BIBLIOGRAPHY

PERALTA, JEAN SALVATERA. APRIL 2007. Seasonal Abundance and Natural Enemy of *Bemesia tabaci* Gennadius (Hemiptera : Aleyrodidae). Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted at the Balili Experimental Area and Swamp Area, La Trinidad, Benguet from July 2006 to January 2007 to monitor the population of *Bemesia tabaci* Gennadius during the wet and dry season, to determine the effect of rainfall, relative humidity, and temperature on the population of *B. tabaci*, to know the natural enemies of *B. tabaci*, and to know the host plants of *B. tabaci*.

Population of *Bemesia tabaci* Gennadius during the wet season was lower than during the dry season. The population of the adult during wet season was 124 and 542 during dry season. The nymph was 125 during wet season and 361 during dry season. The population of pupae during wet season was 92 and 270 during dry season.

A unit rise on the intensity of rain, the average population of adult *B. tabaci* was reduced to 4.08, 2.64 for the nymph and 1.74 for the pupae. Likewise, a unit increase in temperature increased the average population of the adult by 6.55, 3.99 for the nymph and 2.97 for the pupae.

The natural enemy of *B. tabaci* was the predatory mites, *Amblyseious* sp.

The host plants of *B. tabaci* were *Brassica oleracea, Brassica sinensis, Phaseolus vulgaris, Apium graveolens, Pisum sativum, Capsicum annum* L., *Lycopersicon esculentum,*

Smalanthus sonchifolius, *Helianthus anus* Linn., genus *Fragaria*, *Nicotiana tabacu*m, *Rorippa indica* L., *Cardimine hirsute* L., *Solanum nigrum* L., *Cuphea carthaginensis* Jacquin, *Galinsoga parviflora* Cav., genus *Chrysanthemum*.

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INTRODUCTION

Whitefly, *Bemisia tabaci* Gennadius, common name for any member of a family of plant-feeding insects that resemble tiny moths. They are not actually true flies; they have piercing-sucking mouthparts and are related to aphids, cicadas, and jumping plant lice. Whitefly is under family Aleyrodidae, suborder Sternorrhyncha and order Hemiptera.

B. tabaci occur in groups on the underside of leaves. The adults of most species are similar in appearance and are shaped like tiny moths. Most are less than about 2mm (0.08 inch) long. The body is usually yellowish, but they appear white because of a mealy wax that covers the wings and body. Females lay tiny, oblong eggs on the underside of the leaves. Eggs hatch into barely visible, yellowish oblong nymphs known as the "crawlers". After hatching, "crawlers" soon pierce the host plant with their needle like mouthparts and remain settled on the plant until adulthood. The semitransparent nymphs become flattened and oval after the first moult, or shedding off of skin. They are covered with a waxy secretion and look like tiny scale insects. They have an unusually modified form of metamorphosis, in that the immature stages begin life as mobile individuals, but soon attached to the plant and the stage before the adult is called a pupa, though it is not at all the same as the true pupal stage in holometabolous insects (Hunter et al., 1996).

B. tabaci is one of the most destructive pests that damage almost all kinds of plants. They are damaging plants by sucking the flowing sap or phloem of the plants. High populations of these insects may cause leaves to yellow, shrivel and drop prematurely. The excess sap or honeydew excreted by nymphs collect dusts that leads to

growth of sooty molds and attracts ants. Like many other species in the aphid and cicada order, white flies can transmit viruses to plants.

Managing pest could either be done in such ways: these were chemical control, biological control and cultural control. The use of beneficial insects was the most preferred one. By using biological control, leads to no chemical toxicity in the surroundings. Thus, the study shows on the use of natural enemies that could reduce the population of the pest and the factors that contributes in the reduction of population. In such matters, this study could help students as for their research works and an additional knowledge to them.

The objectives of the study were to monitor the population of *Bemesia tabaci* Gennadius during the wet and dry season, to determine the effect of rainfall, relative humidity, and temperature on the population of *B. tabaci*, to know the natural enemies of *B. tabaci*, and to know the host plants of *B. tabaci*.

The study was conducted at the Balili Experimental Area and Swamp Area, La Trinidad, Benguet from July 2006 to January 2007.

REVIEW OF LITERATURE

Life stages, description and characteristics of *Bemesia tabaci* Gennadius. The eggs are pale yellow oval, 0.3 mm in length, and are laid on the underside of the leaves. The egg hatches within 4 to 12 days. The larvae are yellowish that has fine thin wax covering their abdomen so they are hardly be seen. The first instar larvae are called "crawlers". The pupa is elliptical and opaque, deep yellow in color. The adults are small, about 1mm long and slightly with wings covered with white waxy bloom. The larva and adult suck plant juices (Colting et al., 2003).

Distribution and abundance. According to Colting et al., (2003), this pest is distributed throughout the Cordillera and abundant during dry season.

Natural enemies. The aphinilid wasp, lacewings, spiders, staphinilid beetles and some fungi are the enemies of this pest (Colting et al., 2003). In addition, Kruger (2006) mentioned a number of natural enemies that attack *B. tabaci* which includes parasitic wasps, predatory mites, beetles and fungi. Some of them have used successfully in biological control.

