



INTERACTION OF DOSAGE AND SPRAY FREQUENCY OF HENNA (*Lawsonia inermis*) LEAF EXTRACTS IN THE MANAGEMENT OF ALTERNARIA LEAF SPOT DISEASE OF CUCUMBER (*Cucumis sativus* L.) IN MAIDUGURI, NIGERIA

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ABSTRACT

Field trial was conducted in 2018 and 2019 cropping seasons at Teaching and Research Farm of the Faculty of Agriculture, University of Maiduguri to assess the effects of the interaction of dosage and spray frequency of *Lawsonia inermis* leaf extracts in the management of *Alternaria* leaf spot disease of cucumber in Maiduguri. The treatments consisted of three Dosages (50g/L, 75g/L and 100g/L) assigned as a Vertical factor and five spray regimes (no spray, spray once, spray twice, spray thrice and four times) as a horizontal factor, factorially combined and laid out in a split plot design with three replications. Results of the experiment showed that, interaction of the spray frequency (three or four times) and dosage (100g/L) of the leaf extracts significantly reduced disease incidence and severity of *Alternaria* leaf spot disease better than the other treatment combinations. The result further revealed a significantly higher yield increase under the same condition than the other treatments considered. Based on the result of this findings, it can be concluded that spraying of cucumber three or four times coinciding with the fruiting stage of the crop were important in reduction of the disease.

Keywords: *Alternaria* leaf spot, Cucumber, Dosage, Henna, Spray frequency.

INTRODUCTION

Cucumber (*Cucumis sativus* L.) is a member of the Cucurbitaceae family, an important vegetable crop (Eifediyi and Remison, 2010). In Europe, it is the second most important crop after tomato (Phu, 1997). In Nigeria, the cucumber profile is rising due to wide spread knowledge of its benefit (Iyabo and Olabunmi, 2016; Umeh and Ojiako, 2018). FAO (2014) reported that Nigeria produces 347 metric tons of fruit melon with a yield of 43,257 kg/ha compared with the yield of 360,000 metric tons obtained in Egypt. Low yield in Nigeria were attributed to higher insect pest infestation as well as fungal diseases (Pareek and Kavandia, 1988). In Borno state in particular farmers are engaged in both rainfed and dry season farming of the crop but the yield obtained is very low due to insect pest particularly red melon beetles which is endemic (Yirngau, 2020), fungal foliar diseases especially *Alternaria* leaf spot disease caused by *Alternaria alternata* is very common and a limiting factor in the production of cucumber melon, it can devastate crops with yield losses ranging between 5% and 30% in southeastern Nigeria (Onovo, 1992). Farmers most often use synthetic pesticides in the control of pest and diseases. However, due to the deleterious effects of pesticides, alternative means need to be resorted for, therefore, the need for botanical pesticide use arises as their importance cannot be over stressed. Natural products have long played an important role as pest control agents and continue to serve as an excellent source of inspiration for the development of new agrochemical compounds.



In 2012, natural products and natural product-inspired products comprised approximately 30% of the global agrochemical sales, while an additional 22% of synthetic agrochemical compounds could have been inspired by natural products under different circumstances (Gerwick and Sparks, 2014). Thus, the opportunity for discovery and development for natural products in agricultural applications is large. One of the natural derived pesticides is the Henna.

Henna (*Lawsonia inermis* L.) is a shrub belonging to the family Lythraceae also known as Lalle in Hausa, mehndi in Arabic and Hindi, respectively (Mohammed and Mustafa, 1994). It is worldwide known as cosmetic agent used to stain hair, skin and nails (Hanna *et al.*, 1998). *Lawsonia inermis* contain the active ingredient lawsone which has the antimicrobial and fungicidal properties (Borade *et al.*, 2011; Hema *et al.*, 2010), natural naphthoquinones like alkannin and shikonin are the substances responsible for the antimicrobial and fungicidal properties (Abdulmoneim, 2007). Henna is readily available in the study area, cheap, and easy to process. This investigation was therefore initiated to determine the effect of the interaction of dosage and spray frequency of Henna plant leaves extracts in the management of *Alternaria* leaf spot disease of cucumber melon in Maiduguri.

