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STUDY ON *GONOCEPHALUM* BEETLE : AN EMERGING THREAT TO CHICKPEA IN SALINE TRACTS OF VIDARBHA (MAHARASHTRA)

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ABSTRACT

False wireworm, *Gonocephalum indicum* Karzab (Tenebrionidae: Coleoptera), incidence was reported for the first time in such a severe form during *Rabi* 2009 in chickpea, critically confined to saline tracts of western Vidarbha (MS). The *Gonocephalum* adults inflict the scooping up type of injury on tender chickpea stem near soil surface, resulting in collapsed seedlings. The damaged seedlings in turn dry; often translate into re-sowing of crop. Present study was carried out to study various factors associated with incidence pattern in chickpea area with severe infestation. Survey revealed that *Gonocephalum* life stages were confined to soil. The adults prefer to hide in cracks and crevices during bright sunshine hours and were seen during early morning or at dusk near the crop. The adults preferred early crop growth phase. Based on intensity, up to 60 per cent or more with one to two re-sowings were observed in chickpea raised on residual moisture. The chickpea rotation with soybean had more pest menace as compared to rotation with greengram or blackgram. Use of undecomposed FYM invited more pest counts. Improved agronomic practices like clean cultivation, inter culture operations and irrigation translated in lower pest density and can certainly form components of Integrated Pest Management.

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INTRODUCTION

Gonocephalum beetle, false wireworm is basically a soil inhibiting beetle, restricted to decaying organic matter. The association of *Gonocephalum* sp. with various crops is reported in review. *Gonocephalum* sp. along with two other false wireworms were found damaging groundnut pods in Targhadia, Gujarat (Kapadia, 1994), in Andhra Pradesh (Reddy *et al*., 1992) and as an occasional pest of groundnut in sub-Saharan Africa (Umeh *et al*., 2001). *G. simplex* was the earliest described and most destructive species and is known to damage maize seedlings in South Africa (Drinkwater, 1999) and tobacco (Blair, 1990). Fourteen genera of soil-inhabiting Tenebrionidae in maize fields in South Africa were identified, of which *Somaticus* and *Gonocephalum*, were the most common (Drinkwater, 1989). *Gonocephalum civicum* was feeding on the tubers (Pillai and Lal, 1978) in Kerala and was reported as pest of canola [rape] (Miles *et al*., 1997) in Victoria and Upper South East of South Australia and sunflower seedling (Broadley, 2002) in Queensland's. In Andhra Pradesh, adults of *Gonocephalum* sp. were found in large numbers in pitfall traps installed in fields of mature mixed crops of groundnut and pigeonpea on irrigated black soil (vertisol), about 15 days before groundnut harvest (Reddy *et al*.,1992), whereas, ICRISAT, Hyderabad have reported *Gonocephalum dorsogranosum* on chickpea. Although, there are reports of *Gonocephalum* as a pest of pulses, oilseeds, cereals and vegetable crops in literature but it seldom cross the status of minor pest. The incidence of *Gonocephalum* was observed for the first time in severe form in *Rabi* 2008-09 on chickpea, critically confined to major chickpea growing saline tracts of Vidarbha (MS). Since then it is a pest with regular appearance, although at varying intensity. The prevailing species of region was identified as *Gonocephalum indicum* Karzab (Tenebrionidae: Coleoptera).

The *Gonocephalum* life stages viz., egg, grub and pupal stages were confined to soil, whereas, adults were seen on ground damaging the crops. Adults prefer to hide in cracks and crevices during bright sunshine and were seen during early morning or at dusk near the crop. The *Gonocephalum* adults inflict the scooping up type of injury on tender chickpea plant stem near soil surface (collar region), resulting in collapsed chickpea plants. Generally, the adults prefer early crop growth phase but was even observed on later stage, though, at lower intensity. The damaged seedlings in turn often dry and translate into re- sowing of crop. Based on intensity, even up to 60 per cent or more damage with one to two re-sowings were observed in chickpea crop raised on residual moisture. Present study was carried out to study various factors associated with incidence pattern in chickpea area with severe infestation as to find out the probable reason for aggravation of pest abundance on chickpea crop rather than traditional food, the organic matter.

MATERIALS AND METHODS

An intensive survey was carried out during 2010-11 and 2011-12 in the saline tracts of western Vidarbha. The survey areas were selected specifically on the basis of farmers complaints about crop damage by *Gonocephalum* sp. The inferences were based on the farmers feedback about various parameters prevailing in the

zone aggravating the problem of *Gonocephalum* which was previously a minor pest, mostly confined to decaying organic matters.

