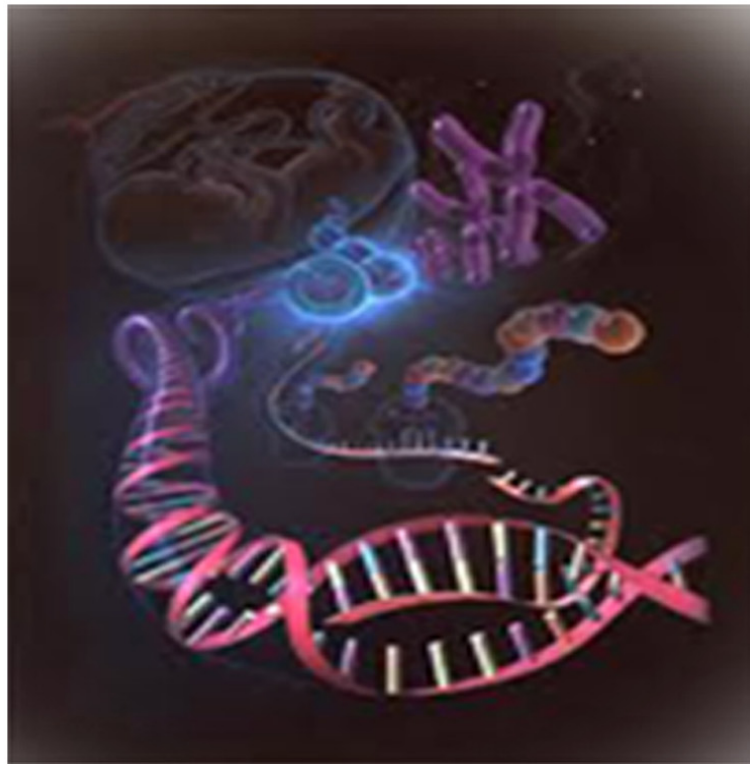




International Journal of Life Sciences Biotechnology and Pharma Research





Review Article

FOOD PLANTS OF A MAJOR AGRICULTURAL PEST *APHIS GOSSYPII* GLOVER (HOMOPTERA: APHIDIDAE) FROM INDIA: AN UPDATED CHECKLIST

Garima Singh¹, N P Singh¹ and Rajendra Singh^{2*}

*Corresponding Author: **Rajendra Singh** ✉ rsingh_gpu@yahoo.com

Aphis gossypii Glover is highly polyphagous and is now considered to consist of distinct phenotypes and genotypes, both holocyclic and anholocyclic, that vary with respect to their ability to reproduce and food preferences on different host plants. The diversity of its host range in India includes plants belonging to 569 species under 103 plant families. Plants belonging to following families are highly infested: Asteraceae, Cucurbitaceae, Fabaceae, Lamiaceae, Malvaceae, Polygonaceae, Rosaceae and Solanaceae. There are 11 plant families where more than 10 species of plants were infested with *A. gossypii* in India upto 2013, viz. Asteraceae (77 plant species), Lamiaceae (45 plant species), Fabaceae (35 plant species), Solanaceae (29 plant species), Malvaceae (25 plant species), Cucurbitaceae (24 plant species), Rosaceae (22 plant species), Polygonaceae (16 plant species), Rubiaceae (14 plant species), Apocynaceae (12 plant species) and Acanthaceae (11 plant species).

Keywords: Cotton aphid, Host plant, Asteraceae, Cucurbitaceae, Lamiaceae, Malvaceae, Solanaceae

INTRODUCTION

The aphid, *Aphis gossypii* was described by Glover in 1877. It probably originated in south-eastern Europe, but is now cosmopolitan. In India, Lefroy and Howlett (1909) reported the species for the first time on *Cucurbita maxima* Duchesne (Cucurbitaceae). Thereafter, several workers reported *A. gossypii* from different parts of the country. Its taxonomic status is complex and there are a number of biotypes having difference

in several morphological characters caused by climatic conditions, food plants and quality of fertilizers (Wool *et al.*, 1995; Liu *et al.*, 2000; Karim *et al.*, 2002; Zhao *et al.*, 2002). There exists a considerable proportion of literature that deals with mainly its geographical distribution, host plants, phenotypic plasticity, economic injury to the several crops (particularly, cotton, brinjal, cucurbits, okra, chilli, etc.), bionomics and studies of its chemical and biological control.

¹ Department of Zoology, University of Rajasthan, Jaipur 302055, Rajasthan, India.

² Department of Zoology, DDU Gorakhpur University, Gorakhpur 273 009, UP, India

A. gossypii is a remarkable species in terms of geographical and host plant range. It is one of the most widespread species of aphids, and displays a large range of host-plants, covering very different families. It is extremely polyphagous infesting over 900 plant species in the world (Blackman and Eastop, 2000). This impressive behavior made it a major pest of numerous crops (Fuchsberg *et al.*, 2007). The aphid has become a serious pest of field and glasshouse crops, especially cotton, okra, gourd, melon, chilli, brinjal and several ornamental plants such as chrysanthemums, roses, etc. The aphid varies in colour and may be light green, dark green, pale yellow or almost white. It is often light green mottled with darker green, with dark siphunculi. Winged alates have black head, thorax and siphunculi.

DISTRIBUTION OF APHIS GOSSYPII IN INDIA

In India, it has been reported from almost all states infesting over 569 plant species (only selected references are given), e.g. Andaman and Nicobar (Ghosh, 1990, 1992); Andhra Pradesh (Jhansi and Subbaratnam, 2005); Arunachal Pradesh (Ghosh, 1970a; Ghosh and Basu, 1994); Assam (Ghosh and Raychaudhuri, 1962, 1963; Ghosh, 1974); Bihar (Ghosh, 1970b; Ahmad and Kumar, 2006); Chhattisgarh (Kulkarni *et al.*, 2008); Delhi (Ghulam-Ullah, 1940; Ghosh, 1997); Gujarat (Butani and Jotwani, 1983; Patil *et al.*, 2013); Haryana (Verma *et al.*, 1975; Raychaudhuri *et al.* 1980; Ghosh, 1990); Himachal Pradesh (Banerjee *et al.*, 1969; Chowdhuri *et al.*, 1969; Bhalla, 1971; Ghosh, 1986); Jammu and Kashmir (Verma, 1971; Bhagat, 1984); Jharkhand (Jha, 1998); Karnataka (Krishnamurthi, 1929; David, 1956b; Joshi and

Poorani, 2007); Kerala (George, 1927; David, 1957; Mohandas *et al.* 2000; Joy and Sherin, 2013); Madhya Pradesh (Dhamdhare and Mathur, 1994; Gupta *et al.*, 1997); Maharashtra (Despande, 1938; Rao and Kulkarni, 1972; Kulkarni and Rao, 1980); Manipur (Chatterjee *et al.*, 1961; Agarwala and Raychaudhuri, 1980; Singh and Singh, 1986); Meghalaya (Stary and Ghosh, 1975); Nagaland (Raha and Raychaudhuri, 1981); Odisha (Sengupta *et al.*, 1962; Basu and Patro, 2007); Punjab (Kandoria *et al.*, 1989; Gill and Singh, 1997); Rajasthan (Raychaudhuri and Ghosh, 1959; Joshi and Mathur, 1967); Sikkim (Ghosh and Raychaudhuri, 1968; Agarwala and Raychaudhuri, 1981a; Tamil Nadu (David, 1956a,b); Tripura (Ganguli and Ghosh, 1965); Uttar Pradesh (Ghosh, 1969; Rizvi and Paul Khurana, 1970; Ahmed and Singh, 1994; Singh *et al.*, 1999); Uttarakhand (Raychaudhuri *et al.*, 1980); and West Bengal (Banerjee and Basu, 1955; Agarwala *et al.*, 1982).

ECONOMIC IMPORTANCE OF APHIS GOSSYPII

A. gossypii is one of the notorious insect pest of the world, particularly ruing the crops such as cotton, cucurbits, brinjal, chilli, okra, etc. It feeds by sucking sap from their host plants. The undersides of leaves are preferred, other leaf surfaces and flower buds are its next choice, but the entire host plant may be covered when populations are large. Infested leaves often become cupped downwards and may appear wrinkled. Heavy infestations on some plants may result in wilting. Young plants may have reduced or stunted growth. *A. gossypii* reduce flower production and yield.

Like other aphids, *A. gossypii* produces copious amounts of honeydew, a sweet and watery excrement. Honeydew serves as a medium on which sooty mould grows that blackens the leaf and decreases photosynthetic activity of the plants (Elmer and Brawner, 1975). When found on the fruits, honeydew and sooty mould reduces their marketability. Growers respond by washing fruit before marketing them. However, unfortunately, fruits often become unmarketable or of a lower grade because the fungus is difficult to wash off. Tinted cotton highly reduced the market price. Honeydew is also fed on by bees, wasps, ants and other insects, which may provide protection for the aphids from their natural enemies.

A. gossypii (both apterous and alate morphs) vector many plant diseases which cause substantially greater losses than damage caused by direct feeding injury. This is often the most damaging feature of an aphid infestation. This aphid transmits more than 80 kinds of virus diseases, including banana mosaic, papaya mosaic, papaya ring spot, citrus tristeza and passionfruit woody virus (Miyazaki, 2001). It is able to vector both P (PRSV-P) and W (PRSV-W) strains of Papaya Ringspot Virus. PRSV-P manifests itself on papaya. PRSV-W does not infect papaya, but does infect cucurbits and watermelon. PRSV-W is also called Watermelon Mosaic Virus 1 (WMV-1). This aphid also transmits Watermelon Mosaic Virus 2 (WMV-2). Cucumber Mosaic Virus (CMV) is mainly transmitted by *A. gossypii*. It also vectors Celery Mosaic Virus (Francki et al., 1979; Garzo et al., 2003). Persistent transmission of Citrus Vein Enation Virus (CVEV) by *A. gossypii* was reported by Mendoza et al. (1987).

The *A. gossypii* may infest approximately 78% of the cotton acreage in India. It injures cotton by continuously feeding on fluids in plant phloem systems (Rohfritsch, 1990). It reduced leaf area by 58% and shoot biomass by 45%. Cotton plants infested with aphids were shorter and produced fewer vegetative branches than non-infested plants. It can also result in fewer fruiting positions, lower fruit retention, and reduced cotton lint weight. Cotton yield losses associated with cotton aphids have been documented by several authors (Harris et al., 1992; Fuchs and Minzenmayer, 1995; Layton et al., 1996).

PHENOTYPIC PLASTICITY IN *APHIS GOSSYPII*

The great success with which *A. gossypii* has exploited a wide diversity of ecosystems may be accredited to its broad phenotypic plasticity and complex life-cycle. The life-cycle of an aphid potentially consists of several clones which are endowed with a remarkable ability to adapt to a heterogeneous environment accompanied by phenotypic changes (Agarwala, 2007; Agarwala et al., 2007). Each clone goes through a seasonal life-cycle made of a sequence of morphs or phenotypes that differ in their morphology, behaviour and physiology, but have identical genotype. The different phenotypes of a genotype provide the species ample scope to seek and exploit food resources under wide conditions (Agarwala, 2007).

