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The effect of spraying sesame oil extracts on the growth and yield of potato (*Solanum tuberosum* L.) varieties

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Abstract

An experiment was carried out in the Farm during the Local Spring of 2023 in the Wasit-Al-Gharraf area in the framework of the agricultural development zone. We conducted the study to determine the effect of plant extract (particularly the sesame seed oil at the concentration of 2 and 4 grams/ litre) on the growth and yields of the known local potato varieties during 2017 Rabi season. We planted Anchorage, Alaska, or Necta Red variety that we imported from NR/AA seeds that are of grade A. The experimental units were twelve-plant-each block and were set up in a factorial experimental design within a randomized complete block design (RCBD) framework (Split-Block). Even more, the plants growing with sesame seed extract attain the highest values of various vegetative growth parameters, including weight both in wet and dry incarnation, as well as the leaf area of the plant. On top of this, the positive influence in terms of the yield properties, such as the average bulb weight, per-plant productivity, and total production, was also noticed. The data show the straight performance of the "Nectar." type in plant height vegetative growth parameters such as number of aerial stems, dry and wet weight of the plant, and leaf area of the plant. Besides the whole Nectard kind as well scored over the Alaskan variety as concerns yield attributes (tuber average weight, plant yield, bumper yield, and marketing yield). The stand up experiment has shown that Variety Nectard was the best variety registered of 5 specified varieties when spraying with a plant extract at a concentration of 4 g/L only compared to the treatment with sesame seed extract at the concentration of 2 g/L and the control treatment. The experimental results can be attributable to the special substances in sesame oil, which might have positive effects on plant growth.

Keywords: Spraying, sesame oil, plant growth regulator, potato

Introduction

Elements are pivotal in the process of building and improving plants. Lack of necessary compound of these components is a prove of growth anathema. The result of this is the issue that nutrition of the plant elements becomes a serious problem [1]. The deficiency of the nutrient will show up when foliar feeding is used because of foliar spraying which is a foliar spraying process and even distribution of the nutrients system-wide results leads to fast response rate. However, the use of this technique as a means of cost cutting and limited nutrients utilization has also been demonstrated [2, 3]. Another aspect of the contemporary research is extremely focused on conserving the environment while attaining sustainably crop yields without the heavy blow of pesticides and fertilizers. Researchers have shown the development of crops to be vital those nutrients that are deemed as of great importance. It should be added that the lack those components is the cause of changes in quality of crop as well, due to which the production decreases (the percentage of lost crop is from several percents to full crop). These elements are not only affecting the growth and reproduction of plants but there is also the possibility it could be influencing different kinds of biological responses happening in plant tissues. As a result, the yield of the product due to modification of genes may change and this may include the proteins, lipids, carbohydrates, and vitamins that it produces [3, 4]. The potato plant (*Tuberosum theadwinki*) is a widely recognized vegetable which contains high genetic concentration, quantity, and absorption of nutrients and the huge vegetative mass are the plant's main signature features. And, because of the economical value of the crop, previously fertilizers have been the best taken means of the plant's feeding requirements during the 90 to 120 days plant Producing a plant's needed rates of major elements and such small quantities of other essential elements, however, hardly

