# Improving growth and productivity of Guinea grass (*Panicum maximum*) using some biostimulants from *Azolla pinnata* and vermicompost.

**H. W. Hussein *, M. S. Al-Anany, and Kh. M. Ghanem**

*Environment and Bio-Agriculture Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt*

* Corresponding author E-mail: amiir88881@gmail.com (H. Hussein)

## ABSTRACT

Guinea grass plant (*Panicum maximum*) is a perennial plant that stays in the soil for 8 to 10 years and belongs to the Poaceae family. Guinea grass is a typical fodder crop highly productive, especially with climate change conditions. At Cairo's "Sadat" Research Farm, which is connected to the Faculty of Agriculture at Al-Azhar University, a study was carried out, to evaluate the use of *A. pinnata* (AE) and vermicompost extracts (VE) as biostimulants on the guinea grass plant (*Panicum maximum*). The experiment consisted of eight treatments (T1, AE 10% - T2, VE 10% - T3, AE 20% - T4, VE 20% - T5, AE and VE 10% - T6, AE and VE 20% - T7, without any fertilizers and T8, chemical fertilizers. In comparison to other concentrations of the biostimulants used, the results indicated that the use of biostimulants from *A. binate* and vermicompost extracts at a concentration of 20% of each together gave the highest values in the fresh and dry forage yield as well as the highest values in the percentage of protein during the two seasons.

**Keywords:** Organic farming; guinea grass (*Panicum maximum*); biostimulants; *Azolla pinnata*; vermicompost.

## INTRODUCTION

Panicum or guinea grass (*Panicum maximum* is a perennial plant that stays in the soil for 8 to 10 years and belongs to the Poaceae family. Panicum is a typical fodder crop, especially with climate change conditions. It is highly productive, producing 10 to 12 tons of dry matter, and its protein content reaches 16%. It can be fed to animals in its fresh form and in the form of silage, and it can be dried for several days and fed as a dry matter. It increases the productivity of dairy animals and is very good with goats, sheep, etc. Guinea grass tolerates soil salinity, irrigation with salty water, and high temperatures and is described as a climate-smart crop (Muir and Jank, 2004).

Materials other than fertilizers known as bio stimulants, when given in small amounts, encourage plant growth. There are numerous formulations and chemical variations for biostimulants. The most popular ingredients include humic substances (humic and fulvic acids), vermicompost and its derivatives, seaweed extracts, cyanobacteria and azolla, as well as beneficial bacteria & fungi (Kauffman *et al*., 2007).

Vermicompost tea is one of the most important growth stimulants for various plants. Additionally, it is abundant in a special kind of advantageous bacteria that can facilitate plant nutrients, enhancing plant development and productivity. (Yatoo *et al*., 2021).

Because liquid forms of vermicompost derivatives may reach the target area of the plant above ground through foliar spray and the underground rhizosphere section of the plant through soil drench, they are more effective than solid forms. To get the best results for controlling pests and diseases as well as, more importantly, for soil health and plant growth, vermicompost derivatives can be used alone or combined with solid vermicompost, fertilizer, or any other organic material in the soil (Sulaiman and Mohamed, 2020).

Azolla extract is used as a foliar fertilizer and bio-stimulant in a number of crops such as tomatoes and corn (Zea *mays*) (Hanafy and El-Emary, 2018 & Maswada *et al*., 2021). Its use with corn in conditions of water stress led to maintaining productivity, and the decrease in yield was slight compared to cultivation under normal conditions (Maswada *et al*., 2021).

The aim of this study is to evaluate the use of some biostimulants on the Panicum or guinea grass (*Panicum maximum*) plant grown in sandy soil under organic farming conditions.

## MATERIALS AND METHODS

### Source of *Panicum maximum* seeds

Guinea grass (*Panicum maximum* cv. Super Mombasa F1) seeds were bought from Agrimax Group Company, Saudi Arabia .The seeds were sown in cell plug trays within a cultivation chamber at 24°C.