The *A. gossypii* varies in size (1.0 mm to 2.75 mm) and colour which may be light green, dark green, pale yellow or almost white. It is often light green mottled with darker green, with dark siphunculi. Winged alates have black head, thorax and siphunculi. Long back, Wall (1933) reported colour and size variations in the population of

A. gossypii on different food plants. The populations of *A. gossypii* are differentiated in food utility, and the host fidelity all over the world. There are several biotypes of the aphid worldwide on different crops. The *A. gossypii* is now considered to consist of distinct genotypes, both holocyclic and anholocyclic, that vary with respect to their ability to reproduce and host preferences on different host plants (Takada and Murakami, 1988; Zhang and Zhong, 1990; Mokhtar *et al.*, 1993; Brevault *et al.*, 2008; Agarwala *et al.*, 2009; Carletto *et al.*, 2009). *A. gossypii* developed distinct host races with different abilities of colonizing host plants and with more potentials of sexual reproduction, and consequently evolutionary differentiation, than previously regarded (Guildemond *et al.*, 1994). *A. gossypii* occurs on chrysanthemums and cucumbers in western European glasshouses, but aphids from chrysanthemums will not colonise cucumber, and vice versa, although both can be reared on cotton (Guildemond *et al.*, 1994). Similarly, Agarwala and Raychoudhury (2013) demonstrated that genotypes living in wild plants of taro, *Colocasia esculenta* var. *esculenta* (L.) Schott (Alismatales: Araceae), and wild brinjal, *Solanum torvum* Swartz (Solanales: Solanaceae), behave as distinct host races for *A. gossypii*. Success rates of colonisation after reciprocal host transfers were very poor. Clones of *A. gossypii* from wild taro partly survived in the first generation when transferred to wild brinjal, but nymph mortality was 100% in the second generation. In contrast, brinjal clones, when transferred to taro, could not survive even in the first generation. Significant differences between the clones from two host species were also recorded in development time and life-table parameters. Morphologically, aphids of wild taro clones possessed longer proboscis and fore-

femora than the aphids of the brinjal clones. It implies that *A. gossypii* exists as distinct host races with different abilities of colonizing host plants, and its populations appear to have more potential of sympatric evolution than previously regarded.

The *A. gossypii* sometimes gives birth to small, yellow offspring that grow to only about half to one-third of the typical adult weight. These 'yellow dwarfs' differ from the typical form in their small size by having 5 instead of 6 antennal segments, and by never attaining dark green/black coloration; they are considered to be a separate developmentally-programmed morph (Watt and Hales, 1996). Yellow dwarfs develop at a slower rate than typical aphids and have a lower biotic potential. Watt and Hales (1996) demonstrated that production of yellow dwarfs can be induced by presumed less-suitable host-plant species at temperatures of 15 and 25°C, but not 20°C. Crowding may also induce birth of yellow dwarfs. Wool and Hales (1997) discussed the possible advantages of the yellow dwarf developmental pathway of *A. gossypii*.

Yuan *et al.* (2002) observed effect of food plants (*Hibiscus syriacus* Linn., *Punica granatum* Linn., *Zanthoxylum simulans* Hance and cotton) on colour differentiation of *A. gossypii* at different periods. The aphids have yellow and green forms. On *H. syriacus*, *P. granatum*, and *Z. simulans*, the green form is dominant in early spring. The yellow form is dominant from late spring to early summer. The green form is dominant from late summer to early autumn. From May to June, the yellow form is dominant on cotton plants and its proportion is similar to that of migratory aphids on winter food plants.

The inheritance of colour of *A. gossypii* through generations was studied by Liu *et al.* (2002) who observed that the yellow progeny of green stem mothers of *A. gossypii* reared under low temperatures (18°C and 22°C) produced both yellow- and green-colored aphids in the first generation, but in the following three generations, the yellow and green progeny produced only green offspring. Under 26°C, the offspring differentiated into green- and yellow-colored aphids after one or two generations. In a field population, the yellow aphids produced both yellow- and green-colored offsprings under low temperatures (18 and 21°C), but maintained the yellow color during four generations under high temperature (24 and 27°C). The green aphids maintained their body color under low temperatures, but produced only yellow-colored progeny under high temperature. The proportion of green aphids on new leaves was significantly higher than on the old leaves. The pre-reproduction period and longevity did not differ between yellow and green aphids, but the fecundity of green-coloured aphids was higher than the yellow-coloured aphids.

The effect of climatic factors such as temperature, relative humidity, dewpoint, rainfall, soil temperature and photoperiod were studied by Karim *et al.* (2002) on the body length, body width, antennal length, processus terminals (p.t.), ultimate rostral segment (u.r.s.), siphuncular length and caudal length. They reported that the temperature has significant effect on all traits in all instars, except with p.t. and u.r.s. length of the II instar; the dewpoint has significant impact on length of body, p.t. and siphunculus in II instar nymphs; RH showed significant effect on body length, body width, length of u.r.s. and siphuncular length in I instar nymphs; soil temperature showed negative significant effect on all traits, except

antennal length, in II instar nymphs; significant correlation with all traits, except siphuncular length, in III instar nymphs; significant correlation with all traits in IV instar nymphs; and significant correlation with all traits, except body width, ultimate rostral segment and caudal length, in adults. Liu *et al.* (2003) observed significant differences in morphology and colour under various temperatures in different climatic zones of China, particularly, in the measurement of head width, length of all femora and tibiae, and siphunculi. The higher temperature always correlated with smaller sizes of *A. gossypii* (Liu *et al.* 2000, 2003). Aphids on the first or second leaves of *Gossypium hirsutum* L. from the apex were significantly larger than those on the apical bud or lower leaves. However, the sizes of aphids at the seedling, flowering and boll setting and boll opening stages did not differ significantly (Liu *et al.*, 2000). Liu *et al.* (2004) found that the ratios of head width, stylet and the femur to body length of the cucumber biotype were significantly lower than that of the cotton biotype. Both the biotypes could be distinguished by measuring the relative lengths of head, siphunculi, stylet, femur and the third segment of antenna to body length.

Margaritopoulos *et al.* (2006) demonstrated a clear morphometric separation of *A. gossypii* originating from Asteraceae and those collected on Cucurbitaceae and Malvaceae, regardless of the geographical origin of the aphids and the host plant on which they were reared. It implies that there are two widely distributed host races or subspecies of *A. gossypii* with different plant family associations. Wool and Hales (1997) and Agarwala and Das (2007) reported that the clones of *A. gossypii* showed variations in their morphology, growth parameters and esterase isozymes when raised on different food plants.

The clones on cotton were found to be largest and showed higher growth rates than the clones on other host plants. Even the N₂ fertilization was found to affect the colour and size of the aphid *A. gossypii* on cotton (Nevo and Coll, 2001). Aphids on nitrogen-fertilised plants were significantly bigger and darker. All body size and darkness of colour measurements were positively correlated with aphid fecundity also. Nevo and Coll (2001) also found that the nutritional quality of the host plant on which the parent generation feeds has a stronger effect on the aphids than that of the quality of their own food plants.

RECORDS OF FOOD PLANTS OF APHIS GOSSYPYII IN INDIA

A. gossypii is highly polyphagous and is now considered to consist of distinct phenotypes and genotypes, both holocyclic and anholocyclic, that vary with respect to their ability to reproduce and food preferences on different host plants. The diversity of its host range in India includes plants belonging to 569 species under 103 plant families.

The following records of food plants of *A. gossypii* are based on the survey of literature. In the most of the literature published, names of the plants were erroneously mentioned even in the recent ones. In the present compilation, attempts were made to provide the valid scientific name of the plants (GRIN, 2013). At several places, their synonymy were also mentioned. Following is the list of familywise food plants of *A. gossypii* recorded in India upto 2013.

1. Acanthaceae: *Ruellia prostrata* Poir (Singh et al., 1999); *Stenosiphonium parviflorum* Anders. (Raychaudhuri et al., 1981); *S. russalianum* Nees (Behura, 1963); *Strobilanthes angustifrons* Clarke (Chakrabarti and Sarkar, 2001); *Strobilanthes atropurpureus* Nees (Chakrabarti, 1972); *S. dalhousianus* Clarke (= *Goldfussia dalhoussiana* (misident.)) (Raychaudhuri et al., 1980); *S. glutinosus* Nees (Chakrabarti and Sarkar, 2001); *S. helictus* Anders. (Raychaudhuri, 1973); *S. penstemonoides* Anders. (Chakrabarti, 1972); *Strobilanthes* sp. (Maity and Chakrabarti, 1979); *Thunbergia erecta* (Benth.) T. Anderson (Basu and Patro, 2007).
2. Acoraceae: *Acorus calamus* L. (Ghosh, 1970b).
3. Adoxaceae: *Viburnum foetidum* Wall. (Raychaudhuri, 1973).
4. Agavaceae: *Agave angustifolia* Haw. (Behura and Roy, 1980)
5. Alliaceae: *Allium cepa* L. (Raychaudhuri, 1973); *Achyranthes bidentata* Blume (Kar et al., 1990); *Achyranthes* sp. (Raychaudhuri, 1973); *Alternanthera nodiflora* R. Br. (Rao, 1969); *Amaranthus spinosus* L. (Behura, 1963); *A. tricolor* L. (= *A. gangeticus* L.) (Ghosh, 1990); *Celosia argentea* L. (Behura, 1963).
6. Amaranthaceae: *Achyranthes aspera* L. (Raychaudhuri et al., 1981); *Amaranthus viridis* Desf. (Singh et al., 1999).
7. Amaryllidaceae: *Crinum* sp. (Raychaudhuri, 1973)
8. Anacardiaceae: *Mangifera indica* L. (Singh et al., 1999).
9. Annonaceae: *Annona* sp. (Raychaudhuri et al., 1981); *Polyalthia longifolia* (Sonn.)

- Thwaites (Behura, 1963); *Polyalthia* sp. (Raychaudhuri et al., 1980).
10. Anthericaceae: *Chlorophytum tuberosum* (Roxb.) Baker (Jha, 1998)
11. Apiaceae: *Coriandrum sativum* L. *Foeniculum vulgare* Mill. (Singh et al., 1999); *Pimpinella monoica* Dalz. (Behura, 1963); *Trachyspermum ammi* (L.) Sprague ex Turrill (= *Carum copticum* (L.) C. B. (Larke)) (Joshi and Poorani, 2007)
12. Apocynaceae: *Allamanda cathartica* L. (Basu and Patro, 2007); *Alstonia* sp. (Raychaudhuri, 1973); *Asclepias curassavica* L. (Raychaudhuri, 1973); *Calotropis gigantea* (L.) W.T. Aiton (Raychaudhuri and Ghosh, 1959; Behura, 1963); *C. procera* (Aiton) W.T. Aiton (Raychaudhuri et al., 1981); *Calotropis* sp. (Raychaudhuri, 1973); *C. pussilus* (Murray) G. Don (Joshi and Poorani, 2007); *Catharanthus roseus* (L.) G. Don. (= *Vinca rosea* L.) (Raha, 1979); *Cryptostegia grandiflora* R. Br. (Behura, 1963); *Cynanchum* sp. (Chakrabarti and Sarkar, 2001); *Holarrhena pubescens* Wall. ex G. Don (= *Holarrhena antidysenterica* (G. (Don) Wall. ex A. DC.) (David, 1957; Behura, 1963); *Ichnocarpus frutescens* (L.) R. Br. (Ghosh, 1970b); *Nerium oleander* L. (= *Nerium odorum* Aiton, *Nerium indicum* Mill.) (Raychaudhuri, 1973; Raychaudhuri et al., 1981).
13. Araceae: *Alocasia macrorrhizos* (L.) G. Don (= *Alocasia indica* (Lour.) Spach (Raychaudhuri, 1973); *Colocasia esculenta* (L.) Schott. (= *C. antiquorum* Schott.); *C. indica* (Lour.) Kunth (Raychaudhuri, 1973; Behura, 1963); *Colocasia* sp. (Rao, 1969); *Typhonium trilobatum* (L.) Schott (Raychaudhuri, 1973)
14. Araliaceae: *Aralia* sp. (Joshi and Poorani, 2007).
15. Asteraceae: *Acanthospermum hispidum* DC. (Behura, 1963); *Acmella paniculata* (Wall. ex DC.) Jansen (= *Spilanthes acmella* (L.) Murray) (Raychaudhuri, 1973); *Ageratum conyzoides* L. (Singh et al., 1999); *Ageratum* sp. (Raychaudhuri et al. 1980); *Anaphalis contorta* Hook.f. (Raychaudhuri et al. 1980); *A. triplinervis* Benth. Ex Hance (Raychaudhuri, 1973); *Anaphalis* sp. (Raychaudhuri et al. 1980); *Artemisia nilagirica* (Clarke) Pamp. (Ghosh, 1990); *A. vulgaris* L. (Raychaudhuri, et al., 1981); *Artemisia* sp. (Raychaudhuri et al., 1981); *Aster trinervius* Roxb. ex D. Don (Verma et al., 1975); *Aster* sp. (Rao, 1969); *Bidens bipinnata* L. (Ghosh, 1977); *B. pilosa* L. (Singh et al., 1999); *Blumea lacera* (Burm.f.) DC. (Raychaudhuri, 1973); *B. laciniata* (Roxb.) DC. (Rao, 1969); *Blumea witiara* DC. (Agarwala, 1979); *Blumea* sp. (Raychaudhuri, 1973); *Calendula* sp. (Chowdhuri et al., 1970); *Chromolaena odorata* (L.) R.M. King and H. Rob. (Agarwala and Raychaudhuri, 1982); *Chrysanthemum hortorum* W. Mill. (Sengupta et al., 1962); *C. indicum* L. (Singh et al., 1999); *C. morifolium* Ramat (= *C. sinense* Sabine ex Sweet) (Behura, 1963); *Chrysanthemum* sp. (Singh et al., 1999); *Conyza bonariensis* (L.) Cronq. (= *Erigeron linifolius* Willd.) (Jha, 1998); *C. japonica* (Thunb.) DC. (Raychaudhuri et al., 1980); *Conyza* sp. (Behura, 1963); *Cosmos* sp. (Ghosh and Agarwala, 1980); *Crepis* sp.

