International Journal of Research in Agriculture and Forestry
Volume 1, Issue 1, November 2014, PP 9-15
ISSN 2394-5907 (Print) & ISSN 2394-5915 (Online)

Mass Multiplication of Two Spotted Spider Mite, Tetranychus Urticae on Pole Bean (Phaseolus Vulgaris L.)

D. Anuradha[1], C. Chinnamade Gowda[2], B. Mallik[3]

[1]Research Associate, Smt. Lakshmi Devi Krishi Vigyan Kendra, Kalyandurg, India
[2]Department of Agril. Entomology, University of Agricultural Sciences, Bangalore, India
[3]Department of Agril. Entomology, University of Agricultural Sciences, Bangalore, India
anuagri.kadapa14@gmail.com

Abstract: *Mass multiplication of two spotted spider mite, Tetranychus urticae was studied on pole bean as well as in French bean in polycarbonate house. 30, 40, 50 and 60 days old pole bean plants were infested with 10, 20 and 30 mites/leaflet and 20 days old French bean plants were infested with 10, 20, 30 and 40 mites/leaflet.The peak mite number was recorded (3,37,102 mites/plant) at 58 DAS when infested with 30 mites/leaflet on 30 days old pole beans, followed by 2,81,740 spider mites/plant at 65 DAS and this was followed by 2,54,479 mites/plant recorded at 65 DAS when initially infested @ 20 mites/leaflet. In French bean, the peak mite population recorded was 48,322 mites/plant at 41 DAS following infestation @ 30 mites/leaflet at 20 days after sowing, whereas, on pole bean 79,565 mites/plant could be recorded at 44 DAS following infestation @ 30 mites/leaflet on 30 days old plants.*

Keywords: *Two spotted spider mite, Tetranychus urticae, polycarbonate house, pole bean, French bean*

1. INTRODUCTION

Phaseolus vulgaris L. which is known by various colloquial names *viz*; French bean, rajma, rajmash, haricot bean, kindey bean, snap bean, navy bean, field bean, dry bean, pole bean *etc*. in different parts of the world was first domesticated in Central and South America more than 6000 years ago. Wild forms of small black seeds are found in Tropical America from where it was introduced to West Africa and later to India. Common beans were spread to Europe, Africa and Asia by Spanish and Portuguese invaders and at present it is grown throughout the cooler tropics but not in the hot or semi-arid or wet-humid regions, as in [1].

Bushy varieties of bean form erect bushes 20–60 cm (7.9”–24”) tall, while pole or running varieties form vines of 2–3 meters (6’ 7”–9’ 10”) long. The colour and shape of pods and seeds vary tremendously. Various pests have negative effects on bean production among them the spider mite has been considered a major pest in many bean-growing areas.

Among 1250 species of spider mites known in the world, the two-spotted spider mite (TSSM), *Tetranychus urticae* Koch, (Acari: Tetranychidae) is the most important polyphagous species. It attacks over 300 host plants including vegetables (e.g., beans, eggplant, pepper, tomato, potato *etc*.), fruits (e.g., strawberry, raspberry, currant, pear *etc*.) and ornamental plants, as in [2]. The life cycle of TSSM consists of an egg, larva, protonymph, deutonymph, and adult, as in [3]. Larva, protonymph, deutonymph are the three active immature stages that feed on the host plant; each are followed by a period of quiescence called the protochrysalis, deutochrysalis, and then teliochrysalis, respectively. The larval form has only 3 pairs of legs while the proto- and deuto-nymphs each have 4 pairs.

In the present investigation, vine type variety of bean, commonly known as Pole bean was evaluated as a host for the production of *T. urticae* Koch which in turn can be used for large scale production of obligatory predatory mite *Neoseiulus longispinosus* . Duration of Pole bean is longer than the bush type variety French bean and being a vine plant, utilizes the vertical space effectively to give more biomass which would be useful in the production of large number of spider mites compared to the French bean. The objective of this study was to obtain maximum spider mite population using pole bean.