**Preparation of biostimulants**

Two biostimulants were used in this study. *Azolla pinnate*, which obtained from Soils, Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt. Vermicompost which obtained from Organic Experimental Farm of Environment and Bio-Agriculture Department, Faculty of Agriculture, Al- Azhar University, Cairo, Egypt. The chemical analysis for the two types of crude and extracts biostimulants (*Azolla pinnate* and vermicompost) were performed at Soils, Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt and displayed in Table (1 and 2).

Extracts of both biostimulants were used. Using an air pump, 100 g of vermicompost extract (VE) was soaked in 400 ml of distilled water for 24 hours to create concentrations that were then made into water extracts, whereas, *Azolla pinnate* extract (AE) extraction were performed according to Taha and El-Shahat (2017) with some of minor modifications. Aqueous extracts of *A. pinnate* prepared by weighted 100 g of Azolla fresh and soaked in 400 ml of sterile distilled water at rate of 1:4 (w/v) then very little crushed, then mixed till a suspension is produced. The resulting suspension, which was filtered through muslin fabric, is the Azolla extract (AE), which *P. maxima* seedlings will be sprayed with foliarly. Two concentrations of both biostimulants water extracts were used as 10 and 20% (20ml water extract dissolved in 80 ml distilled water – 20%) and combinations of each concentration of Vermicompost extract (VE) with each concentration of *A. pinnate* extract (AE).

**Effect of different treatments application on herbage yield of *Panicum maximum* (t/f) during two seasons 2020/2021 – 2021/2022**

***Field experiment preparation***

The field experiment was carried out on guinea grass (*Panicum maximum* cv. Super Mombasa F1) plants during two seasons of 2020/2021 and 2021/2022 at the Experimental Farm of Faculty of Agriculture, Al- Azhar University, Sadat City, El-Menofia Governorate, north of Egypt (latitude: 30°25'18"N, and longitude: 30°32'40"E), in order to production of guinea grass under organic farming systems and investigate organic treatments influence on vegetative growth, yield and quality of guinea grass crop.

Soil received compost before plantation (Narmhikaa *et al*., 2019) which was obtained from Alfayrouz Company, Beheira Governorate, Egypt. With tillage establishment followed by the incorporation of compost at rate 25 t $ha^{-1}$. The soil and compost underwent physical and chemical investigation at the Soils, Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt. The results are displayed in Tables 3 and 4. The Experimental plot was divided into plots of $6m^2$ (3.0×2.0 m) to include 15 plants each. 'Mombasa' grass was sown in June 2020 after preparation of seedlings. Using the greenhouse at the Organic Experimental Farm of Environmental and Bio-Agriculture Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt, (30°03′12" N and 31°19′05.2" E) and elevation of 92 meters above sea level, the seedlings were prepared over the course of two seasons, 2020/2021 and 2021/2022.

In the field and in each cutting, three plants randomly selected from $6m^2$ and each subplot were hand-clipped to 10 cm from the soil level. These samples were collected in paper bags, and kept in the shade. They were weighed before and after drying. To get a consistent weight, these samples were oven dried separately at 60ºC.

***Experimental Design***

Land was ploughed and leveled. Subsequently experimental plots were prepared and each plot size was ($6m^2$).The experiment consisted of eight treatments (T1,Azolla extract 10% at the rate of 300L/$fa^{-1}$ - T2 ,vermicompost tea 10% at the rate of 300L/$fa^{-1}$ - T3, Azolla extract 20% at the rate of 300L/$fa^{-1}$ - T4, vermicompost tea 20% at the rate of 300 L/$fa^{-1}$ - T5, Azolla extract and vermicompost tea10% at the rate of 300L/$fa^{-1}$ - T6, Azolla extract and vermicompost tea 20% at the rate of 300L/$fa^{-1}$ - T7, without any fertilizers and T8, chemical fertilizers with N:P:K (15:15:15) at the rate of 200 kg/$h^{-1}$ ( Michael, D. *et al*., 2014)) and was laid out in a Randomized Complete Block Design (RCBD) with three replication. Chemical treatment added in soil during seedling planting and it was sprayed on the plant's foliage, like other treatments. The plants were irrigated using drip hoses twice a week in summer and once a week in winter.