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coincides with the plant growth rate due to the soil's large abundance of these elements. This vegetable crop - potato (*Solanum tuberosum* L.) - is one of the most diverse and popular plants worldwide, and people consume it after four main foodstuff- wheat, rice, and corn ^[1]. Among the potatoes, there are many features affecting the specific plant size of the shoot, number of the aerial stems, number of tubers, yield plant, and size, complexity and also color of the tuber ^[2]. Many regions all over the globe have studied which potato varieties best suit their environment in various places by weather and soil conditions. Mid-altitude growing desert ecosystems research topic included three kinds of local potato utilized in southern Iraq area. The Escort potato, in vegetative growth properties as leaves area, dry weight of plants and more specifically the stem length, number of the stems, aerobic area, and roots revealed significantly superior characteristics when compared with the other two varieties (Dumont and Priemora) ^[4]. As well as that, an investigation on ten species of potatoes discovered the Species one produced significantly higher yields than the other varieties, judging only by the tuber yield. Moreover, a study of ^[7, 8] the five different a species of potatoes: Kuroda, Aladin, Armada, Artemis, and Desiree) was conducted. Regional starch content, plant height, number of leaves, number of aerial stems, yield of one plant, marketable and total yield were compared among the potato varieties. The results, showed that Kuroda and Desire Taha *et al.* (2007) were the scholars who assessed the effect of the utilization of potassium fertilizer and soil coverage on three varieties of potatoes of local potential (Ajibe, Desiree, and Latana). It was discovered that Ajibe variety was the best in terms of height of plants, number of leaf branches, leaf area, dry matter in the leaves, number of tubers per As well as it, the research of potato growth (var.) improvement by the application of humic acid and plant growth promoting rhizobacteria showed great difference too. The caspar reference, which was difficult to understand, growth and quality restrictions as well as lower yields was registered ^[5]. Size of tuber changed, as well as its specific gravity, weight, dry matter, starch, protein, and mineral content expect from Cu. The investigation of Al-Jubouri *et al.*, 2012 was on the quantity and quality effect of humic acid after the autumn planting condition. It was also established that the candycane variety was indeed much more illustrative. From the positive side, the Swiss bean located in the variety of Latona distinguishes itself as superior greatly in numerous vegetative developmental characteristics (plant height, number of aerial plants, and leaf area) and yield characteristics (yield per plants, average tuber weight, and marketing yield of tubers ^[5]). One of the factors crucially and in getting gain starts with this business is the fertilizer use and growth regulators in an artificial way. From the health implication of these synthetic herbicides on humans to environmental contamination in a long run, the adoption of extract of natural herbs have become the order of the day in crop management since they possess mineral elements, growth regulators and vitamins necessary for plant growth and increases the productivity of various vegetable crops ^[6]. Because of their easily extracted oil, protein, iron, and zinc in abundance, important oils, and rich in anti-oxidant compounds, sesame seed (*Sesamum indicum*) have become so popular ^[9]. Members of sesame oil composition such as sesamin, sesamol, and sesaminol lignan fractions as well as oil oxidative stability and antioxidative efficacy are all

accounted for by the composition of sesame oil. Essential oils come from seeds in the important oil traces and they are good in antioxidant and antimicrobial activities. This kind of natural protection gives the food insurance from different types of pathogens and spoilage microorganisms ^[11-19]. The wide use of these chemicals is particularly the case in the industry dealing with food or agriculture. Mayahi and Fayadh (2015) reported that it was garlic's extract that focused on the green color, with 250 mL L⁻¹ this was significant based on both yield and qualitative and quantitative signs ^[20]. Hayat *et al.*, 2018 reported very interesting results on garlic extract use. Tomato seedlings (*Solanum lycopersicum*) sprayed and/or fertigated with garlic extract in the concentration of 100 µg mL⁻¹ led to the increase in plant height, leaf area, stem diameter, plant frigrsh/dry weight. The present research aims at assessing the chances of qualitative and quantitative variations in plants as sesame oil extract comes along the professional treatments for agricultural purposes as corresponding to the external treatments which are used on the potato plants for unlocking an important part of these interventions.

Materials and Methods

Experimental site

The field experiment was conducted during the spring season, 2023, in the vegetable field of the Agricultural Extension Division/Wasit Agriculture Department Horticultural Experimental Station of Wassit University, Iraq.

Extraction method

The oil extracts were prepared using a way which was described in our article before. Active compound (Lignans) isolation (from 100 grams of ground sesame), The de-fattening was done using n-hexane (500 ml) by mixing well with the help of magnetic stirrer and at room temperature. These produced a cake which was then filtered in an ordinary funnel using No. 4 Graded Paper. The following method was adopted: 1. and the end product was sun-dried for approximately 8 hours. The residue (defatted residue 63 g) was soaked in 6-hour ethanol for 6 hours, the resulting slurries were filtered through a sieve by a Buckner funnel, the ethanolic extract was evaporated to run a rotary evaporator at 40 °C, and kept at a temperature of 4 °C before use (the residue Hashlaman The extracts of sesame oil was prepared at 2 g/l and 4 g/l respectively for the study exercise and its effect on the growth of two varieties of potatoes (Alaska - Nectard) was analyzed.

