung bean has been grown in India since prehistoric times. It is popularly cultivated in Southeast Asia, Africa, South America and Australia. Earlier it was flourished in the United States as early as 1835 as the Chickasaw pea. Mungbean (*Vigna radiata* (L.) Wilczek), also famous as green gram, is one of the most important pulse crops grown in India. Mungbean has been used for variety of purposes. The major product obtained from the mung bean plant is its seed. Mung bean is utilised in wide range of food products, both as a whole seed and in processed form[1]. Being used in dishes like dal, curries, soup, sweets and snacks as well as rich in the thiamine, niacin and ascorbic acid content during its sprouting stage, thus mungbean are rapidly becoming popular in vegetarian diets. It is also rich in food values due to its high and easily digestible protein. Mungbean proves to be an excellent complement to rice for balanced human nutrition as per amino acid analysis. Mungbean is grown mostly during rainy season, however development of short duration and disease resistant varieties led its cultivation during spring season in almost all parts of country, during summer after harvest of potato and wheat in north India and during winter (rice fallows) in peninsular India. Under Gangetic basin of West Bengal, it is mostly grown during pre-kharif season (Mar- Apr to May- June). Mungbean is affected by various insect and non-insect pests, among which the yellow mite, *Polyphagotarsonemus latus* (Banks) plays an important role amounting huge crop loss. The yellow mite, *Polyphagotarsonemous latus* (Banks) (Acari: Tarsonemidae), which is also known as broad mite is enormously polyphagous, and showed its presence on more than 60 plant families. Yellow mites are very small in size (body length between 100 and 200 microns) as a result they got overlooked until they cause serious damage occurring rapidly which appears on the leaves. Farmers who are not aware with the damaging symptoms might confuse them with variety of things like signs of a virus, phytotoxicity from a pesticidal product, or a nutrient related disorder[2]. The mites are usually noticed on the upper part of the plant, feeding on the apical shoots and the abaxial side of young leaves. Yellow mites are basically cell feeders, having styliform simple chelicerae that are only slightly reversible[3]. Being a polyphagous mite pest the yellow mite used to feed on wide variety of crops causing different symptoms in different hosts and plant organs. Usually, the common symptom is the retarded plant growth[4,5]. In general, the immature apical leaves are seriously damaged, seem distorted, more rigid, and with curled down edges. The fruits, if any appear, may be cracked and sometimes reticulated[6,7,2,5].

Materials And Method

Population dynamics **-** A field experiment was conducted to study the population dynamics of yellow mite on mungbean variety IPM-2-3, planted in a piece of land measuring 100 sq.m at District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya (BCKV), Kalyani, Nadia, West Bengal, India located at 22°57’32” N Latitude and 88°29’40” E Longitude with an elevation of 9.75m above MSL. The crop was sown on 7th March 2015 and the mite population was recorded at an interval of 7 days, commencing from 15DAP (days after sowing). The population per square centimeter leaf area was considered for estimating the mite population. The population was collected from the field and measured under the stereo microscope in laboratory. A mean population of 30 observations has been recorded (Table – 1) and correlation co-efficient with abiotic parameters (average of maximum and minimum temperature, Relative humidity was recorded on the respective dates from the Agrometeorology Department, BCKV) have been worked out by using SPSS 16. The plant variety used in the present study complies with international, national and/or institutional guidelines and the source of variety IPM-2-3 is Indian Institute of Pulses Research, Kanpur.

Crop loss assessment **–** To estimate the crop loss caused due to mite infestation a pair plot technique was followed. 6 pair plots of 4m×5m size were taken and the seeds were sown on the same. Six plots were sprayed with diafenthiouron @ 1g/lit of water to keep the plot free from mite infestation whereas, other six plots were allowed to normal infestation of mite. Two rounds of spray were done and then the yield was compared & the loss was estimated in respect of untreated plots yield. The percent loss in potential yield of the crops due to mite alone was worked out using formula:

$$\text{Reduction in yield (\%)} = \frac{(X_1 - X_2) \times 100}{X_1}$$

;where X_1 = Mean yield of protected plots,

X_2 = Mean yield of unprotected plots

Acaricidal Management **–** To determine the bio-efficacy of new acaricide molecule, against yellow mite, *Polyphagotarsonemous latus* (Banks) in mungbean. Single dose of dicofol 18.5% EC (250g a.i./ha), diafenthiouron 50 WP (600g a.i./ha), spiromesifen 22.9% EC (72g a.i./ha), fenazaquin 10%EC (150g a.i./ha), fenpyroximate 5% EC (37.5g a.i./ha), profenfos 50% EC (500g a.i./ha) and propargite 50% EC (500 g *a.i.*/ ha) were sprayed with an untreated check to work out their efficacy against yellow mite. Two round of spray were applied at 10 days interval during early reproductive stage of the crop that ensure the flowering and fruit setting of the crop giving satisfactory yield and thus data on the results of first and second round spray had been pooled together. Observations were taken before the spraying as pre-treatment count on mean mite population/cm^2 leaf area and thereafter mite population was counted at 1, 3, 5 and 7 days after each spray (DAS). The experiment was conducted in plots of 5m×4m with three replications for each of the treatments. The mite population count per square centimeter was taken using a stereoscopic zoom binocular microscope on ten leaves from each of the plots. So, mean mite population/cm^2 was considered as the mean of 30 leaves on which the observation was taken for each of the treatments. The corrected per cent mite mortality was obtained due to different acaricidal treatments at different days after spraying based on pre-treatment mite population and the data thus obtained was analyzed statistically by SPSS 16. The corrected per cent mortality formula:

Percent reduction = $[1 - (T_a \times C_b)/ (T_b \times C_a)] \times 100$; Where, T_b = No. of pest observed before treatment, T_a = No. of pest observed after treatment, C_b = No. of pest observed before treatment in control plot, C_a = No. of pest observed after treatment in control plot.

Results And Discussion

Population dynamics of yellow mite, *Polyphagotarsonemus latus* (Banks) and its correlation with the meteorological parameters were presented in Table 1 and Table 2. The results reveals that the maximum population of broad mite was encountered in the second week of April (23.2 mites/ sq. cm. of leaf area) and it is also evident that high mite population has positive but non-significant correlation (r = 0.393) with high humidity. Mild yellow mite infestation was noticed in the third week of March, followed by a gradual increase of population from last week of March upto second week of April with the increase of humidity. The mite population was recorded during the initial budding stage of the crop and declined thereafter at the end of flowering stage. It was also observed that the peak mite population significantly coincided with the pre-flowering to flowering period of the plant. It was reported that the mite incidence is prolonged during cloudy and humid condition [8,9]. These findings are in general agreement with our findings as because the mite population is negatively but non-significantly correlated with the bright sunshine hours (r = - 0.230). Our results are also in agreement with the outcome of ref[10] that the broad mite infestation period occurred during vegetative to early fruiting stage in chilli crops. Ref [11] also cited a similar observation where he reported the increase in population from vegetative to reproductive stage. From the Table 2 we have seen that the temperature is positively but non-significantly correlated with the mite infestation (r = 0.110) which is similar to the findings of ref [12] which mentioned the directly proportional impact of temperature, rainfall, initial population & the growth condition of food plants on the increase of mite population density. Our results are also in general agreement with the outcome[13] results that temperature and relative humidity are positively correlated with the yellow mite population. But the present experiment is dissimilar to the findings of ref [14], which marks that maximum temperature showed negative and significant correlation and minimum temperature showed negative and none significant correlation with mite population infesting sesame. Linear regression analysis (Fig. 1) revealed the significance of the measured environmental variable on broad mite densities ($P<0.05$) confirming results of correlation analysis. Regression analysis showed that average humidity recorded from the study location positively contributed to the population variation of the broad mite. Similar observation was reported in ref [15].

By comparing the yield of controlled plot with respect to uncontrolled plot, yellow mite feeding caused 56.25 % chilli yield loss (Table 3). Similarly, a yellow mite infestation alone caused chilli yield loss of 27.78 % [16]. In comparison, joint feeding by yellow mite and thrips caused chilli yield loss to vary from 35 to 96 % [17,18,19]. All these findings support our experiment.

Results of efficacy of different acaricides against the yellow mite have been presented in (Table 4). Low mite mortality was recorded in plots treated with propargite and it was observed that mite mortality varied from 57.1% to 63.53% at one to seven DAS. On the other hand maximum mortality (75.20%) was recorded in dicofol treated plots followed by spiromesifen and diafenthiouron treated plots. Similar trend of efficacy of acricides also noticed even 3 days after spray but the scenario was found to be completely changed at 5 and 7 DAS when the mite mortality percentage was record maximum (81.40%) in spiromesifen & (82.00%) in diafenthiouron treated plots on respective DAS. No mite mortality was observed in plots of untreated check treatment. Similar trend of result also obtained after second round of spray. It was observed that population of yellow mite in the treated plots of dicofol, diafenthiouron and spiromesifen was very low and registered 90% mite mortality in 5 and 7 days after second round of spray but in contrast to that low mortality of mite was recorded in fenazaquin and propargite treated plots which was recorded as 70-80% after 7days of second round spray. The pooled data also shows the superiority of dicofol followed by diafenthiouron and spiromesifen in the efficacy of controlling broad mite. Nil mortality percentage was recorded in untreated check followed by the lowest mortality in propargite treated one. According to record [20] dicofol (0.074%) and Wettable sulphur were most efficient against all life stages of yellow mite among the nine acaricides applied while ref [21] recorded that dicofol was the most effective treatment against *Polyphagotarsonemus latus*. According to the experiment[22] on the efficacy of different acaricidal molecules against yellow mite, *Polyphagotarsonemus latus* (Banks) results Diafenthiuron (800 g a.i. /ha) to be the most effective one to manage and control the motile stages of the mite. Ref [23] showed that the treatment with sulphur, dicofol, diafenthiuron and spiromeifen shows the highest mortality of the yellow mite. All these findings are in line with the outcome of the present study. The present study gives an outline about the occurrence of yellow mite in association with the abiotic factors which helps farmers to take necessary steps to control this pest. Moreover, the acaricidal management provides an idea regarding the effective acaricides in controlling yellow mite from causing severe damage.