Damage of this pest. The greatest potential threat from the tobacco whitefly is that it can transmit more than 60 plant viruses including tomato yellow leaf curl, lettuce infectious yellows and squash leaf curl. Direct damage by the feeding of adults and nymphs are unlikely to be seen unless infestation is severe. Detection of the pest therefore relies mainly on seeing adults and immature stages. However, if infestation is severe, damage can occur in the form of sticky honeydew and associated with sooty

molds, chlorotic spots and leaf yellowing. Physiological disorders such as leaf silvering of cucurbits and fruit distortion of tomatoes may also be included (Anon., 1996).

Parasitization of the host. The immature parasitoids develop within the whitefly host, eventually consuming the entire host, except the integument. The immature parasitoid pupates within the integument of the host and the adult parasitoid emerges through a round hole (Anon., 1981).

Host plants of *Bemesia tabaci* Gennadius. This is widely polyphagous, feeding on over 500 species of plants in 74 families. Its hosts include vegetable, field and ornamental crops. Of the important vegetable crops in Florida, this is a major peat of tomato, peppers, squash, cucumber, beans, eggplant, watermelon and cabbage. The Florida-grown field crops of potato, peanut, soybean and cotton are heavily attacked by *Bemesia.* The ornamental host plants of *Bemesia* are too numerous to list, but include poinsettia, hibiscus, and chrysanthemum (Anon., 1981). Also, Achterberg in 1999 added that the hosts are almost exclusively angiosperma, mostly woody dicots. Such preference could be a reflection of their tropical distribution

Spread of *Bemesia tabaci* Gennadius. It has been reported from all except Antarctica. Over 900 host plants have been recorded for this pest and it reportedly transmits 111 virus species. It is believed that *B. tabaci* has been spread throughout the world through the transport of plant products that were infested with whiteflies. Once established, *B. tabaci* quickly spreads and through its feeding habits the transmission of the disease, it carries causes destruction to crops around the world. *B. tabaci* is believed to be a species complex, with a number of recognized biotypes and two described extant cryptic species (Anon., 2000).

MATERIALS AND METHODS

Materials

The materials that were used in this study were as follows: bean seeds (Bean Pole Blue Lake variety), grab hoe, sticks, watering can, a quadrant made out of transparent plastic measuring three square centimeters, water, markers, masking tape, bond papers, thread, magnifying lens, pair of scissors, CP 10 plastic containers, tissue papers, dissecting microscope, and listing materials such as pen and paper.

Methods

Land preparation. An area of 100 m^2 were cleaned and prepared. Ten plots were hilled up and holes about 2 cm deep were made in each plot.

Planting. The seeds were planted with the planting distance of 8 cm with three seeds in each hole. The variety of bean seeds planted was the Bean Pole Blue Lake. After the seeds were planted, application of fertilizer (chicken dung) was done. The fertilizer was placed at the center of the plot.

Data gathering. The gathering of data started when the plants had already leaves and it was attacked by *B. tabaci*. Ten plants per plot were chosen as samples. The number of *B. tabaci* adult, nymph, and pupa, were counted. *B. tabaci* that was found on the quadrant was counted. Twenty sample leaves that contain eggs were collected and it is brought to the laboratory for the observation on how the predator attacks *B. tabaci*.

Data gathering and sample collection outside the study area. This was done from the field near the Balili Mites Predatory Rearing House running to the swamp areas going

to Km.5 and back to the laboratory house. Plants that were attacked by *B. tabaci* and the population of this insect were listed. The data collection was done once a month.

Proving the presence of adult predators by sweeping *B. tabaci*. Sweeping was done ten times on the host plants that had a higher population. The collected specimens were put on the CP 10 plastic containers.

Collection of leaves for proving natural enemies. Twenty sample leaves, measuring three cm^2, that contain eggs, nymph and pupae of *B. tabaci* were collected. The specimens were put on the CP 10 plastic containers. Specimens were reared until such predators were observed.

Rainfall intensity, relative humidity and temperature. The rainfall intensity, relative humidity and temperature were taken at the PAG-ASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration) – BSU.

Hosts plants. Plants that were infested with this pest including the population count on the adult, nymph and pupae were listed.

The data gathered were:

1. Population of *B. tabaci*. The population of adult, nymph and pupae counted in the leaves subjected to transparent plastic quadrant measuring 3 cm^2 were counted and noted

2. Host plants. The plants that were infested with *B. tabaci* during the conduct of the study was also noted.

3. Natural enemies of *B. tabaci*. These were the predators that were associated with *B. tabaci*.

4. Rainfall intensity, relative humidity and temperature. The intensity of rain, relative humidity and temperature during the conduct of the study was taken at the BSU-PAG-ASA.

RESULTS AND DISCUSSION

Population of *Bemesia tabaci* Gennadius
During the Wet and Dry Season

The months of July, August, September and October were the wet season and the months of November, December and January were the dry season.

As shown in Table 1, during wet season, the population of *Bemesia tabaci* Gennadius adult was 124, 125 for the nymph and 92 for the pupae. During dry season, the population of adult was 542, 361 for the nymph and 270 for the pupae.

