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SURVEY OF WHITEFLIES (*BEMISIA TABACI* GENNADIUS) TRANSMITTING VIRUS DISEASES OF VEGETABLES IN MINNA, NORTHERN NIGERIA

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ABSTRACT

Distribution and abundance of whitefly, Bemisia tabaci (Gennadius) (Homoptera: Aleyrodidae) in pepper (Capsicum annuum L.) and tomato (Lycopersicon esculentum Mill) fields was studied in Minna (9 ° 37′ N; 6 ° 33′ E; 1475 m above sea level) northern Nigeria. Pepper and tomato fields were surveyed from March to July, 2009 at Bosso Chanchaga and Sabondaga. Results indicated that whiteflies were prevalent in the study area. B. tabaci population was significantly (P<0.01) higher in tomato compared with pepper fields across the study area. In pepper fields, there were no significant (P>0.05) differences in insect density across the locations. In tomato field, however, substantial population variation existed. Although there were no significant differences in insect number across the months, in pepper fields, whitefly population peaked in June while the lowest density was observed in May. Conversely, in tomato fields the highest population of B. tabaci was observed in May but the lowest occurred in June Symptoms of virus infection such as leaf curling and chlorosis, stunting, and poor yield were evident on heavily infested plants. Integrated pest management could be employed to reduce whitefly population below economic injury level.

Key words: ***Bemisia tabaci*****, pepper, tomato, abundance, distribution.**

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INTRODUCTION

Production of vegetables such as pepper (*C.annuum*) and tomato (*L. esculentum*) is very important in sub-Saharan Africa (SSA). These crop species are sources of vitamins and mineral essential for maintenance of good health and prevention of diseases (Hill and Waller, 1988; Schippers, 2002). In the year 2008 about 0.7 and 1.7 million tonnes of pepper and tomato, respectively were produced in Nigeria, accounting for 27.7 and 13.6 %, respectively of the total output in Africa (FAO, 2010). Although productivity of these vegetables is threatened by numerous insect pests whitefly, *Bemisia tabaci* Gennadius infestation causes the most considerable damage (De Barro *et al.*, 2000).

Whitefly belongs to the order Homoptera, family Aleyrodidae. An adult *B. tabaci* is about 1 mm long. The wings are held tent-like above the body and slightly apart, revealing the yellow tinged body. Adult female oviposits randomly on leaf surfaces (Gill, 1990). Eggs are normally laid on the younger leaves, at the apical part of the infested plants (Leite, 2006). The developmental time of whitefly from egg to adult is greatly influenced by the host plant and weather conditions (Coudriet *et al.*, 1985;Leite, 2006). When these conditions are favourable about 10 – 11 generations can be completed in a year and the insect overseasons as larvae, pupae or adults (Lanjar and Sahito, 2007). Studies have indicated that morphologically indistinguishable populations with different biological traits exist within the whitefly complex (Abdullahi *et al.*, 2003). Conversely, variants of *B. tabaci* differ with respect to host range, dispersal behaviour and competence for virus transmission (Berry *et al.*, 2004).

Whitefly is polyphagus (Frohlich *et al.*, 1999) and widely found in tropical and subtropical regions (Delatte *et al.*, 2005) on cultivated and wild plants (Alegbejo and Banwo, 2005; Lanjar