**Chemical analysis of *Panicum maximum***

To find out how treatments affected the main chemical components of *Panicum maximum* leaves, chemical analysis was done. These assays were performed on 50 grams of dried *Panicum maximum* leaves. The main chemical components—protein, fat,

carbohydrate, moisture, fiber, and ash—were calculated to have the following values. Sample percentages were calculated using NIRA (2013) FOSS 1650-D analyzers.

**Statistical Analysis.**

After being gathered, the data set with the characteristics under study was statistically analyzed. One way ANOVA test and Duncan's multiple rang test were used to treatments comparison using XLSTAT software 2016.

## RESULTS

**Effect of different treatments application on herbage yield of *Panicum maximum* (t/f) during two seasons 2020/2021 – 2021/2022 in the field:**

Table 5 shows the effect of the foliar spray of biostimulants extract on herbage yield of *P. maximum*. There significant (P<0.05) differences among the parameters measured during first and second season. Based on Table 5, T6 (AE&VE 20%) gave the highest values of fresh forage yield at 4.55 and 2.23 t/f in the first cut during the first and second season, respectively, followed by T8 (chemical fertilizers) at 2.31 and 1.94 t/f in the first cut during the first and second season, respectively when compared to other treatments. Similarly, Table 5 showed that, T6 (AE&VE 20%) gave the highest values of dry forage yield at 0.98 and 0.54 t/f in the first cut during the first and second season, respectively, followed by T8 (chemical fertilizers) at 0.49 and 0.50 t/f in the first cut during the first and second season, respectively when compared to other treatments. On the other hand, Table 5 showed that, T8 (chemical fertilizers) gave the highest values of fresh forage yield at 8.98, 8.09, 5.13, 4.15 and 0.71 t/f in the second, third, fourth, fifth and sixth cut during the first season, respectively, followed by T6 (AE&VE 20%), T5 (AE&VE 10%), T3 (AE 20%), T4 (VE 20%), T1 (AE 10%) and T2 (VE 10%), respectively. T7 (without fertilizers) showed the lowest values fresh forage yield in all cuts during the first season. Also, T8 (chemical fertilizers) gave the highest values of dry forage yield at 2.12, 2.02, 1.19, 0.94 and 0.17 t/f in the second, third, fourth, fifth and sixth cut during the first season, respectively, followed by T6 (AE&VE 20%), T5 (AE&VE 10%), T3 (AE 20%), T4 (VE 20%), T1 (AE 10%) and T2 (VE 10%), respectively. T7 (without fertilizers) showed the lowest values of dry forage yield in all cuts during the first season. Similarly, Table 5 showed that, T8 (chemical fertilizers) gave the highest values of fresh and dry forage yield in the second, third, fourth, fifth and sixth cut during the second season, respectively, followed by T6 (AE&VE 20%), T5 (AE&VE 10%), T3 (AE 20%), T4 (VE 20%), T1 (AE 10%) and T2 (VE 10%), respectively. T7 (without fertilizers) showed the lowest values fresh and dry forage yield in all cuts during the second season.

Also, Table 5 shows the effect of the foliar spray of biostimulants extract on total yield of *P. maximum* during the first and second season. There significant (P<0.05) differences among the treatments. Based on Table 3, T8 (chemical fertilizers) gave the highest values of total fresh and dry forage yield at 29.37 and 6.93 t/f during the first season & 23.92 and 5.78 t/f during the second season respectively, followed by T6 (AE&VE 20%), T5 (AE&VE 10%), T3 (AE 20%), T4 (VE 20%), T1 (AE 10%) and T2 (VE 10%), respectively. T7 (without fertilizers) showed the lowest values of total fresh dry forage yield during the first and second season.

**Chemical composition**

There significant (P<0.05) differences among the treatments at averages crud protein percentage during first and second season**.** Whereas there no significant differences among the treatments at other chemical properties. Based on Table 6 T8 (chemical fertilizers) gave the highest values of crud protein percentage at 18.53 and 21.64 % during the first and second seasons, respectively followed by T6 (AE&VE 20%) at 17.62 and 20.64 % during the first and second seasons, respectively when compared to other treatments. Then, followed by T5 (AE&VE 10%), T3 (AE 20%), T4 (VE 20%), T1 (AE 10%) and T2 (VE 10%), respectively. T7 (without fertilizers) showed the lowest values crud protein percentage during the first and second season.