The population of adult, nymph and pupae during the wet season was lower than during dry season as indicated in Appendix Graph 1. The decrease in population during wet season could be due to the high intensity of rain. The increase in population during dry season was due to the increase in temperature.

Table 1. Total Population of *Bemesia tabaci* Gennadius in wet (July to October) and dry season (November to January)

SEASON	POPULATION		
	ADULT	NYMPH	PUPAE
Wet Season	124	125	92
Dry season	542	361	270

Relationship of Population of *Bemesia tabaci* Gennadius During the Wet and Dry Season

Table 2 shows the effect of meteorological factors on the population densities of *B. tabaci*. During wet season, a unit increase on the intensity of rainfall resulted for the decreased in population of *B. tabaci*. The population decreases as the rainfall intensity rises. Likewise, there was an increased in the population of *B. tabaci* as the rainfall intensity declines.

For every unit increase on the intensity of rain there was a decrease in the population of adult by a number of 4.08 and an addition of 6.55 for every unit increase in temperature. For the nymph, a number of 2.64 was reduced and an addition of 3.99. A unit increased in rainfall intensity makes the population of pupa to reduce by a number of 1.74 and the addition by a number of 2.1 for pupa for every rise in temperature.

For every rise in the intensity of rainfall to about 3.74 mm, there was a corresponding decreased on the population of adult to 418, 236 to nymph and 178 to the pupae of *B. tabaci* as presented in Table 3. On the other hand, should there be a rise in temperature by 2.45ºC, the population of adult increased to 418, 236 for the nymph and 178 for the pupae.

Natural Enemy of *Bemesia tabaci*

The predator of *B. tabaci* found during the conduct of the study was the predatory mites, *Amblyseious* sp. The predator predates by sucking the sap or juice of the prey. The predatory stages were the nymph and the adult. The predator attacks the eggs, nymphs and pupae of *B. tabaci*.

Table 2. Effect of meteorological factors on the population densities of *Bemesia tabaci* Gennadius

STAGES OF *B. tabaci* G. (POPULATION)	RAINFALL INTENSITY (mm)		RELATIVE HUMIDITY (%)		TEMPERATURE (ºC)	
	Effect	T-value	Effect	T-value	Effect	T-value
Adult (666)	-4.08	-2.08*	0.31	1.65 n.s.	6.55	2.36**
Nymph (486)	-2.64	-2.43*	0.18	1.73 n.s.	3.99	2.59**
Pupae (362)	-1.74	-1.85 n.s.	0.15	1.63 n.s.	2.91	2.19**

Legend: n.s. – not significant
* - significant
** - highly significant

Table 3. Relationship on the change of intensity of rain and temperature to the population of adult, nymph, and pupa of *B. tabaci*

STAGES		RAINFALL INTENSITY		POPULATION		TEMPERATURE		POPULATION	
			Change		Change		Change		Change
Adult	Initial	1.13		542		21.60		124	
	Final	4.87	3.74	124	418	24.05	2.45	542	418
Nymph	Initial	1.13		361		21.60		361	
	Final	4.87	3.74	125	236	24.05	2.45	125	236
Pupa	Initial	1.13		270		21.60		270	
	Final	4.87	3.74	92	178	24.05	2.45	92	178

Host Plants of *Bemesia tabaci* Gennadius
and the Population of the Insect

Table 4 shows the host plants and the population of *B. tabaci*. The highest population of adult was six on eggplant and the lowest was one on celery, sweet pea, strawberry, kutkutsarita, yellow cress, parparsik and macbride. For the nymph, the lowest was two on kutkutsarita and yellow cress, while the highest was 11 on tomato. As for the population of pupae, the lowest was zero on garden pea, eggplant and strawberry, and the highest was six on chrysanthemum. The egg, nymph and pupae of *B. tabaci* were found mostly on the lower leaves of the plants.

Table 4. Host plants and the population of *Bemesia tabaci*

HOST PLANTS (SCIENTIFIC NAME)	POPULATION			TOTAL
	Adult	Nymph	Pupae	
Broccoli (*Brassica oleracea*)	3	8	3	14
Cabbage (*Brassica sinensis*)	4	7	2	13
Chinese cabbage	2	9	4	15
Pechay	3	5	1	9
Snap beans (*Phaseolus vulgaris*)	4	10	3	17
Celery (*Apium graveolens*)	1	3	4	8
Garden pea (*Pisum sativum*)	1	6	0	7
Bell/Sweet pepper (*Capsicum annum L.*)	2	7	2	11
Tomato (*Lycopersicon esculentum*)	3	11	5	19
Yacon (*Smalanthus sonchifolius)*	4	5	2	11
Sunflower (*Helianthus anus Linn.*)	2	7	3	12
Eggplant (*Solanum melongena)*	6	7	0	13
Strawberry (genus *Fragaria*)	1	4	0	5
Tobacco (*Nicotiana tabacum*)	5	3	4	12
Kutkutsarita	1	2	2	5
Yellow cress (*Rorippa indica* l.)	1	2	0	3
Parparsik (*Cardimine hirsute* L.)	1	4	1	6
Amti (*Solanum nigrum* L.)	2	3	3	8
Macbride (*Cuphea carthaginensis* Jacquin)	1	3	1	5
Galinsoga (*Galinsoga parviflora* Cav.)	2	3	1	6
Chrysanthemum (genus *Chrysanthemum*)	3	8	6	17

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at the Balili Experimental Area, La Trinidad, Benguet from July 2006 to January 2007 to monitor the population of *Bemesia tabaci* Gennadius during the wet and dry season, to determine the effect of rainfall, relative humidity, and temperature on the population of *B. tabaci*, to know the natural enemies of *B. tabaci*, and to know the host plants of *B. tabaci*.