Sahito, 2007). These include plants in the ...ilies Amaranthaceae (*Amaranthus* sp.), ...eraceae (*Ageratum conyzoides* L.), ...icaceae (*Carica papaya* L.), Compositae ...ctuca *sativus* L.), Convolvulaceae (*Ipomea* ...atas L.), Cruciferae (*Brassica* sp.), ...urbitaceae (*Telfaria occidentalis* Hook F), ...phorbiaceae (*Manihot esculenta* Grantz), ...guminosae (*Arachis hypogaea* L.), Malvaceae ...elmoschus *esculentus* L.), Myrtaceae ...idium *guajava* L.), Pedaliaceae (*Sesamum* ...icum L.), Solanaceae (C. *annuum*), and ...aceae (*Corchorus olitorius* L.) (Alegbejo and ...nwo, 2005). Undoubtedly, whitefly is a major ...st of vegetables causing both direct and ...irect damage (Nyoike *et al*., 2008). The ...gnitude of infestation and the nature of extent ... injury vary with plant species, season and ...calities (Lanjar and Sahito, 2007). Generally, ...avy infestation reduces plant vigor and growth. ...lditionally, leaf chlorosis and uneven ripening of ...iits have been reported. Prolonged feeding ...eates physiological imbalance which ...ulminates in loss of immature fruiting parts. ...urthermore, whitefly nymph produces honey ...ew which encourages mould growth and retards ...hotosynthesis ((Jones, 2003). In cultivated ...ants the insect is an important vector of > 110 ...ant viruses. For example in pepper and tomato, ... *tabaci* transmits *Pepper leaf curl virus* and ...*omato yellow leaf curlbegomovirus*, respectively ...Fauquet*et al*., 2003; Salaudeen *et al*., 2009).

Management of whiteflies is extremely ...ifficult due to their remarkable plasticity. This ...ncludes rapid development of resistance to ...nsecticides, adaptation to wide range of ...geographical ecologies, and emergence of ...several races or biotypes. Cultural control is one ...option that has delivered result. This involves the ...use of windbreaks around the crop to restrict ...whitefly movement; observing crop free periods, ...manipulation of planting dates, crop rotation and timely weed control (Hilje *et al*., 2001). Biological control such as use of parasites and parasitoids is also effective (Urbaneja *et al*., 2002). Alternatively, systemic insecticides can be used to reduce high population of the insect. In view of the cosmopolitan nature of *B. tabaci* and several plant viruses it transmits this study was conducted to determine its abundance and distribution in Minna.

MATERIALS AND METHODS

Study area and collection of whiteflies: Pepper and tomato fields were surveyed for whiteflies on weekly basis at three locations (Bosso, Chanchaga, and Sabondaga) in Minna from March to June, 2009. Minna lies on latitude 9 ° 37′ North and longitude 6 ° 33′ East of the equator. It falls within the Southern Guinea Savanna vegetation with a sub-humid climate. The mean annual rainfall of 1102.6 to 1361.7 mm (Kolo and Mohammed, 2006) is distributed between April and October followed by a 5-month period of dry season. Farms where pepper and tomato are widely grown were visited. Surveys were conducted in the morning when the insects were less active. In each location five fields were visited. Ten plants were randomly sampled per field. The number of adult whiteflies per plant was determined `by *in situ* counting. This was accomplished by gently turning a leaf and counting the number of *B. tabaci*. Farmers were interviewed in order to obtain information on the cropping history, insect pest infestation and control measures commonly adopted. Data were analyzed using graphs, general linear model and independent *t* – test. Significance was determined at 5 % level of probability. Data analyses were performed using statistical analysis system (SAS Institute, 2008).

