FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 3 No. 3, September, 2019, pp 509 –518

EVALUATION OF EFFECT OF FIVE SELECTED ANTIBIOTICS ON GROWTH OF WHITE AND YELLOW MAIZE VARIETIES

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ABSTRACT
The toxic and adaptive mutagenic effects of five aminoglycoside antibiotics (ampliclox, tetracycline, septrin, amoxicillin and ciprofloxacin) on germination and growth of white and yellow maize varieties were investigated. Seeds were subjecting to different concentrations of the antibiotics (0%, 0.0005%, 0.005%, 0.05%, 0.5% and 1%) and rinsed in distilled water before planting directly into the soil. The experimental design adopted was Completely Randomized Design with four replicates each. The phytotoxic impact of these antibiotics varied with the maize varieties and different concentrations used. All the maize seeds subjected to 1% of all the antibiotics had lower rates of germinations except for 1% ampliclox and control. It was found that both white and yellow maize varieties treated with the lower concentrations (0.0005 and 0.05%) of the antibiotics especially ampliclox exhibited highest amount of number of leaves, dry weight, number of days to flowering and number of grains while higher concentrations (0.5 and 1%) had limiting effects on the maize plants. The present study thus show that ampiclox drug had the highest percentage rate, highest number of leaves, dry weight, number of days to flowering and number of grains at lower concentration compared to the other drugs at the same concentration among the yellow and white maize varieties.

Keywords: antibiotics, white maize, yellow maize phytotoxic, tetracycline.

INTRODUCTION

Antibiotics which are meant to control bacterial infections in animals or humans are released into the environment via the excreta of treated bodies (Liu et al., 2009). Some of these antibiotics always remain biologically active after they have been released (Sarma et al., 2006) and this makes them more harmful to other organisms in the environments including plants (Baguer et al., 2000). Another frequent source of antibiotics release into the environment is through application of irrigation water particularly untreated wastewaters containing antibiotics (Gulkowska et al., 2008).

Much work has not been done on investigating the ecotoxicological roles of antibiotics on plants as they have not been well regarded as pollutants (Kümmerer, 2001; Rooklidge, 2004, Ikhajiagbe et al.,2015).Some antibiotics have the potentials to affect growth of plants and inhibit useful microbial activities in the soil (Jjemba, 2002). The phytotoxic effects can be investigated using the germination and growth experiments of plants (Kong et al., 2007). The early effects of antibiotics on plants were found to be dependent on the type of antibiotics and plant species (Farkas et al., 2007). This study investigated potential impacts of five antibiotics on germination and growth of white and yellow maize varieties in Mubi, Adamawa State Nigeria.

MATERIALS AND METHODS

Collection of seeds

10g of white and yellow varieties of maize seeds (Zea mays) were obtained from Mubi main Market, Adamawa State, Nigeria.

Preparation of amino glycoside solution

The respective % w/v concentration of each antibiotic was made by dissolving the various grams of the aminoglycoside in 100 ml of water. The five different antibiotics including ampiclox, amoxicillin, tetracycline, septrin and ciprofloxacin were used. Five different concentrations are: 0.0005%, 0.005%, 0.05%, 0.5% and 1.00% respectively. The control was distilled water and was designated 0%.

Pre-treatment of seeds with the five antibiotics.

Seed were subjected to varying concentrations of the five different antibiotics for 24hrs by fully submerging the seeds in the various amino glycosides prepared solutions. The treated seeds were washed in running water to remove excess chemicals and were kept in Petri dishes to observe germination at room temperature.

