

THE EFFECT OF MULCHING PRACTICES ON PATHOGENIC DISEASES OF TWO PEPPER (*Capsicum Spp*) VARIETIES

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Abstract

Field experiments were conducted during the 2013/2014 cropping season to assess the effect of three mulching materials on the pathogenic diseases affecting two common pepper varieties (*Capsicum annum* and *Capsicum frutescence*). The mulching materials were clear nylon, black nylon and hay and the plants sown on bare soil served as control for the experiment. The seedlings were raised for 28 days in an insect proof nursery and then transplanted into the field. The experiment was laid out in a Randomized complete block experimental design with three replications. Data were collected on growth parameters (plant height, number of leaves) and disease severity (number of diseased leaves per plant). The number of fruits, as well as fresh and dry weights of the fruits per plant which served as yield parameters. Results showed that irrespective of variety, soil mulched with hay comparatively produced significantly lowest number of diseased plants compared to mulching with clear nylon, black nylon and control. At 35 days after transplanting, *C. annum* and *C. frutescence* mulched with hay had significantly lowest disease severity of 1.7% and 1.9% respectively. Growth indices also showed that at 35 days after transplanting, *C. annum* plants mulched with hay recorded the tallest and highest number of leaves (20.4cm and 32.5 respectively). Yield parameters also showed that the highest number of fruits (9.3), fresh fruit weight (81.6g) and dry fruit weight (68.8g) were recorded in *C. annum* plants mulched with hay. Mulching pepper plants with hay was the best in this study and thus recommended.

Keywords: Mulching, Pathogen, Pepper, *Capsicum annum*, *Capsicum frutescence*.

Introduction

Pepper belongs to the genus *Capsicum* and family Solanaceae (Díaz-Pérez *et al.*, 2007). It is an indispensable ingredient for food preparation throughout the world (Green and Kim, 1991) and is also utilized in the pharmaceutical, cosmetic and poultry industries (Jin *et al.*, 2009). It is estimated that the total world production of pepper in 2013 to be around 401,000 metric tonnes (WSC, 2014). Large scale pepper production in Nigeria is mostly found in the Northern part (Quinn, 1980).

In spite of the importance of pepper as spice, pests and diseases are still some of the important factors militating against optimum production due to massive loss of pepper produce both on the field and in storage (Balogun *et al.*, 2005). Bacterial spot is one of the most devastating diseases of pepper in warm, moist environments and the most obvious symptoms occur on leaves as small, yellow-green lesions (Ritchie, 2000). Fungi have been reported to be pathogenic to *Capsicum* varieties causing diseases such as seed rot, damping off, root rot, fruit rot, wilt and foliar diseases (Al-kassam and Monawar, 2000). The interaction of fungi and plant parasitic nematodes have been shown to cause plant disease complexes which may increase the severity of disease (Senthamarai *et al.*,

2008). Virus diseases are also important in contributing to low pepper yields and reduce fruit quality (Pares and Gunn, 1989).

Although the use of chemicals have contributed immensely to reduction of pest and diseases on pepper, it is not without problems. Apart from the high cost of these chemicals they undoubtedly pose health hazards to the environment (Gilden *et al.*, 2010). This has encouraged research into more sustainable and environmentally friendly methods of pest control. Mulching involves covering of the soil surface with crop residue(s) or other material such as paper or polyethylene film (Unger, 1995). The use of mulch has become an important cultural practice in commercial production of vegetables in many regions of the world in order to maximise water use by the plant and the reduction of the effect of weeds, pest and diseases (Lamont, 1993; Diaz-Perez *et al.*, 2007).

The objective of the study therefore was to determine the effect of different mulching materials on pathogenic diseases of two capsicum varieties.

Materials and method

Experimental site and source of seed varieties

The experiment was conducted at the Teaching and Research Farm of the Faculty of

Agriculture, University of Ilorin-Nigeria (Latitude 8° 29'N, Longitude 4° 35'E) in the 2013/2014 cropping season. The soil type is sandy-loam with pH of 7.2. Seeds of *Capsicum annum* and *Capsicum frutescens* were obtained from the National seed service station Ilorin, Kwara State.