## DISCUSSION

From previous results it is clear that enhancement was observed in the growth and yield production of *P. maximum* during two seasons following foliar application with Azolla or vermicompost extracts, especially when applying mixing treatments with *Azolla pinnata* and vermicompost extracts at the highest concentration.

Numerous studies have already examined the use of Azolla as a compost or soil supplement in green manure to increase crop productivity. On the other hand, not much is

known about the foliar application of Azolla extract, especially in organic farming. Azolla contributes to the synthesis of vitamins and the availability of macronutrients, which might vary over time with an average of 8.3% K and 0.6% Mg. There is a dearth of research on the effects of AE foliar spray on plant performance, despite the fact that numerous academics have written about the use of Azolla as compost or soil enrichment (El-Serafy *et al*., 2021).

Applying *A. pinnata* and *A. caroliniana* as biofertilizers improved cowpea yield in greenhouse settings (Ismail, 2017). Similarly, when the seeds were soaked in the corresponding concentration 24 hours before sowing, Azolla biofertilizers improved the biochemical characteristics of commercial tomatoes (Alisa) (Hanafy and El-Emary, 2018). The chamomile plant's shoot fresh and dry weights, number of branches per plant, and height were all significantly increased by Azolla treatments. By boosting the active ingredients of chamomile plants grown in sandy soil, (Rabie *et al*., 2020) found that Azolla extract applied topically (azolla spray) improved yield production and had a positive impact on chemical constituents. According to (El-Serafy *et al*., 2021), foliar spraying of extracts from Azolla and Moringa leaves increased the amount of total carbohydrates in quinoa seeds. The protein and carbohydrate content of Azolla and Moringa leaves may be responsible for the protein and carbohydrate buildup in quinoa seeds after extract treatments.

However, vermicomposting is a natural process in which waste material with hard structures is transformed into compost by earthworms. Compost made from this environmentally friendly approach is widely and traditionally used as a natural fertilizer to promote plant development. The Latin words for "worm" are the source of the prefix "vermis." Earthworms are crucial to the vermicomposting process because they help transform biodegradable organic matter into superior manure. Exoenzymes produced by earthworm gut bacteria aid in the breakdown of organic matter into forms of nutrients that are suitable for plant growth. The earthworm stomach has been described as a movable anoxic micro zone rich in easily degradable organic compounds, containing products of microbial fermentation (Drake and Horn, 2007).The existing empirical evidence suggests that vermicompost and its derivatives contain humic acids, nutrients, earthworm excretions, rich microbial populations, growth hormones and enzymes, which help crops withstand a wide range of abiotic and biotic stresses (Vambe *et al*., 2023).

Liquids obtained by vermicomposting, according to Quaik and Ibrahim (2013), include important nutrients that support plant growth. The combination of 50% compost, 25% compost tea, and 25% vermicompost tea utilized by EL-Shaieny *et al*. (2022) had a greater nutrient content and significantly affected the productivity of onion plants as well as the characteristics of the soil.

## CONCLUSION

In conclusion, the biostimulants as *Azolla pinnata* and vermicompost extract are having good stimulating activity on *Panicum maximum* plants. The extracts act as a desirable biological and alternatives to chemical fertilizer in organic farming. The biostimulants extracts are nontoxic, harmless and effective to all plants for attaining better germination, growth and yield. So we have to take necessary steps to apply them in large scale, especially in organic farming.

