

PEST SPECTRA, SUCCESSION AND ITS YIELD LOSSES IN MUNGBEAN AND URDBEAN UNDER CHANGING CLIMATIC SCENARIO

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Received: 02-11-2012

Accepted: 01-03-2013

ABSTRACT

Field experiments were carried out to explore the change in pest spectra, their status, succession and yield loss in mungbean and urdbean under changing climatic scenario. The pest spectra comprised of 35 species on mungbean and 25 species on urdbean during *kharif* season and 17 species were recorded during summer season in both the crops. Broad mite (*Polyphagotarsonemus latus*), blister beetle (*Mylabris pustulata*) and spotted pod borer (*Maruca vitrata*) has assumed the status of major pests during *kharif* season as compared to earlier report at Kanpur location. Bean flower thrips (*Megalurothrips usitatus*), a major pest during spring/summer seasons has now become major pest in *kharif* season also. The avoidable losses due to pest complex on different varieties of mungbean ranged from 27.03 to 38.06% with an average of 32.97%. The avoidable losses due to pest complex on different varieties of urdbean ranged from 15.62 to 30.96% with an average of 24.03%. Seed treatment with imidacloprid 17.8 SL caused 40.2 to 81.4% reduction in sucking pests. Foliar application of monocrotophos 36 SL @ 0.04% at 35, 45 and 55 days after sowing resulted in mean per cent reduction of 35.6 to 90.3% in insect and mite pests.

Key words: Climate change, Mungbean, Pest spectra, Succession, Urdbean, Yield loss.

INTRODUCTION

Mungbean [*Vigna radiata* (L.) Wilczek] and urdbean [*Vigna mungo* (L.) Hepper] are important food legume crops of India cultivated in *kharif* (monsoon), *rabi* (post-rainy) and spring /summer seasons in different agro-ecological zones. In India, mungbean and urdbean are grown in an area of 3.34 and 3.17 million ha, respectively. India has the distinction of being the top producer of these pulse crops in the world, the present production of mungbean and urdbean being 1.06 and 1.33 million tonnes in the country (Ali and Shivkumar, 2006). The present productivity levels of these crops are 317 and 419 kg/ha, respectively, which are quite low as compared with other crops. Among the several constraints for low productivity, the losses due to insect pests are the foremost. The insect pest complex of mungbean and urdbean has undergone a tremendous change during the last two decades due to change in climate, cropping pattern, insecticide application pattern and introduction of high yielding

varieties (Kooner *et al.*, 2006). The production of these pulse crops has been severely threatened by increasing difficulties in controlling the major insect pests as they have developed resistance to insecticides, resurgence and secondary pest outbreak due to indiscriminate and incessant use of insecticides. On the other hand, some species which were of minor importance in the past, have become dominant pests, and others that were never reported have appeared. This kind of shift in the pest complex necessitates a review of the pest complex and economic loss assessment in popular varieties to determine the relative importance of pests and to fix the research priorities for the particular pest species and the crop. Hence, the present study was undertaken to explore the pest spectra of mungbean and urdbean, its succession, effect of weather parameters on their population fluctuation and yield loss assessment for developing effective pest management strategies under changing climatic scenario.

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MATERIALS AND METHODS

Pest spectra and its succession: Pest spectra and its succession on mungbean (cv. samrat) and urdbean (cv. utara) was studied in large field plots (30 x 10 m²) under natural infestation during *kharif*, 2007 and summer, 2008. The crop was sown with the onset of monsoon during *kharif* (23.7.2012) and first week of April during summer (2.4.2008). The rows and plants were spaced 30 cm and 10 cm apart, respectively. A fertilizer dose of 20 kg N and 50 kg P₂O was applied as basal. Recommended crop management practices were adopted except that no insecticide was sprayed. The data on all insect and mite pests associated with the crops were observed from one week after germination and subsequent recordings were recorded at weekly intervals till the harvest of the crops. The pest population count was based on actual count from 25 random plants in five places (5 plants in each place) selected diagonally across the field of each crop. The population of whitefly and jassid was recorded with the help of split cage. In case of yellow broad mite, per cent leaf damage was estimated by counting the total number of leaves and mite damaged leaves. The insect and mite pests present in considerable number were categorized as 'major' pests, insects appeared in small number were categorized as 'minor' pests and those which appeared casually were categorized as 'stray'. Identification of unknown insect species was made with the help of National Bureau of Agriculturally Important Insects, Bangalore.

Assessment of yield loss due to pest complex in mungbean and urdbean: Field experiments were conducted during *kharif*, 2007 with five popular varieties of each mungbean (cv. samrat, meha, NDM 1, PDM 54, HUM 2) and urdbean (cv. utara, Pant U19, Sekhar 1, Type 9, NDU 1) under protected and unprotected conditions in randomized block design with four replications. Under protected conditions, seed treatment with imidacloprid 17.8 SL (3ml/kg of seed) and foliar application of monocrotophos 36 SL (0.04%) at 35, 45 and 55 days after sowing was applied. Different population of insects was recorded periodically. Grain yield at harvest was recorded in protected and unprotected conditions and the per cent avoidable yield loss were computed using the following formula.

$$\text{Per cent avoidable yield loss} = \frac{\text{Yield in protected} - \text{Yield in unprotected}}{\text{Yield in protected}} \times 100$$

Correlation between pest population and weather parameters: Correlation coefficient was performed to determine the relationship between weather parameters and incidence of the insect pests and leaf damage due to mite. For the analysis, the mean maximum temperature, minimum temperature, relative humidity, wind speed, sunshine hours and rainfall during the sampling week and the corresponding incidence of the insect pests and leaf damage due to mite was used and the association was computed using Pearson's correlation coefficient using SPSS software.