MATERIALS AND METHODS

Cucumber (cv. Lege) was used for the experiment in the 2018 and 2019 wet seasons at the Teaching and Research Farm of the Faculty of Agriculture, University of Maiduguri, Nigeria. The seeds were sown on a flatbed which was earlier ploughed, harrowed and pulverized into fine tilth. Three seeds were sown per stand and spaced 75cm apart. The plots size

(3m x 3m) were laid out in a strip plot design, where dosage was assigned as the vertical factor and spray regimes as the horizontal factor, replicated three times. Plots were separated by a gap of 0.5m and replications separated by a 1.0m gap. NPK (20:10:10) fertilizer were applied at the rate of 30kg/ha. At land preparation 16 kg/ha fertilizer were applied at 3weeks after sowing (WAS) and the remaining at 6 WAS (Odeleye and Adedokun, 2006), plants were thinned to two per stand two weeks after emergence.

Henna (*Lawsonia inermis*) fresh leaves were collected and dried for one week in a shade. The dried leaves were lightly crushed and weighed into 50g, 75g and 100g which were dissolved differently into 2L bucket containing 1000ml of portable water, the mixture was allowed to stay overnight. The mixture was sieved using a fine cloth. The filtrate was then poured into a hand-held sprayer (3L capacity). Spraying commences 4WAS and was followed by three other sprays at two weeks interval until harvesting. There were control plots which received no spray.

The disease incidence and severity were first assessed 3weeks after sowing (WAS) followed by assessment every 14 days. Disease incidence was calculated by counting the number of plants with leaf spots per plot which were then expressed as percentage of the total number of plants with leaf spots per plot. The disease severity was assessed using a visual scale of 0 – 5 as adopted by Bhat *et al.* (2013), the scale is as follows: 0 = no infection, 1 = 0.1 – 10%, 2 = 10.1 – 25%, 3 = 25.1- 50%, 4 = 50.1 – 75% and 5 = above 75% infection on the foliage.

The disease severity was calculated using the formula:

$$\text{Disease Severity (\%)} = \frac{\sum n}{N \times 5} \times 100$$

where;



Σn = Summation of Individual rating

N = Total no. of plant assessed

5 = Highest score on the severity scale

Five plants per plot were randomly selected to express the parameter per plant.

RESULTS AND DISCUSSION

The effects of interaction of dosage and spray frequency of *Lawsonia inermis* on disease incidence at 5 and 9 WAS in Maiduguri during the 2018 and 2019 wet seasons is presented in Table 1. Significantly ($P < 0.05$) higher disease incidence occurred in the unsprayed plots than that of the fungicide treated plots in both 2018 and 2019 wet seasons. There was generally rapid increase in the number of infected plants from 5 to 7 weeks after sowing. However, plants treated with 100g/L and sprayed four times had significantly ($P < 0.05$) lower rate of leaf spot disease compared with the other treatments. Regardless of the dosage and spray frequency, disease incidence did not differ significantly except at 9WAS. The result is in agreement with the findings of Zaker and Mosallanejad (2010); Sharma and Sharma (2011); Ahila *et al.* (2013) and Sanjeev *et al.* (2019), where they reported the potency of Henna in the control of *Alternaria* leaf spot disease of other crops in the field. The use of plant extracts in the control of *Alternaria* leaf spot disease have also been reported by Sahu *et al.* (2012) and Lok *et al.* (2020). Disease incidence is low in the treated than in the untreated plots. Similarly, plots treated with higher concentration of Henna had significantly lower value for disease incidence than plots treated with lower dosage of the fungicides.

Table 1: Effects of interaction of Henna dosage and spray frequency on incidence of *Alternaria* leaf spot disease of Cucumber in Maiduguri.