RESULTS

Generally, production was both by rainfed and irrigation methods. Most of the farmers cultivated 1 to 3 hectares (data not shown) with pepper and/or tomato. Whiteflydensity was significantly (P<0.01) higher in tomato compared to the pepper fields (Fig. 1).In pepper fields *B. tabaci*population peaked in June (800) while the lowest (500) occurred in May. Conversely, In tomato fields, the whitefly maximum density was found in May (3080) with the lowest (2400) in June. In pepper fields the differences in the density of whiteflies across the study area were not significant (P>0.05). In March, *B. tabaci* population was 650 in pepper fields but fell to 600 and 500 in April and May, respectively. However, whitefly population peaked in June with a total of 800 (Fig 1.). Of the 650 insects counted on pepper plants in March 15.4 % was recorded at Bosso while 46.2 % was found in Chanchaga. Conversely, it was 38.5 % at Sabondaga (Fig. 2A). In the following month whitefly population totaling 600 was distributed into 50, 16.7, and 33.3 % at Bosso, Chanchaga, and, Sabondaga, respectively (Fig. 2B). Of the 500 whiteflies counted across the study area in May, infestation was lowest (20 %) at Bosso and Sabondaga (20 %) while the highest (60 %) insect pest attack was found at Chanchaga (Fig. 2C). In June, whitefly population peak was 800 in pepper fields across the study area. Of this the lowest (18.8 %) and highest (43.8 %) infestation occurred at Bosso and Sabondaga, respectively. At Chanchaga whitefly infestation of 37.5 % was observed (Fig. 2D). The study also revealed wide spread of the typical symptoms of virus infection. These include leaf chlorosis, curling, stunting and reduced yield.

In tomato fields the differences in the magnitude of whiteflies infestation across the study area were highly significant (P<0.01). However, a characteristic rise and fall pattern of *B. tabaci* infestation was observed across the tomato fields. In March, whitefly population observed in tomato fields stood at 2900 and this increased by approximately 2 % (50) in the following month. In May, *B. tabaci* further increased to 3080 but thereafter declined by 22.1 % (2400) in June (Fig. 1). Substantial differences occurred in the number of whiteflies foundacross the study area. The number of *B. tabaci*observed at Bosso accounted for 8.6 % of the total encountered in March. However, the highest (69 %) was recorded atSabondaga. In April and May whitefly population trend was similar to that observed in March. However, whitefly population fell and rose by 20 % at Bosso (200) and Sabondaga (2500), respectively in April. Furthermore, in May *B. tabaci* population slightly surged by 13 % (230) at Bosso but remained static (2500) at Sabondaga. In June there was a general decrease in whitefly population across the study area. At Bosso and Chanchaga a total of 200 insects were found. Conversely, whitefly population of 2000 was recorded at Sabondaga (Fig 3A, B, C, and D). Similar to the plants in pepper fields most of the tomato plants exhibited leaf curling, stunting and small-sized fruits typical of virus infection.

DISCUSSION

Whitefly population was lowest in June in tomato fields probably because of the heavy rainfall which dislodged them from the plants. Although the result observed in pepper fields was contrary to this, the highest whitefly population encountered in June was three times lower than that in tomato fields. The nonsignificant differences in the population of *B tabaci* in pepper fields across the study area imply that the level of infestation was somewhat uniform. However, the substantial differences in the population of these insects in tomato fields indicate that occurrence and abundance was probably influenced by suitability of the host plants and micro environmental variations across the study area. This is consistent with the findings of Leite (2000) who reported that weather is one of the factors which influence population density of *B tabaci*. The importance of weeds in the survival and perpetuation of whiteflies has been elucidated. For instance, Lanjar and Sahito (2007) observed significantly higher whitefly population in weedy compared to weed-free plots cultivated with okra. In addition to harbouring the insect during the cropping season weeds provide avenue for overwintering during the off-season. Additionally, weeds encourage early migration of *B tabaci* from weed to crop. The higher population of whiteflies recorded in tomato compared with pepper fields was probably due to high (data not shown) weed infestation observed in some tomato fields.

The prevalence of whiteflies in some of the study locations has epidemiological implications. Being a vector of several virus diseases of cultivated crops *B tabaci* abundance projects high incidence and severity of virus diseases on vegetable productivity in the study area. Therefore, control practices that will reduce their population are recommended. Since insecticide control is associated with high cost, misuse, soil contamination, human poisoning and pesticide resistance by the insect, cultural practices including mulching, use of ground cover and timely manual weed control offer alternative management strategy. Others include application of botanical repellents such as neem (*Azadirachta indica*), worm-seed (*Chenopodium ambrosiodes*) and fish bean (*Tephrosia vogelii*). Shedeed *et al.* (2004) reported that *B tabaci* population can be effectively reduced through integrated pest management approach. This involves the use of all suitable techniques in a compatible manner to reduce whitefly population below economic injury level. Additionally, because of the emergence of several biotypes of *B tabaci* species (Hsieh *et al.*, 2006) molecular characterization of these insects is also recommended.