Spatial distribution of mites in different varieties of mungbean: During the study, the broad mite (*Polyphagotarsonemus latus*) assumed the status of major pests in mungbean. The adults and nymphs of this mite damage the plants by sucking cell sap from the leaves. Feeding by both nymphs and adults causes downward cupping of leaves and necrosis of young leaves and flowers. Such leaves are greenish from upper side and reddish brown from lower side. A standard sampling procedure is a prerequisite for estimating the mite population in order to study host plant resistance, the effect of attempted control measures and seasonal fluctuations. Hence, distribution of the eggs and motile stages (nymphal and adult stages) of broad mite (*Polyphagotarsonemus latus*) on five different varieties of mungbean was assessed from three different leaves position (top, middle and bottom leaves) to determine the sampling of leaves for highest population count of mite. The mite population was assessed during the peak infestation period (50 days after sowing). The leaves were carried to the laboratory and observed the population per cm² leaf area in the centre of middle leaflet of the trifoliate leaves under a stereobinocular microscope at 50x magnification. The data were analysed statistically by adopting factorial CRD with four replications.

Statistical analysis: An analysis of variance (ANOVA) was conducted on all data related to yield loss assessment and spatial distribution of mite using Agres statistical software. Following ANOVA, differences between data sets were determined using

least significant difference and the accepted level of significance at $p = 0.05$ in all instances. Data are presented as means within the same column and followed by different letters are significantly different. The association between weather parameters and occurrence of insect and mite pests were computed using Pearson's correlation coefficient using SPSS software.

RESULTS AND DISCUSSION

Pest spectra in mungbean and urdbean: The pest spectra during *kharif* season comprised of 35 species on mungbean (33 insects and 2 mite species) and 25 species on urdbean (24 insects and one mite species). As far as the occurrence and status of the individual insect pest is concerned, eight pests on mungbean and seven pests on urdbean were categorized as major pests. Nine insects in mungbean and seven insects in urdbean were designated as minor pests. As many as 18 insects in mungbean and 11 insects in urdbean were recorded as 'stray'. The major pests are whitefly (*Bemisia tabaci*), blister beetle (*Mylabris pustulata*), bean flower thrips (*Megalurothrips usitatus*), spotted pod borer (*Maruca vitrata*) and pod bugs (*Riptortus pedestris*, *Clavigralla gibbosa* and *C. horrens*) on both the crops and broad mite (*Polyphagotarsonemus latus*) on mungbean. The minor pests include green jassid (*Empoasca kerri*), galerucid beetle (*Madurasia obscurella*), leaf thrips (*Caliothrips indicus*), ash weevil (*Myllocerus* sp.), Bihar hairy caterpillar (*Spilarctia obliqua*), grasshopper (*Oxya* sp.) and red spider mite (*Tetranychus* sp.) on both the crops and green semilooper (*Anomis flava*) and stink bug (*Nezara viridula*) on mungbean. Some other insects, namely bean aphid (*Aphis craccivora*), tobacco caterpillar (*Spodoptera litura*), red hairy caterpillar (*Amsacta moorei*), termite (*Odontotermus* sp.), pumpkin beetle (*Aulacophora foveicollis*), lablab leaf miner (*Cyphosticha* sp.), blue butterfly (*Lampides boeticus*), pulse beetle (*Callosobruchus chinensis* and *Callosobruchus maculatus*) in both the crops; spotted beetle (*Epilachna vigintioctopunctata*), pumpkin beetle (*Aulacophora foveicollis*), sphingid caterpillar (*Acherontia styx*), dusky cotton bug (*Oxycarenus* sp.), chaffer beetle (*Oxycetonia versicolor*), gram pod borer (*Helicoverpa armigera*), red cotton bug (*Dysdercus koenigii*), pod bug

(*Copidosoma* sp.), pod weevil (*Apion* sp.) in mungbean and green semilooper (*Anomis flava*) and stink bug (*Nezara viridula*) in urdbean appeared casually were categorized as 'stray.'

Observations on the pest spectra of mungbean and urdbean during summer season revealed 16 insects and one mite species. As far as occurrence and status of the individual pest is concerned, two pests were recorded as major pests, six were categorized as minor pests and nine were recorded as stray. The crops during summer were mainly infested by two major insect pests viz, whitefly (*Bemisia tabaci*) and bean flower thrips (*Megalurothrips usitatus*). The minor pests during summer season include green jassid (*Empoasca kerri*), galerucid beetle (*Madurasia obscurella*), leaf thrips (*Caliothrips indicus*), pod bugs (*Riptortus pedestris*, *Clavigralla gibbosa* and *C. horrens*). Broad mite (*Polyphagotarsonemus latus*), lablab leaf miner (*Cyphosticha* sp.), grass hopper (*Oxya* sp.), chaffer beetle (*Oxycetonia versicolor*), dusky cotton bug (*Oxycarenus* sp.), stink bug (*Nezara viridula*), red cotton bug (*Dysdercus koenigii*), spotted pod borer (*Maruca vitrata*), blue butterfly (*Lampides boeticus*) which appeared casually were designated as 'stray'.

The pest spectra in mungbean and urdbean recorded in the present study was found to be less as compared to 44 species reported by Sehgal and Ujagir (1988) and 64 species reported by Lal (1987). This may be due to the impact of change in the cropping pattern under climate scenario, release of pest resistant varieties and insecticide application pattern. Similarly, there is a change in status of pests, the insect pests viz, blister beetle (*Mylabris pustulata*) and spotted pod borer (*Maruca vitrata*) assumed the status of major pests in mungbean and urdbean as compared to the major insect pests reported in and around Kanpur (Anonymous, 1997). The 16 species of insect and mite species during summer season is in agreement with the report of Singh and Kalra (1995), however, the status of major pests reported (green jassid, *Empoasca kerri*; stemfly, *Opiomyia phaseoli*; brown jassid, *Austrogallia* sp.) differed from the present study in which only two pests (whitefly and flower thrips) were observed as major pests.

The flower thrips species collected on mungbean and urdbean during the present study was identified as *Megalurothrips usitatus* (Fig. 1 to 5).

This is in contrast to the report of Kooner *et al.* (2006) who reported that the thrips infesting flowers of mungbean and urdbean in Punjab as *Megalurothrips distalis*.

