

## Dedication

*This work is dedicated To:*

*My beloved young daughter Sabah who missed me for long time during this research work.*

*To: My father who did a lot for our success.*

*To: My small family members.*

*To: My wife the partner of life.*

## Acknowledgement

Saying of Prophet Muhammad a person who is not thankful to his benefactor is not thankful to ALLAH'. All and every kind of praises is upon ALLAH, the strength of universe, who ever helps in darkness & difficulties. All and every kind of respect to His Holy Prophet Muhammad for unique comprehensive and everlasting source of guidance and knowledge for humanity.

I would like to acknowledge my Supervisor **Professor Tagelsir Ibrahim Mohamed** for his unlimited and scholarly guideness during the entire period of the study (scholastic guidance, consulting behavior, research plan, executed and completed).

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Elyas

## General Abstract

Although *Aloe vera* L. is an indigenous plant of Sudan with numerous applications in health, cosmetics and food industries in global markets, agricultural research to exploit its potential is almost lacking. This study aimed to investigate the impact of the chemical fertilizers nitrogen, phosphorus, sulfur and compound fertilizer NPK applications, besides foliar application of 6-benzyl adenine and different types and forms of bio-stimulants mainly Argel (*Solenostemma argel* Del. Hayne) and Hazza (*Haplophyllum tuberculatum* L.) at various rates on the growth attributes and quality of *Aloe vera* plants under nursery conditions. Experiments were conducted in Sudan University of Science and Technology, College of Agricultural Studies, Shambat, Khartoum North, Sudan.

The study was composed of seven independent trials as illustrated sequentially: Five levels of; urea 0.0, 1.5, 3, 4.5 and 6 g/plant, triple super phosphate 46% P<sub>2</sub>O<sub>5</sub>) 0.0, 2.5, 5, 7.5 and 10 g/plant, commercial N<sub>15</sub>P<sub>10</sub>K<sub>15</sub> 0.0, 2.5, 5, 7.5 and 10 g/plant) and elemental sulfur 0.0, 0.5, 1.0, 2.0 and 4.0 g/plant were tested as soil applications to the potting media (Gureira) in 25X30 cm plastic bags. In addition 6-Benzyl adenine (BA) at concentrations of 0.0, 75,150, 300 and 600 ppm were tested. Argel foliar and soil treatments were also evaluated. The foliar treatments were cold, hot and boiled water extracts of 15 g dry leaves of Argel per litre while the soil dressing test was for 0.0, 2.5, 5, 7.5 and 10 g/plant dry Argel leaves per plant. The Haza foliar and soil treatments; the foliar treatments were for cold, hot and boiled water extracts of 15 g dry shoots of Haza per litre and the soil application test were for 0.0, 2.5, 5, 7.5 and 10 g/ plant dry Haza shoot treatments. The treatments were arranged in a completely randomized design where each treatment was replicated eight times. Data were collected after 12 months from treatments, analyzed and the results obtained indicated that:

The 1.5 g urea treatment enhanced growth, leaf gel and chlorophyll contents, whereas the higher levels of urea were suppressive. The encouraging results obtained from urea treatments in this study elucidated an economical potential for possible large scale production of the plant under Sudan conditions.

A general increase was obtained in growth parameters in phosphorus treated plants compared to the control. Except for the peel weight, the highest values of all growth

parameters were obtained from the 10 g/plant treatment. The improvements in growth and gel content are indicators of the benefit of Phosphorus applications.

The results showed no significant differences in parameters of number of leaf and root length, while limited enhancement was observed in other parameters in NPK-treated plants compared to the control. Except for the number of leaves and the root length, the highest values of growth parameters were obtained from the 2.5 g NPK treatment. The improvements in growth and gel content at the low rates of the fertilizer are indicators of the benefit of low cost of NPK required for unit number of plants grown. The result revealed a general increase in growth parameters in sulfur treated plants compared to the control. Except for the peel weight and chlorophyll content, the highest values of measured parameters were obtained from the 4.0 g/ plant sulfur treatment. Under the conditions of the study, these results elucidated the benefit of sulfur fertilizer as a tool for enhanced production of *Aloe vera*.

The data showed a general increase in growth and yield parameters in BA-treated plants compared to the control. Except for the root fresh weight, the highest values of all growth parameters were obtained from the 600 ppm BA treatment. The enhanced growth attributes and gel yield obtained from BA applications in this study, might put this growth regulator among essential factors for large scale production of the plant under Sudan conditions.

Also, there was a general increase in growth parameters in the Argel treated plants compared to the control. Except for the root fresh and dry weights, the highest values of all growth parameters were obtained from the boiled Argel water extract and the 7.5 and 10 g/plant soil dressing treatments. The significant improvements in growth and gel content are indicatives to the possibility of commercial organic production of this plant under Sudan conditions.

Relatively, there was a general increase in growth parameters in Haza treated plants compared to the control. Except for the root fresh and dry weights, the highest values of all growth parameters were obtained from the boiled Haza water extract and the 7.5 and 10 g soil dressing treatments. The improvements in growth and gel content are indicators of the agronomic benefit of Haza applications; a step towards organic farming.

## المستخلص العام

بالرغم من أن نبات الألو من النباتات المستوطنة في السودان مع تعدد تطبيقاته عالمياً في مجال الصحة، التجميل و الصناعات الغذائية، إلا أن البحث الزراعي تنتقصه الكثير من الإمكانيات للنهوض بهذا المحصول.