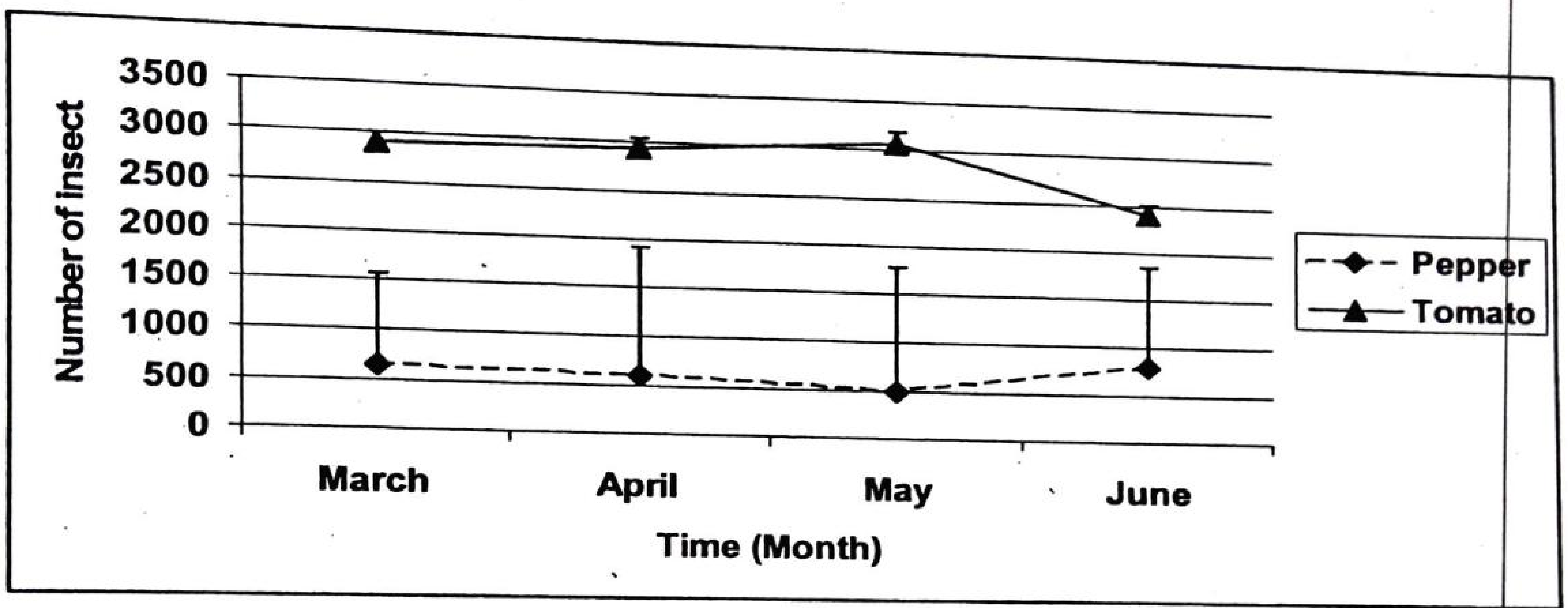

Fig. 1. Abundance of *B. tabaci* in pepper and tomato fields in Minna, March to June, 2009
Vertical lines indicate standard deviation of whitefly number