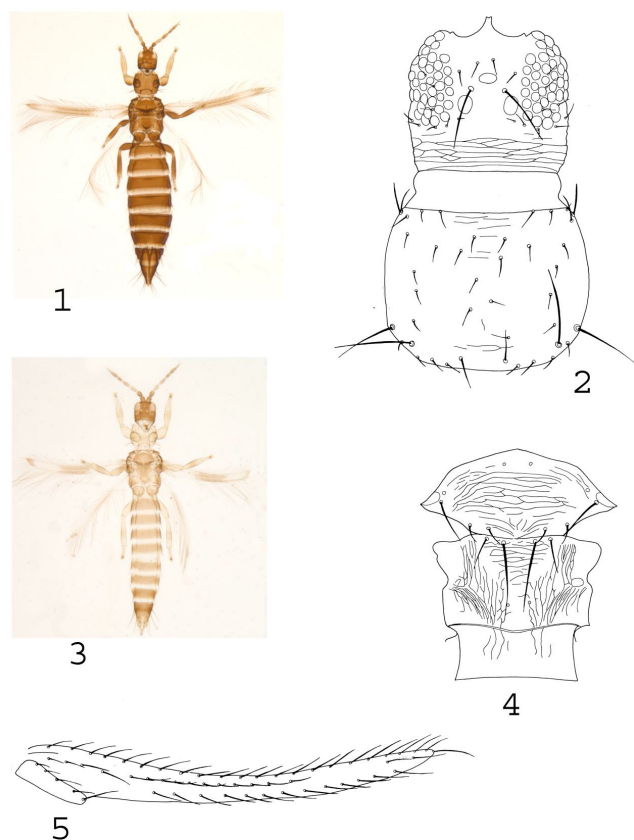
Pest succession in mungbean and urdbean:

During *kharif* season, similar type of pest succession was observed in both mungbean and urdbean. Whitefly appeared in seedling stage (15-21 days after sowing, 32nd SMW) and their incidence was noticeable throughout the growth season, reaching its peak activity at 50-56 days after sowing (37th SMW). The incidence of whitefly on mungbean and urdbean ranged between 0.2 (43-49 DAS, 36th SMW) to 10.4 (50-56 DAS, 37th SMW) and 0.6 (22-28 DAS, 33rd SMW) to 21.0 (50-56 DAS, 37th SMW) per five plants, respectively. As the flowering initiated, blister beetle was observed first and one week later bean flower thrips incidence occurred. Both the pests continued till pod maturation. The blister beetle population ranged between 0.2 (36-42 DAS, 35th SMW) to 2.8 (50-56 DAS, 37th SMW) and 0.2 (36-

42 DAS, 35th SMW) to 0.8 (64-70 DAS, 39th SMW) per five plants in mungbean and urdbean, respectively. Bean flower thrips incidence in mungbean ranged between 2.2 (43-49 DAS, 36th SMW) to 28.0 (64-70 DAS, 39th SMW) per 100 flowers and its incidence in urdbean ranged between 0.4 (43-49 DAS, 36th SMW) to 21.0 (64-70 DAS, 39th SMW) per 100 flowers. Spotted pod borer and pod bugs were observed during pod formation stage and remained active till pod maturation. The spotted pod borer incidence ranged between 0.2 (43-49 DAS, 36th SMW) to 2.6 (50-56 DAS, 37th SMW) and 0.2 (64-70 DAS, 39th SMW) to 1.4 (50-56 DAS, 37th SMW) per five plants in mungbean and urdbean, respectively. The pod bugs incidence ranged between 3.4 (50-56 DAS, 37th SMW) to 20.6 (64-70 DAS, 39th SMW) per five plants in mungbean and 1.2 (50-56 DAS, 37th SMW) to 3.6 (64-70 DAS, 39th SMW) in urdbean. The broad mite infestation was found only on mungbean and its incidence appeared during active vegetative stage (29-35 DAS, 34th SMW) and continued throughout the growing season. Its damage on leaves ranged between 2.65% (29-35 DAS, 34th SMW) to 7.97% (50-56 DAS, 37th SMW) (Fig. 6 and 7).

During summer season, in both the crops, the whitefly appeared in seedling stage at 15-21 DAS (16th SMW) and their incidence was noticeable throughout the growth season. Its population during the season ranged from 4.2 (71-77 DAS, 24th SMW) to 19.0 (43-49 DAS, 20th SMW) per five plant in mungbean and 5.6 (15-21 DAS, 16th SMW) to 24.6 (43-49 DAS, 20th SMW) per five plant in urdbean. In both the crops, its peak activity reached at 43-49 DAS (20th SMW). As the flowering initiated, flower thrips incidence occurred and it remained active till pod maturation. The population ranged from 17.0 (43-49 DAS, 20th SMW) to 57.2 (57-63 DAS, 22nd SMW) per 100 flowers in mungbean and 6.4 (50-56 DAS, 21st SMW) to 15.2 (64-70 DAS, 23rd SMW) per 100 flowers in urdbean. The population of thrips reached its peak at 57-63 DAS (22nd SMW) in mungbean and at 64-70 DAS (23rd SMW) in urdbean (Fig. 8 and 9).

Singh and Singh (1977) and Dhuri and Singh (1983) conducted the preliminary studies on the succession of insect pests in mungbean and urdbean. In the recent years, the insect pests *viz.*,



FIGURES 1-5: *Megalurothrips usitatus* (1) Female; (2) Head and Pronotum, female; (3) Male; (4) Meso- and metanota, female; (5) Fore wing, Female.

