

Effect of Mulching on Infestation of Sweet Pepper (*Capsicum annuum*) by Whiteflies and Aphids

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Summary

The trial was to study the effect of different mulching materials on whitefly, aphids' population and agronomic characteristics of sweet pepper (*Capsicum annuum*). Sweet pepper production is constrained by insect pests which causes some diseases. A field experiment was conducted at the vegetable field, National Horticultural Research Institute (NIHORT) (7^o24" N and 7^o39" E longitude 3^o 50 and 3^o52" N), Idi-Ishin, Ibadan during the 2016 cropping season. The mulching materials used were (1) White plastic mulch (2) Black plastic mulch (3) Yellow plastic mulch (4) Neem leaves (5) Tithonia leaf and (6) Neem leaf + Tithonia leaf (7) Bare soil as control. The experimental field contained twenty one plots using a randomized complete block design in three replications. Parameters measured were disease incidence, severity, whitefly population, aphid population, plant height, stem girth, number of fruits and fruit weight (in grams). The white plastic mulch recorded the least disease incidence (34.43). while bare topsoil plots recorded the peak incidence (100.0). Average severity also followed similar trend as the disease incidence. The reflective white plastic mulch significantly recorded the least severity rate (1.27) as against the bare topsoil (5.32). Whiteflies (*Bemisia tabaci*) population was reduced to (0.33) under the white plastic mulch followed by the neem mulch (1.00) and Neem+tithonia mulch (1.67). Aphids (*Aphis gossypii*) population was reduced by white plastic mulch (0.83). Neem and Neem+ tithonia mulch significantly supported the growth and fruit yield as compared to all other treatments. Data generated in this study have shown that white plastic mulch may be more effective in suppressing pest populations of pepper, but neem mulch may provide better organic manure when decomposed and also as refuge for the natural enemies, it is therefore recommended as an integral option for pest management in pepper production.

Key words: *Pepper, Mulch, Neem, Aphids, Whiteflies.*

INTRODUCTION

PEPPER (*Capsicum annuum* L.) belongs to the family Solanaceae and has always been one of the most important vegetables consumed worldwide, after tomatoes and onions (1). It belongs to the family Solanaceae and was believed to have been introduced by Columbus from the new world (20). Africa's production of green pepper was 7.70 million tons per year both dry and green fruit from 0.89 million hectares (2) It is one of the most important vegetables grown in most parts of sub-humid and semi-arid tropics (2). The species encompasses a wide variety of shapes and sizes of peppers, both mild and hot, ranging from bell peppers to sweet peppers. Sweet pepper may be used fresh or dried as a culinary spice, added to teas, or taken in capsules to reap its many medicinal benefits. These peppers contain high amounts of vitamin C and vitamin A. These vitamins are best obtained from the fresh fruits. Other beneficial bioactive components of the Sweet pepper are the content of flavonoids, alkanoids and tannins (7). Vitamin C has many beneficial effects on the immune system. It helps in repairing damaged brain tissues, reduced risk of oxidative stress, pediatrics asthma, cancer and improved bone health (7). *Capsicum* works as mucilage when ingested by

increasing the production of gastric mucus (21).

Capsicum annuum is attacked by many pathogens but heavy losses are caused by viruses. Aphids and whiteflies are by far the most important insects transmitting plant viruses, several viral disease cause mosaic, mottle, leaf curl, leaf roll, bushy stunt and necrosis symptom (26). The leaf curl disease of peppers (chilli) caused by leaf curl virus is transmitted by viruliferous whitefly, *Bemisia tabaci* (26). Surface Mulching either with synthetic or organic waste has been reported to stimulates the microbial activity in soil through improvement of soil agro-physical properties (29). Mulching also minimizes the use of N fertilizer (12), warms the soil and improves the soil physical condition (14,15), and suppresses weed growth (18,10,16,) and could account for increased yield (27, 25,19).

The objective of this work therefore is to determine the effect of different mulch materials on population of aphids and whiteflies, viral incidence and severity on sweet.