Frequency of foliar spraying with sesame oil extract and experimental design

Potato, specific species of the potatoe (*Solanum tuberosum* L.) was the subject of this experiment. Seeds were taken from the person who nominate the seed production corporation Jobex from France. The sowing date was on February 13 on the 75 cm width beds and the tubers spacing was 30 cm between each other under the fixed pipe sprinkler irrigation system. The sprayed extracted were done thrice throughout the first growing stage of the plants at the 45th day post-planting with a fortnight of interval between one spray and the other. We used control plants that in which only distilled water sprayed to keep the same moisture. Seeds dissemination and preparation of crude extract Cleaning, drying, and common ashes of *Sesamum*

indicum seeds which were bought from nearby market then they were identified by Dr. Ali Al-mousaoy, faculty of Science, Biology Dept., Baghdad University. The collected seeds were detached from unnecessary vacuities and materials by grinding the seeds by an electric grinder; then, the seeds were kept in clean jars. All activities intended to cultivate on the lands tripled including irrigation, fertilization, hoeing, and weeding that was also done uniformly for all the treatment same way that farmers do in the surrounding areas. At the treatments area, we used a split plot and in a complete randomized block design of three replicates. The tubers were harvested manually on June 18 for all plants in the experimental unit, and the following measurements were recorded: The tubers were harvested manually on June 18 for all plants in the experimental unit, and the following measurements were recorded.

Vegetative growth measurements

Five plants were taken from each experimental unit a week before harvest to record vegetative growth measurements, which are.

Plant height

The height of the plant from the area where the stem connects to the roots to the highest peak of the plant.

The number of aerial stems of the plant

This was recorded as average stem count of five hills per plot at 50% flowering.

The fresh and dry weight of the plant

The term "dry weight" pertains to the entirety of plant components, excluding water, and represents a more dependable alternative for assessing weight. Conversely, "fresh weight" encompasses water, rendering it less dependable when attempting to evaluate the impact of specific plant or system management on plant performance. The leaf area of the plant was calculated using a proportional method based on dry weight.

Yield measurements

The number of tubers per plant

The number of potato tubers formed by each potato plant is affected by agronomy and varietal potential.

Average tuber weight (g)

Average tuber weight was determined on the basis of total tuber weight produced per plant/total tuber number counted per plant at harvest.

The experimental scheme was a randomized block with three replications for each variant with the size of experimental plots of 21 m², and the parameters including yield of one plant, total yield of tubers per unit area, and weight of marketable tubers were investigated.

The yield of one plant

The plant yield is a measure of the potato or dry matter quantity in a particular area.

The total yield of tubers per unit area

Total yield is a standard measurement of the amount of tubers harvested—yield of a crop—per unit of land area.

Weight of marketable tubers

The number and weight of both marketable and unmarketable tubers per plant were detected. Tubers, which were greened, misshapen or displayed pathological damage were classed as unmarketable, as well as those with weight lower than 20 g. Other than these conditions, it is considered a marketable tubers. The marketing yield of tubers is the total tuber yield after excluding small tubers of less than 20 grams and those that are cut and deformed.

Statistical analysis

The obtained data were analyzed statistically according to the SAS system^[22] and the means were compared according to the Duncan multinomial test at the 5% level of significance^[23].

Results and Discussion

Figure 1 shows the importance of varieties for vegetative growth characteristics of potato plants. Measuring potato plant height in 59.65 cm and 2.4 stems in Nectard variety, we notice that it is significantly higher and more increased, in terms of vegetative growth, than the 2 Alaska varieties (56.60 cm in height and 1.7 stems in number of a Also plant's wet weight (273.7 grams), dry weight (51.15 grams), and leaf area (2754.7 cm²) are similar to the ones shown in the data set.