1.1. Multiplication of Tetranychus Urticae on Different Host Plants

As in [4], studied within plant distribution and population patterns of *T. urticae* on field corn in Sacramento River delta. Eggs, immature, quiescent females, deutonymphs and adults of both sexes were counted on each leaf of all plants sampled. Population of each stage increased gradually during the first month of the season and then rapidly rose to peak levels. Mites aggregated on the lower leaves early in the season and on the mid-plant leaves towards the end of the season. Most mites did not reach the upper leaves.

As in [5] studied the population growth of *T. urticae* on bean plants of different ages of bean (*Phaseolus vulgaris* var. Cerinza ICA) four, five, six and seven weeks old were concurrently infested with six adult female *T. urticae* per cotyledon and leaflet. Each plant age was considered as a treatment consisting of four replicates. Bean plants of four weeks of age were an excellent substrate for the development of populations of *T. urticae*. The maximum productions of phytophagous mites (approx. 10,000 mites / plant) were achieved between four and five weeks after the initial infestation. This is the time when the population has got not only high growth rates, but also high production of females.

As in [6] studied the population density of *T. urticae* on different agricultural crops including cucumber (var. Superdaminus) and five bean varieties including *Phaseolus vulgaris* var. Talash, *P. lunatus* var. Sadaf, *P. calcaratus* var. Goli, *P. calcaratus* var. Sun-ray and *Vigna sinensis* var. Parastoo. The mean population density of the adults and total life stages of *T. urticae* on cucumber (150.71 mites per leaf) was significantly more than bean crops. Among bean varieties, the higher and lower density of the pest population was observed on Sun-ray (59.37 mites per leaf) and Parastoo (4.73 mites per leaf), respectively.

As in [7] studied the population density of *T. urticae* on seven soyabean cultivars: Williams, Tellar, Zane, Sahar, Dpx, L17 and Sari and one genotype, Ks3494. The mean density of *T. urticae* per leaf on L17 (14.15) was significantly higher than other cultivars and genotype. Lower mite density was observed on Zane and Ks3494 (6.1 and 4.65 mites per leaf, respectively).

As in [8] determined the population of eggs and active stages of the spider mite on nine aubergine cultivars of eggplant in Varamin, Iran, during the 2000 and 2001 cropping seasons. In 2000, the highest mean populations of active mites on lower leaves (37.80 and 46.87) and on upper leaves (27.19 and 38.08) were recorded on the Borazjan cultivar in naturally and artificially infested treatments, respectively. In 2001, eggs and active mite populations on the cultivars were significantly different only in the artificially infested treatment. Maximum number of eggs (63.47) and active stages (107.94) were recorded on the cultivar Imami 905. These cultivars were determined as the most susceptible and resistant cultivars to mite damage, respectively.

As in [9] studied the population dynamics of *T. urticae* on three host plants. Wherein, the highest number of *T. urticae* were recorded on bean (153.2) and eggplant (172.3) in the month of May 2006, and on lady's finger (174.35) in August, the lowest (22.0, 8.99 and 9.81) was recorded in December 2006. The number of mites in three host plants differed significantly ($P<0.001$) among seasons. The temperature had significant ($P<0.05$) impact on the abundance of *T. urticae*.

As in [10] studied the development of *T. urticae* on French bean plants. At nine leaflet stage (twelve days after sowing), a total of 7,750 spider mites of all stages were released on 15 plants, uniformly. *T. urticae* population increased to 378.93 mites per leaflet eighteen days after release and subsequently the mite population declined.

2. MATERIALS AND METHODS

This study was conducted in polycarbonate house using pole bean variety Classic NZ to multiply spider mite *T. urticae***.** In this experiment two levels of treatments were followed. First level of treatments included, pole bean plants infested with spider mites at different growth stages (main treatments) S1, S2, S3 & S4 *i.e.,* the pole bean infested with spider mites at 30 days, 40 days 50 days and 60 days after sowing. The second level treatments included, different densities of spider mites infested to the crop (sub-treatments) MD1, MD2, MD3 & MD4 *i.e.,* the spider mites were infested @ 10, 20, 30 mites per leaflet at each stage of the crop.