هدفت الدراسة إلى تحديد أثر إضافة الاسمدة الكيماوية ( اليوريا، الفسفور، السماد المركب و الكبريت)، إلى جانب الرش الورقي بمركب 6-BA و جرعات و مستخلصات مختلفه من المحفزات الحيويه تحديداً الحرجل و الحزى على معايير النمو و الانتاجيه في نبات الألو تحت ظروف المشتل بجامعة السودان للعلوم و التكنولوجيا- كلية الدراسات الزراعية شمبات، بحري- السودان.

تتكون الدراسة من سبعة تجارب مستقلة كما هو موضح بالتتابع:

خمس جرعات من اليوريا ( 0.0، 1.5، 3.0، 4.5 و 6جم/ النبات).

خمس جرعات من سيوبر فوسفات الثلاثي (46%) (0.0، 2.5، 5.0، 7.5 و 10جم/ النبات).

خمس جرعات من السماد المركب التجاري ( 0.0، 2.5، 5.0، 7.5 و 10جم/ النبات).

خمس جرعات من سماد الكبريت التجاري ( 0.0، 0.5، 1.0، 2.0 و 4جم/ النبات).

خمس تركيزات مختلفة من مركب 6-BA ( 0.0، 75، 150، 300 و 600 جزء من المليون).

معاملات الحرجل رشاً و إضافة للتربة. معاملات الرش كانت من مستخلصات 15جم أوراق حرجل في لتر من الماء المغلي، الماء الساخن، البارد و الشاهد. أما معاملات إضافة التربة فكانت 0.0، 2.5، 5.0، 7.5 و 10جم/ النبات.

معاملات الحزى رشاً و إضافة للتربة. معاملات الرش كانت من مستخلصات 15جم من المجموع الخضري المجفف في لتر من الماء المغلي، الماء الساخن، البارد و الشاهد. أما معاملات إضافة التربة فكانت 0.0، 2.5، 5.0، 7.5 و 10جم/ النبات.

صممت المعاملات بنظام التصميم العشوائي الكامل و التي فيها كررت المعاملات ثمان مرات في كل التجارب.

رصدت النتائج بعد مرور 12 شهر من بداية معاملات التجربه، حلت البيانات إحصائياً باستخدام جهاز الحاسوب و رصدت النتائج كما موضح أدناه:

أثبتت النتائج أن الجرعة 1.5جم/ النبات من اليوريا أعطت تحسناً في النمو، محتوى الورقه من العصاره و الكلوروفيل بينما الجرعات العاليه من اليوريا كانت مثبطه. النتائج المشجعة التي

حصلت عليها في هذه التجربة نتيجة لاستخدام اليوريا أظهرت المقدرات الاقتصادية لإمكانية الإنتاج الموسع للألو تحت ظروف السودان.

أظهرت النتائج زيادة عامة في معايير النمو في النباتات المعاملة بالفسفور مقارنة بالشاهد. ماعدا وزن قلف الأوراق، القيم العالية لكل معايير النمو تمت الحصول عليها من المعاملة 10جم/ النبات. التحسن الملحوظ في معايير النمو و زيادة المحتوى العصيري في الورقة تدل على أهمية إضافة سماد الفسفور.

أظهرت النتائج عدم وجود فروقات معنوية في معايير عدد الأوراق، طول الأوراق و الجذور كما أظهرت تحسن محدود في المعايير الأخرى في النباتات المعاملة بالسماد المركب مقارنة بالشاهد.

ما عدا في عدد الأوراق و طول الجذور فإن القيم العالية لمعايير النمو تم الحصول عليها من المعاملة 2.5جم/ النبات. التحسن في معايير النمو و المحتوى العصيري عند إضافة الجرعات القليلة من السماد، دلالة على التكاليف المتدنية للسماد المطلوب لزراعة نباتات محددة.

أظهرت النتائج وجود زيادة عامة في معايير النمو في النباتات المعاملة بالكبريت مقارنة بالشاهد، ما عدا وزن القلف و محتوى الكلوروفيل و كانت القيم العاليه في المعايير المختبره من المعاملة 4جم/النبات. تحت ظروف الدراسة، تبين الفائده من سماد الكبريت كأداة لتشجيع إنتاج نبات الألو.

تم الحصول على زيادة عامة في معايير النمو في النباتات المعاملة بالبزنزائل أدانين مقارنة بالشاهد، ما عدا الوزن الطازج للجذور كانت القيم العالية لكل معايير النمو المختبره من المعاملة ppm600 . تحفيز معايير النمو وزيادة العصارة الورقية المتحصل عليها في الدراسة نتيجة المعاملة بالبزنزائل أدانين، ربما يضع هذا المنظم (منظم النمو النباتي) ضمن العوامل الهامه التي تقود إلى الإنتاج الموسع للنبات تحت ظروف السودان.

أدت معاملات الحرجل إلى زيادة عامه في كل معايير النمو المختبره مقارنة بالشاهد. ما عدا الوزن الرطب و الجاف للجذور، حصل على القيم العاليه لكل معايير النمو الأخرى من معاملة مستخلص الحرجل المغلي و معاملات إضافة التربه (10&7.5جم/النبات). التحسن الواضح في معايير النمو و زيادة المحتوى العصيري في الورقة هي مؤشرات تدل على إمكانية الانتاج التجاري العضوي للمحصول تحت ظروف السودان.

أظهرت نتائج معاملات الحزى زيادة عامة في كل معايير النمو المختبره مقارنة بالشاهد، ما عدا الوزن الرطب و الجاف للجذور تم الحصول على القيم العالية لكل معايير النمو الأخرى من معاملة مستخلص الحزى المغلي و معاملات إضافة التربه (10&7.5جم/النبات). التحسن

المحوظ في معايير النمو و زيادة المحتوى العصيري في الورقة مؤشرات الفائدة الحقلية للحزى  
كخطوة إلى الأمام للزراعة العضوية.

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