

Whitegrubs in potato and their control

Whitegrubs are highly polyphagous pests and damage almost all the field crops grown during rainy season. The potatoes grown during summer season as rainfed crop under long day conditions suffer maximum attack of whitegrubs. In India, 20 species of whitegrubs are known to damage potato. The tuber damage often exceeds 50% in endemic areas. *B. coriacea* is the most destructive species in the entire north-western Himalaya. *H. longipennis* and *H. seticollis* are predominant species in Uttarakhand. *Melolontha indica* is a localized species in certain pockets of north-western Himalaya, but its damage potential is manifolds higher as compared to *B. coriacea* and *H. longipennis*. For management of beetles, their mass collection and spraying of host trees with carbaryl (0.2%), quinalphos (0.05%), and chlorpyrifos (0.2%) has been found effective. Application of chlorpyrifos or quinalphos in first fortnight of June gives satisfactory control of whitegrubs. *Metarhizium anisopliae*, *Beauveria bassiana*, *Heterorhabditis indica* and *H. bacteriophora* also holds considerable potential to control these soil pests.

WHITEGRUBS are immature stages of scarab beetles popularly known as May-June beetles or chafer beetles. Whitegrubs are most destructive soil pests, having concealed habits and suddenly increase their population in places having enough food and least disturbance of soil. The economic importance of chaffers is primarily due to the feeding of third instar grubs. They are favoured by light soils, fibrous rooted plants, and high particulate and organic matter contents. Almost all the field crops grown during rainy season, viz. potato, vegetables, groundnut, sugarcane, maize, pearl millet, sorghum, cowpea, pigeon pea, green grass, cluster bean, soybean, rajmash, upland rice, ginger *etc.* are damaged.

Nature of injury

The whitegrubs cause severe damage to potato and their problem is quite serious in hilly states where the potatoes are grown during summer season as rainfed crop under long day conditions. Initially, young grubs feed on mother tubers, roots of developing potato plants, but after tuber formation, the older second and third instar grubs feed on the tubers. They make large, shallow and irregular holes into potatoes, and the damaged tubers are rendered unfit for marketing. Even in heavily infested fields, the potato plants continue to grow normally without any manifestation of injury on aerial parts. The grubs of *Brahmina* spp., *Holotrichia* spp. and *Anomala* spp. make



Tuber damage by (a) *B. coriacea* and (b) *M. indica*

several holes on the tubers because they are smaller in size and more than one grub can be seen attacking single tuber. However, in case of *Melolontha* spp., the grubs are very large in size and they make single large hole in the tubers which are filled with the soil. The tuber damage often exceeds 50% in endemic areas.

Diversity and characteristics of potato whitegrubs

In India, 20 species of whitegrubs have been recorded to damage potato from the states of Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Tamil Nadu, Karnataka and north eastern states. The most widespread and destructive species are – *Brahmina coriacea* (Hope), *B. flavoserica* (Bost), *Melolontha indica* (Hope), *Anomala dimidiata* (Hope), *Holotrichia longipennis* Blanchard, *H. serrata* Fabricius, *H. seticollis* Moser and *Phyllognathus dionysius* Fabricius. The general features of beetles, and their grubs are given in Table 1. *B. coriacea* is the most destructive species in the entire north-western Himalaya. In high hills of Himachal Pradesh and Jammu and Kashmir, it constitutes about 90% of the total beetle population. Emergence of *B. coriacea* begins in mid-May and the beetles feed on apple, wild rose, walnut, apricot, *Robinia*, *Polygonum* and *Indigofera* bushes. A single female may lay 20-30 eggs with incubation period ranging from