2.1. First Level Treatments: Infesting Pole Bean with Spider Mites at Different Growth Stages of the Crop

1. S1: Pole bean infested with spider mites at 30 days after sowing (DAS)
2. S2: Pole bean infested with spider mites at 40 DAS
3. S3: Pole bean infested with spider mites at 50 DAS
4. S4: Pole bean infested with spider mites at 60 DAS

2.2. Second Level Treatments: Density Of Spider Mites Infested on Pole Bean

1. MD1: Spider mites infested @ 10 per leaflet
2. MD2: Spider mites infested @ 20 per leaflet
3. MD3: Spider mites infested @ 30 per leaflet

Pole bean was raised in the soil at 60x60cm spacing. Pole bean seeds were sown @ 3-4 seeds per hill and only one healthy plant was retained per hill after removing the excess ones. The experiment was laid out in a factorial RBD design with four replications and two plants per treatment were maintained. The whole experiment contained one hundred twenty eight plants and each replication included twenty four plants excluding one plant left as barrier without infesting mites, between two treatments. The French bean (Selection - 9) was assessed separately for spider mite production for comparison and the crop was infested with spider mites only at one stage *i.e.,* at 20 days after sowing which was the standard check method. However, the spider mites were infested at four mite densities *viz.,* 10, 20, 30 and 40 spider mites per leaflet at 20 days after sowing.

Observations on the number of spider mites per leaflet was recorded from five randomly selected leaflets per treatment under stereo-binocular microscope, every week after infestation and the mean mite population per plant was computed taking into account the number of leaflets present in the plant. The data recorded were subjected to statistical analysis for factorial RBD.

3. RESULTS AND DISCUSSION

The present study was conducted to determine the appropriate crop stage and the optimal number of spider mites to be initially released on pole bean to get maximum spider mite production which could be advantageous for producing more number of obligatory predatory mite *Neoseiulus longispinosus*. In the study, the pole bean variety, Classic-NZ was made used in view of its ability to produce more biomass, apparently supporting the multiplication of spider mites as well.

Results of the present study showed that when pole bean was infested with spider mites at 30 DAS the maximum number of spider mites could be obtained on pole bean at 58 DAS (2,67,338 mites/plant), followed by 2,61,993 mites/plant at 65 DAS. The next best treatment was initial infestation of pole bean with spider mites at 40 DAS which could yield 2, 42,016 spider mites/plant at 65 DAS (given in Table 1). Among the three spider mite densities used for infestation, the maximum number of spider mites was recorded at 65 DAS when initially infested with 30 mites/leaflet (2,67,638 mites/plant) followed by mite infestation @ 20 mites/leaflet (2,43,137 mites/plant) and mite infestation @ 10 mites/leaflet (1,89,640 mites/plant) given in Table 2.

When interaction of both the infestation stage of pole bean and the initial mite infestation densities was considered, the peak spider mite number was recorded (3,37,102 spider mites/plant at 58 DAS) when the pole bean was infested with mites at 30 DAS @ 30 spider mites/leaflet, followed by 2,81,740 spider mites/plant at 65 DAS and this was followed by 2,54,479 mites/plant recorded at 65 DAS when initially infested @ 20 mites/leaflet (given in Table 3)

As in [5] reported that when four weeks old French been was infested with spider mites @ six females per cotyledon and leaflet, the population of spider mite increased to a maximum of 10,000 mites/plant between 4 and 5 weeks after initial infestation. In the present study, when 20 days old French bean was infested with spider mites @ 30 mites/leaflet, 48,322 spider mites/plant could be recorded at only three weeks after initial infestation. More number of spider mites recorded in the shortest time in the present study might be the resultant of higher initial infestation level of 30 mites/leaflet.

As in [10] studied the development of spider mite *T. urticae* on French bean plants. At nine leaflet stage (twelve days after sowing), when 7750 spider mites of all the stages were released on 15 plants, uniformly, the population of *T. urticae* increased to 378.93 mites/leaflet after eighteen days and later

the number declined. Whereas, in the present study, when 30 day old pole bean plants were infested with spider mites @ 30 mites per leaflet, their number increased to 1722.14 mites/leaflet (3,37,102 mites per plant) at 58 days plant age (28 days after infestation). This higher multiplication rate of *T. urticae* in the present study could be attributed to the preference of this mite to pole bean, rather than French bean.