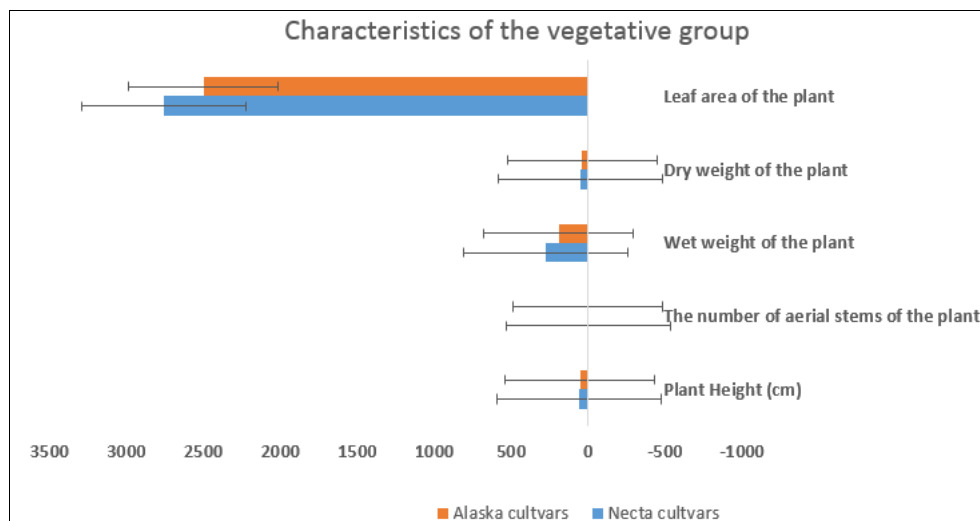


Fig 1: The effect of interaction between varieties and plant extracts on potato vegetative growth

Seeing with our own eyes, it is worth mentioning that the Nectra variety is unrivalled by other varieties yielding longer stems, more stems, bigger aerobic area, large leaves, and bigger yield when compared to others. This fact can be more accurately illustrated by referring to figure 1, where the figure clearly illustrates the various impacts of different varieties on the growth patterns of potato plants. However, the Nected variety of grain, including its height (about 59.65 cm) and produced up to 2.4 stems, finally hit the two Alaska varieties that were used as a standard. Consequently, the value of the plant's wet weight was recorded in the form of 273.7 grams, whereas, dry weight had the value of 51.15 grams while leaf area turned out to be 2754.7 cm². Various scientist have experienced that in their a practical experiment, several potato clones containing quite distinct vegetative growth features [4, 8, 24]. To put it this way, it might be that the fact that the genes of these varieties differ, this difference influences the growth of the plant's vegetative part [25] (Figure one) delineates between the supremacy of the Nectari variety over the Alaska one after

these two varieties are compared on the basis of all yield traits. The rationale behind the choice of this marker is that it will serve as a tool for chemical application of sesame oil in order to determine its effect on yield and other aspects of plant physiology.

It is obvious that in the figure [2], the treatment of plants with plant extracts, sesame seed oil extract, at 4 mg/L was very effective as regards the vegetative growth characteristics of some of the plants (See Figure 2) As well, no changes were observed in the plant-height or the amount of aerial stems due to spraying plant extracts. On the other side, this enabled the plant to add significantly to its dry weight. It should, however, be noted that the increase in wet weight (117.5 gms) found in this group compared to the other treatment (117.5 gms) was tied to closure of the intestinal wall. A similar situation was observed when extracting of sesame oil at the concentration of 4 gm/L caused a great increase in leaf area size (4576.8 cm²). The results in this line of investigation is supportive of that stated in earlier studies.