- (Agarwala, 1979); *Dahlia pinnata* Cav. (= *D. variabilis* (Willd.) Desf.) (Raha, 1979); *Dahlia* sp. (Ganguli and Ghosh, 1965); *Dichrocephala integrifolia* (L.f.) Kuntze (Chakrabarti and Sarkar, 2001); *Dichrocephala* sp. (Chakrabarti and Sarkar, 2001); *Eclipta prostrata* (L.) L. (Raychaudhuri et al., 1981); *Emilia sonchifolia* L. (David, 1958); *Emilia* sp. (Agarwala, 1979); *Enhydra fluctuans* Lour. (Basu and Patro, 2007); *Erechtites valerianaefolia* DC. (Ghosh, 1974); *Erechtites* sp. (Raychaudhuri, 1973); *Erigeron* sp. (Ghosh and Agarwala, 1980); *Eupatorium cannabinum* L. (Ghosh, 1990); *E. heteroclinum* Griseb. (Behura, 1963); *E. odoratum* L. (Raychaudhuri, 1973); *E. wallichii* DC. (Raychaudhuri, 1973); *Eupatorium* sp. (Rao, 1969); *Flaveria australasica* Hook. (Behura, 1963); *Galinsoga parviflora* Cav. (Ghosh and Agarwala, 1980); *Gerbera macrophylla* Benth. and Hook.f. (Raychaudhuri, 1973); *Glebionis coronaria* (L.) Cass. ex Spach (= *Chrysanthemum coronarium* L.) (Agarwala, 1979); *Gnaphalium indicum* L. (Basu and Patro, 2007); *Guizotia abyssinica* (L. f.) Cass. (Basu and Patro, 2007); *Gynura cusimbua* (D. Don) S. Moore (= *Gynura angulosa* DC.) (Agarwala and Raychaudhuri, 1979; Devi et al., 2000); *Gynura nepalensis* DC. (Raychaudhuri, et al., 1980); *Gynura* sp. (Ghosh and Agarwala, 1980); *Helianthus annuus* L. (Singh et al., 1999); *Hypochoeris radicata* L. (Raychaudhuri, 1973); *Inula cappa* (Buch.-Ham. Ex D. Don) DC. (Raychaudhuri, 1973); *Mikania scandens* (L.) Willd. (Raychaudhuri, 1973); *Mikania* sp. (Raychaudhuri, 1973); *Montanoa bipinnatifida* (Kunth) K. Koch (Raychaudhuri, 1973); *Myriactis nepalensis* Less. (Raychaudhuri, 1973); *Parthenium hysterophorus* L. (Singh et al., 1999); *Pseudo-gnaphalium luteoalbum* (L.) Hill. and Burt (=*Gnaphalium luteoalbum* L.) (Raychaudhuri, 1973); *Rudbeckia tagetes* James (= *Rudbeckia tageteiodes* (auct.) (Raha, 1979); *Senecio densiflorus* Wall. ex DC. (Raychaudhuri, 1973); *Senecio* sp. (Raychaudhuri, 1973; Raychaudhuri, 1978); *Siegesbeckia orientalis* L. (Raychaudhuri, 1978); *Sonchus arvensis* L. (Ghosh and Agarwala, 1980); *Sonchus* sp. (Raychaudhuri, 1973); *Tagetes patula* L. (Ghosh, 1970b); *Tagetes* sp. (Ahmed and Singh, 1994); *Taraxacum officinale* aggr. (Dandelion) (Chakrabarti, 1972); *Tridax procumbens* L. (Singh et al., 1999); *Tridax* sp. (Raychaudhuri et al., 1980); *Vernonia cinerea* (L.) Less. (Behura, 1963); *Vernonia* sp. (George, 1927); *Wedelia* sp. (Raychaudhuri, 1973); *Zinnia elegans* Jacq. (Raychaudhuri, 1973); *Zinnia* sp. (Chowdhuri et al., 1970).
16. Balsaminaceae: *Impatiens balsamina* L. (Raychaudhuri, 1973); *Impatiens* sp. (Behura, 1963).
 17. Basellaceae: *Basella alba* L. (= *Basella rubra* L.) (Singh et al., 1999).
 18. Berberidaceae: *Berberis* sp. (Chakrabarti et al., 2002).
 19. Bignoniaceae: *Campsis radicans* (L.), Seem. ex Bureau (Singh et al., 1999); *Jacaranda mimosifolia* D. Don (Rao, 1969); *Martynia annua* L. (= *Martynia diandra* Gloxin)

- L. (Basu and Patro, 2007); *Spathodea campanulata* P. Beauv. (Joshi and Poorani, 2007); *Tecoma* sp. (Raychaudhuri, 1973); *Tecoma stans* (L.) Juss. Ex Kunth (= *Stenolobium stans* (L.) Seem.) (Behura, 1963); *Tecomella undulata* (Sm.) Seem. (Sundararaj and Murugesan, 1997).
20. Boraginaceae: *Cynoglossum furcatum* Wall. (Chakrabarti and Sarkar, 2001); *Cynoglossum lanceolatum* Forssk. (Raychaudhuri, 1973); *Cynoglossum wallichii* G. Don (Chakrabarti and Sarkar, 2001).
21. Brassicaceae: *Brassica juncea* L. Czern. (Raychaudhuri, 1973); *Brassica oleracea* L. (Raychaudhuri, 1973); *Brassica oleracea* var. *botrytis* L. (Singh et al., 1999); *Brassica* sp. (Raychaudhuri, 1973); *Capsella bursapastoris* (L.) Medik (Behura, 1963); *Iberis amara* L. (Chakrabarti and Sarkar, 2001); *Raphanus sativus* L. (Behura, 1965); *Senebiera pinnatifida* DC. (Raychaudhuri, 1973); *Sisymbrium* sp. (Rishi, 1975).
22. Burseraceae: *Commiphora berryi* (Arn.) Engl. (David, 1957).
23. Calceolariaceae: *Calceolaria mexicana* Benth. (Rao, 1969); *Calceolaria esculenta* (Rao, 1969).
24. Cannabaceae: *Cannabis sativa* L. (Behura, 1963); *Trema orientalis* (L.) Blume (= *Trema aureantalia* auct. nonn.) (Kar et al., 1990).
25. Cannaceae: *Canna* sp. (Raychaudhuri, 1973).
26. Capparaceae: *Capparis leucophylla* DC. (Kar et al., 1990); *Capparis stylosa* DC. (Behura, 1963).
27. Caprifoliaceae: *Lonicera* sp. (Raychaudhuri, 1973).
28. Caricaceae: *Carica papaya* L. (Bhalla and Pawar, 1980).
29. Caryophyllaceae: *Drymaria cordata* (L.) Willd. ex Schult. (Agarwala, 1979); *Stellaria media* (L.) Vill. (Raychaudhuri, 1973).
30. Chenopodiaceae: *Beta vulgaris* L. (Agarwala, 1979); *Chenopodium album* L. (Raychaudhuri, 1973); *Chenopodium* sp. (Ghosh and Agarwala, 1980); *Spinacia oleracea* L. (Behura, 1963).
31. Cleomaceae: *Cleome chelidonii* L.f. (Behura, 1963); *Gynandropsis gynandra* (L.) Briq. (= *Cleome gyandra* L. = *Cleome pentaphylla* L.) (Behura, 1963; Raychaudhuri, 1973; Basu and Patro, 2007).
32. Combretaceae: *Terminalia arjuna* (Roxb.) ex DC. Wight and Arn. (Raychaudhuri et al., 1981).
33. Commelinaceae: *Commelina bengalensis* L. (Rao, 1969); *Commelina* sp. (Sengupta et al., 1962); *Cyanotis axillaris* (L.) D. Don (Rao, 1969).
34. Convolvulaceae: *Ipomoea carnea* Jacq. (Raychaudhuri, 1973); *Ipomoea carnea* ssp. *fistulosa* (Mart. Ex Choisy) D.F. Austin (= *Ipomoea fistulosa* Mart. Ex Choisy) (Raychaudhuri, 1973); *Ipomoea hederacea* Jacq. (Raychaudhuri, 1973); *Ipomoea batatas* (L.) Lam. (Behura, 1963); *Ipomoea* sp. (= *Quamoclit* sp.) (Raychaudhuri 1973; Basu and Patro, 2007).
35. Cucurbitaceae: *Benincasa hispida* (Thumb.) Cogn. (= *Benincasa cerifera* Savi) (Singh et

- al., 1999; Basu and Patro, 2007); *Bryonia rhamnoides* (Raychaudhuri, 1973); *Citrullus lanatus* (Thunb.) Matsum. and Nakai var. *lanatus* (= *Citrullus vulgaris* Schrad. ex Eckl. and Zeyh) (Sengupta et al., 1962); *Coccinia grandis* (L.) Voigt. (= *Coccinia indica* Wight and Arn. *Coccinia cordifolia* L.) Cogn) (Rizvi and Paul Khurana, 1970; Sengupta et al., 1962); *Coccinia* sp. (Ghosh, 1990); *Cucumis melo* L. (Joshi and Mathur, 1967; Shuja Uddin, 1973); *Cucumis melo* var. *momordica* (Roxb.) Duthie and Fuller (Behura, 1963); *Cucumis sativus* L. *C. maxima* Duchesne (Singh et al., 1999); *Cucurbita moschata* Duchesne (Behura, 1963); *Cucurbita pepo* L. (Chakrabarti, 1972); *Cucurbita sativa* L. (Chakrabarti, 1972); *Cucurbita* sp. (Ramaseshiah and Dharmadhikari, 1969); *Lagenaria siceraria* (Molino) Standl. (= *Lagenaria vulgaris* Ser.) (Singh et al., 1999); *Luffa acutangula* (L.) Roxb. (Raychaudhuri et al., 1980), *L. aegyptiaca* Mill. (= *L. cylindrica* M. Roem.), *Momordica charantia* L. (Singh et al., 1999); *M. cochinchinensis* (Lour.) Spreng. (Raychaudhuri, 1973); *Sechium edule* (Jacq.) Sw. (Agarwala and Raychaudhuri, 1981b); *Sechium* sp. (Agarwala and Raychaudhuri, 1979); *Solena heterophylla* Lour. (= *Melothria heterophylla* (Lour.) Cogn.) (Ghosh, 1990); *Solenia umbellata* (K and W) de Wilde and Duytjies (= *Zehneria umbellata* (Klein ex Willd.) Thwaites) (Raychaudhuri, 1973); *Trichosanthes cucumerina* var. *anguina* (L.) (= *Trichosanthes anguina* L.) (Sengupta et al., 1962; Rao, 1969); *Trichosanthes dioica* Roxb. (Behura, 1963).
36. Cupressaceae: *Cupressus* sp. (Agarwala, 1979).
37. Cuscutaceae: *Cuscuta reflexa* Roxb. (Raychaudhuri, 1978; Shuja Uddin, 1973).
38. Cyperaceae: *Cyperus rotundus* L. (Rizvi and Paul Khurana, 1970; Chakrabarti, 1972).
39. Dipsacaceae: *Dipsacus mitis* D. Don (Chakrabarti and Sarkar, 2001).
40. Dioscoreaceae: *Dioscorea bulbifera* L. (Bhagat, 2012).
41. Dipterocarpaceae: *Shorea robusta* C.F. Gaertn. (Raychaudhuri, 1973); *Shorea talura* Roxb. (Krishnamurthi, 1929).
42. Ebenaceae: *Diospyros kaki* Thunb. (Basu and Patro, 2007).
43. Ehretiaceae : *Cordia dichotoma* G. Forst. (= *Cordia dichotessa* auct.) (Ghosh, 1990); *Cordia myxa* L. (David, 1957).
44. Ericaceae: *Lyonia ovalifolia* (Wall.) Drude (= *Pieris ovalifolis* (Wall. D. Don)) (Chakrabarti, 1972; Raychaudhuri, 1973); *Rhododendron arboreum* Sm. (Raychaudhuri, 1973); *Rhododendron* sp. (Chakrabarti, 1972).
45. Euphorbiaceae: *Acalypha hispida* Burm. f. (Joshi and Poorani, 2007); *A. indica* L. (Singh et al. 1999); *Acalypha* sp. (Behura, 1963); *Bridelia* sp. (Raychaudhuri et al., 1981); *Euphorbia hirta* L. (Behura, 1963); *Euphorbia pilulifera* (Jacq.) (Krishnamurthi, 1948); *Euphorbia* sp. (Basu and Banerjee, 1958); *Mallotus philippinensis* Müll. Arg. (Chakrabarti and Sarkar, 2001); *Pedilanthus tithymaloides* (L.) Poit. (Raychaudhuri, 1973); *Phyllanthus niruri* L. (Basu and Patro, 2007); *Ricinus communis* L. (Verma et al., 1975).
46. Fabaceae: *Acacia* sp. (Kar et al., 1990); *Bauhinia variegata* L. (Basu and Patro, 2007);