The maximum number of spider mites recorded on French bean was 48,322 mites/plant, at 41 DAS (21 days after initial infestation) when initially infested @ 30 mites/leaflet on 20 days old French bean as given in Table 4. Whereas, on pole bean 79,565 mites/plant were recorded at 44 DAS (24 days after initial infestation) when infested @ 30 mites/leaflet on 30 days old pole bean. After reaching the maximum number at 41 DAS (21 days after initial infestation), the mite population on French bean started declining with the maturity of the crop. Whereas, on pole bean the spider mite population was found still increased and reached peak by 58 DAS (3,37, 102 mites/plant).

Table 1. *Number of two spotted spider mite Tetranychus urticae on pole bean infested with spider mites at different crop growth stages across mite infestation densities in the polycarbonate house during Feb-May, 2013*

Growth stages of pole bean	Mean number of spider mites per plant							
	37 DAS	**44 DAS**	**51 DAS**	**58 DAS**	**65 DAS**	**72 DAS**	**79 DAS**	**86 DAS**
S1	3211 (54.68)	59908 (238.93)	75190 (268.04)^{a}	267338 (513.95)^{a}	261993 (510.53)^{a}	198795 (441.16)^{a}	136203 (357.93)^{a}	74047 (263.34)^{a}
S2	-	-	28788 (166.45)^{b}	69309 (261.10)^{b}	242016 (489.71)^{a}	174215 (413.29)^{ab}	93709 (298.67)^{b}	53048 (224.59)^{ab}
S3	-	-	-	-	196406 (437.00)^{b}	153145 (386.15)^{bc}	86260 (284.37)^{b}	45597 (203.87)^{b}
S4	-	-	-	-	-	133256 (364.25)^{c}	77486 (275.63)^{b}	42676 (198.37)^{b}
F test	-	-	*	*	*	*	*	*
SEM±	-	-	(13.25)	(10.02)	(10.57)	(14.50)	(19.30)	(16.79)
CD (P=0.05)	-	-	(39.94)	(30.20)	(30.25)	(41.71)	(55.51)	(48.31)

Note: Figures in the parentheses are √X+0.5 transformed values

Mean values in each column superscripted by the same letters are not significantly different (P=0.05)

**= Significant at (P=0.05)*

- = Data not available

S1= Pole bean infested with spider mites at 30 days after sowing (DAS)

S2= Pole bean infested with spider mites at 40 DAS

S3= Pole bean infested with spider mites at 50 DAS

S4= Pole bean infested with spider mites at 60 DAS

DAS= Days after sowing

Table 2. *Number of two spotted spider mite Tetranychus urticae on pole bean infested with spider mites at different mite infestation densities across crop growth stages in the polycarbonate house during Feb-May, 2013*

Mite infestation densities	Mean number of spider mites per plant							
	37 DAS	**44 DAS**	**51 DAS**	**58 DAS**	**65 DAS**	**72 DAS**	**79 DAS**	**86 DAS**
MD1	2890 (50.95)	45242 (207.41)	37303 (184.50)^{b}	138123 (356.38)^{b}	189640 (428.79)^{b}	147916 (382.44)^{b}	79529 (271.99)^{b}	40579 (199.13)
MD2	3066 (55.01)	54915 (229.57)	46898 (211.98)^{ab}	159675 (379.35)^{a}	243137 (492.18)^{a}	157776 (393.32)^{ab}	89729 (292.66)^{b}	50545 (218.98)
MD3	3677 (58.09)	79565 (279.80)	71766 (255.21)^{a}	207173 (426.85)^{a}	267638 (516.32)^{a}	188866 (427.88)^{a}	125984 (347.79)^{a}	70403 (249.52)
F –Test	NS	NS	*	*	*	*	*	NS
SEM±	(6.78)	(29.67)	(16.23)	(12.27)	(10.57)	(12.55)	(16.71)	(14.54)
CD (P=0.05)	-	-	(48.92)	(36.99)	(30.25)	(36.12)	(48.07)	-

Note: Figures in the parentheses are √X+0.5 transformed values

Mean values in each column superscripted by the same letters are not significantly different (P=0.05)

*NS= Non significant *= Significant at (P=0.05)*

MD1= Pole bean infested @ 10 spider mites leaflet-1

MD2= Pole bean infested @ 20 spider mites leaflet-1

MD3= Pole bean infested @ 30 spider mites leaflet-1

DAS= Days after sowing

Table 3. *Number of two spotted spider mite Tetranychus urticae on pole bean infested with spider mites at different crop growth stages and at different mite infestation densities in the polycarbonate house during Feb-May, 2013*