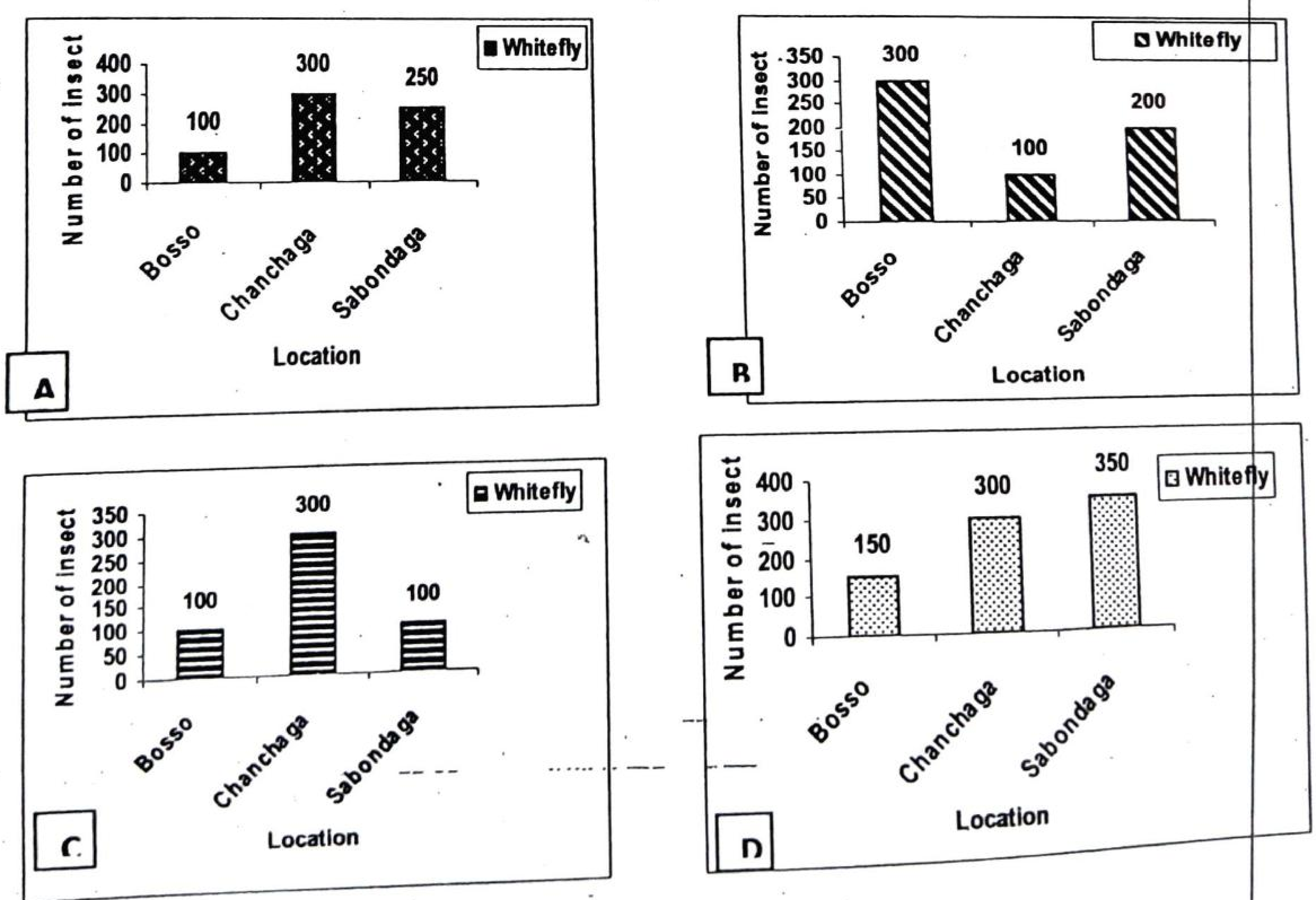

Fig. 2. Distribution and abundance of *B. tabaci* in pepper fields in Minna from March to