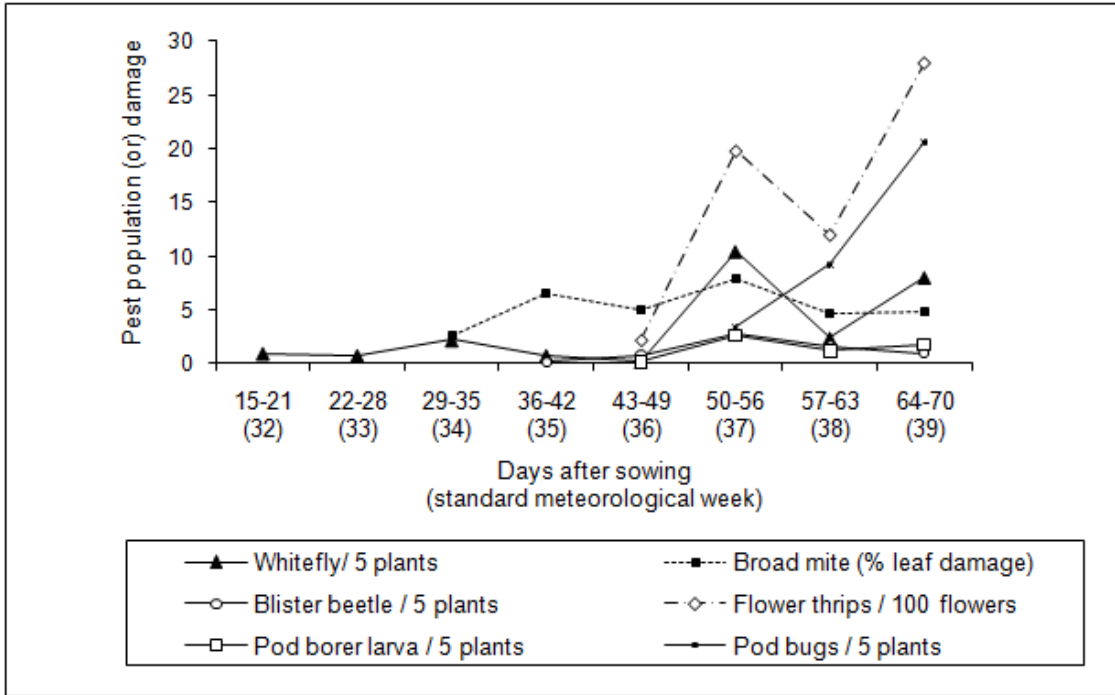


FIGURE 6: Pest succession on mungbean (cv. samrat) during kharif, 2007

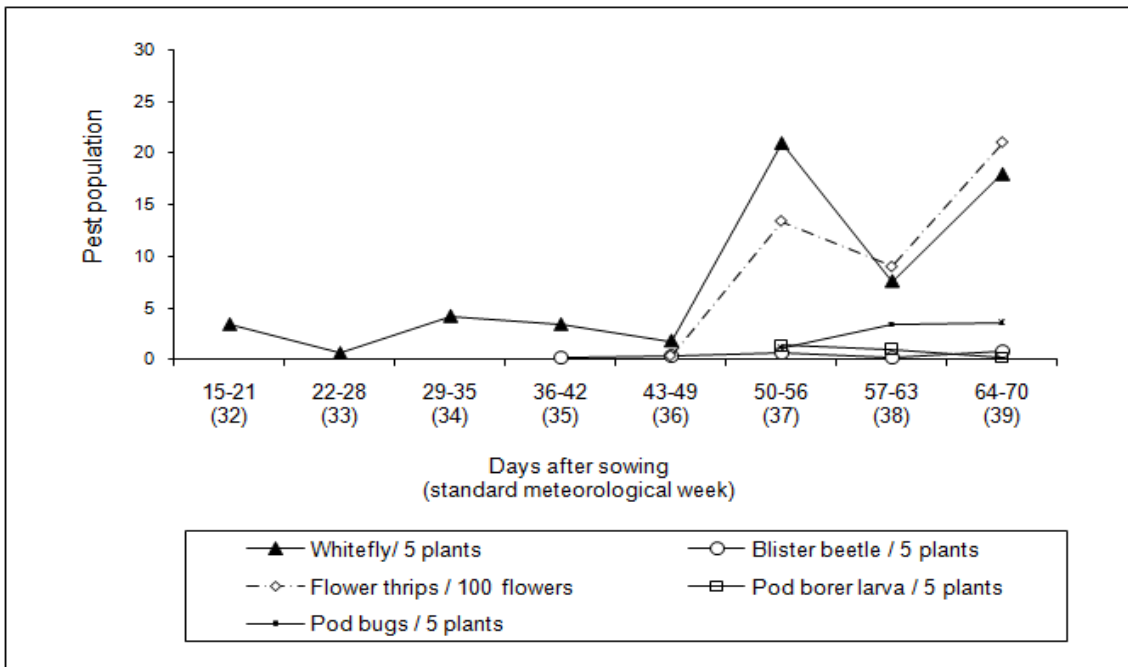


FIGURE 7: Pest succession on urdbean (cv. utara) during kharif, 2007

blister beetle (*Mylabris pustulata*), spotted pod borer (*Maruca vitrata*) and the broad mite (*Polyphagotarsonemus latus*) assumed the status of major pests in mungbean and urdbean. The flower thrips (*Megalurothrips usitatus*), a major pest of spring /summer mungbean assumed status of pests even in kharif season.

Correlation between pest population and weather parameters: The incidence of pests and its relation with the weather parameters are presented in Table 1. Significantly negative correlation of blister beetle with wind speed in morning hours ($r = - 0.88$) and significantly positive correlation of pod bugs with minimum temperature