Treatments	Mean number of spider mites per plant							
	37 DAS	**44 DAS**	**51 DAS**	**58 DAS**	**65 DAS**	**72 DAS**	**79 DAS**	**86 DAS**
S1 MD1	2890 (50.95)	45242 (207.41)	56439 (234.27)	211746 (459.49)^{b}	249760 (498.23)^{ab}	166598 (406.85)	93505 (296.24)	44830 (209.06)
S1 MD2	3066 (55.01)	54915 (229.57)	65090 (255.08)	253166 (502.96)^{b}	254479 (503.46)^{ab}	173477 (413.67)	108989 (324.52)	51936 (227.19)
S1 MD3	3677 (58.09)	79565 (279.80)	104041 (314.76)	337102 (579.40)^{a}	281740 (529.90)^{a}	256311 (502.97)	206114 (453.02)	125375 (353.76)
S2 MD1	-	-	18167 (134.74)	64500 (253.27)^{c}	197505 (441.88)^{c}	169412 (410.75)	78568 (273.42)	50203 (222.37)
S2 MD2	-	-	28706 (168.88)	66184 (255.74)^{c}	252952 (502.75)^{ab}	170883 (410.33)	92855 (294.19)	52771 (222.32)
S2 MD3	-	-	39491 (195.66)	77244 (274.30)^{c}	275590 (524.48)^{a}	182349(418.80)	109706 (328.40)	56168(229.08)
S3 MD1	-	-	-	-	121655 (346.26)^{d}	135736 (366.54)	74564 (251.70)	37149 (192.27)
S3 MD2	-	-	-	-	221981(470.17)^{bc}	146924 (375.66)	82302(283.66)	49473 (215.78)
S3 MD3	-	-	-	-	245583 (494.58)^{abc}	176774 (416.25)	101913 (317.74)	50169(203.56)
S4 MD1	-	-	-	-	-	119916 (345.61)	71480 (266.60)	30132 (172.83)
S4 MD2	-	-	-	-	-	139819 (373.62)	74773(268.25)	47999 (210.62)
S4 MD3	-	-	-	-	-	140031 (373.51)	86204(292.03)	49898(211.66)
F –Test	NA	NA	NS	*	*	NS	NS	NS
SEM±	NA	NA	(22.95)	(17.35)	(18.31)	(25.11)	(33.41)	(29.08)
CD (P= 0.05)	NA	NA	-	(52.31)	(53.44)	-	-	-

Note: Figures in the parentheses are √X+0.5 transformed values

Mean values in each column superscripted by the same letters are not significantly different (P=0.05)

*NA= Not analysed - = Data not available NS= Non significant *= Significant at (P=0.05)*

DAS= Days after sowing

S1= Pole bean infested with spider mites at 30 days after sowing (DAS)

S2= Pole bean infested with spider mites at 40 DAS

S3= Pole bean infested with spider mites at 50 DAS

S4= Pole bean infested with spider mites at 60 DAS

MD1= Pole bean infested @ 10 spider mites leaflet^{-1}

MD2= Pole bean infested @ 20 spider mites leaflet^{-1}

MD3= Pole bean infested @ 30 spider mites leaflet^{-1}

Table 4. *Number of two spotted spider mite Tetranychus urticae on French bean infested with spider mites at different densities at 20 days after sowing in polycarbonate house during Feb-May, 2013*

Spider mite infestation densities	Number of spider mites per plant					
	27 DAS	34 DAS	41 DAS	48 DAS	55 DAS	62 DAS
MD1	572 (22.74)	3507 (53.29)	28665 (165.95)^{b}	8450 (91.76)^{b}	1894 (41.32)	521 (27.19)
MD2	464 (20.64)	3764 (63.08)	36786 (191.30)^{b}	9938 (99.21)^{b}	1965 (44.07)	532 (23.31)
MD3	587(21.70)	3839 (68.26)	48322 (215.78)^{a}	11415 (105.91)^{ab}	2186 (46.27)	566 (21.63)
MD4	514 (22.37)	4647 (85.41)	49719 (219.00)^{a}	15614 (123.37)^{a}	2266 (47.42)	781 (22.83)
F test	NS	NS	*	*	NS	NS
SEM±	(4.02)	(7.50)	(12.39)	(6.47)	(4.02)	(3.21)
CD (P=0.05)	-	-	(38.18)	(19.95)	-	-