Survey questionnaire was basically framed to associate pest abundance or damage intensity with parameters viz., raising of chickpea on residual moisture or irrigated condition. The observations were also recorded for *Gonocephalum* adult behavior, nature and extent of damage and temporal distribution in the season. An assessment was also made for the effect of planting depth, chickpea rotation pattern, use of FYM and effect of stacked crop residues on damage by the pest.

RESULTS AND DISCUSSION

Survey for incidence pattern of *Gonocephalum*

False wireworm, *Gonocephalum indicum* Karzab (Tenebrionidae: Coleoptera), incidence was reported for the first time in severe form in *Rabi* 2008-09 on chickpea, critically confined to major chickpea growing saline tracts of western Vidarbha (MS). The Poorna river spans through over 7500 square kilometer area, of which this saline tract covers over 4000 square kilometer area with 894 villages. In *Rabi* season, chickpea is raised on residual moisture as water available for irrigation is unsuitable on account of high TDS of 6000 which is ten times higher than the normal water.

The prevailing species of region was identified as *Gonocephalum indicum* Karzab (Tenebrionidae: Coleoptera). It has a vernacular nomenclature of "*Kali Mhais*" (Buffalo) on account of its association with crop residues. The *Gonocephalum* life stages *viz*., egg, grub and pupa were confined to soil, whereas, adults were seen under the soil crust or on ground damaging the crops. Eggs were white and generally laid on soil clumps. The false wireworm (*Gonocephalum* spp.) larvae were cylindrical, hard bodied, fast moving, grows to about 20 mm in length, and has light cream to tan in colour, with tan or brown rings around each body segment, giving the appearance of bands around each segment. Adults were generally dark brown-grey, oval beetles, which sometimes had a coating of soil on the body. Usually only one generation occurs in each year (McDonald, 1995).

Adults prefer to hide in cracks and crevices during bright sunshine and were seen during early morning or at dusk near the crop. Both grubs and adults were swift mover. Adults retract their legs and stop movements when touched or tapped. The life stages were seen throughout the year with prominence during *Rabi* season. Pupal stages were more during summer whereas, adults were seen during *Kharif* season, especially during interculture operations in *Kharif* crops.

The *Gonocephalum* adults inflict the scooping up or girdling type of injury on tender chickpea plant stem near soil surface (collar region), resulting in collapsed plants of chickpea. They feed on the hypocotyl (seedling stem) at or just below the soil surface. This causes the stem to be "ring-barked", and eventually the seedling may be lopped off or it wilts under warm conditions (McDonald, 1995). Generally, the adults prefer early crop growth phase but was even observed on later stage, though at lower intensity. The damaged seedlings in turn dry often translate into re- sowing of crop. The higher ability of grown up plants shows higher recovery from injury. Based on intensity, even up to 60 per cent or more with one to two re-sowings were observed.

A survey for incidence pattern of *Gonocephalum* affected chickpea fields revealed that chickpea crop raised on residual moisture condition was more favored by the pest as compared to the irrigated conditions, affecting the free movements of adults in cracks and crevices of soil. This finding was supported by report that the *Gonocephalum* association was prominent in dry farming regions (Kapadia, 1994). An increased seed rates and compaction of the seed bed was found to be effective alternatives to chemical control (Miles *et al*., 1997).

Larvae of most false wireworm species prefer to feed on decaying stubble and soil organic matter. When the soil is reasonably moist, the larvae aggregate in the top 10-20 mm where the plant litter was amassed. However, when the soil dries, the larvae move down through the soil profile, remaining in or close to the subsoil moisture, and occasionally venturing back to the soil surface to feed. Feeding often at night when the soil surface becomes dampened by dew (McDonald, 1995). The trigger for switch in the feeding from organic matter/ litter to plants is not known but significant damage was however, likely to be associated with soils that remain dry for extensive periods of time. Larvae were likely to stop feeding on organic matter when it dries out, and when the crop plants provide the most accessible source of moisture (McDonald, 1995). Adult beetles may also chew off young seedlings at ground level. Damage was most severe in crops sown into dry seedbeds and when germination was slowed by continued dry weather. Feroz and Tara, 2010 reported highest abundance of *Gonocephalum* sp. during October mostly found in litter under stones in Kargil. The seeds sown by tractor were placed at shallower depth and suffered more attack whereas, those sown deep by seed drill were less damaged. A contradictory report that the extent of damage was similar at all planting depths was also reported (Drinkwater, 1994).