Field experiment

Three Seeds were sown directly into soil. NPK fertilizer was applied to the plants at the rate of 300kg per hectare and at placement distance 10cm and 15cm apart as proposed by

Adekayode and Ogunkoya, 2010 at 7 weeks after planting. On the field, plants were assessed for both vegetative and yield parameters which include plant emergence/survival rate, number of leaves, number of days to flowering, dry weight, number of ears per plant and number of grains per ear. The experimental design implemented was the completely randomized block design (CRD) following the assumption of the homogeneity of the experimental plot use. Hence, treatments were used randomly over the whole plot, each consisting of 4 replicates. In order to avoid bias and misidentification, treatment bags were properly labeled according to a given treatment name and replicate numbers following the method of Mshelmbula et al., 2012. Data was subjected to one way analysis of variance and Duncan multiple range tests was used to separate the significant means at $P \leq 0.05$.

RESULTS

Results showed that the maize varieties treated with lowest concentrations of all the antibiotics reached 100% germination rate, except for the ones treated with septrin and ciprofloxacin (Figure 1). All the plants treated with highest concentrations of the antibiotics (1%) have lowest germination rates except for the ones treated with amplicox whereby the 1% white maize reached 100% germination rate. The control maize varieties only had 20% germination rate.

The highest number of leaves (18) was observed on the white maize treated with 0.0005% and 0.5% ampiclox while the ones treated with 0.05% ciprofloxacin had the lowest number of leaves (Table 1). Plants treated with 0.5% and 1 % ciprofloxacin do not have any leaf. As for the yellow maize, the highest number of leaves (16) was also observed on the plant treated with 0.005 and 0.0005 ampliclox while the smallest was observed on the plant treated with 1.0 ciprofloxacin. For all the antibiotics used, the highest number of leaves was observed in the plants treated with lowest concentrations (0.0005%) of the antibiotics and these are significantly differently from the control (Table 1). The control plants were observed to have the significant highest number of days to flowering (74) in the two maize varieties (Table 2). As for the white maize, the lowest number of days to flowering was observed in the plants treated with 0.005% amoxicillin while the 0.005% ampiclox treated yellow maize had the lowest. Concerning the number of ear per plant into flowering, all the maize plants had the same amount (1) in all concentrations of the antibiotics including control, except for 0.0005%, 0.005% and 0.05% ampliclox and amoxicillin treated maize varieties which had significantly higher amount (Figure 2).

The highest number of grains per plant (426) was observed in the white maize treated with 0.0005% ampliclox, while the ones treated with 0.5% ciprofloxacin and control had the lowest values of 264 and 265 respectively (Table 3). As for yellow maize, the ones treated with 0.5% ampliclox had the highest number of grains per plant (651) while control plants have the lowest (224). The highest dry weight was found in white maize treated with 0.005% tetracyclin while 0.005% ciprofloxacin had the lowest (Figure 3). However, as for yellow maize, 0.0005% tetracyclin and 0.0005% amoxicilin treated plants were found to have the significant highest dry weight while 1% tetracyclin and control had the lowest.

DISCUSSION

The Toxic and adaptive mutagenic effects of the selected aminoglycoside antibiotics on growth and parameters of white and yellow maize have been investigated. Compared to septrin and ciprofloxacin at lower concentrations, the other antibiotics recorded 100% germination Marguiles (1962, 1964) reported that chloramphenicol hinders some of the light dependent responses of bean seedlings, including the synthesis of chlorophyll and the development of photosynthetic activity. As both factors are key to total development of the seedling, this may account for the significantly low dry weight of the sprouted seedling as well as the low number of root branches. These light dependent responses inhibited by Chloramphenicol have been reported to be associated with the maturation of the chloroplast (Marguiles, 1962, 1964).

It is known in mutagenic experiment that the germination/survival rate is inversely proportional to the dosage rate, the higher the treatment dosage, the lower the germination (Chandra and Tarar, 1988). This is supported by this work in which the germination rate decreased with increase in concentrations of the antibiotics treatments.

In both maize varieties, ampiclox at lower concentration (0.0005) recorded the highest number of leaves; ciprofloxacin had the least number of leaves among the two varieties of maize used.

