



Integrated Pest Management in Pearl Millet Crop

(*G. M. Parmar, R. P. Juneja, R. J. Chaudhari and K. D. Mungra)

Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar-361006 (Gujarat)

*Corresponding Author's email: gmparmar@jau.in

Pearl millet is one of the most extensively cultivated cereals in the world, after rice, wheat, and maize, and particularly in arid to semi-arid regions. More than 100 insect-pests have been reported to be associated with pearl millet based cropping system (Prem Kishore and Solomon, 1989), but only few of them are potential pests of significant economic importance. The insect-pests viz., shoot fly, stem borer, white grubs, ear head worms and leaf roller are the key pests of pearl millet in India and needs proper control measures. The description of major insect-pests along with their nature of damage and its control measures are discussed in brief below.

Shoot fly, *Atherigona approximate* Malloch: The fly has assumed the status of a serious pest in a number of states, especially Gujarat, Tamil Nadu and Rajasthan. The maggots feed on the seedlings and produce dead heart. Sometimes, the shoot is not killed due quick plant growth. The fly also causes damage to ear heads in later stages of the crop and the ear head appears like cat's tail. Prem Kishore (1996) reported about 23.3 to 36.5 per cent grain losses by shoot fly. The population fluctuation of shoot fly was studied by Raghvani *et al.* (2008) at Jamnagar and revealed that the incidence ranged from 6.4-13.2 per cent during 15 to 50 days after germination of the crop.

Stem borer, *Chilo partellus* (Swinhoe): This is a major pest and most destructive and cosmopolitan species. At seedling stage borer larvae feed in plant whorls and thus parallel shot hole appears in the opening leaves followed by dead hearts at later stage. Whereas, at ear head stage the silver ear head/ empty ear head appears. Losses up to 20-60 % have been reported (Prem Kishore, 1996). The study carried out for 10 years on population fluctuations of pearl millet stem borer revealed that its incidence is noticed 15 days after germination of the crop (4.4%) and gradually increased to its peak (15.1%) at 77 days after germination of the crop (Raghvani *et al.*, 2008).

Ear head worms, *Helicoverpa armigera* Hubner: The losses up to 10-15% has been reported by Juneja and Raghvani (2000) at Jamnagar and they observed that egg laying by female moth is specifically done on the bajra ear heads at ear head emergence stage and freshly hatched larvae feeds on stigma which ultimately leads to poor grain setting and it is sometimes misguided with sterility. Most of the larvae are dark greenish brown, but they can also be pink, cream or almost black. They do not hide in the soil during the day and are therefore, easier to find in the ear head. Pupation takes place in the soil.

Hairy caterpillar, *Amsacta spp*, *Estigmene lactinea* (Black) and *Amsacta moorei* Butl: These caterpillars have been reported as sporadic pests in semi-arid areas of the country. These caterpillars are difficult to kill when in advance stage, however, advantage can be taken of their habit of pupating gregariously in the soil of infested fields.

Eublemma silicula (Swinh.): The caterpillars are observed feeding on the maturing grains, hidden under small dome-shaped or elongated structures formed from the dry anthers. The caterpillars feed mostly the upper part of maturing grains. The excreta of insect leads to fungal attack thus quality of grain are deteriorated. The infestation by this pest varied in different varieties and hybrids. The pest remains active from late August to early September. The attack is visible immediately with the commencement of grain formation.

Leaf roller/binder (*Marasmia trapezalis*): Larvae feed on the tips of leaves causing leaf rolling. Larvae also feed by scrapping the green tissues inside leaf folds. Sometimes heavy attack is found. This is an occasional pest. Incidence of leaf roller is found moderate to low in bajra growing areas. Special control measures are seldom necessary.

Blister beetles: *Mylabris pustulata* Thunb., *Cylindrothorax tenuicollis* : Since the pest feeds on the flower petals and the pollen grain, seed setting in the pearl millet spike is affected. Different species of the beetles are met with in nature. The beetles secrete an acidic substance, which on coming in contact with the human body, causes a “Blister” and hence the name “Blister beetle”.