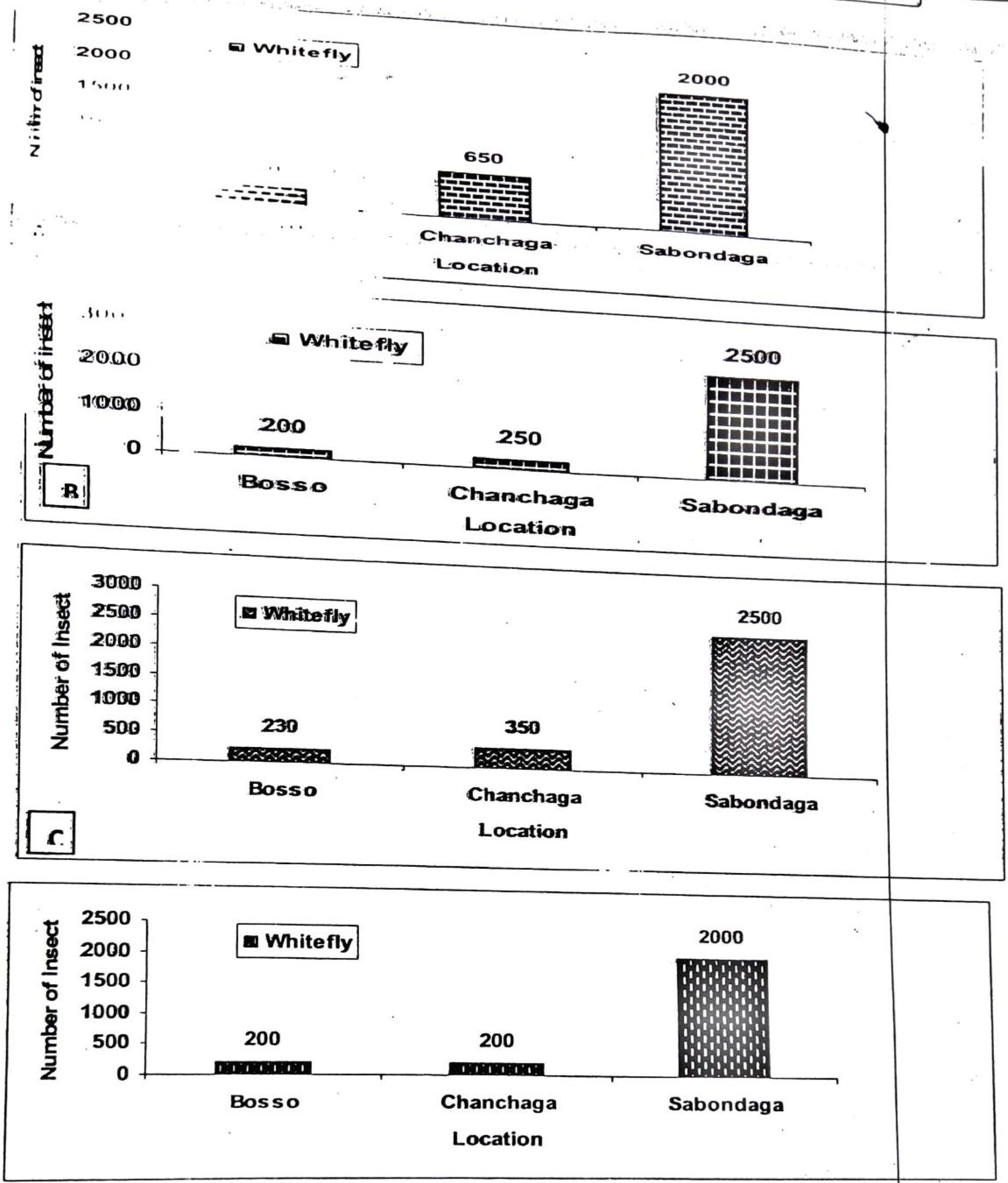

Fig. 3. Distribution and abundance of *B. tabaci* in tomato fields in Minna from March to June, 2009

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