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ORIGINAL ARTICLE

DAMAGE SCALE FOR PHYTOPHAGOUS MITE (*POLYPHAGOTARSONEMUS LATUS*) IN POTATO

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Abstract : Potato (*Solanum tuberosum* L.) is considered as one of the most important vegetable crops all over the world and it is the most important food crop in the world after rice, wheat and maize. The early crop of potato, which is a short duration crop, is planted during September in Indo-Gangetic plains. During this period temperatures are very high during day time but they are suitable for tuberization during night and farmers take this early crop as this fetches premium price for their produce. Leaves of potato crop are heavily damaged in this season by phytophagous mite, *Polyphagotarsonemus latus*. In the recent past under changing climatic conditions the mite, *P. latus* has started damaging the potato foliage severely resulting into mite burn. Burning of leaves affects the quantity and quality of potato. Hence, to measure the severity of damage done by the mite in potato crop, a visual scale of mite damage from 0-6 was developed on the basis of symptoms produced on the foliage in the field.

Key words : Mite, *Polyphagotarsonemus latus*, Potato, Mite burn, Damage scale.

1. Introduction

India is the second largest producer of potato after China with a production and productivity of 45 MT and 23.6 t/ha, respectively. In Indo-Gangetic plains of India, farmers plant early crop of potato in the month of September to get a good price for their produce as this crop is harvested in festive season. The early crop of potato is a short duration crop which is planted during high temperature regime. September planted potato crop is infested by mite, *Polyphagotarsonemus latus* (Banks) also known as broad/yellow/chilli mite or tea mite. It is a minute arthropod belongs to family Tarsonemidae which includes more than 500 mite species distributed worldwide. Numerous crop plants from diverse families including Solanaceae, Cucurbitaceae and Malvaceae and many ornamentals have been reported to be attacked by this polyphagous pest resulting in severe burning symptoms on leaves and yield losses. Its attack is confined mostly to new growths resulting in curling of leaf margins, firmness of infested leaves, necrosis of growing points, aborted buds, malformed fruits and growth inhibition [Grinberg *et al*. (2005)]. The dispersal of female mite from one place to another by whitefly, *Bemisia tabaci* and aphids is well known [Natarajan (1988)] and these mites are also disseminated by humans, particularly when infested plants are moved from one area to another. The broad mite is considered as a pest of substantial economic importance as it has been recorded on a wide range of crops – fruit and vegetable crops throughout the tropical and sub-tropical world. Damage to pepper, eggplant, potato, citrus and some ornamentals (Dahlia, Gerberas) can be quite severe [Jones (1988)]. The impact of *P. latus* feeding has been qualitatively described for cotton, cucumber, potatoes, tomatoes, gerberas, beans, papaya and pepper [Pena and Bullock (1994)]. In India, the damage due to mite is serious in Maharashtra and Karnataka in *Kharif* and western UP and Punjab in early planted *rabi* potatoes. Mite damage on potato has also been observed in Gwalior (MP) and Kangra valley (HP). The pest is responsible for 80-100% foliage

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damage and 12-60% loss in yield [NPCS Board of Consultants & Engineers (2007)]. The seriousness of damage could be judged by the economic threshold on chilli for *P. latus*, which is one mite/leaf and it causes 34.14% loss in yield to brinjal crop in Andhra Pradesh [Dhandapani *et al*. (2003)]. Because of the tarsonemid's short generation time (approx. 5 days), high fecundity, small size and protected habitat, the injury it produces is often confused with diseases and phytotoxicity [Jeppson *et al*. (1975), Cross and Bassett (1982)]. While damage observations suggest a causal relation to host phenology, quantitative assessment of actual impact of feeding by broad mite on growth, leaf area and yield is apparently not well correlated with levels of visible injury and with broad mite densities [Dhoria and Bindra (1977), Brown and Jones (1983)]. Assessment of mite damage under field conditions is very important to take management decisions as it is purely based on visual symptoms. A broad mite infestation was assessed by developing damage index scale of 0-6 in pepper, 0-5 in jute [Kamruzzaman *et al*. 2013)], 0-4 in chilli [Rameash *et al*. (2015)]. Besides, Raj *et al*. (2004) developed rating scale for screening heat tolerant potato germplasm based on ratio between healthy and mite damaged leaves (converted to % damage).