In the study, the population of *B. tabaci* was lower during the wet season than during the dry season. For every unit increase in intensity of rain, *B. tabaci* population was reduced by a number of 4.8 on adult, 2.64 on nymph and 1.74 on pupae. A number of 6.55, 3.99 and 2.91 was added to the population of adult, nymph and pupa as there was a unit rise in temperature. On the other hand, relative humidity does not affect the change in population of the *B. tabaci*. The observed predator of *B. tabaci* was the predatory mites, *Amblyseious* sp. This predator was feeding by sucking the sap of the prey. The predatory stages were the nymph and adult. There were 21 species listed as host of *B. tabaci*. To mention a few, they were cabbage, broccoli and pechay.

Conclusion

Bemesia tabaci Gennadius was abundant during the dry season. The population of *B. tabaci* was affected by rainfall intensity and temperature, but not relative humidity. As the intensity of rain goes higher, the population becomes lower, and as the temperature rises, the population also increases. Chemical control of *B. tabaci* was not the only

control that could be used. *B. tabaci* could be managed by the use of natural enemies. One natural enemy recorded was the predatory mite. *B. tabaci* has 21 host plants making them very difficult to control.

Recommendation

It is recommended that further study should be done including the possibility of conducting under greenhouse condition to know the other factors that may affect the population of the insect.