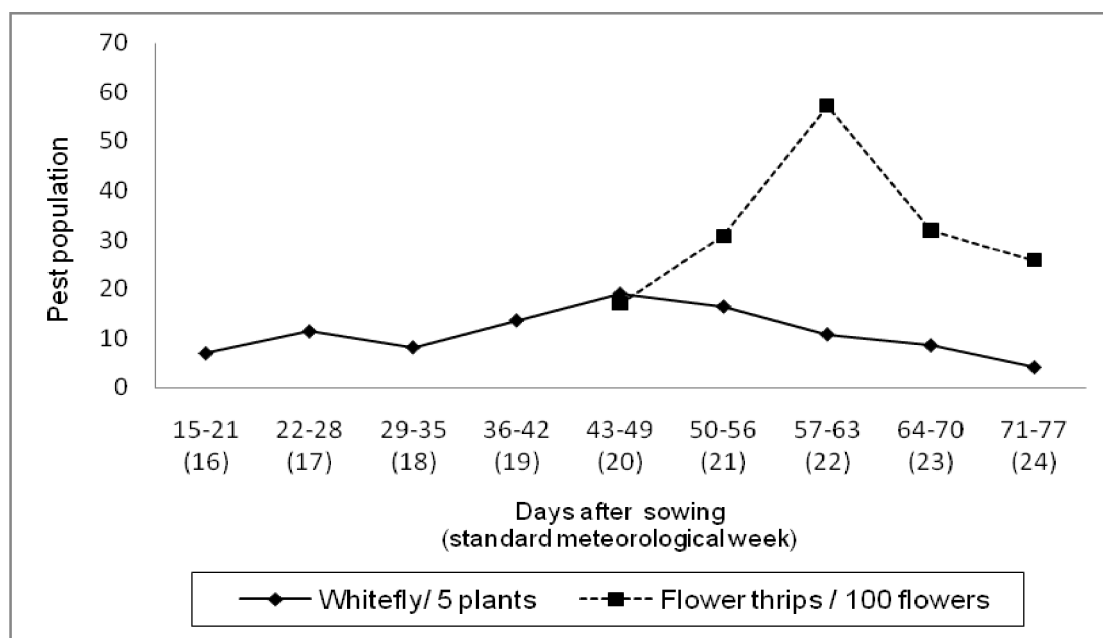


FIGURE 8: Pest succession on mungbean (cv. samrat) during summer, 2008

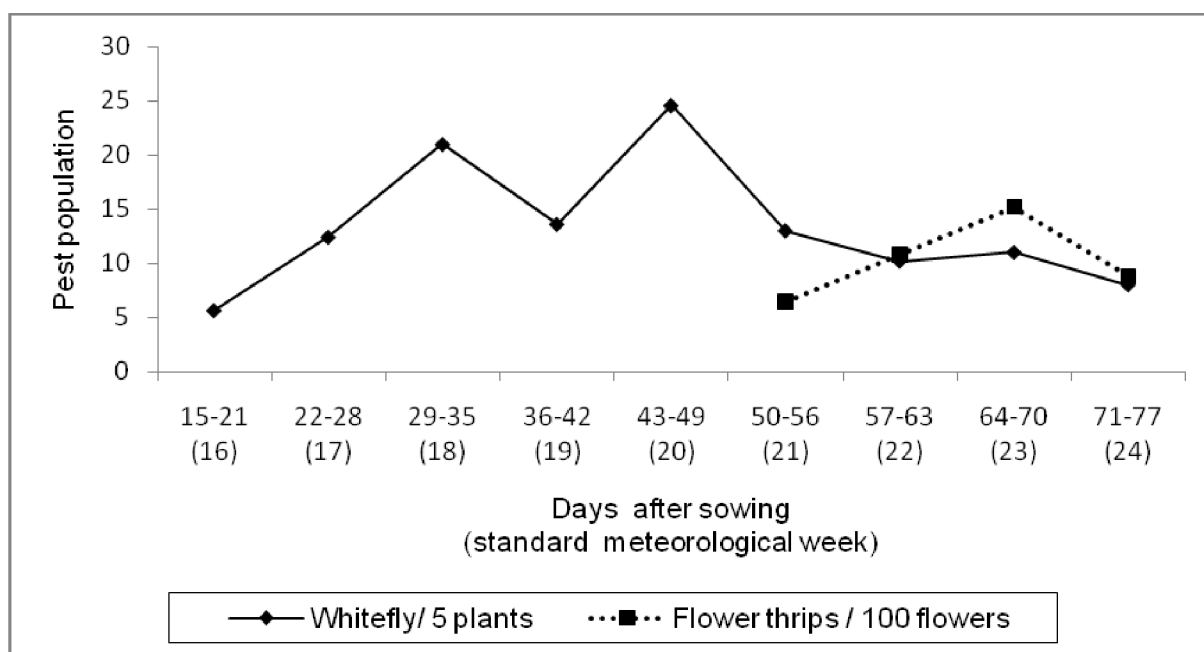


FIGURE 9: Pest succession on urdbean (cv. uttara) during summer, 2008

($r = 0.99$) were recorded in mungbean. In urdbean, significantly negative correlation of spotted pod borer with minimum temperature ($r = -0.99$) and significantly negative correlation of pod bugs with relative humidity ($r = -0.99$) were recorded. The distribution of rainfall during the *kharif* season influenced the status of the pest in mungbean and urdbean. Rainfall recorded a strong negative correlation with the incidence of whitefly ($r = -0.59$

in both mungbean and urdbean), bean flower thrips ($r = -0.78$ in mungbean and $r = -0.79$ in urdbean), blister beetle ($r = -0.70$ in mungbean and $r = -0.55$ in urdbean) and spotted pod borer ($r = -0.83$ in mungbean and $r = -0.95$ in urdbean). It showed a strong positive correlation with the incidence of pod bugs ($r = 0.94$ in mungbean and $r = 0.56$ in urdbean) and broad mite ($r = 0.11$ in mungbean). In both mungbean and urdbean, incidence of bean

TABLE 1: Correlation co-efficient (r) between the incidence of major pests and weather parameters in mungbean and urdbean. Kharif, 2007