Butea monosperma (Lam.) Taub. (= *Butea frondosa* Roxb. ex Willd.) (Ghosh, 1990); *Caesalpinia decapetala* (Roth) Alston (= *Caesalpinia sepiaria* Roxb.) (Chakrabarti and Sarkar, 2001); *Cajanus cajan* (L.) Millsp. (Singh et al., 1999); *Calliandra haematocephala* Hassk. (Raychaudhuri, 1973); *Calliandra* sp. (Singh et al. 1999); *Cassia* sp. (Behura, 1965); *Cicer arietinum* L. (Ahmad and Kumar, 2006); *Clitoria ternatea* L. (Behura, 1965); *Crotalaria alata* Buch.-Ham. ex Roxb. (Rao, 1969); *Crotalaria juncea* L. (Joshi and Mathur, 1967); *Crotalaria pallida* Aiton (= *Crotalaria brownie* Bertero ex DC. = *Crotalaria mucronata* Desv.) (Jha, 1998); *Crotalaria* sp. (Ghosh and Agarwala, 1980); *Cyamopsis tetragonoloba* (L.) Taub. (Rao, 1969); *Desmodium caudatum* (Thunb.) DC. (= *Desmodium laburnifolium* (Poir.) DC.) (Chakrabarti and Sarkar, 2001); *Flemingia macrophylla* (Willd.) Merr. (= *Moghania macrophylla* (Willd.) Kuntz.) (Sen et al., 1987); *Glycine max* (L.) Merr. (Raychaudhuri, 1973); *Indigofera* sp. (Raychaudhuri, 1973); *Lablab purpureus* (L.) Sweet ssp. *purpureus* (= *Dolichos lablab* L.) (Sengupta et al., 1962); *Lathyrus odoratus* L. (Singh et al., 1999); *Lathyrus sativus* L. (Basu and Patro, 2007); *Lens culinaris* ssp. *culinaris* Medik (= *Lens esculenta* Moench.) (Verma et al., 1975); *Leucaena glauca* (Willd.) Benth. (Agarwala, 1979); *Leucaena leucocephala* (Lam.) de Wit. (Sathe and Jadhav, 2008); *Medicago sativa* L. (Singh et al., 1999); *Melilotus indicus* (L.) All. (Verma et al., 1975); *Mimosa pudica* L. (Raychaudhuri, 1973); *Peltophorum pterocarpum* (DC.) Backer ex K. Heyne (= *Peltophorum ferrugineum* (Decne.)

Benth.) (Ghosh, 1990); *Phaseolus vulgaris* Linn. (Behura and Roy, 1980); *Prosopis juliflora* (Sw.) DC. (Behura, 1963); *Senna hirsuta* (L.) H. S. Irwin and Barneby var. *hirsuta* (= *Cassia hirsuta* L.) (Raychaudhuri, 1978); *Senna sophera* (L.) Roxb. (= *Cassia sophera* L.) (Raychaudhuri, 1973); *Sesbania grandiflora* (L.) Pers. (Raychaudhuri, 1973); *Trigonella foenum-graecum* L. *Vicia faba* L. (Singh et al., 1999); *Vicia faba* L. var. *major* (Bhagat, 2012); *Vigna unguiculata* (L.) Walp. ssp. *cylindrica* (L.) Verdc. (= *Vigna catjang* (Burm.f.) Walp.) (Behura, 1963).

47. Fagaceae: *Quercus serrata* Thunb. (Singh et al., 1995).
48. Gentianaceae: *Gentiana kurroo* Royle (Chakrabarti and Sarkar, 2001); *Potalia* sp. (Raychaudhuri, 1983); *Swertia* sp. (Chakrabarti and Sarkar, 2001).
49. Geraniaceae: *Geranium ocellatum* Cambess. (Chakrabarti, 1972); *Pelargonium zonale* (L.)'Hér. (Raychaudhuri, 1973).
50. Hydrangeaceae: *Hydrangea* sp. (Raychaudhuri, 1973); *Philadelphus coronarius* L. (Chakrabarti and Sarkar, 2001).
51. Hypericaceae: *Hypericum oblongifolium* Choisy (Raychaudhuri et al., 1980); *Hypericum patulum* Thunb. (Raychaudhuri, 1973); *Hypericum perforatum* L. (Chakrabarti and Sarkar, 2001); *Hypericum uralum* Buch.-Ham. Ex D. Don (Chakrabarti and Sarkar, 2001).
52. Iridaceae: *Gladiolus* sp. (Behura, 1963).
53. Lamiaceae: *Ajuga brachystemon* Maxim. (Chakrabarti and Sarkar, 2001); *Ajuga*

- cractonia* (Raychaudhuri, 1973); *Ajuga* sp. (Raychaudhuri, D. 1978); *Callicarpa macrophylla* Vahl (Chakrabarti, 1972); *Callicarpa* sp. (Raychaudhuri, 1973); *Caryopteris incana* Miq. (= *Clerodendrum incana* auct. nonn.) (Agarwala, 1979); *Clerodendrum inerme* (L.) Gaertn. (Singh et al., 1999); *C. infortunatum* L. (Agrawal et al., 2006); *Clerodendrum viscosum* Vent. (Singh et al., 1999); *Clerodendrum* sp. (Maity and Chakrabarti, 1979); *Clinopodium umbrosum* (M. Bieb.) K. Koch (= *Calamintha umbrosa* (M. Bieb.) Fisch. and C. Mey.) (Raychaudhuri, 1973); *Craniotome versicolor* Reichenbach (Chakrabarti and Sarkar, 2001); *Dysophylla* sp. (Raychaudhuri, 1973); *Elsholtzia incisa* Benth. (Chakrabarti and Sarkar, 2001); *Elsholtzia polystachya* Benth. (Ghosh, 1977); *Elsholtzia* sp. (Chakrabarti and Sarkar, 2001); *Isodon coesta* (Buch.-Ham. ex D. Don) (= *Plectranthus coetsa* Buch.-Ham. ex D. Don) (Raychaudhuri, 1973); *Isodon lophanthoides* (Buch.-Ham. ex D. Don) H. Hara (= *Plectranthus striatus* Benth.) (Chakrabarti, 1972); *Isodon* sp. (= *Plectranthus* sp.) (Chakrabarti and Sarkar, 2001); *Leucas aspera* (Willd.) Link (Raychaudhuri, 1980); *Leucas cephalotes* (Roth) Spreng. (Raychaudhuri, 1973); *Leucas lavandulifolia* Sm. (= *Leucas linifolia* (Roth) Spreng.) (Raychaudhuri, 1973); *Leucosceptrum cannum* Sm. (Rao, 1969); *Mentha arvensis* L. (Bhalla and Pawar, 1980); *Mentha longifolia* (L.) Huds. (= *Mentha sylvestris* L.) (Bhalla and Pawar, 1980); *Mentha* sp. (Raychaudhuri, 1973); *Mentha spicata* L. (= *Mentha viridis* (L.) L.) (Raychaudhuri, 1973); *Ocimum americanum* L. (= *Ocimum canum* Sim.) (Behura, 1963); *Ocimum basilicum* L. (Sengupta et al. 1962); *Ocimum tenuiflorum* L. (= *Ocimum sanctum* L.) (Singh et al. 1999); *Ocimum* sp. (Raychaudhuri et al., 1981); *Origanum vulgare* L. (Raychaudhuri et al., 1980); *Perilla frutescens* (L.) Britton (= *Perilla ochymoides* L.) (Chowdhuri et al., 1970); *Perilla* sp. (Raychaudhuri, 1973); *Pogostemon benghalensis* (Burm.f.) Kuntz (Chakrabarti and Sarkar, 2001); *Rotheca serrata* (L.) Steane and Mabb. (= *Clerodendrum serratum* (L.) Moon) (Raychaudhuri, 1978); *Salvia aspera* Kunth (Agarwala, 1979); *Salvia* sp. (Chowdhuri et al., 1970); *Scutellaria repens* Buch.-Ham. ex D. Don (Chakrabarti, 1972); *Scutellaria scandens* Buch.-Ham. ex D. Don (Chakrabarti, 1972); *Tectona grandis* L.f. (Singh et al., 1999); *Vitex altissima* L.f. (= *Vitex zeylanica* Turcz.) (Ghosh, 1990); *Vitex japonica* (Raychaudhuri, 1973); *Vitex negundo* L. (David, 1957); *Vitex trifolia* L. (Rao, 1969; Raychaudhuri, 1978).
54. Lauraceae: *Litsea monopetala* (Roxb.) Pers. (= *Litsea polyantha* Juss.) (Raychaudhuri, 1978); *Litsea* sp. (Raychaudhuri, 1973).
55. Lythraceae : *Cuphea* sp. (Raychaudhuri, 1973); *Lagerstroemia floribunda* Jacq. (Maity and Chakrabarti, 1979); *Lagerstroemia speciosa* (L.) Pers. (= *Lagerstroemia flos-reginae* Retz.) (Raychaudhuri, 1973); *Lagerstroemia* sp. (Raychaudhuri, et al. 1980); *Lagerstroemia duperreana* Pierre ex Gagnep. (= *Lagerstroemia thorellii* Gagnep.) (Basu and Patro, 2007); *Lawsonia inermis* L. (= *Lawsonia alba* Lam.) (Singh et al., 1999); *Rotala* sp. (Rao, 1969); *Woodfordia fruticosa*