Treatment	Disease incidence (%)			
	2018		2019	
	5 WAS	9WAS	5 WAS	9 WAS
Dosage x Spray frequency				
50g/l x no spray	73.83 ^a	100.00 ^a	67.56 ^a	100.00 ^a
50g/l x once spray	62.41 ^{ab}	96.67 ^s	30.63 ^c	74.46 ^b
50g/l x twice spray	53.01 ^{bc}	74.33 ^b	28.53 ^c	71.68 ^b
50g/l x thrice spray	46.31 ^{cd}	62.23 ^c	27.13 ^c	52.40 ^{de}
50g/l x four spray	36.15 ^{de}	55.92 ^c	28.73 ^c	57.37 ^{cd}
75g/l x no spray	73.33 ^a	100.00 ^a	52.46 ^b	99.37 ^a
75g/l x once spray	35.20 ^{df}	38.43 ^d	22.03 ^c	62.83 ^c
75g/l x twice spray	29.26 ^{e-g}	35.70 ^{de}	23.43 ^c	49.85 ^{de}
75g/l x thrice spray	26.13 ^{e-g}	37.40 ^d	20.20 ^c	44.63 ^{ef}
75g/l x four spray	34.03 ^{ef}	34.53 ^{de}	20.23 ^c	29.08 ^g
100g/l x no spray	64.68 ^a	100.00 ^a	49.00 ^b	100.00 ^a
100g/l x once spray	32.40 ^{ef}	33.03 ^{de}	22.63 ^c	44.03 ^{ef}
100g/l x twice spray	28.90 ^{e-g}	31.05 ^{ef}	30.34 ^c	37.37 ^g
100g/l x thrice spray	2.30 ^{fg}	24.83 ^{fg}	25.28 ^c	33.03 ^g
100g/l x four spray	21.30 ^g	21.22 ^g	25.14 ^c	31.23 ^g
SE +	5.16	3.06	5.28	3.70

Means within a column followed by the same letter (s) are not significantly different at 5% level of probability according to Duncan Multiple Range Test (DMRT).

Disease severity were significantly lower in the treated plots than the untreated (Table 2). Significantly ($P < 0.05$) lower disease severity was observed in plots sprayed four times with 100g/L of plant extracts than in the other plots treated with lower concentration of the fungicides. Disease severity were generally higher in 2018 than in 2019 wet season. Nahunnaro and Bayaso (2011) reported that higher dosage of plant extracts drastically reduces the radial growth of *Alternaria solani* in-vivo. This implied that disease severity level was directly proportional to the concentration of plant extracts. Moreover, reduction in disease cause by each dose was decrease with increase in the spray frequency. This may clearly support others that spray frequency plays an important role in influencing disease development or secondary spread of disease. The results of this study are in conformity with that of Stephen *et al.* (2013) and Wegulo *et al.* (2015).

Table 2: Effects of interaction of Henna dosage and spray frequency on severity of *Alternaria* leaf spot disease of Cucumber in Maiduguri.