Nursery establishment and field planting operations

Two hundred seeds of each variety were sown in plastic pots in previously steam sterilized sandy-loam soil which was then mixed with organic fertilizer (50kg/ha of poultry droppings) and kept in an insect proof nursery. After 28 days, the seedlings were transplanted to ready prepared beds of 2m X 1.5m with plant spacing of 0.75cm X 0.75cm. 200kg/ha of NPK 10-10-10 was then drilled into the soil. Weeding was done manually with hoes at 4, 6, 8 and 10 weeks after transplanting. The mulching materials were designed to rest closely over the plant rows. The treatments were assigned in a randomized complete block experimental design with three replications as follows: 1) *Capsicum annum* + clear nylon (CA+CN), 2) *Capsicum annum* + black nylon (CA+BN), 3) *Capsicum annum* + Hay (CA+H), 4) *Capsicum annum* + bare soil (CA+control), 5) *Capsicum frutescens* + clear nylon (CF+CN), 6) *Capsicum frutescens* + black nylon (CF+BN), 7) *Capsicum frutescens* + Hay (CF+H), 8) *Capsicum frutescens* + bare soil (CF+control).

Data collection and analysis

Data were collected on weekly basis from the 28 - 84 day after transplanting (D.a.t) of growth (Plant height, Number of leaves per plant), disease (Number of diseased leaves per plant). Percentage severity was calculated as the number of leaves with symptom expression relative to the total number of leaves per plant. At 126 days after transplanting, the total number

of fruits, fresh and dry weights of fruit per plant were calculated as the yield data. Collected data were subjected to analysis of variance using the Statistical package for Social Sciences (SPSS 15.0 for Windows Evaluation Version) and the means separated using Duncan multiple range tests at $P = 0.05$.

Results and Discussion

Effect of mulching material on disease severity

The application of mulches to pepper caused a significant reduction in the severity of diseases caused by pathogens compared with sowing on bare soil (Table 1). The most effective being mulching with hay. At 35 days after transplanting, *C. annum* and *C. frutescens* mulched with hay had the significantly lowest severity of 1.7% and 1.9% respectively. This trend continued even to 84 days after transplanting (14.8% and 15.1%). This indicates that irrespective of variety, mulching pepper particularly with hay resulted in the significantly lowest infection rates compared with other methods. From the 35th (3.2%) to 84th (30.1%) day after transplanting, the pepper plants sown on bare soil (Control), produced the significantly highest infection rates.

According to Orozco-Santos *et al.*, (1995) mulches possess a reflective ability and repellent effect on vectors of pathogenic diseases. Brown *et al.* (1989) also found that the incidence and severity of southern blight was significantly lower in pepper grown with mulches. This was confirmed in the present study. The low disease severity observed on the mulched pepper plants therefore could be as a result of reduced number of vectors occasioned by the reflective ability of the mulches and the preventive nature of the mulches which served as a bridge of preventive covering between the soil and plants.

Table 1: Disease severity of *C. annum* and *C. frutescens* plants as influenced by mulching type

Treatment combination	Days after transplanting								
	28	35	42	49	56	63	70	77	84
CA + CN	0.0	2.4 ^b	4.4 ^b	8.8 ^b	12.6 ^c	14.2 ^c	18.1 ^c	24.3 ^c	24.6 ^c
CA + BN	0.0	2.7 ^{ab}	4.0 ^b	8.1 ^c	9.9 ^d	13.3 ^d	15.5 ^d	18.8 ^e	19.1 ^d
CA + H	0.0	1.7 ^c	2.7 ^c	7.9 ^d	9.1 ^e	11.4 ^e	13.0 ^e	14.7 ^f	14.8 ^f
CA CONTROL	0.0	3.2 ^a	5.7 ^a	12.7 ^a	13.8 ^a	19.7 ^a	25.1 ^a	29.7 ^a	29.8 ^b
CF + CN	0.0	2.5 ^b	4.3 ^b	8.9 ^b	9.6 ^d	14.0 ^c	15.7 ^d	22.0 ^d	24.9 ^c
CF + BN	0.0	2.8 ^b	4.2 ^b	8.1 ^c	13.3 ^b	13.1 ^d	18.0 ^c	18.8 ^e	18.9 ^e
CF + H	0.0	1.9 ^c	2.8 ^c	7.9 ^d	9.4 ^d	13.0 ^d	15.3 ^d	18.6 ^e	15.1 ^f
CF CONTROL	0.0	3.1 ^a	5.8 ^a	12.5 ^a	13.6 ^a	18.9 ^b	24.9 ^b	29.5 ^b	30.1 ^a
EM	0.0	0.192	0.160	0.211	0.274	0.262	0.34	0.587	0.590

Values followed by the same letter in each of the column are not significantly different at $P = 0.05$.