| Pests | Max. Tem (°C) | Min. Tem (°C) | RH morning (%) | RH evening (%) | Mean RH (%) | Wind speed (morning) (km/hr) | Wind speed (evening) (km/hr) | Mean Wind speed (km/hr) | Sunshine hours | Rainfall (mm) |
|--------------------------|---------------|---------------|----------------|----------------|-------------|------------------------------|------------------------------|-------------------------|----------------|---------------|
| Whitefly | | | | | | | | | | |
| Mungbean | 0.32 | -0.16 | -0.26 | -0.52 | -0.42 | -0.44 | 0.33 | -0.11 | 0.37 | -0.59 |
| Urd bean | 0.36 | -0.24 | -0.30 | -0.57 | -0.46 | -0.54 | 0.30 | -0.18 | 0.45 | -0.59 |
| Flower thrips | | | | | | | | | | |
| Mungbean | 0.28 | 0.35 | -0.62 | -0.69 | -0.66 | -0.25 | 0.83 | 0.70 | 0.46 | -0.78 |
| Urd bean | 0.33 | 0.39 | -0.68 | -0.74 | -0.72 | -0.21 | 0.85 | 0.73 | 0.51 | -0.79 |
| Blister beetle | | | | | | | | | | |
| Mungbean | 0.49 | 0.24 | -0.20 | -0.35 | -0.20 | -0.88* | -0.31 | -0.65 | 0.35 | -0.70 |
| Urd bean | -0.13 | 0.65 | -0.27 | -0.33 | -0.31 | -0.45 | 0.63 | 0.27 | 0.02 | -0.55 |
| Spotted pod borer | | | | | | | | | | |
| Mungbean | 0.36 | -0.27 | -0.22 | -0.44 | -0.33 | -0.77 | 0.36 | 0.16 | 0.35 | -0.83 |
| Urd bean | 0.27 | -0.99* | 0.84 | 0.74 | 0.80 | -0.97 | -0.91 | -0.95 | -0.22 | -0.95 |
| Pod bugs | | | | | | | | | | |
| Mungbean | -0.26 | 0.99* | -0.84 | -0.74 | -0.80 | 0.97 | 0.91 | 0.95 | 0.22 | 0.94 |
| Urd bean | 0.36 | 0.78 | -0.99* | -0.99* | -0.99* | 0.92 | 0.48 | 0.58 | 0.76 | 0.56 |
| Broad mite | | | | | | | | | | |
| Mungbean | 0.17 | -0.17 | 0.29 | -0.05 | 0.10 | -0.47 | -0.15 | -0.36 | 0.33 | 0.11 |
| Summer, 2008 | | | | | | | | | | |
| Whitefly | | | | | | | | | | |
| Mungbean | 0.53 | -0.06 | -0.21 | -0.34 | -0.28 | 0.38 | -0.50 | -0.28 | 0.41 | -0.56 |
| Urd bean | 0.53 | 0.31 | -0.16 | -0.24 | -0.20 | 0.39 | -0.36 | -0.09 | 0.04 | -0.34 |
| Flower thrips | | | | | | | | | | |
| Mungbean | 0.39 | 0.83 | -0.40 | -0.35 | -0.37 | 0.14 | -0.52 | -0.82 | 0.44 | -0.25 |
| Urd bean | 0.38 | 0.67 | -0.41 | -0.32 | -0.37 | -0.54 | -0.97* | -0.94 | 0.74 | -0.15 |

flower thrips found strong negative correlation with mean relative humidity ($r = -0.66$ in mungbean and $r = -0.72$ in urdbean), though it was non-significant. Significant negative correlation of wind speed and the incidence of blister beetle may be due to the wind flow affected the settling of beetles on the flowers in the short statured mungbean and urdbean plants.

During summer season, incidence of whitefly found positive correlation with maximum temperature ($r = 0.53$ in both mungbean and urdbean), sunshine hours ($r = 0.41$ in mungbean and $r = 0.04$ in urdbean) and negative correlation with mean relative humidity ($r = -0.28$ in mungbean and $r = -0.20$ in urdbean) and rainfall ($r = -0.56$ in mungbean and $r = -0.34$ in urdbean). Significantly

negative correlation of bean flower thrips with wind speed in evening hours ($r = -0.97$) was recorded in urdbean. In both mungbean and urdbean, incidence of bean flower thrips found positive correlation with maximum ($r = 0.39$ in mungbean and $r = 0.38$ in urdbean) and minimum temperature ($r = 0.83$ in mungbean and $r = 0.67$ in urdbean), sunshine hours ($r = 0.44$ in mungbean and $r = 0.74$ in urdbean) and negative correlation with mean relative humidity ($r = -0.37$ in mungbean and urdbean) and rainfall ($r = -0.25$ in mungbean and $r = -0.15$ in urdbean), though it was non-significant.

The significant positive correlation of pod bugs with temperature and negative correlation of whitefly, bean flower thrips, blister beetle and spotted

pod borer is in agreement with the report of Giraddi *et al.* (2000) who reported that the dry spell causes pest outbreak in *kharif* pulses. The positive correlation of broad mite population with rainfall is in agreement with Kooner *et al.* (2006) who observed the incidence of broad mite in rainy season and it is contrast to the report of Gerson (1992) who found low incidence of broad mite during winter due to a combination of low temperature and heavy rains.

Assessment of avoidable yield loss due to pest complex in mungbean and urdbean: Field experiment was conducted with five varieties under protected and unprotected conditions for each crop during *kharif* season. Significantly less population of insect and mite pests were registered in protected crop than in unprotected crop. In the protected crops, seed treatment with imidacloprid 17.8 SL (3 ml/kg of seed) was found effective against sucking pests and it resulted in an average of 81.4, 71.7 and 45.8% reduction in jassid, leaf thrips and whitefly population, respectively in different varieties of mungbean as compared to unprotected crops at 30 days after sowing (DAS). In urdbean varieties, seed treatment with imidacloprid effected a mean per cent reduction of 70.8, 62.5 and 40.2% in jassid, leaf thrips and whitefly population, respectively at 30 DAS (Fig. 10). Application of monocrotophos 36

SL @ 0.04% at 35, 45 and 55 days after sowing in the protected crop found effective in reducing the incidence of insect and mite pests. An average percent reduction of 85.2% in broad mite damage, 84.0% in whitefly, 78.6% in pod bugs, 74.6% in bean flower thrips, 49.6% in spotted pod borer and 35.6% in blister beetle population was recorded in different varieties of mungbean. In urdbean, foliar spraying of monocrotophos resulted in an average per cent reduction of 90.3% in whitefly, 78.5% in pod bugs, 64.8% in flower thrips, 45.2% in spotted pod borer and 44.1% in blister beetle population in different varieties of urdbean (Fig. 11).

Among the mungbean varieties, Samrat recorded lowest incidence of bean flower thrips (28.8/100 flowers), spotted pod borer (0.9 per five plants) and pod bugs (3.2 per five plants) as compared to other varieties in which the incidence of bean flower thrips, spotted pod borer and pod bugs ranged between 33.8 to 48.1 per 100 flowers, 1.3 to 1.8 per five plants and 4.8 to 6.2 per five plants, respectively. NDM 1 and Samrat recorded lowest percent leaf damage due to broad mite (7.2 and 8.8 % respectively) as compared to other varieties in which the leaf damage ranges between 12.9 to 14.6%. No difference was observed among varieties against whitefly and blister beetle. Among the urdbean varieties, Shekhar-1 recorded less population of bean

