

A New Bio-Activator “Elixir” Effect on Yield Increase of Field Crops

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Abstract: Experiments were conducted under field and on-farm conditions at different sites in Khartoum State in 2013 and 2014. The main objective was to study the effect of a new bio-activator and organic fertilizer “Elixir” on growth and yield of table grapes, alfalfa and musk melon. The results showed that application of Elixir, at the rate of (35 l/ha) split in five weekly doses on heavy clay soils under tropical conditions, significantly improved growth and yield parameters of table grapes *Vitis vinifera* L. Yield of table grapes increased steadily with increase in number of applications in both sites. High fruit cluster weights of 565.1 and 600.0 g and total yields of 27.7 And 41.3 t/ha, were recorded by variety Cardinal, from sites I and II, respectively. Fruits TSS was not significantly affected by Elixir. Supporting noticeably high yield increases were attained from on-farm trials by Elixir at Dal Agric. project on a new alfalfa (*Medicago sativa* L.) crop by 30.4% and the old crops by 42.0% and 35.1% in Dal and 72.7% and 169.6% in Inmaa project for first and second cuts, respectively. Likewise, application of 35l/ha of Elixir significantly increased muskmelon (*Cucumis melo* L.), variety Green star, yield to 24.7 t/ha.

Keywords: Elixir, bio-fertilizer, field crops, yield increase.

1 Introduction

Heavy use of agrochemicals since the “green revolution” of the 1960s boosted food productivity at the cost of environment and society [1]. Harmful effects of these chemicals on human, animals and environment started to be claimed and reported for the last three decades. Consequently, scientists looked back to nature and organic inputs gained more attention and support from the International Federation of Organic Agriculture Movements (IFOAM) and other environment concerned bodied all over the world.

Organic farming is a method of farming system which primarily aims at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health. Organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio-fertilizers) are used to release nutrients to crops. Organic farming increases sustainable production in an eco-friendly pollution free environment [2]. In view of increasing global awareness, there are also growing research activities worldwide concerning organic inputs. The advantages of the organic system in terms of ecosystem conservation, food quality and economic performance have been demonstrated by numerous studies [3], [4] and [5]. In low-income countries of the tropics, Non-Governmental Organizations and farmers’ groups are now increasingly adopting organic techniques as a means of improving productivity and food quality and security. Total global land area under organic farming increased steadily from 11.0 million ha in 1999 to 35.3 million ha in 2008. These 35.3 million hectares of agricultural land are managed organically by almost 1.4 million producers. The largest organic land areas are in Australia, Argentina and Brazil [6]. Area under organic farming in Sudan is only 54.8 thousand ha [7].

The soil microbial biomass is a small but key component of the active soil organic matter pool and serves as a source and sink of soil nutrients [8]. According to [9], bio-activators are defined as a complex organic substance that can alter the growth and is capable of acting on the DNA transcription into the plant, gene expression, membrane proteins, metabolic enzymes and mineral nutrition. Reports [10] indicated that composting process can be accelerated by adding a mixture of various cultures

microorganisms as decomposers. They added that decomposers of organic materials on the market and containing various types of microorganisms are EM4, Stardec, Biocompos, Orgadec, Starbio, Messbio. Mixture of microorganisms in bio-activators can be bacteria, actinomycetes, yeasts, and molds [10]. Based on the experimental results carried out by [11] it can be concluded that bio-activators can accelerate the composting of livestock feces and lower C/N ratio. Findings by [12] revealed that phosphorus concentration in plant parts increased with organic amendments. In the last ten to fifteen years, the importance of micro-organisms in decomposition of organic residues, release of nutrients, availing of nutrients to the plants in available forms and conditioning of soils was recognized and started to be utilized [13]. Reports by [10] indicated that addition of bio-activators increased the amount of apple fruit per tree by 58.57 to 67.14%, and increased the fruit weight by 74.51 to 135.91% compared to control. Studies carried out by [14] on sugar cane indicated that sole application of bio-activators Agrostemin and Crops® resulted in a 13.56 and 12.86 % increase in sucrose percent cane against the check (200 kg /ha urea) as well as the possibility of harvesting cane earlier at the age of 12 months.