As for the white maize, the lowest number of days to flowering was observed in the plants treated with 0.005% amoxicillin while the 0.005% ampiclox treated yellow maize had the lowest. The highest number of grains per plant was observed in the white maize treated with 0.0005% ampliclox, while the ones treated with 0.5% ciprofloxacin and control had the lowest values; for yellow maize, the ones treated with 0.5% ampliclox had the highest number of grains per plant and decrease with decreased ampiclox concentration. Although the effects of the antibiotics varied with the type of antibiotics, white maize variety was a bit more tolerant to the antibiotics than yellow maize variety. Some of these antibiotics particularly tetracycline and amoxicillin have been reported to have significant effects on growth of crop plants such as wheat and rice (Brain et al., 2008). Contrary to the report of Ghava et al., (2015), who stated that tetracycline was the most toxic antibiotic to wheat plants, our own study revealed that ampliclox was more toxic to the two maize varieties.

CONCLUSIONS

On the basis of the observation made on the effect of the five antibiotics on the two maize varieties, it can be asserted that the antibiotics induced variations in most of the parameters under study, more especially ampliclox and amoxicillin. Decreased ampilox concentrations showed promise of increase in seed germinations, number of flowers and yield of the grains of the two varieties of maize considered.

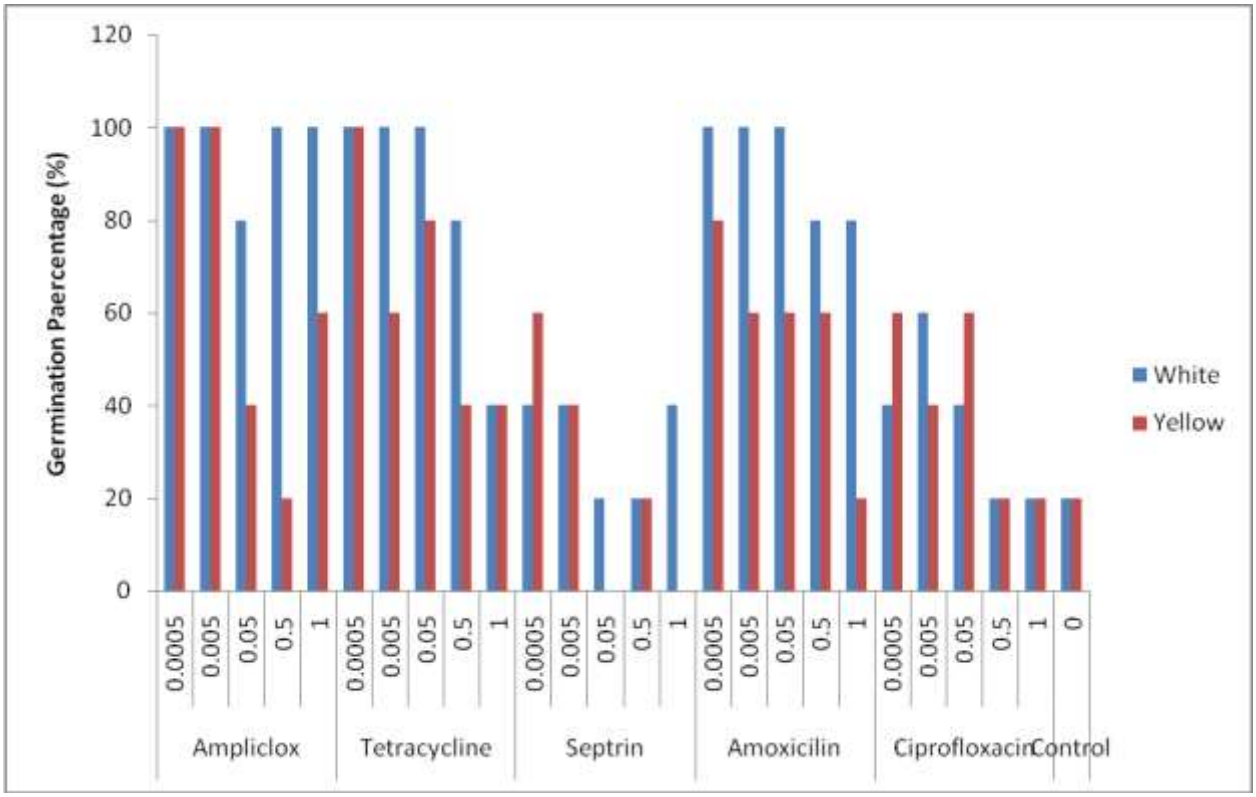

Fig. 1: Germination percentage of plants treated with different antibiotics

Table 1: Number of leaves per plant in two maize varieties treated with different antibiotics