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**Table 1:** The chemical analysis for the two types of crude biostimulants (*A. pinnate* and vermicompost)

| Characters | Vermicompost | *A. pinnate* |
|---|---|---|
| Organic carbon (%) | 11.8 | 52.19 |
| Organic matter (%) | 20.39 | 89.99 |
| C / N ratio | 1 : 15 | 1 : 18 |
| pH | 7.1 | 5.61 |
| EC (dS/m) | 0.6 | 0.32 |
| Total nitrogen % | 0.80 | 2.89 |
| N (ammonium) ppm | 12 | 81.00 |
| N (nitrate) ppm | 71 | 0.00 |
| Total phosphor % | 1.61 | 0.17 |
| Total potassium | 0.11 | 0.27 |
| Ash % | 79.61 | 10.01 |
| Humidity (%) | 13 | 95 |
| Weight per m3 (kg) | 870 | - |
| Nematode | No | No |
| Weed seeds | No | No |
| Parasites | No | No |

**Table 2:** The chemical properties for the two types of biostimulants extract (*A. pinnate* and Vermicompost extracts).

| Characters | Vermicompost (VE) | *A. pinnate* (AE) |
|---|---|---|
| C / N ratio | 1 : 35 | - |
| pH | 7.64 | 5.57 |
| EC (dS/m) | 0.36 | 0.1 |
| Total nitrogen % | 0.35 | 6.13 |
| N (ammonium) % | - | 1.04 |
| N (nitrate) % | - | 0.24 |
| Total phosphor (ppm) | 54 | - |
| Total potassium (ppm) | 179 | - |
| Mg (mg/L) | 53.0 | 15.0 |
| Ca (mg/L) | 152.0 | 45.0 |
| Cu (mg/L) | 3.4 | 28.4 |
| Zn (mg/L) | 1.9 | 1.7 |
| Fe (mg/L) | 0.2 | 3.5 |

**Table 3:** Physical and chemical properties of sandy soil used in the experiment before application of different treatments**.**

| Soil characteristics | Particle size distribution (%) | | | | Chemical analyses | | | Soluble cations (mol $l^{-1}$) | | | | Soluble anions (mol $l^{-1}$) | | | | Available nutrients (mg $kg^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sand | Silt | Clay | Texture class | CaCO3 (%) | pH | EC (dS/m) | $Ca^{++}$ | $Mg^{++}$ | $Na^{++}$ | $K^{++}$ | $CO_3^{--}$ | $HCO_3^{--}$ | $Cl^{-}$ | $SO_4^{-}$ | N | P | K | Fe | Cu | Z | Mn |
| Values | 88.08 | 4.00 | 07.92 | Lomy sand | 0.5 | 7.7 | 2.1 | 6 | 2.2 | 12.2 | 0.6 | - | 0.8 | 5 | 15.6 | 20 | 24 | 160 | 1.96 | 0.12 | 0.22 | 0.97 |

**Table 4:** The chemical properties for compost used in the experiment

| Compost characters | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Organic carbon (%) | Organic matter (%) | C / N ratio | pH | EC (dS/m) | Total nitrogen % | N (ammonium) ppm | N (nitrate) ppm | Total phosphor % | Total potassium | Ash % | Humidity (%) | Weight per m3 (kg) | Nematode | Weed seeds | Parasites |
| 29.0 | 50.01 | 1 : 24 | 7.8 | 3.4 | 1.2 | 86 | 51 | 1.24 | 2.68 | 49.99 | 35 | 710 | No | No | No |

**Table 5:** Effect of different treatments application on herbage yield of *Panicum maximum* (t/f) during two seasons 2020/2021 and 2021/2022