Elixir is a new bio-activator and organic fertilizer produced in Sudan. All inputs of Elixir are organic and are readily available locally in Sudan. The product is proved eco-friendly and 100% safe for human beings, animals and plants and does not contain any harmful synthetic chemicals that cause allergy, toxicity or diseases. It contains considerable amounts of macro elements and sufficient amounts of micro and trace elements and it also contains Millions of beneficial microorganisms which are living organisms produced from, and adapted to, tropical environments.

Availability of nutrients is a problem in heavy clay soils which are predominant along the main crop producing schemes in Sudan as well as in many tropical countries. Organic inputs are generally in short in this part of the world. Converting our agricultural products, mainly the exports, from conventional to high paying organic products requires availability of organic inputs and at affordable prices. The main objective behind these experiments was to study the ability of a new bio-activator and organic fertilizer “Elixir” to increase productivity and quality of plant crops.

2 Materials and Methods

Four experiments were carried out under field and on-farm growing conditions at different sites in 2013 and 2014 in Khartoum State (coordinates: 15:26 to 15:45 N, 32:25 to 32:40 E and 380 to 405 m asl). The bio-activator and organic fertilizer “Elixir” was supplied by Bio-activator Factory for Agricultural Fertilizers, the Industrial Area, Khartoum North. Soil and plant analysis and the microbiological and chemical analysis of Elixir were carried out at the laboratories of the Department of Soil and Environment Science, Faculty of Agriculture, University of Khartoum. The main micro-organisms in Elixir are Photosynthetic Bacteria, Lactic Acid Bacteria, Yeast, Actinomycetes and Fungi. Its pH is acidic and varied between 3.0 and 4.5. The main nutrients in Elixir are shown in (Table 1).

Table 1: The chemical analysis of Elixir

ECe (dS/m ⁻¹)	N (mg/l)	P	K	Ca	Mg	S	Fe	Mn	Na	Cu
		(ppm)								
6.0	3500.0	26.0	305.0	300.0	120.0	137.2	343.96	10.21	83.0	0.51

A basal fertilizer dose of 120 kg/ha of NPK (20:20:20) was applied as a single dose. Elixir was applied split in weekly doses at the rate of 35 l/ha diluted 1:10 units of natural water by volume. Application means of Elixir were as shown in each experiment. The studied parameters were growth and yield parameters and they varied according to experiment. All collected data were summarized and statistically analyzed as shown for each experiment.

2.1 Effect of Elixir on Productivity and Fruit Quality of Table Grapes

Two experiments were carried out on two different heavy clay sites at Zadna farm in Elsilate North, Khartoum North, Sudan, in 2013. The soil was sandy loam, low in nitrogen (0.04%) and organic carbon (0.25%) with pH of 8.8 and classified as “Eilafun soil series”. In both experiments, the effect of applying

Elixir on productivity and fruit quality of table grapes *Vitis vinifera* L. cultivar Cardinal was evaluated. Elixir was applied at the rate of 4.0 ml/plant repeated for 0, 1, 3 and 5 times (0.0, 7.2, 21.6 and 36.0 l/ha, respectively) on one week intervals using a randomized complete block design. The studied parameters were cluster weight (g), total yield (t/ha) and fruit quality (TSS) of table grapes.

2.2 On-Farm Trials on Elixir

Two on-farm experiments were carried out on Alfalfa (*Medicago sativa* L.), at the central pivots of Dal Agri. Waha Project, Khartoum North and Inmaa Project, West of Omdurman in season 2013-2014. Elixir, at the rate of 35l/ha was applied to half pivots in each project (a new crop and one year old crop.) The other halves were left untreated as controls. The area of the pivot was 145 fed. Elixir was applied split into three weekly doses with irrigation water through the fertigation tank of the pivot. Another on-farm trial was carried out in 2013 at Esilate Scheme, Khartoum North to study the effect of Elixir on yield (t/ha) of muskmelon (*Cucumis melo* L.) cultivar, green star. Elixir was applied in three rates (0, 35 and 70 l/ha). Yield in t/ha was evaluated.