Antibiotics	Concentration	White	Yellow
Ampiclox	0.0005	18.00a±1.00	16.00a±1.00
	0.005	18.00a±2.00	16.33a±2.00
	0.05	17.33a±0.58	15.00b±1.53
	0.5	18.00a±1.00	14.00c±1.00
	1.00	16.00b±1.00	14.00c±1.00
Amoxicillin	0.0005	15.33b±1.00	14.00c±1.00
	0.005	14.33c±1.15	14.00c±2.00
	0.05	14.00c±2.00	14.00c±1.00
	0.5	12.00d±.00	10.00d±1.00
	1.00	11.67d±1.00	12.00e±1.00
Ciprofloxacin	0.0005	11.67d±1.00	10.00d±1.00
	0.005	10.00d±0.58	10.00d±1.00
	0.05	9.67d±1.00	10.00d±1.00
	0.5	0e	10.00d±2.00
	1.00	0e	9.33d±1.15
Tetracyclin	0.0005	15.00b±1.00	14.00c±1.00
	0.005	14.00c±1.00	14.00c±2.00
	0.05	14.00c±1.00	13.6c±0.57
	0.5	13.00f±1.00	11.67e±1.53
	1.00	12.00d±1.00	12.00e±1.00

Septrin	0.0005	13.01f±1.00	10.00d±1.00
	0.005	12.33d±1.00	10.00d±2.00
	0.05	10.33d±1.53	0f
	0.5	11.33d±1.53	10.00d±1.00
	1.00	10.67d±1.15	0f
Control	0	12.00d±2.00	10.00d±1.00

Table 2: Numbers of days to flowering in plants treated with different antibiotics

Antibiotics	Concentration	White	Yellow
Ampiclox	0.0005	62.00a±2.00	63.00a±1.00
	0.005	62.00a±0.07	61.33b±1.52
	0.05	62.00a±1.73	63.67c±1.52
	0.5	62.00a±1.73	64.00c±1.00
	1.00	62.00a±1.00	63.67c±0.57
Amoxicillin	0.0005	62.00a±1.00	64.00c±1.00
	0.005	61.3a±0.57	63.33a±0.57
	0.05	62.33a±0.57	65.00d±1.00
	0.5	63.00b±1.00	65.00d±1.00
	1.00	62.33a±0.57	65.00d±1.00
Ciprofloxacin	0.0005	65.00c±1.00	66.00e±1.00
	0.005	65.33c±1.00	65.67e±0.57
	0.05	64.33d±0.57	65.67e±0.57
	0.5	67.00d±1.00	66.00e±1.00
	1.00	0e	67.00f±1.00
Tetracyclin	0.0005	63.67d±1.00	65.00d±2.00
	0.005	63.67d±0.00	64.67d±0.57
	0.05	64.00d±2.00	65.00d±1.00
	0.5	64.00d±1.00	65.00d±2.00
	1.00	64.67c±0.57	65.33d±1.15
Septrin	0.0005	66.33c±0.57	69.00g±1.00
	0.005	67.00d±1.00	68.00h±1.00
	0.05	68.00f±1.00	0i
	0.5	67.33d±0.57	70.33j±0.57
	1.00	66.00c±2.00	0i
Control	0	74.00g±2.00	74.00k±2.00