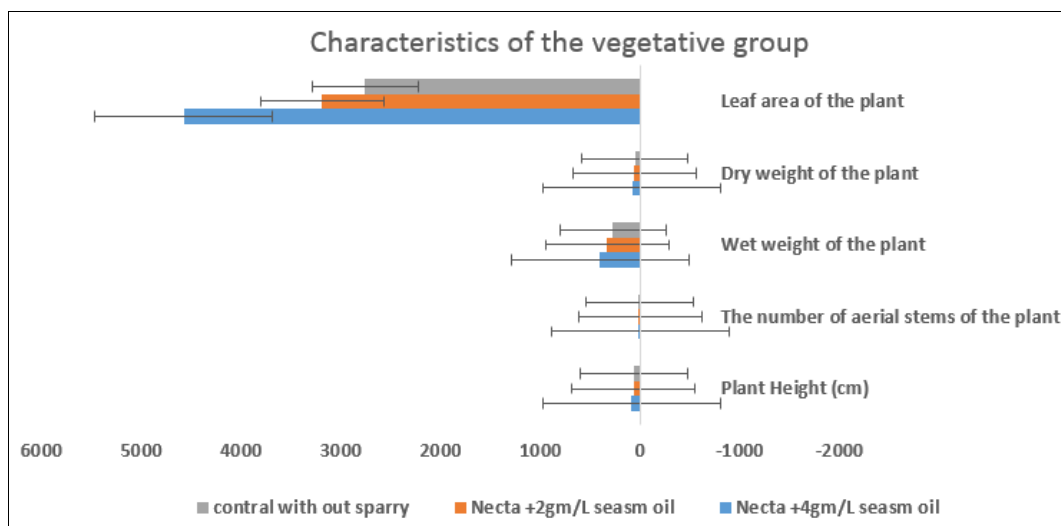


Fig 2: The effect of plant varieties and extracts on yield characteristics of potatoes

What was the final outcome of the study?? Regarding the sesame extract, the researchers found [27, 28] that, the extract relate to the reproductive health functions of women. The cultivation growth characteristics (e.g. humidity and dryness and leaf area) could be highly affected if the application of sesame oil extract is introduced due to the content of sugars, proteins and physiological growth regulators, nutrients and other components. According to the article of Musa *et al.*, licorice root is composed of sugar, protein, and mineral elements, such as copper, zine, iron, manganese, magnesium, and copper, potassium [29]. Although malonic acid cannot be considered as gibberellin, just like al- Jawari and his colleague, claim, it still serves as a signal initiator for the process of gibberellins production. This is created by cells which to results to cell division and elongation [27]. Accordingly, Kumari *et al.* reported that Saponins found in licorice act as stress mitigators for plants by reducing transpiration rates, cell burst, and water losses caused by transpiration since they increase the solute content within plants, hence, boosting their cell turgor and water retention [30]. Chlorophyll synthesis, which is recognized as a major step in the photosynthetic process, requires presence of iron, magnesium, and nitrogen. Moreover, Abou Hussein and his team have shown that the garlic extract has activities that

are comparable to the ones produced by the peopler an enzyme, and this strengthens this enzyme for this activity. This compound, also signifying final cell formation, lengthening, and widening, in the long run, facilitates an increase of plant growth and leaf surface area [31]. In addition, R Hell in 1997, the compound amino acids methionine and cysicine and sulfur were found in garlic extract and were supported by analysis. Sulfur as an element is not a stranger to plants since it contributes to a lot of processes on efficacy [32].

Overall, the variation of these outcome characteristics mainly depended on the difference between Nectar cultivars in their vegetative development just as the values of Nectar's cultivars were better digested in vegetative growth under all types of the extracts. The [3] weather figure illustrates the influence of production of different strains and extracts on the potato yield attributes. It is worth to mention that the varieties Nectard have more tubers per plant compared to the sorts Nectard `0.63 tubers. In addition to this, we have observed significant differences in the weight of a random tuber of the Nectard variety when compared to sparry at 4gm/l with 50.2 grams and sparry 2gm/l with 50.3 grams.

