

Full Length Research Paper

Incidence of okra mosaic virus at different growth stages of okra plants (*Abelmoschus esculentus* (L.) Moench) under tropical condition

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The degree of Okra mosaic virus (OKMV) at different growth stages of okra plants was studied using a netted barrier method. In a two factor RCB design with three replications, a 2 m high netted barrier were laid out in unit plots of 2 x 2 m using eight treatments: T1- Netting up to 7 days after seedling emergence (DAE); T2- Netting up to 14 DAE; T3- Netting up to 21 DAE; T4- Netting up to 28 DAE; T5- Netting up to 35 DAE; T6- Netting up to 42 DAE; T7- Netting up to last harvest; T8- No netting (untreated control). The number of *Podagrica unifoma* (Jac.) and *Podagrica sjostedti* (Jac.) were recorded weekly and the number of virus infected plants from all the plants of each replication. It was observed that by preventing the vectors (*P. unifoma* (Jac.) and *P. sjostedti* (Jac.)) of okra mosaic virus (OKMV) by the use of 2 m high net barrier around the okra plots, until the plants became more than 21 days old after emergence, decreased the populations of *P. unifoma* (Jac.) and *P. sjostedti* (Jac.) and virus infected plants of both the resistant and susceptible okra varieties. Low virus infection in plots netted for 21 days after seedling emergence or more resulted in 25 - 50% increased yields in both tolerant and susceptible varieties. These observations by this study showed that virus infection in okra plants at growth stages earlier than four weeks has more severe effect on the physiological performance of okra plant and subsequent reduction in growth performance and yield of okra. Therefore some effective control measure is very necessary at early growth stages of okra plant.

Key words: *Abelmoschus esculentus*, *Hibiscus esculentus*, Okra Mosaic virus, infection, netted barrier, control, Nigeria.

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench or *Hibiscus esculentus* (Linné)] is an important vegetable crop in much of the tropics including Nigeria (Schippers, 2002). Young fruit are consumed fresh or cooked. Okra is a good source of vitamin A, B, C and protein, carbohydrates, fats, minerals, iron and iodine (Diaz and Ortegon, 1997). Fresh fruit are harvested when 3 - 7 days old. Consumption of 100 g of fresh okra fruit provides 20, 15 and 50% of the daily requirement of calcium, iron and ascorbic acid, respectively (Hamon, 1988; Schippers, 2002). Old fruit are used in processed products (Schippers, 2002).

Okra is a warm, rainy season crop, requiring high soil and high day and night air temperatures, but growers start cultivation in January when average temperatures are below 37°C as an early crop for better returns (Simmons et al., 2004). Pods grow rapidly are ready for harvest in about 60 days when grown from seed. Pods must be picked about 4 - 5 days after flowering, when \approx 10 cm in length and before they mature and toughen. Okra comes in varying shades of green (there is also a new red variety), and can be smooth or have a ribbed surface (Jha and Dubey, 1998). Okra can be picked every other day during fruiting, and several times more if the crop is mowed and allowed to re-grow (Schippers, 2002).

A number of viruses infect okra (Kucharek, 2004) including: that causing Okra leaf curl disease (OLCD), is suspected of being associated with a whitefly-transmitted

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Table 1. Effect of netting on incidence of vectors (*Podagrica unifoma* (Jac.) and *P. sjostedti*) and Okra mosaic virus in tolerant (okra, cv. 47-4) and susceptible (okra cv. Jokoso) okra varieties.

Treatments Days after emergence (DAE)	<i>Podagrica unifoma</i> (Jac.)/10 leaves (no.)		<i>P. sjostedti</i> (Jac.)/10 leaves (no.)		Virus infected plants (%)	
	okra, cv. 47-4	okra cv. Jokoso (s)b	okra, cv. 47-4	okra cv. Jokoso (s)b	okra, cv. 47-4	okra cv. Jokoso (s)b
Netting up to 7 DAE	4.2 ab	4.6 ab	2.9 b	3.2 b	21.2 b	24.4 b
Netting up to 14 DAE	4.3 ab	4.6 ab	2.8 b	3.8 b	20.4 b	24.7 b
Netting up to 21 DAE	4.2 ab	3.4 b	2.6 b	3.6b	17.1 b	24.2 b
Netting up to 28 DAE	2.8 b	3.0 b	2.4 b	2.8 bc	17.1 b	22.1 b
Netting up to 35 DAE	2.4 b	2.6 b	1.4 c	2.7 bc	17.4 b	20.6 c
Netting up to 42 DAE	1.9 b	2.2 b	1.2 c	1.7 c	16.0 b	19.2 c
Netting up to harvests	1.4 b	1.9 b	1.0 c	1.2 c	14.4 b	18.5 c
No netting (control).	6.4 a	7.2 a	4.5 a	8.4 a	30.8 a	38.2 a