However, simple, well-defined damage scale for assessing mite infestation in potato is lacking. This damage scale would be highly helpful in taking management decisions and also screening potato germplasm for resistance. Therefore, the current study was carried out to develop damage scale of mite in potato.

2. Materials and Methods

The potato crop was planted at Central Potato Research Institute Campus, Modipuram (Meerut), Uttar Pradesh in early crop season in the month of September (15.9.2012). In total 30 plots were planted. The variety used was Kufri Bahar, which is most popular variety of Uttar Pradesh and plot size was 2x3.6 m^2 to record the development of symptoms on potato crop. All the standard agronomical practices (NPK- 160:80:100 kg/ha) were followed. Neither soil was treated with any chemical insecticide nor crop sprayed to control the mites. The crop was under observation for the production of symptoms during entire crop season in 2012, 2013 and 2014. Five plants from each plot were selected for visual observations. The scale of mite damage with visual rating of 0 to 6 was devised on the basis of symptoms produced and burning and dying of leaf tissues in potato as a result of mite feeding.

3. Results and Discussion

P. latus is very small, microscopic in size and cannot be seen with naked eyes on plant leaves. Hence, initially one has to be very careful while recording mite and leaves should be minutely observed with the help of lens (10X). It was recorded that mites were present on underside of the leaves even when no symptoms appeared on upper side of the potato leaf. On unsprayed potato crop mite starts appearing immediately after germination in the month of October only and start multiplying in mid October. *P. latus* has been associated with potato crop since long but no significant losses were recorded in the yields earlier (10-15years back). Observations recorded on potato crop since last 4-5 years indicated a change in pest scenario of early planted crop of potato and feeding of mite has resulted in significant losses in yield too (30-40%). The role of abiotic factors becomes more important in climate change scenarios and during 2012, first time heavy damage by mite burn was recorded in September planted crop of potato. In September 2012, the monthly average minimum, maximum temperature, morning and evening RH were 24.5^{0}C, 31.4^{0}C, 73.4 and 50.6 per cent respectively, when potato crop was planted. Mite continued to multiply in the months of October and November which were also warmer (Table 1) and crop was damaged up to 63% in 2012. The maximum temperatures were on the rise during all the three years in September, October and November (Table 1) and mite burn was 65 and 68 per cent respectively in 2013 and 2014. The correlation coefficients were also calculated with mite damage percentage and abiotic factors but no definite pattern was observed during these three years as the values obtained were non-significant. The basic interactions between broad mites and their host plants are affected by several biotic and abiotic factors. Their interactions may influence the population dynamics and the relationship between yield loss and number of mite units either in mite density or mite days. Effects of humidity, temperature and predators on *P. latus* population dynamics have been described [Brown and Jones (1983), Pena *et al*. (2000)]. Rain fall was negatively correlated with per cent mite burn and non-significant. The severity of the damage done could be judged on the basis of