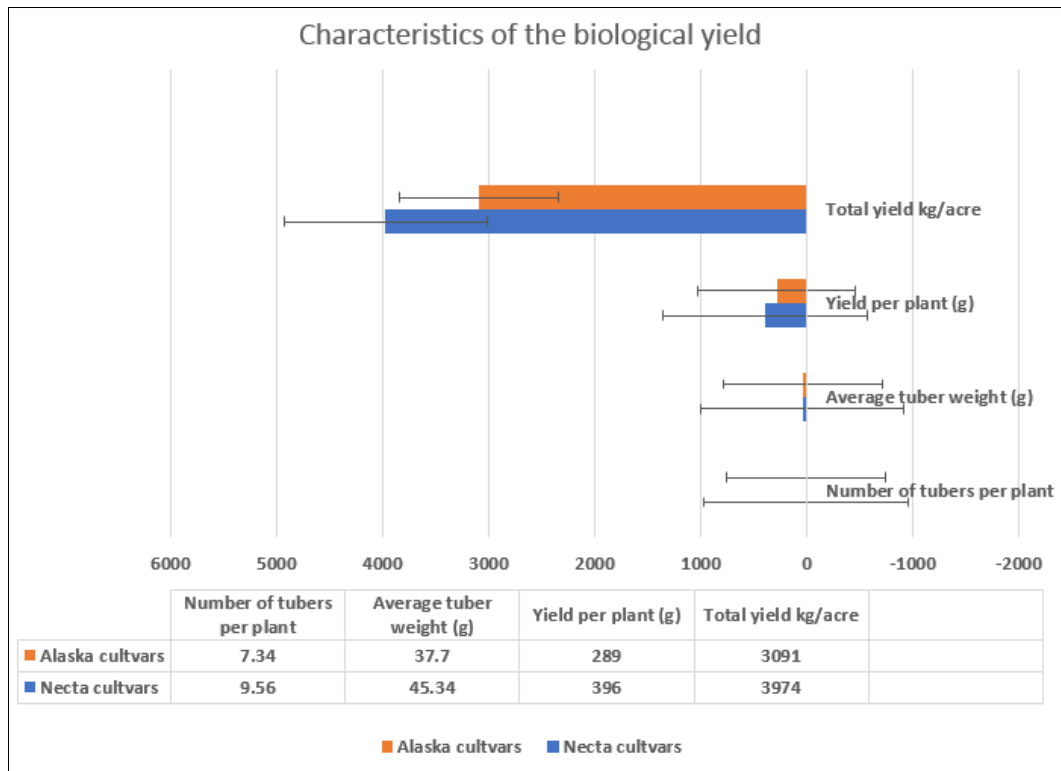


Fig 3: The effect of interaction between varieties and plant extracts on yield characteristics of potatoes

Variety Nectard shows the largest values of produced mass on both the total yield (514.5 g) and marketing yield (5140 kg/ dunum), with the help from sparry as a low-concentrated fertilizer (4 gm/l). The aerial photos values of the Nectard type having sparay at 2 mg/l are significantly higher than those in the control group. Hence the outcome of the research is consistent with the findings of other articles (Study. No. 33, 34), which have shown the existence of the potato crops which yield differently depending on the breeds under comparisons. There is a chance that the diversities are a conclusion of the genetically different genes of these distinct types.

The results obtained in this work correspond to the ones achieved by Al-Jawari [27], which showed that licorice and garlic extracts may be employed as suitable crystal factors to selectively boost the yield parameters among various vegetable crops. We can point at a lack of effect on the number of tubers to the fact that this characteristic is strongly affected by the tally of tubers. Surprisingly, while the plant extracts did not cause any substantial response on the aerial shoots structure, the treatment was conducted thereafter the stems had completely grown, which might explain the delay in any potentially observable effect (Figure 1). In a contrast to this, the number seen in other qualities afterwards plant extracts supplementation could as well be linked to number of themages. It applies face to the composition of mentioned extract which unites sugars, proteins, growth regulators as well as mineral elements. This proposition that has been elaborated on the features of vegetative development is probable to be valid that is why there is a super growth in WW and LW and, additionally, in the development of leaf area (see Figure 1). As was the case with the coefficients of yield characteristics, there were