The chickpea rotation with soybean had more pest menace as compared to chickpea rotation with greengram or blackgram. This was probably on account of less crop duration and faster residue decomposition for the later crops and time farmers get for land preparation from harvesting of *kharif* crops to sowing of chickpea. Soybean, on the contrary has longer crop duration, early withdrawal of monsoon, labour shortage during harvesting, germination of seeds from shattered pods and high withering time for crop residues favors *Gonocephalum* to use it as breeding grounds. Chickpea was a suitable preceding crop leading to increased infestation by these pests. Also one-half to three-quarters of fields that had grown summer crops such as sorghum, sunflower, soyabean and *Vigna radiata* in the preceding season were infested at densities that could cause economic losses in subsequent crops (Robertson and Simpson, 1988).

In a laboratory experiment, *Gonocephalum* adults were released in large number on partially withered, moist soybean residues and soil particles and seedlings of various pulses *viz*., greengram, blackgram, pigeonpea, chickpea and soybean, it was observed that the pest was associated with soybean residues for most of the times.

Crop residues of *kharif* season stacked in field serve as hide outs for *Gonocephalum* stages, and result in radial pattern of incidence on chickpea crop with higher damage towards core portion. It was possible to collect almost all stages in large numbers in the crop residues. In a fallow field, numbers of *G. macleayi* were 2.7 times higher under aggregations of crop residue than the mean over the whole field which supports the present findings (Robertson and Simpson, 1988).

Use of undecomposed FYM invited more pest counts as compared to chemical fertilizer based planting. Improved agronomic practices like clean cultivation, inter culture operations and irrigation translated in lower pest density can certainly form components of Integrated Pest Management. The cultural practices such as improper application of organic manure, leaving crop residues in farms, delay in planting and harvesting and abiotic factors such as rainfall and soil texture also influence soil pest occurrence and damage (Umeh *et al*., 2001). The relative abundance of *Gonocephalum adelaidae* had large differences within, tillage regimes, being higher under less tillage operations (Horne and Edward, 1998).Cultivation *per se* is said not to reduce pest infestation, but stubble removal may depress densities (Umeh *et al*., 2001), whereas, stubble was claimed to offer an alternative food supply such that damage to the emerging crop was reduced (Robertson, 1993).

Varying degree of severity was attributed to adult migration in response to changes in habitat suitability as the cause of changes in population, although, it is also thought that natural enemies, particularly *Beauveria bassiana* and *Metarhizium anisopliae*, play a role in suppressing increased population densities (Robertson, 1993). Crop residues and weedy summer fallows favour survival of larvae and over- summering adult beetles. Clean cultivation over summer would starve adults and larvae by exposing them to hot dry conditions, thus preventing population increase (McDonald, 1995).

Based on survey data low cost tactics for *Gonocephalum* management *viz*., clean cultivation, Inter culture operations and Irrigation (wherever feasible) are suggested which will translate in lower pest density and can certainly be effective components of Integrated Pest Management. Wadaskar and Patil, 2016 in a field study revealed 5.8 – 32.3% damaged plants with lowest damage in Module 9 (Seed treatment with clothianidin 2 gm/kg seed + spaying of chlorpyriphos 2 ml/ liter water 20 days after crop emergence), Module 10 (Application of phorate granules 10 kg/ha at sowing + spraying of chlorpyriphos 2 ml/liter water 20 days after crop emergence) and Module 11 (Seed treatment with clothianidin 2 gm/kg seed + application of clothianidin granules 200 gm/ha 20 days after crop emergence) with 5.8, 6.2 and 8.7% affected plants. The % drying of plants due to injury was in the range of 4.3 – 21.6 % with lowest in Module 11, Module 10 and Module 9 with 4.3, 6.0 and 6.2 % drying of plants, respectively. Superiority of Module 9 (20.4 q/ha) and Module 11 (19.7 q/ ha) was evident in yield, whereas, lowest yield was observed in control plot (13.2 q/ha). Module 9 and Module 11 registered higher net returns of Rs. 13887 and Rs. 9948 per ha, respectively, whereas, Module 9 and Module 10 had highest ICBR of 1: 6.0 indicating the suitability of modules in terms of bioefficacy and cost effectiveness for the management of *Gonocephalum* in problematic area. The use of preplanting sampling, stubble management, crop rotation and insecticides (chlorpyrifos, furathiocarb and thiodicarb) in the control of these pests was recommended (Robertson and Simpson, 1988).

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