- (L.) Kurz (= *Woodfordia floribunda* Salisb.) (Maity and Chakrabarti, 1979); *Duabanga grandiflora* (Roxb. ex DC.) Walp. (= *Duabanga sonneratioides* Buch.-Ham.) (Ghosh, 1990).
56. Maesaceae (=Myrsinaceae) : *Maesa chisia* Buch.-Ham. ex D. Don (Raychaudhuri, 1973); *Maesa indica* (Roxb.) A. DC. (Raychaudhuri, 1973).
57. Magnoliaceae: *Magnolia champaka* (L.) Baill. ex Pierre (= *Michelia champaka* L.) (Raychaudhuri, 1978).
58. Malvaceae: *Abelmoschus esculentus* (L.) Moench (= *Hibiscus esculentus* L.) (Singh et al., 1999; Basu and Patro, 2007); *Abutilon indicum* (L.) Sweet (Verma et al., 1975); *Althaea rosea* Cav. (Singh et al., 1999); *Corchorus capsularis* L. (Basu and Banerjee, 1958); *Corchorus olitorius* L. (Basu and Banerjee, 1958); *Corchorus* sp. (Ganguli and Ghosh, 1965); *Gossypium arboreum* L. (= *Gossypium indicum* Medik.) (Shuja Uddin, 1978); *Gossypium barbadense* L. (Raychaudhuri, 1973); *G. herbaceum* L. *G. hirsutum* L. (Singh et al. 1999); *Gossypium* sp. (Basu and Banerjee, 1958); *Grewia asiatica* L. (Verma et al., 1975); *Helicteres isora* L. (Raychaudhuri et al., 1981); *Hibiscus cannabinus* L. *H. rosa-sinensis* L. (Singh et al., 1999); *H. sabdariffa* L. (Basu and Banerjee, 1958); *Hibiscus* sp. (Raychaudhuri et al., 1981); *Malachra capitata* (L.) L. (Raha, 1979); *Malva parviflora* L. (Behura, 1963); *Malva sylvestris* L. (Behura, 1963); *Malvastrum coromandelianum* (L.) Garcke (= *Malvastrum tricuspdatum* A. Gray) (David, 1957); *Malvaviscus conzattii* Grenm. (= *Malvaviscus conzonthiae* auct.) (Rao, 1969); *Sida acuta* Burm.f. (Rao, 1969; Raychaudhuri, 1978); *Sida cordifolia* L. (Agrawal et al., 2006); *Sida palmata* Cav. (Agarwala, 1979); *Sida rhombifolia* L. (Agarwala, 1979); *Sida* sp. (Ghosh and Agarwala, 1980).
59. Martyniaceae : *Martynia annua* L. (= *Martynia diandra* Gloxin) (Kar et al., 1990).
60. Melastomaceae: *Melastoma malabathricum* L. (Basu and Patro, 2007); *Osbeckia capitata* Benth. Ex Naudin (Raychaudhuri et al., 1981); *Osbeckia chinensis* L. (= *Osbeckia sinensis* auct. non.) (Devi et al., 2000); *Osbeckia crinata* Benth. (Rao, 1969); *Tibouchina roseotincta* Todzia (= *Tibouchina rosaeiformis* auct. nonn.) (Agarwala, 1979); *Tibouchina semidecandra* (Schrank and Mart. Ex DC.) Cogn. (Raychaudhuri, 1973).
61. Meliaceae: *Melia azedarach* L. (Bhagat, 1984, 2012).
62. Menispermaceae: *Cissampelos pareira* L. (Chakrabarti and Sarkar, 2001); *Cissampelos* sp. (Chakrabarti and Sarkar, 2001); *Stephania* sp. (Chakrabarti and Sarkar, 2001); *Tinospora* sp. (Shuja Uddin, 1973).
63. Moraceae: *Artocarpus integrifolia* L.f. (Singh and Raychaudhuri, 1987); *Ficus amplissima* Sm. (= *Ficus tsiela* Roxb.) (Behura, 1963); *Ficus benghalensis* L. (= *Ficus banyana* Oken.) (Behura, 1963); *Ficus heterophylla* L.f. (Raychaudhuri, 1973); *Ficus religiosa* L. (Joshi and Poorani, 2007); *Ficus* sp. (Raychaudhuri, et al. 1981); *Morus alba* L. (Behura, 1963); *Morus* sp. (Raychaudhuri, 1973).

64. Musaceae: *Musa paradisiaca* L. (Raychaudhuri, 1973); *Musa* sp. (Rao, 1969).
65. Myrtaceae: *Eucalyptus* sp. (Singh et al., 1999); *Eugenia michelii* Lam. (Behura, 1963); *Psidium guajava* L. (Singh et al., 1999); *Psidium* sp. (Agarwala and Raychaudhuri, 1979); *Syzygium cumini* (L.) Skeels (= *Eugenia jambolana* Lam.) (Basu and Patro, 2007).
66. Nyctaginaceae: *Boerhavia hispida* (Raychaudhuri, 1973); *Boerhavia repens* L. (Basu and Patro, 2007); *Bougainvillea glabra* Choisy (Behura and Roy, 1980); *Bougainvillea* sp. (Ghosh and Raychaudhuri, 1962); *Bougainvillea spectabilis* Willd. (Raha, 1979); *Mirabilis jalapa* L. (Raha, 1979).
67. Oleaceae: *Forsythia* sp. (Rishi, 1975); *Jasminum sambac* (L.) Aiton (Basu and Patro, 2007); *Nyctanthes arbor-tristis* L. (Joshi and Poorani, 2007).
68. Onagraceae: *Epilobium* sp. (Raychaudhuri, 1973); *Ludwigia parviflora* Roxb. (Ghosh, 1990); *Ludwigia peruviana* (L.) H. Hara (Raychaudhuri, et al., 1981); *Oenothera biennis* L. (Verma et al., 1975).
69. Orchidaceae: *Cypripedium* sp. (Raychaudhuri, 1973).
70. Oxalidaceae: *Oxalis* sp. (Raychaudhuri, 1973).
71. Palmae: *Cocos* sp. (Ganguli and Ghosh, 1965).
72. Papaveraceae: *Argemone mexicana* L. (Behura, 1965); *Papaver somniferum* L. (Singh et al., 1999).
73. Passifloraceae: *Passiflora edulis* Sims (Joy and Sherin, 2013).
74. Pedaliaceae: *Sesamum indicum* L. (= *Sesamum orientale* L.) (Rao, 1969).
75. Phyllanthaceae: *Glochidion heyneanum* (Wight and Arn.) Wight (= *Glochidion velutinum* Wight) (Kar et al., 1990).
76. Piperaceae: *Piper betle* L. (Joshi and Mathur, 1967).
77. Plantaginaceae: *Digitalis* sp. (Raychaudhuri, 1973); *Mecardonia procumbens* (Mill.) Small (= *Herpestis chamaedryoides* Small (Basu and Patro, 2007); *Plantago major* L. (Raychaudhuri, 1973); *Plantago ovata* Forssk. (Manikandan et al., 2006); *Russelia floribunda* Kunth (Basu and Patro, 2007).
78. Plumbaginaceae: *Plumbago zeylanica* L. (Bhagat, 2012).
79. Poaceae: *Apluda mutica* L. (Chakrabarti and Sarkar, 2001); *Aristida adscensionis* L. (Basu and Patro, 2007); *Arthraxon* sp. (Chakrabarti and Sarkar, 2001); *Bambusa bambos* (L.) Voss (= *Bambusa arundinacea* (Retz.) Willd.) (Agarwala, 1979); *Dichanthium annulatum* (Forssk.) Stapf. (Kar et al., 1990); *Eleusine coracana* (L.) Gaertn. (Raha, 1979); *Pennisetum purpureum* Schumach. (Nayak et al., 1982); *Saccharum officinarum* L. (Raychaudhuri, 1973).
80. Polygonaceae: *Antigonon leptopus* Hook. and Arn. (David, 1957); *Fagopyrum dibotrys* (D. Don) H. Hara (= *Fagopyrum cymosum* (Trev.) Meisn) (Raychaudhuri, 1973); *Fagopyrum esculentum* Moench (Chakrabarti and Sarkar, 2001); *Fagopyrum* sp. (Ghulam-Ullah, 1940); *Persicaria barbata*

- (L.) H. Hara (= *Polygonum barbatum* L.) (Raychaudhuri, 1973; Basu and Patro, 2007); *Persicaria capitata* (Buch.-Ham. ex D. Don) H. Gross (= *Polygonum capitatum* Buch.-Ham. ex D. Don) (Chakrabarti, 1972); *Persicaria nepalensis* (Meisn.) H. Gross (= *Polygonum nepalense* Meisn.) (Chakrabarti and Sarkar, 2001); *Persicaria orientale* (L.) Spatch (= *Polygonum orientale* L.) (Behura, 1965); *Persicaria pubescens* (Blume) H. Hara (= *Polygonum flaccidum* auct.) (Raychaudhuri, 1973); *Polygonum alatum* Buch.-Ham. ex D. Don (Raychaudhuri, 1973); *Polygonum flaccidum* Roxb. (= *Polygonum serrulatum* Lagasca) (Rao, 1969); *Polygonum runcinatum* Buch.-Ham. ex D. Don (Agarwala, 1979); *Polygonum* sp. (Raychaudhuri, et al. 1980); *Polygonum vulgaris* (Transy) (Chakrabarti, 1972); *Rumex nepalensis* Spreng. (Agarwala et al., 1981); *Rumex* sp. (Chakrabarti et al., 2002).
81. Portulacaceae: *Portulaca* sp. (Rao, 1969).
82. Punicaceae: *Punica granatum* L. (Ghosh, 1977).
83. Ranunculaceae: *Clematis buchananiana* DC. (Chakrabarti and Sarkar, 2001); *Clematis* sp. (Chakrabarti and Sarkar, 2001).
84. Rhamnaceae: *Rhamnus napalensis* (Wall.) M.A. Lawson (Raychaudhuri, 1973); *Rhamnus* sp. (Chakrabarti, 1972); *Rhamnus triqueter* (Wall.) M.A. Lawson (Chakrabarti and Sarkar, 2001).
85. Rosaceae: *Pyrus communis* L. (Basu and Banerjee, 1958); *Eriobotrya japonica* Lindl. (Kar et al., 1990); *Fragaria* sp. (Raychaudhuri, 1973); *Malus domestica* Borkh. (= *Pyrus malus* L.) (Basu and Banerjee, 1958); *Potentilla* sp. (Chakrabarti and Sarkar, 2001); *Prinsepia utilis* Royle (Raychaudhuri, 1973); *Prunus cerasoides* D. Don (= *Prunus puddum* (Rox. Ex Ser.)) (Raha, 1979); *Prunus cerasus* L. (Agarwala, 1979); *Prunus domestica* L. (Bhalla and Pawar, 1980); *Prunus dulcis* (Mill.) D.A. Webb. (= *Prunus amygdalus* Batsc) (Rao, 1969); *Prunus persica* (L.) Batsch (Ghosh and Raychaudhuri, 1981); *Prunus* sp. (Raychaudhuri, et al., 1980); *Pyrus pashia* Buch.-Ham. ex D. Don (Chakrabarti and Sarkar, 2001); *Pyrus* sp. (Bhalla and Pawar, 1980); *Rosa alba* L. (Verma et al., 1975); *Rosa canina* L. (Raychaudhuri, et al., 1981); *Rosa multiflora* Thunb. (Sathe and Jadhav, 2008); *Rosa* sp. (Behura, 1965); *Rubus ellipticus* Sm. (Ghosh and Agarwala, 1980); *Rubus moluccanus* L. (Rao, 1969); *Rubus* sp. (Shuja Uddin, 1973); *Spiraea cantoniensis* Lour. (Behura, 1965).
86. Rubiaceae: *Gardenia jasminoides* J. Ellis (= *Gardenia florida* L.) (Raychaudhuri, 1973); *Hedyotis scandens* Roxb. (Raychaudhuri, 1973); *Hedyotis* sp. (Raychaudhuri, 1973); *Ixora chinensis* Lam. (Raha, 1979); *I. coccinea* L. (Ghosh, 1970b); *Ixora* sp. (Singh et al., 1999); *Leptodermis griffithii* Hook.f. (Chakrabarti, 1972); *Leptodermis lanceolata* Wall. (Chakrabarti and Sarkar, 2001); *Mussaenda frondosa* L. (Agarwala, 1979); *Paederia foetida* L. (Raychaudhuri, 1973); *Paederia* sp. (Raychaudhuri, 1973); *Rubia cordifolia* L. (Chakrabarti, 1972); *Spermacoce articularis* L. f. (= *Spermacoca hispida* L.) (Agarwala, 1979); *Spermadictyon sauveolens* Roxb. (= *Hamiltonia sauveolens*