a. Data are averages of 3 replications from 8 observations; values followed by the same letters do not differ significantly at 5% by DMRT.
b. s = susceptible.

geminivirus (Genus *Begomovirus*), and Yellow vein mosaic virus (OYVMV), transmitted by the whitefly (*Bemisia tabaci*) (Ali et al., 2000).

Okra mosaic virus (OKMV) has always been a serious problem in okra (Kucharek, 2004). Yield reductions of 20 - 50% have occurred (Kucharek, 2004). This loss may increase to 90% (Pullaiah et al., 1998; Kucharek, 2004). *Okra mosaic virus* symptoms are characterized by a homogenous interwoven network of yellow mosaic pattern enclosing islands of green tissue in leaf blades. In extreme cases, infected leaves become yellowish or creamy color (Kucharek, 2004). The virus is not seed transmitted (Koenig and Givord, 1974), but it is mainly transmitted by the beetles of *Podagrica* spp. (Lana and Taylor, 1975; Atiri, 1984, 1990; Alegbejo, 2001a, b).

The integrated pest management constraints are that vectors usually attack the young okra plants at the vegetative stage for virus transmission. Frequent use of pesticides by the farmers, without recognizing the vector(s), its incidence patterns and the virus infection time, create poisonous residues in the food chain. Understanding the growth stage critical for virus transmission can help greatly to undertake appropriate control measures to prevent virus transmission.

The objective of this study therefore is to identify the degree of *Okra mosaic virus* (OKMV) at different growth stages of okra plants, so that appropriate control measures can be undertaken at the critical stages of vector infestation and virus transmission.

MATERIALS AND METHODS

The experiment was carried out in 2005 and 2006 rainy season at an on farm adaptive experimental field in University of Agriculture Abeokuta Ogun state Nigeria. In a two factor RCB design with three replications, eight treatments were laid out in unit plots of 2m x 2m and using a 2 m high netted barrier: T1- Netting up to 7 days after

seedling emergence (DAE); T2- Netting up to 14 DAE; T3- Netting up to 21 DAE; T4- Netting up to 28 DAE; T5- Netting up to 35 DAE; T6- Netting up to 42 DAE; T7- Netting up to last harvest; T8- No netting (untreated control). Standard cultural practices and recommended rates of fertilizers were applied; no control measures were taken for pest infestation. Weekly observations were made to record the number of *Podagrica unifoma* (Jac.) and *P. sjostedti* (Jac.) from the upper ten leaves of 10 randomly selected plants and the number of virus infected plants from all the plants of each replication. Data were also taken on the height of the plants, number of fruits per plant and yield. Averages for the two year data was given.

Data regarding Okra mosaic virus and *P. unifoma* (Jac.) and *P. sjostedti* (Jac.) population were recoded on weekly basis and subjected to statistical analysis. All possible interactions were determined through ANOVA and treatments mean were compared by LSD or DMR test at 5% level of probability (Steel et al., 1997).

The two cultivars of okra (okra, cv. 47-4 and the susceptible variety okra cv. Jokoso), used for this experiment were collected from National Institute for Horticultural Research, Ibadan, Nigeria. At the on set of pods starting to grow, fertilizer NPK 15:15:15 fertilizer was applied at 150 NPK kg ha⁻¹ on the ground around the plants. The fertilizer was watered into the soil, keeping both the fertilizer and the water off the plant directly.

Weeding commenced at two weeks after sowing of okra seed and subsequent weeding was carried out as at when due. Thinning was done two weeks after sowing of okra seed.