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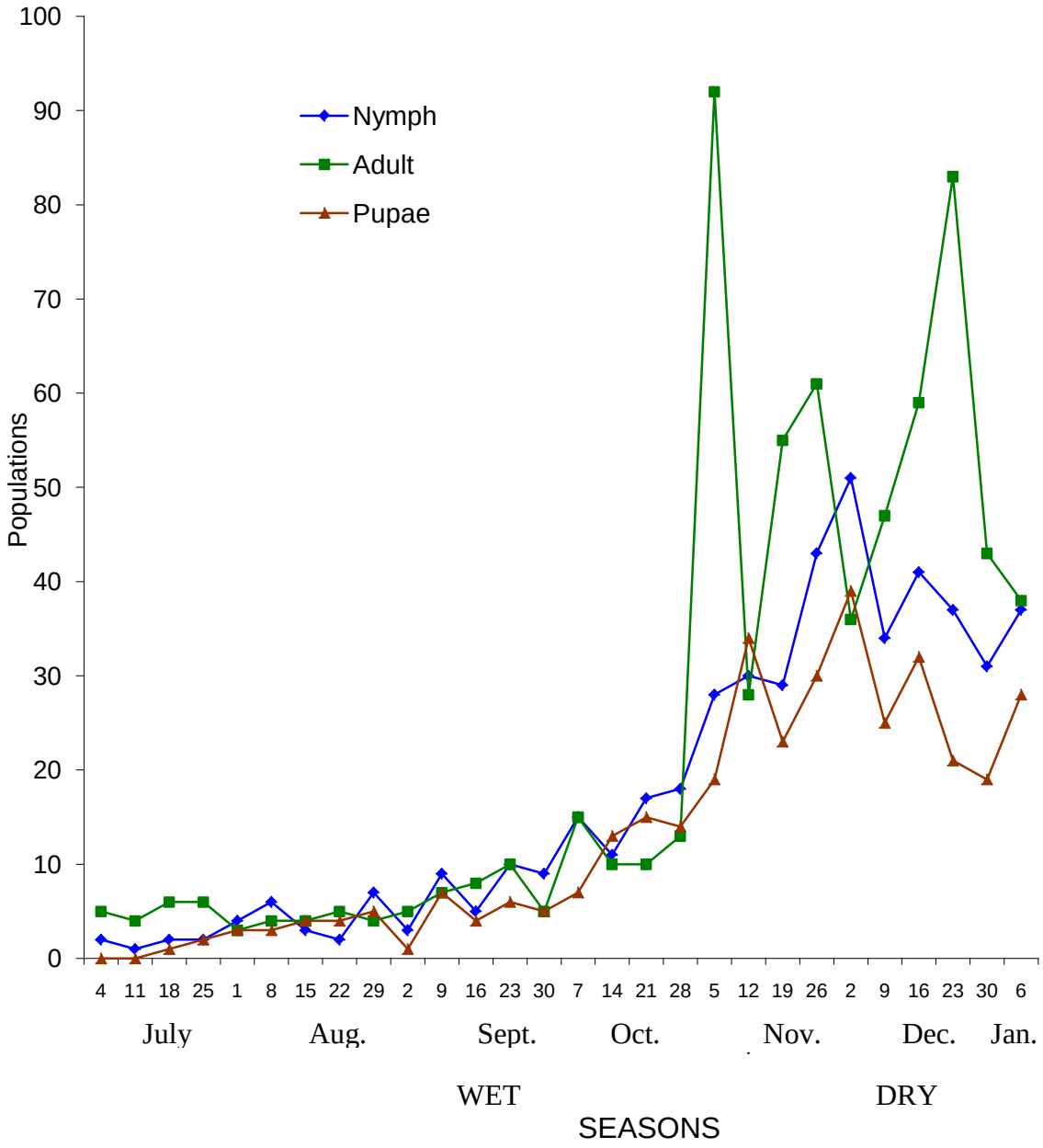
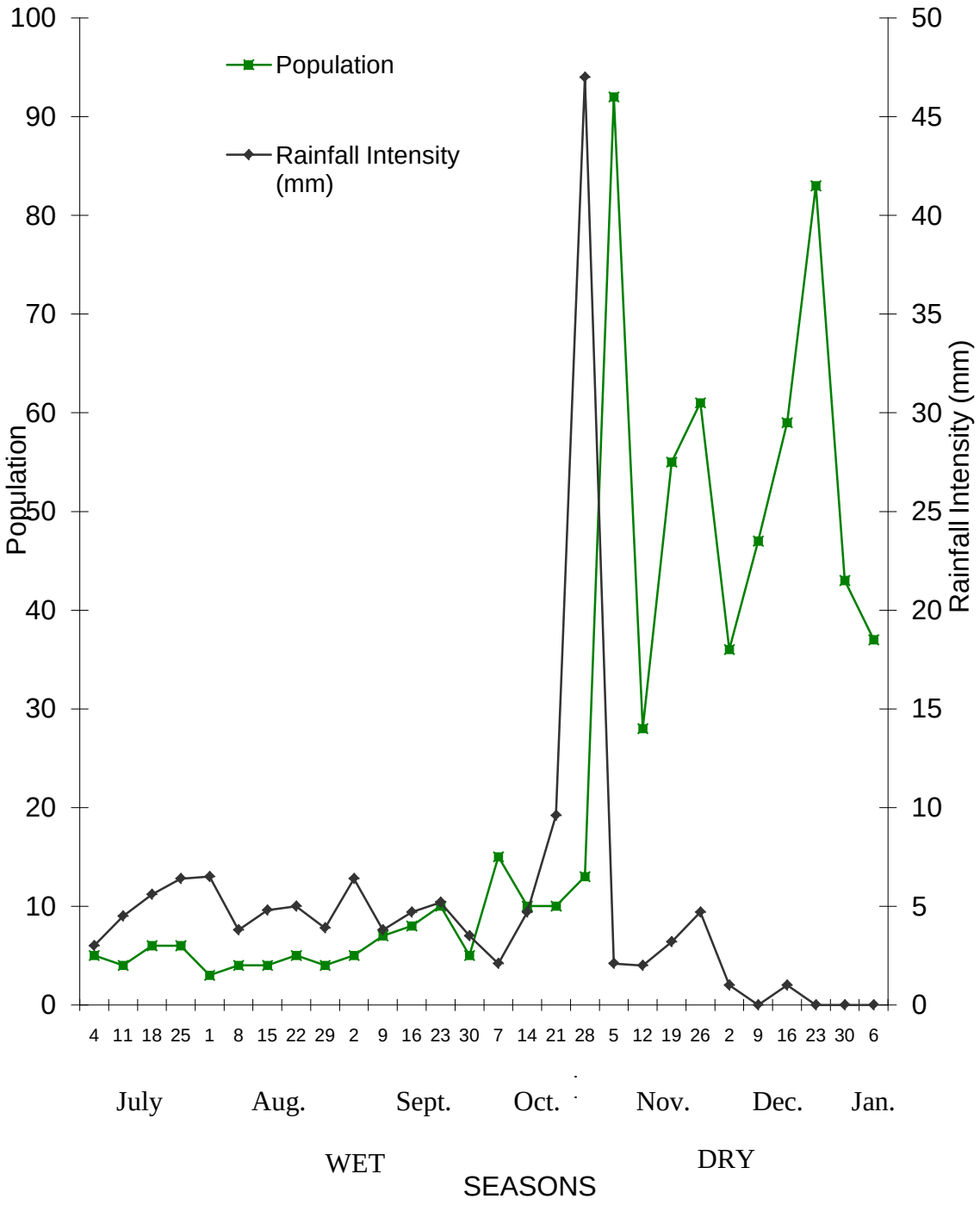
APPENDICES