- auct. nonn.) (Maity and Chakrabarti, 1979); *Wendlandia glabrata* DC. (Raychaudhuri, 1978); *Wendlandia heynei* (Schult.) Santapau and Merchant (= *Wendlandia exserta* (Roxb.) DC.) (Basu and Patro, 2007).
87. Rutaceae: *Citrus aurantium* L. (Behura, 1963); *Citrus limon* (L.) Burm.f. (= *Citrus limonum* Risso) (Behura, 1965); *Citrus maxima* (Burm.) Merr. (= *Citrus decumana* L.) (Ghosh, 1990); *Citrus maxima* (Burm.) Merr. (= *Citrus grandis* Osbeck) (Konar and Paul, 2006); *Citrus maxima* (Burm.) Merr. (Chowdhuri et al., 1970); *Citrus paradise* Macfad. (Behura, 1965); *Citrus reticulata* Blaneo (Behura, 1965); *Citrus sinensis* Osbeck (Behura, 1965); *Citrus* sp. (Basu and Banerjee, 1958).
88. Salicaceae: *Populus* sp. (Singh et al., 1999).
89. Sapotaceae: *Manilkara jaimiqui* (L.) Cronquist (= *Achras zapota* L.) (Basu and Patro, 2007); *Manilkara zapota* (L.) P. Royen (= *Achras zapota* L.) (Behura, 1963) (David, 1958).
90. Scrophulariaceae: *Buddleja cystisoides* (Rao, 1969); *Buddleja asiatica* Lour. (Raychaudhuri, 1973); *Buddleja macrostachya* Benth. (Raychaudhuri, 1973).
91. Smilacaceae: *Smilax aspera* L. (Chakrabarti and Sarkar, 2001); *Smilax* sp. (Raychaudhuri et al., 1980).
92. Solanaceae: *Capsicum annum* L. *C. frutescens* L. (Singh et al., 1999); *Capsicum* sp. (Sengupta et al., 1962); *Cestrum diurnum* L. (David, 1957); *C. nocturnum* L. (Singh et al., 1999); *Cestrum* sp. (Raychaudhuri et al., 1980); *Datura metel* L. (= *Datura fastuosa* L.) (Raychaudhuri, 1973); *Datura* sp. (Ramaseshiah and Dharmadhikari, 1969); *Datura stramonium* L. (Chakrabarti, 1972); *Lycopersicon esculentum* Mill. (Singh et al., 1999); *Nicotiana* sp. (Chakrabarti, 1972); *Nicotiana tabacum* L. (Ghulam-Ullah, 1940); *Petunia* sp. (David, 1957); *Petunia ×atkinsiana* (Sweet) D. Don ex W. H. Baxter (= *Petunia ×hybrida* hort. ex E. Vilm.) (Basu and Patro, 2007); *Physalis peruviana* L. (Rao, 1969); *Solanum aethiopicum* L. (= *Solanum gilo* Raddi. *Solanum zuccagnianum* Dunal (Behura and Roy, 1980); *Solanum betaceum* Cav. (= *Cyphomandra betacea* (Cav.) Sendtn.) (Raychaudhuri, 1973); *S. citrullifolium* A. Braun. (Behura and Roy, 1980); *S. incanum* L. (Behura and Roy, 1980); *S. integrifolium* Poir (Behura and Roy, 1980); *S. lasiocarpum* Dunal (= *S. indicum* L.) (Behura, 1965); *S. melongena* L. *S. nigrum* L. (Singh et al. 1999); *S. quitoense* Lam. (Behura and Roy, 1980); *S. scabrum* Mill. (= *S. melanocerasum* All.) (Behura and Roy, 1980); *S. seafortianum* Andrews (David, 1958); *S. sisymbriifolium* Lam. (Raychaudhuri, 1973); *S. torvum* Sw. (Raychaudhuri et al., 1981); *S. trilobatum* L. (Behura and Roy, 1980); *S. tuberosum* L. (Singh et al., 1999); *S. virginianum* L. (= *S. xanthocarpum* Schrad. *S. surattense* Burm. f. (Ghosh, 1990); *S. wendlandii* Hook.f. (David, 1958). *Solanum* sp. (Agarwala and Raychaudhuri, 1979).
93. Sterculiaceae : *Abroma augusta* Linn. f. (Verma, 1971).
94. Symplocaceae : *Symplocos spicata* Roxb. (Raychaudhuri, 1973).

95. Ternstroemiaceae : *Eurya japonica* Thunb. (Raychaudhuri, 1973).
96. Theaceae : *Camellia sinensis* (L.) Kuntze (Chowdhuri et al., 1970); *Schima wallichii* (DC.) Korth. (Raychaudhuri, 1973).
97. Tropaeolaceae : *Tropaeolum majus* L. (Behura, 1965).
98. Ulmaceae : *Holoptelea integrifolia* (Roxb.) Planch. (David, 1956b).
99. Urticaceae : *Girardinia diversifolia* (Link) Friis (= *Girardinia heterophylla* (Decne.)) (Kar et al., 1990); *Gonostegia hirta* (Hassk.) Miq. (= *Pouzolzia hirta* Blume ex Hassk.) (Ghosh, A.K. and Agarwala, 1980); *Pilea macrocarpa* (L.) Liebm. (Agarwala, 1979); *Pouzolzia* sp. (Agarwala, 1979); *Urtica dioica* L. (Chakrabarti and Sarkar, 2001); *Urtica parviflora* Roxb. (Ghosh, 1977); *Urtica* sp. (Raychaudhuri et al., 1980).
100. Verbenaceae : *Duranta erecta* L. (= *Duranta plumieri* Jacq. *Duranta repens* L.) (Ghosh, A.K. and Raychaudhuri, 1962); *Duranta* sp. (Shuja Uddin, 1973); *Holmskioldia sanguinea* Retz. (Raychaudhuri, 1973); *Lantana camara* L. (Singh et al. 1999); *Lantana* sp. (David, 1957); *Lippia* sp. (Raha, 1979); *Stachytarpheta indica* (L.) Vahl (Basu and Patro, 2007); *Verbena officinalis* L. (Ghosh, 1977).
101. Violaceae: *Viola tricolor* L. (Behura, 1963).
102. Vitaceae: *Vitis vinifera* L. (Behura, 1963).
103. Zingiberaceae: *Curcuma longa* L. (= *Curcuma domestica* Velton) (Basu and Banerjee, 1958); *Elettaria cardamomum* (L.) Maton (Behura and Roy, 1980); *Zingiber officinale* Rosc. (Raychaudhuri, 1973).

ACKNOWLEDGMENT

The authors are thankful to Dr. L.K. Ghosh, ZSI, Kolkata; Prof. B.K. Agarwala, Tripura University, Agartala; Prof. T.K. Singh, Manipur University, Manipur; Prof. S. Chakrabarti, Kalyani University, Kalyani; Dr. M.E. Ahmad, T.M. University of Bhagalpur, Bhagalpur for providing us necessary literature.

REFERENCES

1. Agarwala B K (1979), "Some aspects of aphid (Homoptera : Insecta), studies in Sikkim and Bhutan", *Ph. D thesis University of Calcutta*, India, p. 383.
2. Agarwala B K (2007), "Phenotypic plasticity in aphids (Homoptera : Insecta) : Components of variation and causative factors", *Curr. Sci.* Vol. 93, pp. 308-313.
3. Agarwala B K and Das K (2007), "Host plant based morphological ecological and esterase variations in *Aphis gossypii* Glover populations (Homoptera : Aphididae)", *Entomon*, Vol. 32, No. 2, pp. 89-95.
4. Agarwala B K and Raychaudhuri D (1982), "Notes on some aphids affecting economically important plants in Sikkim", *Indian J. Agric. Sci.*, Vol. 51, pp. 690-692.
5. Agarwala B K and Raychaudhuri D N (1979), "Biotic potential of weeds in respect of *Aphis gossypii* Glover infesting some economic plants in Kalimpong West Bengal", *Indian Agric.*, Vol. 23, pp. 25-29.
6. Agarwala B K and Raychaudhuri D N (1980), "Parasites and predators of aphids in Sikkim and Manipur (northeast India) : III", *Entomon*, Vol. 5, pp. 39-42.

7. Agarwala B K and Raychaudhuri D N (1981a), "An account of aphids (Homoptera: Aphididae), "infesting the important economic plants in Sikkim", *Indian Agric.*, Vol. 25, pp. 101-107.
8. Agarwala B K and Raychaudhuri D N (1981b), "Note on some aphids affecting economically important plants in Sikkim", *Indian J. Agric. Sci.*, Vol. 51, pp. 690-692.
9. Agarwala B K and Raychoudhury P R (2009), "Host plant based biological variations in *Aphis gossypii* Glover populations (Homoptera : Aphididae)," *Entomon*, Vol. 34, pp. 57-60.
10. Agarwala B K and Raychoudhury P R (2013), "Host races of the cotton aphid *Aphis gossypii* in asexual populations from wild plants of taro and brinjal", *J. Insect Sci.*, Vol. 13, pp. 34. doi, pp. 10.1673/031.013.3401
11. Agarwala B K, Das K, Raychoudhury P R and Bhaumik P J (2007), "Polymorphism and phenotypic plasticity in aphids", *J. Aphidol.*, Vol. 21, pp. 1-10.
12. Agarwala B K, Ghosh D, Das S K, Poddar S C and Raychaudhuri D N (1981), "Parasites and predators of aphids (Homoptera : Aphididae) from India - 5. New records of two aphidiid parasites, nine arachnid and one dipteran predators from India", *Entomon*, Vol. 6, pp. 233-238.
13. Agrawal R, Singh K, Upadhyay BS and Singh R (2006), "New records of host plants of *Aphis gossypii* Glover 1877 (Homoptera : Aphididae) from northeastern Uttar Pradesh", *9th National Symposium on Recent Advances in Aphidology held at Banaras Hindu University Varanasi*, November 27-29, pp. 30-31.
14. Ahmad M E and Kumar K M (2006), "Food plants and natural enemies of *Aphis craccivora* Koch (Homoptera: Aphididae) in northeast Bihar", *J. Aphidol.*, Vol. 21, pp. 61-69.
15. Ahmed M E and Singh R (1994), "*Aphis gossypii* Glover on different food plants and its association with parasitoids and hyperparasitoids in Northeastern Uttar Pradesh", *Ann. Entomol.*, Vol. 12, pp. 63-67.
16. Banerjee H, Ghosh AK and Raychaudhuri D N (1969), "On a collection of aphids (Homoptera : Aphididae) from Kulu valley west Himalaya", *Orient. Ins.*, Vol. 3, pp. 255-264.
17. Banerjee S N and Basu AN (1955), "Aphididae of West Bengal", *Curr. Sci.*, Vol. 24, p. 61.
18. Basu AN and Banerjee S N (1958), "Aphids of economic plants of West Bengal", *Indian Agric.*, Vol. 2, pp. 89-112.
19. Basu M and Patro B (2007), "New records of host plants and natural enemies of *Aphis gossypii* Glover (Aphididae : Homoptera) from Orissa India", *J. Plant Prot. Environ.*, Vol. 4, No. 2, pp. 74-80.
20. Behura B K and Roy D K (1980), "Host plants of *Aphis gossypii* Glover", *News Letter Aphidol. Soc. India*, Vol. 1(2), pp. 3.
21. Behura B K (1963), "Aphids of India", Survey of published information Recent Adv. Zool. India 1961, pp. 25-78.