Ear head beetle/Blossom beetles: *Anatona stillata* Newman, *Oxycetonia versicolor* Fab., *Chiloloba acuta* weevil, have been found on bajra crop. These insects are principally pollen feeders. These are seen on bajra ear heads. The larvae develop in organic matter in soil and few infest roots of plant also. These are medium sized to large beetles and are brilliantly coloured and dorsally flattened with a large scutellum (Nayar *et al.*, 1976).

White grub: *Holotrichia consanguinea*, *Holotrichia longipennis* and *Holotrichia serrata*: This is a serious pest of ground nut, sorghum and pearl millet in Gujarat. The pest is prevalent in its larval stage in the fields from March to October. The grubs feed on roots in the soil. The problem is more serious in lighter soils. The grub rapidly moves from one plant to another under the soil. The damaged plant starts drying up and ultimately dies. The seedlings are attacked by this pest. Larvae cause major devastation resulting in the failure of the crop.

Management: As an immediate remedy, chemicals have been used extensively, mainly on high yielding varieties and hybrids. It is emphasized that studies should be intensified on varietal resistance and manipulation of population by cultural practices leading to the possibility of using all available methods on an integrated basis for future pest management programmes for pearl millet. The various management measures are detailed below.

Cultural methods

- Collect and burn stubbles and chaff ear heads and feed the stalks to cattle before the onset of monsoon rains. This will reduce the carryover of stem borers and midge.
- Deep plough one month before sowing will expose immature stages of insects and serve as a food for predators.
- Adopt synchronous and timely/early sowings of cultivars with similar maturity over large areas to reduce the damage by shoot-fly and stem borer.
- Rotate millets with cotton, groundnut, or sunflower, to reduce the damage by shoot fly, stem borer and head bugs.
- Intercropping pearl millet with pigeon pea, cowpea, or lablab also reduces the damage by stem borers.
- Use higher seed rate of pearl millet at the time of sowing of 5 kg/ha and delay thinning (to maintain optimum plant stand) to minimize shoot-fly damage.
- Treat seeds with thiamethoxam 35 FS @ 9.0 ml/kg or imidacloprid 600 FS @ 8.75 ml/kg to improve plant stand, seedling vigour, and reduce the damage by shoot fly and stem borer.

- Initiate plant protection measures at 8 % and 5 % ETL against shoot fly and stem borer, respectively in pearl millet crop, respectively (Raghvani *et al.*, 2005 and Parmar *et al.*, 2022).

Mechanical method

- Set up light traps till midnight to monitor, attract and kill adults of stem borer and white grub adults.
- Set up sex pheromone traps for monitoring of adult male moths of *Helicoverpa sp.* @ 5 traps/ha at 1 ft height above ear head formation from flowering to grain hardening (Juneja *et al.*, 2015).
- Set up the fishmeal traps @ 12/ha till the crop is 30 days old to reduce shoot fly damage.

Biological methods

- Two foliar spray of *Beauveria bassiana* 1.15 WP 5 g/l at 30 and 60 days after germination for management of shoot fly and stem borer in pearl millet (Parmar *et al.*, 2019).
- Farmers who cannot afford the chemical pesticides can apply any one of the botanical materials available to them either neem seed kernel suspension or neem leaves suspension or mint leaves suspension @ 5% spray, (Juneja *et al.*, 2004).
- Apply one spray of HNPV 250 LE/ha at anthesis stage of pearl millet crop for effective and economical management of ear head worm *Helicoverpa sp.*

Chemical methods

- Foliar spray of profenophos 0.05 per cent or fenobucarb 0.1 per cent at 20 and 40 days after germination for the control of shoot fly and stem borer (Parmar *et al.*, 2015).
- For effective and economical management of shoot fly, seed treatment of imidacloprid 600 FS @ 8.75 ml/kg at the time of sowing, removal of shoot fly dead hearts, installation of fish meal traps @ 10/ha and spraying of dimethoate 30 EC 0.03 % (10 ml/10 l of water) at 35 days after germination (Parmar *et al.*, 2021).
- Seed treatment of imidacloprid 600 FS (8.75 ml/kg) followed by two sprays either *Beauveria bassiana* @ 60 g/10 l of water or Panchgavya 3 % (300 ml/10 l of water) at 20 and 40 days after germination is effective for management of shoot fly and stem borer (Parmar *et al.*, 2022).