| Treat | S | Weight (t/f) | Number of cut | | | | | | Total weight in season (T/F) |
|---|---|---|---|---|---|---|---|---|---|
| | | | cut 1 | cut 2 | cut 3 | cut 4 | cut 5 | cut 6 | |
| A10 | S1 | Fresh | 2.18±0.05 b | 6.34±0.35 b | 4.19±0.20 cd | 1.95±0.17 bc | 1.36±0.15 bc | 0.28±0.02 b | 16.31±0.72 E |
| | | Dry | 0.50±0.01 b | 1.43±0.13 b | 0.98±0.03 c | 0.47±0.04 bc | 0.32±0.03 bc | 0.07±0.00 bc | 3.77±0.20 E |
| | S2 | Fresh | 1.48±0.08 a | 5.63±0.43 ab | 4.40±0.26 b | 1.51±0.04 b | 0.49±0.04 c | 0.31±0.04 b | 13.82±0.59 EF |
| | | Dry | 0.37±0.02 b | 1.33±0.10 b | 1.08±0.08 b | 0.37±0.01 b | 0.11±0.01 de | 0.07±0.01 b | 3.33±0.16 DE |
| V10 | S1 | Fresh | 2.25±0.03 b | 6.29±0.32 b | 3.74±0.13 d | 1.90±0.13 bc | 1.29±0.10 bc | 0.25±0.01 b | 15.72±0.00 E |
| | | Dry | 0.49±0.01 b | 1.36±0.06 b | 0.96±0.03 c | 0.45±0.03 bc | 0.29±0.02 bc | 0.06±0.00 bc | 3.61±0.08 E |
| | S2 | Fresh | 1.60±0.11 a | 5.30±0.57 b | 4.15±0.26 b | 1.34±0.02 b | 0.49±0.02 c | 0.27±0.02 b | 13.15±0.66 F |
| | | Dry | 0.40±0.03 ab | 1.28±0.15 b | 0.99±0.07 b | 0.32±0.01 b | 0.11±0.00 e | 0.07±0.01 b | 3.17±0.17 E |
| A20 | S1 | Fresh | 4.12±0.14 a | 8.29±0.59 ab | 5.03±0.20 bcd | 2.54±0.16 b | 1.91±0.14 b | 0.37±0.01 b | 22.26±0.62 C |
| | | Dry | 0.92±0.03 a | 1.97±0.15 a | 1.37±0.06 b | 0.64±0.05 b | 0.45±0.03 b | 0.09±0.00 bc | 5.44±0.16 C |
| | S2 | Fresh | 1.76±0.11 a | 7.16±0.66 ab | 4.57±0.29 b | 1.61±0.02 b | 0.57±0.04 c | 0.33±0.03 b | 16.00±0.54 CD |
| | | Dry | 0.42±0.02 ab | 1.67±0.16 ab | 1.16±0.07 b | 0.39±0.01 b | 0.13±0.01 cd | 0.08±0.01 b | 3.85±0.14 CD |
| V20 | S1 | Fresh | 2.52±0.16 b | 7.11±0.45 ab | 5.99±0.18 abc | 2.26±0.19 b | 1.71±0.14 bc | 0.31±0.02 b | 19.90±0.45 D |
| | | Dry | 0.55±0.04 b | 1.70±0.14 ab | 1.46±0.10 b | 0.56±0.05 b | 0.42±0.04 b | 0.08±0.01 bc | 4.77±0.14 D |
| | S2 | Fresh | 1.84±0.08 a | 6.64±0.38 ab | 4.56±0.49 b | 1.54±0.02 b | 0.56±0.04 c | 0.33±0.04 b | 15.47±0.79 DE |