22. Behura B K (1965) (1963), "Suppliment to aphids of India - a survey of published information", *Prakruti - J Utkal. Univ. Sci.*, Vol. 3, pp. 40-65.
23. Bhagat R C (1984), "New records and hosts of aphid parasitoids (Hymenoptera : Aphidiidae) from Kashmir India", *J. Bombay Nat. Hist. Soc.*, Vol. 81, pp. 93-98.
24. Bhagat R C (2012), "Aphids (Insecta) damaging medicinal and aromatic plants of Jammu and Kashmir State (India) : an updated checklist and biodiversity", *Indian J. Appl. & Pure Biol.*, Vol. 27, No. 1, pp. 1-10.
25. Bhalla O P and Pawar AD (1980), "A survey of insect and non-insect pests of economic importance in Himachal Pradesh", *Department of Entomology and Zoology College of Agriculture Chambaghat Solan (HP)*.
26. Bhalla O P (1971), "Addition to the aphid fauna of Himachal Pradesh", *Himachal J. Agric. Res.*, Vol. 1, pp. 51 -52.
27. Blackman R L and Eastop V F (2000), "*Aphids on the World's Crops, An Identification Guide*", 2nd ed. Wiley New York.
28. Brevault T, Carletto J Linderme D and Vanlerberghe-Masutti F (2008), "Genetic diversity of the cotton aphid *Aphis gossypii* in the unstable environment of a cotton growing area", *Agric. and Forest Entomol.*, Vol. 10, pp. 215–223.
29. Butani D K and Jotwani. M G (1983), "Insects as a limiting factor in vegetable production", *Pesticides*, Vol. 17, No. 9, pp. 6-15.
30. Carletto J, Lombart E, Chavigny P, Brevault T, Lapchin L and Vanlerberghe-Masutti F (2009), "Ecological specialization of the aphid *Aphis gossypii* Glover on cultivated host plants", *Molec. Ecol.*, Vol. 18, pp. 2198–2212.
31. Chakrabarti S (1972), "Aphids of north western India with special reference to Kumaon range Uttar Pradesh", *Ph. D thesis. University of Calcutta*, India pp. 435.
32. Chakrabarti S and Sarkar A (2001), "A supplement to the food-plant catalogue of Indian Aphididae", *J. Aphidol.*, Vol. 15, pp. 9-62.
33. Chakrabarti S, Sarkar S and Das B C (2002), "Aphid parasitoids (Hymenoptera : Braconidae, Aphidiinae) from western Himalaya", *J. Aphidol.*, Vol. 16, pp. 45-49.
34. Chatterjee N B, Ghosh A K and Raychaudhuri D N (1961), "Aphids of Manipur State", *Indian Agric.*, Vol. 5, pp. 87-88.
35. Chowdhuri A N, Ghosh A K, Banerjee H and Raychaudhuri D N (1970), "A few sexual forms and seven newly recorded species of aphids (Aphididae : Homoptera) from Simla", *Sci. and Cult.*, Vol. 36, pp. 550.
36. Chowdhuri A N, Basu R C, Chakrabarti S and Raychaudhuri D N (1969), "Aphids (Homoptera) of Himachal Pradesh India", *Orient. Ins.*, Vol. 3, pp. 83-92.
37. David S K (1956a), "Taxonomic notes on six species of Mysore aphids described as new by Theobald in 1929", *Indian J. Ent.*, Vol. 18, pp. 141-145.
38. David S K (1956b), "Additional notes on some aphids in Madras State", *Madras*

- Agric. J.*, Vol. 43, pp. 103-107.
39. David S K (1957), "Notes on South Indian Aphids. III Lachninae to Aphidinae (part)", *Indian J. Ent.*, Vol. 19, pp. 171-180.
 40. David S K (1958), "Some rare Indian Aphids", *J. Bombay nat. Hist. Soc.*, Vol. 55, pp. 110-116.
 41. Despande V G (1938), "A preliminary account of the Aphididae of Poona", *J. Bombay nat. Hist. Soc.*, Vol. 39, pp. 740-744.
 42. Devi C M, Singh T K and Nilamani L (2000), "Aphidicolous ants (Hymenoptera, pp. Formicidae) of Manipur Subfamily – Formicinae", *J. Adv. Zool.*, Vol. 21, pp. 102-103.
 43. Dhamdhare S and Mathur R (1994), "Efficacy of some foliar insecticides against *Aphis gossypii* Glover infesting brinjal", *J. Entomol. Res.*, Vol. 18, pp. 283-285 .
 44. Elmer H S and Brawner O L (1975), "Control of brown soft scale in central valley", *Citrograph*, Vol. 60, No. 11, pp. 402-403.
 45. Francki R I B, Mossop D W and Hatta T (1979), "Cucumber mosaic virus", CMI/AAB Description of plant viruses No. 231.
 46. Fuchs T W and Minzenmayer R (1995), "Effect of *Aphis gossypii* on cotton development and yield in West Texas", *Southwest. Ent.*, Vol. 20, pp. 341-349.
 47. Fuchsberg J R, Yong T H, Losey J E, Carter M E and Hoffmann M P (2007), "Evaluation of corn leaf aphid (*Rhopalosiphum maidis*; Homoptera : Aphididae) honeydew as a food source for the egg parasitoid *Trichogramma ostrinia* (Hymenoptera : Trichogrammatidae)", *Biol. Contr.*, Vol. 40, pp. 230-236.
 48. Ganguli R N and Ghosh M R (1965), "A notes on the aphids of economically importance in Tripura", *Sci. Cult.*, Vol. 31, pp. 541-542.
 49. Garzo E I, Díaz B, Duque M and Fereres A (2003), "Settlement rate of *Aphis gossypii* (Homoptera : Aphididae) and transmission efficiency of cucumber mosaic virus in melons protected with kaolin-particle films. *Spanish J Agric. Res.*, Vol. 1, No. 4, pp. 65-71.
 50. George C J (1927), "South Indian Aphididae", *J. Asiatic. Soc. Bengal* (N. S.), Vol. 23, pp. 1-12.
 51. Ghosh A K and Agarwala B K (1980), "Weed hosts of major aphid (Homoptera : Insecta) pests in India region", *Indian Agric.*, Vol. 24, pp. 101-107.
 52. Ghosh A K and Raychaudhuri D N (1962), "A preliminary accounts of the bionomics and taxonomy of aphids from Assam", *J. Bombay nat. Hist. Soc.*, Vol. 59, pp. 238-253.
 53. Ghosh A K and Raychaudhuri D N (1963), "Additions to the aphid fauna of Assam", *Sci. and Cult.*, Vol. 29, pp. 104.
 54. Ghosh A K and Raychaudhuri D N (1968), "Aphids (insecta, pp. Homoptera) of Sikkim", *Proc. zool. Soc. Calcutta*, Vol. 21, pp. 179-195.
 55. Ghosh A K (1974), "New species and new records of aphids (Homoptera : Aphididae) from Northeast India", *Orient. Insects*, Vol. 8, pp. 161-175.

56. Ghosh L K (1969), "On a collection of aphids (Homoptera : Aphididae) from Uttar Pradesh, India", *Sci. and Cult.*, Vol. 35, pp. 493-494.
57. Ghosh L K (1970a), "Aphids of NEFA India (Homoptera: Aphididae)", *Sci. and Cult.*, Vol. 36, pp. 562-563.
58. Ghosh L K (1970b), "A note on the preliminary survey of aphids (Homoptera) from Bihar India", *Sci. and Cult.*, Vol. 36, pp. 419-420.
59. Ghosh L K (1977), "A study on the aphids (Homoptera : Aphididae) of Himachal Pradesh in North-West Himalaya India", *Ph. D thesis University of Calcutta. India*, p. 360.
60. Ghosh L K (1986), "A Conspectus of Aphididae (Homoptera) of Himachal Pradesh in Northwest Himalaya India", *Zoological Survey of India. Tech. Mon. No.* 16, pp. 16-182.
61. Ghosh L K (1990), "A taxonomic review of the genus *Aphis* Linnaeus in India (Homoptera : Aphididae)", *Mem. Zool. Surv. India*, Vol. 17, pp. 159 pp.
62. Ghosh L K (1997), "Hemiptera", In *Fauna of Delhi. State Fauna Series Zool. Surv. India, Part 6*, pp. 215-260.
63. Ghosh L K and Basu R C (1994), "*Fauna of West Bengal, Zoological Survey of India Calcutta*", Part 5, pp. 125-318.
64. Ghosh M R and Raychaudhuri D N (1981), "Aphids (Homoptera : Aphididae) infesting rosaceous fruit plants in Darjeeling district of West Bengal and Sikkim", *Entomon*, Vol. 6, pp. 61-68.
65. Ghulam-Ullah (1940), "Studies of Indian Aphididae – I, The Aphid fauna of Delhi", *Indian J. Ent.*, Vol. 2, pp. 13-25.
66. Gill C K and Singh S (1997), "Effect of insecticides on the retention of cucumber mosaic virus by *Aphis gossypii* glover on muskmelon", *J. Aphidol.*, Vol. 11, No. 12, pp. 201-204.
67. GRIN (2013), "U. S. Department of Agriculture's Agricultural Research Service Germplasm Resources Information Network", [http, pp. //www.ars-grin.gov](http://www.ars-grin.gov)
68. Guildemond J A, Tigges W T and Vrijer P W Fde (1994), "Host races of *Aphis gossypii* (Homoptera : Aphididae) on cucumber and chrysanthemum", *Env. Ent.*, Vol. 23, No. 5, pp. 1235-1240.
69. Gupta M P, Sharma S and Shrivastava S K (1997), "Population build-up of some sap sucking insects on cotton in Madhya Pradesh", *J. Insect Sci.*, Vol. 10, No. 2, pp. 153-156.
70. Harris F A, Andrews G L, Caillavet D F and Furr Jr. R E (1992), "Cotton aphid effect on yield quality and economics of cotton", *Proceedings 1992 Beltwide Cotton Conf. National Cotton Council Memphis TN*, pp. 652-656.
71. Jha Y G (1998), "Host plants of aphids (Homoptera : Aphididae) from Ranchi districts of Chhota Nagpur plateau (Bihar). In *Advances in Zoology Environmental Degradation and Biodiversity* (Eds. Pandey B N and Singh B K)", *10th All India Congress of Zoology. Daya Publishing House New Delhi 14th-18th October 1998*. pp. 91-94.

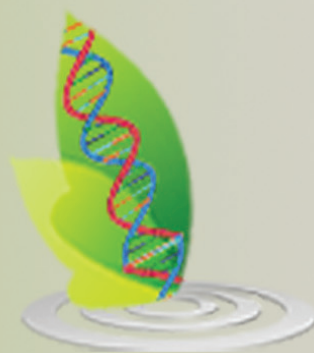
72. Jhansi K and Subbaratnam G V (2005), "Relative Toxicity of Selected Insecticides to Cotton Aphid, *Aphis gossypii* Glover in Andhra Pradesh", *Indian J. Plant Prot.*, Vol. 33, No. 2, 292-293.
73. Joshi HC and Mathur Y K (1967), "Aphids of Rajasthan", *Madras Agric. J.*, Vol. 54, pp. 239-243.
74. Joshi S and Poorani J (2007), "Aphids of Karnataka", URL, www.aphidweb.com
75. Joy P P and Sherin C G (2013), "Insect pests of passion fruit (*Passiflora edulis*) hosts damage natural enemies and control", [http, pp. //kau.edu/prsvkm/Docs/InsectPestsOf PassionFruit.pdf](http://kau.edu/prsvkm/Docs/InsectPestsOfPassionFruit.pdf)
76. Kandoria J L, Jamwal R and Singh G (1989), "Seasonal activity and host range of *Aphis gossypii* Glover in Punjab", *J. Ins. Sci.*, Vol. 2, pp. 68-70.
77. Kar I, Basu G and Khuda-Bukhsh A R (1990), "A Check-list of chromosomes in aphids (Homoptera : Aphididae) worked out in India along with the names and families of their host plants", *Env. and Ecol.*, Vol. 8, No. 1, pp. 414-428.
78. Karim K N S, Das BC and Khalequzzaman M (2002), "Impact of ecological factors on the morphology of *Aphis gossypii* Glover (Homoptera : Aphididae) at Rajshahi Bangladesh", *Pakistan Ent.*, Vol. 24, No. 1, pp. 1-22.
79. Konar A and Paul S (2006), "Studies on pattern of some aphid species on *Citrus grandis* L. in plains of West Bengal. 9th National Symposium on Recent Advances in Aphidology held at Banaras Hindu University Varanasi. November 27-29, pp. 54-56.
80. Krishnamurthi B (1929), "Aphididae of Mysore-II", *Bombay nat. Hist. Soc.*, Vol. 33, pp. 211-215.
81. Krishnamurthi B (1948), "Aphididae of Mysore-III", *Indian J. Ent.*, Vol. 10, pp. 51-53.
82. Kulkarni P P and Rao S N (1980) (1981), "Studies on the aphid fauna (Homoptera : Aphididae) from Marathwada (Maharashtra) – I. Description of a new species and records of three species", *Marathwada Univ. J. Sci. (Biol. Sci.)*, Vol. 19, No. 12, pp. 11-17.
83. Kulkarni R D, Kale GB and Bhamare V K (2008), "Seasonal activity of some important sucking pests on some varieties of cotton in Chhattisgarh India", *Internat. J. Plant Sci. Muzaffarnagar*, Vol. 3, No. 1, pp. 303-304.
84. Layton M B, Smith H R and Andrews G L (1996), "Cotton aphid infestations in Mississippi, efficacy of selected insecticides and impact on yield", In *Proceedings 1996 Beltwide Cotton Conf. National Cotton Council Memphis TN*, pp. 892-893.
85. Lefroy H M and Howlett FM (1909), "*Indian Insect Life. A manual of the insects of the plains (Tropical India)*", W. Thacker and Co. London, pp. 743- 748.
86. Liu J, Kong-ming W U, Kui-jun Z and Yu-yuan G (2003), "Morphological variation of growth and development in *Aphis gossypii* Glover collected from different climatic