Looking to the status of the pests in changing climate, an integrated approach for management of these pests is need of the hour. A farmer friendly IPM packages for management of economically important insect pests of pearl millet crop. In millets, major pests are shoot fly, stem-borer, white grubs and ear head worm. There is need to generate data on yield loss due to key pests of millet crops and effectiveness of natural enemies and their use in existing ecosystems. The traits responsible for resistance must be incorporated into agronomically suitable cultivars.

References

1. Juneja, R. P. and Raghvani, K. L. (2000). Feeding behaviour of *Helicoverpa armigera* (Hubner) and its damage in pearl millet. *Insect Environment*, 6(3): 141-142.
2. Juneja, R. P., Raghvani, K. L., Godhani B. G. and Dangaria, C. J. (2004). Effectiveness of plant origin extracts against pearl millet shoot fly. *Insect Environment*, 10 (2):90-92.
3. Juneja, R. P., Parmar, G. M., Ghelani, Y. H. Mungra, K. D. Patel, P. R. and Chaudhari, N. N. (2015). Monitoring of ear head worm *Helicoverpa armigera* (Hubner) through sex pheromone in Pearl millet crop. *Internat. J. Plant Protec.*, 8 (2):245-249.
4. Parmar, G. M., Juneja, R. P., and Mungra, K. D. (2015). Management of shoot fly and stem borer on pearl millet crop. *International Journal of Plant Protection*, 8 (1):104-107

5. Parmar, G. M., Juneja, R.P., Patel, P.R., Parmar, S.K., Chaudhary, N.N. & Mungra, K. D. (2021). Evaluation of different pest management modules against major insect pests of pearl millet. *Journal of Entomology and Zoology Studies*, 9 (3):390-394.
6. Parmar, G. M., Juneja, R. P., Mungra, K. D Chaudhri R. J. and Detroja, Asha C. (2022). Determination of economic threshold level for the chemical control of pearl millet stem borer, *Chilo partellus*. *International Journal of Agricultural Sciences*, 14(4): 11237-11239.
7. Parmar, G. M., Juneja, R. P. and Chaudhary, N. N. (2019). Management of major insect pests of pearl millet under organic cultivation. *International Journal of Plant Protection*, 12(1): 62-66.
8. Parmar, G. M., Juneja, R. P., Chaudhri R. J. Mungra, K. D and Parmar, S. K. (2022). Ecofriendly management strategy for shoot flies and stem borer infesting pearl millet crop. *Frontiers in Crop Improvement Journal*, 10 (special issue-1) 364-368.
9. Prem Kishore and Solomon, S. (1989). Research needs and future strategy for controlling insect pest problems on bajra based cropping system. *Seeds & Farms*, 15(7&8):23-28.
10. Prem Kishore (1996). Evolving management strategies for pests of millets in *Indian. J ent. Res.*, 20(4):287-297.
11. Raghvani, K.L, Juneja, R. P. and Dangaria, C. J. (2005). Estimation of economic threshold level of shoot fly *Atherigona approximata* (Malloch) in pearl millet. Paper presented in National Symposium on Alternative uses of millets in India, April30, 2005 held at ARS, Beechwal, RAU, Bikaner, pp 43.
12. Raghvani, K.L., Juneja, R.P., Ghelani, Y. H., Parmar, G. M. and Dangaria, C. J. (2008). Influence of abiotic factors on population fluctuations of major insect pest of pearl millet. *Indian J. Applied ent.* 22 (1):48-50.