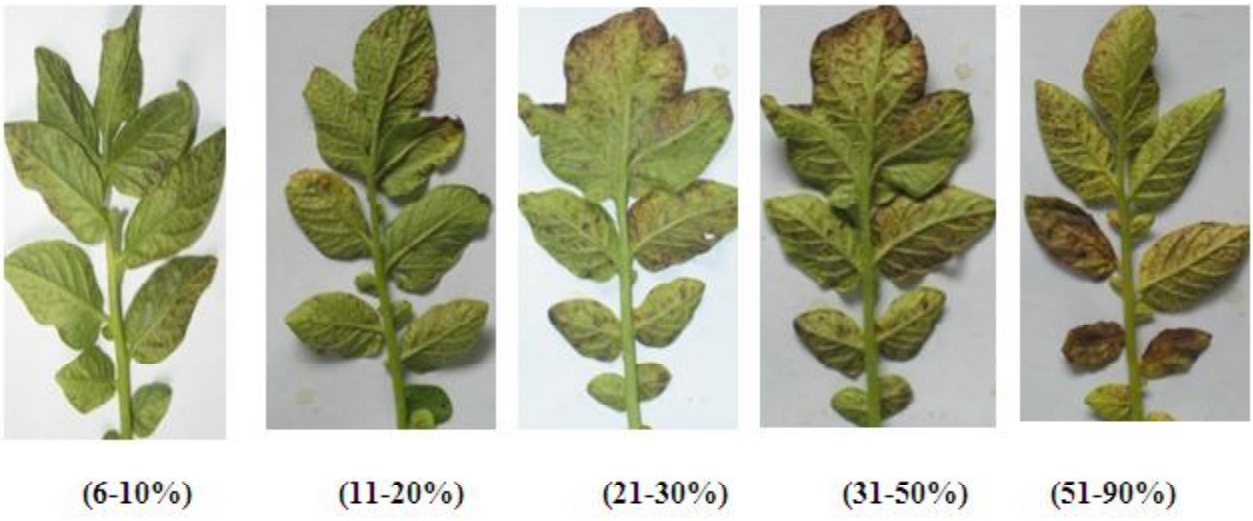

Fig. 1-5 : Visual scale of damage caused by yellow mite (*P. latus*) based on symptoms produced on ventral surface of potato leaf.

Fig. 6 : Mite damage leading to drying of plant (Category 6).

Similarly, 60 per cent yield loss was reported due to mite *P. latus* infestation by Gibson and Valenchia (1978).

This loss in yield in potato by mite burn led us to develop mite damage scale. So the '1-6 Category scale" for mite damage on potato was finalized on the basis of visual observations to educate the farmers as mite infestation is escalating. Besides, this mite damage scale will aid in systematic screening of potato genotypes for tolerance to broad mite. The scale was designed as follows :

Category 1 (0-5%)- 1. Lower surface of lower leaves shines in sunlight but no bronzing 2. Mid-vein becomes sinuous in lower leaves and the colour of the leaves changes from shiny green to opaque green.

Category 2 (6-10%)- 1. Whole lower leaf surface turns bronze. 2. Apical leaves began to curl 3. Margin of leaves turn inside, leaf area was reduced (Fig. 1).

Table 1 : Monthly average of temperature and relative humidity and rain fall during 2012-2013 and 2014 at CPRIC, Modipuram.

Year/month	Average Temp		Average Relative humidity		Rains (mm)
	Min.	Max.	Morning	Evening	
Sep -2012	24.5	31.4	73.4	50.6	60.9
Sep -2013	22.6	32.8	76.2	60.2	27.5
Sep-2014	23.0	34.3	82.4	59.8	9.5
Octo-2012	17.5	30.1	69.7	40.3	3.8
Octo-2013	21.2	30.4	80.2	55.6	94.2
Octo-2014	19.1	30.4	83.7	53.3	0
Nov-2012	11.5	25.0	71.6	41.3	3.75
Nov-2013	12.2	25.6	73.9	44.3	0
Nov 2014	13.0	26.8	78.7	71.3	0

mite damage in untreated control crop where 56.7% mite burn resulted in very poor yield of 8.75t/ha in 2012 with a loss of 43.5%. Broad mite could cause yield loss of 26.80 and 4 per cent at Madenur and Beekanahalli regions of Karnataka [Basavaraju *et al*. (2009)].

Category 3 (11-20%)- 1. Bronze colour is present in the apical leaves. 2. Small leaves completely bronze and their tips show necrosis. 3. Appearance of little yellow spots on the lower leaves (Fig. 2).

Category 4 (21-30%)- 1. Spots on lower leaves start coalescing resulting in small areas of yellowing on upper surface of the leaves 2. Veins of infested leaves becomes thicker. 3. Tips and margins start burning (Fig. 3).

Category 5 (31-50%)- 1. More area of yellowing on upper side of leaves. 2. Lignification and burning of leaves (Fig. 4).

Category 6 (51-90%)- 1. Simultaneous increase in burning. 2. All leaves burn only stems of yellow color visible and lastly whole plant dies (Figs. 5 & 6).

Scale for mite damage developed in this study could be useful for recording the mite damage/burn in potato as well as screening the genotypes for resistance. The mite scale studies would also help farmers to identify the damage symptoms and take the decision to manage this pest in case of mite damage.

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