MATERIALS AND METHODS

The experiment was carried out at the vegetable experimental field, National Horticultural Research Institute (NIHORT), (7^o24''N and 7^o39'' E longitude 3^o 50 and 3^o52''N), Idi-Ishin,

Ibadan during the 2016 cropping season. Twenty one beds each measuring 1.5m × 1.5m with 1m between and within rows were made manually with hoe after ploughing and harrowing, each bed representing a plot. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The treatments were randomized in all plots. Arrangement of the treatment can be seen in Table 1. The organic mulch materials were applied at the rate of 3 kg per plot corresponding to 10t/ha, plastic sheet of 1.5m x 1.5m was used as synthetic mulch. Each plot represented different treatment and each treatment was replicated three times.

Agronomic data such as plants height, number of leaf and stem girth were collected fortnightly while, fruit and yield data were recorded as at when due. Five tagged plants were randomly sampled in each treatment for the population of whitefly, *Bemisia tabaci* and aphids using the scale below

Aphid and whitefly population was counted fortnightly on five tagged plants and the population was rated using the following scale of 0-3

- 0 =None
- 1 =Slight less than 50
- 2 =Moderate 50-100
- 3 =Severe >100.

Some distinct virus symptoms such as mosaic, leaf mottles, curling, malformation, plant stunting and premature fruits abortion were some of the features considered during data collection. Disease incidence and average severity were recorded fortnightly. Disease incidence was estimated using the following formula
Virus incidence (%) = $\frac{T}{D} \times 100$

D

Where, T= Total number of plants in a plot.
D=Total number of diseased plants in a plot

The Disease severity was assessed using a 1-5 Scoring system (3), where, 1 = Symptomless plants (No visible symptom observed).

2 = Mild symptoms (mosaic, mottle, leaf curl, leaf reduction, puckering on at least 25 % of the total plant leaves).

3 = Moderate symptoms (mosaic, mottle, leaf curl, leaf reduction, puckering on at least 50 % of the total plant leaves)

4 = Severe symptoms (mosaic, mottle, leaf curl, leaf reduction, puckering on the entire plant leaves)

5 = Severe symptoms (mosaic, mottle, leaf curl, leaf reduction, puckering on the entire plant leaves) plus stunting of the plant. The average severity is the average of all scored plants which is a reflection of the damage caused by the viral infection. The average severity

was calculated using the formula described below;

$$\text{Average severity} = \frac{ds1 + ds2 + ds3 + \dots + dsn}{Ndn}$$

Where, ds = Severity of diseased plants.

Ndn= Number of diseased plants.

Data collected were subjected to analysis of variance (ANOVA) using Statistical analytical software (SAS). And means separated using least significant difference (LSD) at 5 % level of probability.

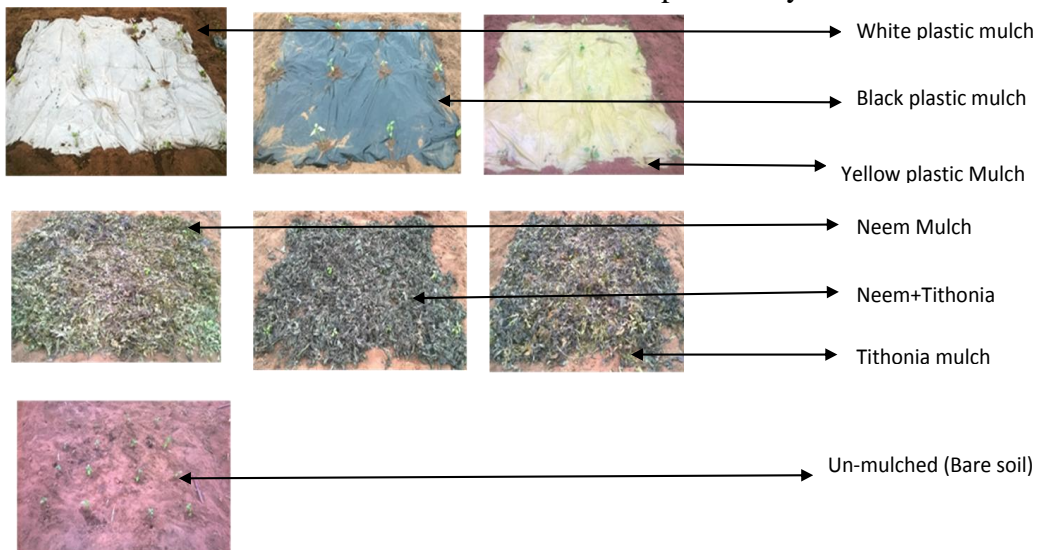


Plate 1: Different mulching materials (organic and synthetic)

RESULTS

Mulching materials effect on population of aphids (*Aphis gossypii*) and white flies (*Bemisia tabaci*).