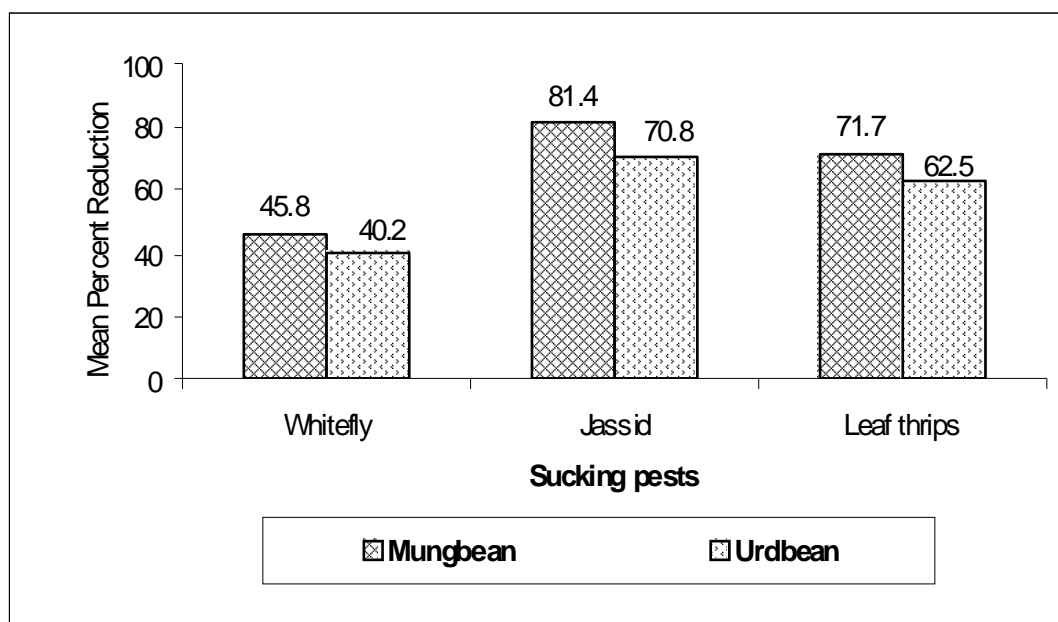


FIGURE 10: Effect of imidacloprid seed treatment against sucking pests in protected crop over unprotected crop (mean percent reduction)

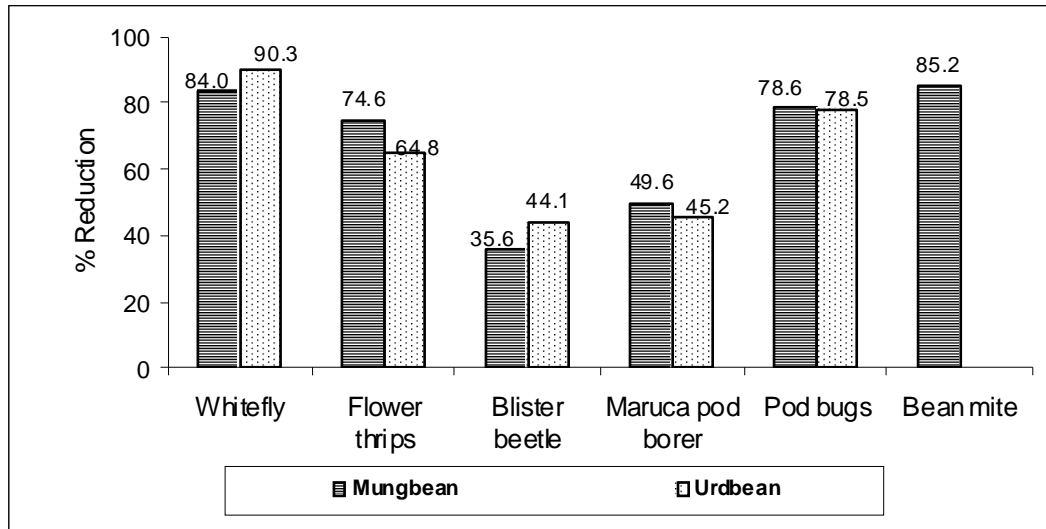


FIGURE 11: Effect of foliar spray of monocrotophos against insect and mite pests in protected crop over unprotected crop (mean percent reduction)

flower thrips (15 per 100 flowers) followed by Uttara and Type 9 (17.5 per 100 flowers) than other varieties viz, NDU 1 (18.8 per 100 flowers) and Pant U 19 (23.1 per 100 flowers). Similarly, Uttara and Shekhar-1 harboured less population of blister beetle (0.4 per five plants) as compared to other varieties in which the incidence ranged between 0.8 - 0.9 per five plants. Uttara recorded lowest incidence of pod bugs (0.1 per five plants) as compared to other varieties (0.4 - 1.0 per five plants). Shekhar-1, NDU 1 (0.7 per five plants) followed by Uttara (0.8 per five plants) recorded lowest incidence of spotted pod borer as compared to other varieties (1.2 - 1.3 per five plants). The varieties did not show much variation in the incidence of whitefly.

Higher grain yield was recorded in protected crops over unprotected in both mungbean and urdbean. Among the mungbean varieties, yield of Samrat was maximum 745 and 1021 kg/ha in unprotected and protected crop, respectively. The avoidable losses due to pest complex on different varieties of mungbean ranged from 27.03% (Samrat) to 38.06% (PDM 54) with an average of 32.97%. The other varieties viz, HUM 2, Meha and NDM 1 were intermediary, registering 29.51, 33.73 and 36.53% avoidable yield loss due to pest complex, respectively. Among the urdbean varieties, yield of Shekhar-1 was maximum 589 kg/ha in unprotected crop, whereas yield of Uttara was maximum 750 kg/ha in protected crop. The avoidable losses due to pest complex on different varieties of urdbean ranged

from 15.62% (Sekhar-1) to 30.96% (Pant U 19) with an average of 24.03%. The respective avoidable yield loss on other varieties viz, Type 9, Uttara and NDU 1 were 20.58, 26.40 and 26.61% (Table 2).