CA+CN = *Capsicum annum* + clear nylon. CA+BN = *Capsicum annum* + black nylon. CA+H = *Capsicum annum* + hay. CA control = *Capsicum annum* on bare soil. CF+CN = *Capsicum frutescens* + clear nylon. CF+BN = *Capsicum frutescens* + black nylon. CF+H = *Capsicum frutescens* + H. CF control = *Capsicum frutescens* grown on bare soil.

Effect of mulching on plant height

Mulching resulted in an increased plant growth as compared to the control (Table 2). At 35 DAT, CA+H had the significantly tallest plants (20.4cm), followed by CF+H (19.4cm), CA+BN (16.2cm), CA+CN (15.2cm) and CF+CN/CF+BN (14.3cm). The control plants sown on bare soil produced the shortest plants (12.2cm). This similar trend was continuous to the 84 day after transplanting.

The experiment showed that plant height was significantly different and

Table 2: Mean plant height of *C. annum* and *C. frutescence* plants as affected by clear nylon mulch, black nylon, dry grass and bare soil mulching effect (cm).

Treatment combination	Days after transplanting								
	28	35	42	49	56	63	70	77	84
CA + CN	12.2	15.2 ^d	18.6 ^c	22.3 ^c	26.4 ^{fb}	32.8 ^c	37.9 ^c	45.1 ^c	51.6 ^b
CA + BN	12.4	16.2 ^c	18.9 ^c	25.5 ^c	30.2 ^d	35.9 ^d	41.9 ^b	46.8 ^b	51.9 ^b
CA + H	12.3	20.4 ^a	25.4 ^a	29.7 ^a	34.5 ^a	39.0 ^{ab}	43.2 ^a	51.7 ^a	57.9 ^a
CA CONTROL	12.2	12.2 ^f	17.7 ^c	22.2 ^d	26.1 ^g	31.9 ^f	36.8 ^d	41.2 ^d	43.2 ^d
CF + CN	12.3	14.3 ^e	18.3 ^d	22.9 ^e	27.6 ^e	32.5 ^e	36.9 ^d	45.6 ^c	49.9 ^c
CF + BN	12.3	14.3 ^e	18.6 ^c	24.1 ^d	31.3 ^c	36.1 ^c	41.0 ^b	46.6 ^b	50.9 ^b
CF + H	12.4	19.4 ^b	25.0 ^{ab}	28.8 ^b	34.0 ^{ab}	39.6 ^a	43.3 ^a	51.6 ^a	57.1 ^a
CF CONTROL	12.2	12.2 ^f	17.8 ^e	22.5 ^f	26.6 ^f	31.4 ^f	36.6 ^d	40.9 ^e	43.5 ^d
SEM	NS	0.609	0.160	0.211	0.274	1.060	1.346	1.117	1.288

Mean values followed by the same letter in of the each column are not significantly different at P = 0.05. NS = Not significant

Effect of mulching on number of leaves

Table 3 shows the effect of mulching types on average number of leaves per plant. From the 35 - 85 days after transplanting, the mulched plants produced the significantly highest number of leaves compared with the plants sown on bare soil (control). However, at all the growth stages of the plants, the highest number of leaves were in the plants with hay mulching. At 84th day after transplanting, the highest means were observed in the following treatments: CF+H (107.1), followed by CA+H(106.9), CA+BN (99.9), CF+BN (98.9), CF+CN (93.9) and CA+CN (92.8). The

Table 3: Average number of leaves per plant of *C. annum* and *C. frutescence* plants as influenced by mulching types