RESULTS AND DISCUSSION

Okra plots under netting for more than 28 DAE reduced the number of *P. unifoma* (Jac.) and *P. sjostedti* (Jac.) as well as virus infection considerably when compared with that of the un-netted plots or plots netted up to 21 DAE (Table 1). Although no consistent trend was evident, plant height and fruit bearing capacity of the plants increased in the plots having a net barrier up to 28 DAE and above. As a result there was a significant increase in okra fruit yields (Table 2). The results strongly indicated that okra plants under 28 DAE were more prone to vector infesta-

Table 2. Effect of netting on plant height, number of fruits per plant and yields of okra in tolerant (okra, cv. 47-4) and susceptible (okra cv. Jokoso) okra varieties.

Netting Days after emergence (DAE)	Pt. ht. at harvest (cm)		Fruits/ plant (no.)		Yield (t/ha)	
	okra, cv. 47-4	okra cv. Jokoso (s)b	okra, cv. 47-4	okra cv. Jokoso (s)b	okra, cv. 47-4	okra cv. Jokoso (s)b
Netting up to 7 DAE	45.5	40.8	23.8	24.0	6.1 b	4.2 b
Netting up to 14 DAE	48.6	45.8	25.4	22.0	6.9 a	4.6 b
Netting up to 21 DAE	50.6	47.2	25.5	23.6	7.4 a	5.9 a
Netting up to 28 DAE	52.8	50.5	26.6	24.8	7.5 a	6.4 a
Netting up to 35 DAE	53.8	54.5	24.2	20.0	7.3 a	6.3 a
Netting up to 42 DAE	64.5	58.3	20.4	21.5	6.0 b	5.8 a
Netting up to harvests	68.8	62.8	22.5	18.2	6.8 a	4.8 b
No netting (control).	70.4	64.8	15.2	14.2	3.6 c	3.1 c

a. Data are averages of 3 replications from 8 observations; values having the same letters do not differ significantly at 5% by DMRT.

b. s = susceptible.

tion and virus infection, and therefore, it is necessary to protect okra crops from virus infection at least up to 28 DAE of plant growth. There was no significant difference in the intensity of virus infection between the tolerant variety (okra, cv. 47-4) and the susceptible variety (okra cv. Jokoso), indicating that okra, cv. 47-4 is not all that tolerant to OKMV.

The use of pesticide in the control of insect pest could be avoided and improved okra plants growth and yields, and low vector and virus infestation achieved by preventing insect vectors of the virus from reaching the plant as observed by this study. In prevention of insect vectors of viruses on okra, similar work was carried out in the management of Okra yellow vein mosaic virus (OYVMV) by Kulat et al. (1997) where aqueous plant leaf extracts of tobacco (2%) *Ipomoea cornea* (5%) and a seed extract of *Azadirachta indica* and *Pongamia braglia* (5%) were used for the control of whitefly (*Bemisia tabaci*) and *Aphis gossypii*, vectors of the virus on okra. The vectors of the virus were targeted and controlled from transmitting the virus resulting in very low incidence of the virus and subsequent improved crop yield.

Also Adiroubane and Letchoumanane (1998) used plant extracts, sacred basil (*Ocimum sanctum*), malbar nut (*Adhutada vesica*), Chinese chaste tree (*Vitex negundo*) and synthetic insecticides (Endosulfan and Carbaryl) and their combinations products in controlling okra jassid, whitefly and fruit borers, vectors of viruses of Okra during rainy season. All the treatments suppressed insect's population. Sprays with leaf extracts of *Prosopchilensis* and *Bougainvillea spectabilis* has been found highly effective in reducing yellow vein mosaic virus in okra by suppressing insect population (Pun et al., 1999).

Okra fields need to be protected up to at least 21 DAE from the attack of virus vectors and viruses for satisfactory yields as observed by this study. Yield loss of okra can be minimized by 25 - 50% if the plants are protected

up to 28 DAE.

Conclusion

The easiest and method of reducing *Okra mosaic* disease of okra is planting of resistant varieties against this disease. However okra plants protected up to 28 days after germination also reduced the spread of OKMV by checking its vector *P. unifoma* (Jac.) and *P. sjostedti* (Jac.). Therefore if virus vectors on okra plants are checked and controlled, viral diseases incidence on cultivated okra plant will be greatly minimized and subsequent healthy crop and increased fruit yield.

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