3 Results and Discussion

3.1 Effect of Elixir on Productivity and Fruit Quality of Table Grapes

Application of Elixir at the rate of 4.0 ml/plant resulted in significantly high cluster weight at both sites with five weekly applications of Elixir. Cluster weight increased with increase in application times of Elixir (Table 2a). However, Elixir at both sites didn't show significant differences for total soluble solids (TSS). Productivity of grapes was improved markedly by Elixir and high yields were recorded at site-II (41.3 t/ha) and site-I (27.7 t/ha) at high times of applications (five times). Elixir, being rich in nutrients and acidic (pH 3.0 – 4.5) as well as, the high number of micro-organisms in it might have improved the soil properties and availability of nutrients. Supporting remarkable yield increases from application of organic fertilizers were reported by Offermann and Nieberg (2000). The overall performance at site-II was far better than at site-I under heavy clay soils of Khartoum, (Table 2b).

Table 2a. Effect of Elixir, (4ml/plant) applied 0, 1, 3 and 5 times on cluster weight (g) and TSS of table grapes variety Cardinal at two sites at Zadna farm, Elsilate, Khartoum North (2013)

Sites	Site-I				Site-II				LSD
	0	1	3	5	0	1	3	5	
Cluster wt. (g)	278.1	251.9	291.7	565.1	366.7	443.3	516.6	600.0	(50.5)
TSS	15.67	16.00	17.00	16.67	17.17	16.67	18.00	18.00	(1.97)

Table 2b. Effect of Elixir, (4ml/plant) applied 0, 1, 3 and 5 times on productivity (t/ha) of table grapes variety Cardinal at two sites at Zadna farm, Elsilate, Khartoum North (2013)

Application times	0	1	3	5
Site – I	14.4(b)	13.7 (b)	16.9 (b)	27.7(a)
Site – II	14.7(c)	21.9(bc)	25.3(b)	41.3(a)

Means with the same letters along the same raw are not significantly different at (0.05).

Application of the organic fertilizer and bio-activator, Elixir, at the rate of (36 l/ha), split in five weekly doses on heavy clay soils under tropical conditions, significantly improved growth and yield parameters of table grapes.

3.2 On-Farm Trials on Elixir

The on-farm trials on Elixir at Dal Agric. project increased the yield of the new alfalfa crop by 30.4%

and the old crop by 42.0% and 35.1% for the first and second cuts, respectively (table 3). The percentage yield increase of an old crop was even higher in Inmaa project and was 72.7% and 169.6% for first and second cuts, respectively (table 3). Similar effects for other bio-activators on a wide range of crops were reported by Arief Budiono *et al.*, (2013) and Mejbah Uddin *et al.*, (2012).

Table 3. Effect of Elixir on Productivity of Alfalfa old and new crops (t/ha/cut.) at Dal Agric. and Inmaa Projects, Khartoum State, 2014.

Parameter	First Cut			Second Cut		
	Not-treated	Treated	% increase	Not-treated	Treated	% increase
DAL Agric(New)	1.02	1.33	30.4%			
DAL Agric.(Old)	1.07	1.52	42.0%	1.19	1.62	36.1%
Inmaa (Old)	0.55	0.95	72.7%	0.69	1.86	169.6%

In another experiment, application of 35l/ha and 70l/ha of Elixir significantly increased musk melon yield to 24.7 and 27.3 t/ha, respectively, compared to zero control (18.6 t/ha). Supporting results were reported by Mejbah Uddin *et al.*, (2012) and Arief Budiono *et al.*, (2013). However, no significant differences were noticed between both rates of Elixir (table 4). The on-farm results confirmed that application of Elixir at the rate of 35l/ha increased growth and productivity of field crops.

Table 4. Muskmelon yield (t/ha) as affected by Elixir at Elsilate, Khartoum North, 2013.

Elixir (l/ha)	Zero	35	70	LSD
Yield (t/ha)	18.6 (b)	24.7 (a)	27.3 (a)	5.2

Means with the same letters along the same raw are not significantly different at (0.05).

4 Conclusions

1. The bio-activator, Elixir, improved the productivity and quality of table grapes.
2. Application of Elixir at the rate of 36 l/ha split in five weekly doses coupled with 120 kg/ha NPK (20:20:20), added in one dose, significantly increased yield of alfalfa and musk melon.

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