Treatment combination	Days after transplanting								
	28	35	42	49	56	63	70	77	84
CA + CN	11.3	17.9 ^d	23.9 ^c	30.4 ^c	44.3 ^d	55.9 ^e	60.8 ^d	81.1 ^c	92.8 ^c
CA + BN	11.1	27.2 ^b	35.9 ^b	40.7 ^b	44.6 ^d	61.5 ^d	80.1 ^a	91.8 ^b	99.9 ^b
CA + H	11.3	32.5 ^a	36.8 ^a	49.3 ^a	59.3 ^b	69.7 ^b	81.0 ^a	97.5 ^a	106.9 ^a
CA CONTROL	11.1	15.7 ^e	22.9 ^d	27.7 ^d	38.6 ^e	50.6 ^f	57.4 ^e	61.6 ^d	64.4 ^d
CF + CN	11.2	18.3 ^c	23.8 ^c	30.6 ^c	45.0 ^c	54.9 ^e	62.1 ^c	81.6 ^c	93.9 ^c
CF + BN	12.9	27.8 ^b	35.8 ^b	40.9 ^b	44.9 ^d	63.1 ^c	81.2 ^a	92.6 ^b	98.9 ^b
CF + H	11.4	32.4 ^a	36.7 ^a	49.1 ^a	60.0 ^a	70.2 ^a	83.3 ^a	97.6 ^a	107.1 ^a
CF CONTROL	11.2	15.3 ^e	22.8 ^d	27.4 ^d	39.1 ^e	51.4 ^f	66.6 ^b	62.9 ^d	65.5 ^d
SEM	NS	1.073	1.225	1.375	1.809	2.920	3.667	3.929	3.357

Mean values followed by the same letter in of the each column are not significantly different at P = 0.05.

increased with plant age depending on the mulching material. Ayoub, (1986) and Faria Larios *et al.*, (1994) reported that water deficit often limits crop growth and that increased plant growth in mulched plants may be related to conservation of soil moisture content. Hassan *et al.* (1994) also revealed that mulching with black or clear plastic increased total plant growth in chilli production. Roy (1996) reported that straw mulches provide a relatively longer period of cover on the soil.

lowest values were in the control treatment (64.5 -65.5).

Ansary and Roy (2005) revealed that different types of mulching materials significantly influenced the number of leaves in watermelon. The increase was attributed to minimized evaporation loss and sufficient soil moisture near root zone due to mulching. It can be opined from the present study that the extended retention of moisture and availability of moisture led to higher uptake of nutrients for proper growth and development of the pepper plants.

Effect of treatment on yield

Table 4 indicates that mulching produced significantly higher number of fruits, fresh and dry fruit weights than the controls. The highest average number of fruits (9.3), fresh fruit weight (81.6g) and dry fruit weight (68.8g) were recorded in the treatment CA+H. The lowest average fresh fruit number (2.2), fresh fruit weight (28.7g) and dry fruit weight (18.8g) was recorded in the CF+control.

Yields were higher in the mulched plants that produced lower infection rates and therefore indicates that yield has an inverse relation with disease severity. Smedegaard-Petersen and Tolstrup (1985) had reported that yield reduction is generally considered as a major problem associated with disease infection. The finding from the present study is in agreement with Anjorin and Mohammed (2009) who found a strong inverse relationship existing between *Pythium aphanidermatum* inoculum density and yield of the host plant.

Table 4: Mean number of fruits, fresh fruit weight and dry fruit weight per plant of *C. annuum* and *C. frutescens* plants as influenced by mulching types

Treatment combination	Number of fruits	Fresh fruit wt (g)	Dry fruit wt (g)
CA + CN	6.3 ^c	66.9 ^c	44.9 ^c
CA + BN	7.6 ^c	77.4 ^b	53.9 ^c
CA + H	9.3 ^a	81.6 ^a	68.8 ^a
CA CONTROL	3.1 ^f	36.3 ^g	21.9 ^g
CF + CN	6.5 ^c	62.4 ^f	43.6 ^f
CF + BN	7.0 ^d	68.8 ^d	47.9 ^d
CF + H	8.4 ^b	71.4 ^c	60.7 ^b
CF CONTROL	2.2 ^g	28.7 ^h	18.8 ^h
SEM	0.272	2.073	2.225

Mean values followed by the same letter in of the each column are not significantly different at P = 0.05.

Conclusion

Mulching causes reduction in the severity of pathogenic diseases associated with pepper and enhanced yield parameters. Mulching pepper plants with hay was the best in this study and thus recommended.

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