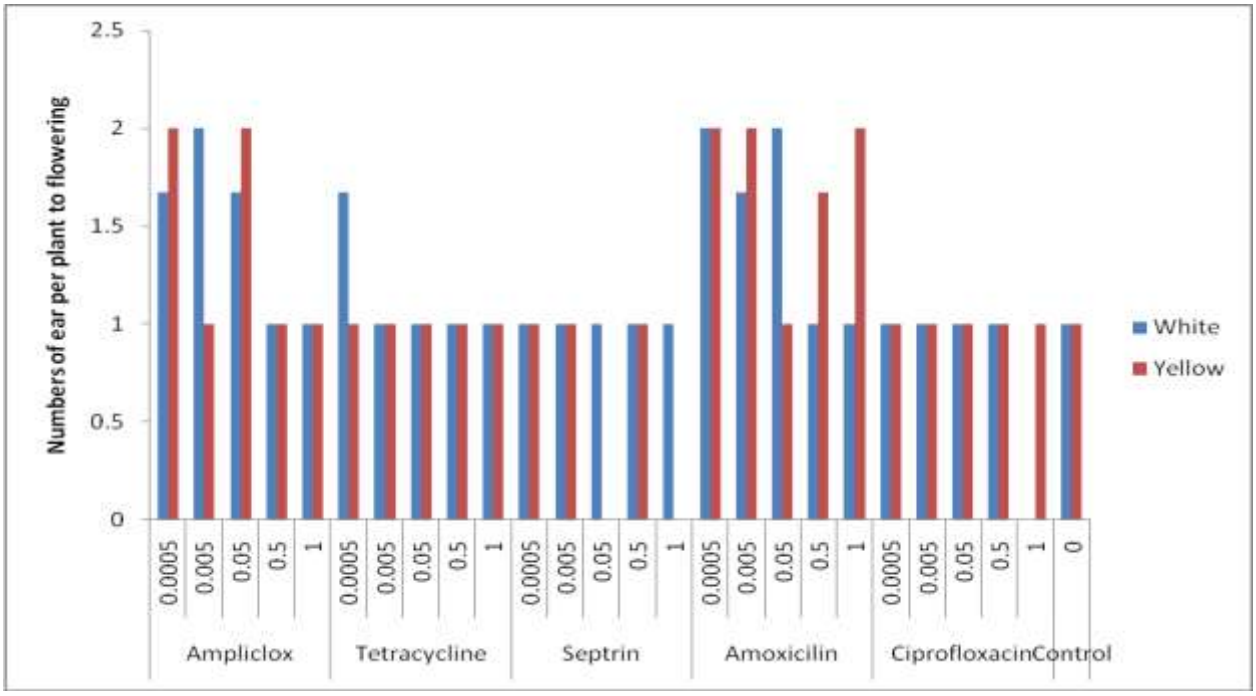

Fig. 2: Numbers of ear per plant to flowering in two Maize varieties treated with different antibiotics

Table 3: number of grain per plant in two maize varieties treated with different antibiotics

Antibiotics	Concentration	White	Yellow
Ampiclox	0.0005	426.00a±1.00	372.00a±2.00
	0.005	417.00a±1.73	362.00a±1.00
	0.05	407.67a±1.15	362.00a±2.00
	0.5	394.00b±2.00	651.00b±1.00
	1.00	383.00b±1.00	346.00c±0.00
Amoxicillin	0.0005	412.00a±2.00	393.00a±1.00
	0.005	409.00a±1.00	383.33a±1.15
	0.05	395.00b±2.00	378.00a±1.00
	0.5	383.00b±1.00	362.00a±1.00
	1.00	372.33c±1.00	267.33d±0.57
Ciprofloxacin	0.0005	411.00a±1.00	396.00a±73.61
	0.005	375.00c±2.00	384.00a±1.00
	0.05	286.00d±1.00	375.00a±2.00
	0.5	264.00d±2.00	362.00a±1.00
	1.00	0e	298.33d±1.15
Tetracyclin	0.0005	374.00c±2.00	342.00c±2.00
	0.005	372.00c±2.00	338.00c±1.00
	0.05	365.00c±2.00	333.00c±2.00
	0.5	352.67c±251	326.00c±1.00
	1.00	353.33c±1.15	304.00d±1.00
Septrin	0.0005	328.00f±2.00	257.33e±1.15
	0.005	343.67f±1.15	295.00d±2.00
	0.05	312.00g±2.00	0f
	0.5	303.33g±1.15	276.00d±2.00
	1.00	294.00d±2.00	0f
Control	0	265.00d±2.00	224.33e±2.30