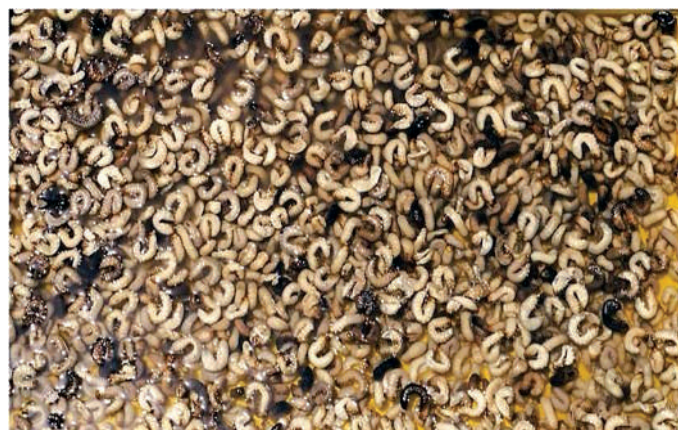
9-12 days. There are three larval instars and total larval period ranges from 9-10 months. *H. longipennis* and *H. seticollis* are predominant species in Uttarakhand. The beetles of *H. longipennis* emerge from soil in late May and its preferred hosts are walnut, *Rubus ellipticus*, chestnut, apple, plum and *toon*. A single beetle may lay 21-41 eggs, 2-5 cm beneath the soil with an incubation period of 12-15 days. Second and third instar grubs feed on potato tubers. Total larval period ranges from 294-323 days, and pupal period varies from 15-23 days. The duration required to complete one life cycle varies from 321-361 days and there is only one generation in a year. *Melolontha indica* is a localized species in certain pockets of north-western Himalaya, but its damage potential is manifold higher as compared to *B. coriacea* and *H. longipennis*. The adult emergence has been recorded in first week of July in Himachal Pradesh. The grubs are large, heavy, yellowish white with light brown head. The life cycle is biennial and third instar grubs during second year inflict severe tuber damage right from sowing in April till harvest.

Integrated pest management techniques

It is very difficult to control whitegrubs by applying a single control measure. The adults are so mobile; therefore, controlling one life stage will not necessarily preclude the problems caused by the other. Management of whitegrubs is feasible by integrating all the components of pest suppression in a befitting manner. In endemic localities, the management programme should be practised on an area basis. Individual efforts may not be very successful.

Ploughing soils

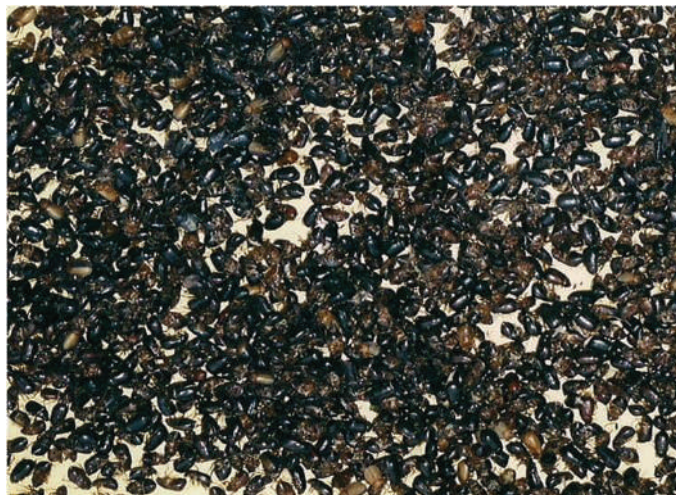
- Fields having a history of whitegrub attack should be tilled several times in April–May or in September. Tilling or discing soil macerates grubs and exposes them to predators such as birds.
- Ploughing infested fields especially in the years when most of the grubs are pupating kills many of the pupae and newly formed adults, exposes them to birds and crush many larvae.



Whitegrubs collected at ploughing time from potato fields in Shimla hills

Table 1. General features of potato whitegrubs and their beetles

Species	Body colour of beetles	Body length (mm)		Peak period of beetle emergence	Vulnerable Period of attack
		Beetle	Grub		
<i>B. coriacea</i>	Black	13-15	28-33	Mid June	September-October
<i>H. longipennis</i>	Reddish brown	19-24	38-40	June (4 th week)	September-October
<i>B. flavoserica</i>	Light yellow	13-14	22-24	Mid April	August
<i>A. dimidiata</i>	Metallic green	20-22	37-40	Mid June	September-October
<i>M. indica</i>	Reddish to dark brown	32-34	50-60	July (First week)	April-September
<i>H. serrata</i>	Dull brown with light brown abdomen	22-25	47-50	May	August-October
<i>A. lineatopennis</i>	Dark brown with blackish thorax	18-19	23-26	Mid May	August-September



Beetles of *B. coriacea* collected from host trees and killed

- The fallow fields should be grazed by pigs as they will usually root out and eat grubs nearly freeing the land of grubs.
- While ploughing, the grubs can be picked up manually and destroyed.
- First instar grubs prefer partially decomposed organic matter and hence application of well decomposed FYM definitely helps in reducing the population of white grubs.

Collection and destruction of adult beetles

- The adult emergence is synchronous; thus, the collection and killing of beetles have been found to be one of the most effective techniques. This management strategy based on large-scale beetle collection is highly cost-effective and area-wide mass campaigns can be organized in endemic locations. Adult collection has to be done from the very first day of the first summer rains.
- The collection should be done by shaking the twigs of most preferred host plants after 8:00 PM.
- The collected beetles can be destroyed/ killed in 5% kerosinized water. This practice is quite effective to check the breeding of pest.
- Light trap, though a tool for population monitoring, can be used in reducing the population for more strongly phototactic species like *A. dimidiata* and *A. lineatopennis*.
- The beetles exhibit distinct preference for particular host in a particular locality.
- The adults of certain species like *A. dimidiata* and *A. lineatopennis* are highly attracted to light, so light traps can be useful tool for monitoring.