Note: Figures in the parentheses are √x+0.5 transformed values

Mean values in each column superscripted by the same letters are not significantly different (P=0.05)

NS= Non significant *= Significant

DAS= Days after sowing

MD1= French bean infested @ 10 spider mites leaflet^{-1}

MD2= French bean infested @ 20 spider mites leaflet^{-1}

MD3= French bean infested @ 30 spider mites leaflet^{-1}

MD4= French bean infested @ 40 spider mites leaflet^{-1}

4. CONCLUSION

The findings of the present study indicated that pole bean raised in soil would be a more suitable host than potted French bean plants for the production of spider mites in the polyhouse. Further, 30 days old pole bean plants infested with spider mites at the rate of 30 mites/leaflet produced significantly more number of spider mites, consequently aiming to produce more number of predatory mites like *Neoseiulus longispinosus*.

REFERENCES

[1] Chatterjee, B. N., K.K Bhattacharyya, Kajalsengupta and Ghosh, R. K., 1986, "Pre-sowing seed treatments for Legumes", Food Legume Improvement for Asian Farming Systems, ICIAR Proceedings No. 18, pp.233 (Australia).

[2] Le Goff, G., Mailleux, A. C., Detrain, C., Deneubourg, J. L., Clotuche, G. and Hance, T., 2009, Spatial distribution and inbreeding in *Tetranychus urticae*. *Biologies*, **332**: 927-933.

[3] Walter, D. E. and Proctor, H. C., 1999, Mites - Ecology, Evolution and Behaviour. University of New South Wales Press and CAB International, Sydney and Wallingford. 322 pp.

[4] Krainacker, D. A. and Carey, J. R., 1990, Spatial and temporal dynamics of two spotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae). *J. Appl. Ent.*, **109**(5): 481-489.

[5] Bustos, A., Cantor, F., Cure, J. R., and Rodriguez, D., 2009, Standardization of the Rearing Procedure of *Tetranychus urticae* Koch (Acari: Tetranychidae) on bean (*Phaseolus vulgaris*): plant age and harvest time. *Neotrop. Entomol*., **38**(5): 653-9.

[6] Mehrkhou, F. Fathipour, Y. Talebi, A. A., Kamali, K. and Naseri, B., 2008, Population density and spatial distribution patterns of *Tetranychus urticae* (Acari, Tetranychidae) and its predator *Stethorus gilvifrons* (Coleoptera: Coccinellidae) on different agricultural crops. *J. Entomol. Res. Soc*., **10**(2): 23-36.

[7] Sedaratian, A., Fathipour, Y., Moharramipour, S. and Talebi, A. A., 2008, Effect of different soybean varieties on bionomics of *Tetranychus urticae* (Acari: Tetranychidae). *Munis. Entomol. Zool.*, **3**(2): 716-730.

[8] Baradaran Anaraki, P., Arbabi Masoud, M. and Shafiei Ajbishe, R., 2007, Study on different eggplant cultivars for infestation to two spotted spider mite (*Tetranychus urticae* complex) in Varamin region. *Seed and Plant*, **23**(1): 15-29.

[9] Hoque, M. F., Khalequzzaman, M. and Islam, W., 2010, Population dynamics of *Tetranychus urticae* Koch and *Phytoseiulus persimilis* Athias-Henriot on three host plants. *Pakistan Entomol*., **32**(1): 6-11.

[10] Vaidya, R., 1999, Management of *Tetranychus urticae* Koch (Acari: Tetranychidae) on rose in polyhouse conditions using *Amblyseius longispinosus* (Evans) (Acari: Phytoseiidae). *M. Sc. Thesis*, University of Agricultural Sciences, Bangalore, pp. 34-61.

AUTHOR'S BIOGRAPHY

D. Anuradha, completed my Master's degree in University of Agricultural Sciences, Bangalore.