Major insect pests observed on the *C. annuum* crop during the study period were aphids (*Aphis gossypii*) mostly located on the under surface of leaves, either singly or in colonies, white flies (*Bemisia tabaci* (Genn.), and variegated grasshoppers (*Zonocerus variegatus*). Table 2 shows the effect

of the different mulching materials on disease incidence, average severity, whiteflies and aphids population. The white plastic mulch recorded the least disease incidence (34.43) and was significantly different from all other mulching materials. Neem plot (50.13) also helped reduced disease incidence and was significantly lower than disease incidence recorded on bare topsoil plots (100.0). Average severity also followed similar trend as the disease incidence, the reflective white plastic mulch significantly recorded lower severity rate (1.27) as against

the bare topsoil (5.32). Whiteflies (*Bemisia tabaci*) population was significantly reduced to (0.33) under the white plastic mulch followed by the neem mulch (1.00) and Neem+tithonia mulch (1.67). Aphids (*Aphis gossypii*) population was significantly reduced by white plastic mulch (0.83), the population recorded was significantly different from the population on all other treatments, while the un-mulched plots had more aphid population on the growing pepper plants resulting into higher disease incidence and severity.

Mulching materials on the growth parameters and yield of *C. annum*:

The following growth parameters (number of leaves, stem girth, number of fruits and fruit weight) were accessed to determine the effect of both synthetic and organic mulch. Data on the mean plant height is presented in Table 3. It revealed that there was significant difference due to various mulch treatments. The maximum mean plant height (18.47 cm) was recorded in treatment 4 (Neem mulch) which was at par with white plastic mulch (16.47 cm) and Neem+ tithonia (16.57 cm) and was

significantly different from the other treatments. The least plant height (9.97 cm) was recorded on plots without mulch (Bare topsoil). The mean number of leaves and stem girth (cm) was significantly increased under neem mulch cover (47.33 and 10.50cm) and was significant over other treatments. The yellow, white and black mulch produced similar number of leaves and was highly significant from the number of leaves produced by plants under no mulch condition (19.00). From the data obtained and trend of the result, there is a significant relationship between higher numbers of leaf (47.33) and the number of fruit (101.17) produced by plants on plots mulched with Neem. The weight of the harvested fruits also significantly vary from each other, the neem mulched plants produced heavier fruits (250 grms). Other treatments such as Neem+tithonia (194.63 grms), tithonia (183.10 grms) and white plastic mulch (188.07grms) also produced marketable fruits and was significantly different from fruits on control plots (98.90 grms).

Table 1: Arrangement of treatments used

Treatment	Mulch	Variant
One	Plastic mulch	White
Two	Plastic mulch	Black
Three	Plastic mulch	Yellow

Four	Organic mulch	Neem leaves
Five	Organic mulch	Tithonia leaf
Six	Organic mulch	Neem leaf + Tithonia leaf
Seven	Control	No mulch

Table 2: Effect of different mulching materials on disease incidence, average severity, white fly and aphid population on sweet pepper

Treatment	Disease incidence (%)	Average severity	Whitefly population	Aphids population
White	34.43±3.35	1.27±0.38	0.33±0.58	0.83±0.76
Black	78.30±2.61	3.52±0.62	3.00±1.00	5.00±1.00
Yellow	90.33±1.19	4.13±0.36	4.17±0.76	6.83±1.04
Neem	50.13±4.67	1.73±0.54	1.00±0.04	1.33±0.58
Tithonia	63.27±3.79	2.26±0.25	2.33±1.04	3.33±0.58
Neem+tithonia	60.27±1.42	2.09±0.13	1.67±0.58	6.83±0.76
No mulch	100.00±2.29	5.32±0.48	8.33±1.53	9.67±0.58
LSD (0.05)	4.76	0.61	1.32	1.49