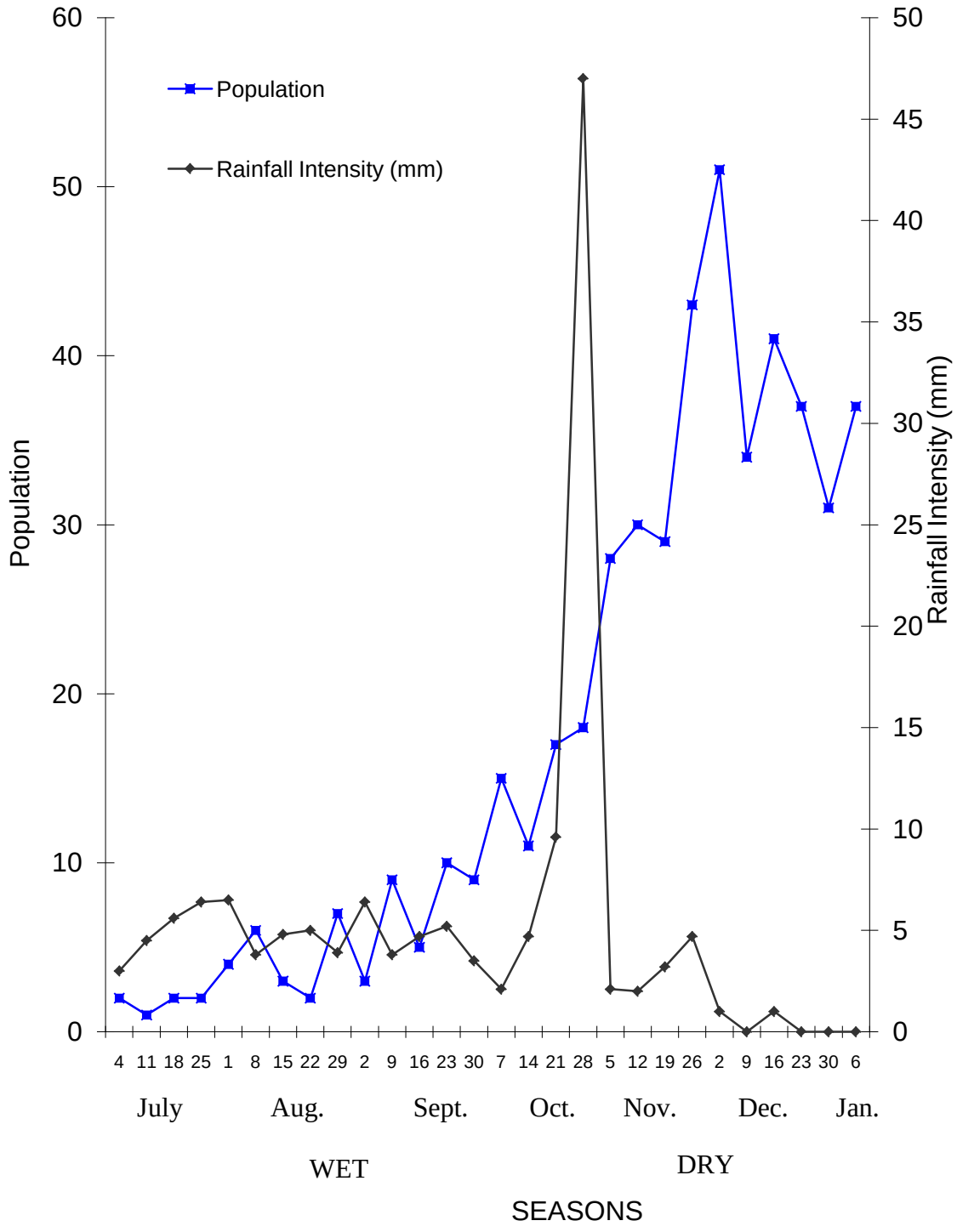
Appendix Graph 1. Population of adult, nymph and pupae *B. tabaci* during the wet & dry season