Spraying insecticides on the adult flight trees

- Night surveillance should be done in the endemic areas to ensure consistent beetle emergence before spraying the host plants.
- Most of the scarab beetles come out of soil immediately after the first good pre-monsoon shower. The emerged beetles congregate on some preferred host for mating

and feeding. These beetles can be conveniently killed by spraying the trees with insecticides like chlorpyrifos 0.05 or rogor 0.03. The beetles which settle on treated hosts would be killed before they return to the soil the next morning for egg laying.

Biological control

- Entomopathogenic fungi and nematodes can effectively combat an infestation of whitegrubs. Entomopathogenic fungi include *M. anisopliae* and *B. bassiana*, and usually, the fungi are used in combination with farmyard manure.
- Entomopathogenic bacterium *Bacillus cereus* Frankland & Frankland developed at VPKAS, Almora also holds considerable potential to contain the infestation of whitegrubs especially in Uttarakhand.
- Among EPNs, *H. indica* and *H. bacteriophora* are effective against potato whitegrubs. The cadaver of *Galleria mellonella* infested with *H. indica* can be applied directly in the field in 1:7 cadaver to plant ratio. To apply a cadaver, 3-4 cm deep hole is dug near the base of plant and one cadaver per hole is gently placed and covered with soil.
- The EPNs have host searching ability and are highly virulent. The soil must be well soaked before applying nematodes as they need water for transport down to the root system. They start to work 48–72 hours after application, and nematodes will die without moisture.

Use of soil insecticides

- The insecticides should be applied in endemic localities to bring down the population below the economic threshold level. Species-specific action thresholds for insecticide application should be worked out. The most effective insecticides are chlorpyrifos or phorate and are recommended for soil application against neonate tiny grubs. The older grubs are hard to control as they move deep into the soil, and the insecticides usually do not penetrate the soil well enough to kill the grubs.
- Application of chlorpyrifos or quinalphos @ 4 litre/ha by mixing in soil in standing crop in first fortnight of June followed by earthing up gives satisfactory control of white grubs.
- Insecticides applied during early April at sowing time did not give desirable results as the beetles lay eggs in May–June, and by that time, the insecticides get dissipated.
- In mid-hills of Himachal Pradesh, soil drenching with chlorpyrifos at 5 kg/a.i. has been found to be effective resulting in 83.3–100% mortality of eggs and grubs of *B. coriacea*.
- The efficacy of insecticidal application increases when it coincides with peak beetle emergence and target eggs and neonate grubs. Insecticides work best when there is adequate moisture in the soil.
- The most critical period in dynamics of whitegrub infestation lies between August–September and timely harvest before September can avoid huge losses in summer potato.

Importance of harvesting date in avoiding white grub infestation

- Farmers want the potato skins to be fully mature before harvesting. Sometimes, harvesting is delayed by environmental factors such as late rains. Early harvesting of potato before the 15th of September in summer-planted crop is very useful.

SUMMARY

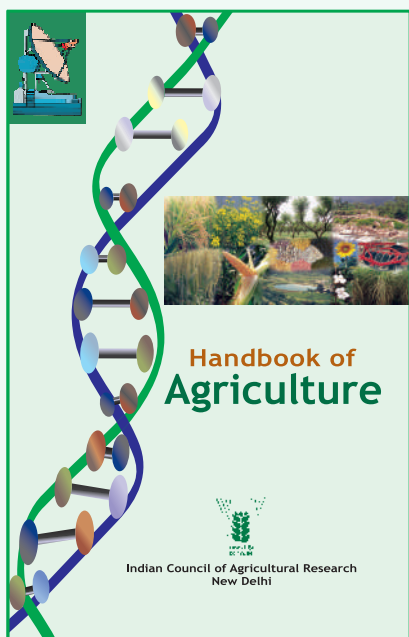
Several species of whitegrubs attack potato causing huge losses in hilly states. Their management is best possible by integrating mechanical, cultural and chemical

control in a befitting manner. The insecticide should be applied soon after emergence of beetles coinciding with their egg laying or egg hatching. In hilly areas, timely harvest of potato in September can avoid huge losses.

For further interaction, please write to:

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TECHNICAL SPECIFICATIONS

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