| | | Dry | 0.45±0.02 ab | 1.56±0.06 ab | 1.11±0.12 b | 0.37±0.01 b | 0.13±0.01 cde | 0.08±0.01 b | 3.70±0.18 DE |
| AV10 | S1 | Fresh | 4.23±0.08 a | 8.94±0.37 a | 6.91±0.20 ab | 2.76±0.52 b | 1.93±0.14 b | 0.40±0.01 b | 25.17±0.89 B |
| | | Dry | 0.92±0.02 a | 1.97±0.04 a | 1.67±0.10 ab | 0.65±0.12 b | 0.46±0.03 b | 0.09±0.00 bc | 5.76±0.17 BC |
| | S2 | Fresh | 2.13±0.20 a | 7.22±0.85 ab | 5.88±0.23 ab | 1.69±0.12 b | 0.57±0.03 c | 0.35±0.01 b | 17.84±0.98 BC |
| | | Dry | 0.52±0.04 ab | 1.68±0.21 ab | 1.45±0.07 ab | 0.40±0.02 b | 0.14±0.01 c | 0.09±0.01 b | 4.28±0.25 BC |
| AV20 | S1 | Fresh | 4.55±0.16 a | 8.95±0.50 a | 7.72±0.40 a | 2.83±0.14 b | 1.96±0.02 b | 0.45±0.08 b | 26.46±0.77 B |
| | | Dry | 0.98±0.04 a | 1.99±0.07 a | 1.95±0.13 a | 0.73±0.05 b | 0.46±0.01 b | 0.11±0.02 b | 6.22±0.19 B |
| | S2 | Fresh | 2.23±0.19 a | 7.27±0.86 ab | 5.89±0.26 ab | 1.71±0.13 b | 0.71±0.09 b | 0.45±0.03 ab | 18.26±0.50 B |
| | | Dry | 0.54±0.04 a | 1.74±0.22 ab | 1.46±0.06 ab | 0.42±0.02 b | 0.17±0.02 b | 0.12±0.01 b | 4.45±0.15 B |
| W. | S1 | Fresh | 1.97±0.11 b | 1,93±0.24 c | 0.87±0.07 e | 0.31±0.03 c | 0.75±0.04 c | 0.17±0.01 b | 4.07±0.23 F |
| | | Dry | 0.47±0.03 b | 0.41±0.05 c | 0.25±0.02 d | 0.07±0.01 c | 0.16±0.01 c | 0.04±0.00 c | 1.40±0.05 F |
| | S2 | Fresh | 0.53±0.15 a | 3.40±0.41 b | 1.55±0.10 c | 0.34±0.03 c | 0.10±0.01 d | 0.21±0.01 b | 6.13±0.51 G |
| | | Dry | 0.13±0.03 c | 0.84±0.10 b | 0.33±0.02 c | 0.08±0.01 c | 0.02±0.00 f | 0.05±0.00 b | 1.45±0.12 F |
| Ch. | S1 | Fresh | 2.31±0.08 b | 8.98±0.19 a | 8.09±0.87 a | 5.13±0.54 a | 4.15±0.32 a | 0.71±0.07 a | 29.37±1.40 A |
| | | Dry | 0.49±0.02 b | 2.12±0.10 a | 2.02±0.14 a | 1.19±0.12 a | 0.94±0.08 a | 0.17±0.02 a | 6.93±0.31 A |
| | S2 | Fresh | 1.94±0.06 a | 9.50±0.68 a | 7.53±0.70 a | 3.12±0.21 a | 1.14±0.12 a | 0.69±0.09 a | 23.92±0.87 A |
| | | Dry | 0.50±0.02 ab | 2.33±0.19 a | 1.76±0.17 a | 0.74±0.04 a | 0.28±0.03 a | 0.17±0.02 b | 5.78±0.23 A |