- zones", *Cotton Sci.*, Vol. 15, No. 1, pp. 13-16.
87. Liu X D, Zhai B, Zhang X and Lu Y (2004), "Differentiation in morphometrics and ecological adaptability of cotton and cucumber biotypes of the cotton aphid *Aphis gossypii* (Homoptera : Aphididae)", *Acta Ent. Sinica*, Vol. 47, No. 6, pp. 768-773.
88. Liu X D, Zhang X X and Zhai B P (2002), "On the variation law of body color and reproductive characteristics of cotton aphid *Aphis gossypii* Glover (Homoptera : Aphididae) possessing different body-color", *Acta Phytophyl. Sinica*, Vol. 29, No. 2, pp. 153-157.
89. Liu Y C, Kuo M H and Yang S C (2000), "The development fecundity and life table of *Aphis gossypii* Glover on lily", *Plant Prot. Bull. Taipei*, Vol. 42, No. 1, pp. 1-10.
90. Maity S P and Chakrabarti S (1979), "Aphids (Homoptera : Aphididae) of northwest India. III. Records of new aphids from Garhwal Himalaya", *Sci. and Cult.*, Vol. 45, pp. 160-162.
91. Manikandan R, Singh A K and Singh H M (2006), "Bionomics of *Aphis gossypii* Glover on isabgol (*Plantago ovata* F.)", *9th National Symposium on Recent Advances in Aphidology held at Banaras Hindu University Varanasi*. November 27-29, pp. 58-59.
92. Margaritopoulos J T, Tzortzi M, Zarpas K D, Tsitsipis J A and Blackman R L (2006), "Morphological discrimination of *Aphis gossypii* (Homoptera : Aphididae) populations feeding on Compositae", *Bull. Ent. Res.*, Vol. 96, No. 2, pp. 153-165.
93. Mendoza A H, Pina J A, Ballester-Olmos J F and Navarro L (1987), "Persistent transmission of citrus vein enation virus by *Aphis gossypii* and *Myzus persicae*. Other virus diseases Twelfth ZOCV Conference", pp. 361-363.
94. Miyazaki M (2001), "Important aphid vectors of fruit tree virus diseases in tropical Asia. *Food and Fertilizer Technology Center (FFTC)*, www.ffc.org.
95. Mohandas K, Mathew G and Anand G (2000), "Incidence of the cotton aphid *Aphis gossypii* Glover (Homoptera : Aphididae) on teak inflorescence in Kerala", *Ann. Forestry*, 8(2), pp. 289-290.
96. Mokhtar A M, Polgar L and Lucas S (1993), "Morphological characteristics and host preference of anoholocyclic forms of *Aphis gossypii* Glover (Homoptera : Aphididae) originated from Egypt Hungary and Sultanate of Oman", in *Critical Issues in Aphid Biology*, Kindlmann P and Dixon A F G (Eds.), pp. 89-94.
97. Nayak M R C, Basu M and Raychaudhuri D N (1982), "Parasites and predators of aphids (Homoptera : Aphididae) from India:", *Pranikee*, Vol. 3, pp. 7-14.
98. Nevo E and Coll M (2001), "Effect of nitrogen fertilization on *Aphis gossypii* (Homoptera : Aphididae) variation in size color and reproduction", *J. Econ. Ent.*, Vol. 94, No. 1, pp. 27-31.
99. Patil S J and Patel B R (2013), "Biology of aphid *Aphis gossypii* Glover (Homoptera :

- Aphididae) infesting isabgol crop”, *Med. Plant Res.*, Vol. 3, No. 7, pp. 52-56.
100. Raha S K and Raychaudhuri D N (1981), “Studies on the aphids of Nagaland”, *Entomon*, Vol. 6, pp. 317-323.
101. Raha S K (1979), “Studies on the aphids (Homoptera : Insecta) of Nagaland”, *Ph. D thesis University of Calcutta*, India, pp. 212.
102. Ramaseshiah G and Dharmadhikari P R (1969), “Aphidiid parasites of aphids in India”, *CIBC Tech. Bull.*, No. 11, pp. 156-164.
103. Rao S N and Kulkarni P P (1972), “New records of aphids (Homoptera : Aphididae) from Marathwada (Maharashtra state). *Part I Marathwada Univ. J Nat. Sci.*, Vol. 19, pp. 287-288.
104. Rao V P (1969), “Survey for natural enemies in India”, *CIBC Indian Station U S PL 480 Project Final Tech. Rep.*, pp. 1-93.
105. Raychaudhuri D (1978), “Taxonomy and biology of aphids (Homoptera : Aphididae) of Manipur”, *Ph. D thesis University of Calcutta, India*, pp. 308+XVI.
106. Raychaudhuri D N and Ghosh A K (1959), “A preliminary account of aphids of Rajasthan”, *Indian Agric.*, Vol. 3, pp. 17-22.
107. Raychaudhuri D N (1973), “Taxonomy of the aphids of the Eastern Himalayas”, *US PI 480 Project Tech. Report*, pp. 107.
108. Raychaudhuri D N (1980)(ed.), “*Aphids of North-East India and Bhutan*”, Zoological Society Calcutta, p. 521.
109. Raychaudhuri D N (1983)(ed.), “*Food Plant Catalogue of Indian Aphididae*”, Graphic Printall Culcutta (India), p. 204.
110. Raychaudhuri D N, Ghosh D, Raychaudhuri D and Agarwala B K (1981), “Studies on the aphids (Homoptera : Aphididae) from south India. I. *Ins. Matsum. n. s.* Vol. 23 , pp. 1-20.
111. Raychaudhuri D N, Ghosh L K and Das S K (1980), “Studies on the aphids (Homoptera : Aphididae) from north and northwest India-I. *Ins. Matsum. n. s.*, Vol. 20, pp. 1-42.
112. Rishi N D (1975), “Aphids (Hemiptera : Aphididae) of Jammu & Kashmir”, *Symposium on Recent Trends in Aphidological Studies, Bhubaneswar*, p. 52.
113. Rizvi S M A and Paul Khurana S M (1970), “Aphid fauna of economic crop plants in Gorakhpur”, *Sci. and Cult.*, Vol. 36, pp. 49.
114. Rohfritsch O (1990), “Aphid stylet movement and host-plant reaction in the case of Adelgidae on spruce; In *Aphid-Plant Genotype Interaction*, (eds.) Campbell R K and Eikenbary R D”, Elsevier Science Publishing Company Inc. New York Nymph, pp. 101-116.
115. Sathe T V and Jadhav B V (2008), “Indian Pest Aphids”, Daya Publishing House New Delhi pp. 211.
116. Sen A K, Bhattacharya A and Srivastava S C (1987), “Record of *Aphis craccivora* Koch and *Aphis gossypii* Glover (Fam. Aphididae) on *Moghania macrophylla* a host plant of lac insect”, *Entomon*, Vol. 12, pp. 229.
117. Sengupta G C, Das J N and Behura B K (1962), “A preliminary account of the aphids of Orissa”, *Prakruti - J Utkal Univ. Sci.*, Vol. 2, pp. 33-39.

118. Shuja Uddin (1973), "Three species of *Trioxys* Haliday (Hymenoptera : Aphidiidae) recorded from India", *Indian J. Ent.*, Vol. 35, pp. 9-14.
119. Shuja Uddin (1978), "New records of *Adialytus* Forster (Hymenoptera : Aphidiidae) from India with comments on the validity of the genus", *J. Ent. Res.*, Vol. 2, pp. 160-162.
120. Singh L S, Bijaya P, Shantibala K and Singh T K (1995), "Population trends of *Aphis gossypii* Glover on *Quercus serrata* Thunberg in Manipur", *J. Aphidol.*, Vol. 9, pp. 68-70.
121. Singh O L and Singh T K (1986), "The aphids (Homoptera : Aphididae) of Mizorum, In *Aphidology in India*, (ed.) Agarwala B K, *Proceedings of the National Symposium of Aphidology in India held at Agartala 2-4 Nov. 1985* pp. 71-73.
122. Singh R, Upadhyay B S, Singh D and Chaudhary H C (1999), "Aphids (Homoptera : Aphididae) and their parasitoids in North-Eastern Uttar Pradesh", *J. Aphidol.*, Vol. 13, pp. 49-62.
123. Singh T K and Raychaudhuri D (1987), "Aphids and their coccinelid predators of fruit trees in Manipur northeast India", *J. Aphidol.*, Vol. 1, pp. 78-79.
124. Starý P and Ghosh A K (1975), "Aphid parasites (Hymenoptera : Aphidiidae) from Meghalaya India", *Orient. Ins.*, Vol. 9, pp. 343-349.
125. Sundararaj R and Murugesan S (1997), "Incidence of *Aphis gossypii* Glover and *Aphis citricola* van der Goot (Aphididae : Homoptera) as pests on rohida [*Tecomella undulata* (Sm) Seem] in Inidan arid zone", *Ann. Forestry*, Vol. 5, No. 2, pp. 211-212.
126. Takada H and Murakami Y (1988), "Esterase variation and insecticide resistance in Japanese *Aphis gossypii*", *Entomol. Exp. Appl.*, Vol. 48, pp. 37-41.
127. Verma A N, Khurana A D and Bhanot J P (1975), "Aphids of Hissar (Haryana)", *Haryana Agric. Univ. J. Res.*, Vol. 5, pp. 11-14.
128. Verma K D (1971), "Additional records of Jammu and Kashmir aphids", *Sci. and Cult.*, Vol. 37, pp. 248-249.
129. Wall R E (1933), "A study of colour and colour-variation in *Aphis gossypii* Glover", *Ann. Ent. Soc. Amer.*, Vol. 26, No. 3, pp. 425-463.
130. Watt M and Hales D F (1996), "Dwarf phenotype of the cotton aphid *Aphis gossypii* Glover (Hemiptera : Aphididae)", *Aust. J Ent.*, Vol. 35, pp. 153-159.
131. Wool D and Hales D (1996), "Components of variation of morphological characters in Australian *Aphis gossypii*, host-plant effects predominate", *Ent. Exp. Appl.*, Vol. 80, pp. 166-168.
132. Wool D, Hales D and Sunnucks P (1995), "Host plant relationships of *Aphis gossypii* Glover (Hemiptera : Aphididae) in Australia", *J. Aust. Ent. Soc.*, Vol. 34, No. 3, pp. 265-271.
133. Yuan G H, Peng H, Pan M, Han X and Fan S P (2002), "Study on the body colour differentiation of *Aphis gossypii* from different hosts", *J. Henan Agric. Univ.*, Vol. 36, No. 1, pp. 10-40.

134. Zhang G X and Zhong T S (1990), "Experimental studies on some aphid life cycles and the hybridization of two sibling species. In *Aphid-Plant Genotype Interactions* (eds.) Campbell R K and Eikenbary R D)", Elsevier, pp. 37–50.
135. Zhao J Y, Zhang X X, Zhang G X and Chen X F (2002), "Studies on numerical taxonomy for intraspecies differentiation of cotton aphids *Aphis gossypii* Glover", *Acta Ent. Sinica* 45(Supplement), pp. 123-127.



International Journal of Life Sciences Biotechnology and Pharma Research

Hyderabad, INDIA. Ph: +91-09441351700, 09059645577

E-mail: editorijlbpr@gmail.com or editor@ijlbpr.com

Website: www.ijlbpr.com