Declarations

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Competing interests **-** On behalf of all authors, the corresponding author states that there is no conflict of interest.

Availability of data and material: Not Applicable

Code availability: Not Applicable

Author’s Contribution – SB conducted and carried out the whole work, KK gone through the literature search and SKY worked out the statistical analysis of this experiment.

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Tables

Table 1. Occurrence of *Polyphagotarsonemus latus* on mungbean and the associated values of temperature, humidity and sunshine hours.

Date of observations	Average temperature (°C)	Average relative humidity (%)	No. of mites/ sq. cm of leaf area	Bright Sunshine Hours (hr)
20/03/16	26.60	58.50	2	10.3
27/03/16	28.05	83.00	13	6.60
30/03/16	26.90	85.00	13.5	7.50
3/04/16	29.85	76.00	15	9.70
7/04/16	28.20	85.50	18.2	8.40
11/04/16	30.05	81.00	22	9.40
14/04/16	27.70	81.50	23.2	10.2
18/04/16	29.75	79.00	16	9.25
21/04/16	28.75	85.50	11	7.05
25/04/16	30.90	82.50	4	9.53
29/04/16	28.60	74.50	3	10.4
2/05/16	27.80	76.00	2	9.50
5/05/16	28.20	80.50	1.5	8.90
9/05/16	27.50	79.50	2	10.3
16/05/16	30.05	81.50	1	9.05
Mean	28.59	79.3	9.82	9.07
SEM	0.33	1.73	2.07	0.31

Table-2. Correlation of *Polyphagotarsonemus latus* (Banks) population on mungbean associated with average daily temperature, percent relative humidity and hours of bright sunshine.

Correlation between	'r' value	Remarks
Mite population and temperature	0.110	Sig. N
Mite population and humidity	0.393	Sig. N
Mite population and sunshine hours	- 0.230	Sig. N

Table-3. Mungbean yields of plots infested with *Polyphagotarsonemus latus* (Banks) (uncontrolled) versus plots treated with the acaricide diafenthiouron (controlled)

Paired plot number	**yield (t/ha)**		**Percent Yield Loss (%)**
	Controlled (x_1)	**Uncontrolled (x_2)**	
1	1.6	0.6	1
2	1.8	0.7	1.1
3	1.5	0.65	0.85
4	1.6	0.8	0.8
5	1.7	0.7	1
6	1.45	0.75	0.7
Total	9.65	4.2	5.45
Mean	1.60	0.7	0.9
SEM	0.052	0.029	0.061

Figures

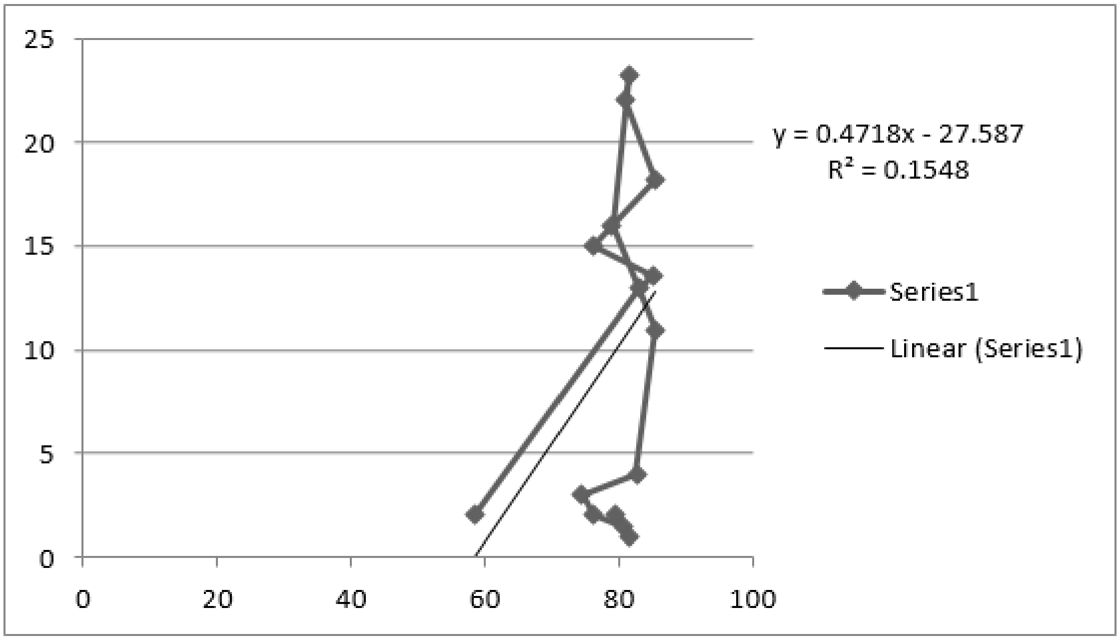

Figure 1

Regression model showing linear equation between mite and humidity (y = No. of mites/ sq. cm of leaf area; x = average relative humidity)

Supplementary Files

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