Means followed by the same letter are not significantly different at the probability level (P<0.05)

**Table 6:** Effect of different treatments application on chemical composition of *Panicum maximum* during two seasons 2020/2021 and 2021/2022.

| Characteristics | Season | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | A10 | V10 | A20 | V20 | AV10 | AV20 | W. | Ch. |
| Fat% | S1 | 1.24±0.20 a | 1.52±0.34 a | 1.22±0.16 a | 1.67±0.59 a | 1.31±0.25 A | 2.03±0.90 a | 1.34±0.32 a | 1.47±0.51 a |
| | S2 | 3.19±1.43 a | 3.01±1.68 a | 2.66±1.03 a | 3.16±1.44 a | 2.00±0.66 a | 2.13±0.55 a | 3.11±1.24 a | 2.86±0.88 a |
| Moisture % | S1 | 7.60±0.21 a | 7.64±0.28 a | 7.76±0.43 a | 7.84±0.29 a | 7.96±0.31 a | 7.75±0.27 a | 7.69±0.35 a | 7.90±0.29 a |
| | S2 | 7.93±0.24 a | 8.18±0.33 a | 7.97±0.31 a | 8.31±0.28 a | 7.89±0.22 a | 8.33±0.12 a | 7.70±0.24 a | 8.42±0.53 a |
| Crud Protein % | S1 | 14.84±0.97 ab | 14.46±0.85 ab | 15.81±1.22 ab | 15.42±1.16 ab | 16.23±1.32 ab | 17.62±1.81 ab | 13.50±0.70 b | 18.53±1.53 a |
| | S2 | 17.81±0.89 bcd | 17.15±0.83 cd | 19.03±1.01 abcd | 18.69±1.00 abcd | 20.12±1.22 abc | 20.64±1.31 ab | 15.73±0.59 d | 21.64±1.42 a |
| Ash % | S1 | 8.86±0.32 a | 8.45±0.35 a | 9.04±0.30 a | 8.33±0.18 a | 8.97±0.42 a | 8.90±0.29 a | 9.14±0.10 a | 8.43±0.43 a |
| | S2 | 9.23±0.31 a | 9.12±0.30 a | 9.59±0.55 a | 9.88±0.84 a | 9.38±0.41 a | 9.62±0.49 a | 9.63±0.52 a | 9.91±0.70 a |
| Fiber % | S1 | 23.33±0.64 a | 22.39±1.02 a | 22.61±0.53 a | 21.97±0.59 a | 22.53±1.34 a | 23.59±1.36 a | 23.02±0.57 a | 22.43±0.65 a |
| | S2 | 24.67±1.15 a | 24.15±1.06 a | 22.58±1.08 a | 24.38±0.52 a | 23.96±0.95 a | 25.17±1.13 a | 23.62±0.55 a | 24.67±1.65 a |
| Carbohydrate % | S1 | 44.14±1.44 a | 45.54±1.24 a | 43.56±1.34 a | 44.78±2.19 a | 43.00±2.80 a | 40.13±4.12 a | 45.32±1.14 a | 41.24±3.04 a |
| | S2 | 37.17±3.59 a | 38.40±3.56 a | 38.18±3.40 a | 35.58±3.49 a | 36.64±2.88 a | 34.12±3.26 a | 40.21±2.46 a | 32.50±4.51 a |

Means followed by the same letter are not significantly different at the probability level (P<0.05)

# تحسين نمو وإنتاجية نبات البونيكام (*Panicum maximum*) باستخدام بعض المنشطات الحيوية من الأزولا بيناتا *Azolla pinnata* والسماد الدودي

**حسين ورسمى حسين *, محمد سعيد العنانى, خالد محمد غانم**

*قسم البيئة والزراعة الحيوية, كلية الزراعة, جامعة الأزهر بالقاهرة, مصر*

* البريد الإلكتروني للباحث الرئيسي: esmaeel.bio@azhar.edu.eg

**الملخص**

نبات البونيكام guinea grass (*Panicum maximum*) هو نبات معمر يبقى في التربة لمدة تصل من 8 إلى 10 سنوات وينتمي إلى العائلة النجيلية Poaceae. ونبات البونيكام يعتبر من المحاصيل العلفية النموذجية عالية الإنتاجية، خاصة مع ظروف تغير المناخ. وقد أجريت هذه الدراسة بمزرعة الكلية البحثية التابعة لكلية الزراعة بالقاهرة - جامعة الأزهر فرع مدينة السادات , وذلك لتقييم استخدام مستخلصات بعض المنشطات الحيوية كالأزولا *Azolla pinnata* (AE)والسماد الدودي vermicompost (VE) كمنشطات حيوية على نبات البونيكام (*P. maximum*). حيث تضمنت التجربة ثمانية معاملات, معاملة 1: AE10%, معاملة 2: VE10%, معاملة 3: AE20%, معاملة 4: VE20%, معاملة 5: AE+VE10%, معاملة 6: AE+VE20%, معاملة 7: بدون أى إضافات (W), معاملة 8: باستخدام أسمدة كيميائية (CH). وقد أظهرت النتائج أن استخدام المحفزات الحيوية الخليط من مستخلصي *A. pinnata* و vermicompost بتركيز 20% لكل منهما معاً أعطى أعلى القيم في إجمالي إنتاجية المحصول الطازج والجاف وكذلك أعلى القيم في نسبة البروتين خلال الموسمين مقارنة بالتركيزات الأخرى للمنشطات الحيوية المستخدمة.

**الكلمات الاسترشادية** : الزراعة العضوية, نبات البونيكام (*Panicum maximum*) guinea grass, المنشطات الحيوية, الأزولا بيناتا *Azolla pinnata* والسماد الدودي