Treatment	Disease severity (%)			
	2018		2019	
	4 WAS	10 WAS	4 WAS	10 WAS
Dosage x Spray frequency				
50g/l x no spray	33.16 ^a	73.00 ^a	25.16 ^a	68.04 ^a
50g/l x once spray	22.95 ^b	46.68 ^{bc}	17.98 ^d	31.01 ^{cd}
50g/l x twice spray	23.08 ^b	40.46 ^{cd}	20.21 ^{bc}	30.31 ^{cd}
50g/l x thrice spray	21.83 ^{bc}	35.88 ^{de}	18.65 ^{cd}	27.58 ^{de}
50g/l x four spray	20.51 ^{b-d}	32.23 ^{ef}	17.98 ^d	20.30 ^{fg}
75g/l x no spray	29.11 ^a	55.10 ^b	19.25 ^{b-d}	64.81 ^a
75g/l x once spray	21.45 ^{bc}	25.40 ^{fg}	17.26 ^d	39.16 ^b
75g/l x twice spray	19.05 ^{b-e}	21.76 ^{g-i}	17.27 ^d	34.61 ^{bc}
75g/l x thrice spray	18.79 ^{b-e}	23.36 ^{f-h}	10.75 ^f	23.00 ^{ef}
75g/l x four spray	17.25 ^{c-f}	19.34 ^{g-i}	10.20 ^{fg}	16.54 ^g
100g/l x no spray	29.40 ^a	67.56 ^a	20.92 ^b	35.07 ^{bc}
100g/l x once spray	16.80 ^{c-f}	17.03 ^{g-i}	17.27 ^d	21.98 ^{ef}
100g/l x twice spray	15.92 ^{d-f}	16.78 ^{g-i}	15.00 ^e	19.16 ^{fg}
100g/l x thrice spray	14.23 ^{ef}	15.14 ^{hi}	8.58 ^{gh}	16.54 ^g
100g/l x four spray	12.20 ^f	12.09 ⁱ	7.28 ^h	8.21 ^h
SE +	2.42	3.93	1.00	2.57

Means within a column followed by the same letter (s) are not significantly different at 5% level of probability according to Duncan Multiple Range Test (DMRT).

Results for the effect of interaction of dosage and spray frequency on the yield of cucumber melon is presented in Table 3. Higher yield of 7 tones and over were obtained in plots treated with 100g/L regardless of the spray frequency in 2018 wet season. Similarly, in 2019, yield of 9.76 tones/ha of cucumber melon was obtained in plots treated with 100g/L of the plant extracts, although fungicidal sprays at 75g/L and 100g/L did not significantly affect yield of cucumber melon. The secondary metabolites of plants are vast repository of compounds with wide range of bioactivity. It has been reported that steroids, phenolics and tannins compounds had great impact on microbial activities. Phytochemical study in Henna have shown the presence of naphthaquinone derivatives, aliphatic compounds, triterpenes, sterols, phenolic, coumarins, xanthenes and flavonoids, (Jiny *et al.*, 2010). The potent activity



of *L.inermis* on the leaves of cucumber melon reduces the severity of *Alternaria altanata* most likely due to the presence of different classes of bioactive compounds. Hence, in this study, yield was significantly affected by fungicidal spray, although dose of 100g/L spray four times had significantly higher yield compare with the other dosages of the same extracts. It can be concluded that spraying of cucumber melon three or four times coinciding with the fruit set stage of the crop were important in the reduction of the disease.

Table 3: Effects of interaction of Henna dosage and spray frequency on yield of Cucumber in Maiduguri

Treatment	Yield (Tons/ha)	
	2018	2019
50g/l x no spray	3.06 ^f	2.28 ^h
50g/l x once spray	5.19 ^e	4.41 ^g
50g/l x twice spray	5.67 ^{de}	5.34 ^f
50g/l x thrice spray	5.37 ^e	6.22 ^e
50g/l x four spray	5.71 ^{de}	7.41 ^{cd}
75g/l x no spray	3.96 ^f	3.26 ^h
75g/l x once spray	6.15 ^{de}	6.66 ^{de}
75g/l x twice spray	6.63 ^{cd}	4.61 ^{fg}
75g/l x thrice spray	6.65 ^{cd}	4.86 ^{fg}
75g/l x four spray	7.66 ^{bc}	8.09 ^{bc}
100g/l x no spray	3.30 ^f	3.06 ^h
100g/l x once spray	7.50 ^c	4.68 ^{fg}
100g/l x twice spray	7.76 ^{bc}	8.64 ^b
100g/l x thrice spray	9.06 ^a	8.81 ^b
100g/l x four spray	8.75 ^{ab}	9.76 ^a
SE +	0.56	0.37

Means within a column followed by the same letter (s) are not significantly different at 5% level of probability according to Duncan Multiple Range Test (DMRT)

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