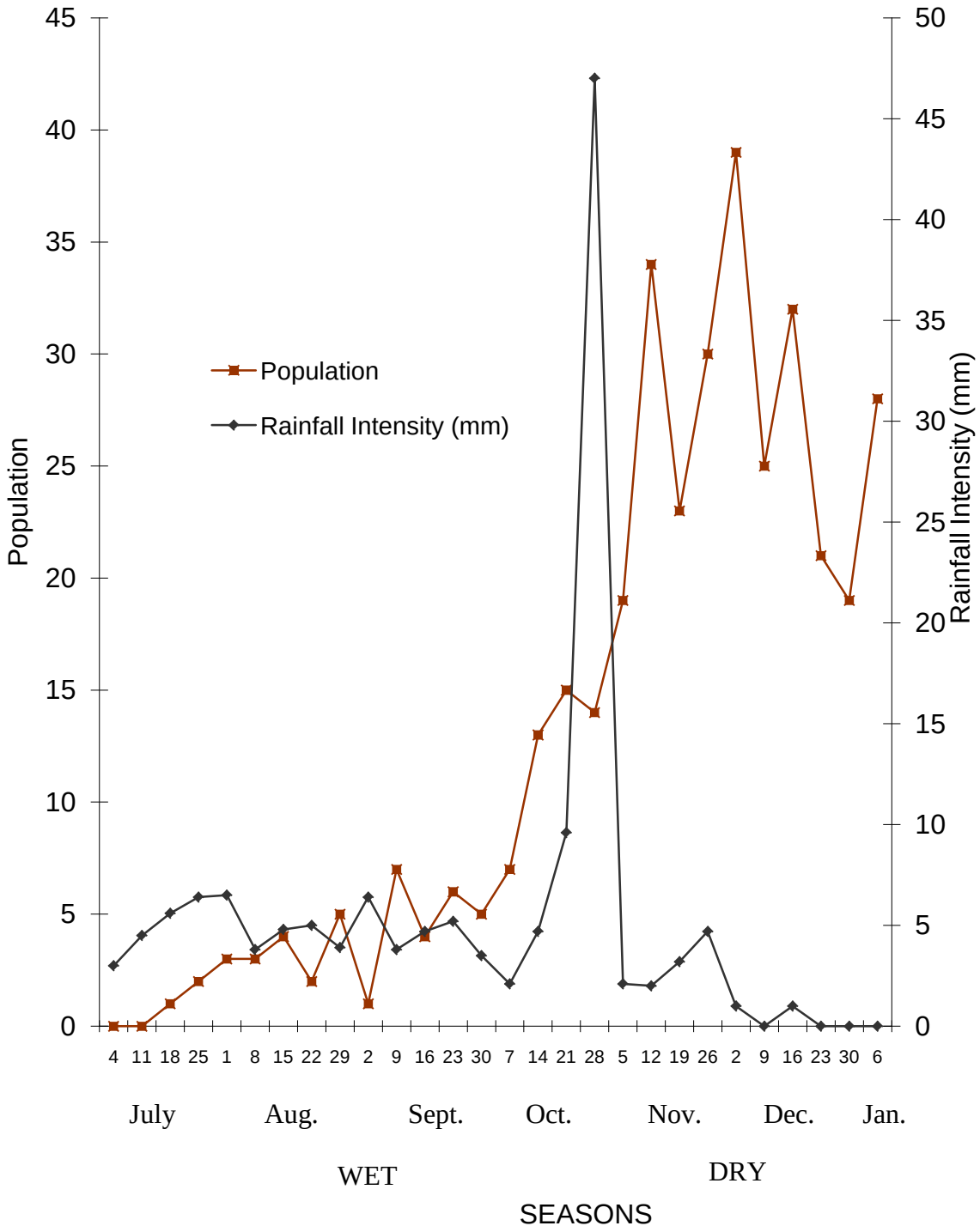
Appendix Graph 2. Rainfall intensity and population of adult *B. tabaci*



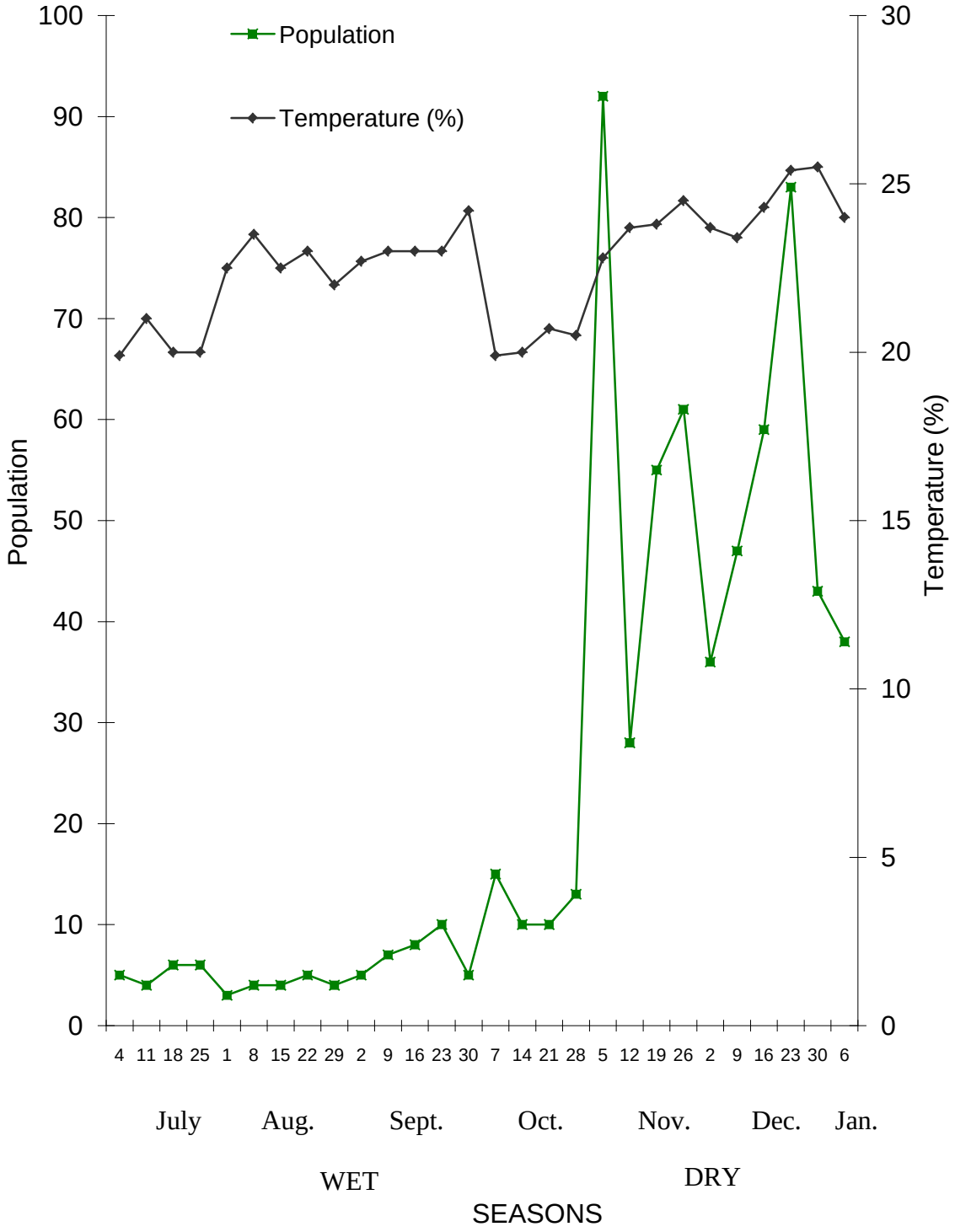
Appendix Graph 3. Rainfall intensity and population of nymph *B. tabaci*