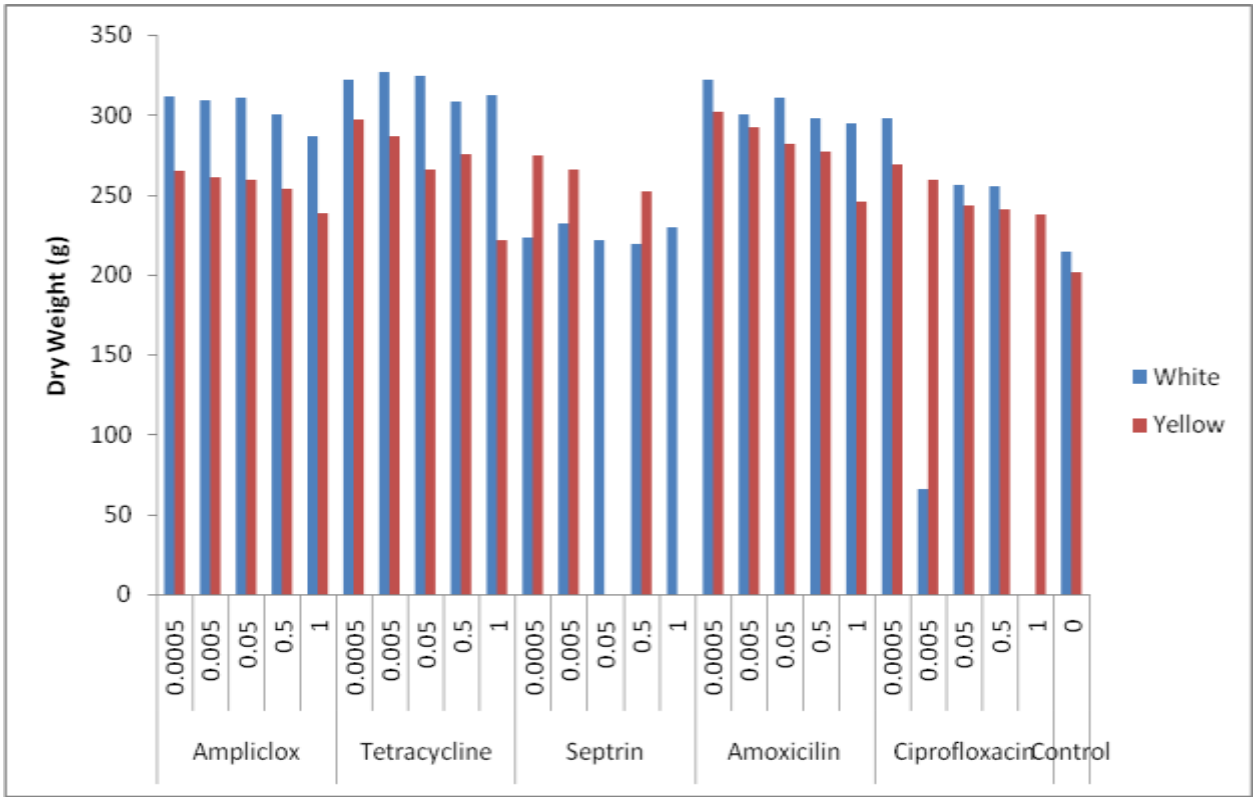

Fig. 3: Dry weights of two maize varieties treated with different antibiotics

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