clear parallels to the fertility increases in terms of the overall yield. We may conclude that approaching plant breeding for greater productivity, development, and resistance can be realized from the trial of plant extracts, specifically sesame oil, instead of artificial chemicals, which usually have adverse impact on environment. It should be supported that the presented diagram (Figure 4) shows a significant impact of not only the species but also extracts on vegetative development of potato in this study. The sesame oil is the combination of the lignans like sesamin, sesamol, sesaminol and sesamolol [36]. Because of the presence of these lignans, spraying sesame oil on plants may help prevent certain pests such as aphids, mites, and worms and stop them from eating the plants and causing the damage. However, the role that these compounds may play is maintaining the population control of the pests and managing the plants with diseases, hence improving plant health and growth. While the other side, there are compounds that have anti-fungal and anti-bacterial products and by applying sesame oil on plants; it is possible to protect it of fungal diseases such as mildew powder and bacterial infections. Sesame oil can be utilized to maintain the moisture level of lush vegetables. This can imply the plant has the ability to maintain the moisture balance in itself. It is involved in mined nutrient absorption and if it is carried on to the maximum, it may lead to the growth and development of animals. In contrast to this, the use of sesame oil in oil treatments increases the cells' structure and functions which are due to the presence of antioxidants and a high concentration of fatty acids [37, 40]. Thus, it appears that the exceptional phytohormones in this oil contribute to the potato tuber growth and its average bulk.

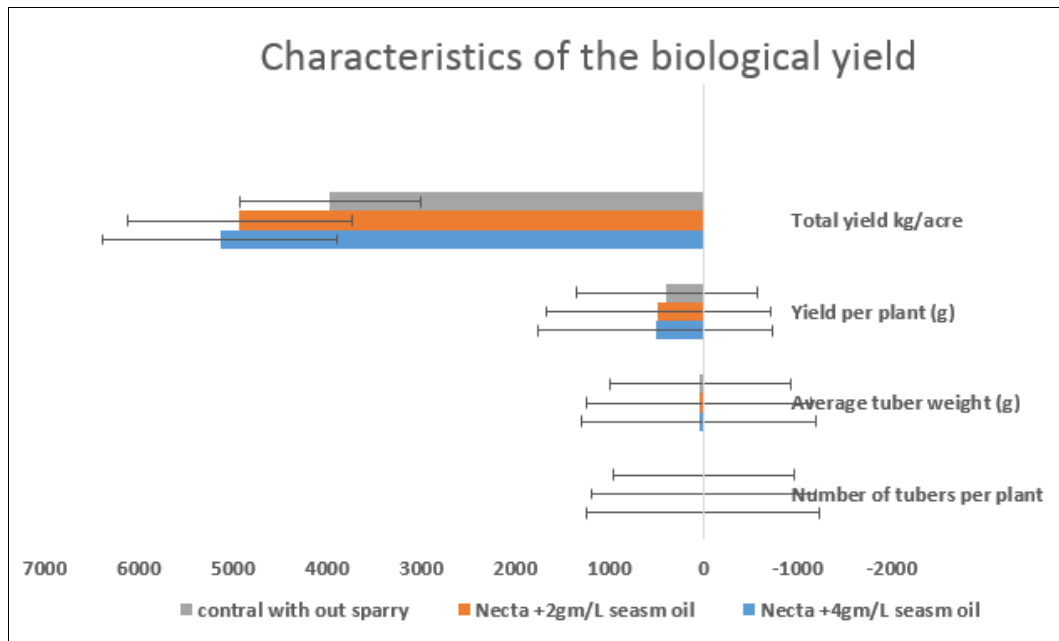


Fig 4: The effect of interaction between varieties and plant extracts on biological yield characteristics of potatoes

Conclusion

The findings of this study displayed great potential, as spraying sesame extract resulted in the augmentation of potato plants, yielding tubers of commendable attributes that are suitable for medium or large-scale commercialization, as well as for seed propagation. The superiority of the Nectard variety in terms of growth properties was observed. When applying a plant extract at a concentration of 4 g/L, the Nectard variety demonstrated superior efficacy in comparison to the treatment utilizing sesame seed extract at a concentration of 2 g/L and the control treatment. Additionally, this treatment and the effective ingredients in it were able to increase growth characteristics and performance characteristics such as average tuber weight, per-plant yield and total yield.

Authors' Declaration

- **Conflicts of Interest:** None.
- We hereby confirm that all the Figures and Tables in the manuscript are mine/ours. Furthermore, any Figures and images, that are not mine/ours, have been included with the necessary permission for re-publication, which is attached to the manuscript.

Authors' Contribution Statement: None.

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