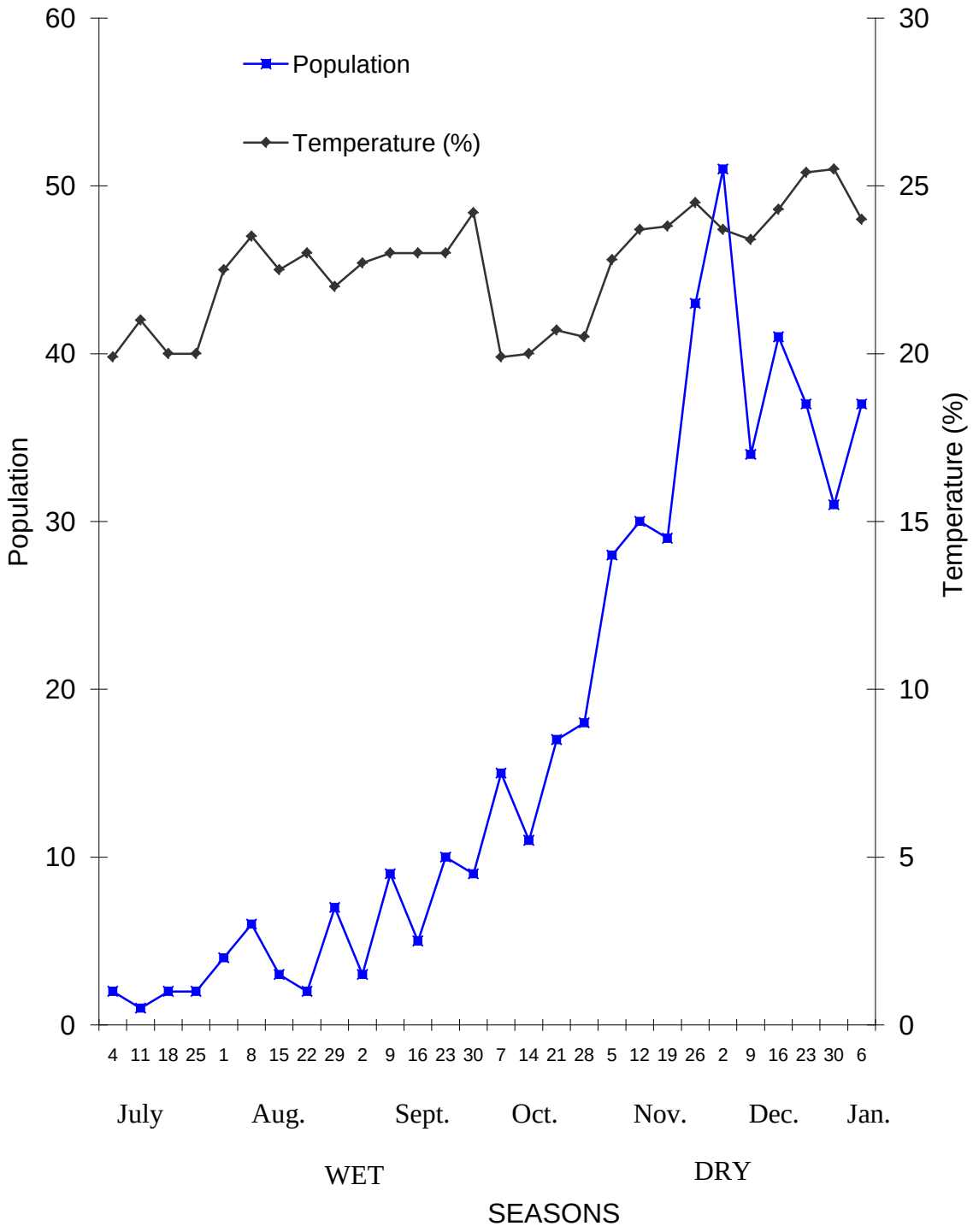
Appendix Graph 4. Rainfall intensity and population of pupae *B. tabaci*



Appendix Graph 5. Temperature and population of adult *B. tabaci*



Appendix Graph 6. Temperature and population of nymph *B. tabaci*



Appendix Graph 7. Temperature and population of pupae *B. tabaci*