Each value represents the mean ± standard deviation

Table 3: Effect of different mulching materials on growth parameters and yield of sweet pepper

Treatment	Plt.hgt	No.lf	Stm.ght	No.Frt	Wt.Frt
White	16.47±1.90	39.46±1.89	7.60±0.62	6.67±1.53	188.07±1.81
Black	13.90±0.17	36.17±8.61	6.73±1.50	5.83±0.58	161.74±1.41
Yellow	13.40±2.15	35.67±4.37	6.73±2.32	4.00±1.00	128.23±2.14
Neem	18.47±1.91	47.33±9.29	10.50±1.23	101.17±1.26	250.50±2.01
Tithonia	12.47±2.40	32.17±3.75	6.53±1.21	6.17±0.76	183.10±2.72
Neem+tithonia	16.57±2.38	43.33±12.21	8.70±1.01	8.33±0.76	194.63±2.51
No mulch	9.97±1.70	19.00±1.00	5.43±1.00	3.33±0.58	98.90±3.36
LSD(0.05)	3.20	12.72	2.56	1.81	3.97

Each value represent the mean ± standard deviation NB: ,Plt.hgt= plant height, No.lf= Number of leaf, Stm.ght= Stem girth, No.Frt= Number of fruit, Wt.Frt= Weight of fruit.

DISCUSSION

This study shows that different types of mulches have different beneficial effects in decreasing aphid and white fly populations and improving the fruiting response of sweet pepper. That fewer aphids recorded on the white plastic mulch plot compared to other mulches and bare soil agrees with earlier reports on the insect-repellent characteristic of this polyethylene film (11,13, 22,23). Therefore, clear mulch may be useful for sweet pepper production where aphids are a problem because they might induce a direct damage by the feeding behaviour (11) and also, they could be vectors of viruses during the growing season (5,30).

The results obtained in this study reveals that Neem, Neem+tithonia and white plastic mulch increased plant height, foliage and resulting into good yield of sweet pepper after it must have decomposed. This is in agreement with previous findings of Hudu *et al.* (2002). (4) .

Low values obtained in white plastic mulch for disease incidence, average severity, whitefly and aphids population could be as a result of the reflective nature of the white plastic mulch. Reflective plastic mulch has been shown to help control whitefly and aphid. This control is due to the fact that reflective plastic mulch reflects ul-traviolet (UV) wavelengths, unlike black or clear plastic mulches. (30) reported that the onset of virus disease symptoms was delayed by 3 to 6 weeks in plants grown over

reflective plastic mulch which was critical for normal flowering and fruiting. In addition, reflective plastic mulch delayed and reduced the severity of silverleaf whitefly infestations in squash, pumpkins and cucumber (30).

The neem plant (*Azadirachta indica* A. Juss), has long been recognized for its properties against insects and flies. They are known to be a natural bio-pesticide with a high rate of insect repellent. (17) observed that azadirachtin operates at the cellular level of insect by disrupting protein synthesis and secretion events and at the molecular level by altering transcription process. This makes them act as bio-pesticides and therefore tends to control insect pests, especially aphids and whiteflies

The high values observed on the control plot (No mulch) in this study for disease incidence, average severity, whitefly and aphid population justifies the fact that mulches reduce whiteflies and aphids borne viruses. This result agrees with the work of (6) who reported that whitefly and aphids was reduced by 59% when plants are mulched with transparent polythene sheet. (8) reported significant reduction in thrips population and has been attributed it to mulch color effect on the vector, due to a modification of the light environment around the plant

The reduction in virus disease incidence in plots with neem and neem+tithonia could be responsible for the increased fruit weight and

yield. (24) reported that mulching reduces the deterioration of soil by way of preventing runoff and soil loss, minimizing weed infestation, checks the water evaporation and improve fertility leading to increase yield.

CONCLUSION

This study has explored the possibility that though mulches might control insect pests and increase yield, however the type of material should be taken into consideration. Data generated in this study have shown that white plastic mulch may be more effective in suppressing pest populations of pepper, but neem mulch may provide better organic manure when decomposed and also as refuge for the natural enemies, it is therefore recommended as an integral option for pest management in pepper production. More studies should be conducted to establish the relationship of mulches to insect pest control in general.

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