Reliable information on crop loss due to insects and other pests to establish the increased yield is obtainable when these agents are controlled at acceptable economic cost. Crop loss estimates are thus regarded as the best way to indicate to both the farmer and the consumer that the opportunities are gained when sound plant protection measures are applied. The yield loss due to insect pest complex in mungbean and urdbean varies from 15% (Lal and Ahmad, 2001) to 23% in Uttar Pradesh (Anonymous, 1997). The increased yield loss 24 to 33% found in the present study may be due to the bean flower thrips, blister beetle, spotted pod borer which assumed as major pests in *kharif* season and cause direct damage to the reproductive parts as compared to jassid, leaf thrips and semilooper, which is reported as major pests in the same locality (Anonymous, 1997). The effectiveness of seed treatment with imidacloprid against sucking pests is in agreement with the findings of Soundararajan and Chitra (2011) who reported that the seed treated with imidacloprid was effective against sucking pests in urdbean. It is also in agreement with the reports of Murugesan and Kavitha (2009) and Zhang *et al.* (2011) who reported that seeds treated with imidacloprid were effective against leafhopper and whitefly in cotton. The effectiveness of foliar

TABLE 2. Avoidable yield loss (%) due to pest complex in mungbean and urdbean (*kharif*, 2007)

| Mungbean varieties | Yield (kg/ha) | | % avoidable yield loss due to pest complex |
|--------------------------|--------------------|-------------------|--|
| | Unprotected | Protected | |
| Samrat | 745 | 1021 ^a | 27.03 |
| Meha | 552 | 833 ^b | 33.73 |
| NDM 1 | 443 | 698 ^c | 36.53 |
| PDM 54 | 568 | 917 ^b | 38.06 |
| HUM 2 | 485 | 688 ^c | 29.51 |
| Mean | 559 ^b | 831 ^a | 32.97 |
| CD at 5% | Main plot 122.2 | Sub-plot 92.96 | Interaction NS |
| Urdbean varieties | | | |
| Uttara | 552 | 750 ^a | 26.40 |
| Pant U19 | 417 | 604 ^b | 30.96 |
| Sekhar 1 | 589 | 698 ^a | 15.62 |
| Type 9 | 521 | 656 ^a | 20.58 |
| NDU 1 | 375 | 511 ^b | 26.61 |
| Mean | 491 ^b | 644 ^a | 24.03 |
| CD at 5% | Main plot 83.77 | Sub-plot 71.18 | Interaction NS |

application of monocrotophos against sucking pests and pod borer complex observed in the present study is in line with the reports of Amarnath (2000).

Spatial distribution of broad mite in different varieties of mungbean: The eggs and motile stages (nymphal and adult stages) of broad mite on different varieties was assessed from three different leaves position (top, middle and bottom leaves) to determine the sampling of leaves for highest population count of mite. The mite population was assessed during the peak infestation period (50 days after sowing).

The leaves were carried to the laboratory and observed the population per cm² leaf area in the centre of middle leaflet of the trifoliate leaves. Among the varieties, NDM 1 recorded lowest incidence of egg and motile stages (0.13 and 0.33 per cm² leaf area, respectively) as compared to other varieties. Among the leaves position, the top leaves recorded significantly high population of egg (0.60 per cm² leaf area) and motile stages (1.6 per cm² leaf area) (Table 3). Literature on hand revealed that earlier workers have made limited efforts to standardize the

TABLE 3: Spatial distribution of broad mite in different varieties of mungbean (*kharif*, 2007)

| Varieties | Eggs / cm ² leaf area | | | | Motile stages (nymphal & adult stages) / cm ² leaf area | | | |
|---------------------|----------------------------------|----------------|----------------|----------------|--|----------------|----------------|----------------|
| | Top | Middle | Bottom | Mean | Top | Middle | Bottom | Mean |
| Samrat | 0.4 (0.91) | 0.2 (0.81) | 0.0 (0.71) | 0.20 (0.81) | 1.2 (1.26) | 0.4 (0.91) | 0.0 (0.71) | 0.53 (0.96) |
| Meha | 0.8 (1.09) | 0.4 (0.91) | 0.2 (0.81) | 0.47 (0.94) | 2.0 (1.57) | 0.8 (1.09) | 0.0 (0.71) | 0.93 (1.12) |
| NDM 1 | 0.4 (0.91) | 0.0 (0.71) | 0.0 (0.71) | 0.13 (0.78) | 0.8 (1.09) | 0.2 (0.81) | 0.0 (0.71) | 0.33 (0.87) |
| PDM 54 | 0.6 (1.02) | 0.6 (1.02) | 0.0 (0.71) | 0.40 (0.92) | 1.8 (1.49) | 1.2 (1.23) | 0.2 (0.81) | 1.07 (1.18) |
| HUM 2 | 0.8 (1.09) | 0.2 (0.81) | 0.0 (0.71) | 0.33 (0.87) | 2.2 (1.62) | 0.8 (1.09) | 0.0 (0.71) | 1.0 (1.14) |
| Mean | 0.60 (1.00) | 0.28 (0.85) | 0.04 (0.73) | 0.31 (0.86) | 1.6 (1.41) | 0.68 (1.03) | 0.04 (0.73) | 0.77 (1.05) |
| | F test | SEd(+) | CD (5%) | CD (1%) | F test | SEd(+) | CD (5%) | CD (1%) |
| Variety (V) | NS | 0.077 | 0.154 | 0.205 | ** | 0.098 | 0.195 | 0.260 |
| Leaves position (L) | ** | 0.059 | 0.119 | 0.159 | ** | 0.076 | 0.151 | 0.201 |
| V x L | NS | 0.133 | 0.267 | 0.355 | NS | 0.169 | 0.338 | 0.450 |

Figures in the parenthesis are square root transformed values, NS- Non significant, ** Significant at 1% level

sampling method of broad mite in mungbean, which has become major status in the recent years. During the present studies, the top leaves recorded significantly high population of broad mite. Hence, sampling of top leaves can be used to get higher population count of broad mite to determine the effect of attempted control measures, screening of varieties and abiotic factors influence on the mite population. These results are in agreement with those of Vishwadhar and Rathore (1994), Reddy *et al.* (1990) and Jagadish and Jayaramaiah (2005) who reported

that the mite and insect pests prefers soft and succulent tender portion of the plant for colonization.

In the scenario of climate change, the present study gives information on the pest spectra, their status in different cropping seasons, sequence of appearing during the crop period, changing pest complex, effect of weather parameters on their population fluctuation, sampling method for emerging pests and economic losses due to pest complex. The information would enable us for developing effective pest management strategies and to harness best yield potential in mungbean and urdbean.

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